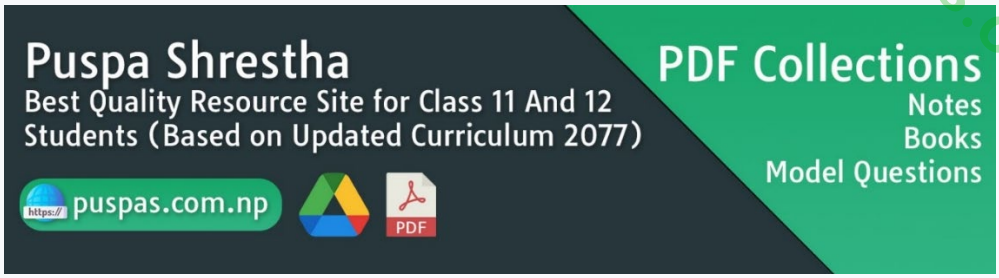
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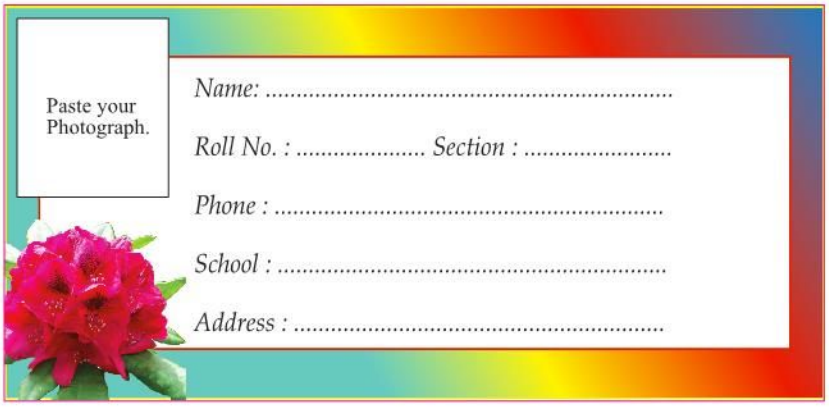
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आठौं संस्करणको बारेमा

सर्वप्रथम !

प्रस्तुत पुस्तक **COMPULSORY MATHEMATICS SEE Manual** को यस अगाडिका संस्करणलाई आशातीत मन पराइदिनु भई यो संस्करण प्रकाशित गर्नमा उत्साह र उर्जा थपिदिनुहुने विद्यार्थीवर्ग र शिक्षक-शिक्षिकाज्यूहरूप्रति हार्दिक आभार तथा धन्यवाद दिँदै एसईई 2076 को लागि, नेपाल सरकार पाठ्यक्रम विकास केन्द्र, सानोठिमी भक्तपुरद्वारा लागू गरिएको विशिष्टीकरण तालिका तथा नमुना प्रश्नपत्रअनुसार, तयार गरिएको यो परिमार्जित छैटौँ संस्करण पाठकवर्ग-समक्ष प्रस्तुत गरिएको छ। विगतका वर्षहरूमा जस्तै यस पुस्तकले यहाँहरूको शैक्षिक परिलक्ष्य हासिल गर्न सहयोग पुऱ्यायो भने मेरो यो प्रयास सफल हुनेछ।

पुस्तकमा !

एसईई तहको अर्थपूर्ण सिकाइको निमित्त पाठ्यक्रमद्वारा निर्देशित उपलब्धिहरू हासिल गराउन र परिणाममुखी बनाउन कसरी, कहाँबाट, के-के पढाउने भन्ने मुख्य सन्दर्भ, यो पुस्तकको अघिल्ला संस्करणहरूका प्रयोगकर्ताहरूबाट प्राप्त सुझावहरू, SEE Preparation Examinations र SEE परीक्षाका प्रश्न-संरचनाको प्रकृति तथा पाठ्यक्रम र विशिष्टीकरण तालिकालाई विचार गरी तयार गरिएको यो पुस्तकमा निम्नलिखित विशेषताहरू पाउनुहुनेछ:

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- अप्ठ्यारा प्रश्नहरूका समाधान दिइएको
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SEE QUESTIONS ANSWERS

परीक्षाको प्रश्न-संरचनाको प्रकृतिलाई नियाल्दा एउटै प्रकृतिका अधिकांश प्रश्नहरू दोहोरिएको पाइन्छ। कक्षा 10 को हरेक किसिमका परीक्षामा सोधिएका सबैखाले प्रश्नहरूका समाधानहरू क्रमश: सरलदेखि जटिलतिर 1, 2, 3,..... का रूपमा राखिएका छन् ।

OTHER IMPORTANT QUESTIONS ANSWERS

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अन्तमा !

पुस्तक प्रकाशन गरिदिने रिडमोर प्रकाशनलाई साधुवाद, पुस्तक लेखनको यात्रामा हरपल सल्लाह एवम् सुझाउ दिनुहुने शिक्षक-शिक्षिकाज्यूहरूलाई विशेष धन्यवाद ज्ञापन गर्दै पुन: पाठकवर्गबाट रचनात्मक सुझाउको अपेक्षा गर्दछु।

काठमाडौँ

२०७६ साउन ९

लेखक

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नमुना प्रश्नपत्र

(नियमित र ग्रेड वृद्धि परीक्षा २०७५ को लागि)

विषय : अनिवार्य गणित | समय : 3 घन्टा | पूर्णाङ्क : 100

समूह क (Group A) — 6 × 1 = 6

1A. भ्याट रकम र विक्रय मूल्य दिइएको अवस्थामा अवस्थामा भ्याट प्रतिशत पत्ता लगाउने सूत्र लेख्नुहोस् ।
Write the formula for finding rate of VAT when VAT amount and selling price are given.

1B. भुजाको नाप 'b' एकाइ भएको समवाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an equilateral triangle whose side is 'b' unit?

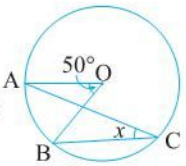
2A. यदि $(a^{m-2} \times a^{n+2}) = a^x$ भए x लाई m र n का रूपमा लेख्नुहोस् ।
If $(a^{m-2} \times a^{n+2}) = a^x$, then express x in terms of m and n.

2B. तल दिइएको तथ्याङ्कमा मध्यिका कुन श्रेणीमा पर्दछ ? लेख्नुहोस् ।
In the following data in which series does median lie? Write it.

X	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
cf	4	12	20	35	40

3A. एउटै आधार र उही समानान्तर रेखाबीच रहेका आयत र त्रिभुजको क्षेत्रफलको सम्बन्ध के हुन्छ ? लेख्नुहोस् ।
What is the relation between area of rectangle and triangle standing on the same base and between the same parallels? Write it.

3B. दिइएको चित्रमा O वृत्तको केन्द्र छ । x को मान कति हुन्छ ?
In the given figure, O is the centre of the circle. What is the value of x?



समूह ख Group B — [17 × 2 = 34]

4A. रु 3000 मा 13% मूल्य अभिवृद्धि कर जोड्दा आउने मूल्य रु 3612 भन्दा कतिले कम छ ?
How much less is Rs. 3612 than the value including 13% VAT in Rs 3000?

4B. एकजना शिक्षकले रु 250000 मा किनेको एउटा मोटर साइकललाई 2 वर्ष पछि 10% प्रतिवर्ष मिश्रह्रासका दरले बेचेछ । उक्त मोटर साइकलको 2 वर्ष पछिको मूल्य कति हुन्छ ? पत्ता लगाउनुहोस् ।
A teacher bought a motorbike for Rs 250000 and sold it after 2 years at 10% depreciation rate per year. What is the cost of the motorbike after 2 years?

5A. एउटा बेलनाकार बन्द ट्याङ्कीको उचाइ 2 मि. र आयतन 3080 लिटर छ । उक्त ट्याङ्कीको आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।
The capacity of a closed cylindrical tank of height 2 m. is 3080 liters. Find the base area of the tank.

5B. 8 ओटा प्रत्येक 'a cm' अर्धव्यास भएका गोलाहरू पगालेर 'b cm' अर्धव्यास भएको गोला बनाइयो । $a : b$ पत्ता लगाउनुहोस् ।
8 solid iron spheres with radius 'a cm' each are melted to form a sphere with radius 'b cm'. Find the ratio of $a : b$.

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5C. एउटा सोली आकारको टेन्टको उचाइ 10 m र आधारको अर्धव्यास 14 m छ । उक्त टेन्ट बनाउन आवश्यक कपडाको प्रति वर्ग मि. रु 400 का दरले जम्मा खर्च कति लाग्छ ?
A conical tent is 10 m high and the radius of its base is 14 m. Find the cost of cloth required to make the tent at the rate of Rs. 400 per square meters.

6A. म.स. पत्ता लगाउनुहोस् । Find the HCF of : $ab^3 - a^3b$, $a^2b + ab^2$

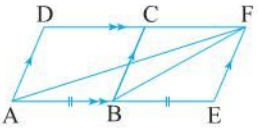
6B. सरल गर्नुहोस् । Simplify : $\sqrt{150} - \sqrt{54} + \sqrt{6}$

7A. सरल गर्नुहोस् । Simplify : $\frac{77^6 \times 6^5 \times 2}{14^6 \times 33^5 \times 11}$

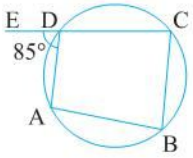
7B. सरल गर्नुहोस् । Simplify : $\frac{3}{x^2-4} + \frac{1}{(x-2)^2}$

7C. दुईओटा सङ्ख्याहरूको योगफल 80 र तिनीहरूको फरक 10 छ । ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two numbers is 80 and their difference is 10. Find the numbers.

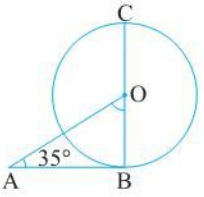
8A. चित्रमा AE // DF र AE को मध्यविन्दु B छ । यदि ΔAEF को क्षेत्रफल 30 वर्ग से.मि. भए समानान्तर चतुर्भुज ABCD को क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the given figure, AE // DF and B is mid-point of AE. If area of ΔAEF is 30 square centimeter, then find the area of parallelogram ABCD.



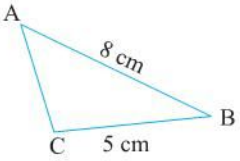
8B. दिइएको चित्रमाABCD एउटा चक्रिय चतुर्भुज हो । यदि ∠ADE = 85° भए∠ADC र ∠ABC को मान पत्ता लगाउनुहोस् ।
In the given figure, ABCD is a cyclic quadrilateral. If ∠ADE = 85° then find the value of ∠ADC and ∠ABC.



8C. दिइएको बृतमा AB स्पर्श रेखा, BC व्यास र ∠BAO = 35° भए ∠AOB को मान पत्ता लगाउनुहोस् ।
In the given circle, AB is a tangent. BC is diameter and ∠BAO = 35°. Find the value of ∠AOB.



9A. चित्रमा AB = 8 cm, BC = 5 cm र ΔABC को क्षेत्रफल 10 cm² भए ∠ABC को मान पत्ता लगाउनुहोस् ।
In the given figure AB = 8 cm, BC = 5 cm and area of ΔABC is 10 cm². Find the value of ∠ABC.



9B. एउटा निरन्तर श्रेणीमा मध्यक मान = 24625, बारम्बारता योगफल (N) = 55 + a र बारम्बारता र मध्यमूल्यको गुणनफलको योगफल $\sum fm = 1345 + 25a$ भए a को मान निकाल्नुहोस् ।
In a continuous series, mean value = 24625, sum of frequency (N) = 55 + a and sum of product of frequency and mid-value ($\sum fm$) = 1345 + 25a then find the value of a.

10A. एउटा डाइसलाई दुईपटक फाल्दा पहिलो पटक 4 र दोस्रो पटक रुढ सङ्ख्या आउने सम्भाव्यता निकाल्नुहोस् ।
A cubical dice is thrown two times, find the probability that the outcomes is 4 in first time and prime number in second time.

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10B. एउटा बाकसमा उही आकारका चारओटा राता र तीनओटा सेताबलहरू राखिएका छन् । एकपछि अर्को गरेर दुईओटा बलहरू (पुन : नराखी) निकाल्दा रातो र सेतो बलहरू आउने सम्भाव्यतालाई बृक्षचित्रमा देखाउनुहोस् ।

Four red and three white balls of the same size are kept in a box. Two drowns are made one after the other (without replacement). Show the probability of getting red and white balls in the tree diagram.

समूह ग Group C [10 × 4 = 40]

11. 300 जना मानिसहरूको समूहमा 240 जनालाई क्रिकेट खेल्न र 170 जनालाई फुटबल खेल्न मन पर्दो रहेछ । यदि 50 जनालाई कुनै खेल मन पर्दो रहेनछ भने :

In a group of 300 people, 240 like to play cricket, 170 football and 50 like to play none of the game

i) माथिको तथ्याङ्कलाई भेन चित्रमा देखाउनुहोस् ।
Show the above information in a Venn-diagram.

ii) कति जनालाई दुवै खेल मन पर्दो रहेछ ?
How many people like to play both the games?

iii) कति जनालाई क्रिकेट मात्र मन पर्दो रहेछ ?
How many people like to play cricket only?

12. एउटा मोबाइल सेट अङ्कित मूल्यमा 20% छुट दिई 13% मूल्य अभिवृद्धि कर जोड्दा मोबाइल सेटको मूल्य रु. 3652.16 भयो भने सो मोबाइल सेटको अङ्कित मूल्य निकाल्नुहोस् ।

After allowing 20% discount and then levying 13% Value Added Tax (VAT), the value of a mobile set will be Rs 3652.16. Find the marked price of the mobile set.

13. एउटा छाता 10 ओटा दुई फरक रङका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । प्रत्येक टुक्राको नाप 41 cm, 41 cm र 18 cm भए उक्त छाता बनाउन कति कपडा चाहिन्छ ? यदि 1 cm^2 कपडाको मूल्य रु. 2 पर्छ भने जम्मा कपडाको मूल्य कति पर्छ ?

An umbrella is made by stitching 10 triangular pieces of cloth of two different colours, each piece measuring 41 cm, 41 cm and 18 cm. How much cloth is required for the umbrella? If the cost of 1 cm^2 is Rs. 2, find the total cost of cloth.

14. ल.स. पत्ता लगाउनुहोस् (Find the LCM of) : $x^4 - 25x^2 + 144$, $x^3 - x(x + 12) + 2x^2$

15. एउटा आयताकार खेत 80 m लामो र 50 m चौडा छ । उक्त खेतको चारैतिर 536 m^2 क्षेत्रफल र एकसमान चौडाई भएको बाटो छ । बाटोको चौडाई पत्ता लगाउनुहोस् ।

A rectangular field is 80 m long and 50 m wide. There is a path of uniform width all around it having an area of 536 m^2. Find the width of the path.

16. एउटै आधार र उही समानान्तर रेखाहरूबिच बनेका समानान्तर चतुर्भुजहरू NEPA र MEPL को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

Prove that the area of parallelogram NEPA and MEPL standing on same base and the same parallels are equal in area.

17. AB = BC = 6.5 cm, CD = DA = 5.5 cm र $\angle A = 60°$ हुने चतुर्भुज ABCD को रचना गर्नुहोस् । चतुर्भुज ABCD को क्षेत्रफलसँग बराबर हुने गरी ΔADE को रचना गर्नुहोस् ।

Construct a triangle ADE equal in area to the quadrilateral ABCD in which AB = BC = 6.5 cm, CD = DA = 5.5 cm and $\angle A = 60°$.

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18. वृत्तको एउटै चाप AB मा आधारित केन्द्रियकोण AOB परिधिकोण APB को दोब्बर हुन्छ भनी प्रयोगात्मक रुपमा सिद्ध गर्नुहोस् । (कम्तिमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवस्यक छन् ।)
Verify experimentally that angle AOB at the centre is twice the inscribed angle APB subtended by the same arc AB. (Two figures with at least 3 cm radii are necessary.)

19. वृत्ताकार पोखरीको केन्द्रमा पानीको सतहदेखि माथि 13.70 m अग्लो खम्बा छ । पोखरीको पानीको सतहभन्दा 2 m अग्लो किनाराको कुनै विन्दुवाट 1.70 m अग्लो मानिसले खम्बाको टुप्पो अवलोकन गर्दा उन्नतांश कोण 60° पायो भने सो पोखरीको व्यास पत्ता लगाउनुहोस् ।
At the centre of a circular pond, there is a pole of 13.70 m high above the surface of water. From a point on the edge which is 2 m above the level of water surface, a man of 1.70 m high observed the angle of elevation of the top of the pole and found to be 60°. Find the diameter of the pond.

20. कुनै परीक्षामा विद्यार्थीहरूले गणित विषयमा निम्न अनुसारको अङ्क प्राप्त गरेका छन् ।
The following are the marks obtained by students in mathematics in an examination.
45, 36, 69, 105, 138, 171, 54, 36, 117, 153, 96, 129, 75, 177, 54, 114, 135, 120, 96, 99
   a) 30 को श्रेणी अन्तरमा हुने बारम्बारता तालिका बनाउनुहोस् ।
      Make a frequency table of class interval 30.
   b) तेस्रो चतुर्थांश पत्ता लगाउनुहोस् । Find the third quartile.

समूह घ (Group D) [4 × 5 = 20]

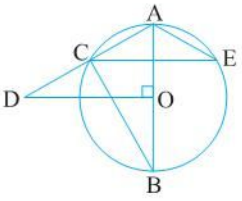
21. रु 4000 को तीन वर्षको 10% प्रतिवर्षका दरले हुन आउने वार्षिक चक्रिय व्याज रु 4200 को 3 वर्षमा हुन आउने साधारण व्याजभन्दा कति प्रतिशतले बढी हुन्छ ? पत्ता लगाउनुहोस् ।
By what percent more is the yearly compound interest on Rs. 4000 for 3 years at 10% p.a. than simple interest on Rs. 4200 for 3 years at 8% p.a. Find it.

22. तेन्जिङले छोरी फुर्साङको विवाह भोजका लागि 220 जनालाई व्यवस्था गरेछन् । तेन्जिङले उक्त कार्यका लागि सोली आकारको टेन्टमा वस्ने व्यवस्था मिलाएछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि $5\frac{5}{7}$ वर्ग मि.ठाउँ र सास फेर्न 40 घन मि. हावा चाहिन्छ । उक्त सोली आकारको टेन्टको उचाई कति हुन्छ ? पत्ता लगाउनुहोस् ।
Tenzing managed the accommodation for 220 guests in his daughter Phursang's marriage ceremony. For this purpose he plans to build a conical tent in such a way that each person have $5\frac{5}{7}$ sq.m. of the space on ground and 40 cu.m. of air to breadth. What should be the height of the tent? Find it.

23. यदि w + 2m = m – n भए प्रमाणित गर्नुहोस् (If $w + 2m = m - n$, prove that) :

$$\frac{1}{1+x^{w}+x^{-m}}+\frac{1}{1+x^{m}+x^{-n}}+\frac{1}{1+x^{n}+x^{-w}}$$

24. दिइएको चित्रमा वृत्तको केन्द्र विन्दु O, व्यास AB, र DO ⊥ AB भए ∠AEC = ∠ODA हुन्छ भनी सिद्ध गर्नुहोस् ।
In the given figure, O is the centre of the circle. AB the diameter and DO ⊥ AB. Prove that ∠AEC = ∠ODA.



Good Luck

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माध्यमिक शिक्षा परीक्षा/प्रवेशिका परीक्षा

Secondary Education Examination (SEE)

नमुना प्रश्नपत्र - २०७४ (Model Questions 2074)

विषय : अनिवार्य गणित (Compulsory Mathematics) पूर्णाङ्क : १००

समय : ३ घन्टा

1. SEE MODEL QUESTIONS ISSUED BY CDC

समूह 'क' (Group 'A') [6 x 1 = 6]

1. (a) वास्तविक छुट र अङ्कित मूल्य दिइएको अवस्थामा छुट प्रतिशत पत्ता लगाउने सूत्र लेख्नुहोस् ।
Write the formula for finding rate of discount when discounted amount and marked price are given.

☞ Here, Rate of discount $= \frac{\text{Discount amount}}{\text{Marked price}} \times 100\%$

(b) भुजाको नाप 'a' एकाइ भएको समवाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an equilateral triangle whose side is 'a' unit?

☞ Here, Area of equilateral triangle $= \frac{\sqrt{3}}{4} a^2$ square units.

2. (a) यदि $\sqrt{x} = 9$ भए x को मान पत्ता लगाउनुहोस् । **(Find out the value of x if $\sqrt{x} = 9$.)**

☞ Here, $\sqrt{x} = 9$
Squaring on both the sides then $x = 81$.

(b) तल दिइएको तथ्याङ्कमा मध्यिका कुन श्रेणीमा पर्दछ ? लेख्नुहोस् ।
In the following data, in which series does median lie? Write it.

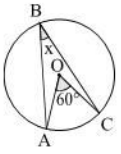
X	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70
cf	16	36	61	77	80

☞ Here, $\frac{N}{2} = \frac{80}{2} = 40 < 61$ So, median class is 40-50.

3. (a) एउटै आधार र उही समानान्तर रेखाबिच रहेका समानान्तर चतुर्भुज र त्रिभुजको क्षेत्रफलको सम्बन्ध के हुन्छ ? लेख्नुहोस् ।
What is the relation between area of parallelogram and triangle standing on same base and between same parallels? Write it.

☞ Here, Area of the parallelogram = 2 × Area of the triangle.

(b) दिइएको चित्रमा O वृत्तको केन्द्र छ । x को मान कति हुन्छ ?
In the given figure, O is the centre of the circle. What is the value of x?



☞ Here, $x° = \frac{1}{2} \times 60°$ (∵ Inscribed angle is half of central angle standing on same arc.)

$\therefore \quad x = 30°$

समूह 'ख' (Group 'B') [17 x 2 = 34]

4. (a) रु. 2700 मा 13% मूल्य अभिवृद्धि कर जोड्दा आउने मूल्य भन्दा रु. 3060 कतिले बढी छ ?
How much more is Rs 3060 than the value including 13% VAT in Rs 2700?

☞ Here, Price = Rs 2700 and Rate of VAT = 13%
We have, price including VAT = Rs 2700 + 13% of Rs 2700 = Rs 2700 + 0.13 × Rs 2700
= Rs 2700 + Rs 351 = Rs 3051
Required value = Rs 3060 – Rs 3051 = Rs 9
Thus, the required value is Rs 9

(b) एक जना किसानले रु. 400000 मा किनेको एउटा ट्याक्टर केही समय चलाएर 10% प्रतिवर्ष मिश्रह्रासका दरले बेचेछ । उक्त ट्याक्टरको 2 वर्ष पछिको मूल्य कति हुन्छ ? पत्ता लगाउनुहोस् ।
A farmer bought a tractor for Rs 400000 and sold it after using some time at 10% depreciation rate per year. What is the cost of tractor after 2 years?

☞ Here, Initial price (P) = Rs 400000, Time (T) = 2 yrs and Rate (R) = 10%
We know that, $(P_T) = P\left(1 - \frac{R}{100}\right)^T$ or, $P_T = 400000 \times \left(1 - \frac{10}{100}\right)^2$
or, $P_T = 400000 \times 0.81 = 324000$
Thus, the price after 2 years is Rs 324000.

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5. (a) उचाइ 1 मि. भएको एउटा बेलनाकार धातुको ट्याङ्कीमा 1500 लिटर पानी अटाउँछ । उक्त ट्याङ्कीको आधार बनाउन कति वर्ग मि. धातु आवश्यक पर्छ ? पत्ता लगाउनुहोस् ।
The capacity of a closed cylindrical pot of height 1 m is 1500 liters. How many square metres of metal sheet would be needed to make its base?

☞ Here, height (h) = 1 m
Capacity of the tank = 1500 litre
We know that,
Volume of the tank (V) $= \frac{1500}{1000}\ m^3$
or, Base area × Height $= 1.5\ m^3$
or, Base area × 1 m $= 1.5\ m^3$
∴ Base area $= 1.5\ m^2$
Thus, $1.5\ m^2$ metal is required to prepare the base.

(b) 27 ओटा प्रत्येक 'x cm' अर्धव्यास भएका गोलाहरू पगालेर 'y cm' अर्धव्यास भएको गोला बनाइयो । x : y पत्ता लगाउनुहोस् ।
27 solid iron spheres, each of radius 'x cm' are melted to form a sphere with radius 'y cm'. Find the ratio x : y.

☞ Here, volume of a sphere with x cm radius $= \frac{4}{3}\pi x^3$

Volume of a sphere with y cm radius $= \frac{4}{3}\pi y^3$

By the question, $27 \times \frac{4}{3}\pi x^3 = \frac{4}{3}\pi y^3$ or, $27x^3 = y^3$

or, $(3x)^3 = y^3$ or, $3x = y$ or, $\frac{x}{y} = \frac{1}{3}$

∴ x : y = 1 : 3
Thus, value of x : y = 1 : 3.

(c) एउटा सोली आकारको टेन्टको छड्के उचाइ 10 m र आधारको अर्धव्यास 7 m छ । उक्त टेन्ट बनाउन आवश्यक कपडाको रु. 300 प्रति वर्ग मि. का दरले जम्मा कति खर्च लाग्छ ?
A conical tent has 10 m slant height and the radius of its base is 7 m. Find the cost of cloth required to make the tent at the rate of Rs 300 per square meteRs

☞ Here, the height of tent (h) = 10 m, radius of base (r) = 7 m and rate of tent making = Rs $300/m^2$
We know that, CSA of cone $= \pi r\ell = \frac{22}{7} \times 7 \times 10\ m^2 = 220\ m^2$
We have, cost of cloth required = Rs 300 × 220 = Rs 66000
Thus, Rs 66000 is required to make the tent.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $(x^3 - xy^2)$, $(x - y)$

☞ Here, F.E. $= x^3 - xy^2 = x(x^2 - y^2) = x(x - y)(x + y)$
S.E. $= x - y$
∴ HCF $= x - y$

(b) सरल गर्नुहोस् (Simplify): $\sqrt{125} - \sqrt{45} + \sqrt{5}$

☞ Here, $\sqrt{125} - \sqrt{45} + \sqrt{5} = 5\sqrt{5} - 3\sqrt{5} + \sqrt{5} = 6\sqrt{5} - 3\sqrt{5} = 3\sqrt{5}$

7. (a) सरल गर्नुहोस् (Simplify): $\frac{14^6 \times 15^5}{35^6 \times 6^5}$

☞ Here, $\frac{14^6 \times 15^5}{35^6 \times 6^5} = \left(\frac{14}{35}\right)^6 \times \left(\frac{15}{6}\right)^5 = \left(\frac{2}{5}\right)^6 \times \left(\frac{5}{2}\right)^5 = \left(\frac{2}{5}\right)^6 \times \left(\frac{2}{5}\right)^{-5} = \left(\frac{2}{5}\right)^{6-5} = \frac{2}{5}$

(b) ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $p^2 + 2pq + q^2$, $pq^2 + p^2q$

☞ Here, First expression $= p^2 + 2pq + q^2 = (p + q)^2 = (p + q)(p + q)$
Second expression $= pq^2 + p^2q = pq(q + p) = pq(p + q)$
Thus, the LCM is $pq(p + q)(p + q)$.

(c) दुईओटा सङ्ख्याहरूको योगफल 128 र तिनिहरूको फरक 16 छ । ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two numbers is 128 and their difference is 16. Find the numbeRs

☞ Here, let the numbers be x and y (x > y).
First condition: x + y = 128 … …(i) Second condition: x – y = 16 … …(ii)

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Solving equation (i) and (ii)

$x + y = 128$

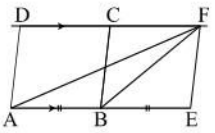
$x - y = 16$

$2x = 144$ $\therefore$ $x = 72$

Now, substituting the value of x in equation (i); $y = 128 - 72 = 56$ $\therefore$ $y = 56$

Thus, $x = 72$ and $y = 56$ is the required solution.

8. (a) चित्रमा AE // DF र AE को मध्यबिन्दु B छ । यदि ΔAEF को क्षेत्रफल 20 वर्ग से.मि. भए समानान्तर चर्तुभुज ABCD को क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the given figure, AE // DF and B is mid-point of AE. If area of ΔAEF is 20 square centimeter then find the area of parallelogram ABCD.



☞ Here,

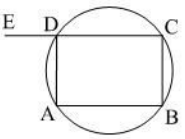
(i) Area of $\Delta ABF = \frac{1}{2}$ area of ΔAFE ($\because$ FB bisect the area of ΔAEF)

or, Area of $\Delta ABF = \frac{1}{2} \times 20\ cm^2 = 10\ cm^2$

(ii) Again, area of $\square ABCD = 2 \times$ area of $\Delta ABF = 2 \times 10\ cm^2 = 20\ cm^2$

Thus, the area of parallelogram ABCD is $20\ cm^2$.

(b) दिइएको चित्रमा ABCD एउटा चक्रीय चतुर्भुज हो । यदि ∡ADE = 75° भए ∡ADC र ∡ABC को मान पत्ता लगाउनुहोस् ।
In the given figure, ABCD is a cyclic quadrilateral. If ∡ADE = 75° then find the value of ∡ADC and ∡ABC.



☞ Here, $\measuredangle ADE = 75°$ and ABCD is a cyclic quadrilateral.

(i) $\measuredangle ADE + \measuredangle ADC = 180°$ ($\because$ Being linear part.)

or, $75° + \measuredangle ADC = 180°$

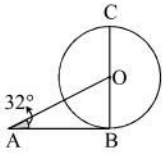
or, $\measuredangle ADC = 180° - 75° = 105°$

(ii) $\measuredangle ADC + \measuredangle ABC = 180°$ ($\because$ Being opposite angles of cyclic quadrilateral.)

or, $105° + \measuredangle ABC = 180°$ or, $\measuredangle ABC = 180° - 105° = 75°$

Thus, the value of $\measuredangle ADC$ and $\measuredangle ABC$ are 105° and 75° respectively.

(c) दिइएको वृत्तमा AB स्पर्श रेखा, BC व्यास र ∡BAO = 32° भए ∡AOB को मान पत्ता लगाउनुहोस् ।
In the given circle, AB is a tangent, BC is diameter and ∡BAO = 32°. Find the value of ∡AOB.



☞ Here, $\measuredangle BAO = 32°$ and AB is a tangent.

(i) $\measuredangle ABO = 90°$ ($\because$ Angle between radius and tangent at point of contact.)

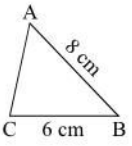
(ii) $\measuredangle OAB + \measuredangle ABO + \measuredangle AOB = 180°$ ($\because$ Being sum of interior angles of triangle.)

or, $32° + 90° + \measuredangle AOB = 180°$

or, $\measuredangle AOB = 180° - 32° - 90° = 58°$

Thus, the value of $\measuredangle AOB$ is 58°.

9. (a) चित्रमा AB = 8 cm, BC = 6 cm र ΔABC को क्षेत्रफल 12 cm² भए ∡ABC को मान पत्ता लगाउनुहोस् ।
In the given figure, AB = 8 cm, BC = 6 cm and area of ΔABC is 12 cm². Find the value of ∡ABC.



☞ Here, AB = 8 cm, BC = 6 cm and area of ΔABC is 12 cm².

We know that, Area of $\Delta ABC = \frac{1}{2} AB \times BC \sin B$

or, $12\ cm^2 = \frac{1}{2} \times 8\ cm \times 6\ cm \sin B$ or, $\frac{12}{24} = \sin B$

or, $\frac{1}{2} = \sin B$ or, $\sin 30° = \sin B$

$\therefore$ $B = 30°$ Thus, the value of $\measuredangle ABC$ is 30°

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(b) एउटा निरन्तर श्रेणीमा यदि मध्यक मान = 25, बारम्बारता योगफल (N) = 55 + a र बारम्बारता र मध्यमानको गुणनफलको योगफल $\Sigma fm = 1345 + 26a$ भए a को मान निकाल्नुहोस् ।
In a continuous series, if mean value = 25, sum of frequency (N) = 55 + a and sum of product of frequency and mid value (Σfm) = 1345 + 26a then find the value of a.

☞ Here, mean value ($\bar{x}$) = 25, sum of frequency (N) = 55 + a and $\Sigma fm = 1345 + 26a$

We know that, $\bar{x} = \frac{\Sigma fm}{N}$ or, $25 = \frac{1345 + 26a}{55 + a}$

or, $25(55 + a) = 1345 + 26a$ or, $1375 + 25a = 1345 + 26a$

or, $1375 - 1345 = 26a - 25a$ or, $30 = a$

$\therefore$ $a = 30$ Thus, the value of a is 30.

10. (a) एउटा डाइस लाई दुईपटक फाल्दा पहिलो पटक 5 र दोस्रो पटक विजोर सङ्ख्या आउने सम्भाव्यता निकाल्नुहोस् ।
A cubical dice is thrown two times. Find the probability that the outcomes is 5 in first time and odd number in second time.

☞ Here, when a dice is thrown two times then sample space = {1, 2, 3, 4, 5, 6}

First time: Probability of getting 5 is $P(5) = \frac{1}{6}$

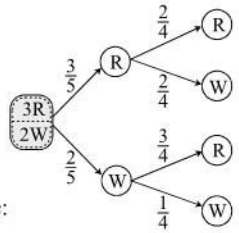
Second time: Probability of getting odd numbers is $P(\text{odd numbered face}) = \frac{3}{6}$

We know that, $P(A \text{ and } B) = P(A) \times P(B)$

So, $P(5 \text{ and odd numbered face}) = P(5) \times P(\text{odd face}) = \frac{1}{6} \times \frac{3}{6} = \frac{1}{12}$

Thus, the required probability is $\frac{1}{12}$.

(b) एउटा बाकसमा उहि आकारका तीनओटा राता र दुईओटा सेता बलहरू राखिएका छन् । एकपछि अर्को गरेर दुईओटा बलहरू (पुन : नराखी) निकाल्दा रातो र सेतो बलहरू आउने सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् ।
Three red and two white balls of the same size are kept in a box. Two draws are made one after the other (without replacement). Show the probability of getting red and white balls in the tree diagram.



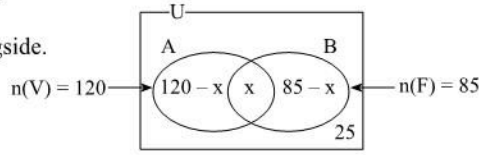
☞ Here, let R and W denote the set of red and white balls.
So, the n(R) = 3 and n(W) = 2
Now, the tree diagram of possible outcomes are shown in the alongside:

समूह 'ग' **(Group 'C')** **[10 × 4 = 40]**

11. 150 जना मानिसहरूको समूहमा 120 जनालाई भलिबल खेल्न र 85 जनालाई फुटबल खेल्न मन पर्दो रहेछ । यदि 25 जनालाई कुनै खेल मन पर्दो रहेनछ भने :
In a group of 150 people, 120 like to play volleyball, 85 like to play football and 25 like to play none of the games:
i) माथिको तथ्याङ्क भेनचित्रमा देखाउनुहोस् । (Show the above information in a Venn-diagram.)
ii) कति जनालाई दुवै खेल खेल्न मन पर्दो रहेछ ? (How many people like to play both the games?)
iii) कति जनालाई भलिबल मात्र खेल्न मन पर्दो रहेछ ? (How many people like to play volleyball only?)

☞ Here, let V and F denote the set of people who like volleyball and football respectively.

So, n(U) = 150, n(V) = 120, n(F) = 85 and $n(\overline{V \cup F}) = 25$
Let $n(V \cap F)$ be x then,
Venn-diagram of above information is shown alongside.
From the Venn-diagram alongside,



$n(U) = n(V) + n_0(F) + n(\overline{V \cup F})$
or, $150 = 120 + 85 - x + 25$
or, $150 = 230 - x$
$\therefore$ $x = 80$
Hence, 80 people like to play both of the games.
$\therefore$ $n_0(V) = 120 - x = 120 - 80 = 40$
Thus, the no. of people who like both and volleyball only are 80 and 40 respectively.

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12. एउटा घडीको अङ्कित मूल्यमा 20% छुट दिइ 13% मूल्य अभिवृद्धि कर जोड्दा घडीको मूल्य रु. 904 भयो भने सो घडीको अङ्कित मूल्य निकाल्नुहोस् ।

After allowing 20% discount and then levying 13% Value Added Tax (VAT), the value of the watch will be Rs 904. Find the marked price of the watch.

☞ Here, Discount rate = 20% Value added tax = 13%

Let, the marked price be Rs x Then Discount = 20% of x = 0.2 × x = 0.2x

We have, price after discount = MP – Discount = Rs x – Rs 0.2x = Rs 0.8 x

We know that, VAT = 13% of price after discount = 0.13 × Rs 0.8 x = Rs 0.104x

Now, Price with VAT = Rs 0.8x + Rs 0.104 x = Rs 0.904 x

By the question, Rs 0.904x = Rs 904 or, x = 1000

Thus, the marked price is Rs 1000.

Alternative method:

Here, D% = 20% and VAT = 13%

Price with VAT $= \frac{MP \times (100 - D)(100 + VAT)}{100 \times 100}$ or, $904 = \frac{MP \times (100 - 20)(100 + 13)}{100 \times 100}$

or, $904 = \frac{MP \times 80 \times 113}{100 \times 100}$ or, $904 = MP \times 0.904$

$\therefore$ MP = 1000 Thus, the marked price is Rs 1000

13. एउटा छाता 10 ओटा दुई फरक रङ्गका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । प्रत्येक टुक्राको नाप 15 cm, 41 cm र 28 cm भए उक्त छाता बनाउन कति कपडा चाहिन्छ ? यदि 1 cm² कपडाको मूल्य रु. 0.50 पर्छ भने जम्मा कपडाको मूल्य कति पर्छ ?

An umbrella is made by stitching 10 triangular pieces of cloth of two different colours, each piece measuring 15 cm, 41 cm and 28 cm. How much cloth is required for the umbrella? If the cost of 1 cm² is Rs 0.50, find the total cost of cloth.

☞ Here, let a = 15 cm, b = 41 cm and c = 28 cm

We know that, For a piece of a cloth, $s = \frac{15 + 41 + 28}{2}$ cm = 42 cm

We have, Area of a piece $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{42(42-15)(42-41)(42-28)}$ cm²

$= \sqrt{42 \times 27 \times 1 \times 14}$ cm² = 126 cm²

Area of 10 pieces of the clothes = 10 × 126 cm² = 1260 cm²

We have given that,

The cost of 1 cm² is Rs 0.50.

Cost of 1260 cm² = Rs 0.50 × 1260 = Rs 630

Thus, the total cost of the cloth is Rs 630.

14. सरल गर्नुहोस् (Simplify): $\frac{1}{a^2 - 3a + 2} + \frac{1}{a^2 - 5a + 6} + \frac{2}{a^2 - 8a + 15}$

☞ Here,

$= \frac{1}{a^2 - 2a - a + 2} + \frac{1}{a^2 - 3a - 2a + 6} + \frac{2}{a^2 - 5a - 3a + 15}$

$= \frac{1}{a(a-2) - 1(a-2)} + \frac{1}{a(a-3) - 2(a-3)} + \frac{2}{a(a-5) - 3(a-5)}$

$= \frac{1}{(a-1)(a-2)} + \frac{1}{(a-2)(a-3)} + \frac{2}{(a-3)(a-5)}$ $= \frac{a-3+a-1}{(a-1)(a-2)(a-3)} + \frac{2}{(a-3)(a-5)}$

$= \frac{2a-4}{(a-1)(a-2)(a-3)} + \frac{2}{(a-3)(a-5)}$ $= \frac{2(a-2)}{(a-1)(a-2)(a-3)} + \frac{2}{(a-3)(a-5)}$

$= \frac{2}{(a-1)(a-3)} + \frac{2}{(a-3)(a-5)}$ $= \frac{2(a-5) + 2(a-1)}{(a-1)(a-3)(a-5)}$

$= \frac{2a - 10 + 2a - 2}{(a-1)(a-3)(a-5)}$ $= \frac{4a - 12}{(a-1)(a-3)(a-5)}$

$= \frac{4(a-3)}{(a-1)(a-3)(a-5)}$ $= \frac{4}{(a-1)(a-5)}$

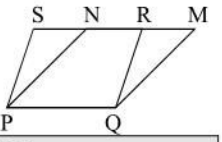
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15. एउटा आयताकार खेत 16 m लामो र 10 m चौडा छ । उक्त खेतको वरिपरि चारैतिर 120 m² क्षेत्रफल र एकसमान चौडाइ भएको बाटो छ । बाटोको चौडाइ पत्ता लगाउनुहोस् ।
A rectangular field is 16 m long and 10 m wide. There is a path of uniform width all around form outside it having an area of 120 m². Find the width of the path.

☞ Here, length (ℓ) = 16 m and breadth (b) = 10 m and area of outer path = 120 m^2
Let the width of path be (d) = x meter
Now, area of path $= (\ell + 2d) \times (b + 2d) - (\ell \times b) = (16 + 2x)(10 + 2x) - 16 \times 10$
$= 160 + 32x + 20x + 4x^2 - 160 = 4x^2 + 52x$
We have given, area of path is 120 m^2. So, $4x^2 + 52x = 120$
or, $x^2 + 13x = 30$ or, $x^2 + 13x - 30 = 0$
or, $x^2 + 15x - 2x - 30 = 0$ or, $x(x + 15) - 2(x + 15) = 0$
or, $(x + 15)(x - 2) = 0$ or, $x = -15, 2$
Thus, the width of the path is 2 m.

16. एउटै आधार र उही समानान्तर रेखाहरूबिच बनेका समानान्तर चर्तुभुजहरू PQRS र PQMN को क्षेत्रफल बराबर हुन्छ भनि प्रमाणित गर्नुहोस् ।
Prove that the area of parallelograms PQRS and PQMN standing on same base and the same parallels are equal in area.

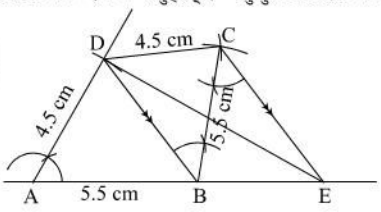


☞ **Given:** PQRS and PQMN are parms. standing on the same base PQ and parallel lines PQ and SM.
To prove: Area of ▱PQMN = Area of ▱PQRS
Proof:

Statement	Reasons
1. In ΔPSN and ΔQRM (i) ∠PSN = ∠QRM (ii) ∠PNS = ∠QMR (iii) PN = QM	1. (i) Corresponding angles, PS // QR (ii) Corresponding angles, PN // QM (iii) Opposite sides of parm
2. ΔPNS ≅ ΔQMR	2. By AAS
3. Area (ΔPNS = ΔQMR)	3. Being area of congruent triangles
4. Area (ΔPNS + Trapezium PQRN = ΔQRM + trapezium PQRN)	4. Adding trapezium on the both sides.
5. Area of ▱PQRS = ▱PQMN	5. From the statement (4) whole part axiom.

Proved.

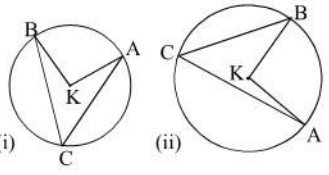
17. AB = BC = 5.5 cm, CD = DA = 4.5 cm र ∠A = 60° हुने चर्तुभुज ABCD को रचना गर्नुहोस् । चर्तुभुज ABCD को क्षेत्रफलसँग बराबर हुने गरि ΔADE को रचना गर्नुहोस् ।
Construct a triangle ADE equal in area to the quadrilateral ABCD in which AB = BC = 5.5 cm, CD = DA = 4.5 cm and ∠A = 60°.



☞ Here, AB = BC = 5.5 cm, CD = DA = 4.5 cm and ∠A = 60°
ABCD is the given quadrilateral and ΔADE is requireds triangle.

18. वृत्तको एउटै चाप AB मा आधारीत केन्द्रियकोण AKB परिधिकोण ACB को दोब्बर हुन्छ भनि प्रयोगात्मक रूपमा सिद्ध गर्नुहोस् । (कम्तिमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Verify experimentally that angle AKB at the centre is twice the inscribed angle ACB subtended by the same arc AB. (Two figures with at least 3 cm radii are necessary.)

☞ Here, K is the centre of circles. ∠AKB and ∠ACB are central angle and inscribed angle on the same arc AB.



Measurement Table

Fig	∠ACB	∠AKB	Remarks
(i)	46°	92°	∠AKB = 2∠ACB
(ii)	47°	94°	∠AKB = 2∠ACB

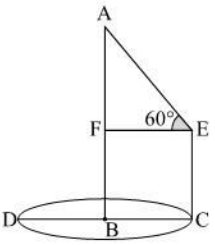
Conclusion: From the above table it is verified that ∠AKB is double of ∠ACB, standing on same arc AB. i.e. central angle is double of inscribed angle, standing on the same arc.

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19. एउटा वृत्ताकार पोखरीको केन्द्रमा पानीको सतहदेखि माथि 11.62 m अग्लो खम्बा छ । पोखरीको किनाराको कुनै बिन्दुबाट 1.62 m अग्लो मानिसले खम्बाको टुप्पो अवलोकन गर्दा उन्नतांश कोण 60° पायो भने सो पोखरीको व्यास पत्ता लगाउनुहोस् ।

At the centre of a circular pond, there is a pole of 11.62 m high above the surface of water. From a point on the edge of a pond, a man of 1.62 m high observes the angle of elevation of the top of the pole and found to be 60°. Find the diameter of the pond.

☞ Here, let CE = 1.62 m be an observer, BA = 11.62 m be the height of the pole. DC be the diameter of the pond. Let $\angle AEF = 60°$ be angle of elevation.



From right angled triangle AEF, $\tan\theta = \frac{p}{b}$

or, $\tan 60° = \frac{AF}{FE}$ or, $\sqrt{3} = \frac{11.62 - 1.62}{FE}$

or, $FE = \frac{10}{\sqrt{3}}$ $\therefore$ $BC = \frac{10}{\sqrt{3}}$ $(\because FE = BC)$

We know that, diameter (CD) = $2BC = 2\times\frac{10}{\sqrt{3}} = \frac{20}{\sqrt{3}} = 11.54$

Thus, the diameter of the pond is 11.54 m.

20. कुनै परीक्षामा विद्यार्थीहरूले गणित विषयमा निम्न अनुसारको अङ्क प्राप्त गरेका छन् ।

The following are the marks obtained by students in mathematics in an examination.

15, 12, 23, 35, 46, 57, 18, 12, 39, 51, 32, 43, 25, 59, 18, 38, 45, 40, 32, 33

(a) 10 को श्रेणी अन्तरमा हुने बारम्बारता तालिका बनाउनुहोस् । (Make a frequency table of class interval 10.)

(b) तेस्रो चतुर्थांस पत्ता लगाउनुहोस् । (Find the third quartile.)

☞ Here, the smallest number = 12 and the largest number = 59

Construction of frequency table and calculation of third quartile:

x	Tallies	f	c.f.
10-20	𝍸	5	5
20-30	||	2	7
30-40	𝍸|	6	13
40-50	||||	4	17
50-60	|||	3	20
		N = 20	

We know that, Q_3 class = $\frac{3N}{4} = 3\times\frac{20}{4} = 15^{th}$ item, So, Q_3 class is 40-50.

We have, $Q_3 = L + \frac{\frac{3N}{4} - cf}{f}\times h = 40 + \frac{15-13}{4}\times 10 = 45$

समूह 'घ' (Group 'D') **[4 x 5 = 20]**

21. रु. 2000 को तीन वर्षको 10% प्रति वर्षका दरले हुन आउने चक्रिय ब्याज रु. 3000 को 2 वर्षमा वार्षिक 8 प्रतिशतको दरले हुन आउने साधारण ब्याजभन्दा कति प्रतिशतले बढि हुन्छ, पत्ता लगाउनुहोस् ।

By what percent is the yearly compound interest on Rs 2000 for 3 years at 10% p.a. more than simple interest on Rs 3000 for 2 years at 8% p.a. Find it.

☞ Here,

Compound	Simple
P_1 = Rs 2000, R_1 = 10% and T_1 = 3 yrs	P_2 = Rs 3000, R_2 = 8% and T_2 = 2 yrs

We know that, $CI = P_1\left[\left(1+\frac{R_1}{100}\right)^{T_1} - 1\right] = 2000\left[\left(1+\frac{10}{100}\right)^3 - 1\right]$

$= 2000 \times (1.331 - 1) = 2000 \times 0.331 = \text{Rs } 662$

Again, simple interest = $\frac{P_2T_2R_2}{100} = \frac{3000\times 2\times 8}{100} = \text{Rs } 480$

$\therefore$ CI = Rs 662 and SI = Rs 480 shows that CI is more than SI.

So, required more percentage = $\frac{CI - SI}{SI}\times 100\% = \frac{662-480}{480}\times 100\% = 37.92\%$

Thus, the required percentage is 37.92%.

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22. पेम्वाले छोरी डोल्माको विवाह भोजका लागी 150 जनालाई व्यवस्था गरेछन् । उक्त कार्यका लागी उनले सोली आकारको टेन्टमा बस्ने व्यवस्था मिलाएछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि 4 वर्ग मि.ठाउँ र सास फेर्न 20 घन मि. हावा चाहिन्छ । सोली आकारको टेन्टको उचाइ कति हुन्छ ? पत्ता लगाउनुहोस् ।

In a marriage ceremony of Pemba's daughter, he has to make arrangement for accommodation of 150 persons. For this purpose, he plans to build a conical tent in such a way that each person have 4 sq.m of the space on ground and 20 cu.m of air to breath. What should be the height of the tent? Find it.

☞ Here, number of persons = 150, the area for 1 person on base = 4 m^2

Volume for 1 person in the space = 20 m^3

Let h be the height of conical tent and r be the radius of its base.

So, area of base = $150 \times 4\ m^2 = 600\ m^2$

Since the base is circular so $\pi r^2 = 600$ or, $r^2 = \frac{600}{\pi}\ m^2$

Now, the volume of the cone = $150 \times 20\ m^3 = 3000\ m^3$

or, $\frac{1}{3}\pi r^2 h = 3000$ or, $\frac{1}{3}\pi . \frac{600}{\pi} . h = 3000$ or, $200h = 3000$

$\therefore \quad h = 15$ m

Thus, the height of the tent is 15 m.

23. यदि a + b + c = 0 भए प्रमाणित गर्नुहोस् **(If a + b + c = 0, prove that):**

$$\frac{1}{1+x^a+x^{-b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = 1$$

☞ Here, $a + b = -c$, $b + c = -a$, $a + c = -b$

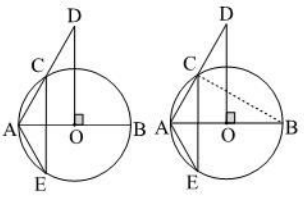
Now, $\frac{1}{1+x^a+x^{-b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = \frac{1}{1+x^a+\frac{1}{x^b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}}$

$= \frac{x^b}{x^b+x^{a+b}+1} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = \frac{x^b+1}{x^b+x^{-c}+1} + \frac{1}{1+x^c+x^{-a}}$

$= \frac{x^b+1}{x^b+\frac{1}{x^c}+1} + \frac{1}{1+x^c+x^{-a}} = \frac{x^b.x^c+x^c}{x^b.x^c+1+x^c} + \frac{1}{1+x^c+x^{-a}} = \frac{x^{-a}+x^c+1}{x^{-a}+1+x^c} = 1$. **Proved.**

24. दिइएको चित्रमा वृत्तको केन्द्रबिन्दु, O, व्यास AB, र DO ⊥ AB भए ∡AEC = ∡ODA हुन्छ भनी सिद्ध गर्नुहोस् ।

In the given figure, O is the centre of the circle, AB is the diameter and DO ⊥ AB. Prove that ∡AEC = ∡ODA.



☞ Here,

Given: O is the centre of the circle. AB the diameter and DO ⊥ AB.

To prove: ∡AEC = ∡ODA

Construction: Join BC,

Proof:

Statements	Reasons
1. ∡AEC = ∡ABC	1. Angles on same arc AC
2. ∡ACB = ∡AOD	2. Being angle at semicircle.
3. ∡BAC = ∡DAO	3. Being common angle.
4. ∡ABC = ∡ODA	4. Being remaining angles
5. ∡AEC = ∡ODA	5. From statement (1) and (4).

Proved

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2. SEE MODEL QUESTIONS ISSUED BY OCE SET A

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) मूल्य अभिवृद्धि करको परिभाषा लेख्नुहोस् । (Write down the definition of Value Added Tax (VAT).)

⇨ Here, value added tax is multi-stage tax as it is levied in every stage of distribution channels. The channels may be importer, manufacturer, whole-seller and retailer.

(b) कुनै त्रिभुजका तीनओटा भुजाहरू क्रमशः a, b र c छन् भने सो त्रिभुजको अर्धपरिमिति कति हुन्छ ? लेख्नुहोस् । If three sides of a triangle are a, b and c respectively, what is the semi perimeter of the triangle? Write it.

⇨ Here, semi-perimeter of a triangle $= \frac{a+b+c}{2}$ when the three sides are a, b and c respectively.

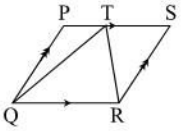
2. (a) सरल गर्नुहोस् (Simplify): $x^{a-b} \times x^{b-a}$

⇨ Here, $x^{a-b} . x^{b-a} = x^{a-b+b-a} = x^0 = 1$

(b) वर्गीकृत तथ्याङ्कमा तल्लो चतुर्थांशको मान (Q_1) पत्ता लगाउने सूत्र लेख्नुहोस् । Write the formula to find the value of lower quartile (Q_1) of a continuous data.

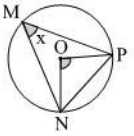
⇨ Here, in a continuous data, value of $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - c.f.\right)$

3. (a) दिइएको चित्रमा समानान्तर चतुर्भुज PQRS र ΔQTR को क्षेत्रफल बिच के सम्बन्ध हुन्छ ? लेख्नुहोस् । In the given figure, what is the relation between the area of the parallelogram PQRS and the ΔQTR? Write it.



⇨ Here, in the figure, ΔQTR and □PQRS are on the same base QR and between the same parallels PQ // SR so the required relation is; Area of $\Delta QTR = \frac{1}{2}$ Area of □PQRS.

(b) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠NMP = x° भए ∠NOP को मान पत्ता लगाउनुहोस् । In the adjoining figure, O is the center of a circle. If ∠NMP = x°, find the value of ∠NOP.



⇨ Here, ∠M and ∠NOP are on the same arc.
So, ∠NOP = 2∠M ∴ ∠NOP = 2x°

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) एउटा वस्तुको 13% मूल्यअभिवृद्धि करसहितको मूल्य रु. 5763 छ भने मूल्यअभिवृद्धि कर रकम कति होला ? पत्ता लगाउनुहोस् । The price of an object with 13% value added tax is Rs 5763. What will be the value added tax amount? Find it.

⇨ Here, let the price of the object without VAT be Rs x.
Then, x + 13% of x = 5763 or, 113% of x = 5763
or, $\frac{113x}{100} = 5763$ ∴ x = Rs 5100
VAT amount = Price with VAT – Price without VAT = Rs 5763 – Rs 5100 = Rs 663
Thus, the amount of value added tax is Rs 663.

(b) एउटा मोटरसाइकलको हालको मूल्य रु. 2,25,000 छ । यदि सो मूल्यमा प्रतिवर्ष 8% का दरले वार्षिक ह्रास हुन्छ भने, कति वर्षपछि मोटरसाइकलको मूल्य रु. 1,75,204.80 होला ? पत्ता लगाउनुहोस् । The present price of a motorcycle is Rs 2,25,000. If its price is depreciated per year by 8%, after how many years will the price of the motorcycle be Rs 1,75,204.80? Find it.

⇨ Here, Present price (P) = Rs 225000
Rate of depreciation (R) = 8%
Price after T years (P_T) = Rs 175204.80
We know that,
$P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $175204.80 = 225000\left(1 - \frac{8}{100}\right)^T$
or, $0.778688 = 0.92^T$ or, $0.92^3 = 0.92^T$
∴ T = 3 Thus, the required time is 3 years.

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5. (a) आधार भुजाको लम्बाइ 10 मिटर भएको एउटा समद्विबाहु त्रिभुजाकार जग्गाको क्षेत्रफल 60 वर्ग मिटर भए सो जग्गाको बाँकी भुजाहरूको नाप पत्ता लगाउनुहोस् ।
The area of an isosceles triangular land whose base side length 10 meter is 60 square meter. Find the measure of its remaining sides.

⇨ Here, Base side (b) = 10 m
Area of isosceles triangle = 60 m^2
We know that,

$$\text{Area of isosceles triangle} = \frac{b}{4}\sqrt{4a^2 - b^2}$$

or, $60 = \frac{10}{4}\sqrt{4a^2 - b^2}$ or, $24 = \sqrt{4a^2 - 100}$
or, $576 = 4a^2 - 100$ or, $676 = 4a^2$
or, $169 = a^2$ or, $a^2 = 13^2$
∴ $a = 13$ Thus, the measure of remaining side is 13 m.

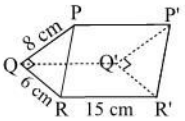
(b) आधारको व्यास 14 से.मि. भएको एउटा बेलनाको आयतन 2156 घन से.मि. छ भने सो बेलनाको उचाइ पत्ता लगाउनुहोस् ।
The volume of a cylinder with diameter of its base 14 cm is 2156 cm^3. Find the height of the cylinder.

⇨ Here, diameter (d) = 14 cm and volume (V) = 2156 cm^3.
We know that,

$$\text{Volume (V)} = \frac{1}{4}\pi d^2 h \quad \text{or, } 2156 = \frac{1}{4} \times \frac{22}{7} \times 14^2 \times h$$

or, $2156 = 154 \times h$ ∴ $h = 14$
Thus, the height of the cylinder is 14 cm.

(c) दिइएको ठोस त्रिभुजाकार प्रिज्ममा यदि PQ ⊥ QR, PQ = 8 से.मि., QR = 6 से.मि. र RR' = 15 से.मि. छन् भने सो प्रिज्मको छड्के सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given solid triangular prism, if PQ ⊥ QR, PQ = 8 cm, QR = 6 cm and RR' = 15 cm, find the lateral surface area of the prism.



⇨ Here, PQ = 8 cm, QR = 6 cm and RR' = 15 cm.
We have, $PR = \sqrt{PQ^2 + QR^2}$ or, $PR = \sqrt{(8)^2 + (6)^2} = 10$ cm
Now, Area of the lateral surface of the prism = ph = (8 + 6 + 10) cm × 15 cm = 360 sq. cm
Thus, the LSA is 360 cm^2.

6. (a) सरल गर्नुहोस् (Simplify): $2\sqrt{98} - 8\sqrt{32} + 3\sqrt{72}$

⇨ Here, $2\sqrt{98} - 8\sqrt{32} + 3\sqrt{72} = 2\sqrt{2 \times 49} - 8\sqrt{2 \times 16} + 3\sqrt{2 \times 36}$
$= 2 \times 7\sqrt{2} - 8 \times 4\sqrt{2} + 3 \times 6\sqrt{2} = 14\sqrt{2} - 32\sqrt{2} + 18\sqrt{2} = 0 \times \sqrt{2} = 0$

(b) हल गर्नुहोस् (Solve): $9 - \sqrt{x - 4} = 5$

⇨ Here, $9 - \sqrt{x - 4} = 5$ or, $4 = \sqrt{x - 4}$
or, $16 = x - 4$ ∴ $x = 20$
Thus, x = 20 is the solution.

7. (a) मान निकाल्नुहोस् (Evaluate): $\frac{3 \times 4^x + 4^{x-1}}{13 \times 4^x}$

⇨ Here, $\frac{3 \times 4^x + 4^{x-1}}{13 \times 4^x} = \frac{3 \times 4^x + 4^x \cdot 4^{-1}}{13 \times 4^x} = \frac{4^x\left(3 + \frac{1}{4}\right)}{13 \times 4^x} = \frac{\frac{13}{4}}{13} = \frac{1}{4}$

(b) कुनै धनात्मक सङ्ख्याको वर्गमा 5 जोड्दा योगफल 69 हुन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If 5 is added to the square of a positive number, the sum is 69. Find the number.

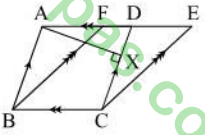
⇨ Here, let a positive number be x.
So, $x^2 + 5 = 69$ or, $x^2 = 64$
or, $x^2 = 8^2$ ∴ $x = 8$
Thus, the positive number is 8.

(c) सरल गर्नुहोस् (Simplify): $\frac{1}{(x-y)} - \frac{1}{(x+y)} + \frac{2x}{x^2 - y^2}$

⇨ Here, $\frac{1}{(x-y)} - \frac{1}{(x+y)} + \frac{2x}{x^2 - y^2} = \frac{x + y - (x - y)}{(x-y)(x+y)} + \frac{2x}{x^2 - y^2} = \frac{x + y - x + y}{x^2 + y^2} + \frac{2x}{x^2 - y^2}$
$= \frac{2y}{x^2 - y^2} + \frac{2x}{x^2 - y^2} = \frac{2y + 2x}{x^2 - y^2} = \frac{2(x+y)}{(x+y)(x-y)} = \frac{2}{x-y}$

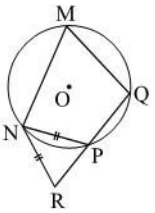
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8. (a) दिइएको चित्रमा BC // AE, BA // CD, BF // CE र AX ⊥ CD छन् । यदि AB = 12 से.मि. र चतुर्भुज BCEF को क्षेत्रफल 84 वर्ग से.मि. छ भने AX को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, BC // AE, BA // CD, BF // CE and AX ⊥ CD. If AB = 12 cm and area of the quadrilateral BCEF = 84 sq. cm., find the length of AX.



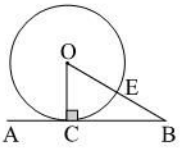
⇨ Here, AB = 12 cm, Ar. (▱BCEF) = 84 cm^2.
We know that, parallelograms on the same base and between the same parallels are equal.
So, Area of ABCD = Area of BCEF = 84 sq. cm
or, DC × AX = 84 sq. cm or, AB × AX = 84 sq. cm
or, 12 cm × AX = 84 sq. cm ∴ AX = 7 cm
Thus, the length of AX is 7 cm.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु र MNPQ एउटा चक्रीय चतुर्भुज हो । यदि NR = NP र ∠PNR = 50° भए ∠NMQ को नाप पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle and MNPQ is a cyclic quadrilateral. If NR = NP and ∠PNR = 50°, find the size of ∠NMQ.



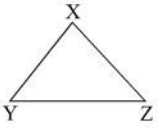
⇨ Here, NR = NP, ∠PNR = 50°, ∠NMQ = ?
(i) ΔPNR is an isosceles triangle.
So, 2∠NPR + ∠PNR = 180° or, 2∠NPR + 50° = 180°
or, 2∠NPR = 130° ∴ ∠NPR = 65°
(ii) MNPQ is a cyclic quadrilateral.
So, ∠NMQ = ∠NPR [∵ Exterior angle and opposite interior angle.]
∴ ∠NMQ = 65°
Thus, the measure of ∠NMQ is 65°.

(c) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु र AB स्पर्श रेखा हो । यदि OC = 5 से.मि. र BC = 12 से.मि. भए BE को नाप पत्ता लगाउनुहोस् ।
In the given figure, O is the center of the circle and AB is a tangent line. If OC = 5 cm and BC = 12 cm, find the measure of BE.



⇨ (i) Here, AB is tangent and OC is radius. So, ∠OCB = 90°
(ii) OB = $\sqrt{OC^2 + BC^2} = \sqrt{(5\text{ cm})^2 + (12\text{ cm})^2}$ = 13 cm
(iii) BE = OB – OE = 13 cm – 5 cm = 8 cm. (∵ OC = OE)

9. (a) दिइएको त्रिभुज XYZ मा XY = 8 से.मि., YZ = 12 से.मि. र ΔXYZ को क्षेत्रफल 24 वर्ग से.मि. छन् भने ∠XYZ को नाप पत्ता लगाउनुहोस् ।
In the given triangle XYZ, XY = 8 cm, YZ = 12 cm and area of ΔXYZ is 24 sq. cm. Find the size of ∠XYZ.



⇨ Here, XY = 8 cm, YZ = 12 cm and Ar. (ΔXYZ) = 24 cm^2
We know that,

$$\text{Area of } \Delta XYZ = \frac{1}{2} XY \times YZ \times \sin \angle XYZ$$

or, $24 = \frac{1}{2} \times 8 \times 12 \times \sin \angle XYZ$ or, $24 = 4 \times 12 \times \sin \angle XYZ$

or, $\frac{1}{2} = \sin \angle XYZ$ or, $\sin 30° = \sin \angle XYZ$ ∴ ∠XYZ = 30°

Thus, the size of ∠XYZ is 30°.

(b) एउटा वर्गीकृत तथ्याङ्कमा, यदि पदहरूको सङ्ख्या (N) = 9b + 5, Σfm = 350 र मध्यक ($\overline{X}$) = 7 भए N को मान पत्ता लगाउनुहोस् ।

In a grouped data, if the number of terms (N) = 9b + 5, Σfm = 350 and Mean ($\overline{X}$) = 7, find the value of N.

⇨ Here, N = 9b + 5, Σfm = 350 and $\overline{X}$ = 7
We know that,

$\overline{X} = \frac{\Sigma fm}{N}$ or, $\overline{X} \times N = \Sigma fm$ or, 7(9b + 5) = 350

or, 63b + 35 = 350 or, 63b = 315 ∴ b = 5

Now, N = 9b + 5 = 9 × 5 + 5 = 50. Thus, the value of N is 50.

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10. (a) एउटा डाइसलाई उफार्दा 3 ले भाग जाने सङ्ख्या अथवा वर्ग सङ्ख्या आउने सम्भाव्यता कति हुन्छ, पत्ता लगाउनुहोस् । **Find the probability of getting a number divisible by 3 or a square number when a fair dice is thrown.**

⇨ Here, Let A and B be two events of getting the numbers divisible by 3 and square numbers.

So, $A = \{3, 6\}$ $\therefore$ $n(A) = 2$

$B = \{1, 4\}$ $\therefore$ $n(B) = 2$

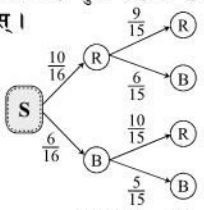
$S = \{1, 2, 3, 4, 5, 6\}$ $\therefore$ $n(S) = 6$

We have,

$$P(A \text{ or } B) = P(A) + P(B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{2}{6} + \frac{2}{6} = \frac{4}{6} \qquad \therefore \quad P(A \text{ or } B) = \frac{2}{3}$$

Thus, the required probability is $\frac{2}{3}$.

(b) 10 ओटा राता र 6 ओटा काला उत्रै र उस्तै बलहरू भएको एउटा झोलाबाट एकपछि अर्को गरी पुनः नराखी 2 ओटा बलहरू क्रमशः झिक्दा आउने सबै परिणामका सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् । **From a bag containing 10 red and 6 black balls of the same shape and size, two balls are taken randomly in succession without replacement. Show the probabilities of all outcomes in a tree diagram.**



⇨ Here, let R and B denote red balls and black balls respectively.
Then the probability tree diagram is shown alongside.

समूह 'ग' (Group' C') **[10 × 4 = 40]**

11. 180 जना विद्यार्थीहरूको समूहमा सर्वेक्षण गर्दा 50 जनाले क्रिकेट खेलमात्र मन पराउँछु भने, 30 जनाले बास्केट बल खेलमात्र मन पराउँछु भने र 50 जनाले दुवै खेल मन पराउँदैनौं भने,
In a survey of a group of 180 students, 50 students say to like cricket game only, 30 students say to like basketball game only and 50 students say do not like both games.

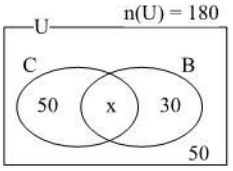
i) माथिको भनाइलाई भेन चित्रमा प्रस्तुत गर्नुहोस् । **(Represent the above information in a Venn diagram.)**

ii) क्रिकेट खेल मन पराउने र बास्केट बल खेल मन पराउने विद्यार्थीहरूको अनुपात पत्ता लगाउनुहोस् । **Find the ratio of the students who like cricket game and basketball game.**

⇨ Here, Let C and B represent sets of students who like cricket game and basketball game respectively, x be number of students who like both and U be the universal set.

So, $n(U) = 180$, $n_0(C) = 50$, $n_0(B) = 30$, $n(\overline{C \cup B}) = 50$

Representation of the information in Venn-diagram is shown alongside:



We have, $n(C \cup B) = n(U) - n(\overline{C \cup B}) = 180 - 50 = 130$

Again, $n(C \cap B) = x = n(C \cup B) - n_0(C) - n_0(B) = 130 - 50 - 30 = 50$

So, $n(C) = 50 + 50 = 100$ and $n(B) = 30 + 50 = 80$

Now, $n(C) : n(B) = 100 : 80 = 5 : 4$

Thus, the required ratio is 5 : 4.

12. मनिषले रु. 2,00,000 मा केही अमेरिकी डलर किने । तर चार दिनपछि अमेरिकी डलरको तुलनामा नेपाली मुद्रा 5% ले अवमूल्यन भयो । नेपाली मुद्रा अवमूल्यन भएको दिन मनिषले फेरि नेपाली रुपियाँ साट्दा उसलाई कति नाफा वा नोक्सान हुन्छ ? पत्ता लगाउनुहोस् । ($1 = NRs 104.28)
Manish bought some American dollar for Rs 2,00,000. But after four days, the Nepalese currency was devaluated in the comparison of American dollar by 5%. Again Manish exchanged the Nepali currency by giving American dollar in the day of devaluation of Nepalese currency. How much does he gain or loss? Find it. ($1 = NRs104.28)

⇨ Here, we have given, Rs 104.28 = $1 So, Rs 200000 = $ $\frac{1}{104.28} \times 200000$ = $ 1917.91

Therefore, Rs 200000 = $1917.91 Since, Nepali currency was devaluated by 5%,

So, $1 = Rs 104.28 + 5% of Rs 104.28 = Rs 104.28 + 0.05 × Rs 104.28

= Rs 104.28 + Rs 5.214 = Rs 109.49

Again, he exchanged dollar into NRs

So, $1917.91 = Rs 109.49 × 1917.91 = Rs 209991.96

Initially he had Rs 200000 and finally he has Rs 209991.96

So, Manish makes profit and i.e. = Final amount – Initial amount = Rs 209991.96 – Rs 200000

$\therefore$ Profit = Rs 9991.96 Thus, his profit is Rs 9991.96.

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13. छड्के उचाइ 10 से.मि. र ठाडो उचाइ 8 से.मि. भएको एउटा वर्गाकार आधार भएको पिरामिडको पुरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।

Find the total surface area of a square based pyramid having the slant height 10 cm and vertical height 8 cm.

⇨ Here, Slant height (ℓ) = 10 cm, vertical height (h) = 8 cm.

Let, the length of the side of the base of the square based pyramid be a cm. Then

$10^2 = 8^2 + \left(\frac{a}{2}\right)^2$ or, $100 = 64 + \frac{a^2}{4}$ or, $36 = \frac{a^2}{4}$

or, $144 = a^2$ or, $a^2 = 12^2$ ∴ $a = 12$ cm

Now, T.S.A of the pyramid = $a^2 + 2a\ell = 12^2 + 2 \times 12 \times 10 = 384$ sq. cm.

Thus, the total surface area is 384 cm^2.

14. ल.स.निकाल्नुहोस् **(Find the LCM of): $a^3 + 1 + 2a^2 + 2a$, $a^3 - 1$ and $a^4 + a^2 + 1$**

⇨ Here, 1st exp. = $a^3 + 1 + 2a^2 + 2a = (a + 1)(a^2 - a + 1) + 2a(a + 1) = (a + 1)(a^2 - a + 1 + 2a) = (a + 1)(a^2 + a + 1)$

2nd exp. = $a^3 - 1 = (a - 1)(a^2 + a + 1)$

3rd exp. = $a^4 + a^2 + 1 = (a^2)^2 + 2.a^2 . 1 + 1^2 - a^2 = (a^2 + 1)^2 - a^2 = (a^2 + 1 + a)(a^2 + 1 - a)$

LCM = $(a + 1)(a - 1)(a^2 + a + 1)(a^2 - a + 1)$

15. सरल गर्नुहोस् **(Simplify): $\frac{x}{(x-y)(x-z)} + \frac{y}{(y-z)(y-x)} + \frac{z}{(z-x)(z-y)}$**

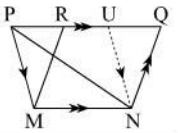
⇨ Here, $\frac{x}{(x-y)(x-z)} + \frac{y}{(y-z)(y-x)} + \frac{z}{(z-x)(z-y)} = -\frac{x}{(x-y)(z-x)} - \frac{y}{(y-z)(x-y)} - \frac{z}{(z-x)(y-z)}$

$= -\frac{x(y-z) + y(z-x) + z(x-y)}{(x-y)(z-x)(y-z)} = -\frac{xy - xz + yz - xy + xz - zy}{(x-y)(z-x)(y-z)} = -\frac{0}{(x-y)(z-x)(y-z)} = 0$

16. एउटै आधार MN र उही समानान्तर रेखाहरू MN र PQ बिचमा बनेका त्रिभुज PMN र समानान्तर चतुर्भुज RMNQ हुन् भने सिद्ध गर्नुहोस् : ΔPMN को क्षेत्रफल = $\frac{1}{2}$ $\square RMNQ$ को क्षेत्रफल ।

A triangle PMN and a parallelogram RMNQ are constructed on the same base MN and between the same parallel lines MN and PQ. Prove that: area of $\Delta PMN = \frac{1}{2}$ area of $\square RMNQ$.

⇨ Here, **Given:** ΔMNP and parallelogram RMNQ are on the same base MN and between the same parallels PQ and MN.



To prove: $\Delta MNP = \frac{1}{2}$ parallelogram RMNQ (in area)

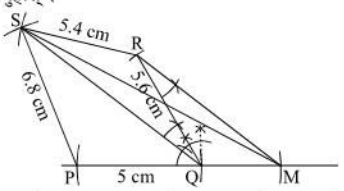
Construction: Draw NU parallel to MP to meet PQ at U on PQ.

Proof:

	Statements		Reasons
1.	PMNU is a parallelogram.	1.	Being the opposite sides parallel.
2.	Ar.(ΔMNP) = $\frac{1}{2}$ Ar. ($\square$PMNU)	2.	The diagonal PN bisects the parallelogram $\square$PMNU.
3.	Ar. ($\square$PMNU) = Ar. ($\square$RMNQ)	3.	Both parallelograms are standing on the same base MN and between same parallels, PQ and MN.
4.	∴ Ar. (ΔMNP) = $\frac{1}{2}$ Ar. ($\square$RMNQ)	4.	From the statements (2) and (3) ***Proved***

17. PQ = 5 से.मी, QR = 5.6 से.मी, RS = 5.4 से.मि. SP = 6.8 से.मी र $\angle PQR = 75°$ भएको एउटा चतुर्भुज PQRS को रचना गरी उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुने गरी एउटा त्रिभुज PSM को रचना गर्नुहोस् ।

Construct a quadrilateral PQRS in which PQ = 5 cm, QR = 5.6 cm, RS = 5.4 cm, SP = 6.8 cm, and $\angle PQR = 75°$. Then construct a triangle PSM equal in area to the quadrilateral PQRS.



⇨ Here, PQ = 5 cm, QR = 5.6 cm, RS = 5.4 cm, SP = 6.8 cm and $\angle PQR = 75°$.

ΔPSM is the required triangle whose area is equal to the area of given quadrilatera PQRS.

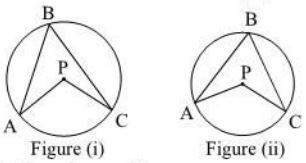
18. वृत्त ABC को एउटै चाप AC मा आधारित केन्द्रीयकोण APC र परिधिकोण ABC बीचको सम्बन्ध प्रयोगद्वारा परीक्षण गरी पत्ता लगाउनुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Explore experimentally the relation between the central angle APC and the circumference angle ABC standing on the same arc AC of a circle ABC. (Two circles of radii not less than 3 cm are necessary.)

⇨ Here, In the figure, $\angle APC$ is central angle and $\angle ABC$ is the inscribed angle on arc AC.

Measurement table.

Fig	$\angle APC$	$\angle ABC$	Remarks
(i)	110°	55°	$\angle APC = 2\angle ABC$
(ii)	110°	55°	$\angle APC = 2\angle ABC$



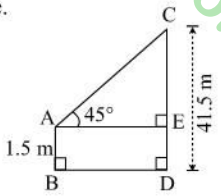
From the above table it is concluded that central angle is twice the inscribed angle standing on same arc.

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19. 1.5 मिटर अग्लो मानिसले 41.5 मिटर अग्लो एउटा रुखको ठीक अगाडि उभिएर रुखको टुप्पोमा हेर्दा आँखामा 45° को कोण बनेछ भने, उक्त रुख र मानिसबिचको दूरी पत्ता लगाउनुहोस् ।
A 1.5 meter tall person is standing in front of 41.5 meter high tree. When observing the top of the tree an angle of 45° is formed with the eyes. Find the distance between the tree and the person.

⇨ Here, let AB = 1.5 m be the height of a man, CD = 41.5 m be the height of tree.
Let $\angle CAE = 45°$ be an angle of elevation.
From the figure. CE = CD – ED = CD – AB = 41.5 m – 1.5 m = 40 m.
Now, In right angled ΔAEC,



$\tan 45° = \frac{CE}{AE}$ or, $1 = \frac{40\text{ m}}{AE}$

or, AE = 40 m
Thus, the distance between the tree and the person = BD = AE = 40 m.

20. यदि तल दिइएको आँकडाको मध्यिका 19 भए p को मान पत्ता लगाउनुहोस् ।
If the median of the following given data is 19, find the value of P.

Age in year	6-12	12-18	18-24	24-30	30-36	36-42
Number of students	4	10	p	4	3	3

⇨ Here, calculation of missing frequency.

Age in years	No. of students (f)	c.f.
6 - 12	4	4
12 - 18	10	14
18 - 24	p	14 + p
24 - 30	4	18 + p
30 - 36	3	21 + p
36 - 42	3	24 + p
	N = 24 + p	

Here, Median (Md) = 19, so median class = 18 – 24
We know that,

$\text{Median(Md)} = L + \frac{i}{f}\left(\frac{N}{2} - c.f\right)$ or, $19 = 18 + \frac{6}{p}\left(\frac{24+p}{2} - 14\right)$ or, $1 = \frac{6}{p}\left(\frac{24+p-28}{2}\right)$

or, $1 = \frac{3}{p}(p-4)$ or, $p = 3p - 12$ or, $2p = 12$

∴ $p = 6$ Thus, the value of p is 6.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. एउटा बैङ्कले खाता A मा 10% प्रति वर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता B मा 12% प्रति वर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ । यदि तपाई 2 वर्षका लागि रु. 25,000 सो बैङ्कमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? गणना गरी कारणसहित उल्लेख गर्नुहोस् ।
A bank has fixed the rate of interest 10% per annum semiannually compound interest in account A and 12% per annum annually compound interest in account B. If you are going to deposit Rs 25,000 for 2 years in the same bank, in which account will you deposit and why? Give your reason with calculation.

⇨ Here,

Account A	Account B
Rate (R) = 10% Time (T) = 2 years Principal (P) = Rs 25000	Rate (R) = 12% Time (T) = 2 years Principal (P) = Rs 25000
Semiannual Interest	Annual Interest

Interest in account A (CI_1) $= P\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right]$

or, $CI_1 = P\left[\left(1 + \frac{10}{200}\right)^{2\times 2} - 1\right] = 25000\,[(1.05)^4 - 1]$ ∴ CI_1 = Rs 5387.65

Interest in account B (CI_2) $= \left[\left(1 + \frac{R}{100}\right)^{T} - 1\right]$

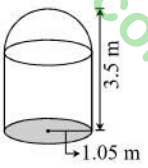
or, $CI_2 = P\left[\left(1 + \frac{12}{100}\right)^{2} - 1\right] = 25000[1.2544 - 1]$ ∴ CI_2 = Rs 6360

Thus, it is more convenient to deposit Rs 25000 in account B because the interest in account B is more than the interest in account A by; Rs 6360 – Rs 5387.65 = Rs 972.35.

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22. एकजना मानिसले आफ्नो घरको प्रयोजनको लागि 1.05 मिटर अर्धव्यास र 3.5 मिटर उचाइ भएको एउटा वृत्ताकार आधार भएको पानी ट्याङ्कीको पसलबाट किनेर ल्याउनु भयो । यदि उक्त ट्याङ्कीको माथिल्लो भाग अर्धगोलाकार छ भने सो ट्याङ्कीमा कति लिटर पानी अटाउँछ होला ? पत्ता लगाउनुहोस् ।

A person bought a water tank of circular base having the radius 1.05 meter and height 3.5 meter for the use of own house from the shop. If the upper part of the tank is hemi spherical, how many liters of water will be contained in the tank? Find it.



⇨ Here, radius of base (r) = 1.05 m

Total height of the tank (H) = 3.5 m

Radius of the hemi-spherical part of the tank = r = 1.05 m

Hence, the height of the cylindrical part of the tank (h) = 3.5 m – 1.05 m = 2.45 m

We have, Volume of the cylindrical part $= \pi r^2 h = \frac{22}{7} \times 1.05^2 \times 2.45 = 8.48925\ m^3$

Again, Volume of hemi-spherical part $= \frac{2}{3}\pi r^3 = 2.4255\ m^3$

So, Total Volume of water tank = V(Cylinder) + V(Hemisphere) = $8.48925\ m^3 + 2.4255\ m^3 = 10.91475\ m^3$

Now, Volume of water = Volume of the tank = $10.91475\ m^3 = 10.91475 \times 1000\ \ell = 10914.75$ litres.

Thus, 10914.75 litres of water will contained in the tank.

23. यदि तीन वर्ष अघि बाबु र छोराको उमेरको योगफल 48 वर्ष थियो । अबको 3 वर्ष पछि बाबु र छोराको उमेरको अनुपात 3 : 1 हुन्छ भने छोराभन्दा बाबु कति वर्षले जेठो हुनुहुन्छ ? पत्ता लगाउनुहोस् ।

Three years ago, the sum of the ages of the father and son was 48 years. After three years the ratio of the ages of the father and son will be 3 : 1, then how much older is the father from his son? Find it.

⇨ Here, let present ages of the father and his son be x years and y years respectively.

Then, three years ago, $(x - 3) + (y - 3) = 48$ $\quad\therefore\quad x + y = 54$ ...(i)

Again, after three years, $(x + 3) : (y + 3) = 3 : 1$

or, $\frac{x+3}{y+3} = \frac{3}{1}$ $\quad$ or, $x + 3 = 3y + 9$ $\quad\therefore\quad x - 3y = 6$ ...(ii)

Solving equation (i) and (ii) then,

$x + y = 54$

$x - 3y = 6$

$- \quad + \quad -$

$4y = 48 \quad\therefore\quad y = 12$

From equation (i)

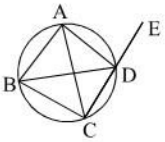
$x + y = 54$ $\quad$ or, $x + 12 = 54$ $\quad\therefore\quad x = 42$

Hence, the difference between their ages = 42 – 12 = 30,

Thus, the father is 30 years older than his son.

24. दिइएको चित्रमा ABCD एउटा चक्रीय चतुर्भुज हो । भुजा CD लाई लम्ब्याएर E सम्म पुऱ्याइएको छ । यदि AD ले ∠BDE लाई आधा गरेको छ भने ΔABC एउटा समद्विबाहु त्रिभुज हो भनी प्रमाणित गर्नुहोस् ।

In the given figure, ABCD is a cyclic quadrilateral. The side CD is produced to E. If AD bisects ∠BDE, prove that ΔABC is an isosceles triangle.



⇨ Here, Given: (i) ABCD is a cyclic quadrilateral. (ii) AD bisects ∠BDE

To prove: ΔABC is an isosceles triangle.

Proof:

	Statements		Reasons
1.	∠ADE = ∠ADB	1.	Being AD bisector of ∠BDE.
2.	∠ADE = ∠ABC	2.	Being exterior angle and opposite interior angle of cyclic quad.
3.	∠ADB = ∠ACB	3.	Being inscribed angles on same arc.
4.	∠ABC = ∠ACB	4.	From (1), (2) and (3) with reason
5.	ΔABC is an isosceles triangle.	5.	Base angles are equal in (4).

Proved.

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3. SEE MODEL QUESTIONS ISSUED BY OCE SET B

समूह 'क' (Group 'A') [3 × 2 = 6]

1. (a) यदि कुनै सामानको सुरुको मूल्य रु. P र वार्षिक ह्रासदर R% छ भने T वर्ष पछिको मूल्य पत्ता लगाउने सूत्र लेख्नुहोस् ।
If the initial price of an article is Rs P and annual rate of depreciation is R%, then write the formula to find the price after T years.

⇨ Here, the formula to find the price after T years is $P_T = P\left(1 - \frac{R}{100}\right)^T$ where P = initial price, R = rate and T = time.

(b) एउटा समद्विबाहु त्रिभुजको आधार भुजा b से.मि. र बराबर दुई भुजाहरू a से.मि. छन् भने उक्त त्रिभुजको क्षेत्रफल कति हुन्छ ? लेख्नुहोस् ।
The base of an isosceles triangle is b cm and equal sides are a cm. What is the area of the triangle? Write it.

⇨ Here, area of the isosceles triangle is $\frac{b}{4}\sqrt{4a^2 - b^2}$ where, b = base side and a is equal sides.

2. (a) ल.स. को परिभाषा लेख्नुहोस् । **(Define LCM.)**

⇨ Here, the LCM of given expressions is the smallest expression that is divisible by each of the given expressions. In other words LCM is the product of common factors and remaining factors.

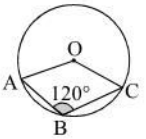
(b) यदि कुनै तथ्याङ्कको मध्यिका श्रेणीको तल्लो सीमा L, सो श्रेणीको बारम्बारता f, श्रेणी अन्तर i, बारम्बारताहरूको जोड N र मध्यिका श्रेणीभन्दा अघिल्लो श्रेणीको सञ्चित बारम्बारता cf छन् भने मध्यिका (Md) पत्ता लगाउने सूत्र लेख्नुहोस् ।
If the lower limit of the median class of any data is L, frequency of that class is f, class interval i, sum of the frequencies N and the cumulative frequency of pre-median class is cf then write the formula for finding the median (Md).

⇨ Here, the formula of median according to given information is given by $M_d = L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$.

3. (a) एउटै आधार र उही समानान्तर रेखाहरूबिच रहेका आयत र त्रिभुजका क्षेत्रफलहरूबिचको सम्बन्ध लेख्नुहोस् ।
Write the relationship between the areas of a rectangle and a triangle standing on the same base and between the same parallel lines.

⇨ Here, the required relationship is Ar (Rectangle) = 2 × Ar. (Triangle)

(b) दिइएको चित्रमा O वृत्तको केन्द्र हो । यदि ∠ABC = 120° भए वृहत ∠AOC को नाप कति हुन्छ ? लेख्नुहोस् ।
In the given figure, O is the centre of the circle. If ∠ABC = 120°, what is the size of the reflex ∠AOC? Write it.



⇨ Here, central angle is twice the inscribed angle standing on same arc.
So, reflex ∠ AOC = 2 ∠ABC = 2 × 120° = 240°
Thus, the reflex angle AOC is 240°.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) नेपाल राष्ट्र बैङ्कको मुद्रा विनिमय दर अनुसार अमेरिकन डलर 1 को खरीद दर र बिक्रीदर क्रमशः नेपाली रु. 103.72 र रु. 104.32 छन् भने :
According to the money exchange rate of Nepal Rastra Bank, the purchasing and selling rates of 1 American dollar are NRs103.72 and NRs 104.32 respectively, then
   i) नेपाली रु. 57,376 सँग कति अमेरिकन डलर साट्न सकिन्छ ?
   How many American dollars can be exchanged with NRs 57,376?
   ii) तपाईंले $500 सँग कति नेपाली रूपैयाँ साट्न सक्नुहुन्छ ? पत्ता लगाउनुहोस् ।
   How much Nepali rupees can you exchange with $500? Find it.

⇨ Here, buying rate is; $ 1 = Rs 103.72 and selling rate is; $ 1 = Rs 104.32
(i) Rs 57376 can be exchanged using selling rate.
So, American dollar = $\frac{\text{Amount to be exchanged}}{\text{Selling rate}} = \frac{\text{Rs } 57376}{\text{Rs } 104.32} = \$\ 550$
(ii) US dollar can be excahanged into Nepali rupees using buying rate.
So, amount in NRS = dollar to be exchanged × buying rate = 500 × Rs 103.72 = Rs 51860
Thus, the required NRs is Rs 51860.

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(b) वि.सं. 2072 को शुरुमा एउटा शहरको जनसङ्ख्या 50,000 थियो । यदि वार्षिक जनसङ्ख्या वृद्धिदर 10% छ भने वि.सं. 2074 को अन्तमा त्यो शहरको जनसङ्ख्या कति होला ? पत्ता लगाउनुहोस् ।
In the beginning of 2072 B.S., the population of a town was 50,000. If the annual population growth rate is 10%, what will be the population of the town at the end of 2074 B.S.? Find it.

⇨ Here, initial population (P) = 50000, growth rate (R) = 10%, population in 2074 = ?
So time (T) = 3 years

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T = 50000\left(1+\frac{10}{100}\right)^3 = 50000 \times 1.1^3$

$\therefore \quad P_T = 66550$

Thus, the population at the end of 2074 is 66550.

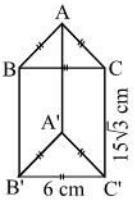
5. (a) भुजाहरू 3 से.मि., 4 से.मि. र 5 से.मि. भएको एउटा त्रिभुजको क्षेत्रफल निकाल्नुहोस् ।
Find the area of a triangle with sides 3 cm, 4 cm and 5 cm.

⇨ Here, sides of given triangle; a = 3 cm, b = 4 cm & c = 5 cm.
Since $a^2 + b^2 = c^2$ is satisfied by the given sides, so given triangle is a right angled triangle.

We have, area of right angled triangle $= \frac{1}{2}$ product of smaller sides $= \frac{1}{2} \times 3 \text{ cm} \times 4 \text{ cm} = 6 \text{ cm}^2$

Thus, the area of given triangle is 6 cm^2.

(b) दिइएको समबाहु त्रिभुजाकार प्रिज्ममा B'C' = 6 से.मि.र CC' = $15\sqrt{3}$ से.मि. छन् भने सो प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
In the given equilateral triangular prism, B'C' = 6 cm and CC' = $15\sqrt{3}$ cm. Find the volume of the prism.



⇨ Here, B'C' = 6 cm, CC' = $15\sqrt{3}$ cm

We know that, Base area $= \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times (6 \text{ cm})^2 = 9\sqrt{3} \text{ cm}^2$

Again, we have,

Volume (V) = Base area × height = $9\sqrt{3} \text{ cm}^2 \times 15\sqrt{3} \text{ cm} = 135 \times 3 \text{ cm}^3 = 405 \text{ cm}^3$

Thus, the volume of the prism is 405 cm^3.

(c) यदि एउटा गोलाको आयतन 4851 घन से.मि. छ भने यसको व्यास निकाल्नुहोस् ।
If the volume of a sphere is 4851 cubic cm, find its diameter.

⇨ Here, given volume of sphere = 4851 cm^3

We know that, Volume of a sphere $= \frac{1}{6}\pi d^3$

or, $4851 = \frac{1}{6} \times \frac{22}{7} \times d^3$ or, $\frac{4851 \times 6 \times 7}{22} = d^3$

or, $d^3 = 9261 = 21^3$ $\therefore \quad d = 21 \text{ cm}$

Thus, the diameter of the sphere is 21 cm.

6. (a) $x^4 - x$ र $x^2 + x + 1$ को म.स. पत्ता लगाउनुहोस् । **(Find the HCF of $x^4 - x$ and $x^2 + x + 1$.)**

⇨ Here, first exp. = $x^4 - x = x(x^3 - 1) = x(x - 1)(x^2 + x + 1)$
Second exp. = $x^2 + x + 1$ $\therefore$ HCF = $x^2 + x + 1$

(b) सरल गर्नुहोस् **(Simplify) :** $\sqrt[3]{16} + \sqrt[3]{54} - \sqrt[3]{250}$

⇨ Here, $\sqrt[3]{16} + \sqrt[3]{54} - \sqrt[3]{250} = \sqrt[3]{2 \times 8} + \sqrt[3]{2 \times 27} - \sqrt[3]{2 \times 125} = \sqrt[3]{2 \times 2^3} + \sqrt[3]{2 \times 3^3} - \sqrt[3]{2 \times 5^3}$

$= 2\sqrt[3]{2} + 3\sqrt[3]{2} - 5\sqrt[3]{2} = (2 + 3 - 5)\sqrt[3]{2} = 0 \times \sqrt[3]{2} = 0$

7. (a) के समीकरण $\sqrt{2x-1} = -1$ को एकल समाधान हुन्छ कि हुँदैन ? जाँच गर्नुहोस् ।
Whether the equation $\sqrt{2x-1} = -1$ has a unique solution or not? Check it.

⇨ Here, $\sqrt{2x-1} = -1$
Squaring both sides then,

$\left(\sqrt{2x-1}\right)^2 = (-1)^2$ or, $2x - 1 = 1$

or, $2x = 2$ $\therefore \quad x = 1$

Putting x = 1 in the given equation then,

$\sqrt{2 \times 1 - 1} = -1$ or, $\sqrt{2-1} = -1$

or, $\sqrt{1} = -1$ or, $1 = -1$ (False)

Which shows that given equation has no solution.

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(b) सरल गर्नुहोस् (Simplify) : $\frac{1}{1-x^{b-a}}+\frac{1}{1-x^{a-b}}$

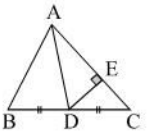
⇨ Here, $\frac{1}{1-x^{b-a}}+\frac{1}{1-x^{a-b}} = \frac{1}{1-\frac{x^b}{x^a}}+\frac{1}{1-\frac{x^a}{x^b}} = \frac{1}{\frac{x^a-x^b}{x^a}}+\frac{1}{\frac{x^b-x^a}{x^b}}$

$= \frac{x^a}{x^a-x^b}+\frac{x^b}{x^b-x^a} = \frac{x^a}{x^a-x^b}-\frac{x^b}{x^a-x^b} = \frac{x^a-x^b}{x^a-x^b} = 1$

(c) यदि तीनओटा क्रमागत: जोर सङ्ख्याहरूको योगफल 36 छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If the sum of three consecutive even numbers is 36, find the numbers.

⇨ Here, let the three consecutive even numbers be x, x + 2, x + 4
By the question, sum = 36
or, x + x + 2 + x + 4 = 36 or, 3x + 6 = 36 or, 3x = 30
∴ x = 10
Putting the value of x in above then the numbers are; 10, 12, 14.
Thus, the required numbers are 10, 12, 14.

8. (a) दिइएको चित्रमा BC को मध्यबिन्दु D हो र DE ⊥ AC छ । यदि AC = 12 से.मि. र DE = 5 से.मि. छन् भने ΔABC को क्षेत्रफल निकाल्नुहोस् ।
In the given figure D is the mid-point of BC and DE ⊥ AC. If AC = 12 cm and DE = 5 cm, find the area of ΔABC.



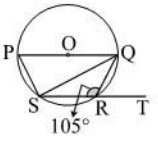
⇨ Here, AC = 12 cm, DE = 5 cm

(i) Area of ΔADC $= \frac{1}{2}$ base × height $= \frac{1}{2}$ AC × DE $= \frac{1}{2} \times 12$ cm × 5 cm = 30 cm^2

(ii) Area of ΔABC = 2 Area of ΔADC [∵ AD is median]
= 2 × 30 cm^2 = 60 cm^2

Thus, the area of ΔABC is 60 cm^2.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠QRS = 105° भए ∠PQS को मान कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the given diagram, O is the centre of the circle. If ∠QRS = 105°, what is the value of ∠PQS? Find it.



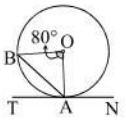
⇨ Here, ∠QRS = 105°

(i) The opposite angles of a cyclic quad. PQRS is supplementary.
So, ∠QRS + ∠QPS = 180° or, 105° + ∠QPS = 180° ∴ ∠QPS = 75°

(ii) PQ is a diameter so angle on diameter is 90°.
i.e. ∠QPS + ∠PQS = 90° or, 75° + ∠PQS = 90° ∴ ∠PQS = 15°

Thus, the value of ∠PQS is 15°.

(c) दिइएको चित्रमा O वृत्तको केन्द्र, TN स्पर्शरेखा र A स्पर्शबिन्दु हुन् । यदि ∠AOB = 80° भए ∠BAT को नाप पत्ता लगाउनुहोस् ।
In the given figure O is the centre of the circle, TN is the tangent and A is the point of contact. If ∠AOB = 80°, find the measurement of ∠BAT.



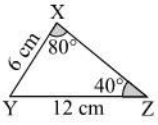
⇨ Here, ∠AOB = 80°

(i) ΔOBA is an isosceles triangle.
So, 2 ∠OAB + ∠AOB = 180° or, 2 ∠OAB + 80° = 180° or, 2 ∠ OAB = 100°
∴ ∠OAB = 50°

(ii) Radius is perpendicular to the tangent at point of contact.
So, ∠OAT = 90° or, ∠OAB + ∠BAT = 90° or, 50° + ∠BAT = 90°
∴ ∠BAT = 40°

Thus, the value of ∠BAT is 40°.

9. (a) ΔXYZ मा ∠X = 80°, ∠Z = 40°, XY = 6 से.मि. र YZ = 12 से.मि. छन् भने ΔXYZ को क्षेत्रफल निकाल्नुहोस् ।
In ΔXYZ, ∠X = 80°, ∠Z = 40°, XY = 6 cm and YZ = 12 cm. Find the area of ΔXYZ.



⇨ Here, ∠X = 80°, ∠Z = 40°, XY = 6 cm and YZ = 12 cm.

(i) Sum of angles in a Δ is 180°.
So, ∠X + ∠Y + ∠Z = 180° or, 80° + ∠Y + 40° = 180° or, 120° + ∠Y = 180°
∴ ∠Y = 60°

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(ii) We have, Area of $\Delta XYZ = \frac{1}{2} XY \cdot YZ \cdot \sin\angle Y = \frac{1}{2} \times 6 \text{ cm} \times 12 \text{ cm} \times \sin 60°$

$= 3 \text{ cm} \times 12 \text{ cm} \times \frac{\sqrt{3}}{2} = 18\sqrt{3} \text{ cm}^2$

Thus, the area of ΔXYZ is $18\sqrt{3} \text{ cm}^2$.

(b) एउटा निरन्तर श्रेणीमा यदि मध्यक ($\bar{x}$) = 6, $\Sigma fm = 72 + 8k$ र $\Sigma f = 16 + k$ भए जम्मा पदहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

In a continuous series, if the mean ($\bar{x}$) = 6, $\Sigma fm = 72 + 8k$ and $\Sigma f = 16 + k$, find the total number of terms.

⇨ Here, $\bar{x} = 6$, $\Sigma fm = 72 + 8k$ and $\Sigma f = 16 + k$

We know that, $\bar{x} = \frac{\Sigma fm}{\Sigma f}$

or, $6 = \frac{72 + 8k}{16 + k}$ or, $72 + 8k = 96 + 6k$

or, $2k = 24$ $\therefore \quad k = 12$

Now, the total number of terms $= 16 + k = 16 + 12 = 28$

Thus, the total number of terms is 28.

10. (a) एउटा डाइस र एउटा सिक्का एकैसाथ उफार्दा डाइसमा रुढ सङ्ख्या र सिक्कामा शीर आउने सम्भाव्यता पत्ता लगाउनुहोस् ।
Find the probability of getting a prime number on the dice and head on the coin when a dice is rolled and a coin is tossed simultaneously.

⇨ Here, in a dice, prime numbers $= \{2, 3, 5\}$ $n(\text{prime numbers}) = 3, \therefore \ n(s_1) = 6$

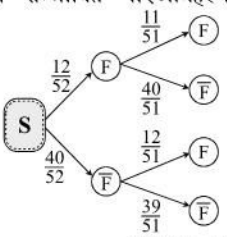
in a coin, $s = \{H, T\}$; $\therefore \ n(s_2) = 2$

We have, $P(\text{prime number and head}) = P(\text{prime no.}) \times P(\text{head}) = \frac{n(\text{prime no.})}{n(s_1)} \times \frac{n(H)}{n(s_2)}$

$= \frac{3}{6} \times \frac{1}{2} = \frac{1}{4}$

Thus, the required probability is $\frac{1}{4}$.

(b) राम्रो फिटिएको 52 पत्तीको एक प्याकेट तासबाट नहेरीकन एकपछि अर्को पुनः नराखीकन दुईओटा तास झिकिएका छन् । वृक्षचित्र खिची अनुहार भएको तास पर्ने र नपर्ने सबै सम्भावित परिणामहरूको सम्भाव्यताहरूलाई देखाउनुहोस् ।
Two cards are drawn randomly in succession without replacement from a well shuffled pack of 52 cards. By drawing a tree diagram show the probabilities of all the possible outcomes of getting and not getting a faced card.



⇨ Here, let F denote face cards and $\bar{F}$ denote the cards other than face cards. The probability tree diagram is shown here:

समूह 'ग' (Group 'C') **[10 × 4 = 40]**

11. 50 जना विद्यार्थीहरूको एक समूहमा 20 जनाले गणित मात्र र 15 जनाले विज्ञान मात्र मन पराउँछन् । यदि यी दुई विषयहरू मध्ये कुनै पनि विषय मन नपराउने विद्यार्थीहरूको सङ्ख्या दुवै विषय मन पराउने विद्यार्थीहरूको सङ्ख्याभन्दा दोब्बर छन् भने भेनचित्र प्रयोग गरेर बढीमा एउटा विषय मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
In a group of 50 students, 20 like only Maths and 15 like only Science. If the number of students who do not like any of the two subjects is double of the number of students who like both subjects, find the number of students who like at most one subject by using a Venn-diagram.

⇨ Here, let M and S be the set of students who like Maths and Science respectively.

Here, $n(U) = 50$, $n_o(M) = 20$, $n_o(S) = 15$,

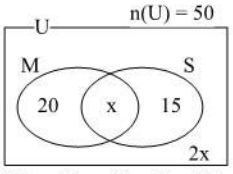
$n(\overline{M \cup S}) = 2n(M \cap S)$, let $n(M \cap S)$ be x.

The Venn-diagram of given information is shown alongside.

From the Venn-diagram,

$20 + x + 15 + 2x = 50$ or, $35 + 3x = 50$

or, $3x = 15$ $\therefore \quad x = 5$



Now, the no. of students who like at most one subject $= n(\overline{M \cap S}) = n(U) - n(M \cap S) = 50 - 5 = 45$

Thus, 45 students like at most one subject.

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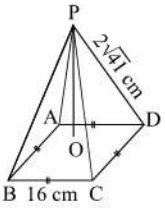
12. एकजना पर्यटकले 20% छुट र 13% मूल्य अभिवृद्धिकरसहित एउटा नेपाली टोपी किनेछन् । आफ्नो देश फर्कंदा उनलाई विमानस्थलमा मूल्यअभिवृद्धिकर रकम रु. 83.20 फिर्ता दिईयो भने सो टोपीको अङ्कित मूल्य कति रहेछ ? पत्ता लगाउनुहोस् ।

A tourist bought a Nepali cap with 20% discount and 13% value added tax. When returning to his country the VAT amount Rs 83.20 was given back to him at the airport. What was the marked price of the cap? Find it.

⇨ Here, discount rate = 20%, VAT rate = 13%.
Let the marked price be Rs x.
Then, price after discount = (100 – 20)% of x = 80% of x = 0.8 × x = 0.8x
Again, amount of VAT = 13% of price after discount = 13% of 0.8x = 0.13 × 0.8x = 0.104x
By the question, VAT amount is given back at airport.
So, 0.104x = Rs 83.20
∴ x = Rs 800
Thus, the marked price is Rs 800.

13. दिइएको चित्र एउटा वर्गाकार आधार भएको ठोस पिरामिडको हो । यदि आधार भुजाको लम्बाइ (BC) 16 से.मि. र छड्के किनाराको लम्बाइ (PD) $2\sqrt{41}$ से.मि.भए सो पिरामिडको आयतन पत्ता लगाउनुहोस् ।

The given figure is of a solid square based pyramid. If the length of side of the base (BC) is 16 cm and the length of the lateral edge (PD) is $2\sqrt{41}$ cm, find the volume of the pyramid.



⇨ Here, edge (e) = $2\sqrt{41}$ cm, and length of base (a) = 16 cm

We know that, slant height (ℓ) $= \sqrt{e^2 - \left(\frac{a}{2}\right)^2} = \sqrt{(2\sqrt{41})^2 - 8^2} = \sqrt{164 - 64} = \sqrt{100} = 10$ cm

Again, vertical height (h) $= \sqrt{(\ell)^2 - \left(\frac{a}{2}\right)^2} = \sqrt{10^2 - 8^2} = \sqrt{36} = 6$ cm

Now, volume of the pyramid $= \frac{1}{3}a^2h = \frac{1}{3} \times 16^2 \times 6 = 512$ cm^3

Thus, the volume of the pyramid is 512 cm^3.

14. सरल गर्नुहोस् **(Simplify):** $\frac{x+2}{x^2+2x+4} + \frac{x-2}{x^2-2x+4} + \frac{16}{x^4+4x^2+16}$

⇨ Here, $\frac{x+2}{x^2+2x+4} + \frac{x-2}{x^2-2x+4} + \frac{16}{x^4+4x^2+16}$

$= \frac{(x+2)(x^2-2x+4) + (x-2)(x^2+2x+4)}{(x^2+2x+4)(x^2-2x+4)} + \frac{16}{x^4+4x^2+16}$

$= \frac{x^3+2^3+x^3-2^3}{\{(x^2+4)+2x\}\{(x^2+4)-2x\}} + \frac{16}{x^2+4x^2+16}$

$= \frac{2x^3}{x^4+8x^2+16-4x^2} + \frac{16}{x^4+4x^2+16}$

$= \frac{2x^3+16}{x^4+4x^2+16}$

$= \frac{2(x^3+2^3)}{x^4+4x^2+16}$

$= \frac{2(x+2)}{x^2+2x+4}$

$= \frac{2x^3}{(x^2+4)^2-(2x)^2} + \frac{16}{x^4+4x^2+16}$

$= \frac{2x^3}{x^4+4x^2+16} + \frac{16}{x^4+4x^2+16}$

$= \frac{2(x^3+8)}{x^4+4x^2+16}$

$= \frac{2(x+2)(x^2-2x+4)}{(x^2+2x+4)(x^2-2x+4)}$

15. रु.1000 केही मानिसहरूलाई बराबरी हुनेगरी बाँडियो । यदि 5 जना मानिसहरू बढी भएको भए प्रत्येकले रु.10 कम पाउने थिए भने कतिजना मानिसहरूलाई सो रकम बाँडिएको थियो ? पत्ता लगाउनुहोस् ।

Rs 1000 was distributed equally among a certain number of people. If there were 5 people more, each would have received Rs 10 less. Among how many people was the amount distributed? Find it.

⇨ Here, let the number of people be x then,

Each would receive $= \frac{1000}{x}$

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By the question, $\frac{1000}{x} - \frac{1000}{x+5} = 10$

or, $\frac{1000x + 5000 - 1000x}{x^2 + 5x} = 10$

or, $10x^2 + 50x - 5000 = 0$

or, $x^2 + 25x - 20x - 500 = 0$

or, $(x - 20)(x + 25) = 0$

but $x = -25$ (impossible)

or, $\frac{1000(x+5) - 1000x}{x(x+5)} = 10$

or, $5000 = 10x^2 + 50x$

or, $x^2 + 5x - 500 = 0$

or, $x(x + 25) - 20(x + 25) = 0$

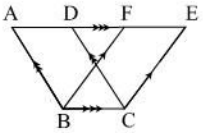
$\therefore \quad x = 20$ or -25

Thus, the required no. of people is 20.

16. दिइएको चित्रमा AE // BC, AB // DC र BF // CE छन् भने, प्रमाणित गर्नुहोस् :

In the given figure, AE // BC, AB // DC and BF // CE, then prove that :

(i) $\Delta ABF \cong \Delta DCE$ (ii) $\square ABCD = \square FBCE$



⇨ Here, **Given:** Parallelograms ABCD and FBCE are on the same base BC and between the same parallels AE and BC.

To prove: $\Delta ABF \cong \Delta DCE$ and Parallelogram ABCD = Parallelogram FBCE

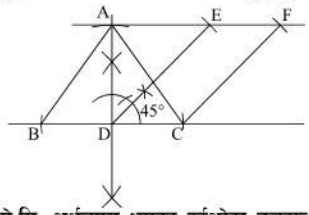
Proof:

	Statements		Reasons
1.	In ΔABF and ΔDCE	1.	
	(i) $AB = DC$ (S)		(i) Opposite sides of parallelogram ABCD
	(ii) $\angle BAF = \angle CDE$ (A)		(ii) Corresponding angles in AB//DC
	(iii) $\angle AFB = \angle DEC$ (A)		(iii) Corresponding angles in FB//EC
2.	$\therefore \Delta ABF \cong \Delta DCE$	2.	AAS fact
3.	$\Delta ABF = \Delta DCE$	3.	Area of congruent triangles are equal.
4.	ΔABF + trapezium FBCD = ΔDCE +trapezium FBCD	4.	Addition axiom
5.	$\therefore \square ABCD = \square FBCE$	5.	Whole part axiom (From statement 4)

Proved.

17. आधार BC = 6 से.मि. र उचाइ AD = 4 से.मि. भएको एउटा समद्विबाहु त्रिभुज ABC रचना गर्नुहोस् । त्रिभुज ABC को क्षेत्रफलसँग बराबर हुनेगरी एउटा कोण CDE = 45° भएको एउटा समानान्तर चतुर्भुज CDEF को रचना पनि गर्नुहोस् ।

Construct an isosceles triangle ABC having base BC = 6 cm and the altitude AD = 4 cm. Also construct a parallelogram CDEF equal in area to ΔABC and having one angle CDE = 45°.

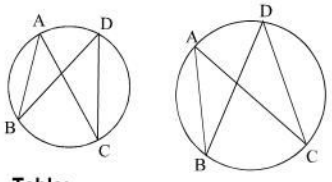


⇨ Here, base (BC) = 6 cm and height (AD) = 4 cm.
ΔABC is given and parallelogram EDCF is the required parallelogram whose area is equal to the area of ΔABC.

18. एउटै वृत्तखण्डका कोणहरू बराबर हुन्छन् भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally that the angles in the same segment of a circle are equal. (Two circles having radii at least 3 cm are necessary.)

⇨ Here, Experimental verification



(i) Draw two circles with radii of different measurements.

(ii) In every figure, $\angle BAC$ and $\angle BDC$ at the circumference.

(iii) Measure the angles with protractor as shown in the following table.

Table:

Figure	$\angle BAC$	$\angle BDC$	Remarks
1.	41	41	$\angle BAC = \angle BDC$
2.	43	43	$\angle BAC = \angle BDC$

Conclusion : In every figure, angles $\angle BAC$ and $\angle BDC$ are equal. Hence, angles in the same arc of a circle are equal. **Proved.**

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19. एउटा घरको छतबाट 20 फीट अग्लो एउटा रुखको टुप्पोको अवनति कोण 30° पाइयो । यदि घर र रुखबीचको दूरी $10\sqrt{3}$ फीट छ भने घरको उचाइ पत्ता लगाउनुहोस् ।

From the roof of a house the angle of depression of the top of a tree 20 ft. high was found to be 30°. If the distance between the house and the tree is $10\sqrt{3}$ ft, find the height of the house.

⇨ Here, let AB be the height of a house and CD = 20 ft be the height of a tree. Let BD = CE be the distance between house and the tree. Let $\angle FAC = 30°$ be an angle of depression.

From the figure, $\angle ACE = \angle FAC$ $\quad\therefore\quad \angle ACE = 30°$

Again, from right angled triangle AEC,

$$\tan\theta = \frac{AE}{EC} \qquad \text{or, } \tan 30° = \frac{AE}{10\sqrt{3}}$$

$$\text{or, } \frac{1}{\sqrt{3}} = \frac{AE}{10\sqrt{3}} \qquad \therefore\quad AE = 10 \text{ ft}$$

Now, height of the house (AB) = AE + EB = 10 ft + 20 ft = 30 ft

Thus, the height of the house is 30 ft.

20. दिइएको तथ्याङ्कको पहिलो चतुर्थांश 35 भए x को मान पत्ता लगाउनुहोस् ।

The first quartile of the given data is 35, find the value of x.

Marks Obtained	0-20	20-40	40-60	60-80	80-100
No of Students	2	x	8	5	1

⇨ Here, calculation of missing frequency.

Marks	No. of Students	cf
0 - 20	2	2
20 - 40	x	2 + x
40 - 60	8	10 + x
60 - 80	5	15 + x
80 - 100	1	16 + x
	N = 16 + x	

Since, the first quartile is 35. So, the first quartile class = 20 - 40.

We know that,

$$\text{First quartile} = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$$

$$\text{or, } 35 = 20 + \frac{20}{x}\left(\frac{16+x}{4} - 2\right)$$

$$\text{or, } 15 = \frac{20}{x}\left(\frac{16+x-8}{4}\right) \qquad \text{or, } 3x = 4\left(\frac{8+x}{4}\right)$$

$$\text{or, } 3x = 8 + x \qquad \text{or, } 2x = 8$$

$$\therefore\quad x = 4$$

Thus, the value of x is 4.

समूह 'घ' (Group D) [4 × 5 = 20]

21. कुनै धन 3 वर्षसम्म वार्षिक 10% ले साधारण ब्याजमा राखियो र त्यसपछिको मिश्रधनलाई सोही दरमा 2 वर्षसम्म चक्रीय ब्याजमा लगानी गरियो । यदि 5 वर्षमा जम्मा मिश्रधन रु. 471,900 भयो भने मूलधन कति थियो ? पत्ता लगाउनुहोस् ।

A sum of money is placed at simple interest for 3 years at 10% per annum and then the amount is invested for 2 years at the same rate at compound interest. If the total amount of 5 years became Rs 471,900, what was the sum? Find it.

⇨ Here, let the principal be Rs x.

SI	CI
Time (T) = 3 yrs Rate (R) = 10%	Time (T) = 2 yrs Rate (R) = 10%
Total amount = Rs 4,71,900	

We know that, $SI = \frac{PTR}{100} = \frac{x \times 3 \times 10}{100} = \frac{3x}{10}$

So, Amount = P + SI = $x + \frac{3x}{10} = \frac{13x}{10}$

Again, $CA = P\left(1 + \frac{R}{100}\right)^T = \frac{13x}{10}\left(1 + \frac{10}{100}\right)^2 = \frac{13x}{10} \times \frac{121}{100}$

But by the question, 471900 = CA $\qquad$ So, $\frac{13x}{10} \times \frac{121}{100} = 471900$

$$\text{or, } x = \frac{471900 \times 10 \times 100}{13 \times 121} \qquad \therefore\quad x = 300000$$

Thus, the required amount is Rs 300000.

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22. दिइएको चित्र एउटा सोली र बेलना मिली बनेको ठोस वस्तुको हो । यदि बेलना र सोलीको उचाइहरू क्रमशः 20 से.मि. र 24 से.मि. छन् र आधारको व्यास 14 से.मि. छ भने उक्त वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

The given figure is of a solid object made up of a cone and a cylinder. If the heights of the cylinder and cone are 20 cm and 24 cm respectively and the diameter of the base is 14 cm, find the total surface area of the object.



⇨ Here, common radius $(r) = \frac{d}{2} = \frac{14\text{ cm}}{2} = 7\text{ cm}$

Slant height of cone $(\ell) = \sqrt{r^2 + h^2} = \sqrt{7^2 + 24^2} = 25\text{ cm}$

Now, TSA = TSA of cone + CSA of cylinder

$= \pi r(r + \ell) + 2\pi rh$

$= \pi r(r + \ell + 2h)$

$= \frac{22}{7} \times 7\,(7 + 25 + 2 \times 20)$

$= 22 \times 72$

$= 1584\text{ cm}^2$

Thus, the total surface area of the given solid is 1584 cm^2.

23. यदि $x^2 - 2 = 2^{\frac{2}{3}} + 2^{\frac{-2}{3}}$ भए, प्रमाणित गर्नुहोस् **(If $x^2 - 2 = 2^{\frac{2}{3}} + 2^{\frac{-2}{3}}$ then prove that) :**

(i) $x = 2^{\frac{1}{3}} + 2^{\frac{-1}{3}}$ **(ii)** $2x^3 - 6x = 5$

⇨ Here, $x^2 - 2 = 2^{\frac{2}{3}} + 2^{\frac{-2}{3}}$

or, $x^2 = \left(2^{\frac{1}{3}}\right)^2 + 2 \cdot 2^{\frac{1}{3}} \cdot 2^{\frac{-1}{3}} + \left(2^{\frac{-1}{3}}\right)^2$

$\therefore\ x = 2^{\frac{1}{3}} + 2^{\frac{-1}{3}}$

Now, cubing on both the sides then,

$$x^3 = \left(2^{\frac{1}{3}} + 2^{\frac{-1}{3}}\right)^3 = \left(2^{\frac{1}{3}}\right)^3 + \left(2^{\frac{-1}{3}}\right)^3 + 3 \cdot 2^{\frac{1}{3}} \cdot 2^{\frac{-1}{3}} \left(2^{\frac{1}{3}} + 2^{\frac{-1}{3}}\right)$$

or, $x^3 = 2 + 2^{-1} + 3 \times x$

or, $x^3 = \frac{4 + 1 + 6x}{2}$

$\therefore\ 2x^3 - 6x = 5$

or, $x^2 = 2^{\frac{2}{3}} + 2 + 2^{\frac{-2}{3}}$

or, $x^2 = \left(2^{\frac{1}{3}} + 2^{\frac{-1}{3}}\right)^2$

Proved.

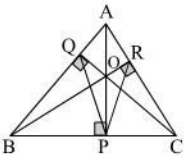
or, $x^3 = 2 + \frac{1}{2} + 3x$

or, $2x^3 = 5 + 6x$

Proved.

24. दिइएको चित्रमा AP ⊥ BC, BR ⊥ AC र CQ ⊥ AB छन् भने, प्रमाणित गर्नुहोस् : ∡OPQ = ∡OPR

In the given figure, AP ⊥ BC, BR ⊥ AC and CQ ⊥ AB. Prove that: ∡OPQ = ∡OPR.



⇨ Here,

Given: AP ⊥ BC, BR ⊥ AC and CQ ⊥ AB

To prove: ∡OPQ = ∡OPR

Proof:

Statements	Reasons
1. Quad. PORC is a cyclic quad.	1. Being sum of opposite angles 180°.
2. Quad. BPOQ is a cyclic quad.	2. Being sum of opposite angles 180°.
3. B, C, R and Q are the cyclic points.	3. Being inscribed angles on BC are equal.
4. ∡OPR = ∡OCR ∡OPQ = ∡OBQ	4. Being inscribed angles on same arcs.
5. ∡OBQ = ∡OCR	5. Being inscribed angles on same arcs.
6. ∡OPQ = ∡OPR	6. From (4) and (5)

Proved.

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SOLUTIONS OF SEE QUESTIONS 2075

4. प्रदेश नं. 1: SEE EXAMINATION 2075 RE-109'AP'

समयः ३ घण्टा पूर्णाङ्कः १००

सबै प्रश्नहरूको उत्तर दिनुहोस् । (Answer all the questions.)

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) यदि कुनै ठाउँको शुरुको जनसङ्ख्या P_o, T वर्षपछिको जनसङ्ख्या P_T र वार्षिक जनसङ्ख्या वृद्धिदर Q% प्रति वर्ष भए P_T लाई P_o, T र Q को रूपमा व्यक्त गर्नुहोस् ।
If initial population of any place is P_o, population after T years is P_T and annual rate of population growth is Q% per annum then express P_T in terms of P_o, T and Q.

⇨ Here, P_T in terms of P_o, T and Q is, $P_T = P_o\left(1+\frac{Q}{100}\right)^T$

(b) बराबर भुजाहरूको नाप *x* से.मि. र तेस्रो भुजाको नाप *y* से.मि. भएको समद्विबाहु त्रिभुजको क्षेत्रफल लेख्नुहोस् ।
Write the area of an isosceles triangle having length of equal sides x cm and third side y cm.

⇨ Here, the area of isosceles triangle in terms of given sides $= \frac{y}{4}\sqrt{4x^2-y^2}$ sq. units.

2. (a) $(7x)^0$ को मान कति हुन्छ ? **(What is the value of $(7x)^0$?)**

⇨ Here, the value of $(7x)^0 = 1$

(b) अविच्छिन्न श्रेणीको तथ्याङ्कलाई तल्लो 25% मा विभाजन गर्ने चतुर्थांशको नाम लेख्नुहोस् ।
Write the name of the quartile which divides the continuous data below 25%.

⇨ Here, the quartile which divides the continuous data below 25% is lower quartile or first quartile.

3. (a) एउटै आधार XY र उही समानान्तर रेखाहरू XY र MN बीच रहेका वर्ग र त्रिभुजको क्षेत्रफल बीचको सम्बन्ध लेख्नुहोस् ।
Write down the relation between the area of a square and a triangle standing on the same base XY and between the same parallel lines XY and MN.

⇨ Here, the required relation is; Area of triangle $= \frac{1}{2}$ Area of square.

(b) चक्रीय चतुर्भुजका सम्मुख कोणहरू बीचको सम्बन्ध लेख्नुहोस् ।
Write the relation between the opposite angles of a cyclic quadrilateral.

⇨ Here, the required relation is ;
The opposite angles of a cyclic quadrilateral is supplementary or two right angles.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) रु. 2000 पर्ने एउटा सामानको मूल्यमा 13% मूल्य अभिवृद्धिकर लगाउँदा सो सामानको मूल्य कति पर्छ ? पत्ता लगाउनुहोस् ।
What is the price of an article costing Rs 2000 after levying 13% Value Added Tax? Find it.

⇨ Here, price of article = Rs 2000
So, price with 13% VAT = Rs 2000 + 13% of Rs 2000
= 113% of Rs 2000
= 1.13 × Rs 2000 = Rs 2260
Thus, the price with VAT is Rs 2260.

(b) एउटा टेलिभिजनको हालको मूल्य रु. 40,000 छ । यदि यसको मूल्य प्रतिवर्ष 10% ले घट्दै जान्छ भने कति वर्ष पछि यसको मूल्य रु. 29,160 हुन्छ ? पत्ता लगाउनुहोस् ।
The present price of a Television is Rs 40,000. If its price reduces every year by 10%, after how many years it's price will be Rs 29,160? Find it.

⇨ Here, present price (P) = Rs 40000, rate of depreciation (R) = 10%
Price after T years (P_T) = Rs 29160

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $29160 = 40000\left(1-\frac{10}{100}\right)^T$

or, $\frac{29160}{40000} = \left(\frac{90}{100}\right)^T$ or, $0.729 = 0.9^T$

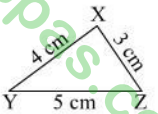
or, $0.9^3 = 0.9^T$ ∴ T = 3 yrs

Thus, the required time is 3 yrs.

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SEE SOLUTION /25

5. (a) दिइएको चित्रमा ΔXYZ को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, find the area of ΔXYZ.



⇨ Here, let, a = 5 cm, b = 3 cm and c = 4 cm

So, $s = \frac{a+b+c}{2} = \frac{5\text{ cm} + 3\text{ cm} + 4\text{ cm}}{2} = 6\text{ cm}$

We have, area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{6(6-5)(6-3)(6-4)} = \sqrt{6 \times 1 \times 3 \times 2} = 6\text{ cm}^2$

Thus, the area of triangle is 6 cm^2.

(b) यदि एउटा अर्धगोलाको आयतन 9216π घन से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the volume of a hemisphere is 9216π cubic cm then find its radius.

⇨ Here, volume of hemisphere (V) = 9216π cm^2

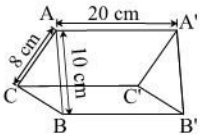
We have, $V = \frac{2}{3}\pi r^3$ or, $9216\pi = \frac{2}{3}\pi r^3$

or, $\frac{9216 \times 3}{2} = r^3$ or, $r^3 = 13824$

or, $r^3 = 24^3$ ∴ r = 24 cm

Thus, the radius of the hemisphere is 24 cm.

(c) दिइएको चित्रमा AB = 10 से.मि., AA' = 20 से.मि., AC = 8 से.मि. र प्रिज्मको आयताकार सतहहरूको क्षेत्रफल 480 वर्ग से.मि. भए, BC को नाप पत्ता लगाउनुहोस् ।
In the given figure, AB = 10 cm, AA' = 20 cm, AC = 8 cm and the area of rectangular surfaces of prism is 480 square cm, find the length of BC.



⇨ Here, AB = 10 cm, AA' = 20 cm, AC = 8 cm and RSA = 480 cm^2

So, perimeter of Δ(P) = AB + BC + AC = 10 cm + BC + 8 cm = 18 cm + BC

We have, RSA = Ph

or, 480 = (18 + BC) AA'

or, 480 = (18 + BC) × 20

or, 24 = 18 + BC ∴ BC = 6 cm

Thus, the length of BC is 6 cm.

6. (a) प्रमाणित गर्नुहोस् (Prove that): $\frac{7^{x+2} + 7^x}{50 \times 7^x} = 1$

⇨ Here, LHS = $\frac{7^{x+2} + 7^x}{50 \times 7^x} = \frac{7^x \cdot 7^2 + 7^x}{50 \times 7^x} = \frac{7^x(7^2+1)}{50 \times 7^x} = \frac{7^x \times 50}{7^x \times 50} = 1 = \text{RHS}$ Proved.

(b) हरको आनुपातिकरण गर्नुहोस् (Rationalize the denominator of) : $\frac{\sqrt{2}+1}{\sqrt{2}-1}$

⇨ Here, $\frac{\sqrt{2}+1}{\sqrt{2}-1} = \frac{\sqrt{2}+1}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = \frac{(\sqrt{2}+1)^2}{(\sqrt{2})^2 - (1)^2} = \frac{(\sqrt{2})^2 + 2.\sqrt{2}.1 + 1^2}{2-1} = \frac{2 + 2\sqrt{2} + 1}{1} = 3 + 2\sqrt{2}$

Thus, the rationalized form is $3 + 2\sqrt{2}$.

7. (a) ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $x^2 - y^2$, $(x + y)^2$

⇨ Here, First expression = $x^2 - y^2 = (x + y)(x - y)$

Second expression = $(x + y)^2 = (x + y)(x + y)$

Thus, the LCM is $(x + y)^2 (x - y)$.

(b) हल गर्नुहोस् (Solve): $\sqrt{x-2} = \sqrt[3]{125}$

⇨ Here, $\sqrt{x-2} = \sqrt[3]{125}$ or, $\sqrt{x-2} = \sqrt[3]{5 \times 5 \times 5}$

or, $\sqrt{x-2} = 5$

Squaring on both the sides then,

x − 2 = 25 ∴ x = 27

Thus, x = 27 is the solution.

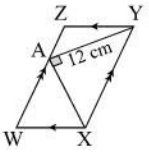
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(c) यदि दुईओटा क्रमागत जोर सङ्ख्याहरूको योगफल 42 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If the sum of two consecutive even numbers is 42, find the numbers.

⇨ Here, let the consecutive even numbers be x and x + 2.
By the question,
$x + x + 2 = 42$ or, $2x + 2 = 42$
or, $2x = 40$ ∴ $x = 20$
Thus, the consecutive even numbers are 20 and 22.

8. (a) दिइएको चित्रमा WXYZ एउटा समानान्तर चतुर्भुज हो । यदि ∠XAY = 90°, AY = 12 से.मि. र □WXYZ को क्षेत्रफल 120 वर्ग से.मि. छन् भने AX को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, WXYZ is a parallelogram. If ∠XAY = 90°, AY = 12 cm and the area of □WXYZ is 120 sq. cm, find the length of AX.

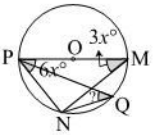


⇨ Here, AY = 12 cm, Ar.(□WXYZ) = 120 cm²

(i) Area of $\Delta AYX = \frac{1}{2}$ Ar.(□WXYZ) [Being both on the same base and between the same parallels.]
$= \frac{1}{2} \times 120 \text{ cm}^2 = 60 \text{ cm}^2$

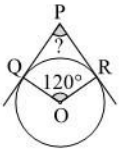
(ii) Area of $\Delta AYX = \frac{1}{2} AX \times AY$
or, $60 \text{ cm}^2 = \frac{1}{2} AX \times 12 \text{ cm}$
∴ AX = 10 cm Thus, the length of AX is 10 cm.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠MPN = 6x° र ∠PMN = 3x° छन् भने ∠PQNको नाप पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle. If ∠MPN = 6x° and ∠PMN = 3x°, find the size of ∠PQN.



⇨ Here, ∠MPN = 6x°, ∠PMN = 3x°
(i) ∠MPN + ∠PMN = 90° [Being PM a diameter]
or, 6x° + 3x° = 90°
or, 9x° = 90°
∴ x = 10
(ii) ∠PQN = ∠PMN [Being inscribed angles on same arc.]
or, ∠PQN = 3x° = (3 × 10)° = 30°
Thus, the value of ∠PQN is 30°.

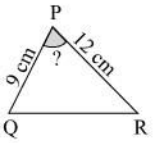
(c) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । PQ र PR दुई स्पर्शरेखाहरू हुन् । यदि ∠QOR = 120° भए ∠QPR को मान निकाल्नुहोस् ।
In the given figure O is centre of the circle, PQ and PR are two tangents. If ∠QOR = 120°, find the value of ∠QPR.



⇨ Here, ∠QOR = 120° and ∠QPR = ?
(i) ∠PQO = 90° and ∠PRO = 90° [Being the radius is perpendicular to the tangent at point of contact.]
(ii) ∠PQO + ∠QOR + ∠ORP + ∠P = 360° [Sum of angles of a quadrilateral.]
or, 90° + 120° + 90° + ∠P = 360°
or, 300° + ∠P = 360°
∴ ∠P = 60° Thus, the value of ∠QPR is 60°.

9. (a) ΔPQR मा PQ = 9 से.मि. र PR = 12 से.मि. छन् । यदि ΔPQR को क्षेत्रफल $27\sqrt{3}$ वर्ग से.मि. भए ∠RPQ को मान निकाल्नुहोस् ।
In ΔPQR, PQ = 9 cm and PR = 12 cm. If the area of ΔPQR is $27\sqrt{3}$ sq. cm, find the value of ∠RPQ.

⇨ Here, PQ = 9 cm, PR = 12 cm and Ar.(ΔPQR) = $27\sqrt{3}$ cm²
We know that, Area of $\Delta PQR = \frac{1}{2} PQ \times PR \times \sin \angle QPR$



or, $27\sqrt{3} = \frac{1}{2} \times 9 \times 12 \times \sin \angle QPR$
or, $27\sqrt{3} = 54 \times \sin \angle QPR$
or, $\sin \angle QPR = \frac{\sqrt{3}}{2}$
or, $\sin \angle QPR = \sin 60°$ ∴ $\angle QPR = 60°$
Thus, the value of ∠QPR is 60°.

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(b) एउटा निरन्तर श्रेणीमा केही विद्यार्थीहरूको औसत तौल 45 कि.ग्रा. र तिनीहरूको तौलको योगफल ($\sum fm$) 540 कि.ग्रा. छन् भने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस् ।
In a continuous series, the average weight of some students is 45 kg and the sum of their weights ($\sum fm$) is 540 kg. Find the number of students.

⇨ Here, Average ($\overline{X}$) = 45 kg, $\sum fm$ = 540 kg

We have, $\overline{X} = \frac{\sum fm}{N}$ or, $45 = \frac{540}{N}$ or, $N = \frac{540}{45} = 12$

Thus, the number of students is 12.

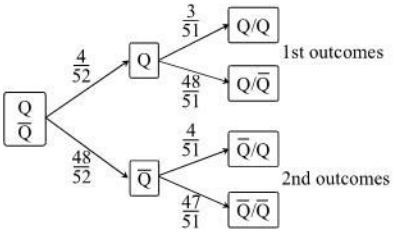
10. (a) यदि एउटा डाइसलाई उछालियो र उही समयमा एउटा सिक्कालाई उफाऱ्यो भने डाइसमा रुढ सङ्ख्या र सिक्कामा अग्रभाग पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।
If a dice is rolled and a coin is tossed at the same time, find the probability of occurring prime number on the dice and head on the coin.

⇨ Here, sample space in dice (S_1) = {1, 2, 3, 4, 5, 6} and Sample space in coin (S_2) = {H, T}
We have,

$$P(\text{prime number and head}) = P(\text{Prime number}) \times P(\text{head}) = \frac{n(\text{Prime number})}{n(S_1)} \times \frac{n(\text{head})}{n(S_2)} = \frac{3}{6} \times \frac{1}{2} = \frac{1}{4}$$

Thus, the probability of prime number and head is $\frac{1}{4}$.

(b) रामरी फिटिएको 52 ओटा तासको गड्डीबाट दुईओटा तासहरू नहेरीकन एकपछि अर्को गरी पुनः नराखीकन झिक्दा रानी तास पर्ने र नपर्ने सम्भावित परिणामहरूका सम्भाव्यताहरूलाई एउटा वृक्षचित्रमा देखाउनुहोस् ।
Two cards are drawn randomly from a well shuffled deck of 52 cards in succession without replacement. Show the probabilities of possible outcomes of getting and not getting a queen card in a tree diagram.



⇨ Here, No. of Queen cards = n(Q) = 4

No. of cards other than Queen = n($\overline{Q}$) = 48 and total number of cards = n(S) = 52
Now, the probability tree diagram is shown alongside.

समूह 'ग' (Group 'C') **[10 × 4 = 40]**

11. मानिसहरूको एउटा समूहमा गरिएको सर्वेक्षणमा 70% मानिसले लोकगीत मन पराएको पाइयो, 60% मानिसले आधुनिक गीत मन पराएको र 4000 ले दुवै मन पराएको पाइयो । यदि 10% ले कुनै पनि गीतमा रूचि नभएको पाइयो भने,
In a survey of a group of people, it was found that 70% of the people liked folk songs, 60% liked modern songs and 4000 people liked both of them. If 10% liked none of them then,

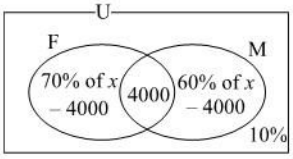
(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Draw a Venn-diagram to illustrate the above information.)**

(ii) सर्वेक्षणमा भाग लिएका जम्मा मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् । **(Find the total number of people in the survey.)**

(iii) लोकगीत मात्र मन पराउने मानिसको सङ्ख्या पत्ता लगाउनुहोस् ।
find the number of people who like folk song only.

⇨ Here, let, F and M be the set of people who like folk songs and modern songs respectively.

Let n(U) be x then, n(F) = 70% of x, n(M) = 60% of x, $n(\overline{F \cup M})$ = 10% of x



We know that, $n(U) = n(F) + n(M) - n(F \cap M) + n(\overline{F \cup M})$
or, $x = 70\% \text{ of } x + 60\% \text{ of } x - 4000 + 10\% \text{ of } x$
or, $x = 0.70 \times x + 0.60 \times x - 4000 + 0.10 \times x$
or, $x = 1.40x - 4000$
or, $4000 = 0.4x$ ∴ $x = 10000$

(ii) Total number of people participated in the survey is 10000.

(iii) $n_0(F) = n(F) - n(F \cap M)$
$= 70\% \text{ of } x - 4000$
$= 0.70 \times 10000 - 4000$
$= 7000 - 4000$
∴ $n_0(F) = 3000$

Thus, the number of people who like folk song only is 3000.

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12. एक जना व्यापारीले £1 = रु. 140 को दरमा रु. 8,40,000 को पाउण्ड स्टर्लिङ साट्यो । एकदिन पछि नेपाली मुद्रा 5% ले अधिमूल्यन भयो र उक्त दिनमा उसँग भएको पाउण्ड पुनः नेपाली मुद्रामा साट्दा उसलाई कति नाफा वा नोक्सान भयो होला ? पत्ता लगाउनुहोस् ।

A businessman exchanged Rs 8,40,000 into pound sterling at the rate of £1 = Rs 140. After one day, Nepali currency is revaluated by 5% and he exchanged the pounds which he had into Nepali currency again. What is his gain or loss? Find it.

⇨ Here, £1 = Rs 140, Nepali money = Rs 840000 and Rate of revaluation = 5%

Amount of pound sterling before revaluation $= \frac{\text{Nepali Money}}{\text{Exchange rate}} = \frac{\text{Rs } 840000}{\text{Rs } 140/£} = £6000$

Nepali currency is revaluated by 5%

So, new rate; £1 = Rs 140 – 5% of Rs 140

= 95% of Rs 140

= 0.95 × Rs 140

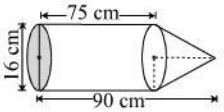
∴ £ 1 = Rs 133

Again, Nepali money of £6000 = 6000 × Rs 133 = Rs 798000

So, loss amount = Rs 840000 – Rs 798000 = Rs 42000

Thus, the required amount of loss is Rs 42000.

13. दिइएको चित्र बेलना र सोली मिलेर बनेको संयुक्त ठोस वस्तु हो । सो वस्तुको आधारको व्यास 16 से.मि., बेलनाकार भागको लम्बाइ 75 से.मि. र ठोस वस्तुको जम्मा लम्बाइ 90 से.मि. छन् । उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।



The given figure is combined solid made up of a cylinder and a cone. The diameter of the base of the object is 16 cm, length of the cylindrical part is 75 cm and the total length of the solid object is 90 cm. Find the total surface area of the combined solid.

⇨ Here, common diameter (d) = 16 cm. $\therefore r = \frac{d}{2} = \frac{16}{2} = 8$ cm

Height of cylinder (h_1) = 75 cm Height of cone (h_2) = 90 cm – 75 cm = 15 cm

We know that; Slant height of cone (ℓ) $= \sqrt{(h_2)^2 + r^2} = \sqrt{15^2 + 8^2} = \sqrt{289} = 17$ cm

Now, TSA of the solid = TSA (cone) + CSA (cylinder)

$= \pi r(r + \ell) + 2\pi r h_1$

$= \pi r[r + \ell + 2h_1]$

$= \frac{22}{7} \times 8(8 + 17 + 2 \times 75)$

$= \frac{22}{7} \times 8(25 + 150)$

$= \frac{22}{7} \times 8 \times 175$

$= 4400 \text{ cm}^2$

Thus, the TSA of the solid is 4400 cm^2.

14. म.स. निकाल्नुहोस् **(Find the HCF of): $b^2(b^2 + 4bc + 4c^2)$, $b^5 + 8b^2c^3$ and $3b^4 + b^3c - 10b^2c^2$**

⇨ Here, first exp. $= b^2(b^2 + 4bc + 4c^2)$

$= b^2\{b^2 + 2 . b . 2c + (2c)^2\}$

$= b^2(b + 2c)^2$

$= b^2(b + 2c)(b + 2c)$

Second exp. $= b^5 + 8b^2c^3$

$= b^2(b^3 + 8c^3)$

$= b^2\{b^3 + (2c)^3\}$

$= b^2(b + 2c)(b^2 - 2bc + 4c^2)$

Third exp. $= 3b^4 + b^3c - 10b^2c^2$

$= b^2(3b^2 + bc - 10c^2)$

$= b^2(3b^2 + 6bc - 5bc - 10c^2)$

$= b^2\{3b(b + 2c) - 5c(b + 2c)\}$

$= b^2(b + 2c)(3b - 5c)$

Thus, the HCF $= b^2(b + 2c)$

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15. सरल गर्नुहोस् (Simplify): $\frac{1}{1-p+p^2} - \frac{1}{1+p+p^2} - \frac{2p}{1-p^2+p^4}$

⇨ Here, $\frac{1}{1-p+p^2} - \frac{1}{1+p+p^2} - \frac{2p}{1-p^2+p^4}$

$= \frac{1+p+p^2-(1-p+p^2)}{(1-p+p^2)(1+p+p^2)} - \frac{2p}{1-p^2+p^4}$

$= \frac{1+p+p^2-1+p-p^2}{(1+p^2)^2-p^2} - \frac{2p}{1-p^2+p^4}$

$= \frac{2p}{1+2p^2+p^4-p^2} - \frac{2p}{1-p^2+p^4}$

$= \frac{2p}{1+p^2+p^4} - \frac{2p}{1-p^2+p^4}$

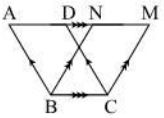
$= \frac{2p(1-p^2+p^4)-2p(1+p^2+p^4)}{(1+p^2+p^4)(1-p^2+p^4)}$

$= \frac{2p-2p^3+2p^5-2p-2p^3-2p^5}{(1+p^4)^2-(p^2)^2}$

$= \frac{-4p^3}{1+2p^4+p^8-p^4}$

$= \frac{-4p^3}{1+p^4+p^8}$

16. दिइएको चित्रमा AM // BC, AB // DC र NB // MC छन् भने प्रमाणित गर्नुहोस् :
(i) ΔABN ≅ ΔDCM (ii) □ABCD को क्षेत्रफल = □NBCM को क्षेत्रफल
In the given figure, AM // BC, AB // DC and NB // MC. Prove that:
(i) ΔABN ≅ ΔDCM (ii) Area of □ABCD = Area of □NBCM



⇨ Here, Given: AM // BC, AB // DC and NB // MC
To prove: (i) ΔABN ≅ ΔDCM
(ii) Area of □ABCD = Area of □NBCM

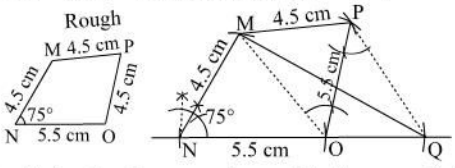
Proof:

Statements	Reasons
1. In Δ^s ABN and DCM (i) ∠BAN = ∠CDM (ii) ∠ANB = ∠DMC (iii) BN = CM	1. (i) Corresponding angles in parallel lines (ii) Corresponding angles in parallel lines (iii) Opposite sides of a parallelogram.
2. ΔABN ≅ ΔDCM	2. AAS fact
3. Ar. (ΔABN) = Ar. (ΔDCM)	3. Congruent Δs are equal in area.
4. Ar. (Trap. ABCM) – Ar. (ΔABN) = Ar. (Trap.ABCM) – Ar. (ΔDCM)	4. Subtraction axiom from (3)
5. Ar. (□ NBCM) = Ar. (□ABCD) i.e. Ar. (□ABCD) = Ar. (□ NBCM)	5. From (4) whole part axiom.

Proved.

17. NO = OP = 5.5 से.मि., PM = MN = 4.5 से.मि. र ∠MNO = 75° भएको चतुर्भुज MNOP को क्षेत्रफलसँग बराबर हुने एउटा त्रिभुज MNQ को रचना गर्नुहोस् ।
Construct a ΔMNQ equal in area to the quadrilateral MNOP having NO = OP = 5.5 cm, PM = MN = 4.5 cm and ∠MNO = 75°.

⇨ Here, NO = OP = 5.5 cm, PM = MN = 4.5 cm and ∠MNO = 75°.



Thus, ΔMNQ is the required triangle whose area is equal to the area of given quadrilateral MNOP.

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18. वृत्तको एउटै चाप MN मा आधारित केन्द्रीय कोण MAN र परिधि कोण MIN बीचको सम्बन्ध प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Verify experimentally that the relationship between centre angle MAN and circumference angle MIN standing on the same arc MN of the circle. (Two circles having radii at least 3 cm are necessary.)

⇨ Here,



Fig (i)



Fig (ii)

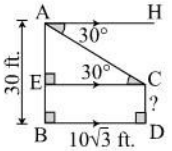
$\measuredangle$MAN is central angle and $\measuredangle$MIN is the inscribed angle on the same arc MN.

fig	$\measuredangle$MAN	$\measuredangle$MIN	Result
(i)	120°	60°	$\measuredangle MAN = 2\measuredangle MIN$
(ii)	130°	65°	$\measuredangle MAN = 2\measuredangle MIN$

Conclusion: From the above table, it is verified that central angle is double of the inscribed angle standing on same arc.

19. 30 फिट अग्लो एउटा घरको छतबाट एउटा रुखको टुप्पो हेर्दा अवनति कोण 30° पाइयो । यदि घर र रुख बीचको दूरी $10\sqrt{3}$ फिट छ भने रुखको उचाइ पत्ता लगाउनुहोस् ।
The angle of depression of the top of a tree as observed from the roof of a house 30 ft high is found to be 30°. If the distance between the house and tree is $10\sqrt{3}$ ft, find the height of the tree.

⇨ Here, let AB = 30 ft be the height of the house.
Let CD be the height of the tree and BD = $10\sqrt{3}$ ft be the distance between the house and tree.
Let, $\measuredangle$HAC = 30° be the angle of depression.
We have, (i) $\measuredangle$ACE = $\measuredangle$HAC = 30°.



From the right angled ΔAEC, $\tan\theta = \frac{AE}{EC}$

or, $\tan 30° = \frac{AE}{10\sqrt{3}}$

or, $\frac{1}{\sqrt{3}} = \frac{AE}{10\sqrt{3}}$

$\therefore$ AE = 10 ft.

Now, CD = EB = AB – AE = 30 ft – 10 ft = 20 ft.

Thus, the height of the tree is 20 ft.

20. तल दिइएको तथ्याङ्कबाट मध्यिकाको गणना गर्नुहोस् । (Calculate the median from the data given below.)

Marks Obtained	0 - 20	20 - 40	40 - 60	60 - 80	80 -100
No. of Students	2	3	5	4	6

⇨ Here, calculation of median.

Marks	No. of students	cf
0 - 20	2	2
20 - 40	3	5
40 - 60	5	10
60 - 80	4	14
80 - 100	6	20
	N = 20	

For median, median class = $\left(\frac{N}{2}\right)^{th}$ item = $\left(\frac{20}{2}\right)^{th}$ item = 10^{th} item = 40 – 60

We know that; Median = $L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 40 + \frac{20}{5}(10 - 5) = 40 + 4 \times 5 = 40 + 20 = 60$

Thus, the median of the data is 60.

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समूह 'घ' (Group 'D') [4 × 5 = 20]

21. एकजना व्यक्तिले बैंक 'M' मा दुई वर्षका लागि रु. 50,000 प्रतिवर्ष 10% को दरमा वार्षिक चक्रीय ब्याज पाउने गरी जम्मा गरेछ । तर ठीक एक वर्ष पछि बैंकले नीति परिवर्तन गरी सोही ब्याजदरमा अर्धवार्षिक चक्रीय ब्याज दिने निर्णय गरेछ । पहिलो वर्षको र दोस्रो वर्षको ब्याज रकममा कति प्रतिशतले फरक परेछ ? हिसाब गरी कारण लेख्नुहोस् ।

A person deposited Rs 50,000 in bank 'M' for two years at the rate of 10% p.a. compound interest compounded annually. But after one year, bank has changed the policy and decided to pay semi-annual compound interest at the same rate. What is the percentage difference between compound interests of first and second year? Give reason with calculation.

⇨ Here,

For the first year

Principal (P) = Rs 50000

Rate of interest (R) = 10%

Compound interest of first year (CI_1)

$$= P\left[\left(1+\frac{R}{100}\right)^{1}-1\right]$$

$$= 50000\left[\left(1+\frac{10}{100}\right)-1\right]$$

$$= 50000\times\frac{1}{10}$$

$\therefore CI_1 =$ Rs 5000

Again, for the second year,

Principal (P) = Rs 50000 + Rs 5000 = Rs 55000

Time (T) = 1 year

Rate (R) = 10%

We know that,

Semiannual compound interest (CI_2)

$$= P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]$$

$$= \text{Rs } 55000\left[\left(1+\frac{10}{200}\right)^{2}-1\right]$$

$$= \text{Rs } 55000\times\left[\frac{441}{400}-1\right]$$

$$= \text{Rs } 55000\times\frac{41}{400}$$

$\therefore CI_2 =$ Rs 5637.50

So, difference in interest = $CI_2 - CI_1$ = Rs 5637.50 – Rs 5000 = Rs 637.50

Now, percentage difference between two interests = $\frac{\text{Difference}}{\text{First interest}}\times 100\% = \frac{\text{Rs } 637.50}{5000}\times 100\% = 12.75\%$

Thus, the required percentage is 12.75%.

22. एउटा रंगशालाको गेटका चारओटै सतह देखिने 8 फिट अग्ला दुईओटा पिलरहरूमाथि उही आधारका एक-एक ओटा 4 फिट उचाइ भएका पिरामिडहरू राखिएका छन् । प्रत्येक पिलरको आधार 6 फिट × 6 फिट छ । उक्त पिरामिडसहितको पिलरहरूमा प्रति वर्ग फिट रु. 60 का दरले रङ्ग लगाउँदा जम्मा कति खर्च लाग्छ ? पत्ता लगाउनुहोस् ।

Two pillars of height 8 feet each where its four faces are shown in the gate of a stadium have one-one pyramid of height 4 feet each having the same base on their tops. The base of each pillars is 6 ft × 6 ft. If the pillar with pyramid are painted at the rate of Rs 60 per square feet, what will be the total cost? Find it.

⇨ Here, the measurements of one pillar.

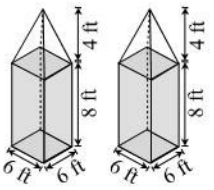
length of base (a) = 6 ft

height of cuboid (h_1) = 8 ft

height of pyramid (h_2) = 4 ft

Slant height of pyramid (ℓ) $= \sqrt{(h_2)^2+\left(\frac{a}{2}\right)^2} = \sqrt{4^2+3^2} = \sqrt{16+9}$

$= 5$ ft



Now, total surface area of painting areas of two pillars $= 2[2h_1(a+a)+2a\ell]$

$= 2[2\times 8(6+6)+2\times 6\times 5]$

$= 2[192+60]$

$= 504\ \text{cm}^2$

We know that, Total cost of painting = Painting area × Rate = 504 × 60 = 30240

Thus, the total cost of painting the pillars is Rs 30240.

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23. एउटा आयताकार खेतको क्षेत्रफल 1440 वर्ग मिटर र परिमिति 152 मिटर छ । उक्त खेतलाई वर्गाकार बनाउन लम्बाइ अथवा चौडाइलाई के कति प्रतिशतले घटाउनु पर्छ र किन ? पत्ता लगाउनुहोस् ।

The area of a rectangular field is 1440 sq. metre and perimeter is 152 metre. Out of length or breadth, which one is to be decreased by what percentage to make it a square? Why? Find it.

⇨ Here, area of field (A) = 1440 m^2 and Perimeter = 152 m

Let the length and breadth be x m and y m respectively.

By the question, $\ell \times b = A = 1440$

or, $xy = 1440$ .....(i)

Again, perimeter = 152

or, $2(\ell + b) = 152$

or, $2(x + y) = 152$

or, $x + y = 76$

$\therefore \quad x = 76 - y$ .....(ii)

From (i) and (ii);

$(76 - y)\, y = 1440$

or, $76y - y^2 = 1440$

or, $y^2 - 76y + 1440 = 0$

or, $y^2 - 40y - 36y + 1440 = 0$

or, $y(y - 40) - 36(y - 40) = 0$

or, $(y - 40)(y - 36) = 0$

$\therefore \quad y = 40$ or 36

From (ii); $x = 36$ or 40

So, length = 40 m and breadth = 36 m.

To make it square;

The length should also be 36 m

i.e. length should be decreased by (40 – 36) m = 4 m

Decreased percentage = $\frac{4}{40} \times 100\%$

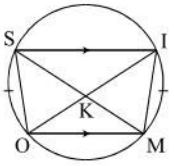
Thus, the length should be decreased by 10%.

24. बिन्दुहरू S, O, M र I चक्रीय छन् । जहाँ चाप SO = चाप IM छन् । यदि जीवाहरू SM र IO बिन्दु K मा प्रतिच्छेदन भएका छन् भने प्रमाणित गर्नुहोस् ।

(i) ΔSOK को क्षेत्रफल = ΔIMK को क्षेत्रफल (ii)SM = IO

Points S, O, M and I are concyclic such that arc SO = arc IM. If the chords SM and IO are intersected at the point K, prove that:

(i) Area of ΔSOK = Area of ΔIMK (ii) SM = IO



⇨ Here, Given: In the figure, $\overset{\frown}{SO} = \overset{\frown}{IM}$. SM and OI are intersected at K.

To prove: (i) Area of ΔSOK = Area of ΔIMK (ii) SM = IO

Construction: SI and OM are joined.

Proof:

Statements	Reasons
1. SI // OM	1. Being arc SO = arc IM
2. Ar. (ΔSOM) = Ar.(ΔIOM)	2. Being both are on the same base and between the same parallels.
3. ΔSOK = ΔIKM	3. Subtracting ΔOKM from both the sides of statement (2).
4. arc SOM = arc IMO	4. Adding arc OM on arc SO = arc IM (given).
5. SM = IO	5. Corresponding chords of equal arcs from (4).

Proved.

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5. प्रदेश नं. 2 SEE EXAMINATION 2075 RE-109'BP'

समय: ३ घण्टा पूर्णाङ्क: १००

सबै प्रश्नहरूको उत्तर दिनुहोस् । (Answer all the questions.)

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) यदि कुनै ठाउँको शुरुको जनसङ्ख्या M_0 र वार्षिक जनसङ्ख्या वृद्धिदर R% प्रतिवर्ष भए सो ठाउँको N वर्ष पछिको जनसङ्ख्या कति हुन्छ ? लेख्नुहोस् ।
If initial population of any place is M_0 and annual rate of population growth is R% per annum then what is the population of that place after N years? Write it.

⇨ Here, the population after N years $= M_0\left(1+\frac{R}{100}\right)^N$

(b) बराबर भुजाहरूको नाप x से.मि. र तेस्रो भुजाको नाप y से.मि. भएको समद्विबाहु त्रिभुजको क्षेत्रफल लेख्नुहोस् ।
Write the area of an isosceles triangle having length of equal sides x cm and third side y cm.

⇨ Here, area of an isosceles triangle in terms of given sides $= \frac{y}{4}\sqrt{4x^2-y^2}\ \text{cm}^2$

2. (a) $(4a)^\circ$ को मान कति हुन्छ ? लेख्नुहोस् । **(What is the value of $(4a)^0$? Write it.)**

⇨ Here, value of $(4a)^\circ = 1$

(b) अविच्छिन्न श्रेणीको तथ्याङ्कलाई तल्लो 25% मा विभाजन गर्ने चतुर्थांशको नाम लेख्नुहोस् ।
Write the name of the quartile which divides the continuous data below 25%.

⇨ Here, the quartile which divides the continuous data below 25% is lower quartile or first quartile.

3. (a) एउटै आधार XY र उही समानान्तर रेखाहरू XY र AB बीच रहेका वर्ग र त्रिभुजको क्षेत्रफलहरूबीचको सम्बन्ध लेख्नुहोस् ।
Write down the relation between the areas of a square and a triangle standing on the same base XY and between the same parallel lines XY and AB.

⇨ Here, the required relation is; Area of square = 2 (Area of triangle)

(b) चक्रीय चतुर्भुजका सम्मुख कोणहरू बीचको सम्बन्ध लेख्नुहोस् ।
Write the relation between the opposite angles of a cyclic quadrilateral.

⇨ Here, the required relation is; the opposite angles of a cyclic quadrilateral are supplementray. i.e. sum is two right angles.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) रु. 1000 पर्ने एउटा झोलामा 13% मूल्य अभिवृद्धिकर लगाउँदा उक्त झोलाको मूल्य कति पर्छ ? पत्ता लगाउनुहोस् ।
What is the price of a bag costing Rs 1000 after levying 13% Value Added Tax? Find it.

⇨ Here, price of the bag excluding VAT = Rs 1000
Percentage of VAT = 13%
Price of the bag including the VAT $= 1000 + 13\%\text{ of }1000$
$= 1000 + \frac{13}{100}\times 1000 = 1000 + 130 = \text{Rs } 1130$
Thus, price after levying 13% VAT is Rs 1130.

(b) एउटा कारको हालको मूल्य रु. 10,00,000 छ । यदि यसको मूल्य प्रतिवर्ष 10% ले घट्दै जान्छ भने कति वर्ष पछि यसको मूल्य रु. 7,29,000 हुन्छ ? पत्ता लगाउनुहोस् ।
The recent price of a Car is Rs 10,00,000. If its price reduces by 10% yearly, after how many years it's price will be Rs 7,29,000? Find it.

⇨ Here, Present price (P) = Rs 1000000
Price of the car after T yrs = Rs 729000
Depreciation Rate (R) = 10% p.a.
Time period (T) = ?

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$

or, $729000 = 1000000\left(1-\frac{10}{100}\right)^T$

or, $\frac{729000}{1000000} = \left(\frac{100-10}{100}\right)^T$

or, $\frac{729}{1000} = \left(\frac{90}{100}\right)^T$

or, $\left(\frac{9}{10}\right)^3 = \left(\frac{9}{10}\right)^T$

$\therefore\ T = 3$

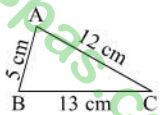
$\therefore$ Time period (T) = 3 years.

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5. (a) दिइएको चित्रमा ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, find the area of ΔABC.



⇨ Here, in ΔABC, a = 13 cm, b = 12 cm, c = 5 cm

So, $s = \frac{a+b+c}{2} = \frac{13+12+5}{2} = \frac{30}{2} = 15$ cm

We have, Area of ΔABC $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{15(15-13)(15-12)(15-5)}$

$= \sqrt{15 \times 2 \times 3 \times 10}$

$= \sqrt{900} = 30$ cm^2

Thus, area of ΔABC is 30 cm^2.

(b) यदि एउटा अर्धगोलाको आयतन 19404 घन से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the volume of a hemisphere is 19404 cubic cm then find its radius.

⇨ Here, Volume of the hemi-sphere (V) = 19404 cm^3

Radius of the hemi-sphere (r) = ?

We know that, $V = \frac{2}{3}\pi r^3$ or, $19404 = \frac{2}{3} \times \frac{22}{7} \times r^3$

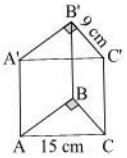
or, $19404 = \frac{44}{21} \times r^3$ or, $19404 \times \frac{21}{44} = r^3$

or, $441 \times 21 = r^3$ or, $21^2 \times 21 = r^3$

or, $21^3 = r^3$ ∴ $r = 21$

Thus, the radius of the hemisphere is 21 cm.

(c) चित्रमा दिइएको प्रिज्मको आयताकार सतहहरूको क्षेत्रफल 1188 वर्ग से.मि., ∡ABC = 90°, AC = 15 से.मि. र B'C' = 9 से.मि. भए, AA' को लम्बाइ निकाल्नुहोस् ।
In the figure, the area of rectangular surface of given prism is 1188 sq. cm, ∡ABC = 90°, AC = 15 cm and B'C' = 9 cm, find the length of AA'.



⇨ Here, ∡ABC = 90°, AC = 15 cm = A'C', B'C' = 9 cm = BC,

∴ $AB = \sqrt{AC^2 - BC^2} = \sqrt{15^2 - 9^2} = \sqrt{225 - 81} = \sqrt{144} = \sqrt{12 \times 12} = 12$ cm

By the question, LSA of prism = 1188 cm^2

or, (BC + AC + AB)AA' = 1188

or, (9 + 15 + 12)AA' = 1188

or, $AA' = \frac{1188}{36}$

or, 36AA' = 1188

∴ AA' = 33

Thus, the length of AA' is 33 cm.

6. (a) प्रमाणित गर्नुहोस् (Prove that): $\frac{3^{x+1} + 3^x}{4 \times 3^x} = 1$

⇨ Here, LHS $= \frac{3^{x+1} + 3^x}{4 \times 3^x} = \frac{3^x \times 3^1 + 3^x}{4 \times 3^x} = \frac{3^x . (3+1)}{4 \times 3^x} = \frac{4}{4} = 1 =$ RHS Proved.

(b) हरको आनुपातिकरण गर्नुहोस् (Rationalize the denominator of): $\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}$

⇨ Here, $\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}} = \frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}} \times \frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}-\sqrt{3}} = \frac{(\sqrt{5}-\sqrt{3})^2}{(\sqrt{5})^2 - (\sqrt{3})^2}$

$= \frac{(\sqrt{5})^2 - 2 . \sqrt{5} . \sqrt{3} + (\sqrt{3})^2}{5-3} = \frac{8 - 2\sqrt{15}}{2} = \frac{2(4 - \sqrt{15})}{2} = 4 - \sqrt{15}$

Thus, the rationalized form is $4 - \sqrt{15}$.

7. (a) ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $a^2 - b^2$, $(a-b)^2$

⇨ Here, first expression = $a^2 - b^2 = (a+b)(a-b)$

Second expression = $(a-b)^2 = (a-b)(a-b)$

Thus, the LCM is $(a-b)(a+b)(a-b) = (a+b)(a-b)^2$

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(b) हल गर्नुहोस् (Solve): $\sqrt{x+1} = \sqrt[3]{8}$

⇨ Here, $\sqrt{x+1} = \sqrt[3]{8}$ or, $\sqrt{x+1} = \sqrt[3]{2^3}$ or, $\sqrt{x+1} = 2$

Squaring on both sides, $(\sqrt{x+1})^2 = (2)^2$

or, $x + 1 = 4$ or, $x = 4 - 1$

$\therefore \quad x = 3$ Thus, $x = 3$ is the solution.

(c) यदि दुईओटा क्रमागत जोर सङ्ख्याहरूको योगफल 26 भए, ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।

If the sum of two consecutive even numbers is 26, find the numbers.

⇨ Here, let x and x + 2 are the two consecutive even numbers.

By the question, $x + x + 2 = 26$

or, $2x + 2 = 26$ or, $2x = 26 - 2$

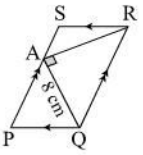
or, $2x = 24$ or, $x = \frac{24}{2}$

$\therefore \quad x = 12$ $\therefore \quad x + 2 = 12 + 2 = 14$

Thus, two consecutive even numbers are 12 and 14.

8. (a) दिइएको चित्रमा PQRS एउटा समानान्तर चतुर्भुज हो । यदि ∠QAR = 90°, AQ = 8 से.मि. र □PQRS को क्षेत्रफल 72 वर्ग से.मि. छ भने AR को लम्बाइ पत्ता लगाउनुहोस् ।

In the given figure, PQRS is a parallelogram. If ∠QAR = 90°, AQ = 8 cm and the area of □PQRS is 72 sq. cm, find the length of AR.



⇨ Here, AQ = 8 cm, Ar. (□PQRS) = 72 cm²

(i) Area of $\Delta AQR = \frac{1}{2}$ Ar. (□PQRS) $= \frac{1}{2} \times 72 \text{ cm}^2 = 36 \text{ cm}^2$

[Being both on the same base and between the same parallels.]

(ii) Area of $\Delta AQR = \frac{1}{2} \times AQ \times AR$

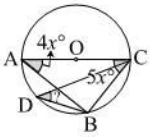
or, $36 \text{ cm}^2 = \frac{1}{2} \times 8 \text{ cm} \times AR$

$\therefore \quad AR = 9 \text{ cm}$

Thus, the length of AR is 9 cm.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠BAC = 4x° र ∠ACB = 5x° छन् भने ∠BDC को नाप पत्ता लगाउनुहोस् ।

In the given figure, O is the centre of the circle. If ∠BAC = 4x° and ∠ACB = 5x°, find the size of ∠BDC.



⇨ Here, ∠BAC = 4x°, ∠ACB = 5x°

(i) ∠BAC + ∠ACB = 90° (Being AC a diameter)

or, $4x° + 5x° = 90°$

or, $9x° = 90°$

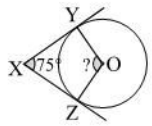
or, $x = 10°$

(ii) ∠BDC = ∠BAC = $4x° = 4 \times 10° = 40°$ (Being inscribed angles on same arc.)

Thus, the measure of ∠BDC is 40°.

(c) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । XY र XZ दुई स्पर्शरेखाहरू हुन् । यदि ∠YXZ = 75° भए ∠YOZ को मान निकाल्नुहोस् ।

In the given figure, O is centre of the circle. XY and XZ are two tangents. If ∠YXZ = 75°, find the value of ∠YOZ.



⇨ Here, ∠YXZ = 75°, ∠YOZ = ?

(i) ∠OYX = ∠OZX = 90° [Being radius is perpendicular to the tangent at the point of contact.]

(ii) ∠OYX + ∠OZX + ∠YXZ + ∠YOZ = 360° [Sum of angles of a quadrilateral]

or, $90° + 90° + 75° + \angle YOZ = 360°$

or, $\angle YOZ + 255° = 360°$

or, $\angle YOZ = 360° - 255°$

or, $\angle YOZ = 105°$

$\therefore \quad \angle YOZ = 105°$

Thus, the value of ∠YOZ is 105°

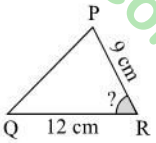
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9. (a) ΔPQR मा PR = 9 से.मि. र QR = 12 से.मि. छन्। यदि ΔPQR को क्षेत्रफल $27\sqrt{2}$ वर्ग से.मि. भए ∠PRQ को मान पत्ता लगाउनुहोस्।

In ΔPQR, PR = 9 cm and QR = 12 cm. If the area of ΔPQR is $27\sqrt{2}$ sq. cm, find the value of ∠PRQ.

⇨ Here, PR = 9 cm and QR = 12 cm and Ar (ΔPQR) = $27\sqrt{2}$ cm^2



We know that, Area of $\Delta PQR = \frac{1}{2} \times PR \times QR \times \sin \angle PRQ$

or, $27\sqrt{2} = \frac{1}{2} \times 9 \times 12 \times \sin \angle PRQ$ or, $27\sqrt{2} = 54 \sin \angle PRQ$

or, $\sin \angle PRQ = \frac{1}{\sqrt{2}}$ or, $\sin \angle PRQ = \sin 45°$

∴ $\angle PRQ = 45°$ Thus, the value of ∠PRQ is 45°.

(b) एउटा निरन्तर श्रेणीमा केही विद्यार्थीहरूको औसत तौल 50 कि.ग्रा. र तिनीहरूको तौलको योगफल ($\sum fm$) 1850 कि.ग्रा. छ भने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस्।

In a continuous series, the average weight of some students is 50 kg and the sum of their weights ($\sum fm$) is 1850 kg. Find the number of students.

⇨ Here, Average ($\bar{x}$) = 50 kg, $\sum fm$ = 1850, N = ?

We have, $\bar{x} = \frac{\Sigma fm}{N}$ or, $50 = \frac{1850}{N}$

or, $N = \frac{1850}{50}$ ∴ N = 37

Thus, the number of the students is 37.

10. (a) यदि एउटा डाइसलाई उछालियो र त्यही समयमा एउटा सिक्कालाई उफाऱ्यो भने डाइसमा रुढ सङ्ख्या र सिक्कामा पछिल्लो भाग पर्ने सम्भाव्यता निकाल्नुहोस्।

If a dice is rolled and a coin is tossed at the same time, find the probability of occurring prime number on dice and tail on the coin.

⇨ Here, sample space in a dice (S_1) = {1, 2, 3, 4, 5, 6} and Sample space in a coin (S_2) = {H, T}

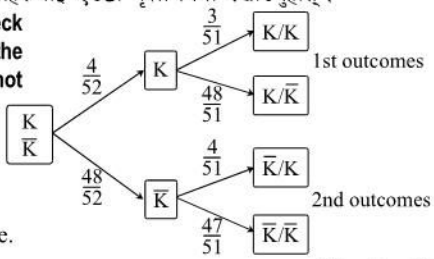
We have, P(Prime number and tail) = P(Prime number) × P (tail) $= \frac{n(\text{Prime number})}{n(S_1)} \times \frac{n(\text{tail})}{n(S_2)}$

$= \frac{3}{6} \times \frac{1}{2} = \frac{1}{4}$

Thus, the probability of occurring prime number & tail is $\frac{1}{4}$.

(b) राम्ररी फिटिएको 52 ओटा तासको गड्डीबाट दुईओटा तासहरू नहेरीकन एकपछि अर्को गरी पुनः नराखीकन झिक्दा राजा पर्ने र नपर्ने सम्भावित परिणामहरूका सम्भाव्यताहरूलाई एउटा वृक्षचित्रमा देखाउनुहोस्।

Two cards are drawn randomly from a well shuffled deck of 52 cards in succession without replacement. Show the probabilities of possible outcomes of getting and not getting a king in a tree diagram.



⇨ Here, No. of total cards; n(S) = 52

No. of king cards; n(K) = 4

No. of cards other than king; n($\bar{K}$) = 48

Now, the probability tree diagram is shown alongside.

समूह 'ग' **(Group 'C')** **[10 × 4 = 40]**

11. एउटा समुदायमा गरिएको सर्वेक्षणमा 65% ले लोकगीत मन पराउँछन्; 50% ले आधुनिक गीत मन पराउँछन्; 30% ले दुवै गीत मन पराउँछन् र 450 जनाले दुवै गीतहरू मन पराएनन् भने

In a survey of a community, it was found that 65% liked folk songs, 50% liked modern songs, 30% like both songs and 450 didn't like both the songs then,

(i) माथिको तथ्यलाई भेन चित्रमा प्रस्तुत गर्नुहोस्। **(Draw a Venn-diagram to illustrate the above information.)**

(ii) सर्वेक्षणमा सहभागी मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस्।
Find the total number of people participated in the survey.

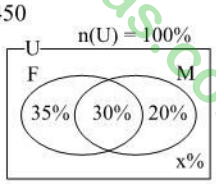
(iii) लोकगीत मात्र मन पराउने मानिसको सङ्ख्या पत्ता लगाउनुहोस्। **(Find the number of people who like folk songs only.)**

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⇨ Here, F and M denote the set of people who liked folk songs and modern songs respectively then,

Let $n(U) = 100\%$ then, $n(F) = 65\%$, $n(M) = 50\%$, $n(F \cap M) = 30\%$, $n(\overline{F \cup M}) = 450$



(i) We know, $n(U) = n(F \cup M) + n(\overline{F \cup M})$

or, $n(U) = n(F) + n(M) - n(F \cap M) + n(\overline{F \cup M})$

or, $100\% = 65\% + 50\% - 30\% + n(\overline{F \cup M})$

or, $100\% = 85\% + n(\overline{F \cup M})$

$\therefore \quad n(\overline{F \cup M}) = 100\% - 85\% = 15\%$

Now, according to the question, 15% of $n(U) = 450$

or, $\frac{15}{100} \times n(U) = 450$ or, $n(U) = 450 \times \frac{100}{15}$ $\therefore \quad n(U) = 3000$

(ii) Total number of people participated in the survey is 3000.

(iii) In percent $n_0(F) = n(F) - n(F \cap M) = 65\% - 30\% = 35\%$

$\therefore \quad n_0(F) = 35\%$ of $3000 = \frac{35}{100} \times 3000 = 1050$

Thus, there are 1050 people who like folk songs only.

12. एक जना व्यापारीले $1 = ने रु. 110 को दरमा रु. 5,50,000 को अमेरिकी डलर साट्यो । चार दिन पछि नेपाली मुद्रा 10% ले अधिमूल्यन भयो र उक्त दिनमा पुनः उसँग भएको डलर नेपाली मुद्रामा साट्दा उसलाई कति नाफा वा नोक्सान भयो होला ? पत्ता लगाउनुहोस् ।

A businessman exchanged Rs 5,50,000 into US dollar at the rate of $1 = NRs 110. After four days, Nepali currency was revaluated by 10% and in that day he exchanged the dollars he had into Nepali currency again. What is his gain or loss? Find it.

⇨ Here, exchange rate is $1 = NRs 110, Nepali money = Rs 550000

Amount of US dollar before revaluation $= \frac{\text{Nepali money}}{\text{Exchange rate}} = \frac{\text{Rs } 550000}{\text{Rs } 110/\$} = \$\ 5000$

Since Nepali currency was revaluated by 10% so, new rate;

1\$ = Rs 110 – 10% of Rs 110

= 90% of Rs 110

= 0.9 × Rs 110 = Rs 99

$\therefore$ \$1 = Rs 99

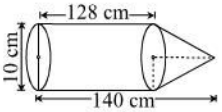
Again, Nepali money of \$5000 = 5000 × Rs 99 = Rs 495000.

Clearly loss happened.

$\therefore$ Loss amount in Nepali currency = Rs 550000 – Rs 495000 = Rs 55000.

Thus, the required amount of loss is Rs 55000.

13. दिइएको चित्र बेलना र सोली मिलेर बनेको एउटा संयुक्त ठोस वस्तु हो । सो वस्तुको आधारको व्यास 10 से.मि., बेलनाकार भागको लम्बाइ 128 से.मि. र ठोस वस्तुको जम्मा लम्बाइ 140 से.मि. छन् । उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।



The given figure is combined solid made up of a cylinder and a cone. The diameter of the base of the object is 10 cm, length of the cylindrical part is 128 cm and the total length of the solid object is 140 cm. Find the total surface area of the solid object.

⇨ Here, common diameter (d) = 10 cm $\therefore \quad r = \frac{d}{2} = \frac{10}{2} = 5$ cm

The combined solid made up of a cylinder & cone.

Total height of the solid (H + h) = 140 cm

Height of the cylinder (H) = 128 cm

Height of the cone (h) = 140 cm – 128 cm = 12 cm

we know that, Slant height of a cone $(\ell) = \sqrt{h^2 + r^2} = \sqrt{12^2 + 5^2} = \sqrt{144 + 25} = \sqrt{169} = 13$ cm

Now, TSA of the solid object = Area of base + CSA (cylinder) + CSA (cone)

$= \pi r^2 + 2\pi rH + \pi r\ell$ $= \pi r\,(r + 2H + \ell)$

$= \frac{22}{7} \times 5\,(5 + 2 \times 128 + 13)$ $= \frac{110}{7} \times (5 + 256 + 13)$

$= \frac{110}{7} \times 274$ $= \frac{30140}{7} = 4305.71\ \text{cm}^2$

Thus, TSA of the solid object is 4305.71 cm^2.

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14. म.स. निकाल्नुहोस् (Find the HCF of): $p^3 + 4p^2q + 4pq^2$, $p^4 + 8pq^3$ and $3p^4 + p^3q - 10p^2q^2$

⇨ Here,

1^{st} exp. $= p^3 + 4p^2q + 4pq^2$
$= p(p^2 + 4pq + 4q^2)$
$= p(p^2 + 2 \cdot p \cdot 2q + (2q)^2)$
$= p(p + 2q)^2$
$= p(p + 2q)(p + 2q)$

2^{nd} exp. $= p^4 + 8pq^3$
$= p(p^3 + 8q^3)$
$= p[(p)^3 + (2q)^3]$
$= p(p + 2q)[(p)^2 - p \cdot 2q + (2q)^2]$
$= p(p + 2q)(p^2 - 2pq + 4q^2)$

3^{rd} exp. $= 3p^4 + p^3q - 10p^2q^2$
$= p^2(3p^2 + pq - 10q^2)$
$= p^2(3p^2 + 6pq - 5pq - 10q^2)$
$= p^2[3p(p + 2q) - 5q(p + 2q)]$
$= p^2(p + 2q)(3p - 5q)$

Thus, HCF $= p(p + 2q)$

15. सरल गर्नुहोस् (Simplify): $\frac{1}{1 - m + m^2} - \frac{1}{1 + m + m^2} - \frac{2m}{1 - m^2 + m^4}$

⇨ Here, $\frac{1}{1 - m + m^2} - \frac{1}{1 + m + m^2} - \frac{2m}{1 - m^2 + m^4}$

$= \frac{1(1 + m + m^2) - 1(1 - m + m^2)}{(1 - m + m^2)(1 + m + m^2)} - \frac{2m}{1 - m^2 + m^4}$

$= \frac{1 + m + m^2 - 1 + m - m^2}{1 + m^2 + m^4} - \frac{2m}{1 - m^2 + m^4}$

$= \frac{2m}{1 + m^2 + m^4} - \frac{2m}{1 - m^2 + m^4}$

$= \frac{2m[(1 - m^2 + m^4) - (1 + m^2 + m^4)]}{(1 + m^2 + m^4)(1 - m^2 + m^4)}$

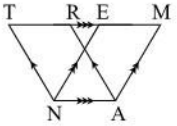
$= \frac{2m(1 - m^2 + m^4 - 1 - m^2 - m^4)}{(1 + m^2 + m^4)(1 - m^2 + m^4)}$

$= \frac{2m(-2m^2)}{(1 + m^2 + m^4)(1 - m^2 + m^4)}$

$= \frac{-4m^3}{1 + m^4 + m^8}$

16. चित्रमा एउटै आधार NA र NA // TM बीच बनेका समानान्तर चतुर्भुजहरू NAME र NART छन् । प्रमाणित गर्नुहोस् :

(i) $\Delta NET \cong \Delta AMR$ (ii) $\square$NAME को क्षेत्रफल = $\square$NART को क्षेत्रफल



In the figure, parallelograms NAME and NART are standing on same base NA and between NA // TM. Prove that:

(i) $\Delta NET \cong \Delta AMR$ (ii) Area of $\square$NAME = Area of $\square$NART

⇨ Here, Given, NA // TM, AR // NT and NE // AM.

To prove: (i) $\Delta NET \cong \Delta AMR$ (ii) Area of $\square$NAME = Area of $\square$NART

Proof:

Statements	Reasons
1. In ΔNET and ΔAMR (i) $\angle NET = \angle AMR$ (ii) $\angle NTE = \angle ARM$ (iii) TN = AR	1. (i) Corresponding angles in parallel lines. (ii) Corresponding angles in parallel lines. (iii) Opposite sides of a parallelogram are equal.
2. $\Delta NET \cong \Delta AMR$	2. By AAS axiom.
3. $\square MANT = \square MANT$	3. Identity axiom.
4. $\Delta NET = \Delta AMR$	4. From (2), congruent triangles
5. $\square MANT - \Delta NET = \square MANT - \Delta AMR$	5. Subtracting statement (4) from statement (3)
6. $\square NAME = \square NART$	6. Whole part axiom

Proved.

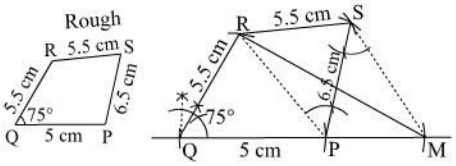
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17. PQ = 5 से.मि., QR = 5.5 से.मि., RS = 5.5 से.मि., SP = 6.5 से.मि. र ∠PQR = 75° भएको चतुर्भुज PQRS को रचना गर्नुहोस् । उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुने त्रिभुज QRM को पनि रचना गर्नुहोस् ।

Construct a quadrilateral PQRS with PQ = 5 cm, QR = 5.5 cm, RS = 5.5 cm, SP = 6.5 cm and ∠PQR = 75°. Also construct a triangle QRM whose area is equal to quadrilateral PQRS.

⇨ Here, PQ = 5 cm, QR = 5.5 cm, RS = 5.5 cm, SP = 6.5 cm, ∠PQR = 75°



Now, ΔQRM is the required triangle whose area is equal to the area of given quadrilateral PQRS.

18. वृत्तको एउटै चाप BN मा आधारित परिधी कोण BAN र केन्द्रीय कोण BIN बीचको सम्बन्ध प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally the relationship between circumference angle BAN and central angle BIN standing on the same arc BN of a circle. (Two circles having radii at least 3 cm are necessary.)

⇨ Here, ∠BIN is the central angle and ∠BAN is the circumference angle standing on the same arc BN.

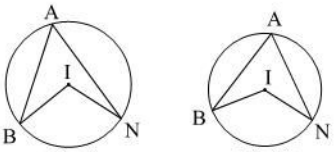


Fig (i) Fig (ii)

To verify: $\angle BAN = \frac{1}{2} \angle BIN$ or $\angle BIN = 2.\angle BAN$

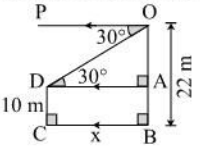
Verification: Measuring ∠BAN and ∠BIN by protractor and tabulate them in following table.

Figure No.	∠BAN	∠BIN	Results
(i)	55°	110°	$\angle BAN = \frac{1}{2} \angle BIN$
(ii)	70°	140°	$\angle BAN = \frac{1}{2} \angle BIN$

Conclusion: It is verified that circumference angle is half of central angle standing on the same arc. Or, the central angle is double of circumference angle standing on the same arc.

19. एउटा घर र मन्दिरको उचाइ क्रमशः 10 मिटर र 22 मिटर छन् । यदि मन्दिरको छानाबाट एक व्यक्तिले घरको छतमा हेर्दा अवनति कोण 30° पाउँछ भने घर र मन्दिरबीचको दूरी पत्ता लगाउनुहोस् ।

The heights of a house and a temple are 10 metre and 22 metre respectively. If a man observes the roof of house from the roof of temple and gets the angle of depression to be 30°, find the distance between the house and temple.



⇨ Here, Let CD = 10 m is a house and OB = 22 m is a temple.

Angle of depression is ∠POD = ∠ODA = 30°

Now, AB = CD = 10 m, AD = BC = x m (say), OA = (22 – 10) m = 12 m.

From ΔOAD, $\tan 30° = \frac{OA}{AD}$

or, $\frac{1}{\sqrt{3}} = \frac{12}{x}$

or, $x = 12\sqrt{3}$

or, $x = 12 \times 1.732$

or, $x = 20.784$

Thus, the distance between the house and temple is 20.78 m.

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20. तल दिइएको तथ्याङ्कको मध्यिका गणना गर्नुहोस् । (Compute the median from following data.)

Age in years	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
No. of People	2	5	4	3	2

⇨ Here, calculation of the median.

Age in year (x)	No. of people (f)	c.f
0 - 10	2	2
10 - 20	5	7
20 - 30	4	11
30 - 40	3	14
40 - 50	2	16
	N = 16	

Median lies in $\left(\frac{N}{2}\right)^{th}$ term= $\left(\frac{16}{2}\right)^{th}$ term = 8^{th} term

∴ Median class is (20 - 30)

We know, Median $(Q_2) = \ell + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 20 + \frac{10}{4}(8-7) = 20 + \frac{5}{2} \times 1 = 20 + 2.5 = 22.5$

Thus, median of given data is 22.5.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. एकजना व्यक्तिले बैंक 'X' मा दुई वर्षका लागि रु. 1,00,000 वार्षिक 10% को दरमा प्रतिवर्ष चक्रीय ब्याज पाउने गरी जम्मा गरेछन् । तर ठीक एक वर्ष पछि बैंकले नीति परिवर्तन गरी सोही ब्याजदरमा अर्धवार्षिक चक्रीय ब्याज दिने निर्णय गरेछ । पहिलो वर्षको र दोस्रो वर्षको ब्याज रकममा कति प्रतिशतले फरक परेछ ? हिसाब गरी कारण लेख्नुहोस् ।
A person deposited Rs 1,00,000 in bank 'X' for two years, at the rate of 10% compounded. But after one year, bank has changed the policy and decided to pay semi-annual compound interest at the same rate. What is the percentage difference between compound interests of the first year and second year? Give reason with calculation.

⇨ Here, Principal (P) = Rs 100000 and Rate of interest (R) = 10% p.a.

Compound interest of first year $(CI_1) = \left[\left(1 + \frac{R}{100}\right)^T - 1\right]$

$= 100000\left[\left(1 + \frac{10}{100}\right)^1 - 1\right]$

$= 100000 \times \frac{1}{10}$

$=$ Rs 10000

∴ Compound interest of first year (CI_1) = Rs 10000

Again, for the second year, Principal (P) = Rs 100000 + Rs 10000 = Rs 110000

Time (T) = 1 year and Rate (R) = 10%

We know that,

Semi-annual compound interest $(CI_2) = \left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right]$

$=$ Rs $110000\left[\left(1 + \frac{10}{200}\right)^2 - 1\right]$

$=$ Rs $110000 \times \left[\frac{441}{400} - 1\right]$

$=$ Rs $110000 \times \frac{41}{400}$ = Rs 11275

∴ Semi-annual compound interest (CI_2) = Rs 11275

So, difference in interests = $CI_2 - CI_1$=Rs 11275 – Rs 10000 = Rs 1275

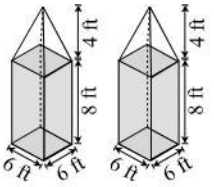
Now, percentage difference between two interests is; $= \frac{\text{Difference}}{\text{First interest}} \times 100\% = \frac{1275}{10000} \times 100\% = 12.75\%$

Thus, the required percentage is 12.75%.

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22. एउटा रंगशालाको गेटका चारैओटा सतहहरू देखिने 8 फिट अग्ला दुईओटा पिलरहरूमाथि उही आधारका एक-एक ओटा 4 फिट उचाइ भएका पिरामिडहरू राखिएका छन् । प्रत्येक पिलरको आधार 6 फिट × 6 फिट छ । उक्त पिरामिडसहितको पिलरहरूमा प्रति वर्ग फिट रु. 100 का दरले रङ्ग लगाउँदा जम्मा कति खर्च लाग्छ ? पत्ता लगाउनुहोस् ।

Two pillars of height 8 feet each with four faces shown, of the gate of a stadium have one-one pyramid of height 4 feet each having same base on their tops. The base of each pillar is 6 ft × 6 ft. If the pillars with pyramid are painted at the rate of Rs 100 per square feet, what will be the total cost? Find it.



⇨ Here, the measurements of one piller; length of base (a) = 6 ft,
height of cuboid (h_1) = 8 ft height of pyramid (h_2) = 4 ft

Slant height of pyramid (ℓ) = $\sqrt{(h_2)^2 + \left(\frac{a}{2}\right)^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = 5$ ft

Now, total surface area of painting areas of two pillars
$= 2[2h_1 (a + a) + 2a\ell]$ $= 2\,[2 \times 8\,(6 + 6) + 2 \times 6 \times 5]$
$= 2\,[192 + 60]$ $= 504$ ft^2

Rate of painting (R) = Rs 100/ ft^2

Total cost of painting (T) = Area × Rate = 504 × 100 = Rs 50400

Thus, the total cost of painting the pillars is Rs 50400.

23. एउटा आयताकार जग्गाको क्षेत्रफल 720 वर्ग मिटर र परिमिति 108 मिटर छन् । उक्त जग्गालाई वर्गाकार बनाउन लम्बाइ अथवा चौडाइलाई के कति प्रतिशतले घटाउनु पर्छ र किन ? पत्ता लगाउनुहोस् ।

The area of a rectangular field is 720 sq. metre and perimeter is 108 metre. Out of length or breadth, which one is to be decreased by what percentage to make it a square? Why? Find it.

⇨ Here, the area of rectangular field (A) = 720 m^2

Perimeter (P) = 108 m Length of field = ℓ (say) Breadth of field = b (say)

$\because$ $2(\ell + b) = P$ or, $2(\ell + b) = 108$ or, $\ell + b = 54$

or, $b = 54 - \ell$ .....(i)

Again $\ell \times b = A$ or, $\ell\,(54 - \ell) = 720$ or, $54\ell - \ell^2 = 720$

or, $\ell^2 - 54\ell + 720 = 0$ or, $\ell^2 - 30\ell - 24\ell + 720 = 0$ or, $\ell(\ell - 30) - 24(\ell - 30) = 0$

or, $(\ell - 30)\,(\ell - 24) = 0$

Either, $\ell - 30 = 0 \Rightarrow \ell = 30$ or, $\ell - 24 = 0 \Rightarrow \ell = 24$

if $\ell = 30$ then $b = 54 - 30 = 24$ if $\ell = 24$ then $b = 54 - 24 = 30$

So, length = 30 m and breadth = 24 m

To make it a square, the length should also be 24 m. i.e. length should be decreased by (30 – 24) = 6 m.

Decreased percentage = $\frac{6}{30} \times 100\% = 20\%$

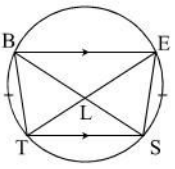
Thus, the length should be decreased by 20%.

24. बिन्दुहरू B, E, S, T चक्रीय छन् । जहाँ चाप BT = चाप SE छ । यदि जीवा BS र जीवा ET एकआपसमा बिन्दु L मा प्रतिच्छेदित भएका छन् भने प्रमाणित गर्नुहोस् :

(i) क्षेत्रफल (ΔBLT) = क्षेत्रफल (ΔSEL) **(ii) जीवा BS = जीवा ET**

Points B, E, S, T are concyclic such that arc BT = arc SE. If the chord BS and chord ET are intersected at the point L, prove that:

(i) Area of ΔBLT = Area of ΔSEL **(ii) chord BS = chord ET**



⇨ Here, **Given:** In the figure, $\overset{\frown}{BT} = \overset{\frown}{SE}$. BS and ET are intersected at L.

To prove: (i) Ar(ΔBLT) = Ar(ΔSEL) (ii) chord BS = chord ET

Construction: BE and TS are joined.

Proof

Statements	Reasons
1. BE // TS	1. Being arc BT = arc ES
2. Ar. (ΔBTS) = Ar.(ΔETS)	2. Being both are on the same base and between the same parallels.
3. ΔBTL = ΔELS	3. Subtracting ΔTLS from both the sides of statement (2).
4. arc BTS = arc EST	4. Adding arc TS on arc BT = arc ES (given).
5. BS = ET	5. Corresponding chords of equal arcs from (4).

Proved.

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6. SEE EXAMINATIONS 2074 (2018) [SUPPLEMENTARY] RE-109

समूह 'क' (Group 'A') [3 × (1+1)= 6]

1. (a) यदि कुनै सामानको विक्रय मूल्य रु. a र मूल्य अभिवृद्धिकर रकम रु. b छ भने मूल्य अभिवृद्धि करको दर कति होला ? लेख्नुहोस् ।
If the selling price of an article is Rs a and the value added tax amount is Rs b, what is the rate of value added tax? Write it.

⇨ Here, the rate of value added tax is $\frac{b}{a} \times 100\%$.

(b) आधार भुजा p cm र छड्के उचाइ q cm भएको वर्ग आधार पिरामिडको पूरा सतहको क्षेत्रफल कति हुन्छ ? लेख्नुहोस् ।
What is the total surface area of a square based pyramid having a side of base p cm and slant height q cm? Write it.

⇨ Here, the total surface area of a square based pyramid = $(2pq + p^2)$ cm^2.

2. (a) $\sqrt[n]{q}$ मा सर्डको क्रम कति हो ? लेख्नुहोस् । **(Write down the order of surd in $\sqrt[n]{q}$.)**

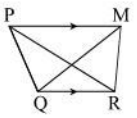
⇨ Here, the order of surd in $\sqrt[n]{q}$ is n.

(b) यदि तेस्रो चतुर्थांश $(Q_3) = L + \frac{\frac{3N}{4} - c.f.}{f} \times i$ भए i ले के जनाउँछ ? लेख्नुहोस् ।

If third quartile $(Q_3) = L + \frac{\frac{3N}{4} - c.f.}{f} \times i$ then what does i represent for? Write it.

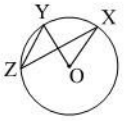
⇨ Here, i represents the class interval of Q_3 class.

3. (a) दिइएको चित्रमा ΔPQR को क्षेत्रफल 20 वर्ग मि. भए ΔMQR को क्षेत्रफल कति होला ?
In the given figure, area of ΔPQR is 20 square m, what will be the area of ΔMQR?



⇨ Here, area of ΔPQR and ΔMQR are equal. So, area of ΔMQR is 20 m^2.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । ∡XOY र ∡XZY बीचको सम्बन्ध लेख्नुहोस् ।
In the given figure, O is the centre of the circle. Write the relation between ∡XOY and ∡XZY



⇨ Here, the relation between ∡XOY and ∡XZY is ∡XOY = 2 ∡XZY.

समूह 'ख' (Group 'B') [4 × (2+2) + 3 × (2+2+2) = 34]

4. (a) यदि £1 = रु. 135 र $1 = रु. 105 छ भने £63 लाई डलरमा रुपान्तरण गर्नुहोस् ।
If £1 = Rs 135 and $1 = Rs 105, then convert £63 into dollar.

⇨ Here, £1 = Rs 135
Rs 105 = $1
let, $x = £63
Using the chain rule,
$1 \times 105 \times x = 135 \times 1 \times 63$
or, $x = \frac{135 \times 1 \times 63}{105} = 81$
$\therefore \quad x = 81.$
Thus, the required amount of dollar is $81.

(b) कुनै सहरको अहिलेको जनसङ्ख्या 66,550 छ । यदि 3 वर्ष पहिले त्यो सहरको जनसङ्ख्या 50,000 थियो भने वार्षिक जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।
The present population of a certain city is 66,550. If 3 years ago, the population of the city was 50,000, find the annual population growth rate.

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⇨ Here, Present population (P_T) = 66550, Time (T) = 3 years
Initial population (P) = 50000

We have, $(P_T) = P\left(1 + \frac{R}{100}\right)^T$

or, $66550 = 50000\left(1 + \frac{R}{100}\right)^3$ or, $\frac{6655}{5000} = \left(1 + \frac{R}{100}\right)^3$

or, $\frac{1331}{1000} = \left(1 + \frac{R}{100}\right)^3$ or, $\left(\frac{11}{10}\right)^3 = \left(1 + \frac{R}{100}\right)^3$

or, $\frac{11}{10} = 1 + \frac{R}{100}$ or, $\frac{1}{10} = \frac{R}{100}$

$\therefore$ R = 10

Thus, the required growth rate 10%.

5. (a) एउटा बेलनाकार ट्याङ्कीमा $\frac{49}{100}\pi$ लिटर अटाउँछ । यदि उक्त ट्याङ्कीको आधारको क्षेत्रफल 154 वर्ग से.मि. भए सो ट्याङ्कीको उचाइ पत्ता लगाउनुहोस् ।

The capacity of a cylindrical tank is $\frac{49}{100}\pi$ litre. If the base area of the tank is 154 sq. cm, then find the height of the tank.

⇨ Here, $V(\text{tank}) = \frac{49}{100}\pi$ litre

A (Base) = 154 cm^2

We have, V(tank) = Base area × height

or, $\frac{49}{100}\pi$ litre = 154 × h or, $\frac{49}{100}\pi \times 1000 = 154 \times h$ [$\because$ 1 litre = 1000 cm^3]

or, $h = \frac{49 \times 1000}{100 \times 154} \times \frac{22}{7}$ $\therefore$ h = 10 cm

Thus, the height of the tank is 10 cm.

(b) यदि एउटा गोलाकार गुच्चाको आयतन $\frac{4\pi}{3}$ घन से.मि. भए यसको व्यास पत्ता लगाउनुहोस् ।

If the volume of a spherical marble is $\frac{4\pi}{3}$ cubic cm, find its diameter.

⇨ Here, $V(\text{sphere}) = \frac{4\pi}{3}$ cm^3, d = ?

We know that, $V(\text{sphere}) = \frac{1}{6}\pi d^3$

or, $\frac{4\pi}{3} = \frac{1}{6}\pi d^3$ or, $3d^3 = 24$

or, $d^3 = 8$ or, $d^3 = 2^3$ $\therefore$ d = 2 cm

Thus, the diameter is 2 cm.

(c) यदि एउटा सोलीको उचाइ आधारको अर्धव्यासको पाँचगुणा र यसको आयतन 360 π घन से.मि. भए सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।

If the height of a cone is five times radius of the base and its volume is 360 π cubic cm, then find the radius of the base of the cone.

⇨ Here, height of cone = 5 × radius So, h = 5r

Volume of cone = 360π cm^3

We know that, $V(\text{cone}) = \frac{1}{3}\pi r^2 h$ or, $360\pi = \frac{1}{3}\pi r^2 \times 5r$

or, $360 = \frac{1}{3} 5 \times r^3$ or, $r^3 = \frac{360 \times 3}{5}$ or, $r^3 = 216$

or, $r^3 = 6^3$ $\therefore$ r = 6 cm

Thus, the radius of the cone is 6 cm.

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6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^2 - x + 1$ and $x^4 + x$

⇨ Here, First expression $= x^2 - x + 1$

Second expression $= x^4 + x = x(x^3 + 1) = x(x + 1)(x^2 - x + 1)$

$\therefore$ HCF $= (x^2 - x + 1)$

Thus, the HCF is $(x^2 - x + 1)$.

(b) सरल गर्नुहोस् (Simplify): $4\sqrt[3]{24} - 11\sqrt[3]{192} + 6\sqrt[3]{648}$

⇨ Here, $4\sqrt[3]{24} - 11\sqrt[3]{192} + 6\sqrt[3]{648}$

$= 4\sqrt[3]{2^3 \times 3} - 11\sqrt[3]{2^6 \times 3} + 6\sqrt[3]{2^3 \times 3^3 \times 3}$

$= 4 \times 2\sqrt[3]{3} - 11 \times 2^2 \times \sqrt[3]{3} + 6 \times 2 \times 3\sqrt[3]{3} = 8\sqrt[3]{3} - 44\sqrt[3]{3} + 36\sqrt[3]{3}$

$= (8 - 44 + 36)\sqrt[3]{3} = 0 \times \sqrt[3]{3} = 0$

7. (a) यदि $a = 6^x$, $b = 6^y$ र $a^y.b^x = 36$ भए, प्रमाणित गर्नुहोस्: $xy = 1$.
If $a = 6^x$, $b = 6^y$ and $a^y.b^x = 36$ then prove that: $xy = 1$.

⇨ Here, $a^y b^x = 36$ or, $(6^x)^y (6^y)^x = 36$

or, $6^{xy} 6^{xy} = 6^2$ or, $6^{2xy} = 6^2$ or, $2xy = 2$

$\therefore$ $xy = 1$ Proved.

(b) सरल गर्नुहोस् (Simpilfy): $\frac{1}{b-c} - \frac{b+c}{b^2 - c^2}$

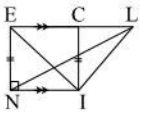
⇨ Here, $\frac{1}{b-c} - \frac{b+c}{b^2 - c^2} = \frac{1}{b-c} - \frac{b+c}{(b+c)(b-c)} = \frac{1}{b-c} - \frac{1}{b-c} = 0$

(c) सरल गर्नुहोस् (Simpilfy): $\frac{m^2 + mn + n^2}{m+n} + \frac{m^2 - mn + n^2}{m-n}$

⇨ Here, $\frac{m^2 + mn + n^2}{m+n} + \frac{m^2 - mn + n^2}{m-n} = \frac{(m-n)(m^2 + mn + n^2) + (m+n)(m^2 - mn + n^2)}{(m+n)(m-n)}$

$= \frac{m^3 - n^3 + m^3 + n^3}{m^2 - n^2} = \frac{2m^3}{m^2 - n^2}$

8. (a) चित्रमा NICE एउटा वर्ग र NI // EL छ । यदि विकर्ण EI = 10 से.मि. भए ΔNIL को क्षेत्रफल निकाल्नुहोस् ।
In the figure, NICE is a square and NI // EL. If diagonal EI = 10 cm, then find the area of ΔNIL.



⇨ Here, diagonal (EI) = 10 cm

(i) Area of square NICE $= \frac{1}{2}(\text{diagonal})^2 = \frac{1}{2}(10\text{ cm})^2 = 50\text{ cm}^2$

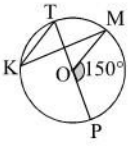
(ii) 2(Area of ΔNIL) = Area of square NICE

or, $2 \times$ Area of ΔNIL $= 50\text{ cm}^2$

$\therefore$ Area of ΔNIL $= 25\text{ cm}^2$

Thus, the area of ΔNIL is 25 cm^2.

(b) चित्रमा, O वृत्तको केन्द्रबिन्दु हो । यदि ∡POM = 150° भए, ∡TKM को मान पत्ता लगाउनुहोस् ।
In the figure, O is the centre of circle. If ∡POM = 150°, then find the value of ∡TKM.



⇨ Here, ∡POM = 150°

(i) ∡MOT + ∡MOP = 180° [Adjacent angles in a straight line]

or, ∡MOT + 150° = 180° $\therefore$ ∡MOT = 30°

(ii) $\angle TKM = \frac{1}{2}\angle MOT$ [Being both are on same arc]

or, $\angle TKM = \frac{1}{2} \times 30°$ $\therefore$ ∡TKM = 15°

Thus, the value of ∡TKM is 15°.

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(c) चित्रमा, O वृत्तको केन्द्रबिन्दु, TN स्पर्शरेखा र E स्पर्शबिन्दु छ । यदि ∠PTN = 35° भए ∠OPE को मान पत्ता लगाउनुहोस् ।

In the figure, O is centre of the circle, TN is a tangent to the circle and E is a point of contact. If ∠PTN = 35° then find the value of ∠OPE.



⇨ Here, ∠PTN = 35°

∠OPE + ∠OEP + ∠OET + ∠OTE = 180° [Interior angles of ΔPET]

or, 2∠OPE + 90° + 35° = 180° [Being OE = OP]

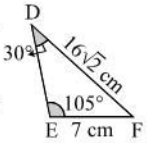
or, 2∠OPE + 125° = 180° or, 2∠OPE = 55°

∴ ∠OPE = 27.5°

Thus, the value of ∠OPE is 27.5°.

9. (a) दिइएको चित्रमा, ∠EDF = 30° र ∠DEF = 105° छन् । यदि DF = $16\sqrt{2}$ से.मि. र EF = 7 से.मि. भए ΔDEF को क्षेत्रफल पत्ता लगाउनुहोस्

In the given figure, ∠EDF = 30° and ∠DEF = 105°. If DF = $16\sqrt{2}$ cm and EF = 7 cm, find the area of the ΔDEF.



⇨ Here, (i) ∠D + ∠E + ∠F = 180° [Sum of angles of ΔDEF]

or, 30° + 105° + ∠F = 180°

or, ∠F = 180° – 135°

∴ ∠F = 45°

(ii) Area of $\Delta DEF = \frac{1}{2}$ EF × DF × sin∠F

$= \frac{1}{2} \times 7 \text{ cm} \times 16\sqrt{2} \text{ cm} \times \sin 45°$

$= 56\sqrt{2} \text{ cm}^2 \times \frac{1}{\sqrt{2}} = 56 \text{ cm}^2$

Thus, the area of ΔDEF is 56 cm^2.

(b) एउटा निरन्तर श्रेणीमा Σfx = 5160 + 30 p, जम्मा बारम्बारता (N) = 92 + p र मध्यक मान ($\bar{x}$) = 50 भए, p को मान पत्ता लगाउनुहोस् ।

In a continuous series, Σfx = 5160 + 30 p, total frequency (N) = 92 + p and mean value ($\bar{x}$) = 50, then find the value of p.

⇨ Here, Σfx = 5160 + 30 p, N = 92 + p and ($\bar{x}$) = 50

We know that, $(\bar{x}) = \frac{\Sigma fx}{N}$

or, $50 = \frac{5160 + 30p}{92 + p}$ or, 4600 + 50p = 5160 + 30p

or, 20p = 560 ∴ p = 28

Thus, the value of p is 28.

10. (a) यदि $P(A) = \frac{2}{3}$ र $p(\bar{B}) = \frac{1}{6}$ भए $P(A \cap B)$ पत्ता लगाउनुहोस् जहाँ A र B अनाश्रित घटनाहरू हुन् ।

If $P(A) = \frac{2}{3}$ and $P(\bar{B}) = \frac{1}{6}$ then find $P(A \cap B)$, where A and B are independent events.

⇨ Here, $P(A) = \frac{2}{3}$ and $P(\bar{B}) = \frac{1}{6}$

We have, $P(B) = 1 - P(\bar{B}) = 1 - \frac{1}{6} = \frac{5}{6}$

Now, $P(A \cap B) = P(A) \times P(B) = \frac{2}{3} \times \frac{5}{6} = \frac{5}{9}$

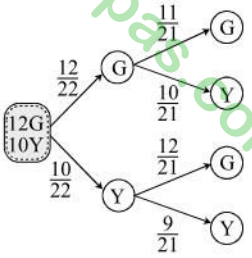
Thus, the required probability is $\frac{5}{9}$.

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(b) एउटा झोलामा 12 ओटा हरिया र 10 ओटा पहँला उस्तै र उत्रै अम्बाहरू छन् । उक्त झोलाबाट दुईओटा अम्बाहरू एकपछि अर्को पूनः नराखी झिक्दा आउने सबै परिणामहरूको सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् ।

A bag contains 12 green and 10 yellow guavas of same shape and size. Two guavas are drawn randomly in succession without replacement. Show the probabilities of all possible outcomes in a tree diagram.



⇨ Here, let G and Y denote the green and yellow guavas respectively.
n(G) = 12 and n(Y) = 10
The probability of possible outcomes are shown alongside.

समूह 'ग' (Group' C') [10×4=40]

11. एउटा नगरपालिकाको चुनावमा P र Q दुई उम्मेदवारहरू मेयर पदका लागि उठेछन् र त्यहाँ मतदाताको सूचीमा 35,000 जना रहेछन् । मतदाताले एक जनालाई मात्रै मत खसाल्नुपर्ने थियो । 22,000 जनाले P लाई, त्यस्तै 5500 जनाले Q लाई र 1500 जनाले दुवैलाई पनि मत दिएछन् ।

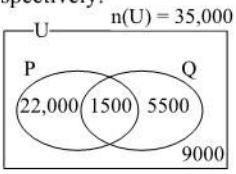
In an election of a municipality two candidates P and Q stood for the post of Mayor and 35,000 people were in the voter list. Voters were supposed to cast the vote for a single candidate. 22,000 people cast vote for P, 5500 people cast for Q and 1500 people cast vote even for both.

(i) यी जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show these information in a Venn-diagram.)

(ii) कति जनाले मत खसालेनन् ? पत्ता लगाउनुहोस् । (How many people didn't cast vote? Find it.)

(iii) कति जनाको भोट सदर भयो ? पत्ता लगाउनुहोस् । (How many votes were valid? Find it.)

⇨ Here, let P and Q denote the sets of votes given for the candidates P and Q respectively.
Then, n(U) = 35000, n(P) = 22000, n(Q) = 5500 and $n(P \cap Q) = 1500$
We know that,
$n(P \cup Q) = n(P) + n(Q) - n(P \cap Q) = 22000 + 5500 - 1500 = 26000$
Now, (i) $n(\overline{P \cup Q}) = n(U) - n(P \cup Q) = 35000 - 26000 = 9000$
(ii) Valid votes $= n_o(P) + n_o(Q) = 20500 + 4000 = 24500$
Thus, the required numbers are 9000 and 24500.



12. एउटा स्मार्ट बोर्डको अङ्कित मूल्यमा 20% छुट दिई 15% मूल्य अभिवृद्धि कर लगाएर बेचियो । यदि मूल्य अभिवृद्धि करसहितको मूल्य र छुटपछिको मूल्यबीचको फरक रु. 4500 भए स्मार्ट बोर्डको अङ्कित मूल्य पत्ता लगाउनुहोस् ।

After allowing 20% discount on the marked price of a Smart Board, 15% VAT was levied and sold it. If the difference between the selling price with VAT and selling price after discount is Rs 4500, find the marked price of that Smart Board.

⇨ Here, Price with VAT – Price after discount = Rs 4500
Discount rate = 20% and VAT rate = 15%
Let, MP be Rs x then

(i) Price after discount = x – 20% of x = 80% of x $= \frac{80}{100} \times x = \frac{4x}{5}$

(ii) SP with VAT $= \frac{4x}{5} + 15\%$ of $\frac{4x}{5}$

$= 115\%$ of $\frac{4x}{5} = \frac{115}{100} \times \frac{4x}{5} = \frac{23x}{25}$

Now, by the question,
SP with VAT – Price after discount = Rs 4500

or, $\frac{23x}{25} - \frac{4x}{5} = 4500$ or, $x\left(\frac{23}{25} - \frac{4}{5}\right) = 4500$

or, $x \times \frac{3}{25} = 4500$ ∴ $x = 37500$

Thus, the marked price is Rs 37500.

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13. एउटा त्रिभुजाकार जग्गाको किनाराहरू 5 : 6 : 7 को अनुपातमा छन् । यदि यसको परिमिति 3600 मिटर भए, उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।

The sides of a triangular field are in the ratio of 5 : 6 : 7. If its perimeter is 3600 m, find the area of that land.

⇨ Here, Ratio of sides = 5 : 6 : 7 and Perimeter = 3600 m. So, $s = \frac{P}{2} = \frac{3600\text{ m}}{2} = 1800\text{ m}$

Let the sides be 5x m, 6x m and 7x m.

We know that, sum of sides = 3600

or, $5x + 6x + 7x = 3600$

or, $18x = 3600 \quad \therefore \quad x = 200$

So, the sides are, $a = 5x\text{ m} = 5 \times 200\text{ m} = 1000\text{ m}$

$b = 6x\text{ m} = 6 \times 200\text{ m} = 1200\text{ m}$

$c = 7x\text{ m} = 7 \times 200\text{ m} = 1400\text{ m}$

We know that, Area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{1800(1800-1000)(1800-1200)(1800-1400)}$

$= \sqrt{1800 \times 800 \times 600 \times 400} = 587877.54\text{ m}^2.$

Thus, the area of the land is 587877.54 m^2.

14. ल.स. निकाल्नुहोस् (Find the LCM of): $b^4 + b^3 - b^2 - b$, $b^4 - b$ and $6b^2 - 6$

⇨ Here, First Expression $= b^4 + b^3 - b^2 - b$

$= b(b^3 + b^2 - b - 1)$

$= b\{b^2(b+1) - 1(b+1)\}$

$= b(b+1)(b^2-1) = b(b+1)(b+1)(b-1)$

Second Expression $= b^4 - b = b(b^3-1) = b(b-1)(b^2+b+1)$

Third Expression $= 6b^2 - 6 = 6(b^2-1) = 6(b+1)(b-1)$

We have LCM = Common factors × Remaining factors

$= (b-1)(b+1)b(b+1)(b^2+b+1)6$

$= 6b(b+1)(b+1)(b-1)(b^2+b+1)$

$= 6b(b+1)^2(b-1)(b^2+b+1)$

$= 6b(b+1)^2(b^3-1)$

Thus, the LCM is $6b(b+1)^2(b^3-1)$.

15. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 9 छ । यदि सो सङ्ख्याबाट 45 घटाइयो भने अङ्कहरूको स्थान परिवर्तन हुन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।

The sum of the digits in a two digits number is 9. If 45 is subtracted from the number then places of the digits are interchanged. Find the number.

⇨ Here, let, digit of ones place be y and digit of tens place be x then the two digit number = $10x + y$

First condition, $x + y = 9$ ....(i)

Second condition, $10x + y - 45 = 10y + x$

or, $9x - 9y = 45 \quad \therefore \quad x - y = 5$ .....(ii)

Solving equation (i) and (ii) then,

$x + y = 9$

$x - y = 5$

$2x = 14 \quad \therefore \quad x = 7$

Putting $x = 7$ in equation (i) then,

$x + y = 9$ or, $7 + y = 9 \quad \therefore \quad y = 2$

Now, the two digit number = $10x + y = 10 \times 7 + 2 = 72$

Thus, the required two digit number is 72.

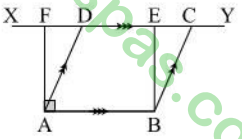
16. एउटै आधार AB र उही समानान्तर रेखाहरु AB र XY बीचमा बनेको समानान्तर चतुर्भुज ABCD र आयत ABEF को क्षेत्रफल बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।

Prove that the areas of parallelogram ABCD and rectangle ABEF standing on the same base AB and between the same parallel lines AB and XY are equal.

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⇨ Here, **Given:** Parallelogram ABCD and rectangle ABEF are on the same base and between the same parallels.
To Prove: Ar.(Parallelogram ABCD) = Ar. (Rectangle ABEF)

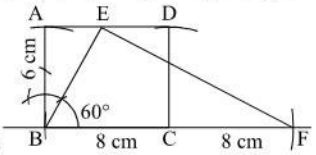


Proof:

Statements	Reasons
1. Ar. (Parm. ABCD) = AB × EB	1. Area of parm. = base × height
2. Ar. (Rect. ABEF) = AB × EB	2. Area of Rectangle = $\ell \times b$
3. Ar. (Parm. ABCD) = Ar. (Rect. ABEF)	3. From (1) and (2).

Proved.

17. लम्बाइ 8 से.मि. र चौडाइ 6 से.मि. भएको आयतको क्षेत्रफलसँग बराबर हुने गरी एउटा कोण 60° भएको त्रिभुजको रचना गर्नुहोस् ।
Construct a rectangle having 8 cm length and 6 cm breadth. Also construct a triangle having one angle 60° and equal in the area of the rectangle.



⇨ Here, ΔEBF is the required triangle whose area is equal to the area of given rectangle ABCD.

18. चक्रीय चतुर्भुज PQRS का सम्मुख कोणहरूबीचको सम्बन्ध प्रयोगद्वारा खोजी गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Explore experimentally the relationship between opposite angles of a cyclic quadrilateral PQRS. (Two circles having radii at least 3 cm are necessary.)

⇨ Here, experimental verification:
(i) Two circles of different radii are drawn.
(ii) PQRS is the cyclic quadrilateral.
(iii) The angle ∠P, ∠Q, ∠R and ∠S are measured and are tabulated as below.

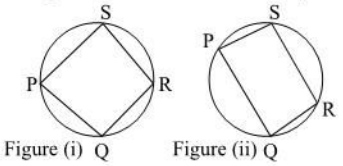


Fig	∠P	∠Q	∠R	∠S	∠P + ∠R	∠Q + ∠S	Remarks
(i)	100°	110°	80°	70°	100° + 80° = 180°	110° + 70° = 180°	∠P + ∠R = 180° and ∠Q + ∠S = 180°
(ii)	80°	70°	100°	110°	80° + 100° = 180°	70° + 110° = 180°	∠P + ∠R = 180° and ∠Q + ∠S = 180°

Conclusion: From the above table, it is concluded that the opposite angles of a cyclic quadrilateral are supplementary.

19. एउटा वृत्ताकार पोखरीको व्यास 104 मिटर र यसको बीचमा एउटा खम्बा गाडिएको छ । एउटा अवलोकनकर्ताले पोखरीको किनारको कुनै बिन्दुबाट खम्बाको टुप्पोमा हेर्दा θ° को उन्नतांश कोण पायो । यदि पोखरीको गहिराइ 3 मिटर र खम्बाको उचाइ 55 मिटर भए θ° को मान पत्ता लगाउनुहोस् ।
The diameter of a circular pond is 104 m and a pillar is fixed at the centre of the pond. An observer found that the angle of elevation θ° at the top of the pillar from any point of the bank of the pond. If the depth of the pond is 3 m and height of the pillar is 55 m, then find the value of θ°.

⇨ Here, let BC = 104 m be the diameter of the pond.

So, $OB = \frac{BC}{2} = \frac{104\text{ m}}{2} = 52\text{ m}$

Let AO = 55 m – 3 m = 52 m be the height of the pillar above the water level.

∠ABO = θ be an angle of the elevation.

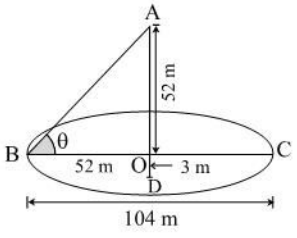
From the right angled ΔAOB,

$\tan\theta = \frac{p}{b} = \frac{AO}{OB} = \frac{52\text{ m}}{52\text{ m}} = 1$

or, $\tan\theta = \tan 45°$

$\therefore\ \theta = 45°$

Thus, the required value of θ is 45°.



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20. तल दिइएको आँकडाको तेस्रो चतुर्थांश (Q_3) = 128 भए m को मान पत्ता लगाउनुहोस् ।
Find the value of m if third quartile (Q_3) of the data given below is 128.

आय रु. (Income Rs)	0 - 30	30 - 60	60 - 90	90 - 120	120 - 150	150 - 180
कामदार सङ्ख्या (No. of Labours)	2	8	22	24	m	9

⇨ Here, calculation of missing frequency :

Wages	No. of workers	cf
0 - 30	2	2
30 - 60	8	10
60 - 90	22	32
90 - 120	24	56
120 - 150	m	56 + m
150 - 180	9	65 + m
	N = 65 + m	

Given Q_3 is 128 so the Q_3 class = 120 - 150
We know that,

$$Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right)$$

or, $8 = \frac{30}{m}\left(\frac{195 + 3m - 224}{4}\right)$

or, $16m = 15\,(3m - 29)$

or, $435 = 29m$

or, $128 = 120 + \frac{30}{m}\left(\frac{3(65+m)}{4} - 56\right)$

or, $8 = \frac{30}{m}\left(\frac{3m - 29}{4}\right)$

or, $16m = 45m - 435$

$\therefore \quad m = 15$

Thus, the value of m is 15.

समूह 'घ' (Group 'D') **4 × 5 = 20**

21. एउटा बैङ्कले खाता X मा 8% प्रतिवर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता Y मा 12% प्रतिवर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ । यदि तपाईं 2 वर्षका लागि रु. 120,000 सो बैङ्कमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? गणना गरी कारणसहित उल्लेख गर्नुहोस् ।
A bank has fixed the rate of interest 8% p.a. semi-annually compound interest in account X and 12% p.a. annually compound interest in account Y. If you are going to deposit Rs 120,000 for 2 years in the same bank, in which account will you deposit and why? Give your reason with calculation.

⇨ Here,

Account X	Account Y
Rate of interest = 8%	Rate of interest = 12%
Time = 2 years	Time = 2 years
Principal = Rs 120000	Principal = Rs 120000
Semi-annually	Annually

We have, Semi-annualy CI $= P\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right]$

$= 120000\left[\left(1 + \frac{8}{200}\right)^{4} - 1\right]$

$= 120000 \times 0.16985856$

$= \text{Rs } 20383.03$

Again, Annual CI $= P\left[\left(1 + \frac{R}{100}\right)^{T} - 1\right]$

$= 120000\left[\left(1 + \frac{12}{100}\right)^{2} - 1\right]$

$= 120000 \times 0.2544$

$= \text{Rs } 30528$

Now, Anual CI – Semi-annual CI = Rs 30528 – Rs 20383.03 = Rs 10144.97
Thus, I will deposit in account Y because it gives me Rs 10144.97 more interest.

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22. एउटा पानी ट्याङ्कीको बेलनाकार र अर्धगोलाकार भाग मिली बनेको छ । सो ट्याङ्कीको पूरा उचाइ 17 मि. छ र आधारको क्षेत्रफल 154 वर्ग मि. छ । उक्त ट्याङ्कीमा प्रतिलिटर 10 पैसाका दरले पानी भर्न जम्मा कति खर्च लाग्ला ? पत्ता लगाउनुहोस् ।
A water tank is made up with the combination of cylinder and hemisphere. The total height of the tank is 17 m and its base area is 154 sq. m. Find the total cost to fill the tank with water at the rate of 10 paisa per litre.

⇨ Here, Base area (BA) = 154 m^2 and total height (H) = 17 m

We know that, Base area = πr^2 or, $154 = \frac{22}{7} \times r^2$

or, $r^2 = \frac{154 \times 7}{22} = 49$ or, $r^2 = 7^2$

So, height of the cylindrical part (h) = 17 m – 7 m = 10 m

We have, Total volume = V(Cylinder) + V(Hemisphere)

$$= BA \times h + \frac{2}{3}\pi r^3$$

$$= 154 \times 10 + \frac{2}{3} \times \frac{22}{7} \times 7^3$$

$$= 1540 + \frac{2156}{3} = \frac{6776}{3}\ m^3 = \frac{6776}{3} \times 1000\ell \qquad [\because\ 1m^3 = 1000\ell]$$

$$= 2258666.667\ell$$

Now, the total cost = Rate × Capacity
= 10 paisa × 2258666.667
= Rs 0.1 × 2258666.667
= Rs 225866.67

Thus, the required cost is Rs 225866.67.

23. सरल गर्नुहोस् (Simplify): $\dfrac{\left(x^2-\frac{1}{y^2}\right)^x\left(x-\frac{1}{y}\right)^{y-x}}{\left(y^2-\frac{1}{x^2}\right)^y\left(y+\frac{1}{x}\right)^{x-y}}$

⇨ Here, $\dfrac{\left(x^2-\frac{1}{y^2}\right)^x\left(x-\frac{1}{y}\right)^{y-x}}{\left(y^2-\frac{1}{x^2}\right)^y\left(y+\frac{1}{x}\right)^{x-y}}$

$$= \frac{\left(x+\frac{1}{y}\right)^x\left(x-\frac{1}{y}\right)^x\left(x-\frac{1}{y}\right)^{y-x}}{\left(y+\frac{1}{x}\right)^y\left(y-\frac{1}{x}\right)^y\left(y+\frac{1}{x}\right)^{x-y}}$$

$$= \frac{\left(x+\frac{1}{y}\right)^x\left(x-\frac{1}{y}\right)^y}{\left(y+\frac{1}{x}\right)^x\left(y-\frac{1}{x}\right)^y}$$

$$= \frac{\left(\frac{xy+1}{y}\right)^x\left(\frac{xy-1}{y}\right)^y}{\left(\frac{xy+1}{x}\right)^x\left(\frac{xy-1}{x}\right)^y}$$

$$= \left(\frac{\frac{xy+1}{y}}{\frac{xy+1}{x}}\right)^x\left(\frac{\frac{xy-1}{y}}{\frac{xy-1}{x}}\right)^y$$

$$= \left(\frac{x}{y}\right)^x\left(\frac{x}{y}\right)^y = \left(\frac{x}{y}\right)^{x+y}$$

24. SONG एउटा चक्रीय चतुर्भुज हो । यदि ∠SGN र ∠SON का अर्धकहरूले वृत्तलाई क्रमशः बिन्दुहरू A र T मा भेट्छन् भने AT वृत्तको व्यास हो भनी प्रमाणित गर्नुहोस् ।
SONG is a cyclic quadrilateral. If the bisectors of ∠SGN and ∠SON meet the circle at the points A and T respectively, then prove that AT is the diameter of the circle.



⇨ Here, **Given:** SONG is a cyclic quadrilateral.
To prove: AT is the diameter of circle.
Proof:

Statements	Reasons
1. $\overset{\frown}{NOA} = \overset{\frown}{AS}$	1. Opposite arcs of equal angles.
2. $\overset{\frown}{TGN} = \overset{\frown}{TS}$	2. Same as reason (1).
3. $\overset{\frown}{NOA} + \overset{\frown}{TGN} = \overset{\frown}{AS} + \overset{\frown}{TS}$	3. Addition axiom in (1) and (2).
4. $\overset{\frown}{TGNOA} = \overset{\frown}{TSA}$	4. Whole part axiom in (3).
5. AT is a diameter.	5. From (4), arcs on both sides of AT are equal.

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7. SEE EXAMINATIONS 2074 SET 4 [EDR] RE-109'AC'

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) यदि कुनै सामानको विक्रय मूल्य रु. x र मूल्य अभिवृद्धि कर रकम रु. y छ भने मूल्य अभिवृद्धि करको दर कति हुन्छ ? लेख्नुहोस् ।
If the selling price of an article is Rs x and the value added tax amount is Rs y, what is the rate of value added tax? Write it.

⇨ Here, the rate of value added tax $= \frac{y}{x} \times 100\%$

(b) आधार भुजा k cm र छड्के उचाइ ℓ cm भएको वर्ग आधार पिरामिडको पूरा सतहको क्षेत्रफल कति हुन्छ ? लेख्नुहोस् ।
What is the total surface area of a square based pyramid having base side k cm and slant height ℓ cm. Write it.

⇨ Here, the total surface area of a square based pyramid $= (k^2 + 2k\ell)$ sq. cm.

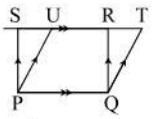
2. (a) $\sqrt[m]{y}$ मा सर्डको क्रम कति हुन्छ ? लेख्नुहोस् । **(Write down the order of surd in $\sqrt[m]{y}$.)**

⇨ Here, Order of surd in $\sqrt[m]{y}$ is m.

(b) एउटा वर्गीकृत तथ्याङ्ककको मध्यिका निकाल्ने सूत्र $Md = L + \frac{\frac{N}{2} - c.f.}{f} \times h$ मा c.f. ले के जनाउँछ ?
What does c.f. denote in the formula $Md = L + \frac{\frac{N}{2} - c.f.}{f} \times h$ for the calculation of median in a grouped data?

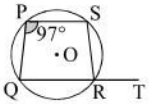
⇨ Here, c.f. denotes the cumulative frequency of preceeding class interval.

3. (a) दिइएको चित्रमा PQ // ST, PU // QT र PS // QR छन् । यदि ∠PSR = 90° छ भने आयत PQRS र समानान्तर चतुर्भुज PQTU को क्षेत्रफलबीच के सम्बन्ध छ ? लेख्नुहोस् ।
In the given figure, PQ // ST, PU // QT and PS // QR. If ∠PSR = 90°, what is the relation between the areas of rectangle PQRS and the parallelogram PQTU? Write it.



⇨ Here, Ar. (▱PQRS) = Ar. (▱PQTU) is the required relation.

(b) दिइएको चित्रमा ∠SPQ = 97° भए ∠SRT को मान कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the given figure, ∠SPQ = 97°, what is the value of ∠SRT? Find it.



⇨ Here, ∠SRT = ∠SPQ = 97° (exterior angle of a cyclic quadrilateral is equal to opposite interior angle).

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) अमेरिकामा उच्चशिक्षा अध्ययन गर्न जानको लागि सोहनलाई $3500 चाहिएको छ । यदि $1 = ने.रु. 105 र बैंकले सो को 2% कमिसन लिने गर्दछ भने सोहनलाई कति नेपाली रुपैयाँ आवश्यक पर्दछ ? पत्ता लगाउनुहोस् ।
Sohan needs $3500 for the higher study in America. If $1 = NRs 105 and the bank charges 2% as commission, how much Nepali rupees does Sohan require? Find it.

⇨ Here, $ 3500 = Rs 105 × 3500 = Rs 367500.
Now, Price with 2% commission = 2% of Rs 367500 + Rs 367500 = Rs 7350 + Rs 367500
= Rs 374850.
Thus, Sohan requires Rs 374850.

(b) एउटा सहरको वर्तमान जनसङ्ख्या 50,000 छ । यदि जनसङ्ख्या वर्षेनि 10% ले बढ्दै जान्छ भने कति वर्षपछि त्यो सहरको जनसङ्ख्या 66,550 होला ? पत्ता लगाउनुहोस् ।
The present population of a town is 50,000. If the population increases by 10% every year, after how many years the population of the town will be 66,550? Find it.

⇨ Here, Present population (P) = 50,000 Rate (R) = 10%
Population after time (T) years (P_T) = 66,550 Time (T) = ?

We know that, $(P_T) = P\left(1 + \frac{R}{100}\right)^T$

or, $66550 = 50000\left(1 + \frac{10}{100}\right)^T$ or, $\frac{66550}{5000} = (1.1)^T$

or, $1.331 = (1.1)^T$ or, $(1.1)^3 = (1.1)^T$ ∴ T = 3 Years

Thus, after 3 years the population of the town will be 66,550.

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5. (a) एउटा बेलनाकार ट्याङ्कीमा 498.96 लिटर पानी अटाउँछ । यदि यसको उचाइ 0.9 मिटर भए आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
A cylindrical tank contains 498.96 litres of water. If its height is 0.9 m then find the radius of the base.

⇨ Here, Volume (V) = 498.96 liters = $498.96 \times 1000\ cm^3 = 498960\ cm^3$
Height (H) = 0.9 m = $0.9 \times 100 = 90$ cm
Radius (R) = ?
We know that, Volume (V) = $\pi r^2 h$

or, $498960 = \frac{22}{7} \times r^2 \times 90$ or, $\frac{498960 \times 7}{22 \times 90} = r^2$

or, $r^2 = 1764$ ∴ $r = 42$ cm

Thus, required radius of base is 42 cm.

(b) यदि एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 7392 वर्ग से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the total surface area of a hemi-sphere is 7392 square cm then find its radius.

⇨ Here, total surface area of a hemisphere (TSA) = $7392\ cm^2$
Radius (r) = ?
We know that,

or, $(T.S.A) = 3\pi r^2$ or, $3\pi r^2 = 7392$

or, $3 \times \frac{22}{7} \times r^2 = 7392$ or, $r^2 = 784$ ∴ $r = 28$ cm

Thus, the required radius of hemisphere is 28 cm.

(c) यदि एउटा सोलीको उचाइ आधारको अर्धव्यासको तीन गुणा र यसको आयतन 729 π घन से.मि. भए सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
If the height of a cone is three times the radius of the base and its volume of 729π cubic cm then find the radius of the base of the cone.

⇨ Here, Volume of cone (v) = $729\pi\ cm^3$
Height (h) = 3 × radius (r) i.e. $h = 3r$
We know that, Volume (v) = $\frac{1}{3}\pi r^2 h = 729\pi\ cm^3$

or, $\frac{1}{3} r^2 h = 729$ or, $\frac{1}{3} r^2 \times (3r) = 729$

or, $r^3 = 729$ ∴ $r = 9$ cm

Thus, radius of the base of the cone is 9 cm.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^2 + x + 1$ and $x^7 - x^4$

⇨ Here, First expression = $x^2 + x + 1$
Second expression = $x^7 - x^4 = x^4(x^3 - 1) = x^4(x - 1)(x^2 + x + 1)$
∴ HCF = $x^2 + x + 1$

(b) सरल गर्नुहोस् (Simplify): $4\sqrt[3]{192} - 4\sqrt[3]{375} + 2\sqrt[3]{24}$

⇨ Here, $4\sqrt[3]{192} - 4\sqrt[3]{375} + 2\sqrt[3]{24}$

$= 4\sqrt[3]{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3} - 4\sqrt[3]{5 \times 5 \times 5 \times 3} + 2\sqrt[3]{2 \times 2 \times 2 \times 3}$

$= 4 \times 4\sqrt[3]{3} - 4 \times 5\sqrt[3]{3} + 2 \times 2\sqrt[3]{3} = 16\sqrt[3]{3} - 20\sqrt[3]{3} + 4\sqrt[3]{3} = 0$

7. (a) यदि $x = 10^a$, $y = 10^b$ र $x^b.y^a = 100$ भए प्रमाणित गर्नुहोस्: $ab = 1$
If $x = 10^a$, $y = 10^b$ and $x^b.y^a = 100$ then prove that: $ab = 1$.

⇨ Here, $x = 10^a$, $y = 10^b$, and $x^b.y^a = 100$.
Now,

$x^b.y^a = 100$ or, $10^{ab}.10^{ab} = 100$

or, $100^{ab} = 100$ ∴ $ab = 1$ **Proved.**

(b) सरल गर्नुहोस् (Simpilfy): $\frac{1}{c-d} - \frac{c+d}{c^2-d^2}$

⇨ Here, $\frac{1}{c-d} - \frac{c+d}{c^2-d^2} = \frac{1}{c-d} - \frac{c+d}{(c+d)(c-d)} = \frac{c+d-c-d}{(c+d)(c-d)} = 0$

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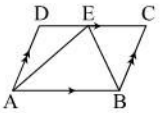
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(c) सरल गर्नुहोस् (Simpilfy): $\frac{x^2+xy+y^2}{x+y}+\frac{x^2-xy+y^2}{x-y}$

⇨ Here, $\frac{x^2+xy+y^2}{(x+y)}+\frac{x^2-xy+y^2}{(x-y)} = \frac{(x-y)(x^2+xy+y^2)+(x+y)(x^2-xy+y^2)}{(x+y)(x-y)}$

$= \frac{x^3-y^3+x^3+y^3}{x^2-y^2} = \frac{2x^3}{x^2-y^2}$

8. (a) सँगैको चित्रमा DC को मध्यबिन्दु E हो । यदि समानान्तर चतुर्भुज ABCD को क्षेत्रफल 52 वर्ग से.मि. भए चतुर्भुज ABCE को क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure, E is the mid-point of DC. If the area of the parallelogram ABCD is 52 square cm, find the area of the quadrilateral ABCE.



⇨ Here, Ar. $(\Delta AEB) = \frac{1}{2} \times$ (Ar. parallelogram ABCD) $= \frac{1}{2} \times 52 = 26\ cm^2$

Also, Ar. $(\Delta BEC) = \frac{1}{2} \times$ Ar. $(\Delta AEB) = \frac{1}{2} \times 26 = 13\ cm^2$

Now, Area of quadrilateral ABCE = Ar. (ΔABE) + Ar. $(\Delta BEC) = 26 + 13 = 39\ cm^2$.

(b) चित्रमा O वृत्तको केन्द्रबिन्दु र MN // KL छ । यदि ∠NML = 40° भए, ∠KOM को मान पत्ता लगाउनुहोस् ।
In the figure, O is the centre of circle and MN // KL. If ∠NML = 40°, find the value of ∠KOM



⇨ Here, ∠NML = 40° = ∠KLM (∵ alternate angles)

Now, ∠KOM = 2 × ∠KLM (∵ angle at centre of a circle is double of the circumference angle standing on the same arc).

= 2 × 40°

= 80°

∴ ∠KOM = 80°.

(c) चित्रमा, L वृत्तको केन्द्र, MN व्यास र M स्पर्शबिन्दु छ । यदि ∠MCL = 55° भए ∠CLN को मान पत्ता लगाउनुहोस् ।
In the figure, L is centre of circle, NM is diameter and M is the point of contact. If ∠MCL = 55° then find the value of ∠CLN.



⇨ Here, CMN = 90° (Tangent at any point of a circle is perendicular to the radius drawn to the point of contact).

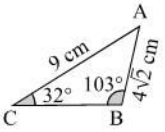
Now, ∠CLM = 180° − 55° − 90° = 35°

∴ ∠CLN = 180° − ∠CLM (∵ ∠CLM and ∠CLN are adjacent angles)

= 180° − 35° = 145°

Thus, ∠CLN = 145°

9. (a) दिइएको त्रिभुज ABC मा ∠ABC = 103° र ∠ACB = 32° छन् । यदि AB = $4\sqrt{2}$ से.मि. र AC = 9 से.मि. भए त्रिभुज ABC को क्षेत्रफल निकाल्नुहोस् ।
In the given triangle ABC, ∠ABC = 103° and ∠ACB = 32°. If AB = $4\sqrt{2}$ cm and AC = 9 cm, find the area of ΔABC.



⇨ Here, ∠A = 180 − 32° − 103° = 45°

We know that, Ar. $(\Delta ABC) = \frac{1}{2} \times AB \times AC \times \sin A = \frac{1}{2} \times 9 \times 4\sqrt{2} \times \sin 45° = \frac{1}{2} \times 36\sqrt{2} \times \frac{1}{\sqrt{2}} = 18\ cm^2$.

Thus, the area of ΔABC is $18\ cm^2$.

(b) एउटा निरन्तर श्रेणीमा मध्यिका पर्ने वर्गान्तर 10 - 15 छ र यसको अघिल्लो वर्गान्तरसम्मको सञ्चित बारम्बारता 28 छ । यदि मध्यिका पर्ने वर्गान्तरको बारम्बारता 15 र उक्त श्रेणीको बारम्बारताको योग 65 भए, मध्यिका निकाल्नुहोस् ।
In a continuous series, median lies in the class interval 10-15 and the cumulative frequency of its preceeding class is 28. If the frequency of median class is 15 and the sum of the frequencies of the series is 65, find the median.

⇨ Here, Medium class = 10 − 15, Cumulative frequency (c.f) = 28,
frequency (f) = 15 and sum of frequencies $\sum f = N = 65$

We know that, median $(Md) = L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 10 + \frac{5}{15}\left(\frac{65}{2} - 28\right) = 10 + \frac{1}{3} \times 4.5 = 11.5$

Thus, median is 11.5.

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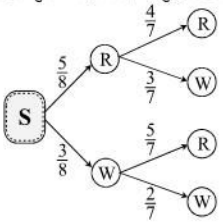
10. (a) रामरी फिटिएको 52 ओटा तासको गड्डीबाट एउटा तास झिकियो । उक्त तासबाट एक्का अथवा राजा पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।
A card is drawn from well-shuffled pack of 52 playing cards. What is the probability that it is either an ace or a king? Find it.

⇨ Here, Probability of an ace, $P(A) = \frac{4}{52}$ Probability of a king, $P(K) = \frac{4}{52}$

Now, probability that the drawn card is either an ace or a king, $P(A \text{ or } K) = P(A) + P(K)$

$= \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13}$

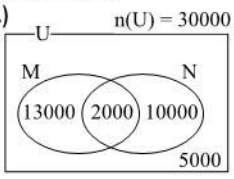
(b) एउटा झोलामा उस्तै र उत्रै 5 ओटा राता र 3 ओटा सेता बलहरू छन् । एकपछि अर्को गरी पुनः नराखीकन दुईओटा बलहरू झिकियो । सम्भावित परिणामहरूलाई एउटा वृक्षचित्रमा प्रस्तुत गर्नुहोस् ।
There are 5 red and 3 white balls of same shape and size in a bag. Two balls are drawn from the bag one after another without replacement. Show all the possible outcomes in a tree diagram.



⇨ Here, let R and W denote the set of red and white balls.
So, n(R) = 5 and n(W) = 3
Now the tree diagram of possible outcomes are shown in the figure alongside.

समूह 'ग' (Group' C') **[10 × 4 = 40]**

11. एउटा नगरपालिकाको चुनावमा M र N दुई उम्मेदवारहरू मेयर पदका लागि उठेछन् र त्यहाँ मतदाताको सूचीमा 30,000 जना रहेछन् । मतदाताले एक जनालाई मात्रै मत खसाल्नुपर्ने थियो । 15,000 जनाले M लाई, त्यस्तै 12,000 जनाले N लाई र 2,000 जनाले दुवैलाई पनि मत दिएछन् ।
In an election of a municipality two candidates M and N stood for the post of Mayor and 30,000 people were in the voter list. Voters were supposed to cast the vote for a single candidate. 15,000 people cast vote for M, 12,000 people cast for N and 2,000 people cast vote even for both.
(i) यी जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show these information in a Venn-diagram.)
(ii) कति जनाले मत खसालेनन् ? पत्ता लगाउनुहोस् । (How many people didn't cast vote? Find it.)
(iii) कति मत सदर भयो ? पत्ता लगाउनुहोस् । (How many votes were valid? Find it.)



⇨ Here, let M and N be the set of votes given for two candidates M and N respectively.
According to the question,
$n(U) = 30000$, $n(M) = 15000$, $n(N) = 12000$, $n(M \cap N) = 2000$
We know that,
$n(M \cup N) = n(M) + n(N) - (M \cap N) = 15000 + 12000 - 2000 = 25000$
Now, $n(\overline{M \cup N}) = n(U) - n(M \cup N) = 30000 - 25000 = 5000$
Number of valid votes $= n_0(M) + n_0(N) = 13000 + 10000 = 23000$
Thus, 5000 people didn't cast vote and 23000 votes were valid votes because the votes given to both the candidates were not valid votes.

12. एउटा साइकलको अङ्कित मूल्यमा 10% छुट दिई 13% मूल्य अभिवृद्धि कर लगाएर बेचियो । यदि मूल्य अभिवृद्धि करसहितको मूल्य र छुटपछिको मूल्यबीचको फरक रु. 585 भए साइकलको अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After allowing 10% discount on the marked price of a Cycle, 13% VAT was levied and sold it. If the difference between the selling price with VAT and selling price after discount is Rs 585, find the marked price of that Cycle.

⇨ Here, Discount rate = 10% and value, added tax = 13%
Let, M.P. of a cycle be Rs x.

SP after discount $= x - 10\% \text{ of } x = \frac{90x}{100} = 0.9x$

SP including VAT $= 0.9x + 13\% \text{ of } 0.9x = 0.9x + \frac{13}{100} \times 0.9x = 1.017x$

According to the question,
SP including VAT – SP after discount = Rs 585
or, $1.017x - 0.9x = 585$
or, $0.117x = 585$
$\therefore \quad x = \frac{585}{0.117} = 5000$

Thus, required marked price of the cycle is Rs 5000.

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13. एउटा त्रिभुजाकार जग्गाका भुजाहरू 2 : 3 : 4 को अनुपातमा छन् । यदि यसको परिमिति 900 मिटर भए, उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।

The sides of a triangular field are in the ratio of 2 : 3 : 4. If its perimeter is 900 m, what is the area of that field? Find it.

⇨ Here, Perimeter of a triangular field (P) = 900 m.
Let, the sides of triangular field be 2x, 3x, and 4x.
Then, $P = 2x + 3x + 4x$
or, $9x = 900$
$\therefore \quad x = 100$ m.
Thus, the sides are; $a = 2x = 2 \times 100$ m $= 200$ m
$b = 3x = 3 \times 100$ m $= 300$ m
$c = 4x = 4 \times 100$ m $= 400$ m
Now, semi-perimeter $(S) = \frac{a+b+c}{2} = \frac{200+300+400}{2} = 450$ m

We know that,
Area of triangular field, $(A) = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{450(450-200)(450-300)(450-400)}$
$= \sqrt{450 \times 250 \times 150 \times 50} = 29047.38$ m^2.
Thus, the required area of triangular field is 29047.38 m^2.

14. ल.स. निकाल्नुहोस् **(Find the LCM of): $a^4 + a^3 - a^2 - a$, $a^4 - a$ and $5a^2 - 5$**

⇨ Here,
First Expression $= a^4 + a^3 - a^2 - a = a^3(a+1) - a(a+1) = (a^3 - a)(a+1) = a(a^2-1)(a+1)$
$= a(a+1)(a-1)(a+1)$
Second Expression $= a^4 - a = a(a^3 - 1) = a(a-1)(a^2 + a + 1)$
Third Expression $= 5a^2 - 5 = 5(a^2 - 1) = 5(a+1)(a-1)$
Thus, LCM $= 5a(a+1)^2(a-1)(a^2 + a + 1)$

15. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 5 छ । यदि सो सङ्ख्याबाट 27 घटाइयो भने अङ्कहरूको स्थान परिवर्तन हुन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।

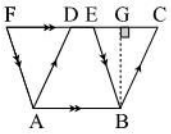
The sum of the digits in a two digits number is 5. If 27 is subtracted from the number then places of the digits are interchanged. Find the number.

⇨ Here, let, digit of one's place = x
Digit of ten's place = y
$\therefore$ Required number $= 10y + x$
According to the question,
$x + y = 5$ ... ...(i) and $10y + x - 27 = 10x + y$ ... ...(ii)
Putting $x = 5 - y$ from equation (i) in (ii), we get,
$10y + 5 - y - 27 = 10(5 - y) + y$ or, $9y - 22 = 50 - 9y$
or, $18y = 72$ $\therefore \quad y = \frac{72}{18} = 4$
Substituting y in (i), we get, $x = 5 - 4 = 1$.
Thus, required number is $10y + x = 10 \times 4 + 1 = 41$.

16. एउटै आधार AB र उही समानान्तर AB र FC को बीच बनेका समानान्तर चतुर्भुजहरू ABCD र ABEF को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

Prove that the parallelograms ABCD and ABEF standing on the same base AB and between the same parallels AB and FC are equal in area.

⇨ Here, Given: Parallelograms ABCD and ABEF are standing on the same base AB and between the same parallels AB and FC as shown in figure.



To Prove: Ar.(□ABCD) = Ar. (□ABEF)
Construction: Draw BG ⊥ AB.
Proof:

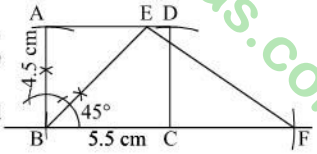
Statements	Reasons
1. Ar. (□ABCD) = AB × BG	1. Area of // gm = b × h.
2. Ar. (□ABEF) = AB × BG	2. Same as reason (1).
3. Ar. (□ABCD) = Ar. (□ABEF)	3. From (1) and (2).

Proved.

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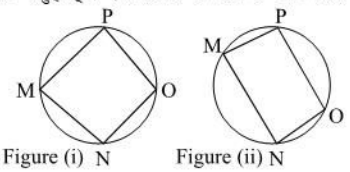
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17. लम्बाइ 5.5 से.मि. र चौडाइ 4.5 से.मि. भएको आयत ABCD को क्षेत्रफलसँग बराबर हुने गरी एउटा कोण 45° भएको त्रिभुज EBF को रचना गर्नुहोस् ।
Construct a rectangle ABCD with length 5.5 cm and breadth 4.5 cm. Also construct a triangle EBF having one angle 45° and equal to the area of the rectangle.



⇨ Here, ABCD is the given rectangle and ΔEBF is the required triangle whose area is equal to the area of rectangle ABCD.

18. चक्रीय चतुर्भुज MNOP का सम्मुख कोणहरूबिचको सम्बन्ध प्रयोगद्वारा खोजी गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Explore experimentally the relationship between opposite angles of a cyclic quadrilateral MNOP. (Two circles having radii at least 3 cm are necessary.)



⇨ Here, Experimental verification:
(i) Two cricles of different radii with centre O' are drawn.
(ii) MNOP are the cyclic quadrilaterals.
(iii) The angles ∠M, ∠N, ∠O, ∠P are measured and are tabulated as below.

Fig	∠M	∠N	∠O	∠P	∠M + ∠O	∠N + ∠P	Remarks
(i)	70°	100°	110°	80°	70° + 110° = 180°	100° + 80° = 180°	∠P + ∠N = 180° and ∠M + ∠O = 180°
(ii)	130°	115°	50°	65°	130° + 50° = 180°	115° + 65° = 180°	∠P + ∠N=180° and ∠M + ∠O = 180^0

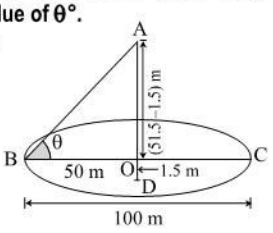
From the above table, it is concluded that the sum of opposite angles of a cyclic quadrilateral is 180°.

19. एउटा वृत्ताकार पोखरीको व्यास 100 मिटर छ र यसको बीचमा एउटा खम्बा गाडिएको छ । एउटा व्यक्तिले पोखरीको किनाराबाट खम्बाको टुप्पोको उन्नतांश कोण θ° पाएछ । यदि पोखरीको गहिराइ 1.5 मिटर र खम्बाको जम्मा उचाइ 51.5 मिटर भए θ° को मान पत्ता लगाउनुहोस् ।
The diameter of a circular pond is 100 meter and a pillar is fixed at the centre of the pond. A person finds the angle of elevation of the top of the pillar is θ° from the bank of the pond. If the depth of the pond is 1.5 meter and total height of the pillar is 51.5 meter then find the value of θ°.

⇨ Here, let, COB = 100 m be the diameter of a circular pond and θ is the angle of elevation. Then radius OB = 50 m
Let OA = 51.5 – 1.5 = 50 m be the height of pillar above the water level.
In right angled ΔAOB,

$$\tan\theta = \frac{OA}{OB} = \frac{50}{50} = 1 \quad \text{or, } \tan\theta = \tan 45° \quad \therefore \ \theta = 45°$$

Thus, required angle of elevation (θ) is 45°.



20. तल दिइएको आँकडाको तेस्रो चतुर्थांश (Q_3) = 35 भए m को मान पत्ता लगाउनुहोस् ।
Find the value of m if third quartile (Q_3) of the data given below is

Marks Obtained	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
No. of Students	3	7	15	m	5

⇨ Here, calculation table for third quartile (Q_3) is as below.

Marks (x)	No. of students (f)	c.f
0 - 10	3	3
10 - 20	7	10
20 - 30	15	25
30 - 40	m	25 + m
40 - 50	5	30 + m

Since Q_3 is 35. So, the corresponding Quartile class is 30 - 40.
∴ f = m, c.f = 25, L = 30, i = 10.
We know that,

$$Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right) \quad \text{or, } 35 = 30 + \frac{10}{m}\left(\frac{3\times(30+m)}{4} - 25\right)$$

$$\text{or, } 35 - 30 = \frac{10}{m}\left(\frac{90 + 3m - 100}{4}\right) \quad \text{or, } 5 = \frac{10}{4m}(3m - 10)$$

or, 20m = 30m – 100
or, 100 = 10m
∴ m = 10
Thus, the required value of m is 10.

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समूह 'घ' (Group 'D') $4 \times 5 = 20$

21. एउटा बैंकले खाता A मा 10% प्रतिवर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता B मा 12% प्रतिवर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ । यदि तपाईं 2 वर्षका लागि रु. 30,000 सो बैंकमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? गणना गरी कारणसहित उल्लेख गर्नुहोस् ।
A bank has fixed the rate of interest 10% p.a. semi-annually compound interest in account A and 12% per annum annually compound interest in account B. If you are going to deposit Rs 30,000 for 2 years in the same bank in which account will you deposit and why? Give your reason with calculation.

⇨ Here,

Account A	Account B
Rate (R) = 10% (semi-annually)	Rate (R) = 12% (annually)
Principal (P) = Rs 30,000	Principal (P) = Rs 30,000
Time(T) = 2 years	Time (T) = 2 years

Now, semi-annual (Half yearly) compound interest is given by:

$$\text{H.Y.C.I} = p\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right] = 30{,}000\left[\left(1+\frac{10}{200}\right)^{2\times 2} - 1\right] = 30{,}000 \times (0.2155) = \text{Rs } 6465.18$$

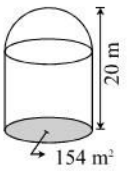
Also, yearly compound interest is given by:

$$\text{Y.C.I} = P\left[\left(1+\frac{R}{100}\right)^{T} - 1\right] = 30{,}000\left[\left(1+\frac{12}{100}\right)^{2} - 1\right] = 30{,}000 \times (0.2544) = \text{Rs } 7632$$

Now, Y.C.I – H.Y.C.I = Rs 7632 – Rs 6465.18 = Rs 1166.82
Since, the yearly compound interest given by the bank in account B is greater than the half yearly compound interest in account A by Rs 1166.82. So, I will deposit in account B.

22. एउटा पानी ट्याङ्की बेलनाकार र अर्धगोलाकार भाग मिलेर बनेको छ । सो ट्याङ्कीको पूरा उचाइ 20 m छ र आधारको क्षेत्रफल 154 m^2 छ । उक्त ट्याङ्कीमा प्रतिलिटर 45 पैसाका दरले पानी भर्न जम्मा कति खर्च लाग्ला ? पत्ता लगाउनुहोस् ।
A water tank is formed with the combination of cylinder and hemisphere. The total height of the tank is 20 m and base area is 154 m^2. If the tank is filled with water at the rate of 45 paisa per litre, what is the total cost to fill the water? Find it.

⇨ Here, base area of tank is 154 m^2



i.e. $\pi r^2 = 154$ or, $\frac{22}{7} r^2 = 154$

or, $r^2 = 49$ or, $r = 7$ m

i.e. radius of tank (r) = 7 m

Then, the height of cylindrical part (h) = 20 – 7 = 13 m

We know that, volume of tank $= \text{Area} \times \text{height} + \frac{2}{3}\pi r^3 = 154 \times 13 + \frac{2}{3} \times \frac{22}{7} \times (7)^3$

$= 2002 + 718.67 = 2720.67\ m^3$

So, we have, Volume of water = 2720670 L.
Since the cost to fill one litre is 45 paisa, so the cost to fill 2720670 litre is
2720670 × 45 = Rs 1224301.50 Thus, the required cost is Rs 1224301.50

23. सरल गर्नुहोस् (Simplify): $\dfrac{\left(v^2-\frac{1}{w^2}\right)^v\left(v-\frac{1}{w}\right)^{w-v}}{\left(w^2-\frac{1}{v^2}\right)^w\left(w+\frac{1}{v}\right)^{v-w}}$

⇨ Here, $\dfrac{\left(v^2-\frac{1}{w^2}\right)^v\left(v-\frac{1}{w}\right)^{w-v}}{\left(w^2-\frac{1}{v^2}\right)^w\left(w+\frac{1}{v}\right)^{v-w}} = \dfrac{\left(v-\frac{1}{w}\right)^v\left(v+\frac{1}{w}\right)^v\left(v-\frac{1}{w}\right)^{w-v}}{\left(w+\frac{1}{v}\right)^w\left(w-\frac{1}{v}\right)^w\left(w+\frac{1}{v}\right)^{v-w}} = \dfrac{\left(v-\frac{1}{w}\right)^w\left(v+\frac{1}{w}\right)^v}{\left(w+\frac{1}{v}\right)^v\left(w-\frac{1}{v}\right)^w}$

$= \left(\dfrac{wv-1}{\frac{w}{wv-1}}\right)^w\left(\dfrac{wv+1}{\frac{w}{wv+1}}\right)^v = \left(\dfrac{v}{w}\right)^w\left(\dfrac{v}{w}\right)^v = \left(\dfrac{v}{w}\right)^{w+v}$

24. PQRS एउटा चक्रीय चतुर्भुज हो । यदि ∠QPS र ∠QRS का अर्धकहरूले वृत्तलाई क्रमशः बिन्दुहरू A र B मा भेट्छन् भने AB वृत्तको व्यास हो भनी प्रमाणित गर्नुहोस् ।
PQRS is a cyclic quadrilateral. If the bisectors of ∠QPS and ∠QRS meet the circle at the points A and B respectively then prove that AB is the diameter of the circle.



⇨ Here, Given: PQRS is a cyclic quadrilateral.
To prove: AB is the diameter of circle.

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Proof:

Statements	Reasons
1. $\overset{\frown}{QRA} = \overset{\frown}{AS}$	1. Opposite arcs of equal angles.
2. $\overset{\frown}{BPQ} = \overset{\frown}{BS}$	2. Same as reason 1.
3. $\overset{\frown}{QRA} + \overset{\frown}{BPQ} = \overset{\frown}{AS} + \overset{\frown}{BS}$	3. Addition axiom in (1) and (2).
4. $\overset{\frown}{BPQRA} = \overset{\frown}{BSA}$	4. Whole part axiom in (3).
5. AB is a diameter.	5. From (4), arcs on both sides of AB are equal.

Proved.

8. SEE EXAMINATIONS 2074 SET 5 [CDR] RE-109'BC'

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

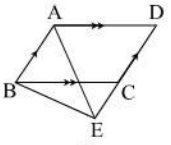
1. (a) यदि कुनै सामानको अङ्कित मूल्य रु. x, छुट रकम रु. y र मूल्य अभिवृद्धि कर रु. z छ भने सो सामानको मूल्य अभिवृद्धि कर सहितको विक्रय मूल्य कति हुन्छ ? पत्ता लगाउनुहोस् ।
If the marked price of an article is Rs x, discount amount is Rs y and the VAT amount is Rs z then what is the selling price of the article including VAT? Find it.
⇨ Here, the selling price of the article including VAT if marked price is Rs x, discount amount is Rs y and VAT amount is Rs z, is x – y + z.

(b) आधार भुजा x cm र छड्के उचाइ y cm भएको वर्ग आधार पिरामिडको पूरा सतहको क्षेत्रफल कति हुन्छ, लेख्नुहोस् ।
Write down the total surface area of a square based pyramid having base side x cm and slant height y cm.
⇨ Here, length of base side is x cm and slant height is y cm.
Thus, the total surface area of a square based pyramid is $(2xy + x^2)$ sq.cm

2. (a) $\sqrt[P]{x}$ मा सर्डको क्रम कति हुन्छ ? लेख्नुहोस् । **(Write down the order of surd in $\sqrt[P]{x}$.)**
⇨ Here, the order of surd in $\sqrt[P]{x}$ is P.

(b) दिइएको सूत्र $Q_1 = L + \frac{\frac{N}{4} - c.f.}{f} \times h$ मा h ले के जनाउँछ ? लेख्नुहोस् ।
What does h denote in the formula $Q_1 = L + \frac{\frac{N}{4} - c.f.}{f} \times h$? Write it.
⇨ Here, h denotes the class interval.

3. (a) दिइएको चित्रमा AB // DE र AD // BC छन् भने ΔABE र ▱ABCD को क्षेत्रफलबीचको सम्बन्ध लेख्नुहोस् ।
In the given figure, AB // DE and AD // BC. Write relation between the areas of ΔABE and ▱ABCD.



⇨ Here, Ar.(ΔABE) = $\frac{1}{2}$ Ar. (▱ABCD) [Both are standing on the same base AB.]

(b) दिइएको वृत्तमा ∠PQR र ∠PSR को के सम्बन्ध छ ? लेख्नुहोस् ।
In the given circle, what is the relation of ∠PQR and ∠PSR? Write it.



⇨ Here, ∠PQR = ∠PSR. [Both are standing on the same arc PR]

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) नेपाल राष्ट्र बैंकको मुद्रा विनिमय दरअनुसार अमेरिकी डलर 1 को खरिद दर र बिक्री दर क्रमशः ने.रु. 103.72 र ने.रु. 104.32 छन् भने,
According to the money exchange rate of Nepal Rastra Bank, the purchasing and selling rates of one American dollar are NRs 103.72 and NRs 104.32 respectively then,
(i) नेपाली रु. 57,376 सित कति अमेरिकी डलर साट्न सकिन्छ ? पत्ता लगाउनुहोस् ।
How many American dollars can be exchanged with NRs 57,376? Find it.
(ii) $500 सित कति नेपाली रुपैयाँ साट्न सकिन्छ ? पत्ता लगाउनुहोस् ।
How much Nepali rupees can be exchanged with $500? Find it.
⇨ (i) Here, one american dollar can be exchanged with NRs 104.32.
So, $\frac{57,376}{104.32}$ = $550 can be exchanged with NRs 57,376.

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⇨ (ii) Here, $ 1 = NRs 103.72
So, $500 = 103.72 × 500 = Rs 51,860
Thus, Rs 51,860 can be exchanged with $500.

(b) वि.सं. 2069 को सुरुमा र वि.सं. 2070 को अन्तमा एउटा गाउँको जनसङ्ख्या क्रमशः 5000 र 5408 थियो भने वार्षिक जनसङ्ख्या वृद्धिदर कति रहेछ ? पत्ता लगाउनुहोस् ।
In the beginning of 2069 B.S. and at the end of 2070 B.S., the pouplation of village was 5000 and 5408 respectively. What is the annual population growth rate? Find it.

⇨ Here, initial population (P) = 5000, population after two years (P_T) = 5408
Population growth rate (R) = ?
We know that,

$P_T = P\left(1 + \frac{R}{100}\right)^T$ or, $5408 = 5000\left(1 + \frac{R}{100}\right)^2$

or, $\frac{5408}{5000} = \left(1 + \frac{R}{100}\right)^2$ or, $1.0816 = \left(1 + \frac{R}{100}\right)^2$

or, $(1.04)^2 = \left(1 + \frac{R}{100}\right)^2$ or, $1.04 - 1 = \frac{R}{100}$

∴ R = 4% Thus, the required growth rate is 4%.

5. (a) एउटा बेलनाकार पानी ट्याङ्कीको क्षमता 539 लिटर छ । यदि यसको उचाइ 1.4 मिटर भए आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The capacity of a cylindrical water tank is 539 litres. If its height is 1.4 meter then find the radius of the base.

⇨ Here, given volume of cylinder = 539 litres = 539 × 1000 = 539000 cm^3
Height of cylinder (h) = 1.4 m = 140 cm
Radius of the base (r) = ?
We know that,
Volume of cylinder = $\pi r^2 h$

or, $\pi r^2 h = 539000$ or, $\frac{22}{7} \times r^2 \times 140 = 539000$

or, $r^2 = \frac{539000 \times 7}{22 \times 140} = 1225$ ∴ r = 35 cm

Thus, the radius of the base is 35 cm.

(b) यदि एउटा गोलाको सतहको क्षेत्रफल 30184 वर्ग से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the surface area of a sphere is 30184 square cm, then find its radius.

⇨ Here, surface area of a sphere = 30184 cm^2
Radius of sphere (r) = ?
We know that,
Surface area of a sphere = $4\pi r^2$

or, $4\pi r^2 = 30184$ or, $4 \times \frac{22}{7} r^2 = 30184$

or, $r^2 = \frac{30184 \times 7}{88} = 2401$ ∴ r = 49 cm

Thus, the required radius of sphere is 49 cm

(c) यदि एउटा सोलीको उचाइ आधारको अर्धव्यासको तीन गुणा र यसको आयतन 512π घन से.मि. भए सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
If the height of a cone is three times the radius of the base and its volume of 512π cubic cm then find the radius of the base of the cone.

⇨ Here, volume of cone (v) = 512 π cm^3
According to the question, height (h) = 3 × radius (r)
We know that,

Volume (v) = $\frac{1}{3}\pi r^2 h$

or, 512 π $cm^3 = \frac{1}{3}\pi r^2 (3r)$ or, $r^3 = 512\ cm^3$ ∴ r = 8 cm

Thus, required radius of base is 8 cm.

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6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^4 - x$ and $x^2 + x + 1$

⇨ Here, first expression $= x^4 - x = x(x^3 - 1) = x(x - 1)(x^2 + x + 1)$
Second expression $= x^2 + x + 1$
Thus, HCF $= x^2 + x + 1$

(b) सरल गर्नुहोस् (Simplify): $5\sqrt[3]{54} - 3\sqrt[3]{128} + 2\sqrt[3]{16}$

⇨ Here, $5\sqrt[3]{54} - 3\sqrt[3]{128} + 2\sqrt[3]{16}$

$= 5\sqrt[3]{3 \times 3 \times 3 \times 2} - 3\sqrt[3]{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2} + 2\sqrt[3]{2 \times 2 \times 2 \times 2}$

$= 5 \times 3\sqrt[3]{2} - 3 \times 4\sqrt[3]{2} + 2 \times 2\sqrt[3]{2} = 15\sqrt[3]{2} - 12\sqrt[3]{2} + 4\sqrt[3]{2} = 7\sqrt[3]{2}$

7. (a) यदि $p = 10^m$, $q = 10^n$ र $p^n.q^m = 100$ भए प्रमाणित गर्नुहोस्: $mn = 1$
If $p = 10^m$, $q = 10^n$ र $p^n.q^m = 100$ then prove that: $mn = 1$.

⇨ Here, given $p = 10^m$, $q = 10^n$ and $p^n q^m = 100$
To prove: $mn = 1$
We have,
$p^n q^m = 100$ or, $(10^m)^n (10^n)^m = (10)^2$ or, $(10^2)^{mn} = (10)^2$
or, $(100)^{mn} = (100)^1$ ∴ $mn = 1$ Proved.

(b) सरल गर्नुहोस् (Simpilfy): $\frac{1}{e-f} - \frac{e+f}{e^2 - f^2}$.

⇨ Here, $\frac{1}{e-f} - \frac{e+f}{e^2 - f^2} = \frac{1}{e-f} - \frac{e+f}{(e-f)(e+f)} = \frac{e+f-e-f}{(e+f)(e-f)} = 0$

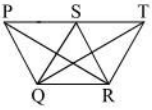
(c) सरल गर्नुहोस् (Simpilfy): $\frac{p^2 + pq + q^2}{p+q} + \frac{p^2 - pq + q^2}{p-q}$.

⇨ Here,

$$\frac{p^2 + pq + q^2}{p+q} + \frac{p^2 - pq + q^2}{p-q}$$

$$= \frac{(p-q)(p^2 + pq + q^2) + (p+q)(p^2 - pq + q^2)}{(p+q)(p-q)} = \frac{p^3 - q^3 + p^3 + q^3}{p^2 - q^2} = \frac{2p^3}{p^2 - q^2}$$

8. (a) सँगैको चित्रमा PQRS एउटा समबाहु चतुर्भुज हो जसमा PS लाई T सम्म बढाइएको छ । यदि PR = 10 से.मि. र SQ = 8 से.मि. भए ΔQRT को क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure, PQRS is a rhombus in which PS is produced to T. If PR = 10 cm and SQ = 8 cm, find the area of ΔQRT.



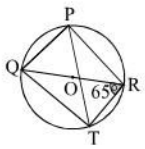
⇨ Here, Area of rhombus PQRS $= \frac{1}{2} \times 10 \times 8\ cm^2 = 40\ cm^2$

Area of ΔQRT $= \frac{1}{2} \times$ Area of rhombus PQRS [both are standing on the same base QR]

$= \frac{1}{2} \times 40 = 20\ cm^2$

Thus, the area of ΔQRT $= 20\ cm^2$.

(b) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠QRT = 65° भए ∠RQT र ∠QPT को मान पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If ∠QRT = 65°, find the values of the ∠RQT and ∠QPT.

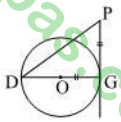


⇨ Here, ∠QRT = 65°
We have,
∠QRT + ∠RQT + ∠QTR = 180°
or, 65° + ∠RQT + 90° = 180° [∠QTR = 90°, being the angle at semi circle]
∴ ∠RQT = 25°
Also, ∠QRT = ∠QPT = 65° [both are standing on the same base QT]

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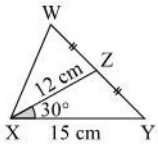
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(c) चित्रमा, O वृत्तको केन्द्र, PG स्पर्शरेखा र G स्पर्शबिन्दु छ । यदि PG = DG भए ∠DPG को मान पत्ता लगाउनुहोस् ।
In the figure, O is centre of circle, PG is tangent to the circle and G is point of contact. If PG = DG then find the value of ∠DPG.



⇨ Here, given PG = DG
We have,
∠PGD = 90° [Since tangent at any point of the circle is perpendicular to the radius]
Also, ∠DPG + ∠PGD + ∠PDG = 180°
or, ∠DPG + 90° + ∠DPG = 180° [∵ ∠P = ∠D since DG = GP]
or, 2 ∠DPG = 90°
∴ ∠DPG = 45°
Thus, required angle DPG is 45°.

9. (a) दिइएको चित्रमा ΔWXY को भुजा WY लाई XZ ले आधा गरेको छ । यदि XZ = 12 से.मि., XY = 15 से.मि. र ∠ZXY = 30° भए ΔWXY को क्षेत्रफल निकाल्नुहोस् ।
In the given figure, the side WY of the ΔWXY is bisected by XZ. If XZ = 12 cm, XY = 15 cm and ∠ZXY = 30° then find the area of ΔWXY.



⇨ Here, given, XZ = 12 cm, XY = 15 cm and ∠ZXY = 30°

Area of $\Delta XYZ = \frac{1}{2} \times XY \times XZ \times \sin 30° = \frac{1}{2} \times 15 \times 12 \times \frac{1}{2} = 45 \text{ cm}^2$

Area of ΔWXY = 2 × Area of Δ XYZ [since XZ bisects WY] = 2 × 45 = 90 cm^2
Thus, the required area of Δ WXY = 90 cm^2.

(b) मध्यक 5 भएको एउटा निरन्तर श्रेणीमा Σfx = p र Σf = 10 भए p को मान निकाल्नुहोस् ।
In a continuous series, the mean is 5. If Σfx = p and Σf = 10 then find the value of p.

⇨ Here, mean $(\bar{x}) = 5$, Σfx = p and Σf = 10

We know that, mean $(\bar{x}) = \frac{\Sigma fx}{\Sigma f}$

or, $5 = \frac{p}{10}$ ∴ p = 50

Thus, the value of p is 50.

10. (a) एउटा थैलीमा 1 देखि 20 सम्म लेखिएका जम्मा 20 ओटा उस्तै र उत्रै बलहरू छन् । कुनै एउटा बल स्वतन्त्र रूपले निकाल्दा (झिक्दा) त्यो बल 5 अथवा 7 को गुणाङ्क पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।
There are 20 balls of same size and shape in a bag numbered from 1 to 20. A ball is taken out independently from the bag, what is the probability of getting a ball that is multiple of 5 or 7? Find it.

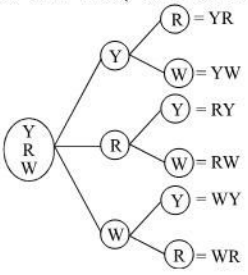
⇨ Here, multiples of 5 from 1 to 20 = {5, 10, 15, 20} ∴ n(5) 4
multiples of 7 from 1 to 20 = {7, 14} ∴ n(7) = 2

Then, $P(5) = \frac{4}{20}$ and $P(7) = \frac{2}{20}$

Now, $P(5 \text{ or } 7) = P(5) + P(7) = \frac{4}{20} + \frac{2}{20} = \frac{6}{20} = \frac{3}{10}$

Thus, the required probability that the ball is a multiple of 5 or 7 is $\frac{3}{10}$.

(b) एउटा झोलामा एउटा पहेँलो, एउटा रातो र एउटा सेतो गरी तीनओटा उस्तै र उत्रै मिठाइहरू राखिएका छन् । उक्त झोलाबाट नहेरिकन एउटा मिठाई तान्ने र उक्त मिठाई पुनः झोलामा नराखी अर्को मिठाई तान्दा आउन सक्ने परिणामहरूका सम्भाव्यताहरूलाई वृक्षचित्रमा देखाउनुहोस् ।
There are one yellow, one red and one white sweets in a bag. A sweet is drawn randomly and without replacing the sweet, another sweet is drawn from the bag. Show all the possible outcomes of the probabilities in a tree diagram.



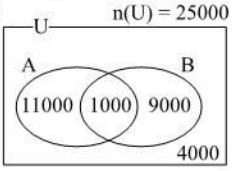
⇨ Here, let Y, R and W denote yellow, Red and White sweets respectively.
Now, the tree diagram of possible outcomes are shown in the figure alongside.

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समूह 'ग' (Group' C') **[10 × 4 = 40]**

11. एउटा नगरपालिकाको चुनावमा A र B दुई उम्मेदवारहरू मेयर पदका लागि उठेछन् र त्यहाँ मतदाताको सूचीमा 25000 जना रहेछन् । मतदाताले एक जनालाई मात्रै भोट खसाल्नुपर्ने थियो । 12000 जनाले A लाई, त्यस्तै 10000 जनाले B लाई र 1000 जनाले दुवैलाई पनि मत दिएछन् ।
In an election of a municipality, two candidates A and B stood for the post of Mayor and 25000 people were in the voter list. Voters were supposed to cast the vote for a single candidate. 12000 people cast vote for A, 10000 people cast for B and 1000 people cast vote even for both.
(i) यी जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show these information in a Venn-diagram.)
(ii) कति जनाले भोट खसालेनन् ? पत्ता लगाउनुहोस् । (How many people didn't cast vote? Find it.)
(iii) कति भोट सदर भयो ? पत्ता लगाउनुहोस् । (How many votes were valid? Find it.)

⇨ Here, let A and B be the sets of votes given for two candidates A and B respectively.
By the question, n(U) = 25000, n(A) = 12000, n(B) = 10000, n(A∩B) = 1000
We know that, n(A∪B) = $n_0(A) + n_0(B) + n(A \cap B)$
= 11000 + 9000 + 1000 = 21000



(i) $n(\overline{A \cup B}) = n(U) - n(A \cup B) = 25000 - 21000 = 4000$
(ii) Since the votes given to both the candidates are invalid votes.
So, number of valid votes = $n_0(A) + n_0(B) = 11000 + 9000 = 20000$
Thus, 4000 people didn't cast their vote and 20000 votes were valid.

12. एउटा रेडियोको अङ्कित मूल्यमा 10% छुट दिई 13% मूल्य अभिवृद्धि कर लगाएर बेचियो । यदि मूल्य अभिवृद्धि करसहितको मूल्य र छुटपछिको मूल्यबीचको फरक रु. 1170 भए सो रेडियोको अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After allowing 10% discount on the marked price of a radio, 13% VAT was levied and sold it. If the difference between the selling price with VAT and selling price after discount is Rs 1170, find the marked price of that radio.

⇨ Here, let M.P of the radio be Rs x.
S.P. after 10% discount = x – 10% of x = 0.9x
S.P including VAT = 0.9x + 13% of 0.9x = 1.017x
According to the question,
S.P. including VAT – S.P after discount = Rs 1170 or, 1.017x – 0.9x = 1170
or, 0.117x = 1170 ∴ x = Rs 10,000
Thus, the required marked price of radio is Rs 10,000.

13. एउटा त्रिभुजाकार जग्गाको भुजाहरू 6 : 9 : 10 को अनुपातमा छन् । यदि यसको परिमिति 2500 मिटर भए उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The sides of a triangular field are in the ratio of 6 : 9 : 10. If its perimeter is 2500 m, what is the area of that field? Find it.

⇨ Here, perimeter of a triangular field (P) = 2500 m.
Let the sides of triangular field be 6x, 9x, 10x.
Then, P = 6x + 9x + 10x = 2500 m or, 25x = 2500 m ∴ x = 100 m
Thus, the sides are a = 6x = 6 × 100 m = 600 m
b = 9x = 9 × 100 m = 900 m
c = 10x = 10 × 100 m = 1000 m
Now,

$$\text{Semi-perimeter (s)} = \frac{a+b+c}{2} = \frac{600+900+1000}{2} = 1250 \text{ m}$$

We know that,
Area of triangular field (A) $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{1250\,(1250-600)\,(1250-900)\,(1250-1000)}$
$= \sqrt{1250 \times 650 \times 350 \times 250} = \sqrt{7.109375 \times 10^{10}}$
$= 266634.11 \text{ m}^2$
Thus, the required area of triangular field is 266634.11 m^2

14. ल.स. निकाल्नुहोस् (Find the LCM of): $x^4 + x^3 - x^2 - x$, $x^4 - x$ and $4x^2 - 4$

⇨ Here, first expression = $x^4 + x^3 - x^2 - x = x^3(x+1) - x(x+1) = (x^3 - x)(x+1) = x(x+1)(x-1)(x+1)$
Second expression = $x^4 - x = x(x^3 - 1) = x(x-1)(x^2 + x + 1)$
Third expression = $4x^2 - 4 = 4(x^2 - 1) = 4(x+1)(x-1)$
Thus, LCM = $4x(x+1)^2(x-1)(x^2 + x + 1)$

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15. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 10 छ । यदि सो सङ्ख्याबाट 72 घटाइयो भने अङ्कहरूको स्थान परिवर्तन हुन्छ भने सुरुको सङ्ख्या पत्ता लगाउनुहोस् ।
The sum of the digits in a two digits number is 10. If 72 is subtracted from the number, the places of the digits are interchanged. Find the initial number.

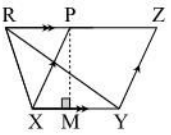
⇨ Here, let digit of one's place = x and digit of ten's place = y.
∴ Required number = 10y + x
According to the question, x + y = 10 ... ...(i)
and, 10y + x – 72 = 10 x + y or, 9y – 9x = 72 or, y – x = 8 ... ...(ii)
Solving equations (i) and (ii), we get,

$$\begin{array}{r} x + y = 10 \\ \underline{-x + y = 8} \\ 2y = 18 \end{array} \quad \therefore \; y = 9$$

Putting the value of y in (i), x = 10 – 9 = 1
Thus, the required number is 10y + x = 10 × 9 + 1 = 91

16. समान आधार XY र उही समानान्तर रेखाहरू XY र RZ बीच बनेका ΔRXY को क्षेत्रफल समानान्तर चतुर्भुज PXYZ को क्षेत्रफलको आधा हुन्छ भनी प्रमाणित गर्नुहोस् ।
Prove that the area of triangle RXY is half of the area of parallelogram PXYZ standing on the same base XY and between the same parallel lines XY and RZ.

⇨ Here,
Given: ΔRXY and parallelogram PXYZ are on the same base XY and between the same parallels PZ and XY.



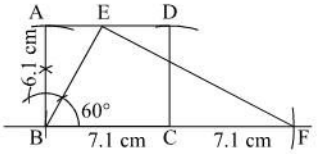
To prove: Ar. (ΔRXY) = $\frac{1}{2}$ × Ar. (□PXYZ)

Construction: Draw PM ⊥ XY
Proof:

Statements	Reasons
1. Ar. (ΔRXY) = $\frac{1}{2}$ × XY × PM	1. Area of triangle = $\frac{1}{2}$ × b × h
2. Ar. (□PXYZ) = XY × PM	2. Area of parallelogram = b × h
3. Ar. (ΔRXY) = $\frac{1}{2}$ Ar. (□PXYZ)	3. From (1) & (2).

Proved.

17. लम्बाइ 7.1 से.मि. र चौडाइ 6.1 से.मि. भएको आयतको क्षेत्रफलसँग बराबर हुने गरी एउटा कोण 60° भएको त्रिभुजको रचना गर्नुहोस् ।
Construct a rectangle with length 7.1 cm and breadth 6.1 cm. Also, construct a triangle having one angle 60° and equal in the area to the rectangle.



⇨ Here, length = 7.1 cm, breadth = 6.1 cm and one angle of required triangle is 60°.
So, ABCD is the given rectangle and ΔBEF is the required triangle whose area is equal to the given rectangle ABCD.

18. चक्रीय चतुर्भुज PQRS का सम्मुख कोणहरूबीचको सम्बन्ध प्रयोगद्वारा खोजी गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Explore experimentally the relationship between opposite angles of a cyclic quadrilateral PQRS. (Two circles having radii at least 3 cm are necessary.)

⇨ Here, Experimental verification:
(i) Two circles of different radii with centre O are drawn.
(ii) PQRS is the cyclic quadrilaterals.
(iii) The angle ∠P, ∠Q, ∠R and ∠S are measured and are tabulated as below.

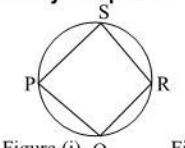


Figure (i)

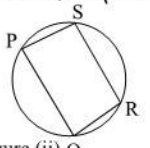


Figure (ii)

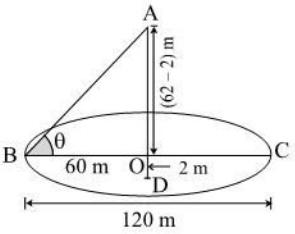
Fig	∠P	∠Q	∠R	∠S	∠P + ∠R	∠Q + ∠S	Remarks
(i)	100°	110°	80°	70°	100° + 80° = 180°	110° + 70° = 180°	∠P + ∠R = 180° and ∠Q + ∠S = 180°
(ii)	80°	70°	100°	110°	80° + 100° = 180°	70° + 110° = 180°	∠P + ∠R = 180° and ∠Q + ∠S = 180°

Conclusion: From the above table it is concluded that the opposite angles of a cyclic quadrilateral are supplementary.

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19. एउटा वृत्ताकार पोखरीको व्यास 120 मिटर छ । उक्त पोखरीको ठीक बीचमा गाडिएको खम्बाको टुप्पोमा सो पोखरीको किनाराबाट हेर्दा $\theta°$ को उन्नतांश कोण बनेको पाइयो । यदि पोखरीको गहिराइ 2 मिटर र खम्बाको जम्मा उचाइ 62 मिटर भए $\theta°$ को मान पत्ता लगाउनुहोस् ।

The diameter of a circular pond is 120 meter. The angle of elevation of the top of pillar is fixed in the middle of the pond as observed from the edge of the pond is found to be $\theta°$. If the depth of the pond is 2 meter and height of the pillar is 62 m then find the value of $\theta°$.



⇨ Here, let, COB = 120 m be the diameter of a circluar pond and θ is the angle of elevation. Then radius OB = 60 m. Also assume, the height of the pillar above the water surface is
AO = 62 m – 2 m = 60 m In right angled Δ AOB,

$\tan\theta = \frac{OA}{OB} = \frac{60}{60} = 1$ or, $\tan\theta = \tan 45°$

$\therefore\ \theta = 45°$ Thus, the required value of θ is 45°.

20. तल दिइएको आँकडाको तेस्रो चतुर्थांश 390 भए p को मान पत्ता लगाउनुहोस् ।

Find the value of p if third quartile of the data given below is 390:

Daily profit (Rs)	0-100	100-200	200-300	300-400	400-500	500-600
No. of Shops	12	18	27	p	17	6

⇨ Here, calculation table for third quartile (Q_3) is as below.

Daily profit (x)	No. of shops (f)	Cumulative frequency (c.f)
0 - 100	12	12
100 - 200	18	30
200 - 300	27	57
300 - 400	p	57 + p
400 - 500	17	74 + p
500 - 600	6	80 + p

Since, Q_3 is 390. So, the corresponding quartile class is 300 - 400. $\therefore$ f = p, c.f = 57, L = 300, i = 100
We know that,

$Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - c.f.\right)$ or, $390 = 300 + \frac{100}{p}\left(3\frac{(80+p)}{4} - 57\right)$

or, $390 - 300 = \frac{100}{4p}(240 + 3p - 228)$ or, $90 = \frac{25}{P}(12 + 3p)$

or, $90\,p = 300 + 75\,p$ or, $15\,p = 300$

$\therefore\ p = 20$ Thus, the required value of p is 20.

समूह 'घ' (Group 'D') **4 × 5 = 20**

21. एउटा बैंकले खाता P मा 10% प्रतिवर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता Q मा 12% प्रतिवर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ । यदि तपाई 2 वर्षका लागि रु. 50,000 सो बैंकमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? गणना गरी कारणसहित उल्लेख गर्नुहोस् ।

A bank has fixed the rate of interest 10% p.a. semi-annually compound interest in account P and 12% per annum annually compound interest in account Q. If you are going to deposit Rs 50,000 for 2 years in the same bank in which account will you deposit and why? Give your reason with calculation.

⇨ Here,

Account P	Account Q
Rate (R) = 10% (semi-annually)	Rate (R) = 12% (annually)
Principal (P) = Rs 50000	Principal (P) = Rs 50000
Time (T) = 2 years	Time (T) = 2 years

Now, Semi-annual (Half yearly) compound interest is given by

$$H.Y.C.I = P\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right] = 50000\left[\left(1 + \frac{10}{200}\right)^{2\times 2} - 1\right] = 50000 \times (0.2155) = \text{Rs } 10775.3125$$

Also, yearly compound interest is given by;

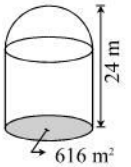
$$Y.C.I = P\left[\left(1 + \frac{R}{100}\right)^{T} - 1\right] = 50000\left[\left(1 + \frac{12}{100}\right)^{2} - 1\right] = 50000 \times (0.2544) = \text{Rs } 12720$$

Now, Y.C.I – H.Y.C.I = Rs 12720 – Rs 10775.3125 = Rs 1944.6875
Since, the yearly compound interest given by the bank in account Q is greater than the half yearly compound interest in account P by Rs 1944.6875. So, i will deposit in account Q.

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22. एउटा पानी ट्याङ्की बेलनाकार र अर्धगोलाकार भाग मिलेर बनेको छ । सो ट्याङ्कीको पूरा उचाइ 24 m छ र आधारको क्षेत्रफल 616 m^2 भए उक्त ट्याङ्कीमा प्रतिलिटर 65 पैसाका दरले पानी भर्न जम्मा कति खर्च लाग्ला ? पत्ता लगाउनुहोस् ।

A water tank is formed with the combination of cylinder and hemisphere. The total height of the tank is 24 m and base area is 616 m^2. If the tank is filled with water at the rate of 65 paisa per litre, what is the total cost for the water? Find it.



⇨ Here, Base area of tank is 616 m^2

i.e. $\pi r^2 = 616$ or, $r^2 = \frac{616}{\frac{22}{7}} = 196$ or, $r = 14$ m

i.e. radius of tank (r) = 14 m

The height of cylindrical part (h) = 24 – 14 = 10 m

We know that,

$$\text{Volume of tank} = \text{Area} \times \text{height} + \frac{2}{3}\pi r^3 = 616 \times 10 + \frac{2}{3} \times \frac{22}{7} \times 14^3$$

$$= 6160 + 5749.333 = 11909.333 \text{ m}^3$$

$$= 11909333 \text{ L}$$

So, we have, volume of water = 11909333 L.

Since cost to fill one litre is 65 paisa,

So, the cost to fill 11909333 litre is 65 × 11909333= 774106645 Paisa = Rs 7741066.45

Thus, the required cost is Rs 7741066.45

23. सरल गर्नुहोस् **(Simplify):** $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}}$

⇨ Here, $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}} = \dfrac{\left(a+\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b+\frac{1}{a}\right)^b\left(b-\frac{1}{a}\right)^b\left(b+\frac{1}{a}\right)^{a-b}}$

$$= \frac{\left(a+\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^b}{\left(b+\frac{1}{a}\right)^a\left(b-\frac{1}{a}\right)^b} = \frac{\left(\frac{ab+1}{b}\right)^a\left(\frac{ab-1}{b}\right)^b}{\left(\frac{ab+1}{a}\right)^a\left(\frac{ab-1}{a}\right)^b}$$

$$= \left(\frac{\frac{ab+1}{b}}{\frac{ab+1}{a}}\right)^a\left(\frac{\frac{ab-1}{b}}{\frac{ab-1}{a}}\right)^b = \left(\frac{a}{b}\right)^a\left(\frac{a}{b}\right)^b = \left(\frac{a}{b}\right)^{a+b}$$

24. WXYZ एउटा चक्रीय चतुर्भुज हो । यदि ∠XWZ र ∠XYZ का अर्धकहरूले वृत्तलाई क्रमशः बिन्दुहरू A र B मा भेट्छन् भने AB वृत्तको व्यास हो भनी प्रमाणित गर्नुहोस् ।

WXYZ is a cyclic quadrilateral. If the bisectors of ∠XWZ and ∠XYZ meet the circle at the points A and B respectively then prove that AB is the diameter of the circle.



⇨ Here,

Given: WXYZ is a cyclic quadrilateral.

To prove: AB is the diameter of circle.

Proof:

Statements	Reasons
1. $\overset{\frown}{XYA} = \overset{\frown}{AZ}$	1. Opposite arcs of equal angles.
2. $\overset{\frown}{BWX} = \overset{\frown}{BZ}$	2. Same as reason (1).
3. $\overset{\frown}{XYA} + \overset{\frown}{BWX} = \overset{\frown}{AZ} + \overset{\frown}{BZ}$	3. Addition axiom in (1) and (2).
4. $\overset{\frown}{BWXYA} = \overset{\frown}{BZA}$	4. Whole part axiom in (3).
5. AB is a diameter.	5. From (4), arcs on both sides of AB are equal.

Proved.

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9. SEE EXAMINATIONS 2074 SET 6 [WDR] RE-109'CC'

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) कुनै सहरको हालको जनसङ्ख्या P छ । यदि प्रत्येक वर्ष जनसङ्ख्या R% ले वृद्धि हुन्छ भने T वर्षपछि त्यो सहरको जनसङ्ख्या कति होला ? लेख्नुहोस् ।
The present population of a town is P. If the population increases by R% every year, what will be the population of the town after T years? Write it.

⇨ Here, present population = P and growth rate = R %

Thus, the population of the town after T years is $P_T = P\left(1 + \frac{R}{100}\right)^T$

(b) एउटा वर्ग आधार पिरामिडको आधारको भुजा p से.मि. र छड्के उचाइ q cm से.मि. भए सो पिरामिडको पूरा सतहको क्षेत्रफल कति हुन्छ ? लेख्नुहोस् ।
The length of a side of the square base of a pyramid is p cm and the slant height is q cm, what is the total surface area of the pyramid? Write it.

⇨ Here, slant height = q cm and the length of a side = p cm.
Thus, the total surface area of the pyramid is $(p^2 + 2pq)$ sq. cm.

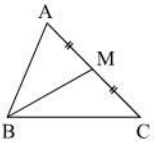
2. (a) $\sqrt[x]{p}$ मा सर्डको क्रम कति हुन्छ ? लेख्नुहोस् । **(Write down the order of surd in $\sqrt[x]{p}$.)**

⇨ Here, the order of surd in $\sqrt[x]{p}$ is x.

(b) यदि कुनै तथ्याङ्ककको मध्यिका श्रेणीको तल्लो सीमा L, सो श्रेणीको बारम्बारता f, श्रेणीअन्तर i, बारम्बारताहरूको जोड N र मध्यिका श्रेणीभन्दा अघिल्लो श्रेणीको सञ्चित बारम्बारता c.f. छन् भने मध्यिका पत्ता लगाउने सूत्र लेख्नुहोस् ।
If the lower limit of the median class of any data is L, frequency of that class is f, class interval i, sum of the frequencies N and the cumulative frequency of pre-median class is c.f. then write the formula for finding the median.

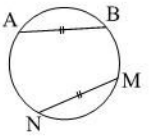
⇨ Here, the formula for finding the median is $M_d = L + \frac{i}{f}\left(\frac{N}{2} - c.f\right)$

3. (a) दिइएको चित्रमा AC को मध्यबिन्दु M हो भने ΔBMC र ΔABC को क्षेत्रफलबीचको सम्बन्ध लेख्नुहोस् ।
In the given figure, if M is the middle point of AC then write the relation between the areas of ΔBMC and ΔABC.



⇨ Here, M is the middle point of AC. Thus, Area of ΔBMC = $\frac{1}{2}$ Area of ΔABC.

(b) दिइएको वृत्तमा जीवाहरू AB र MN बराबर छन् भने चापहरू AB र MN को सम्बन्ध के हुन्छ ? लेख्नुहोस् ।
In the given circle, chords AB and MN are equal. What is the relation of arcs AB and MN? Write it.



⇨ Here, chord AB = chord MN. Thus, Arc AB = Arc MN.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) यदि 176 डलर = 100 पाउन्ड र 1 पाउन्ड = ने.रु. 119 भए 132 डलरसित कति नेपाली रुपैयाँ साट्न सकिन्छ ? पत्ता लगाउनुहोस् ।
If 176 dollars = 100 pounds and 1 pound = NRs 119, how much Nepali rupees can be exchanged with 132 dollars? Find it.

⇨ Here, let x NRs can be exchanged with 132 dollars.
By using chain rule, we have,

NRs 119 = 1 pound
or, \$132 = x NRs
or, $x = \frac{1570800}{176} = 8925$

or, 100 pounds = \$176
∴ $119 \times 100 \times 132 = 1 \times 176 \times x$
Thus Rs 8925 can be exchanged with 132 dollars.

(b) एउटा सहरको हालको जनसङ्ख्या 66,550 छ । यदि वार्षिक जनसङ्ख्या वृद्धिदर 10% छ भने 3 वर्ष पहिले त्यो सहरको जनसङ्ख्या कति थियो ? पत्ता लगाउनुहोस् ।
The present population of a town is 66,550. If the annual population growth rate is 10%, what was the population of the town 3 years ago? Find it.

⇨ Here, Present population (P_T) = 66,550
Population growth rate (R) = 10% and Time(T) = 3 years

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We know that, population $(P_T) = P\left(1+\frac{R}{100}\right)^T$ or, $66{,}550 = P\left(1+\frac{10}{100}\right)^3$

or, $P = \frac{66550}{1.331}$ $\therefore$ $P = 50{,}000$

Thus, the required population of the town before 3 years was 50,000.

5. (a) एउटा बेलनाकार ट्याङ्कीमा 172.48 लिटर पानी अटाउँछ । यदि यसको उचाइ 0.7 मिटर भए आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
A cylindrical tank contains 172.48 litres of water. If its height is 0.7 m then find the radius of the base.

⇨ Here, Volume of cylinder (v) = 172.48 L = 174480 cm^3
Height (h) = 0.7 m = 70 cm
Radius(r) = ?

We know that, volume $(v) = \pi r^2 h$ or, $\frac{22}{7} \times r^2 \times 70 = 172480$

or, $r^2 = \frac{172480 \times 7}{1540} = 784$ $\therefore$ $r = 28$ cm

Thus, the required radius of base is 28 cm.

(b) यदि एउटा गोलाको सतहको क्षेत्रफल 22176 वर्ग से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the surface area of a sphere is 22176 sq. cm then find its radius.

⇨ Here, given, surface area of a sphere (A) = 22176 cm^2.
Radius of sphere (r) = ?

We know that, $A = 4\pi r^2$ or, $4 \times \frac{22}{7} \times r^2 = 22176$

or, $r^2 = \frac{22176 \times 7}{88} = 1764$ $\therefore$ $r = 42$ cm

Thus, required radius is 42 cm

(c) यदि एउटा सोलीको उचाइ आधारको अर्धव्यासको चार गुणा र यसको आयतन 36π घन से.मि. भए सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
If the height of a cone is four times the radius of the base and its volume of 36π cu. cm then find the radius of the base of the cone.

⇨ Here, volume of cone (v) = 36π cm^3
According to the question,
height (h) = 4 × radius (r) i.e. $h = 4r$

We know that, $v = \frac{1}{3}\pi r^2 h$ or, $\frac{1}{3} \times \pi \times r^2 \times (4r) = 36\pi$

or, $r^3 = \frac{36 \times 3}{4} = 27$ $\therefore$ $r = 3$ cm

Thus, the required radius of cone is 3 cm.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $p^5 + p^2$ and $p^2 - p + 1$

⇨ Here, First expression = $p^5 + p^2 = p^2(p^3 + 1) = p^2(p+1)(p^2 - p + 1)$
Second expression = $p^2 - p + 1$
Thus, HCF = $p^2 - p + 1$.

(b) सरल गर्नुहोस् (Simplify): $4\sqrt[3]{250} - 8\sqrt[3]{128} + 4\sqrt[3]{54}$

⇨ Here, $4\sqrt[3]{250} - 8\sqrt[3]{128} + 4\sqrt[3]{54} = 4\sqrt[3]{125 \times 2} - 8\sqrt[3]{64 \times 2} + 4\sqrt[3]{27 \times 2}$

$= 4\sqrt[3]{5^3 \times 2} - 8\sqrt[3]{4^3 \times 2} + 4\sqrt[3]{3^3 \times 2} = 4 \times 5\sqrt[3]{2} - 8 \times 4\sqrt[3]{2} + 4 \times 3\sqrt[3]{2}$

$= 20\sqrt[3]{2} - 32\sqrt[3]{2} + 12\sqrt[3]{2} = 0$

7. (a) यदि $a = 5^x$, $b = 5^y$ र $a^y.b^x = 25$ भए प्रमाणित गर्नुहोस्: $xy = 1$.
If $a = 5^x$, $b = 5^y$ र $a^y.b^x = 25$ then prove that: $xy = 1$.

⇨ Here, $a = 5^x$, $b = 5^y$ and $a^y.b^x = 25$. To prove: $xy = 1$

We have, $a^y.b^x = 25$ or, $(5^x)^y . (5^y)^x = 25$ or, $5^{xy}.5^{xy} = 25$
or, $5^{2xy} = 25$ or, $25^{xy} = 25^1$ Thus, $xy = 1$ Proved.

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(b) सरल गर्नुहोस् (Simpilfy): $\frac{1}{m-n} - \frac{m+n}{m^2-n^2}$.

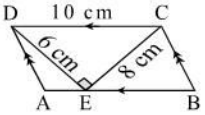
⇨ Here, $\frac{1}{m-n} - \frac{m+n}{m^2-n^2} = \frac{1}{m-n} - \frac{m+n}{(m+n)(m-n)} = \frac{m+n-m-n}{(m+n)(m-n)} = 0$

(c) सरल गर्नुहोस् (Simpilfy): $\frac{c^2+cd+d^2}{c+d} + \frac{c^2-cd+d^2}{c-d}$.

⇨ Here, $\frac{c^2+cd+d^2}{c+d} + \frac{c^2-cd+d^2}{c-d} = \frac{(c-d)(c^2+cd+d^2)+(c+d)(c^2-cd+d^2)}{(c+d)(c-d)}$

$= \frac{c^3-d^3+c^3+d^3}{c^2-d^2} = \frac{2c^3}{c^2-d^2}$

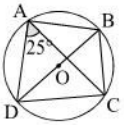
8. (a) चित्रमा ABCD एउटा समबाहु चतुर्भुज हो । जसमा AB मा एउटा बिन्दु E छ । यदि DE = 6 cm, CE = 8 cm र ∠DEC = 90° भए समानान्तर चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।
In the figure, ABCD is a parallelogram. E is a point on AB. If DE = 6 cm, CE = 8 cm and ∠DEC = 90° then find the area of parallelogram ABCD.



⇨ Here, Area of $\Delta DEC = \frac{1}{2} \times DE \times EC \times \sin 90° = \frac{1}{2} \times 6 \times 8 \times 1 = 24 \text{ cm}^2$

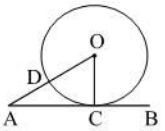
Ar. ($\square$ABCD) = 2 × Ar. (ΔDEC) [Area of // gm is twice the area of triangle standing on the same base CD]
$= 2 \times 24 = 48 \text{ cm}^2$.
Thus, the required area of // gm ABCD is 48 cm^2

(b) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो र यदि ∠DAC = 25° भए ∠BDC र ∠BAC को मान पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If ∠DAC = 25°, find the values of the ∠BDC and ∠BAC



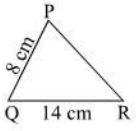
⇨ Here, ∠DAB = 90° [angle on semi–circle] i.e. ∠DAC + ∠CAB = 90°
or, ∠CAB = 90° – 25° = 65°.
Also, ∠BDC = ∠BAC = 65° [Both are standing on same arc BC]
Thus, ∠BDC = 65° and ∠BAC = 65°

(c) दिइएको चित्रमा केन्द्रबिन्दु O भएको वृत्तमा AB स्पर्शरेखा र C स्पर्शबिन्दु छ । यदि OC = 9 से.मि. र AC = 40 से.मि. भए AD को लम्बाइ पत्ता लगाउनुहोस् ।
In the figure, AB is the tangent and C is the point of contact of a circle having the centre O. If OC = 9 cm and AC = 40 cm, find the length of AD.



⇨ Here, OC = 9 cm and AC = 40 cm
(i) OC = OD = 9 cm [Being the radii of same circle]
(ii) $AO^2 = OC^2 + AC^2$ [Being OC ⊥ AC]
$= 9^2 + 40^2 = 81 + 1600 = 1681$
or, $AO^2 = 41^2$ ∴ AO = 41 cm
(iii) AD = AO – OD = 41 cm – 9 cm ∴ AD = 32 cm
Thus, the measure of AD is 32 cm.

9. (a) दिइएको चित्रमा ΔPQR को क्षेत्रफल $28\sqrt{3}$ वर्ग से.मि. छ । यदि PQ = 8 से.मि. र QR = 14 से.मि. भए ∠PQR को मान पत्ता लगाउनुहोस् ।
In the given figure, the area of ΔPQR is $28\sqrt{3}$ square cm. If PQ = 8 cm and QR = 14 cm then find the value of the ∠PQR.



⇨ Here, area of $\Delta PQR = 28\sqrt{3} \text{ cm}^2$, PQ = 8 cm and QR = 14 cm
We know that,

$$\text{Area of } \Delta PQR = \frac{1}{2} PQ \times QR \times \sin \angle PQR$$

or, $28\sqrt{3} = \frac{1}{2} 8 \times 14 \times \sin \angle PQR$ or, $\frac{28\sqrt{3}}{56} = \sin \angle PQR$

or, $\sin \angle PQR = \frac{\sqrt{3}}{2}$ or, $\sin \angle PQR = \sin 60°$

∴ ∠PQR = 60° Thus, the value of ∠PQR = 60°.

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(b) एउटा वर्गीकृत तथ्याङ्कमा, मध्यिका श्रेणीको तल्लो सीमा = 400, वर्गान्तर = 100, जम्मा बारम्बारता = 44, मध्यिका श्रेणीको अघिल्लो श्रेणीको सञ्चित बारम्बारता = 8 र मध्यिका श्रेणीको बारम्बारता = 20 भए मध्यिकाको मान पत्ता लगाउनुहोस् ।
In a continuous data, lower limit of median class = 400, width of the class interval = 100, total frequency = 44, cumulative frequency of pre-median class = 8 and frequency of the median class = 20. Find the value of median.

⇨ Here, L = 400, i = 100, N = 44, cf = 8, f = 20
We know that,

$$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - c.f\right) = 400 + \frac{100}{20}\left(\frac{44}{2} - 8\right) = 400 + 5 \times 14$$

∴ Median = 470
Thus, the median is 470.

10. (a) 1 देखि 30 सम्म लेखिएका सङ्ख्यापत्तीहरूबाट नहेरीकन एउटा पत्ती थुत्दा सो पत्ती 5 अथवा 7 ले निःशेष भाग जाने सङ्ख्या पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।
A number card is drawn randomly from a group of number card numbered from 1 to 30. Find the probability of getting a card which is exactly divisible by 5 or 7.

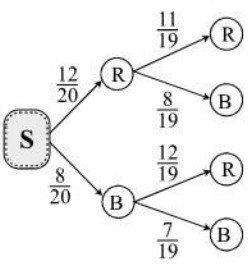
⇨ Here, S = {1, 2, 3, ..., 30} ∴ n(S) = 30
Let A and B be the events of numbers divisible by 5 and 7 respectively.
So, A = {5, 10, 15, 20, 25, 30} ∴ n(A) = 6
and B = {7, 14, 21, 28} ∴ n(B) = 4
We know that,

$$P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{6}{30} + \frac{4}{30} = \frac{10}{30}$$

∴ $P(A \text{ or } B) = \frac{1}{3}$

Thus, the required probability is $\frac{1}{3}$.

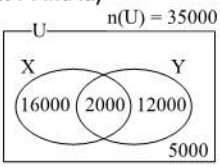
(b) एउटा बाकसमा 20 ओटा उस्तै र उत्रै खेलौनाहरू छन् । तिनीहरूमध्ये 12 ओटा रातो रङ्का र बाँकी निलो रङ्का छन् । यदि नहेरीकन पालैपालो दुईओटा खेलौनाहरू निकाल्दा (पुनः नराखी) बन्ने सबै परिणामहरूको सम्भाव्यताहरूलाई वृक्षचित्रमा देखाउनुहोस् ।
There are 20 toys of same shape and size in a box. Out of them, 12 are red colured and remainhing blue coloured. If two toys are drawn randomly in succession (without replacement), show the probabilities of all possible outcomes in a tree-diagram.



⇨ Here, let, R and B be the events with red and blue colours respectively.
So, n(S) = 20, n(R) = 12 and n(B) = n(S) – n(R) = 20 – 12 = 8
Now, the probability tree diagram is given alongside.

समूह 'ग' (Group 'C') [10 × 4 = 40]

11. एउटा नगरपालिकाको चुनावमा X र Y दुई उम्मेदवारहरू मेयर पदका लागि उठेछन् र त्यहाँ मतदाताको सूचीमा 35000 जना रहेछन् । मतदाताले एक जनालाई मात्रै मत खसाल्नुपर्ने थियो । 18000 जनाले X लाई, त्यस्तै 14000 जनाले Y लाई र 2000 जनाले दुवैलाई पनि मत दिएछन् ।
In an election of a municipality, two candidates X and Y stood for the post of Mayor and 35000 people were in the voter list. Voters were supposed to cast the vote for a single candidate. 18000 people cast vote for X, 14000 people cast for Y and 2000 people cast vote even for both.
(i) यी जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show these information in a Venn-diagram.)
(ii) कति जनाले मत खसालेनन् ? पत्ता लगाउनुहोस् । (How many people didn't cast vote? Find it.)
(iii) कति मत सदर भयो ? पत्ता लगाउनुहोस् । (How many votes were valid? Find it.)



⇨ Here, let, X and Y be the sets of votes given to the candidates X and Y respectively.
By the question, n(U) = 35000, n(X) = 18000, n(Y) = 14000 and n(X ∩ Y) = 2000.
(i) We have, $n(X \cup Y) = n_0(X) + n_0(Y) + n(X \cap Y) = 16000 + 12000 + 2000$
∴ $n(X \cup Y) = 30000$

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(ii) Again, people did not cast vote $n(\overline{X \cup Y}) = n(U) - n(X \cup Y)$
$= 35000 - 30000 = 5000$
(iii) Now, no. of valid votes = $n_0(X) + n_0(Y) = 16000 + 12000 = 28000$
Thus, 5000 people did not cast vote and 28000 were the valid no. of votes.

12. एउटा क्यामेराको अङ्कित मूल्यमा 15% छुट दिई 15% मूल्य अभिवृद्धि कर लगाएर बेचियो । यदि मूल्य अभिवृद्धि करसहितको मूल्य र छुटपछिको मूल्यबीचको फरक रु. 1275 भए सो क्यामेराको अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After allowing 15% discount on the marked price of a Camera, 15% VAT was levied and sold it. If the difference between the selling price with VAT and selling price after discount is Rs 1275, find the marked price of that Camera.

⇨ Here, Discount rate (R) = 15%
VAT = 15% and Price with VAT – Price after discount = Rs 1275
Let, the marked price be x then,
Price after discount = (100 – 15)% of x = 85% of x = 0.85x
Price with VAT = (100 + 15)% of 0.85x = 115% of 0.85x = 1.15 × 0.85x
We know that,
$1.15 \times 0.85x - 0.85x = 1275$ or, $0.85x (1.15 - 1) = 1275$
or, $0.85x = 8500$ $\therefore$ $x = 10000$
Thus, the marked price is Rs 10000.

13. एउटा त्रिभुजाकार जग्गाका किनाराहरू 4 : 5 : 6 को अनुपातमा छन् । यदि यसको परिमिति 1500 मिटर भए उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The sides of a triangular field are in the ratio of 4 : 5 : 6. If its perimeter is 1500 m, what is the area of that field? Find it.

⇨ Here, let the sides of the triangular field be 4x, 5x and 6x respectively.
By the question,
Perimeter = 1500 m or, $4x + 5x + 6x = 1500$ m
or, $15x = 1500$ m $\therefore$ $x = 100$ m
So, the sides of triangular field are;
$a = 4x = 4 \times 100$ m $= 400$ m
$b = 5x = 5 \times 100$ m $= 500$ m
$c = 6x = 6 \times 100$ m $= 600$ m
We have, $s = \frac{a+b+c}{2} = \frac{400+500+600}{2} = \frac{1500}{2} = 750$ m
Now, Area of the field $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{750\,(750-400)\,(750-500)\,(750-600)}$
$= \sqrt{750 \times 350 \times 250 \times 150} = 99215.67$ m^2
Thus, the area of the field is 99215.67 m^2.

14. ल.स. निकाल्नुहोस् (Find the LCM of): $m^4 + m^3 - m^2 - m$, $m^4 - m$ and $4m^2 - 4$

⇨ Here, First expression $= m^4 + m^3 - m^2 - m = m(m^3 + m^2 - m - 1) = m\{m^2(m+1) - 1(m+1)\}$
$= m(m+1)(m^2-1) = m(m+1)(m+1)(m-1)$
Second expression $= m^4 - m = m(m^3 - 1) = m(m-1)(m^2 + m + 1)$
Third expression $= 4m^2 - 4 = 4(m^2 - 1) = 4(m+1)(m-1)$
Now, LCM = HCF × remaining factors
$= (m-1) \cdot m(m+1)(m+1)(m^2+m+1)\,4 = 4\,m\,(m+1)^2\,(m-1)\,(m^2+m+1)$
Thus, the LCM is $4m\,(m+1)^2\,(m-1)\,(m^2+m+1)$

15. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 6 छ । यदि सो सङ्ख्याबाट 36 घटाइयो भने अङ्कहरूको स्थान परिवर्तन हुन्छ । सुरुको सङ्ख्या पत्ता लगाउनुहोस् ।
The sum of the digits in a two digits number is 6. If 36 is subtracted from the number, the places of the digits are interchanged. Find the initial number.

⇨ Here, let digit of one's place = x, digit of ten's place = y then the required number = 10y + x
In the first condition:
$x + y = 6$ .....(i)
In the second condition:
$10y + x - 36 = 10x + y$ or, $9y - 9x - 36 = 0$
or, $9x - 9y = -36$ $\therefore$ $x - y = -4$ .....(ii)
Solving equation (i) and (ii) then,
$x + y = 6$
$x - y = -4$
$2x = 2$
$\therefore$ $x = 1$

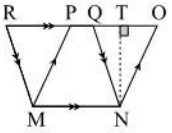
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Putting the value of x in (i) then,
$x + y = 6$
or, $1 + y = 6$ $\quad\therefore\quad y = 5$
Now, the required number $= 10y + x = 10 \times 5 + 1 = 51$
Thus, the required two digit number is 51.

16. एउटै आधार MN र उही समानान्तर रेखाहरू MN र RO बीच बनेका समानान्तर चतुर्भुजहरू RMNQ र PMNO को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।
Prove that the parallelograms RMNQ and PMNO standing on the same base MN and between the same parallel lines MN and RO have the same area.

⇨ Here,
Given: Parallelograms RMNQ and PMNO are standing on the same base and between the same parallels.
To prove: Ar. (□RMNQ) = Ar. (□PMNO)
Construction: NT height of □PMNO is drawn.

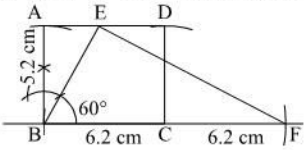


Proof:

S.N.	Statements	S.N.	Reasons
1.	Ar. (□RMNQ) = MN × TN	1.	Area of parallelogram = b × h
2.	Ar. (□PMNO) = MN × TN	2.	Area of parallelogram = b × h
3.	Ar. (□RMNQ) = Ar. (□PMNO)	3.	From (1) and (2)

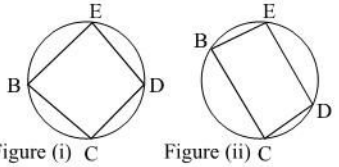
Proved.

17. लम्बाइ 6.2 से.मि. र चौडाइ 5.2 से.मि. भएको आयतको क्षेत्रफलसँग बराबर हुने गरी एउटा कोण 60° भएको त्रिभुजको रचना गर्नुहोस् ।
Construct a rectangle with length 6.2 cm and breadth 5.2 cm. Also, construct a triangle having one angle 60° and equal in the area to the rectangle.



⇨ Here, ΔEBF is the required triangle whose area is equal to the area of given rectangle ABCD.

18. चक्रीय चतुर्भुज BCDE का सम्मुख कोणहरूबीचको सम्बन्ध प्रयोगद्वारा खोजी गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Explore experimentally the relationship between opposite angles of a cyclic quadrilateral BCDE. (Two circles having radii at least 3 cm are necessary.)



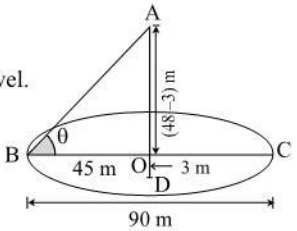
⇨ Here, experimental verification.
Cyclic quadrilaterals BCDE are drawn.
Measurement table

Fig.	∠B	∠D	∠E	∠C	∠B + ∠D	∠E + ∠C	Remarks
(i)	95°	85°	88°	92°	180°	180°	∠B + ∠D = 180° ∠E + ∠C = 180°
(ii)	93°	87°	92°	88°	180°	180°	∠B + ∠D = 180° ∠E + ∠C = 180°

From the above table, it is concluded that the sum of opposite angles of a cyclic quadrilateral is 180°.

19. एउटा वृत्ताकार पोखरीको व्यास 90 मिटर छ र यसको बीचमा एउटा खम्बा गाडिएको छ । उक्त खम्बाको उचाइ 48 मिटर छ र पोखरीको गहिराइ 3 मिटर छ भने परिधिको कुनै एक बिन्दुबाट उक्त खम्बाको टुप्पोको उन्नतांश कोण पत्ता लगाउनुहोस् ।
The diameter of a circular pond is 90 meter and a pillar is fixed at the centre of pond. The height of the pole is 48 meter and the pond is 3 meter deep. Find the angle of elevation of the top of pole from a point of the circumference.

⇨ Here, let BC = 90 m be the diameter of the pond.
So, OB = 45 m
Let, AO = (48 – 3) = 45 m be the height of the pole above the water level.
∠ABO = θ be angle of elevation.
From the right angled ΔAOB,



$\tan\theta = \frac{p}{b}$ $\quad$ or, $\tan\theta = \frac{AO}{OB} = \frac{48\text{ m} - 3\text{ m}}{45\text{ m}} = \frac{45\text{ m}}{45\text{ m}} = 1$

or, $\tan\theta = \tan 45°$ $\quad\therefore\quad \theta = 45°$
Thus, the required angle of elevation is 45°

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20. यदि तल दिइएको आँकडाको तेस्रो चतुर्थांश (Q_3) = 32 भए x को मान पत्ता लगाउनुहोस् ।
Find the value of x if third quartile (Q_3) of the data given below is 32:

Marks obtained	0-10	10-20	20-30	30-40	40-50
No. of Students	3	7	10	x	3

⇨ Here, calculation of missing frequency:

Marks (x)	No. of students (f)	c.f
0 - 10	3	3
10 - 20	7	10
20 - 30	10	20
30 - 40	x	20 + x
40 - 50	3	23 + x
	N = 23 + x	

Given Q_3 is 32 so Q_3 class = 30 - 40

We know that,

$$Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - \text{c.f.}\right) \quad \text{or, } 32 = 30 + \frac{10}{x}\left[\frac{3(23+x)}{4} - 20\right] \quad \text{or, } 2 = \frac{10}{x}\left[\frac{69 + 3x - 80}{4}\right]$$

$$\text{or, } 1 = \frac{5}{x}\frac{(3x-11)}{4} \quad \text{or, } 15x - 55 = 4x \quad \text{or, } 11x = 55$$

$\therefore$ x = 5 Thus, the value of x is 5.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. एउटा बैंकले खाता M मा 5% प्रतिवर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता N मा 6% प्रतिवर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ । यदि तपाईं 2 वर्षका लागि रु. 12,500 सो बैंकमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? हिसाब गरी कारणसहित उल्लेख गर्नुहोस् ।
A bank has fixed the rate of interest 5% p.a. semi-annually compound interest in account M and 6% per annum annually compound interest in account N. If you are going to deposit Rs 12,500 for 2 years in the same bank, in which account will you deposit and why? Give your logic with calculation.

⇨ Here,

Account M	Account N
Rate (R) = 5% Time (T) = 2 years Principal (P) = Rs 12500	Rate (R) = 6% Time (T) = 2 years Principal (P) = Rs 12500
Semi–annually	Annually

We have,

$$\text{Semi–annually compound interest} = P\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right] = 12500\left[\left(1 + \frac{5}{200}\right)^{2\times 2} - 1\right]$$

$$= 12500\,[1.103812891 - 1] \quad = 12500 \times 0.1038128906$$

$\therefore$ S.A. C.I. = Rs 1297.66

Again,

$$\text{Annually compound interest} = P\left[\left(1 + \frac{R}{100}\right)^{T} - 1\right] = 12500\left[\left(1 + \frac{6}{100}\right)^{2} - 1\right] = 12500 \times 0.1236$$

$\therefore$ A. C.I. = Rs 1545

Now, A.C.I – S.A.C.I = Rs 1545 – Rs 1297.66 = Rs 247.34

Thus, I will deposit in account N because it gives me more interest.i.e. Rs 247.34.

22. एउटा पानी ट्याङ्की बेलनाकार र अर्धगोलाकार भाग मिलेर बनेको छ । सो ट्याङ्कीको पूरा उचाइ 14 मिटर छ र आधारको क्षेत्रफल 38.5 वर्गमिटर भए उक्त ट्याङ्कीमा प्रतिलिटर 24 पैसाका दरले पानी भर्न जम्मा कति खर्च लाग्ला ? पत्ता लगाउनुहोस् ।
A water tank is formed with the combination of cylinder and hemisphere. The total height of the tank is 14 m and base area is 38.5 square m. If the tank is filled with water at the rate of 24 paisa per litre, what is the total cost for the water? Find it.

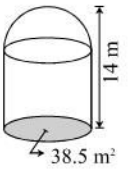
⇨ Here, base area (A) = 38.5 m^2

Total height (H) = 14 m

We know that,

$$\text{Base area (A)} = \pi r^2 \quad \text{or, } 38.5 = \frac{22}{7}r^2 \quad \text{or, } \frac{38.5 \times 7}{22} = r^2$$

$$\text{or, } r^2 = \frac{49}{4} \quad \text{or, } r^2 = \left(\frac{7}{2}\right)^2 \quad \therefore \quad r = 3.5 \text{ m}$$



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We have, Total volume $= V(\text{Cylinder}) + V(\text{Hemisphere}) = BA \times h + \frac{2}{3}\pi r^3$

$= 38.5 \times (14 - 3.5) + \frac{2}{3} \times \frac{22}{7} \times (3.5)^3 = 404.25 + 89.83 = 494.08\ m^3$

Now, Volume of water $= 494.08 \times 1000\ \ell = 494080\ \ell$

So, the total cost $= 494080 \times$ Rs $0.24 =$ Rs 118579.20

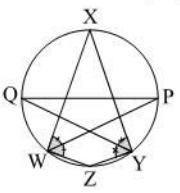
Thus, the total cost for the water is Rs 118579.20

23. सरल गर्नुहोस् (Simplify): $\dfrac{\left(d^2-\frac{1}{e^2}\right)^d\left(d-\frac{1}{e}\right)^{e-d}}{\left(e^2-\frac{1}{d^2}\right)^e\left(e+\frac{1}{d}\right)^{d-e}}$

⇨ Here, $\dfrac{\left(d^2-\frac{1}{e^2}\right)^d\left(d-\frac{1}{e}\right)^{e-d}}{\left(e^2-\frac{1}{d^2}\right)^e\left(e+\frac{1}{d}\right)^{d-e}} = \dfrac{\left[\left(d+\frac{1}{e}\right)\left(d-\frac{1}{e}\right)\right]^d\left(d-\frac{1}{e}\right)^{e-d}}{\left[\left(e+\frac{1}{d}\right)\left(e-\frac{1}{d}\right)\right]^e\left(e+\frac{1}{d}\right)^{d-e}} = \dfrac{\left(d+\frac{1}{e}\right)^d\left(d-\frac{1}{e}\right)^{d+e-d}}{\left(e+\frac{1}{d}\right)^{e+d-e}\left(e-\frac{1}{d}\right)^e}$

$= \dfrac{\left(d+\frac{1}{e}\right)^d\left(d-\frac{1}{e}\right)^e}{\left(e+\frac{1}{d}\right)^d\left(e-\frac{1}{d}\right)^e} = \left(\dfrac{\frac{de+1}{e}}{\frac{ed+1}{d}}\right)^d\left(\dfrac{\frac{de-1}{e}}{\frac{de-1}{d}}\right)^e = \left(\frac{d}{e}\right)^d\left(\frac{d}{e}\right)^e = \left(\frac{d}{e}\right)^{d+e}$

24. WXYZ एउटा चक्रीय चतुर्भुज हो । यदि ∠XWZ र ∠XYZ का अर्धकहरूले वृत्तलाई क्रमशः बिन्दुहरू P र Q मा भेट्छन् भने PQ वृत्तको व्यास हो भनी प्रमाणित गर्नुहोस् ।
WXYZ is a cyclic quadrilateral. If the bisectors of ∠XWZ and ∠XYZ meet the circle at the poinhts P and Q respectively then prove that PQ is the diameter of the circle.



⇨ Here, Given: WXYZ is a cyclic quadrilateral. WP and QY are the bisectors of ∠XWZ and ∠XYZ respectively.
To prove: PQ is a diameter.
Proof:

Statements	Reasons
1. $\overset{\frown}{PYZ} = \overset{\frown}{XP}$ and $\overset{\frown}{QWZ} = \overset{\frown}{XQ}$	1. Opposite arcs of equal angles.
2. $\overset{\frown}{PYZ} + \overset{\frown}{QWZ} = \overset{\frown}{XP} + \overset{\frown}{XQ}$	2. Addition axiom in statement (1)
3. $\overset{\frown}{QWZYP} = \overset{\frown}{PXQ}$	3. Whole part axiom.
4. PQ is a diameter.	4. From (3), arcs on both the sides of PQ are equal.

Proved.

10. SEE EXAMINATIONS 2074 SET 7 [MWDR & FWDR] RE-109'DC'

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) कुनै सामानको अङ्कित मूल्य रु. x छ । यदि यसमा रु. y छुट दिइयो भने छुट प्रतिशत कति हुन्छ ? लेख्नुहोस् ।
The marked price of an article is Rs x. If a discount of Rs y is allowed on it, what is the discount percent? Write it.

⇨ Here, discount percent $(D)\% = \frac{y}{x} \times 100\%$

(b) आधार भुजा a cm र छड्के उचाइ b cm भएको वर्ग आधार पिरामिडको पूरा सतहको क्षेत्रफल कति हुन्छ ? लेख्नुहोस् ।
What is the total surface area of a square based pyramid having base side a cm and slant height b cm? Write it.

⇨ Here, TSA of square based pyramid $= (2ab + b^2)$ sq. cm

2. (a) $\sqrt[4]{x}$ मा सर्डको क्रम कति हुन्छ ? लेख्नुहोस् । (Write down the order of surd in $\sqrt[4]{x}$.)

⇨ Here, the order of given surd is 4.

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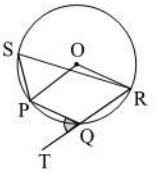
(b) यदि कुनै तथ्याङ्कको पहिलो चतुर्थांश पर्ने श्रेणीको तल्लो सीमा L, सो श्रेणीको बारम्बारता f, श्रेणीअन्तर i, बारम्बारताहरूको जोड N र पहिलो चतुर्थांश श्रेणीभन्दा अघिल्लो श्रेणीको सञ्चित बारम्बारता c.f. छन् भने पहिलो चतुर्थांश पत्ता लगाउने सूत्र लेख्नुहोस् ।
If the lower limit of the first quartile class is L, frequency of that class is f, class interval i, sum of the frequencies N and the cumulative frequency of preceeding class is c.f. then write the formula for finding the first quartile.

⇨ Here, the formula of $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

3. (a) एउटै आधार QR र उही समानान्तर रेखाहरू QR र PS बीच रहेका त्रिभुजहरू PQR र SQR को क्षेत्रफलबीच के सम्बन्ध छ ? लेख्नुहोस् ।
What is the relation between the areas of triangle PQR and SQR standing on the same base QR and between the same parallel lines QR and PS? Write it.

⇨ Here, Area of ΔPQR = Area of ΔSQR is the required relation.

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो भने ∡PQT सँग बराबर हुने कोण कुन हो ? लेख्नुहोस् ।
In the given circle, O is the centre of circle. Which angle is equal to ∡PQT? Write it.



⇨ Here, ∡PSR is equal to ∡PQT.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) अमेरिकी डलर 1 = ने.रु. 105 दिइएको छ । यदि यो दरमा नेपाली मुद्रा 10% ले अवमूल्यन भयो भने नेपाली रु. 173250 सित कति अमेरिकी डलर साट्न सकिन्छ ? निकाल्नुहोस् ।
It is given that 1 American dollar = NRs 105. If the Nepali currency is devaluated by10% at this rate, how many American dollars can be exchanged with NRs 173,250? Find it.

⇨ Here, US dollar 1 = NRs 105
Nepali currency is devaluated by 10%
So, new rate is; US dollar 1 = NRs 105 + 10% of NRs 105
or, US dollar 1 = NRs 105 + 0.1 × NRs 105
∴ US dollar 1 = NRs 115.50
Now, the required US dollar $= \frac{\text{Amount to be exchanged}}{\text{New rate}} = \frac{\text{NRs } 173250}{\text{NRs } 115.50} = 1500$
Thus, the required US dollar ($) is 1500.

(b) वि.सं. 2072 को सुरुमा एउटा सहरको जनसङ्ख्या 50,000 थियो । यदि वार्षिक जनसङ्ख्या वृद्धिदर 10% छ भने वि.सं. 2074 को अन्तमा त्यो सहरको जनसङ्ख्या कति होला ? पत्ता लगाउनुहोस् ।
The beginning of 2072 B.S., the population of a town was 50,000. If the annual population growth rate is 10%, what will be the population of the town at the end of 2074 B.S.? Find it.

⇨ Here, Population of the town in 2072 (P) = 50000
Population growth rate (R) = 10%
Population in 2074 (P_T) = ?
Time = 3 years [From beginning of 2072 to end of 2074]
We know that;

$P_T = P\left(1 + \frac{R}{100}\right)^T$ or, $P_T = 5000\left(1 + \frac{10}{100}\right)^3$

or, $P_T = 50000 \times 1.331$ ∴ $P_T = 66550$

Thus, the population of the town at the end of 2074 is 66550.

5. (a) एउटा बेलनाकार ट्याङ्कीको क्षमता 673.75 लिटर छ । यदि यसको उचाइ 1.75 मिटर भए आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The capacity of cylindrical water tank is 673.75 litres. If its height is 1.75 meter then find the radius of the base.

⇨ Here, Capacity of the tank = 673.75 litres
Height of the tank = 1.75 m
We know that;
Volume of the tank = 673.75 × 1000 cm^3

So, $\pi r^2 h = 673750$ or, $\frac{22}{7} \times r^2 \times 1.75 \times 100 = 673750$ or, $r^2 = \frac{673750 \times 7}{22 \times 175}$

or, $r^2 = 1225$ or, $r^2 = 35^2$ ∴ $r = 35$ cm

Thus, the height of the tank is 35 cm.

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(b) यदि एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 1848 वर्ग से.मि. भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
If the total surface area of a hemi-sphere is 1848 square cm then find its radius.

⇨ Here, TSA of hemisphere = 1848 cm^2
We know that, TSA of hemisphere = $3\pi r^2$

or, $3\pi r^2 = 1848$ or, $3 \times \frac{22}{7} \times r^2 = 1848$

or, $r^2 = \frac{1848 \times 7}{3 \times 22} = 196$ or, $r^2 = 14^2$

∴ r = 14 cm Thus, the radius of the hemisphere is 14 cm.

(c) यदि एउटा सोलीको उचाइ आधारको अर्धव्यासको तीन गुणा र यसको आयतन 1331π घन से.मि. भए सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
If the height of a cone is three times the raidus of the base and its volume is 1331π cubic cm then find the radius of the base of the cone.

⇨ Here, height of cone = 3 × radius of the cone ∴ h = 3r
We have given, Volume (V) = 1331 π cm^3

or, $\frac{1}{3}\pi r^2 h = 1331\ \pi$ or, $\frac{1}{3}\pi r^2 \times 3\ r = 1331\ \pi$

or, $r^3 = 1331$ or, $r^3 = 11^3$ ∴ r = 11 cm

Thus, the radius of the cone is 11 cm.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $b^2 - b + 1$ and $b^4 + b$

⇨ Here, First expression = $b^2 - b + 1$
Second expression = $b^4 + b = b(b^3 + 1) = b(b + 1)(b^2 - b + 1)$
Thus, HCF = $b^2 - b + 1$

(b) हल गर्नुहोस् (Solve): $\sqrt{4x^2 - 4} = 2x - 2$

⇨ Here, $\sqrt{4x^2 - 4} = 2x - 2$
Squaring both the sides we get,

$(\sqrt{4x^2 - 4})^2 = (2x - 2)^2$ or, $4x^2 - 4 = 4x^2 - 8x + 4$

or, $8x = 8$ ∴ x = 1

Thus, the value of x is 1.

7. (a) यदि $a = 4^x$, $b = 4^y$ र $a^y.b^x = 16$ भए प्रमाणित गर्नुहोस्: xy = 1.
If $a = 4^x$, $b = 4^y$ र $a^y.b^x = 16$ then prove that: xy = 1.

⇨ Here, $a = 4^x$, $b = 4^y$ and $a^y b^x = 16$
So, $a^y b^x = 16$ or, $(4^x)^y (4^y)^x = 16$ or, $4^{xy}\ 4^{xy} = 16$ or, $4^{xy + xy} = 4^2$
or, $4^{2xy} = 4^2$ or, 2xy = 2 Thus, xy = 1. **Proved.**

(b) सरल गर्नुहोस् (Simpilfy): $\frac{1}{a-b} - \frac{2b}{a^2 - b^2}$.

⇨ Here, $\frac{1}{a-b} - \frac{2b}{a^2 - b^2} = \frac{1}{a-b} - \frac{2b}{(a+b)(a-b)}$

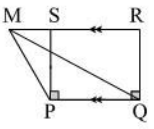
$= \frac{a + b - 2b}{(a+b)(a-b)} = \frac{a-b}{(a+b)(a-b)} = \frac{1}{a+b}$

(c) सरल गर्नुहोस् (Simpilfy): $\frac{e^2 + ef + f^2}{e+f} + \frac{e^2 - ef + f^2}{e-f}$.

⇨ Here, $\frac{e^2 + ef + f^2}{e+f} + \frac{e^2 - ef + f^2}{e-f} = \frac{(e-f)(e^2 + ef + f^2) + (e+f)(e^2 - ef + f^2)}{(e+f)(e-f)}$

$= \frac{e^3 - f^3 + e^3 + f^3}{e^2 - f^2} = \frac{2e^3}{e^2 - f^2}$

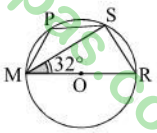
8. (a) चित्रमा PQRS एउटा आयत हो, जहाँ PQ = 3PS = 12 से.मि. छ । रेखा RS लाई बिन्दु M सम्म लम्ब्याइएको छ । ΔPQM को क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the figure, PQRS is a rectangle, in which PQ = 3PS = 12 cm. RS is extended up to the point M, what is the area of ΔPQM? Find it.



⇨ Here, PQRS is a rectangle, PQ = 3 PS = 12 cm
∴ PQ = 12 cm and PS = 4 cm
(i) Area of rectangle = PQ × PS = 12 cm × 4 cm = 48 cm^2
(ii) ΔPQM and rectangle PQRS are on the same base and between the same parallels.
So, Area of ΔPQM = $\frac{1}{2}$ Area of rectangle PQRS = $\frac{1}{2} \times 48\ cm^2 = 24\ cm^2$
Thus, the area of ΔPQM is 24 cm^2.

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(b) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠SMR = 32° भए ∠SRM र ∠MPS को नाप पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If ∠SMR = 32°, find the values of the ∠SRM and ∠MPS.



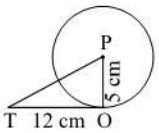
⇨ Here, ∠SMR = 32°

(i) ∠SMR + ∠SRM = 90° [Being MR a diameter]
or, 32° + ∠SRM = 90° ∴ ∠SRM = 58°

(ii) ∠MPS + ∠SRM = 180° [Being the opposite angles of a cyclic quadrilateral MRSP]
or, ∠MPS + 58° = 180° ∴ ∠MPS = 122°

Thus, the values of ∠SRM and ∠MPS are 58° and 122° respectively.

(c) चित्रमा P वृत्तको केन्द्र र TO स्पर्शरेखा छ । यदि TO = 12 से.मि. र PO = 5 से.मि. भए PT को लम्बाइ कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the figure, P is centre of circle and TO is tangent to the circle. If TO = 12 cm and PO = 5 cm then what is the length of PT? Find it.



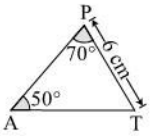
⇨ Here, PO = 5 cm and TO = 12 cm.

(i) ∠POT = 90° [Being PO radius and TO tangent]

(ii) $PT^2 = PO^2 + TO^2$ [Being ΔPOT a right angled triangle] $= 5^2 + 12^2 = 25 + 144 = 169$
or, $PT^2 = 13^2$ ∴ PT = 13 cm

Thus, the length of PT is 13 cm.

9. (a) दिइएको ΔTAP मा ∠TAP = 50°, ∠TPA = 70°, TP = 6 cm र ΔTAP को क्षेत्रफल 18 वर्ग से.मि. भए TA को लम्बाइ पत्ता लगाउनुहोस् ।
In the given ΔTAP, ∠TAP = 50°, ∠TPA = 70°, TP = 6 cm and area of ΔTAP = 18 sq. cm, find the length of TA.



⇨ Here, ∠P = 70°, ∠A = 50°

(i) From ΔTAP, ∠T = 180° − (∠P + ∠A) = 180° − (70° + 50°) = 180° − 120° ∴ ∠T = 60°

(ii) Area of $\Delta PAT = \frac{1}{2} PT \times TA \times \sin \angle T$

or, $18 = \frac{1}{2} \times 6 \times TA \times \sin 60°$ or, $18 = 3 \times TA \times \frac{\sqrt{3}}{2}$

or, $6 \times 2 = \sqrt{3}\, TA$ or, $TA = \frac{12}{\sqrt{3}} = 4\sqrt{3}$

Thus, the length of TA is $4\sqrt{3}$ cm.

(b) एउटा निरन्तर श्रेणीको बारम्बारता र मध्यमानको गुणनफलको योग (Σfx) = 460 + 23a छ । यदि बारम्बारताको योगफल (Σf) = 20 + a भए सो श्रेणीको मध्यक ($\bar{x}$) को मान निकाल्नुहोस् ।
In a continuous series, the sum of the product of the frequencies and mid-values (Σfx) = 460 + 23a. If the sum of the frequencies (Σf) = 20 + a, find the value of the mean ($\bar{x}$) of the series.

⇨ Here, Σfx = 460 + 23a, Σf = 20 + a.

We know that, Mean $(\bar{X}) = \frac{\Sigma fx}{\Sigma f} = \frac{460 + 23a}{20 + a} = \frac{23(20 + a)}{(20 + a)}$ ∴ Mean $(\bar{X})$ = 23

Thus, the mean is 23.

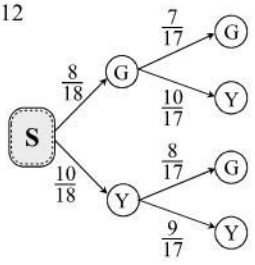
10. (a) एउटा निष्पक्ष सिक्का र एउटा निष्पक्ष डाइसलाई एकैपटक उफारियो । सिक्कामा टाउको र डाइसमा 5 आउने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।
A fair coin is tossed and at the same time a fair dice is rolled. What is the probability of getting head in coin and 5 in dice? Find it.

⇨ Here, S in dice = {1, 2, 3, 4, 5, 6}, ∴ $n(S_1)$ in dice = 6
S in coin = {H, T}, ∴ $n(S_2)$ in coin = 2

We have P(5 and H) = $P(5) \times P(H) = \frac{n(5)}{n(S_1)} \times \frac{n(H)}{n(S_2)} = \frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$

Thus, the probability of getting 5 on dice and head on coin is $\frac{1}{12}$.

(b) एउटा झोलामा 8 ओटा हरिया र 10 ओटा पहेँला उत्रै र उस्तै कागतीहरू छन् । उक्त झोलाबाट दुईओटा कागतीहरू एकपछि अर्को पुनः नराखी झिक्दा आउने सबै परिणामहरूको सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् ।
A bag contains 8 green and 10 yellow lemons of same size and shape. Two lemons are drawn randomly in succession without replacement. Show the probabilities of all possible outcomes in a tree diagram.



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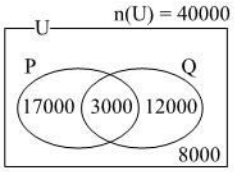
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⇨ Here, let G and Y denote the set of green balls and yellow balls respectively.
So, n(G) = 8, n(Y) = 10 & n(S) = 18
Now, the probability tree diagram is shown alongside.

समूह 'ग' (Group 'C') [10 × 4 = 40]

11. एउटा नगरपालिकाको चुनावमा P र Q दुई उम्मेदवारहरू मेयर पदका लागि उठेछन् र त्यहाँ मतदाताको सूचीमा 40000 जना रहेछन् । मतदाताले एक जनालाई मात्रै भोट खसाल्नुपर्ने थियो । 20000 जनाले P लाई, त्यस्तै 15000 जनाले Q लाई र 3000 जनाले दुवैलाई पनि मत दिएछन् ।
In an election of a municipality, two candidates P and Q stood for the post of Mayor and 40000 people were in the voter list. Voters were supposed to cast the vote for a single candidate. 20000 people cast vote for P, 15000 people cast for Q and 3000 people cast vote even for both.
(i) यी जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show these information in a Venn-diagram.)
(ii) कति जनाले भोट खसालेनन् ? पत्ता लगाउनुहोस् । (How many people didn't cast vote? Find it.)
(iii) कति भोट सदर भयो ? पत्ता लगाउनुहोस् । (How many votes were valid? Find it.)

⇨ Here, let P and Q be the sets of votes given for two candidates P and Q respectively.
By the question,
n(U) = 40000, n(P) = 20000, n(Q) = 15000 and n(P ∩ Q) = 3000
Now, the Venn–diagram of above information;
From the Venn–diagram,



(i) $n(\overline{P \cup Q}) = n(U) - n(P \cup Q) = 40000 - (17000 + 12000 + 3000) = 8000$
(ii) Now, no. of valid votes = $n_0(P) + n_0(Q) = 17000 + 12000 = 29000$
Thus, 8000 people did not cast vote and 29000 were the valid no. of votes.

12. एउटा मोबाइलको अङ्कित मूल्यमा 20% छुट दिई 15% मूल्य अभिवृद्धि कर लगाएर बेचियो । यदि मू.अ.करसहितको मूल्य र छुटपछिको मूल्यबीचको फरक रु. 1800 भए मोबाइलको अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After allowing 20% discount on the marked price of a mobile, 15% VAT was levied and sold it. If the differences between selling price with VAT and selling price after discount is Rs 1800, find the marked price of that mobile.

⇨ Here, Discount rate (R) = 20%; VAT = 15%
Price with VAT – Price after discount = Rs 1800
Let the marked price be x then,
Price after discount = (100 – 20)% of x = 80% of x = 0.8 × x = 0.8x
Price with VAT = (100 + 15)% of 0.8x = 115% of 0.8x = 1.15 × 0.8x = 0.92 x
Now, price including VAT – Price after discount = 1800
or, 0.92x – 0.8x = 1800 or, 0.12 x = 1800
∴ x = 15000 Thus, the marked price of the mobile is Rs 15000.

13. एउटा त्रिभुजाकार जग्गाका किनाराहरू 5 : 6 : 7 को अनुपातमा छन् । यदि यसको परिमिति 1800 मिटर भए उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The sides of a triangular field are in the ratio of 5 : 6 : 7. If its perimeter is 1800 m, what is the area of that field? Find it.

⇨ Here, let the sides of the triangular field be 5x, 6x and 7x respectively.
By the question, perimeter = 1800 m
or, 5x + 6x + 7x = 1800 or, 18x = 1800
∴ x = 100 m
So, the sides of triangular field are;
a = 5x = 5 × 100 m = 500 m b = 6x = 6 × 100 m = 600 m c = 7x = 7 × 100 m = 700 m
We have, $s = \frac{a+b+c}{2} = \frac{500+600+700}{2} = 900$ m
Now, Area of the field $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{900\,(900-500)\,(900-600)\,(900-700)}$
$= \sqrt{900 \times 400 \times 300 \times 200} = 146969.38$ m^2
Thus, the area of the field is 146969.38 m^2.

14. ल.स. निकाल्नुहोस् (Find the LCM of): $p^4 + p^3 - p^2 - p$, $p^4 - p$ and $4p^2 - 4$

⇨ Here, First expression $= p^4 + p^3 - p^2 - p = p(p^3 + p^2 - p - 1) = p\,\{p^2(p+1) - 1(p+1)\}$
$= p(p+1)(p^2-1) = p(p+1)(p+1)(p-1)$
Second expression $= p^4 - p = p(p^3 - 1) = p(p-1)(p^2 + p + 1)$
Third expression $= 4p^2 - 4 = 4(p^2 - 1) = 4(p+1)(p-1)$
Now, LCM = HCF × Remaining factors $= (p-1)\,p\,(p+1)\,(p+1)\,(p^2+p+1)\,.\,4$
$= 4p(p+1)^2(p-1)(p^2+p+1)$
Thus, the LCM is $4p(p+1)^2(p-1)(p^2+p+1)$.

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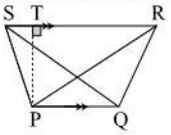
15. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 7 छ । यदि सो सङ्ख्याबाट 45 घटाइयो भने अङ्कहरूको स्थान परिवर्तन हुन्छ । सुरुको सङ्ख्या पत्ता लगाउनुहोस् ।
The sum of the digits in a two digits number is 7. If 45 is subtracted from the number, the places of the digits are interchanged. Find the initial number.

⇨ Here, let digit of ten's place = x
Digit of one's place = y
Then, the two digit number = 10x + y
In the first condition: x + y = 7 ... ...(i)
In the second condition: 10x + y – 45 = 10y + x
or, 9x – 9y = 45 ∴ x – y = 5 ... ...(ii)
Solving equation (i) and (ii) then,

$$\begin{array}{r} x + y = 7 \\ \underline{x - y = 5} \\ 2x = 12 \end{array}$$

∴ x = 6
Putting the value of x in (i) then, x + y = 7 or, 6 + y = 7 ∴ y = 1
Now, the two digit number = 10x + y = 10 × 6 + 1 = 61
Thus, the two digit number is 61.

16. एउटै आधार PQ र उही समानान्तर रेखाहरू PQ र SR बीच बनेका ΔPQR र ΔPQS को क्षेत्रफलहरू बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।
Prove that the areas of triangles PQR and PQS standing on the same base PQ and between the same parallel lines PQ and SR are equal.

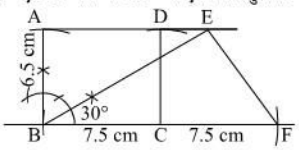


⇨ Here, Given: ΔPQR and △PQS are standing on same base and between the same parallels.
To prove: Area of △SPQ = Area of △PQR
Construction: Draw PT ⊥ SR
Proof:

S.N.	Statements	S.N.	Reasons
1.	Ar. (△PQR) = $\frac{1}{2}$ PQ × TP	1.	Area of △ is $\frac{1}{2}$ base × height
2.	Ar. (△PQS) = $\frac{1}{2}$ PQ × TP	2.	Area of △ is $\frac{1}{2}$ base × height
3.	Ar. (△PQR) = Ar. (△PQS)	3.	From (1) and (2)

Proved

17. लम्बाइ 7.5 से.मि. र चौडाइ 6.5 से.मि. भएको आयतको क्षेत्रफलसँग बराबर हुने गरी एउटा कोण 30° भएको त्रिभुजको रचना गर्नुहोस् ।
Construct a rectangle with length 7.5 cm and breadth 6.5 cm. Also, construct a triangle having one angle 30° and equal in the area of the rectangle.



⇨ Here, Length = 7.5 cm and breadth = 6.5 cm.
ΔEBF is the required triangle whose area is equal to the area of given rectangle ABCD.

18. चक्रीय चतुर्भुज IJKL का सम्मुख कोणहरूबीचको सम्बन्ध प्रयोगद्वारा खोजी गर्नुहोस् । (कम्तीमा 3 से.मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Explore experimentally the relationship between opposite angles of a cyclic quadrilateral IJKL. (Two circles having radii at least 3 cm are necessary.)

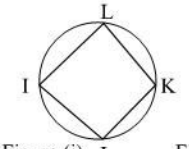


Figure (i)

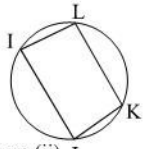


Figure (ii)

⇨ Here, experimental verification.
Cyclic quadrilaterals IJKL are drawn.
Measurement table

Fig.	∠I	∠K	∠L	∠J	∠I + ∠K	∠L + ∠J	Remarks
(i)	84°	96°	86°	94°	180°	180°	∠I + ∠K = 180° ∠L + ∠J = 180°
(ii)	85°	95°	94°	86°	180°	180°	∠I + ∠K = 180° ∠L + ∠J = 180°

From the above table, it is concluded that the sum of opposite angles of a cyclic quadrilateral is 180°.

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19. एउटा वृत्ताकार पोखरीको व्यास 130 मिटर छ। उक्त पोखरीको ठीक बीचमा एउटा खम्बा गाडिएको छ। एउटा व्यक्तिले पोखरीको किनाराको कुनै बिन्दुबाट खम्बाको टुप्पोको उन्नतांश कोण $\theta°$ पाएछ। यदि पोखरीको गहिराइ 3 मिटर र खम्बाको उचाइ 68 मिटर भए $\theta°$ को मान पत्ता लगाउनुहोस्।

The diameter of a circular pond is 130 m and a pillar is fixed at the centre of pond. A person finds the angle of elevation $\theta°$ of the top of the pillar from a point of the bank of the pond. If the depth of the pond is 3 meter and height of the pillar is 68 m then find the value of $\theta°$.

⇨ Here, Let BC = 130 m be the diameter of the pond.

So, $OB = \frac{130}{2} = 65$ m.

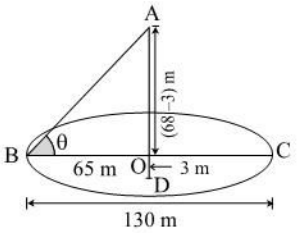
Let AO = (68 – 3) m = 65 m be the height of the pillar above the water level. $\measuredangle ABO = \theta$ be the angle of elevation.

From the right angled $\triangle AOB$,

$\tan\theta = \frac{p}{b}$ or, $\tan\theta = \frac{AO}{OB} = \frac{65}{65} = 1$

or, $\tan\theta = \tan 45°$ ∴ $\theta = 45°$

Thus, the required angle of elevation is 45°.



20. तल दिइएको आँकडाको तेस्रो चतुर्थांश (Q_3) = 128 भए x को मान पत्ता लगाउनुहोस्।

Find the value of x if third quartile (Q_3) of the data given below is 128:

Wages Rs/hr.	0-30	30-60	60-90	90-120	120-150	150-180
No. of workers	2	8	22	24	x	9

⇨ Here, Calculation of missing frequency :

Wages	No. of workers	cf
0 - 30	2	2
30 - 60	8	10
60 - 90	22	32
90 - 120	24	56
120 - 150	x	56 + x
150 - 180	9	65 + x
	N = 65 + x	

Given Q_3 is 128 so the Q_3 class = 120 - 150

We know that,

$Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right)$ or, $128 = 120 + \frac{30}{x}\left(\frac{3(65+x)}{4} - 56\right)$

or, $8 = \frac{30}{x}\left(\frac{195 + 3x - 224}{4}\right)$ or, $8 = \frac{30}{x}\left(\frac{3x - 29}{4}\right)$

or, 16x = 15 (3x – 29) or, 16x = 45x – 435

or, 435 = 29x ∴ x = 15 Thus, the value of x is 15.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. एउटा बैंकले खाता M मा 10% प्रतिवर्ष अर्धवार्षिक चक्रीय ब्याजदर र खाता N मा 15% प्रतिवर्ष वार्षिक चक्रीय ब्याजदर कायम गरेको छ। यदि तपाईं 2 वर्षका लागि रु. 40,000 सो बैंकमा जम्मा गर्दै हुनुहुन्छ भने कुन खातामा जम्मा गर्नुहुन्छ र किन ? गणना गरी कारणसहित उल्लेख गर्नुहोस्।

A bank has fixed the rate of interest 10% p.a. semi-annually compound interest in account M and 12% per annum annually compound interest in account N. If you are going to deposit Rs 40,000 for 2 years in the same bank, in which account will you deposit and why? Give your reason with calculation.

⇨ Here,

Account M	Account N
Rate (R) = 10%	Rate (R) = 15%
Time (T) = 2 years	Time (T) = 2 years
Principal (P) = Rs 40000	Principal (P) = Rs 40000
Semi-annually	Annually

We have,

Semiannually compound interest $= p\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right] = 40000\left[\left(1 + \frac{10}{200}\right)^{2\times 2} - 1\right]$

$= 40000 \times 0.21550625 = \text{Rs } 8620.25$

Again, Annually compound interest $= P\left[\left(1 + \frac{R}{100}\right)^{T} - 1\right] = 40000\left[\left(1 + \frac{15}{100}\right)^{2} - 1\right]$

$= 40000 \times 0.3225 = \text{Rs } 12900$

Now, A.C.I – S.A.C.I = Rs 12900 – Rs 8620.25 = Rs 4279.75

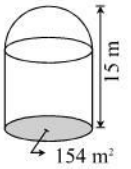
Thus, I will deposit in account N because it gives me more interest i.e. Rs 4279.75.

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22. एउटा पानी ट्याङ्कीको तल्लो भाग बेलना र त्यसमाथि अर्धगोला हुने गरी बनेको छ। सो ट्याङ्कीको पुरा उचाइ 15 मिटर छ र आधारको क्षेत्रफल 154 वर्गमिटर भए उक्त ट्याङ्कीमा प्रतिलिटर रु. 0.35 का दरले पानी भर्न जम्मा कति खर्च लाग्छ ? पत्ता लगाउनुहोस् ।

A water tank is formed with the combination of cylinder in the lower part and hemisphere above it. The total height of the tank is 15 m and base area is 154 sq. m. If the tank is filled with water at the rate of Rs 0.35 per litre, what is the total cost for the water? Find it.



⇨ Here, Base area (BA) = 154 m^2 Total height (H) = 15 m

We know that,

Base area = πr^2 or, $154 = \frac{22}{7} \times r^2$

or, $r^2 = \frac{154 \times 7}{22} = 49$ or, $r^2 = 7^2$

$\therefore$ $r = 7$ m

We have, total volume = V(Cylinder) + V(Hemisphere)

$$= BA \times h + \frac{2}{3}\pi r^3 = 154 \times (15 - 7) + \frac{2}{3} \times \frac{22}{7} \times (7)^3 = 1232 + 718.667$$

$$= 1950.667 \text{ m}^3 = 1950.667 \times 1000 \ell = 1950667 \ell$$

Now, the total cost = Rate × capacity = Rs 0.35 × 1950667 = Rs 682733.33

Thus, the total cost is Rs 682733.33.

23. सरल गर्नुहोस् **(Simplify):** $\dfrac{\left(p^2 - \frac{1}{q^2}\right)^p \left(p - \frac{1}{q}\right)^{q-p}}{\left(q^2 - \frac{1}{p^2}\right)^q \left(q + \frac{1}{p}\right)^{p-q}}$

⇨ Here, $\dfrac{\left(p^2 - \frac{1}{q^2}\right)^p \left(p - \frac{1}{q}\right)^{q-p}}{\left(q^2 - \frac{1}{p^2}\right)^q \left(q + \frac{1}{p}\right)^{p-q}} = \dfrac{\left[\left(p + \frac{1}{q}\right)\left(p - \frac{1}{q}\right)\right]^p \left(p - \frac{1}{q}\right)^{q-p}}{\left[\left(q + \frac{1}{p}\right)\left(q - \frac{1}{p}\right)\right]^q \left(q + \frac{1}{p}\right)^{p-q}} = \dfrac{\left(p + \frac{1}{q}\right)^p \left(p - \frac{1}{q}\right)^{p+q-p}}{\left(q + \frac{1}{p}\right)^{q+p-q} \left(q - \frac{1}{p}\right)^q}$

$= \dfrac{\left(p + \frac{1}{q}\right)^p \left(p - \frac{1}{q}\right)^q}{\left(q + \frac{1}{p}\right)^p \left(q - \frac{1}{p}\right)^q} = \left(\dfrac{pq + 1}{\frac{q}{qp + 1}{p}}\right)^p \left(\dfrac{\frac{pq - 1}{q}}{\frac{pq - 1}{p}}\right)^q$

$= \left(\frac{p}{q}\right)^p \left(\frac{p}{q}\right)^q = \left(\frac{p}{q}\right)^{q+p}$

24. PQRS एउटा चक्रीय चतुर्भुज हो । यदि ∡QPS र ∡QRS का अर्धकहरूले वृत्तलाई क्रमशः बिन्दुहरू M र N मा भेट्छन् भने MN वृत्तको व्यास हो भनी प्रमाणित गर्नुहोस् ।

PQRS is a cyclic quadrilateral. If the bisectors of ∡QPS and ∡QRS meet the circle at the points M and N respectively then prove that MN is the diameter of the circle.



⇨ Here, Given: PQRS is a cyclic quadrilateral. PM and NR are the bisectors of ∡QPS and ∡QRS respectively.

To prove: MN is a diameter

Proof:

Statements	Reasons
1. $\overset{\frown}{MRS} = \overset{\frown}{QM}$ and $\overset{\frown}{NPS} = \overset{\frown}{QN}$	1. Opposite arcs of equal angles.
2. $\overset{\frown}{MRS} + \overset{\frown}{NPS} = \overset{\frown}{QM} + \overset{\frown}{QN}$	2. Addition axiom in statement (1)
3. $\overset{\frown}{NPSRM} = \overset{\frown}{MQN}$	3. Whole part axiom.
4. MN is a diameter.	4. From (3) arcs on both the sides of MN are equal.

Proved.

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11. PABSON BOARD EXAM. 2075 [PABSON KATHMANDU]

समूह 'क' (Group 'A') [6 x 1 = 6]

1. (a) छुटको दर पत्ता लगाउने सूत्र लेख्नुहोस् जब विक्रय मूल्य रु. y र अङ्कित मूल्य रु. x दिइएका छन् ।
Write the formula for finding rate of discount when selling price Rs y and marked price Rs x are given.

⇨ Here, the rate of discount is $\frac{x-y}{x} \times 100\%$.

(b) एउटा समबाहु त्रिभुजको क्षेत्रफल पत्ता लगाउने सूत्र लेख्नुहोस् जहाँ सो त्रिभुजको भुजाको लम्बाइ 'a' छ ।
Write the area of an equilateral triangle where 'a' is the length of the side of the triangle.

⇨ Here, the area of an equilateral triangle is $\frac{\sqrt{3}}{4} a^2$.

2. (a) सरल गर्नुहोस् (Simplify): $\frac{\sqrt[3]{4-x^2}}{\sqrt[3]{2-x}}$

⇨ Here, $\frac{\sqrt[3]{4-x^2}}{\sqrt[3]{2-x}} = \sqrt[3]{\frac{4-x^2}{2-x}} = \sqrt[3]{\frac{(2+x)(2-x)}{(2-x)}} = \sqrt[3]{2+x}$

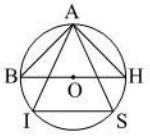
(b) माथिल्लो चतुर्थांश (Q_3) को तल्लो सीमा 'L', माथिल्लो चतुर्थांश वर्गान्तरको बारम्बारता 'f', Q_3 वर्गान्तरको आकार 'i', बारम्बारताहरूको योगफल 'N' र अघिल्लो वर्गान्तरको सञ्चित बारम्बारता 'c.f.' भए Q_3 निकाल्ने सूत्र लेख्नुहोस् ।
The lower limit of upper quartile (Q_3) is 'L', frequency of upper quartile class is 'f', size of Q_3 class is 'i', sum of the frequencies is 'N' and the cumulative frequency of pre-ceeding class is c.f., write the formula to calculate Q_3.

⇨ Here, formula of upper quartile $(Q_3) = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right)$

3. (a) एउटै आधार AM र उही समानान्तर रेखाहरू AM र RI बिचमा रहेको त्रिभुज RAM र समानान्तर चतुर्भुज AMIN बिचको क्षेत्रफलको सम्बन्ध के हुन्छ ?
What is the relation between the area of triangle RAM and parallelogram AMIN standing on the same base AM and between the same parallel lines AM and RI?

⇨ Here, the required relation is;
Area of parallelogram AMIN = 2 × Area of triangle RAM.

(b) दिइएको चित्रमा $\overset{\frown}{BI} = \overset{\frown}{HS}$ छ । ∡HAS सँग बराबर हुने परिधिकोण लेख्नुहोस् ।
In the given figure, $\overset{\frown}{BI} = \overset{\frown}{HS}$. Write name of inscribed angle which is equal to ∡HAS.



⇨ Here, the inscribed angle which is equal to ∡HAS is ∡BAI. [$\because \overset{\frown}{BI} = \overset{\frown}{HS}$]

समूह 'ख' (Group 'B') [17 x 2 = 34]

4. (a) यदि ने.रु. 200 = 2.45 अष्ट्रेलियन डलर र 8116 अष्ट्रेलियन डलर = 8152 क्यानेडियन डलर भए ने.रु. 45000 सँग कति क्यानेडियन डलर साट्न सकिएला ?
If NC. 200 = 2.45 Australian dollar and 8116 Australian dollar = 8152 Canadian dollar, how much Canadian dollar can be exchanged with NC. 45000?

⇨ Here, Rs 200 = 2.45 Aus. dollar
8116 Aus. dollar = 8152 Canadian dollar
x canadian dollar = Rs 45000 (say)
We know that,
$200 \times 8116 \times x = 2.45 \times 8152 \times 45000$
or, $x = \frac{2.45 \times 8152 \times 45000}{200 \times 8116}$
$\therefore \quad x = 553.70$
Thus, the required Canadian dollar is 553.70

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(b) एउटा शहरको हालको जनसङ्ख्या 21216 छ । यदि यो पहिलो वर्ष 2% र अर्को वर्ष 4% ले बढेको भए 2 वर्ष अगाडिको जनसङ्ख्या कति थियो ?
The present population of a town is 21216. If it was increased by 2% at the first year and by 4% in the next year, what was the population of town before 2 years?

⇨ Here, Present population = 21216 = P_T Growth rate for first year (R_1) = 2%
Growth rate for second year (R_2) = 4% Initial population (P) = ?

We know that, $P_T = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)$

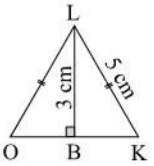
or, $21216 = P\left(1+\frac{2}{100}\right)\left(1+\frac{4}{100}\right)$

or, $21216 = P \times 1.02 \times 1.04$

or, $P = \frac{21216}{1.02 \times 1.04} = 20000$

Thus, the population of town before 2 years was 20000.

5. (a) ΔLOK को क्षेत्रफल पत्ता लगाउनुहोस् । जहाँ LO = LK = 5 cm र LB = 3 cm छन् ।
Find the area of ΔLOK, where LO = LK = 5 cm and LB = 3 cm.



⇨ Here, LO = LK = 5 cm and LB = 3 cm.
We know that,

(i) $BK = \sqrt{LK^2 - LB^2} = \sqrt{5^2 - 3^2} = 4$ cm

(ii) Area of $\Delta LOK = \frac{1}{2}$ OK × LB = $\frac{1}{2}$ 2 BK × LB = BK × LB = 4 cm × 3 cm = 12 cm^2

Thus, the area of ΔLOK is 12 cm^2.

(b) एउटा सोलीको पूरा सतहको क्षेत्रफल र वक्र सतहको क्षेत्रफल 110 cm^2 र 71.50 cm^2 छन् । सो सोलीको अर्धव्यास पत्ता लगाउनुहोस् ।
The total surface area and curved surface area of the cone are 110 cm^2 and 71.5 cm^2. Find the radius of the cone.

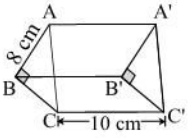
⇨ Here, TSA of cone = 110 cm^2 and CSA of cone = 71.50 cm^2
We know that, Area of base= TSA – CSA = 110 cm^2 – 71.50 cm^2 = 38.5 cm^2

Again, πr^2 = Area of base or, $\frac{22}{7} \times r^2 = 38.5$

or, $r^2 = \frac{38.5 \times 7}{22} = \frac{49}{4} = \frac{7^2}{2^2}$ ∴ $r = \frac{7}{2}$ cm

Thus, the radius of the cone is 3.5 cm.

(c) दिइएको प्रिज्ममा, AB = 8 cm र उचाइ 10 cm छन् । यदि यसको आयतन 240 cm^3 भए BC पत्ता लगाउनुहोस् ।
In the given prism, AB = 8 cm and height is 10 cm. If its volume is 240 cm^3, find BC.



⇨ Here, AB = 8 cm, CC' = 10 cm & volume = 240 cm^3
We know that; V(prism) = base area × height

or, $240 = \frac{1}{2}$ AB × BC × CC'

or, $240 = \frac{1}{2} \times 8 \times BC \times 10$

or, 240 = BC × 40

∴ BC = 6 cm

Thus, the measure of BC is 6 cm.

6. (a) हल गर्नुहोस् (Solve): $4 - \sqrt[3]{3y+4} = 0$

⇨ Here, $4 - \sqrt[3]{3y+4} = 0$ or, $4 = \sqrt[3]{3y+4}$

Cubing on both the sides; $4^3 = 3y + 4$

or, 64 – 4 = 3y or, 3y = 60

∴ y = 20

Thus, y = 20 is the solution.

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(b) सरल गर्नुहोस् (Simplify): $\frac{81x^2}{9x-7y}+\frac{49y^2}{7y-9x}$

⇨ Here, $\frac{81x^2}{9x-7y}+\frac{49y^2}{7y-9x}=\frac{81x^2}{9x-7y}-\frac{49y^2}{9x-7y}=\frac{81x^2-49y^2}{9x-7y}=\frac{(9x+7y)(9x-7y)}{(9x-7y)}=9x+7y$

7. (a) मान निकाल्नुहोस् (Evaluate): $\sqrt{2x^2y^3}\times\sqrt{12x^3y^2}\times\sqrt{6x^5y}$

⇨ Here, $\sqrt{2x^2y^3}\times\sqrt{12x^3y^2}\times\sqrt{6x^5y}$ $=\sqrt{2\times12\times6\times x^2\times x^3\times x^5\times y^3\times y^2\times y}$

$=\sqrt{12^2\times x^5\times x^5\times y^3\times y^3}$ $=12x^5y^3$

(b) हल गर्नुहोस् (Solve): $3^{4x^2-3}=3^{4x-3}$

⇨ Here, $3^{4x^2-3}=3^{4x-3}$

or, $4x^2-3=4x-3$

or, $4x^2-4x=0$

or, $4x(x-1)=0$

Either $4x=0$ or, $x-1=0$

$\therefore\ x=0$ $\therefore\ x=1$

Thus $x=0$ and $x=1$ are the solutions.

(c) दुईओटा सङ्ख्याहरूको अनुपात 4 : 3 छ । यदि ठूलो सङ्ख्याबाट 4 घटाइयो र सानो सङ्ख्यामा 8 जोडियो भने तिनीहरू बराबर हुन्छन् । ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।

The ratio of two numbers is 4 : 3. If 4 is subtracted from the larger number and 8 is added to the smaller number then they become equal. Find the numbers.

⇨ Here, let the two numbers be 4x and 3x respectively.

By the question, $4x-4=3x+8$

or, $4x-3x=8+4$

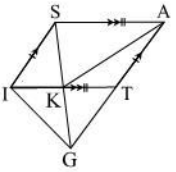
$\therefore\ x=12$

So, the numbers are $=4\times12$ and 3×12 $=48$ and 36

Thus, the numbers are 48 and 36.

8. (a) चित्रमा ΔSIK को क्षेत्रफल = ΔAKT को क्षेत्रफल र समानान्तर चतुर्भुज SITA को क्षेत्रफल = 140 cm² छन् । ΔSIK को क्षेत्रफल पत्ता लगाउनुहोस् ।

In the diagram, area of ΔSIK = area of ΔAKT and area of parallelogram SITA = 140 cm². Find the area of ΔSIK.



⇨ Here, Ar. (ΔSIK) = Ar. (ΔAKT) and Ar. (▱SITA) = 140 cm²

(i) Ar. (ΔSKA) $=\frac{1}{2}$ Ar. (parm. SITA) $=\frac{1}{2}\times140$ cm²

$\therefore$ Ar. (ΔSKA) = 70 cm² [Being both on the same base and between the same paralles.]

(ii) Ar. (ΔSIK) + Ar. (ΔAKT) = Ar. (▱SITA) – Ar. (ΔSKA) [Comparision axiom]

or, Ar. (ΔSIK) + Ar. (ΔSIK) = 140 cm² – 70 cm²

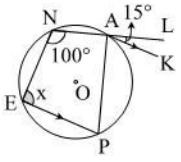
or, 2 Ar. (ΔSIK) = 70 cm²

$\therefore$ Ar. (ΔSIK) = 35 cm²

Thus, the area of ΔSIK is 35 cm².

(b) चित्रमा O वृत्तको केन्द्र बिन्दु हो, ∠LAK = 15°, ∠ENA = 100° र AK // EP छन् । x° को नाप पत्ता लगाउनुहोस् ।

In the given figure, O is the centre of circle, ∠LAK = 15°, ∠ENA = 100° and AK // EP. Find the measurement of x°.



⇨ Here, ∠LAK = 15°, ∠ENA = 100° and AK // EP.

(i) ∠EPA + ∠ENA = 180° [opposite angles of cyclic quadrilateral]

or, ∠EPA + 100° = 180°

$\therefore$ ∠EPA = 80°

(ii) ∠PAK = ∠EPA [Alternate angles in parallel lines]

$\therefore$ ∠PAK = 80°

(iii) ∠NEP = ∠PAL [Exterior angle and opposite interior angle of cyclic quadrilateral]

or, x = ∠LAK + ∠PAK = 15° + 80°

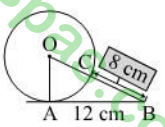
$\therefore\ x=95°$

Thus, the value of x is 95°.

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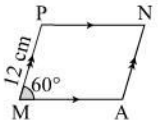
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(c) चित्रमा O वृत्तको केन्द्रबिन्दु हो र AB स्पर्शरेखा हो । यदि A स्पर्श बिन्दु भए दिइएको वृत्तको अर्धव्यास पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle and AB is tangent. If A is the point of contact then, find the length of the radius of given circle.



⇨ Here, BC = 8 cm, AB = 12 cm.
(i) OA ⊥ AB [radius is perpendicular to tangent at point of contact]
(ii) $OB^2 = OA^2 + AB^2$ [Pythagorean theorem]
or, $(OC + BC)^2 = r^2 + 12^2$
or, $(r + 8)^2 = r^2 + 144$
or, $r^2 + 16r + 64 = r^2 + 144$
or, $16r = 80$
∴ $r = 5$
Thus, the radius of the circle is 5 cm.

9. (a) समानान्तर चतुर्भुज MANP को क्षेत्रफल = $60\sqrt{3}$ cm² छ । यदि PM = 12 cm र ∠PMA = 60° भए MA को लम्बाइ पत्ता लगाउनुहोस् ।
Area of parallelogram MANP = $60\sqrt{3}$ cm². If PM = 12 cm and ∠PMA = 60°, find the length of MA.



⇨ Here, Ar. (□MANP) = $60\sqrt{3}$ cm², PM = 12 cm, and ∠PMA = 60°
We know that,
Area of parallelogram MANP = PM × MA sin ∠M
or, $60\sqrt{3} = 12 \times MA \times \sin 60°$
or, $5\sqrt{3} = MA \times \frac{\sqrt{3}}{2}$
∴ MA = 10 cm
Thus, the measure of MA is 10 cm.

(b) एउटा श्रेणीमा, यदि $\Sigma fm = 150 + 5a$, मध्यक $(\bar{x}) = 10$ र $\Sigma f = 10 + a$ भए a को मान पत्ता लगाउनुहोस् ।
In a series, if $\Sigma fm = 150 + 5a$, mean $(\bar{x}) = 10$ and $\Sigma f = 10 + a$, find the value of 'a'.

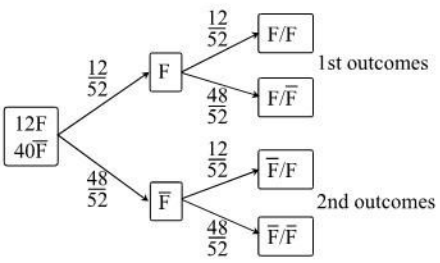
⇨ Here, $\Sigma fm = 150 + 5a$, $\bar{X} = 10$ and $\Sigma f = 10 + a$
We know that, $\bar{X} = \frac{\Sigma fm}{\Sigma f}$ or, $10 = \frac{150 + 5a}{10 + a}$
or, $100 + 10a = 150 + 5a$ or, $5a = 50$
∴ $a = 10$ Thus, the value of a is 10.

10. (a) एउटा सिक्का र एउटा डाइसलाइ सँगसँगै Çयाँक्दा सिक्कामा 'पुच्छर' र डाइसमा '6' आउने सम्भाव्यता पत्ता लगाउनुहोस् ।
Find the probability of getting tail on the coin and '6' on the dice when a coin and a dice are thrown together.

⇨ Here, In a coin, sample space $(S_1) = \{H, T\}$
In a dice, sample space $(S_2) = \{1, 2, 3, 4, 5, 6\}$
We have, $P(\text{tail and } 6) = P(\text{tail}) \times P(6) = \frac{n(\text{tail})}{n(S_1)} \times \frac{n(6)}{n(S_2)} = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$
Thus, the probability of getting tail and 6 is $\frac{1}{12}$.

(b) 52 पत्तीको खेल्ने तासबाट एउटा पत्ती तास झिकिएको छ । पहिला झिकिएको तास पुनः राखियो र फेरी अर्को तास झिकियो । अनुहार भएको तास पर्ने र नपर्ने सबै सम्भावनाहरू देखाउन सम्भाव्यता वृक्ष चित्र खिच्नुहोस् ।
A card is drawn randomly from a well shuffled pack of 52 playing cards. The first card is replaced and the next card is drawn. Draw a tree diagram to show the all possible outcomes with their probabilities of getting face cards or non-face cards.

⇨ Here, no. of face cards [n(F)] = 12
no. of non-face cards $[n(\bar{F})] = 52 - 12 = 40$
The probability tree diagram of getting face cards or non-face cards is as follows:



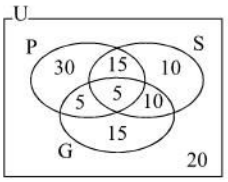
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समूह 'ग' (Group 'C') [10 × 4 = 40]

11. 110 जना मानिसहरूबिच गरिएको एउटा सर्वेक्षणमा 55 जनाले पारस खड्का मन पराए, 40 जनाले सन्दिप लामिछाने, 35 जनाले शक्ती गौचन, 20 जनाले पारस र सन्दिप, 10 जनाले पारस र शक्ती, 15 जनाले शक्ती र सन्दिप र 20 जनाले कुनैपनि मन पराएनन् । कति जनाले सबै मन पराए ? प्राप्त जानकारीलाई भेनचित्रमा देखाउनुहोस् र साथै :
A survey is made among 110 people and found 55 people liked Parash Khadka, 40 liked Sandeep Lamichhane, 35 liked Shakti Gauchan, 20 liked Parash and Sandeep, 10 liked Parash and Shakti, 15 liked Shakti and Sandeep and 20 liked none of them. Find how many liked all of them. Show the information obtained in a Venn-diagram and also find;

(i) तिनीहरूमध्ये ठीक एकजना मात्र मनपराउने मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Number of people who liked exactly one of them.

(ii) तिनीहरूमध्ये ठीक दुईजना मात्र मनपराउने मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Number of people who liked exactly two of them.



⇨ Here, let P, S and G denote the set of people who liked Parash, Sandeep and Shakti respectively.

Then, $n(U) = 110$, $n(P) = 55$, $n(S) = 40$, $n(G) = 35$
$n(P \cap S) = 20$, $n(P \cap G) = 10$, $n(G \cap S) = 15$

$n(\overline{P \cup S \cup G}) = 20$, $n(P \cap S \cap G) = ?$

We know that,

$$n(P \cup S \cup G) = n(P) + n(S) + n(G) - n(P \cap S) - n(P \cap G) - n(G \cap S) + n(P \cap S \cap G)$$

or, $n(U) - n(\overline{P \cup S \cup G}) = 55 + 40 + 35 - 20 - 10 - 15 + n(P \cap S \cap G)$
or, $110 - 20 = 85 + n(P \cap S \cap G)$
or, $90 - 85 = n(P \cap S \cap G)$
$\therefore \quad n(P \cap S \cap G) = 5$

Now the Venn-diagram;
(i) The no. of people who liked exactly one = 30 + 10 + 15 = 55
(ii) The no. of people who liked exactly two = 15 + 10 + 5 = 30
Thus, the required numbers are; 5, 55 and 30.

12. एकजना पसलेले उसको पसलमा भएका सबै सामानहरूमा समान छुट दिन्छ । ज्याकेटको अङ्कित मूल्य रु. 5000 छ र निश्चित छुट दिएर यसलाई रु. 4000 मा बेच्दछ । टिसर्टको अङ्कित मूल्य रु. 1000 छ । सोहि छुट दर अनुसार पसलेले उक्त टिसर्ट कतिमा बेच्दछ ? एकजना ग्राहकले 13% भ्याट सहित उक्त टिसर्टलाई कति तिर्छ होला ?
A shopkeeper allows equal discount to sell the article in his shop. The marked price of the Jacket is Rs 5000 and he sells it at Rs 4000 with certain discount. The marked price of the T-shirt is Rs 1000. At what price does the shopkeeper sell the T-shirt at same rate of discount? How much does a customer pay to buy the T-shirt with 13% VAT?

⇨ Here,

Jacket	T-shirt
Marked price (MP) = Rs 5000	Marked price (MP) = Rs 1000
Selling price (SP) = Rs 4000	Selling price (SP) = ?
Discount rate = ?	Price with 13% VAT = ?

We have, Discount amount = MP – SP
= Rs 5000 – Rs 4000
= Rs 1000

$$\text{Discount rate} = \frac{\text{discount amount}}{\text{MP}} \times 100\% = \frac{\text{Rs } 1000}{\text{Rs } 5000} \times 100\% = 20\%$$

For the T-shirt, SP = MP – discount
= Rs 1000 – 20% of Rs 1000
= 80% of Rs 1000
= 0.80 × Rs 1000
= Rs 800

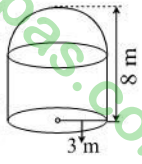
Now, Price with 13% VAT = Rs 800 + 13% of Rs 800
= 113% of Rs 800
= 1.13 × Rs 800
= Rs 904

Thus, SP and SP with VAT are Rs 800 and Rs 904 respectively.

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13. सँगैको चित्र अन्तिम भाग अर्धगोलाकार भएको बेलनाकार ट्याङ्कीको हो । सो ट्याङ्कीको भित्री अर्धव्यास 3 m र पूरा उचाइ 8 m छ । सो ट्याङ्कीमा कति लिटर पानी अट्ला ? यदि एउटा परिवारले प्रति दिन 2000 लिटर पानी उपभोग गर्दछ भने सो ट्याङ्कीको पानीले कति दिन पुग्ला ?
The adjoining diagram is a cylindrical tank with an end of hemisphere. The internal radius of the tank is 3 m and total height is 8 m. How much water in Liter does the tank hold? If a family consumes 2000 Liter water a day, for how many days the water of the tank last?



⇨ Here, common radius (r) = 3m, total height (h) = 8 m
Height of cylinder (h_1) = h – r = 8m – 3m = 5 m
We have, V(tank) = V(Cylinder) + V (Hemisphere)

$$= \pi r^2 h_1 + \frac{2}{3}\pi r^3 \qquad = \pi r^2\left(h_1 + \frac{2}{3}r\right)$$

$$= \frac{22}{7} \times 3^2\left(5 + \frac{2}{3}3\right)$$

$$= \frac{22}{7} \times 9 \times 7 = 198$$

∴ V (tank) = 198 m^3 = 198 × 1000 ℓ = 198000 ℓ
Consumption per day = 2000 litre

Now, consumption period = $\frac{\text{Volume of tank}}{\text{Consumption per day}} = \frac{198000\ \ell}{2000\ \ell \text{ per day}} = 99$ days

Thus, the volume of the tank is 198000 ℓ and time required is 99 days.

14. म.स. पत्ता लगाउनुहोस् (Find the HCF): $y^3 - 1$, $y^4 + y^2 + 1$ and $y^3 + 1 + 2y^2 + 2y$

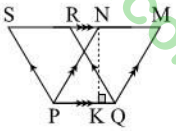
⇨ Here, first exp. $= y^3 - 1 = (y - 1)(y^2 + y + 1)$
Second exp. $= y^4 + y^2 + 1$
$= (y^2)^2 + 2 \cdot y^2 \cdot 1 + 1^2 - y^2$
$= (y^2 + 1)^2 - y^2$
$= (y^2 + 1 + y)(y^2 + 1 - y)$
$= (y^2 + y + 1)(y^2 - y + 1)$
Third exp. $= y^3 + 1 + 2y^2 + 2y$
$= y^3 + 1^3 + 2y^2 + 2y$
$= (y + 1)(y^2 - y + 1) + 2y(y + 1)$
$= (y + 1)(y^2 - y + 1 + 2y)$
$= (y + 1)(y^2 + y + 1)$
Thus, the HCF is $(y^2 + y + 1)$.

15. एउटा दुई अङ्कको सङ्ख्या यसका अङ्कहरूको योगफलको सात गुणा छ । यदि यसका अङ्कहरूलाई उल्ट्याएर बनाइएको सङ्ख्या सुरूको सङ्ख्या भन्दा 18 ले कम छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
A two digits number is seven times the sum of its digits. The number formed by reversing the digits is 18 less than the original number. Find the number.

⇨ Here, let 10x + y be the two digits number.
First case:
$10x + y = 7(x + y)$
or, $10x + y = 7x + 7y$
or, $3x - 6y = 0$
or, $x - 2y = 0$
∴ $x = 2y$ .....(i)
Second case:
$10y + x = 10x + y - 18$
or, $10y + x - 10x - y = -18$
or, $-9x + 9y = -18$
∴ $x - y = 2$ .....(ii)
From (i) and (ii);
$2y - y = 2$
∴ $y = 2$
From (i) $x = 2y = 2 \times 2 = 4$
So, the two digits number $= 10x + y = 10 \times 4 + 2 = 42$
Thus, the required two digits number is 42.

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16. एउटै आधार र उही समानान्तर रेखाहरूबिच रहेका समानान्तर चतुर्भुजहरू PQRS र PQMN क्षेत्रफलमा बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।
Prove that the area of parallelograms PQRS and PQMN standing on the same base and the same parallels are equal in area.



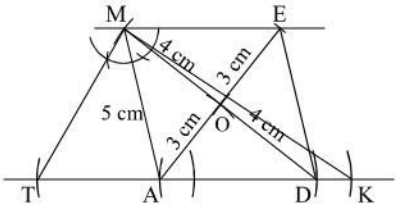
⇨ Here, Given: parallelograms PQRS and PQMN are standing on the same base PQ and between the same parallels SM // PQ.
To prove: Ar. (parm. PQRS) = Ar. (parm. PQMN)
Construction: NK ⊥ PQ is drawn.
Proof:

Statements	Reasons
1. Area of $\square$PQRS = PQ × KN	1. Area of parallelogram = base × height
2. Area of $\square$PQMN = PQ × KN	2. Area of parallelogram = base × height
3. Area of $\square$PQRS = Area of $\square$PQMN	3. From (1) and (2)

Proved.

17. एउटा समानान्तर चतुर्भुज MADE को रचना गर्नुहोस् । जहाँ MA = 5 cm, विकर्ण MD = 8 cm र विकर्ण EA = 6 cm छन् । ∡MTK = 60° र समानान्तर चतुर्भुजको क्षेत्रफलसँग बराबर क्षेत्रफल हुनेगरी ΔMKT को रचना गर्नुहोस् ।
Construct a parallelogram MADE in which MA = 5 cm, diagonal MD = 8 cm and diagonal EA = 6 cm. Construct a triangle MKT, whose ∡MTK = 60°, area is equal to the area of the parallelogram.

⇨ Here, MA = 5 cm, MD = 8 cm, EA = 6 cm and ∡MTK = 60°.



ΔMKT is the required triangle whose area is equal to the area of parallelogram MADE.

18. एउटै आधार LK मा आधारित केन्द्रीयकोण ∡LOK परिधिकोण ∡LPK को दोब्बर हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् (कम्तिमा 3 cm अर्धव्यास भएका दुई चित्रहरू अनिवार्य छन् ।)
Verify experimentally that ∡LOK at the centre is twice the inscribed ∡LPK subtended by the same arc LK. (Two figures with at least 3 cm radii are necessary)

⇨ Here, ∡LOK is central angle and ∡LPK is inscribed angle standing on same arc LK.



Fig (i)



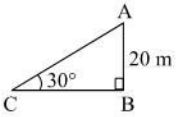
Fig (ii)

Measurement table

Fig.	∡LOK	∡LPK	Result
(i)	80°	40°	∡LOK = 2∡LPK
(ii)	96°	43°	∡LOK = 2∡LPK

From the above table, it is verified that the central angle ∡LOK is double of the inscribed angle on same arc LK.

19. एउटा नदिको एक किनारामा रहेको 20 m अग्लो स्तम्भबाट नदिको अर्को किनारामा रहेको स्तम्भको टुप्पोमा हेर्दा 30° को उन्नतांश कोण बन्दछ भने नदिको चौडाइ पत्ता लगाउनुहोस् ।
A tower on the bank of a river is 20 m high and the angle of elevation of the top of the tower from the opposite bank of river is 30°. Find the width of the river.



⇨ Here, let AB = 20 m be the height of a tower. ∡ACB = 30° be an angle of elevation of the tower from opposite bank. Le BC be the width of the river.

From the right angled triangle ABC, $\tan\theta = \frac{AB}{BC}$

or, $\tan 30° = \frac{20}{BC}$ or, $\frac{1}{\sqrt{3}} = \frac{20}{BC}$ ∴ $BC = 20\sqrt{3}$ m

Thus, the width of the river is $20\sqrt{3}$ m.

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20. तलको तथ्याङ्कको तल्लो चतुर्थांश 38 भए छुटेको बारम्बारता पत्ता लगाउनुहोस् ।
Find the missing frequency of the data in which the lower quartile is 38.

Class	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	10	20	K	30	14	5

⇨ Here, calculation of value of K.

Class	frequency	cf
20 - 30	10	10
30 - 40	20	30
40 - 50	K	30 + K
50 - 60	30	60 + K
60 - 70	14	74 + K
70 - 80	5	79 + K
	N = 79 + K	

Position of first quartile $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{79+K}{4}\right)^{th}$ item

first quartile class = 30 - 40

We know that, $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

or, $38 = 30 + \frac{10}{20}\left(\frac{79+K}{4} - 10\right)$

or, $8 = \frac{10}{20} \times \frac{79+K-40}{4}$

or, $8 = \frac{1}{2} \times \frac{K+39}{4}$

or, $64 = K + 39$

or, $64 - 39 = K$

$\therefore$ $K = 25$

Thus, the value of K is 25.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. कुनै धनराशी रु. 5000 चक्रीय वार्षिक ब्याजदरअनुसार 2 वर्षमा रु. 6050 हुन्छ । उही ब्याजदर र समयमा रु. 5000 को अर्धवार्षिक ब्याजले कति मश्रिधन प्राप्त होला ?
A sum of Rs 5000 amounts to Rs 6050 in 2 years at the certain rate of compound interest payable annually. How much does Rs 5000 amounts in the same time at the same rate of compound interest payable semi annually?

⇨ Here, Principal (P) = Rs 5000 Time (T) = 2 years
Compound Amount (CA) = Rs 6050
We know that,

$CA = P\left(1 + \frac{R}{100}\right)^T$

or, $6050 = 5000\left(1 + \frac{R}{100}\right)^2$

or, $\frac{605}{500} = \left(1 + \frac{R}{100}\right)^2$

or, $\frac{121}{100} = \left(1 + \frac{R}{100}\right)^2$

or, $\left(\frac{11}{10}\right)^2 = \left(1 + \frac{R}{100}\right)^2$

or, $\frac{11}{10} = 1 + \frac{R}{100}$

or, $\frac{1}{10} = \frac{R}{100}$

$\therefore$ $R = 10\%$

Again, semi-annual CA $= P\left(1 + \frac{R}{200}\right)^{2T}$

$= 5000\left(1 + \frac{10}{200}\right)^{2\times 2}$

$= 5000\left(\frac{21}{20}\right)^4$

$= 5000 \times 1.2155$

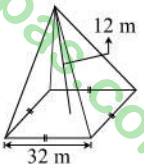
Semi-annual CA. $= 6077.53$

Thus, the required semiannual compound amount is Rs 6077.53.

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22. सँगैको चित्रमा दिइएको टेन्ट वर्गाकार आधार भएको पिरामिडको रूपमा छ । आधारको हरेक भुजा 32 m र पिरामिडको उचाइ 12 m छ ।
The diagram alongside is a tent of pyramid shape with square base. Each side of the base is 32 m and height of the pyramid is 12 m.



(i) सो टेन्ट बनाउन कति वर्गमिटर कपडा लाग्ला ?
How many square meters of clothes is required to make the tent?

(ii) रु. 50/m² दरअनुसार कपडाको जम्मा खर्च कति होला ? (What is the total cost of clothes at the rate Rs 50/m² ?)

⇨ Here, length of base (a) = 32 m, vertical height (h) = 12 m Slant height (ℓ) = ?

Slant height (ℓ) $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{12^2 + \left(\frac{32}{2}\right)^2} = \sqrt{12^2 + 16^2} = 20$ cm

For the tent, CSA of pyramid $= 2a\ell$
$= 2 \times 32 \times 20$
$= 1280\ m^2$

(i) The required clothes for the tent is $1280\ m^2$.

(ii) Rate = Rs $50/m^2$
We have, total cost = Area × Rate
$= 1280\ m^2 \times$ Rs $50/m^2$
= Rs 64000

Thus, the area of clothes for the tent is $1280\ m^2$ and the total cost is Rs 64000.

23. सरल गर्नुहोस् (Simplify): $1 + \frac{y^2 + 2xy - x^2}{x^2 - y^2} + \frac{2xy}{x^2 + y^2} + \frac{4x^3y}{x^4 + y^4}$

⇨ Here, $1 + \frac{y^2 + 2xy - x^2}{x^2 - y^2} + \frac{2xy}{x^2 + y^2} + \frac{4x^3y}{x^4 + y^4}$

$= \frac{x^2 - y^2 + y^2 + 2xy - x^2}{x^2 - y^2} + \frac{2xy}{x^2 + y^2} + \frac{4x^3y}{x^4 + y^4}$

$= \frac{2xy}{x^2 - y^2} + \frac{2xy}{x^2 + y^2} + \frac{4x^3y}{x^4 + y^4}$

$= \frac{2xy\,(x^2 + y^2) + 2xy\,(x^2 - y^2)}{(x^2 - y^2)\,(x^2 + y^2)} + \frac{4x^3y}{x^4 + y^4}$

$= \frac{2xy\,[x^2 + y^2 + x^2 - y^2]}{x^4 - y^4} + \frac{4x^3y}{x^4 + y^4}$

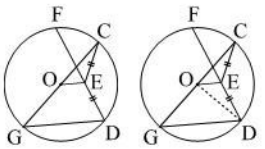
$= \frac{4x^3y}{x^4 - y^4} + \frac{4x^3y}{x^4 + y^4}$

$= \frac{4x^3y\,(x^4 + y^4) + 4x^3y(x^4 - y^4)}{(x^4 - y^4)\,(x^4 + y^4)}$

$= \frac{4x^3y[x^4 + y^4 + x^4 - y^4]}{(x^4 - y^4)\,(x^4 + y^4)}$

$= \frac{8x^7y}{x^8 - y^8}$

24. चित्रमा O वृत्तको केन्द्र बिन्दु हो र CE = DE छन् । प्रमाणित गर्नुहोस् :
In the figure, 'O' is the centre of a circle and CE = DE. Prove that: OE // GD.



⇨ Here, **Given:** O is the centre of circle and CE = DE.
To prove: OE // GD
Construction: Join DO.

	Statements		Reasons
1.	$\Delta COE \cong \Delta DOE$	1.	OC = OD [Being radii of same circle], OE = OE [Common sides] and CE = DE [Given] by SSS fact.
2.	$2\angle G = \angle COD$	2.	Both are on the same arc.
3.	$2\angle COE = \angle COD$	3.	Being $\angle COE = \angle EOD$.
4.	$\angle G = \angle COE$	4.	From (2) and (3)
5.	EO // DG	5.	Being corresponding angles are equal in (4).

Proved.

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12. PABSON BOARD EXAM. 2075 [PABSON PROVINCE NO. 5]

समूह 'क' (Group 'A') [6 × 1 = 6]

1. (a) कमल यूएईमा काम गर्दछन् । उनले हरेक महिना 2300 दिराम कमाउँदछन् । जहाँ 1 दिराम = रु. 29.35 छ । 2019 AD को जनवरी महिनाको उनको आम्दानी रुपैयाँमा पत्ता लगाउनुहोस् ।

Mr. Kamal is serving in UAE. He earns 2300 Dirhams in each month, where 1 Dirham = Rs 29.35. Find his income in rupees for the January month of 2019 AD.

⇨ Here, earning of Mr. Kamal in rupees = 2300 × Rs 29.35 = Rs 67,505

(b) एउटा विषमबाहु त्रिभुजको तीनओटा भुजाका लम्बाइहरू a, b र c भए दिइएको भुजाको रूपमा अर्धपरिमिति निकाली हिरोन्ज सूत्र लेख्नुहोस् ।

If a, b and c be the length of three sides of a scalene triangle, compute semi-perimeter in terms of given sides and write down Heron's formula.

⇨ Here, We know that, Semi-perimeter, $s = \frac{a+b+c}{2}$

Heron's formula is, $A = \sqrt{s(s-a)(s-b)(s-c)}$

2. (a) x को कुन मानले $\sqrt[x+1]{m^{20}}$ र m^5 बराबर हुन्छन् ?

For what value of x makes $\sqrt[x+1]{m^{20}}$ equals to m^5?

⇨ Here, $\sqrt[x+1]{m^{20}} = m^5$

or, $m^{\frac{20}{x+1}} = m^5$ or, $\frac{20}{x+1} = 5$

or, $20 = 5x + 5$ or, $\frac{15}{5} = x$

or, $x = 3$

Thus, the value of x is 3.

(b) दिइएको तथ्याङ्कबाट तेस्रो चतुर्थांश वर्गान्तर पत्ता लगाउनुहोस् ।

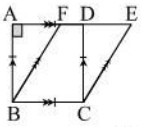
Find 3rd quartile class from the given data.

CI	5-15	15-25	25-35	35-45	45-55
cf	3	8	17	20	22

⇨ Here, Position of 3rd quartile = $\left(\frac{3N}{4}\right)^{th}$ term = $\left(\frac{3 \times 22}{4}\right)^{th}$ term = $\left(\frac{66}{4}\right)^{th}$ term = 16.5^{th} term = 25-35

3. (a) सँगैको चित्रमा ABCD र BCEF क्रमशः वर्ग र समानान्तर चतुर्भुजहरू हुन् । यदि वर्गको क्षेत्रफल 40 cm^2 भए समानान्तर चतुर्भुज BCEF को क्षेत्रफल पत्ता लगाउनुहोस् ।

In the adjoining figure, ABCD and BCEF are square and parallelogram respectively. If 40 cm^2 is the area of square, then find the area of parallelogram BCEF.



⇨ Here, We know that, Area of parallelograms standing on same base and between same parallels are equal.

So, Ar. parm. BCEF = Ar. sq. ABCD

∴ Ar. parm. BCEF = 40 cm^2

(b) दिइएको चित्रबाट ∡ACB को मान पत्ता लगाउनुहोस् । जहाँ O वृत्तको केन्द्रबिन्दु हो ।

Find the value of ∡ACB from the given figure where O is centre of circle.



⇨ Here, ΔOAB is an equilateral triangle.

So, ∡AOB = 60°

Now, we know that, $\angle ACB = \frac{1}{2} \times \angle AOB$

∴ $\angle ACB = \frac{1}{2} \times 60° = 30°$.

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समूह 'ख' (Group 'B') [17 × 2 = 34]

4. (a) एउटा सुपरमार्केटमा नेपालको हालको भ्याटदर अनुसार एउटा ज्याकेटको मूल्य रु. 5650 पर्छ । भ्याट बाहेकको मूल्य कति हुनु पर्ला ?
The price of a jacket with the current rate of VAT in Nepal is Rs 5,650 in a super market. What may be its price excluding VAT?

⇨ Here, Given, for a jacket,
Price including VAT = Rs 5,650
Current VAT rate = 13%
Price excluding VAT i.e. SP = ? (Let x)
We know that,
Price including VAT = SP + VAT % of SP
or, Rs 5650 = x + 13% × x or, Rs 5650 = 113% of x
or, Rs 5650 = 1.13 × x or, Rs 5650 = 1.13x
or, Rs $\frac{5650}{1.13}$ = x ∴ x = Rs 5000

Thus, the price excluding VAT is Rs 5000.

(b) एउटा व्यापारीक संस्थाको शेयरको मूल्य प्रति वर्ष 10% को दरले 2 वर्षसम्म घट्छ । यदि उक्त शेयरहरू बेच्दा रु. 8100 पाइएको थियो भने रु. 100 पर्ने कति ओटा शेयरहरू बेचिएको थियो ?
A trade company's share price depreciates at 10% p.a. for 2 years. If Rs 8100 was received by selling the shares, how many shares of Rs 100 were sold?

⇨ Here, Rate of depreciation (R) = 10% p.a.
Selling price after 2 years (P_T) = Rs 8100
No. of shares each of rate Rs. 100 per share = ?
Let initial price be Rs P

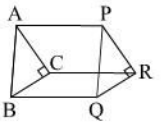
We know that, $P_T = P\left(1 - \frac{R}{100}\right)^T$

or, Rs 8100 $= P\left(1 - \frac{10}{100}\right)^2$
or, Rs 8100 $= P(1 - 0.1)^2$
or, Rs 8100 $= P \times (0.9)^2$
or, Rs 8100 $= P \times 0.81$
or, Rs $\frac{8100}{0.81}$ = P ∴ P = Rs 10000

Now, No. of shares each of Rs 100 = $\frac{\text{Rs } 10000}{\text{Rs } 100}$ = 100 shares

Thus, altogether 100 shares were sold before.

5. (a) दिइएको चित्रमा ∠ACB = 90°, PR = 12 cm, AB = 20 cm छ । यदि प्रिज्मको आयतन 1920 cm^3 भए प्रिज्मको लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, ∠ACB = 90°, PR = 12 cm, AB = 20 cm. If the volume of the prism is 1920 cubic cm, find the length of the prism.



⇨ Here, ∠ACB = 90°, PR = 12 cm = AC, AB = 20 cm
Volume of prism (V) = 1920 cu.cm
Length of prism (L) = ?
In right angled ΔACB, applying Pythagoraean theorem, $AB^2 = AC^2 + BC^2$
or, $(20)^2 = (12)^2 + (BC)^2$
or, $400 - 144 = (BC)^2$
or, $\sqrt{256}$ = BC
or, BC = 16 cm

Now, Ar. of right ΔACB = $\frac{1}{2}$ × AC × BC = $\frac{1}{2}$ × 12 cm × 16 cm = 96 cm^2 [∵ A = $\frac{1}{2}$ × p × b]

Again, We know that, Volume of prism, V = A × L
∴ L = $\frac{V}{A} = \frac{1920\ cm^3}{96\ cm^2}$ = 20 cm

Thus, the length of the prism is 20 cm.

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(b) एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 4158 cm² छ भने ठूलो वृत्तको परिमिति पत्ता लगाउनुहोस् ।
If the total surface area of a hemi-sphere is 4158 cm², then compute the perimeter of the greatest circle.

⇨ Here, TSA of hemi-sphere is 4158 cm²
Perimeter of great circle, P = ?
We know that, TSA of hemi-sphere = $3\pi r^2$

or, $4158 = 3\pi r^2$ or, $4158 = 3 \times \frac{22}{7} \times r^2$

or, $4158 = \frac{66}{7} \times r^2$ or, $4158 \times \frac{7}{66} = r^2$

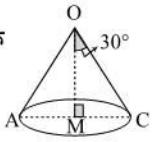
or, $63 \times 7 = r^2$ or, $r^2 = 441$

$\therefore \quad r = \sqrt{441} = 21$ cm

Now, Perimeter of great circle, $P = 2\pi r = 2 \times \frac{22}{7} \times 21$ cm $= 132$ cm

Thus, the perimeter of the great circle is 132 cm.

(c) सँगैको चित्र एउटा ठोस सोलीको हो । यदि AC = 14 cm र ∠COM = 30° भए सो ठोसको वक्र सतहको क्षेत्रफल निकाल्नुहोस् ।
The diagram alongside is of a solid cone. If AC = 14 cm and ∠COM = 30° then compute curved surface area of the solid.



⇨ Here, AC = 14 cm, ∠COM = 30°
Curved surface area of solid (CSA) = ?
Radius (r) $= \frac{d}{2} = \frac{AC}{2} = \frac{14}{2} = 7$ cm

In rt. ΔOMC, $\sin 30° = \frac{MC}{OC}$

or, $\frac{1}{2} = \frac{7 \text{ cm}}{OC}$

or, OC = 14 cm = slant height (ℓ)

We know that, CSA $= \pi r\ell = \frac{22}{7} \times 7$ cm $\times 14$ cm $= 308$ cm²

Thus, the curved surface area of cone is 308 cm².

6. (a) म.स. निकाल्नुहोस् (Find HCF of): $a^2 - 4a$, $a^4 - 4a^2$ and $a^5 - 16a$

⇨ Here, 1st exp. $= a^2 - 4a = a(a - 4)$
2nd exp. $= a^4 - 4a^2 = a^2(a^2 - 4) = a^2(a^2 - 2^2) = a^2(a - 2)(a + 2)$
3rd exp. $= a^5 - 16a = a(a^4 - 16) = a((a^2)^2 - 4^2)$
$= a(a^2 - 4)(a^2 + 4) = a(a + 2)(a - 2)(a^2 + 4)$
Now, HCF = multiple of common factors = a.
Thus, HCF is a.

(b) मान निकाल्नुहोस् (Find the value of): $\frac{3^{-1} + 5^{-1}}{(3 + 5)^{-1}} \times \left(\frac{64}{15}\right)^{-1}$

⇨ Here, $\frac{3^{-1} + 5^{-1}}{(3 + 5)^{-1}} \times \left(\frac{64}{15}\right)^{-1} = \frac{\frac{1}{3} + \frac{1}{5}}{8^{-1}} \times \frac{15}{64} = \frac{\frac{5 + 3}{15}}{\frac{1}{8}} \times \frac{15}{64} = \frac{8}{15} \times \frac{8}{1} \times \frac{15}{64} = 1$

7. (a) यदि $a = 2^x$, $b = 2^y$ र $a^{2y} b^x = 8$ भए $xy = 1$ हुन्छ भनी प्रमाणित गनुहोस् ।
If $a = 2^x$, $b = 2^y$ and $a^{2y} b^x = 8$, prove that $xy = 1$.

⇨ Here, $a = 2^x$, $b = 2^y$, $a^{2y} b^x = 8$
$a^{2y} b^x = 8$
or, $(2^x)^{2y} \cdot (2^y)^x = 8$
or, $2^{2xy} \cdot 2^{xy} = 8$
or, $2^{2xy + xy} = 8$
or, $2^{3xy} = 2^3$
or, $3xy = 3$
$\therefore \quad xy = 1$ Proved.

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(b) सरल गनुहोस् (Simplify): $\sqrt[4]{18x^5y^{-3}} \div \sqrt[4]{\frac{2}{9}x^{-3}y}$

⇨ Here, $\sqrt[4]{18x^5y^{-3}} \div \sqrt[4]{\frac{2}{9}x^{-3}y} = \sqrt[4]{\frac{18x^5y^{-3}}{\frac{2}{9}x^{-3}y}} = \sqrt[4]{\frac{18\times 9}{2}x^{5+3}y^{-3-1}}$

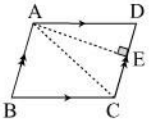
$= \sqrt[4]{81x^8y^{-4}} = \sqrt[4]{3^4(x^2)^4(y^{-1})^4} = 3x^2y^{-1}$

(c) यदि एक जना केटाको 10 वर्ष अघि र 10 वर्ष पछिको उमेरको गुणनफल 156 भए उक्त केटाको हालको उमेर पत्ता लगाउनुहोस् ।

If the product of the age of a boy 10 years before and 10 years hence is 156, find the present age of that boy.

⇨ Here, Let the present age of the boy be x years.
According to question, $(x - 10)(x + 10) = 156$
or, $x^2 - 10^2 = 156$
or, $x^2 = 156 + 100 = 256$
or, $x = \sqrt{256} = 16$ years
Thus, the present age of the boy is 16 years.

8. (a) चित्रमा $\frac{2}{3}AE = \frac{3}{4}AB = 12$ cm भए, ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।



In the given figure, $\frac{2}{3}AE = \frac{3}{4}AB = 12$ cm, find the area of ΔABC.

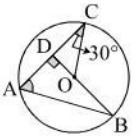
⇨ Here, (i) $\frac{2}{3}AE = \frac{3}{4}AB = 12$ cm

or, $AE = 12\text{ cm} \times \frac{3}{2} = 18$ cm and $AB = 12\text{ cm} \times \frac{4}{3} = 16\text{ cm} = CD$

(ii) We have, area of $\Delta ACD = \frac{1}{2} \times CD \times AE = \frac{1}{2} \times 16\text{ cm} \times 18\text{ cm} = 144\text{ cm}^2$

(iii) We know that, Ar. ΔABC = Ar.ΔACD [∵ diagonal bisects the parm.]
or, Ar. $\Delta ABC = 144\text{ cm}^2$
Thus the area of ΔABC is 144 cm^2.

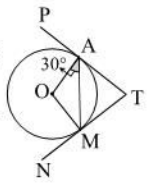
(b) सँगैको वृत्तको चित्रबाट ∡BAC को मान पत्ता लगाउनुहोस् जहाँ O वृत्तको केन्द्र हो ।



Find the value of ∡BAC from the given figure of circle, where O is the centre of circle.

⇨ Here, ∡BDA = 90 °, ∡OCD = 30°, ∡BAC = ?
We know that,
(i) ∡BOC = ∡OCD + ∡ODC [∵ext. ∡= sum of 2 opposite int. ∡s of a Δ]
$= 30° + 90° = 120°$
(ii) $\angle BAC = \frac{1}{2} \times \angle BOC = \frac{1}{2} \times 120° = 60°$ [∵ inscribed ∡ $= \frac{1}{2}\times$ central ∡ based on same arc]
Thus, ∡BAC is 60°

(c) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । A र M मा TP र TN स्पर्श रेखाहरू छन् । यदि ∡OAM = 30° भए ∡ATM को मान पत्ता लगाउनुहोस् ।



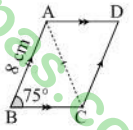
In the given figure, O is the centre of the circle. TP and TN are tangents at A and M. If ∡OAM = 30°, find the value of ∡ATM.

⇨ Here, ∡OAM = 30°
(i) 2∡OAM + ∡AOM = 180° [∵ Sum of angles of isosceles ΔAOM.]
or, $2 \times 30° + \angle AOM = 180°$
∴ ∡AOM = 120°
(ii) ∡AOM + ∡OAT + ∡ATM + ∡OMT = 360° [∵ Sum of angles of quad. OATM.]
or, $120° + 90° + \angle ATM + 90° = 360°$
or, $300° + \angle ATM = 360°$
∴ ∡ATM = 60°
Thus, the measure of ∡ATM is 60°.

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9. (a) यदि ABCD एउटा समानान्तर चतुर्भुज हो र ΔABC मा AB = AC भए ΔACD र स.च. ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
If ABCD is a parallelogram and AB = AC in ΔABC, find the area of ΔACD & parallelogram ABCD.



⇨ Here, ABCD is a parallelogram, AB = AC, $\measuredangle ABC = 75°$ and area of ΔA CD = ?

(i) $\measuredangle ABC = \measuredangle ACB = 75°$ [∵ Base angles of isosceles Δ are equal.]

(ii) $\measuredangle ABC + \measuredangle ACB + \measuredangle BAC = 180°$

or, $75° + 75° + \measuredangle BAC = 180°$

or, $150° + \measuredangle BAC = 180°$

or, $\measuredangle BAC = 180° - 150° = 30°$

(iii) Area of $\Delta ABC = \frac{1}{2}$ AB × AC × sin $\measuredangle BAC = \frac{1}{2} \times 8\text{ cm} \times 8\text{ cm} \times \sin 30° = 32\text{ cm}^2 \times \frac{1}{2} = 16\text{ cm}^2$

Again, Ar. (ΔABC) = Ar. (ΔACD) ∴ Ar. $\Delta ACD = 16\text{ cm}^2$

(iv) Area of parm. ABCD = 2 × area of $\Delta ABC = 2 \times 16 = 32\text{ cm}^2$

Thus, area of ΔACD is 16 sq. cm and area of parm. ABCD is 32 cm^2.

(b) एउटा निरन्तर श्रेणीको तथ्याङ्कमा मध्यक ($\bar{x}$) = 35.8, f र m को गुणनफलहरूको योगफल 1587 + 4p र Σf = 7p + 3 छन् । p को मान पत्ता लगाउनुहोस् र जम्मा सङ्ख्या पत्ता लगाउनुहोस् ।
In a continuous series of a data, the mean ($\bar{x}$) = 35.8, sum of the product of f and m is 1587 + 4p and Σf = 7p + 3. Find the value of p and total number of terms.

⇨ Here, $\bar{x} = 35.8$, $\Sigma fm = 1587 + 4p$ and $\Sigma f = 7p + 3$

As we know that, $\bar{x} = \frac{\Sigma fm}{\Sigma f}$ or, $35.8 = \frac{1587 + 4p}{7p + 3}$

or, $35.8(7p + 3) = 1587 + 4p$ or, $250.6p + 107.4 = 1587 + 4p$

or, $250.6p - 4p = 1587 - 107.4$ or, $246.6p = 1479.6$

or, $p = \frac{1479.6}{246.6}$ ∴ $p = 6$

Again, $\Sigma f = 7p + 3 = 7 \times 6 + 3 = 42 + 3 = 45$

Thus, value of p is 6 and total number of terms is 45.

10. (a) 52 पत्तीको एउटा प्याक खेल्ने तासबाट अनुहार भएका तासहरू हटाइएका छन् । बाँकी तासहरूबाट एउटा तास नहेरीकन झिकिएको छ । एउटा एक्का वा 10 आउने सम्भाव्यता पत्ता लगाउनुहोस् ।
From a pack of 52 playing cards, face cards are removed. If one card is taken out from the rest cards, find the probability of getting an ace or 10.

⇨ Here, Total cards in a pack = 52 No. of face cards which are removed = 12

Probability of getting an ace or 10, P(A or B) = ?

Where, A refers ace cards and B refers cards having number 10 which are 4 in number.

Again, Total sample space, n(S) = 52 – 12 = 40 Number of ace card n(A) = 4

Number of cards having number 10 n(B) = 4

We know that, P(A or B) = P(A) + P(B)

or, $P(A \text{ or } B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{4}{40} + \frac{4}{40} = \frac{8}{40} = \frac{1}{5}$

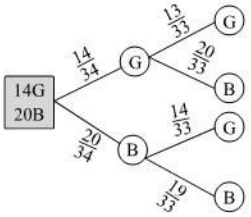
Thus, the probability of getting ace or 10 card is 1/5 from the sample of 40 cards.

(b) एउटा कक्षामा 14 जना केटी र 20 जना केटाहरू छन् । पहिले छानिएको विद्यार्थी पुनः समावेश नगरी दुई जना विद्यार्थी छानिएका छन् भने सबै सम्भाव्य परिणामहरूलाई वृक्ष चित्रमा देखाउनुहोस् र दुवै केटी विद्यार्थी पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।
There are 14 girls and 20 boys in a class. If two students are selected randomly one by one without including first, show the probability of all possible outcomes in a tree diagram and find the probability of both the girl students.

⇨ Here, Let G denotes girls and B denotes boys.

Given, n(G) = 14 and n(B) = 20 so, total students n(S) = 34.

All possible outcomes in tree-diagram is,



Probability of getting both girls,

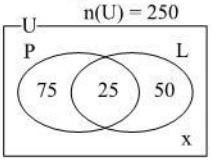
$P(GG) = P_1(G) \times P_2(G) = \frac{14}{34} \times \frac{13}{33} = \frac{91}{561}$

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समूह 'ग' (Group 'C') [10 × 4 = 40]

11. नेपाल भ्रमणमा आएका 250 जना पर्यटकहरू मध्ये 40% ले यस अघि नै पोखरा र 30% ले लुम्बिनी भ्रमण गरिसकेका रहेछन् । त्यसपछि पनि 10% ले त दुवै ठाउँ भ्रमण गरिसकेका रहेछन् भने :
Out of 250 tourists arriving to visit Nepal, 40% of them have already visited Pokhara and 30% visited Lumbini. Also, 10% of them have already visited both the places. Then
(i) पोखरा र लुम्बिनी भ्रमण नगर्ने कति जना थिए ? (How many tourists had not visited both places?)
(ii) पोखरा भ्रमण गर्ने र लुम्बिनी भ्रमण गर्नेहरूको अनुपात पत्ता लगाउनुहोस् ।
Find the ratio of tourists who visited Pokhara to Lumbini.

⇨ Here, Let P and L denote the sets of tourists who have visited Pokhara and Lumbini respectively.
Given, n(U) = 250



$$n(P) = 40\% \times n(U) = \frac{40}{100} \times 250 = 100$$

$$n(L) = 30\% \times n(U) = \frac{30}{100} \times 250 = 75$$

$$n(P \cap L) = 10\% \times n(U) = \frac{10}{100} \times 250 = 25$$

(i) $n(\overline{P \cup L})$ = ? Let x [who hadn't visited both places]
(ii) n(P) : n(L) = ? [ratio of tourists who've visited Pokhara to Lumbini]
From Venn-diagram, 75 + 25 + 50 + x = 250
or, 150 + x = 250
or, x = 250 – 150 = 100
(i) Hence 100 tourists hadn't visited both the places.
(ii) $n(P) : n(L) = \frac{100}{75} = \frac{4}{3} = 4 : 3$

Thus, the ratio of tourists who had visited Pokhara to Lumbini is 4 : 3.

12. एउटा सामानको अङ्कित मूल्य क्रयमूल्य भन्दा निश्चित प्रतिशत माथि निर्धारण गरिएको थियो र यसलाई 5% छुटमा बिक्री गरिएको थियो । यदि सो सामानको क्रयमूल्य रु. 16000 थियो र 10% भ्याटसहित रु. 20900 मा बिक्री गरियो भने क्रयमूल्य भन्दा कति प्रतिशत धेरै अङ्कित मूल्य थियो ?
The price of an article is fixed at a certain percent above the cost price and sold it at 5% discount. If the cost price of the article is Rs 16,000 and sold for Rs 20,900 with 10% VAT, by how many percent is the marked price above the cost price?

⇨ Here, given, Discount rate = 5% Cost price, CP = Rs 16,000
SP with VAT = Rs 20,900 VAT rate = 10%
Percentage by which MP is more than CP = ?
Let SP be x and MP be y.
We know that, SP with VAT = SP + VAT% of SP
or, Rs 20,900 = x + 10% of x
or, Rs 20,900 = x + 0.1x
or, Rs 20,900 = 1.1x
or, $\text{Rs } \frac{20900}{1.1} = x$
∴ x = Rs 19,000
Aagain, we know that,
SP = MP – dis% of MP
or, Rs 19000 = y – 5% of y
or, Rs 19000 = y – 0.05 y
or, Rs 19000 = 0.95 y
or, $\text{Rs } \frac{19000}{0.95} = y$
∴ y = Rs 20,000
Now, MP – CP = Rs 20000 – Rs 16000 = Rs 4,000
So at last, Percentage by which MP is more than $CP = \frac{MP - CP}{CP} \times 100\% = \frac{4000}{16000} \times 100\% = 25\%$
Thus, the marked price is above the cost price by 25%.

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13. एउटा छाता प्रत्येकको नापहरू 25 cm, 110 cm र 110 cm भएका 8 ओटा दुई फरक रङ्गका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । यस्तै 2 ओटा छाता बनाउन कति कपडा लाग्ला ? दुवैको लागि रु. 2.5 प्रति cm^2 को दरमा कपडामा हुने जम्मा खर्च पत्ता लगाउनुहोस् ।
An umbrella is made by stitching eight triangular pieces of clothes of two different colors each piece measuring 25 cm, 110 cm and 110 cm. How much clothes is required for making such two umbrellas? Find the total cost of cloth for both at the rate of Rs 2.5 per cm^2.

⇨ Here, given no. of triangular pieces of clothes, n = 8
Measure of 3 sides, a = 110 cm, a = 110 cm and b = 25 cm
Area of clothes required to make 2 umbrellas = ?
Rate of clothes = Rs 2.5 per cm^2
Total cost of clothes for both umbrella = ?
We know that,

$$\text{Area of each piece of clothes} = \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{25}{4}\sqrt{4 \times 110^2 - 25^2} = 6.25 \times \sqrt{4 \times 12100 - 625}$$
$$= 6.25 \times \sqrt{48400 - 625} = 6.25 \times \sqrt{47775} = 6.25 \times 218.575 = 1366.09375 \text{ cm}^2$$

Again, total area of clothes required for 2 umbrellas = $2 \times 8 \times 1366.09375 = 21857.5$
Cost of clothes = rate × area = Rs 2.5×21857 = Rs 54642.5
Thus, the cost of clothes for making 2 umbrellas is Rs 54642.50 and area of clothes needed is 21857.5 sq. cm.

14. सरल गर्नुहोस् (Simplify): $\frac{m}{m^2-4} - \frac{m^3+8}{m^4-16} + \frac{2m}{(m+2)(m^2+4)}$

⇨ Here, $\frac{m}{m^2-4} - \frac{m^3+8}{m^4-16} + \frac{2m}{(m+2)(m^2+4)}$

$= \frac{m}{m^2-4} - \frac{m^3+8}{(m^2)^2-4^2} + \frac{2m}{(m+2)(m^2+4)}$

$= \frac{m}{m^2-4} - \frac{m^3+8}{(m^2-4)(m^2+4)} + \frac{2m}{(m+2)(m^2+4)}$

$= \frac{m(m^2+4)-m^3-8}{(m^2-4)(m^2+4)} + \frac{2m}{(m+2)(m^2+4)}$

$= \frac{m^3+4m-m^3-8}{(m^2-4)(m^2+4)} + \frac{2m}{(m+2)(m^2+4)}$

$= \frac{4(m-2)}{(m-2)(m+2)(m^2+4)} + \frac{2m}{(m+2)(m^2+4)}$

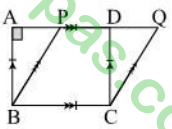
$= \frac{4+2m}{(m+2)(m^2+4)} = \frac{2(m+2)}{(m+2)(m^2+4)} = \frac{2}{m^2+4}$

15. दुई अङ्कको एउटा सङ्ख्यामा दशम स्थानको अङ्क र एकाइ स्थानको अङ्कको अनुपात 3 : 1 छ । यदि सो सङ्ख्याको अङ्कहरूको योगफलको तीन गुणामा 3 जोड्दा विपरीत सङ्ख्या बन्दछ भने सुरूको सङ्ख्या पत्ता लगाउनुहोस् ।
In a number of two digits, the ratio of digit in ten's place and digit in unit's place is 3 : 1. If 3 is added to three times of the sum of its digits then the opposite number is formed, find the initial number.

⇨ Here, let a two-digit number be 10x + y where x is at ten's place and y at unit's place.
According to 1st condition, x : y = 3 : 1
or, $\frac{x}{y} = \frac{3}{1}$
or, x = 3y .....(i)
According to 2nd condition,
$10y + x = 3 + 3 \times (x + y)$
or, $10y + x = 3 + 3x + 3y$
or, $10y - 3y + x - 3x = 3$
or, $7y - 2x = 3$ .....(ii)
Substituting the value of x in equation (ii) from equation (i), $7y - 2 \times 3y = 3$
or, $7y - 6y = 3$
$\therefore$ y = 3
Again, from equation (i), putting value of y, we get, $x = 3 \times 3 = 9$
$\therefore$ $10x + y = 10 \times 9 + 3 = 90 + 3 = 93$
Thus, the two digit number is 93.

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16. आयत ABCD र समानान्तर चतुर्भुज PBCQ एउटै आधार BC र AQ // BC बिचमा रहेका छन् । प्रमाणित गर्नुहोस् : आयत ABCD को क्षेत्रफल = समानान्तर चतुर्भुज PBCQ को क्षेत्रफल
Rectangle ABCD and parallelogram PBCQ are on the same base BC and between AQ // BC. Prove that: Area of rectangle ABCD = Area of parallelogram PBCQ



⇨ Here,

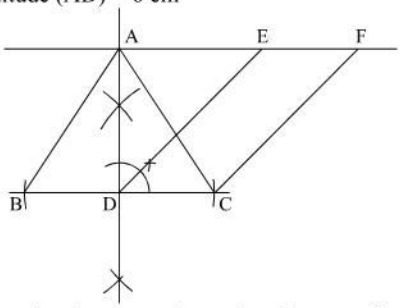
Given: Rectangle ABCD and parallelogram PBCQ are standing on same base BC and between AQ // BC.
To prove: Area of rectangle ABCD = Area of parallelogram PBCQ.
Proof:

Statements	Reasons
1. In ΔABP and ΔDCQ, (i) ∠PAB = ∠QDC (A) (ii) ∠APB = ∠DQC (A) (iii) BP = CQ (S)	1. (i) Both being right angle. (ii) Corresponding angles. (iii) Opposite sides of parallelogram.
2. ΔABP ≅ ΔDCQ	2. By AAS axiom.
3. Ar. ΔABP = Ar. ΔDCQ	3. Congruent triangles have equal area.
4. Ar. ΔABP + Ar. rhombus BPDC = Ar. ΔDCQ + Ar. rhombus BPDC	4. Same rhombus is added on the both sides of statement (3).
5. Ar. rectangle ABCD = Ar. parm. PBCQ	5. By whole part axiom from (4).

Proved.

17. आधार BC = 7 cm र उचाइ AD = 6 cm भएको एउटा समद्विबाहु त्रिभुज ABC को रचना गर्नुहोस् । साथै, सो त्रिभुजसँग बराबर क्षेत्रफल हुने र एउटा कोण 45° भएको एउटा समानान्तर चतुर्भुजको पनि रचना गर्नुहोस् ।
Construct an isosceles triangle ABC in which base BC = 7 cm and altitude AD = 6 cm. Also draw a parallelogram equal in area to the triangle ABC whose one angle is 45°.

⇨ Here, Base (BC) = 7 cm, altitude (AD) = 6 cm



Thus, ΔABC is the given triangle whose area is equal to the area of parallelogram DCFE where ∠EDC is 45°.

18. एउटा वृत्तको केन्द्र O मा केन्द्रीय कोण AOB र परिधिको C मा परिधिकोण ACB एउटै चाप AB मा आधारीत छन् । केन्द्रीय कोण परिधिकोणको दोब्बर हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (दुईओटा फरक फरक नापका र 3 cm भन्दा धेरै अर्धव्यास भएका वृत्तहरू आवश्यक छन् ।)
In a circle, central angle AOB at O and inscribed angle ACB at C are standing on the same arc AB. Verify experimentally that the central angle is double of inscribed angle. [Draw two different figures of circle of radius more than 3 cm.]

⇨ Here,

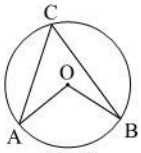


Fig (i)

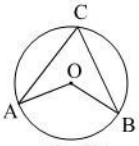


Fig (ii)

In each circle central angle ∠AOB and inscribed angle ∠ACB are measured and tabulated below.

Fig.	∠AOB	∠ACB	Results
(i)	120°	60°	∠AOB = 2 × ∠ACB
(ii)	140°	70°	∠AOB = 2 × ∠ACB

Conclusion: Central angle is double of the inscribed angle based on same arc.

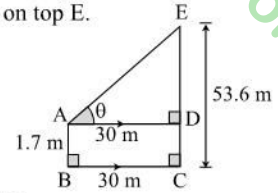
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19. 1.7 m अग्लो एउटा मानिसले आफ् अगाडि रहेको 53.6 m अग्लो रूखको टुप्पोमा रहेको एउटा चरा हेर्दछ । यदि रूख र मानिस बिचको दूरी 30 m छ भने सो मानिसले बनाएको उन्नतांशकोण पत्ता लगाउनुहोस् ।
A man 1.7 m tall, observes a bird sitting on the top of a tree of height 53.6 m in front of him. If the distance between the man and the tree is 30 m, find the angle of elevation made by the man.

⇨ Here, Let AB be the man and CE be the tree and bird is supposed to sit on top E.



Given, AB = 1.7 m = Height of man
CE = 53.6 m = Height of tree
BC = 30 m = Distance between man and the tree.
∠EAD = θ = ? = Angle of elevation of the bird sitting on the top.
CD = AB and AD = BC [∵ opposite sides of rectangle]
DE = CE – CD = 53.6 m – 1.7 m = 51.9 m

In right angled triangle ADE, $\tan\theta = \frac{DE}{AD}$ or, $\tan\theta = \frac{51.9\text{ m}}{30\text{ m}} = 1.73$ m

or, $\tan\theta = \tan 60°$ ∴ $\theta = 60°$

Thus, angle of elevation is 60°.

20. यदि दिइएको तथ्याङ्कको मध्यिका 24 भए y को मान पत्ता लगाउनुहोस् ।
If the median of the given data is 24, calculate the value of y.

Marks obtained	0-10	0-20	0-30	0-40	0-50
No. of students	9	30	30 + y	45 + y	55 + y

⇨ Here, Calculation of median

Marks	No. of students	c.f.
0 - 10	9	9
10 - 20	21	30
20 - 30	y	30 + y
30 - 40	15	45 + y
40 - 50	10	55 + y
	N = 55 + y	

Median value = 24 So, median class = (20 - 30)

Hence we have,
L = 20 = lower limit of the class
N = 55 + y = Total no. of students
f = y = frequency of the median class
i = 10 = length of class interval
c.f. = 30 = cumulative frequency of the pre-median class.

We know that, $\text{Median} = L + \frac{\frac{N}{2} - \text{c.f.}}{f} \times i$ or, $24 = 20 + \frac{\frac{55+y}{2} - 30}{y} \times 10$

or, $24 - 20 = \frac{55 + y - 60}{2y} \times 10$ or, $4 \times 2y = (y - 5) \times 10$

or, $8y = 10y - 50$ or, $50 = 10y - 8y$

or, $50 = 2y$ or, $\frac{50}{2} = y$

∴ $y = 25$ Thus, the value of y is 25.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. कुनै धन राशिको 2 वर्ष र 4 वर्षमा चक्रीय व्याजहरू क्रमशः रु. 5460 र रु. 12066.60 छन् । सो धन राशि र त्यसको 3 वर्षको चक्रीय व्याजको अन्तर पत्ता लगाउनुहोस् ।
The compound interest on a sum of money in 2 years and 4 years are Rs 5,460 and Rs 12,066.60 respectively. Find the difference between principal and compound interest of 3 years.

⇨ Here, given, Compound interest of 2 years, CI_1 = Rs 5,460
Compound interest of 4 years, CI_2 = Rs 12,066.60
Difference between principal and compound interest of 3 years, $CI_3 - P$ = ?

We know that, $CI = P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$

For T = 2 years, $CI_1 = P\left[\left(1 + \frac{R}{100}\right)^2 - 1\right]$

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or, Rs 5460 = $P\left[\left(1+\frac{R}{100}\right)^2-1\right]$ .....(i)

Again, for T = 4 years, $CI_2 = P\left[\left(1+\frac{R}{100}\right)^4-1\right]$

or, $12066.60 = P\left[\left(1+\frac{R}{100}\right)^4-1\right]$

or, Rs $12066.60 = P\left[\left(1+\frac{R}{100}\right)^2-1\right]\left[\left(1+\frac{R}{100}\right)^2+1\right]$ .....(ii)

Now dividing equation (ii) by equation (i), we get,

$$\frac{\text{Rs } 12066.60}{\text{Rs } 5460} = \frac{P\left[\left(1+\frac{R}{100}\right)^2-1\right]\left[\left(1+\frac{R}{100}\right)^2+1\right]}{P\left[\left(1+\frac{R}{100}\right)^2-1\right]}$$

or, $2.21 = \left(1+\frac{R}{100}\right)^2+1$ or, $2.21-1 = \left(1+\frac{R}{100}\right)^2$

or, $1.21 = \left(1+\frac{R}{100}\right)^2$ or, $\sqrt{1.21} = 1+\frac{R}{100}$

or, $1.1-1 = \frac{R}{100}$ or, $0.1\times 100 = R$

∴ R = 10% p.a.

Putting the value of R in equation (i) we get, Rs 5460 = $P\left[\left(1+\frac{10}{100}\right)^2-1\right]$

or, Rs $5460 = P[(1+0.1)^2-1]$ or, Rs $5460 = P[1.1^2-1]$

or, Rs $5460 = P(1.21-1)$ or, Rs $5460 = 0.21\,P$

or, Rs $\frac{5460}{0.21} = P$ ∴ P = Rs 26,000

Thus, the principal is Rs 26,000.

Again, for time T = 3 years, CI_3 = Rs $26000\left[\left(1+\frac{10}{100}\right)^3-1\right]$ = Rs $26000\times[(1+0.1)^3-1]$

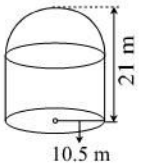
= Rs $26000\times[1.1^3-1]$ = Rs $26000\times[1.331-1]$

= Rs 26000×0.331 = Rs 8606

Thus, the required difference is; $P - CI_3$ = Rs 26000 – Rs 8606 = Rs 17394.

22. एकजना मानिसले उनको समुदायको प्रयोजनको लागि 10.5 m अर्धव्यास र 21 m उचाइ भएको एउटा वृत्ताकार आधार भएको पानी ट्याङ्की ज्ञानी ट्याङ्की फ्याक्ट्रीबाट किनेर ल्याए । यदि उक्त ट्याङ्कीको माथिल्लो भाग अर्धगोलाकार छ भने सो ट्याङ्कीमा कति लिटर पानी अटाउँछ होला ?

A person bought a water tank of circular base having the radius 10.5 m and height 21 m for the use of his community from the *'Gyani Tank Factory'*. If the upper part of the tank is semi spherical, how many litre of water will be contained in the tank?



⇨ Here, given, A water tank made up of cylinder and hemi-shpere at the top.
Height of tank, H = 21 m and Radius of base, r = 10.5 m
Volume of water that can be contained in it (in liter) = ?
The radius of hemisphere will be same that of the radius of base of cylinder.
So, height of cylinder, h = H – r = 21 m – 10.5 m = 10.5 m
We know that, Volume of vessel, V = Volume of cylinder + Volume of Hemisphere

$$V = \pi r^2 h + \frac{2}{3}\pi r^3 = \pi r^2\left(h+\frac{2}{3}r\right)$$

$$= \frac{22}{7}\times 10.5^2\left(10.5+\frac{2}{3}\times 10.5\right)$$

$$= \frac{22}{7}\times 110.25\times(10.5+7) = \frac{22\times 110.25\times 17.5}{7} = 6063.75\ m^3$$

= 6063.75 × 1000 litre = 6063750 liter.

Thus, the tank can store 6063750 litre of water in it.

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23. यदि $-1+p+q=1-r$ जहाँ p, q र r अचरहरू हुन् भने दिइएको सम्बन्ध हल गर्नुहोस् :
If $-1+p+q=1-r$, where p, q and r are constants, then solve the given relation:

$$\frac{\sqrt{x-1}-q-r}{p}+\frac{\sqrt{x-1}-r-p}{q}+\frac{\sqrt{x-1}-p-q}{r}=3$$

⇨ Here, given, $-1+p+q=1-r$ or, $p+q+r=2$

To solve; $\frac{\sqrt{x-1}-q-r}{p}+\frac{\sqrt{x-1}-r-p}{q}+\frac{\sqrt{x-1}-p-q}{r}=3$

or, $\frac{\sqrt{x-1}-(q+r)}{p}+\frac{\sqrt{x-1}-(r+p)}{q}+\frac{\sqrt{x-1}-(p+q)}{r}=3$

or, $\frac{\sqrt{x-1}-(2-p)}{p}+\frac{\sqrt{x-1}-(2-q)}{q}+\frac{\sqrt{x-1}-(2-r)}{r}=3$

or, $\frac{\sqrt{x-1}}{p}-\frac{2}{p}+\frac{p}{p}+\frac{\sqrt{x-1}}{q}-\frac{2}{q}+\frac{q}{q}+\frac{\sqrt{x-1}}{r}-\frac{2}{r}+\frac{r}{r}=3$

or, $\sqrt{x-1}\left(\frac{1}{p}+\frac{1}{q}+\frac{1}{r}\right)-\left(\frac{2}{p}+\frac{2}{q}+\frac{2}{r}\right)+3=3$

or, $\sqrt{x-1}\left(\frac{1}{p}+\frac{1}{q}+\frac{1}{r}\right)=3-3+2\left(\frac{1}{p}+\frac{1}{q}+\frac{1}{r}\right)$

or, $\sqrt{x-1}\left(\frac{1}{p}+\frac{1}{q}+\frac{1}{r}\right)=2\left(\frac{1}{p}+\frac{1}{q}+\frac{1}{r}\right)$

$\therefore \sqrt{x-1}=2$

Squaring on both sides, we get, $\left(\sqrt{x-1}\right)^2=2^2$

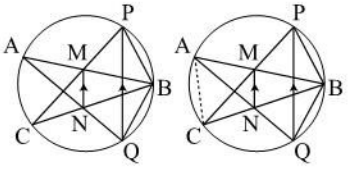
or, $x-1=4$

or, $x=4+1$

$\therefore x=5$

Thus, the value of x is 5.

24. सँगै दिइएको वृत्तमा MN // PQ भए प्रमाणित गर्नुहोस : जीवा PB = जीवा QB छन् ।
In the adjoining figure of circle, MN // PQ, prove that: chord PB = chord QB:



⇨ Here, **Given:** MN // PQ
To prove: Chord PB = Chord QB
Construction: AC is joined.
Proof:

Statement	Reasons
1. $\measuredangle CMN = \measuredangle CPQ$	1. Corresponding angles MN // PQ
2. $\measuredangle CAQ = \measuredangle CPQ$	2. Inscribed angle based on same arc.
3. $\measuredangle CMN = \measuredangle CAQ$	3. From statements (1) and (2).
4. C, A, M and N are concyclic.	4. Being $\measuredangle CMN = \measuredangle CAN$, both angles stand on CN.
5. $\measuredangle MCN = \measuredangle MAN$ i.e. $\measuredangle PCB = \measuredangle BAQ$	5. Inscribed angles on the same arc of small circle CAMN.
6. $\measuredangle PCB \overset{\circ}{=} \frac{1}{2}\overset{\frown}{PB}$ and $\measuredangle BAQ \overset{\circ}{=} \frac{1}{2}\overset{\frown}{BQ}$	6. Relation between inscribed angle and opposite arc.
7. $\overset{\frown}{PB} = \overset{\frown}{BQ}$	7. From statements (5) and (6).
8. PB = BQ	8. Being $\overset{\frown}{PB} = \overset{\frown}{BQ}$.

Proved.

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13. PABSON BOARD EXAM. 2075 [PABSON KAVREPALANCHOK]

Time: 3:00 hrs **Full Marks: 100**

समूह 'क' (Group 'A') **[6 × 1 = 6]**

1. (a) भ्याट रकम र विक्रय मूल्य दिइएको अवस्थामा भ्याटको दर पत्ता लगाउने सूत्र लेख्नुहोस् ।
Write the formula for finding rate of VAT when VAT amount and selling price are given.

⇨ Here, the percentage of VAT $= \frac{\text{VAT Amount}}{\text{SP}} \times 100\%$

(b) भुजाको नापहरू 'a, a, b' एकाइ भएको त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of triangle whose sides are 'a, a, b' units?

⇨ Here, area of triangle $= \frac{b}{4}\sqrt{4a^2 - b^2}$ sq. units

2. (a) हल गर्नुहोस् (Solve): $\sqrt{x-1} = \sqrt{2}$

⇨ Here, $\left(\sqrt{x-1}\right)^2 = \left(\sqrt{2}\right)^2$ or, $x - 1 = 2$ $\therefore$ $x = 3$

(b) तल दिइएको तथ्याङ्कमा मध्यिका कुन श्रेणीमा पर्दछ ? लेख्नुहोस् ।
In the following data, in which series does median lie? Write it.

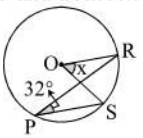
X	200 - 300	300 - 400	400 - 500	500 - 600	600 - 700
cf	40	55	68	77	80

⇨ Here, median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{80}{2}\right)^{th}$ item $= 40^{th}$ item $= 200 - 300$

3. (a) एउटै आधार र उही समानान्तर रेखाहरूबीच रहेका आयत र त्रिभुजको क्षेत्रफलको सम्बन्ध के हुन्छ ?
What is the relation between area of rectangle and triangle standing on same base and between same parallels?

⇨ Here, the required relation is; Area of rectangle = 2 (Area of triangle)

(b) दिइएको चित्रमा ∡SOR को मान पत्ता लगाउनुहोस् । (In the given figure, find the value of ∡SOR.)



⇨ Here, $\measuredangle SOR = 2\ \measuredangle SPR = 2 \times 32° = 64°$

समूह 'ख' (Group 'B') **[17 × 2 = 34]**

4. (a) हाल नेपाली रुपैयाँ रु. 130 मा 1 युरो किन्न सकिन्छ । यदि नेपाली मुद्रा 10% ले अधिमूल्यन भए 50 युरोलाई कति पर्ला ?
At present, 1 Euro can be bought at Rs 130. If Nepali money is revaluated by 10%, what is the cost of 50 Euro ?

⇨ Here, 1 Euro = Rs 130, Revaluation rate = 10% (Nepali money)
We have, New rate of 1 Euro = Rs 130 – 10% of Rs 130 = Rs 130 – 0.1 × Rs 130
$\therefore$ 1 Euro = Rs 117
So, 50 Euro = Rs 117 × 50 = Rs 5850
Thus, the required amount is Rs 5850.

(b) एकजना किसानले रु 400000 मा किनेको एउटा ट्याक्टरलाई 2 वर्ष पछि 10% प्रतिवर्ष मिश्रह्रासका दरले बेचेछ । उक्त ट्याक्टरको 2 वर्ष पछिको मूल्य ह्रास कति हुन्छ ? पत्ता लगाउनुहोस् ।
A farmer bought a tractor for Rs 400000 and sold it after 2 years at 10% depreciation rate per year. What is the price depreciation of tractor after 2 years?

⇨ Here, Initial price (P) = Rs 400,000, Time (T) = 2 years and Rate (R) = 10%
We have, $P_T = P\left(1 - \frac{R}{100}\right)^T = 400000\left(1 - \frac{10}{100}\right)^2 = 400000 \times 0.81 = 324000$
Now, price depreciation = $P - P_T$ = Rs 400000 – Rs 324000 = Rs 76000
Thus, the required amount of depreciation is Rs 76000.

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5. (a) एउटा बेलनाको वक्रसतहको क्षेत्रफल यसैको पूरा सतहको क्षेत्रफलको एक तिहाइ र उचाइ 5 cm भए व्यास पत्ता लगाउनुहोस् ।
The curved surface area of a cylinder is one third of its total surface area and the height is 5 cm. Find the diameter.

⇨ Here, CSA (Cylinder) $= \frac{1}{3}$ TSA (Cylinder)

or, $2\pi rh = \frac{1}{3} 2\pi r (r + h)$ or, $h = \frac{1}{3}(r + h)$ or, $3h = r + h$

or, $2h = r$ or, $2 \times 5 \text{ cm} = r$ ∴ $r = 10$ cm

Now, diameter $= 2r = 2 \times 10$ cm $= 20$ cm

Thus, the required diameter is 20 cm.

(b) प्रत्येकको अर्धव्यास 'x cm' भएका 512 ओटा फलामका गोलाहरू पगालेर 'y cm' अर्धव्यास भएको गोला बनाइयो । x : y पत्ता लगाउनुहोस् ।
512 solid iron spheres, each of radius 'x cm' are melted to form a sphere with radius 'y cm'. Find the ratio x : y.

⇨ Here, Volume of sphere having x cm radius $= \frac{4}{3}\pi x^3$ Volume of sphere having y cm radius $= \frac{4}{3}\pi y^3$

By the question,

$512 \times \frac{4}{3}\pi x^3 = \frac{4}{3}\pi y^3$ or, $512 x^3 = y^3$ or, $\frac{x^3}{y^3} = \frac{1}{512}$

or, $\left(\frac{x}{y}\right)^3 = \left(\frac{1}{8}\right)^3$ ∴ $x : y = 1 : 8$ Thus, the required ratio is 1 : 8.

(c) यदि एउटा समबाहु चतुर्भुजका विकर्णहरूको लम्बाइ क्रमशः 12 cm र 16 cm भए सो समबाहु चतुर्भुजको क्षेत्रफल र परिमिति पत्ता लगाउनुहोस् ।
If the diagonals of a rhombus are 12 cm and 16 cm respectively, find the area and perimeter of the rhombus.

⇨ Here, $d_1 = 12$ cm and $d_2 = 16$ cm

We know that, Area of rhombus $= \frac{1}{2} d_1 \times d_2 = \frac{1}{2} \times 12 \text{ cm} \times 16 \text{ cm} = 96 \text{ cm}^2$

Again, length of side $= \sqrt{\left(\frac{d_1}{2}\right)^2 + \left(\frac{d_2}{2}\right)^2} = \sqrt{6^2 + 8^2} = \sqrt{100} = 10$ cm

Now, perimeter of rhombus $= 4\ell = 4 \times 10$ cm $= 40$ cm

Thus, the area is 96 cm^2 and the perimeter is 40 cm.

6. (a) म.स. पत्ता लगाउनुहोस् **(Find the HCF of) : $(a + b)^2 - 4ab$ & $2a^2b - 4ab^2 + 2b^3$**

⇨ Here,

First Exp. $= (a + b)^2 - 4ab$
$= (a - b)^2$
$= (a - b)(a - b)$

Second Exp. $= 2a^2b - 4ab^2 + 2b^3$
$= 2b(a^2 - 2ab + b^2)$
$= 2b(a - b)^2$
$= 2b(a - b)(a - b)$

Thus, the HCF is $(a - b)(a - b)$ or $(a - b)^2$.

(b) सरल गनुहोस् **(Simplify):**

$\sqrt{125} - \sqrt{45} + \sqrt[4]{25} - 3\sqrt{5}$

⇨ Here, $\sqrt{125} - \sqrt{45} + \sqrt[4]{25} - 3\sqrt{5}$

$= \sqrt{5 \times 5^2} - \sqrt{5 \times 3^2} + \sqrt[4]{5^2} - 3\sqrt{5}$
$= 5\sqrt{5} - 3\sqrt{5} + \sqrt{5} - 3\sqrt{5}$
$= (5 - 3 + 1 - 3)\sqrt{5}$
$= 0 \times \sqrt{5}$
$= 0$

7. (a) सरल गर्नुहोस् **(Simplify):** $\left[\left(\frac{x}{y}\right)^2 - \frac{x}{y^2}\right] : \left(\frac{x-1}{y}\right)^2$

⇨ Here, $\left[\left(\frac{x}{y}\right)^2 - \frac{x}{y^2}\right] : \left(\frac{x-1}{y}\right)^2$

$= \left[\frac{x^2}{y^2} - \frac{x}{y^2}\right] : \frac{(x-1)^2}{y^2}$
$= \frac{x^2 - x}{y^2} \div \frac{(x-1)^2}{y^2}$
$= \frac{x(x-1)}{y^2} \times \frac{y^2}{(x-1)^2} = \frac{x}{x-1}$

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(b) सरल गनुहोस् (Simplify):

$$\left(1-\frac{1}{N}\right)\left(1-\frac{1}{N-1}\right)\left(1+\frac{2}{N-2}\right)$$

⇨ Here, $\left(1-\frac{1}{N}\right)\left(1-\frac{1}{N-1}\right)\left(1+\frac{2}{N-2}\right)$

$$=\frac{N-1}{N}\times\frac{N-1-1}{N-1}\times\frac{N-2+2}{N-2}$$

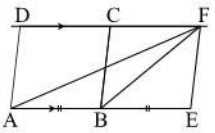
$$=\frac{N-1}{N}\times\frac{N-2}{N-1}\times\frac{N}{N-2}$$

$$=1$$

(c) दुईओटा सङ्ख्याहरूको योगफल 8 र तिनिहरूको फरक 4 छ । ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two numbers is 8 and their difference is 4. Find the numbers.

⇨ Here, let the numbers be x and (8 – x).
Their difference = 4
or, x – (8 – x) = 4
or, x – 8 + x = 4
or, 2x = 12
∴ x = 6
So, the numbers are 6 and (8 – 6) = 2
Thus, the required numbers are 6 and 2.

8. (a) चित्रमा AE // DF र AE को मध्यबिन्दु B छ । यदि ΔAEF को क्षेत्रफल 20 वर्ग से.मि. भए समानान्तर चतुर्भुज ABCD को क्षेत्रफल कति हुन्छ ?
In the given figure, AE // DF and B is mid-point of AE. If area of ΔAEF is 20 square centimeter, then find the area of parallelogram ABCD.

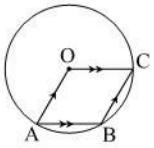


⇨ Here, Ar. (ΔAEF) = 20 cm²

(i) Ar. (ΔABF) = $\frac{1}{2}$ Ar. (ΔAEF) = $\frac{1}{2}\times 20\ cm^2 = 10\ cm^2$ [∵ BF is a median of ΔAEF.]

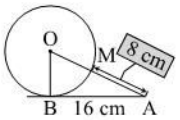
(ii) Ar. (□ABCD) = 2 Ar. (ΔABF) [∵ Both are on the same base and on same //s]
or, Ar. (□ABCD) = 2 × 10 cm² = 20 cm²
Thus, the area of parm. ABCD is 20 cm².

(b) दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो र OABC एउटा समानान्तर चतुर्भुज हो भने सो समानान्तर चतुर्भुजको कुनै एउटा कोणको नाप निकाल्नुहोस् ।
In the given figure, if O is the centre of the circle and OABC is a parallelogram, find the measure of any one angle of the parallelogram.



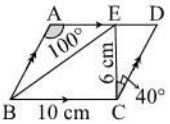
⇨ Here, (i) 2 ∠ABC = Reflex ∠AOC [∵ Both are on same arc.]
(ii) ∠ABC = ∠AOC [∵ Opposite angles of a parallelogram]
(iii) ∠AOC + Reflex ∠AOC = 360° [∵ angles at a point]
or, ∠ABC + 2 ∠ABC = 360°
or, 3∠ABC = 360°
∴ ∠ABC = 120°
Thus, the measure of ∠ABC is 120°.

(c) चित्रमा वृत्तको व्यास पत्ता लगाउनुहोस् । **(In the figure, find the diameter of the circle.)**



⇨ Here, let OB = OM = x then,
(i) $OB^2 = OA^2 - AB^2$
or, $x^2 = (x+8)^2 - 16^2$
or, $x^2 = x^2 + 16x + 64 - 256$
or, 16x = 192
∴ x = 12 cm
(ii) Diameter = 2 × radius = 2x = 2 × 12 cm = 24 cm
Thus, the diameter of the circle is 24 cm.

9. (a) चित्रमा ΔBEC को क्षेत्रफल पत्ता लगाउनुहोस् । **(Find the area of ΔBEC in thefigure.)**



⇨ Here, (i) ∠ECB = ∠BCD – 40° = 100° – 40° = 60°

(ii) Ar. (ΔBEC) = $\frac{1}{2}$ BC × EC sin ∠ECB = $\frac{1}{2}$ 10 cm × 6 cm × sin 60° = $30\times\frac{\sqrt{3}}{2} = 15\sqrt{3}\ cm^2$

Thus, the area of ΔBEC is $15\sqrt{3}$ cm².

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(b) यदि मध्यक $(\bar{x}) = 12$, $\Sigma fx = 70\,m + 10\,ma$ र पदसङ्ख्या $(N) = 5\,m + a\,m$ भए a को मान पत्ता लगाउनुहोस् । $[m \neq 0]$
If mean $(\bar{x}) = 12$, $\Sigma fx = 70\,m + 10\,ma$ and the sum of frequency $(N) = 5\,m + a\,m$, find the value of a. $[m \neq 0]$

⇨ Here, $\bar{x} = 12$, $\Sigma fx = 70\,m + 10\,ma$ and $N = 5\,m + am$

We know that, $\bar{x} = \frac{\Sigma fx}{N}$ or, $12 = \frac{70\,m + 10\,ma}{5\,m + am}$

or, $12 = \frac{m(70 + 10\,a)}{m(5 + a)}$ or, $60 + 12\,a = 70 + 10\,a$

or, $2a = 10$ ∴ $a = 5$

Thus, the value of a is 5.

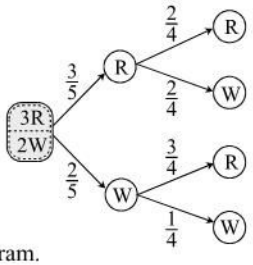
10. (a) एउटा डाइस लाई दुईपटक फाल्दा पहिलो पटक 5 र दोस्रो पटक विजोर सङ्ख्या आउने सम्भाव्यता निकाल्नुहोस् ।
A cubical dice is thrown two times. Find the probability that the outcomes is 5 in first time and odd number in second time.

⇨ Here, Sample space = {1, 2, 3, 4, 5, 6} So, set of odd numbers {1, 3, 5}

Now, P(5 & odd numbers) = P(5) + P(odd numbers) $= \frac{n(5)}{n(s)} + \frac{n(\text{odd numbers})}{n(s)} = \frac{1}{6} + \frac{3}{6} = \frac{4}{6} = \frac{2}{3}$

Thus the required probability is $\frac{2}{3}$.

(b) एउटा वाकसमा उहि आकारका तीनओटा राता र दुईओटा सेता बलहरू राखिएका छन् । एकपछि अर्को गरेर दुईओटा बलहरू (पुन : नराखी) निकाल्दा रातो र सेतो बलहरू आउने सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् ।
Three red and two white balls of the same size are kept in a box. Two draws are made one after the other (without replacement). Show the probability of getting red and white balls in the tree diagram.

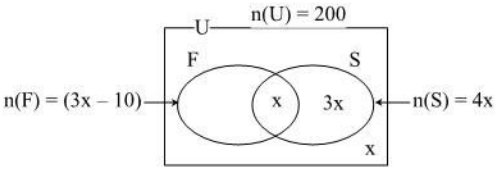


⇨ Here, let R and W be the red and white ball respectively.
Then, the probability of getting the balls is shown in adjoining tree diagram.

समूह 'ग' (Group 'C') [10 × 4 = 40]

11. 200 जना विद्यार्थीहरू भएको एउटा विद्यालयमा विद्यार्थीहरू फ्रेन्च, स्पानिस, दुवै अथवा अरू कुनै अध्ययन गर्न सक्छन् । दुवैथरी अध्ययन गर्ने जति दुवैथरी अध्ययन नगर्ने छन् । स्पानिस अध्ययन गर्नेको एक चौथाइले फ्रेन्च पनि अध्ययन गर्दछन् । फ्रेन्च अध्ययन गर्नेहरूको सङ्ख्या स्पानिस मात्र अध्ययन गर्ने भन्दा 10 ले कम छ । फ्रेन्च मात्र कति प्रतिशतले अध्ययन गर्दछन् ?
In a certain school of 200 students, the students can study French, Spanish, both or neither. Just as many study both as study neither. One quarter of those who study Spanish also study French. The total number who study French is 10 fewer than those who study Spanish only. What percentage study French only?

⇨ Here, let F and S be the set of students who can study French and Spanish respectively.
From the question, $n(U) = 200$



Let $n(S \cap F) = n(\overline{S \cup F}) = x$
So, $n(S) = 4x$
We have, $n_0(S) = n(S) - n(S \cap F) = 4x - x = 3x$
And, $n(F) = 3x - 10$

Now, $n(U) = n_0(S) + n(F) + n(\overline{S \cup F})$
or, $200 = 3x + 3x - 10 + x$
or, $210 = 7x$ ∴ $x = 30$
So, $n(S \cap F) = 30$
And, $n(F) = 3x - 10 = 3 \times 30 - 10 = 80$
We have, $n_0(F) = n(F) - n(S \cap F) = 80 - 30 = 50$

The percentage of french only $= \frac{n_0(F)}{n(U)} \times 100\% = \frac{50}{200} \times 100\% = 25\%$

Thus, the required percentage is 25%.

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12. एउटा घड्रीको अङ्कित मूल्य रु. 2700 छ । यदि दिइएको छुटको दर भ्याटको दर भन्दा दोब्बर छ र भ्याट जोडे पछि सो घड्रीको मूल्य रु. 2376 पुग्यो भने भ्याट दर पत्ता लगाउनुहोस् ।

The marked price of a watch is Rs 2700. If the percentage of discount given on marked price is twice of the percentage of VAT and the value of the watch after adding VAT is Rs 2376 then find the rate of VAT.

⇨ Here, let the rate of VAT be x % then the rate of discount will be 2x %.

So, the discount = 2x % of 2700 = $\frac{2x}{100} \times 2700 = 54x$

Again, price after discount = 2700 – 54x

Now, price including VAT = 2376

So, (2700 – 54x) + x % of (2700 – 54x) = 2376

or, $2700 - 54x + \frac{x}{100} \times (2700 - 54x) = 2376$

or, $270000 - 5400x + 2700x - 54x^2 = 237600$

or, $54x^2 + 2700x - 32400 = 0$

or, $x^2 + 50x - 600 = 0$

or, $x^2 + 60x - 10x - 600 = 0$

or, $x(x + 60) - 10(x + 60) = 0$

or, $(x + 60)(x - 10) = 0$

Either $x + 60 = 0 \Rightarrow x = -60$ (impossible)

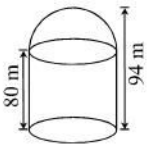
or, $x - 10 = 0 \Rightarrow x = 10$

Thus, the required VAT rate is 10%.

13. एउटा बेलानामाथि अर्धगोला भएको ठोस वस्तुमा बेलनाको अर्धव्यास र अर्धगोलाको अर्धव्यास बराबर छन् । यदि संयुक्त ठोस वस्तुको कुल उचाइ 94 से.मि. र बेलनाको उचाइ 80 से.मि. भए सो ठोस वस्तुको पूरा सतहको क्षेत्रफल र आयतन पत्ता लगाउनुहोस् ।

A hemisphere is on the top of a cylinder in a solid object in which radius of hemisphere and cylinder are equal to each other. If the total height of the combined solid is 94 cm and height of the cylinder is 80 cm, find the total surface area and volume of the solid.

⇨ Here, common radius = 94 cm – 80 cm = 14 cm



We have,

TSA (Solid) = $2\pi rh + 3\pi r^2 = \pi r(2h + 3r) = \frac{22}{7} \times 14(2 \times 80 + 3 \times 14) = 44 \times 202 = 8888\ cm^2$

Again,

Volume (Solid) = $\frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2 \left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 14^2 \left(\frac{2}{3} \times 14 + 80\right) = 616 \times 89.33 = 55029.33\ cm^3$

Thus, TSA is 8888 cm^2 & volume is 55029.33 cm^3.

14. ल.स. पत्ता लगाउनुहोस् **(Find the LCM of): $5a^3 - 20a$, $a^3 - 3a^2 - 10a$, $a^2(a - 1) - 2a + 8$**

⇨ Here,

First Exp.	Second Exp.	Third Exp.
$= 5a^3 - 20a$	$= a^3 - 3a^2 - 10a$	$= a^2(a - 1) - 2a + 8$
$= 5a(a^2 - 4)$	$= a(a^2 - 3a - 10)$	$= a^3 - a^2 - 2a + 8$
$= 5a(a + 2)(a - 2)$	$= a(a^2 - 5a + 2a - 10)$	$= a^3 + 8 - a^2 - 2a$
	$= a\{a(a - 5) + 2(a - 5)\}$	$= (a + 2)(a^2 - 2a + 4) - a(a + 2)$
	$= a(a - 5)(a + 2)$	$= (a + 2)(a^2 - 2a + 4 - a)$
		$= (a + 2)(a^2 - 3a + 4)$

Now, LCM = $(a + 2)\,5a(a - 2)(a - 5)(a^2 - 3a + 4) = 5a(a + 2)(a - 2)(a - 5)(a^2 - 3a + 4)$

$= 5a(a^2 - 4)(a - 5)(a^2 - 3a + 4)$

15. अन्जलीका दुई छोराहरू, एउटा अर्को भन्दा 2 वर्ष जेठो छ । हाल उनको उमेर छोराहरूको उमेरहरूको वर्गहरूको योगफलसँग बराबर छ । यदि 6 वर्षपछि उनको उमेर ठुलो छोराको हालको उमेरको आठगुणा हुनेछ भने तिनीहरूको उमेरहरू पत्ता लगाउनुहोस् ।

Anjali has two sons, one being exactly 2 years older than the other. At present, her age is equal to the sum of the squares of the ages of her sons. If 6 years hence her age will be eight times the present age of the elder son, find their present ages.

⇨ Here, let the age of Anjali be x years then the age of her sons will be y years and (y + 2) years.

From the first condition, $x = y^2 + (y + 2)^2$

$= y^2 + y^2 + 4y + 4$

$\therefore x = 2y^2 + 4y + 4$ .....(i)

From the second condition, $x + 6 = 8(y + 2)$

or, $x + 6 = 8y + 16$

or, $x = 8y + 10$ .....(ii)

From the equation (i) and (ii) $8y + 10 = 2y^2 + 4y + 4$

or, $2y^2 - 4y - 6 = 0$

or, $2(y^2 - 2y - 3) = 0$

or, $y^2 - 2y - 3 = 0$

or, $y^2 - 3y + y - 3 = 0$

or, $y(y - 3) + 1(y - 3) = 0$

or, $(y - 3)(y + 1) = 0$

Either, $y - 3 = 0 \Rightarrow y = 3$

or, $y + 1 = 0 \Rightarrow y = -1$ (impossible)

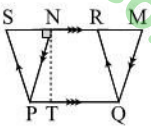
Age of Anjali = $8y + 10 = 8 \times 3 + 10 = 34$ years

Thus, the age of Anjali is 34 years & age of her sons are 3 years and 5 years.

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16. एउटै आधार र उही समानान्तर रेखाहरू बीच बनेका समानान्तर चतुर्भुजहरू PQRS र PQMN को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।
Prove that the area of parallelogram PQRS and PQMN standing on same base and between the same parallels are equal in area.

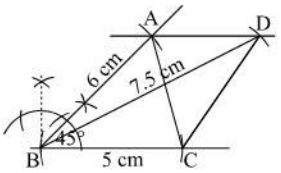


⇨ Here, Given: Parallelograms PQRS and PQMN are on the same base and between the same parallels SM // TQ.
To prove: Ar. (parm. PQRS) = Ar. (parm. PQMN)
Construction: Draw NT ⊥ PQ
Proof:

Statements	Reasons
1. Ar. (Parm. PQRS) = PQ × NT	1. By the formula of area of parallelogram.
2. Ar. (Parm PQMN) = PQ × NT	2. Same as reason (1)
3. Ar. (parm. PQRS) = Ar. (parm PQMN)	3. From the statements (1) and (2)

Proved.

17. AB = 6 cm, BC = 5 cm र ∠ABC = 45° भएको ΔABC को रचना गर्नुहोस् । DB = 7.5 cm भएको अर्को ΔDBC पनि यसरी रचना गर्नुहोस् कि यसको क्षेत्रफल ΔABC को क्षेत्रफलसँग बराबर होस् ।
Construct a ΔABC in which AB = 6 cm, BC = 5 cm and ∠ABC = 45°. Also construct another ΔDB C which is equal in area to the triangle ABC such that DB = 7.5 cm.



⇨ Here, AB = 6 cm, BC = 5 cm and ∠ABC = 45°; BD = 7.5 cm.
ΔABC is given triangle and ΔDBC is the required triangle whose area is equal to the area of ΔABC.

18. वृत्तको एउटै चाप VE मा आधारीत केन्द्रीयकोण VOE परिधिकोण VLE को दोब्बर हुन्छ भनी प्रयोगात्मक रुपमा सिद्ध गर्नुहोस् (कम्तिमा 3 cm अर्धव्यास भएका दुईओटा वृत्तहरू आवस्यक छन् ।)
Verify experimentally that angle VOE at the centre is twice the inscribed angle VLE subtended by the same arc VE. (Two figures with at least 3 cm radii are necessary.)

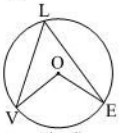


Fig (i)



Fig (ii)

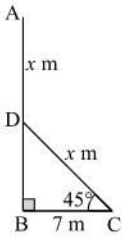
⇨ Here, Central angle VOE and inscribed ∠VLE are on the same arc VE.

Measurement Table

	∠VOE	∠VLE	Remarks
Fig. (i)	120°	60°	∠VOE = 2 ∠VLE
Fig. (ii)	140°	70°	∠VOE = 2 ∠VLE

From the above table, it is concluded that the angle VOE at the centre is twice the inscribed angle VLE subtended by the same arc VE.

19. हुरीले गर्दा सीधा रूख भाँचिएर रूखको टुप्पोले छेउबाट 7 m टाढाको समतल सतहको बिन्दुमा छुँदा 45° को कोण बनाउँदछ भने त्यो रूखको हालको उचाइ र भाँचिनु भन्दा पहिलेको उचाइ पत्ता लगाउनुहोस् ।
The upper part of a straight tree broken by the wind makes an angle of 45° with plain surface at point 7 m from the foot of the tree. Find the present height and the height of the tree before it was broken.



⇨ Here, let AB be the height of a tree, AD = CD = x m be the height of broken part.
Let ∠DCB = 45° be angle of elevation.

From the right angled triangle, $\tan\theta = \frac{BD}{BC}$ & $\cos\theta = \frac{BC}{CD}$

or, $\tan 45° = \frac{BD}{7}$ or, $\cos 45° = \frac{7}{x}$

or, $1 = \frac{BD}{7}$ or, $\frac{1}{\sqrt{2}} = \frac{7}{x}$

$\therefore$ BD = 7 m $\therefore$ $x = 7\sqrt{2}$

Now, height of the tree before broken = x + BD = $(7 + 7\sqrt{2})$ m = 16.89 m
Thus, the present height is 7 m and the height before broken was 16.89 m.

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20. दिइएको तथ्याङ्कको $Q_3 = 60$ भए P को मान पत्ता लगाउनुहोस् । **(The Q_3 of the given data = 60. Find the value of P.)**

C.I.	10-20	20-30	30-40	40-50	50-60	60-70	70-80
cf	3	8	12	17	21	21 + P	24 + P

⇨ Here, calculation of missing frequency

CI	C*f*	*f*
10-20	3	3
20-30	8	5
30-40	12	4
40-50	17	5
50-60	21	4
60-70	21 + P	P
70-80	24 + P	3
		N = 24 + P

We have given,

$Q_3 = 60$, So Q_3 class = 60 - 70

We know that, $Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right)$

or, $60 = 60 + \frac{10}{21+P}\left(\frac{3\times(24+P)}{4} - 21\right)$

or, $0 = \frac{10}{21+P}\left(\frac{72+3P-84}{4}\right)$

or, $3P - 12 = 0$

or, $3P = 12$

$\therefore \quad P = 4$

Thus, the value of P is 4.

समूह 'घ' (Group 'D') **[4 × 5 = 20]**

21. वार्षिक 20% ब्याजदरले 2 वर्षमा हुने वार्षिक मिश्रित ब्याज र अर्धवार्षिक मिश्रित ब्याजको योगफल रु. 18082 छ । यदि वार्षिक मिश्रित ब्याजको सट्टा अर्धवार्षिक मिश्रित ब्याजमा लगानी गरियो भने लगानीकर्तालाई कति फाइदा होला ?

The sum of annual compound interest and semi-annual compound interest on a sum of money for 2 years at the interest rate of 20% per annum is Rs 18082. If semiannual compound interest is applied instead of annual compound interest, what will be the profit of an investor?

⇨ Here, R = 20%, T = 2 years

We have,

Annual CI $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

$= P\left[\left(1+\frac{20}{100}\right)^2 - 1\right]$

$= P \times 0.44$

Semi-annual CI $= P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right]$

$= P\left[\left(1+\frac{20}{200}\right)^{2\times 2} - 1\right]$

$= P \times 0.4641$

By the question,

Sum of interests = 18082

or, $P \times 0.44 + P \times 0.4641 = 18082$

or, $P \times 0.9041 = 18082$

$\therefore \quad P = Rs\ 20000$

Substituting the value of P above then,

Annual CI = Rs 20000 × 0.44 = Rs 8800

Semi-annual CI = Rs 20000 × 0.4641 = Rs 9282

Now, Difference of interests = Rs 9282 – Rs 8800 = Rs 482

The difference of the interests is the profit of investor.

Thus, the profit of investor is Rs 482.

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22. शान्वीको जन्मदिनको भोजको लागि 400 जनालाई व्यवस्था गरियो । शान्वीले उक्त कार्यका लागि वर्गाकार पिरामिड आकारको टेन्टमा बस्ने व्यवस्था मिलाइछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि 4 वर्गमिटर ठाउँ र सास फेर्न 20 घनमिटर हावा चाहिन्छ । सो पिरामिड आकारको टेन्टको उचाइ कति हुनुपर्छ ?
In a birthday party, Shaanvi managed an arrangement for 400 people. For this purpose, she plans to build a squared shaped pyramid in such a way that each person have 4 sq. m of the space on ground and 20 cu. m of air to breathe. What should be the height of the tent?

⇨ Here, let the height of the pyramid be h m and length of base be a m.

By the question,
Base area = $4\ m^2 \times 400$
or, $a^2 = 1600\ m^2$
$\therefore\ a = 40\ m$

Again, volume = $400 \times 20\ m^3$
or, $\frac{1}{3} a^2 h = 8000$
or, $\frac{1}{3} \times 40^2 \times h = 8000$
or, $h = \frac{8000 \times 3}{1600}$
$\therefore\ h = 15\ m$

Thus, the height of the pyramid is 15 m.

23. सरल गर्नुहोस् (Simplify): $\frac{4}{1 + x^{a-b} + x^{c-b}} + \frac{4}{1 + x^{b-c} + x^{a-c}} + \frac{4}{1 + x^{c-a} + x^{b-a}}$
यो सरलीकरणमा प्रयोग भएको घाताङ्कको कुनै एउटा नियम लेख्नुहोस् ।
Write any one law of indices used for its simplification.

⇨ Here, $\frac{4}{1 + x^{a-b} + x^{c-b}} + \frac{4}{1 + x^{b-c} + x^{a-c}} + \frac{4}{1 + x^{c-a} + x^{b-a}}$

Multiplying the both denominator and numerator of fractions by x^b, x^c and x^a respectively, we get,

$$= \frac{4 \times x^b}{1 \times x^b + x^{a-b} \times x^b + x^{c-b} \times x^b} + \frac{4 \times x^c}{1 \times x^c + x^{b-c} \times x^c + x^{a-c} \times x^c} + \frac{4 \times x^a}{1 \times x^a + x^{c-a} \times x^a + x^{b-a} \times x^a}$$

$$= \frac{4 \times x^b}{x^b + x^a + x^c} + \frac{4 \times x^c}{x^c + x^b + x^a} + \frac{4 \times x^a}{x^a + x^c + x^b} \qquad [\because x^m \times x^n = x^{m+n}]$$

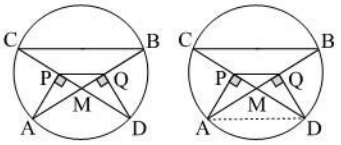
$$= \frac{4 \times x^b}{x^a + x^b + x^c} + \frac{4 \times x^c}{x^a + x^b + x^c} + \frac{4 \times x^a}{x^a + x^c + x^b}$$

$$= \frac{4 \times x^b + 4 \times x^c + 4 \times x^a}{x^a + x^b + x^c}$$

$$= \frac{4(x^b + x^c + x^a)}{(x^a + x^b + x^c)} = 4$$

The formula used for its simplification is given by: $x^m \times x^n = x^{m+n}$

24. चित्रमा जीवाहरू AB र CD बिन्दु M मा प्रतिच्छेदन भएका छन् । यदि AP ⊥ CD र DQ ⊥ AB भए PQ // CB हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the figure, chords AB and CD are intersected at M. If AP ⊥ CD and DQ ⊥ AB then prove that: PQ // CB.



⇨ Here, **Given:** Chords AB and CD are intersected at M. AP ⊥ CD and DQ ⊥ AB.
To prove: PQ // CB
Construction: Join AD.
Proof:

Statements	Reasons
1. ∠APD = ∠AQD	1. Being both 90°.
2. APQD is a cyclic quadrilateral.	2. From statement (1)
3. ∠AQP = ∠ADP and ∠ABC = ∠ADC	3. Angles on same arc
4. ∠AQP = ∠ABC	4. From the statement (3)
5. PQ // CB	5. Corresponding angles are equal in (4).

Proved

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14. PABSON BOARD EXAMINATION 2074 [KATHMANDU]

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) यदि कुनै सामानको विक्रय मूल्य रु. x र मूल्य अभिवृद्धि कर रु. y भए मूल्य अभिवृद्धि करको दर कति हुन्छ ?
If the selling price of an article is Rs x and VAT amount is Rs y, what is the VAT rate?

⇨ Here, the required VAT rate $= \frac{y}{x} \times 100\%$

(b) बराबर भुजा k एकाई र आधार h एकाई भएको समद्विबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an isosceles triangle whose equal side is k units and base is h units?

⇨ Here, the area of an isosceles triangle with given sides $= \frac{h}{4}\sqrt{4k^2 - h^2}$ sq. units

2. (a) हल गर्नुहोस् (Solve): $\sqrt{x+5} = 6$

⇨ Here, $\sqrt{x+5} = 6$, or, $x + 5 = 36 \therefore x = 31$

(b) एउटा निरन्तर श्रेणीमा मध्यक $(\overline{X}) = 25$ र $\Sigma fx = 625$ भए पदहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

In a continuous series, mean $(\overline{X}) = 25$ and $\Sigma fx = 625$, find the number of terms.

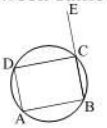
⇨ Here, $\overline{X} = 25$, $\Sigma fx = 625$

We know that, $\overline{X} = \frac{\Sigma fx}{N}$ or, $25 = \frac{625}{N}$ $\therefore$ $N = 25$

3. (a) एउटै आधार र उही समानान्तर रेखाबिच रहेका समबाहु चतुर्भुज र त्रिभुजको क्षेत्रफलको सम्बन्ध के हुन्छ ? लेख्नुहोस् ।
What is the relation between area of rhombus and triangle standing on the same base and between same parallels? Write it.

⇨ Here, area of triangle is half of the area of rhombus standing on the same base and between same parallels.

(b) दिइएको चित्रबाट ∠ECD सँग बराबर हुने कोण कारणसहित लेख्नुहोस् ।
In the given figure, write the angle which is equal to the ∠ECD with reason.



⇨ Here, ∠BAD = ∠ECD (∵ Exterior angle is equal to non-adjacent interior opposite angle.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) एउटा बैङ्कमा अष्ट्रेलियन डलर 1 को खरिददर र विक्रय मूल्य क्रमशः रु. 80.20 र रु. 81.40 छन् । सो बैङ्कलाई कति अष्ट्रेलियन डलर किनेर बेच्दा रु. 6000 फाइदा होला ?
The buying rate and selling rate of Australian dollar in a bank are Rs 80.20 and Rs 81.40 respectively. How much Australian dollar should be bought and sold by the bank to get Rs 6000 profit?

⇨ Here, buying rate; AUD 1 = Rs 80.20
Selling rate; AUD 1 = Rs 81.40
So, the difference = 81.40 – 80.20 = Rs 1.20
It will be profit when AUD 1 is bought and sold. i.e. Profit = Rs 1.20 is made in AUD 1.
or, Profit Re. 1 is made in AUD $\frac{1}{1.20}$ $\therefore$ Profit Rs 6000 is made in AUD $\frac{6000}{1.20}$ = AUD 5000
Thus, the required amount is AUD 5000.

(b) एउटा सहरको वार्षिक जनसङ्ख्या वृद्धिदर 5% छ र हालको जनसङ्ख्या 28665 छ भने 2 वर्ष पहिलेको जनसङ्ख्या कति थियो ? पत्ता लगाउनुहोस् ।
The annual population growth rate of a town is 5% and present population is 28665. What was the population of the town 2 years ago? Find it.

⇨ Here, Growth rate (R) = 5%; Present population (P_T) = 28665
Time (T) = 2 years; Initial population (P) = ?
We know that,

$P_T = P\left(1 + \frac{R}{100}\right)^T$ or, $28665 = P\left(1 + \frac{5}{100}\right)^2$

or, $28665 = P \times 1.1025$ $\therefore$ $P = 26{,}000$

Thus, the required population is 26000.

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5. (a) एउटा त्रिभुजको दुई भुजाहरूको अनुपात 2 : 3 छ र बाँकी भुजाको लम्बाइ 5 से. मि. छ। यदि सो त्रिभुजको परिमिति 15 से.मि. भए क्षेत्रफल कति होला ?
The two sides of a triangle are in the ratio of 2 : 3 and its third side is 5 cm. If the perimeter of the triangle is 15 cm, what is the area of the triangle?

⇨ Here, let the two sides of a triangle be a = 2x cm and b = 3x cm
Third side (c) = 5 cm
We have given, peimeter = 15 cm
or, $a + b + c = 15$ or, $2x + 3x + 5 = 15$
or, $5x = 10$ $\therefore \quad x = 2$
Thus, the two sides are a = 2x cm = 2 × 2 cm = 4 cm and b = 3x cm = 3 × 2 cm = 6 cm

Now, semi perimeter $(s) = \frac{a+b+c}{2} = \frac{4+6+5}{2} = \frac{15}{2}$ cm

Now, Area of the triangle (A) $= \sqrt{s(s-a)(s-b)(s-c)}$

$$= \sqrt{\frac{15}{2}\left(\frac{15}{2}-4\right)\left(\frac{15}{2}-6\right)\left(\frac{15}{2}-5\right)}$$

$$= \sqrt{7.5 \times 1.5 \times 3.5 \times 2.5} = \sqrt{98.4375} = 9.92 \text{ sq. cm}$$

Thus, the area of the triangle is 9.92 cm^2.

(b) उचाइ 1 मि. भएको एउटा बेलनाकार धातुको ट्याङ्कीमा 1500 लि. पानी अटाउँछ। उक्त ट्याङ्कीको आधार बनाउन कति वर्ग मि. धातु आवश्यक पर्छ ?
The capacity of a cylindrical metal tank of height 1 m is 1500 litres. How much square metres of metal sheet would be needed to make its base?

⇨ Here, height (h) = 1 m, capacity of the tank (V) = 1500 litres
So, V = 1500 litres $= \frac{1500}{1000} m^3 = 1.5 m^3$
We have, $V = \pi r^2 h$ or, $1.5 m^3 = \pi r^2 \times 1 m$ $\therefore \quad \pi r^2 = 1.5 m^2$
Thus, the area of metal sheet is 1.5 m^2.

(c) 64 ओटा a cm अर्धव्यास भएका गोलाहरू पगालेर b cm अर्धव्यास भएको एउटा गोला बनाइयो भने a र b को अनुपात पत्ता लगाउनुहोस् ।
64 solid iron spheres each of radius a cm are melted to form a sphere with radius b cm. Find the ratio of a and b.

⇨ Here, radius of small sphere (r) = a cm and radius of big sphere (R) = b cm
By the question, V(64 small sphere) = V(Big sphere)

or, $64 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$ or, $\frac{64 \times 4}{3} r^3 = \frac{4}{3} R^3$ or, $64r^3 = R^3$

or, $64a^3 = b^3$ or, $\frac{a^3}{b^3} = \frac{1}{64}$ or, $\left(\frac{a}{b}\right)^3 = \left(\frac{1}{4}\right)^3$

$\therefore \quad \frac{a}{b} = \frac{1}{4}$

Thus, the required ratio is 1 : 4.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $5a^2 - 20$ and $a + 2$

⇨ Here, 1st Exp = $5a^2 - 20 = 5(a^2 - 4) = 5(a - 2)(a + 2)$
2nd Exp = $(a + 2)$
Thus, HCF = $(a + 2)$

(b) सरल गर्नुहोस् (Simplify): $\sqrt[3]{128} + 2\sqrt[3]{54} - 2\sqrt[3]{250}$

⇨ Here, $\sqrt[3]{128} + 2\sqrt[3]{54} - 2\sqrt[3]{250} = \sqrt[3]{2 \times 64} + 2\sqrt[3]{2 \times 27} - 2\sqrt[3]{2 \times 125}$

$= \sqrt[3]{2 \times 4^3} + 2\sqrt[3]{2 \times 3^3} - 2\sqrt[3]{2 \times 5^3} = 4\sqrt[3]{2} + 2 \times 3\sqrt[3]{2} - 2 \times 5\sqrt[3]{2}$

$= 4\sqrt[3]{2} + 6\sqrt[3]{2} - 10\sqrt[3]{2} = (4 + 6 - 10)\sqrt[3]{2} = 0$

7. (a) सरल गर्नुहोस् (Simplify): $(1 - k^{x-y})^{-1} + (1 - k^{y-x})^{-1}$

⇨ Here, $(1 - k^{x-y})^{-1} + (1 - k^{y-x})^{-1} = \frac{1}{1 - k^{x-y}} + \frac{1}{1 - k^{y-x}} = \frac{k^y}{k^y - k^x} - \frac{k^x}{k^y - k^x} = \frac{k^y - k^x}{k^y - k^x} = 1$

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(b) हल गर्नुहोस् (Solve): $\frac{\sqrt{b}+\sqrt{5}}{\sqrt{b}-\sqrt{5}} = 3$

⇨ Here, $\frac{\sqrt{b}+\sqrt{5}}{\sqrt{b}-\sqrt{5}} = 3$ or, $\sqrt{b}+\sqrt{5} = 3\sqrt{b}-3\sqrt{5}$ or, $2\sqrt{b} = 4\sqrt{5}$

or, $\sqrt{b} = 2\sqrt{5}$ ∴ $b = 20$

(c) दुईओटा धनात्मक सङ्ख्याहरूको गुणनफल 162 छ। यदि एउटा सङ्ख्या अर्को सङ्ख्याको दोब्बर छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस्।

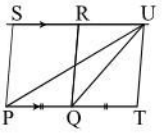
The product of two positive numbers is 162. If one number is double of the other number, find these numbers.

⇨ Here, let, numbers be x and 2x, then,

or, $2x^2 = 162$ or, $x^2 = \frac{162}{2} = 81$ ∴ $x = 9$ and $2x = 2 \times 9 = 18$

Thus, the required numbers are 9 and 18.

8. (a) चित्रमा SU // PT र PT को मध्य बिन्दु Q छ। यदि समानान्तर चतुर्भुज PQRS को क्षेत्रफल 40 वर्ग से. मि. भए ΔQUT को क्षेत्रफल पत्ता लगाउनुहोस्।



In the given figure, SU // PT and Q is midpoint of PT. If area of parallelogram PQRS is 40 cm² then find the area of ΔQUT.

⇨ Here, area of parallelogram PQRS is 40 cm^2

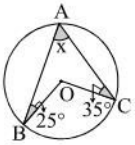
(i) Ar. (ΔPQU) = $\frac{1}{2}$ Ar.(▱PQRS) = $\frac{1}{2} \times 40 = 20$ cm^2 (∵ Area of triangle is half of the area of parallelogram standing on the same base and between same parallels.)

(ii) Ar. (ΔQUT) = Ar. (ΔPQU) = 20 cm^2 (∵ Triangles standing on the equal bases and between same parallels are equal in area.)

Thus, the area of ΔQUT is 20 cm^2.

(b) चित्रमा ∡ABO = 25° र ∡ACO = 35° भए ∡BOC को मान पत्ता लगाउनुहोस्।

In the given figure, ∡ABO = 25° and ∡ACO = 35°, find the value of ∡BOC.



⇨ Here, ∡ABO = 25°, ∡ACO = 35°, Join AO.

(i) ∡ABO = ∡OAB [∵ Being OB = AO]

∴ ∡OAB = 25°

(ii) ∡OAC = ∡OCA [∵ Being OC = OA]

∴ ∡OAC = 35°

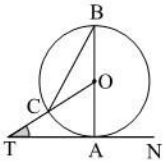
(iii) ∡BAC = ∡OAB + ∡OAC = 25° + 35° = 60°

(iv) ∡BOC = 2∡BAC = 2 × 60° (∵ Central angle is double of inscribed angle.)
= 120°

Thus, the value of ∡BOC is 120°.

(c) चित्रमा TAN वृत्तको स्पर्स रेखा हो। AB व्यास र ∡ABC = 14° भए ∡ATO को मान पत्ता लगाउनुहोस्।

In the given figure, TAN is the tangent at the point of contact A. AB is diameter and ∡ABC = 14°, find value of ∡ATO.



⇨ Here, ∡ABC = 14°

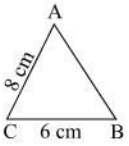
(i) ∡AOC = 2∡OBC = 2 × 14° (∵ central angle is double of inscribed angle.)
= 28°

(ii) ∡OAT = 90° (∵ Diameter is perpendicular to tangent at point of contact.)

(iii) ∡ATO = 90° − ∡AOT = 90° − 28° (∵ Sum of acute angles in right angled triangle.)
= 62°

Thus, the value of ∡ATO is 62°.

9. (a) चित्रमा AC = 8 से. मि., BC = 6 से. मि. र ΔABC को क्षेत्रफल 12 वर्ग से. मि. भए ∡ACB को मान पत्ता लगाउनुहोस्।



In the given figure, AC = 8 cm and BC = 6 cm and area of ΔABC = 12 cm². Find the value of ∡ACB.

⇨ Here, AC = 8 cm, BC = 6 cm and Ar.(ΔABC) = 12 cm^2

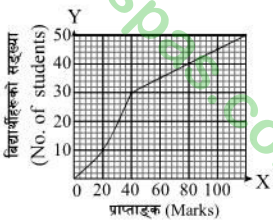
We know that, Area of ΔABC = $\frac{1}{2}$ AC × BC × sin C

or, $12 = \frac{1}{2} \times 8 \times 6 \times \sin C$ or, $\sin C = \frac{12 \times 2}{8 \times 6}$ or, $\sin C = \frac{1}{2}$

or, $\sin C = \sin 30°$ ∴ ∡C = 30° Thus, ∡ACB = 30°.

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(b) दिइएको संचित बारम्बारता वक्रबाट तेस्रो चतुर्थांश पर्ने श्रेणी पत्ता लगाउनुहोस् ।
Find the third quartile class from the given ogive curve.



⇨ Here, from the graph, N = 50

So, Position of third quartile = $\left(\frac{3N}{4}\right)^{th}$ item = $\frac{3 \times 50}{4} = 37.5^{th}$ item

Thus, third quartile class = 60 - 80

10. (a) Q र R दुई पारस्परिक निषेधित घटनाहरू हुन् जसमा P(Q) = 0.6 र P(R) = 0.2 छ भने दिइएको घटनाहरूको सम्भाव्यता पत्ता लगाउनुहोस् ।
Two events Q and R are mutually exclusive with P(Q) = 0.6 and P(R) = 0.2. Find the probability of the following events:

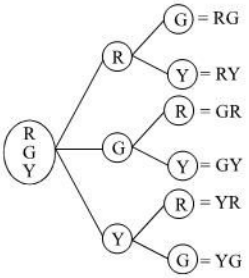
i) $P(Q \cup R)$ ii) $P(\overline{Q \cup R})$

⇨ We have, $P(Q \cup R) = P(Q) + P(R) = 0.6 + 0.2 = 0.8$

Again, $P(\overline{Q \cup R}) = 1 - P(Q \cup R) = 1 - 0.8 = 0.2$

Thus, the required probabilities are 0.8 and 0.2.

(b) एउटा रातो, एउटा हरियो र एउटा पहँलो उस्तै बलहरू भएको झोलाबाट नहेरी एक पछि अर्को गरी पूनः नराखी दुईओटा बलहरू निकाल्दा आउने सबै परिणामहरूको सम्भाव्यतालाई वृक्ष चित्रमा देखाई नमुना क्षेत्र लेख्नुहोस् ।
From a bag containing one red, one green and one yellow ball of the same shape and size, two balls are drawn randomly in succession without replacement. Show the probabilities of all outcomes in a tree diagram and write the sample space.

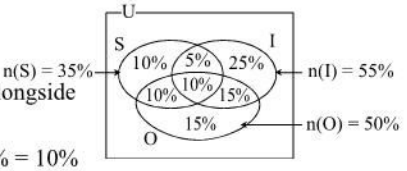


⇨ Here, R, G and Y denote the red, green and yellow balls respectively.
Now, the probability tree diagram is shown here.
Thus, the sample space (S) = {RG, RY, GR, GY, YR, YG}

समूह 'ग' (Group' C') [10 × 4 = 40]

11. हालै गरिएको सर्वेक्षणको प्रतिवेदन अनुसार 55% ग्राहकले आइफोन, 35% सामसुङ, 15% ले मात्र ओपो मोबाइल सेट प्रयोग गर्न रुचाउँछन् । 25% आइफोन र ओपो, 20% ओपो र सामसुङ, 15% आइफोन र सामसुङ र 10% ले तीनैथरिका मोबाइल सेट प्रयोग गर्छन् । यदि 65 जनाले कुनै पनि सेट प्रयोग गर्न चाहदैनन् भने भेन चित्रको प्रयोग गरी उक्त सर्वेक्षणमा सहभागी ग्राहकहरूको कुल सङ्ख्या पत्ता लगाउनुहोस् ।
In a recent survey, it was found that 55% of customers want to use Iphone mobile sets, 35% want to use Samsung, 15% want to use Oppo only. 25% want to use Iphone and Oppo, 20% want to use Oppo and Samsung, 15% want Iphone and Samsung and 10% use all three. If 65 people do not want to use any mobile set, find the total number of customers involved in the survey by using Venn-diagram.

⇨ Here, let I, S, O denote the set of customers who want to use i-phone, Samsung and Oppo respectively.
Then, $n(U) = 100\%$, $n(I) = 55\%$, $n(S) = 35\%$,
$n_0(O) = 15\%$, $n(I \cap O) = 25\%$, $n(O \cap S) = 20\%$,
$n(I \cap S) = 15\%$, $n(I \cap S \cap O) = 10\%$



Now, the above information in a Venn-diagram is shown alongside
From the Venn-diagram,

$n(I \overline{S \cup O}) = 100\% - (10 + 25 + 15 + 10 + 5 + 15 + 10)\% = 10\%$

Let, x be total no. of customers involved in survey.

10% of x = 65 or, $0.1 \times x = 65$ ∴ $x = 650$

Thus, the customers praticipated in the survey is 650.

12. एउटा डिजिटल क्यामेराको अङ्कित मूल्य रु.24000 छ । यदि मूल्य अभिवृद्धि करको दर छुट प्रतिशत भन्दा दोब्बर र मूल्य अभिवृद्धि कर सहितको मूल्य अङ्कित मूल्य भन्दा 8% ले बढि भए, मूल्य अभिवृद्धि कर को दर पत्ता लगाउनुहोस् ।
The marked price of a digital camera is Rs 24000. If VAT rate is double of discount percentage and the price with VAT is 8% more than the marked price, find the rate of VAT.

⇨ Here, MP = 24000, let, d% = x% and VAT% = 2x%
By the question,

$$\text{SP with VAT} = \text{MP} + 8\% \text{ of MP} = 24000 + 8\% \text{ of } 24000 = 24000 + \frac{8}{100} \times 24000$$

$$= 24000 + 1920 = \text{Rs } 25920$$

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Again, Discount = x% of MP = x% of 24000 = $\frac{x}{100} \times 24000 = 240x$

Now, Price after discount = MP – Discount = 24000 – 240x

or, $25920 = (24000 - 240x) + 2x\%$ of $(24000 - 240x)$ or, $1920 = -240x + \frac{2x}{100} \times (24000 - 240x)$

or, $1920 = -240x + 480x - \frac{24}{5}x^2$ or, $24x^2 - 1200x + 9600 = 0$

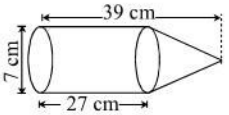
or, $x^2 - 50x + 400 = 0$ or, $x^2 - 40x - 10x + 400 = 0$

or, $x(x - 40) - 10(x - 40) = 0$ or, $(x - 40)(x - 10) = 0$

∴ x = 10% or 40% So, VAT rate = 2x = 20% or 80%

Thus, the required VAT rate is 20% or 80%.

13. दिइएको ठोस वस्तुको पुरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the given solid.



⇨ Here, r = radius = $\frac{7}{2}$ cm = 3.5 cm, h = height of cylinder = 27 cm

h' = height of cone = 39 cm – 27 cm = 12 cm

ℓ = slant height of the cone = $\sqrt{h'^2 + r^2} = \sqrt{12^2 + 3.5^2} = \sqrt{156.25} = 12.5$ cm

Total surface area of given solid = $\pi r^2 + 2\pi rh + \pi r\ell = \pi r(r + 2h + \ell) = \frac{22}{7} \times 3.5\,(3.5 + 2 \times 27 + 12.5)$

= 770 cm^2

Thus, the total surface area of the given solid is 770 cm^2.

14. सरल गर्नुहोस् (Simplify): $\frac{1}{x-1} - \frac{2}{2x+1} + \frac{1}{x+1} - \frac{2}{2x-1}$

⇨ Here, $\frac{1}{x-1} + \frac{1}{x+1} - \frac{2}{2x+1} - \frac{2}{2x-1} = \left[\frac{1}{x-1} + \frac{1}{x+1}\right] - \left[\frac{2}{2x+1} + \frac{2}{2x-1}\right]$

$= \frac{2x}{x^2-1} - \frac{4x - 2 + 4x + 2}{4x^2 - 1} = \frac{2x}{x^2-1} - \frac{8x}{4x^2-1}$

$= \frac{2x(4x^2 - 1) - 8x(x^2 - 1)}{(x^2 - 1)(4x^2 - 1)} = \frac{8x^3 - 2x - 8x^3 + 8x}{(x^2 - 1)(4x^2 - 1)}$

$= \frac{6x}{(x^2 - 1)(4x^2 - 1)}$

15. दुईओटा अङ्कले बनेको एउटा धनात्मक सङ्ख्यामा भएका अङ्कहरू मध्ये एकाइ स्थानको अङ्कलाई दश स्थानको अङ्कले भाग गर्दा भागफल 3 हुन्छ । यो सङ्ख्यामा 36 जोड्ने हो भने त्यो सङ्ख्याको विपरित सङ्ख्या बन्छ भने त्यो सङ्ख्या पत्ता लगाउनुहोस् ।
A positive number consists of two digits. When digit in the unit place is divided by the digit in the tenth place then the quotient is 3. If 36 is added to the number then digits of the number are reversed. Find the number.

⇨ Here, let number be 10x + y.

From the first part of the question, $\frac{y}{x} = 3$ ∴ y = 3x ... ...(i)

From the second part of the question,

10x + y + 36 = 10y + x or, 10x – x + y – 10y = – 36

or, 9x – 9y = – 36 ∴ y – x = 4 … …(ii)

From equation (i) and (ii)

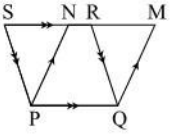
3x – x = 4 ∴ x = 2

Putting the value of x in equation (i), y = 6

Hence, the required number = 10x + y = 10 × 2 + 6 = 26

Thus, the required number is 26.

16. एउटै आधार र उही समानान्तर रेखाहरूबिच बनेका समानान्तर चतुर्भुजहरू PQRS र PQMN को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।
Prove that the area of parallelogram PQRS and PQMN standing on the same base and between same parallel lines are equal.



⇨ Here, **Given:** Parallelograms SPQR and NPQM are on the same base PQ and between the same parallels SM and PQ.

To prove: Ar. (Parallelogram SPQR = Parallelogram NPQM)

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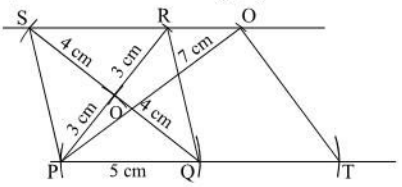
Proof:

	Statements		Reasons
1.	In ΔSPN and ΔRQM	1.	
	(i) SP = RQ (S)		(i) Opposite sides of parallelogram SPQR
	(ii) ∡PSN = ∡QRM (A)		(ii) Corresponding angles in SP // RQ
	(iii) ∡SNP = ∡RMQ (A)		(iii) Corresponding angles in NP // MQ
2.	∴ ΔSPN ≅ ΔRQM	2.	SAA fact
3.	ΔSPN = ΔRQM	3.	Area of congruent triangles are equal.
4.	ΔSPN + trapezium NPQR = ΔRQM + trapezium NPQR	4.	Addition axiom
5.	∴ Ar. (□SPQR = □NPQM)	5.	Whole part axiom (From statement 4)

Proved

17. समानान्तर चतुर्भुज PQRS को रचना गर्नुहोस् जसमा भुजा PQ = 5 से. मि., विकर्ण PR = 6 से. मि.र QS = 8 से.मि. छन् । (उक्त समानान्तर चतुर्भुजसँग बराबर हुने गरी OT = 7 से. मि. भएको ΔPOT को रचना गर्नुहोस् ।)

Construct a parallelogram PQRS in which PQ = 5 cm, diagonal PR = 6 cm and QS = 8 cm. Also, construct a ΔPOT having a side OT = 7 cm and equal area to the parallelogram.



⇨ Here, PQ = 5 cm, PR = 6 cm, QS = 8 cm and OT = 7 cm.
ΔPOT is the required triangle whose area is equal to the area of parallelogram PQRS.

18. कुनै वृत्तको एउटै चाप PR मा उभिएको केन्द्रीय कोण PQR परिधि कोण PSR भन्दा दोब्बर हुन्छ भनि प्रयोगात्मक परिक्षणबाट सिद्ध गर्नुहोस् । (कम्तिमा 3 से. मि. अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally that central angle PQR is double of inscribed angle PSR standing on the same arc PR of the same circle. (Two circles of more than 3 cm radii are necessary.)

⇨ Here, Experimental verification:
Measurement Table :

Figure	∡PQR	∡PSR	Remarks
(i)	126°	63°	2∡PSR = ∡PQR
(ii)	124°	62°	2∡PSR = ∡PQR



Fig (i)



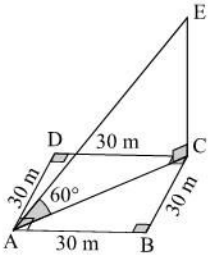
Fig (ii)

Conclusion: From the above table, it is concluded that central angle is equal to the double of the angle at the circumference standing on the same arc of a circle. **Proved.**

19. एउटा 30 मि. भुजा भएको वर्गाकार कोठाको एउटा कुनामा झण्डा गाडिएको छ । झण्डा गाडिएको विपरित कुनाबाट झण्डाको टुप्पोको उन्नतांश कोण 60° पाइयो भने झण्डाको उचाइ कति होला ?

A flagstaff is fixed at one corner of a square room of sides 30 m. The angle of elevation to the top of the flagstaff from the opposite corner of the room is found to be 60°. Find the height of the flagstaff.

⇨ Here, let AB = AD = 30 m be the sides of a squared room.
Let EC be the height of the flag staff and ∡EAC be an angle of elevation.
From the adjoining figure,



$AC^2 = AB^2 + AB^2 = 2AB^2$

$AC^2 = 2 \times 30^2 = 2 \times 900 = 1800 \therefore AC = 30\sqrt{2}$ m

In ΔACE,

or, $\sin 60° = \frac{EC}{AC}$ or, $\frac{\sqrt{3}}{2} = \frac{EC}{30\sqrt{2}}$

or, $EC = \frac{30\sqrt{6}}{2} = 15\sqrt{6}$ ∴ EC = 36.74 m.

Thus, the required length of flagstaff is 36.74 m.

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20. दिइएको आँकडाबाट मध्यिका पत्ता लगाउनुहोस्: (Find the median from the given data:)

Wages (Rs)	15-25	15-35	15-45	15-55	15-65
No. of workers	4	10	22	27	30

⇨ Here, calculation of median,

Wages	c.f.	C.I	f
15-25	4	15-25	4
15-35	10	25-35	6
15-45	22	35-45	12
15-55	27	45-55	5
15-65	30	55-65	3
			N = 30

Position of median $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{30}{2}\right)^{th}$ item $= 15^{th}$ item

In c.f. column, c.f. 22 is just greater than 15, so the median class = 35-45.

We know that,

$$Md = L + \frac{\frac{N}{2} - c.f.}{f} \times i = 35 + \frac{15-10}{12} \times 10 = 35 + \frac{50}{12} = 35 + 4.16$$

$\therefore$ Md = 39.16

Thus, the median of the given data is 39.16.

समूह 'घ' (Group D) **[4 × 5 = 20]**

21. कुनै रकमको वार्षिक चक्रीय व्याज अनुसार एक वर्ष र दुई वर्षको व्याज क्रमशः रु. 1800 र रु. 3816 हुन्छ भने व्याजदर र मूलधन निकाल्नुहोस् ।

The yearly compound interest on a sum of money in 1 year and 2 years are Rs 1800 and Rs 3816 respectively. Calculate the rate of compound interest and the principal.

⇨ Here, let sum and rate be Rs P and r% respectively

We have,

$$CI_1 = P\left[\left(1+\frac{r}{100}\right)^n - 1\right]$$

$$\therefore \quad 1800 = P\left[\left(1+\frac{r}{100}\right) - 1\right] \text{ ..... (i)}$$

We know that,

$$CI_2 = P\left[\left(1+\frac{r}{100}\right)^n - 1\right]$$

$$\therefore \quad 3816 = P\left[\left(1+\frac{r}{100}\right)^2 - 1\right] \text{ ..... (ii)}$$

Dividing eq^n (ii) by eq^n (i)

$$\frac{3816}{1800} = \frac{\left[\left(1+\frac{r}{100}\right)^2 - 1\right]}{\left[\left(1+\frac{r}{100}\right) - 1\right]}$$

$$\text{or, } 2.12 = \frac{\left(1+\frac{r}{100}-1\right)\left(1+\frac{r}{100}+1\right)}{\left(1+\frac{r}{100}-1\right)} \qquad \text{or, } 2.12 = 2 + \frac{r}{100}$$

$$\text{or, } \frac{r}{100} = 0.12 \qquad \therefore \quad r = 12\%$$

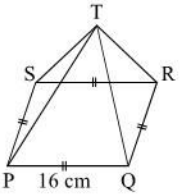
Putting the value of r in eq^n (i), then,

$$1800 = P\left[1 + \frac{12}{100} - 1\right] \qquad \text{or, } P = \frac{1800 \times 100}{12}$$

Thus, the Principal = Rs 15000

22. दिइएको चित्र वर्गाकार आधार भएको पिरामिड हो । जसमा त्रिभुजाकार सतहहरूको क्षेत्रफल 544 वर्ग से. मि. र आधारको भूजाको लम्बाइ 16 से. मि. भए उक्त पिरामिडको आयतन पत्ता लगाउनुहोस् ।

In the given figure, the area of triangular surfaces of the square based pyramid is 544 cm^2 and the length of the side of base is 16 cm. Find the volume of the pyramid.



⇨ Here, area of triangular faces = 2aℓ

or, $2a\ell = 544$ or, $2 \times 16\ell = 544$ $\therefore \quad \ell = 17$ cm

We have, $h = \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2}$ or, $h = \sqrt{17^2 - 8^2}$ $\therefore \quad h = 15$ cm

Now, $V = \frac{1}{3}a^2h = \frac{1}{3} \times 16 \times 16 \times 15 = 1280 \text{ cm}^3$

Thus, the volume of the pyramid is 1280 cm^3.

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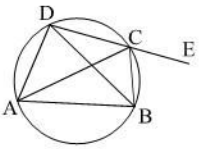
23. सरल गर्नुहोस् (Simplify): $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}}$

⇨ Here, $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}} = \dfrac{\left(a-\frac{1}{b}\right)^{a+b-a}\left(a+\frac{1}{b}\right)^a}{\left(b+\frac{1}{a}\right)^{b+a-b}\left(b-\frac{1}{a}\right)^b}$

$= \dfrac{\left(\frac{ab-1}{b}\right)^b\left(\frac{ab+1}{b}\right)^a}{\left(\frac{ab+1}{a}\right)^a\left(\frac{ab-1}{a}\right)^b} = \left(\frac{ab-1}{b}\right)^b \times \left(\frac{ab+1}{b}\right)^a \times \frac{a^a}{(ab+1)^a} \times \frac{a^b}{(ab-1)^b}$

$= \left(\frac{a}{b}\right)^a \cdot \left(\frac{a}{b}\right)^b = \left(\frac{a}{b}\right)^{a+b}$

24. दिइएको चित्रमा ABCD एउटा चक्रीय चतुर्भुज हो। ∠ACE को अर्धक BC भए BD = AB हुन्छ भनि प्रमाणित गर्नुहोस्।



In the adjoining figure, BC is the bisector of ∠ACE and ABCD is a cyclic quadrilateral. Prove that BD = AB.

⇨ Here, Given: (i) ABCD is a cyclic quadrilateral. (ii) BC is the bisector of ∠ACE

To Prove: BD = AB

Proof:

	Statements		Reasons
1.	∠ACB = ∠BCE	1.	BC is bisector of ∠ACE.
2.	∠BAD = ∠BCE	2.	Exterior angle of a cyclic quadrilateral is equal to opposite interior angle.
3.	∠ACB = ∠BAD	3.	From st. (1) and (2)
4.	∠ACB = ∠BDA	4.	Inscribed angles standing on the same arc.
5.	∠BDA = ∠BAD	5.	From st. (3) and (4).
6.	AB = BD	6.	Sides opposite to equal angles in ΔABD. from (5)

15. PABSON BOARD EXAMINATION 2074 [LALITPUR] SET A

समूह 'क' (Group 'A') [3 × (1 + 1) = 6]

1. (a) छुट रकम र अङ्कित मूल्य दिइएको छ भने छुटको दर निकाल्ने सूत्र लेख्नुहोस्।
Write the formula for finding rate of discount when discount amount and marked price are given.

⇨ Here, Rate of discount $= \dfrac{\text{Discount amount}}{\text{M.P.}} \times 100\%$

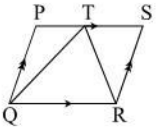
(b) एउटा भुजा 'b' cm र अरु दुई बराबर भुजाहरू प्रत्येक 'a' cm भए त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of triangle having one side 'b' cm and each of other two equal sides is 'a' cm?

⇨ Here, Area of an isosceles triangle $= \dfrac{b}{4}\sqrt{4a^2-b^2}$ cm^2

2. (a) यदि $\sqrt[n]{8} = x^{\frac{3}{n}}$ भए x को मान कति हुन्छ ? **(What is the value of x if $\sqrt[n]{8} = x^{\frac{3}{n}}$?)**

⇨ Here, $8^{\frac{1}{n}} = x^{\frac{3}{n}}$ or, $2^{\frac{3}{n}} = x^{\frac{3}{n}}$ ∴ $x = 2$

(b) समानान्तर चतुर्भुज PQRS को क्षेत्रफल 60 वर्ग.से.मि. भए ΔTQR को क्षेत्रफल पत्ता लगाउनुहोस्।
Find the area of ΔTQR if the area of parallelogram PQRS = 60 cm^2.



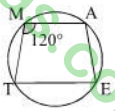
⇨ Here, area of a parallelogram PQRS = 60 cm^2.

Area of ΔTQR $= \dfrac{1}{2}$ area of parm. PQRS $= \dfrac{1}{2} \times 60$ cm^2 $= 30$ cm^2

Thus, the area of ΔTQR is 30 cm^2.

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3. (a) यदि ∡TMA = 120° भए ∡TEA को नाप पत्ता लगाउनुहोस् । (Find the value of ∡TEA if ∡TMA = 120°.)



⇨ Here, ∡TEA = 180° – ∡TMA (opp. ∡s of cyclic quadrilateral are supplementary)
= 180° – 120° = 60°
Thus, the value of ∡TEA is 60°.

(b) तल दिइएको तथ्याङ्कबाट 40-60 श्रेणीको बारम्बारता पत्ता लगाउनुहोस् ।
Find the frequency of the class interval (40-60) from the following data.

C.I.	0-20	20-40	40-60	60-80	80-100
C.F.	3	12	15	21	24

⇨ Here, frequency of class interval (40-60) = 15 – 12 = 3
Thus, reuqired frequency is 3.

समूह 'ख' (Group 'B') [4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]

4. (a) अष्ट्रेलिया जाँदै गरेको एकजना विद्यार्थीलाई 3000 अष्ट्रेलियन डलर आवश्यक पऱ्यो । यदि 1 AUD = रु. 75 र बैङ्कलाई 2% कमिसन दिनुपर्छ भने उसलाई कति नेपाली रूपैंया आवश्यक पर्छ ?
A student going to Australia needs 3000 AUD. How much Nepali rupees does he need if 1 AUD = Rs 75 and the bank charges 2% commission?

⇨ Here, 1 AUD = Rs 75
So, 3000 AUD = Rs (3000 × 75) = Rs 225000
Again, Bank commission = 2% of Rs 225000 = 0.02 × Rs 225000 = Rs 4500
Now, Total Nepali rupees required = Rs 225000 + Rs 4500 = Rs 229500
Thus, the required Nepali rupees is Rs 229500.

(b) एउटा सामानको मूल्य 2 वर्षमा रु 40000 बाट घटेर रु. 32400 भयो भने मिश्र ह्रासदर पत्ता लगाउनुहोस् ।
The value of an article is depreciated from Rs 40000 to Rs 32400 in two years. Find the rate of compound depreciation.

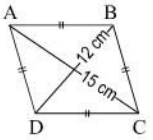
⇨ Here, initial price (P) = Rs 40000 Final price (P_T) = Rs 32400
We know that,

$$P_T = P\left(1 - \frac{R}{100}\right)^T \quad \text{or,} \quad 32400 = 40000\left(1 - \frac{R}{100}\right)^2$$

$$\text{or,} \quad 0.81 = \left(1 - \frac{R}{100}\right)^2 \quad \text{or,} \quad 1 - \frac{R}{100} = 0.9$$

$\therefore$ R = 10%
Thus, the rate of depreciation is 10%.

5. (a) दिइएको समबाहु चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of the given rhombus ABCD.



⇨ Here, Area of rhombus ABCD $= \frac{1}{2} \times AC \times BD = \frac{1}{2} \times 15 \times 12 = 90\ cm^2$
Thus, the area of the rhombus is 90 cm^2.

(b) 7 से.मि. अर्धव्यास र 1.5 से.मि. मोटाइ भएका 20 ओटा वृत्ताकार रिकापीहरूलाई एक अर्को माथि राख्दा बन्ने ठोस वस्तुको आयतन निकाल्नुहोस् ।
20 circular plates, each or radius 7 cm and thickness 1.5 cm are placed one above the other. Find the volume of the solid so formed.

⇨ Here, height (h) = 20 × 1.5 cm = 30 cm

$$\text{Volume (v)} = \pi r^2 h \quad \text{or,} \quad v = \frac{22}{7} \times 7^2 \times 30 \quad \therefore \quad v = 4620\ cm^3$$

Thus, the volume of the solid 4620 cm^3.

(c) ठुलो वृत्तको परिधी 88 से.मि. भएको गोलाको सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The circumference of a great circle of a sphere is 88 cm. Find its surface area.

⇨ Here, C = 88 cm

We know that, $C = 2\pi r$ or, $88 = 2 \times \frac{22}{7} \times r$ i.e., r = 14 cm

Now, $A = 4\pi r^2 = 4 \times \frac{22}{7} \times (14)^2 = 2464\ cm^2$. Thus, surface area of the sphere is 2464 cm^2.

6. (a) हल गर्नुहोस् (Solve): $\sqrt{y} + 4 = y - 16$

⇨ Here, $\sqrt{y} + 4 = y - 16$

$$\text{or,} \quad 1 = \frac{y - 16}{\sqrt{y} + 4} \quad \text{or,} \quad 1 = \frac{(\sqrt{y} + 4)(\sqrt{y} - 4)}{\sqrt{y} + 4} \quad \text{or,} \quad 1 = \sqrt{y} - 4$$

$$\text{or,} \quad \sqrt{y} = 5 \quad \therefore \quad y = 25$$

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(b) सरल गर्नुहोस् (Simplify): $\frac{4 \times 3^x - 3^{x-1}}{11 \times 3^x}$

⇨ Here, $\frac{4 \times 3^x - 3^{x-1}}{11 \times 3^x} = \frac{4 \times 3^x - 3^x \times \frac{1}{3}}{11 \times 3^x} = \frac{3^x\left(4 - \frac{1}{3}\right)}{11 \times 3^x} = \frac{4 - \frac{1}{3}}{11} = \frac{12 - 1}{3} \times \frac{1}{11} = \frac{1}{3}$

7. (a) हल गर्नुहोस् (Solve): $3^{x-4} \times 2^{x-3} = \frac{1}{3}$

⇨ Here, $3^{x-4} \times 2^{x-3} = \frac{1}{3}$ or, $3^{x-4} \cdot 3^1 \cdot 2^{x-3} = 1$ or, $3^{x-4+1} \times 2^{x-3} = 1$

or, $3^{x-3} \times 2^{x-3} = 1$ or, $(3 \times 2)^{x-3} = 1$ or, $6^{x-3} = 6^0$

or, $x - 3 = 0$ ∴ $x = 3$

(b) म.स. निकाल्नुहोस् (Find the HCF of): $a^3 - ab^2$ & $a^2b + 2ab^2 + b^3$

⇨ Here, First expression = $a^3 - ab^2 = a(a^2 - b^2) = a(a + b)(a - b)$

Second expression = $a^2b + 2ab^2 + b^3 = b(a^2 + 2ab + b^2) = b(a + b)^2$

∴ HCF = $(a + b)$

(c) यदि कुनै धनात्मक सङ्ख्याको वर्गको आधाबाट 4 घटाउँदा 28 हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।

If 4 is subtracted from the half of the square of a positive number, the result is 28. Find the number.

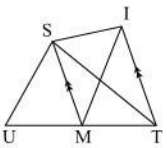
⇨ Here, let the positive number be x then,

or, $\frac{1}{2}x^2 - 4 = 28$ or, $\frac{1}{2}x^2 = 32$ or, $x^2 = 64$ ∴ $x = \pm 8$

Thus, the positive number is 8.

8. (a) दिइएको चित्रमा चतुर्भुज SUMI = 40 वर्ग से.मि. र ΔSUM = $\frac{5}{8}$ (चतुर्भुज SUMI को क्षेत्रफल) भए ΔSMT को क्षेत्रफल पत्ता लगाउनुहोस् ।

In the given figure if the area of quadrilateral SUMI = 40 cm², ΔSUM = $\frac{5}{8}$ (area of quadrilateral SUMI), find the area of ΔSMT.



⇨ Here, the area of quad. SUMI = 40 cm²

(i) ΔSUM = $\frac{5}{8}$ are of quad. SUMI = $\frac{5}{8} \times 40 = 25$ cm²

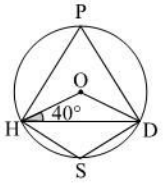
(ii) ΔSMI = Quad. SUMI − ΔSUM = 40 cm² − 25 cm² = 15 cm²

(iii) ΔSMI = ΔSMT i.e. ΔSMT = 15 cm². (∵ Δ^s on the same base and between the same parallels)

Thus, the area of ΔSMT is 15 cm².

(b) दिइएको 'O' केन्द्रबिन्दु भएको वृत्तमा ∠OHD = 40° भए ∠HPD र ∠HSD को नाप पत्ता लगाउनुहोस् ।

In the given figure, O is the centre of the circle. If ∠OHD = 40°, find ∠HPD and ∠HSD.



⇨ Here,

(i) ∠ODH = ∠OHD = 40° [∵ Being OH = OD.]

(ii) ∠HOD + ∠OHD + ∠ODH = 180°

∠HOD + 40° + 40° = 180°

i.e. ∠HOD = 100°

(iii) ∠HPD = $\frac{1}{2}$ ∠HOD [∵ Both are on same arc.] or, ∠HPD = $\frac{1}{2} \times 100° = 50°$

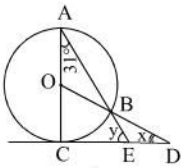
(iv) ∠HSD + ∠HPD = 180° [∵ Opposite angles of cyclic quad.]

or, ∠HSD + 50° = 180° ∴ ∠HSD = 130°

Thus, the measures of ∠HPD and ∠HSD are 50° and 130° respectively.

(c) 'O' केन्द्रबिन्दु भएको सँगैको चित्रमा CD स्पर्श रेखा छ । यदि ∠OAB = 31° भए x र y का मानहरू पत्ता लगाउनुहोस् ।

In the adjoining figure, O is the centre of the circle in which CD is a tangent. If ∠OAB = 31°, find the value of x & y.



⇨ Here, (i) In ACE, 31° + y + 90° = 180° (∵ Sum of ∠^{s} of a Δ)

or, y = 59°

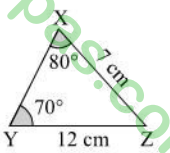
(ii) ∠COB = 2 ∠CAB = 2 × 31 = 62° (∵ Inscribed angle and central angle on same arc.)

Now, 62° + 90° + x = 180° or, 152° + x = 180° ∴ x = 28°

Thus, the values of x and y are 28° and 59° respectively.

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9. (a) दिइएको ΔXYZ को क्षेत्रफल निकाल्नुहोस् । (Find the area of the given ΔXYZ.)



⇨ Here, sum of angles of ΔXYZ is 180°.
So, ∠XZY + ∠X + ∠Y = 180°
or, ∠XZY + 80° + 70° = 180°
or, ∠XZY = 180° − (80° + 70°) = 30°

Now, Area of $\Delta XYZ = \frac{1}{2} \times XZ \times ZY \times \sin 30° = \frac{1}{2} \times 7 \text{ cm} \times 12 \text{ cm} \times \frac{1}{2} = 21 \text{ cm}^2$

Thus, the area of ΔXYZ is 21 cm^2.

(b) एउटा अविच्छिन्न श्रेणीमा 40 ओटा पदहरूको मध्यक 30 थियो । यदि वारम्बारता 10 भएको एउटा वर्गान्तर (10 - 20) हटाइयो भने नयाँ मध्यक कति हुन्छ ?
In a continuous series of 40 observations, the mean was 30. If an observation (10 - 20) having frequency 10 is excluded from the series, find the new mean.

⇨ Here, N = 40, $\overline{X} = 30$,

We know that, $\overline{X} = \frac{\Sigma fx}{N}$ or, $30 = \frac{\Sigma fx}{40}$ i.e. $\Sigma fx = 1200$

An observation (10 – 20) having frequency 10 is excluded. So,
New $\Sigma fx = 1200 - 10 \times 15 = 1050$ New N = 40 − 10 = 30

New $\overline{X} = \frac{\Sigma fx}{N} = \frac{1050}{30} = 35$ Thus, the new mean is 35.

10. (a) 3 देखि 31 सम्म अङ्कित गरिएका सङ्ख्या पत्तिहरूको समूहबाट एउटा पत्ती नहेरिकन थुत्दा 4 अथवा 7 ले निशेष भाग जाने सङ्ख्या पत्ती पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।
If a card is drawn randomly from a set of numbered cards from 3 to 31, what is the probability of getting a numbered card exactly divisible by 4 or 7?

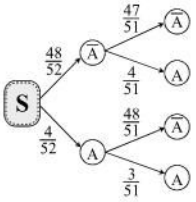
⇨ Here, let A and B be two events divisible by 4 and 7 respectively.
∴ S = {3, 4, 5, ..., 31} so n(S) = 29
A = {4, 8, 12, 16, 20, 24, 28} ∴ n(A) = 7
B = {7, 14, 21, 28} ∴ n(B) = 4

We know that,

$$P(A \text{ or } B) = P(A) + P(B) - P(A \cap B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} - \frac{n(A \cap B)}{n(S)} = \frac{7}{29} + \frac{4}{29} - \frac{1}{29} = \frac{10}{29}$$

Thus, the required probability is $\frac{10}{29}$.

(b) राम्रो फिटेको 52 पत्ती तासको प्याकेटबाट दुइओटा तास एक पछि अर्को (फिर्ता नराख्ने गरी) थुत्दा दुवै पत्ती एक्का नै पर्ने सम्भाव्यतालाई वृक्ष चित्र बनाई पत्ता लगाउनुहोस् ।
Two cards are drawn from a well shuffled deck of 52 cards. Find the probability that both cards are ace cards by drawing a tree diagram if the first drawn card is not replaced before the second draw.

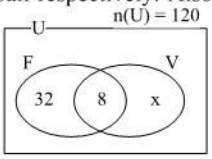


⇨ Here, let A be ace card and $\overline{A}$ be the cards other than ace card.
So, n(A) = 4 and $n(\overline{A}) = 48$
The probability tree diagram is shown alongside.

समूह 'ग' (Group' C') **[10 × 4 = 40]**

11. 120 जना खेलाडीहरूमध्ये 32 जनाले फुटबल मात्र खेले, 8 जनाले फुटबल र भलिबल दुवै खेले । भलिबल खेल्ने खेलाडीको सङ्ख्या फुटबल खेल्ने खेलाडीको सङ्ख्याभन्दा दोब्बर छ भने भेनचित्रको प्रयोगबाट भलिबल मात्र खेल्ने र दुवै खेल नखेल्ने खेलाडीको सङ्ख्या पत्ता लगाउनुहोस् ।
Out of 120 players, 32 play football only, 8 played both football and volleyball. The number of players who played volleyball is twice the number of players who played football. Using a Venn-diagram find the number of students who played volleyball only and who didn't play both games.

⇨ Here, Let 'F' and 'V' represent the set of players who like football and volleyball respectively. Also $n_0(V) = x$



From question,
n(V) = 2 n(F) or, (8 + x) = 2 (32 + 8)
or, 8 + x = 80 ∴ x = 72
Hence, 72 players like to play volleyball only.

Now, $n(F \cup V) = 120 - (32 + 8 + x) = 120 - (40 + x) = 80 - x = 80 - 72 = 8$
i.e. 8 players didn't play both games.
Thus, the players who play volleyball only is 72 and did not play both the games is 8.

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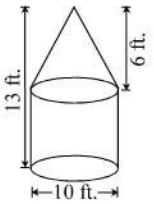
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12. एउटा घडीको अङ्कित मूल्यमा 10% छुट दिइ 13% भ्याट लगाउँदा त्यसको मूल्य रु. 2034 पर्दछ। यदि छुटको दर 15% भए छुट रकम कति हुने थियो, पत्ता लगाउनुहोस्।
The price of an article including 13% VAT after giving 10% discount is Rs 2034. Find the amount of discount if the rate of discount was 15%.

⇨ Here, Discount rate = 10%, VAT rate = 13% and
Price with VAT = Rs 2034
We know that,
SP with VAT = SP + VAT% of SP or, Rs 2034 = SP + 13% of SP
or, Rs 2034 = $\frac{113 \text{ S.P.}}{100}$ ∴ SP = Rs 1800
We have,
SP = MP – d% of MP or, Rs 1800 = MP – 10% of MP
or, Rs 1800 = MP – 0.1 of MP = 0.9 of MP ∴ MP = Rs 2000
Now, Amount of discount = 15% of MP = $\frac{15}{100} \times$ Rs 2000 = Rs 300
Thus, the required amount of discount is Rs 300.

13. 6 फिट अग्लो सोली आकारको छानो भएको एउटा बेलनाकार टेन्ट छ। यदि आधारको व्यास 16 फिट र पुरा उचाइ 13 फिट भए प्रति वर्ग फिट रु. 30 का दरले उक्त टेन्ट बनाउन लाग्ने वस्तुको खर्च कति पर्दछ ? पत्ता लगाउनुहोस्।
A cylindrical tent having a conical roof of a height 6 ft is made. If the diameter of the base is 16 ft and its total height is 13 ft, find the total cost of material to make this tent at the rate of Rs 30 per square feet.

⇨ Here, Height of cone = 6 ft.
Height of cylinder = 13 ft – 6 ft = 7 ft
Common radius = $\frac{d}{2} = \frac{16 \text{ cm}}{2} = 8$ cm



We know that, Slant height of cone(ℓ) = $\sqrt{h^2 + r^2} = \sqrt{6^2 + 8^2} = 10$ ft
We have, C.S.A. of cone = $\pi r\ell = \frac{22}{7} \times 8 \times 10 = 251.43$ sq. ft.
Again, C.S.A. of cylinder = $2\pi rh = 2 \times \frac{22}{7} \times 8 \times (13 - 6) = 352$ sq. ft.
We have, T.S.A. of tent = CSA of cone + CSA of cylinder = (251.43 + 352) sq. ft = 603.43 sq.ft
Now, Total cost = Area × rate = Rs (603.43 × 30) = Rs 18102.9
Thus, the required cost is Rs 18102.90.

14. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $a^4 - 2ya^3 + y^2a^2 - x^4$ & $a^4 + (2x^2 - y^2)a^2 + x^4$

⇨ Here, 1st exp. = $a^4 - 2ya^3 + y^2a^2 - x^4 = (a^2 - ya)^2 - (x^2)^2 = (a^2 - ya + x^2)(a^2 - ya - x^2)$
2nd exp. = $a^4 + (2x^2 - y^2)a^2 + x^4 = a^4 + 2x^2a^2 - y^2a^2 + x^4 = a^4 + 2x^2a^2 + x^4 - y^2a^2 = (a^2 + x^2)^2 - (ya)^2$
$= (a^2 + x^2 + ya)(a^2 + x^2 - ya)$
∴ LCM = $(a^2 - ya + x^2)(a^2 + ya + x^2)(a^2 - ya - x^2)$

15. 3 वर्षपछि दिदीको उमेर भाइको उमेरको 4 गुणा हुनेछ। 3 वर्ष अघि दिदीको उमेर भाइको अब 4 वर्ष पछि हुने उमेरको दुई गुणा थियो। उनीहरूको हालको उमेर कति कति होला?
3 years later a sister will be 4 times as old as her brother. 3 years ago, the sister's age was two times her brother's age will be 4 years hence. What are their present ages?

⇨ Here, let the present age of a sister be x years and her brother be y years.
From the first condition of the question,
$x + 3 = 4(y + 3)$ or, $x + 3 = 4y + 12$ ∴ $x - 4y = 9$ ...(i)
From the second condition of the question,
$x - 3 = 2(y + 4)$ or, $x - 3 = 2y + 8$ or, $x - 2y = 11$ ...(ii)
Solving equation (i) and (ii) then,

$$\begin{array}{r} x - 4y = 9 \\ x - 2y = 11 \\ \hline -2y = -2 \end{array}$$

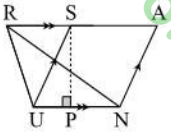
∴ $y = 1$
Putting the value of y in equation (i) then,
$x - 4y = 9$ or, $x - 4 \times 1 = 9$ ∴ $x = 13$
Thus, the present ages of the sister and the brother are 13 years and 1 year respectively.

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16. एउटै आधार UN र उहि समानान्तर रेखाहरू SR र UN बिच बनेको समानान्तर चतुर्भुज SUNA को क्षेत्रफल त्रिभुज RUN को भन्दा दोब्बर हुन्छ भनि प्रमाणित गर्नुहोस् ।

Prove that area of parallelogram SUNA is double of the area of triangle RUN standing on the same base UN and between the same parallels SR and UN.



⇨ Here, Given: $\square$SUNA and ΔRUN are standing on the same base UN and between the same parallels SR and UN.

To prove: Area ($\square$SUNA) = 2 Area (ΔRUN)

Construction: SP $\perp$ UN is drawn.

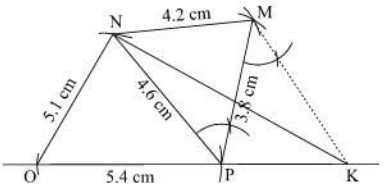
Proof:

	Statements		Reasons
1.	Area of $\square$SUNA = UN × SP	1.	Area of $\square$ = b × h
2.	Area ΔRUN = $\frac{1}{2}$ UN × SP	2.	Area of $\Delta = \frac{1}{2}$ bh
3.	Area (ΔRUN) = $\frac{1}{2}$ Area ($\square$SUNA) i.e. Area ($\square$SUNA) = 2 Area (ΔRUN)	3.	From statements 1 & 2

Proved.

17. MN = 4.2 से.मि. NO = 5.1 से.मि. OP = 5.4 से.मि., PM = 3.8 से.मि. र NP = 4.6 से.मि. भएको एउटा चतुर्भुज MNOP को रचना गर्नुहोस् साथै चतुर्भुज MNOP सँग बराबर क्षेत्रफल हुने एउटा त्रिभुज NOK को रचना गर्नुहोस् ।

Construct a quadrilateral MNOP in which MN = 4.2 cm, NO = 5.1 cm, OP = 5.4 cm, PM = 3.8 cm and NP = 4.6 cm. Also, construct triangle NOK equal in area to the quadrilateral MNOP.



⇨ Here, MN = 4.2 cm, NO = 5.1 cm, OP = 5.4 cm, PM = 3.8 cm and NP = 4.6 cm

ΔNOK is the required triangle whose area is equal to the area of given quadrilateral MNOP.

18. एउटै चापमा बनेका परिधिका कोणहरू बराबर हुन्छन् भनि प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तिमा 3 से.मि. अर्धव्यास भएका दुइवटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally that inscribed angles in the same arc of a circle are equal. (Two figures with at least 3 cm radius are necessary.)

⇨ Here, In the figure, $\measuredangle$ACB and $\measuredangle$ADB are the inscribed angles on the same arc.

Measurement Table

Fig.	$\measuredangle$ACB	$\measuredangle$ADB	Remarks
I	46°	46°	$\measuredangle$ACB = $\measuredangle$ADB
II	51°	51°	$\measuredangle$ACB = $\measuredangle$ADB



Fig. I



Fig. II

Conclusion: From the above table it is concluded that the inscribed angles on the same arc are equal to each other.

19. 14 मिटर अग्लो एउटा खम्बा भुकम्पले गर्दा भाँचिएर टुप्पोले जमिनसँग 60° को कोण बनायो भने उक्त खम्बाको भाँचिएको भागको लम्बाइ पत्ता लगाउनुहोस् ।

A pole of height 14 m was broken by the earthquake so that its top touches the ground to make an angle of 60° with the ground. Find the length of the broken part of the pole.

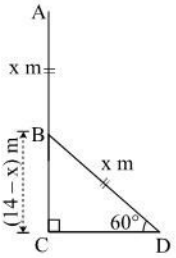
⇨ Here, let AC = 14 m be the height of a pole which is broken at B.

Let AB = BD = x m be the length of broken part.

Let $\measuredangle$BDC be angle made by the broken part with the ground.

We have, BC = AC – AB = 14 m – x m = (14 – x) m

In ΔCBD,



$$\sin 60° = \frac{BC}{BD} \qquad \text{or, } \frac{\sqrt{3}}{2} = \frac{14 - x}{x}$$

$$\text{or, } \sqrt{3}x = 28 - 2x \qquad \text{or, } x(\sqrt{3} + 2) = 28$$

$$\text{or, } x = \frac{28}{\sqrt{3} + 2} \qquad \therefore \quad x = 7.5 \text{ m}$$

Thus, the length of the broken part of the pole is 7.5 m.

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20. तल दिइएको तथ्याङ्कको $Q_1 = 25$ भए k को मान पत्ता लगाउनुहोस् ।
If Q_1 of the data given below is 25, find the value of 'k'.

Class	20-30	10-20	30-40	50-60	40-50
Frequency	4	3	k	3	4

⇨ Here, calculation of first quartile and missing frequency:

C.I.	f	C.f
10-20	3	3
20-30	4	7
30-40	k	7 + k
40-50	4	11 + k
50-60	3	14 + k
	N = 14 + k	

$\therefore$ $Q_1 = 25$. So, Q_1 class is 20-30

We know that,

$$Q_1 = L + \frac{\frac{N}{4} - c.f.}{f} \times i \qquad \text{or, } 25 = 20 + \frac{\frac{14+k}{4} - 3}{4} \times 10$$

$$\text{or, } 5 = \frac{14 + k - 12}{4} \times \frac{1}{4} \times 10 \qquad \text{or, } 40 = 10 + 5k$$

$\therefore$ $k = 6$ Thus, the value of k is 6.

समूह 'घ' (Group D) **[4 × 5 = 20]**

21. रु. 10000 को 2 वर्ष 6 महिनामा 10% का दरले हुने साधारण व्याज सोही रकमको उहि समय र व्याजदरमा हुने वार्षिक चक्रीय व्याज भन्दा कति प्रतिशतले कम हुन्छ ?
By what percent, the simple interest on Rs 10000 for 2 years 6 months at the rate of 10% per annum is less than the yearly compound interest on the same sum for same time and rate ?

⇨ Here,

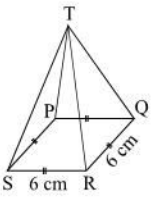
Simple Interest	Compound Interest
P = Rs 10000 T = 2 years 6 months R = 10% We know that, $S.I. = \frac{PTR}{100} = \frac{10000 \times \frac{5}{2} \times 10}{100}$ $\therefore$ S.I. = Rs 2500	P = Rs 1000 T = 2 years 6 months R = 10% Again, $C.I. = P\left[\left(1+\frac{R}{100}\right)^T\left(1+\frac{MR}{1200}\right)-1\right]$ $= 10000\left[\left(1+\frac{10}{100}\right)^T\left(1+\frac{6\times10}{1200}\right)-1\right]$ $= 10000\,[1.2705 - 1]$ $\therefore$ CI = Rs 2705

Now, the difference = C.I. – S.I. = Rs 2705 – Rs 2500 = Rs 205

So, the difference percentage $= \frac{C.I. - S.I.}{C.I.} \times 100\% = \frac{205}{2705} \times 100\% = 7.58\%$

Thus, S.I. is 7.58% less than C.I.

22. दिइएको ठोस चित्रको पुरा सतहको क्षेत्रफल 96 वर्ग से.मि. छ । यदि 1 घन से.मि. = 10 ग्राम भए उक्त ठोस वस्तुको जम्मा तौल कति हुन्छ ?
The given solid figure has total surface area 96 cm². If 1 cm³ = 10 gm, what is the total weight of this solid?



⇨ Here, length of base (a) = 6 cm TSA = 96 cm² and 1 cm³ = 10 gm

We know that,

T.S.A. $= a^2 + 2a\ell$ or, $96 = 6^2 + 2 \times 6 \times \ell$ or, $96 = 36 + 12\ell$

or, $60 = 12\ell$ $\therefore$ $\ell = 5$ cm

We have,

$$\ell^2 = h^2 + \left(\frac{a}{2}\right)^2 \qquad \text{or, } 5^2 = h^2 + 3^2 \qquad \text{or, } 25 - 9 = h^2 \qquad \therefore \quad h = 4 \text{ cm}$$

Now, $V = \frac{1}{3}a^2 h = \frac{1}{3} \times (6)^2 \times 4 = 48 \text{ cm}^3$ So, Weight of the solid = (48 × 10) gm = 480 gm

Thus, the total weight of the solid is 480 gm.

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23. सरल गर्नुहोस् (Simplify): $\frac{1}{1-x}+\frac{2}{1+x^2}+\frac{4}{1+x^4}-\frac{8}{1-x^8}$

⇨ Here, $\frac{1}{1-x}+\frac{2}{1+x^2}+\frac{4}{1+x^4}-\frac{8}{1-x^8}$

$= \frac{1+x+1-x}{(1+x)(1-x)}+\frac{2}{1+x^2}+\frac{4}{1+x^4}-\frac{8}{1-x^8}-\frac{1}{1+x}$

$= \frac{2-2x^2+2+2x^2}{(1+x^2)(1-x^2)}+\frac{4}{1+x^4}-\frac{8}{1-x^8}-\frac{1}{1+x}$

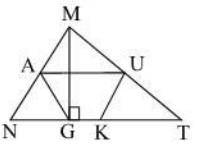
$= \frac{8}{1-x^8}-\frac{8}{1-x^8}-\frac{1}{1+x} = -\frac{1}{1+x}$

$= \frac{1}{1-x}+\frac{1}{1+x}+\frac{2}{1+x^2}+\frac{4}{1+x^4}-\frac{8}{1-x^8}-\frac{1}{1+x}$

$= \frac{2}{1-x^2}+\frac{2}{1+x^2}+\frac{4}{1+x^4}-\frac{8}{1-x^8}-\frac{1}{1+x}$

$= \frac{4}{1-x^4}+\frac{4}{1+x^4}-\frac{8}{1-x^8}-\frac{1}{1+x}$

24. दिइएको चित्रमा A, U र K क्रमशः भुजाहरू MN, MT र NT का मध्य बिन्दु हुन्। यदि MG ⊥ NT भए A, U, K, G एउटै वृत्तका परिधिका बिन्दुहरू हुन् भनि प्रमाणित गर्नुहोस्।
In the given figure A, U & K are the mid-point of sides MN, MT and NT respectively. If MG ⊥ NT, prove that A, U, K, G are concyclic.



⇨ Here, Given: A,U and K are the midpoints of sides MN, MT and NT respectively. MG ⊥ NT

To prove: A,U,K,G are the concyclic points.

Proof:

S.N	Statements	S.N	Reasons
1.	AU // NT and UK // MN	1.	Midpoint theorem
2.	AUKN is a parallelogram	2.	Opp. sides being parallel.
3.	∡AUK = ∡ANG	3.	Being opp. ∡^{s} of a parm.
4.	AN = AG	4.	Mid point of hypotenuse is equidistant from all the vertices.
5.	∡ANG = ∡AGN	5.	from statement 4, the base angles of isosceles triangle
6.	∡AUK = ∡AGN.	6.	From statements 3 and 5
7.	AUKG is a cyclic quad.	7.	Being exterior angle equal to opp. interior angle.
8.	∴ A, U, K, G are concyclic.	8.	From statement 7

Proved

16. SEDIPS BOARD EXAMINATION 2074 SET B

समूह 'क' (Group 'A') **[3 × (1 + 1) = 6]**

1. (a) भ्याट सहितको विक्रयमूल्य र भ्याट बाहेकको विक्रयमूल्य दिइएको अवस्थामा भ्याटको दर पत्ता लगाउने सूत्र लेख्नुहोस्।
Write the formula for finding the rate of VAT when the selling price with VAT and selling price without VAT are given.

⇨ Here, Rate of VAT $= \frac{\text{S.P. with VAT} - \text{S.P. without VAT}}{\text{S.P. without VAT}} \times 100\%$

(b) त्रिभुजको क्षेत्रफल कति हुन्छ, जसका भुजाहरू 'p', 'q' र 'r' छन्।
What is the area of a triangle whose three sides are 'p', 'q' and 'r'

⇨ Here, Area of triangle $= \sqrt{s(s-p)(s-q)(s-r)}$ sq. units where, 's' is the semi-perimeter and 'p', 'q' and 'r' are sides of the triangle.

2. (a) हल गर्नुहोस् (Solve): $\frac{1}{3^{-x}} = 81$

⇨ Here, $\frac{1}{3^{-x}} = 81$ or, $3^x = 81$ or, $3^x = 3^4$ Thus, $x = 4$

(b) तल दिइएको तथ्याङ्कमा माथिल्लो चतुर्थांश कुन वर्गान्तरमा पर्दछ ?
In which class interval does the upper quartile lies in the data given below.

X	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
c.f.	8	12	20	30	36

⇨ Here, N = 36 ∴ $Q_3 = \left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 36}{4}\right)^{th}$ item $= 27^{th}$ item.

The c.f. just greater than 27 is 30. ∴ Q_3 class = 30 - 40.

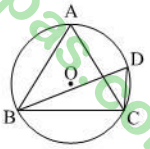
Thus, the required class interval is 30 - 40.

3. (a) एउटै आधार र उही समानान्तर रेखाहरूबिच रहेका वर्ग र त्रिभुजको सम्बन्ध लेख्नुहोस्।
Write down the relation between the area of square and triangle standing on the same base and between same parallels.

⇨ Here, the relation between the area of square and triangle standing on same base and between same parallels is that the area of square is twice the area of triangle.

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(b) यदि ΔABC एउटा समबाहु त्रिभुज भए ∡BDC को नाप पत्ता लगाउनुहोस् ।
Find the measurement of ∡BDC if ΔABC is an equilateral triangle.



⇨ Here, ABC is an equilateral triangle.
$\therefore \quad \angle ABC = \angle BCA = \angle BAC = 60°$
Again, $\angle BDC = \angle BAC$ [∵ Inscribed angles standing on same segment]
$\therefore \quad \angle BDC = 60°$
Thus, the measure of ∡BDC is 60°.

समूह 'ख' (Group 'B') **[4 × (2 + 2) + 3 × (2 + 2 + 2) = 34]**

4. (a) यदि 5 डलर 4 पाउण्डसँग साट्न सकिन्छ र 3 डलर रु. 315 सँग साट्न सकिन्छ भने रु. 5625 सगँ कति पाउण्ड साट्न सकिएला ?
If 5 dollars can be exchanged for 4 pounds and 3 dollars can be exchanged for Rs 315, how many pounds can be exchanged for Rs 5625?

⇨ Here, let £ x = Rs 5625 Rs 315 = $ 3 $ 5 = £ 4
By chain rule, $x \times 315 \times 5 = 5625 \times 3 \times 4$
or, $x = \frac{5625 \times 3 \times 4}{315 \times 5}$ or, $x = 42.86$
Thus, 42.86 pounds can be exchanged for Rs 5625

(b) यदि प्रति वर्ष 12% को दरमा एउटा ल्यापटपको मूल्य ह्रास हुँदा 2 वर्षमा रु. 92,928 हुन्छ भने सो ल्यापटपको सुरूको मूल्य पत्ता लगाउनुहोस् ।
If the cost is depreciated at the rate of 12 % per annum, the cost of a laptop computer becomes Rs 92,928 after 2 years, find the original price of the computer.

⇨ Here, Rate of depreciation (R) = 12% p.a. Time (T) = 2 years
Cost of laptop after 2 years (P_2) = Rs 92928 Initial cost of laptop (P) = ?
We have,
$P_T = P\left(1 - \frac{R}{100}\right)^T$ i.e. $92928 = P\left(1 - \frac{12}{100}\right)^2$ or, $92928 = P\left(\frac{88}{100}\right)^2$
or, $92928 = P \times 0.7744$ or, $P = \frac{92928}{0.7744}$ or, P = Rs 120,000
Thus, the original price of the laptop is Rs 120,000.

5. (a) एउटा बेलनाको बक्र सतहको क्षेत्रफल 22 cm किनारा भएको एउटा घनको पुरा सतहको क्षेत्रफलसँग बराबर छ । यदि बेलनाको उचाइ 33 cm भए यसको अर्धव्यास पत्ता लगाउनुहोस् ।
The curved surface area of a cylinder is equal to the total surface area of a cube whose edge is 22 cm. If the height of cylinder is 33 cm, find its radius.

⇨ Here, Height of cylinder (h) = 33 cm Edge of cube (ℓ) = 22 cm
Let 'r' be the radius of cylinder,
Then, According to the question, curved surface area of cylinder = total surface area of cube
i.e., $2\pi rh = 6\ell^2$ or, $2 \times \frac{22}{7} \times r \times 33 = 6 \times (22)^2$
or, $\frac{1452r}{7} = 2904$ or, $r = \frac{2904 \times 7}{1452}$ or, r = 14 cm
Thus, the radius of the cylinder is 14 cm.

(b) एउटा ठोस अर्धगोलाको आयतन 19404 cm^3 छ । पुरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The volume of a solid hemisphere is 19404 cubic cm. Find its total surface area.

⇨ Here, Volume of hemi-sphere = 19404 cm^3
i.e. $\frac{2}{3}\pi r^3 = 19404\ cm^3$ or, $\pi r^3 = 19404\ cm^3 \times \frac{3}{2}$ or, $\frac{22}{7} r^3 = 29106\ cm^3$
or, $r^3 = 29106\ cm^3 \times \frac{7}{22}$ or, $r^3 = 9261\ cm^3$ or, $r^3 = (21cm)^3$
or, r = 21 cm
Again, Total surface area of hemisphere = $3\pi r^2 = 3 \times \frac{22}{7} \times (21)^2 = 4158\ cm^2$
Thus, the total surface area of the solid hemisphere is 4158 cm^2

(c) एउटा सोली आकारको टेन्ट बनाउन प्रति वर्ग मिटर रु. 300 को दरले रु. 66000 खर्च लाग्दछ । यदि सो सोलीको छड्के उचाइ 10 m भए आधारको व्यास पत्ता लगाउनुहोस् ।
The cost of cloth required to make a conical tent at the rate of Rs 300 per square meter is Rs 66000. If the slant height of the cone is 10 m then find the diameter of base.

⇨ Here, Slant height of cone (ℓ) = 10 m and let 'r' be the radius of the cone.
So, Curved surface area of cone = $\frac{66000}{300} = \frac{\text{Total cost of cloth}}{\text{Rate of cloth per } m^2}$

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i.e. $\pi r\ell = \frac{66000}{300}$ or, $\frac{22}{7} \times r \times 10\text{ m} = 220\text{ m}$

or, $r = 220\text{ m}^2 \times \frac{7}{220\text{ m}}$ or, $r = 7\text{ m}$

Now, Diameter $= 2r = 2 \times 7\text{ m} = 14\text{ m}$ Thus, the diameter of the base is 14 m.

6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): $2x^2 - 18$ and $6x + 18$

⇨ Here, First expression $= 2x^2 - 18 = 2(x^2 - 9) = 2(x + 3)(x - 3)$

Second expression $= 6x + 18 = 6(x + 3) = 2 \times 3(x + 3)$

Thus, HCF $= 2(x + 3)$

(b) सरल गर्नुहोस् (Simplify): $5\sqrt{28} + 7\sqrt{63} - 6\sqrt{175}$

⇨ Here, $5\sqrt{28} + 7\sqrt{63} - 6\sqrt{175} = 5\sqrt{4 \times 7} + 7\sqrt{7 \times 9} - 6\sqrt{7 \times 25}$

$= 5 \times 2\sqrt{7} + 7 \times 3\sqrt{7} - 6 \times 5\sqrt{7} = 10\sqrt{7} + 21\sqrt{7} - 30\sqrt{7}$

$= 31\sqrt{7} - 30\sqrt{7} = \sqrt{7}$

7. (a) सरल गर्नुहोस् (Simplify): $\frac{9^{x+1} \times 8 - 9^{x-1} \times 81}{9^x \times 66 - 9^{x-2} \times 243}$

⇨ Here, $\frac{9^{x+1} \times 8 - 9^{x-1} \times 81}{9^x \times 66 - 9^{x-2} \times 243} = \frac{9^x(9 \times 8 - 9^{-1} \times 81)}{9^x(66 - 9^{-2} \times 243)} = \frac{72 - 9^{-1} \times 9^2}{66 - 9^{-2+2} \times 3} = \frac{72 - 9}{66 - 1 \times 3} = \frac{63}{66 - 3} = \frac{63}{63} = 1$

(b) ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $2x^2 - 10x + 12$ and $2x^4 - 54x$

⇨ Here, First expression $= 2x^2 - 10x + 12 = 2(x^2 - 5x + 6) = 2(x^2 - 2x - 3x + 6)$

$= 2\{x(x - 2) - 3(x - 2)\} = 2(x - 3)(x - 2)$

Second expression $= 2x^4 - 54x = 2x(x^3 - 27) = 2x(x - 3)(x^2 + 3x + 9)$

Thus, LCM $= 2x(x - 3)(x - 2)(x^2 + 3x + 9)$

(c) यदि एउटा प्राकृतिक सङ्ख्याको वर्गको तीन गुणाबाट 12 घटाइयो भने परिणाम 36 हुन्छ । सो सङ्ख्या पत्ता लगाउनुहोस् ।
If 12 is subtracted from the thrice of the square of a natural number, the result is 36. Find the number.

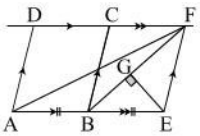
⇨ Here, let the required natural number be x.

Then, $3x^2 - 12 = 36$ or, $3(x^2 - 4) = 36$ or, $x^2 - 4 = 12$

or, $x^2 = 12 + 4$ or, $x^2 = 16$ or, $x^2 = 4^2$

or, $x = 4$ Thus, the required natural number is 4.

8. (a) सँगैको चित्रमा समानान्तर चतुर्भुज ABCD को क्षेत्रफल 84 cm² र BF = 21 cm छ । यदि AB = BE भए GE को लम्बाइ पत्ता लगाउनुहोस् ।
In the adjoining figure, area of parallelogram ABCD is 84 cm² and BF = 21 cm. If AB = BE, find the length of GE.



⇨ Here, Area of parallelogram ABCD = 84 sq. cm

And,

(i) Area of $\Delta ABF = \frac{1}{2}$ Area of $\square ABCD$ [∵ Both standing on same base and between same parallels]

$= \frac{1}{2} \times 84\text{ cm}^2 = 42\text{ cm}^2$

(ii) Area of ΔBEF = Area of ΔABF [∵ Both standing on same base and between same parallels]

∴ Area of $\Delta BEF = 42\text{ cm}^2$

(iii) Area of $\Delta BEF = \frac{1}{2} \times BF \times GE$ or, $42\text{ cm}^2 = \frac{1}{2} \times 21\text{ cm} \times GE$

or, $42\text{ cm}^2 \times \frac{2}{21\text{ cm}} = GE$ or, $GE = 4\text{ cm}$

Thus, the length of GE is 4 cm

(b) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो र MN व्यास हो । यदि MN // RP र ∠NPR = 25° भए ∠PQR को मान पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle and MN is a diameter. Find the value of ∠PQR if MN // RP and ∠NPR = 25°.



⇨ Here, ∠NPR = 25° and NM // RP

We have,

(i) ∠RON = 2∠RPN [∵ Relation between central and inscribed angles standing on same arc]

$= 2 \times 25° = 50°$

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(ii) $\measuredangle RPN = \measuredangle PNM = 25°$ [$\because$ NM // RP and alternate angles]

(iii) $\measuredangle MOP = 2 \times \measuredangle PNM$ [$\because$ Relation between central & inscribed angles standing on same arc]
$= 2 \times 25° = 50°$

(iv) $\measuredangle POM + \measuredangle RON + \measuredangle POR = 180°$ [$\because$ sum of angles in a straight line]

or, $50° + 50° + \measuredangle POR = 180°$

or, $\measuredangle POR = 180° - 100°$

$\therefore \quad \measuredangle POR = 80°$

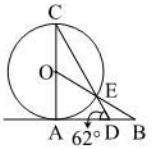
(v) $\measuredangle PQR = \frac{1}{2}\measuredangle POR$ [$\because$ Inscribed angle is half of the central angle standing on same arc]

$= \frac{1}{2} \times 80° = 40°$

Thus, the value of $\measuredangle$ PQR is 40°

(c) सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो, AC व्यास र ADB स्पर्श रेखा हो। यदि $\measuredangle ADC = 62°$ भए $\measuredangle ABO$ को मान पत्ता लगाउनुहोस्।

In the adjoining figure, O is the centre of the circle, AC is a diameter and ADB is the tangent. Find the value of $\measuredangle ABO$ if $\measuredangle ADC = 62°$.



⇨ Here, OA ⊥ AB $\therefore \quad \measuredangle OAB = 90°$

(i) In rt. $\measuredangle$ed ΔACD,

$\measuredangle ACD + \measuredangle CDA = 90°$ [$\because$ sum of remaining acute angles of rt. $\measuredangle$ed triangle]

or, $\measuredangle ACD + 62° = 90° \qquad \therefore \quad \measuredangle ACD = 28°$

(ii) $\measuredangle AOE = 2 \times \measuredangle ACE$ [$\because$ Relation between central and inscribed angles standing on same arc]
$= 2 \times 28° = 56°$

(iii) In rt. $\measuredangle$ed ΔOAB

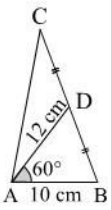
$\measuredangle AOB + \measuredangle ABO = 90°$ [$\because$ sum of remaining acute angles of a rt. $\measuredangle$ed triangle]

or, $56° + \measuredangle ABO = 90° \qquad$ or, $\measuredangle ABO = 34°$

Thus, the value of $\measuredangle ABO$ is 34°

9. (a) दिइएको चित्रमा ΔABC को मध्यिका AD हो। यदि $\measuredangle BAD = 60°$, AD = 12 cm र AB = 10 cm भए ΔABC को क्षेत्रफल पत्ता लगाउनुहोस्।

In the given figure, AD is a median of ΔABC. If $\measuredangle BAD = 60°$, AD = 12 cm and AB = 10 cm, find the area of ΔABC



⇨ Here, Area of $\Delta ABD = \frac{1}{2} \times AD \times AB \times \sin 60° = \frac{1}{2} \times 12 \text{ cm} \times 10 \text{ cm} \times \frac{\sqrt{3}}{2}$

$= 30\sqrt{3} \text{ cm}^2$

Again, Area of $\Delta ABC = 2 \times$ Area of ΔABD [$\because$ AD is median] $= 2 \times 30\sqrt{3} \text{ cm}^2 = 103.92 \text{ cm}^2$

Thus, the area of ΔABC is 103.92 cm^2.

(b) 5 जना केटाहरूको औषत उमेर 8 छ। यदि हरेक केटाहरूको उमेरमा 2 जोडियो भने नँया औषत पत्ता लगाउनुहोस्।

The average age of 5 boys is 8. If 2 is added to the age of each boy, find the new average.

⇨ Here, No. of boys (n) = 5, Average age ($\bar{x}$) = 8, Sum of all ages (Σx) = ?

We have, $\bar{x} = \frac{\Sigma x}{n} \qquad$ or, $8 = \frac{\Sigma x}{5} \qquad$ or, $\Sigma x = 40$

Again, 2 is added to age of each boy.

Then, $\Sigma x = 40 + 2 \times 5 = 40 + 10 = 50 \qquad \therefore \quad$ New average $= \frac{\Sigma x}{n} = \frac{50}{5} = 10$

10. (a) 5 देखि 25 सम्म अङ्कित सङ्ख्या पत्तिहरूबाट एउटा सङ्ख्या पत्ति झिक्दा वर्ग सङ्ख्या वा जोर सङ्ख्या भएको सङ्ख्या पत्ति पर्ने सम्भाव्यता पत्ता लगाउनुहोस्।

Find the probability of getting square number or even number card while drawing a flash card from the set of cards numbered from 5 to 25.

⇨ Here, let Q and E denote the events of getting square and even numbered card respectively.
Then, n(S) = 21, n(Q) = 3, n(E) = 10

Now, $P(Q \text{ or } E) = P(Q \cup E) = P(Q) + P(E) - P(Q \cap E) = \frac{n(Q)}{n(S)} + \frac{n(E)}{n(S)} - \frac{n(Q \cap E)}{n(S)}$

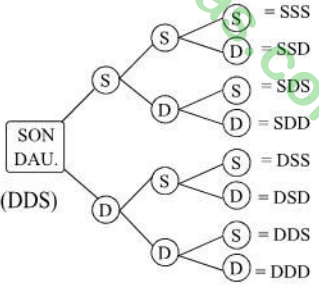
$= \frac{3}{21} + \frac{10}{21} - \frac{1}{21} \quad = \frac{3 + 10 - 1}{21} \quad = \frac{12}{21}$

Thus, the probability of getting square or even number card is $\frac{12}{21}$.

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(b) एउटा परिवारमा तीनजना बच्चाहरू जन्मिएका छन् । कम्तीमा एकजना छोरा जन्मिन सक्ने सम्भाव्यता वृक्ष चित्र खिचेर पत्ता लगाउनुहोस् ।

Three children are born in a family. Calculate the probability of getting at least one son by drawing a tree diagram



⇨ Here, let S denote the event of getting son and D denote the event of getting daughter.

First trial second trial third trial sample space probability

∴ P(at least one son)

$= P(SSS) + P(SSD) + P(SDS) + P(SDD) + P(DSS) + P(DSD) + P(DDS)$

$= \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{7}{8}$

Thus, the probability of getting at least one son is $\frac{7}{8}$

समूह 'ग' (Group' C') [10 × 4 = 40]

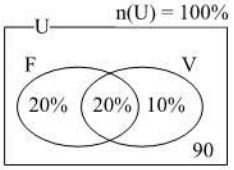
11. एउटा विद्यालयको 40% विद्यार्थीले फुटबल खेल्दछन्, 30% ले भलिबल खेल्दछन् र 20% ले फुटबल र भलिबल दुबै खेल्दछन् । यदि 90 जना न फुटबल न त भलिबल खेल्दछन् भने सो विद्यालयको विद्यार्थी सङ्ख्या र फुटबल मात्र खेल्ने विद्यार्थी सङ्ख्या भेन चित्र प्रयोग गरी पत्ता लगाउनुहोस् ।

40% of the students of a school play football, 30% play volleyball and 20% play both football and volleyball. If 90 students play neither football nor volleyball, find the number of students in the school and number of students who play only football by using a Venn-diagram.

⇨ Here, let F and V denote the sets of student playing football and volleyball respectively.

Then, $n(F) = 40\%$, $n(V) = 30\%$, $n(F \cap V) = 20\%$, $n(\overline{F \cup V}) = 90$, $n(U) = 100\%$

Representing above information in Venn-diagram.



From Venn-diagram, $n(F \cup V) = 20\% + 20\% + 10\% = 50\%$

∴ $n(\overline{F \cup V}) = n(U) - n(F \cup V) = 100\% - 50\% = 50\%$

Let, $n(U) = x$, then, 50% of $x = 90$

or, $\frac{50}{100} \times x = 90$ or, $\frac{x}{2} = 90$ ∴ $x = 180$

Thus, the number of students in the school is 180.

Again, $n_0(F) = 20\%$ of $n(U) = \frac{20}{100} \times 180 = 36$

Thus, the number of students who play only football is 36.

12. एउटा रेडियो अङ्कित मूल्यमा 20% छुट दिएपछि 13% भ्याट जोडेर बेचिएको छ । यदि क्रेताले रु. 416 भ्याट तिरेको भए उसले कति छुट पाउथ्यो होला ? साथै उसले रेडियो किन्दा तिरेको जम्मा मूल्य पत्ता लगाउनुहोस् ।

After allowing 20% discount on the marked price and then levying 13% VAT, a radio was sold. If buyer had paid Rs 416 for VAT, how much would he get the discount? Also, find the amount paid by him/her to buy the radio.

⇨ Here, let the marked price (MP) of the radio be x.

Then, SP = MP – 20% of MP $= x - \frac{20}{100} \times x = x - \frac{x}{5} = \frac{4x}{5}$

Given, VAT amount = Rs 416 or, 13% of SP = 416

or, $\frac{13}{100} \times \frac{4x}{5} = 416$ or, $\frac{13}{25} \times \frac{x}{5} = 416$ or, $\frac{13x}{125} = 416$

or, $13x = 52000$ or, $x = 4000$ i.e. MP = Rs 4000

Now, Discount amount = 20% of MP $= \frac{20}{100} \times 4000 = \text{Rs } 800$

∴ He got Rs 800 as discount. Again, SP $= \frac{4x}{5} = \frac{4 \times 4000}{5} = \text{Rs } 3200$

SP with VAT = SP + VAT amount = Rs 3200 + Rs 416 = Rs 3616

Thus, the amount paid by him/her to buy radio is Rs 3616.

13. एउटा भुइँमा 20 ओटा त्रिभुजाकार टाइलहरू प्रयोग गरी डिजाइन गरिएको छ । एउटा त्रिभुजाकार टाइलको भुजाहरू 6 cm, 8 cm र 10 cm छन् । सो टाइलहरूलाई प्रति वर्ग cm रू 15 को दरले पालिस लगाउन लाग्ने जम्मा खर्च पत्ता लगाउनुहोस् ।

A floral design on a floor is made up of 20 tiles which are triangular, the sides of a triangle being 6 cm, 8 cm and 10 cm. Find the cost of polishing the tiles at the rate of Rs 15 per square cm.

⇨ Here, Sides of the triangular tiles are 6 cm, 8 cm and 10 cm.

Semi-perimeter $= \left(\frac{6+8+10}{2}\right) \text{cm} = \left(\frac{24}{2}\right) \text{cm} = 12 \text{ cm}$

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Now, Area of each tile $= \sqrt{12(12-6)(12-8)(12-10)} = \sqrt{12 \times 6 \times 4 \times 2} = \sqrt{576} = 24\ cm^2$
No. of tiles = 20 Total area of the floor/design $= 20 \times 24\ cm^2 = 480\ cm^2$
Given, Cost of polishing the tiles = Rs 15 per cm^2 Total cost $= 480 \times$ Rs 15 = Rs 7200
Thus, the cost of polishing the tiles at the rate of Rs 15 per sq. cm is Rs 7200.

14. सरल गर्नुहोस् (Simplify): $\frac{(x+y)^2-(x-y)^2}{x^2-y^2} + \frac{4xy}{x^2+y^2} - \frac{8x^3y}{x^4+y^4}$

⇨ Here, $\frac{(x+y)^2-(x-y)^2}{x^2-y^2} + \frac{4xy}{x^2+y^2} - \frac{8x^3y}{x^4+y^4} = \frac{x^2+2xy+y^2-x^2+2xy-y^2}{x^2-y^2} + \frac{4xy}{x^2+y^2} - \frac{8x^3y}{x^4+y^4}$

$= \frac{4xy(x^2+y^2)+4xy(x^2-y^2)}{(x^2-y^2)(x^2+y^2)} - \frac{8x^3y}{x^4+y^4} = \frac{4xy(x^2+y^2+x^2-y^2)}{x^4-y^4} - \frac{8x^3y}{x^4+y^4}$

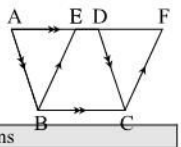
$= \frac{4xy \times 2x^2}{x^4-y^4} - \frac{8x^3y}{x^4+y^4} = \frac{8x^3y(x^4+y^4)-8x^3y(x^4-y^4)}{(x^4-y^4)(x^4+y^4)}$

$= \frac{8x^3y(x^4+y^4-x^4+y^4)}{(x^4-y^4)(x^4+y^4)} = \frac{8x^3y \times 2y^4}{x^8-y^8} = \frac{16x^3y^5}{x^8-y^8}$

15. एक जना बाबु र उसको छोराको उमेरको योगफल 36 वर्ष छ । यदि दुबै बाँचीरहे छोराको उमेर बाबुको अहिलेको उमेर पुग्ने बेला तिनीहरूको उमेरको योगफल 84 वर्ष हुन्छ । उनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The sum of the present ages of a father and his son is 36 years. If they both live until the son becomes as old as the father is now, the sum of their ages will be 84 years. Find their present ages.

⇨ Here, Let the present ages of father and his son be x years and y years respectively.
Then, $x + y = 36$ or, $x = 36 - y$ ... ...(i)
And, $x + (x - y) + y + (x - y) = 84$ or, $3x - y = 84$ or, $3x = 84 + y$ ... ...(ii)
Substituting the value of x from eq^n (i) in eq^n (ii) we get,
$3(36 - y) = 84 + y$ or, $108 - 3y = 84 + y$
or, $108 - 84 = 3y + y$ or, $24 = 4y$ or, $y = 6$
Putting the value of y in eq^n (i), we get, $x = 36 - 6 = 30$
Thus, the present ages of father and his son are 30 years and 6 years respectively.

16. एउटै आधार BC र उही समानान्तर रेखाहरू AF र BC बिच रहेका दुईओटा समानान्तर चतुर्भुजहरू ABCD र EBCF का क्षेत्रफलहरू बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।
Prove that the two parallelograms ABCD and EBCF standing on the same base BC and between the same parallel lines AF and BC are equal in area.

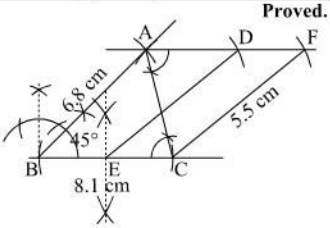


⇨ Here, Given: ABCD and EBCF are two parallelograms standing on same base BC and between same parallels BC and AF.
To prove: Parallelogram ABCD = Parallelogram EBCF (in area)
Proof:

	Statements		Reasons
1.	In Δ AEB and CDF	1.	
	i. $\measuredangle EAB = \measuredangle CDF$		i. Corresponding angles
	ii. $\measuredangle AEB = \measuredangle CFD$		ii. Corresponding angles
	iii. AB = CD		iii. Opposite sides of a parallelogram
	iv. $\Delta AEB \cong \Delta CDF$		iv. By A.A.S axiom
2.	Area. ($\Delta AEB = \Delta CDF$)	2.	From statement (1. iv)
3.	Area. (ΔAEB + trap. BCDE = ΔCDF + trap. BCDE)	3.	Adding trap. BCDE in statement (2)
4.	Area.($\square ABCD = \square EBCF$)	4.	From statement (3) whole part axiom

Proved.

17. एउटा ΔABC को रचना गर्नुहोस् जहाँ a = 8.1 cm, $\measuredangle ABC = 45°$ र c = 6.8 cm छन् । साथै, दिइएको त्रिभुजसँग बराबर क्षेत्रफल हुने गरी एउटा भुजा 5.5 cm भएको एउटा समानान्तर चतुर्भुज DECF को पनि रचना गर्नुहोस् ।
Construct a ΔABC in which a = 8.1 cm, $\measuredangle ABC = 45°$ and c = 6.8 cm. Also, construct a parallelogram DECF equal in area to the given triangle having one side 5.5 cm.



⇨ Here, a = 8.1 cm, $\measuredangle ABC = 45°$ and c = 6.8 cm
DECF is the required parallelogram equal in area to the ΔABC.

18. केन्द्रबिन्दु O भएको वृत्तको एउटै चापमा आधारित परिधिको कोण ABC केन्द्रियकोण AOC को आधा हुन्छ भनी प्रयोगद्वारा प्रमाणित गर्नुहोस् । (3 cm भन्दा धेरै अर्धव्यास भएका दुई वृत्तहरू आवश्यक छन् ।)
Verify experimentally that the angle ABC at the circumference is half of the angle AOC at the centre O of a circle standing on the same arc BC. (Two circles of radii more than 3 cm are necessary)

⇨ Here, (i) Two circles of radius 3.5 cm and 4 cm with centre O are drawn respectively.
(ii) Circumference angle $\measuredangle ABC$ and centre angle $\measuredangle AOC$ standing on same arc AC is drawn in each circle.
To verify: $\measuredangle ABC = \frac{1}{2} \measuredangle AOC$

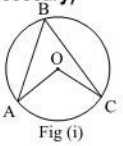


Fig (i)

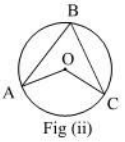


Fig (ii)

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Verification:

Fig.	∡ABC	∡AOC	Result
i.	55°	110°	$\angle ABC = \frac{1}{2}\angle AOC$
ii.	30°	60°	$\angle ABC = \frac{1}{2}\angle AOC$

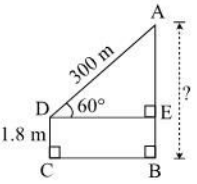
Conclusion: From the above table it is concluded that, ∡ABC of the circle is half of the ∡AOC i.e. inscribed angle is half of the central angle standing on same arc.

समूह 'घ' (Group D) **[4 × 5 = 20]**

19. 1.8 m उचाइ भएको एउटा केटाले चङ्गा उडाइ रहँदा चङ्गाको धागोले क्षितिजसँग 60° को कोण बनाउँछ। यदि धागोको लम्बाइ 300 m भए जमिनबाट सो चङ्गा कति उचाइमा छ, पत्ता लगाउनुहोस्।

The thread of a kite makes an angle of 60° with the horizon while a boy of height 1.8 m flying a kite. If the length of the thread is 300 m, find the height of the kite from the ground.

⇨ Here, Let CD be the height of the boy, AD be the length of the thread of kite, AB be the height of kite from the ground and ∡ADE be the angle made by the kite with the horizon.



In rt. ∡ed ΔAED,

$\sin 60° = \frac{AE}{AD}$ or, $\frac{\sqrt{3}}{2} = \frac{AB - BE}{300}$ or, $\frac{300\sqrt{3}}{2} = AB - 1.8$

or, $150\sqrt{3} = AB - 1.8$ or, $AB = 150\sqrt{3} + 1.8$ or, $AB = 261.60$ m

Thus, the height of the kite from the ground is 261.60 m

20. दिइएको तथ्याङ्कको मध्यिका पत्ता लगाउनुहोस्। (Find the median of given data.)

Class	15 – 30	30– 45	45–60	60–75	75–90
Frequency	10	8	15	7	10

⇨ Here, calculation of median:

Class	f	c.f.
15-30	10	10
30-45	8	18
45-60	15	33
60-75	7	40
75-90	10	50
	N = 50	

$\text{Median} = \left(\frac{N}{2}\right)^{th}\text{ item} = \left(\frac{50}{2}\right)^{th}\text{ item} = 25^{th}\text{ item.}$

In c.f. column, c.f. just greater than 25 is 33.

∴ Median class is 45-60

Now, $\text{Median} = \ell + \frac{\frac{N}{2} - \text{c.f.}}{f} \times i = 45 + \frac{25 - 18}{15} \times 15 = 45 + 7 = 52$

Thus, the median of the given data is 52.

21. हरिले राम र कृष्ण दुबैलाई 2 वर्षको निमित्त रु. 6600 जम्मा रकम ऋण दिन्छ। रामले 15% वार्षिक व्याजदरले साधारण व्याज र कृष्णले उही दरमा चक्रीय व्याज तिर्न मन्जुर हुन्छन्। यदि रामले रु. 112.50 व्याज कृष्ण भन्दा कम तिर्छ भने हरिले दुबैलाई कति कति रकम ऋणमा दिएको थियो होला ?

Hari lent altogether Rs 6,600 to Ram and Krishna for 2 years. Ram agreed to pay simple interest at the rate of 15% per annum and Krishna agreed to pay compound interest at the same rate. If Ram paid Rs 112.50 less than Krishna as the interest, find how much did he lend to each of them.

⇨ Here, let the sum lent to Ram and Krishna be x and (6600 – x) respectively.

Time taken by both (T) = 2 years

Case I: Ram	Case II : Hari
Rate (R) = 15% Principal (P) = x	Principal (P) = 6600 – x Rate (R) = 15%
Simple Interest (S.I.)	Compound Interest (C.I.)
Simple Interest (S.I.) $= \frac{PTR}{100}$ $= \frac{x \times 2 \times 15}{100} = \frac{3x}{10}$	Compound Interest (C.I.) $= P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$ $= (6600 - x)\left[\left(1 + \frac{15}{100}\right)^2 - 1\right] = (6600 - x)\left[\left(\frac{115}{100}\right)^2 - 1\right]$ $= (6600 - x)(1.3225 - 1) = 0.3225(6600 - x)$

Again, Given that, Ram paid Rs 112.50 more than Krishna

i.e. S.I. = C.I. + 112.50 or, $\frac{3x}{10} = 0.3225(6600 - x) + 112.50$

or, $3x = 3.225(6600 - x) + 1125$ or, $3x = 21285 - 3.225x + 1125$

or, $3x + 3.225x = 21285 + 1125$ or, $6.225x = 22410$

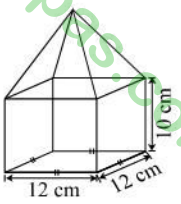
or, $x = \frac{22410}{6.225}$ or, $x = 3600$

Also, 6600 – x = 6600 – 3600 = 3000

Thus, the sum lent to Ram and Krishna are Rs 3600 and Rs 3000 respectively.

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22. सँगै दिइएको ठोस वस्तु एउटा वर्गाकार आधार भएको पिरामिड र वर्गाकार आधार भएको प्रिज्मको संयुक्त रूप हो। यदि सो ठोसको पूरा सतहको क्षेत्रफल 864 cm² भए उक्त ठोसको आयतन पत्ता लगाउनुहोस्।
The solid given alongside is the combination of a square-based pyramid and a square-based prism. If the total surface area of the solid is 864 cm², find the volume of the solid.



⇨ Here, Length of each side of square base (a) = 12 cm
Length of square-based prism = 12 cm
Height of the prism = 10 cm
Slant height of pyramid (ℓ) = ?

We have,
Total surface area of given solid = 864 cm²
i.e. $2a\ell + 2(12 \times 12 + 12 \times 10 + 12 \times 10) - 12 \times 12 = 864$
or, $2 \times 12 \times \ell + 2\,(144 + 120 + 120) - 144 = 864$
or, $24\ell + 2 \times 384 - 144 = 864$ or, $24\ell + 768 - 144 = 864$
or, $24\ell + 624 = 864$ or, $24\ell = 240$
or, $\ell = 10$ cm

Now, Height of the pyramid (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{10^2 - \left(\frac{12}{2}\right)^2} = \sqrt{100 - 36} = \sqrt{64} = 8$ cm

Again, Volume of given solid = Volume of pyramid + volume of the prism
$= \frac{1}{3}a^2h + 12 \times 12 \times 10 = \frac{1}{3} \times (12)^2 \times 8 + 1440$
$= \frac{1}{3} \times 1152 + 1440 = 384 + 1440 = 1824$ cm³

Thus,the volume of the solid is 1824 cm³.

23. यदि a + b + c = n भए प्रमाणित गर्नुहोस्। (If a + b + c = n, prove that):

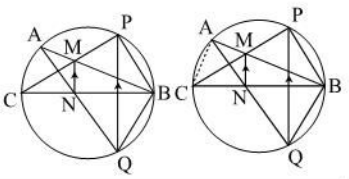
$$\frac{x^{2a}}{x^{2a} + x^{n-b} + x^{n-c}} + \frac{x^{2b}}{x^{2b} + x^{n-c} + x^{n-a}} + \frac{x^{2c}}{x^{2c} + x^{n-a} + x^{n-b}} = 1$$

⇨ Here, given, a + b + c = n or, a + b = n – c, a + c = n – b, b + c = n – a

$$\text{LHS} = \frac{x^{2a}}{x^{2a} + x^{n-b} + x^{n-c}} + \frac{x^{2b}}{x^{2b} + x^{n-c} + x^{n-a}} + \frac{x^{2c}}{x^{2c} + x^{n-a} + x^{n-b}}$$
$$= \frac{x^{2a}}{x^{2a} + x^{a+c} + x^{a+b}} + \frac{x^{2b}}{x^{2b} + x^{a+b} + x^{b+c}} + \frac{x^{2c}}{x^{2c} + x^{b+c} + x^{a+c}}$$
$$= \frac{x^{2a}}{x^{2a} + x^{a+c} + x^{a+b}} \times \frac{x^c}{x^c} + \frac{x^{2b}}{x^{2b} + x^{a+b} + x^{b+c}} \times \frac{x^{-b}}{x^{-b}} + \frac{x^{2c}}{x^{2c} + x^{b+c} + x^{a+c}} \times \frac{x^a}{x^a}$$
$$= \frac{x^{2a+c}}{x^{2a+c} + x^{a+2c} + x^n} + \frac{x^b}{x^b + x^a + x^c} + \frac{x^{c+a}}{x^{2c+a} + x^n + x^{2a+c}}$$
$$= \frac{x^{2a+c}}{x^{2a+c} + x^{a+2c} + x^n} + \frac{x^b}{x^b + x^a + x^c} \times \frac{x^{a+c}}{x^{a+c}} + \frac{x^{2c+a}}{x^{2a+c} + x^{a+2c} + x^n}$$
$$= \frac{x^{2a+c}}{x^{2a+c} + x^{a+2c} + x^n} + \frac{x^n}{x^n + x^{2a+c} + x^{2c+a}} + \frac{x^{2c+a}}{x^{2a+c} + x^{a+2c} + x^n} = \frac{(x^{2a+c} + x^n + x^{2c+a})}{(x^{2a+c} + x^n + x^{2c+a})}$$
$$= 1 = \text{RHS}$$

Thus, Proved.

24. दिइएको चित्रमा MN // PQ छ। जीवा PB = जीवा QB हुन्छ भनी प्रमाणित गर्नुहोस्।
In the adjoining MN // PQ. Prove that: chord PB = chord QB



⇨ Here, Given: MN // PQ
To prove: Chord PB = Chord QB
Construction: AC is joined.
Proof:

	Statements		Reasons
1.	∠CAQ = ∠CPQ	1.	Inscribed angles standing on same arc
2.	∠CMN = ∠CPQ	2.	Corresponding angles
3.	∠CAQ = ∠CMN	3.	From statements (1) and (2)
4.	A,M,N and C are concyclic	4.	Being equal angles standing on same arc.
5.	∠NCM = ∠NAM	5.	Inscribed angles standing on same segment
6.	PB = QB	6.	Corresponding chords of equal angles.

Proved.

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Unit I: समूह (Sets)

1 समूहको गणात्मकता (Cardinality of Sets)

[4 Marks]

Formulae and Key Points

1. यदि A र B मात्र U का उपसमूहहरू भए (If A and B are only subsets of U):

पदावली (Terminology)	समूह सङ्केत (Set Symbol)
• n(A मात्र) = n(only A)	• $n_0(A)$
• n(B मात्र) = n(only B)	• $n_0(B)$
• n(ठीक एउटा) अथवा n(एउटा मात्र) [n(exactly one) or n(only one)]	• $n_0(A) + n_0(B)$
• n(कम्तीमा एउटा) अथवा n(A वा B वा दुवै) n(at least one) or n(either A or B or both)	• $n(A \cup B)$
• n(दुवै) = n(both)	• $n(A \cap B)$

2. यदि A र B मात्र U का उपसमूहहरू भए (If A and B are only subsets of U):

(a) $n(\overline{A \cup B}) = n(U) - n(A \cup B)$

(b) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

(c) $n(A \cup B) = n_o(A) + n_o(B) + n(A \cap B)$

(d) $n_O(A) = n(A) - n(A \cap B)$; where $n_O(A) = n(A - B)$

(e) $n_O(B) = n(B) - n(A \cap B)$; where $n_O(B) = n(B - A)$

3. $n(\overline{A} \cap B) = n(B - A) = n_O(B)$

4. $n(A \cap \overline{B}) = n(A - B) = n_O(A)$

5. यदि U का उपसमूहहरू A, B र C भए (If A, B and C are only subsets of U) :

पदावली (Terminology)	समूह सङ्केत (Set Symbol)
n(A मात्र) = n(only A)	$n_o(A)$
n(ठीक एउटा) अथवा n(एउटा मात्र) [n(exactly one) or n(only one)]	$n_O(A) + n_O(B) + n_O(C)$
n(कम्तीमा एउटा) = n(at least one)	$n(A \cup B \cup C)$
n(ठीक दुईओटा) = n(exactly two)	$n_O(A \cap B) + n_O(B \cap C) + n_O(C \cap A)$

6. यदि U का उपसमूहहरू A, B र C भए (If A, B and C are only subsets of U.)

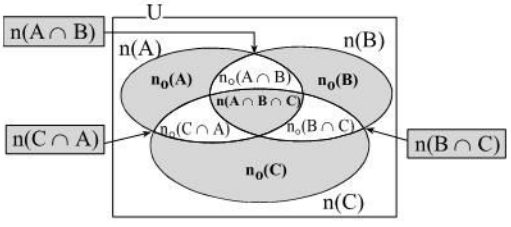
(a) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

(b) $n(A \cup B \cup C)$

$= [\, n_O(A) + n_O(B) + n_O(C) \,] + [\, n_O(A \cap B) + n_O(B \cap C) + n_O(C \cap A) \,] + n(A \cap B \cap C)$

= n(एउटा मात्र) + n(दुइओटा मात्र) + n(तीनैओटा)

= n(only one) + n(only two) + n(all three)



(c) $n(\overline{A \cup B \cup C}) = n(U) - n(A \cup B \cup C)$

(d) $n(A \cup B \cup C) = n(A \cup B) + n_O(C)$

(e) $n(A \cup B \cup C) = n(B \cup C) + n_O(A)$

(f) $n(A \cup B \cup C) = n(C \cup A) + n_O(B)$

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1.1 दुई ओटा समूहहरू सम्मिलित समस्याहरू
Problems Including Two Sets

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 11]

Q. 11. 150 जना मानिसहरुको समुहमा 120 जनालाई भलिबल खेल्न र 85 जनालाई फुटबल खेल्न मन पर्दो रहेछ । यदि 25 जनालाई कुनै खेल मन पर्दो रहेनछ भने :

In a group of 150 people, 120 like to play volleyball, 85 football and 25 like to play none of the games.

i) माथिको तथ्याङ्कलाई भेनचित्रमा देखाउनुहोस् । **(Show the above information in a Venn-diagram.)**

ii) कति जनालाई दुवै खेल मन पर्दो रहेछ ? **(How many people like to play both the games?)**

iii) कति जनालाई भलिबल मात्र मन पर्दो रहेछ ? **(How many people like to play volleyball only?)**

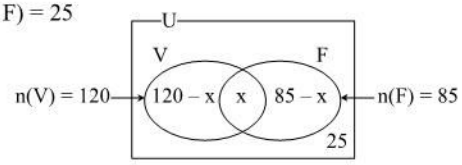
☞ Here, let V and F denote the set of people who like volleyball and football respectively.

So, $n(U) = 150$, $n(V) = 120$, $n(F) = 85$ and $n(\overline{V \cup F}) = 25$

Let $n(V \cap F)$ be x then,

Venn-diagram of above information,

From the Venn-diagram alongside,



$n(U) = n(V) + n_0(F) + n(\overline{V \cup F})$

or, $150 = 120 + 85 - x + 25$

or, $150 = 230 - x$ $\quad\therefore\quad x = 80$

Now, $n_0(V) = 120 - x = 120 - 80 = 40$

Thus, the no. of people who like both and volleyball only are 80 and 40 respectively.

BASIC EXERCISE 1.1

QUESTIONS FROM SEE /SLC PAPERS

Model 1

1. यदि $n(A) = 40$, $n(B) = 60$ र $n(A \cup B) = 80$ छ भने, **(If $n(A) = 40$, $n(B) = 60$ and $n(A \cup B) = 80$,)** **[2057 C2]**

(i) $n(A \cap B)$ को मान पत्ता लगाउनुहोस् । **(Find the value of $n(A \cap B)$.)**

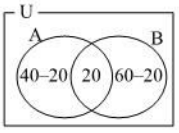
(ii) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Draw a Venn-diagram of the above information.)**

☞ (i) Here, $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

or, $80 = 40 + 60 - n(A \cap B)$

or, $80 = 100 - n(A \cap B)$

or, $n(A \cap B) = 100 - 80 = 20$



(ii) The Venn-diagram of the given information is shown in the adjoining figure:

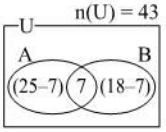
2. A र B सर्वव्यापक समूह 'U' का उपसमूहहरू हुन्, जसमा $n(U) = 43$, $n(A) = 25$, $n(B) = 18$ र $n(A \cap B) = 7$ छन् भने,

A and B are two subsets of a universal set 'U' in which $n(U) = 43$, $n(A) = 25$, $n(B) = 18$ and $n(A \cap B) = 7$,

(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Draw a Venn-diagram of the information.)**

(ii) $n(\overline{A \cup B})$ को मान पत्ता लगाउनुहोस् । **(Find the value of $n(\overline{A \cup B})$.)** **[2057C1]**

☞ (i) Here, the Venn-diagram of the given information is shown in the adjoining figure:



(ii) Here, $n(A \cup B) = n(A) + n(B) - n(A \cap B) = 25 + 18 - 7 = 36$

$\therefore\quad n(\overline{A \cup B}) = n(U) - n(A \cup B) = 43 - 36 = 7$

Thus, the value of $n(\overline{A \cup B})$ is 7.

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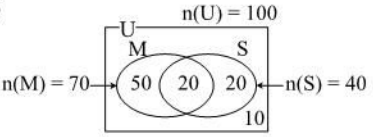
Model 2

3. एउटा वनभोजमा सम्मिलित 100 जना सहभागिमध्ये 70 जनाले दुध, 40 जनाले सुप तथा 20 जनाले दुवै पेय पदार्थ पिए ।
Out of 100 participants in a picnic, 70 drank milk, 40 drank soup and 20 drank both. **[2070 S]**

(i) माथिको जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Represent the above information in a Venn-diagram.)**

(ii) भेनचित्र प्रयोग गरी कुनै पनि पेय पदार्थ नपिउने सहभागिहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of participants who drank neither of the drinks by using the Venn-diagram.

☛ Here, let M and S denote the set of participants who like milk and soup respectively.
Then, n(U) = 100, n(M) = 70, n(S) = 40 and $n(M \cap S) = 20$
Now, the Venn-diagram of above data is shown alongside,



From the Venn-diagram $n(\overline{M \cup S}) = 10$
Thus, the required no. of participants is 10.

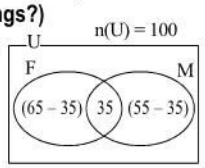
4. 100 जना मानिसहरूमा गरिएको एउटा सर्वेक्षणमा 65 जनाले लोकगीत, 55 जनाले आधुनिक गीत र 35 जनाले लोकगीत तथा आधुनिक गीत दुवै मन पराउने पाइयो भने,
In a survey of 100 people, it was found that 65 liked folk songs, 55 liked modern songs and 35 liked folk as well as modern songs: **[2061 E1]**

(i) उक्त तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Draw the Venn-diagram to illustrate the fact.)**

(ii) दुवैथरी गीत मन नपराउने कति थिए ? **(How many people did not like both songs?)**

☛ Here, let F and M denote the sets of people who like folk and modern song respectively. Then, n(U) = 100, n(F) = 65, n(M) = 55, $n(F \cap M) = 35$

(i) The above information is shown in the adjoining Venn-diagram.



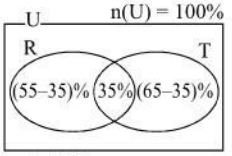
(ii) $n(\overline{F \cup M}) = 100 - (35 + 30 + 20) = 100 - 85 = 15$
Thus, people did not like both songs is 15.

5. एउटा समुदायमा गरिएको सर्वेक्षणमा 55% ले रेडियो सुन्न, 65% ले टेलिभिजन हेर्न र 35% ले रेडियो सुन्न र टेलिभिजन हेर्न मन पराउने व्यक्तिहरू भेटिए भने,
In the survey of a community, 55% of the people like to listen the radio, 65% like to watch the television and 35% like to listen the radio as well as to watch the television:

(i) उक्त जानकारीलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Show the above information in a Venn-diagram.)**

(ii) रेडियो सुन्न र टेलिभिजन हेर्न मन नपराउने प्रतिशत पत्ता लगाउनुहोस् ।
Find the percentage of the people who do not like to listen the radio as well as to watch the television. **[2058 A1]**

☛ Here, let R denote the set of people like to listen the radio and T denote the set of people like to watch the television.
Then, n(R) = 55%, n(T) = 65% and $n(R \cap T) = 35\%$
Venn-diagram of the above information is shown alongside.



Here, all the members of the community = n (U) = 100%
Then, $n(R \cup T) = n(R) + n(T) - n(R \cap T) = 55\% + 65\% - 35\% = 85\%$
People who do not like to listen the radio as well as to watch the television

$= n(\overline{R \cup T}) = n(U) - n(R \cup T) = 100\% - 85\% = 15\%$

Thus, people who do not like to listen the radio as well as to watch the television is 15%.

6. 350 जना विद्यार्थीहरू भएको एउटा विद्यालयमा सर्वेक्षण गर्दा 200 जनाले पोखरा मन पराए, 220 जनाले चितवन मन पराए र 120 जनाले दुवै ठाउँ मन पराएको पाइयो भने :
In a survey of 350 students of a school, 200 liked Pokhara, 220 liked Chitwan and 120 liked both places, then :

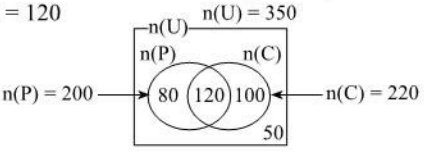
(i) माथिको तथ्यलाई भेनचित्रमा देखाउनुहोस् । **(Show the above information in a Venn-diagram.)**

(ii) दुवै ठाउँ मन नपराउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who liked neither of two places. **[SLC 2066 E]**

☞ Here, let, P and C denote the set of students who liked Pokhara and Chitwan respectively.
Then, n(U) = 350, n(P) = 200, n(C) = 220 & $n(P \cap C) = 120$

(i) Now, in a Venn-diagram.

(ii) From the Venn-diagram above:



$n(\overline{P \cup C}) = 50$
Thus, 50 students who liked neither of two places.

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Model 3

7. एउटा समूहमा गरिएको सर्वेक्षणमा 50% रेडियो सुन्न र 60% ले टेलिभिजन हेर्न मन पराउने पाइयो । यदि 30% व्यक्तिहरू रेडियो सुन्न र टेलिभिजन हेर्न मन नपराउने भेटिए भने:

In a survey of a group, 50% liked to listen radio and 60% liked to watch television. If 30% of them neither listen radio nor watch television then:

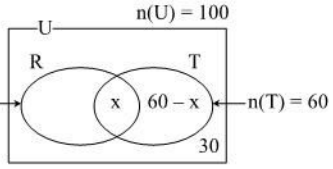
(i) उक्त जानकारीलाई भेनचित्रमा देखाउनुहोस् । **(Represent the above information in a Venn-diagram.)**

(ii) रेडियो सुन्न र टेलिभिजन हेर्न दुवै मन पराउनेको प्रतिशत पत्ता लगाउनुहोस् ।
Find the percentange of people who like to listen radio as well as watch television. [2072 MW]

☞ Here, let R and T denote the set of group who like to listen radio and watch TV respectively.

Let, $n(U) = 100$ then, $n(R) = 50$, $n(T) = 60$, $n(\overline{R \cup T}) = 30$

Then Venn-diagram of above information is shown alongside



From the Venn-diagram, $n(R) + n_0(T) + n(\overline{R \cup T}) = n(U)$

or, $50 + 60 - x + 30 = 100$ or, $140 - x = 100$

$\therefore$ $x = 40$ Thus, the required percentage is 40%.

8. एउटा विद्यालयमा रहेका 560 विद्यार्थीहरूको सर्वेक्षणमा निम्नलिखित तथ्याङ्क पाइयो, जसमा 320 जनाले फुटबल खेल मन पराउँदा रहेछन् । 300 जनाले भलिबल खेल मन पराउँदा रहेछन् र कमसेकम एउटा खेल मन पराउने 500 जना रहेछन् भने,

A survey conducted among 560 students of a school, the following information are found, in which 320 like football game. 300 like volleyball game and 500 like at least one of the game: [2068 E]

(i) दुवै खेल मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like both games.

(ii) दुवै खेल मन नपराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who don't like both games.

(iii) उक्त तथ्याङ्कलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Show the above information in a Venn-diagram.)**

☞ Here, let F and V denote the set of students who like football game and volleyball game respectively. So, $n(U) = 560$, $n(F) = 320$, $n(V) = 300$ and $n(F \cup V) = 500$

We know that, $n(F \cup V) = n(F) + n(V) - n(F \cap V)$

or, $500 = 320 + 300 - n(F \cap V)$

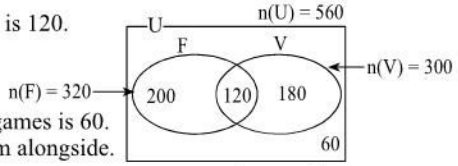
or, $n(F \cap V) = 120$

Thus, the number of students who like both games is 120.

Again, $n(\overline{F \cup V}) = n(U) - n(F \cup V)$
$= 560 - 500 = 60$

Thus, the number of students who don't like both games is 60.

The above information is shown in a Venn-diagram alongside.



9. 115000 विद्यार्थीहरूमध्ये 20% एस.एल.सी. परीक्षामा असफल भए । असफल भएकामध्ये 40% विज्ञानमा मात्र र 35% गणितमा मात्र असफल भएछन् तर 5% भने अरू नै विषयमा असफल भएछन् भने,

Out of 115000 students 20% failed in SLC, 40% of the failures failed in Science only and 35% in mathematics only. But 5% of them failed in other subject. Then, [2068 B]

(i) कति जना विज्ञान र गणित दुवैमा असफल भएछन् ? पत्ता लगाउनुहोस् ।
How many failed in both Science and Mathematics? Find them.

(ii) माथिको जानकारी भेनचित्रमा देखाउनुहोस् । **(Show the above information in a Venn-diagram.)**

☞ Here, let S and M denote the set of students who failed in science and maths respectively.

Then, $n(U) = 20\%$ of $115000 = \frac{20}{100} \times 115000$ $\therefore$ $n(U) = 23000$

$n_0(S) = 40\%$ of $23000 = 9200$, $n_0(M) = 35\%$ of $23000 = 8050$ & $n(S \cup \overline{M}) = 5\%$ of $23000 = 1150$

(i) We have, $n(S \cup M) = n(U) - n(\overline{S \cup M})$

or, $n(S \cup M) = 23000 - 1150 = 21850$

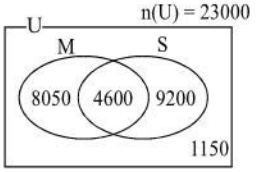
or, $n_0(S) + n_0(M) + n(S \cap M) = 21850$

or, $9200 + 8050 + n(S \cap M) = 21850$

$\therefore$ $n(S \cap M) = 4600$

Thus, 4600 failed in both the subjects.

(ii) Now, the information is shown in a Venn-diagram alongside.



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Model 4

10. एउटा विद्यालयका 900 जना विद्यार्थीहरूमाझ गरिएको एक सर्वेक्षणमा स्याउ मन पराउने 600 जना, सुन्तला मन पराउने 500 जना र कुनै पनि मन नपराउने 125 जना पाइयो ।

In a survey among the 900 students of a school, it was found that 600 students liked apple, 500 liked orange and 125 did not like any fruits. **[2070 B]**

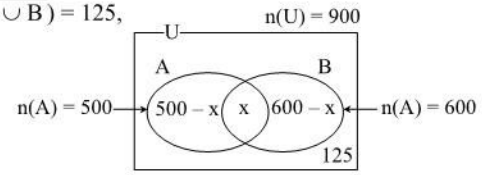
(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Draw a Venn-diagram to illustrate the above information.)**

(ii) दुवै फलफुल मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like both fruits.

(iii) स्याउ मात्र मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like apple only.

☛ Here, let A and B represent the set of students who like apple and oranges respectively.

Then, $n(U) = 900$, $n(A) = 600$, $n(B) = 500$, $n(\overline{A \cup B}) = 125$,
Let $n(A \cap B)$ be x.
The Venn-diagram of given information:
From the Venn-diagram,



$n(A) + n_0(B) + n(\overline{A \cup B}) = 900$
or, $500 + 600 - x + 125 = 900$
or, $1225 - x = 900$ or, $325 = x$ ∴ $n(A \cap B) = 325$
Now, $n_0(A) = 500 - x = 500 - 325 = 175$
Thus, 325 students like both fruits and 175 students like apple only.

11. एउटा विद्यालयमा रहेका 450 जना विद्यार्थीहरूको सर्वेक्षणमा निम्नलिखित तथ्यहरू पाइयो, जसमा 250 जनाले सुन्तला मनपराउँदा रहेछन्, 280 जनाले स्याउ मन पराउँदा रहेछन् र 40 जनाले दुवै फल मन पराउँदैनन् भने:

A survey conducted among 450 students of a school, the following information are found where 250 like orange, 280 like apple and 40 dislike both the fruits. **[2066 A]**

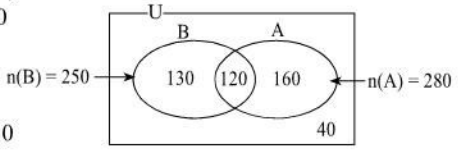
(i) दुवै फल मनपराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like both the fruits.

(ii) सुन्तला मात्र मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like orange only.

☛ Here, Let, B and A denote the set of students who like orange and apple respectively.

Then, $n(U) = 450$, $n(B) = 250$, $n(A) = 280$ and $n(\overline{B \cup A}) = 40$

(i) We know that, $n(U) = n(B \cup A) + n(\overline{B \cup A})$
or, $450 = n(B) + n(A) - n(B \cap A) + 40$
or, $450 = 250 + 280 - n(B \cap A) + 40$
∴ $n(B \cap A) = 120$
Thus, 120 like both the fruits.



(ii) $n_0(B) = n(B) - n(B \cap A) = 250 - 120 = 130$
Thus, 130 like orange only.

(iii) Showing the above information in a Venn-diagram.

12. 100 जना विद्यार्थीहरूको समूहमा 68 जनाले फुटबल खेल, 60 जनाले भलिबल खेल मन पराउँछन् र 2 जनाले कुनै पनि खेल मन पराउँदैनन् भने भेनचित्र बनाई पत्ता लगाउनुहोस् :

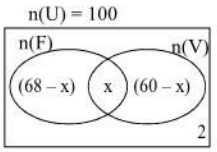
In a group of 100 students, 68 like football game, 60 like volleyball game and 2 dislike both the games. By drawing a Venn-diagram, find: **[2060S, 2065 A]**

(i) दुवै खेल मन पराउने कति जना रहेछन् ? **(How many students like both the games?)**

(ii) फुटबल मात्र मन पराउने कति जना रहेछन् ? **(How many students like only football?)**

☛ Here, let, F and V denote set of students who like football and volleyball respectively.

So, $n(F) = 68$, $n(V) = 60$, $n(U) = 100$, $n(\overline{F \cup V}) = 2$,
$n(F \cap V) = x$ (say), $n_0(F) = ?$
Representing this information in a Venn-diagram
From the Venn-diagram, $68 - x + x + 60 - x + 2 = 100$



or, $130 - x = 100$
or, $x = 30$ ∴ $n(F \cap V) = 30$
Now, $n_0(F) = 68 - x = 68 - 30 = 38$ Thus, 30 like both games & 38 like football only.

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13. खेल मन पराउने 200 जना विद्यार्थीको समूहमा 120 जनाले क्रिकेट खेल र 105 जनाले फुटबल खेल मन पराउँछन् भने भेनचित्र बनाइ पत्ता लगाउनुहोस्:

In a group of 200 students who like game, 120 like cricket game and 105 like football game. By drawing Venn-diagram, find: [2067 B]

(i) दुवै खेल मन पराउने कति जना रहेछन् ? **(How many students like both the games ?)**

(ii) क्रिकेट मात्र मन पराउने कति जना रहेछन् ? **(How many students like only cricket ?)**

☞ Here, let, C and F denote set of students who like to play cricket game and football game respectively.

So, $n(C \cup F) = 200$, $n(C) = 120$, $n(F) = 105$

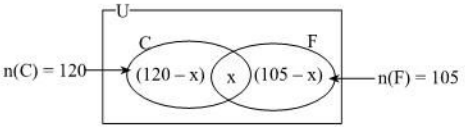
(i) $n(U) = 200$

Let $n(C \cap F) = x$ then, From the Venn-diagram,

$120 - x + x + 105 - x = n(C \cup F)$

or, $225 - x = 200$

or, $25 = x$



(ii) $n_0(C) = n(C) - n(C \cap F) = 120 - 25 = 95$

Thus, 25 students like both the games and 95 students like only cricket.

14. एउटा विद्यालयका 900 जना विद्यार्थीहरूमाभ गरिएको एक सर्वेक्षणमा चिया मन पराउने 600 जना, कफी मन पराउने 500 जना र दुवै पेय पदार्थ मन नपराउने 125 जना पाइयो ।

In a survey, among the 900 students in a school it was found that 600 students liked tea, 500 liked coffee and 125 did not liked both drink;

(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Represent the above fact in a Venn-diagram.)**

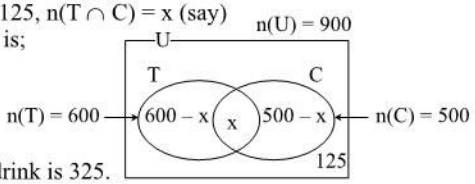
(ii) दुवै पेय पदार्थ मन पराउने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस् ।
Find the number of students who liked both drink.

(iii) चिया मात्र मन नपराउने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस् ।
Find the number of students who didn't like tea only. [2067 E]

☞ Here, let, T and C denote the set of students who like tea and coffee respectively.

$n(U) = 900$, $n(T) = 600$, $n(C) = 500$, $n(\overline{T \cup C}) = 125$, $n(T \cap C) = x$ (say)

(i) The Venn-diagram of above information is;



From the Venn-diagram,

$600 - x + x + 500 - x + 125 = n(\cup)$

or, $1225 - x = 900$

or, $325 = x$

(ii) The number of students who liked both drink is 325.

(iii) $n_0(T) = n(T) - n(T \cap C) = 600 - 325 = 275$

Students who didn't like tea only $\overline{n_0(T)} = n(U) - n_0(T) = 900 - 275 = 625$

Thus, the students who liked both drink is 325 and who didn't like tea only is 625.

15. एउटा कक्षामा रहेका 120 विद्यार्थीहरू मध्ये 95 जनाले लेखा विषय मन पराउँछन्, 80 जनाले जीव विज्ञान मन पराउँछन् । यदि उक्त समूहमा कुनै पनि विषय मन नपराउने विद्यार्थी छैनन् भने,

In a class of 120 students, 95 like Account subject, 80 like Biology. If there are none who don't like both subjects then : [2066 C]

(i) लेखा विषय मात्र मन पराउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like Account only.

(ii) जीव विज्ञान मात्र मन पराउने विद्यार्थीको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like Biology only.

(iii) उक्त तथ्यलाई भेनचित्रमा देखाउनुहोस् । **(Show the above information in a Venn-diagram.)**

☞ Here, let A and B denote the set of students who like Account and Biology respectively.

Then, $n(U) = 120$, $n(A) = 95$, $n(B) = 80$, $n(\overline{A \cup B}) = 0$

So, $n(A \cup B) = n(U)$

or, $n(A) + n(B) - n(A \cap B) = 120$

or, $95 + 80 - n(A \cap B) = 120$

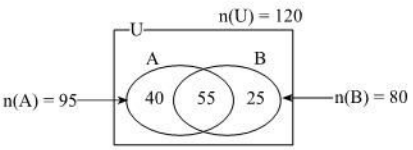
or, $175 - 120 = n(A \cap B)$

$\therefore$ $n(A \cap B) = 55$

(i) $n_0(A) = n(A) - n(A \cap B) = 95 - 55 = 40$

(ii) $n_0(B) = n(B) - n(A \cap B) = 80 - 55 = 25$

(iii) Now, showing the above information in a Venn-diagram.



Thus, 40 students like account only and 25 students like biology only.

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Model 5

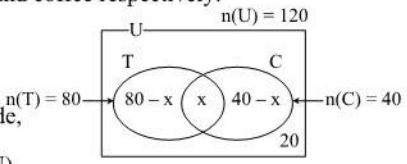
16. **120 जना मानिसहरूमध्ये 80 जनाले चिया र 40 जनाले कफि पिउँछन् । 20 जनाले चिया र कफिमध्ये कुनै पनि पिउँदैनन् भने भेनचित्रको मद्दतले तलका प्रश्नहरूको उत्तर दिनुहोस् :**
Among 120 people, 80 drink tea and 40 drink coffee. 20 of them drink neither tea nor coffee, answer the following questions with the help of a Venn-diagram:
(i) कति जनाले चिया मात्र पिउँछन् ? **(How many of them drink tea only?)**
(ii) एक थोक मात्र पिउने कति जना छन् ? **(How many of them drink only one out of these two?)** **[2072 FW]**

☞ Here, let T and C denote the set of people who like tea and coffee respectively.

Then, $n(U) = 120$, $n(T) = 80$, $n(C) = 40$, $n(\overline{T \cup C}) = 20$

$n(T \cap C) = x$ (say)

Now, the Venn-diagram of given data is shown alongside,



From the Venn-diagram, $n(T) + n_0(C) + n(\overline{T \cup C}) = n(U)$

or, $80 + 40 - x + 20 = 120$

or, $140 - x = 120$

$\therefore \quad x = 20$

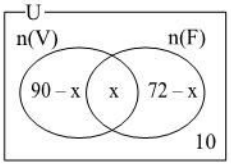
(i) $n_0(T) = 80 - x = 80 - 20 = 60$

(ii) $n_0(T) + n_0(C) = 80 - x + 40 - x = 120 - 2x = 120 - 2 \times 20 = 80$

Thus, the required no. of people are 60 and 80 respectively.

17. **120 जना मानिसका समूहमा, 90 जनाले भलिबल, 72 जनाले फूटबल र 10 जनाले कुनै पनि खेल खेल्दैनन् ।**
(क) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (ख) कति मानिसहरूले एक मात्र खेल खेल्छन् ?
In group of 120 people, 90 play volleyball, 72 play football and 10 play neither of games.
(i) Construct Venn-diagram to represent the given information.
(ii) How many people play only one game ? **[2065 E]**

☞ Here, let V and F denote the set of people who play volleyball and football respectively. By the question is shown alongside



$n(U) = 120$, $n(V) = 90$, $n(F) = 72$, $n(\overline{V \cup F}) = 10$ and $n(F \cap V) = x$ (say)

(i) Venn-diagram for the informationis shown alongside

(ii) From the Venn-diagram, $90 - x + x + 72 - x + 10 = 120$

or, $172 - x = 120$

$\therefore \quad x = 52$

Now, people who play only one game $= n_0(V) + n_0(F) = 90 - x + 72 - x$
$= 162 - 2x = 162 - 2 \times 52 = 58$

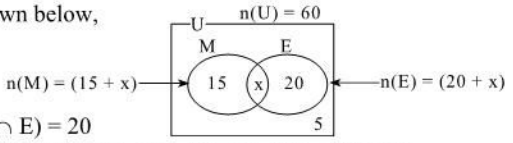
Thus, 58 people play only one game.

18. **60 जना विद्यार्थीहरू भएको एउटा कक्षामा 15 जनाले गणित मात्र मन पराए, 20 जनाले अङ्ग्रेजी मात्र मन पराए र 5 जनाले कुनै पनि विषय मन पराएनन् भने:**
In a class of 60 students, 15 students liked math only, 20 liked English only and 5 did not liked any subject, then:
(i) दुवै विषय मन पराउने विद्यार्थीको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like both the subjects.
(ii) कम्तिमा 1 विषय मन पराउने विद्यार्थीको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who like at least one subject. **[2067 D]**

☞ Here, let M and E denote the set of students who like Math and English respectively.

So, $n(U) = 60$, $n_0(M) = 15$, $n_0(E) = 20$, $n(\overline{M \cup S}) = 5$, $n(M \cap E) = x$ (say)

Now, the Venn-diagram of above data is shown below,



From the Venn-diagram,

$15 + x + 20 + 5 = n(U)$

or, $40 + x = 60$

or, $x = 20 \qquad \therefore \quad n(M \cap E) = 20$

The number of students who like at least one subject $= 15 + x + 20 = 15 + 20 + 20 = 55$

Thus, the number of students who like both the subjects is 20 and no. of student who like at least one subject is 55.

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Model 6

19. **200 जना विद्यार्थीको समूहमा 30 जनाले गीत गाउन र नाच्न दुवै नजान्ने, 60 जनाले गाउन मात्र जान्ने र 50 जनाले नाच्न मात्र जान्ने पाइयो भने:**

In a survey of 200 students 30 liked neither to sing a song nor to dance, 60 liked to sing a song only and 50 liked to dance only then: **[2065 S]**

(i) उक्त तथ्यलाई भेनचित्रमा देखाउनुहोस् । **(Illustrate these information in a Venn-diagram.)**

(ii) गीत गाउन जान्ने जम्मा विद्यार्थी कति होलान् ? **(Find the total number of student who can sing a song.)**

☞ Here, let, S and D denote the set of students who like to sing and to dance respectively.

By the question, $n(U) = 200$, $n(\overline{S \cup D}) = 30$, $n_0(S) = 60$, $n_0(D) = 50$ and $n(S \cap D) = x$(say)

(i) Representing above information in a Venn-diagram,

(ii) From the Venn-diagram,

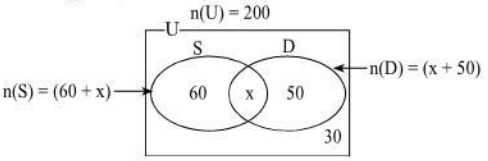
$60 + x + 50 + 30 = n(U)$

or, $140 + x = 200$

$\therefore$ $x = 60$

Now, $n(S) = 60 + x = 60 + 60 = 120$

Thus, 120 students can sing a song.



20. **चिया र कफि पिउनेहरूको सर्वेक्षणमा एउटा मात्रै पेय पदार्थ पिउनेको सङ्ख्या 300 जना, कुनै पनि पेय पदार्थ नपिउनेको सङ्ख्या 50 जना र सर्वेक्षणमा भाग लिनेको जम्मा सङ्ख्या 400 जना थियो भने दुवै पेय पदार्थ पिउनेको सङ्ख्या निकाल्नुहोस् ।**

In a survey of 400 people, 300 people drink only one drink out of tea and coffee. 50 people drink none of them. Find the number of people who drink both of drinks. **[2071 A]**

☞ Here, let T and C represent the set of the people who drink tea and coffee respectively.

$[n_0(T) + n_0(C)] = 300$, $n(\overline{T \cup C}) = 50$, $n(U) = 400$, $n(T \cap C) = ?$

We know that, $n(T \cup C) = n(U) - n(\overline{T \cup C}) = 400 - 50 = 350$

Now, $n(T \cap C) + n_0(T) + n_0(C) = n(T \cup C)$

or, $n(T \cap C) + 300 = 350$

$\therefore$ $n(T \cap C) = 50$

Thus, the number of people who drink both of drinks is 50.

Model 7

21. **एउटा कलेजमा 65 जना विद्यार्थी गणित, 50 जना विद्यार्थी विज्ञान र 35 जना विद्यार्थी दुवै विषयमा अध्ययनरत छन् । यदि दुवै अध्ययन नगर्ने कोहि पनि नभए कति जना विद्यार्थीहरू,**

In a college, 65 students are studying mathematics, 50 students are studying science and 35 students are studying both subjects. If none of the students study other subjects then how many students, **[2062 B2]**

(a) कलेजमा जम्मा अध्ययनरत छन् ? **(are studying in the college ?)**

(b) गणितमा मात्र अध्ययनरत छन् ? **(are studying mathematics only ?)**

(c) विज्ञानमा मात्र अध्ययनरत छन् ? **(are studying science only ?)**

(d) प्राप्त नतिजालाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Represent all results in a Venn-diagram.)**

☛ Here, let M and S denote the sets of students studying in Mathematics and Science respectively.

Then, $n(M) = 65$, $n(S) = 50$ and $n(M \cap S) = 35$

(a) $n(M \cup S) = n(M) + n(S) - n(M \cap S) = 65 + 50 - 35 = 80$

Thus, the number of students studying in the college = 80

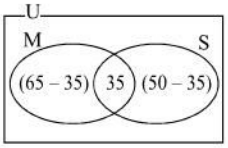
(b) Number of students studying in Mathematics only

$= n(M) - n(M \cap S) = 65 - 35 = 30$

(c) Number of students studying Science only

$= n(S) - n(M \cap S) = 50 - 35 = 15$

(d) Now, the above information is shown in the adjoining Venn-diagram.



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22. एउटा समूहमा गरिएको सर्वेक्षणमा 40% मानिसहरूले साहित्य मन पराएको, 65% ले सङ्गीत मन पराएको र 10% ले ती दुवैमध्ये कुनै पनि मन नपराएको पाइयो भने :

In a survey conducted among some people of a group, it was found that 40% of them liked literature, 65% of them liked music and 10% of them liked none : **[SLC 2066 D]**

(i) उक्त तथ्यलाई भेनचित्रमा देखाउनुहोस् । **(Illustrate these information in a Venn-diagram.)**

(ii) यदि त्यो समूहबाट 30 जनाले साहित्य र सङ्गीत दुवै मन पराउने पाइयो भने उक्त सर्वेक्षणमा कति जनाले भाग लिएका थिए, पत्ता लगाउनुहोस् ।

If there were 30 people who liked both of them, find the number of people participated in the survey.

☞ Here, let L and M denote the set of people who like literature and music respectively.

Then, $n(L) = 40\%$, $n(M) = 65\%$, $n(\overline{L \cup M}) = 10\%$, Let $n(L \cap M) = x$

(i) Now, the above information in a Venn-diagram is shown along side.

(ii) We know that, $n(U) = 100\%$

or, $40 - x + x + 65 - x + 10 = 100$

or, $115 - 100 = x$

$\therefore \quad x = 15$

$\therefore \quad n(L \cap M) = 15\%$

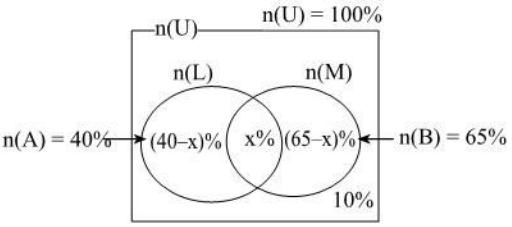
Let, there are y people,

Then, 15% of y = 30

or, $\frac{15}{100} \times y \ 30$

$\therefore \quad y = 30 \times \frac{100}{15} = 200$

Thus, the people participated in the survey is 200.



Model 8

23. एउटा परीक्षामा सम्मिलित केही विद्यार्थीहरूमध्ये 80% अङ्ग्रेजीमा उत्तीर्ण भए, 75% विज्ञानमा उत्तीर्ण भए र 5% दुवै विषयमा अनुत्तीर्ण भए । यदि 300 जना विद्यार्थीहरू दुवै विषयमा उत्तीर्ण भएका भए कति जना विद्यार्थीहरू परीक्षामा सम्मिलित थिए ? भेनचित्र प्रयोग गरेर पत्ता लगाउनुहोस् ।

Out of some students appeared in an examination, 80% passed in English, 75% passed in Science and 5% failed in both subjects. If 300 of them were passed in both subjects, how many students were appeared in the examination ? Find it by using a Venn-diagram. **[2072 C]**

☞ Here, let, E and S denote the set of students who passed in English and Science respectively.

Let $n(U) = x$ then, $n(E) = 80\%$ of x, $n(S) = 75\%$ of x, $n(\overline{E \cup S}) = 5\%$ of x and $n(E \cap S) = 300$

Now, the Venn-diagram of above information is shown alongside,

Let $n(E \cap S) = y$

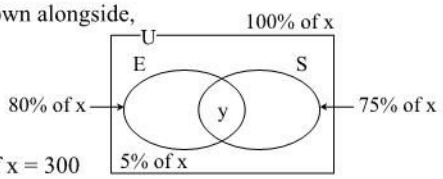
From the Venn-diagram,

80% of x – y + 75% of x + 5% of x = 100% of x

$\therefore \quad y = 60\%$ of x Now, 60% of x = 300

or, $0.6 \times x = 300$ $\therefore \quad x = 500$

Thus, the required no. of students is 500.



24. एउटा समूहमा गरिएको सर्वेक्षणमा 70% विद्यार्थीहरूले बि.बि.ए. मा अध्ययन गरिएको पाइयो, 65% ले बि.बि.एस., 430 विद्यार्थीहरूले दुवै कोर्स गरिएको पाइयो र 8% ले कुनै पनि कोर्स नगरिएको पाइयो भने:

In a survey of the students, it was found that 70% of the students studied BBA courses, 65% of the students studied BBS courses, 430 students studied both the course and 8% did not study both courses then: **[SLC 2065 D]**

(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Show the above information in a Venn-diagram.)**

(ii) सर्वेक्षणमा भाग लिएका जम्मा विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।

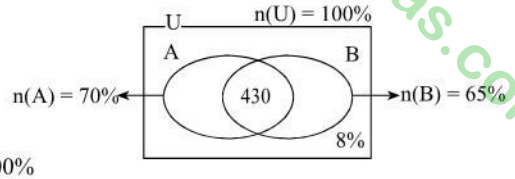
Find the total number of students who take part in the survey.

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☞ Here, let, A and B denote set of students who studied BBA course and BBS course respectively.
$n(A) = 70\%$, $n(B) = 65\%$

$n(A \cap B) = 430$ and $n(\overline{A \cup B}) = 8\%$



(i) Representation in a Venn-diagram
From the Venn-diagram,
$70\% - 430 + 65\% + 8\% = 100\%$
or, $143\% - 430 = 100\%$
or, $43\% = 430$
$\therefore$ $1\% = 10$

(ii) Total number of students = $100\% = 100 \times 10 = 1000$
Thus, the total number of students who take part in the survey is 1000.

25. केही विद्यार्थीहरूबीच लिइएको एउटा सर्वेक्षणमा वाणिज्य (Commerce) र विज्ञान (Science) विषय पढ्ने विद्यार्थीहरू क्रमशः 60% र 40% पाइयो । यदि 40 जना दुवै विषय पढ्ने र 10% कुनै पनि विषय नपढ्ने रहेछन् भने भेनचित्रको प्रयोग गरी :

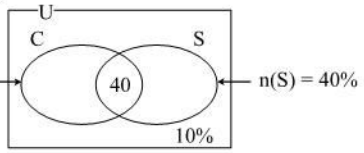
In a survey of some students, it was found that 60% of the students studied Commerce and 40% studied Science. If 40 students studied both the subjects and 10% didn't study any of the subjects, by drawing a Venn-diagram,

(i) जम्मा विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् । **(Find the total number of students.)**

(ii) विज्ञान विषयमात्र पढ्नेको सङ्ख्या पत्ता लगाउनुहोस् ।
Find the number of students who studied science only. **[2067 A]**

☞ Here, let C and S denote the set of students who study Commerce and science respectively.

$\therefore$ $n(C) = 60\%$, $n(S) = 40\%$, $n(C \cap S) = 40$, $n(\overline{C \cup S}) = 10\%$



(i) $n(C \cup S) = n(U) - n(\overline{C \cup S}) = 100\% - 10\%$
or, $n(C) + n(S) - n(C \cap S) = 90\%$
or, $60\% + 40\% - n(C \cap S) = 90\%$
$\therefore$ $10\% = n(C \cap S)$
By the question $n(C \cap S) = 40$
So, 10% of total students $= 40$
1% of total students $= \frac{40}{10}$
or, 100% of total students $= \frac{40}{10} \times 100$
Thus, the total number of students = 400

(ii) $n_0(S) = n(S) - n(C \cap S) = 40\% - 10\% = 30\% = 30\%$ of $400 = \frac{30}{100} \times 400 = 120$
Thus, 120 students studied science only.

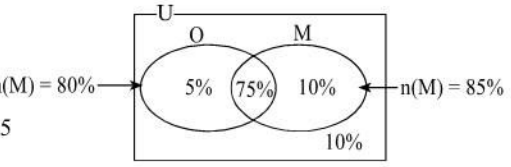
26. एउटा सर्वेक्षणमा 80% मानिसहरूले सुन्तला, 85% ले आँप मन पराउने र 75% ले दुवै मन पराउने पाइयो । तर 45 जनाले दुवै फलफूल मन नपराउने पाइयो भने भेनचित्र बनाई सर्वेक्षण गरिएको मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
In a survey, it was found that 80% people liked oranges, 85% liked mangoes and 75% liked both. But 45 people liked none of them. By drawing a Venn-diagram, find the number of people who were in the survey. **[2068 D]**

☞ Here, let, O and M denote the set of people who like oranges and mangoes respectively.

Then, $n(O) = 80\%$, $n(M) = 85\%$, $n(O \cap M) = 75\%$, $n(\overline{O \cup M}) = 45$ and $n(U) = 100\%$

From the Venn-diagram, $n(\overline{O \cup M}) = 10\%$

But by the question, $n(\overline{O \cup M}) = 45$
Let, people who were in the survey be x.



Then, 10% of x = 45 or, $\frac{10}{100} \times x = 45$

or, $x = 45 \times \frac{100}{10}$ $\therefore$ $x = 450$

Thus, the number of people who were in the survey is 450.

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Model 9

27. 80 जना मानिसहरूमा गरिएको सर्वेक्षणमा 60 जनाले सुन्तला मात्र मन पराएको र 10 जनाले सुन्तला र स्याउ दुवै मन पराएको पाइयो । सुन्तला मन पराउने मानिसको सङ्ख्या स्याउ मन पराउने मानिसको सङ्ख्याभन्दा 5 गुणा छ । भेनचित्र प्रयोग गरी स्याउ मात्र मन पराउने र दुवैमध्ये कुनै पनि फलफूल मन नपराउने मानिसको सङ्ख्या पत्ता लगाउनुहोस् ।

In a survey of 80 people, it was found that 60 liked oranges only and 10 liked both oranges and apples. The number of people who liked oranges is five times the number of people who liked apples. By using a Venn-diagram, find the number of people who liked apples only and who didn't like any of these fruits. [2072 W]

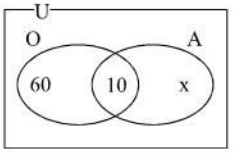
☛ Here, let, O and A denote the set of people who like orange and apple respectively.

From the question, $n_0(O) = 60$, $n(O \cap A) = 10$, $n_0(A) = x$ (say)

We have, $n(O) = 5n(A)$ or, $60 + 10 = 5(10 + x)$

or, $70 = 50 + 5x$ or, $20 = 5x$

$\therefore$ $x = 4$ $\therefore$ $n_0(A) = 4$



Now, $n(\overline{O \cup A}) = 80 - (60 + 10 + x)$

$\therefore$ $n(\overline{O \cup A}) = 80 - 74 = 6$

Thus, 4 people liked apples only and 6 didn't like any of them.

28. 70 मानिसहरू माझ गरिएको सर्वेक्षणमा 50 जनाले फुटबल मात्र मन पराए, 10 जनाले फुटबल र भलिबल दुवै मन पराए । फुटबल मन पराउने मानिसहरूको सङ्ख्या भलिबल मन पराउने मानिसहरूको सङ्ख्याको चार गुणा छ । भेनचित्र प्रयोग गरी भलिबल मात्र मन पराउने र दुवैमध्ये कुनै पनि खेल मन नपराउने मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

In a survey among 70 people, it was found that 50 liked football only and 10 liked both football and volleyball. The number of people who liked football is four times the number of people who liked volleyball. By using a Venn-diagram, find the number of people who liked volleyball only and who didn't like any of the games. [2071 E]

☞ Here, let, F and V denote sets of people who liked football and volleyball respectively.

Let x and y be the no. of people who liked volleyball only and who liked none respectively.

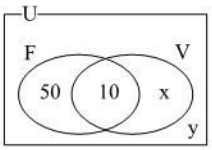
$\therefore$ $n(U) = 70$, $n_0(F) = 50$, $n(F \cap V) = 10$, $n_0(V) = x$ & $n(\overline{F \cup V}) = y$

We have, given, $n(F) = 4n(V)$

or, $50 + 10 = 4(10 + x)$

or, $60 = 40 + 4x$

or, $20 = 4x$ $\therefore$ $x = 5$



Again, $50 + 10 + x + y = n(U)$

or, $60 + x + y = 70$

or, $60 + 5 + y = 70$ $\therefore$ $y = 5$

Thus, 5 people liked volleyball only and 5 like none of them.

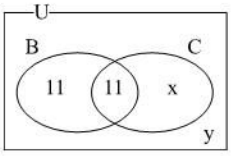
29. 65 जना खेलाडीहरूमध्ये 11 जना बास्केटबल मात्र खेल्छन्, 11 जना बास्केटबल र क्रिकेट दुवै खेल्दछन् । क्रिकेट खेल्ने खेलाडीको सङ्ख्या बास्केटबल खेल्ने खेलाडीको सङ्ख्या भन्दा दोब्बर छ । भेनचित्र प्रयोग गरी क्रिकेट मात्र खेल्ने र दुवै खेल नखेल्ने खेलाडीको सङ्ख्या पत्ता लगाउनुहोस् ।

Out of 65 players, 11 play basketball only, 11 play both basketball and cricket. The number of players who play cricket is twice the number of players who play basketball. By using a Venn-diagram find the number of players who play cricket only and who don't play both the games. [2071 D]

☞ Here, let, B and C denote the sets of players who play Basketball and Cricket respectively.

$\therefore$ $n(U) = 65$, $n_0(B) = 11$, $n(B \cap C) = 11$, $n(C) = 2$, $n(B)$

Let, x and y be the no. of players who play cricket only and who don't play both respectively.



Now, $2n(B) = n(C)$

or, $2(11 + 11) = 11 + x$ or, $44 = 11 + x$ $\therefore$ $x = 33$

Again, $11 + 11 + x + y = n(U)$

or, $22 + 33 + y = 65$ or, $55 + y = 65$ $\therefore$ $y = 10$

Thus, the no. of players who play cricket only and don't play both games are 33 and 10 respectively.

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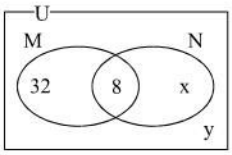
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30. 120 जना विद्यार्थीहरू मध्ये 32 जना गणितमा मात्र, 8 जना गणित र नेपाली दुवैमा उत्तीर्ण भएछन् । नेपालीमा उत्तीर्ण हुने विद्यार्थीको सङ्ख्या, गणितमा उत्तीर्ण हुने विद्यार्थीको सङ्ख्या भन्दा दोब्बर छ । भेनचित्र प्रयोग गरी नेपालीमा मात्र उत्तीर्ण हुने र दुवै विषयमा अनुत्तीर्ण हुने विद्यार्थीको सङ्ख्या पत्ता लगाउनुहोस् ।

Out of 120 students, 32 passed in Mathematics only, 8 passed in both Mathematics and Nepali. The number of students who passed in Nepali is twice the number of students who passed in Mathematics. Using a Venn-diagram find the number of students who passed in Nepali only and who didn't pass in both subjects. [2071 C]

☞ Here, let, M and N denote the sets of students who passed in Maths and Nepali respectively.
So, $n_0(M) = 32$, $n(M \cap N) = 8$, $n_0(N) = x$ (say)
Let, x and y be the no. of students who passed in Nepali only and who didn't pass in both subjects.
From the question, $2n(M) = n(N)$
or, $2(32 + 8) = 8 + x$ or, $80 = 8 + x$
$\therefore$ $x = 72$
Again, from the Venn-diagram,
$32 + 8 + x + y = 120$ or, $40 + 72 + y = 120$
or, $112 + y = 120$ or, $y = 120 - 112$
$\therefore$ $y = 8$

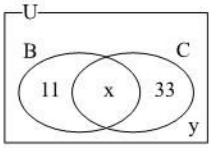


Thus, 72 students passed in Nepali only and 8 didn't pass in both subjects.

31. 65 जना खेलाडीहरूमध्ये 11 जना बास्केटबल मात्र खेल्छन् र 33 जना क्रिकेट मात्र खेल्छन् । यदि क्रिकेट खेल्ने खेलाडीको सङ्ख्या बास्केटबल खेल्ने खेलाडीको सङ्ख्याभन्दा दोब्बर छ भने भेनचित्र प्रयोग गरी दुवै खेल खेल्ने र कुनै पनि खेल नखेल्ने खेलाडीको सङ्ख्या पत्ता लगाउनुहोस् ।

Out of 65 players, 11 play basketball only and 33 play cricket only. If the number of players who play cricket is twice the number of players who play basketball. By using a Venn-diagram find the number of player who play both games and who do not play any of the games. [2071 B]

☞ Here, let, B and C denote the set of players who play basketball and cricket respectively.
Let, x and y be the no. of players who play both games and who do not play any games respectively.
Now, from the question,
$n(U) = 65$, $n_0(B) = 11$, $n_0(C) = 33$, $n(C) = 2[n(B)]$
Since, $n(C) = 2[n(B)]$
So, $(x + 33) = 2(11 + x)$ or, $x + 33 = 22 + 2x$
or, $x = 11$
Again, from the Venn-diagram,
$11 + x + 33 + y = n(U) = 65$ or, $11 + 11 + 33 + y = 65$
or, $y = 65 - 55$ $\therefore$ $y = 10$



Thus, no. of the players who play both games and who do not play any games are 11 and 10 respectively.

Model 10

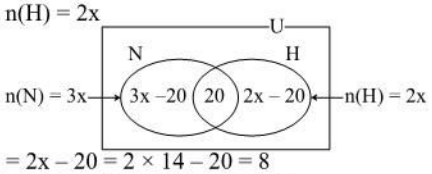
32. एउटा कक्षामा भएका 50 जना विद्यार्थीहरूलाई नेपाली, इतिहास वा दुवै विषय मन पर्दछन् । तीमध्ये 20 जनाले दुवै विषय मन पराउँदछन् । यदि नेपाली मन पर्ने विद्यार्थी सङ्ख्या र इतिहास मन पर्ने विद्यार्थी सङ्ख्याको अनुपात 3 : 2 छ भने भेनचित्र प्रयोग गरेर पत्ता लगाउनुहोस् :

50 students in a classroom like Nepali, History or both subjects. Out of them, 20 like both subjects. If the ratio of the numbers of students who like Nepali and History is 3 : 2, using Venn-diagram, find:

(i) कतिजना विद्यार्थीहरूलाई नेपाली मन पर्छ ? **(How many students like Nepali?)**

(ii) कतिजनालाई इतिहास मात्र मन पर्छ ? **(How many like History only?)** [2070 E]

☞ Here, let, N and H denote the set of students who like Nepali and History respectively.
Then, $n(N \cup H) = 50$, $n(N \cap H) = 20$, $n(N) = 3x$ and $n(H) = 2x$
Now, the Venn-diagram
$3x + 2x - 20 = 50$
or, $5x = 70$
$\therefore$ $x = 14$
We have, $n(N) = 3x = 3 \times 14 = 42$ $n_0(H) = 2x - 20 = 2 \times 14 - 20 = 8$



Thus, the no. of students who like Nepali and History only are 42 and 8 respectively.

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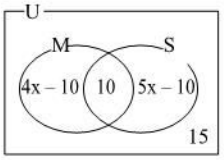
33. 95 जना विद्यार्थी भएको एउटा समूहमा गणित र विज्ञान मन पराउने विद्यार्थीको अनुपात 4 : 5 छन् । यदि 10 जना विद्यार्थीले दुवै विषय मन पराउँछन् र 15 जनाले दुवैमध्ये कुनैपनि विषय मन पराउदैनन् भने भेनचित्रको सहायताबाट (i) गणित विषय मात्र मनपर्ने र (ii) विज्ञान विषय मात्र मनपर्ने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस् ।

In a group of 95 students, the ratio of students who like mathematics and science is 4 : 5. If 10 of them like both the subjects and 15 of them like non of the subjects then by drawing a Venn-diagram, find how many of them,

(i) like only mathematics (ii) like only science. **[SLC 2065 C]**

☞ Here, let, M and S denote the sets of students who like mathematics and science respectively.

From the Venn-diagram,



$4x - 10 + 10 + 5x - 10 + 15 = 95$

or, $9x - 10 = 80$

or, $9x = 90$

$\therefore \quad x = 10$

(i) $n_0(M) = 4x - 10 = 4 \times 10 - 10 = 30$

(ii) $n_0(S) = 5x - 10 = 5 \times 10 - 10 = 40$

Thus, 30 students like Math only and 40 students like Science only

34. 100 जना विद्यार्थी भएको एउटा समूहमा भूगोल र समाजशास्त्र मन पराउने विद्यार्थीको अनुपात 3 : 5 छ । यदि 30 जना विद्यार्थीले दुवै विषय मन पराउँछन् र 10 जनाले दुवैमध्ये कुनै पनि विषय मन पराउँदैनन् भने भेनचित्रको सहायताबाट (i) भूगोलमात्र मन पराउने, (ii) समाजशास्त्रमात्र मन पराउने विद्यार्थीहरूको सङ्ख्या निकाल्नुहोस् ।

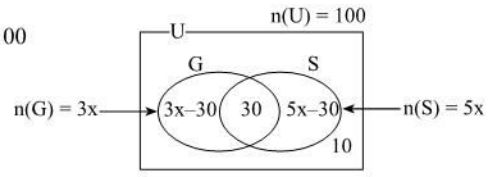
In a group of 100 students, the ratio of students who like Geography and Sociology is 3 : 5. If 30 of them like both the subjects and 10 of them like none of the subjects then by drawing a Venn-diagram find how many students of them (i) like Geography only (ii) like Sociology only ? **[2068 A]**

☞ Here, let, G and S denote the set of students who like Geography and Sociology respectively.

$n(U) = 100$, $n(G) = 3x$ and $n(S) = 5x$ (say)

$n(G \cap S) = 30$, $n(\overline{G \cup S}) = 10$,

From the Venn-diagram, $3x + 5x - 30 + 10 = 100$



or, $8x - 20 = 100$

or, $8x = 120$

$\therefore \quad x = 15$

Now, $n_0(G) = 3x - 30 = 3 \times 15 - 30 = 15$

(ii) $n_0(S) = 5x - 30 = 5 \times 15 - 30 = 45$

Thus, the number of students who like geography only is 15 and sociology only is 45.

Model 11

35. 50 जना विद्यार्थीहरू भएको एउटा कक्षामा 10 जना विद्यार्थीले गणित विषय मन पराउँछन् तर विज्ञान विषय मन पराउँदैनन् र 15 जना विद्यार्थीले विज्ञान विषय मन पराउँछन् तर गणित विषय मन पराउँदैनन् । यदि 10 जना विद्यार्थीले दुई विषयमध्ये कुनै पनि विषय मन पराउँदैनन् भने

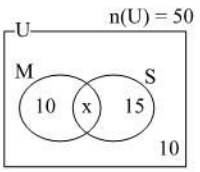
Out of 50 students in a class, 10 students like Maths but not Science and 15 students like Science but not Maths. If 10 students like neither of both subjects. **[SEE 2073 PU]**

(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् ।
Show the above information in a Venn-diagram.

(ii) गणित विषय मन पराउने विद्यार्थी र विज्ञान विषय मन पराउने विद्यार्थीहरूको अनुपात पत्ता लगाउनुहोस् ।
Find the ratio of the students who like Maths to the students who like Science.

☞ Here, let, M and S represent the sets of students who like Maths and Science respectively and x be the number of students who like both.

From the Venn-diagram, $n(U) = n_0(M) + n_0(S) + n(M \cap S) + n(\overline{M \cup S})$



or, $50 = 10 + 15 + x + 10$

or, $50 = 35 + x$

$\therefore \quad x = 15$

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So, $n(M) = 10 + 15 = 25$ and
$n(S) = 15 + x = 15 + 15 = 30$

Now, the required ratio $= \frac{n(M)}{n(S)} = \frac{25}{30} = \frac{5}{6} = 5 : 6$

Thus, the ratio of the students who like maths to the students who like science is 5 : 6.

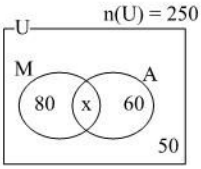
36. **250 जना विद्यार्थीको समूहमा आँप अथवा स्याउ कुन मन पराउँछन् भनी सोधिएको प्रश्नमा 80 जनाले आँप मन पराउँछन् तर स्याउ मन पराउँदैनन् र 60 जनाले स्याउ मन पराउँछन् तर आँप मन पराउँदैनन् । यदि 50 जना विद्यार्थीले दुवै थरीका फलफुल मन पराउँदैनन् भने**

250 students in a group were asked whether they like mango or apple. 80 students like mango but not apple and 60 students like apple but not mango. If 50 students do not like both of the fruits, then

(i) **माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Represent the above information in Venn-diagram.)**

(ii) **आँप मन पराउने विद्यार्थी र स्याउ मन पराउने विद्यार्थीको अनुपात निकाल्नुहोस् ।**
Find the ratio of the students who like mango to the students who like apple. **[SEE 2073 MA]**

☞ Here, let, M and A represent sets of students who like mangoes and apples respectively and x be the number of students who like both and U be the universal set.



From the Venn-diagram; $n(U) = n_0(M) + n_0(A) + n(M \cap A) + n(\overline{M \cup A})$
or, $250 = 80 + 60 + x + 50$
or, $250 = 190 + x$
$\therefore$ $x = 60$
So, $n(M) = 80 + x = 80 + 60 = 140$ and
$n(A) = x + 60 = 60 + 60 = 120$

Now, the required ratio $= \frac{n(M)}{n(A)} = \frac{140}{120} = \frac{7}{6} = 7 : 6$

Thus, the ratio of students who like mango to the students who like apple is 7 : 6.

37. **200 जना मानिसको समूहमा गरिएको सर्वेक्षणमा 60 जनाले चियामात्र मन पराउँछन् र 20 जनाले कफीमात्र मन पराउँछन् । यदि 60 जना मानिसले दुवै पेय पदार्थ मन पराउँदैनन् भने**

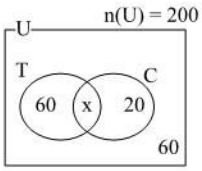
In a survey of a group of 200 people, 60 people like tea only and 20 people like coffee only. If 60 people do not like both the drinks then, **[SEE 2073 PA]**

(i) **माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् ।**
Represent above information in a Venn-diagram.

(ii) **चिया मन पराउने मानिस र कफी मन पराउने मानिसको अनुपात पत्ता लगाउनुहोस् ।**
Find the ratio of the people who like tea to the people who like coffee.

☞ Here, let, U, T and C represent the sets of Universal, number who like tea and coffee respectively.

From the Venn-diagram,



$n(U) = n_0(T) + n_0(C) + n(T \cap C) + n(\overline{T \cup C})$
or, $200 = 60 + 20 + x + 60$
or, $200 = 140 + x$
$\therefore$ $x = 60$
So, $n(T) = 60 + x = 60 + 60 = 120$ and
$\therefore$ $n(C) = x + 20 = 60 + 20 = 80$

Now, the required ratio $= \frac{n(T)}{n(C)} = \frac{120}{80} = \frac{3}{2} = 3 : 2$

Thus, the ratio of the people who like tea to the people who like coffee is 3 : 2.

38. **85 जना विद्यार्थीको समूहमा 25 जनाले नेपाली उपन्यास मात्र पढ्न मन पराउँछन् र 15 जनाले अङ्ग्रेजी उपन्यास मात्र पढ्न मन पराउँछन् । यदि 35 जनाले दुवै भाषाको उपन्यासमध्ये कुनै पनि उपन्यास पढ्न मन पराउँदैनन् भने**

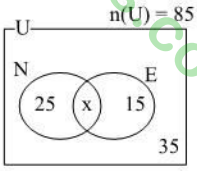
In a group of 85 students, 25 students like to read Nepali Novel only and 15 students like to read English Novel only. If 35 student do not like to read any of the two novels, then **[SEE 2073 MP]**

(i) **माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Represent the above information in a Venn-diagram.)**

(ii) **नेपाली उपन्यास पढ्ने विद्यार्थीहरू र अङ्ग्रेजी उपन्यास पढ्ने विद्यार्थीहरूको अनुपात निकाल्नुहोस् ।**
Find the ratio of the students who read Nepali Novel to the students who read English Novel.

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☞ Here, let, U, N and E represent universal set, set of students who read Nepali Novel and set of students who read English Novel respectively and x be the number of students who read both.
From the Venn-diagram,



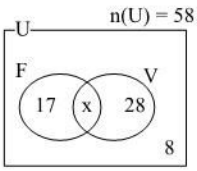
$n(U) = n_0(N) + n(N \cap E) + n_0(E) + n(\overline{N \cup E})$
or, $85 = 25 + x + 15 + 35$
or, $85 = 75 + x$
$\therefore$ $x = 10$
So, $n(N) = x + 25 = 10 + 25 = 35$ and
$n(E) = x + 15 = 10 + 15 = 25$
Now, the required ratio $= \frac{n(N)}{n(E)} = \frac{35}{25} = \frac{7}{5} = 7 : 5.$

Thus, ratio of students who read Nepali Novel to the students who read English Novel is 7 : 5.

39. 58 जना मानिसको समूहमा 17 जनाले फुटबल मात्र खेल्छन् र 28 जनाले भलिबल मात्र खेल्छन् । यदि 8 जनाले दुवै खेलमध्ये कुनै पनि खेल खेल्दैनन् भने
In a group of 58 people, 17 play football only and 28 play volleyball only. If 8 play neither of the two games, then [SEE 2073 SP]

(i) माथिको तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Represent above information in a Venn-diagram.)
(ii) फुटबल खेल्ने मानिसहरू र भलिबल खेल्ने मानिसहरूको अनुपात निकाल्नुहोस् ।
Find the ratio of the people who play football to the people who play volleyball.

☞ Here, let F and V represent the set of people who like football and volleyball respectively and U be the universal set and x be the number of people who like both.
From the Venn-diagram,



$n(U) = n_0(F) + n(F \cap V) + n_0(V) + n(\overline{F \cup V})$
or, $58 = 17 + x + 28 + 8$
or, $58 = 53 + x$
$\therefore$ $x = 5$
So, $n(F) = 17 + x = 17 + 5 = 22$ and
$n(V) = 28 + x = 28 + 5 = 33$
Now, the required ratio $= \frac{n(F)}{n(V)} = \frac{22}{33} = \frac{2}{3} = 2 : 3$

Thus, the ratio of people who play football to the people who play volleyball is 2 : 3.

Model 12

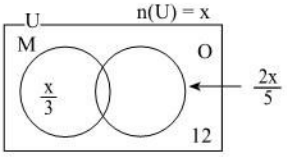
40. एउटा सर्वेक्षणमा एकतिहाई बालकहरूले आँप मात्र मन पराउँछन् र 22 जनाले आँप पटक्कै मन पराउँदैनन् । त्यस्तै $\frac{2}{5}$ बालकले सुन्तला मन पराएको पाइयो । तर 12 जनाले चाहिँ यी दुवै फलहरू मन नपराएको पाइयो ।

In a survey, one third children like only mango and 22 don't like mango at all. Also $\frac{2}{5}$ children like orange but 12 like none of them.

(i) माथिको आँकडालाई भेनचित्रमा देखाउनुहोस् । (Show the above data in a Venn-diagram.)
(ii) कति जनाले दुवैखाले फलहरू मन पराउँदा रहेछन् ? पत्ता लगाउनुहोस् ।
How many children like both types of fruit? Find it.

☛ Here, let, M and O denote the set of students who like mango and orange respectively.
Let, x be the total number of students.

Then, $n(U) = x$, $n_0(M) = \frac{x}{3}$, $n(\overline{M}) = 22$, $n(O) = \frac{2x}{5}$, $n(\overline{M \cup O}) = 12$



Now, the information in a Venn-diagram
From the Venn-diagram,

$n_0(M) + n(O) + n(\overline{M \cup O}) = n(U)$
or, $\frac{x}{3} + \frac{2x}{5} + 12 = x$
or, $12 = \frac{4x}{15}$
or, $12 = x - \frac{x}{3} - \frac{2x}{5}$
$\therefore$ $x = 45 \Rightarrow n(U) = 45$

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Now, $n(U) = n(\overline{M}) + n(M)$

or, $45 = 22 + n(M)$ $\quad\therefore\quad n(M) = 23$

or, $n_0(M) + n(M \cap O) = 23$ $\quad$ or, $\frac{x}{3} + n(M \cap O) = 23$

or, $\frac{45}{3} + n(M \cap O) = 23$ $\quad\therefore\quad n(M \cap O) = 8$

Thus, 8 children like both types of the fruit.

41. एउटा सर्वेक्षणमा एकतिहाइ युवाहरूले आइफोन मात्र मन पराउँछन् र 80 जनाले आइफोन पटक्कै मन पराउँदैनन् । त्यस्तै $\frac{2}{5}$ युवाले एन्ड्रोइडफोन मन पराएको पाइयो तर, 40 जनाले चाहिँ यी दुवै फोनहरू मन नपराएको पाइयो ।

In a survey, one third youth like only i-phone and 80 don't like i-phone at all. Also $\frac{2}{5}$ youth like android phone but 40 like none of them. **[Proposed Model]**

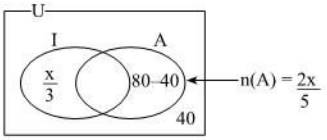
(i) माथिको आँकडालाई भेनचित्रमा देखाउनुहोस् । **(Show the above data in a Venn-diagram.)**

(ii) कति जनाले दुवैखाले फोनहरू मन पराउँदा रहेछन् ? **(How many youth like both types of phones?)**

☞ Here, let, I and A denote the set of youth who like i-phone and android phone respectively.

Let, $n(U) = x$ then, $n_0(I) = \frac{x}{3}$, $n(A) = \frac{2x}{5}$, $n(\overline{I}) = 80$ and $n(\overline{I \cup A}) = 40$

Now, Venn-diagram of given information is shown alongside,
From the Venn-diagram,



$n_0(I) + n(A) + n(\overline{I \cup A}) = n(U)$

or, $\frac{x}{3} + \frac{2x}{5} + 40 = x$ $\quad$ or, $\frac{5x + 6x}{15} + 40 = x$

or, $40 = x - \frac{11x}{15}$ $\quad$ or, $40 = \frac{4x}{15}$ $\quad$ or, $x = 150$ $\quad\therefore\quad n(U) = 150$

Now, $n(I \cap A) = n(A) - n_0(A) = \frac{2x}{5} - 40 = \frac{2 \times 150}{5} - 40 = 60 - 40 = 20$

Thus, 20 youth like the both type of phones.

QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 1.1]

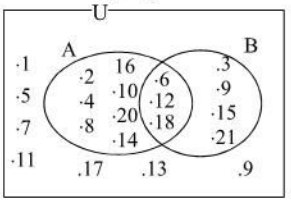
1A. दिइएको भेनचित्रबाट तल दिइएका समूहहरू तथा समूहहरूको गणनात्मक सङ्ख्या पत्ता लगाउनुहोस्:

From the given Venn-diagram find the given sets and cardinality of the sets:

(i) $n(A)$ **(ii)** $n(B)$ **(iii)** $n(A \cap B)$ **(iv)** $n_0(A)$

(v) $n_0(B)$ **(vi)** $n(\overline{A})$ **(vii)** $n(\overline{A \cap B})$ **(viii)** $n(\overline{A} \cap \overline{B})$

(ix) $n(\overline{A \cap B})$ **(x)** $n(U)$



☞ (i) $A = \{2, 4, 8, 16, 10, 20, 14, 6, 12, 18\}$ $\quad\therefore\quad n(A) = 10$

(ii) $B = \{3, 6, 9, 12, 15, 18, 21\}$ $\quad\therefore\quad n(B) = 7$

(iii) $A \cap B = \{6, 12, 18\}$ $\quad\therefore\quad n(A \cap B) = 3$

(iv) Only $A = \{2, 4, 8, 10, 14, 16, 20\}$ $\quad\therefore\quad n_0(A) = 7$

(v) Only $B = \{3, 9, 15, 21\}$ $\quad\therefore\quad n_0(B) = 4$

(vi) $\overline{A} = \{1, 5, 11, 7, 13, 17, 19, 3, 9, 15, 21\}$ $\quad\therefore\quad n(\overline{A}) = 11$

(vii) $\overline{A \cap B} = \{1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 19\}$ $\quad\therefore\quad n(\overline{A \cap B}) = 16$

(viii) $\overline{A} \cap \overline{B} = (\overline{A \cup B}) = \{1, 5, 11, 7, 13, 17, 19\}$ $\quad\therefore\quad n(\overline{A} \cap \overline{B}) = 7$

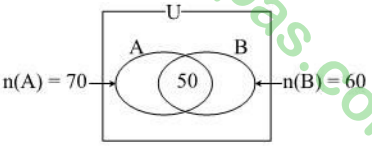
(ix) $(\overline{A \cup B}) = \{1, 5, 11, 7, 13, 17, 19\}$ $\quad\therefore\quad n(\overline{A \cup B}) = 7$

(x) $U = \{1, 2, 3, \ldots\ldots, 21\}$ $\quad\therefore\quad n(U) = 21$

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2A. यदि $n(A) = 70$, $n(B) = 60$ र $n(A \cap B) = 50$ भए $n(A \cup B)$ र $n_0(A)$ पत्ता लगाएर भिन्ना भिन्नै भेनचित्रमा प्रस्तुत गर्नुहोस् ।

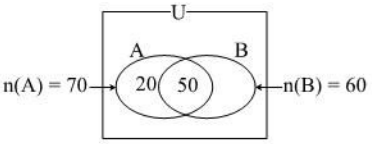
If $n(A) = 70$, $n(B) = 60$ and $n(A \cap B) = 50$ then find $n(A \cup B)$ & $n_0(A)$, represent in separate Venn-diagrams.



☞ Here, $n(A) = 70$, $n(B) = 60$ and $n(A \cap B) = 50$

(i) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
$= 70 + 60 - 50$
$= 130 - 50 = 80$

(ii) $n_0(A) = n(A) - n(A \cap B) = 70 - 50 = 20$



Now, the Venn-diagrams:

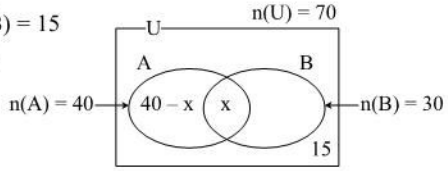
Thus, $n(A \cup B) = 80$ and $n_0(A) = 20$.

2B. समूहहरू A र B सर्वव्यापक समूहहरू U का उपसमूहहरू हुन्, जसमा $n(U) = 70$, $n(A) = 40$, $n(B) = 30$ र $n(\overline{A \cup B}) = 15$ छ भने भेनचित्र बनाएर $n(A \cup B)$ र $n(A \cap B)$ पत्ता लगाउनुहोस् ।

A and B are the subsets of universal set U in which $n(U) = 70$, $n(A) = 40$, $n(B) = 30$ and $n(\overline{A \cup B}) = 15$ then find $n(A \cup B)$ and $n(A \cap B)$ and represent in a Venn-diagram.

☞ Here, $n(U) = 70$, $n(A) = 40$, $n(B) = 30$ and $n(\overline{A \cup B}) = 15$

The Venn-diagram of above information is shown:



Let, $n(A \cap B) = x$ then,

$n(U) = n_0(A) + n(B) + n(\overline{A \cup B})$

or, $70 = 40 - x + 30 + 15$

or, $70 = 85 - x$

$\therefore$ $x = 15$ i.e. $n(A \cap B) = 15$

Now, $n(A \cup B) = 40 - x + 30 = 40 - 15 + 30 = 55$

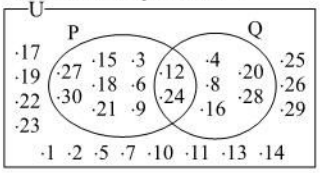
Thus, $n(A \cup B) = 55$ and $n(A \cap B) = 15$

2C. यदि समूह P = {3 का 30 सम्मका अपवर्त्यहरू}, Q = {4 का 30 सम्मका अपवर्त्यहरू} र U = {1 देखि 30 सम्मका पूर्णाङ्कहरू} का समूह भएमा P र Q को सम्बन्धलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । समूह P मा मात्र पर्ने सदस्यहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

If set P = {multiples of 3 upto 30}, Q = {multiples of 4 upto 30} and U = {whole numbers from 1 to 30} show the relation of P and Q in a Venn-diagram. Find the number of elements only in set P ?

☞ Here, P = {3, 6, 9, **12**, 15, 18, 21, **24**, 27, 30}
Q = {4, 8, **12**, 16, 20, **24**, 28}
U = {1, 2, 3, ……., 30}

The Venn-diagram of above data is shown alongside.



From the Venn-diagram: $n_0(P) = 8$

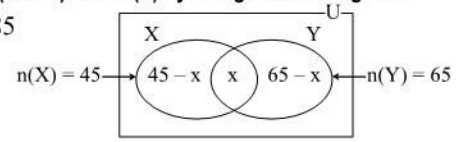
Thus, the no. of elements only in P is 8.

2D. यदि $n(X) = 45$, $n(Y) = 65$ र $n(X \cup Y) = 85$ छ भने $n(X \cap Y)$ र $n_0(Y)$ भेनचित्रका माध्यमबाट पत्ता लगाउनुहोस् ।

If $n(X) = 45$, $n(Y) = 65$ and $n(X \cup Y) = 85$ then find $n(X \cap Y)$ and $n_0(Y)$ by using a Venn-diagram.

☞ Here, $n(X) = 45$, $n(Y) = 65$ and $n(X \cup Y) = 85$

The Venn-diagram of given information:



Let, $n(X \cap Y) = x$

We have, $n(X \cup Y) = 85$

or, $n_0(X) + n(Y) = 85$

or, $110 - x = 85$

i.e. $n(X \cap Y) = 25$

Thus, $n(X \cap Y) = 25$ and $n_0(Y) = 40$

or, $45 - x + 65 = 85$

$\therefore$ $x = 25$

Again, $n_0(Y) = 65 - x = 65 - 25 = 40$

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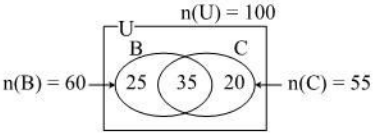
3A. कृषकहरूको एउटा समूहमा गरिएको सर्वेक्षणमा 60% ले भैंसी पालन, 55% ले गाई पालन र 35% ले भैंसी र गाई दुवै पाल्दा रहेछन् । यसलाई भेनभित्रमा प्रस्तुत गरी भैंसी र गाई कुनै पनि नपाल्ने किसानहरूको प्रतिशत पत्ता लगाउनुहोस् ।

In a survey of group of farmer, 60% do buffalo farming, 55% do cow farming and 35% do both the buffalo and cow farming. Show it in a Venn-diagram and find the percentage of farmers who do not do any of buffalo and cow farming.

☞ Here, let B and C denote the set of farmers who do buffalo and cow farming respectively.

Then, let $n(U) = 100$, then $n(B) = 60$, $n(C) = 55$, $n(B \cap C) = 35$ and $n(\overline{B \cup C}) = ?$

Now, the Venn-diagram,



From the Venn-diagram, $n(U) = n(B) = n_0(C) + n(\overline{B \cup C})$

or, $100 = 60 + 20 + n(\overline{B \cup C})$

$\therefore \quad n(\overline{B \cup C}) = 20$

Thus, the required percentage of farmers is 20.

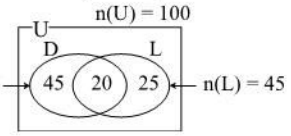
3B. शान्ति उच्च मा.वि.का 200 जना विद्यार्थीहरूमा गरिएको एक सर्वेक्षणमा 65% ले दसैँ मन पराए र 45% ले ल्होसार मन पराए तर 20% ले दसैँ र ल्होसार दुवै मन पराए । उपर्युक्त तथ्यलाई भेनचित्रमा प्रस्तुत गरी दसैँ र ल्होसार बाहेकमा चाड मन पराउने विद्यार्थीहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

In a survey of 200 students of Shanti Higher Secondary school, 65% liked Dashain and 45% liked Losar festival but 20% like Dashain and Losar both. Show the above information in a Venn-diagram and find the number of students who like the festivals other than Dashain and Losar.

☞ Here, let, D and L denote the set of students who like Dashain and Losar respectively.

$n(D) = 65$, $n(L) = 45$ and $n(D \cap L) = 20$

Now, the Venn-diagram of this data is shown alongside,



From the Venn-diagram, $n(U) = n(D) + n_0(L) + n(\overline{D \cup L})$

or, $100 = 65 + 25 + n(\overline{D \cup L})$

or, $100 = 90 + n(\overline{D \cup L}) \qquad \therefore \quad n(\overline{D \cup L}) = 10$

Now, $n(\overline{D \cup L}) = 10$ of $200 = \frac{10}{100} \times 200 = 20$

Thus, the required no. of students is 20.

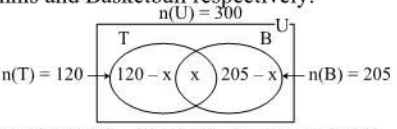
3C. 300 जना विद्यार्थीहरूमा गरिएको एक सर्वेक्षणमा 120 जनाले टेबल टेनिस र 205 जनाले बास्केट बल खेल मन पराउँछन् । यदि सबै विद्यार्थीहरूले कम्तीमा पनि एउटा खेल मन पराउँदा रहेछन् भने भेनचित्रको निर्माण गरी (क) दुवै खेल मन पराउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् । (ख) एउटा मात्र खेल मन पराउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।

In a survey of 300 students of 120 like Tennis and 205 like Basketball. If every student likes at least one of the games then by drawing a Venn-diagram. (a) Find the no. of students who like both the games. (b) Find the number of students who like only one game.

☞ Here, let, T and B denote the set of students who like Tennis and Basketball respectively.

Then $n(T \cup B) = 300$, $n(T) = 120$ and $n(B) = 205$

Now, the Venn-diagram,



Let, $n(T \cap B) = x$ then $n(T \cup B) = n(T) + n_0(B)$

or, $300 = 120 + 205 - x$ or, $300 = 325 - x$

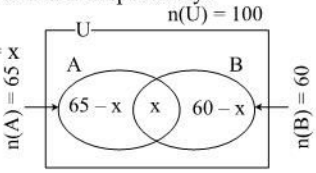
$\therefore \quad x = 25$ Thus, the required no. of students who like both the games is 25.

3D. मतदान पूर्व गरिएको एउटा नमुना सर्वेक्षणमा 65% जनताले नेता A लाई र 60% जनताले नेता B लाई मन पराएको पाइयो । यदि 15% जनताहरू कतै पनि खुल्न चाहेनन् भने भेनचित्रको प्रयोग गरी दुवै नेतालाई मन पराउने जनताको प्रतिशत पत्ता लगाउनुहोस् ।

In a survey done before an election, 65% people liked leader A and 60% people liked leader B. If 15% people did not like to open their views of any of the leaders. Using a Venn-diagram find the percentage of people who liked both the leaders.

☞ Here, let A and B denote the set of people who like leader A and leader B respectively.

Let, $n(U) = 100$, $n(A) = 65$, $n(B) = 60$, $n(\overline{A \cup B}) = 15$ and $n(A \cap B) = x$



From the Venn-diagram, $n(U) = n(A) + n_0(B) + n(\overline{A \cup B})$

or, $100 = 65 + 60 - x + 15$ or, $100 = 140 - x$

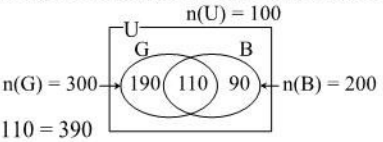
$\therefore \quad x = 40$ Thus, the required percentage is 40%.

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4. गौरीशङ्कर उच्च मा.वि.मा गरिएको एउटा सर्वेक्षणमा 300 जनाले भविष्यमा सरकारी जागिर गर्ने, 200 जनाले व्यवसाय सञ्चालन गर्ने र 110 जनाले दुवै काम गर्न सक्ने इच्छा जाहेर गरे । यदि सबै जनामा कम्तीमा एउटा काम गर्ने इच्छा भएको पाइयो भने भेनचित्रको प्रयोग गरी (क) सरकारी जागिर मात्र गर्ने इच्छा हुने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् । (ख) व्यवसाय मात्र गर्ने इच्छा हुने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् । (ग) जम्मा कति जना विद्यार्थीमा उक्त सर्वेक्षण गरिएको रहेछ पत्ता लगाउनुहोस् ।

In a survey conducted in Gauri Shankar Higher Secondary school, 300 said they will do government job, 200 said they will run business and 110 said they will do both in the future. If all of them do at least one work, using a Venn-diagram. (a) Find, the no. of students who like to do government job only. (b) Find the no. of students who like to run business only. (c) Find how many students were surveyed.

☞ Here, let G and B denote the set of students who like to do government job and run business in the future.



So, $n(G) = 300$, $n(B) = 200$ and $n(G \cap B) = 110$

(a) $n_0(G) = n(G) - n(G \cap B) = 300 - 110 = 190$

(b) $n_0(B) = n(B) - n(G \cap B) = 200 - 110 = 90$

(c) $n(G \cup B) = n(G) + n(B) - n(G \cap B) = 300 + 200 - 110 = 390$

Thus, (a) The no. of students who like to do government job only is 190.

(b) The no. of students who like to run business only is 90.

(c) The no. of students surveyed is 390.

1.2 तीन ओटा समूहहरू सम्मिलित समस्याहरू
Problems Including Three Sets

BASIC EXERCISE 1.2

QUESTIONS FROM SEE /SLC PAPERS

Model 1

1. यदि $n(A) = 65$, $n(B) = 50$, $n(C) = 35$, $n(A \cap B) = 25$, $n(B \cap C) = 20$, $n(C \cap A) = 15$, $n(A \cap B \cap C) = 5$ र $n(U) = 100$ भए $n(\overline{A \cup B \cup C})$ को मान पत्ता लगाउनुहोस् ।

If $n(A) = 65$, $n(B) = 50$, $n(C) = 35$, $n(A \cap B) = 25$, $n(B \cap C) = 20$, $n(C \cap A) = 15$, $n(A \cap B \cap C) = 5$ and $n(U) = 100$, find the value of $n(\overline{A \cup B \cup C})$. **[SLC 2057 A2]**

☛ Here, $n(A) = 65$, $n(B) = 50$, $n(C) = 35$, $n(A \cap B) = 25$, $n(B \cap C) = 20$, $n(C \cap A) = 15$, $n(A \cap B \cap C) = 5$

We know that,

$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(C \cap A) - n(B \cap C) + n(A \cap B \cap C)$

$= 65 + 50 + 35 - 25 - 15 - 20 + 5 = 95$

Now, $n(\overline{A \cup B \cup C}) = n(U) - n(A \cup B \cup C) = 100 - 95 = 5$

2. यदि $n(A) = 48$, $n(B) = 51$, $n(C) = 40$, $n(A \cap B) = 11$, $n(B \cap C) = 10$, $n(C \cap A) = 9$, $n(A \cap B \cap C) = 4$ र $n(U) = 120$ भए $n(A \cup B \cup C)$ र $n(\overline{A \cup B \cup C})$ को मान पत्ता लगाई उक्त तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् ।

If $n(A) = 48$, $n(B) = 51$, $n(C) = 40$, $n(A \cap B) = 11$, $n(B \cap C) = 10$, $n(C \cap A) = 9$, $n(A \cap B \cap C) = 4$ and $n(U) = 120$, find the values of $n(A \cup B \cup C)$ and $n(\overline{A \cup B \cup C})$. Present the above information in a Venn-diagram. **[SLC 2065 B]**

☛ Here, $n(A) = 48$, $n(B) = 51$, $n(C) = 40$, $n(A \cap B) = 11$, $n(B \cap C) = 10$

$n(C \cap A) = 9$, $n(A \cap B \cap C) = 4$ and $n(U) = 120$

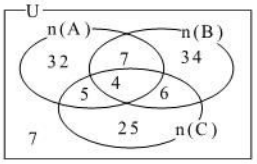
We know that,

$n(A \cup B \cup C)$

$= n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

$= 48 + 51 + 40 - 11 - 10 - 9 + 4$

$\therefore \quad n(A \cup B \cup C) = 113$



Again $n(\overline{A \cup B \cup C}) = n(U) - n(A \cup B \cup C) = 120 - 113 = 7$

Now, presenting the above information in a Venn-diagram.

Thus, $n(A \cup B \cup C) = 113$ and $n(\overline{A \cup B \cup C}) = 7$.

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Model 2

3. 100 जना मानिसहरूमा गरिएको एउटा सर्वेक्षणमा 65 जनाले कान्तिपुर, 45 जनाले गोरखापत्र, 40 जनाले हिमालय टाइम्स, 25 जनाले कान्तिपुर तथा गोरखापत्र, 20 जनाले कान्तिपुर तथा हिमालय टाइम्स, 15 जनाले गोरखापत्र र हिमालय टाइम्स र 5 जनाले तीनओटै पत्रिका पढ्ने गरेको पाइयो भने,

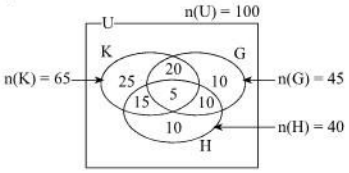
In a survey of 100 people, 65 read the Kantipur, 45 read the Gorakhapatra, 40 read the Himalaya Times, 25 read the Kantipur as well as the Gorakhapatra, 20 read the Kantipur as well as the Himalaya Times, 15 read the Gorakhapatra as well as the Himalaya Times and 5 read all three news papers. [2057B2]

(i) उक्त तथ्यलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । **(Show the above information in a Venn-diagram.)**

(ii) तीनओटै पत्रिका नपढ्ने कति थिए ? **(How many people didn't read all three newspapers?)**

☛ Here, let K, G and H be the sets of people reading Kantipur, Gorkhapatra and Himalaya Times.

Here, $n(U) = 100$, $n(K) = 65$, $n(G) = 45$, $n(H) = 40$,
$n(G \cap H) = 15$, $n(K \cap G) = 25$, $n(K \cap H) = 20$
and $n(K \cap H \cap G) = 5$



(i) Let us draw the Venn-diagram to illustrate the above given information

(ii) Then, $n(K \cup H \cup G) = n(K) + n(H) + n(G) - n(G \cap H) - n(K \cap G) - n(K \cap H) + n(K \cap H \cap G)$
$= 65 + 40 + 45 - 15 - 25 - 20 + 5 = 95$

$\therefore n(\overline{K \cup H \cup G}) = n(U) - n(K \cup H \cup G) = 100 - 95 = 5$

Thus, 5 people didn't read all three newspapers.

4. एउटा कक्षामा 175 विद्यार्थीहरू छन् । तलका जानकारीले तलका विषयहरू भन्दा एउटा धेरै विषय पढ्ने विद्यार्थी भएको देखाउदछ । गणित 100, भौतिक विज्ञान 70, रसायन विज्ञान 46, गणित र भौतिक विज्ञान 30, गणित र रसायन विज्ञान 28, भौतिक विज्ञान र रसायन विज्ञान 28, भौतिक विज्ञान र रसायन विज्ञान 23, गणित, भौतिक विज्ञान र रसायन विज्ञान 18 जना छन् ।

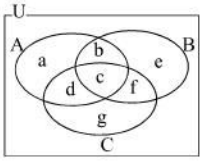
A class has 175 students. The following is the description showing the number of students studying one more of the following subjects in this class. Mathematics 100; Physics 70; Chemistry 46, Mathematics and Physics 30; Mathematics and Chemistry 28, Physics and Chemistry 23; Mathematics, Physics and Chemistry 18.Find

(i) गणित मात्र, भौतिक विज्ञान मात्र र रसायन विज्ञान मात्र कति-कति विद्यार्थीहरू होलान् ?
How many students are enrolled in Mathematics alone Physics alone and Chemistry alone;

(ii) यीमध्ये कुनै पनि विषय नपढ्ने विद्यार्थीहरू कतिजना होलान् ?
The number of students who have not offered any of these three subjects.

☞ Here, let A, B, C denote the sets of students enrolled in Mathematics, Physics and Chemistry respectively.

Let us denote the number of elements contained in each bounded region by small letters a, b, c, d, e, f, g as shown in figure. Using the given data, we have,



$a + b + c + d = 100$; $b + c + e + f = 70$; $c + d + f + g = 46$;
$b + c = 30$; $c + d = 28$; $c + f = 23$; $c = 18$

Solving these equations, we get; $c = 18$; $f = 5$; $d = 10$; $b = 12$; $g = 13$; $e = 35$ and $a = 60$

(i) Number of students enrolled in: Mathematics alone = a = 60;
Physics alone = e = 35; and Chemistry alone = g = 13

(ii) Number of students who have not offered any of these three subjects
$= [175 - (a + b + c + d + e + f + g)]$
$= [175 - (60 + 12 + 18 + 10 + 35 + 5 + 13)] = (175 - 153) = 22$

Model 3

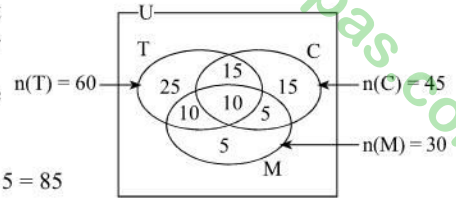
5. एउटा समूहमा गरिएको सर्वेक्षणमा चिया मन पराउने 60 जना, कफी मन पराउने 45 जना, दूध मन पराउने 30 जना, कफी र चिया दुवै मन पराउने 25 जना, चिया र दूध मन पराउने 20 जना, कफी र दूध मन पराउने 15 जना, तीनओटै मन पराउने 10 जना भेटिए भने जम्मा कति व्यक्तिलाई सो प्रश्न सोधिएको थियो ? भेनचित्र बनाई हल गर्नुहोस् ।

In a survey of a group of people, showed that 60 liked tea, 45 liked coffee, 30 liked milk, 25 liked coffee as well as tea, 20 liked tea as well as milk, 15 liked coffee as well as milk and 10 liked all three. How many people were asked this question ? Solve it by drawing the Venn- diagram. [SLC 2057 A1]

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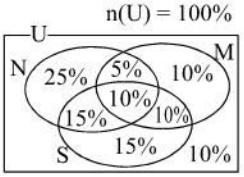
☛ Here, let T, C and M denote respectively the set of people who like tea, coffee and milk. Venn-diagram of given problem is as follows:



Here, the no. of people whom were asked the question = $n(T \cup C \cup M)$.
From above Venn-diagram.
$n(T \cup C \cup M) = 25 + 15 + 10 + 15 + 5 + 10 + 5 = 85$
Thus, the required number of people is 85.

6. **हालसालै गरिएको सर्वेक्षणमा यो थाहा भयो कि, 55% ग्राहकहरू नोकिया मोबाइल प्रयोग गर्न चाहन्छन्, 35% मोटोरोला, 15% सोनि इरिक्सन मात्र प्रयोग गर्न चाहन्छन् । 25% ले नोकिया र सोनी इरिक्सन 20% ले सोनी इरिक्सन र मोटोरोला, 15% ले नोकिया र मोटोरोला र 10% ले तीनैओटा मन पराउँछन् । यदि 65 जना ग्राहकले तिनीहरूमध्ये कुनै पनि मन पराएनन् भने सो सर्वेक्षणमा भाग लिएका जम्मा ग्राहकहरूको सङ्ख्या पत्ता लगाउनुहोस् ।**
In a recent survey it was found that 55% of customers want to use Nokia mobile sets, 35% want Motorola, 15% want Sony Erickson only. 25% want to use Nokia and Sony Erickson, 20% want Sony Erickson and Motorola, 15% want Nokia and Motorola and 10% want all three. If 65 customers do not want any of them, find the total number number of customers involved in the survey.

☛ Here, let, N, M and S denote the sets of customers who want Nokia, Motorola and Sony Erickson sets respectively.



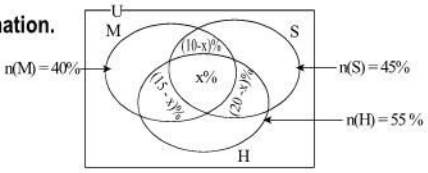
$n_0(N \cap S) = 25\% - 10\% = 15\%$
$n_0(N \cap M) = 15\% - 10\% = 5\%$
$n_0(S \cap M) = 20\% - 10\% = 10\%$
$n_0(N) = 55\% - 10\% - 5\% - 15\% = 25\%$
$n_0(M) = 35\% - 5\% - 10\% - 10\% = 10\%$
From the Venn-diagram it is clear that,
$25\% + 15\% + 10\% + 5\% + 10\% + 10\% + 15\% + x = 100\%$
or, $90\% + x = 100\%$ $\therefore$ $x = 10\%$
10% customers want non of them. But it is given that 65 want non of them.
So, 10% of total customers = 65 i.e. 100% of total customers = 650
Thus, the total number of customers is 650.

Model 4

7. **कुनै परीक्षामा सम्मिलित विद्यार्थीहरूमध्ये गणितमा 40%, विज्ञानमा 45% र स्वास्थ्यमा 55% परीक्षार्थीहरू उत्तीर्ण भए । गणित र विज्ञानमा 10%, विज्ञान र स्वास्थ्यमा 20% र स्वास्थ्य र गणितमा 15% विद्यार्थीहरू उत्तीर्ण भएका रहेछन् भने,**
Of the total candidates in an examination, 40% students passed in Maths, 45% in Science and 55% in Health. 10% students passed both in Maths and Science, 20% in Science and Health and 15% in Health and Maths. Then **[SLC 2058 C2]**

(i) उक्त जानकारीलाई भेनचित्र बनाई देखाउनुहोस् ।
Draw a Venn-diagram to show the above information.

(ii) तीनओटै विषयमा उत्तीर्ण हुने विद्यार्थीहरूको प्रतिशत निकाल्नुहोस् ।
Calculate the percent who passed in all Maths, Science and Health.



☛ Here, let S, H and M represent the set of students passed in Science, Health and Mathematics respectively. We represent the given problem in Venn-diagram as shown:
We know that, $n(M \cup S \cup H) = 100\%$
From Venn-diagram, we have,
$n(M) = 40\%$, $n(S) = 45\%$, $n(H) = 55\%$, $n(M \cap S) = 10\%$.
$n(M \cap H) = 15\%$, $n(S \cap H) = 20\%$, $n(M \cap S \cap H) = ?$
We have, $n(M \cup S \cup H) = n(M) + n(S) + n(H) - n(M \cap S) - n(S \cap H) - n(M \cap H) + n(M \cap S \cap H)$
or, $100\% = 40\% + 45\% + 55\% - 10\% - 20\% - 15\% + n(M \cap S \cap H)$
or, $100\% = 95\% + n(M \cap S \cap H)$
$\therefore$ $n(M \cap S \cap H) = 100\% - 95\% = 5\%$
Thus, students who passed all three subjects is 5%.

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8. 140 घरधुरी रहेको कुनै एक गाउँमा हिन्दू धर्म मान्ने 70, बौद्ध धर्म मान्ने 60 र अन्य धर्म मान्ने 45 घर रहेछन् । तीमध्ये हिन्दू र बौद्ध धर्ममा अन्तर नदेख्ने 17, हिन्दू र अन्य धर्ममा अन्तर नदेख्ने 18 एवम् बौद्ध र अन्य धर्ममा अन्तर नदेख्ने 16 घर रहेछन् । त्यहाँ कुनै पनि धर्म नमान्ने घर सङ्ख्या 6 रहेछ भने तीनै प्रकारका धर्ममा अन्तर नदेख्ने घर सङ्ख्या पत्ता लगाई भेनचित्रमा देखाउनुहोस् ।

In a village of 140 houses, 60 believe in Buddhism, 70 in Hindu religion and 45 in other religion. Among them 17 houses don't find any difference in Hindu and Buddhism, 18 houses don't find any difference in Hindu and other religion. While 16 houses don't find any difference between Buddhism and other religion. If 6 houses don't believe in any religion, find how many houses don't find any difference in any religion. Show it in a Venn-diagram.

☞ Here, let H, B and A denote the set of houses who believe Hindu religion, Buddhism and other religion respectively.

From the question, $n(U) = 140$, $n(B) = 60$, $n(H) = 70$, $n(A) = 45$, $n(B \cap H) = 17$, $n(H \cap A) = 18$, $n(B \cap A) = 16$ and $n(\overline{B \cup H \cup A}) = 6$

We know that, $n(U) = (B \cup H \cup A) + n(\overline{B \cup H \cup A})$

$= n(B) + n(H) + n(A) - n(B \cap H) - n(H \cap A) - n(B \cap A) + n(B \cap H \cap A) + n(\overline{B \cup H \cup A})$

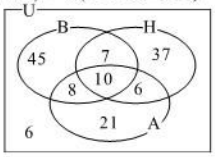
or, $140 = 60 + 70 + 45 - 17 - 18 - 16 + n(B \cap H \cap A) + 6$

or, $140 = 130 + n(B \cap H \cap A)$

$\therefore n(B \cap H \cap A) = 10$

Thus, 10 houses do not find any difference in any religion.

Now, drawing the Venn-diagram.

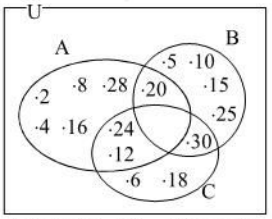


QUESTIONS FROM TEXT BOOKS [EXERCISE: 1.2]

1. सँगैको भेनचित्रको अवलोकन गरी निम्न समूहको गणनात्मक सङ्ख्या पत्ता लगाउनुहोस्:

Observe the adjoining Venn-diagram, find the cardinality of following sets:

(i) n(A) **(ii) n(B)** **(iii) n(C)**
(iv) n(A ∩ B) **(v) n(B ∩ C)** **(vi) n(A ∩ B ∩ C)**
(vii) n(A – B) **(viii) n(C – A)** **(ix) n(A ∪ B ∪ C)**
(x) n{A ∪ (B – C)}



☞ Here, from the given Venn-diagram:

(i) $n(A) = 8$ (ii) $n(B) = 6$ (iii) $n(C) = 5$
(iv) $n(A \cap B) = 1$ (v) $n(B \cap C) = 1$ (vi) $n(A \cap B \cap C) = \phi$
(vii) $n(A - B) = 7$ (viii) $n(C - A) = 3$ (ix) $n(A \cup B \cup C) = 15$ (x) $n\{A \cup (B - C)\} = 12$

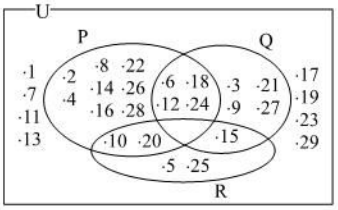
2. यदि **U = {30 भन्दा साना धनात्मक पूर्णाङ्कहरू}, P = {2 का 30 भन्दा साना अपवर्त्यहरू}, Q = {3 का 30 भन्दा साना अपवर्त्यहरू} R = {5 का 30 भन्दा साना अपवर्त्यहरू}** भएमा **P, Q, R** को सम्बन्धलाई भेनचित्रमा प्रस्तुत गरी तलका सम्बन्धहरू प्रमाणित गर्नुहोस् :

If U = {positive integer less than 30}, P = {multiples of 2 less than 30}, Q = {multiples of 3 less than 30}, and R = {multiples of 5 less than 30}, show the relation among P, Q and R in a Venn-diagram and prove the following relations:

(i) $n(P \cup Q) = n(P) + n(Q) - n(P \cap Q)$
(ii) $n(P \cup Q \cup R) = n(P) + n(Q) + n(R) - n(P \cap Q) - n(Q \cap R) - n(R \cap P) + n(P \cap Q \cap R)$
(iii) $n(P \cup Q \cup R) = n(P - Q) + n(Q - R) + n(R - P) + n(P \cap Q \cap R)$

☞ Here, $U = \{1, 2, 3, \ldots\ldots, 29\}$
$P = \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28\}$
$Q = \{3, 6, 9, 12, 15, 18, 21, 24, 27\}$ and
$R = \{5, 10, 15, 20, 25\}$

Now, the Venn-diagram,



(i) $n(P \cup Q) = 19$, $n(P) = 14$, $n(Q) = 9$, $n(P \cap Q) = 4$

Now, $n(P) + n(Q) - n(P \cap Q)$
$= 14 + 9 - 4 = 19$

$\therefore n(P \cup Q) = n(P) + n(Q) - n(P \cap Q)$

(ii) $n(P \cup Q \cup R) = 21$

$n(P) + n(Q) + n(R) - n(P \cap Q) - n(Q \cap R) - n(R \cap P) + n(P \cap Q \cap R)$
$= 14 + 9 + 5 - 4 - 1 - 2 + 0 = 21$

$\therefore n(P \cup Q \cup R) = n(P) + n(Q) + n(R) - n(P \cap Q) - n(Q \cap R) - n(R \cap P) + n(P \cap Q \cap R)$

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(iii) $n(P \cup Q \cup R) = 21$

$n(P - Q) + n(Q - R) + n(R - P) + n(P \cap Q \cap R) = 10 + 8 + 3 + 0 = 21$

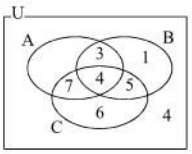
$\therefore\ n(P \cup Q \cup R) = n(P - Q) + n(Q - R) + n(R - P) + n(P \cap Q \cap R)$

3A. यदि $n(A) = 14, n(B) = 13, n(C) = 22, n(A \cap B \cap C) = 4$ र $n(A \cap B) = 7, n(B \cap C) = 9, n(C \cap A) = 11,$ $\overline{n(A \cup B \cup C)} = 4$ भए भेनचित्रको प्रयोग गरी $n(U)$ पत्ता लगाउनुहोस् ।

If $n(A) = 14, n(B) = 13, n(C) = 22, n(A \cap B \cap C) = 4$ and $n(A \cap B) = 7, n(B \cap C) = 9, n(C \cap A) = 11,$ $\overline{n(A \cup B \cup C)} = 4$ then find $n(U)$ using a Venn-diagram.

☞ Here, $n(A) = 14, n(B) = 13, n(C) = 22, n(A \cap B \cap C) = 4$ and

$n(A \cap B) = 7, n(B \cap C) = 9, n(C \cap A) = 11, \overline{n(A \cup B \cup C)} = 4$



From the Venn-diagram,

$n(U) = 3 + 4 + 7 + 1 + 5 + 6 + 4$

$\therefore\ n(U) = 30$

Thus, the value of $n(U)$ is 30.

3B. समूहहरू P, Q, R सर्वव्यापक समूह U का उपसमूहहरू हुन्, जसमा $n(P) = 100, n(Q) = 90, n(R) = 110, n(P \cap Q) = 60, n(Q \cap R) = 40, n(P \cap R) = 45$ र $n(P \cup Q \cup R) = 180$ भए $n(P \cap Q \cap R)$ कति होला ?

P, Q and R are the subsets of the universal set U in which $n(P) = 100, n(Q) = 90, n(R) = 110, n(P \cap Q) = 60, n(Q \cap R) = 40, n(P \cap R) = 45$ and $n(P \cup Q \cup R) = 180$, what is the value of $n(P \cap Q \cap R)$?

☞ Here, $n(P) = 100, n(Q) = 90, n(R) = 110, n(P \cap Q) = 60, n(Q \cap R) = 40, n(P \cap R) = 45$ & $n(P \cup Q \cup R) = 180$

We know that, $n(P \cup Q \cup R) = n(P) + n(Q) + n(R) - n(P \cap Q) - n(Q \cap R) - n(R \cap P) + n(P \cap Q \cap R)$

or, $180 = 100 + 90 + 110 - 60 - 40 - 45 + n(P \cap Q \cap R)$

or, $180 = 155 + n(P \cap Q \cap R)$ $\quad\therefore\quad n(P \cap Q \cap R) = 25$

Thus, the value of $n(P \cap Q \cap R)$ is 25.

3C. यदि X, Y, Z सर्वव्यापक समूह U का उपसमूहहरू हुन्, जहाँ $n(X) = 48, n(Y) = 51, n(Z) = 40, n(X \cap Y) = 11$ $n(Y \cap Z) = 10, n(Z \cap X) = 9, n(X \cap Y \cap Z) = 4$ र $n(U) = 120$ भए $n(X \cup Y \cup Z)$ र $n(\overline{X \cup Y \cup Z})$ पत्ता लगाउनुहोस् ।

If X, Y and Z are the subsets of universal set U in which $n(X) = 48, n(Y) = 51, n(Z) = 40, n(X \cap Y) = 11, n(Y \cap Z) = 10, n(Z \cap X) = 9, n(X \cap Y \cap Z) = 4$ and $n(U) = 120$, find the value of $n(X \cup Y \cup Z)$ and $n(\overline{X \cup Y \cup Z})$.

☞ Here, $n(X) = 48, n(Y) = 51, n(Z) = 40, n(X \cap Y) = 11, n(Y \cap Z) = 10, n(Z \cap X) = 9, n(X \cap Y \cap Z) = 4$ and $n(U) = 120$

We have, $n(X \cup Y \cup Z) = n(X) + n(Y) + n(Z) - n(X \cap Y) - n(Y \cap Z) - n(Z \cap X) + n(X \cap Y \cap Z)$

$= 48 + 51 + 40 - 11 - 10 - 9 + 4$

$\therefore\quad n(X \cup Y \cup Z) = 113$

Again, $n(\overline{X \cup Y \cup Z}) = n(U) - n(X \cup Y \cup Z) = 120 - 113 = 7$

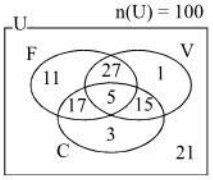
Thus, $n(X \cup Y \cup Z) = 113$ and $n(\overline{X \cup Y \cup Z}) = 7$

4A. 100 जना विद्यार्थीहरूमा गरिएको सर्वेक्षणमा 60 जना फुटबल, 48 जनाले भलिबल र 40 जनाले क्रिकेट खेल्न मन पराउँछन् । त्यस्तै 32 जनाले फुटबल र भलिबल, 22 जनाले फुटबल र क्रिकेट र 20 जनाले भलिबल र क्रिकेट खेल्न मन पराए । 5 जनाले तिन ओटै खेल खेल्न मन पराए भने भेनचित्रको प्रयोग गरी यी कुनै पनि खेल मन नपराउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।

In a survey of 100 students, 60 like to play football 48 like volleyball and 40 like cricket. Similarly 32 like football and volleyball, 22 like football and cricket and 20 liked volleyball and cricket. If 5 liked to play all the three games then, find the number of students who do not like any of these games using a Venn-diagram.

☞ Here, let F, V and C denote the set of students who like to play football, volleyball and cricket resp. Then, $n(U) = 100, n(F) = 60, n(V) = 48, n(C) = 40, n(F \cap V) = 32, n(F \cap C) = 22, n(V \cap C) = 20$ & $n(F \cap V \cap C) = 5$

Drawing a Venn-diagram:



From the Venn-diagram, $n(\overline{F \cup V \cup C}) = 21$

Thus, the required number of students is 21.

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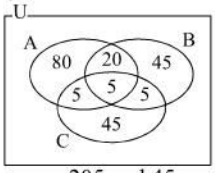
4B. एउटा संस्थाले गरेको सर्वेक्षणअनुसार एचआइभी सर्ने कारणहरूमध्ये 110 जनाले असुरक्षित यौन सम्पर्कका कारणले, 75 जनाले सिरिन्जको प्रयोगले र 60 जनाले सङ्क्रमित आमाबाबुबाट उनीहरूका सन्तानमा सर्ने कुरा बताए। त्यस्तै 25 जनाले असुरक्षित यौन सम्पर्क र सिरिन्जको प्रयोगले, 10 जनाले सिरिन्ज तथा सङ्क्रमित आमाबाट एवम् 10 जनाले असुरक्षित यौन सम्पर्क र सङ्क्रमित आमाबाट बच्चामा सर्ने बताए भने 5 जनाले तिन ओटै कारणहरू औँल्याए। यदि प्रत्येकले कम्तीमा एउटा उत्तर दिए भने : (क) माथिको तथ्याङ्कलाई भेनचित्रमा प्रस्तुत गर्नुहोस्। (ख) जम्मा कति जना मानिसहरूमा सर्वेक्षण गरिएको रहेछ ? पत्ता लगाउनुहोस्। (ग) सिरिन्जको प्रयोगबाट मात्र एचआइभी सर्छ भन्नेहरूको सङ्ख्या पत्ता लगाउनुहोस्।

In a survey organized by an institution regarding the causes of HIV, 110 said it is transferred by unprotected sex, 75 said it is by infected syringes and 60 said it is by infected father and mother can infect their babies. Similarly 25 said it is by unprotected sex and infected syringes, 10 said it is by infected syringes and infected father and mother and 10 said it is by unprotected sex and infected father and mother and 5 said it is by all the three causes. If each of them said atleast one answer: (a) Show the above information in a Venn-diagram. (b) How many people were surveyed ? (c) How many people said that it is caused by infected syringes ?

☞ Here, let A, B, C represent the set of people who said the causes of HIV are due to unprotected sex, infected syringes and infected father and mother respectively.

By the question, $n(A) = 110$, $n(B) = 75$, $n(C) = 60$, $n(A \cap B) = 25$, $n(B \cap C) = 10$, $n(C \cap A) = 10$ and $n(A \cap B \cap C) = 5$

(a) The Venn-diagram of above information is shown alongside;



(b) From the Venn-diagram,

Number of people surveyed

$n(U) = n(A \cup B \cup C) = 80 + 20 + 45 + 5 + 5 + 5 + 45 = 205$

$\therefore \quad n(A \cup B \cup C) = 205$

(c) $n_0(B) = 45$

Thus, the required numbers are 205 and 45.

4C. एउटा विज्ञापनमा दरखास्त दिनेहरूमध्ये 70 जना तथ्याङ्क शास्त्रमा, 60 जना कम्प्युटरमा, 50 जना अङ्ग्रेजीमा, 30 जना तथ्याङ्क शास्त्र र कम्प्युटरमा, 20 जना कम्प्युटर र अङ्ग्रेजीमा, 25 जना अङ्ग्रेजी र तथ्याङ्क शास्त्रमा र 20 जना तिन ओटै विषयमा दक्ष भएको पाइयो। यदि सबै जना कम्तीमा एउटा विषयमा दक्ष भएको भए यसलाई भेनचित्रमा प्रस्तुत गरी (क) कम्प्युटरमा मात्र दक्ष भएका उमेदवारको सङ्ख्या पत्ता लगाउनुहोस्। (ख) जम्मा कति जनाले दरखास्त दिएका रहेछन् ? पत्ता लगाउनुहोस्।

Among applicants in an advertisement 70 are expert in statistics, 60 are expert in computer, 50 are in English, 30 in statistics and computer, 20 in computer and English, 25 in English and statistics and 20 in all the three subjects. If every applicant is expert in atleast one subject then using Venn-diagram.

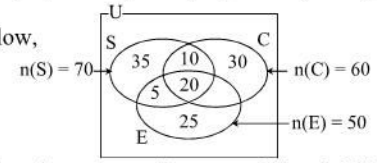
(a) How many candidates are expert only in computer ?

(b) How many did apply for the advertisement ?

☞ Here, let S, C, E denote the set of applicants who are experts in statistics, computer and English respectively.

Then, by the question, $n(S) = 70$, $n(C) = 60$, $n(E) = 50$, $n(S \cap C) = 30$, $n(C \cap E) = 20$, $n(E \cap S) = 25$ and $n(S \cap C \cap E) = 20$

Now, the Venn-diagram of above information is shown below,



From the Venn-diagram,

(a) $n_0(C) = 30$

(b) $n(S \cup C \cup E) = 35 + 10 + 5 + 20 + 25$

$\therefore \quad n(S \cup C \cup E) = 125$

Thus, the no. of expert only in computer and apply for advertisement applicants are 30 and 125 respectively.

4D. एउटा सर्वेक्षणमा बिहान चिया पिउने 60 जना, कफी पिउने 45 जना, दुध पिउने 40 जना, कफी र दुध दुवै पिउने 13 जना, कफी र चिया पिउने 25 जना, चिया र दुध पिउने 20 जना एवम् चिया, कफी र दुध तिन ओटै पिउने 10 जना रहेछन्। यदि 5 जनाले यी तिनै पेय पदार्थ पिउँदैनन् भने

In a survey it is found that 60 drink tea in the morning, 45 drink coffee, 40 drink milk, 13 drink coffee and milk, 25 drink coffee and tea, 20 drink tea and milk 10 drink all the three tea, coffee and milk. If 5 did not drink all the three.

(क) माथिको तथ्याङ्कलाई भेनचित्रमा प्रस्तुत गर्नुहोस्। **(Show the above information in a Venn-diagram.)**

(ख) कम्तीमा एउटा पेय पदार्थ पिउने कति जना होलान् ? **(How many people drink at least one drinks?)**

(ग) जम्मा कति जनामा सर्वेक्षण गरिएको रहेछ, पत्ता लगाउनुहोस्। **(How many people were surveyed?)**

(घ) एउटा मात्र पेय पदार्थ लिने मानिसको सङ्ख्या पत्ता लगाउनुहोस्।

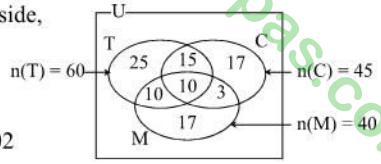
Find the number of people who drink only one drinks.

☞ Here, let T, C and M denote the set of people who drink tea, coffee and milk respectively.

So, $n(T) = 60$, $n(C) = 45$, $n(M) = 40$, $n(C \cap M) = 13$, $n(C \cap T) = 25$, $n(T \cap M) = 20$, $\overline{(T \cup C \cup M)} = 5$ and $n(C \cap M \cap T) = 10$

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(a) Now, the Venn-diagram of above data is shown alongside,



(b) $n(T \cup C \cup M) = 25 + 15 + 17 + 10 + 10 + 3 + 17$
$= 97$

(c) $n(U) = n(T \cup C \cup M) + n(\overline{T \cup C \cup M}) = 97 + 5 = 102$

(d) $n_0(T) + n_0(C) + n_0(M) = 25 + 17 + 17 = 59$

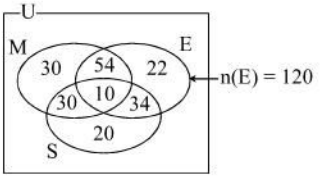
Thus, the required numbers of people are 97, 102 and 59 respectively.

5A. **एउटा विद्यालयका 200 विद्यार्थीहरूमध्ये 60% अङ्ग्रेजी, 32% गणित र अङ्ग्रेजी, 20% विज्ञान र गणित, 22% विज्ञान र अङ्ग्रेजी, 15% ले गणित मात्र, 10% ले विज्ञान मात्र र 5% ले तिन ओटै विषयहरू रुचाउँछन् भने, भेनचित्रको प्रयोग गरी गणित रुचाउने र अङ्ग्रेजी मात्र रुचाउने विद्यार्थी सङ्ख्या पत्ता लगाउनुहोस् ।**

Among 200 students of a school, 60% are interested in English, 32% Maths and English, 20% Science and Maths, 22%, Science and English, 15% Math only, 10% in Science only and 5% are interested in all the three subjects, using a Venn-diagram find the number of students who are interested in Math and English only.

☞ Here, let E, M and S denote the set of students interested in English, Maths and Science respectively.

$n(U) = 200$, $n(E) = 60\%$ of $200 = 120$,
$n(M \cap E) = 32\%$ of $200 = 64$,
$n(S \cap M) = 20\%$ of $200 = 40$,
$n(S \cap E) = 22\%$ of $200 = 44$,
$n_0(M) = 15\%$ of $200 = 30$,
$n_0(S) = 10\%$ of $200 = 20$ and
$n(M \cap S \cap E) = 5\%$ of $200 = 10$



(a) The Venn-diagram of above information:

(b) $n(M) = 30 + 54 + 10 + 30$ $\therefore$ $n(M) = 124$

(c) $n_0(E) = 120 - (54 + 10 + 34)$ $\therefore$ $n_0(E) = 22$

Thus, the required number of students are 124 and 22 respectively.

5B. **एउटा परीक्षामा सम्मिलित परीक्षार्थीहरूमध्ये 40% ले विज्ञानमा, 45% ले गणितमा र 55% ले सामाजिक अध्ययनमा A+ ग्रेड हासिल गरे । त्यस्तै 10% ले गणित र विज्ञानमा, 20% ले विज्ञान र सामाजिक अध्ययनमा, 15% ले सामाजिक अध्ययन र गणितमा A+ ग्रेड प्राप्त गरे यदि प्रत्येकले कम्तीमा एउटा विषयमा A+ ग्रेड प्राप्त गरे भने**

Among examinees in an examination, 40% in Science, 45% in Maths and 55% in Social Studies obtained A+ grades. Similarly, 10% in Maths and Science, 20% in Science and Social Studies and 15% in social studies and Maths obtained A+ grades. If every student obtain A+ at least in one subject.

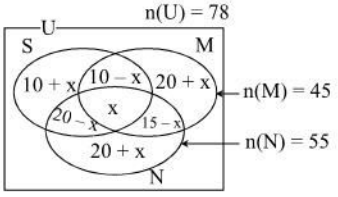
(a) **माथिको तथ्याङ्कलाई भेनचित्रमा प्रस्तुत गर्नुहोस् । (Show the above information in a Venn-diagram.)**

(b) **तिन ओटै विषयमा A+ ग्रेड प्राप्त गर्ने विद्यार्थीहरूको प्रतिशत पत्ता लगाउनुहोस् ।**
Find the percentage of students who obtained A+ grade in all the three subjects.

(c) **यदि जम्मा 300 जनामा सर्वेक्षण गरिएको भए कति जनाले एउटा मात्र विषयमा A+ ग्रेड हासिल गरे होलान् ।**
If 300 students were surveyed, how many students did obtain A+ grades in only one subject ?

☞ Here, let S, M and N denote the set of students who obtained A+ grades in Science, Maths and Social Studies respectively.

From the question, If $n(S \cup M \cup N) = 100$ then
$n(S) = 40$, $n(M) = 45$, $n(N) = 55$,
$n(M \cap S) = 10$, $n(S \cap N) = 20$, $n(N \cap M) = 15$



(a) Now, the Venn-diagram of given data is shown alongside,
Let $n(S \cap M \cap N) = x$

(b) From the Venn-diagram
$10 + x + 10 - x + 20 + x + 20 + x + x + 15 - x + 20 - x = 100$
or, $95 + x = 100$
$\therefore$ $x = 5$
Thus, the percentage who like all the three is 5%.

(c) $n_0(S) + n_0(M) + n_0(N) = 10 + x + 20 + x + 20 + x$
$= 50 + 3x = 50 + 3 \times 5 = 65$
So, the percentage who obtained A+ in only one subject = 65%
i.e. 65% of 300 $= 0.65 \times 300 = 195$

Thus, the required no. of students is 195.

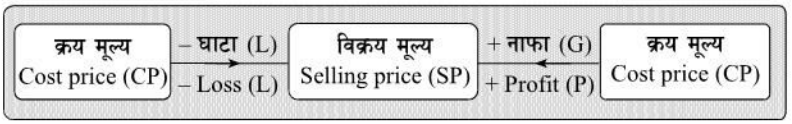
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2. कर र मुद्रा विनिमय (Tax and Money Exchange)

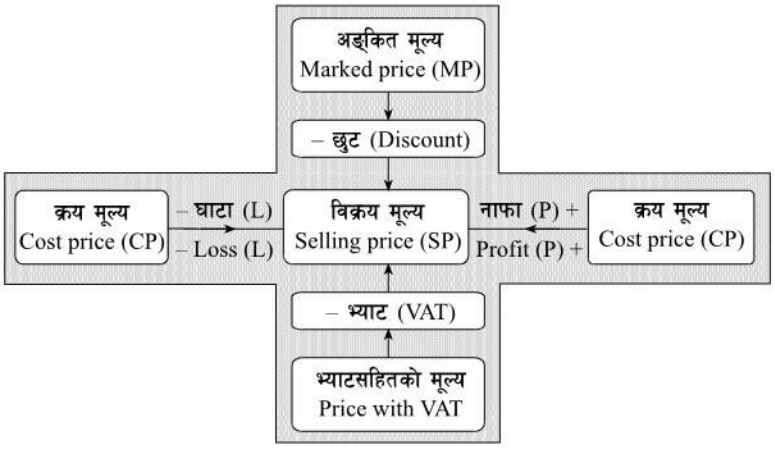
Formulae and Key Points



1. नाफा (Profit) = SP – CP
2. घाटा (Loss) = CP – SP
3. नाफा % (Profit%) $= \frac{\text{नाफा (Profit)}}{\text{CP}} \times 100$
4. घाटा % (Loss %) $= \frac{\text{नोक्सान (Loss)}}{\text{CP}} \times 100$
5. $\text{SP} = \frac{(100 + \text{P}\%)\,\text{CP}}{100}$ OR, $\frac{(100 - \text{L}\%)\,\text{CP}}{100}$
6. $\text{CP} = \frac{100 \times \text{SP}}{100 + \text{P}\%}$ OR, $\frac{100 \times \text{SP}}{100 - \text{L}\%}$
7. कुनै दुई सामानहरू रु. p मा खरिद गरी एउटालाई x% नाफा र अर्कोलाई x% घाटामा बिक्री गर्दा दुवैको विक्रयमूल्य एउटै भए सधैं कुल कारोबारमा घाटा हुन्छ र प्रतिशत घाटा $= \left(\frac{\text{x}}{10}\right)^2$ % हुन्छ ।

   If two articles are bought for Rs p and one is sold for x% profit and other for x% loss so that the selling price of both are equal then there will be always loss and

   Percentage of loss $= \left(\frac{\text{x}}{10}\right)^2$ %.
8. x% नाफाको अर्थ; SP = CP को (100 + x) % (Meaning of x% profit; SP = (100 + x) % of CP)
9. x% घाटाको अर्थ; SP = CP को (100 – x) % (Meaning of x% loss ; SP = (100 – x) % of CP)



10. यदि मूल्य रु. x भएको सामानमा d% छुट र V% भ्याट लगाइयो भने सो सामानको भ्याटपछिको मूल्य $= \frac{\text{x} \times (100 - \text{d}\%)\,(100 + \text{V}\%)}{100 \times 100}$ हुन्छ ।

    If the price of an article is Rs x and a discount of d% and VAT of V% is applied on it, then the price after VAT $= \frac{\text{x} \times (100 - \text{d}\%)\,(100 + \text{V}\%)}{100 \times 100}$.
11. अङ्कित मूल्य (MP) = विक्रयमूल्य + छुट, (Marked Price = Selling Price + Discount)
12. अङ्कित मूल्य – छुट = क्रयमूल्य + नाफा, (Marked Price – Discount = Cost Price + Profit)
13. छुट (Discount)% $= \frac{\text{वास्तविक छुट (Actual Discount)}}{\text{अंकित मूल्य (Marked Price)}} \times 100$

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14. यदि अङ्कित मूल्य (MP), क्रयमूल्य (CP), छुट (d) % र नाफा (P)% भए

(i) अङ्कित मूल्य (MP) $= \frac{(100 + P)\,CP}{(100 - d)}$ (ii) क्रयमूल्य (CP) $= \frac{(100 - d) \times MP}{100 + P}$

15. भ्याट (VAT)

- हाल नेपालमा भ्याटको प्रचलित दर 13% छ । (The present rate of VAT in Nepal is 13%.)
- विदेश निर्यात गरिने वस्तु तथा सेवाहरूमा भ्याट लाग्दैन ।
  VAT is exempted to the goods and services that are exported.
- भ्याट लागिसकेको सामान विदेश लैजादा विमानस्थलमा भ्याट फिर्ता पाइन्छ ।
  If VAT exposed-articles are exported then the VAT is got back at airport.
- आधारभूत आवश्यकताहरू, कृषिजन्य उत्पादनहरू, शिक्षा, स्वास्थ्य, संस्कृति तथा समाजकल्याणसम्बन्धी वस्तु तथा सेवाहरू, जग्गा र घरसम्बन्धी खरिद बिक्री र भाडामा भ्याट लाग्दैन ।
  VAT is exempted on goods and services of basic needs, basic agricultural products, educational, health related, cultural, goods and services, purchase and renting of lands and building etc.

2.1 मूल्य अभिवृद्धि कर
Value Added Tax

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 1(a), 4(a) & 12]

Q. 1 (a) वास्तविक छुट र अङ्कित मूल्य दिइएको अवस्थामा छुट प्रतिशत पत्ता लगाउने सूत्र लेख्नुहोस् ।
Write the formula for finding rate of discount when discounted amount and marked price are given.

⇨ Here, Rate of discount $= \frac{\text{Discount amount}}{\text{Marked price}} \times 100\%$

Q. 4. (a) रु 2700 मा 13% मुल्य अभिवृद्धि कर जोड्दा आउने मुल्य रु 3060 भन्दा कतिले बढी छ ?
How much more is Rs 3060 than the value including 13% VAT in Rs 2700?

⇨ Here, Price = Rs 2700 and Rate of VAT = 13%
We have, price including VAT = Rs 2700 + 13% of Rs 2700 = Rs 2700 + 0.13 × Rs 2700
= Rs 2700 + Rs 351 = Rs 3051
Required value = Rs 3060 – Rs 3051 = Rs 9
Thus, the required value is Rs 9.

Q. 12. एउटा घडीको अङ्कित मूल्यमा 20% छुट दिइ 13% मुल्य अभिवृद्धि कर जोड्दा घडीको मुल्य रु 904 भयो भने सो घडीको अङ्कित मूल्य निकाल्नुहोस् ।
After allowing 20% discount and then levying 13% Value Added Tax (VAT), the value of the watch will be Rs 904. Find the marked price of the watch.

⇨ Here, Discount rate = 20% Value added tax = 13%
Let, the marked price be Rs x. Then Discount = 20% of x = 0.2 × x = 0.2x
We have, price after discount = MP – Discount = Rs x – Rs 0.2x = Rs 0.8x
We know that, VAT = 13% of price after discount = 0.13 × Rs 0.8x = Rs 0.104x
Now, Price with VAT = Rs 0.8x + Rs 0.104x = Rs 0.904x
By the question, Rs 0.904x = Rs 904
$\therefore$ x = 1000
Thus, the marked price is Rs 1000.

Alternative method:
Here, D% = 20% and VAT % = 13%
Price with VAT $= \frac{MP \times (100 - D)\,(100 + VAT)}{100 \times 100}$ or, $904 = \frac{MP \times (100 - 20)\,(100 + 13)}{100 \times 100}$
or, $904 = \frac{MP \times 80 \times 113}{100 \times 100}$ or, $904 = MP \times 0.904$
$\therefore$ MP = 1000
Thus, the marked price is Rs 1000.

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A. BASIC EXERCISE 2.1

Very Short Questions

1. मूल्य अभिवृद्धि करको परिभाषा लेख्नुहोस् । (Write down the definition of Value Added Tax (VAT).[SEE 2074 M2]

⇨ Here, **Tax:** Tax is an amount of money that you have to pay to the government so that it can pay for public service.

VAT: Value Added Tax (VAT) is a consumption tax placed on a product whenever value is added at each stage of the supply chain, from production to the point of sale.

2. भ्याट रकम र बिक्रय मूल्य दिइएको अवस्थामा भ्याटको दर पत्ता लगाउने सूत्र लेख्नुहोस् ।
Write the formula for finding rate of VAT when VAT amount and selling price are given.

⇨ Here, The formula for finding rate of VAT when VAT amount and selling price are given:

$$\text{VAT rate} = \frac{\text{VAT Amount}}{\text{Selling Price}} \times 100\%$$

3. यदि अङ्कित मूल्य र छुटपछिको विक्रय मूल्य दिइएको अवस्थामा छुटको दर निकाल्ने सूत्र पत्ता लगाउनुहोस् ।
Write a formula to calculate discount percent when marked price and selling price after discount are given.

⇨ Here, $\text{Discount Percent} = \frac{(MP - SP)}{MP} \times 100\%$

4. भ्याटसहितको विक्रय मूल्य र भ्याट बाहेकको विक्रय मूल्य दिइएको अवस्थामा भ्याट प्रतिशत निकाल्ने सूत्र लेख्नुहोस् ।
Write the formula to calculate the VAT percent when selling price with VAT and selling price without VAT are given.

⇨ Here, $\text{VAT Percent} = \frac{(\text{SP with VAT} - \text{SP without VAT})}{\text{SP without VAT}} \times 100\%$

5. एउटा ल्यापटपको मूल्य भ्याटबाहेक रु. 40000 र भ्याटसहित रु. 45200 छ । भ्याट रकम पत्ता लगाउनुहोस् ।
A laptop costs Rs 40000 without VAT & Rs 45200 including VAT. Find the VAT amount.

⇨ Here, SP without VAT = Rs 40,000 and SP with VAT = Rs 45200
VAT Amount = SP with VAT – SP without VAT = Rs 45200 – Rs 40,000 = Rs 5200.

6. एउटा रेडियोको मूल्य भ्याटबाहेक रु. 3200 र भ्याटसहित रु. 3600 छ । भ्याट रकम पत्ता लगाउनुहोस् ।

A radio costs Rs 3200 without VAT & Rs 3600 including VAT. Find the VAT amount.

⇨ Here, Price without VAT = Rs 3200 and Price with VAT = Rs 3600
∴ VAT Amount = Price with VAT – Price without VAT = Rs 3600 – Rs 3200 = Rs 400.

7. एउटा टेलिभिजनको मूल्य रु. 24000 छ । यदि मूल्यमा रु. 1200 छुट दिइयो भने छुट प्रतिशत कति होला ? [2057 D1]
Price of a TV is Rs 24000. If the price is discounted by Rs 1200, what is the discount percentage ?

⇨ Here, discount percentage $= \frac{\text{Rs } 1200}{\text{Rs } 24000} \times 100 = 5\%$

8. रु.62500 मूल्य पर्ने सामानमा 12% को दरले लाग्ने करको रकम निकाल्नुहोस् ।
Find the sales tax on the purchase of goods worth Rs 62,500 at 12 %. [2058 D2]

⇨ Here, the sales tax = 12% of Rs 62,500 $= \frac{12}{100} \times$ Rs 62,500 = Rs 7,500

Short Questions

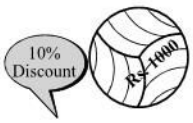
MODEL 1

1. चित्रमा देखाइएको भलिबल किन्नको लागि तपाईंले कति तिर्नुपर्दछ ?
How much should you have to pay to buy the volleyball shown in the figure? [2067 D]

⇨ Here, discount rate = 10% and Marked price = Rs 1000
We have to pay = Rs 1000 – 10% of Rs 1000

$$= 90\% \text{ of Rs } 1000 = \frac{90}{100} \times \text{Rs } 1000 = \text{Rs } 900$$

Thus, the required amount is Rs 900.



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2. एउटा क्याल्कुलेटरको अङ्कित मूल्य रु. 260 छ । 5% छुट दिँदा यसको बिक्रय मूल्य कति होला ? **[2057 C2]**
The marked price of a calculator is Rs 260. What is the selling price of it, if 5% discount is allowed ?

⇨ Here, MP = Rs 260, discount = 5%, SP = ?
We know, MP = SP + discount or, 260 = SP + 5% of 260
or, 260 – 5% of 260 = SP
$\therefore$ $SP = 260 - \frac{5 \times 260}{100} = 260 - 13 = Rs\ 247$
Thus, SP = Rs 247.

3. रु. 800 को बिलमा 5% छुट दिँदा कति रकम तिर्नुपर्ला ?
What is the cash payment of a bill amounting Rs 800 after allowing a discount of 5%?

⇨ Here, MP = Rs 800, discount = 5%, SP = ?
Now, $SP = MP \times (100 - 5)\% = 800 \times \frac{95}{100} = Rs\ 760$

4. कुनै वस्तुको मूल्यमा 12% छुटपछिको रकम रु. 1320 हुन्छ भने अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After 12% discount, the price of an article is Rs 1320. Find its marked price.

⇨ Here, discount = 12%, SP after discount = Rs 1320, MP = ?
Let, MP be x then, x – 12% of x = 1320
or, $x - \frac{12x}{100} = 1320$ or, $\frac{88x}{100} = 1320$
$\therefore$ $x = \frac{1320 \times 100}{88} = 1500.$ Thus, MP = Rs 1500.

5. एउटा सामानको अङ्कित मूल्य रु. 2000 छ । 13% भ्याटसहित बिक्रय मूल्य कति होला ?
Marked price of an article is Rs 2000. What is the selling price with 13% VAT?

⇨ Here, MP = Rs 2000, VAT = 13%, SP with VAT = ?
We know, SP with VAT = MP + VAT% of MP = 2000 + 13% of 2000 = 2000 + 260 = 2260
Thus, SP with 13% VAT = Rs 2260.

6. एउटा क्यामेराको अङ्कित मूल्य रु. 5000 छ । 13% भ्याटसहित बिक्रय मूल्य कति होला ?
Marked price of a camera is Rs 5000. What is the selling price with 13% VAT?

⇨ Here, MP = Rs 5000, VAT = 13%, SP with VAT = ?
We know, SP with VAT = MP + VAT% of MP = 5000 + 13% of 5000 = 5000 + 650 = 5650
Thus, SP with 13% VAT = Rs 5650.

7. रु. 1800 को बिलमा 5% छुट दिँदा कति रकम तिर्नुपर्ला ?
What is the cash payment of a bill amounting Rs 1800 allowing a discount of 5% ? **[2060 C]**

⇨ Here, cash payment of the bill $= Rs\ 1800 - 5\%\ of\ Rs\ 1800 = Rs\ 1800 - Rs\ 1800 \times \frac{5}{100}$
$= Rs\ 1800 - Rs\ 90 = Rs\ 1710$
Thus, the cash payment is Rs 1710.

8. एउटा वस्तुको वास्तविक मूल्यमा 15% बढाइ अङ्कित मूल्य रु. 1380 कायम गरीयो भने सो वस्तुको वास्तविक मूल्य निकाल्नुहोस् ।
The marked price of an article was fixed to Rs 1380 by increasing 15% on its actual price. Find its actual price. **[2057 B1]**

⇨ Here, suppose, actual price = Rs x Then, $x + \frac{15}{100} \times x = 1380$
or, $\frac{115x}{100} = 1380$ or, $115x = 1380 \times 100$
$\therefore$ $x = \frac{1380 \times 100}{115} = 1200$ Thus, the actual price is Rs 1200.

9. एउटा घडीको मूल्य रु. 300 छ । विजयादशमीको उपलक्ष्यमा यसको मूल्यमा 5% छुट दिइएको छ । अब सो घडीको वास्तविक मूल्य कति हुन्छ ?
Marked price of a watch is Rs 300. At the occasion of Vijayadashami 5% discount is given, then what is the actual price of the watch ? **[2072 S]**

⇨ Here, marked price (MP) = Rs 300 and rate of discount = 5%
We know that, discount amount = 5% of Rs 300 = 0.05 × Rs 300 = Rs 15
Now, actual price = marked price – discount = Rs 300 – Rs 15 = Rs 285
Thus, the actual price is Rs 285.

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10. एउटा बिजुलीको चिमको मूल्य रु. 150 छ । एउटा व्यापारीले उक्त मूल्यमा 10% छुट दिई बेच्दछ भने उसले सो चिम कतिमा बेच्दछ ?
The cost of an electric bulb is Rs 150. If a shopkeeper sells the bulb by allowing 10% discount, find the actual selling price of the bulb. [2065 M]

⇨ Here, the marked price of the bulb = Rs 150 Discount rate (R) = 10%

Discount = 10% of Rs 150 = $\frac{10}{100} \times$ Rs 150 = Rs 15

$\therefore$ SP = MP – Discount = Rs 150 – Rs 15 = Rs 135

Thus, the actual selling price is Rs 135.

11. कुनै वस्तुको अङ्कित मूल्य रु. 550 छ । यस मूल्यमा 10% छुट दिँदा यसको वास्तविक मूल्य कति हुन्छ ?
The cost of an article is Rs 550. If a shopkeeper sells the article by allowing 10% discount, find the actual selling price of the article. [SLC 2066 C, 2059 S]

⇨ Here, price of an article = Rs 550 and discount = 10%

We know that, actual price = MP – Discount = Rs 550 – 10% of Rs 550

$= \text{Rs } 550 - \frac{10}{100} \times \text{Rs } 550 = \text{Rs } 550 - \text{Rs } 55 = \text{Rs } 495$

Thus, the actual price is Rs 495.

12. एउटा क्यालकुलेटरको अङ्कित मूल्य रु. 260 छ । 5% छुट दिँदा यसको विक्रयमूल्य कति होला ?
The marked price of a calculator is Rs 260. What is the sale price of it, if 5% discount is allowed ? [2057 C2]

⇨ Here, selling price = Marked price – Discount

$= \text{Rs } 260 - 5\% \text{ of Rs } 260 = \text{Rs } 260 - \frac{5}{100} \times \text{Rs } 260 = \text{Rs } 260 - \text{Rs } 13 = \text{Rs } 247$

Thus, selling price is Rs 247.

13. एउटा घडीको विक्रय मूल्य रु. 595 छ । यदि घडीको अङ्कित मूल्यमा 15% छुट दिई बिक्री गरिएको थियो भने घडीको अङ्कित मूल्य निकाल्नुहोस् ।
The selling price of a watch is Rs 595. If the watch was sold at 15% discount on the marked price, find the marked price of the watch. [2068 C]

⇨ Here, selling price (SP) = Rs 595, Marked price (MP) = Rs x (say)
Discount rate (R) = 15%
We have, MP – Discount = SP

or, $x - 15\% \text{ of } x = 595$ or, $85\% \text{ of } x = 595$

or, $\frac{85}{100} \times x = 595$ or, $x = 595 \times \frac{100}{85} = 700$

Thus, the marked price of the watch is Rs 700.

14. गौरवले एउटा मोबाइल सेट 10% छुट पाएर रु. 15750 मा किन्यो भने उक्त मोबाइल सेटको मूल्य छुटभन्दा अगाडि कति थियो पत्ता लगाउनुहोस् ।
Gaurav bought a mobile set for Rs 15750 after allowing the discount of 10%. Find the price of the mobile set before the discount. [2065 D]

⇨ Here, discount rate = 10% Price after discount = Rs 15750
Let, marked price = x then, $x - 10\% \text{ of } x = 15750$

or, $x - \frac{10}{100} \times x = 15750$ or, $x - \frac{x}{10} = 15750$

or, $\frac{9x}{10} = 15750$ $\therefore$ $x = 17500$

Thus, the marked price = Rs 17500

15. रु. 180 मूल्य भएको एउटा खेलौनामा कति प्रतिशत छुट दिँदा क्रेताले रु. 160 मा किन्न पाउँछ ?
What percent of discount should be given in a doll costing Rs 180 such that a customer has to buy it for Rs 160 ? [2066 A]

⇨ Here, Marked price = Rs 180 and Selling price = Rs 160

We have, discount percentage $= \frac{MP - SP}{MP} \times 100\% = \frac{180 - 160}{180} \times 100\% = 11\frac{1}{9}\%$

Thus, percentage of discount is $11\frac{1}{9}\%$.

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MODEL 2

16. एउटा सामानको 15% भ्याटसहितको मूल्य रु. 690 छ । भ्याटबाहेकको मूल्य कति होला ?
The price of an article with 15% VAT is Rs 690. What will be the price excluding VAT ? [2064 A1]

⇨ Here, Rate of VAT = 15%, Price with VAT = Rs 690
Let, the price excluding VAT = Rs x Then, x + 15% of x = 690

or, $x + \frac{15}{100} \times x = 690$ or, $x + \frac{3x}{20} = 690$ or, $\frac{23x}{20} = 690$

$\therefore$ $x = 600$ Thus, the price excluding VAT is Rs 600.

17. एउटा मोबाइल सेटलाई भ्याटबाहेक रु. 30000 र भ्याटसहित रु. 33900 पर्छ । भ्याट रकम र भ्याट प्रतिशत पत्ता लगाउनुहोस् ।
A mobile set costs Rs 30000 without VAT & Rs 33900 including VAT. Find the VAT amount and the VAT percent.

⇨ Here, SP without VAT = Rs 30000 and SP with VAT = Rs 33900
VAT Amount = Rs 33900 – Rs 30000 = Rs 3900

$$\text{VAT Percent} = \frac{\text{VAT Amount}}{\text{SP without VAT}} \times 100\% = \frac{3900}{30000} \times 100\% = 13\%$$

Thus, VAT Amount is RS 3900 and VAT Percent is 13%.

18. एउटा सामानको अङ्कित मूल्य रु. 1500 छ । 10% भ्याटसहित विक्रय मूल्य कति हुन्छ ?
Marked price of an article is Rs 1,500. What is the selling price with 10% VAT ? [2057 D2]

⇨ Here, selling price with VAT = Marked price + VAT = Rs 1500 + Rs $1500 \times \frac{10}{100}$
= Rs 1500 + Rs 150 = Rs 1650

19. अङ्कित मूल्य रु. 2700 भएको कमिजमा 13% मूल्य अभिवृद्धिकर लगाउँदा जम्मा विक्रय मूल्य कति होला ? पत्ता लगाउनुहोस् ।
Find the total selling price of a shirt whose marked price is Rs 2700 when 13% VAT is levied? [2068 B]

⇨ Here, marked price = Rs 2700, VAT rate = 13%

We know that, Price with VAT = 2700 + 13% of 2700 = $2700 + \frac{13}{100} \times 2700 = 2700 + 351 = 3051$

Thus, the total selling price is Rs 3051.

20. एउटा सामानको अङ्कित मूल्य रु. 1500 छ । 10% भ्याटसहित विक्रयमूल्य कति हुन्छ ?
Marked price of an article is Rs 1500. What is the selling price with 10% VAT ? [2057 D2]

⇨ Here, selling price with VAT = Marked price + VAT
= Rs 1500 + 10% of Rs 1500 = Rs 1500 + $\frac{10}{100}$ × Rs 1500
= Rs 1500 + Rs 150 = Rs 1650

Thus, selling price is Rs 1650.

21. अङ्कित मूल्य रु.1200 भएको एउटा कमिजमा 13% मूल्य अभिवृद्धिकर लगाउँदा चुक्ता मूल्य कति हुन्छ ? [2065 E]
Find the net selling price of a shirt marked at Rs 1200 when VAT of 13% is levied.

⇨ Here, Marked Price (MP) = Rs 1200, VAT rate = 13%

We know that, Price with VAT = 1200 + 13% of 1200 = $1200 + \frac{13}{100} \times 1200 = 1200 + 156 = 1356$

Thus, the total selling price is Rs 1356.

22. रु. 5000 मूल्य भएको सामानमा 13% मूल्य अभिवृद्धिकर जोडदा हुने मूल्य पत्ता लगाउनुहोस् .
Find the price of an article with price Rs 5000 including 13% VAT. [2071 S]

⇨ Here, price = Rs 5000, VAT rate = 13%
We have, price with VAT = Rs 5000 + 13% of Rs 5000
= Rs $5000 + \frac{13}{100} \times$ Rs 5000 = Rs 5000 + Rs 650 = Rs 5650

Thus, the price with VAT is Rs 5650.

23. एउटा सामानको 13% भ्याटसहितको मूल्य रु. 1356 छ । उक्त सामानको भ्याट बाहेकको मूल्य निकाल्नुहोस् ।
The price of an article with 13% VAT is Rs 1356. Find the price of the article excluding VAT. [2067 B]

⇨ Here, VAT rate = 13% and Price with VAT = Rs 1356
Let, the price excluding VAT be Rs x Then, x + 13% of x = Price with VAT
or, 113% of x = Price with VAT or, 113% of x = Rs 1356
or, $\frac{113}{100} \times x = 1356$ or, $x = \frac{1356 \times 100}{113} = 1200$

Thus, the price excluding VAT is Rs 1200.

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24. एउटा विद्यार्थीले भ्याटसहित रु. 565 मा एउटा क्यालकुलेटर किनेछ । भ्याटदर 13% हुँदा भ्याटबाहेक सो क्यालकुलेटरको मूल्य कति होला ?
A student bought a calculator for Rs 565 including 13% VAT. What is the price of the calculator before levying VAT on it ? [2067 A]

⇨ Here, price with VAT = Rs 565 VAT rate = 13%
Let, price before VAT be Rs x then, x + 13% of x = Rs 565
or, $\frac{113}{100} \times x = 565$ or, $x = 565 \times \frac{100}{113} = 500$
Thus, the price before levying VAT = Rs 500

Long Questions

MODEL 1

1. एउटा वस्तुको अङ्कित मूल्य रु. 6000 छ, सो वस्तुमा 15% छुट दिई 13% मूल्य अभिवृद्धि कर लगाउँदा सो वस्तुको मूल्य कति हुन्छ ? पत्ता लगाउनुहोस् । साथै मूल्य अभिवृद्धिकरको रकम पनि पत्ता लगाउनुहोस् ।
The marked price of an article Rs 6000. 13% VAT is levied after allowing 15% discount on the article, what will be the price of the article ? Find it. Also find the amount of VAT. [2072 S]

⇨ Here, marked price (MP) = Rs 6000, Discount = 15%, VAT = 13%
We have, price after discount = MP – Discount = Rs 6000 – 15% of Rs 6000
= Rs 6000 – 0.15 × Rs 6000 = Rs 6000 – Rs 900 = Rs 5100
We have, VAT amount = 13% of price after discount = 0.13 × Rs 5100 = Rs 663
Now, price with VAT = Price after discount + VAT = Rs 5100 + Rs 663 = Rs 5763
Thus, the VAT amount is Rs 663 and price with VAT is Rs 5763.

2. एउटा रेडियोको अङ्कित मूल्य रु. 5000 राखिएको थियो, सो रेडियोमा 15% छुट दिई 10% भ्याट लगाउँदा सोको मूल्य कति पुग्यो ?
The marked price of a radio was Rs 5000. What will be price of the radio, if 10% VAT was levied after allowing 15% discount on it ? [2057 A1, 2063 M]

⇨ Here, marked price = Rs 5000, VAT = 10%, Discount = 15%
After allowing 15% discount the price of the radio $= \text{Rs } 5000 - \text{Rs } 5000 \times \frac{15}{100}$
$= \text{Rs } 5000 - \text{Rs } 750 = \text{Rs } 4250$
Now, price of the radio with 10% VAT $= \text{Rs } 4250 + \text{Rs } 4250 \times \frac{10}{100}$
$= \text{Rs } 4250 + \text{Rs } 425 = \text{Rs } 4675$
Thus, the price of radio is Rs 4675.

3. एउटा क्यामेराको अङ्कित मूल्य रु. 3200 छ । यसलाई पसलेले 8% छुटपछि 10% भ्याट लगाइदिन्छ भने उक्त क्यामेरालाई ग्राहकले किन्न कति तिर्नुपर्ला ?
If the marked price of camera is Rs 3200, a shopkeeper announces a discount of 8%. How much will a customer have to pay for buying the camera if 10% VAT was levied on it ? [2060 C]

⇨ Here, MP = Rs 3200, Discount = 8%, VAT = 10%
SP after discount = $\text{Rs } 3200 - \frac{8}{100} \times \text{Rs } 3200 = \text{Rs } 3200 - \text{Rs } 256 = \text{Rs } 2944$
SP of camera with VAT = $\text{Rs } 2944 + \frac{10}{100} \times \text{Rs } 2944 = \text{Rs } 2944 + \text{Rs } 294.4 = \text{Rs } 3238.40$
Thus, the price of the camera is Rs 3238.40.

4. एउटा साइकलको अङ्कित मूल्य रु. 5550 राखिएको थियो । सो साइकलमा 10% छुट दिई 15% मूल्य अभिवृद्धिकर लगाउँदा सोको मूल्य कति पर्ला ?
The marked price of a bicycle was Rs 5550. What will the price of the bicycle if 15% VAT was levied after allowing 10% discount on it ? [2062 B1]

⇨ Here, MP= Rs 5550, VAT = 15% and Discount = 10%
After allowing 10% discount, SP $= \text{MP} - \frac{10}{100} \times \text{MP} = \text{Rs } 5550 - \frac{1}{10} \times \text{Rs } 5550$
$= \text{Rs } 5550 - \text{Rs } 555 = \text{Rs } 4995$
Price of bicycle with 15% VAT $= \text{SP} + \frac{15}{100} \times \text{SP} = \text{Rs } 4995 + \frac{15}{100} \times \text{Rs } 4995$
$= \text{Rs } 4995 + \text{Rs } 749.25 = \text{Rs } 5744.25$
Thus, price of bicycle is Rs 5744.25.

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5. एउटा मोटरसाइकलको अङ्कित मूल्य रु. 150000 राखिएको थियो । सो मोटरसाइकलको मूल्यमा 10% छुट दिई 13% मूल्य अभिवृद्धिकर लगाउँदा मूल्य कति पुग्यो ?
The marked price of motorcycle was Rs 150000. What was the price of the motorcycle after 10% discount and 13% VAT included in its price. [2066 C]

⇨ Here, Marked priced = Rs 150000, Discount rate = 10%, VAT rate = 13%

We know that,

Price with VAT $= \frac{MP \times (100 - d\%) \times (100 + V\%)}{100 \times 100} = \frac{Rs\ 150000\ (100 - 10)\ (100 + 13)}{100 \times 100}$

$= Rs\ 15 \times 90 \times 113 = Rs\ 152550$

Thus, the price with VAT is Rs 152550.

6. एउटा रेडियोको अङ्कित मूल्य रु. 5210 छ । यदि पसलेले 10% छुट दिई 10% भ्याट जोडेर बेच्छ भने
The labelled price of a radio is Rs 5,210. If the shopkeeper allows 10% discount and adds 10% VAT, then
(i) ग्राहकले उक्त रेडियोको मूल्य कति तिर्नुपर्ला ? **(How much will a customer pay for the radio ?)**
(ii) यसको अङ्कित मूल्य र विक्रयमूल्यको फरक निकाल्नुहोस् ।
Find the difference between its labelled and selling price. [2057 E1]

⇨ (i) Here, marked price = Rs 5210, Discount = 10%, VAT = 10%
Price after allowing discount

$= Rs\ 5210 - Rs\ 5210 \times \frac{10}{100} = Rs\ 5210 - Rs\ 521 = Rs\ 4689$

Price with 10% VAT $= Rs\ 4689 + Rs\ 4689 \times \frac{10}{100} = Rs\ 4689 + Rs\ 468.90 = Rs\ 5157.90$

Thus, the customer should pay Rs 5157.9.

(ii) Difference between labelled and selling price $= Rs\ 5210 - Rs\ 5157.90 = Rs\ 52.10$

Thus, the required difference between MP & SP is Rs 52.10.

MODEL 2

7. एउटा मेसिनको अङ्कित मूल्यमा 10% छुट दिएपछि 10% भ्याट लगाउँदा उक्त मेसिनको अन्तिम मूल्य रु. 99000 हुन्छ । उक्त मेसिनको अङ्कित मूल्य पत्ता लगाउनुहोस् ।
After allowing 10% discount on marked price of a machine and then levying 10% VAT, the final price of machine becomes Rs 99,000. Find the marked price of the machine. [2072 C]

⇨ Here, Discount = 10%, VAT = 10% and price with VAT is Rs 99000

Let, the MP be Rs x then

Price after discount = (100 – 10)% of MP = 90% of x = 0.9 × x = 0.9x

Price with VAT = (100 + 10)% of price after discount = 110% of 0.9x = 1.1 × 0.9x = 0.99x

By the question, 0.99x = Rs 99000 or, x = Rs 100000

Thus, the marked price is Rs 100000.

8. एउटा घडीको अङ्कित मूल्यमा 20% छुट दिई 10% भ्याट जोड्दा सो घडीको मूल्य रु. 2376 भयो भने सो घडीको अङ्कित मूल्य निकाल्नुहोस् ।
Allowing 20% discount on the marked price of a watch, the value of the watch will be Rs 2376 when a VAT of 10% is added. Find its marked price. [2057 B2]

⇨ Here, Discount = 20%, VAT = 10% and Price with VAt = Rs 2376

Suppose, Marked price = x

Price after allowing 20% discount $= x - x \times \frac{20}{100} = x - \frac{x}{5} = \frac{4x}{5}$

Selling price after adding 10% VAT $= \frac{4x}{5} + \frac{4x}{5} \times \frac{10}{100} = \frac{4x}{5} + \frac{4x}{50} = \frac{40x + 4x}{50} = \frac{44x}{50}$

Here, $\frac{44x}{50} = Rs\ 2376$ or, $44x = Rs\ 2376 \times 50$

$\therefore\ x = Rs\ \frac{2376 \times 50}{44} = Rs\ 2700$ Thus, the marked price is Rs 2700.

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9. एउटा वस्तुको मूल्यमा 15% छुट गरी हुन आउने रकममा 13% मूल्य अभिवृद्धिकर लगाउँदा सो वस्तुको मूल्य रु. 13447 हुन आयो भने उक्त वस्तुको अङ्कित मूल्य पत्ता लगाउनुहोस् । [2066 B]

After allowing 15% discount on the price of an article and 13% value added tax (VAT) was levied on the remaining amount, then the price of the article becomes Rs 13447. Find the marked price of the article.

⇨ Here, let, the marked price of an article be Rs x

Then, price after discount $= x - 15\% \text{ of } x = 85\% \text{ of } x = \frac{85}{100} \times x = \frac{17x}{20}$

Now, price with VAT $= \frac{17x}{20} + 13\% \text{ of } \frac{17x}{20} = 113\% \text{ of } \frac{17x}{20}$

or, $13447 = \frac{113}{100} \times \frac{17x}{20}$ or, $\frac{13447 \times 100 \times 20}{113 \times 17} = x$

$\therefore \quad x = 14000$

Thus, the required marked price is Rs 14000.

10. एउटा साइकलमा 20% छुट र 13% मूल्य अभिवृद्धि कर लगाएर रु.9040 मा बेचियो । उक्त साइकलको अङ्कित मूल्य पत्ता लगाउनुहोस् ।

A bicycle is sold at Rs 9040 after allowing 20% discount and imposing 13% VAT. Find the marked price of the bicycle. [2067 D]

⇨ Here, final price = Rs 9040, Discount rate = 20%, Vat rate = 13%
Marked price = Rs x (Say)

We know that, SP = MP – discount $= x - 20\% \text{ of } x = 80\% \text{ of } x = \frac{80}{100} \times x = \frac{4x}{5}$

Now, SP with VAT $= \frac{4x}{5} + 13\% \text{ of } \frac{4x}{5} = 113\% \text{ of } \frac{4x}{5}$

or, Rs $9040 = \frac{113}{100} \times \frac{4x}{5}$ or, $\frac{9040 \times 100 \times 5}{113 \times 4} = x$

$\therefore \quad x = 10000$ Thus, the marked price is Rs 10000.

11. एकजना विदेशीले 15% छुटमा सामान किन्दा रु. 17289 तिरेछ । यदि सो सामानमा 13% मूल्यअभिवृद्धि कर (VAT) लगाइएको थियो भने अङ्कित मूल्य कति रहेछ ? पत्ता लगाउनुहोस् ।

A foreigner bought an article at a discount of 15% and paid Rs 17289. If 13% Value Added Tax (VAT) was levied on it, what was the marked price of the article? Find it. [2068 D]

⇨ Here, discount rate = 15%, VAT rate = 13% and Price with VAT = Rs 17289
Let, the marked price be Rs x

Then, price after discount $= x - 15\% \text{ of } x = 85\% \text{ of } x = \frac{85}{100} \times x = \frac{17x}{20}$

Now, price with VAT $= \frac{17x}{20} x + 13\% \text{ of } \frac{17x}{20}$ or, $17289 = 113\% \text{ of } \frac{17x}{20}$

or, $17289 = \frac{113}{100} \times \frac{17x}{20}$ or, $x = 17289 \times \frac{100}{113} \times \frac{20}{17}$

$\therefore \quad x = 18000$ Thus, the marked price is Rs 18000.

12. एउटा रेडियोको अङ्कित मूल्यमा 15% छुट दिई 13% भ्याट लगाउँदा सो रेडियोको मूल्य रु. 1997.84 हुन्छ भने उक्त रेडियोको अङ्कित मूल्य निकाल्नुहोस् ।

After allowing 15% discount on the marked price of a radio 13% VAT is levied, then the cost of radio becomes Rs 1997.84. Find the marked price of the radio. [2063 D1]

⇨ Here, let, the marked price of a radio be Rs x and Discount = 15%

Selling price (SP) $= \text{M. P.} - \text{discount} = x - 15\% \text{ of } x = x - \frac{15x}{100} = \frac{85x}{100} = \frac{17x}{20}$

Selling price with VAT = SP + VAT $= \frac{17x}{20} + \frac{13}{100} \times \frac{17x}{20} = \frac{17x}{20} + \frac{221x}{2000} = \frac{1921x}{2000}$

We have given that,

SP with VAT = Rs 1997.84 i.e. $\frac{1921}{2000} x = \text{Rs } 1997.84$

or, $x = \frac{\text{Rs } 1997.84 \times 2000}{1921} = \frac{\text{Rs } 3995680}{1921} = \text{Rs } 2080$

Thus, MP of the radio is Rs 2080.

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MODEL 3

13. यदि अङ्कित मूल्यमा 10% छुट दिई 15% भ्याट (VAT) जोडेर एउटा घडी रु. 1656 मा बिक्री गरियो भने छुट रकम पत्ता लगाउनुहोस् ।
If a watch was sold for Rs 1656 after allowing 10% discount on the marked price and adding 15% VAT, find the discount amount. **[2070 E]**

⇨ Here, discount = 10%, VAT = 15% and price with VAT = Rs 1656

We know that, price with VAT $= \frac{MP \times (100 - D) \times (100 + VAT)}{100 \times 100}$

or, Rs 1656 $= \frac{MP \times (100 - 10)(100 + 15)}{100 \times 100}$

or, Rs 1656 $= MP \times \frac{207}{200}$ $\quad \therefore$ MP $=$ Rs $1656 \times \frac{200}{207} =$ Rs 1600

The marked price = Rs 1600

Now, discount = 10% of MP = 0.1 × Rs 1600 = Rs 160

Thus, the discount amount is Rs 160.

14. एउटा रेडियोको अङ्कित मूल्यमा 5% छुट दिई 10% भ्याट लगाउँदा सो रेडियोको मूल्य रु. 1672 कायम भएको थियो भने, कति रकम छुट दिइएको थियो ?
After allowing 5% discount on the marked price of a radio, 10% VAT is charged on it, then its price became Rs 1672. How much amount was given in the discount ? **[2057 A2, 2067 S]**

⇨ Here, suppose, marked price = x. Then price after discount $= x - \frac{5}{100} \times x = x - \frac{x}{20} = \frac{19x}{20}$

Price with VAT $= \frac{19x}{20} \times \frac{10}{100} + \frac{19x}{20} = \frac{19x}{20} + \frac{19x}{200} = \frac{190x + 19x}{200} = \frac{209x}{200}$

By question, $\frac{209x}{200}$ = Rs 1672 $\quad$ or, $\quad x =$ Rs $\frac{1672 \times 200}{209} =$ Rs 1600.

$\therefore$ Amount of discount = 5% of Rs 1600 $= \frac{5}{100} \times$ Rs 1600 = Rs 80

Thus, the discount amount is Rs 80.

15. एउटा सामानको अङ्कित मूल्यमा 10% छुट दिई 15% भ्याट लगाउँदा सो टेलिभिजनको मूल्य रु. 16720 कायम भएको थियो भने कति रकम छुट दिइएको थियो ?
After allowing 10% discount on the marked price of an article and then 15% VAT is charged. Its price become Rs 16720. How much amount was given as discount ? **[2060 E2, 2063 A1]**

⇨ Here, let, MP = x, Discount = 10%, VAT = 15%

SP after allowing discount $= x - \frac{10}{100} \times x = x - \frac{x}{10} = \frac{9x}{10}$

Price with VAT $= \frac{9x}{10} + \frac{15}{100} \times \frac{9x}{10}$ $\quad$ or, $\quad$ Rs $16720 = \frac{9x}{10} + \frac{135x}{1000}$

or, Rs $16720 = \frac{900x + 135x}{1000}$ $\quad$ or, $\quad$ Rs $16720 \times 1000 = 1035x$

$\therefore$ x = Rs 16154.58

Amount given as discount = 10 % of x = 0.10 × Rs 16154.58 = Rs 1615.46

Thus, the discount is Rs 1615.46.

16. एउटा पसलेले 25% छुट गरी 13% मूल्य अभिवृद्धि कर (VAT) जोडेर कुनै सामान रु. 16950 मा बिक्री गऱ्यो भने सो सामानमा कति रकम छुट गरिएको थियो ?
A shopkeeper sold his goods for Rs 16950 allowing 25% discount and then levied 13% VAT, what was the amount of discount ? **[SLC 2063 B2]**

⇨ Here, let, MP = x, Discount = 25%, VAT = 13%

Actual discount $= \frac{25}{100} \times x = \frac{x}{4}$ $\quad$ SP after allowing discount $= x - \frac{x}{4} = \frac{3x}{4}$

Now, price after allowing VAT $= \frac{3x}{4} + \frac{13}{100} \times \frac{3x}{4} = \frac{300x + 39x}{400} = \frac{339x}{400}$

By the question, $\frac{339x}{400}$ = Rs 16950 $\quad$ or, $\quad x = \frac{\text{Rs } 16950 \times 400}{339} =$ Rs 20000

Thus, Amount of discount $= \frac{x}{4} = \frac{\text{Rs } 20000}{4} =$ Rs 5000

Thus, the discount is Rs 5000.

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17. एउटा कम्प्युटरको अङ्कित मूल्यमा 25% छुट दिई हुन आउने रकममा 15% मूल्य अभिवृद्धि कर लगाइएको थियो । यदि सो कम्प्युटरको मूल्य रु. 17250 कायम भयो भने कति रकम छुट दिइएको थियो ?

After allowing 25% discount on the marked price of a computer, 15% VAT was levied on it. If its price becomes Rs 17250, how much amount was given in the discount ? **[2064 C2]**

⇨ Here, discount rate = 25%, VAT rate = 15%, Price with VAT = Rs 17250

Let, the marked price (MP) = Rs x

Price after discount $= x - 25\% \text{ of } x = 75\% \text{ of } x = \frac{75}{100} \times x = \frac{3x}{4}$

Price with VAT $= \frac{3x}{4} + 15\% \text{ of } \frac{3x}{4} = \frac{3x}{4} + \frac{15}{100} \times \frac{3x}{4} = \frac{3x}{4} + \frac{3}{20} \times \frac{3x}{4} = \frac{3x \times 20 + 3 \times 3x}{80} = \frac{69x}{80}$

From the question, $\frac{69x}{80} = 17250$ or, $x = 17250 \times \frac{80}{69}$ $\therefore$ $x = 20000$

Now, Discount $= 25\% \text{ of } x = \frac{25}{100} \times 20000 = 5000$

Thus, the discount amount is Rs 5000.

MODEL 4

18. एउटा काठको कलात्मक झ्यालको 15% छुट सहितको मूल्यमा 10% मूल्य अभिवृद्धि कर (VAT) जोडेर एउटा पर्यटकले रु. 5610 तिर्‍यो भने, नेपाल छोड्ने बेलामा उसले कति रकम फिर्ता पाउँछ ? पत्ता लगाउनुहोस् ।

If a tourist paid Rs 5610 for a carved window made of wood with a discount of 15% including 10% value added tax (VAT), how much does he get back while leaving Nepal? Find it. **[2071 A]**

⇨ Here, let marked price be Rs x Discount = 15%

So, SP $= MP - \text{Discount} = x - 15\% \text{ of } x = x - \frac{15}{100} \times x = \frac{85x}{100}$ $\therefore$ $SP = \frac{17x}{20}$

VAT amount $= 10\% \text{ of } SP = \frac{10}{100} \times \frac{17x}{20} = \frac{17x}{200}$

Given, price with VAT = 5610

$\frac{17x}{20} + \frac{17x}{200} = 5610$ or, $x = 5610 \times \frac{200}{187}$

$\therefore$ $x = 6000$

Now, VAT amount $= \frac{17x}{200} = \frac{17 \times 6000}{200} = 510$ Thus, the VAT amount is Rs 510.

19. एउटा वस्तुको अङ्कित मूल्यमा 15% छुट दिई 13% VAT लगाएर रु. 19210 मा बेचियो भने अङ्कित मूल्य र VAT रकम पत्ता लगाउनुहोस् ।

After allowing 15% discount on the marked price of an article and levying 13% VAT, the price of the article become Rs 19210. Find the marked price and VAT. **[2071 C]**

⇨ Here, let MP = Rs x Discount rate = 15%, VAT rate = 13%

Price with VAT = Rs 19210, MP = ? VAT = ?

We have, $SP = MP - \text{Discount} = x - 15\% \text{ of } x = 85\% \text{ of } x = \frac{85}{100} \times x$ $\therefore$ $SP = \frac{17x}{20}$

We know that, VAT amount $= 13\% \text{ of } SP = \frac{13}{100} \times \frac{17x}{20} = \frac{221x}{2000}$

Price with VAT = 19210 or, $\frac{17x}{20} + \frac{221x}{2000} = 19210$

or, $\frac{1921x}{2000} = 19210$ $\therefore$ $x = 20000$

Now, marked price = Rs 20000 VAT amount $= \frac{221 \times 20000}{2000} = 2210$

Thus, the marked price and VAT are Rs 200000 and 2210 respectively.

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20. एउटा साइकलको अङ्कित मूल्यमा 15% छुट दिई 10% भ्याट लगाउँदा सो साइकलको मूल्य रु. 4488 कायम भएको थियो भने कति रकम भ्याट लगाइएको थियो ?

After allowing 15% discount on the marked price of a cycle and 10% VAT levied on it, its price was fixed to be Rs 4488. What amount of VAT was levied ? [2060 E1]

⇨ Here, suppose, MP = x, Discount = 15%, VAT = 10%

SP after allowing 15% discount = MP – 15% of MP = $x - \frac{15}{100} \times x = \frac{85x}{100} = \frac{17x}{20}$

Actual SP with VAT = SP + 10% of SP = $\frac{17x}{20} + \frac{10}{100} \times \frac{17x}{20} = \frac{17x}{20} + \frac{17x}{200} = \frac{170x + 17x}{200} = \frac{187x}{200}$

By the question, $\frac{187x}{200}$ = Rs 4488 or, 187x = Rs 4488 × 200

$x = \text{Rs}\ \frac{4488 \times 200}{187} = \text{Rs}\ 24 \times 200 = \text{Rs}\ 4800$

Then, Amount of VAT = 10% of $\frac{17x}{20} = \frac{10}{100} \times \frac{17x}{20} = \frac{17 \times \text{Rs}\ 4800}{200} = 17 \times \text{Rs}\ 24 = \text{Rs}\ 408$

Thus, amount of VAT is Rs 408.

21. मनिषाले एउटा टेलिभिजनसेटलाई 15% छुट दिई 10% भ्याटसहित रु. 7480 मा किनिन् भने उक्त टेलिभिजन सेटको वास्तविक मूल्य र भ्याट रकम कति होला ?

Manisha buys a television set with 10% VAT after allowing her 15% discount for Rs7480. What was the actual price of television set and amount of VAT ? [2058 C2]

⇨ Here, suppose, actual price = x, VAT = 10%, Discount = 15%

Price after allowing discount = x – 15% of x = $x - \frac{15}{100} \times x = \frac{85x}{100} = \frac{17x}{20}$

Now, the price paid with VAT = $\frac{17x}{20}$ + 10% of $\frac{17x}{20}$ or, Rs 7480 = $\frac{17x}{20} + \frac{10}{100} \times \frac{17x}{20}$

or, Rs 7480 = $\frac{17x}{20} + \frac{17x}{200} = \frac{170x + 17x}{200} = \frac{187x}{200}$

or, Rs 7480 × 200 = 187x ∴ $x = \frac{\text{Rs}\ 7480 \times 200}{187} = \text{Rs}\ 8000$

Amount of VAT = 10% of $\frac{17x}{20} = \frac{10}{100} \times \frac{17 \times 8000}{20} = \text{Rs}\ 680$

Thus, actual price of TV = Rs 8000 and VAT amount = Rs 680.

22. एउटा मेसिनको अङ्कित मूल्यमा 10% छुट गरी 10% VAT (मूल्य अभिवृद्धि कर) लगाउँदा सो मेसिनको मूल्य रु. 99000 कायम भयो भने छुट र VAT रकम पत्ता लगाउनुहोस् ।

A machine is sold at Rs 99000 after 10% discount and 10% VAT on the marked price. Find the discount and VAT amount. [SLC Model 2065]

⇨ Here, Discount rate = 10%, VAT rate = 10%, Price with VAT = Rs 99000

Let, the marked price be Rs x,

Selling price (SP) = MP – Discount = x – 10% of x = $x - \frac{10}{100} \times x = \frac{9x}{10}$

= SP + VAT = $\frac{9x}{10} + \frac{10}{100} \times \frac{9x}{10} = \frac{9x}{10} + \frac{9x}{100}$

By question, $\frac{99x}{100}$ = Rs 99000 or, $x = \text{Rs}\ 99000 \times \frac{100}{99}$ ∴ x = Rs 100000

Selling price (SP) = $\frac{9x}{10} = \frac{9 \times 100000}{10} = \text{Rs}\ 90000$

Discount = 10% of MP = 10% of Rs 100000 = $\frac{10}{100} \times \text{Rs}\ 100000 = \text{Rs}\ 10000$

VAT amount = 10% of Rs 90000 = $\frac{10}{100} \times \text{Rs}\ 90000 = \text{Rs}\ 9000$

Thus, the discount and VAT amount are Rs 10000 and Rs 9000.

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23. एउटा वस्तुको अङ्कित मूल्यमा 16% छुट गरी 13% मूल्य अभिवृद्धि कर लगाउँदा सो वस्तुको मूल्य रु. 9429 हुन्छ भने मूल्य अभिवृद्धि कर पत्ता लगाउनुहोस् ।

After allowing 16% discount on the marked price of an article and levying 13% value added tax, then the price of the article becomes to Rs 9429. Find the value added tax. [SLC 2065 B]

⇨ Here, let, the marked price be Rs x Discount rate = 16%

VAT = 13% Price with VAT = Rs 9429

We know that,

Price after discount $= (100 - 16)\%$ of $x = 84\%$ of $x = \frac{21x}{25}$

And, price with VAT $= (100 + 13)\%$ of $\frac{21x}{25}$ or, $9429 = \frac{113}{100} \times \frac{21x}{25}$

or, $\frac{9429 \times 100 \times 25}{113 \times 21} = x$ $\therefore$ $x = \text{Rs } 9933.63$

Now, VAT $= 13\%$ of $\frac{21x}{25} = \frac{13}{100} \times \frac{21 \times 9933.63}{25} = \text{Rs } 1084.75$

Thus, the VAT amount is Rs 1084.75.

24. एउटा कलर टि.भी. 10% छुट दिई 15% भ्याट (मूल्य अभिवृद्धिकर) लगाएर रु. 20,700 मा बेचियो भने भ्याट पत्ता लगाउनुहोस् ।

A color T.V. is sold at Rs 20,700 after 10% discount with 15% VAT. Find the VAT. [SLC 2065 D]

⇨ Here, discount rate = 10%, VAT rate = 15% and Price with VAT = Rs 20700

By the question,

115% of price after discount = Rs 20700 1% of price after discount = Rs $\frac{20700}{115}$

15% of price after discount = Rs $\frac{20700}{115} \times 15$ $\therefore$ VAT = Rs 2700

Thus, the VAT is Rs 2700.

25. एउटा घडीको अङ्कित मूल्यमा 10% छुट दिई 15% VAT सहित रु. 4140/- मा विक्री गरियो भने छुट रकम र VAT रकम कति कति होला ?

A watch is sold at Rs 4140/- after allowing 10% discount on the marked price and adding 15% VAT. Find the discount and VAT amount. [2067 E]

⇨ Here, discount rate = 10%, VAT rate = 15%, Price with VAT = Rs 4140

Let, the marked price (MP) = Rs x Discount = 10 % of $x = \frac{10}{100} \times x = \frac{x}{10}$

Price after discount = MP – Discount $= x - \frac{x}{10} = \frac{9x}{10}$

VAT $= 15\%$ of $\frac{9x}{10} = \frac{15}{100} \times \frac{9x}{10} = \frac{27x}{200}$

SP with VAT = SP + VAT $= \frac{9x}{10} + \frac{27x}{200} = \frac{180x + 27x}{200} = \frac{207x}{200}$

From the question, $\frac{207x}{200} = 4140$ or, $x = 4140 \times \frac{200}{207}$ $\therefore$ $x = \text{Rs } 4000$

Now, Discount $= \frac{x}{10} = \frac{4000}{10} = \text{Rs } 400$ and VAT $= \frac{27x}{200} = \frac{27 \times 4000}{200} = \text{Rs } 540$

Thus, the discount amount is Rs 400 and VAT amount is Rs 540.

MODEL 5

26. एक पर्यटकले अङ्कित मूल्यमा 15% छुट लिई 13% मूल्य अभिवृद्धि कर (VAT) तिरेर एउटा नेपाली थाङ्का किनेछ । जब उ आफ्नो देश फर्किन्छ, विमानस्थलमा मूल्य अभिवृद्धि कर (VAT) रकम वापत रु. 663 फिर्ता आउँछ भने उक्त थाङ्काको अङ्कित मूल्य र मूल्य अभिवृद्धि कर (VAT) सहितको विक्रय मूल्य पत्ता लगाउनुहोस् ।

A tourist buys a Nepali Thanka at 15% discount on the marked price with 13% value added tax (VAT). When he returned to his own country he got Rs 663 back for value added tax (VAT) at the airport, find the marked price and the selling price including value added tax (VAT). [2071 B]

⇨ Here, let the marked price (MP) = Rs x

We have, SP = MP – Discount $= x - 15\%$ of $x = x - \frac{15}{100} \times x = \frac{85x}{100}$ $\therefore$ SP $= \frac{17x}{20}$

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Again, VAT amount = Rs 663

or, 13% of SP = Rs 663 or, $\frac{13}{100} \times \frac{17x}{20} = \text{Rs } 663$

$\therefore \quad x = \frac{663 \times 20 \times 100}{13 \times 17} = 6000$

Now, SP with VAT $= \text{SP} + \text{VAT} = \frac{17x}{20} + 663 = \frac{17 \times 6000}{20} + 663 = 5100 + 663 = 5763$

Thus, the marked price and the SP with VAT are Rs 6000 and Rs 5763 respectively.

27. एक पर्यटकले अङ्कित मूल्यमा 20% छुट लिई 13% मूल्य अभिवृद्धि कर (VAT) तिरेर एउटा मूर्ति किनेछ । जब उ आफ्नो देश फर्किन्छ, विमानस्थलमा मूल्य अभिवृद्धि कर (VAT) रकम वापत रु. 1872 फिर्ता पाउँछ भने उक्त मूर्तिको अङ्कित मूल्य र अभिवृद्धि कर (VAT) सहितको विक्रय मूल्य पत्ता लगाउनुहोस् ।
A tourist buys a statue at 20% discount on the marked price with 13% value added tax (VAT). When he returned to his own country he got Rs 1872 back for value added tax (VAT) at the airport, find the marked price and the selling price including value added tax (VAT) of the statue. [2071 S]

⇨ Here, Discount rate = 20%, VAT rate = 13% VAT amount = Rs 1872

Let, MP be Rs x then, SP = MP – Discount = x – 20% of x $= x - \frac{20}{100} \times x = x - \frac{x}{5} = \frac{4x}{5}$

Again, amount of VAT = 13% of $\frac{4x}{5} = 1872$ or, $1872 = \frac{13}{100} \times \frac{4x}{5}$

or, $13 \times 4x = 100 \times 5 \times 1872$ or, $x = \frac{100 \times 5 \times 1872}{13 \times 4} = 18000$

Now, SP with VAT $= \text{SP} + \text{VAT} = \frac{4x}{5} + 1872 = \frac{4 \times 18000}{5} + 1872 = 16272$

Thus, the marked price is Rs 18000 and SP with VAT is Rs 16272.

28. एउटा रेडियोको अङ्कित मूल्यमा 20% छुट दिई सो रकममा 10% भ्याट जोडेर बेचियो । यदि किन्ने मानिसले रु. 320 भ्याट तिरेको थियो भने कति रकम उसले छुट पाएको थियो ?
After allowing 20% discount on the marked price and then levying 10%, VAT, the radio was sold. If buyer had paid Rs 320 for VAT, how much had he got the discount ? [2059 A1]

⇨ Here, suppose, marked price = x and Actual discount $= x \times \frac{20}{100} = \frac{x}{5}$

Selling price after allowing discount $= x - \frac{x}{5} = \frac{4x}{5}$ VAT $= \frac{4x}{5} \times \frac{10}{100} = \frac{2x}{25}$

According to the question, VAT = Rs 320

or, $\frac{2x}{25} = \text{Rs } 320$ or, $2x = \text{Rs } 320 \times 25 \quad \therefore \quad x = \text{Rs } \frac{320 \times 25}{2} = \text{Rs } 4000$

Thus, discount got by him $= \frac{x}{5} = \frac{\text{Rs } 4000}{5} = \text{Rs } 800$

29. एउटा व्यक्तिले 13% छुटमा एउटा वस्तु किन्दा 16% भ्याट तिर्छ । यदि उसले तिरेको भ्याटको रकम रु. 261 भए वस्तुको अङ्कित मूल्य र सो वस्तु किन्दा उसले तिरेको रकम पनि पत्ता लगाउनुहोस् ।
A person buys an article at a discount of 13% and pays 16% VAT. If he pays Rs 261 for VAT, find the marked price of the article and also the amount paid by him to buy the article. [2067 C]

⇨ Here, VAT rate = 16%, Discount rate = 13%, VAT amount = Rs 261

Let, the marked price be Rs x So, discount = 13% of Rs $x = \frac{13}{100} \times x = \frac{13x}{100}$

SP = MP – discount $= x - \frac{13x}{100} = \frac{87x}{100}$ VAT = 16% of $\frac{87x}{100}$

or, $261 = \frac{16}{100} \times \frac{87x}{100}$ or, $\frac{261 \times 100 \times 100}{16 \times 87} = x \quad \therefore \quad x = 1875$

Now, price with VAT = SP + VAT $= \frac{87x}{100} + 261 = \frac{87 \times 1875}{100} + 261 = 1892.25$

Thus, the SP with VAT is Rs 1892.25 and the marked price is Rs 1875.

30. एकजना पर्यटकले अङ्कित मूल्यमा 15% छुट लिई 5% भ्याट तिरेर एउटा वस्तु किनेछ । यदि उसले भ्याट बराबरको मूल्य रु. 850 तिर्छ भने उक्त वस्तुको अङ्कित मूल्य र भ्याटसहितको विक्रयमूल्य पत्ता लगाउनुहोस् ।
A tourist buys an article at 15% discount on the mark price and he pays 5% VAT. If the VAT amounts to Rs 850, find the marked price and the selling price including the VAT. [2063 C1]

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⇨ Here, let MP = Rs x then, Price after discount = MP – discount = x – 15% of x = $x - \frac{15}{100} \times x = \frac{85x}{100}$

Amount of VAT = $\frac{85x}{100} \times \frac{5}{100} = \frac{17x}{400}$

By questions, $\frac{17x}{400}$ = Rs 850 or, 17x = Rs 850 × 400

∴ $x = \frac{\text{Rs } 850 \times 400}{17}$ = Rs 20000

Selling price including the VAT $= \frac{85x}{100} + \text{Rs } 850 = \frac{85}{100} \times \text{Rs } 20000 + \text{Rs } 850$

= Rs 17000 + Rs 850 = Rs 17850

Thus, MP = Rs 20000, SP including VAT = Rs 17850

31. एउटा पर्यटकले **15%** छुटमा नेपाली झण्डा किन्दछ तर उसले **10%** भ्याट पनि तिर्छ । यदि उसले तिरेको भ्याट रकम रु. **170** छ भने:

A tourist buys a Nepalese flag at a discount of 15% but pays 10% VAT. If he pays Rs 170 for VAT, find:

(क) झण्डाको अङ्कित मूल्य र **(Marked price of the flag.)**

(ख) झण्डा किन्दा उसले तिरेको रकम निकाल्नुहोस् । **(Amount he paid for the flag while buying.)** **[2065 C]**

⇨ Here, discount rate = 15%, VAT rate = 10%, VAT amount = Rs 170

Let, the marked price be Rs x

Then SP = (100 – 15)% of Rs x = $\frac{85}{100} \times \text{Rs } x = \text{Rs } \frac{17x}{20}$ & VAT = 10% of SP

or, Rs 170 = $\frac{10}{100} \times \text{Rs } \frac{17x}{20}$ or, $\frac{170 \times 100 \times 20}{10 \times 17} = x$

∴ x = 2000

(a) Marked price = Rs 2000

(b) Amount paid for flag = SP + VAT = Rs $\frac{17x}{20}$ + Rs 170 = Rs $\frac{17 \times 2000}{20}$ + Rs 170

= Rs 1700 + Rs 170 = Rs 1870

Thus, marked price & selling price of the flag are Rs 2000 and Rs 1870 respectively.

MODEL 6

32. एउटा सामानको अङ्कित मूल्य रु. **2200** छ । यदि सो सामानमा केही प्रतिशत छुट दिई **13%** मूल्य अभिवृद्धिकर **(VAT)** लगाएर रु. **2063.38** मा बेचिन्छ भने छुट प्रतिशत पत्ता लगाउनुहोस् ।

The marked price of an article is Rs 2200. After allowing a certain percent of discount with 13% Value Added Tax (VAT) levied, the articles is sold at Rs 2063.38. Find the discount percent. **[2068 A, 2063 E2]**

⇨ Here, MP = Rs 2200, Discount rate = d%, VAT rate = 13% Final price = Rs 2063.38

Price after discount (SP) = Rs 2200 – d% of Rs 2200 ∴ SP = Rs 2200 (1 – d%)

Price with VAT = 113% of SP = $\frac{113}{100} \times 2200\ (1 - d\%)$

or, 2063.38 = 2486 (1 – d%) or, 0.83 = 1 – d%

or, d% = 0.17 or, $\frac{d}{100} = 0.17$ ∴ d = 17

Thus, the discount rate is 17%.

33. एउटा बाइसाइकलको अङ्कित मूल्य रु. **2000** छ । विक्रेताले केही छुट दिई उक्त साइकल बेचेछ । यदि ग्राहकले **13%** मूल्य अभिवृद्धिकरसहित रु. **1921** मा किनेछ भने छुटको रकम पत्ता लगाउनुहोस् ।

The marked price of a bicycle is Rs 2000. If the shopkeeper allows some discount and a customer bought it for Rs 1921 including 13% VAT, how much amount was given in the discount ? **[2062 C1]**

⇨ Here, MP = Rs 2000 Let, Rs x be the discount allowed by the shopkeeper.

Then, Selling price (SP) = MP – x = Rs (2000 – x)

Price of bicycle with 13% VAT = SP + SP × $\frac{13}{100}$ = (2000 – x) + (2000 – x) $\frac{13}{100}$

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$= 2000 - x + 260 - \frac{13x}{100} = 2260 - x - \frac{13x}{100}$

Since, the customer bought the bicycle for Rs 1921.

$2260 - x - \frac{13x}{100} = 1921$ or, $2260 - 1921 = x + \frac{13x}{100}$

or, $339 = \frac{113}{100}\, x$ or, $339 \times 100 = 113x$ $\therefore\ x = \frac{339 \times 100}{113} = 300$

Thus, Rs 300 was given as discount.

34. एउटा वस्तुको अङ्कित मूल्य रु. 4500 छ । यदि सो वस्तुमा केही प्रतिशत छुट दिई 10% भ्याट लगाएर रु. 4400 मा बेच्छ भने छुट प्रतिशत पत्ता लगाउनुहोस् ।

The marked price of an article is Rs 4,500. After allowing some percent of discount with 10% VAT levied, the article is sold at Rs 4400, find the discount percent. **[2063 E1]**

⇨ Here, let, MP = Rs 4,500 and amount of discount = x

SP after allowing discount = MP – x = Rs 4,500 – x

The SP with VAT = (Rs 4,500 – x) + Rs (4500 – x) × $\frac{10}{100}$

or, $\text{Rs } 4{,}400 = \text{Rs } 4{,}500 - x + \text{Rs } 450 - \frac{x}{10}$ or, $\text{Rs } 4{,}400 = \text{Rs } 4950 - x - \frac{x}{10}$

or, $\text{Rs } 4{,}400 - \text{Rs } 4950 = -\frac{10x + x}{10}$ or, $-\text{Rs } 550 = -\frac{11x}{10}$

or, $\text{Rs } 5500 = 11x$ $\therefore$ $x = \text{Rs } 500$

$\therefore$ Actual discount = Rs 500

Now, Percent of discount = $\frac{\text{Actual discount}}{\text{MP}} \times 100\% = \frac{\text{Rs } 500}{\text{Rs } 4500} \times 100\% = 11.11\%$

Thus, required discount rate is 11.11%.

35. एउटा सामानको अङ्कित मूल्य रु. 4000 छ । यदि 13% मूल्य अभिवृद्धि कर (VAT) पछिको मूल्य रु. 3616 भए उक्त सामानमा दिइएको छुट प्रतिशत निकाल्नुहोस् ।

The marked price of an article is Rs 4000. If the price of the article including 13% VAT is Rs 3616, find the discount percentage given in it. **[SLC 2066 A]**

⇨ Here, let, the price before VAT = x Then, x + 13% of x = 3616

or, 113% of x = 3616 $\therefore$ $x = 3616 \times \frac{100}{113} = \text{Rs } 3200$

$\therefore$ MP = 4000, SP = 3200

Discount rate = $\frac{\text{MP} - \text{SP}}{\text{MP}} \times 100\% = \frac{4000 - 3200}{4000} \times 100\% = 20\%$

Thus, the required discount rate is 20%.

36. एउटा कारको अङ्कित मूल्यमा 10% छुट दिई 15% VAT लगाउँदा यसको मूल्य रु. 450300 हुन्छ भने कति रकम छुट दिइएको होला ?

After allowing 10% discount on the marked price of a car, 15% VAT is charged on it, then its price becomes Rs 450300. How much amount was given in the discount? **[2064 D1]**

⇨ Here, discount = 10%, VAT = 15% and Price with VAT = Rs 450300

We know that,

Price with VAT = $\frac{\text{MP} \times (100 - \text{D}\%)\,(100 + \text{VAT}\%)}{100 \times 100}$

$450300 = \frac{\text{MP} \times (100 - 10)\,(100 + 15)}{100 \times 100}$

or, $\text{MP} = \frac{450300 \times 100 \times 100}{90 \times 115}$

$\therefore$ MP = 435072.46

Now, Discount = $435072.46 \times \frac{10}{100} = 43507.246$

Thus, Rs 43507.246 was given in discount.

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MODEL 7

37. अङ्कित मूल्यमा 25% छुट दिई 15% भ्याट लगाई एउटा सामान बेचियो । यदि छुट रकम रु. 1000 भए सो सामानको भ्याटसहितको विक्रयमूल्य पत्ता लगाउनुहोस् ।

After allowing 25% discount on the marked price and levying 15% VAT, an article was sold. If the discount amount is Rs 1000, Find the selling price of the article including VAT. [2070 A]

⇨ Here, Discount = 25% , VAT = 15% and Discount amount = Rs 1000

Let the MP be Rs x. Discount = 25% of x

or, Rs 1000 = 0.25 × x ∴ x = Rs 4000

Thus, the MP is Rs 4000.

Price after discount = MP – Discount = Rs 4000 – Rs 1000 = Rs 3000

Now, price with VAT = Rs 3000 + 15% of Rs 3000 = Rs 3000 + 0.15 × Rs 3000 = Rs 3450

Thus, the price with VAT is Rs 3450.

38. एउटा साइकल अङ्कित मूल्यमा **25%** छुट दिई सो रकममा **10%** भ्याट जोडेर बेचियो । यदि छुट रकम रु. **750** थियो भने सो साइकलमा कति रकम भ्याट लगाइएको थियो ?

After allowing 25 % discount on the marked price and then levying 10% VAT, a cycle was sold. If the discounted amount was Rs 750, how much VAT was levied on the price of the cycle ? [2059 A2]

⇨ Here, suppose marked price = x Actual discount = $x \times \frac{25}{100} = \frac{x}{4}$

By question, Actual discount = Rs 750 or, $\frac{x}{4}$ = Rs 750

∴ x = Rs 750 × 4 = Rs 3000

Now, the SP after allowing discount = MP – actual discount = Rs 3000 – Rs 750 = Rs 2250

∴ VAT = Rs 2250 × $\frac{10}{100}$ = Rs 225

Thus, the amount of VAT is Rs 225.

39. अङ्कित मूल्य रु. **2000** र छुट **10%** भएको एउटा वस्तुलाई ग्राहकले मूल्य अभिवृद्धिकरसहित मूल्य रु. **2034** मा किनेछ भने कति प्रतिशत अभिवृद्धिकर लगाइएको थियो ?

The marked price of an article is Rs 2,000 and the shopkeeper allows 10% discount. After levying VAT, if a customer pays it Rs 2,034, what percentage of VAT was charged ? [2062 C2]

⇨ Here, MP = Rs 2000.

SP = selling price after allowing 10% discount = MP – MP × $\frac{10}{100}$

= Rs 2000 – Rs 2000 × $\frac{10}{100}$ = Rs 2000 – Rs 200 = Rs 1800

Since the customer pays Rs 2034 with VAT,

Amount of VAT = Rs 2034 – Rs 1800 = Rs 234

∴ Percentage of VAT = $\frac{\text{Rs } 234}{\text{Rs } 1800} \times 100 = 13\%$

Thus, VAT percentage is 13%.

MODEL 8

40. रु. **1200** मा किनिएको घडी **20%** छुट दिएर बेच्दा पनि $33\frac{1}{3}\%$ नाफा गर्न अङ्कित मूल्य कति राख्नुपर्ला ? यसको विक्रयमूल्य पनि पत्ता लगाउनुहोस् ।

A watch was bought for Rs 1200. At what labelled price should it be sold to gain $33\frac{1}{3}$ % after its discount 20%. Find also its selling price. [2057 E2]

⇨ Here, cost price = Rs 1200, Suppose, labelled price = x

Then, selling price after allowing discount = $x - \frac{20}{100} \times x = x - \frac{x}{5} = \frac{4x}{5}$

Profit that should be done = $33\frac{1}{3}\% \times \text{Rs } 1200 = \text{Rs } 1200 \times \frac{100}{3\times100} = \text{Rs } 400$

Now, selling price = cost price + profit

or, $\frac{4x}{5}$ = Rs 1200 + Rs 400 or, $\frac{4x}{5}$ = Rs 1600

∴ x = Rs $\frac{1600 \times 5}{4}$ = Rs 2000 Hence, labelled price = Rs 2000.

and selling price = cost price + profit = Rs 1200 + Rs 400 = Rs 1600

Thus, selling price is Rs 1600 and labelled price is Rs 2000.

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B. QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 2.1]

1. तल दिइएको तालिकाबाट प्रत्येक अवस्थामा मूल्य अभिवृद्धि करसहितको मूल्य पत्ता लगाउनुहोस् :
In each of the following condition, find the price including VAT from the given table:

क्र.सं. S.N.	अङ्कित मूल्य Marked price	छुट % Discount%	भ्याट % VAT%	भ्याटसहितको मूल्य Price Including VAT
(a)	Rs 3200	–	13%	?
(b)	Rs 52100	10%	13%	?
(c)	Rs 60000	15%	13%	?
(d)	Rs 85000	13%	13%	?
(e)	Rs 250000	15%	13%	?

⇨ (a) Here, MP = Rs 3200, VAT = 13%

Price including VAT = MP + VAT = Rs 3200 + 13% of Rs 3200
= Rs 3200 + 0.13 × Rs 3200 = Rs 3616

Thus, the price including VAT is Rs 3616.

(b) Here, MP = Rs 52100, Discount = 10% and VAT = 13%

We know that,

Price after discount = MP – Discount = Rs 52100 – 10% of Rs 52100
= Rs 52100 – 0.1 × Rs 52100 = Rs 46890

Again, price with VAT = Price after discount + VAT = Rs 46890 + 13% of Rs 46890
= Rs 46890 + Rs 6095.70 = Rs 52985.70

Thus, the required price with VAT is Rs 52985.70.

(c) Here, MP = Rs 60000, Discount = 15% and VAT = 13%

We know that,

Price after discount = MP – Discount = Rs 60000 – 15% of Rs 60000
= Rs 60000 – 0.15 × Rs 60000 = Rs 60000 – Rs 9000
= Rs 51000

Now, price with VAT = Price after Discount + VAT = Rs 51000 + 13% of Rs 51000
= Rs 51000 + 0.13 × Rs 51000 = Rs 51000 + Rs 6630
= Rs 57630

Thus, the price with VAT is Rs 57630.

(d) Here, MP = Rs 85000, Discount = 13% and VAT = 13%

We know that,

Price after discount = MP – Discount = Rs 85000 – 13% of Rs 85000
= Rs 85000 – 0.13 × Rs 85000 = Rs 85000 – Rs 11050
= Rs 73950

Now, price with VAT = Price after discount + VAT = Rs 73950 + 13% of Rs 73950
= Rs 73950 + 0.13 × Rs 73950 = Rs 73950 + Rs 9613.50
= Rs 83563.50

Thus, the price with VAT is Rs 83563.50.

(e) Here, MP = Rs 250000, Discount 15% and VAT = 13%

We know that,

Price after Discount = MP – Discount = Rs 250000 – 15% of Rs 250000
= Rs 250000 – 0.15 × Rs 250000 = Rs 250000 – Rs 37500
= Rs 212500

Now, price with VAT = Price after discount + VAT =Rs 212500 + 13% of Rs 212500
= Rs 212500 + 0.13 × Rs 212500
= Rs 212500 + Rs 27625 = Rs 240125

Thus, the price with VAT is Rs 240125.

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2. तल दिइएको तालिकाबाट प्रत्येक अवस्थामा मूल्य अभिवृद्धि करसहितको मूल्य पत्ता लगाउनुहोस् :
In each of the following condition, find the price including VAT from the given table:

क्र.सं. S.N.	छुट % Discount %	भ्याट % VAT%	भ्याटसहितको मूल्य (रु.) Price Including VAT	अङ्कित मूल्य Marked Price
(a)	5%	13%	Rs 5763	?
(b)	10%	10%	Rs 30510	?
(c)	25%	13%	Rs 3390	?
(d)	15%	13%	Rs 57630	?
(e)	12%	13%	Rs 119328	?

⇨ (a) Here, Discount = 5%, VAT = 13%, Price with VAT = Rs 5763
Let, marked price (MP) be Rs x.
Price after discount = MP – Discount = Rs x – 5% of Rs x
= 95% of Rs x = Rs 0.95x
Price with VAT = Price after discount + VAT = Rs 0.95x + 13% of Rs 0.95x
= Rs 0.95x + 0.13 × Rs 0.95x = Rs 0.95x + 0.1235x
or, Rs 5763 = Rs 1.0735x
$\therefore \quad x = \frac{5763}{1.0735} = 5368.42$ Thus, the marked price Rs 5368.42.

(b) Here, Discount = 10% , VAT = 10% and Price with VAT = Rs 30510
Let, MP be Rs x.
We have, price after discount = MP – Discount = Rs x – 10% of Rs x
= 90% of x = 0.9x
Again, Price with VAT = Price after discount + VAT = 0.9x + 10% of 0.9x
= 110% of 0.9x = 1.1 × 0.9x
or, 30510 = 0.99x
$\therefore \quad x = \frac{30510}{0.99} = 30818.18$ Thus, the marked price is Rs 30818.18.

(c) Here, Discount = 25%, VAT = 13% and Price with VAT = Rs 3390
Let, MP be Rs x.
We have, price after discount = MP – Discount = Rs x – 25% of Rs x
= 75% of Rs x = 0.75 × Rs x = Rs 0.75x
Again, price with VAT = Price after discount + VAT
= Rs 0.75x + 13% of Rs 0.75x = 113% of Rs 0.75x
= 1.13 × Rs 0.75x
or, 3390 = 0.8475x
$\therefore \quad x = \frac{3390}{0.8475} = 4000$ Thus, the marked price is Rs 4000.

(d) Here, Discount = 15%, VAT = 13% and Price with VAT = Rs 57630
We know that,
Price after Discount = MP – Discount = MP – 15% of MP
= 85% of MP = 0.85 × MP
Again, price with VAT = Price after Discount + VAT = 0.85 MP + 13% of 0.85 MP
= 0.85 MP + 0.13 × 0.85 MP
or, 57630 = 0.9605 MP
or, $MP = \frac{57630}{0.9605} = 60000$ Thus, the marked price is Rs 60000.

(e) Here, Discount = 12%, VAT = 13% and Price with VAT = Rs 119328
We have, Price after Discount = MP – Discount = MP – 12% of MP
= 88% of MP = 0.88 MP
Again, price with VAT = Price after discount + VAT
= 0.88 MP + 13% of 0.88 MP
= 113% of 0.88 MP = 1.13 × 0.88 MP
or, 119328 = 0.9944 MP
$\therefore \quad MP = \frac{119328}{0.9944} = 120000$

Thus, the marked price is Rs 120000.

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3A. कुनै एउटा वस्तुको अङ्कित मूल्यमा **25%** छुट दिएर **13 %** मूल्य अभिवृद्धि कर लगाई बेचियो । यदि छुट रकम रु. **2000** भएमा उक्त सामानको मूल्य अभिवृद्धि करसहितको विक्रय मूल्य पत्ता लगाउनुहोस् ।
After allowing 25% discount on marked price and then levying 13% value added tax, an article was sold. If the discount amount is Rs 2000, find the price of the article with value added tax.

⇨ Here, Discount = 25% of MP = Rs 2000 and VAT 13%
So, $0.25 \times MP = Rs\ 2000$
or, $MP = Rs\ \frac{2000}{0.25} = Rs\ 8000$

We have,
Price after discount = MP – Discount = Rs 8000 – Rs 2000 = Rs 6000
Now, Price with VAT = Price after Discount + VAT = Rs 6000 + 13% of Rs 6000
= Rs 6000 + 0.13 × Rs 6000 = Rs 6000 + Rs 780 = Rs 6780
Thus, the price with VAT is Rs 6780.

3B. एउटा टेलिभिजन **20 %** छुट दिएर **13%** मू.अ.क. लगाएर बिक्री गरियो । यदि छुट रकम रु. **1500** भए मू.अ.क. रकम कति होला ? पत्ता लगाउनुहोस् ।
After allowing 20% discount and then levying 13% VAT a television is sold. If the discount amount is Rs 1500 then find the VAT amount.

⇨ Here, Discount = 20% of MP = Rs 1500 and VAT = 13%
So, $0.20 \times MP = Rs\ 1500$
or, $MP = Rs\ \frac{1500}{0.20} = Rs\ 7500$

We have, Price after discount = MP – Discount = Rs 7500 – Rs 1500 = Rs 6000
Now, VAT amount = 13% of price after discount = 0.13 × Rs 6000 = Rs 780
Thus, the VAT amount is Rs 780.

3C. एउटा पसलेले रु. **60,000** अङ्कित मूल्य भएको वस्तुमा **15 %** छुट दिएर मूल्य अभिवृद्धि कर लगाएर रु. **57,630** मा बिक्री गऱ्यो भने मूल्य अभिवृद्धि करको दर कति होला ? पत्ता लगाउनुहोस् ।
After allowing 15% discount on the marked price of Rs 60000 and then levying VAT, a shopkeeper sold an article at Rs 57630, what is the rate of value added tax ? Find it.

⇨ Here, Discount = 15%, MP = Rs 60000, SP with VAT = Rs 57630
We know that,
Price after discount = MP – Discount = Rs 60000 – 15% of Rs 60000
= 85% of Rs 60000 = 0.85 × Rs 60000 = Rs 51000
Again, VAT amount = SP with VAT – Price after discount = Rs 57630 – Rs 51000
= Rs 6630
Now, Rate of VAT $= \frac{\text{VAT}}{\text{Price after Discount}} \times 100\% = \frac{\text{Rs } 6630}{\text{Rs } 51000} \times 100\% = 13\%$
Thus, the required VAT rate is 13%.

3D. अङ्कित मूल्य रु. **64,000** भएको ल्यापटपमा **12 %** छुट दिएर केही प्रतिशत **VAT** जोड्दा रु.**63641.50** तिर्नुपर्दछ भने **VAT** रकम र प्रतिशत पत्ता लगाउनुहोस् ।
After allowing 12% discount in a laptop having marked price Rs 64000 and certain VAT is added so that a customer has to pay Rs 63641.50. Find the VAT amount and the percentage.

⇨ Here, Discount = 12%, MP = Rs 64000, Price with VAT = Rs 63641.50
Discount = 12% of MP = 0.12 × Rs 64000 = Rs 7688
Price after discount = Rs 64000 – Rs 7688 = Rs 56320
We have,
VAT amount = Price with VAT – Price after discount
= Rs 63641.50 – Rs 56320 = Rs 7321.50
Now, VAT percentage $= \frac{\text{VAT amount}}{\text{Price after discount}} \times 100 = \frac{\text{Rs } 7321.50}{\text{Rs}56320} \times 100 = 12.99\% = 13\%$

Thus, VAT amount and VAT percentage are; Rs 7321.50 and 13% respectively.

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3E. एउटा क्याल्कुलेटरमा 20 % छुट गरी 13 % मूल्य अभिवृद्धि कर लगाउँदा क्रेताले रु. 520 मूल्य अभिवृद्धि कर तिरेका रहेछन् भने कति रकम छुट पाएका होलान् ? पत्ता लगाउनुहोस् ।

After allowing 20% discount and levying 13% VAT, a customer had paid Rs 520 for VAT, how much had he got the discount? Find it.

⇨ Here, Discount = 20%, VAT = 13% and VAT amount = Rs 520

We have, 13% of Price after Discount = Rs 520

or, $0.13 \times$ Price after discount = Rs 520

$\therefore$ Price after discount $= \frac{\text{Rs } 520}{0.13} = \text{Rs } 4000$

Let, the marked price be Rs x.

Discount = 20% of x $= 0.2 \times x = 0.2x$

Price after discount $= x - 0.2x = 0.8x$

or, $0.8x = 4000$ $\quad \therefore \quad x = \frac{4000}{0.8} = 5000$

Now, the discount amount = $0.2 \times$ Rs 5000 = Rs 1000

Thus, the discount amount is Rs 1000.

4A. एउटा डिलरले एउटा फोटोकपी मेसिनलाई रु. 4,20,000 मा 13 % मू.अ.क. लगाएर खुद्रा पसलेलाई बिक्री गऱ्यो । खुद्रा पसलेले उक्त मेसिनको ढुवानी खर्च रु. 2500 स्थानीय कर रु. 4,000 र रु. 20,000 नाफासहित फोटोकपी सेन्टरमा आपूर्ति गऱ्यो भने फोटोकपी सेन्टरले हालको दर रेटमा उक्त मेसिनको जम्मा कति रकम र मूल्य अभिवृद्धि कर तिर्नुपर्ला ?

A dealer sold a photocopy machine for Rs 420000 plus 13% VAT to the retailer. If the retailer spent Rs 2500 on transportation cost, Rs 4000 on local tax and made Rs 20000 profit and then supplied to the photocopy centre, how much did the photocopy centre pay the VAT amount at the present rate of VAT ?

⇨ Here, cost price for retailer = Rs 420000, VAT = 13%

Cost price with VAT = 113% of Rs 420000 = $1.13 \times$ Rs 420000 = Rs 474600

VAT applicable amount for photocopy centre = Rs 420000 + Rs 2500 + Rs 4000 + Rs 20000

= Rs 446500

Price with VAT = 113% of Rs 446500 = $1.13 \times$ Rs 446500 = Rs 504545

Now VAT amount = Rs 504545 – Rs 446500 = Rs 58045

Thus, the VAT amount is Rs 58045.

4B. अन्नपूर्ण सप्लायर्सले रु. 4,40,000 बराबरको निर्माण सामग्री 10% नाफा र 13% मू.अ.क. सहित एन्जल सप्लायर्सलाई बिक्री गऱ्यो । एन्जल सप्लायर्सले उक्त सामग्रीको मूल्यमा ढुवानी खर्च रु. 5000 आफ्नो क्रय मूल्यमा 10% नाफा र स्थानीय कर रु. 2500 सहित निर्माण कर्तालाई बिक्री गऱ्यो । अब, निर्माण कर्ताले कति रकमको कति मूल्य अभिवृद्धि कर तिर्नुपर्ला ?

Annapurana suppliers sold construction materials costing Rs 440000 to Angel suppliers making 10% profit and adding 13% VAT. Angel suppliers spent Rs 5000 for transportation cost and made 10% profit and levied local tax Rs 2500 and sold to constructor, what VAT amount should be paid by constructor?

⇨ Here, **For Annapurana Suppliers**

Selling price = Rs 4,40,000 + 10% of Rs 4,40,000

= Rs 4,40,000 + $0.1 \times$ Rs 4,40,000

= Rs 4,40,000 + Rs 44,000

Selling price excluding VAT = Rs 484000

For Angel Suppliers: Cost price excluding VAT = Rs 4,84,000

VAT applicable amount = Cost price excluding VAT + Transportation cost + Profit + Local Tax

= Rs 484000 + Rs 5000 + 10% of Cost price + Rs 2500

= Rs 484000 + Rs 5000 + $0.1 \times$ 484000 + Rs 2500

= Rs 484000 + Rs 5000 + Rs 48400 + Rs 2500 = Rs 539900

VAT amount = 13% of VAT applicable amount = $0.13 \times$ Rs 539900 = Rs 70187

Thus, the required VAT amount is Rs 70187.

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➢ शृङ्खला नियम (Chain Rule)

यदि x = y, y = z र z = a भए,	If x = y, y = z and z = a then,
$\Rightarrow x \times y \times z = y \times z \times a$ $\therefore x = a$	

नियमहरू (Rules)

➢ दिइएका राशीहरूलाई बीचमा '=' चिह्न प्रयोग गरी दुई लहरमा राशीहरूको शृङ्खला मिलाउने
Arrange the given variables in two columns making the chain of variables and putting '=' sign in between.

➢ मान पत्ता लगाउनुपर्ने राशीलाई x ले सङ्केत गर्ने । (Suppose x for the variable whose value is to be found.)

➢ समीकरण निर्माण गरी हल गर्ने (By constructing equation, solve it.)

A. BASIC EXERCISE 2.2

Very Short Questions

1. प्रति अमेरिकी डलरको रु. 110 का दरले रु. 11000 को कति डलर हुन्छ ?
Using the rate of Rs 110 per US Dollar, calculate the US Dollars for Rs 11000.

⇨ Here, \$ 1 = Rs 110 or, Re 1 = \$ $\frac{1}{110}$

$\therefore$ Rs 11000 = \$ $\frac{1}{110} \times 11000$ = \$ 100.

2. प्रति पाउण्ड स्टर्लिङ रु. 135 को दर प्रयोग गरी रु. 27000 लाई पाउण्ड स्टर्लिङमा रुपान्तरण गर्नुहोस् ।
Using the rate of Rs 135 per Pound Sterling, calculate the Pound Sterling for Rs 27000.

⇨ Here, Rs 135 = £1 or, Re 1 = £ $\frac{1}{135}$

$\therefore$ Rs 27000 = £ $\frac{1}{135} \times 27000$ = £ 200.

3. रु. 115 / युरोको दरअनुसार रु. 345000 को युरो निकाल्नुहोस् ।
Using the rate of Rs 115 per Euro, calculate the Euro for Rs 345000.

⇨ Here, Rs 115 = Euro 1 or, Re 1 = Euro $\frac{1}{115}$

$\therefore$ Rs 345000 = Euro $\frac{1}{115} \times 345000$ = Euro 3000.

4. रु. 81 / अष्ट्रेलियन डलरको दरअनुसार रु. 324000 को अष्ट्रेलियन डलर निकाल्नुहोस् ।
Using the rate of Rs 81 per Australian Dollar, calculate the Australian Dollar for Rs 324000.

⇨ Here, Rs 81 = 1 AUD or, Re 1 = $\frac{1}{81}$ AUD

$\therefore$ Rs 324000 = $\frac{1}{81} \times 324000$ AUD = 4000 AUD.

5. रु. 30 / कतारी रियालको दरअनुसार रु. 150000 को कतारी रियाल निकाल्नुहोस् ।
Using the rate of Rs 30 per Qatari Riyal, calculate the Qatari Riyal for Rs 150000.

⇨ Here, Rs 30 = 1QR or, Re 1 = $\frac{1}{30}$ QR

$\therefore$ Rs 150000 = $\frac{1}{30} \times 150000$ QR = 5000 QR.

6. यदि अमेरिकी डलर 1 = रु.110 भए अमेरिकी \$ 500 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If US \$ 1 = Rs 110 then convert US \$ 500 into Rupees.

⇨ Here, \$ 1 = Rs 110 $\therefore$ \$ 500 = Rs 110 × 500 = Rs 55000.

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7. यदि पाउण्ड स्टर्लिङ 1 = रु.135 भए पाउण्ड स्टर्लिङ 450 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If £1 = Rs 135 then convert £450 into Rupees.

⇨ Here, £1 = Rs 135 ∴ £ 450 = Rs 135 × 450 = Rs 60750.

8. यदि ¥ 1000 = रु.984 भए जापानी येन ¥ 550000 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If ¥1000 = Rs 984 then convert ¥550000 into Rupees.

⇨ Here, ¥1000 = Rs 984 or, ¥1 = Rs $\frac{984}{1000}$

∴ ¥ 550000 = Rs $\frac{984}{1000}$ × 550000 = Rs 541200.

9. यदि मलेसियन रिङ्गीट (RM) 10 = रु.246 भए RM 2460 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If Malaysian Ringgit (RM) 10 = Rs 246 then convert RM 2460 into Rupees.

⇨ Here, RM 10 = Rs 246 or, RM 1 = Rs $\frac{246}{10}$

∴ RM 2460 = Rs $\frac{246}{10}$ × 2460 = Rs 60516.

10. यदि हङकङ डलर (HKD) $1 = रु.14 भए $2100 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If Hong Kong Dollar (HKD) $ 1 = Rs 14 then convert $2100 into Rupees.

⇨ Here, HKD $ 1 = Rs 14 ∴ HKD $ 2100 = Rs 14 × 2100 = Rs 29400.

11. रु. 109.77 / अमेरिकी डलरको दरअनुसार रु. 10977 को अमेरिकी डलर निकाल्नुहोस् ।
Using the rate of Rs 109.77 per US dollar, calculate the US dollars for Rs 10977.

⇨ Here, Rs 109.77 = $ 1 or, Re 1 = $ $\frac{1}{109.77}$

∴ Rs 10977 = $ $\frac{1}{109.77}$ × 10977 = $ 100

12. यदि स्वीस फ्रान्क 1 = रु.108.33 भए रु. 32499 को कति स्वीस फ्रान्क हुन्छ पत्ता लगाउनुहोस् ।
If 1 Swiss franc = Rs 108.33 then find the Swiss franc for Rs 32499.

⇨ Here, Rs 108.33 = 1 Swiss franc or, Re 1 = $\frac{1}{108.33}$ Swiss franc

∴ Rs 32499 = $\frac{1}{108.33}$ × 32499 Swiss franc = 300 Swiss franc.

13. अमेरिकी डलरको रु. 70 का दरले रु. 50540 को कति डलर हुन्छ ?
Using the rate of Rs 70 for 1US dollar, calculate the US dollars for Rs 50540. **[2057 D1]**

⇨ Here, Rs 70 = 1US dollar

or, Re 1 = $\frac{1}{70}$ US dollar

∴ Rs 50540 = $\frac{1}{70}$ × 50540 US dollars = 722 US dollars

Short Questions

1. यदि £15 = $20 र $5 = रु. 390 भए रु. 31200 ले कति पाउण्ड साट्न सकिन्छ ?
If £15 = $20 and $5 = Rs 390, how many pounds can be exchanged for Rs 31200 ? **[2059 A1]**

⇨ Here, suppose £x can be exchanged for Rs 31,200.

∴ £x = Rs 31,200
Rs 390 = $5
$20 = £15

Then by chain rule,
x × 390 × 20 = 31,200 × 5 × 15
∴ x = $\frac{31,200 \times 5 \times 15}{390 \times 20}$ = 300

Thus, £300 can be exchanged for Rs 31,200.

2. यदि रु. 1326 = $17 र रु. 1650 = £15 सटही गर्न सकिन्छ भने कति डलरले £195 साट्न सकिएला ?
If Rs 1326 = $17 and Rs 1650 = £15, how many dollars can be exchanged for £195 ? **[2059 A2]**

⇨ Here, suppose $ x can be exchanged for £195.

Here, $ x = £ 195
£ 15 = Rs 1650
Rs 1326 = $ 17

By chain rule,
x × 15 × 1326 = 195 × 1650 × 17
or, x = $\frac{195 \times 1650 \times 17}{15 \times 1326}$ = 275

Thus, $275 can be exchanged for £195.

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3. यदि £52 = $91 र रु. 2112 = £16 भए रु. 5280 बराबर कति डलर ($) हुन्छ ?
If £52 = $91 and Rs 2112 = £16, how many dollars ($) will be equal to Rs 5280 ? **[2061 C1]**

⇨ Here, let Rs 5280 be equal to $x

Then, $x = Rs 5280
Rs 2112 = £16
£52 = $91

By chain rule, we have
$x \times 2112 \times 52 = 5280 \times 16 \times 91$
$\therefore \quad x = \frac{5280 \times 16 \times 91}{2112 \times 52} = 70$

Thus, Rs 5820 is equal to $70.

4. यदि $77 = £44 र रु. 1575 = £21 भए रु. 4725 बराबर कति पाउण्ड (£) हुन्छ ?
If $77= £44 and Rs 1575 = $21, how many pounds (£) will be equal to Rs 4725? **[2061 C2]**

⇨ Here, let, Rs 4725 be equal to £x.

Then, £x = Rs 4725
Rs 1575 = $21
$77 = £44

By the chain rule, we have
$x \times 1575 \times 77 = 4725 \times 21 \times 44$
$\therefore \quad x = \frac{4725 \times 21 \times 44}{1575 \times 77} = 36$

Thus, Rs 4725 is equal to £36.

5. यदि ₹ 100 (IC) = रु. 160 (NC) र 1 अमेरिकन डलर = रु. 75 (NC) भए ₹ 75000 (IC) बराबर कति अमेरिकन डलर हुन्छ ?
If Rs 100 (IC) = Rs 160 (NC) and 1 American dollar = Rs 75 (NC), how many American dollars will be equal to Rs 75000 (IC) ? **[2061 E1]**

⇨ Here, let, Rs 75000 (IC) be equal to US $x.

Then $x = Rs 75000 (IC)
Rs 100 (IC) = Rs 160 (NC)
Rs 75 (NC) = US $ 1

By the chain rule, we have
$x \times 100 \times 75 = 75000 \times 160 \times 1$
$\therefore \quad x = \frac{75000 \times 160 \times 1}{100 \times 75} = 1600$

Thus, Rs 75000 (IC) is equal to $1600.

6. यदि ₹ 100 (IC) = रु. 160 (NC) र 1 युरो = रु. 95 (NC) भए ₹ 9500 (IC) बराबर कति यूरो हुन्छ ? **[2061 E2]**
If Rs 100 (IC) = Rs 160 (NC) and 1 Euro = Rs 95 (NC), how many Euro will be equal to Rs 9500 (IC) ?

⇨ Here, let, Rs 9500 (IC) be equal to x Euro

Then, x Euro = Rs 9500 (IC)
Rs 100 (IC) = Rs 160 (NC)
Rs 95 (NC) = 1 Euro

By the chain rule, we have
$x \times 100 \times 95 = 9500 \times 160 \times 1$
$\therefore \quad x = \frac{9500 \times 160}{100 \times 95} = 160$

Thus, Rs 9500 (IC) is equal to 160 Euro.

7. यदि $6 = £3.5 र Rs 220 = $3 भए रु. 4400 बराबर कति पाउण्ड हुन्छ ?
If $6 = £ 3.5 and Rs 220 = $3, how many pounds (£) will be equal to Rs 4400 ? **[2062 C1]**

⇨ Here, let, £x be equal to Rs 4400.

Then, £x = Rs 4400
Rs 220 = $3
$6 = £3.5

By using chain rule, we have
$x \times 220 \times 6 = Rs\ 4400 \times 3 \times 3.5$
$\therefore \quad x = Rs\ \frac{4400 \times 3 \times 3.5}{220 \times 6} = £35$

Thus, £ 35 is equal to Rs 4400.

8. यदि रु. 126 = 1 पाउण्ड, 10 पाउण्ड = 125 फ्र्याङ्क भए रु. 6300 को कति फ्र्याङ्क हुन्छ ?
If Rs 126 = 1 pound, 10 pounds = 125 francs, how many francs are equivalent to Rs 6300 ? **[2062 C2]**

⇨ Here, let, x francs be equal to Rs 6300.

Then, x francs = Rs 6300
Rs 126 = 1 pound
10 pounds = 125 francs

Using chain rule, we have
$x \times 126 \times 10 = 6300 \times 1 \times 125$
or, $x = \frac{6300 \times 1 \times 125}{126 \times 10} = 625$

Thus, Rs 6300 is equal to 625 francs.

9. यदि 10 जापानिज येन = ने.रु. 6.28 छ भने जापानिज येन 35800 लाई नेपाली रुपैयाँमा रुपान्तरण गर्नुहोस् ।
If 10 Japanese Yen = Nepali Rs 6.28, then convert Japanese Yen 35800 into Nepali rupees. **[2058 B2]**

⇨ Here, 10 Japanese Yen = Nepali Rs 6.28

or, 1 Japanese Yen = Nepali Rs $\frac{6.28}{10}$

$\therefore \quad$ 35800 Japanese Yen = Nepali Rs $\frac{6.28}{10} \times 35800$ = Nepali Rs 2248.40.

Thus, 35800 Japanese Yen is equal to Rs 2248.40.

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10. यदि 1 अमेरिकी डलर ($) = ने.रु. 78 र 1 पाउण्ड (£) = ने.रु. 117 भए 55 अमेरिकी डलर ($) लाई पाउण्डमा परिवर्तन गर्नुहोस् ।

If 1 American dollar ($) = Rs 78 and 1 pound (£) = Rs 117, convert 55 American dollar ($) into pound. [2060 C]

⇨ Here, suppose, $55 = £x

Then, £x = $55
$1 = Rs 78
Rs 117 = £1

Using chain rule, we have
Now, $x \times 1 \times 117 = 55 \times 78 \times 1$
$\therefore \quad x = \frac{55 \times 78 \times 1}{1 \times 117} = 36.67$

Thus, $55 is equal to £ 36.67.

11. यदि **£15 = $20** र **$5 =** रु. **390** भए रु. **31200** ले कति पाउण्ड साट्न सकिन्छ ?

If £15 = $20 and $5 = Rs 390, how many pounds can be exchanged for Rs 31200 ? [2059 A1]

⇨ Here, suppose, £x can be exchanged for Rs 31,200.

$\therefore$ £x = Rs 31,200
Rs 390 = $5
$20 = £15

Then by chain rule,
$x \times 390 \times 20 = 31{,}200 \times 5 \times 15$
$\therefore \quad x = \frac{31{,}200 \times 5 \times 15}{390 \times 20} = 300$

Thus, £300 can be exchanged for Rs 31,200.

12. यदि रु. **1326 = $17** र रु. **1650 = £15** सटही गर्न सकिन्छ भने कति डलरले **£195** साट्न सकिएला ?

If Rs 1326 = $17 and Rs 1650 = £15, how many dollars can be exchanged for £195 ? [2059 A2]

⇨ Here, suppose, $ x can be exchanged for £195.

Here, $ x = £ 195
£ 15 = Rs 1650
Rs 1326 = $ 17
By chain rule,
$x \times 15 \times 1326 = 195 \times 1650 \times 17$
or, $x = \frac{195 \times 1650 \times 17}{15 \times 1326} = 275$
Thus, $275 can be exchanged for £195.

Alternatively:
Here, Rs 1326 = $ 17
$ x = £ 195
£ 15 = Rs 1650
$\therefore \quad 1326 \times x \times 15 = 17 \times 195 \times 160$
or, $x = \frac{17 \times 195 \times 1650}{1326 \times 15} = 275$
Thus, $ 275 can be exchanged for £ 195.

B. QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 2.2]

माथि दिइएको विदेशी मुद्रा विनिमय दर प्रयोग गरी तलका मुद्राहरूलाई नेपाली रुपियाँमा रूपान्तरण गर्नुहोस् ।

Using the foreign money exchange rate given above convert the following money into Nepali currencies.

1A. खरिद दर प्रयोग गरी **(Using buying rate)**

(i) भा.रु. **1250 (IC 1250)** **(ii)** **$** (अमेरिकी डलर) **1400(US $ 1400)**
(iii) पाउन्ड स्टर्लिङ **4752 (Pound Sterling 4752)** **(iv)** सिङ्गापुर डलर **2340(Singapore dollar 2340)**
(v) कतारी रियल **2000 (Quatari Riyal 2000)**
(vi) दक्षिण कोरियाली वन **5,76,000 (South Korean Won 576000)**
(vii) थाइ भाट **3600 (Thai Baht 3600)** **(viii)** जापानी ऐन **6840(Japanese Yen 6840)**
(ix) स्विडिस फैन्क **450 (Swiss Franc 450)** **(x)** मलेसियन रिङ्गेट **5250(Malaysian Ringgit 5250)**

⇨ Here,

(i) Using buying rate,
Rs 160 = IC 100
IC 1250 = x (say)
Using the chain rule,
$160 \times 1250 = 100 \times x$
or, $2000 = x$
Thus, Nepali rupees of IC 1250 is Rs 2000.

(iii) Using the buying rate,
$x \times 1 = 155.63 \times 4752$
$\therefore \quad x =$ Rs 739553.76
Thus, NC equal to $ 4752 is Rs 739553.76

(ii) Using buying rate,
$1 = Rs 105.52
Rs x = $ 1400 (say)
Using the chain rule,
$x \times 1 = 105.52 \times 1400$
$\therefore \quad x = 147728$
Thus, NC equal to $ 1400 is Rs 147728.

(iv) Singapore dollar 1 = Rs 74.42
x = Singapore dollar 2340
Using the chain rule,
$x \times 1 = 74.42 \times 2340$
$\therefore \quad x = 174142.80$
Thus, the NC equal to SGD 2340 is Rs174142.80

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(v) Using the buying rate,
Qatari Riyal 1 = Rs 28.98
x = Qatari Riyal 2000
Using chain rule,
$1 \times x = 28.98 \times 2000$
$\therefore$ x = 57960
Thus, NC of Qatari Riyal 2000 is Rs 57960.

(vi) Using the buying rate,
South Korean Won 100 = Rs 8.98
x = South Korean Won 576000
Using chain rule,
$100 \times x = 8.98 \times 576000$
$\therefore$ x = 51724.80
Thus, NC of KRW 576000 is Rs 51724.80.

(vii) Using the buying rate,
Thai Baht 1 = Rs 2.93
x = Thai Baht 3600
Using the chain rule,
$x \times 1 = 2.93 \times 3600$
$\therefore$ x = Rs 10548
Thus, NC of Thai Baht 3600 is Rs 10548.

(viii) Using the buying rate,
Japanese Yen 10 = Rs 8.77
x = Japanese Yen 6840
Using the chain rule,
$x \times 10 = 8.77 \times 6840$
$\therefore$ x = 5998.68
Thus, NC of Japanese Yen 6840 is Rs 5998.68.

(ix) Using the buying rate,
Swiss Frank 1 = Rs 105.37
x = Swiss Frank 450
Using the chain rule,
$x \times 1 = 105.37 \times 450$
$\therefore$ x = Rs 47416.50
Thus, NC of CHF 450 is Rs 47416.50.

(x) Using the buying rate,
Malaysian Ringgit 1 = Rs 24.58
x = Malaysian Ringgit 5250
Using chain rule,
$1 \times x =$ Rs 24.58×5250
$\therefore$ x = 129045
Thus, the NC of MYR 5250 is Rs 129045.

1B. बिक्रीदर प्रयोग गरी प्रश्न नं. (1A) का विदेशी मुद्रालाई नेपाली रुपियाँमा रूपान्तरण गर्नुहोस् ।
Using the selling rate convert the foreign money into Nepali currencies.

⇨ Here,

(i) Using the selling rate,
Rs 160.15 = IC 100
IC 1250 = x (say)
Using the chain rule,
$x \times 100 = 1250 \times 160.15$
$\therefore$ x = 2001.875
Thus, the NC of IC 1250 is Rs 2001.88.

(ii) Here, using the selling rate,
$1 = Rs 106.12
x = $ 1400
Using the chain rule,
$x \times 1 = 106.12 \times 1400$
$\therefore$ x = 148568
Thus, the NC of $ 1400 is Rs 148568.

(iii) Here, using the selling rate,
£1 = Rs 156.51
x = £ 4752
Using the chain rule,
$1 \times x = 156.51 \times 4752$
$\therefore$ x = 743735.52
Thus, the NC of £ 4752 is Rs 743735.52.

(iv) We have,
Selling rate of 1 Singapore dollar = Rs 74.84
NC of 2340 Singapore dollar = ?
We have,
NC of 2340 SGD = Rs 74.84×2340 = Rs 175125.60
Thus, the NC of 2340 SGD is Rs 175125.60.

(v) We have, Qatari Riyal 2000
Selling rate of QAR 1 = Rs 29.15
NC of QAR 2000 = 29.15×2000 = Rs 58300
Thus, the NC of QAR 2000 is Rs 58300.

(vi) We have,
Selling rate of KRW 100 = Rs 9.03
NC of KRW 576000 = $\frac{\text{Rs } 9.03 \times 57600}{100}$ = Rs 5201.28
Thus, the NC of KRW 57600 is Rs 5201.28.

(vii) Thai Baht 3600
Selling rate of Thai Baht 1 = Rs 2.94
NC of TB 3600 = Rs 2.94×3600 = Rs 10584
Thus, the NC of TB 3600 is Rs 10584.

(viii) Japanese Yen 6840
Selling rate of Japanese Yen 10 = Rs 8.82
NC of JPY 6840 = $\frac{\text{Rs } 8.82 \times 6840}{10}$ = Rs 6032
Thus, the NC of JPY 6840 is Rs 6032.

(ix) Swiss Franc 450
Selling rate of CHF 1 = Rs 105.97
NC of CHF 450 = Rs 105.97×450 = Rs 47686.50
Thus, the NC of CHF 450 is 47686.50

(x) Malaysian Ringgit 5250
Selling rate of Malaysian Ringgit 1 = Rs 24.72
NC of MYR 5250 = Rs 24.72×5250 = Rs 128730
Thus, the NC of MYR 5250 is Rs 128730.

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1C. अमेरिकामा माध्यमिक शिक्षकको तलब $10.05 देखि $30.89 प्रति घण्टा भएमा उक्त दरमा नेपाली मुद्रामा कति रुपैयाँ प्रति घण्टा होला ?
The salary of secondary teacher in the USA is from $ 10.05 to $ 30.89 per hour. What is the hourly salary in Nepali currency? (Using selling rate)

⇨ Here, salary = $ 10.05 to $ 30.89
We know that; $ 1 = Rs 106.12
So, the salary = 10.05 × Rs 106.12 to 30.89 × Rs 106.12 = Rs 1066.506 to Rs 3278.0468
Thus, the salary is from Rs 1066.51 to Rs 3278.047 hourly.

1D. उपर्युक्तअनुसार यदि एक दिनमा बढीमा 8 घण्टा र हप्तामा 5 दिन काम गर्दछन् भने एक जना शिक्षकको प्रति हप्ताको औसत आम्दानी कति होला ? नेपाली रुपियाँमा पत्ता लगाउनुहोस् ।
If the teacher works 8 hours a day and 5 days a week, what is the weekly average income? Find in Nepali rupees.

⇨ Here, average salary in 1 hour $= \frac{\$\ 10.05 + \$\ 30.89}{2} = \$\ 20.47$

Using the rate, $1 = Rs 105.52
Average salary in 1 hour = Rs 20.47 × 105.52 = Rs 2159.99
Average salary in 8 hours = 8 × Rs 2159.99 = Rs 17279.95
Average salary in 5 days = 5 × Rs 17279.95 = Rs 86399.77
Thus, the average salary in NC is Rs 86399.77.

2. माथि दिइएको मुद्रा विनिमय दरअनुसार तलका मुद्रा विनिमय पत्ता लगाउनुहोस् (खरिद दर मात्र प्रयोग गर्ने):
According to the money exchange rate given above find the following money exchange. (Using buying rate only)

(a) 1 अमेरिकी डलरको कति कतारी रियल हुन्छ ?
How many Qatari Riyal is equal to US dollar 1 ?

⇨ Here, We have,
$1 = Rs 105.52
Rs 28.98 = Qatari Riyal 1
Using chain rule,
$1 × Rs 28.98 = Rs 105.52 × QAR 1
or, $1 = Qatari Riyal $\frac{105.52}{28.98}$
∴ $ 1 = Qatari Riyal 3.64
Thus, Qatari Riyal of $1 is 3.64.

(b) 1 जापानी येनको कति पाउन्ड स्टर्लिङ हुन्छ ?
How many pound sterling is equal to 1 Japanese Yen ?

⇨ Here, £ 1 = Rs 155.63
Rs 8.77 = Japanese Yen 10
Using chain rule, £ 1 × Rs 8.77 = Rs 155.63 × JPY 10
or, 1 Japanese Yen $= \frac{8.77}{155.63 \times 10}$
∴ 1 Japanese Yen $= 5.259 \times 10^{-3} = 0.056$
Thus, 1 Japanese Yen is £ 0.056.

(c) कति मलेसियन रिङ्गेटको 50 चिनियाँ युआन हुन्छ ? **(How many Malaysian Ringgit is equal to 50 Chinese Yuan?)**

⇨ Here, Malaysian Ringgit 1 = Rs 24.58
Rs 16.25 = Chinese Yuan 1
Using chain rule, MYR 1 × Rs 16.25 = Rs 24.58 × CNY 1
or, CNY 1 $= \frac{16.25}{24.58}$ MYR
or, CNY 50 $= \frac{16.25}{24.58} \times 50$ MYR
Thus, Chinese Yuan 50 is equal to 33.06 Malaysian Ringgit.

(d) कति कोरियन वन भएमा 2000 युरो हुन्छ ? **(How many South Korean Won is equal to 2000 Euro?)**

⇨ Here, 100 South Korean won = Rs 8.98
Rs 114.60 = 1 Euro
Using chain rule, Rs 8.98 × 1 EUR = 100 KRW × Rs 114.60.
or, 2000 Euro $= \frac{100 \times 114.60}{8.98} \times 2000$ KRW
∴ 2000 Euro = 255238.53 South Korean Won.
Thus, 2552338.53 is equal to 2000 Euro.

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(e) 1 कुवेती दिनारको कति थाई भाट हुन्छ ? (How many Thai Baht is equal to 1 Kuwaity Dinar?)

⇨ Here, 1 Thai Baht = Rs 2.93

Rs 347.46 = 1 Kuwaity Dinar

Using Chain rule,

1 Thai Baht × 347.46 = 2.93 × 1 Kuwaity Dinar

or, $\frac{\text{1 Thai Baht} \times 347.46}{2.93}$ = 1 Kuwaity Dinar

∴ 1 Kuwaity Dinar = 118.59 Thai Baht

Thus, 1 Kuwaity Dinar is equal to 118.59 Thai Baht.

3A. रु. 2,50,000 लाई पाउन्ड स्टर्लिङमा साट्दा 2% कमिसन तिर्नुपर्छ भने कति पाउन्ड स्टर्लिङ प्राप्त गर्न सकिन्छ ? पत्ता लगाउनुहोस् ।

2% commission should be paid to exchange Rs 250000 into pound sterling, what amount of pound sterling can be received ? Find it.

⇨ Here, let, the total exchange amount is Rs x. and the commission rate = 2%

So, 2% of Rs x + x = Rs 250000 or, 0.02 × x + x = 250000

or, 1.02x = 250000 ∴ x = 245098.03

Exchanged amount = Rs 245098.03

We know that,

£ 1 = Rs 155.63

Rs 245098.03 = £ x

Using chain rule,

x × 155.63 = 1 × 245098.03

or, $x = \frac{245098.03}{155.63}$ = 1574.87

Thus, pound sterling 1574.25 can be received.

3B. विदेश घुम्नका लागि अब्दुललाई $3,500 साट्नु छ । यदि बैङ्कले उक्त मुद्रा सटहीमा 2% कमिसन लिने गर्दछ भने जम्मा कति रुपियाँ आवश्यक पर्ला ?

To visit foreign country Abdul has to exchange $ 3500. If the bank charges 2% commission then what amount of Nepali rupees is required ?

⇨ Here, $1 = Rs 105.52

Rs x = $3500

Using chain rule, 1 × x = 105.52 × 3500 ∴ x = 369320

Let, Rs y is required then

We have, y – 2% of y = 369320 or, 98% of y = 369320

or, 98% of y = 369320 or, 0.98 × y = 369320

∴ $y = \frac{369320}{0.98}$ = 376857.14 Thus, Rs 376857.14 is required.

3C. माथि दिइएको विनिमय दरअनुसार $4750 किन्न पुग्ने नेपाली रुपियाँको 10% अवमूल्यनपछि 3% कमिसन सहित किन्दा कति पाउन्ड किन्न सकिन्छ ?

According to the above exchange rate, what amount of pound sterling, after devaluating Nepali currency by 10% and 3% commission, can be bought by the amount which can buy £ 4750 ?

⇨ Here, $1 = Rs 106.12

x = $ 4750

Using chain rule,

1 × x = 106.12 × 4750

∴ x = 504070

∴ $4750 can be exchanged by Rs 504070.

Again, £ 1 = Rs 156.51

Nepali money is devaluated by 10%

So, £ 1 = Rs 156.51+ 10% of Rs 156.51

= 110% of Rs 156.51

= 1.1 × Rs 156.51

∴ £ 1 = Rs 172.161

Now, £ 1 = Rs 172.161

Rs 504070 = x

Using chain rule,

1 × 504070 = x × 172.161

∴ $x = \frac{504070}{172.161}$ = 2927.90

3% commission is allowed,

So, 97% of 2927.90

= 0.97 of 2927.90

= 2840.06

∴ x = 2840.06

Thus, the required pound sterling is 2840.06.

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4A. अमेरिकी बजारबाट प्रति तोला $ 553 मा किनिएको 10 तोला सुनलाई नेपाली बजारमा 20 % भन्सार शुल्क र 13% VAT सहित बिक्री गर्दा कम्तीमा कति रुपैयामा बिक्री गर्नुपर्ला ?

10 tolas gold bought from American market at $ 553 per tola is sold in Nepal at 20% customs duty charge and 13% VAT. At what price should it be sold ?

⇨ Here, price of 1 tola = $ 553 Price of 10 tola = 10 × $ 553 = $ 5530

20% custom duty charge is applied,

So, price after custom = 120% of $5530 = 1.20 × $5530 = $ 6636

Again, price after VAT = 113% of $ 6636 = 1.13 × $ 6636 = $ 7498.68

Thus, the price of 10 tolas gold is $ 7498.68.

We have, $1 = Rs 105.52

x = 7498.68

Using chain rule, x = Rs 105.52 × 7498.68

∴ x = Rs 791260.71

Thus, the 791260.71 is required.

4B. यूरो 120 मा बिक्री गर्दा 35% नाफा हुने सामानलाई कति रुपियाँमा बिक्री गर्दा 40% नाफा होला ?

An article is sold at Euro 120 and 35% profit is made, at what rupees should it be sold to get 40% profit ?

⇨ Here, selling price = Euro 120

Profit = 35%

We have, 135% of CP = SP

or, 1.35 × CP = Euro 120

or, $CP = \text{Euro } \frac{120}{1.35} = \text{Euro } \frac{800}{9}$

To make 40% profit,

$SP = 140\% \text{ of } CP = 1.40 \times \frac{800}{9}$

$\therefore SP = \frac{1120}{9} \text{ Euro}$

We know that, 1 Euro = Rs 114.60

$\therefore \frac{1120}{9} \text{ Euro} = \text{Rs } 114.60 \times \frac{1120}{9} = \text{Rs } 14261.33$

Thus, Rs 14261.33 is required.

4C. नेपालको बजारमा भादगाउँले टोपी रु. 400 प्रतिगोटा किनेर निर्यात कर 5% तिरेर बेलायतमा 5000 ओटा बिक्री गर्दा 150% नाफा हुन्छ भने प्रत्येक टोपीको बिक्री मूल्य कति पाउन्ड स्टर्लिङ होला ?

500 Bhadgaule caps bought for Rs 400 per piece in Nepali market is sold in Britain after paying 5% export tax then 150% profit was made. Find the selling price of each cap in pound sterling.

⇨ Here, cost price of 1 cap = Rs 400

Price after export tax = 105% of Rs 400 = 1.05 × Rs 400 = Rs 420

Selling price = 250% of Rs 420 = 2.5 × Rs 420 = Rs 1050

We know that, £ 1 = Rs 155.63

Rs 1050 = x

Using chain rule,

or, 1 × 1050 = x × 155.63 $\therefore x = \frac{1050}{155.63} = 6.77$

Thus, the selling price of 1 cap is £ 6.77.

4D. नेपाल वायुसेवा निगमबाट काठमाडौँ लन्डन काठमाडौँको हवाई टिकट रु. 90,000 पर्दछ । पुन: लन्डनमा लन्डन काठमाडौँ लन्डनको टिकट लिँदा युरो 800 पर्दछ भने कुन ठाउँबाट कति प्रतिशत सस्तो पर्दछ ? पत्ता लगाउनुहोस् ।

The plane fare of Nepal airlines from Kathmandu to London is Rs 90000. If the ticket is bought in London then it cost 800 Euro, which place is cheaper and by what percentage ? Find it.

⇨ Here, price in Kathmandu = Rs 90000

Price in London = 800 Euro = 800 × Rs 114.60 = Rs 91680

It shows that Kathmandu's price is cheaper.

Cheap amount = Rs 91680 – Rs 90000 = Rs 1680

Cheap percentage = $\frac{\text{Rs } 1680}{\text{Rs } 91680} \times 100\% = 1.83$

Thus, the required percentage is 1.83%.

☺☺☺

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3. चक्रीय ब्याज (Compound Interest)

Formulae and Key Points

यदि T = वर्षको सङ्ख्या, R = वार्षिक ब्याजदर र P = सावाँ भए (If T = Number of years, R = Rate of interest and P = Principal)

❑ ब्याज चक्रीय वार्षिक हुँदा (When the interest is compounded annually)

	चक्रीय मिश्रधन Compound Amount	चक्रीय ब्याज Compound Interest	टिप्पणी Remakrs
1.	$CA = P\left(1+\frac{R}{100}\right)^{T}$	$CI = P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]$	T = समय (पूर्णसङ्ख्या) T = Time (Whole number)
2.	$CA = P\left(1+\frac{R}{100}\right)^{T}\left(1+\frac{MR}{1200}\right)$	$CI = P\left[\left(1+\frac{R}{100}\right)^{T}\left(1+\frac{MR}{1200}\right)-1\right]$	T वर्ष र M महिनामा In T years and M month

Note: 1. T को मान पूर्णसङ्ख्यामा हुनुपर्दछ । T को मान वर्षको भिन्नमा भए वर्ष र महिनामा बदली निम्नलिखित सूत्र प्रयोग गर्नुपर्दछ । जस्तै: समय $= 2\frac{1}{2}$ वर्ष वा 30 महिना भए T = 2 वर्ष र M = 6 महिना हुन्छ ।

The value of T must be in whole number. If the value of T contains a fraction of a year then it must be converted into year and month and following formulae must be applied.

e.g. When time $= 2\frac{1}{2}$ years or 30 months then T = 2 years and M = 6 months

2. 1 वर्ष वा सो समय भन्दा कम अवधिको वार्षिकी चक्रीय ब्याज र साधारण ब्याज एउटै हुन्छ ।
The annual compound interest for 1 year or less will be same as the simple interest.

❑ ब्याज चक्रीय अर्धवार्षिक हुँदा (When the interest is compounded semi-annually)

	चक्रीय मिश्रधन Compound Amount	चक्रीय ब्याज Compound Interest	टिप्पणी Remakrs
1.	$CA = P\left(1+\frac{R}{200}\right)^{2T}$	$CI = P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]$	2T = समय (पूर्णसङ्ख्या) 2T = Time (Whole number)
2.	$CA = P\left(1+\frac{R}{200}\right)^{2T}\left(1+\frac{MR}{1200}\right)$	$CI = P\left[\left(1+\frac{R}{200}\right)^{2T}\left(1+\frac{MR}{1200}\right)-1\right]$	2T को मान वर्ष र महिनामा हुँदा If 2T is in years and month

Note:

1. 2T को मान पूर्णसङ्ख्यामा हुनुपर्दछ । 2T को मान भिन्नमा भए, जस्तै, समय = 21 महिना वा $1\frac{3}{4}$ वर्ष हुँदा,

समय $= 6 \times 3$ महिना $+ 3$ महिना $= \frac{1}{2} \times 3$ वर्ष $+ 3$ महिना $= \frac{3}{2}$ वर्ष $+ 3$ महिना, अब, $T = \frac{3}{2}$ वर्ष र M = 3 हुन्छ ।

Value of 2T must be in a whole number. If the value of 2T is in fraction;

E.g. when, Time $= 1\frac{3}{4}$ years or 21 months $= 6 \times 3$ month $+ 3$ month $= \frac{1}{2} \times 3$ year $+ 3$ month $= \frac{3}{2}$ year $+ 3$ month

Now, $T = \frac{3}{2}$ year and M = 3 month and the following formulae must be used.

2. 6 महिना वा सोभन्दा कम अवधिको अर्धवार्षिक चक्रीय ब्याज र साधारण ब्याज एउटै हुन्छ ।
The semi-annual compound interest for 6 month or less will be the same as the simple interest.

❑ हरेक वर्षको ब्याजदर फरक-फरक हुँदा (When the rates of interest are different for consecutive years):

चक्रीय मिश्रधन Compound Amount	चक्रीय ब्याज Compound Interest	टिप्पणी Remakrs
$CA = P\left(1+\frac{R_1}{100}\right)^{T1}\left(1+\frac{R_2}{100}\right)^{T2}$	$CI = P\left[\left(1+\frac{R_1}{100}\right)^{T1}\left(1+\frac{R_2}{100}\right)^{T2}-1\right]$	R_1 = पहिलो वर्षको ब्याजदर, R_1 = Rate of Interest of first year R_2 = दोस्रो वर्षको ब्याजदर R_2 = Rate of Interest of second year

यदि T वर्षको चक्रीय मिश्रधन CA_1 र (T + 1) वर्षको चक्रीय मिश्रधन CA_2 भए,

If compound amount for T years is CA_1 and the compound amount for (T + 1) years is CA_2

(i) ब्याजदर (Rate of interest) $= \left(\frac{CA_2}{CA_1}-1\right) \times 100\%$ (ii)सावाँ (Principal) $= \frac{CA_1}{\left(1+\frac{R}{100}\right)^{T}}$

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❑ यदि 1 वर्षको चक्रीय ब्याज CI_1 र 2 वर्षको चक्रीय ब्याज CI_2 भए,
If compound interest for 1 year is CI_1 and the compound interest for 2 years is CI_2,

ब्याजदर (Rate of Interest)	सावाँ (Principal)
$R = \left(\frac{CI_2}{CI_1} - 2\right) \times 100\%$	$P = \frac{CI_1 \times 100}{R}$

❑ चक्रीय ब्याज र साधारण ब्याजको अन्तर (Difference between CI and SI) = $P\left[\left(1+\frac{R}{100}\right)^T - \left(\frac{TR+100}{100}\right)\right]$

❑ चक्रीय ब्याज र साधारण ब्याजको योगफल (Sum of CI and SI) = $P\left[\left(1+\frac{R}{100}\right)^T + \left(\frac{TR-100}{100}\right)\right]$

SEE Model QUESTIONS ISSUED BY CDC [Q. NO. 21]

Q. 21.रु 2000 को तीन वर्षको 10% प्रतिवर्षका दरले हुन आउने वार्षिक चक्रीय ब्याज रु 3000 को 2 वर्षमा वार्षिक प्रतिशतको दरले हुन आउने साधारण ब्याजभन्दा कति प्रतिशतले बढी हुन्छ, पत्ता लगाउनुहोस् । 8
By what percent more is the yearly compound interest on Rs 2000 for 3 years at 10% p.a. than simple interest on Rs 3000 for 2 years at 8% p.a. Find it.

⇨ Here,

Compound	Simple
P_1 = Rs 2000, R_1 = 10% and T_1 = 3 yrs	P_2 = Rs 3000, R_2 = 8% and T_2 = 2 yrs

We know that, CI $= P_1\left[\left(1+\frac{R_1}{100}\right)^{T_1} - 1\right] = 2000\left[\left(1+\frac{10}{100}\right)^3 - 1\right]$

$= 2000 \times (1.331 - 1) = 2000 \times 0.331 = 662$

Again, simple interest $= \frac{P_2T_2R_2}{100} = \frac{3000 \times 2 \times 8}{100} = 480$

∴ CI = Rs 662 and SI = Rs 480 shows that CI is more than SI.

So, required more percentage $= \frac{CI - SI}{SI} \times 100\% = \frac{662 - 480}{480} \times 100\% = 37.92\%$

Thus, the required percentage is 37.92%.

A. BASIC EXERCISE

Very Short Questions

1. वार्षिक मिश्रित ब्याजअनुसार, मिश्रधन A, वार्षिक दर R र समय T भए मूलधन (P) कति होला ?
According to annual compound interest, A is the amount, R is the rate percent per annum and T is the time, what will be the principal (P) ? [2057 A1]

⇨ Here, $A = P\left(1+\frac{R}{100}\right)^T$ ∴ $P = \frac{A}{\left(1+\frac{R}{100}\right)^T}$

2. मुलधन P को T वर्षमा R% प्रतिवर्षका दरले वार्षिक चक्रीय ब्याज CI हुँदा P, T, R र CI को सम्बन्ध लेख्नुहोस् ।
The annual compound interest on a sum P in T years at R% p.a. is CI. Write down the relation among: P, T, R and CI. [2067 A]

⇨ Here, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

3. रु. 5000 को तीन वर्षमा चक्रीय मिश्रधन रु. 8000 भए चक्रीय ब्याज पत्ता लगाउनुहोस् ।
The compound amount of Rs 5000 for three years is Rs 8000. Find the compound interest.

⇨ Here, CI = CA – P = Rs 8000 – Rs 5000 = Rs 3000

4. रु. 8000 को तीन वर्षमा चक्रीय मिश्रधन रु. 11500 भए चक्रीय ब्याज पत्ता लगाउनुहोस् ।
The compound amount of Rs 8000 for three years is Rs 11500. Find the compound interest.

⇨ Here, CI = CA – P = Rs 11500 – Rs 8000 = Rs 3500

5. यदि सावाँ र चक्रीय ब्याज क्रमशः रु. 4000 र रु. 1000 भए चक्रीय मिश्रधन पत्ता लगाउनुहोस् ।
If the principal and the compound interest are Rs 4000 and Rs 1000 respectively, find the compound amount.

⇨ Here, CA = CI + P = Rs 1000 + Rs 4000 = Rs 5000

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6. यदि सावाँ र चक्रीय ब्याज क्रमशः रु. 7000 र रु. 2500 भए चक्रीय मिश्रधन पत्ता लगाउनुहोस् ।
If the principal and the compound interest are Rs 7000 and Rs 2500 respectively, find the compound amount.

⇨ Here, CA = CI + P = Rs 2500 + Rs 7000 = Rs 9500

7. चक्रीय ब्याज रु. 3000 र चक्रीय मिश्रधन रु. 5000 हुने धनराशि कति होला ?
What sum of money has the compound interest Rs 3000 and compound amount Rs 5000?

⇨ Here, P = CA – CI = Rs 5000 – Rs 3000 = Rs 2000

8. चक्रीय ब्याज रु. 4000 र चक्रीय मिश्रधन रु. 10000 हुने धनराशि कति होला ?
What sum of money has the compound interest Rs 4000 and compound amount Rs 10000?

⇨ Here, P = CA – CI = Rs 10000 – Rs 4000 = Rs 6000

9. मिश्रीत ब्याज अनुसार, मिश्रधन A, वार्षिक दर r र समय T भए मूलधन (P) कति होला ?

According to compound interest, A is the amount, r is the rate percent per annum and T is the time. What will be the principal ? **[2057 A1]**

⇨ Here, $A = P\left(1+\frac{r}{100}\right)^T \therefore P = \frac{A}{\left(1+\frac{r}{100}\right)^T}$

10. कुनै धन P को T वर्षमा प्रतिवर्ष r% को दरले चक्रीय ब्याज CI हुन्छ भने P,T,r र CI को सम्बन्ध लेख्नुहोस् ?

The compound interest on a sum P in T years at r% per annum is CI. Write down the relation among P, T, r and CI. **[2057 B2]**

⇨ Here, $CI = P\left[\left(1+\frac{r}{100}\right)^T - 1\right]$

11. रु.20000 को 3 वर्षको प्रतिवर्ष 13% ब्याज दरले साधारण ब्याज पत्ता लगाउनुहोस् ।
Calculate the simple interest on Rs 20000 for 3 years at 13% per annum. **[2057 D1]**

⇨ Here, simple interest $= \frac{PTR}{100} = \frac{\text{Rs } 20000 \times 3 \times 13}{100} = \text{Rs } 7800$

Short Questions

1. यदि रु. 1000 को एक वर्षको चक्रीय ब्याज रु. 100 भए ब्याजको दर पत्ता लगाउनुहोस् ।
If the compound interest of Rs 1000 for 1 year is Rs 100, find the rate of interest.

⇨ Here, $CI = 1000\left[\left(1+\frac{R}{100}\right)^1 - 1\right]$

or, $\frac{100}{1000} = \frac{R}{100}$ $\therefore$ R = 10%

2. यदि रु. 2000 को एक वर्षको चक्रीय ब्याज रु. 400 भए ब्याजको दर पत्ता लगाउनुहोस् ।
If the compound interest of Rs 2000 for 1 year is Rs 400, find the rate of interest.

⇨ Here, $CI = 2000\left[\left(1+\frac{R}{100}\right)^1 - 1\right]$

or, $\frac{400}{2000} = \frac{R}{100}$ $\therefore$ R = 20%

3. यदि सावाँ चक्रीय ब्याजको दोब्बर छ भने चक्रीय ब्याजको कति गुणा चक्रीय मिश्रधन होला ?
If the principal is twice the compound interest then how many times of compound interest is the compound amount?

⇨ Here, P = 2CI then, P = CA – CI or, 2CI = CA – CI $\therefore$ 3CI = CA
Thus, compound amount is thrice the compound interest.

4. यदि सावाँ चक्रीय ब्याजको चार गुणा र चक्रीय मिश्रधन रु. 1500 भए चक्रीय ब्याज कति होला ?
If the principal is four times the compound interest and compound amount is Rs 1500, find the compound interest.

⇨ Here, P = 4CI then, CA = Rs 1500
Now, CI = CA – P = Rs 1500 – 4CI or, CI + 4CI = Rs 1500
$\therefore$ $CI = \text{Rs } \frac{1500}{5} = \text{Rs } 300$
Thus, compound interest is Rs 300.

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5. मुलधन P को T वर्षमा R% प्रतिवर्षका दरले चक्रीय ब्याज र मिश्रधन क्रमश: CI र CA हुँदा
The compound interest and the compound amount on a sum P in T years at R% p.a. are CI and CA respectively. Write down the relation among; **[2067 A]**
(i) P, T, R र CI को वार्षिक चक्रीय रूपमा सम्बन्ध लेख्नुहोस् । [P, T, R and CI (Compounding annually)]
(ii) P, T, R र CA को अर्ध-वार्षिक चक्रीय रूपमा सम्बन्ध लेख्नुहोस् ।
P, T, R and CA (Compounding semi-annually)

⇨ Here, (i) $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$ (ii) $CI = P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right]$

6. कति प्रतिशत चक्रीय ब्याजदरले 2 वर्षमा रु. 700 को मिश्रधन रु. 847 हुन्छ होला ?
At what rate percent compound interest will Rs 700 amount to Rs 847 in 2 years? **[2064 E1]**

⇨ Here, principal (P) = Rs 700, Compound Amount (CA) = Rs 847 and Time (T) = 2 years

We know that, $CA = P\left(1+\frac{R}{100}\right)^T$ or, $847 = 700\left(1+\frac{R}{100}\right)^2$

or, $\frac{847}{700} = \left(1+\frac{R}{100}\right)^2$ or, $\left(\frac{11}{10}\right)^2 = \left(1+\frac{R}{100}\right)^2$

or, $\frac{11}{10} - 1 = \frac{R}{100}$ or, $\frac{1}{10} = \frac{R}{100}$

$\therefore$ $R = 10$ Thus, the interest rate is 10%.

7. कति प्रतिशत चक्रीय ब्याजदरले 2 वर्षमा रु. 625 को मिश्रधन रु. 729 हुन्छ होला ?
At what rate percent compound interest will Rs 625 amount to Rs 729 in 2 years ? **[2064 E2]**

⇨ Here, principal (P) = Rs 625, Compound Amount (CA) = Rs 729 and Time (T) = 2 years

We know that, $CA = P\left(1+\frac{R}{100}\right)^T$ or, $729 = 625\left(1+\frac{R}{100}\right)^2$

or, $\frac{729}{625} = \left(1+\frac{R}{100}\right)^2$ or, $\left(\frac{27}{25}\right)^2 = \left(1+\frac{R}{100}\right)^2$

or, $\frac{27}{25} - 1 = \frac{R}{100}$ or, $\frac{2}{25} = \frac{R}{100}$

$\therefore$ $R = 8\ \%$ Thus, the interest rate is 8%.

Long Questions

MODEL 1

1. वार्षिक 21 प्रतिशत ब्याजदरमा सन्तोषले सुरेशसँग रु. 130000 सापटी लिएछ भने 2 वर्षको अन्त्यमा हुने साधारण ब्याज र वार्षिक चक्रीय ब्याज निकाल्नुहोस् ।
Santosh borrowed Rs 130000 from Suresh at the rate of 21% per annum. Find the simple interest at the end of 2 years and interest compounded yearly. **[2060A1]**

⇨ Here, P = Rs 130000, R = 21% per annum, T = 2 yrs

By formula, $SI = \frac{PTR}{100} = \frac{130000 \times 2 \times 21}{100} = \text{Rs } 54600$

$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = \text{Rs } 130000\left[\left(1+\frac{21}{100}\right)^2 - 1\right]$

$= \text{Rs } 130000\ (1.4641 - 1) = \text{Rs } 130000 \times 0.4641 = \text{Rs } 60333$

Thus, simple interest & compound interest are Rs 54600 & Rs 60333 respectively

2. वार्षिक 21 प्रतिशत ब्याजदरमा शर्मिलाले रमिलासँग रु. 150000 सापटी लिएछ भने 2 वर्षको अन्त्यमा हुने साधारण ब्याज र वार्षिक चक्रीय ब्याज निकाल्नुहोस् ।
Sharmila borrowed Rs 1,50,000 from Ramila at the rate of 21% per annum. Find the simple interest at the end of two years and interest compounded yearly. **[2060 A2]**

⇨ Here, P = Rs 150000, R = 21% per annum, T = 2 yrs

(i) $SI = \frac{PTR}{100} = \frac{\text{Rs } 150000 \times 2 \times 21}{100} = \text{Rs } 63000$

(ii) $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = \text{Rs } 1,50,000\left[\left(1+\frac{21}{100}\right)^2 - 1\right]$

$= \text{Rs } 150000\ [(1.21)^2 - 1] = \text{Rs } 150000\ (1.4641 - 1)$

$= \text{Rs } 150000 \times 0.4641 = \text{Rs } 69615$

Thus. the simple interest and interest compounded yearly are Rs. 63000 and Rs. 69615 respectively.

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3. वार्षिक 21% ब्याजदरमा सीताले राधासँग रु. 170000 सापटी लिइछन् भने 1 वर्ष 6 महिनाको अन्त्यमा,
(i) उनीले साधारण ब्याज कति तिर्नुपर्ला ? (ii) चक्रीय ब्याज कति तिर्नुपर्ला ?
Sita borrowed Rs 1,70,000 from Radha at the rate of 21% per annum, at the end of 1 year 6 months:
(i) How much simple interest will she have to pay ?
(ii) How much compound interest will she have to pay ? **[2058 B2]**

⇨ Here, Principal (P) = Rs 1,70,000 and rate of interest (R) = 21% per annum

Time (T) = 1 year and 6 months = $1\frac{1}{2}$ yrs = $\frac{3}{2}$ yrs

(i) Simple interest (S. I.) = $\frac{PTR}{100} = \frac{\text{Rs } 1,70,000 \times 3 \times 21}{100 \times 2}$ = Rs 53,550

(ii) Time = 1 year 6 month = 1.5 yrs

We know, CA = $P\left[\left(1+\frac{R}{100}\right)^T\right]$

CA for 1 year = Rs $170000\left[\left(1+\frac{21}{100}\right)^1\right]$ = Rs 170000 ×1.21 = Rs 205700

Again, for next 6 months SI will be taken,

SI = $\frac{PTR}{100} = \frac{\text{Rs } 205700 \times 0.5 \times 21}{100}$ = Rs 21598.5

Thus, compound interest = Rs (205700 – 170000) + Rs 21598.5 = Rs 57298.5

4. रामले 21% प्रतिवर्षको दरले सीतासँग रु. 150000 सापटी लियो । नौ महिनाको अन्त्यमा अर्धवार्षिक रूपमा कति चक्रीय ब्याज तिर्नुपर्छ ?
Ram borrowed Rs 1,50,000 from Sita at the rate of 21% per year. At the end of nine months how much compound interest should he pay in nine months compounded half yearly ? **[SLC 2065 A]**

⇨ Here, rate = 21% p.a. and Principal = Rs 150000

Time = 9 month = 6 month + 3 month

= $\frac{1}{2}$ year + 3 month = No. of half year (T) + No. of month (M)

Semi-annual interest for 1st 6 months;

$\therefore$ CI = $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right] = \left[\left(1+\frac{21}{200}\right)^{2\times 1/2}-1\right] = 150000\left[1+\frac{21}{200}-1\right]$

= Rs 15750

New principal for next 3 months = Rs 150000 + Rs 15750 = Rs 165750

Now SI for 3 months'; SI = $\frac{PTR}{100} = \frac{165750 \times 3 \times 21}{100 \times 12}$ = Rs 8701.875

Thus, total interest for 9 months = Rs 15750 + Rs 7875 = Rs 24451.875

Alternative Method:

Compound Interest: CI = $P\left[\left(1+\frac{R}{200}\right)^{2T}\left(1+\frac{MR}{1200}\right)-1\right]$

= Rs $150000\left[\left(1+\frac{21}{200}\right)^{2\times 1/2}\left(1+\frac{3\times 21}{1200}\right)-1\right]$

= Rs 150000 × 0.1630125

Thus, total interest for 9 months = Rs 24451.875

MODEL 2

5. रु. 7500 को वार्षिक 10% ब्याजदरले 2 वर्षमा हुने मिश्रित ब्याज र साधारण ब्याज बीचको अन्तर पत्ता लगाउनुहोस् ।
Find the difference between the compound interest and simple interest on Rs 7500 in 2 years at 10% per annum. **[2057 A1]**

⇨ Here, Principal (P) = Rs 7500, Time (T) = 2 years, Rate (R) = 10% and Simple Interest (SI) = ?

We know that, SI = $\frac{PTR}{100} = \frac{7500 \times 2 \times 10}{100}$ = Rs 1500

Again, we know that, CI = $P\left[\left(1+\frac{R}{100}\right)^T-1\right]$ = Rs $7500\left[\left(1+\frac{10}{100}\right)^2-1\right]$

= Rs 7500 $[(1.1)^2 - 1]$ = Rs 7500 × 0.21 = Rs 1575

Thus, the difference of the interests = CI – SI = Rs 1575 – Rs 1500 = Rs 75

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6. रु. 18000 को वार्षिक 15% ब्याजदरमा 2 वर्षमा हुने साधारण ब्याज र वार्षिक चक्रीय ब्याज बीचको अन्तर पत्ता लगाउनुहोस् ।
Find the difference between simple interest and the annual compound interest on Rs18000 for 2 years at the rate of 15% per annum. **[2058 C2]**

⇨ Here, Principal (P) = Rs 18000, Time (T) = 2 years
Rate (R) = 15%, Simple Interest (S. I.) = ?

By formula, $SI = \frac{PTR}{100} = \frac{Rs\ 18000 \times 2 \times 15}{100} = Rs\ 5400$

Again, by formula, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = Rs\ 18000\left[\left(1+\frac{15}{100}\right)^2 - 1\right]$

$= Rs\ 18000\ [(1+0.15)^2 - 1] = Rs\ 18000\ [(1.15)^2 - 1]$

$= Rs\ 18000\ (1.3225 - 1) = Rs\ 18000 \times 0.3225 = Rs\ 5805$

Now, difference between compound and simple interest i.e. CI – S. I. = Rs 5805 – Rs 5400 = Rs 405
Thus, the difference between CI & annual CI is Rs 405.

7. रु. 8,000 को 10% ब्याजदरले $1\frac{1}{2}$ वर्षमा हुने अर्धवार्षिक चक्रीय ब्याज र साधारण ब्याज बीचको अन्तर पत्ता लगाउनुहोस् ।
Find the difference between compound interest compounded semi-annually and simple interest on Rs 8,000 at 10% per annum in $1\frac{1}{2}$ years. **[SLC 2065 E]**

⇨ Here, principal (P) Rs 8000, Rate (R) = 10% and Time (T) = $1\frac{1}{2}$ years = $\frac{3}{2}$ years

We have, Semi-annual compound interest (CI)

$= P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right] = 8000\left[\left(1+\frac{10}{200}\right)^{2\times 3/2} - 1\right] = 8000 \times \frac{1261}{8000} = Rs\ 1261$

Simple interest (SI) $= \frac{P \times T \times R}{100} = \frac{8000 \times 3 \times 10}{2 \times 100} = Rs\ 1200$

Now, CI – SI = Rs 1261 – Rs 1200 = Rs 61.
Thus, difference between CI (Semi-annual) & SI is Rs 61.

8. एक साहूले 8% साधारण ब्याजदरमा रु. 3000 दाम सापटी दिएछ र सो दाम 10% चक्रीय ब्याजदरमा लगानी गरेछ । यदि दुई वर्षको अन्त्यमा दामको कारोबार पूरा गरेछ भने उसलाई कति लाभ भएछ ?
A trader borrows Rs 3000 at 8% simple interest and invests the same at 10% compound interest. If the transaction is closed at the end of two years, what is his gain ? **[2069 B]**

⇨ Here, For simple interest, Principal (P) = Rs 3000
Rate of interest (R) = 8% per annum Time (T) = 2 years

Simple interest (SI) $= \frac{PTR}{100} = \frac{Rs\ 3000 \times 2 \times 8}{100} = Rs\ 480$

For compound interest: Principal (P) = Rs 3000
Rate of interest (R) = 10% per annum Time (T) = 2 years

Compound interest (CI) $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = Rs\ 3000\left[\left(1+\frac{10}{100}\right)^2 - 1\right]$

$= Rs\ 3000\ [(1.1)^2 - 1] = Rs\ 3000\ (1.21 - 1)$

$= Rs\ 3000 \times 0.21 = Rs\ 630$

Thus, gain = CI – SI = Rs 630 – Rs 480 = Rs 150

MODEL 3

9. मोहनले वार्षिक चक्रीय ब्याज 8% ले रु. 5000 एउटा बैङ्कमा जम्मा गरेको रहेछ भने दुई वर्षमा सोको वार्षिक र अर्ध वार्षिकले हुने मिश्रधनबीच फरक पत्ता लगाउनुहोस् ।
Mohan deposited Rs 5000 at 8% p.a. compound interest in a bank. Find the difference between the amounts compounded yearly and half yearly in two years **[2063 E1]**

⇨ Here, **Case I:** P = Rs 5000, R = 8% p.a. , T = 2 yrs

$A_1 = \text{Amount} = P\left(1+\frac{R}{100}\right)^T = Rs\ 5000\left(1+\frac{8}{100}\right)^2$

$= Rs\ 5000\ (1.08)^2 = Rs\ 5000 \times 1.1664 = Rs\ 5832$

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Case II: P = Rs 5000, R = $\frac{8}{2}$ % = 4% half yearly, T = 2 × 2 = 4 half years

$A_2 = P\left(1+\frac{R}{100}\right)^T$ = Rs 5000 $\left(1+\frac{4}{100}\right)^4$ = Rs 5000 $(1.04)^4$

= Rs 5000 × 1.16985856 = Rs 5849.29

Thus, difference between two amounts = Rs 5849.29 – Rs 5832 = Rs 17.29

10. आदर्शले वार्षिक चक्रीय ब्याज 6% ले रु. 4000 एउटा बैङ्कमा जम्मा गरेको रहेछ भने 2 वर्षमा सोको वार्षिक र अर्धवार्षिक ले हुने मिश्रधन बीच फरक पत्ता लगाउनुहोस् ।

Adrash deposited Rs 4000 at 6% p.a. compound interest in a bank. Find the difference between the amounts compounded yearly and half yearly in two years **[2063 E2]**

⇨ Here, **Case I:** P = Rs 4000, R = 6% p.a., T = 2 yrs

Now, Amount $(A_1) = P\left(1+\frac{R}{100}\right)^T$ = Rs 4000 $\left(1+\frac{6}{100}\right)^2$ = Rs 4000 $(1.06)^2$

= Rs 4000 × 1.1236 = Rs 4494.40

Case II: P = Rs 4000, R = $\frac{6}{2}$ % = 3% half yearly, T = 2 × 2 = 4 half years

Now, Amount $(A_2) = P\left(1+\frac{R}{100}\right)^T$ = Rs 4000 $\left(1+\frac{3}{100}\right)^4$ = Rs 4000 $(1.03)^4$

= Rs 4000 × 1.12550881 = Rs 4502.035

Thus, difference between the amounts = $A_2 - A_1$ = Rs 4502.035 – Rs 4494.4 = Rs 7.635

MODEL 4

11. वार्षिक 10% ब्याजदरले 3 वर्षमा एक धनराशीको चक्रीय वार्षिक ब्याज र साधारण ब्याजको अन्तर रु. 3875 भने सावाँ पत्ता लगाउनुहोस् ।।

The difference between compound interest compounded annually and the simple interest of a certain sum of money at the rate of 10% per annum in 3 years is Rs 3875. Find the principal. **[2072 C]**

⇨ Here, rate of interest (R) = 10%, Time (T) = 3 yrs and CI – SI = Rs 3875

We know that, CI – SI = 3875 or, $P\left[\left(1+\frac{R}{10}\right)^T - 1\right] - \frac{PTR}{100} = 3875$

or, $P\left[\left(1+\frac{10}{100}\right)^3 - 1\right] - \frac{P\times 3\times 10}{100} = 3875$

or, P(1.331 – 1) – P × 0.3 = 3875 or, P(0.331 – 0.3) = 3875

or, P × 0.031 = 3875 ∴ P = 125000

Thus, the principal is Rs 125000.

12. 2 वर्षमा, 12% वार्षिक ब्याजदरमा कुनै रकमको साधारण ब्याज वार्षिक चक्रीय ब्याजभन्दा रु. 36 ले कम हुन आउँछ भने मूलधन निकाल्नुहोस् ।

The simple interest on a sum of money in 2 years is Rs 36 less than the compound interest compounded annually. If the rate of interest is 12% p.a. Find the sum. **[SLC 2066D]**

⇨ Here, Time (T) = 2 yrs, Rate (R) = 12%, CI – SI = Rs 36

We have, $P\left[\left(1+\frac{R}{100}\right)^T - 1\right] - \frac{PTR}{100} = 36$

or, $P\left[\left(1+\frac{12}{100}\right)^2 - 1 - \frac{2\times 12}{100}\right] = 36$ or, $P\left[\frac{784}{625} - 1 - \frac{6}{25}\right] = 36$

or, $P\times\frac{9}{625} = 36$ or, $P = 36\times\frac{625}{9}$

∴ P = 2500

Thus, the required principal is Rs 2500.

13. कुनै रकमको चक्रीय ब्याज 8% वार्षिक दरले 2 वर्षमा सोही रकमको साधारण ब्याज वार्षिक उत्तिनै दरले उही समयमा रु. 76.80 ले बढी हुन्छ भने सो रकम पत्ता लगाउनुहोस् ।

The compound interest on the sum of money at 8% per annum for 2 years is more than the simple interest on the same sum at the same rate for the same time by Rs 76.80. Find the sum. **[SLC 2065 D]**

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⇨ Here, Rate = 8% and Time = 2 yrs.

We have, $CI = P\left[\left(1+\frac{R}{100}\right)^2 - 1\right] = P\left[\left(1+\frac{8}{100}\right)^2 - 1\right]$ $\therefore$ $CI = \frac{104P}{625}$

Again, $SI = \frac{P \times T \times R}{100} = \frac{P \times 2 \times 8}{100} = \frac{4P}{25}$

By the question; $\frac{104P}{625} - \frac{4P}{25} = 76.80$ or, $\frac{104P - 100P}{625} = 76.80$

or, $4P = 76.80 \times 625$ $\therefore$ $P = Rs\ 12000$

Thus, the required sum = Rs 12000

14. दुई वर्षमा वार्षिक 5% ब्याजको दरले हुने चक्रीय ब्याज र साधारण ब्याजको फरक रु. 15 हुन्छ भने साँवा निकाल्नुहोस् ।
The difference between simple and compound interest on a sum for 2 years at 5% per annum is Rs 15. Find the sum. **[2062 C1, 2071 C]**

⇨ Here, let, P be the sum and R be the rate of interest. The compound interest after T years is given by

$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$, Since R = 5% and T = 2 yrs

$CI = P\left[\left(1+\frac{5}{100}\right)^2 - 1\right] = P[(1.05)^2 - 1] = P \times 0.1025$

The simple interest of the same sum in same time at the same rate is given by

$SI = \frac{P \times T \times R}{100} = \frac{P \times 2 \times 5}{100} = P \times 0.1$

By the question,

$CI - SI = Rs\ 15$ or, $P \times 0.1025 - P \times 0.1 = Rs\ 15$

or, $P \times 0.0025 = Rs\ 15$ $\therefore$ $P = Rs\ \frac{15}{0.0025} = Rs\ 6000$

Thus, the required sum is Rs 6000.

15. एकजना व्यापारीले साधारण ब्याजदर 5% का दरले 2 वर्षको लागि केही रुपैयाँ सापटी लियो र तुरुन्तै उसले वार्षिक चक्रीय ब्याजदरमा सोही दरमा उत्ति नै समयको निम्ति सापटी दियो । सो कारोवारमा उसले रु. 50 नाफा गऱ्यो भने कति रुपैयाँ सापटी लिएको थियो होला ? पत्ता लगाउनुहोस् ।
A businessman borrowed a sum of money at the rate of 5% simple interest for 2 years and immediately he lent it in compound interest compounded annually at the same rate for the same duration of time. In this transaction if he gained Rs 50, find the sum borrowed. **[2071 E]**

⇨ Here, rate of interest (R) = 5%, time (T) = 2 yrs and gain = Rs 50

We know that, $SI = \frac{PTR}{100} = \frac{P \times 2 \times 5}{100} = \frac{P}{10}$

We have, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = P\left[\left(1+\frac{5}{100}\right)^2 - 1\right] = P \times \left[\frac{441}{400} - 1\right] = P \times \frac{41}{400}$

By the question, CI – SI = 50

or, $\frac{41P}{400} - \frac{P}{10} = 50$ or, $\frac{41P - 40P}{400} = 50$ or, $\frac{P}{400} = 50$ $\therefore$ $P = 20000$

Thus, the sum borrowed is Rs 20000.

16. एक साहुले 3% प्रतिवर्ष साधारण ब्याजका दरले केही रकम सापट लिएछ र सो रकम वार्षिक 5% चक्रीय ब्याजका दरले लगानी गरेछ । यदि, उसले 3 वर्षपछि रु. 1082 नाफा गरेछ भने कति रकम सापट लिएको थियो होला ? पत्ता लगाउनुहोस् ।
A money lender borrows a certain sum of money at 3% per annum simple interest and invests the same sum at 5% per annum compound interest. If he makes a profit of Rs 1082 after 3 years, what is the amount he borrowed ? Find it. **[2071 B]**

⇨ Here, rate of simple interest (R_1) = 3% Rate of compound interest (R_2) = 5%

Time (T) = 3 years Profit = Rs 1082

We know that, $SI = \frac{PTR}{100} = \frac{P \times 3 \times 3}{100} = \frac{9P}{100}$

Again, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = P\left[\left(1+\frac{5}{100}\right)^3 - 1\right] = P\left[\left(1+\frac{1}{20}\right)^3 - 1\right] = P \times \frac{1261}{8000}$

By the question, CI – SI = 1082

or, $P \times \frac{1261}{8000} - \frac{9P}{100} = 1082$ or, $\frac{1261P - 720P}{8000} = 1082$

or, $\frac{541 \times P}{8000} = 1082$ or, $P = 1082 \times \frac{8000}{541} = 16000$

Thus, the principal is Rs 16000.

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MODEL 5

17. वार्षिक 10% ब्याजदरले 2 वर्षमा कुनै एक धनराशीको अर्धवार्षिक चक्रीय ब्याज र वार्षिक चक्रीय ब्याजको अन्तर रु. 220.25 हुन्छ भने सो धनराशी पत्ता लगाउनुहोस् ।

The difference between the compound interest compounded semi-annually and compound interest compounded annually on a sum of money is Rs 220.25 at the rate of 10% per annum for 2 years. Find the sum. **[2072 FW]**

⇨ Here, Rate = 10%, Time (T) = 2 yrs, Semi-annual CI – Annual CI = 220.25

or, $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]-P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=220.25$

or, $P\left[\left(1+\frac{10}{200}\right)^{4}-1\right]-P\left[\left(1+\frac{10}{200}\right)^{2}-1\right]=220.25$

or, $P \times 0.21550625 - P \times 0.21 = 220.25$ or, $P \times 0.00550625 = 220.25$

$\therefore$ $P = 40000$ Thus, the principal is Rs 40000.

18. कुनै धनको 12% चक्रीय ब्याजका दरले 2 वर्षमा हुने वार्षिक चक्रीय ब्याज अर्धवार्षिक चक्रीय ब्याज भन्दा रु. 2019.24 कम भए मूलधन निकाल्नुहोस् ।

At the rate of 12% per annum, the annual compound interest of a sum of money in 2 years is Rs 2019.24 less than the semi-annual compound interest, find the principal. **[2068 E]**

⇨ Here, Rate of interest (R) = 12% and Time (T) = 2 yrs

Semi-annual CI – Annual CI = Rs 2019.24

We have, Semi-annual CI $= P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]=P\left[\left(1+\frac{12}{200}\right)^{2\times2}-1\right]=P\times\left[\left(\frac{53}{50}\right)^{4}-1\right]$

$= P \times 0.26247696$

And, annual CI $= P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=P\left[\left(1+\frac{12}{100}\right)^{2}-1\right]=P\times0.2544$

Now, Semi-annual CI – Annual CI = 2019.24

or, $P \times 0.26247696 - P \times 0.2544 = 2019.24$

or, $P \times 0.00807696 = 2019.24$ $\therefore$ $P = 250000$

Thus, the principal is Rs 250000.

19. वार्षिक 20% ब्याजदरले 2 वर्षमा कुनै धनराशीको वार्षिक चक्रीय ब्याज र अर्धवार्षिक चक्रीय ब्याजको अन्तर रु. 482 भए सो धनराशी पत्ता लगाउनुहोस् ।

The difference between the annual and semi-annual compound interest on a sum of money is Rs 482 at the rate of 20% per annum for 2 years. Find the sum. **[SLC 2066 C]**

⇨ Here, Semi-annual CI – Annual CI = 482

or, $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]-P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=482$

or, $P\left[\left(1+\frac{20}{200}\right)^{2\times2}-1\right]-P\left[\left(1+\frac{20}{100}\right)^{2}-1\right]=482$

or, $P\left[\left(\frac{11}{10}\right)^{4}-1\right]-P\left[\left(\frac{6}{5}\right)^{2}-1\right]=482$

or, $P\times\frac{4641}{10000}-P\times\frac{11}{25}=482$ or, $P\times\frac{241}{10000}=482$

$\therefore$ $P = 20000$

Thus, the required principal is Rs 20000.

20. वार्षिक 10% का दरले एक वर्षमा कुनै धनराशिको अर्धवार्षिक चक्रीय ब्याज सोही समयमा उही दरले वार्षिक चक्रीय ब्याज भन्दा रु. 40 ले बढी हुन्छ भने मूलधन पत्ता लगाउनुहोस् ।

If the compound interest on a sum of money compounded semi-annually in one year at 10% per annum be Rs 40 more than the compound interest on the same sum compounded annually in the same time and at the same rate, find the sum. **[2067 B]**

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⇨ Here, Time = 1 year and Rate = 10% and Semi-annual CI – annual CI = Rs 40

or, $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]-P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=40$

or, $P\left[\left(1+\frac{10}{200}\right)^{2}-1\right]-P\left[\left(1+\frac{10}{100}\right)-1\right]=40$

or, $P\left[\frac{441}{400}-1\right]-P\frac{10}{100}=40$ or, $P\frac{41}{400}-P\frac{1}{10}=40$

or, $P\left[\frac{41}{400}-\frac{1}{10}\right]=40$ or, $P\frac{1}{400}=40$

∴ P = 16000 Thus, the principal (sum) is Rs 16000.

21. एक पर्यटकले अङ्कित मूल्यमा 20% छुट लिई 13% मूल्य अभिवृद्धि कर (VAT) तिरेर एउटा मूर्ति किनेछ । जब उ आफ्नो देश फर्किन्छ, विमानस्थलमा मूल्य अभिवृद्धि कर (VAT) रकम वापत रु. 1872 फिर्ता पाउँछ भने उक्त मूर्तिको अङ्कित मूल्य र अभिवृद्धि कर (VAT) सहितको विक्रय मूल्य पत्ता लगाउनुहोस् ।

A tourist buys a statue at 20% discount on the marked price with 13% value added tax (VAT). What he returned to his own country he got Rs 1872 back for value added tax (VAT) at the airport, find the marked price and the selling price including value added tax (VAT) of the statue. [2071S]

⇨ Here, Discount rate = 20%, VAT rate = 13% VAT amount = Rs 1872

Let, MP be Rs x then, SP = MP – Discount = x – 20% of x $= x-\frac{20}{100}\times x = x-\frac{x}{5} = \frac{4x}{5}$

Again, amount of VAT = 13% of $\frac{4x}{5}$ = 13% of $\frac{4x}{5}$

or, $1872=\frac{13}{100}\times\frac{4x}{5}$ or, $13\times 4x = 100\times 5\times 1872$

or, $x=\frac{100\times 5\times 1872}{13\times 4}=18000$

Now, SP with VAT $= SP + VAT = \frac{4x}{5}+1872 = \frac{4\times 18000}{5}+1872 = 16272$

Thus, the marked price is Rs 18000 and SP with VAT is Rs 16272.

MODEL 6

22. कुनै धनको 2 वर्षमा 8% वार्षिक ब्याजदरले साधारण ब्याज र चक्रीय ब्याजको योगफल रु. 612 हुन्छ भने मुलधन पत्ता लगाउनुहोस् ।

The sum of the simple interest and compound interest on a sum of money for 2 years at the rate of 8% per annum is Rs 612. Find the principal. [2070 S]

⇨ Here, Time (T) = 2 yrs, Rate = 8%, Sum of SI and CI = Rs 612

We have given, SI + CI = 612

or, $\frac{PTR}{100}+P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=612$ or, $\frac{P\times 2\times 8}{100}+P\left[\left(1+\frac{8}{100}\right)^{2}-1\right]=612$

or, P × 0.16 + P × 0.1664 = 612 or, P × 0.3264 = 612

∴ P = 1875 Thus, the principal is Rs 1875.

23. वार्षिक 10% ब्याजदरले कुनै धनराशीको 2 वर्षमा अर्धवार्षिक चक्रीय ब्याज र वार्षिक चक्रीय ब्याजको योग रु. 17020.25 हुन्छ भने सो धनराशी पत्ता लगाउनुहोस् ।

The sum of compound interest compounded semi-annually and the compound interest compounded annually of a sum of money at the rate of 10% per annum for 2 years is Rs 17020.25. Find the sum. [2072 MW]

⇨ Here, Rate (R) = 10%, Time (T) = 2 yrs, Semi-annual CI + Annual CI = Rs 17020.25

We know that, $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]+P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=$ Rs 17020.25

or, $P\left[\left(1+\frac{10}{200}\right)^{4}-1\right]+P\left[\left(1+\frac{10}{100}\right)^{2}-1\right]=$ Rs 17020.25

or, P × 0.21550625 + P × 0.21 = Rs 17020.25 or, P × 0.42550625 = Rs 17020.25

∴ P = 40000 Thus, the principal is Rs 40000.

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24. वार्षिक 10% ब्याजका दरले 3 वर्षको अन्त्यमा साधारण ब्याज र चक्रीय ब्याजको योग रु. 504.80 भए मूलधन पत्ता लगाउनुहोस् ।
The sum of simple interest and compound interest after 3 years is Rs 504.80 and the rate of interest is 10% per annum. Find the principal. **[2062 E2]**

⇨ Here, T = 3 yrs and R = 10% p.a.

Now, Compound interest (CI) $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = P\left[\left(1+\frac{10}{100}\right)^3 - 1\right]$

$= P[(1.1)^3 - 1] = P \times (1.331 - 1) = P \times 0.331$

The simple interest (SI) $= \frac{PTR}{100} = \frac{P \times 3 \times 10}{100} = P \times 0.3$

By question, CI + SI = Rs 504.80

or, $P \times 0.331 + P \times 0.3 = Rs\ 504.80$

or, $P\ (0.331 + 0.3) = Rs\ 504.80$

or, $P \times 0.631 = Rs\ 504.80$ $\quad\therefore\quad P = Rs\ \frac{504.80}{0.631} = Rs\ 800$

Thus, the required sum = Rs 800

25. कुनै रुपैयाँको एक वर्षको वार्षिक 10% का दरले हुने वार्षिक र अर्धवार्षिक चक्रीय ब्याजको योगफल रु.3240 हुन्छ भने मुलधन पत्ता लगाउनुहोस् ।
The sum of annual and semi-annual compound interest of a certain amount of money in 1 year at the interest rate of 10% per annum is Rs 3240. Find the principal. **[2071 D]**

⇨ Here, interest rate (R) = 10% and Annually CI + Semi-annually CI = Rs 3240

or, $P\left[\left(1+\frac{R}{100}\right)^T - 1\right] + P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right] = 3240$

or, $P\left[\left(1+\frac{10}{100}\right)^1 - 1\right] + P\left[\left(1+\frac{10}{200}\right)^2 - 1\right] = 3240$

or, $P \times 0.1 + P \times 0.1025 = 3240$ $\quad$ or, $P \times 0.2025 = 3240$

or, $P = \frac{3240}{0.2025}$ $\quad\therefore\quad P = 16000$

Thus, the principal is Rs 16000.

MODEL 7

26. प्रकाशले अनिमा र एलिना दुवैलाई 2 वर्षको निम्ति रु. 6000 जम्मा रकम ऋण दिन्छ । अनिमाले 10% वार्षिक ब्याजदरले साधारण ब्याज र एलिनाले 8% वार्षिक चक्रीय ब्याजदरले ब्याज तिर्न मञ्जुर हुन्छिन् । यदि एलिनाले रु. 50 ब्याज अणिमाभन्दा बढी तिर्छिन् भने प्रकाशले दुवैलाई कति कति रकम ऋणमा दिएको थियो होला, पत्ता लगाउनुहोस् ।
Prakash lend altogether Rs 6000 to Anima and Elina for 2 years Anima agree to pay simple interest at 10% p.a. and Elina agree to pay compound interest at the rate of 8% p.a. If Elina paid Rs 50 more than Anima as the interest, find how much did he lend to each. **[2062 D1]**

⇨ Here, for Anima, Let, P = x, T = 2 yrs, R = 10%

Simple interest (SI) $= \frac{P \times T \times R}{100} = \frac{x \times 2 \times 10}{100} = \frac{x}{5} = x \times 0.2$

For Elina, P = (6000 – x), T = 2 yrs, R = 8%

Compound interest (CI) $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = (6000 - x)\left[\left(1+\frac{8}{100}\right)^2 - 1\right]$

$= (6000 - x) \times (0.1664) = 998.4 - x \times 0.1664$

By question, CI – SI = $998.4 - x \times 0.1664 - x \times 0.2$

or, $50 = 998.4 - x \times (0.1664 + 0.2)$ $\quad$ or, $50 = 998.4 - x \times 0.3664$

or, $x \times 0.3664 = 998.4 - 50$ $\quad$ or, $x \times 0.3664 = 948.4$

$\therefore\quad x = \frac{948.4}{0.3664} = 2588.43$

Thus, he lent Rs 2588.43 to Anima & Rs (6000 – 2588.43) = Rs 3411.57 to Elina.

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27. मोहनले राम र श्याम दुवैलाई 2 वर्षको निमित्त रु. 6600 जम्मा रकम ऋण दिन्छ । रामले 15% वार्षिक ब्याजदरले साधारण ब्याज र श्यामले उही दरमा चक्रीय ब्याज तिर्न मञ्जुर हुन्छन् । यदि रामले रु.112.50 ब्याज श्यामभन्दा बढी तिर्छ भने मोहनले दुवैलाई कति कति रकम ऋणमा दिएको थियो होला ?

Mohan lend altogether Rs 6,600 to Ram and Shyam for 2 years Ram agree to pay simple interest at 15% p.a. and Shyam agree to pay compound interest at the same rate. If Ram paid Rs 112.50 more than Shyam as the interest, find how much did he lend to each. **[2062 D2]**

⇨ Here, For Ram : let, P = x, T = 2 yrs, R = 15% p.a.

Simple interest (SI) $= \frac{P \times T \times R}{100} = \frac{x \times 2 \times 15}{100} = x \times 0.3$

For Shyam : P = (6600 – x), T = 2 yrs, R = 15%

Compound interest (CI) $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = (6600 - x)\left[\left(1+\frac{15}{100}\right)^2 - 1\right]$

$= (6600 - x) \times 0.3225 = 2128.5 - x \times 0.3225$

By question, SI – CI = 112.5 or, $x \times 0.3 - (2128.5 - x \times 0.3225) = 112.5$

or, $x \times 0.3 - 2128.5 + x \times 0.3225 = 112.5$ or, $x \times (0.3 + 0.3225) = 112.5 + 2128.5$

or, $x \times 0.6225 = 2241$ $\therefore \quad x = \frac{2241}{0.6225} = 3600$

Thus, he lent to Ram = x = Rs 3600 and to Shyam = Rs(6600 – 3600) = Rs 3000

MODEL 8

28. यदि कुनै रकम वार्षिक चक्रीय ब्याजअनुसार 2 वर्षमा रु. 8820 र 3 वर्षमा रु. 9261 हुन्छ भने साँवा रकम र ब्याजदर निकाल्नुहोस् ।

The compound amount of a certain sum of money in 2 years and 3 years become Rs 8820 and Rs 9261 respectively. Find the sum and the rate of interest. **[2068 A]**

⇨ Here, CA_1 in 2 years = Rs 8820 and CA_2 in 3 years = Rs 9261

We know, $CA_1 = P\left(1+\frac{R}{100}\right)^T$ or, $8820 = P\left(1+\frac{R}{100}\right)^2$ ..... (i)

And, $CA_2 = P\left(1+\frac{R}{100}\right)^T$ or, $9261 = P\left(1+\frac{R}{100}\right)^3$ ..... (ii)

Dividing equation (ii) by equation (i); $\frac{9261}{8820} = \frac{P\left(1+\frac{R}{100}\right)^3}{P\left(1+\frac{R}{100}\right)^2}$

or, $1.05 = 1 + \frac{R}{100}$ or, $0.05 = \frac{R}{100}$ $\therefore \quad R = 5$

From (i) $8820 = P\left(1+\frac{5}{100}\right)^2$ or, $8820 = P \times \left(\frac{21}{20}\right)^2$

or, $8820 = P \times \frac{441}{400}$ or, $P = 8820 \times \frac{400}{441}$ $\therefore \quad P = 8000$

Thus, the sum and the rate of interest are Rs 8000 and 5% respectively.

29. वार्षिक मिश्रित ब्याज प्रणालीअनुसार कुनै रकमको मिश्रधन 2 वर्षमा रु. 7260 पुग्दछ र 3 वर्षमा रु. 7986 पुग्दछ भने सो रकमको ब्याजदर पत्ता लगाउनुहोस् ।

According to the system of compound interest, a sum of money in 2 years amounts to Rs 7260 years and in 3 years, it amounts to Rs 7986. Find the rate of interest. **[2059 A1]**

⇨ Here, suppose, principal= P and rate of interest = R

At the end of 2 years, amount (A) = Rs 7260 and Time (T) = 2 years

By formula, $A = P\left(1+\frac{R}{100}\right)^T$ $\therefore \quad \text{Rs } 7260 = P\left(1+\frac{R}{100}\right)^2$ .... (1)

Again, at the end of 3 years, amount (A) = Rs 7986 and Time (T) = 3 years

By formula, $A = \left(1+\frac{R}{100}\right)^T$ $\therefore \quad \text{Rs } 7986 = P\left(1+\frac{R}{100}\right)^3$ ..... (2)

Dividing equation (2) by equation (1), $\frac{\text{Rs } 7986}{\text{Rs } 7260} = \frac{P}{P}\frac{\left(1+\frac{R}{100}\right)^3}{\left(1+\frac{R}{100}\right)^2}$

or, $1.1 = 1 + \frac{R}{100}$ or, $0.1 = \frac{R}{100}$ $\therefore \quad R = 0.1 \times 100 = 10\%$ per year

Thus, the rate of interest is 10%.

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30. वार्षिक चक्रीय ब्याजदरमा कुनै रकमको मिश्रधन दुई वर्षको अन्तमा रु. 12,100 र तीन वर्षको अन्तमा रु. 13,310 हुन आउँछ भने चक्रीय ब्याजदर र मूलधन पत्ता लगाउनुहोस् ।

In yearly compound interest, if the amount of the sum of money becomes Rs 12,100 at the end of two years and Rs 13,310 at the end of three years, find the rate of compound interest and the sum. **[SLC 2066 E]**

⇨ Here, compound amount for 2 years = CA_2 = Rs 12100

Compound amount for 3 years = CA_3 = Rs 13310

Now, $CA_3 - CA_2$ = Rs 13310 – Rs 12100 = Rs 1210

So, Rs 1210 is the simple interest on Rs 12100 for 1 year.

i.e. I = Rs 1210, T = 1 year and P = Rs 12100

We know that, Rate of interest (R) $= \frac{I \times 100}{P \times T} = \frac{1210 \times 100}{12100 \times 1} = 10\%$

Again, CA_2 = Rs 12100

or, $P\left(1+\frac{R}{100}\right)^T = 12100$ or, $P\left(1+\frac{10}{100}\right)^2 = 12100$

or, $P \times 1.1^2 = 12100$ $\therefore P = 10000$

Thus, the principal is Rs 10000 and the rate is 10%.

31. 10% वार्षिक चक्रीय ब्याजको दरले $1\frac{1}{2}$ वर्षमा कति धनले अर्धवार्षिक चक्रीय ब्याज रु. 6305 देला ?

What sum of money will yield Rs 6305 compound interest compounded semi-annually at 10% per annum in $1\frac{1}{2}$ years ? **[SLC 2066 C]**

⇨ Here, rate of interest (R) = 10% Time (T) = $1\frac{1}{2}$ yrs = 1 year 6 months = $\frac{3}{2}$ yrs.

Compound interest (CI) = Rs 6305

We know that, $CI = P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right]$ or, Rs 6305 $= P\left[\left(1+\frac{10}{200}\right)^{2\times 3/2} - 1\right]$

or, Rs 6305 $= P \times \left[\left(1+\frac{10}{200}\right)^3 - 1\right]$ or, Rs 6305 $= P \times \frac{1261}{8000}$

$\therefore$ P = 40000 Thus, the required principal is Rs 40000.

MODEL 9

32. वार्षिक चक्रीय ब्याज अनुसार 1 वर्ष र 2 वर्षमा कुनै रकमको चक्रीय ब्याज क्रमशः रु. 450 र रु. 945 पुग्दछ भने ब्याजदर र मूलधन पत्ता लगाउनुहोस् ।

The compound interest of a sum of money in 1 year and 2 years are Rs 450 and Rs 945 respectively. Find the rate of interest compounded yearly and the sum. **[2064 B1]**

⇨ Here, CI in 1 years = Rs 450, CI in 2 years = Rs 945 $\therefore P\left[\left(1+\frac{R}{100}\right)^1 - 1\right] = 450$ ..... (i)

And, $P\left[\left(1+\frac{R}{100}\right)^2 - 1\right] = 945$ ..... (ii)

Dividing (ii) by (i), $\frac{P\left[\left(1+\frac{R}{100}\right)+1\right]\left[\left(1+\frac{R}{100}\right)-1\right]}{\left[\left(1+\frac{R}{100}\right)-1\right]} = \frac{945}{450}$

or, $\left[\left(1+\frac{R}{100}\right)+1\right] = \frac{21}{10}$ or, $\frac{R}{100}+2 = \frac{21}{10}$

or, $\frac{R}{100} = \frac{1}{10}$ $\therefore$ R = 10%

From equation (i) $P\left[\left(1+\frac{10}{100}\right)-1\right] = 450$

or, $P \times \frac{1}{10} = 450$ $\therefore$ P = Rs 4500

Thus, the rate of interest is 10% and the principal is Rs 4500.

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MODEL 10

33. रु. 8000 को वार्षिक 20% का दरले चक्रीय ब्याज रु. 5824 हुन्छ । सोही समयमा र सोही ब्याजदरमा उक्त रकमको साधारण ब्याज कति हुन्छ ?
If the compound interest on Rs 8000 at the rate of 20% is Rs 5824. Find simple interest of the same sum at the same rate and the same time. **[2071 A]**

⇨ Here, principal (P) = Rs 8000 Rate of interest (R) = 20%

Compound interest (CI) = Rs 5824

We have, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

or, $5824 = 8000\left[\left(1+\frac{20}{100}\right)^T - 1\right]$

or, $0.728 = (1.2)^T - 1$

or, $1.728 = (1.2)^T$

$\therefore$ $T = 3$ years

Now, we know that, $SI = \frac{PTR}{100} = \frac{8000 \times 3 \times 20}{100} = 4800$

Thus, the simple interest is Rs 4800.

34. कुनै धनराशिको 10% वार्षिक ब्याजका दरले 2 वर्षमा चक्रीय ब्याज रु. 420 हुन्छ भने त्यत्तिकै समयको लागि उही नै वार्षिक ब्याज दरले सोही सावाँमा लाग्ने साधारण ब्याज निकाल्नुहोस ।
The compound interest on a certain sum for two years at 10% per annum is Rs 420. What would be the simple interest on the same sum at the same rate for the same time ? **[2058 D2]**

⇨ Here, rate (R) = 10% per annum, Time (T) = 2 years, Principal (P) = ?

By formula, Compound Interest (CI) $= P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

or, Rs $420 = P\left[\left(1+\frac{10}{100}\right)^2 - 1\right]$

or, Rs $420 = P\left[(1.1)^2 - 1\right]$

or, Rs $420 = P \times 0.21$

or, Rs $420 = P\left[(1+0.1)^2 - 1\right]$

or, Rs $420 = P\,(1.21 - 1)$

$\therefore$ $P = \frac{\text{Rs } 420}{0.21} = \text{Rs } 2000$

$\therefore$ Simple Interest (S. I.) $= \frac{PTR}{100} = \frac{\text{Rs}2000 \times 2 \times 10}{100} = \text{Rs } 400$

Thus, the simple interest is Rs 400.

35. कुनै सावाँको चक्रीय ब्याज वार्षिक 8% को दरले 2 वर्षमा रु. 312 हुन्छ भने, त्यही अवधि र त्यही ब्याजदरले उक्त सावाँको साधारण ब्याज निकाल्नुहोस् ।
The compound interest on a certain sum for 2 years at 8% per annum compounded annually is Rs 312. Find the simple interest for the same time and the same rate. **[2065 C]**

⇨ Here, Rate of interest (R) = 8% and Time (T) = 2 years

Compound interest (CI) = Rs 312

We have, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

or, $312 = P\left[\left(1+\frac{8}{100}\right)^2 - 1\right]$

or, $312 = P \times \frac{104}{625}$

$\therefore$ $P = \text{Rs } 1875$

Now, simple interest $= \frac{P \times T \times R}{100} = \frac{1875 \times 2 \times 8}{100}$

$\therefore$ Simple interest = Rs 300

Thus, the simple interest is Rs 300.

36. धनराशी रु. 150000 को केही प्रतिशत साधारण ब्याजदरले 5 वर्षमा मिश्रधन रु. 262500 हुन्छ । त्यो धनराशी पत्ता लगाउनुहोस् जसको सोही प्रतिशत चक्रीय ब्याजदरले 2 वर्षमा मिश्रधन रु. 198375 हुन्छ ।
A sum of Rs 150000 amounts to Rs 262500 at a certain rate of simple interest in 5 years. Find the sum of money that amounts of Rs 198375 at the same rate of compound interest in 2 years. **[2072 E]**

⇨ Here,

Case I	Case II
Principal (P) = Rs 150000, Time (T) = 5 yrs Amount (A) = Rs 262500	P = ?, Time (T) = 2 yrs CA = Rs 198375

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From the first case: SI = A – P = Rs 262500 – Rs 150000 ∴ SI = Rs 112500

We know that, $R = \frac{SI \times 100}{P \times T} = \frac{112500 \times 100}{150000 \times 5} = 15\%$

From the second case:

We have, $CA = P\left(1 + \frac{R}{100}\right)^T$ or, $198375 = P\left(1 + \frac{15}{100}\right)^2$

or, $198375 = P \times 1.3225$ or, $P = 150000$

Thus, the principal is Rs 150000.

MODEL 11

37. अर्धवार्षिक चक्रीय ब्याजले कुनै धनको चक्रीय मिश्रधन 1 वर्षमा रु. 400 र 2 वर्षमा रु. 441 भए मूलधन र ब्याजदर निकाल्नुहोस् ।
The semi-annual compound amounts of a sum of money in 1 year is Rs 400 and in 2 years is Rs 441. Find the principal and the rate of interest. **[2068 C]**

⇨ Here, semi-annual CA_1 in 1 year = Rs 400 Semi-annual CA_2 in 2 years = Rs 441

We have,

$CA = P\left(1 + \frac{R}{200}\right)^{2T}$ So, $CA_1 = P\left(1 + \frac{R}{200}\right)^{2 \times 1}$ ∴ $400 = P\left(1 + \frac{R}{200}\right)^2$ ... (i)

Again, $CA_2 = P\left(1 + \frac{R}{200}\right)^{2 \times 2}$ or, $441 = P\left(1 + \frac{R}{200}\right)^4$ ..... (ii)

Dividing equation (ii) by equation (i) then,

$\frac{441}{400} = \frac{P\left(1 + \frac{R}{200}\right)^4}{P\left(1 + \frac{R}{200}\right)^2}$ or, $\left(\frac{21}{20}\right)^2 = \left(1 + \frac{R}{200}\right)^2$ or, $\frac{21}{20} = 1 + \frac{R}{200}$

or, $\frac{R}{200} = \frac{21}{20} - 1$ or, $\frac{R}{200} = \frac{1}{20}$ ∴ R = 10%

Putting the value of R in equation (i) then,

$400 = P\left(1 + \frac{10}{200}\right)^2$ or, $400 = P \times \frac{441}{400}$

or, $\frac{400 \times 400}{441} = P$

∴ P = Rs 362.81

Thus, the principal and rate of interest are Rs 362.81 and 10% respectively.

MODEL 12

38. वार्षिक 20% मिश्रित ब्याजका दरले कति वर्षमा रु. 8000 को मिश्रधन रु. 13824 हुन्छ ?
In how many years will Rs 8000 amounts to Rs 13824 at 20% per annum interest compounded annually ? **[SLC 2066 A, 2060 C1]**

⇨ Here, rate of interest (R) = 20% and Principal (P) = Rs 8000

Compound amount (CA) = Rs 13824

We know that, $CA = P\left(1 + \frac{R}{100}\right)^T$ or, $13824 = 8000\left(1 + \frac{20}{100}\right)^T$

or, $\frac{13824}{8000} = \left(\frac{6}{5}\right)^T$ or, $\frac{216}{125} = \left(\frac{6}{5}\right)^T$

or, $\left(\frac{6}{5}\right)^3 = \left(\frac{6}{5}\right)^T$ ∴ T = 3

Thus, the required time period is 3 yrs.

39. वार्षिक चक्रीय ब्याजअनुसार प्रतिवर्ष 6.5% ब्याजका दरले कति समयमा रु. 400000 को चक्रीय ब्याज रु. 53690 होला ?
According to the yearly compound interest in what time will the compound interest on Rs 400000 at the rate of interest 6.5% per annum be Rs 53690 ? **[2063 D1]**

⇨ Here, rate of yearly compound interest (R) = 6.5%, Time (T) = ?, Principal (P) = Rs 400000

Compound interest (CI) = Rs 53690

We know, Compound amount (A) = P + CI

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i.e. $P\left(1+\frac{R}{100}\right)^T = Rs\ (400000 + 53690)$

or, $Rs\ 400000\left(1+\frac{6.5}{100}\right)^T = 453690$ or, $\left(\frac{100+6.5}{100}\right)^T = \frac{453690}{400000}$

or, $\left(\frac{106.5}{100}\right)^T = 1.134225$ or, $(1.065)^T = (1.065)^2$

$\therefore$ T = 2 yrs Thus, the required time (T) = 2 years.

40. एउटा व्यक्तिले रु. 46,875 को कर्जा लिएछ । यदि प्रतिवर्ष प्रति रुपियाँ चक्रीय ब्याजदर 4 पैसा भए कति वर्षमा रु. 5853 चक्रीय ब्याज होला ?
A person took a loan of Rs 46875. If the rate of the compound interest is 4 paisa per rupee per year, in how many years will the compound interest be Rs 5,853.[2065 B, 2067 D]

⇨ Here, Principal (P) = Rs 46875 and Rate = 4 paisa per rupee per year = 4% p.a.
Compound Interest (CI) = Rs 5853

We know that, $CA = P\left(1+\frac{R}{100}\right)^T$ or, $(P+I) = P\left(1+\frac{R}{100}\right)^T$

or, $(46875 + 5853) = 46875\left(1+\frac{4}{100}\right)^T$

or, $1.124864 = \left(1+\frac{4}{100}\right)^T$ or, $1.124864 = (1.04)^T$

or, $(1.04)^3 = (1.04)^T$ $\therefore$ T = 3 years

Thus, the required time is 3 years.

41. रु. 15625 को 1 वर्ष 6 महिनाको अर्धवार्षिक चक्रीय ब्याज रु. 1951 हुन्छ भने ब्याजदर पत्ता लगाउनुहोस् ।
If the semi-annual compound interest of Rs 15625 for 1 year 6 months is Rs 1951, find the rate of interest. [2068 B]

⇨ Here, principal (P) = Rs 15625 and Time (T) = 1 year + 6 month = $1+\frac{1}{2}=\frac{3}{2}$ yrs

Compound interest (CI) = Rs 1951

We know that, $CI = P\left[\left(1+\frac{R}{200}\right)^{2T} - 1\right]$ or, $1951 = 15625\left[\left(1+\frac{R}{200}\right)^{2\times 3/2} - 1\right]$

or, $\frac{1951}{15625} = \left(1+\frac{R}{200}\right)^3 - 1$ or, $1.124864 = \left(1+\frac{R}{200}\right)^3$

or, $(1.04)^3 = \left(1+\frac{R}{200}\right)^3$ or, $1.04 = 1+\frac{R}{200}$

or, $0.04 = \frac{R}{200}$ $\therefore$ R = 8%

Thus, the rate of interest is 8%.

42. वार्षिक कति चक्रीय ब्याजका दरले रु. 343000 को 3 वर्षमा रु. 169000 चक्रीय ब्याज होला ?
At what rate of compound interest per annum will be compound interest on Rs 343000 be Rs 169000 in 3 years? [2064 D1]

⇨ Here, principal (P) = Rs 343000, Compound Interest (CI) = Rs 169000
Time (T) = 3 years, Interest (R) ?

We have, $CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$ or, $169000 = 343000\left[\left(1+\frac{R}{100}\right)^3 - 1\right]$

or, $\frac{169}{343} = \left(1+\frac{R}{100}\right)^3 - 1$ or, $\frac{169}{343} + 1 = \left(1+\frac{R}{100}\right)^3$

or, $\frac{512}{343} = \left(1+\frac{R}{100}\right)^3$ or, $\left(\frac{8}{7}\right)^3 = \left(1+\frac{R}{100}\right)^3$

or, $1+\frac{R}{100} = \frac{8}{7}$ or, $\frac{R}{100} = \frac{8}{7} - 1$

or, $\frac{R}{100} = \frac{1}{7}$ $\therefore$ $R = 14\frac{2}{7}$

Thus, the interest rate is $14\frac{2}{7}\%$.

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MODEL 13

43. कुनै धनराशीको 2 वर्षमा हुने साधारण ब्याज र चक्रीय ब्याज क्रमशः रु. 1000 र रु. 1050 छन् भने वार्षिक ब्याजदर र सावाँ पत्ता लगाउनुहोस् ।

The simple interest and compound interest of a sum of money in 2 years are Rs 1000 and Rs 1050 respectively. Find the annual rate of interest and the principal. **[2072 W]**

⇨ Here, Time (T) = 2 yrs, SI = Rs 1000 and CI = Rs 1050

We know that, $SI = \frac{PTR}{100}$ or, $1000 = \frac{P \times 2 \times R}{100}$

$\therefore \quad P = \frac{50000}{R}$

We have, $CI = P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$ or, $1050 = \frac{50000}{R}\left[\left(1 + \frac{R}{100}\right)^2 - 1\right]$

or, $1050 = \frac{50000}{R}\left[1 + 2 \times \frac{R}{100} + \frac{R^2}{10000} - 1\right] = \frac{50000}{R}\left[\frac{2R}{100} + \frac{R^2}{10000}\right]$

$= 50000\left[\frac{2}{100} + \frac{R}{10000}\right] = 50000 \times \frac{1}{100}\left[2 + \frac{R}{100}\right]$

or, $1050 = 500\left[2 + \frac{R}{100}\right]$ or, $\frac{21}{10} = 2 + \frac{R}{10}$

or, $\frac{1}{10} = \frac{R}{100}$ $\therefore$ $R = 10\%$

Now, $P = \frac{50000}{R} = \frac{50000}{10} = 5000$

Thus, the principal is Rs 5000 and rate is 10%.

B. QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 3]

1. सूत्र प्रयोग नगरी हिसाब गर्नुहोस् **(Calculate without using formula):**

A. वार्षिक **12%** ब्याजदरमा रूपकले विदुरसँग रु. **14000** कर्जा लिएछ भने **2** वर्षपछि रूपकले विदुरलाई जम्मा कति चक्रीय ब्याज तिर्नुपर्ला ? पत्ता लगाउनुहोस् ।

Rupak borrowed Rs 14000 with Bidur at 12% annual rate of interest and how much compound interest should be paid by Rupak to Bidur ? Find it.

⇨ Here, interest of Rs 14000 at 12% in 1 year = 12% of Rs 14000 = 0.12 × Rs 14000
= Rs 1680

We have, Amount = Rs 14000 + Rs 1680 = Rs 15680

For the 2nd year,

Interest of Rs 15680 at 12% in year = 12% of Rs 15680 = 0.12 × Rs 15680
= Rs 1881.60

Again, we have, Total compound interest = Rs 1680 + Rs 1881.60 = Rs 3561.60

Thus, the required amount is Rs 3561.60.

B. मूलधन रु. **10,000** को वार्षिक **6%** ब्याजदरमा ब्याज हिसाब गर्दा **2** वर्षपछिको वार्षिक चक्रीय मिश्रधन र चक्रीय ब्याज पत्ता लगाउनुहोस् ।

Find the compound amount and compound interest of principal Rs 10000 for 2 years at the rate of 6% per annum.

⇨ Here, principal (P) = Rs 10000

At 6% interest

Interest of Rs 10000 for 1 year = 6% of Rs 10000 = 0.06 × Rs 10000 = Rs 600

New principal for 2nd year

Amount = Rs 10000 + Rs 600 = Rs 10600

Interest of Rs 10600 for 1 year = 6% of Rs 10600 = 0.06 × Rs 10600 = Rs 636

Compound interest = Rs 600 + Rs 636 = Rs 1236

Compound amount = Rs 10000 + Rs 1236 = Rs 11236

Thus, the compound interest and amount are Rs 1236 and Rs 11236 respectively.

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C. रु. 64,000 लाई 3 वर्षका लागि ब्याजदर 4% प्रतिवर्ष पहिलो वर्षका लागि, 5% प्रतिवर्ष दोस्रो वर्षका लागि र 6% तेस्रो वर्षकालागि निर्धारण गरी लगानी गर्दा तिन वर्षपछिको चक्रीय मिश्रधन र चक्रीय ब्याज पत्ता लगाउनुहोस् ।
Find the compound amount and interest of Rs 64000 for 3 years at 4% per annum rate of interest for first year, 5% per annum rate of interest for second year and 6% per annum rate of interest for third year.

⇨ Here, principal (P) = Rs 64000

For the first year

Interest of Rs 64000 at 4% p.a. = 4% of Rs 64000 = 0.04 × Rs 64000 = Rs 2560

For the second year

New principal = Rs 64000 + Rs 2560 = Rs 66560

Interest of Rs 66560 at 5% p.a. = 5% of Rs 66560 = 0.05 × Rs 66560 = Rs 3328

For the third year

New principal = Rs 3328 + Rs 66560 = Rs 69888

Interest of Rs 69888 at 6% = 6% of Rs 69888 = 0.06 × Rs 69888 = Rs 4193.28

Now, compound amount = Rs 69888 + Rs 4193.28 = Rs 74081.28

And, compound interest = Rs 74081.28 – Rs 64000 = Rs 10081.28

Thus, the compound amount and interest are Rs 74081.28 and Rs 10081.28 respectively.

2. सूत्र प्रयोग गरेर हिसाब गर्नुहोस् **(Calculate using formula):**

A. रु. 20,000 लाई वार्षिक 5% प्रतिवर्ष ब्याजदरमा 3 वर्षका लागि बैङ्कमा राख्दा 3 वर्षपछिको वार्षिक चक्रीय ब्याज र वार्षिक चक्रीय मिश्रधन पत्ता लगाउनुहोस् ।
Rs 20000 is deposited in a bank for 3 years at 5% p.a. rate of interest. Find the compound interest and amount after 3 years.

⇨ Here, Principal (P) = Rs 20000, Time (T) = 3 years and Rate of interest (R) = 5% p.a.

We know that, $CA = P\left(1+\frac{R}{100}\right)^T = \text{Rs } 20000\left(1+\frac{5}{100}\right)^3 = \text{Rs } 20000 \times 1.157625$

$\therefore$ CA = Rs 23152.50

Now, CI = CA – P = Rs 23152.50 – Rs 20000 = Rs 3152.50

Thus, the CA and CI are Rs 23152.50 and Rs 3152.50 respectively.

B. पेम्बाले वार्षिक 4% ब्याजदरमा एउटा सहकारीबाट रु. 48,000 कर्जा लिएछन् । 4 वर्षपछि चक्रीय ब्याज र मिश्रधन कति कति तिर्नुपर्ला ? पत्ता लगाउनुहोस् ।
Pemba borrowed Rs 48000 from a cooperative at 4% rate of interest. How much compound interest and amount should be paid after 4 years ? Find it.

⇨ Here, Principal (P) = Rs 48000 and Rate of interest (R) = 4%

We know that,

$$CA = P\left(1+\frac{R}{100}\right)^T = \text{Rs } 48000\left(1+\frac{4}{100}\right)^4$$

$$= \text{Rs } 48000 \times 1.16985856 = \text{Rs } 56153.21$$

Now, CI = CA – P = Rs 56153.21 – Rs 48000

CI = Rs 8153.21

Thus, the compound interest and compound amount are Rs 8153.21 and Rs 56153.21 respectively.

C. सार्थकले रु. 20000 बैङ्कमा जम्मा गरे । यदि बैङ्कले वार्षिक 8% चक्रीय ब्याज प्रदान गर्दछ भने 2 वर्ष 6 महिनापछिको चक्रीय ब्याज र चक्रीय मिश्रधन पत्ता लगाउनुहोस् ।
Sarthak deposited Rs 20000 in a bank if the bank gives 8% p.a. compound interest, find the amount after 2 years 6 months.

⇨ Here, Principal (P) = Rs 20000 and Rate of interest (R) = 8% p.a.

We know that,

$$CA = P\left(1+\frac{R}{100}\right)^T\left(1+\frac{mR}{1200}\right) = \text{Rs } 20000\left(1+\frac{8}{100}\right)^2\left(1+\frac{6\times 8}{1200}\right)$$

$$= \text{Rs } 20000 \times 1.1664 \times 1.04 = \text{Rs } 24261.12$$

Again, CI = CA – P = Rs 24261.12 – Rs 20000 = Rs 4261.12

Thus, the CI and CA are Rs 4261.12 and Rs 24261.12 respectively.

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3A. अरविन्दले रु. 80,000 एउटा बैङ्कमा जम्मा गरे । यदि बैङ्कले वार्षिक 8% ब्याजदर प्रदान गर्दछ भने 2 वर्षपछिको साधारण ब्याज र चक्रीय ब्याजको फरक पत्ता लगाउनुहोस् ।

Arbinda deposited Rs 80000 in a bank. If the bank provides annual 8% rate of interest, find the difference between compound interest and simple interest after 2 years.

⇨ Here, Principal (P) = Rs 80000, Rate of interest (R) = 8% and Time (T) = 2 years

We know that,

$$SI = \frac{PTR}{100} = \frac{Rs\ 80000 \times 2 \times 8}{100} = Rs\ 12800$$

We have,

$$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = Rs\ 80000\left[\left(1+\frac{8}{100}\right)^2 - 1\right]$$

$$= 80000 \times 0.1664 = Rs\ 13312$$

Now, CI – SI = Rs 13312 – Rs 12800 = Rs 512

Thus, the required difference is Rs 512.

3B. रु. 7,500 को वार्षिक 12% ब्याजदरले 3 वर्षमा हुने साधारण ब्याज तथा वार्षिक चक्रीय ब्याजको फरक पत्ता लगाउनुहोस् ।

Find the difference between the compound interest and simple interest of Rs 7500 in 3 years at 12% per annum.

⇨ Here, Principal (P) = Rs 7500, Time (T) = 3 years and Rate of interest (R) = 12%

We know that,

$$SI = \frac{PTR}{100} = \frac{Rs\ 7500 \times 3 \times 12}{100} = Rs\ 2700$$

And $$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = Rs\ 7500\left[\left(1+\frac{12}{100}\right)^3 - 1\right]$$

$$= Rs\ 7500 \times 0.404928 = Rs\ 3036.96$$

Now, CI – SI = Rs 3036.96 – Rs 2700 = Rs 336.96

Thus, the rqeuired difference is Rs 336.96.

3C. निमाले एउटा वाणिज्य बैङ्कबाट 12.5% साधारण ब्याजका दरले 3 वर्षका लागि रु. 24,000 कर्जा लिइन । उनीले सोही ब्याजदरले चक्रीय ब्याज पाउने गरी सङ्गीतालाई कर्जा दिइन् भने 3 वर्षपछिको उनीलाई हुने फाइदा रकम पत्ता लगाउनुहोस् ।

Neema borrowed Rs 24000 from a commercial bank for 3 years at the rate of 12.5% p.a. in simple interest. She lent the money to Sangita in compound interest at the same rate, how much does she will have profit after 3 years ? Find it.

⇨ Here, Principal (P) = Rs 24000, Rate of interest (R) = 12.5% and Time (T) = 3 years

We know that, SI for Neema $= \frac{PTR}{100} = \frac{Rs\ 24000 \times 3 \times 12.5}{100}$

$\therefore$ SI = Rs 9000

Again, We have,

$$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = Rs\ 24000\left[\left(1+\frac{12.5}{100}\right)^3 - 1\right]$$

$$= Rs\ 24000 \times 0.423828125 = Rs\ 10171.875$$

Her profit after 3 years = CI – SI = Rs 10171.875 – Rs 9000 = Rs 1171.875

Thus, her profit is Rs 1171.87.

4A. रूपाले वार्षिक चक्रीय ब्याज 8% ले रु. 50,000 एउटा बैङ्कमा जम्मा गरिन् । यदि बैङ्कले अर्ध वार्षिक हिसाबले चक्रीय ब्याज दिने रहेछ भने 2 वर्षपछि उनले पाउने मिश्रधन र चक्रीय ब्याज पत्ता लगाउनुहोस् ।

Rupa deposited Rs 50000 in a bank at the rate of 8% p.a. If the bank provides semi annual compound interest, find the compound amount and interest she gets after 2 years.

⇨ Here, Principal (P) = Rs 50000, Rate of interest (R) = 8% and Time (T) = 2 years

We have, CI $= P\left(1+\frac{R}{200}\right)^{2T} = Rs\ 50000\ \left(1+\frac{8}{200}\right)^{2\times 2}$

$= Rs\ 50000 \times 1.16985856 = Rs\ 58492.93$

Now, CI = CA – P = Rs 58492.93 – Rs 50000 = Rs 8492.93

Thus, the CA and CI are Rs 58492.93 and Rs 8492.93 respectively.

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4B. एउटा बैङ्कले अर्ध वार्षिक चक्रीय ब्याज दिन्छ जसमा मञ्जुले रु. 1,00,000 वार्षिक 8% ब्याज पाउने गरी जम्मा गरिन् भने 3 वर्षपछि उनले प्राप्त गर्ने मिश्रधन र चक्रीय ब्याज पत्ता लगाउनुहोस् ।

A bank provides semi-annual compound interest in which Manju deposited Rs 100000 at the rate of 8% p.a. Find the compound amount and interest after 3 years.

⇨ Here, Principal (P) = Rs 100000, Rate of interest (R) = 8% and Time (T) = 3 years

We know that, $CA = P\left(1+\frac{R}{200}\right)^{2T} = \text{Rs } 100000\left(1+\frac{8}{200}\right)^{2\times 3}$

$= \text{Rs } 100000 \times 1.265319081 = \text{Rs } 126531.90$

Now, CI $= CA - P = \text{Rs } 126531.90 - \text{Rs } 100000 = \text{Rs } 26531.90$

Thus, CA and CI are Rs 126531.90 and Rs 26531.90 respectively.

4C. रु. 14,000 को 3 वर्षमा 12% प्रतिवर्ष ब्याजदरले हुने वार्षिक चक्रीय ब्याज र अर्ध वार्षिक चक्रीय ब्याजबिचको अन्तर पत्ता लगाउनुहोस् ।

Find the difference between annual compound interest and semi annual compound interest on Rs 14000 in 3 years at 12% per annum rate of interest.

⇨ Here, Principal (P) = Rs 14000, Time (T) = 3 years and Rate of interest (R) = 12% p.a.

We know that, annual interest, $CI = P\left[\left(1+\frac{R}{100}\right)^{T}-1\right] = \text{Rs } 14000\left[\left(1+\frac{12}{100}\right)^{3}-1\right]$

$= \text{Rs } 14000 \times [1.404928 - 1] = \text{Rs } 5668.99$

Again, semi annual compound interest $CI = P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right] = \text{Rs } 14000\left[\left(1+\frac{R}{200}\right)^{2\times 3}-1\right]$

$= \text{Rs } 14000\left[\left(1+\frac{12}{200}\right)^{6}-1\right] = \text{Rs } 14000\,[1.418519112 - 1]$

$= \text{Rs } 14000 \times 0.418519112 = \text{Rs } 5859.27$

Now, difference between annual and semi annual (CI) = Rs 5859.27 – Rs 5668.99 = Rs 190.28

Thus, the required difference is Rs 190.28.

4D. प्रतिभाले एउटा बैङ्कमा रु. 1,50,000 प्रतिवर्ष 10% ब्याज पाउने गरी रकम जम्मा गरिन् । प्रमिलाले उक्त बैङ्कमा रु. 1,50,000 प्रतिवर्ष 12% ब्याजदरमा रकम जम्मा गरिन् । यदि प्रतिभाले अर्ध वार्षिक चक्रीय ब्याज प्राप्त गर्छिन् र प्रमिलाले वार्षिक चक्रीय ब्याज प्राप्त गर्दछिन् भने 3 वर्षपछि कसको ब्याज कतिले बढी हुन्छ ? पत्ता लगाउनुहोस् ।

Prativa deposited Rs 150000 in a bank at the rate of 10% p.a. Pramila deposited Rs 150000 in the bank at the rate of 12% p.a. If Prativa received semi annual compound interest and Pramila received annual compound interest, which interest is more and by how much in 3 years ? Find it.

⇨ Here,

Prativa	**Pramila**
Principal (P) = Rs 150000, Rate (R) = 10% Time (T) = 3 years	Principal (P) = Rs 150000, Rate (R) = 12% Time (T) = 3 years
Semi annual	Annual
CI for Prativa $CI = P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]$ $= \text{Rs } 150000\left[\left(1+\frac{10}{200}\right)^{2\times 3}-1\right]$ $= \text{Rs } 150000 \times 0.3400956406$ $\therefore\ CI = \text{Rs } 51014.35$	**CI for Pramila** $CI = P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]$ $= \text{Rs } 150000\left[\left(1+\frac{12}{100}\right)^{3}-1\right]$ $= \text{Rs } 150000 \times [1.404928 - 1]$ $= \text{Rs } 60739.20$

Now, Interest for Pramila is more i. e. Rs 60739.20 – Rs 51014.35 = Rs 9724.85

Thus, the required more interest is Rs 9724.85.

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5A. रोशनले 5% साधारण ब्याजदरमा 4 वर्षका लागि केही रुपैयाँ कर्जा लियो र तुरुन्तै उसले सोही दरको चक्रीय ब्याज पाउने गरी रामकलीलाई दियो र 4 वर्षपछि उसले रु. 30 नाफा गऱ्यो भने रोशनले कति रुपैयाँ कर्जा लिएको रहेछ ? पत्ता लगाउनुहोस् ।

Roshan borrowed a sum of money in simple interest at 5% p.a. for 4 years and he immediately lent the sum to Ramkali in compound interest at the same rate. He made a profit Rs 30 after 4 years. How much sum was borrowed by Roshan ?

⇨ Here, Time (T) = 4 years and Rate of interest (R) = 5% p.a.

We know that,

$$SI = \frac{PTR}{100} = \frac{P \times 4 \times 5}{100} = \frac{P}{5}$$

Again, $$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = P\left[\left(1+\frac{5}{100}\right)^4 - 1\right] = P \times 0.21550625$$

We have, given CI – SI = 30

or, $P \times 0.21550625 - \frac{P}{5} = 30$ or, $P \times 0.01550625 = 30$

or, $P = \frac{30}{0.01550625}$ ∴ $P = 1934.70$

Thus, the principal (P) is Rs 1934.70.

5B. प्रतिवर्ष 15% ब्याजदरले 2 वर्षमा कुनै रकमको चक्रीय ब्याज साधारण ब्याजभन्दा रु. 180 ले बढी हुन आउँछ भने मूलधन पत्ता लगाउनुहोस् ।

The compound interest on the sum of money in 2 years at 15% per annum will be Rs 180 more than simple interest. Find the sum. **[2060 E1]**

⇨ Here, R = 15% per year, T = 2 yrs and CI – SI – Rs 180

Suppose, P = x.

Then, we have, $SI = \frac{PTR}{100} = \frac{x \times 2 \times 15}{100} = \frac{30x}{100} = 0.3 \times x$

$$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = x\left[\left(1+\frac{15}{100}\right)^2 - 1\right] = x[(1.15)^2 - 1]$$

$$= x(1.3225 - 1) = x \times 0.3225$$

Now, CI – SI = $x \times 0.3225 - 0.3 \times x$ or, Rs 180 = x (0.3225 – 0.3)

or, Rs 180 = $x \times 0.0225$ ∴ $x = \frac{\text{Rs } 180}{0.0225} = \text{Rs } 8000$

Thus, the required sum is Rs 8000.

5C. एक जना व्यापारीले 3% प्रतिवर्ष साधारण ब्याजदरले केही रकम सापट लिएछ र वार्षिक 5% प्रतिवर्ष चक्रीय ब्याजदरले पुनः लगानी गरेछ । यदि 3 वर्षपछि उसले रु. 1082 लाभ गरेछ भने उसले कति रकम सापटी लिएको हो ? पत्ता लगाउनुहोस् ।

A business man borrows a certain sum of money at 3% per annum simple interest and invests the same sum at 5% per annum compound interest compounded annually. If after 3 years he makes a profit of Rs 1082, what is the amount he borrowed ?

⇨ Here, Rate of interest (R) = 3% (For SI) and Rate of interest (R) = 5% (For CI)

Time (T) = 3 years

We have, $SI = \frac{PTR}{100} = \frac{P \times 3 \times 3}{100} = 0.09P$

$$CI = P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = P\left[\left(1+\frac{5}{100}\right)^3 - 1\right] = P \times 0.157625$$

Now, CI – SI = 1082

or, $P \times 0.157625 - 0.09 \times P = 1082$ or, $P \times 0.067625 = 1082$

∴ P = 16000 Thus, the amount borrowed was Rs 16000.

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5D. वार्षिक 10% का दरले एक वर्षमा हुने धनराशिको अर्ध वार्षिक चक्रीय ब्याज सोही अवधिमा उही दरले हुन आउने वार्षिक चक्रीय ब्याजभन्दा रु. 40 ले बढी हुन्छ भने मूलधन पत्ता लगाउनुहोस् ।

If the compound interest on a sum of money compounded semi-annually in one year at 10% per annum be Rs 40 more than the compound interest on the same sum compounded annually in the same time and at the same rate, find the sum. **[2067 B]**

⇨ Here, Time = 1 year and Rate = 10% and Semi-annual CI – annual CI = Rs 40

or, $P\left[\left(1+\frac{R}{200}\right)^{2T}-1\right]-P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]=40$

or, $P\left[\left(1+\frac{10}{200}\right)^{2}-1\right]-P\left[\left(1+\frac{10}{100}\right)-1\right]=40$

or, $P\left[\frac{441}{400}-1\right]-P\frac{10}{100}=40$ or, $P\frac{41}{400}-P\frac{1}{10}=40$

or, $P\left[\frac{41}{400}-\frac{1}{10}\right]=40$ or, $P\frac{1}{400}=40$

∴ P = 16000 Thus, the principal (sum) is Rs 16000.

6A. वार्षिक मिश्रित ब्याजदरअनुसार कुनै रकमको मिश्रधन 2 वर्षमा रु. 14,520 र 3 वर्षमा रु. 15,972 हुन्छ भने मूलधन र ब्याजदर पत्ता लगाउनुहोस् ।

According to the system of yearly compound interest, a sum of money amounts to Rs 14520 in 2 years and in 3 years it amounts to Rs 15972. Find the sum and the rate of interest. **[2059 E1]**

⇨ Here, suppose, principal = P and Rate of interest = R

Amount after 2 years (A_1) = Rs 14520, Time (T) = 2 years

By formula, $A_1 = P\left(1+\frac{R}{100}\right)^{T}$ or, $\text{Rs } 14{,}520 = P\left(1+\frac{R}{100}\right)^{2}$ ..... (1)

Again, amount after 3 years (A_2) = Rs 15972 and Time (T) = 3 years

By formula, $A_2 = P\left(1+\frac{R}{100}\right)^{T}$ or, $\text{Rs } 15972 = P\left(1+\frac{R}{100}\right)^{3}$ .....(2)

Dividing equation (2) by equation (1), $\frac{\text{Rs } 15972}{\text{Rs } 14520} = \frac{P\left(1+\frac{R}{100}\right)^{3}}{P\left(1+\frac{R}{100}\right)^{2}}$

or, $1.1 = 1+\frac{R}{100}$ or, $1.1-1=\frac{R}{100}$

or, $0.1=\frac{R}{100}$ ∴ $R = 0.1 \times 100 = 10\%$ per annum

Putting the value of R in equation (1),

or, $\text{Rs } 14520 = P\left(1+\frac{10}{100}\right)^{2}$ or, $\text{Rs } 14520 = P(1.1)^2$

or, $\text{Rs } 14520 = P \times 1.21$ ∴ $P=\frac{\text{Rs } 14520}{1.21} = \text{Rs } 12000$

Thus, sum = Rs 12000 and rate of interest = 10% p.a.

6B. वार्षिक चक्रीय ब्याजदरमा कुनै रकमको 2 वर्षको र 3 वर्षको मिश्रधन क्रमशः रु. 10,580 र रु. 12,167 भए मूलधन र ब्याजदर पत्ता लगाउनुहोस् ।

The compound amount of a sum of money in 2 years and 3 years are Rs 10580 and Rs 12167 respectively. Find the rate of interest and sum, compounded yearly. **[2063 B2]**

⇨ Here, let, P be the principal and R the rate of interest, then

Amount (A) $= P\left(1+\frac{R}{100}\right)^{T}$, where T is time period.

By the question, A_1 = Rs 10580, T_1 = 2 yrs, A_2 = Rs 12167, T_2 = 3 yrs

Now, $A_1 = P\left(1+\frac{R}{100}\right)^{T_1}$ or, $10580 = P\left(1+\frac{R}{100}\right)^{2}$ ..... (1)

Again, $A_2 = P\left(1+\frac{R}{100}\right)^{T_2}$ or, $12167 = P\left(1+\frac{R}{100}\right)^{3}$ ..... (2)

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Dividing (2) by (1), we get, $\frac{12167}{10580} = \frac{P\left(1+\frac{R}{100}\right)^3}{P\left(1+\frac{R}{100}\right)^2}$ or, $1.15 = 1 + \frac{R}{100}$

or, $1.15 - 1 = \frac{R}{100}$ or, $0.15 = \frac{R}{100}$ $\therefore$ $R = 0.15 \times 100 = 15\%$

Putting the value of R in equation (1), we have,

$10580 = P\left(1+\frac{15}{100}\right)^2$ or, $10580 = P(1.15)^2$

or, $10580 = P \times 1.3225$ $\therefore$ $P = \frac{10580}{1.3225} = 8000$

Thus, Rate = 15% p.a. and sum = Rs 8000

6C. वार्षिक चक्रीय ब्याजदरले कुनै रकमको 3 वर्ष र 4 वर्षको अन्तमा मिश्रधन क्रमशः रु. 79,860 र रु. 87,846 हुन्छ भने चक्रीय ब्याजदर र मूलधन पत्ता लगाउनुहोस् ।

According to the yearly compound interest a sum of money amounts in 3 years and 4 years are Rs 79860 and Rs 87846 respectively. Find the interest rate and principal.

⇨ Here, CA in 3 years = Rs 79860 and CA in 4 years = Rs 87846

We know that, $CA = P\left(1+\frac{R}{100}\right)^T$

So, $P\left(1+\frac{R}{100}\right)^3 = \text{Rs } 79860$ ..... (i) and $P\left(1+\frac{R}{100}\right)^4 = \text{Rs } 87846$ ..... (ii)

Dividing (ii) by (i) then, $\frac{P\left(1+\frac{R}{100}\right)^4}{P\left(1+\frac{R}{100}\right)^3} = \frac{87846}{79860}$

or, $1 + \frac{R}{100} = 1.1$

or, $\frac{R}{100} = 0.1$

$\therefore$ $R = 10$

Now, $P\left(1+\frac{10}{100}\right)^3 = 79860$

or, $P \times 1.331 = 79860$

$\therefore$ $P = 60000$

Thus, the rate of interest and principal are 10% and Rs 60000 respectively.

6D. कुनै रकमको वार्षिक चक्रीय ब्याजअनुसार एक वर्ष र दुई वर्षको चक्रीय ब्याज क्रमशः रु. 1800 र रु. 3816 हुन्छ भने चक्रीय ब्याज दर र मूलधन पत्ता लगाउनुहोस् ।

The compound interest of a sum of money in 1 year and 2 years are Rs 1800 and Rs 3816 respectively. Find the rate of interest compounded yearly and the sum.

⇨ Here, CI in 1 year = Rs 1800 and CI in 2 years = Rs 3816

We have, $P\left[\left(1+\frac{R}{100}\right)^T - 1\right] = CI$

So, $P\left[\left(1+\frac{R}{100}\right)^1 - 1\right] = 1800$ ..... (i) and $P\left[\left(1+\frac{R}{100}\right)^2 - 1\right] = 3816$ ..... (ii)

Dividing (ii) by (i) then,

$\frac{P\left[\left(1+\frac{R}{100}\right)+1\right]\left[\left(1+\frac{R}{100}\right)-1\right]}{P\left[\left(1+\frac{R}{100}\right)-1\right]} = \frac{3816}{1800}$ or, $P\left[\left(1+\frac{R}{100}\right)+1\right] = 2.12$

or, $\frac{R}{100} = 2.12 - 2$ or, $\frac{R}{100} = 0.12$

$\therefore$ $R = 12\%$ Now, $P\left[\left(1+\frac{R}{100}\right)^1 - 1\right] = 1800$

or, $P\left[\left(1+\frac{12}{100}\right)-1\right] = 1800$ or, $P \times \frac{12}{100} = 1800$

or, $P = 1800 \times \frac{100}{12}$ $\therefore$ $P = 15000$

Thus, the rate of interest and principal are 12% and Rs 15000 respectively.

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7A. रु. 50,000 को वार्षिक 10% ब्याजदरमा 2 वर्ष 6 महिनाको अर्ध वार्षिक चक्रीय ब्याज र चक्रीय मिश्रधन पत्ता लगाउनुहोस् ।
Find the semi annual compound interest and compound amount of Rs 50000 at the rate of 10% p.a. for 2 years 6 months.

⇨ Here, Principal (P) = Rs 50000, Rate of interest (R) = 10%

Time (T) = 2 years + 6 months = 2 years + $\frac{1}{2}$ years = $\frac{5}{2}$ years

We have, CA = $P\left[\left(1+\frac{R}{100}\right)^{2T}\right] = 50000\left(1+\frac{10}{200}\right)^{2\times 5/2}$

= 50000 × 1.276281563 = 63814.08

Now, CI = CA – P = Rs 63814.08 – Rs 50000 = Rs 13814.08.

Thus, the CI is Rs 13814.08 and the compound amount is Rs 63814.08.

7B. 8% प्रतिवर्ष चक्रीय ब्याजदरमा रु. 3000 को 1 वर्ष 6 महिनाको अर्ध वार्षिक चक्रीय मिश्रधन र चक्रीय ब्याज पत्ता लगाउनुहोस् ।
Find the semi annual compound interest and compound amount of Rs 3000 at the rate of 8% for 1 year 6 months.

⇨ Here, Principal (P) = Rs 3000, Time (T) = 1 year + 6 months = $\left(1+\frac{1}{2}\right)$years = $\frac{3}{2}$ years

Rate of interest (R) = 8%

We know that, CA = $P\left(1+\frac{R}{200}\right)^{2T} = 3000\left(1+\frac{8}{200}\right)^{2\times 3/2} = 3000 \times 1.124864$ = Rs 3374.59

Now, CI = CA – P = Rs 3374.59 – Rs 3000 = Rs 374.59

Thus, the CA and CI are Rs 3374.59 and Rs 374.59 respectively.

7C. 2 वर्षपछि सबै रकम निकाल्ने गरी कुनै बैङ्कमा रु. 80,000 जम्मा गर्दा तलका मध्ये कुन विकल्प उपयुक्त होला ? कारण दिनुहोस् ।
(i) 12% वार्षिक चक्रीय ब्याजदरमा (ii) 10% अर्ध वार्षिक चक्रीय ब्याजदरमा
Rs 80000 is deposited in a bank, which of the following option is the best for withdrawing all the amount after 2 years ?
(i) 12% annually compound interest rate. (ii) 10% semi annual compound interest rate.

⇨ Here,

First offer	**Second offer**
Principal (P) = Rs 80000, Time (T) = 2 years	Principal (P) = Rs 80000,
Rate of interest = 12%	Time (T) = 2 years, Rate of interest = 10%
Annual CA	**Semi annual CA**
We have, CA = $P\left(1+\frac{R}{100}\right)^{T}$	We have, CA = $P\left(1+\frac{R}{200}\right)^{2T}$
= Rs 80000$\left(1+\frac{12}{100}\right)^{2}$	= Rs 80000$\left(1+\frac{10}{200}\right)^{4}$
= Rs 80000 × 1.12^2	= Rs 80000 × 1.21551
∴ CA = Rs 100352	∴ CA = Rs 97240.8

Since, first offer has more CA so the first offer is the best for him.

7D. कुनै रकम प्रत्येक 6 महिनामा त्यसको 0.05 का दरले ब्याज बढ्दै जान्छ भने कति समयपछि रु. 4000 को वार्षिक चक्रीय ब्याज रु. 1324 हुन्छ ?
A sum of money increased by its 0.05 in every 6 months after how long time the annual compound interest on Rs 4000 will be Rs 1324 ?

⇨ Here, interest rate (R) = 0.05 in 6 month = 0.05 × 2 in 12 months = 0.1 in 1 year

= 0.1 × 100 in 1 year = 10% p.a.

We know that, CI = $P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]$ or, $1324 = 4000\left[\left(1+\frac{10}{100}\right)^{T}-1\right]$

or, $\frac{1324}{4000} = (1.1)^T - 1$ or, $0.331 = (1.1)^T - 1$ or, $1.331 = (1.1)^T$

or, $(1.1)^3 = (1.1)^T$ ∴ T = 3

Thus, the required time is 3 years.

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4

जनसङ्ख्या वृद्धि र मिश्रह्रास
Population Growth and Compound Depreciation

Formulae and Key Points

1. यदि सुरुको जनसङ्ख्या 'P' भए (If P be the initial population);

   (i) T वर्षपछिको जनसङ्ख्या (Popualtion after T years): $P_T = P\left(1+\frac{R}{100}\right)^T$

   (ii) बढेको जनसङ्ख्या (Increased population): $P_G = P\left(1+\frac{R}{100}\right)^T - P$

2. (i) जम्मा जन्मेको नवजात शिशुको सङ्ख्या = जम्मा बढेको जनसङ्ख्या + जम्मा मृत्यु सङ्ख्या
   Total number of new born babies = Total increased Popualtion + Total death number

   (ii) जम्मा बढेको जनसङ्ख्या = जम्मा जन्मेको नवजात शिशुको सङ्ख्या – जम्मा मृत्यु सङ्ख्या
   Total increased Popualtion = Total number of new born babies – Total death number

   (iii) जम्मा मृत्यु सङ्ख्या = जम्मा जन्मेको नवजात शिशुको सङ्ख्या – जम्मा बढेको जनसङ्ख्या
   Total death number = Total number of new born babies – Total increased Popualtion

3. यदि P = सुरुको जनसङ्ख्या (Initial population)
   D = T वर्षको अन्त्यमा भएको मृत्यु सङ्ख्या (Number of deaths at the end of T years)
   M_{in} = T वर्षको पछि बसाइँसराइबाट प्रवेश भएको सङ्ख्या (No. of migrants entered after T years)
   M_{out} = T वर्षपछि बसराइँसराइबाट अन्यत्र गएको सङ्ख्या र (No. of migrants left after T years and)
   P_T = T वर्षपछिको जनसङ्ख्या भए (Popualtion at the end of T years)

   $P_T = P\left(1+\frac{R}{100}\right)^T + M_{in} - M_{out} - D$

4. यदि पहिला तिनवर्षको जनसङ्ख्या वृद्धिदरहरू क्रमशः R_1, R_2 र R_3% भए,
   If the growth rate of the population for first three years be R_1, R_2 and R_3% respectively then,

   $P_T = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$

5. यदि P_T = T वर्षपछिको मूल्य (Price after T years), P = सुरूको मूल्य (Initial Price),
   R = ह्रासदर (Depreciation Rate), T = समय (Time)

   (i) T वर्षपछिको मूल्य (Price after T years): $P_T = P\left(1-\frac{R}{100}\right)^T$

   (ii) ह्रास भएको मूल्य (Depreciated price): $P_D = P - P_T$ or, $P_D = P - P\left(1-\frac{R}{100}\right)$

   (iii) सुरुको मूल्य (Initial Price): $P = \frac{P_T}{\left(1-\frac{R}{100}\right)^T}$

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 4 (b)]

Q. 4. (b) एकजना किसानले रु 400000 मा किनेको एउटा ट्याक्टरलाई 2 वर्ष पछि 10% प्रतिवर्ष मिश्रह्रासका दरले बेचेछ । उक्त ट्याक्टरको 2 वर्ष पछिको मुल्य कति हुन्छ ? पत्ता लगाउनुहोस् ।
A farmer bought a tractor for Rs 400000 and sold it after 2 years at 10% depreciation rate per year. What is the cost of tractor after 2 years?

⇨ Here, Intitial price (P) = Rs 400000, Time (T) = 2 yrs and Rate (R) = 10%

We know that, $(P_T) = P\left(1-\frac{R}{100}\right)^T$ or, $P_T = 400000 \times \left(1-\frac{10}{100}\right)^2$

or, $P_T = 400000 \times 0.81 = 324000$

Thus, the price after 2 years is Rs 324000.

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4.1 जनसङ्ख्या वृद्धि (Population Growth)

A. BASIC EXERCISE 4.1

Very Short Questions

1. सुरुको जनसङ्ख्या P, T वर्षमा R% प्रतिवर्षका दरले वृद्धि हुन्छ। यदि जनसङ्ख्या वृद्धि (P_G) हुँदा, P, T, R र P_G को सम्बन्ध लेख्नुहोस्।
If the initial population P increases at the rate of R% per annum in T years and population growth (P_G) then write the relation among P, T, R and P_G.

⇨ Here, $P_G = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

2. सुरुको जनसङ्ख्या P, T वर्षमा R% प्रतिवर्षका दरले वृद्धि हुन्छ। यदि जनसङ्ख्या वृद्धि (P_G) र T वर्षपछिको जनसङ्ख्या (P_T) हुँदा, P_G, P_T र P को सम्बन्ध लेख्नुहोस्।
If the initial population P increases at the rate of R% per annum in T years, population growth (P_G) and population after T years (P_T) then write the relation among P_G, P_T and P.

⇨ Here, $P_G = P\left(1+\frac{R}{100}\right)^T - P$ $\quad\therefore\quad P_G = P_T - P$

3. कुनै गाउँको जनसङ्ख्या 1 वर्ष पहिले 7000 थियो। त्यहाँको जनसङ्ख्या वृद्धिदर 3.1% छ भने, हालको जनसङ्ख्या निकाल्नुहोस्।
The population of a village was 7,000 one year ago. If the population growth rate of village is 3.1%, find the population at percent. [2058 B1]

⇨ Here, the population at present $= 7{,}000 + 7{,}000 \times \frac{3.1}{100} = 7{,}000 + 217 = 7217$

4. कुनै गाउँको जनसङ्ख्या 1 वर्ष पहिले 5,400 थियो। त्यहाँको जनसङ्ख्या वृद्धिदर 2.5% छ भने हालको जनसङ्ख्या निकाल्नुहोस्।
The population of a village was 5,400 one year ago. If the population growth rate of village is 2.5%, find the population at present. [2058 B2]

⇨ Here, the population at present $= 5{,}400 + 5{,}400 \times \frac{2.5}{100} = 5{,}400 + 135 = 5{,}535$

5. एउटा गाउँको जनसङ्ख्या 64000 छ। 5% प्रतिवर्षको दरले जनसङ्ख्या वृद्धि हुन्छ। एकवर्ष पछिको जनसङ्ख्या कति हुनेछ ?
Population of a village is 6400. It increases at the rate of 5% per annum. What will be the population after one year ? [2060 D2]

⇨ Here, population after one year $= 6400 + 6400 \times \frac{5}{100} = 6400 + 320 \quad = 6720$

6. एउटा टोलको जनसङ्ख्या 2000 थियो। एक वर्ष भित्र 3 प्रतिशत जन्मदरका कारण वृद्धि र 2 प्रतिशत स्थानान्तरण भई त्यस टोलमा थपिए भने, सो टोलको जनसङ्ख्या कति पुग्यो होला ?
The population of a place was 2000. Within a year the population is increased 3% by birthrate and 2% by migration. How much population was there now ? [2059 E2]

⇨ Here, original population (P) = 2000, Increase rate (R) = (3 + 2)% = 5% per annum
Time period (T) = 1 year

By formula, $P_T = P\left(1+\frac{R}{100}\right)^T = 2000\left(1+\frac{5}{100}\right)^1 = 2000 \times \frac{105}{100} = 2100$

7. एउटा शहरको जनसङ्ख्या प्रत्येक वर्ष 3 प्रतिशतको दरले वृद्धि हुन्छ। यदि अहिलेको जनसङ्ख्या 480000 भए एक वर्षपछि उक्त शहरको जनसङ्ख्या कति होला ?
The population of a town increases by 3% each year. If the population at present is 4,80,000, what will it be one year later ? [2059 C1]

⇨ Here, increase rate (R) = 3%, Present population (P) = 480000 and Time (T) = 1 year

By formula, $P_T = P\left(1+\frac{R}{100}\right)^T = 4{,}80{,}000\left(1+\frac{3}{100}\right)^1 = 4{,}80{,}000 \times \frac{103}{100} = 4{,}94{,}400$

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8. 2 वर्ष पहिले एउटा गाउँको जनसङ्ख्या 16000 थियो । उक्त गाउँको जनसङ्ख्या वृद्धिदर 5% छ भने अहिलेको जनसङ्ख्या कति होला ?
2 years ago, the population of a village was 16000. The rate of population growth of the village is 5%. What is the population at present ? [2058 C2]

⇨ Here, Present population $= P\left(1+\frac{R}{100}\right)^T = 16000\left(1+\frac{5}{100}\right)^2$
$= 16000\,(1+0.05)^2$
$= 16000\,(1.05)^2 = 16000 \times 1.1025 = 17640$

9. कुनै एउटा गाउँको कुल जनसङ्ख्या 7200 थियो । एक वर्ष भित्र पूरा जनसङ्ख्याको 5% बसाइँ सराइले अन्यत्र गएका थिए र 2% विविध कारणले मृत्यु भएको थियो भने एक वर्ष पछि सो गाउँको जनसङ्ख्या कति पुग्यो होला ?
The population of a village was 7200. 5% of the population was migrated and 2% died due to different causes within a year. What would be the population of the village after a year ? [2059 E1]

⇨ Here, original value (P) = 7200, Depreciation rate (R) = 5% + 2% = 7% and Time (T) = 1 year
By formula, $P_T = P\left(1-\frac{R}{100}\right)^T = 7200\left(1-\frac{7}{100}\right)^1 = 7200 \times \frac{93}{100} = 6696$

10. कुनै गाउँको जनसङ्ख्या एक वर्षपहिले 10000 थियो । अहिलेको जनसङ्ख्या 10210 छ भने जनसङ्ख्या वृद्धिदर निकाल्नुहोस् ।
The population of a village was 10,000 one year ago. The population at present is 10,210; find the population growth rate. [2060 A1]

⇨ Here, increase in population = 10210 – 10000 = 210
$\therefore$ Growth rate $= \frac{210}{10000} \times 100\% = 2.1\%$

11. कुनै गाउँको जनसङ्ख्या एक वर्षपहिले 10000 थियो । अहिलेको जनसङ्ख्या 9780 छ भने जनसङ्ख्या ह्रासदर निकाल्नुहोस् ।
The population of a village was 10,000 one year ago. The population at present is 9,790; find the population decreasing rate. [2060 A2]

⇨ Here, decrease in population = 10000 – 9790 = 210
$\therefore$ Decreasing rate $= \frac{210}{10000} \times 100\% = 2.1\%$

Short Questions

MODEL 1

1. एउटा गाउँको जनसङ्ख्या 20000 छ । यदि उक्त गाउँको जनसङ्ख्याको वृद्धिदर वार्षिक 2% भए 1 वर्षपछिको जनसङ्ख्या कति होला ?
The population of a village is 20000. If the population growth rate of the village is 2% per annum, what will be the population after 1 year ?

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T = 20000\left(1+\frac{2}{100}\right)^1 = 20000 \times 1.02 = 20400$
Thus, population after one year = 20400

2. कुनै एउटा सहरको सन् 1990 को जनसङ्ख्या 50000 थियो । यदि वार्षिक जनसङ्ख्या वृद्धिदर 2% थियो भने सन् 1991 को जनसङ्ख्या कति थियो ? पत्ता लगाउनुहोस् ।
The population of a certain city in 1990 AD was 50000. If the rate of population growth was 2%, what was the population of 1991 ? Find it.

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T = 50000\left(1+\frac{2}{100}\right)^1 = 50000 \times 1.02 = 51000$
Thus, the population of 1991 A.D was 51000.

3. अघिल्लो वर्ष एउटा सहरको जनसङ्ख्या 50000 थियो । यदि वार्षिक जनसङ्ख्या वृद्धिदर 5% छ भने सो सहरको वर्तमान जनसङ्ख्या पत्ता लगाउनुहोस् ।
Last year the population of a town was 50000. If the annual rate of population growth is 5%, find the present population of the town.

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T = 50000\left(1+\frac{5}{100}\right)^1 = 50000 \times 1.05 = 52500$
Thus, the present population of the town is 52500.

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4. अघिल्लो वर्ष एउटा सहरको जनसङ्ख्या 120000 थियो । यदि जनसङ्ख्या वृद्धिदर 3% प्रतिवर्ष छ भने सो सहरको अहिलेको जनसङ्ख्या कति होला ?
Last year the population of a town was 120000. If the rate of growth of population is 3% p.a., what is the present population of the town ?

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T = 120000\left(1+\frac{3}{100}\right)^1 = 120000 \times 1.03 = 123600$

Thus, the present population of the town is 123600.

5. कुनै एउटा सहरको जनसङ्ख्या सन् 2013 मा 40000 थियो । यदि जनसङ्ख्या वृद्धिदर 5% प्रतिवर्ष थियो भने सन् 2014 मा उक्त जनसङ्ख्या कति पुग्यो ? पत्ता लगाउनुहोस् ।
The population of a city in 2013 AD was 40000. If the rate of population growth was 5% per annum, what was the population in 2014 ? Find it.

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T = 40000\left(1+\frac{5}{100}\right)^1 = 40000 \times 1.05 = 42000$

Thus, the population in 2014 A.D was 42000.

6. कुनै सहरको जनसङ्ख्या वृद्धिदर 2 प्रतिशत प्रतिवर्ष छ । यदि उक्त सहरको 2072 सालको जनसङ्ख्या 81600 भए 2071 सालको जनसङ्ख्या कति थियो होला, पत्ता लगाउनुहोस् ।
The population growth rate of a town is 2% p.a. If the population of a town in the year 2072 is 81600, find the population of the town in the year 2071.

⇨ Here, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $81600 = P\left(1+\frac{2}{100}\right)^1$

or, $81600 = 1.02P$ $\therefore\ P = \frac{81600}{1.02} = 80000$

Thus, the population in 2071 was 80000.

7. कुनै एउटा गाउँको कुल जनसङ्ख्या 7200 थियो । एक वर्ष भित्र पूरा जनसङ्ख्याको 500 बसाइँसराइले भित्रिएका थिए र 200 को भुकम्पका कारणले मृत्यु भएको थियो भने एक वर्षपछि सो गाउँको जनसङ्ख्या कति पुग्यो होला ?
The population of a village was 7200. If 500 of the population was migrated in and 200 died due to earthquake within a year, what would be the population of the village after a year?

⇨ Here, initial population (P) = 7200
Increased population = 500 – 200 = 300
Thus, population after one year = 7200 + 300 = 7500.

8. एउटा गाउँको एक वर्ष पहिलेको जनसङ्ख्या 1000 थियो । हालको जनसङ्ख्या वृद्धि 30 छ । जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।

The population of a village was 1000 one year ago. The growth population is 30 at present. Find the population growth rate.

⇨ Here, initial population (P) = 1000 Increased population (P_G) = 30
Population growth rate (R) = ?

By formula, $P_G = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$ or, $30 = 1000\left[\left(1+\frac{R}{100}\right)^1 - 1\right]$

or, $\frac{30}{1000} = \frac{R}{100}$ $\therefore\ R = 3\%$

Thus, population growth rate is 3%

9. यदि कुनै सहरको जनसङ्ख्या एक वर्षमा दोब्बर हुन्छ भने जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।
If the population of a town doubles in a year, find the population growth rate.

⇨ Here, let the initial population be x and the population after one year be 2x then,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $2x = x\left(1+\frac{R}{100}\right)^1$

or, $2 = 1+\frac{R}{100}$ $\therefore\ R = 100\%$

Thus, population growth rate is 100%.

10. एउटा सहरको जनसङ्ख्या 1 वर्षमा दश भागको एक भागले बढेको थियो । जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।

The population of a town was increased by one-tenth with in a year. Find the population growth rate.

⇨ Here, let the initial population be x and increased population be $\frac{x}{10}$ then,

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$P_G = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$ or, $\frac{x}{10} = x\left[\left(1+\frac{R}{100}\right)^1 - 1\right]$

or, $0.1 = \frac{R}{100}$ $\therefore$ $R = 10\%$

Thus, population growth rate is 10%.

MODEL 2

11. एउटा गाउँमा जनसङ्ख्या 20000 छ । यदि उक्त गाउँको जनसङ्ख्याको वृद्धिदर वार्षिक 2% भए 2 वर्षपछिको जनसङ्ख्या कति होला ? पत्ता लगाउनुहोस् ।
The population of a village is 20000. If the population growth rate of the village is 2% per annum, what will be the population after 2 years ? Find it. [2068 A]

⇨ Here, initial population (P) = 20000 and Growth rate (R) = 2%

Population after 2 yrs (P_2) $= P\left(1+\frac{R}{100}\right)^T = 20000\left(1+\frac{2}{100}\right)^2 = 20000 \times 1.0404 = 20808$

Thus, the population after 2 yrs = 20808.

12. कुनै एउटा सहरको सन् 1990 को जनसङ्ख्या 50000 थियो । यदि वार्षिक जनसङ्ख्या वृद्धिदर 2% थियो भने सन् 1992 को जनसङ्ख्या कति थियो ? पत्ता लगाउनुहोस् ।
The population of a certain city in 1990 A.D. was 50000. If the rate of population growth was 2%, what was the population of 1992 ? Find it. [2068 E]

⇨ Here, initial population (P) = 50000, Growth rate (R) = 2%
Time interval (T) = 1992 – 1990 = 2 yrs

We have, $P_T = P\left(1+\frac{R}{100}\right)^T = 50000\left(1+\frac{2}{100}\right)^2 = 50000 \times 1.0404 = 52020$

Thus, the population in 1992 was 52020.

13. एउटा सहरको अहिलेको जनसङ्ख्या 1,70,000 छ । यदि यो वार्षिक 2% का दरले बढ्छ भने 2 वर्षपछि हुन आउने जनसङ्ख्या पत्ता लगाउनुहोस् ।
The population of a city at present is 1,70,000 and it grows at the rate of 2% per year. What will be the population after 2 years? [SLC 2065 A]

⇨ Here, present population (P) = 170000, Growth rate (R) = 2% and Time (T) = 2 years

We have; $P_T = P\left(1+\frac{R}{100}\right)^T = 170000\left(1+\frac{2}{100}\right)^2 = 170000 \times \frac{2601}{2500}$

$\therefore$ $P_T = 176868$

Thus, the population after 2 years will be 176868.

14. एउटा गाउँको अहिलेको जनसङ्ख्या 30,000 छ । यदि जनसङ्ख्या वृद्धिदर 10% प्रतिवर्ष छ भने 2 वर्ष पछिको सो गाउँको जनसङ्ख्या निकाल्नुहोस् ।
The present population of a village is 30,000. If it is increased at the rate of 10% per annum, what will be the population after 2 years ? [SLC 2066 D]

⇨ Here, present population (P) = 30000, Growth rate (R) = 10% and Time (T) = 2 yrs

We have, Population after 2 years (P_2) $= P\left(1+\frac{R}{100}\right)^T = 30000\left(1+\frac{10}{100}\right)^2 = 36300$

Thus, the population after 2 years will be 36300.

15. कुनै एउटा सहरको जनसङ्ख्या सन् 2011 मा 50000 थियो । यदि जनसङ्ख्या वृद्धिदर 3% प्रतिवर्ष थियो भने सन् 2013 मा उक्त जनसङ्ख्या कति पुग्यो ? पत्ता लगाउनुहोस् ।
The population of a certain city in 2011 A.D. was 50000. If the rate of population growth was 3% per annum, what was the population in 2013. Find it. [2071 A]

⇨ Here, population in 2011 (P) = 50000 and Population in 2013 (P_T) = ?
Population growth rate (R) = 3%, Time (T) = 2 yrs

We have, $P_T = P\left(1+\frac{R}{100}\right)^T = 50000\left(1+\frac{3}{100}\right)^2 = 50000 \times 1.0609 = 53045$

Thus, the population in 2013 is 53045.

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MODEL 3

16. एउटा गाउँको जनसङ्ख्या **17640** छ । यदि जनसङ्ख्या वृद्धिदर **5%** भए उक्त गाउँको **2** वर्ष अगाडिको जनसङ्ख्या पत्ता लगाउनुहोस् ।
A village has a population 17640. If its population growth rate is 5%, find its population before 2 years. **[2071 D, 2067 D]**

⇨ Here, present population (P_T) = 17640 and Growth rate (R) = 5% and time (T) = 2 years

We know that, $P_T = P\left(1+\frac{R}{100}\right)^2$ or, $17640 = P\left(1+\frac{5}{100}\right)^2$

or, $17640 = P \times \left(\frac{105}{100}\right)^2$ or, $17640 = P \times \frac{105}{100} \times \frac{105}{100}$

or, $P = \frac{17640 \times 100 \times 100}{105 \times 105}$ ∴ $P = 16000$

Thus, the required population is 16000.

17. कुनै एउटा सहरको अहिलेको जनसङ्ख्या **1,05,840** छ । यदि प्रत्येक वर्ष जनसङ्ख्या **5%** ले बढ्छ भने **2** वर्ष अगाडिको सो सहरको जनसङ्ख्या कति थियो होला ? पत्ता लगाउनुहोस् ।
The present population of a city is 1,05,840. If the population increases every year by 5%, find what was the population of city of before 2 years? **[2068 B]**

⇨ Here, present population (P_T) = 105840 and Population growth rate (R) = 5%
Time (T) = 2 yrs

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $105840 = P\left(1+\frac{5}{100}\right)^2$

or, $105840 = P \times \left(\frac{21}{20}\right)^2$ or, $105840 = P \times \frac{441}{400}$

or, $105840 \times \frac{400}{441} = P$ ∴ $P = 96000$

Thus, the population before 2 yrs was 96000.

MODEL 4

18. एउटा गाउँको जनसङ्ख्या **20,000** थियो । दुई वर्षभित्र **3%** जन्मका कारणले र **2%** अन्यत्रबाट बसाईंसराइ गरी यहाँ आएको कारणले जनसङ्ख्या वृद्धि हुन्छ भने **2** वर्षपछि सो गाउँको जनसङ्ख्या कति पुग्ला ?
The population of a village was 20,000. Within 2 years, the population is increased 3% by birth rate and 2% by immigration. What will be the population of the village after 2 years ? Find it. **[2068 C]**

⇨ Here, initial population (P) = 20000 and Growth rate (R) = 3% + 2% = 5%
Time (T) = 2 years
We know that,

Population after 2 years (P_2) $= P\left(1+\frac{R}{100}\right)^T = 20000\left(1+\frac{5}{100}\right)^2$

$= 20000 \times \left(\frac{21}{20}\right)^2 = 20000 \times \frac{441}{400} = 22050$

Thus, the population of the village after 2 years will be 22050.

19. **40,000** जनसङ्ख्या भएको कुनै सहरको जनसङ्ख्या वृद्धिदरको कारणले **2%** र अन्यत्रबाट बसाईंसराइ गरी यहाँ आएको कारणले **3%** को दरले जनसङ्ख्या वृद्धि हुँदा **2** वर्ष पछि उक्त सहरको जनसङ्ख्या कति पुग्ला ?
The present population of a town is 40,000. If the population increases by 2% by birth and 3% by immigration, what will be the population of the town after 2 years ? Find it. **[SLC 2066 A]**

⇨ Here, Initial population (P) = 40000, Growth rate (R) = 2% + 3% = 5% Time (T) = 2 yrs

Population after 2 yrs (P_2) $= P\left(1+\frac{R}{100}\right)^T = 40000\left(1+\frac{5}{100}\right)^2 = 44100$

Thus, the populatoin of the town after 2 years will be 44100.

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MODEL 5

20. एउटा सहरको जनसङ्ख्या 2 वर्षमा बढेर 30,000 बाट 36,300 पुग्दछ भने वार्षिक जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।
The population of a town increases from 30,000 to 36,300 in 2 years. Find the annual population growth rate. **[2072 C]**

⇨ Here, initital population (P) = 30000 Final population (P_T) = 36300

We know that, $P_T = P\left(1+\frac{R}{100}\right)^2$ [$\because$ T = 2]

or, $36300 = 30000\left(1+\frac{R}{100}\right)^2$ or, $\frac{121}{100} = \left(1+\frac{R}{100}\right)^2$

or, $\left(\frac{11}{10}\right)^2 = \left(1+\frac{R}{100}\right)^2$ or, $\frac{11}{10} = 1+\frac{R}{100}$

or, $\frac{1}{10} = \frac{R}{100}$

$\therefore$ R = 10

Thus, required growth rate is 10%.

21. कुनै गाउँको जनसङ्ख्या एक वर्षमा 10,000 बाट 11,000 पुग्यो भने जनसङ्ख्या वृद्धिदर निकाल्नुहोस् ।
The population of a village increased from 10,000 to 11,000 in one year, then find out the population increasing rate. **[2067 E]**

⇨ Here, Initial population (P) = 10000, Final population (P_1) = 11000 Time (T) = 1 year

We know that, $P_1 = P\left(1+\frac{R}{100}\right)^T$ or, $11000 = 10000\left(1+\frac{R}{100}\right)$

or, $\frac{11}{10} = 1+\frac{R}{100}$ or, $\frac{1}{10} = \frac{R}{100}$ $\therefore$ R = 10%

Thus, the growth rate is 10%.

MODEL 6

22. कति वर्षमा 5% वार्षिक वृद्धिदरले एउटा सहरको जनसङ्ख्या 1,90,000 बाट बढेर 2,09,475 पुग्ला ? पत्ता लगाउनुहोस् ।
In how many years the population of a town will increase from 1,90,000 to 2,09,475 at the growth rate of 5% per annum ? Find it. **[2072 W]**

⇨ Here, growth rate (R) = 5%, Initial population (P) = 190000 and Final population (P_T) = 209475
We know that,

$P_T = \left(1+\frac{R}{100}\right)^T$ or, $209475 = 190000\left(1+\frac{5}{100}\right)^T$

or, $\frac{441}{400} = \left(\frac{21}{20}\right)^T$ or, $\left(\frac{21}{20}\right)^2 = \left(\frac{21}{20}\right)^T$

$\therefore$ T = 2 Thus, the required time is 2 years.

23. कति वर्षमा 2% वार्षिक वृद्धिदरले एउटा गाउँको जनसङ्ख्या 2000 बाट 2040 हुन्छ ? पत्ता लगाउनुहोस् ।
In how many years will the population of a village be 2040 from 2000 at the growth rate of 2% per annum ? Find it. **[2071 E]**

⇨ Here, growth rate (R) = 2%, Initial population (P) = 2000 and Final population (P_T) = 2040
We know that,

$P_T = \left(1+\frac{R}{100}\right)^T$ or, $2040 = 2000\left(1+\frac{2}{100}\right)^T$

or, $\frac{204}{200} = \left(1+\frac{2}{100}\right)^T$ or, $1.02^1 = 1.02^T$

$\therefore$ T = 1 year

Thus, the required time is 1 year.

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24. 40,000 जनसङ्ख्या भएको एउटा सहरको जनसङ्ख्या वृद्धिदर 4% प्रतिवर्ष छ भने कति वर्षमा उक्त सहरको जनसङ्ख्या 43,264 पुग्ला ?
The population of a town is 40,000 and the population growth rate is 4% per year. In how many years will the population of the town be 43264? [2067 S, 2071 S]

⇨ Here, initial population (P) = 40000 Final population (P_T) = 43264
Growth rate (R) = 4%

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $43264 = 40000 \times \left(1+\frac{4}{100}\right)^T$

or, $\frac{676}{625} = \left(\frac{104}{100}\right)^T$ or, $\left(\frac{26}{25}\right)^2 = \left(\frac{26}{25}\right)^T$

$\therefore$ T = 2 Thus, the required time is 2 years.

25. कति वर्षमा 10% वार्षिक जनसङ्ख्या वृद्धिदरले एउटा शहरको जनसङ्ख्या 50,000 बाट बढेर 66,550 पुग्ला ?
In how many years will the population of a city be 66,550 from 50,000 at the population growth rate of 10% per annum? Find it. [2068 D]

⇨ Here, growth rate (R) = 10%, Initial population (P) = 50000 Final population (P_T) = 66550

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $66550 = 50000\left(1+\frac{10}{100}\right)^T$

or, $\frac{1331}{1000} = \left(\frac{11}{10}\right)^T$ or, $\left(\frac{11}{10}\right)^3 = \left(\frac{11}{10}\right)^T$ $\therefore$ T = 3 yrs

Thus, the required time is 3 yrs.

26. कति वर्षमा 5% वार्षिक वृद्धिदरले एउटा सहरको जनसङ्ख्या 190000 बाट बढेर 209475 पुग्ला ?
In how many years will the population of a town be 209475 from 190000 at the growth rate of 5% per annum ? [SLC Model 2065]

⇨ Here, initial population of the town (P) = 190000 and Final population (P_T) = 209475
Population growth rate (R) = 5% p.a.

We have, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $209475 = 190000\left(1+\frac{5}{100}\right)^T$

or, $\frac{209475}{190000} = \left(1+\frac{5}{100}\right)^T$ or, $\left(\frac{105}{100}\right)^T = \frac{209475}{19000}$

or, $(1.05)^T = (1.05)^2$ $\therefore$ T = 2 years

Thus, the required time (T) = 2 years

27. एउटा सहरको जनसङ्ख्या 96,000 छ । यदि प्रत्येक वर्ष जनसङ्ख्या 5% ले वृद्धि हुन्छ भने कति वर्षमा सो सहरको जनसङ्ख्या 1,05,840 होला ?
The population of a town is 96,000. In how many years later would it be 1,05,840 if the population increased at the rate of 5% every year ? [SLC 2065 E]

⇨ Here, initial population (P) = 96000, Growth rate (R) = 5%, Final population (P_T) = 105840

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $105840 = 96000\left(1+\frac{5}{100}\right)^T$

or, $\frac{441}{400} = \left(\frac{21}{20}\right)^T$ or, $\left(\frac{21}{20}\right)^2 = \left(\frac{21}{20}\right)^T$

$\therefore$ T = 2 years

Thus, the required time (T) = 2 years

28. कति वर्षमा 5 प्रतिशत वार्षिक वृद्धिदरले एउटा सहरको जनसङ्ख्या 24400 बाट बढेर 26901 पुग्ला ?[SLC 2066 C]
In how many years will be population of a town be 26901 from 24400 at the growth rate of 5% per annum ?

⇨ Here, initial population (P) = 24400 and final population (P_T) = 26901
Growth rate (R) = 5%

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$

or, $26901 = 24400\left(1+\frac{5}{100}\right)^T$ or, $\frac{26901}{24400} = \left(\frac{21}{20}\right)^T$

or, $\frac{441}{400} = \left(\frac{21}{20}\right)^T$ or, $\left(\frac{21}{20}\right)^2 = \left(\frac{21}{20}\right)^T$

$\therefore$ T = 2 years Thus, the required time period is 2 years.

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29. कति वर्षमा 5% वार्षिक वृद्धिदरले एउटा गाउँको जनसङ्ख्या 40000 बाट बढेर 46305 पुग्ला ? **[SLC 2066 E]**
In how many years will the population of a village be 46305 from 40000 at the growth rate of 5% per annum ?

⇨ Here, initial population (P) = 40000, Final population (P_T) = 46305
Growth rate (R) = 5%

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T$

or, $46305 = 40000\left(1+\frac{5}{100}\right)^T$ or, $\frac{46305}{40000} = \left(1+\frac{5}{100}\right)^T$

or, $\frac{9261}{8000} = \left(\frac{21}{20}\right)^T$ or, $\left(\frac{21}{20}\right)^3 = \left(\frac{21}{20}\right)^T$

∴ T = 3 yrs Thus, the required time is 3 yrs.

Long Questions

MODEL 1

1. एउटा गाउँको जनसङ्ख्या प्रत्येक वर्ष 5 प्रतिशत बढ्दै जान्छ । यदि दुई वर्षको अन्त्यमा 1025 जना बसाईं सरेर अन्यत्र जाँदा सो गाउँको जनसङ्ख्या 10000 भयो भने सुरुमा सो गाउँको जनसङ्ख्या कति थियो ?
The population of a village increases every year by 5%. At the end of two years, the total population of the village was 10000. If 1025 were migrated to other places, what was the population of a village in the beginning ? **[2060 B1]**

⇨ Here, suppose, P_2 = Total population at the end of two years = 10000 + 1025 = 11025
T = 2 years, R = 5% per year

By formula, we have $P_2 = P\left(1+\frac{R}{100}\right)^T$ or, $11025 = P\left(1+\frac{5}{100}\right)^2$

or, $11025 = P(1.05)^2$ ∴ $P = \frac{11025}{(1.05)^2} = \frac{11025}{1.1025} = 10000$

Thus, the population of the village was 10000.

2. रामकोट गाउँको जनसङ्ख्या प्रत्येक वर्ष 2.5% ले वृद्धि हुन्छ । दुई वर्षको अन्तमा सो गाउँको जनसङ्ख्या 24895 थियो । यदि 320 मानिस अर्को गाउँमा बसाईंसराइ गरी गए भने सुरुमा सो गाउँमा कुल जनसङ्ख्या कति थियो होला ?
The population of Ramkot village increases every year by 2.5%. At the end of two years, the total population of the village was 24895. If 320 people were migrated to the other village, what was the population of the village in the beginning ? **[2064 E1]**

⇨ Here, growth rate (R) = 2.5% and Time interval (T) = 2 years
Total population at the end of of 2 years (P_T) = 24895 + 320 = 25215

We have, $P_T = P\left(1+\frac{R}{100}\right)^2$ or, $25215 = P\left(1+\frac{2.5}{100}\right)^2$

or, $25215 = P \times \left(\frac{41}{40}\right)^2$ or, $25215 \times \frac{40}{41} \times \frac{40}{41} = P$ ∴ P = 24000

Thus, the initial population of the village was 24000.

3. वि.सं. 2065 को सुरुमा एउटा सहरको जनसङ्ख्या 1,00,000 थियो र जनसङ्ख्या वृद्धिदर वर्षेनी 2% छ । वि.सं. 2066 को सुरुमै 8,000 जना अन्यत्र ठाउँबाट त्यहाँ बसाईं सरेर आए भने वि.सं. 2068 को सुरुमा सो सहरको जनसङ्ख्या कति पुग्ला ?

In the beginning of 2065 B.S., the population of a town was 1,00,000 and the rate of population growth is 2% every year. If in the beginning of 2066 B.S. 8,000 people migrated there from different places. What will be the population of the town in the beginning of 2068? **[2067 A]**

⇨ Here, population at the beginning of 2065 = 100000
Population growth rate = 2% and migrated people in 2066 = 8000

We have, Population at 2066 = $P\left(1+\frac{R}{100}\right)^T = 100000\left(1+\frac{2}{100}\right)^1 = 102000$

Population of 2066 = 102000 + 8000 = 110000
For population of 2068, Time (T) = 2068 – 2066 = 2 yrs, Rate (R) = 2% and P = 11000

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T = 110000\left(1+\frac{2}{100}\right)^2 = 114444$

Thus, population at the beginning of 2068 is 114444.

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B. QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 4.1]

1A. एउटा सहरको हालको जनसङ्ख्या 1,85,220 छ, यदि जनसङ्ख्या वृद्धिदर प्रतिवर्ष 5% भएमा 3 वर्षपछि उक्त सहरको जनसङ्ख्या कति हुन्छ ? पत्ता लगाउनुहोस् ।

The population of a town is 185220. If the annual population growth is 5% p.a., what will be the population of the town after 3 years ?

⇨ Here, Present population (P) = 185220, Growth rate (R) = 5% and Time (T) = 3 years

We know that,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 185220\left(1+\frac{5}{100}\right)^3 = 185220 \times 1.157625 = 214415.30$$

Thus, the population of the town after 3 years will be 214415 approximately.

1B. 2 वर्षअगाडि एउटा गाउँको जनसङ्ख्या 1250 थियो, यदि जनसङ्ख्या वृद्धिदर 2.5% प्रतिवर्ष छ भने अहिलेको जनसङ्ख्या पत्ता लगाउनुहोस् ।

2 years ago the population of a village was 1250. If the population growth rate is 2.5% p.a., find the present population.

⇨ Here, Time (T) = 2 years, Initial population (P) = 1250 and Population growth rate (R) = 2.5%

We know that,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 1250\left(1+\frac{2.5}{100}\right)^2 = 1250 \times (1.025)^2 = 1313.28$$

Thus, the present population is 1313.

1C. वि.सं. 2070 मा प्रकाशित एक तथ्याङ्कअनुसार वि.सं. 2069 मा माध्यमिक तहमा छात्राहरूको भर्ना सङ्ख्या लगभग 4,37,000 थियो । यदि उक्त वृद्धिदर लगभग 4% भए वि.स. 2071 मा माध्यमिक तहमा कति जना छात्राहरू भर्ना भए होलान् ? पत्ता लगाउनुहोस् ।

According to the data published in 2070, the school admission rate of girls secondary school in 2069 was approximately 437000. If the growth rate was nearly 4%, how many girls were admitted in 2071 ? Find it.

⇨ Here, Girls in 2069 = 437000 and Growth rate = 4% and Time (T) = 2071 – 2069 = 2 yrs

We know that,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 437000\left(1+\frac{4}{100}\right)^2$$

$$= 437000 \times 1.0816 = 472659.20$$

Thus, the admitted girls in 2071 were 472659.

1D. एउटा घर धनीले वार्षिक 15% प्रतिवर्षका दरले घर भाडा वृद्धि गर्ने सम्झौता गरेको छ, यदि उक्त घरको हालको भाडा रु. 7500 भएमा 3 वर्षपछि उक्त घरको घर भाडा कति होला ? पत्ता लगाउनुहोस् ।

A house owner did a rent contract in such a way to increase the rent 15% per annum. If the present rent of the house is Rs 7500, what will be the rent after 3 years ? Find it.

⇨ Here, Initial rent (P) = Rs 7500, Growth rate (R) = 15% and Time frame (T) = 3 years

We know that, $P_T = P\left(1+\frac{R}{100}\right)^T = 7500\left(1+\frac{15}{100}\right)^3 = 7500 \times 1.520875$

$\therefore P_T = 11406.56$

Thus, the rent of the house after 3 years will be Rs 11406.56.

2A. दुई वर्ष पहिले एउटा सहरको जनसङ्ख्या 254000 थियो, यदि उक्त सहरको जनसङ्ख्या वृद्धिदर 3% प्रतिवर्ष रहेछ भने दुई वर्षमा कतिले वृद्धि भयो होला ? पत्ता लगाउनुहोस् ।

Two years ago the population of a town was 254000. The population growth of the town was 3%, what population was increased in 2 years ? Find it.

⇨ Here, Initial population (P) = 25400, Growth rate (R) = 3% and Time (T) = 2 years

We know that,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 254000\left(1+\frac{3}{100}\right)^2 = 254000 \times 1.0609$$

$$= 263468.60 \approx 263469$$

Now, increased population $= P_T - P = 263469 - 254000 = 15469$

Thus, the increased population was 15469.

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2B. एउटा बिरुवाको वृद्धिदर प्रति महिना 2% छ । यदि 2072 पुसको सुरुमा यसकोउचाइ 4 m छ भने 2072 चैतको सुरुमा उक्त बिरुवाको उचाइ कतिले वृद्धि होला ? (दुई दसमलव स्थानसम्म निकाल्नुहोस् ।)
The growth rate of a plant is 2% per month. In the beginning of Poush 2072 its height was 4 m, what height was increased in the beginning of Chaitra 2072 ?

⇨ Here, Growth rate = 2% per months
No. of months = 3 months (12 – 9)
We have,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 4\left(1+\frac{2}{100}\right)^3 = 4 \times 1.061208 = 4.245$$

Increased height = 4.24 – 4 = 0.24 m
Thus, the increased height is 0.24 m.

2C. 2068 सालको जन गणनाअनुसार नेपालको जनसङ्ख्या लगभग 2 करोड 65 लाख थियो । यदि जनसङ्ख्या वृद्धिदर प्रतिवर्ष लगभग 1.5% भएमा 2071 सालको अन्त्यसम्म जनसङ्ख्या लगभग कतिले वृद्धि भयो होला ? पत्ता लगाउनुहोस् ।
According to the population census 2068 the population of Nepal was 2 crore 65 lakh approximately. If the population growth rate was 1.5% per annum approximately, by what it was increased till the end of 2071 ? Find it.

⇨ Here, Initial population (P) = 26500000, Growth rate (R) = 1.5% and Time (T) = 2071 – 2068 = 3 years
We know that,

$$P_T = P\left(1+\frac{R}{100}\right)^T = 26500000\left(1+\frac{1.5}{100}\right)^3$$
$$= 26500000 \times 1.045678375 = 27710476.94 \approx 27710477$$

Increased population = $P_T - P$ = 27710477 – 26500000 = 1210476
Thus, the increased population was 1210476.

3A. एउटा गाउँको जनसङ्ख्या प्रत्येक वर्ष 4% ले बढ्दै जान्छ । यदि उक्त गाउँको हालको जनसङ्ख्या 15,000 भएमा 3 वर्षअगाडि कति थियो होला ?
The population of a village increases every year by 4% p.a. If the present population of the village is 15000, what was the population before 3 years ?

⇨ Here, Growth rate (R) = 4%, Present population (P_T) = 15000 and Time (T) = 3 years
We have,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $15000 = P\left(1+\frac{4}{100}\right)^3$

or, $15000 = P \times 1.04^3$ or, $\frac{15000}{1.124864} = P$

$\therefore P = 13334.94$ Thus, the population was 13335.

3B. एउटा जग्गाको हालको मूल्य.रु. 6,00,000 प्रतिआना रहेको छ । यदि उक्त जग्गाको वार्षिक मूल्य वृद्धिदर 10% भए 4 वर्षअगाडि उक्त जग्गाको मूल्य प्रति आना कति थियो होला ? पत्ता लगाउनुहोस् ।
The present price of land is Rs 600000 per aana. If the annual price increasing rate is 10%, how much was the per aana price of the land before 4 years ?

⇨ Here, Present price (P_T) = Rs 600000, Price increasing rate (R) = 10% and Time (T) = 4 years
We have,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $600000 = P\left(1+\frac{10}{100}\right)^4$

or, $600000 = P \times 1.4641$ $\therefore P = 409808.07$

Thus, the price of the land before 4 years was Rs 409808.07.

3C. दही जमाउने ब्याक्टेरियाको वृद्धिदर 5% प्रति घण्टा रहेको छ, यदि बेलुकी 7 बजे ब्याक्टेरियाको सङ्ख्या 10.12×10^{11} रहेको छ भने 4 घण्टा अगाडि उक्त सङ्ख्या कति थियो होला ? पत्ता लगाउनुहोस् ।
The growth of curd clotting bacteria is 5% per hour. If number of bacteria in 7 pm evening is 10.12×10^{11}, what was the number before 4 hours ? Find it.

⇨ Here, Growth rate (R) = 5%, No. of bacteria (P_T) = 10.12×10^{11}
We know that,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $10.12 \times 10^{11} = P\left(1+\frac{5}{100}\right)^4$

or, $10.12 \times 10^{11} = P \times (1.05)^4$ or, $8.32 \times 10^{11} = P$

Thus, the number of bacteria before 4 hours was 8.32×10^{11}.

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4A. 2068 सालको जन गणनाअनुसार पोखराको जनसङ्ख्या लगभग 2 लाख 80 हजार थियो । यदि 2071 सालको अन्त्यमा उक्त सहरको जनसङ्ख्या 2 लाख 90 हजार भएमा वार्षिक जनसङ्ख्या वृद्धिदर पत्ता लगाउनुहोस् ।
According to the population census 2068, the population of Pokhara was 2 lakh 80 thousands approximately. If the population at the end of 2071 was 2 lakh 90 thousand, find the population growth rate.

⇨ Here, Population in 2068 (P) = 280000, Population in 2071 (P_T) = 290000
Time (T) = 2071 – 2068 = 3 yrs
We have,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $290000 = 280000\left(1+\frac{R}{100}\right)^3$

or, $\frac{29}{28} = \left(1+\frac{R}{100}\right)^3$ or, $1+\frac{R}{100} = \sqrt[3]{\frac{29}{28}}$

or, $1+\frac{R}{100} = 1.012$ or, $\frac{R}{100} = 0.012$

$\therefore$ R = 1.2%
Thus, the growth rate is 1.2% p.a.

4B. एउटा सहरको जनसङ्ख्या इ.सं. 2012 को अन्त्यमा 40,000 थियो । इ.सं. 2014 को अन्त्यमा उक्त सङ्ख्या बढेर 44,100 भयो भने जनसङ्ख्या वृद्धिदर कति होला ?
The population of a town at the end of 2012 AD was 40000. If at the end of 2014 AD the population of the town increased to 44100, what is the population growth rate ?

⇨ Here, Population in 2012 AD (P) = 40000, Population in 2014 AD (P_T) = 44100
Time (T) = 2014 – 2012 = 2 yrs
We have,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $44100 = 40000\left(1+\frac{R}{100}\right)^2$

or, $\frac{441}{400} = \left(1+\frac{R}{100}\right)^2$ or, $\frac{21}{20} = 1+\frac{R}{100}$

or, $\frac{1}{20} = \frac{R}{100}$ $\therefore$ R = 5

Thus, the population growth rate is 5%.

4C. एउटा सहरको जनसङ्ख्या 24400 छ, यदि जनसङ्ख्या वृद्धिदर प्रतिवर्ष 5% भए कति वर्षपछि उक्त सहरको जनसङ्ख्या 26901 होला ?
The population of a town is 24400. If the population growth rate is 5% p.a., in how many years later, the population will be 26091 ?

⇨ Here, Initial Population (P) = 24400 Population growth rate (R) = 5%
Final population (P_T) = 26901
We know that,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $26901 = 24400\left(1+\frac{5}{100}\right)^T$

or, $1.1025 = \left(1+\frac{5}{100}\right)^T$ or, $1.1025 = 1.05^T$

or, $1.05^2 = 1.05^T$ $\therefore$ T = 2
Thus, the required time is 2 years.

4D. वार्षिक 30% का दरले वृद्धि भएको एउटा सहरको जनसङ्ख्या कति वर्षपछि 40,000 बाट बढेर 87,880 हुन्छ ?
The population of a town increases by 30% per annum, in how many years the population 40000 increased to 87880 ?

⇨ Here, Population growth rate (R) = 30%, Initial population (P) = 40000 and Final population (P_T) = 87880
We know that,

$P_T = P\left(1+\frac{R}{100}\right)^T$ or, $87880 = 40000\left(1+\frac{30}{100}\right)^T$

or, $2.197 = (1.3)^T$ or, $(1.3)^3 = (1.3)^T$
$\therefore$ T = 3 Thus, the time period (T) = 3 years.

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5A. एउटा गाउँको जनसङ्ख्या 2 वर्षअगाडि 31,250 थियो । यदि उक्त गाउँको जनसङ्ख्या वृद्धिदर 6% छ । एक वर्षअगाडि 625 जनाले अर्कै गाउँमा बसाइँ सराइ गरे भने उक्त गाउँ को हालको जनसङ्ख्या पत्ता लगाउनुहोस् ।

The population of a village 2 years ago was 31250. The population growth rate of the village is 6%. One year ago, 625 people migrated to the other village, find the present population.

⇨ Here, Initial population (P) = 31250,
Population growth rate (R) = 6%

$$\text{Population after 1 year (P)} = P\left(1+\frac{R}{100}\right)^1 + 625 = 31250\left(1+\frac{6}{100}\right) + 625$$
$$= 33125 + 625 = 33750$$

$$\text{Again, present population } (P_T) = P\left(1+\frac{R}{100}\right) = 33750\left(1+\frac{6}{100}\right) = 35775$$

Thus, the present population is 35775.

5B. एउटा सहरको जनसङ्ख्या प्रत्येक वर्ष 10 प्रतिशत बढ्दै जान्छ । यदि दुई वर्षको अन्त्यमा सो सहरको जम्मा जनसङ्ख्या 30000 पुगेको थियो । यदि सो सङ्ख्यामा 5800 जना अन्तिममा बसाइँ सरेर थपिएका थिए भने सुरुको जनसङ्ख्या कति थियो ?

The population of a town increases every year by 10%. At the end of two years, the total population of the town was 30000. If 5800 people were added by migration, what was the population of the town in the beginning ? **[2060 B2]**

⇨ Here, P = Population in the beginning
P_2 = Population at the end of 2 year excluding the migrated = 30000 – 5800 = 24200
R = 10% per annum, T = 2 years

By formula, we have, $P_T = P\left(1+\frac{R}{100}\right)^T$ or, $P_2 = P\left(1+\frac{R}{100}\right)^2$

or, $24200 = P(1+0.1)^2$ or, $24200 = P(1.1)^2$

$\therefore P = \frac{24200}{(1.1)^2} = \frac{24200}{1.21} = 20000$

Thus, the required population is 20000.

5C. 3 वर्षअगाडि 3,75,000 जनसङ्ख्या भएको एउटा जिल्लाको वार्षिक जनसङ्ख्या वृद्धिदर 2% छ । यदि दोस्रो वर्षको अन्त्यमा 1480 जना मानिस बसाइ सराइँ गरेर आए र प्राकृतिक प्रकोपका कारण 2750 जनाको मृत्यु भयो भने उक्त जिल्लाको हालको जनसङ्ख्या पत्ता लगाउनुहोस् ।

3 years ago, a district had population 375000 and the annual population growth rate 2%. If at the end of second year 1480 people were migrated in and 2750 people died due to the epidemic disease, find the present population of the district.

⇨ Here, Initial Population (P) = 375000,
Population growth rate (R) = 2%

We have, Population at the end of 2nd year $= P\left(1+\frac{R}{100}\right)^T$
$= 375000\left(1+\frac{2}{100}\right)^2$
$= 375000 \times 1.02^2$
$= 390150$

$\therefore$ Population at the end of second year $= 390150 + 1480 - 2750$
$= 388880$

Now, present population $(P_T) = P\left(1+\frac{R}{100}\right)^1$
$= 388880\left(1+\frac{2}{100}\right) = 396657.6$

Thus, the present population is 396658.

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4.2 मिश्रह्रास (Compound Depreciation)

A. BASIC EXERCISE 4.2

Very Short Questions

1. यदि P_T = T वर्षपछिको मूल्य, P_D = ह्रास भएको मूल्य, P = सुरुको मूल्य, R = वार्षिक ह्रासदर र T = समय भए P, T, R र P_T को सम्बन्ध लेख्नुहोस् ।
   If P_T = Price after T years, P_D = depreciated price, P = initial price, R = depreciation rate and T = time then, write the relation among P, T, R and P_T.

⇨ Here, $P_D = P - P_T$, where $P_T = P\left(1 - \frac{R}{100}\right)^T$

2. एउटा पुस्तकको हरेक वर्षमा यसको मूल्यको पाँच भागको 1 भागले मूल्य ह्रास हुन्छ । सो मूल्य ह्रासदर पत्ता लगाउनुहोस् ।
   The price of a book is depreciated by one-fifth in a year. Find the rate of depreciation.

⇨ Here, Price depreciation rate $= \frac{1}{5} \times 100\ \% = 20\%$

3. एउटा रेडियोको हरेक वर्षमा यसको मूल्यको दस भागको 1 भागले मूल्य ह्रास हुन्छ । सो मूल्य ह्रासदर पत्ता लगाउनुहोस् ।
   The price of a radio is depreciated by one-tenth in a year. Find the rate of depreciation.

⇨ Here, Price depreciation rate $= \frac{1}{10} \times 100\ \% = 10\%$

4. रु. 3000 पर्ने एउटा साइकलको 1 वर्षमा 30 प्रतिशत ह्रासकट्टा हुन्छ भने ह्रासकट्टा रकम कति होला ?
   A bicycle of Rs 3000 is depreciated in a year by 30%, find the amount of depreciation. [2060 E2]

⇨ Here, amount of depreciation $= \text{Rs } 3000 \times \frac{30}{100} = \text{Rs } 900$

5. रु. 75000 मा किनिएको एउटा टाइपराइटर एक वर्ष पछि $12\frac{1}{2}\%$ ह्रासकट्टा गरी बेचियो भने, ह्रासकट्टा गरिएको रकम कति थियो ?
   A typewriter bought for Rs 75000 was sold after a year depreciating at the rate of $12\frac{1}{2}\%$ per year. What was the amount of depreciation ? [2060 B1]

⇨ Here, amount of depreciation $= \text{Rs } 75000 \times \frac{12\frac{1}{2}}{100} = \text{Rs } 750 \times \frac{25}{2} = \text{Rs } 9375$

6. रु. 3000 पर्ने एउटा साइकलको एक वर्षमा 33% ह्रासकट्टा हुन्छ भने ह्रास रकम कति होला पत्ता लगाउनुहोस् ।
   A bicycle of Rs 3000 is depreciated in a year by 33%, find the amount of depreciation. [2057 C2]

⇨ Here, amount of depreciation $= 33\%$ of Rs $3000 = \frac{33}{100} \times \text{Rs } 3000 = \text{Rs } 990$

7. रु. 12000 पर्ने मेसिनको मूल्यमा प्रति वर्ष 10% ह्रासकट्टा हुन्छ भने सो मेसीनको एक वर्ष पछि हुने मूल्य पत्ता लगाउनुहोस् ।
   A machine of Rs 12000 is depreciated at 10% per annum. Find the value of the machine after one year. [2057 B2]

⇨ Here, the value of machine after one year $= \text{Rs } 12000 - \text{Rs } 12000 \times \frac{10}{100}$
$= \text{Rs } 12000 - \text{Rs } 1200 = \text{Rs } 10800$

8. रु. 83,000 पर्ने मोटरसाइकलको एक वर्षमा 25% ह्रासकट्टा हुन्छ भने एक वर्ष पछि सो मोटर साइकलको मूल्य पत्ता लगाउनुहोस् ।
   A motor cycle costing Rs 83,000 is depreciated by 25% every year. Find the value of the motor cycle after one year. [2057 E2]

⇨ Here, value of motor cycle after one year $= \text{Rs } 83000 - \text{Rs } 83000 \times \frac{25}{100}$
$= \text{Rs } 83000 - \text{Rs } 20750 = \text{Rs } 62250$

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9. रु.45000 मा किनेको एउटा टाइपराइटर एकवर्ष पछि 15% ह्रासकट्टा गरी कतिमा बेच्नुपर्ला ?
At what price should a type–writer costing Rs 45000 be sold after one year, if it depreciated at the rate of 15%? [2058 E1]

⇨ Here, price of type-writer after one year $= \text{Rs } 45000 - \text{Rs } 45000 \times \frac{15}{100}$

$= \text{Rs } 45000 - \text{Rs } 6750 = \text{Rs } 38250$

10. प्रतिवर्ष 5 प्रतिशत ह्रासकट्टा गरी एउटा मोटरसाइकल एक वर्ष पछि रु. 57,000 मा बेचियो भने उक्त मोटरसाइकल कतिमा किनिएको थियो ?
A motor cycle which is supposed to depreciate at the rate of 5 % per year was sold at Rs 57,000 after a year. At what price was it bought ? [2059 A1]

⇨ Here, Present value $(P_1) = \text{Rs } 57,000$, Rate of depreciation $(R) = 5\%$ per annum
Time $(T) = 1$ year and Initial value $(P) = ?$

By formula, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $P_1 = P\left(1 - \frac{5}{100}\right)^1$

or, $\text{Rs } 57000 = P\ (0.95)$ $\therefore\ P = \text{Rs } \frac{57000}{0.95} = \text{Rs } 60,000$

11. प्रतिवर्ष 15 प्रतिशत ह्रासकट्टा गरी एउटा स्कुटर एक वर्ष पछि रु. 72250 मा बेचियो भने उक्त स्कुटर कतिमा किनिएको थियो ?
A scooter which is supposed to depreciate at the rate of 15 % per year was sold at Rs 72250 after a year. At what price was it bought ? [2059 A2]

⇨ Here, value of scooter after one year $(P_1) = \text{Rs } 72,250$, Rate of Depreciation $(R) = 15\%$
Time $(T) = 1$ year and Original price $(P) = ?$

By formula, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $P_1 = P\left(1 - \frac{15}{100}\right)^1$

or, $\text{Rs } 72,250 = P(0.85)$ or, $P = \frac{\text{Rs } 72,250}{0.85} = \text{Rs } 85,000$

12. एउटा मेसिनको सुरुको मूल्य रु. 40,000 छ । प्रत्येक वर्ष 10 प्रतिशतले ह्रास कट्टी गरिएको छ भने एक वर्ष पछि यसको मूल्य कति होला ?
The original cost of a machine is Rs 40,000. It is depreciated at the rate of 10% per annum. Find the value of machine at the end of the year.[2059 C2]

⇨ Here, original cost $(P) = \text{Rs } 40,000$, Depreciated rate $(R) = 10\%$
Value at the end of the year $(P_1) = ?$ and Time $(T) = 1$ year

By formula, $P_T = P\left(1 - \frac{R}{100}\right)^T = \text{Rs } 40,000\left(1 - \frac{10}{100}\right)^1 = \text{Rs } 40,000 \times (1 - 0.1)$

$= \text{Rs } 40,000 \times 0.9 = \text{Rs } 36,000$

13. रु. 10,000 पर्ने मेसिनको मूल्यमा 10% ह्रासकट्टा हुन्छ भने सो मेसिनको एक वर्षपछि हुने मूल्य पत्ता लगाउनुहोस् ।
A machine of Rs 10,000 is depreciated at 10% per annum. Find its value after one year. [2060 D1]

⇨ Here, value of machine after one year $= \text{Rs } 10000 - \text{Rs } 10000 \times \frac{10}{100} = \text{Rs } 10000 - \text{Rs } 1000$

$= \text{Rs } 9000$

14. एउटा मेसीनको मूल्य एक वर्षमा रु. 3200 बाट घटेर रु. 3040 कायम भएछ भने वार्षिक ह्रास प्रतिशत पत्ता लगाउनुहोस् ।
The value of a machine is depreciated from Rs 3200 to Rs 3040 in a year. Find the rate of depreciation in percent. [2057 A1]

⇨ Here, initial value $(P) = \text{Rs } 3200$ and Value after one year $(P_1) = \text{Rs } 3040$,

We have, Depreciation rate $(R) = \frac{P - P_1}{P} \times 100\% = \frac{3200 - 3040}{3200} \times 100\% = \frac{160}{3200} \times 100\% = 5\%$

15. हरिले रु. 5500 पर्ने एउटा साइकल एक वर्षपछि रु. 5060 मा बेच्यो भने त्यसमा कति प्रतिशत ह्रासकट्टा गरिएको थियो ?
Hari sold a bicycle costing Rs 5500 after one year at Rs 5060. At what percent was it depreciated ?[2059 D2]

⇨ Here, amount of depreciation $= \text{Rs } 5500 - \text{Rs } 5060 = \text{Rs } 440$

Percentage of depreciation $= \frac{\text{Rs } 440}{\text{Rs } 5500} \times 100\% = 8\%$

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16. रु.90000 मा किनेको एउटा मोटरसाइकल एकवर्ष पछि रु. 81000 मा बेचिएको थियो भने त्यसमा कति प्रतिशत ह्रासकट्टा गरिएको थियो ?
A motorcycle which was purchased at Rs 90000 was sold for Rs 81000 after one year. At what percent was it depreciated ? [2058 A2]

⇨ Here, actual depreciation = Rs 90000 – Rs 81000 = Rs 9000

$$\text{Percentage depreciation} = \frac{\text{actual depreciation}}{\text{original price}} \times 100 = \frac{\text{Rs } 9000}{\text{Rs } 90000} \times 100 = 10\%$$

17. एउटा मेसिनको मूल्य एक वर्षमा रु. 1800 बाट घटेर रु. 1650 कायम भएछ भने वार्षिक ह्रास प्रतिशत पत्ता लगाउनुहोस् ।
The value of a machine is depreciated from Rs 1800 to Rs 1650 in a year, find the rate of depreciation in percent. [2060 E1]

⇨ Here, amount of depreciation = Rs 1800 – Rs 1650 = Rs 150

$$\therefore \text{ Rate of depreciation} = \frac{\text{Rs } 150}{\text{Rs } 1800} \times 100\% = \frac{25}{3}\% = 8\frac{1}{3}\% \text{ per year}$$

Short Questions

MODEL 1

1. रु. 16000 पर्ने दराजको मूल्य वार्षिक 15% का दरले ह्रास कट्टि गर्दा 1 वर्षपछि सो दराजको मूल्य कति हुन्छ ?
A furniture costing Rs 16000 is depreciated at the rate of 15% per year. What will be the cost of the furniture after 1 year?

⇨ Here, cost of furniture after 1 year $(P_T) = P\left(1 - \frac{R}{100}\right)^T = 16000\left(1 - \frac{15}{100}\right)^1 = 16000 \times 0.85 = \text{Rs } 13600$

2. एउटा सामानको मूल्य प्रत्येक वर्ष 8% ले ह्रास कट्टा हुँदै जान्छ भने रु. 45000 पर्ने सामानको मूल्य 1 वर्षपछि कति होला ?
The value of an article is depreciated every year by 8%. What will be the value of the article worth Rs 45000 after 1 year?

⇨ Here, price after 1 year $(P_T) = P\left(1 - \frac{R}{100}\right)^T = 45000\left(1 - \frac{8}{100}\right)^1 = 45000 \times 0.92 = \text{Rs } 41400$

3. एक वर्ष पहिले किनिएको एउटा मेशिनको मूल्य 10% प्रतिवर्षका दरले ह्रास हुन्छ । यदि यसको वर्तमान मूल्य रु. 63000 भए उक्त मेशिन कति मूल्यमा किनिएको थियो ? पत्ता लगाउनुहोस् ।
The value of a machine bought 1 year ago depreciates 10% per annum. If its present value is Rs 63000, at what price was it bought? Find it.

⇨ Here, initial price P is given by; $P = \frac{P_T}{\left(1 - \frac{R}{100}\right)^T} = \frac{63000}{\left(1 - \frac{10}{100}\right)^1} = \frac{63000}{0.9} = \text{Rs } 70000.$

4. एकजना मानिसले एउटा मोबाइल रु. 10000 मा खरिद गरी 1 वर्ष प्रयोग पश्चात् रु. 9,000 मा बेच्दा हुने मिश्रित ह्रासदर पत्ता लगाउनुहोस् ।
A man bought a mobile for Rs 10000 and sold it for Rs 9000 after using for 1 year. Find the rate of compound depreciation.

⇨ Here, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $9000 = 10000\left(1 - \frac{R}{100}\right)^1$

or, $\frac{9000}{10000} = 1 - \frac{R}{100}$ or, $1 - \frac{9}{10} = \frac{R}{100}$

or, $\frac{1}{10} = \frac{R}{100}$ $\therefore$ $R = 10\%$

5. एउटा सामानको मूल्य रु. 1000 छ । यदि यसको मूल्य 1 वर्षमा रु. 200 ले ह्रास भयो भने मूल्य ह्रासदर पत्ता लगाउनुहोस् ।
The value of an article is Rs 1000. If it is depreciated by Rs 200 in 1 year, find the rate of depreciation.

⇨ Here, initial price (P) = Rs 1000

Price after depreciation (P_T) = Rs 1000 – Rs 200 = Rs 800

We know, $P_T = P\left(1 - \frac{R}{100}\right)^T$

or, $\text{Rs } 800 = \text{Rs } 1000\left(1 - \frac{R}{100}\right)^1$ or, $\frac{800}{1000} = 1 - \frac{R}{100}$

or, $0.8 = 1 - \frac{R}{100}$ or, $\frac{R}{100} = 0.2$ $\therefore$ $R = 20\%$

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MODEL 2

6. रु. 16800 पर्ने दराजको मूल्य वार्षिक 15% का दरले ह्रास कट्टि गर्दा 2 वर्षपछि सो दराजको मूल्य कति हुन्छ ?

A cupboard costing Rs 16800 is depreciated at the rate of 15% per year. What will be the cost of furniture after 2 years? [2067 C, 2071 B]

⇨ Here, initial price (P) = Rs 16800, Depreciation rate (R) = 15% and Time interval (T) = 2 yrs

We know that, $P_T = \left(1 - \frac{R}{100}\right)^T = 16800\left(1 - \frac{15}{100}\right)^2 = 16800 \times 0.85^2 = 12138$

Thus, the price of the cupboard after 2 years will be Rs 12138.

7. कम्प्युटरको मूल्यमा प्रतिवर्षको 10% को दरले मिश्रह्रास हुन्छ । रु. 40,000 मा किनिएको कम्प्युटरको मूल्य 2 वर्षपछि कति हुन्छ ? पत्ता लगाउनुहोस् ।

The value of a computer depreciates at 10% annually. What will be the value of a computer after two years which was bought for Rs 40,000? [SLC 2065 C]

⇨ Here, deprecation rate = 10%, CP of the computer = Rs 40000 and Time (T) = 2 years

Price of the computer after 2 years $= P\left(1 - \frac{R}{100}\right)^T = 40000\left(1 - \frac{10}{100}\right)^2 = 40000 \times \left(\frac{9}{10}\right)^2$

Thus, price of the computer after 2 years = Rs 32400

8. रु. 12000 मूल्य पर्ने एउटा साइकलमा वार्षिक 10% ले मूल्य ह्रास हुन्छ भने दुई वर्षपछि सो साइकलको मूल्य कति हुन्छ ?

A cycle costing Rs 12000 is depreciated annually by 10%. What is the price of the cycle after two years ? [SLC 2065 D]

⇨ Here, initial Price (P) = Rs 12000, Rate of depreciation (R) = 10% and Time (T) = 2 years

We know that; $P_T = P\left(1 - \frac{R}{100}\right)^T = 12000\left(1 - \frac{10}{100}\right)^2$

Thus, price after 2 years = Rs 9720

9. रु. 11600 पर्ने एउटा टेलिभिजनको मूल्यमा बार्षिक 15% का दरले ह्रास कट्टी गर्दा 2 वर्षपछि सो टेलिभिजनको मूल्य कति होला ?

A television costing Rs 11600 is depreciated at the rate of 15% per annum. What will be the cost of the television after 2 years ? [SLC 2066 B]

⇨ Here, initial price (P) = Rs 11600, Rate of depreciation (R) = 15% and Time period (T) = 2 yrs

We know that, Cost after 2 years $(P_2) = P\left(1 - \frac{R}{100}\right)^2 = 11600\left(1 - \frac{15}{100}\right)^2 = 8381$

Thus, the required cost of the television is Rs 8381.

MODEL 3

10. दुई वर्ष पहिले किनिएको एउटा मेशिनको मूल्य 10% प्रतिवर्षका दरले ह्रास हुन्छ । यदि यसको वर्तमान मूल्य रु. 64800 भए उक्त मेशिन कति मूल्यमा किनिएको थियो ? पत्ता लगाउनुहोस् ।

The value of a machine bought in 2 years ago depreciates 10% per annum. If its present value is Rs 64800, at what price was it bought? Find it. [2070 B]

⇨ Here, Time (T) = 2 yrs, Rate of interest (R) = 10% and Present price (P_T) = Rs 64800

We know that, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $64800 = P\left(1 - \frac{10}{100}\right)^2$

or, $64800 = P \times 0.9^2$ or, $P = \frac{64800}{0.81} = 80000$

Thus, the intitial price was Rs 80000.

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11. प्रतिवर्ष 10% का दरले मूल्य ह्रास हुँदा एउटा मोटर साइकलको मूल्य 3 वर्षपछि रु. 92583 हुन्छ भने सो मोटर साइकलको सुरुको मूल्य पत्ता लगाउनुहोस् ।
If the cost is depreciated at the rate of 10% per annum, the cost of a motorcycle after 3 years becomes Rs 92583. Calculate the original price of the motorcycle. **[2063 D1, 2067 B]**

⇨ Here, original price of the motorcycle be (P) ∴ Present value (P_3) = Rs 92583
Rate of depreciation (R) = 10% Time (T) = 3 years

We know that, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $P_3 = P\left(1 - \frac{10}{100}\right)^3$

or, Rs 92583 = $P(0.9)^3$ or, Rs 92583 = P(0.729)

∴ $P = \frac{\text{Rs } 92583}{0.729} = \text{Rs } 127000$ Thus, original price = Rs 127000

MODEL 4

12. एकजना मानिसले एउटा मोबाइल रु. 44,100 मा खरिद गरी 2 वर्ष प्रयोग पश्चात् रु. 40,000 मा बेच्दा हुने मिश्रित ह्रासदर पत्ता लगाउनुहोस् ।
A man bought a mobile for Rs 44,100 and sold it for Rs 40,000 after using for 2 years. Find the rate of compound depreciation. **[2072 E]**

⇨ Here, initital price (P) = Rs 44100, Time (T) = 2 yrs and final price (P_T) = Rs 40000

We know that, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $40000 = 44100\left(1 - \frac{R}{100}\right)^2$

or, $\frac{400}{441} = \left(1 - \frac{R}{100}\right)^2$ or, $\left(\frac{20}{21}\right)^2 = \left(1 - \frac{R}{100}\right)^2$

or, $\frac{R}{100} = 1 - \frac{20}{21}$ or, $\frac{R}{100} = \frac{1}{21}$

∴ R = 4.76 Thus, the rate of depreciation is 4.76%.

13. एउटा सामानको मूल्य रु. 36,000 छ । यदि यो मूल्य 2 वर्षमा रु. 6840 ले ह्रास हुन्छ भने ह्रास दर पत्ता लगाउनुहोस् ।
The value of an article is Rs 36,000. If it is depreciated by Rs 6840 in 2 years, find the rate of depreciation. **[2072 MW]**

⇨ Here, initital price (P) = Rs 36000, Time (T) = 2 yrs and Amount of depreciation = Rs 6840

We have, Depreciation = $P - P\left(1 - \frac{R}{100}\right)^T$ or, $6840 = 36000 - 36000\left(1 - \frac{R}{100}\right)^2$

or, $36000\left(1 - \frac{R}{100}\right)^2 = 29160$ or, $\left(1 - \frac{R}{100}\right)^2 = \frac{81}{100}$

or, $\left(1 - \frac{R}{100}\right)^2 = \left(\frac{9}{10}\right)^2$ or, $1 - \frac{R}{100} = \frac{9}{10}$

or, $\frac{1}{10} = \frac{R}{100}$ ∴ R = 10

Thus, the rate of depreciation is 10%.

14. एउटा मोटरसाइकलको मूल्य वि.सं 2070 मा रु. 250,000 थियो र वि.सं. 2072 मा रु. 160,000 छ भने वार्षिक मिश्रह्रास दर पत्ता लगाउनुहोस् ।
The price of a motorcycle was Rs 250,000 in 2070 B.S. and in 2072 B.S., it is Rs 1,60,000. Find the annual rate of compound depreciation. **[2072 FW]**

⇨ Here, price in 2070 (P) = Rs 250000, Price in 2072 (P_T) = Rs 160000 and
Time (T) = 2072 – 2070 = 2 yrs

We know that, $P_T = P\left(1 - \frac{R}{100}\right)^T$ or, $160000 = 250000\left(1 - \frac{R}{100}\right)^2$

or, $\frac{16}{25} = \left(1 - \frac{R}{100}\right)^2$ or, $\left(\frac{4}{5}\right)^2 = \left(1 - \frac{R}{100}\right)^2$

or, $\frac{4}{5} = 1 - \frac{R}{100}$ or, $\frac{R}{100} = \frac{1}{5}$

∴ R = 20%

Thus, the rate of depreciation is 20%.

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15. रु. 6000 पर्ने रेडियोको प्रतिवर्ष मूल्यह्रासकट्टा गर्दा 2 वर्षपछि रेडियोको मूल्य रु. 5415 भयो भने ह्रासदर पत्ता लगाउनुहोस् ।
A radio costing Rs 6,000 is depreciated per year and 2 years later its price becomes to Rs 5,415. Find the rate of depreciation in percent. **[SLC 2065 B]**

⇨ Here, initial price (P) = Rs 6000, Time (T) = 2 years and Final price (P_T) = Rs 5415

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $5415 = 6000\left(1-\frac{R}{100}\right)^2$

or, $\frac{361}{400} = \left(1-\frac{R}{100}\right)^2$ or, $1-\frac{R}{100} = \frac{19}{20}$

or, $\frac{R}{100} = \frac{1}{20}$ ∴ $R = 5\%$

Thus, rate of depreciation is 5%.

Long Questions

MODEL 1

1. एकजना मानिसले रु. 44100 तिरेर किनेको एउटा कम्प्युटर 2 वर्षको प्रयोगपछि रु. 40000 मा बिक्री गऱ्यो भने उक्त कम्प्युटरको मिश्रह्रासदर पत्ता लगाउनुहोस् ।
A man bought a computer for Rs 44,100 and after using it for 2 years, sold it for Rs 40,000. Find the rate of compound depreciation of the computer. **[2061 E1]**

⇨ Here, P = Rs 44100, D_T = Rs 40,000, T = 2 yrs

By formula, we have, $D_T = P\left(1-\frac{R}{100}\right)^T$

or, $40000 = 44100\left(1-\frac{R}{100}\right)^2$ or, $\frac{40000}{44100} = \left(1-\frac{R}{100}\right)^2$

or, $\frac{400}{441} = \left(1-\frac{R}{100}\right)^2$ or, $\left(\frac{20}{21}\right)^2 = \left(1-\frac{R}{100}\right)^2$

or, $\frac{20}{21} = 1-\frac{R}{100}$ or, $\frac{R}{100} = 1-\frac{20}{21}$

or, $\frac{R}{100} = \frac{1}{21}$ ∴ $R = \frac{100}{21} = 4.76\%$ per annum.

Thus, rate of compound depreciation = 4.76%

2. एकजना मानिसले रु. 96100 तिरेर किनेको एउटा मोटरसाइकल 2 वर्षको प्रयोगपछि रु. 90000 मा बिक्री गऱ्यो भने उक्त मोटरसाइकलको मिश्रह्रासदर पत्ता लगाउनुहोस् ।
A man bought a motor cycle for Rs 96,100 and after using it for 2 years, he sold it for Rs 90,000. Find the rate of compound depreciation of the motorcycle. **[2061 E2]**

⇨ Here, original value (P) = Rs 96100, Value after 2 yrs (D_T) = Rs 90,000 and Time (T) = 2 yrs

We know that, $D_T = P\left(1-\frac{R}{100}\right)^T$ or, $D_2 = P\left(1-\frac{R}{100}\right)^2$

or, $90,000 = 96100\left(1-\frac{R}{100}\right)^2$ or, $\frac{90000}{96100} = \left(1-\frac{R}{100}\right)^2$

or, $\frac{900}{961} = \left(1-\frac{R}{100}\right)^2$ or, $\left(\frac{30}{31}\right)^2 = \left(1-\frac{R}{100}\right)^2$

or, $\frac{30}{31} = 1-\frac{R}{100}$ or, $\frac{R}{100} = 1-\frac{30}{31}$

or, $\frac{R}{100} = \frac{31-30}{31}$ or, $\frac{R}{100} = \frac{1}{31}$

∴ $R = \frac{100}{31} = 3.23\%$ per annum.

Thus, rate of compound depreciatoin is 3.23% per annum.

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B. QUESTIONS FROM CDC TEXT BOOKS [EXERCISE 4.2]

1A. एउटा मोटरसाइकलको हालको मूल्य रु. 1,25,000 छ । यदि उक्त मोटरसाइकलको मूल्य 4% प्रतिवर्षका दरले घट्दै जान्छ भने 3 वर्षपछि यसको मूल्य कति होला ?

The present price of a motorcycle is Rs 125000. If the price of the motorcycle depreciates at the rate of 4% p.a., what will be its price after 3 years?

⇨ Here, Initial price (P) = Rs 125000, Rate of depreciation (R) = 4% and Time (T) = 3 years

We know that,

$$P_T = P\left(1-\frac{R}{100}\right)^T = 125000\left(1-\frac{4}{100}\right)^3 = 125000 \times 0.884736 = 110592$$

Thus, the price after 3 years will be Rs 110592.

1B. एउटा मेसिनको हालको मूल्य रु. 90,000 छ । उक्त मेसिनको मूल्य 10% प्रतिवर्षका दरले घट्दै जान्छ भने 2 वर्षपछि उक्त मेसिनको मूल्य कति होला ?

The present price of a machine is Rs 90000. If the price of the machine depreciates by 10% per annum, what will be the price of the machine after 2 years ?

⇨ Here, Initial price (P) = Rs 90000, Rate of depreciation (R) = 10% and Time (T) = 2 yrs

We know that,

$$P_T = P\left(1-\frac{R}{100}\right)^T = \text{Rs } 90000\left(1-\frac{10}{100}\right)^2 = \text{Rs } 90000 \times 0.9^2$$

$\therefore$ P_T = Rs 72900

Thus, the price of the machine will be Rs 72900.

1C. एउटा फाइनान्स कम्पनीको सेयरको मूल्यमा लगातार 2 वर्षसम्म 10% मिश्रह्रासका दरले कमी आएपछि कोपिलाले केही सेयर रु. 2430 मा बिक्री गरिन् भने उनले रु. 100 दरका कति ओटा सेयरहरू बिक्री गरिन् ? पत्ता लगाउनुहोस् ।

The share value of a finance company depreciates by 10% continually until 2 years so that Kopila sold some shares at Rs 2430. How many shares of Rs 100 were sold by her ?

⇨ Here, Rate of depreciation (R) = 10% and Time (T) = 2 years

We have, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $2430 = P\left(1-\frac{10}{100}\right)^2$

or, $2430 = P \times 0.81$ or, $P = \frac{2430}{0.81} = 3000$

No. of sold shares costing 100 $= \frac{3000}{100} = 30$ Thus, the no. of shares was 30.

1D. एउटा कम्पनीले 3 वर्षअगाडि रु. 2,80,000 मा 5 रोपनी जग्गा खरिद गऱ्यो । देशको राजनीतिक तरलताको स्थितिले गर्दा उक्त जग्गाको मूल्य घट्न गयो । यदि उक्त जग्गाको मूल्य 5% प्रतिवर्ष मिश्रह्रास दरमा घट्दै गएको भए अहिले प्रतिरोपनी सो जग्गाको मूल्य कति होला ?

3 years ago a company bought 5 ropani of land at Rs 280000. Due to the political instability of the country the price of the land is depreciated. If the price of the land is depreciated at 5% p.a., what is the price of the land per ropani ?

⇨ Here, Price of 5 ropani land = Rs 280000 Price of 1 ropani land (P) $= \frac{\text{Rs } 280000}{5}$

$\therefore$ P = Rs 56000

Rate of depreciation (R) = 5% p.a. and Time (T) = 3 years

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$

or, $P_T = \text{Rs } 56000\left(1-\frac{5}{100}\right)^3 = \text{Rs } 56000 \times 0.857375 = \text{Rs } 48013$

Thus, the price of the land per ropani is Rs 48013.

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1E. फुर्वाले रु. 7,20,000 मा एउटा ट्याक्टर किने । उनले 3 वर्षमा रु. 2,20,000 आम्दानी गरे र 3 वर्षपछि 10% प्रतिवर्ष मिश्रह्रास दरले मूल्य निर्धारण गरी बिक्री गरे भने उनलाई कति नाफा वा नोक्सान भयो होला ?
Furba bought a tractor at Rs 720000. He earned Rs 220000 in 3 years from this and sold it at a price which is depreciated rate of 10% p.a., what is his profit or loss ? Find it.

⇨ Here, CP of a tractor = Rs 720000
We have,

$$\text{Selling price of the tractor} = P\left(1-\frac{R}{100}\right)^3 = \text{Rs } 720000\left(1-\frac{10}{100}\right)^3$$
$$= \text{Rs } 720000 \times 0.729 = \text{Rs } 524880$$
His total earning = Selling price + Earning = Rs 524880 + Rs 220000
= Rs 744880
Now, profit = Total earning – Cost price = Rs 744880 – Rs 720000
= Rs 24880

Thus, his total profit is Rs 24880.

2A. 3 वर्षअगाडि प्रकाशित एउटा किताबको मूल्य रु. 3000 थियो । उक्त किताबलाई हरेक वर्ष निश्चित दरमा छुटमा दिँदै बिक्री गरी हाल उक्त किताबलाई रु. 1536 मा बिक्री गरियो भने कति प्रतिशतका दरले मूल्यमा ह्रास आयो ? पत्ता लगाउनुहोस् ।
The price of a book published 3 years ago was Rs 3000. If the book is depreciated every year by certain rate and sold the book at Rs 1536, by what percentage was it depreciated ? Find it.

⇨ Here, Initial price (P) = Rs 3000 and Final price (P_T) = Rs 1536 and Time (T) = 3 years
We know that,

$P_T = P\left(1-\frac{R}{100}\right)^T$ or, $\text{Rs } 1536 = \text{Rs } 3000\left(1-\frac{R}{100}\right)^3$

or, $0.512 = \left(1-\frac{R}{100}\right)^3$ or, $(0.8)^3 = \left(1-\frac{R}{100}\right)^3$

or, $1-\frac{R}{100} = 0.8$ ∴ $R = 20\%$

Thus, the rate of depreciation is 20%.

2B. एक जना किसानले रु. 2,50,000 मा किनेको थ्रेसर मेसिन 2 वर्षपछि रु. 1,60,000 मा बिक्री गरे भने उक्त मेसिनको मिश्रह्रास दर पत्ता लगाउनुहोस् ।
A farmer bought a thresher machine at Rs 250000 and after 2 years sold it at Rs 160000. Find the depreciation rate of the machine.

⇨ Here, Initial price (P) = Rs 250000, Final price (P_T) = Rs 160000 and Time (T) = 2 years
We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $160000 = 250000\left(1-\frac{R}{100}\right)^2$

or, $0.64 = \left(1-\frac{R}{100}\right)^2$ or. $(0.8)^2 = \left(1-\frac{R}{100}\right)^2$

or, $1-\frac{R}{100} = 0.8$ or, $1-0.8 = \frac{R}{100}$

or, $0.2 = \frac{R}{100}$ ∴ $R = 20\%$

Thus, the rate of depreciation is 20%.

2C. एउटा घरको हालको मूल्य रु. 20,48,000 छ । यदि वार्षिक 15% का दरले मिश्रह्रास हुने भए कति वर्षपछि उक्त घरको मूल्य रु. 12,57,728 होला ? पत्ता लगाउनुहोस् ।
The present price of a house is Rs 2048000. If the annual depreciation rate is 15%, how many years later its price will be Rs 1257728 ? Find it.

⇨ Here, Present price of a house (P) = Rs 2048000,
Final price (P_T) = Rs 1257728 Rate of depreciation (R) = 15%
We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $1257728 = 2048000\left(1-\frac{15}{100}\right)^T$

or, $0.614125 = (0.85)^T$ or, $(0.85)^3 = (0.85)^T$

∴ $T = 3$

Thus, the required time (T) is 3 years.

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2D. एउटा धानकुट्ने मेसिन केही वर्षअगाडि रु. **4,00,000** मा किनिएको थियो । अहिले यसको मूल्य रु. **1,96,000** पर्छ । उक्त मेसिनको मूल्य **30%** प्रतिवर्ष ह्रास भइरहेको भए उक्त मेसिन कति वर्षअगाडि किनिएको रहेछ ?
A rice mill was bought some years ago at Rs 400000. Now its price is Rs 196000. If the machine is depreciated at the rate of 30%, how many years ago was the machine purchased ?

⇨ Here, Initial price (P) = Rs 400000, Final price (P_T) = 196000 and Rate of depreciation (R) = 30%

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $196000 = 400000\left(1-\frac{30}{100}\right)^T$

or, $0.49 = (0.7)^T$ or, $(0.7)^2 = (0.7)^T$

$\therefore$ T = 2 Thus, the required time is 2 yrs.

3A. एउटा सामुदायिक जङ्गलमा लगभग **20,000** ठुला रुखहरू थिए । उर्जा सङ्कटका कारण वार्षिक रूपमा उपभोक्ताहरूले इन्धनका लागि **8%** रुखहरू काट्ने गरेका भए **2** वर्षसम्म जम्मा कति ओटा रुख काटिएलान् ? यस्ता समस्याहरूको समाधानका वैकल्पिक उपायहरूका बारेमा छलफल गर्नुहोस् ।
In a community Jungle, there are 20000 tall trees. Due to energy scarcity, the consumers use to cut 8% trees, how many trees are cut in 2 years ? Discuss the alternative ways to solve such problems.

⇨ Here, No. of trees (P) = 20000, Rate of depreciation (R) = 8% and Time (T) = 2 years

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T = 20000\left(1-\frac{8}{100}\right)^2 = 20000 \times 0.8464 = 16928$

No. of cut trees = 20000 – 16928 = 3072
Thus, the required no. of trees is 3072.
Now alternative ways to solve such problem, using low watt's appliances.
- Using day light to do essential work than night.
- Using solar energy instead of electric energy.

3B. एउटा मेसिनको हालको मूल्य रु. **5,00,000** छ । उक्त मेसिनको मूल्य पहिलो वर्ष **15%** र त्यसपछिका वर्षहरूमा क्रमशः **10%** र **5%** ले ह्रास हुँदै जान्छ भने **3** वर्षपछि उक्त मेसिनको मूल्य कति होला ?
The present price of a machine is Rs 500000. If the price of the machine depreciates first year by 15% and then 10% and 5% respectively in following years, what will be the price of the machine after 3 years ?

⇨ Here, Present price (P) = Rs 500000, Rate of depreciation (R) = 15%, 10%, 5% and Time (T) = 3 years

We have, $P_T = P\left(1-\frac{R_1}{100}\right)\left(1-\frac{R_2}{100}\right)\left(1-\frac{R_3}{100}\right) = 500000\left(1-\frac{15}{100}\right)\left(1-\frac{10}{100}\right)\left(1-\frac{5}{100}\right)$

$= 500000 \times 0.85 \times 0.9 \times 0.95 = 36337.50$

Thus, the price of the machine after 3 years will be Rs 36337.50.

3C. एउटा विद्युतीय सामग्री उत्पादन उद्योगले आफ्नो बजार खस्कँदै गएका कारण प्रतिवर्ष **10%** कामदार कटौती गर्दै लैजाने घोषणा गऱ्यो । त्यसै बमोजिम अहिले उक्त उद्योगमा जम्मा **40,000** कामदार कार्यरत छन् भने **3** वर्षअघि उक्त उद्योगमा कति कामदार कार्यरत थिए ? पत्ता लगाउनुहोस् ।
The electric items production industry declared that to cut off its 10% workers every year due to the decreasing status of market. There are 40000 workers recently working in the company accordingly. How many workers were there in the industry before 3 years ? Find it.

⇨ Here, Final no. of workers (P_T) = 40000, Rate of depreciation (R) = 10% and Time (T) = 3 years

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $40000 = P\left(1-\frac{10}{100}\right)^3$

or, $40000 = P \times 0.729$ or, $P = 54869.69$

Thus, the no. of workers before 3 years was 54870.

4. औषधी प्रयोगका कारणले प्रतिदिन **20%** ले घटिरहेको ब्याक्टेरियाको सङ्ख्या चार दिनपछि जम्मा 1.6×10^8 भएछ भने **4** दिन अगाडि उक्त ब्याक्टेरियाको सङ्ख्या कति थियो होला ?
Due to the use of medicines, the number of bacteria is decreasing at the rate of 20% per day so that the number of bacteria after 4 days is 1.6×10^8, what was the number of bacteria before 4 days ?

⇨ Here, No. of bacteria after 4 days = 1.6×10^8 and Rate of depreciation (R) = 20%

We know that, $P_T = P\left(1-\frac{R}{100}\right)^T$ or, $1.6 \times 10^8 = P\left(1-\frac{20}{100}\right)^4$

or, $1.6 \times 10^8 = P \times 0.8^4$ or, $P = \frac{1.6 \times 10^8}{0.8^4}$

$\therefore$ $P = 3.906 \times 10^8$

Thus, the no. of required bacteria is 3.906×10^8 or 390600000.

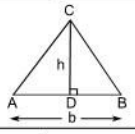
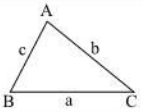
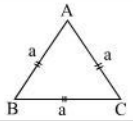
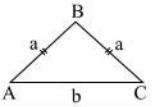
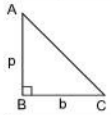
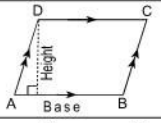
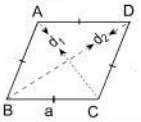
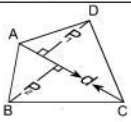
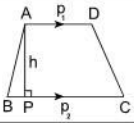
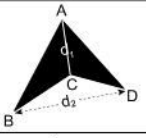
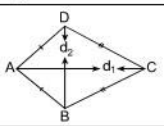
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Unit III: क्षेत्रमिती (Mensuration)

5 त्रिभुजको क्षेत्रफल
Area of Triangle

Formulae Key Points

	Name	Figure	Area	Perimeter
1.	**त्रिभुज** Triangle		$A = \frac{1}{2} b \times h$	$P = AB + BC + AC$
2.	**त्रिभुज** Triangle		$A = \sqrt{s(s-a)(s-b)(s-c)}$	$P = (a + b + c)$
3.	**समबाहु त्रिभुज** Equilateral Triangle		$A = \frac{\sqrt{3}}{4} a^2$	$P = 3a$
4.	**समद्विबाहु त्रिभुज** Isosceles Triangle		$A = \frac{b}{4}\sqrt{4a^2 - b^2}$	$P = b + 2a$
5.	**समकोणी त्रिभुज** Right angled Triangle		$A = \frac{1}{2} b \times p$	$P = p + b + \sqrt{p^2 + b^2}$
6.	**समानान्तर चतुर्भुज** Parallelogram		$A = b \times h$	$P = 2 (AD + AB)$
7.	**समबाहु चतुर्भुज** Rhombus		$A = \frac{1}{2} d_1 \times d_2$	$P = 4a$
8.	**चतुर्भुज** Quadrilateral		$A = \frac{1}{2} d (p_1 + p_2)$	$P = AB + BC + CD + DA$
9.	**समलम्ब चतुर्भुज** Trapezium		$A = \frac{1}{2} h (p_1 + p_2)$	$P = p_1 + p_2 + AB + CD$
10.	**एरोहेड** Arrow–head		$A = \frac{1}{2} d_1 \times d_2$	$P = AB + BC + CD + AD$
11.	**चङ्गा** Kite		$A = \frac{1}{2} d_1 \times d_2$	$P = AB + BC + CD + DA$

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SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 1 (b) & 13]

Q.1.(b) भुजाको नाप 'a' एकाइ भएको समबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an equilateral triangle whose side is 'a' unit?

⇨ Here, Area of equilateral triangle $= \frac{\sqrt{3}}{4} a^2$ square units.

Q. 13. एउटा छाता 10 ओटा दुई फरक रङ्गका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । प्रत्येक टुक्राको नाप 15 cm, 41 cm र 28 cm भए उक्त छाता बनाउन कति कपडा चाहिन्छ ? यदि 1 cm² कपडाको मुल्य रु. 0.50 पर्छ भने जम्मा कपडाको मूल्य कति पर्छ ?
An umbrella is made by stitching 10 triangular pieces of cloth of two different colours, each piece measuring 15 cm, 41 cm and 28 cm. How much cloth is required for the umbrella? If the cost of 1 cm² is Rs 0.50, find the total cost of cloth.

⇨ Here, let a = 15 cm, b = 41 cm and c = 28 cm

We know that, For a piece of a cloth, $s = \frac{15 + 41 + 28}{2}$ cm = 42 cm

We have, Area of a piece $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{42(42-15)(42-41)(42-28)}$ cm²
$= \sqrt{42 \times 27 \times 1 \times 14}$ cm² = 126 cm²

Area of 10 pieces of the clothes = 10 × 126 cm² = 1260 cm²

We have given that, The cost of 1cm² is Rs 0.50.
Cost of 1260 cm² = Rs 0.50 × 1260 = Rs 630
Thus, the total cost of the cloth is Rs 630.

A. BASIC EXERCISE 5

A. VERY SHORT QUESTIONS

1. भुजाको नाप '*a*' एकाइ भएको समबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an equilateral triangle whose side is *'a'* unit?

⇨ Here, Area of equilateral triangle $= \frac{\sqrt{3}}{4} a^2$ square units.

2. भुजाको नाप 4 cm भएको समबाहु त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of an equilateral triangle whose side is 4 cm.

⇨ Here, Area (A) $= \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times 4^2 = 4\sqrt{3}$ sq. cm.

3. बराबर भुजा '*a*' एकाइ र भुजा आधार भुजा '*b*' एकाइ भएको एउटा समद्विबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of an isosceles triangle whose equal side is *'a'* units and base side 'b' units?

⇨ Here, Area (A) $= \frac{b}{4}\sqrt{4a^2 - b^2}$ sq. units.

4. भुजाका नापहरू ***a*** cm, ***b*** cm र ***c*** cm भएको विषमबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of a scalene triangle whose sides are *a* cm, *b* cm and *c* cm ?

⇨ Here, Area of scalene triangle is given by, (A) $= \sqrt{s(s-a)(s-b)(s-c)}$ cm².

5. आधार र उचाइ क्रमशः ***a*** cm र ***b*** cm भएको एउटा समकोण त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of a right-angled triangle whose base and height are *a* cm and *b* cm respectively.

⇨ Here, area of a right angled triangle is $\frac{1}{2} \times a \times b$ cm².

6. एउटा समकोण त्रिभुजमा समकोण बनाउने भुजाहरू क्रमशः 3 cm र 4 cm भए सो त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of a right-angled triangle whose right-angle making sides are 3 cm and 4 cm.

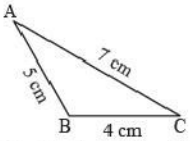
⇨ Here, Area (A) $= \frac{1}{2} \times b \times h = \frac{1}{2} \times 3 \times 4 = 6$ cm²

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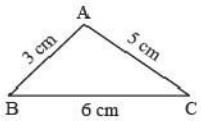
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7. दिइएका त्रिभुजहरुको अर्ध परिमिति पत्ता लगाउनुहोस् (Find the semi-perimeter of the given triangles):

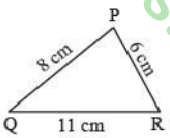
(a)



(b)



(c)



⇨ (a) Here, a = 4 cm, b = 7 cm, c = 5 cm

Now, semi perimeter (s) $= \frac{a+b+c}{2} = \frac{4+7+5}{2} = 8$ cm.

(b) Here, a = 6 cm, b = 5 cm, c = 3 cm

Now, semi perimeter (s) $= \frac{a+b+c}{2} = \frac{6+5+3}{2} = 7$ cm.

(c) Here, a = 11 cm, b = 6 cm, c = 8 cm

Now, semi perimeter (s) $= \frac{a+b+c}{2} = \frac{11+6+8}{2} = 12.5$ cm.

B. SHORT QUESTIONS

MODEL 1

1. भुजाका नापहरू 4 cm, 13 cm र 15 cm भएको विषमबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
What is the area of a scalene triangle whose sides are 4 cm, 13 cm and 15 cm ?

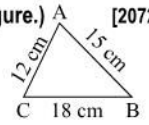
⇨ Here, $s = \frac{a+b+c}{2} = \frac{4+13+15}{2} = 16$ cm

Now, Area (A) $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{16(16-4)(16-13)(16-15)}$

$= \sqrt{16 \times 12 \times 3 \times 1} = 24$ cm^2

2. दिइएको त्रिभुजको क्षेत्रफल कति हुन्छ ? (Find the area of the triangle given in adjoining figure.) [2072 S]



⇨ Here, a = 18 cm, b = 15 cm and c = 12 cm

We know that, $s = \frac{a+b+c}{2} = \frac{18\text{ cm} + 15\text{ cm} + 12\text{ cm}}{2} = 22.5$ cm

We have, area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{22.5(22.5-18)(22.5-15)(22.5-12)}$

$= \sqrt{22.5 \times 4.5 \times 7.5 \times 10.5} = 89.29$ cm^2

Thus, the area of ΔABC is 89.29 cm^2.

3. 4.5 से.मि., 3.5 से.मि. र 6 से.मि. भुजाहरू भएको त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of triangle having its sides 4.5 cm, 3.5 cm and 6 cm. [2071 B]

⇨ Here, a = 4.5 cm, b = 3.5 cm and c = 6 cm

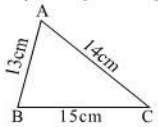
We know, $s = \frac{a+b+c}{2} = \frac{4.5+3.5+6}{2} = 7$ cm

Now, area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{7(7-4.5)(7-3.5)(7-6)}$

$= \sqrt{7 \times 2.5 \times 3.5 \times 1} = 7.826$ cm^2

Thus, the area of given Δ is 7.826 cm^2.

4. दिइएको त्रिभुजको क्षेत्रफल कति हुन्छ ? (Find the area of the triangle given in adjoining figure.) [2060 A1]



⇨ Here, a = 15 cm, b = 14 cm and c = 13 cm

So, $s = \frac{a+b+c}{2} = \frac{15+14+13}{2}$ cm $= \frac{42}{2}$ cm $= 21$ cm

By formula,

Area of triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{21(21-15)(21-14)(21-13)}$ cm^2

$= \sqrt{21 \times 6 \times 7 \times 8}$ cm^2

$= 84$ cm^2

Thus, area of the given Δ is 84 cm^2.

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5. त्रिभुजाकार मैदानका भुजाहरूको नाप क्रमशः 42 m, 34 m र 20 m दिइएको छ । त्यस मैदानको क्षेत्रफल निकाल्नुहोस् ।
A triangular field having the length of sides are 42 m, 34 m and 20 m respectively. Find the area of the field. [2058 D2]

⇨ Here, suppose, a = 42 m, b = 34 m and c = 20 m

Then, $s = \frac{a+b+c}{2} = \frac{42\text{ m} + 34\text{ m} + 20\text{ m}}{2} = 48\text{ m}$

By formula,

The area of the triangular field $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{48(48-42)(48-34)(48-20)}\ \text{m}^2$

$= \sqrt{48 \times 6 \times 14 \times 28}\ \text{m}^2 = 336\ \text{m}^2$

Thus, the area of the triangular field is 336 m^2.

6. मैदानकाको तीनओटा भागको नाप क्रमशः 41 m, 40 m र 9 m दिइएको छ । त्यस मैदानको क्षेत्रफल निकाल्नुहोस् ।
If the lengths of the three sides of a triangular field are 41 m, 40 m and 9 m, calculate the area of the field. [2063 D1]

⇨ Here, length of three sides of a triangular field are a = 41 m, b = 40 m and c = 9 m.

Semi-perimeter $(s) = \frac{a+b+c}{2} = \frac{41+40+9}{2} = 45\text{ m}$

By formula, Area of the triangular field (A) $= \sqrt{s(s-a)(s-b)(s-c)}\ \text{m}^2$

$= \sqrt{45(45-41)(45-40)(45-9)}\ \text{m}^2$

$= \sqrt{45 \times 4 \times 5 \times 36}\ \text{m}^2 = 180\ \text{m}^2$

Thus, area of triangular field is 180 m^2.

7. त्रिभुजकार मैदानकाको भागको नाप क्रमशः 10 m, 11 m र 15 m छ । यसको क्षेत्रफल निकाल्नुहोस् ।
Find the area of a triangular field where edges are 10 m, 11 m and 15 m. [2063 E2]

⇨ Here, a = 10 m, b = 11 m, c = 15 m

So, $s = \frac{a+b+c}{2} = \frac{10+11+15}{2}\ \text{m} = 18\text{ m}$

By formula, Area of the triangular field (A) $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{18(18-10)(18-11)(18-15)}$

$= \sqrt{18 \times 8 \times 7 \times 3}$

$= 54.99\ \text{m}^2$

Thus, the area of triangular field is 54.99 m^2.

8. एउटा त्रिभुजको परिमिति र दुई भुजाहरूको लम्बाइ क्रमशः 54 से.मि., 12 से.मि. तथा 18 से.मि छन् भने सो त्रिभुजको क्षेत्रफल निकाल्नुहोस् ।
The perimeter and the length of two sides of a triangle are 54 cm, 12 cm and 18 cm respectively. Calculate the area of the triangle. [2064 C2]

⇨ Here, Perimeter (P) = 54 cm, a = 12 cm and b = 18 cm

Third side = P – (a + b) = {54 – (12 + 18)} cm = 24 cm ∴ c = 24 cm

Semi–perimeter $(s) = \frac{P}{2} = \frac{54\text{ cm}}{2} = 27\text{ cm}$

By formula,

Area of the triangle (A) $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{27(27-12)(27-18)(27-24)}$

$= \sqrt{27 \times 15 \times 9 \times 3}$

Thus, Area of the triangle (A) = 104.57 cm^2

MODEL 2

9. यदि एउटा समबाहु त्रिभुजको परिमिति 18 से.मि. भए यसको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the perimeter of an equilateral triangle is 18 cm, find its area. [2071 S]

⇨ Here, perimeter of equilateral Δ = 18 cm

or, 3a = 18 cm ∴ a = 6 cm

We know that, Area of $\Delta = \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4}(6\text{ cm})^2 = \frac{\sqrt{3}}{4} \times 36\ \text{cm}^2 = 9\sqrt{3}\ \text{cm}^2$

Thus, the area of the equilateral Δ is $9\sqrt{3}$ cm^2.

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10. यदि एउटा समबाहु त्रिभुजको क्षेत्रफल $16\sqrt{3}$ cm² छ भने त्यसको परिमिति निकाल्नुहोस् ।
If the area of an equilateral triangle is $16\sqrt{3}$ cm², find the its perimeter. [2065 A, 2064 C1, 2058 A2]

⇨ Here, area of an equilateral triangle = $16\sqrt{3}$ cm²

or, $\frac{\sqrt{3}}{4}a^2 = 16\sqrt{3}$ or, $a^2 = 64$ ∴ $a = 8$ cm

We have, Perimeter = $3a = 3 \times 8$ cm = 24 cm
Thus, perimeter of the triangle is 24 cm.

11. यदि एउटा समबाहु त्रिभुजको क्षेत्रफल $9\sqrt{3}$ cm² छ भने त्यसको परिमिति निकाल्नुहोस् ।
If the area of an equilateral triangle is $9\sqrt{3}$ cm², find its perimeter. [2063 C1]

⇨ Here, the area of an equilateral triangle is $9\sqrt{3}$ cm²
Let, a be the side of an equilateral triangle.

Then, area of equilateral triangle = $\frac{\sqrt{3}}{4}a^2$

or, $9\sqrt{3} = \frac{\sqrt{3}}{4}a^2$ or, $a^2 = 36$

∴ $a = 6$ cm
Thus, perimeter of the triangle = $3a = 3 \times 6$ cm = 18 cm

12. यदि एउटा समबाहु त्रिभुजको परिमिति 30 cm छ भने त्यसको क्षेत्रफल पत्ता निकाल्नुहोस् ।
Find the area of an equilateral triangle of perimeter 30 cm. [2064 A1]

⇨ Here, Perimeter (P) = 30 cm

So, Length of a side (a) = $\frac{P}{3} = \frac{30 \text{ cm}}{3} = 10$ cm

By formula, Area of equilateral triangle (A) = $\frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times (10 \text{ cm})^2$

Thus, area of equilateral triangle (A) = $25\sqrt{3}$ cm²

13. यदि एउटा समबाहु त्रिभुजको क्षेत्रफल $16\sqrt{3}$ cm² भए त्यसको भुजाको लम्बाइ पत्ता लगाउनुहोस् ।
If the area of an equilateral triangle is $16\sqrt{3}$ cm², find the length of a side.

⇨ Here, area of an equilateral triangle (A) = $16\sqrt{3}$ cm²

or, $\frac{\sqrt{3}}{4}a^2 = 16\sqrt{3}$ cm² or, $a^2 = 16 \times 4 = 64$ cm²

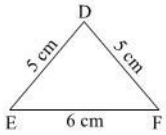
∴ $a = \sqrt{64} = 8$ cm. Thus, the length of side is 8 cm.

14. बराबर भुजा 5 cm र भुजा आधार भुजा 6 cm एकाइ भएको एउटा समद्विबाहु त्रिभुजको क्षेत्रफल कति हुन्छ ?
Find the area of an isosceles triangle whose equal side is 5 cm and base side 6 cm.

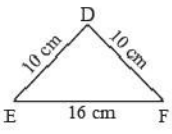
⇨ Here, Area (A) = $\frac{b}{4}\sqrt{4a^2 - b^2} = \frac{6}{4}\sqrt{4 \times 5^2 - 6^2} = \frac{6}{4}\sqrt{64} = \frac{6}{4} \times 8 = 12$ cm².

15. दिइएको त्रिभुजहरूको क्षेत्रफल पत्ता लगाउनुहोस् (Find the area of given triangles):

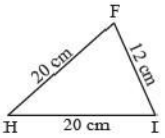
(a)



(b)



(c)



⇨ (a) Here, area of isosceles triangle DEF is given by

$A = \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{6}{4}\sqrt{4 \times 5^2 - 6^2} = \frac{6}{4} \times 8 = 12$ cm²

(b) Here, area of isosceles triangle DEF is given by

$A = \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{16}{4}\sqrt{4 \times 10^2 - 16^2} = 4 \times 12 = 48$ cm²

(c) Here, area of isosceles triangle FIH is given by

$A = \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{12}{4}\sqrt{4 \times 20^2 - 12^2} = 3 \times 38.157 = 114.47$ cm²

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MODEL 3

16. एउटा त्रिभुजको भुजाहरूका अनुपात 3 : 4 : 5 र परिमिति 12 cm छ भने सो त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
The ratio of the sides of a triangle is 3 : 4 : 5 and its perimeter 12 cm. Find its area of the triangle. [SLC 2066 D]

⇨ Here, 1st side (a) $= \frac{3}{(3+4+5)} \times 12 = 3$ cm, 2nd side (b) $= \frac{4}{(3+4+5)} \times 12 = 4$ cm

3rd side (c) $= \frac{5}{(3+4+5)} \times 12 = 5$ cm

We know that, Area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{6(6-3)(6-4)(6-5)}$

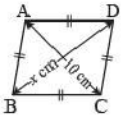
$= \sqrt{6 \times 3 \times 2 \times 1} = 6$ cm^2

Thus, the area of given triangle is 6 cm^2.

17. एउटा त्रिभुजाकार जग्गाको परिमिति 450 m र यसका भुजाहरू 13 : 12 : 5 को अनुपातमा छन् । सो त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
The perimeter of a triangular field is 450 m and its sides are in the ratio of 13 : 12 : 5. Find the area of the triangle.

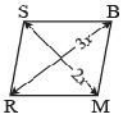
⇨ Here, it is given that the sides a, b, c of the triangle are in the ratio of 13 : 12 : 5.
i.e. a : b : c = 13 : 12 : 5
So, a = 13x, b = 12x and c = 5x
Perimeter = 450 = 2s $\quad\therefore\quad$ s = 225
We have, a + b + c = P
or, 13x + 12x + 5x = 450
or, 30x = 450
$\therefore$ x = 15
So the sides of the triangle are; a = 13 × 15 = 195 m, b = 12 × 15 = 180 m and c = 5 × 15 = 75 m
Now, Area $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{225(225-195)(225-180)(225-75)}$
$= \sqrt{225 \times 30 \times 45 \times 150}$
$= 6750$ m^2
Thus, the area of the land is 6750 m^2.

18. यदि दिइएको समबाहु चतुर्भुजको क्षेत्रफल 48 cm^2 भए x को मान पत्ता लगाउनुहोस् ।
If the area of the given rhombus is 48 cm^2, find the value of x.



⇨ Here, area of rhombus = 48 cm^2
or, $\frac{1}{2} \times x \times 10 = 48$ $\quad$ or, $x = \frac{48 \times 2}{10} = 9.6$
$\therefore$ x = 9.6 cm

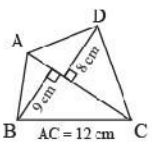
19. यदि दिइएको समबाहु चतुर्भुजको क्षेत्रफल 75 cm^2 भए x को मान पत्ता लगाउनुहोस् ।
If the area of given rhombus is 75 cm^2, find the value of x.

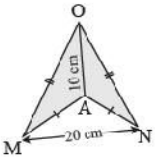


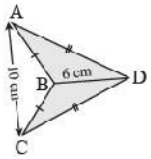
⇨ Here, area of rhombus = 75 cm^2
or, $\frac{1}{2} \times 2x \times 3x = 75$ $\quad$ or, $3x^2 = 75$
or, $x^2 = \frac{75}{3} = 25$ $\quad\therefore\quad$ x = 5 cm

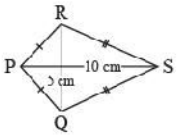
20. दिइएका चित्रहरूको क्षेत्रफल पत्ता लगाउनुहोस् (Find the area of the given figures):

(a) **(b)** **(c)** **(d)**









⇨ (a) Here, area of quad. ABCD = Ar. (ΔABC) + Ar. (ΔADC) $= \frac{1}{2} \times 9 \times 12 + \frac{1}{2} \times 8 \times 12$

$= 54 + 48 = 102$ cm^2

Thus, area of quad. ABCD = 102 cm^2

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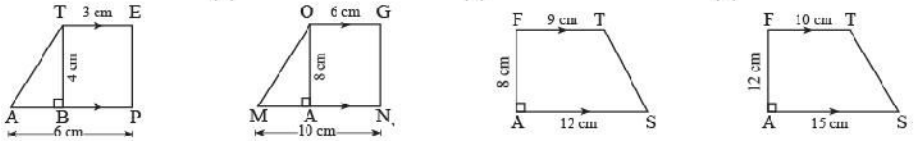
(b) Here, area of quad. OMAN $= \frac{1}{2} \times d_1 \times d_2 = \frac{1}{2} \times 20\text{ cm} \times 10\text{ cm} = 100\text{ cm}^2$

(c) Here, area of quad. ABCD $= \frac{1}{2} \times d_1 \times d_2 = \frac{1}{2} \times 10\text{ cm} \times 6\text{ cm} = 30\text{ cm}^2$

(d) Here, area of quad. PQSR $= \frac{1}{2} \times d_1 \times d_2 = \frac{1}{2} \times 5\text{cm} \times 10\text{ cm} = 25\text{ cm}^2$

21. दिइएका चित्रहरूको क्षेत्रफल पत्ता लगाउनुहोस् (Find the area of the given figures):

(a) **(b)** **(c)** **(d)**



⇨ (a) Here, area of quad. ABPET = Ar.(ΔABT) + Ar. (□BPET)
Now, AB = AP – BP = 6 cm – TE = 6 cm – 3 cm = 3 cm

So, area of Δ ABT $= \frac{1}{2} \times AB \times BT = \frac{1}{2} \times 3 \times 4 = 6\text{ cm}^2$

Again, area of □ BPET = $BP \times BT = 3 \times 4 = 12\text{ cm}^2$
Thus, total area of given figure = $6\text{ cm}^2 + 12\text{ cm}^2 = 18\text{ cm}^2$

(b) Here, MA= MN – AN = 10 cm – OG = 10 cm – 6 cm = 4 cm

So, area of Δ MOA $= \frac{1}{2} \times MA \times OA = \frac{1}{2} \times 4 \times 8 = 16\text{ cm}^2$

Again, area of □ OANG = $OA \times AN = 8 \times 6 = 48\text{ cm}^2$
Thus, area of given figure = Ar.(Δ MOA) + Ar.(□ OANG) = $16\text{ cm}^2 + 48\text{ cm}^2 = 64\text{ cm}^2$

(c) Here, height (h) = 8 cm,

Now, area (A) $= \frac{1}{2} \times h\,(P_1 + P_2) = \frac{1}{2} \times 8\,(12 + 9) = 4 \times 21 = 84\text{ cm}^2$

Thus, the area of given figure is 84 cm^2.

(d) Here, height (h) = 12 cm,

Now, area (A) $= \frac{1}{2} \times h\,(P_1 + P_2) = \frac{1}{2} \times 12\,(50 + 10) = 6 \times 25 = 150\text{ cm}^2$

Thus, the area of given figure is 150 cm^2.

C. LONG QUESTIONS

1. एउटा त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् जसका दुई भुजाहरू 8 cm र 11 cm र परिमिति 32 cm छन् ।
Find the area of a triangle, two sides of which are 8 cm and 11 cm and the perimeter is 32 cm.

⇨ Here, let a, b, c be the sides of the given triangle and 2s be its perimeter such that a = 8 cm, b = 11 cm and 2s = 32 cm i.e. s = 16 cm.

We have, $a + b + c = 2s$ or, $8 + 11 + c = 32$ ∴ $c = 13$

Now, Area of given triangle $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{16\,(16-8)\,(16-11)\,(16-13)}$
$= \sqrt{16 \times 8 \times 5 \times 3} = 8\sqrt{30}\text{ cm}^2$

Thus, the area of the triangle is $8\sqrt{30}\text{ cm}^2$.

2. एउटा समद्विबाहु त्रिभुजको परिमिति 30 cm र हरेक बराबर भुजाहरू 12 cm छन् । सो त्रिभुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
An isosceles triangle has perimeter 30 cm and each of equal sides is 12 cm. Find the area of the triangle.

⇨ Here, let the length of unequal side be x cm then,
Perimeter = 30 cm or, $x + 12 + 12 = 30$ or, $x + 24 = 30$
∴ $x = 6$ cm

We have, $s = \frac{P}{2} = \frac{30\text{ cm}}{2} = 15\text{ cm}$

Now, Area $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{15\,(15-12)\,(15-12)\,(15-6)}$
$= \sqrt{15 \times 3 \times 3 \times 9}$
$= 9\sqrt{15}\text{ cm}^2$

Thus, the area of the triangle is $9\sqrt{15}\text{ cm}^2$.

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4. यदि त्रिभुजको हरेक भुजालाई दोब्बर गरियो भने क्षेत्रफल कति प्रतिशतले बढ्छ पत्ता लगाउनुहोस् ।
If each side of a triangle is doubled then find the percentage increase in the area of the triangle.

⇨ Here, let a, b, c be the sides of original triangle and s be its semi perimeter.

Then, $s = \frac{1}{2}(a + b + c)$

The sides of new triangle will be; 2a, 2b, 2c and perimeter = 2a + 2b + 2c = 2 (a + b + c) = 2 × 2s

∴ Semi perimeter (s') = 2s

Let Δ and Δ' be the area of original and new triangles respectively.

Then, $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$ and $\Delta' = \sqrt{s'(s'-2a)(s'-2b)(s'-2c)}$

So, $\Delta' = \sqrt{2s\,(2s-2a)\,(2s-2b)\,(2s-2c)}$

$= \sqrt{2s \,.\, 2(s-a)\, 2(s-b)\, 2(s-c)}$

$= 4\sqrt{s(s-a)(s-b)(s-c)}$

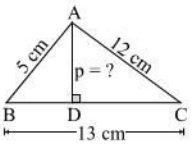
∴ $\Delta' = 4\Delta$

∴ Increase in the area of the triangle = $\Delta' - \Delta = 4\Delta - \Delta = 3\Delta$

So, percentage increase in area = $\left(\frac{3\Delta}{\Delta} \times 100\right)\% = 300\%$

Thus, the required percentage is 300%.

5. एउटा त्रिभुजका भुजाहरूको लम्बाइहरू 5 cm, 12 cm र 13 cm छन् । विपरीत शीर्षबाट नाप 13 cm भएको भुजामा खिचिएको लम्बको लम्बाइ पत्ता लगाउनुहोस् ।
The lengths of the sides of a triangle are 5 cm, 12 cm and 13 cm. Find the length of perpendicular drawn from the opposite vertex to the side whose length is 13 cm.



⇨ Here, let a = 5 cm, b = 12 cm, c = 13 cm

So, $s = \frac{a+b+c}{2} = \frac{5\text{ cm} + 12\text{ cm} + 13\text{ cm}}{2} = 15\text{ cm}$

We know that,

Area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{15\,(15-5)\,(15-12)\,(15-13)}$

$= \sqrt{15 \times 10 \times 3 \times 2}$

$= 30\text{ cm}^2$

Again, Area of the triangle = $\frac{1}{2}$ base × height

or, $30\text{ cm}^2 = \frac{1}{2} 13\text{ cm} \times p$ or, $\frac{60\text{ cm}^2}{13\text{ cm}} = p$ ∴ $p = \frac{60}{13}\text{ cm} = 4.61\text{ cm}$

Thus, the length of perpendicular is 4.61 cm.

6. एउटा चतुर्भुज ABCD का भुजाहरू क्रमशः 9 m, 40 m, 28 m र 15 m छन् र पहिला दुई भुजाहरू बिचको कोण एक समकोण भए सो चतुर्भुजको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the area of a quadrilateral ABCD whose sides are 9 m, 40 m, 28 m and 15 m respectively and the angle between the first two sides is a right angle.

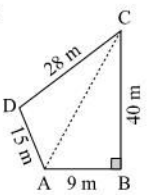
⇨ Here, ABCD be the given quadrilateral such that ∠ABC = 90° and
AB = 9 m, BC = 40 m, CD = 28 m, AD = 15 m

In ΔABC, $AC^2 = AB^2 + BC^2$ or, $AC^2 = 9^2 + 40^2 = 1681$ ∴ AC = 41 m

We have, Area of $\Delta ABC = \frac{1}{2} b \times h = \frac{1}{2} AB \times BC = \frac{1}{2}(9 \times 40) = 180\text{ m}^2$

Again, for Area of ΔACD; a = AC = 41 m, b = CD = 28 m and c = DA = 15 m

We know that; $s = \frac{1}{2}(a + b + c) = \frac{1}{2}(41 + 28 + 15) = 42\text{ m}$



Now, Area of $\Delta ACD = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{42\,(42-41)\,(42-28)\,(42-15)}$

$= \sqrt{42 \times 1 \times 14 \times 27}$

$= 126\text{ m}^2$

So, Area of quadrilateral ABCD = Area of ΔABC + Area of ΔACD

$= 180\text{ m}^2 + 126\text{ m}^2$

$= 306\text{ m}^2$

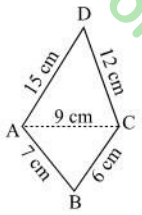
Thus, the area of quadrilateral ABCD is 306 m².

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7. चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् जहाँ AB = 7 cm, BC = 6 cm, CD = 12 cm, DA = 15 cm र AC = 9 cm छन् ।

Find the area of a quadrilateral ABCD in which AB = 7 cm, BC = 6 cm, CD = 12 cm, DA = 15 cm and AC = 9 cm.

⇨ Here, AB = 7 cm, BC = 6 cm, CD = 12 cm, DA = 15 cm, AC = 9 cm



So, for ΔABC, we have, $s = \frac{a+b+c}{2} = \frac{6+7+9}{2} = 11$ cm

$\therefore$ Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{11(11-6)(11-7)(11-9)}$

$= \sqrt{11 \times 5 \times 4 \times 2}$

$\therefore$ Area of $\Delta ABC = 20.98$ cm^2

Again, for ΔADC, we have, $s = \frac{a+b+c}{2} = \frac{9+12+15}{2} = 18$ cm

So, Area of $\Delta ADC = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{18(18-9)(18-12)(18-15)}$

$= \sqrt{18 \times 9 \times 6 \times 3}$

$\therefore$ Area of $\Delta ADC = 54$ cm^2

Now, area of quadrilateral ABCD = Area of ΔABC + Area of ΔADC

$= 20.98$ cm$^2 + 54$ cm^2

$= 74.98$ cm^2

Thus, the area of the quadrilateral ABCD is 74.98 cm^2.

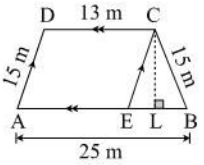
8. एउटा खेत समलम्ब चतुर्भुज आकारको छ जसको समानान्तर भुजाहरू 25 m र 13 m छन् । समानान्तर नहुने भुजाहरू 15 m र 15 m छन् । सो खेतको क्षेत्रफल पत्ता लगाउनुहोस् ।

A field is in the shape of a trapezium whose parallel sides are 25 m and 13 m. The non-parallel sides are 15 m and 15 m. Find the area of the field.

⇨ Here, let ABCD be the given trapezium in which AB = 25 m, CD = 13 m, BC = 15 m and AD = 15 m

Draw CE // AD.

So, AECD is a parallelogram in which AD // CE and AE // CD.



$\therefore$ AE = DC = 13 m and BE = AB − AE = 25 − 13 = 12 m

In ΔBCE we have, $s = \frac{15+15+12}{2} = 21$ m

(i) Area of $\Delta BCE = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{21(21-15)(21-15)(21-12)}$

$= \sqrt{21 \times 6 \times 6 \times 9}$

$= 18\sqrt{21}$ m^2

Let h be the height of ΔBCE,

Area of $\Delta BCE = \frac{1}{2} b \times h = \frac{1}{2} 12 \times h = 6h$

So, $6h = 18\sqrt{21}$ m^2

$\therefore$ $h = 3\sqrt{21}$ m

Now, the area of trapezium ABCD $= \frac{1}{2}(AB + CD) \times h$

$= \frac{1}{2}(25 + 13) \times 3\sqrt{21}$

$= \frac{1}{2} \times 38 \times 3\sqrt{21}$

$= 57\sqrt{21}$ m^2

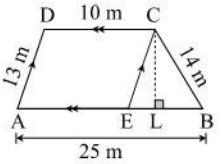
Thus, the area of the trapezium is $57\sqrt{21}$ m^2.

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9. एउटा खेत समलम्ब चतुर्भुज आकारको छ जसको समानान्तर भुजाहरू 25 m र 10 m छन् । समानान्तर नहुने भुजाहरू 14 m र 13 m छन् । सो खेतको क्षेत्रफल पत्ता लगाउनुहोस् ।
A field is in the shape of a trapezium whose parallel sides are 25 m and 10 m. The non-parallel sides are 14 m and 13 m. Find the area of the field.

⇨ Here, let ABCD is the given trapezium. From C, draw CE // DA.
So, ADCE is a parallelogram
∴ AE = DC = 10 m and CE = AD = 13 m and BE = AB – AE = 25 m – 10 m = 15 m
In ΔBCE we have,
BC = 14 m, CE = 13 m and BE = 15 m
So, $2s = BC + CE + BE = 14 + 13 + 15 = 42$ m
∴ $s = 21$ m
We know that,



$$\text{Area of } \Delta BCE = \sqrt{s(s-a)(s-b)(s-c)}$$
$$= \sqrt{21(21-14)(21-13)(21-15)}$$
$$= \sqrt{21 \times 7 \times 8 \times 6}$$
$$= \sqrt{7^2 \times 3^2 \times 4^2}$$

∴ Area of ΔBCE = 84 m^2

Also, Area of $\Delta BCE = \frac{1}{2} BE \times CL$

or, $84 = \frac{1}{2} 15 \times CL$

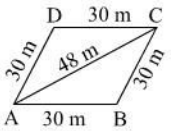
or, $CL = \frac{84 \times 2}{15} = \frac{56}{5}$ m

Now, Area of trapezium $= \frac{1}{2}$ (sum of parallel sides) × h
$$= \frac{1}{2}(CD + AB) \times CL$$
$$= \frac{1}{2}(10 + 25) \times \frac{56}{5}$$
$$= \frac{1}{2} \times 35 \times \frac{56}{5}$$
$$= 196 \text{ m}^2$$

Thus, the area of the trapezium is 196 m^2.

10. 18 ओटा गाइहरूलाई चर्नको लागि एउटा समबाहु चतुर्भुज आकारको हरियो घाँस भएको जमीन छ । यदि सो समबाहु चतुर्भुजको हरेक भुजा 30 m र लामो विकर्ण 48 m भए हरेक गाइलाई कति क्षेत्रफल घाँस भएको जमीन चर्न पुग्छ होला ?
A rhombus shaped field has green grass for 18 cows to graze. If each side of the rhombus is 30 m and its longer diagonal is 48 m, how much area of grass field will each cow be grazing?

⇨ Here, let ABCD be the rhombus shaped field.



For Area of ΔABC,

$$s = \frac{a+b+c}{2} = \frac{30 \text{ m} + 30 \text{ m} + 48 \text{ m}}{2} = 54 \text{ m}$$

We have,

$$\text{Area of } \Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$$
$$= \sqrt{54(54-30)(54-30)(54-48)}$$
$$= \sqrt{54 \times 24 \times 24 \times 6}$$
$$= 432 \text{ m}^2$$

So, Area of rhombus = 2 Area of ΔABC
$$= 2 \times 432 \text{ m}^2$$
$$= 864 \text{ m}^2$$

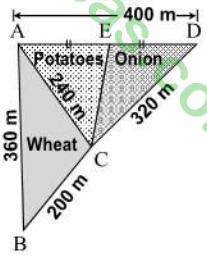
Now, Area of grass field each cow will graze $= \frac{864}{18}$ m^2 = 48 m^2

Thus, the area of field for each cow is 48 m^2.

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11. कमलासँग 240 m, 200 m, 360 m नाप भएको एउटा त्रिभुजाकार जग्गा छ जहाँ उनले गहुँ खेती गर्दछिन् । सोही खेतसँगै भुजाहरू 240 m, 320 m, 400 m भएको अर्को खेतमा उनले आलु र प्याज खेती गर्ने चाहना गरिन् र सो जग्गालाई चित्रमा देखाए झैं लामो भुजाको मध्यबिन्दु र शीर्षबिन्दु जोडेर 2 भागमा विभाजन गरिन् । गहुँ, आलु र प्याज कति कति क्षेत्रफलमा खेती गरिन् ?

Kamala has a triangular field with sides 240 m, 200 m, 360 m where she grew wheat. In another triangular field with sides 240 m, 320 m, 400 m adjacent to the previous field, she wanted to grow potatoes and onions as shown in the figure. She divided the field in two parts by joining the midpoint of the longest side to the opposite vertex and grew potatoes in one part and onion in other part. How much area has been used for wheat, potatoes and onion?



⇨ Here, for the area of ΔABC, a = 200 m, b = 240 m and c = 360 m

$\therefore \quad s = \frac{a+b+c}{2} = \frac{200+240+360}{2} = 400 \text{ m}$

So, Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{400(400-200)(400-240)(400-360)}$

$= \sqrt{400 \times 200 \times 160 \times 40}$

$\therefore \quad$ Area of $\Delta ABC = 16000\sqrt{2} \text{ m}^2$

For the area of ΔACD,

a = 320 m, b = 400 m, c = 240 m

$\therefore \quad s = \frac{a+b+c}{2} = \frac{320+400+240}{2} = 480 \text{ m}$

So, Area of $\Delta ACD = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{480(480-320)(480-400)(480-240)}$

$= \sqrt{480 \times 160 \times 80 \times 240}$

$= 38400 \text{ m}^2$

Now, Area used for growing wheat = Area of $\Delta ABC = 16000\sqrt{2} \text{ m}^2$

Area used for growing potatoes $= \text{Area of } \Delta AEC$

$= \frac{1}{2} \text{ Area of } \Delta ACD$

$= \frac{1}{2} \times 38400 \text{ m}^2$

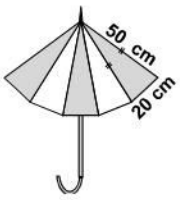
$= 19200 \text{ m}^2$

Area used for growing onion = Area of ΔCED = Area of $\Delta AEC = 19200 \text{ m}^2$

Thus, the area for wheat, potatoes and onion are $16000\sqrt{2} \text{ m}^2$, 19200 m^2 and 19200 m^2 respectively.

12. एउटा छाता 20 cm, 50 cm र 50 cm का 10 ओटा फरक फरक दुई रङ्गका टुक्राहरू जोडेर बनाइएको छ र हरेक टुक्राको नाप 20 cm, 50 cm र 50 cm छन् । हरेक रङ्गका कति कपडा सो छाता बनाउन चाहिएला ?

An umbrella is made by stitching 10 triangular pieces of cloth of two different colours, each piece measuring 20 cm, 50 cm and 50 cm. How much cloth of each colour is required for the umbrella?



⇨ Here, the sides of one triangular piece of cloth are of length;

a = 20 cm, b = 50 cm and c = 50 cm

Let, s be the semi-perimeter of triangular peice, then,

2s = a + b + c = 50 cm + 50 cm + 20 cm = 120 cm

$\therefore \quad s = 60 \text{ cm}$

So, Area of triangular piece $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{60(60-20)(60-50)(60-50)}$

$= \sqrt{60 \times 40 \times 10 \times 10}$

$= \sqrt{10 \times 10 \times 10 \times 10 \times 4 \times 6}$

$= 200\sqrt{6} \text{ cm}^2$

Now, area of cloth of each colour $= 5 \times 200\sqrt{6} \text{ cm}^2 = 1000\sqrt{6} \text{ cm}^2$.

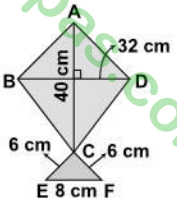
Thus, required area of cloth is $1000\sqrt{6} \text{ cm}^2$.

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13. एउटा चड्गा चित्रमा देखाए जस्तै समद्विबाहु त्रिभुजहरू मिलेर बनेको छ । चतुर्भुज आकारको विकर्णहरू 40 cm र 32 cm र तल्लो समद्विबाहु त्रिभुजका नापहरू 6 cm, 6 cm र 8 cm भए सो चड्गाको क्षेत्रफल पत्ता लगाउनुहोस् ।

A kite is made by arranging isosceles triangles as shown in the adjoining figure. The diagonals of quadrilateral are 40 cm and 32 cm. The measures of lower part isosceles triangle are 6 cm, 6 cm and 8 cm. Find the area of the kite.



⇨ Here,

Area of quadrilateral shaped = Area of kite ABCD

$= \frac{1}{2} d_1 \times d_2$

$= \frac{1}{2} 40 \text{ cm} \times 32 \text{ cm}$

$= 20 \times 32 \text{ cm}^2$

$= 640 \text{ cm}^2$

For, area of ΔCEF, equal sides (a) = 6 cm, base side (b) = 8 cm

We have, area of isosceles triangle $= \frac{b}{4}\sqrt{4a^2 - b^2}$

$= \frac{8}{4}\sqrt{4 \times 6^2 - 8^2}$

$= 2\sqrt{144 - 64}$

$= 2\sqrt{80}$

$= 8\sqrt{5} \text{ cm}^2$

Now, the total area of the kite = $640 \text{ cm}^2 + 8\sqrt{5} \text{ cm}^2 = 657.89 \text{ cm}^2$

Thus, the required area is 657.89 cm^2.

14. एउटा समकोण त्रिभुजको समकोण बनाउने भुजाहरूको अन्तर 14 cm छ । सो त्रिभुजको क्षेत्रफल 120 cm² छ । उक्त त्रिभुजको परिमिति पत्ता लगाउनुहोस् ।

The difference between the sides containing the right angle in a right angled triangle is 14 cm. The area of the triangle is 120 cm². Calculate the perimeter of the triangle.

⇨ Here, let the sides containing the right angle be x cm and (x – 14) cm.

Then, Area = $\frac{1}{2}$ product of right angle making sides

or, $120 = \frac{1}{2} x(x - 14)$

or, $240 = x^2 - 14x$

or, $x^2 - 14x - 240 = 0$

or, $x^2 - 24x + 10x - 240 = 0$

or, $x(x - 24) + 10(x - 24) = 0$

or, $(x - 24)(x + 10) = 0$

∴ $x = 24$ (neglecting $x = -10$)

One side = 24 cm

Other side = 24 cm – 14 cm = 10 cm

Hypotenuse $= \sqrt{24^2 + 10^2}$

$= \sqrt{576 + 100}$

$= \sqrt{676} = 26 \text{ cm}$

Now, perimeter of the triangle = 24 cm + 10 cm + 26 cm = 60 cm

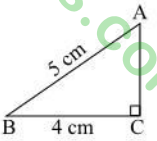
Thus, the perimeter of the triangle is 60 cm.

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B. QUESTIONS FROM CDC TEXT BOOKS

1. दिइएका चित्रहरूको क्षेत्रफल निकाल्नुहोस् (Find the area of given figures):

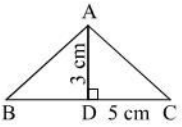


⇨ (a) Here, $AC = \sqrt{AB^2 - BC^2} = \sqrt{5^2 - 4^2}$ ∴ $AC = 3$ cm

We know that,

Area of $\Delta ABC = \frac{1}{2} b \times h = \frac{1}{2} 4 \text{ cm} \times 3 \text{ cm} = 6 \text{ cm}^2$

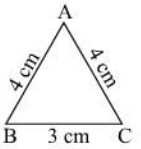
Thus, the area of ΔABC is 6 cm^2.



(b) Here, base (b) = 5 cm and height (h) = 3 cm

We know that, Area of $\Delta ABC = \frac{1}{2} b \times h = \frac{1}{2} 5 \text{ cm} \times 3 \text{ cm} = 7.5 \text{ cm}^2$

Thus, the area of ΔABC is 7.5 cm^2.

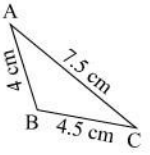


(c) Here, From the given figure, a = 4 cm and b = 3 cm

We know that,

Area of $\Delta ABC = \frac{1}{4} b \sqrt{4a^2 - b^2} = \frac{1}{4} \times 3 \sqrt{4 \times 4^2 - 3^2} = \frac{1}{4} \times 3 \sqrt{55} = 5.56 \text{ cm}^2$

Thus, the area of ΔABC is 5.56 cm^2.



(d) Here, from the given figure, a = 4.5 cm, b = 7.5 cm, c = 4 cm

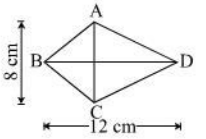
We have, $s = \frac{a + b + c}{2} = \frac{4.5 + 7.5 + 4}{2} = 8$

We know that,

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{8(8-4.5)(8-7.5)(8-4)}$

∴ Area of $\Delta ABC = 7.48$

Thus, the area of ΔABC is 7.48 cm^2.



(e) Here, from the given figure, Diagonals (d_1) = 12 cm and d_2 = 8 cm

We know that,

Area of kite (A) $= \frac{1}{2} d_1 \times d_2 = \frac{1}{2} \times 12 \times 8 = 48 \text{ cm}^2$

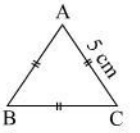
Thus, the area of given kite is 48 cm^2.

(f) Here, From the given figure, a = 5 cm

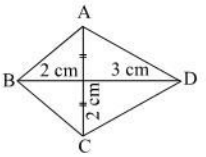
We have,

Area of equilateral $\Delta = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times (5 \text{ cm})^2 = \frac{\sqrt{3}}{4} 25 \text{ cm}^2 = 10.82 \text{ cm}^2$

Thus, the area of Δ is 10.82 cm^2.



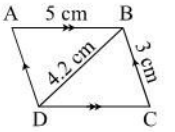
2. तल दिएका समतल सतहको क्षेत्रफल निकाल्नुहोस् (Find the area of given figures below):



⇨ (a) Here, diagonals, $d_1 = 2 \text{ cm} + 3 \text{ cm} = 5 \text{ cm}$ and $d_2 = 2 \text{ cm} + 2 \text{ cm} = 4 \text{ cm}$

We know that, area $= \frac{1}{2} d_1 \times d_2 = \frac{1}{2} 5 \times 4 = 10 \text{ cm}^2$

Thus, the area of the kite is 10 cm^2.



(b) Here, sides of ΔABD are; 5 cm, 4.2 cm and 3 cm [∵ AD = BC = 3 cm]

$S = \frac{a + b + c}{2} = \frac{5 + 4.2 + 3}{2} = 6.1 \text{ cm}$

We know that,

Area of $\Delta ABD = \sqrt{s(s-a)(s-b)(s-c)}$

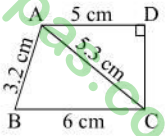
$= \sqrt{6.1(6.1-5)(6.1-4.2)(6.1-3)} = 6.29 \text{ cm}^2$

Now, the area of parallelogram ABCD = 2 area of $\Delta = 2 \times 6.29 = 12.57 \text{ cm}^2$

Thus, the area of parallelogram is 12.57 cm^2.

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(c) From the figure, $CD = \sqrt{5.3^2 - 5^2} = \sqrt{3.09} = 1.76$ cm



Now, area of $\Delta ADC = \frac{1}{2} AD \times CD = \frac{1}{2} 5 \times 1.76 = 4.39$ cm^2

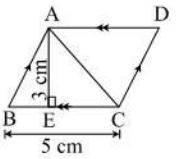
Again, area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{7.25\,(7.25-6)\,(7.25-5.3)\,(7.25-3.2)}$

$= \sqrt{71.57} = 8.46$ cm^2

We have, area of Quad. ABCD = $\Delta ABC + \Delta ACD = 8.46 + 4.39 = 12.85$

Thus, the area of Quad. is 12.85 cm^2.



(d) Area of parallelogram ABCD = BC × AE = 5 cm × 3 cm = 15 cm^2

Thus, the area of parallelogram ABCD is 15 cm^2.

3. भुजाको नाप 12 से.मि. भएको समबाहु त्रिभुजको क्षेत्रफल निकाल्नुहोस् ।
Calculate the area of equilateral triangle having a side 12 cm.

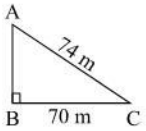
⇨ Here, length of a side (a) = 12 cm

We have, Area of equilateral $\Delta = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times (12)^2 = 62.35$

Thus, the area of Δ is 62.35 cm^2.

4. एउटा समकोण त्रिभुजाकार जग्गाको सबभन्दा लामो किनाराको लम्बाइ 74 मिटर र अर्को एउटा किनारा 70 मिटर छ । उक्त जग्गाको क्षेत्रफल निकाल्नुहोस् ।
The longest edge of a right angled triangle 74 m and one of the other edges is 70 m. Find the area of the land.

⇨ Here, let ABC be the triangle in which AC = 74 m and BC = 70 m



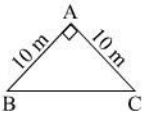
We have, $AB = \sqrt{AC^2 - BC^2} = \sqrt{74^2 - 70^2}$ ∴ AB = 24

Now, area of $\Delta ABC = \frac{1}{2} b \times h = \frac{1}{2} 70 \times 24$

∴ Area of ΔABC = 840 cm^2 Thus, the area of ΔABC is 840 cm^2.

5. समकोण समद्विबाहु त्रिभुजाकार जग्गाको दुई ओटा बराबर किनाराहरूमध्ये एउटा किनाराको लम्बाइ 10 मिटर छ भने त्यसको क्षेत्रफल र बाँकी किनाराको लम्बाइ पत्ता लगाउनुहोस् ।
In a right angled isosceles triangular land, one of the equal edge is 10 m. Find the area of the land and remaining edge.

⇨ Here, let, ΔABC be given Δ.



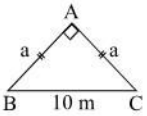
Area of $\Delta ABC = \frac{1}{2} AB \times AC = \frac{1}{2} 10 \text{ m} \times 10 \text{ m} = 50 \text{ m}^2$

Length of $BC = \sqrt{AB^2 + AC^2} = \sqrt{10^2 + 10^2} = \sqrt{200} = 10\sqrt{2}$ m

Thus, the area of the land is 50 m^2 and the length of BC is $10\sqrt{2}$ m.

6. कुनै त्रिभुजको एउटा भुजाको लम्बाइ 10 से.मि. र त्यसको क्षेत्रफल 60 वर्ग से.मि. छ, यदि उक्त त्रिभुज समद्विबाहु हो भने बराबर भुजाहरूको नाप पत्ता लगाउनुहोस् ।
A side of a triangle is 10 cm and its area is 60 cm^2. If the triangle is isosceles then find the measure of equal sides.

⇨ Here, b = 10 cm,



We have, Area of $\Delta ABC = \frac{b}{4} \sqrt{4a^2 - b^2} = \frac{10}{4} \sqrt{4a^2 - 10^2}$

or, $60 = 2.5 \sqrt{4a^2 - 100}$ or, $24 = \sqrt{4a^2 - 100}$

or, $576 = 4a^2 - 100$ or, $676 = 4a^2$

or, $169 = a^2$ ∴ a = 13

Thus, the length of equal sides is 13 cm.

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7. एउटा त्रिभुजाकार जग्गाका किनाराहरू 12 : 17 : 25 को अनुपातमा छन् र परिमिति 540 फिट छ। उक्त जग्गाको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The edges of a triangular land area in the ratio of 12 : 17 : 25 and perimeter 540 feet. What is the area of the land ? Find it.

⇨ Here, let the sides are; a = 12x, b = 17x and c = 25x
We have, a + b + c = P or, 12x + 17x + 25x = 540
or, 54x = 540 ∴ x = 10
So, a = 12 × 10 = 120, b = 17 × 10 = 170 and c = 25 × 10 = 250
We have, $s = \frac{a+b+c}{2} = \frac{120+170+250}{2} = 270$
Now, area of Δ $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{270(270-120)(270-170)(270-250)}$
$= \sqrt{270 \times 150 \times 100 \times 120} = 22045.41$
Thus, the area of Δ is 22045.41 sq. feet.

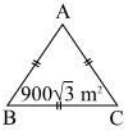
8. क्षेत्रफल 336 वर्ग मिटर र परिमिति 84 मिटर भएको एउटा त्रिभुजाकार जग्गाको एउटा किनाराको लम्बाइ 26 मिटर छ। उक्त जग्गाको बाँकी दुई ओटा किनाराको नाप निकाल्नुहोस् ।
A triangular land having area 336 m^2 and perimeter 84 m has length of an edge 26 m. Calculate the measure of remaining two sides.

⇨ Here, area = 336 m^2, perimeter = 84 m, a = 26 m, b = ? and c = ?
We have, a + b + c = P or, 26 + b + c = 84 or, b + c = 58
∴ b = 58 – c

Now, Area $= \sqrt{s(s-a)(s-b)(s-c)}$ or, $336 = \sqrt{\frac{84}{2}\left(\frac{84}{2}-26\right)\left(\frac{84}{2}-58+c\right)\left(\frac{84}{2}-c\right)}$
or, $336 = \sqrt{42(42-26)(42-58+c)(42-c)}$ or, $336 = \sqrt{672(c-16)(42-c)}$
or, $336^2 = 672(c-16)(42-c)$ or, $168 = (c-16)(42-c)$
or, $168 = 42c - c^2 - 672 + 16c$ or, $c^2 - 58c + 840 = 0$
or, $c^2 - 30c - 28c + 840 = 0$ or, $c(c-30) - 28(c-30) = 0$
or, $(c-30)(c-28) = 0$
Either, $c - 30 = 0 \Rightarrow c = 30$ or, $c - 28 = 0 \Rightarrow c = 28$
When, c = 30 then b = 28 When c = 28 then b = 30
Thus, the two sides are 30 cm and 28 cm.

9. एउटा समबाहु त्रिभुजाकार जग्गाको क्षेत्रफल $900\sqrt{3}$ वर्ग मिटर छ भने उक्त जग्गाको प्रत्येक किनाराको लम्बाइ पत्ता लगाउनुहोस् ।
The area of an equilateral triangular land is $900\sqrt{3}$ square meter. Find the length of each side.

⇨ Here, let a be the sides of equilateral Δ.
Then, area $= \frac{\sqrt{3}}{4}a^2$ or, $900\sqrt{3} = \frac{\sqrt{3}}{4} \times a^2$ or, $3600 = a^2$
or, $60^2 = a^2$ ∴ a = 60
Thus, the measure of each side is 60 m.



10. एउटा भुजाको नाप 4 मिटर भएको त्रिभुजको क्षेत्रफल $\sqrt{135}$ वर्ग मिटर र परिमिति 18 मिटर छन् । त्यसका बाँकी दुई भुजाहरूको नाप पत्ता लगाउनुहोस् ।
A triangle having area $\sqrt{135}$ sq. meter and perimeter 18 m has a side 4 m. Find the measure of remaining two sides.

⇨ Here, let, a = 4 m We have, a + b + c = 18 m or, 4 + b + c = 18
or, b + c = 14 ∴ b = 14 – c and $s = \frac{P}{2} = \frac{18}{2} = 9$ m

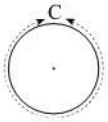
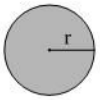
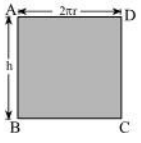
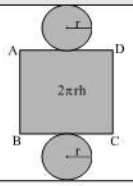
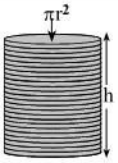
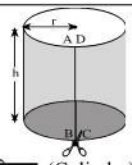
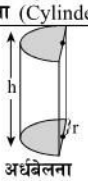
Now, area $= \sqrt{s(s-a)(s-b)(s-c)}$ or, $\sqrt{135} = \sqrt{9(9-4)(9-b)(9-c)}$
or, $\sqrt{135} = \sqrt{9 \times 5(9-14+c)(9-c)}$ or, $135 = 9 \times 5(-5+c)(9-c)$
or, $3 = (c-5)(9-c)$ or, $3 = 9c - c^2 - 45 + 5c$
or, $c^2 - 14c + 48 = 0$ or, $c^2 - 8c - 6c + 48 = 0$
or, $c(c-8) - 6(c-8) = 0$ or, $(c-8)(c-6) = 0$
Either, $c - 8 = 0 \Rightarrow c = 8$ or, $c - 6 = 0 \Rightarrow c = 6$
When c = 8 then b = 6 When c = 6 then b = 8
Thus, the remaining two sides are 6 cm and 8 cm respectively.

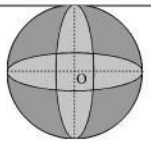
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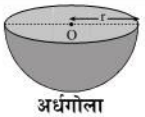
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6. बेलना र गोला
Cylinder and Sphere

Formulae

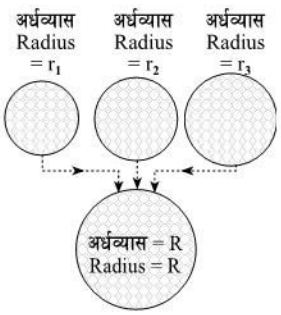
ठोस Solid	आधारको (Base)		सतहको क्षेत्रफल (Curved Surface)		आयतन Volume
	परिधि Circumference	क्षेत्रफल Area	वक्र Curved	पूरा Total	
बेलनाका जालीहरू Nets of Cylinder					
 बेलना (Cylinder)	$C = 2\pi r$ OR $C = \pi d$	$A_1 = \pi r^2$ OR $A_1 = \frac{\pi d^2}{4}$	$S = 2\pi rh$ OR $S = \pi dh$ OR $S = Ch$	$A = 2\pi r(r + h)$ OR $A = \pi d\left(\frac{d}{2} + h\right)$ OR $A = C(r + h)$	$V = \pi r^2 h$ OR $V = \frac{\pi}{4}d^2h$ OR $V = A_1h$
 अर्धबेलना (Hemi–cylinder)	$C = \pi r + 2r$	$A_1 = \frac{\pi r^2}{2}$	$S = (\pi r + 2r)h$	$A = (\pi r + 2r)h + \pi r^2$	$V = \frac{1}{2}\pi r^2 h$

ठोस Solid	ठूलो वृत्तको क्षेत्रफल Area of great circle	ठूलो वृत्तको परिधि Circumference of great circle	सतहको क्षेत्रफल Surface area	आयतन Volume
 गोला (Sphere)	$A_1 = \pi r^2$ OR $A_1 = \frac{\pi d^2}{4}$	$C = 2\pi r$ OR $C = \pi d$	$A = 4\pi r^2$ OR $A = \pi d^2$	$V = \frac{4}{3}\pi r^3$ OR $V = \frac{1}{6}\pi d^3$

	ठूलो वृत्तको क्षेत्रफल Area of great circle	ठूलो वृत्तको परिधि Circumference of great circle	वक्रसतहको क्षेत्रफल Curved surface area	पूरा सतहको क्षेत्रफल Total Surface area	आयतन Volume
 अर्धगोला (Hemisphere)	$A_1 = \pi r^2$ OR $A_1 = \frac{\pi d^2}{4}$	$C = 2\pi r$ OR $C = \pi d$	$S = 2\pi r^2$ OR $S = \frac{\pi}{2}d^2$	$A = 3\pi r^2$ OR $A = \frac{3\pi d^2}{4}$	$V = \frac{2}{3}\pi r^3$ OR $V = \frac{1}{12}\pi d^3$

1. $1000\ cm^3 = 1\ \ell$ and $1000\ \ell = 1\ m^3$

2. **तीनओटा गोलाहरूलाई पगालेर नयाँ गोला बनाउँदा,**
When three spheres are melted together to form a new sphere then



(i) **नयाँ गोलाको अर्धव्यास** (R) $= \sqrt[3]{r_1^3 + r_2^3 + r_3^3}$

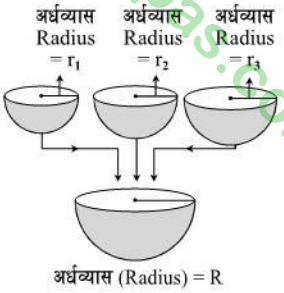
Radius of new sphere (R) $= \sqrt[3]{r_1^3 + r_2^3 + r_3^3}$

(ii) **नयाँ गोलाको व्यास** (D) $= \sqrt[3]{d_1^3 + d_2^3 + d_3^3}$

Diameter of new sphere (D) $= \sqrt[3]{d_1^3 + d_2^3 + d_3^3}$

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3. तीनओटा अर्धगोलाहरूलाई पगालेर नयाँ अर्धगोला बनाउँदा,
When three hemi–spheres are melted together to form a new hemi–sphere then



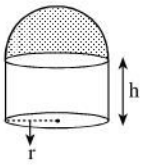
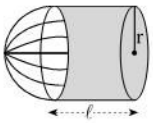
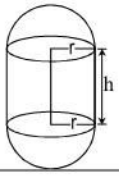
(i) नयाँ अर्धगोलाको अर्धव्यास (R) $= \sqrt[3]{r_1^3 + r_2^3 + r_3^3}$

Radius of new hemi–sphere (R) $= \sqrt[3]{r_1^3 + r_2^3 + r_3^3}$

(ii) नयाँ अर्धगोलाको व्यास (D) $= \sqrt[3]{d_1^3 + d_2^3 + d_3^3}$

Diameter of new hemi–sphere (D) $= \sqrt[3]{d_1^3 + d_2^3 + d_3^3}$

Combined Solid

S.N.	संयुक्त ठोस Combined Solid	आयतन Volume	वक्र सतहको क्षेत्रफल Curved Surface Area	पूरा सतहको क्षेत्रफल Total surface area
1.		$V = \pi r^2\left(\frac{2}{3}r + h\right)$	$S = 2\pi r(r + h)$	$A = \pi r(3r + 2h)$
2.		$V = \pi r^2\left(\frac{2}{3}r + \ell\right)$	$S = 2\pi r(r + \ell)$	$A = \pi r(3r + 2\ell)$
3.		$V = \pi r^2\left(\frac{4}{3}r + h\right)$	$S = 2\pi r(2r + h)$	$A = 2\pi r(2r + h)$

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 5(a) & 5 (b)]

Q. 5(a) एउटा बेलनाकार बन्द भाँडोको उचाइ 1 मी. र आयतन 15.4 लीटर छ। उक्त ट्याङ्कीको आधार बनाउन कति वर्ग मिटर धातु आवश्यक पर्छ ?
The capacity of a closed cylindrical pot of height 1 m. is 15.4 liters. How many square metres of metal sheet would be needed to make its base?

⇨ Here, height(h) = 1 m = 100 cm and volume (V) = 15.4 litres = $15.4 \times 1000\ cm^3 = 15400\ cm^3$
We know that, Volume = base area × height
or, $15400\ cm^3$ = base area × 100 cm or, base area = $154\ cm^2$
Thus, $154\ cm^2$ metal is required to prepare the base.

Q. 5(b) 27 ओटा प्रत्येक 'x cm' अर्धव्यास भएका गोलाहरू पगालेर 'y cm' अर्धव्यास भएको गोला बनाइयो। x : y पत्ता लगाउनुहोस्।
27 solid iron spheres, each of radius 'x cm' are melted to form a sphere with radius 'y cm'. Find the ratio x : y.

⇨ Here, volume of a sphere with x cm radius $= \frac{4}{3}\pi x^3$

Volume of a sphere with y cm radius $= \frac{4}{3}\pi y^3$

By the question, $27 \times \frac{4}{3}\pi x^3 = \frac{4}{3}\pi y^3$ or, $27x^3 = y^3$

or, $(3x)^3 = y^3$ or, $3x = y$

or, $\frac{x}{y} = \frac{1}{3}$ $\therefore$ $x : y = 1 : 3$

Thus, value of x : y = 1 : 3.

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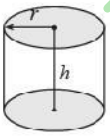
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A. BASIC EXERCISE 6

A. VERY SHORT QUESTIONS

बेलना (CYLINDER)



1. एउटा बेलनाको अर्धव्यास *r* unit र उचाइ *h* unit भए पत्ता लगाउनुहोस्:
A cylinder has radius *r* unit and height *h* unit. Find the following.
(a) आधारको परिधि (Circumference of base) (b) वक्रसतहको क्षेत्रफल (Curved surface area)
(c) पूरा सतहको क्षेत्रफल (Total surface area) (d) आयतन (Volume)

⇨ (a) Circumference of base = $2\pi r$ (b) Curved surface area = $2\pi rh$
(c) Total surface area = $2\pi r(r + h)$ (d) Volume = $\pi r^2 h$

2. एउटा बेलनाको आधारको परिधि *C* cm र उचाइ *h* cm भए यसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The circumference of base of a cylinder is C cm and height is *h* cm. Find its curved surface area.

⇨ Here, curved surface area of cylinder is given by, CSA = $2\pi r \times h = Ch$ cm^2

3. **एउटा बेलनाको आधारको परिधि 44 cm र उचाइ 7 cm भए यसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।**
The circumference of base of a cylinder is 44 cm and height is 7 cm. Find its curved surface area.

⇨ Here, curved surface area of cylinder is given by, CSA = $C \times h = 44 \times 7 = 308$ cm^2

4. **एउटा बेलनाको आधारको व्यास *d* cm र उचाइ *h* cm छन् । यसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।**
The diameter of base of a cylinder is *d* cm and height is *h* cm. Find its curved surface area.

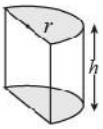
⇨ Here, curved surface area of cylinder is given by, CSA = $2\pi rh = 2r.\pi h = d\pi h$ cm^2

5. **एउटा बेलनाको आधारको क्षेत्रफल *A* cm^2 र उचाइ *h* cm छ । यसको आयतन पत्ता लगाउनुहोस् ।**
The area of base of a cylinder is *A* cm^2 and the height is *h* cm. Find its volume.

⇨ Here, volume of cylinder is given by, $V = \pi r^2 h = A \times h = Ah$ cm^3

6. **एउटा बेलनाको आधारको क्षेत्रफल 44 cm^2 र उचाइ 4 cm छ । यसको आयतन पत्ता लगाउनुहोस् ।**
The area of base of a cylinder is 44 cm^2 and the height is 4 cm. Find its volume.

⇨ Here, base area (A) = 44 cm^2 and height (h) = 4 cm
We know that, volume of cylinder is given by, $V = A \times h = 44 \times 4 = 176$ cm^3



7. **एउटा अर्धबेलनाको अर्धव्यास *r* एकाइ र उचाइ *h* एकाइ छन् । निम्नलिखित पत्ता लगाउनुहोस् ।**
A half cylinder has radius *r* unit and height *h* unit. Find the following.
(a) आधारको परिधि (Circumference of base)
(b) वक्रसतहको क्षेत्रफल (Curved surface area)
(c) पूरा सतहको क्षेत्रफल (Total surface area) (d) आयतन (Volume)

⇨ Here, radius = r unit and height = h unit

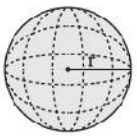
Now, (a) Circumference of base of half cylinder = $\frac{1}{2} \times 2\pi r = \pi r$ unit

(b) Curved surface area of half cylinder = $\frac{1}{2} \times 2\pi rh = \pi rh$ sq. unit

(c) Total surface area of half cylinder is given by,
TSA = Area of curved surface + 2 × Area of half circle at the end + Area of rectangle
= $(\pi rh + \pi r^2 + hr)$sq. units.

(d) Volume of half cylinder = $\frac{1}{2}\pi r^2 h$

गोला र अर्धगोला (SPHERE AND HEMISPHERE)



8. **एउटा गोलाको अर्धव्यास *r* एकाइ छ । निम्नलिखित पत्ता लगाउनुहोस् ।**
A sphere has radius *r* unit. Find the following.
(a) ठुलो वृत्तको परिधि (Circumference of great circle) (b) ठुलो वृत्तको क्षेत्रफल (Area of a great circle)
(c) सतहको क्षेत्रफल (Surface area) (d) आयतन (Volume)

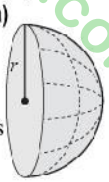
⇨ Here, radius of sphere = r unit
Now, (a) Circumference of great circle = $2\pi r$ units (b) Area of a great circle = πr^2 sq. units

(c) Surface area of the sphere = $4\pi r^2$ sq. units (d) Volume of sphere = $\frac{4}{3}\pi r^3$ cubic units.

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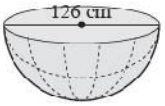
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9. एउटा अर्धगोलाको अर्धव्यास *r* एकाइ छ । निम्नलिखित पत्ता लगाउनुहोस् ।
A hemisphere has radius *r* unit. Find the following.
(a) ठुलो वृत्तको परिधि (Circumference of great circle) (b) ठुलो वृत्तको क्षेत्रफल (Area of a great circle)
(c) वक्र सतहको क्षेत्रफल (Curved surface area) (d) पूरा सतहको क्षेत्रफल (Total surface area)
(e) अर्धगोलाको आयतन (Volume of the hemisphere)



⇨ Here, radius of hemisphere = r unit
Now,
(a) Circumference of great circle = $2\pi r$ units (b) Area of a great circle = πr^2 sq. units
(c) Curved surface area of hemisphere = $2\pi r^2$ sq. units
(d) Total surface area of hemisphere = $3\pi r^2$ sq. units
(e) Volume of hemisphere = $\frac{2}{3}\pi r^3$ cubic units.

10. एउटा गोलाको ठुलो वृत्तको क्षेत्रफल A cm² छ । सो गोलाको सतहको क्षेत्रफल कति होला ?
The area of a great circle of a sphere is A cm². What is the surface area of the sphere?



⇨ Here, Area of a great circle = A cm² i.e. $\pi r^2 = A$ cm²
We know that, surface area of a sphere $= 4\pi r^2 = 4A$ cm²
Thus, the surface area of sphere is 4A cm².

11. एउटा गोलाको ठुलो वृत्तको क्षेत्रफल 44 cm² छ । सो गोलाको सतहको क्षेत्रफल कति होला ?
The area of a great circle of a sphere is 44 cm². What is the surface area of the sphere?
⇨ Here, Area of a great circle of sphere = 44 cm² i.e. $\pi r^2 = 44$ cm²
We know that, surface area of a sphere $= 4\pi r^2 = 4 \times 44$ cm² $= 176$ cm²
Thus, the surface area of sphere is 176 cm².

12. आयतनहरू 50 cm³ र 60 cm³ भएका दुई ठोस गोलाहरू पगालेर एउटा नयाँ ठोस गोला बनाइएको छ । नयाँ गोलाको आयतन पत्ता लगाउनुहोस् ।
Two metal spheres having volumes 50 cm³ and 60 cm³ are melted together to form a new sphere. What is the volume of the new sphere so formed?
⇨ Here, volume $(V_1) = 50$ cm³ and volume $(V_2) = 60$ cm³
Now, volume of new formed sphere $(V) = V_1 + V_2 = 50 + 60 = 110$ cm³.
Thus, the volume of new sphere so formed is 110 cm³.

13. आयतनहरू 80 cm³, 70 cm³ र 60 cm³ भएका तीनओटा ठोस गोलाहरू पगालेर एउटा नयाँ ठोस ठोला बनाइएको छ । नयाँ गोलाको आयतन पत्ता लगाउनुहोस् ।
Three metal spheres having volumes 80 cm³, 70 cm³ and 60 cm³ are melted together to form a new sphere. What is the volume of the new sphere so formed?
⇨ Here, First volume $(V_1) = 80$ cm³, Second volume $(V_2) = 70$ cm³, Third volume $(V_3) = 60$ cm³
When three metal spheres are melted together,
volume of new sphere $(V) = V_1 + V_2 + V_3 = (80 + 70 + 60)$ cm³ $= 210$ cm³
Thus, the volume of new sphere so formed is 210 cm³.

संयुक्त ठोसहरू (COMBINED SOLIDS)

14. दिइएको संयुक्त ठोसको चित्रमा बेलनामाथि अर्धगोला राखिएको छ । यदि बेलनाको आधारको अर्धव्यास *r* एकाइ र बेलनाको उचाइ *h* एकाइ भए निम्नलिखित पत्ता लगाउनुहोस् ।

Given figure is a solid composed of a cylinder with a hemisphere on the top. If the radius of base of the cylinder is *r* unit and height of the cylinder is *h* unit, find the following:



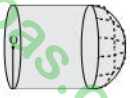
(a) जम्मा उचाइ (Total height) (b) आधारको परिधि (Circumference of base)
(c) आधारको क्षेत्रफल (Area of base) (d) वक्र सतहको क्षेत्रफल (Curved surface area)
(e) पूरा सतहको क्षेत्रफल (Total surface area) (e) आयतन (Volume)

⇨ Here, radius of base = r unit and Height of cylinder = h unit
Now, (a) Total height = (h + r) unit (b) Circumference of base = $2\pi r$ unit
(c) Area of base = πr^2 sq. unit (d) Curved surface area = $(2\pi rh + 2\pi r^2)$ sq. units
(e) Total surface area = $2\pi rh + 2\pi r^2 + \pi r^2 = (2\pi rh + 3\pi r^2)$ sq. units
(f) Volume = $\left(\frac{2}{3}\pi r^3 + \pi r^2 h\right)$ cubic units.

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15. दिइएको संयुक्त ठोसको चित्रमा बेलनामाथि अर्धगोला राखिएको छ । यदि अर्धगोला र बेलनाका वक्र सतहहरू क्रमशः 50 cm² र 75 cm² भए उक्त ठोसको वक्र सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere on the top. If the curved surface of areas of hemisphere and cylinder are 50 cm² and 75 cm² respectively, find the curved surface area of the solid.



⇨ Here, CSA of hemisphere = 50 cm² and CSA of cylinder = 75 cm²
Now, CSA of solid = CSA of hemisphere + CSA of cylinder = (50 + 75) cm² = 125 cm²

16. दिइएको संयुक्त ठोसको चित्रमा बेलनामाथि अर्धगोला राखिएको छ । यदि अर्धगोला र बेलनाका वक्र सतहहरू क्रमशः 50 cm² र 75 cm² तथा आधारको क्षेत्रफल 25 cm² भए उक्त ठोसको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere on the top. If the curved surface of areas of hemisphere and cylinder are 50 cm² and 75 cm² respectively and area of base is 25 cm², find the total surface area of the solid.



⇨ Here, CSA of hemisphere = 50 cm² and CSA of cylinder = 75 cm²
Area of base = 25 cm²
Now, total surface area of solid is given by,
TSA = CSA(hemisphere) + CSA(cylinder) + area of base = (50 + 75 + 25) cm² = 150 cm²
Thus, total surface area is 150 cm².

17. दिइएको संयुक्त ठोसको चित्रमा बेलनामाथि अर्धगोला राखिएको छ । यदि अर्धगोलाको आयतन 150 cm³ र बेलनाको आयतन अर्धगोलाको आयनतको दोब्बर भए उक्त ठोसको पूरा आयतन पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere on the top. If the volume of the hemisphere is 150 cm³ and the volume of the cylinder is twice the volume of the hemisphere, find the total volume of the solid.



⇨ Here, Volume of hemisphere = 150 cm³
Volume of cylinder = 2 × Volume of hemisphere = 2 × 150 = 300 cm³
Now, total volume of solid = Volume (hemisphere) + Volume (Cylinder) = (150 + 300) cm³ = 450 cm³.
Thus, total volume of the solid is 450 cm³.

18. दिइएको चित्र एउटा बेलना र सोको फेदमा एउटा अर्धगोला मिलेर बनेको छ । यदि सो ठोसको वक्र सतहको क्षेत्रफल पूरा सतहको क्षेत्रफल भन्दा 50 cm² कम भए माथिल्लो भागको क्षेत्रफल पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere at the bottom. If the curved surface area of the solid is 50 cm² less than the total surface area, find the area of the top.

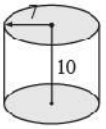


⇨ Here, TSA of solid = CSA of solid + area of top
or, TSA = (TSA – 50) + area of Top ∴ Area of top = 50 cm²

B. SHORT QUESTIONS बेलना (CYLINDER)

MODEL 1

1. एउटा बेलनाको अर्धव्यास 7 units र उचाइ 10 units भए पत्ता लगाउनुहोस्:
A cylinder has radius 7 units and height 10 unit. Find the following.
(a) आधारको परिधि (Circumference of base) (b) वक्रसतहको क्षेत्रफल (Curved surface area)
(c) पूरा सतहको क्षेत्रफल (Total surface area) (d) आयतन (Volume)



⇨ Here, radius (r) = 7 units and height (h) = 10 units

(a) Circumference of base = $2\pi r = 2 \times \frac{22}{7} \times 7 = 44$ units.

(b) Curved surface area = $2\pi rh = 44 \times 10 = 440$ sq. units.

(c) Total surface area = $2\pi r(r + h) = 44\ (7 + 10) = 44 \times 17 = 748$ sq. units.

(d) Volume = $\pi r^2 h = \frac{22}{7} \times 7^2 \times 10 = 22 \times 70 = 1540$ cubic units.

2. एउटा बेलनाको आधारको व्यास 14 cm र उचाइ 20 cm छन् । यसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The diameter of base of a cylinder is 14 cm and height is 20 cm. Find its curved surface area.

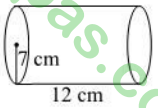
⇨ Here, diameter (d) = 14 cm and height (h) = 20 cm

We know that, curved surface area is given by, CSA = $d\pi h = \frac{22}{7} \times 14 \times 20 = 880$ cm²

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3. दिइएको ठोस वस्तुको आयतन निकाल्नुहोस् । जहाँ आधारको अर्धव्यास 7 cm र लम्बाइ 12 cm छन् ।
Find the volume of a given solid object, where the radius of base is 7 cm and height is 12 cm. [2068 B]



⇨ Here, radius (r) = 7 cm and Height (h) = 12 cm

We have, volume of cylinder = $\pi r^2 h = \frac{22}{7} \times 7^2 \times 12 = 1848$

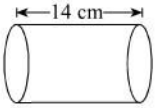
Thus, the volume of the cylinder is 1848 cm^3.

4. 12 मिटर अग्लो एउटा बेलनाकार चिम्नीको आधारको क्षेत्रफल 616 वर्गमिटर छ । बेलनाको आयतन निकाल्नुहोस् ।
The area of the base of a cylindrical chimney of 12m high was 616 square meters. Find the volume of the chimney. [2059 A2]

⇨ Here, volume of chimney (V) = $\pi r^2 h$ (area of base = πr^2) = area of base × height
= 616 m^2 × 12 m = 7392 m^3

Thus, volume of the chimney is 7392 m^3.

5. सँगैको चित्रमा दिइएको बेलनाको लम्बाइ र आधारको क्षेत्रफल 14 cm र 154 cm^2 भए बेलनाको आयतन निकाल्नुहोस् ।
The length and base area of cylinder given in the figure alongside are 14 cm and 154 sq. cm respectively. Find the volume of the cylinder. [2068 D]



⇨ Here, length of cylinder (ℓ) = 14 cm and Area of base (A) = 154 cm^2
We have, volume of the cylinder = Aℓ = 154 cm^2 × 14 cm = 2156 cm^3
Thus, the volume of the cylinder is 2156 cm^3.

6. 60 से.मि. अग्लो र 14 से.मि. व्यास भएको एउटा बेलनालाई ठाडो चिरेर दुई बराबर भाग लगाउँदा एक भागको आयतन कति हुन्छ ?
A 60 cm high cylinder with 14 cm its diameter is cut vertically into two equal halves. What is the volume of a half part ? [2067 A]

⇨ Here, height (h) = 60 cm and Diameter (d) = 14 cm ∴ Radius (r) = $\frac{d}{2} = \frac{14 \text{ cm}}{2} = 7$ cm

Volume of hemi–cylinder (V) = $\frac{1}{2}\pi r^2 h = \frac{1}{2} \times \frac{22}{7} \times 7^2 \times 60 = 4620$ cm^3

Thus, the volume of a half part = 4620 cm^3

7. एउटा बेलनाकार ट्याङ्कीको उचाइ 21 cm र आधारको व्यास 14 cm छ । यसको आयतन पत्ता लगाउनुहोस् ।
The height of cylindrical tank be 21 cm and diameter of the base be 14 cm. Find its volume. [2057C1]

⇨ Here, radius of base circle (r) = $\frac{14}{2}$ cm = 7 cm and Height of tank (h) = 21 cm.

∴ Volume = $\pi r^2 h = \frac{22}{7} \times (7)^2 \times 21$ cm^3 = 3234 cm^3

Thus, volume of the tank is 3234 cm^3.

MODEL 2

8. एउटा बेलनाको आधारको परिधि 44 से.मि. छ । यदि सो बेलनाको अर्धव्यास र उचाइको योगफल 27 से.मि. छ भने उक्त बेलनाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The circumference of the base of a cylinder is 44 cm. If the sum of the radius and height of the cylinder is 27 cm, find the total surface area of the cylinder. [2071 C]

⇨ Here, circumference of base = 44 cm and r + h = 27 cm
We know that, TSA (cylinder) = $2\pi r(r + h) = c \times (r + h) = 44 \times 27 = 1188$ cm^2
Thus, the TSA of cylinder is 1188 cm^2

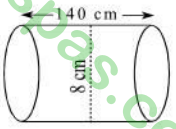
9. एउटा बेलनाको आधारको क्षेत्रफल 154 वर्ग से.मि. र वक्र सतहको क्षेत्रफल 880 वर्ग से.मि. छ भने पूरा सतहको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The base area of a cylinder is 154 sq. cm and the curved surface area is 880 sq. cm. What is the total surface area ? Find it. [2071 D]

⇨ Here, Area of base = 154 cm^2
Area of curved surface = 880 cm^2
We know that, TSA (cylinder) = Area of base × 2 + CSA = 154 × 2 + 880
= 308 + 880 = 1188 cm^2
Thus, the TSA (cylinder) is 1188 cm^2.

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10. चित्रमा दिइएको बेलनाको वक्र सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the curved surface area of the given cylinder. [2058 C1]



⇨ Here, radius of cylinder (r) $= \frac{8\text{ cm}}{2} = 4\text{ cm}$

$\therefore$ Curved surface area of cylinder $= 2\pi rh = 2 \times \frac{22}{7} \times 4 \times 140\text{ cm}^2 = 3520\text{ cm}^2$

Thus, CSA of the cylinder is 3520 cm^2.

11. 20 से.मि. उचाइ भएको एउटा बेलनाको वृत्ताकार आधारको परिधि 88 से.मि. छ भने दिइएको बेलनाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the circumference of the circular base of a cylinder with height 20 cm. is 88 cm, calculate its total surface area. [2062 D1]

⇨ Here, let, r be the radius of circular base and h be the height of the cylinder.
Now, Circumference $= 2\pi r$ or, $88 = 2\pi r$

or, $r = \frac{88}{2\pi} = \frac{88}{2 \times \frac{22}{7}} = 88 \times \frac{7}{44} = 14\text{ cm}$

$\therefore$ Total surface area $= 2\pi r(r + h) = 88\text{ cm} \times (14 + 20)\text{ cm} = 88 \times 34\text{ cm}^2 = 2992\text{cm}^2$
Thus, TSA of the cylinder is 2992 cm^2.

12. आधारको परिधि 44 से.मि. र अर्धव्यास र उचाइको योग 17 से.मि. छ भने दिइएको बेलनाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The circumference of the base of a cylinder is 44 cm and the sum of its radius and height is 17 cm. Find the total surface area of the cylinder. [2062 E2, 2064 D1]

⇨ Here, let, r & h be the radius & height of the cylinder respectively.
Then, $r + h = 17$ cm and circumference = 44 cm.
We know that,
Total surface area $= 2\pi r(r + h) =$ circumference $\times 17\text{ cm} = 44\text{ cm} \times 17\text{ cm} = 748\text{ cm}^2$
Thus, TSA of the cylinder is 748 cm^2.

13. एउटा बेलनाको अर्धव्यास र उचाइको योग 10 cm र आधारको परिधि 308 cm छ भने दिइएको बेलनाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If sum of radius and height of a cylinder is 10 cm and circumference of base is 308 cm., find the total surface area of that cylinder. [2066 D]

⇨ Here, $r + h = 10$ cm, $2\pi r = 308$ cm
We know that, Total surface area of cylinder $= 2\pi r(r + h) = 308\text{ cm} \times 10\text{ cm} = 3080\text{ cm}^2$
Thus, the required TSA is 3080 cm^2.

MODEL 3

14. एउटा बेलनाको आयतन 1078 cm^3 र उचाइ 7 cm भए आधारको अर्धव्यास निकाल्नुहोस् ।
The volume of a cylinder is 1078 cm^3 and height 7 cm. Find the radius of the base. [2068 E]

⇨ Here, volume of cylinder (V) = 1078 cm^3 and Height (h) = 7 cm
We know that, Volume of cylinder $= \pi r^2 h$

or, $1078 = \frac{22}{7} \times r^2 \times 7$ or, $r^2 = 49$ $\therefore$ $r = 7$ cm

Thus, the radius of the cylinder is 7 cm.

15. आधारको अर्धव्यास र उचाइको अनुपात 5 : 7 छ र आयतन 550 घन से.मि. छ भने बेलनाको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The base radius and the height of a cylinder are in the ratio 5 : 7. If the volume of the cylinder is 550 cubic cm, find the radius of the base of the cylinder. [2062A1]

⇨ Here, let, r & h be the radius and the height of a cylinder respectively, Then, $\frac{r}{h} = \frac{5}{7}$, or $r = \frac{5h}{7}$.

By formula, volume of the cylinder $= \pi r^2 h$

or, $550 = \pi \left(\frac{5h}{7}\right)^2 h$ or, $550 = \frac{22}{7} \times \frac{25}{49} \times h^3$ or, $550 = \frac{550}{343} h^3$

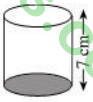
or, $h^3 = \frac{550 \times 343}{550}$ or, $h^3 = 343$ or, $h^3 = (7)^3$

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$\therefore$ $h = 7$ cm. Now, $r = \frac{5}{7}h = \frac{5}{7} \times 7$ cm $= 5$ cm.

Thus, radius of the cylinder is 5 cm.



16. आधारको क्षेत्रफल 50 cm² र उचाइ 7 cm भएको ठोस बेलनाको पूरा सतहको क्षेत्रफल 188 cm² भए आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
Find the radius of the base of a solid cylinder whose height is 7 cm, base area is 50 cm² and total surface area 188 square cm. **[2065 C]**

⇨ Here, base area $= 50$ cm^2

or, $\pi r^2 = 50$ or, $\frac{22}{7} \times r^2 = 50$ or, $r^2 = \frac{350}{22}$

$\therefore$ $r = 3.99$ cm

Again, CSA $=$ TSA $- 2$(Base area) $= 188 - 2 \times 50 = 88$ cm^2

or, $2\pi rh = 88$ or, $2 \times \frac{22}{7} \times r \times 7 = 88$ or, $r = \frac{88}{44}$

$\therefore$ $r = 2$ cm

The information in the question is wrong since there are two values of r.

17. उचाइ र आधारको अर्धव्यासको योगफल 34 से.मि. र पूरा सतहको क्षेत्रफल 2992 cm² छ भने बेलनाको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The sum of the height and the radius of the base of a cylinder is 34 cm. If the total surface area of the cylinder is 2992 square cm, find the radius of its base. **[2067 C]**

⇨ Here, $r + h = 34$ cm and TSA $= 2992$ cm^2

We have, TSA $= 2992$ or, $2\pi r(r + h) = 2992$ or, $2 \times \frac{22}{7} \times r \times 34 = 2992$

$\therefore$ $r = 14$ cm Thus, the radius of base is 14 cm.

18. एउटा बेलनाको वक्रसतहको क्षेत्रफल र उचाइ क्रमशः 616 वर्ग से.मि. र 14 से.मि. छ भने बेलनाको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The curved surface area and height of a cylinder are 616 cm² and 14 cm respectively. Find the radius of the cylinder. **[SLC 2065 E]**

⇨ Here, CSA $= 616$ cm^2, Height (h) $= 14$ cm

We know that,

CSA(cylinder) $= 2\pi rh$ or, $616 = 2 \times \frac{22}{7} \times r \times 14$ or, $\frac{616 \times 7}{2 \times 22 \times 14} = r$

$\therefore$ $r = 7$ cm

Thus, the radius of cylinder is 7 cm.

MODEL 4

19. एउटा बेलनाकार बट्टाको आयतन 1.54 लिटर र आधारको क्षेत्रफल 77 cm² छ भने बेलनाको उचाइ निकाल्नुहोस् ।
The volume of a cylindrical can is 1.54 litre. If the area of its base is 77 cm², find its height. **[2060 A1, 2070 B]**

⇨ Here, Volume (V) $= 1.54$ litres $= 1.54 \times 1000$ cm$^3 = 1540$ cm^3 and Area of base (A) $= 77$ cm^2

Here, $V = A \times h$ or, $1540 = 77 \times h$ $\therefore$ $h = \frac{1540}{77}$ cm $= 20$ cm

20. यदि उचाइ र अर्धव्यास बराबर भएको एउटा बेलनाकार काठको कुट्काको वक्र सतहको क्षेत्रफल 308 वर्ग से.मि. छ । उक्त वस्तुको उचाइ पत्ता लगाउनुहोस् ।
The height and radius of a cylindrical log of wood are equal. If the curved surface area of the object is 308 sq. cm, find the height of the object. **[2058 C2, 2071 A]**

⇨ Here, height (h) $=$ radius (r)

We have,

curved surface area $= 308$ cm^2 or, $2\pi rh = 308$ or, $2\pi hh = 308$

or, $2\pi h^2 = 308$ or, $2 \times \frac{22}{7} \times h^2 = 308$ or, $h^2 = \frac{308 \times 7}{2 \times 22} = 49$

$\therefore$ $h = 7$

Thus, the height is 7 cm.

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21. 1.4 m व्यास भएको एउटा बेलनाकार भाँडोमा 770 ℓ पानी अटाउँछ भने बेलनाको उचाइ निकाल्नुहोस् ।
A cylindrical water vessel of diameter 1.4 metre holds 770 litres of water. Calculate the height of the vessel. [2057 D1]

⇨ Here, radius base of cylindrical vessel (r) $= \frac{1.4\text{ m}}{2} = 0.7$ m

Volume = 770 litre $= \frac{770}{1000}\text{ m}^3 = 0.77\text{ m}^3$

Now, Volume $= \pi r^2 h$ or, $0.77 = \frac{22}{7} \times (0.7)^2 \times h$

or, $0.77 = \frac{22}{7} \times 0.07 \times h$ or, $0.77 = 1.54\,h$ $\therefore\ h = \frac{0.77}{1.54} = 0.5$ m

22. बेलनाकार काठको मुढाको व्यास 28 से.मि. छ र वक्रसतहको क्षेत्रफल 7392 वर्ग से.मि. छ भने बेलनाको उचाइ निकाल्नुहोस् ।
The diameter of the cylindrical log of wood is 28 cm. If the area of the curved surface is 7392 sq. cm; find its height. [2062 B1]

⇨ Here, radius of cylindrical log of wood $= \frac{28}{2}$ cm = 14 cm and Area of curved surface = 7392 cm^2

If h is the height of the log wood, Area of curved surface = $2\pi rh$ $\therefore$ $7392 = 2\pi rh$

or, $h = \frac{7392}{2\pi r} = \frac{7392 \times 7}{2 \times 22 \times 14}$ cm = 84 cm.

Thus, height of the wood is 84 cm.

MODEL 5

23. एउटा बेलनाकार ट्याङ्कीको आयतन 936 घ.मि. छ । यदि यसको उचाइ 6 मि. भए सो ट्याङ्कीको आधारको क्षेत्रफल पत्ता लगाउनुहोस् । [2060 C1]
The volume of a cylindrical tank is 936 m^3. If its height is 6 m, determine the base area of the tank.

⇨ Here, volume (V) = 936 m^3 and height (h) = 6 m
We know that, V = 936 or, base area × height = 936
or, base area × 6 = 936 $\therefore$ base area = 156
Thus, the base area is 156 m^2.

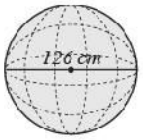
24. एउटा बेलनाको आयतन 1.54 लिटर छ । यदि उचाइ 20 cm छ भने यसको आधारको क्षेत्रफल निकाल्नुहोस् ।
The volume of a cylindrical is 1.54 litre. If the height is 20 cm, find the area of its base. [2060 A2]

⇨ Here, volume (V) = 1.54 litre and height (h) = 20 cm
We know that, Volume (V) = 1.54 litre or, base area × height = 1.54 × 1000 cm^3
or, base area × 20 cm = 1.54 × 1000 cm^3 $\therefore$ base area = 77 cm^2
Thus, the base area is 77 cm^2.

गोला र अर्धगोला (SPHERE AND HEMISPHERE)

MODEL 6

25. एउटा गोलाको व्यास 126 cm छ । निम्नलिखित पत्ता लगाउनुहोस् ।
A sphere has diameter 126 cm. Find the following.
(a) ठुलो वृत्तको परिधि (Circumference of great circle)
(b) ठुलो वृत्तको क्षेत्रफल (Area of a great circle)
(c) गोलाको सतहको क्षेत्रफल (Surface area of the sphere)
(d) गोलाको आयतन (Volume of the sphere)



⇨ Here, diameter of sphere = 126 cm so, radius (r) $= \frac{126}{2} = 63$ cm

Now, (a) Circumference of great circle = $2\pi r = 2 \times \frac{22}{7} \times 63 = 396$ cm
Thus, circumference of great circle is 396 cm.

(b) Area of a great circle = $\pi r^2 = \frac{22}{7} \times 63^2 =$ 12474 cm^2

Thus, area of a great circle is 12474 cm^2.

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(c) Surface area of the sphere $= 4\pi r^2 = 4 \times 12474 \text{ cm}^2 = 49896 \text{ cm}^2$
Thus, surface area of the sphere is 49896 cm^2.

(d) Volume of sphere $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 63^3 = 1047816 \text{ cm}^3$

Thus, volume of sphere is 1047816 cm^3.

26. एउटा अर्धगोलाको व्यास 126 cm छ । निम्नलिखित पत्ता लगाउनुहोस् ।
A hemisphere has diameter 126 cm. Find the following.

(a) ठुलो वृत्तको परिधि (Circumference of great circle) (b) ठुलो वृत्तको क्षेत्रफल (Area of a great circle)
(c) वक्र सतहको क्षेत्रफल (Curved surface area) (d) पूरा सतहको क्षेत्रफल (Total surface area)
(e) अर्धगोलाको आयतन (Volume of the hemisphere)

⇨ Here, diameter = 126 cm ∴ radius $(r) = \frac{126}{2} = 63$ m

Now,

(a) Circumference of great circle $= 2\pi r = 2 \times \frac{22}{7} \times 63 = 396$ cm

Thus, circumference of great circle is 396 cm.

(b) Area of a great circle $= \pi r^2 = \frac{22}{7} \times 63^2 = 12474 \text{ cm}^2$

Thus, area of a great circle is 12474 cm^2.

(c) Curved surface area of hemisphere $= 2\pi r^2 = 2 \times 12474 \text{ cm}^2 = 24948 \text{ cm}^2$
Thus, curved surface area of hemisphere is 24948 cm^2.

(d) Total surface area of hemisphere $= 3\pi r^2 = 3 \times 12474 \text{ cm}^2 = 37422 \text{ cm}^2$
Thus, total surface area of hemisphere is 37422 cm^2.

(e) Volume of hemisphere $= \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 63^3 = 523908 \text{ cm}^3$

Thus, volume of hemisphere is 523908 cm^3.

27. एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 300 cm^2 छ । सो अर्धगोलाको अर्धव्याससँग बराबर अर्धव्यास हुने गोलाको सतहको क्षेत्रफल कति हुन्छ ?
The total surface area of a hemisphere is 300 cm^2. What is the surface area of a sphere having equal radius to the hemisphere?

⇨ Here, total surface area of a hemisphere = 300 cm^2

or, $3\pi r^2 = 300$ or, $3 \times \frac{22}{7} r^2 = 300$

∴ $r^2 = \frac{7 \times 300}{3 \times 22} = \frac{350}{11} \text{ cm}^2$ Since, radius of sphere = radius of hemisphere.

So, surface area of sphere $= 4\pi r^2 = 4 \times \frac{22}{7} \times \frac{350}{11} = 400 \text{ cm}^2$

28. एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 240 cm^2 छ । सो अर्धगोलाको अर्धव्याससँग बराबर अर्धव्यास हुने गोलाको सतहको क्षेत्रफल कति हुन्छ ?
The total surface area of a hemisphere is 240 cm^2. What is the surface area of a sphere having equal radius to the hemisphere?

⇨ Here, total surface area of a hemisphere = 240 cm^2

or, $3\pi r^2 = 240$ ∴ $\pi r^2 = \frac{240}{3} = 80 \text{ cm}^2$

Since radius of sphere = radius of hemisphere. So, surface area of sphere $= 4\pi^2 = 4 \times 80 \text{ cm}^2 = 320 \text{ cm}^2$
Thus, the surface area of sphere is 320 cm^2.

MODEL 7

29. एक गोलाको आयतन 36π घन से.मि. छ भने यसको व्यास पत्ता लगाउनुहोस् ।
The volume of a sphere is 36π cu. cm. Find its diameter. **[2072 FW, 2072 S]**

⇨ Here, Volume $(V) = 36\pi \text{ cm}^3$ or, $\frac{1}{6}\pi d^3 = 36\pi$

or, $d^3 = 36 \times 6$ or, $d^3 = 6^3$

∴ $d = 6$ Thus, the diameter is 6 cm.

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30. एउटा गोलाकार वस्तुको आयतन $\frac{9p}{2}$ घन से.मि. भए त्यसको व्यास पत्ता लगाउनुहोस् ।

If the volume of a spherical object is $\frac{9p}{2}$ cm³, find its diameter. **[2065 A]**

⇨ Here, volume of a sphere (V) $= \frac{9\pi}{2}$ cm³ So, $\frac{1}{6}\pi d^3 = \frac{9\pi}{2}$

or, $d^3 = 27$ Thus, Diameter (d) = 3 cm

31. एउटा गोलाको आयतन 38808 cm³ भए उक्त गोलाको अर्धव्यास पत्ता लगाउनुहोस् ।

The volume of a sphere is 38808 cubic centimeter, find the radius of the sphere. **[2068 A]**

⇨ Here, volume of sphere (V) = 38808 cm³

We have, $V = \frac{4}{3}\pi r^3$ or, $38808 = \frac{4}{3} \times \frac{22}{7} \times r^3$

or, $r^3 = \frac{38808 \times 3 \times 7}{4 \times 22}$ or, $r^3 = 9261$

∴ $r = 21$ Thus, the radius of sphere is 21 cm.

32. एउटा अर्धगोलाकार वस्तुको आयतन 19404 cm³ भए त्यसको अर्धव्यास पत्ता लगाउनुहोस् ।

If the volume of a hemisphere is 19404 cm³, find its radius. **[2070 C, 2066 E]**

⇨ Here, volume of hemisphere (V) = 19404 cm³

or, $\frac{2}{3}\pi r^3 = 19404$ or, $\frac{2 \times 22}{3 \times 7} r^3 = 19404$ or, $r^3 = \frac{19404 \times 21}{44}$

or, $r^3 = 9261$ or, $r = 21$ cm

Thus, the radius of the hemisphere is 21 cm.

MODEL 8

33. एक गोलाको सतहको क्षेत्रफल 36π वर्ग से.मि. छ भने यसको व्यास पत्ता लगाउनुहोस् ।

The surface area of a sphere is 36π square cm. Find its diameter. **[2072 C]**

⇨ Here, TSA (sphere) = 36 π cm² or, $4\pi r^2 = 36\pi$ cm²

or, $r^2 = 9$ cm² ∴ $r = 3$ cm

Now, diameter (d) = 2r = 2 × 3 = 6 cm Thus, the diameter is 6 cm.

34. एउटा गोलाको पूरा सतहको क्षेत्रफल 22176 वर्ग से.मि. छ भने उक्त गोलाको व्यास पत्ता लगाउनुहोस् ।

The total surface area of a sphere is 22176 cm². Find the diameter of the sphere. **[2065 D]**

⇨ Here, total surface area of a sphere (A) = 22176 cm²

or, $\pi d^2 = 22176$ or, $\frac{22}{7} \times d^2 = 22176$

or, $d^2 = 7056$ ∴ $d = 84$ cm

Thus, diameter is 84 cm.

35. यदि एउटा ठोस गोलाको पूरा सतहको क्षेत्रफल 616 cm² छ भने उक्त वस्तुको अर्धव्यास कति होला ?

If the total surface area of a solid sphere is 616 cm², what will be its radius ? **[2066A, 2068 S]**

⇨ Here, total surface area of sphere = 616 cm²

or, $4\pi r^2 = 616$ or, $r^2 = \frac{616}{4\pi} = 49$

∴ $r = 7$ cm Thus, the radius is 7 cm.

36. $\frac{1372}{3}\pi$ cm³ आयतन भएको गोलाको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

Find the total surface area of a sphere whose volume is $\frac{1372}{3}\pi$ cm³. **[2067 D]**

⇨ Here, volume of sphere $= \frac{1372}{3}\pi$ or, $\frac{4}{3}\pi r^3 = \frac{1372}{3}\pi$

or, $r^3 = 343 = 7^3$ ∴ $r = 7$

Now, TSA (sphere) $= 4\pi r^2 = 4 \times \frac{22}{7} \times 7^2 = 616$ cm²

Thus, the TSA of sphere is 616 cm².

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MODEL 9

37. एउटा ठोस अर्धगोलाको परिधि 44 से.मि. छ । उक्त अर्धगोलाको आयतन पत्ता लगाउनुहोस् । [2072 W]
The circumference of the base of a solid hemi-sphere is 44 cm. Find the volume of the hemi-sphere.

⇨ Here, circumference = 44 cm or, $2\pi r = 44$ cm

or, $2 \times \frac{22}{7} \times r = 44$ cm $\therefore$ $r = 7$ cm

We know that, $V(\text{Hemisphere}) = \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 7^3 = 718.67 \text{ cm}^3$

Thus, the volume is 718.67 cm^3.

38. एउटा अर्धगोलाको आयतन 486π घन से.मि. छ भने यसको आधारको परिधि निकाल्नुहोस् ।
Find the circumference of the base of a hemi-sphere whose volume is 486π cu.cm. [2072 E]

⇨ Here, volume = $486\pi \text{ cm}^3$ or, $\frac{2}{3}\pi r^3 = 486\pi \text{ cm}^3$

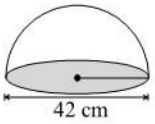
or, $r^3 = 729 \text{ cm}^3$ $\therefore$ $r = 9$ cm

Now, circumference = $2\pi r = 2 \times \pi \times 9 \text{ cm} = 18\pi$ cm

Thus, the circumference is 18π cm.

MODEL 10

39. दिइएको अर्धगोलाकार ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the given solid hemisphere. [2070 E]



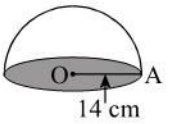
⇨ Here, diameter (d) = 42 cm $\therefore$ $2r = 42$ cm

$\therefore$ $r = 21$ cm

Now, we know that, $TSA(\text{Hemisphere}) = 3\pi r^2 = 3 \times \frac{22}{7} \times 21^2 = 4158 \text{ cm}^2$

Thus, the TSA is 4158 cm^2.

40. सँगै दिइएको अर्ध गोलाकार ठोस वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the total surface area of the adjoining solid hemisphere. [2065 M]



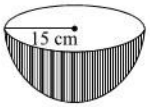
⇨ Here, radius (r) = 14 cm

We have, Total surface area of the hemisphere (TSA) = $3\pi r^2$

or, $TSA = 3 \times \frac{22}{7} \times 14 \text{ cm} \times 14 \text{ cm}$

Thus, the total surface area (TSA) = 1848 cm^2

41. दिइएको अर्धगोलाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् । जहाँ अर्धगोलाको आधारको अर्धव्यास 15 cm छ ।
Find the total surface area of the given solid hemisphere. In which the radius of the base of hemisphere is 15 cm. [2068 C]



⇨ Here, radius of hemisphere (r) = 15 cm

We know that, total surface area of hemisphere $= 3\pi r^2 = 3 \times \frac{22}{7} \times 15^2 = 2121.43 \text{ cm}^2$

Thus, the total surface area of hemisphere is 2121.43 cm^2.

42. 21 से.मि. व्यास भएको एउटा अर्ध-गोलाकारको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Obtain the total surface area of the a hemisphere having the diameter 21 cm. [2065 B]

⇨ Here, radius (r) = $\frac{21 \text{ cm}}{2} = 10.5$ cm

We know that; TSA of a hemisphere = $3\pi r^2 = 3 \times \frac{22}{7} \times 10.5^2 = 1039.50$.

So, the TSA of a hemisphere is 1039.50 cm^2.

43. एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 243 π cm^2 छ । यसको आयतन पत्ता लगाउनुहोस् ।
The total surface area of a hemi-sphere is 243 π cm^2. Find its volume. [2067 B]

⇨ Here, total surface area of hemisphere = 243 π cm^2

or, $3\pi r^2 = 243\pi$ or, $r^2 = 81$ $\therefore$ $r = 9$ cm

Now, volume = $\frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 9^3$ $\therefore$ Volume = 1527.42 cm^3

Thus, the volume of the hemi–sphere is 1527.42 cm^3.

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MODEL 11

44. एउटा 7 से.मि. व्यासार्ध भएको धातुको गोलालाई दुई बराबर भाग हुने गरी काट्दा बन्ने दुई अर्धगोलाहरूको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
A solid metallic sphere of radius 7 cm is cut into two halves. Find the total surface area of the two hemispheres or formed. [2061 E1]

⇨ Here, r = radius of sphere = 7 cm

Total surface area of two hemispheres $= 3\pi r^2 + 3\pi r^2 = 6\pi r^2 = 6 \times \frac{22}{7} \times (7\text{ cm})^2$

$= 132 \times 7\text{ cm}^2 = 924\text{ cm}^2$

45. उस्तै र उत्रै माटोले बनेका दुई ठोस अर्धगोलाकार वस्तुहरू छन् । यदि एउटा अर्धगोलाकार वस्तुको पूरा सतहको क्षेत्रफल 462 cm² छ भने ती दुई अर्धगोलालाई टाँसेर बनाइएको गोलाकार वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
There are two solid hemispherical objects made of earth having the same shape and size. If the total surface area of one hemispherical object is 462 square cm, find the total surface area of the sphere which is formed by attaching those two hemispherical objects. [2059 A2]

⇨ Here, by formula, Total area of hemisphere $= 3\pi r^2$, where r is radius of sphere.

or, $462\text{ cm}^2 = 3\pi r^2$ or, $\pi r^2 = \frac{462}{3}\text{ cm}^2 = 154\text{ cm}^2$

Now, area of a sphere made by attaching 2 hemisphers $= 4\pi r^2 = 4 \times 154\text{ cm}^2 = 616\text{ cm}^2$

MODEL 12

46. 6 cm, 8 cm र 10 cm व्यास भएका तीनओटा गोलाहरू पगालेर एउटै गोला बनाइएछ भने सो गोलाको व्यास पत्ता लगाउनुहोस् ।
Three spheres of diameters 6 cm, 8 cm, and 10 cm are melted and formed a single sphere. Find the diameter of the sphere. [2066 B]

⇨ Here, $d_1 = 6$ cm, $d_2 = 8$ cm and $d_3 = 10$ cm

If they are melted to form a new sphere then,

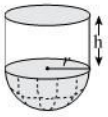
or, $\frac{1}{6}\pi d^3_1 + \frac{1}{6}\pi d^3_2 + \frac{1}{6}\pi d^3_3 = \frac{1}{6}\pi d^3$ where d is the diameter of new sphere

or, $\frac{1}{6}\pi(6^3 + 8^3 + 10^3) = \frac{1}{6}\pi d^3$ or, $216 + 512 + 1000 = d^3$

or, $12^3 = d^3$ ∴ $d = 12$

Thus, the diameter of the new sphere is 12 cm.

संयुक्त ठोसहरू (COMBINED SOLIDS)



47. दिइएको संयुक्त ठोसको चित्रमा बेलनामाथि अर्धगोला राखिएको छ । यदि अर्धगोलाको आयतन बेलनाको आयतनको एक-तिहाइ छ र बेलनाको आयतन 333 cm³ भए उक्त ठोसको पूरा आयतन पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere on the top. If the volume of the hemisphere is one-third of the volume of cylinder and the volume of the cylinder is 333 cm³, find the total volume of the solid.

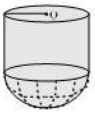
⇨ Here, Volume of cylinder = 333 cm³

Volume of hemisphere $= \frac{1}{3} \times$ Volume of cylinder $= \frac{1}{3} \times 333\text{ cm}^3 = 111\text{ cm}^3$

Now, total volume of solid = Volume (Cylinder) + Volume (hemisphere)

$= 333\text{ cm}^3 + 111\text{ cm}^3 = 444\text{ cm}^3$

Thus, total volume of the solid is 444 cm³.



48. दिइएको चित्र एउटा बेलना र सोको फेदमा एउटा अर्धगोला मिलेर बनेको छ । यदि अर्धगोला र बेलनाका आयतनहरू 3 : 4 को अनुपातमा छन् र सो ठोसको पूरा आयतन 777 cm³ भए बेलनाको पूरा आयतन पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere on the bottom. If the volumes of the hemisphere and cylinder are in the ratio of 3 : 4 and the total volume of the solid is 777 cm³, find the total volume of the cylinder.

⇨ Here, Let V_1 = Volume of cylinder and V_2 = Volume of hemisphere

From question, $\frac{V_2}{V_1} = \frac{3}{4} \Rightarrow V_2 = \frac{3}{4}V_1$

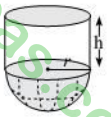
Again, $V_1 + V_2 = 777\text{ cm}^3$

or, $V_1 + \frac{3}{4}V_1 = 777$ or, $\frac{7V_1}{4} = 777$ ∴ $V_1 = \frac{777 \times 4}{7} = 444\text{ cm}^3$

Thus, volume of cylinder is 444 cm³.

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49. दिइएको चित्र एउटा बेलना र सोको फेदमा एउटा अर्धगोला मिलेर बनेको छ । यदि अर्धगोलाको वक्र सतहको क्षेत्रफल बेलनाको वक्र सतहको क्षेत्रफलको एक तीहाइ छ भने *r* र *h* को सम्बन्ध पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with a hemisphere at the bottom. If the curved surface area of the hemisphere is one third of the curved surface area of cylinder, find the relation between *r* and *h*.

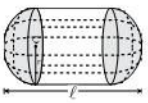


⇨ Here, CSA of hemisphere $= \frac{1}{3} \times$ CSA of cylinder

or, $2\pi r^2 = \frac{1}{3} \times 2\pi rh$ or, $r = \frac{1}{3} \times h$ or, $r = \frac{h}{3}$

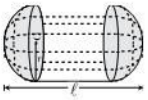
$\therefore$ $h = 3r$ is the required relation.

50. दिइएको चित्र एउटा बेलना र सोको दुवैतिर अर्धगोलाकार भागहरू मिली बनेको छ । यदि अर्धगोलाको व्यास र बेलनाको लम्बाइ बराबर छन् र तिनीहरूको गुणनफल 196 cm² भए सो ठोसको पूरा लम्बाइ पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with two hemispheres at the ends. If the diameter of the hemisphere is equal to length of cylinder and their product is 196 cm², find the total length of the solid.



⇨ Here, let d be the diameter of hemisphere and h be the length of cylinder.
From question, $d = h$ and $d \times h = 196$ or, $h^2 = 196$ $\therefore$ $h = 14$ cm
So diameter = 14 cm and radius = 7 cm
Total length of solid (ℓ) = r + r + h = (7 + 7 + 14) cm = 28 cm

51. दिइएको चित्र एउटा बेलना र सोको दुवैतिर अर्धगोलाकार भागहरू मिली बनेको छ । यदि अर्धगोलाको अर्धव्यास बेलनाको लम्बाइको आधा छ र तिनीहरूको योगफल 21 cm भए सो ठोसको पूरा लम्बाइ पत्ता लगाउनुहोस् ।
Given figure is a solid composed of a cylinder with two hemispheres at the ends. If the radius of the hemisphere is one-half of the length of the cylinder and their sum is 21 cm, find the total length of the solid.



⇨ Here, let r be the radius of hemisphere and h be the length of cylinder.
From question, $r = \frac{1}{2} h$ $\therefore$ $h = 2r$
Also, $h + r = 21$ or, $2r + r = 21$
$\therefore$ $r = \frac{21}{3} = 7$ cm and $h = 2 \times 7 = 14$ cm
So total length of solid = r + r + h = (7 + 7 + 14) cm = 28 cm

C. LONG QUESTIONS

MODEL 1

1. एउटा ठोस बेलनाको वक्रसतहको क्षेत्रफल यसको पूरा सतहको क्षेत्रफलको 2/3 छ । यदि पूरा सतहको क्षेत्रफल 924 व.से.मि. छ भने यसको व्यासार्ध र उचाइ पत्ता लगाउनुहोस् ।
The area of the curved surface of a solid cylinder is equal to 2/3 of the total area of the same cylinder. If the total surface of it is 924 sq.cm, find the radius and height. **[2057 C2]**

⇨ Here, let, r and h be radius and height of the cylinder. Then, total surface area = $2\pi r$ (r+h)
or, $924 = 2\pi r^2 + 2\pi rh$ ... ... (i)
Again, curved surface area = $2\pi rh$
or, $\frac{2}{3} \times 924 = 2\pi rh$ or, $616 = 2\pi rh$ ... ... (i)
Putting the value of $2\pi rh$ in (i)
$2\pi r^2 + 616 = 924$ or, $2\pi r^2 = 924 - 616$ or, $2\pi r^2 = 308$
or, $r^2 = \frac{308}{2\pi}$ or, $r^2 = \frac{308 \times 7}{2 \times 22}$ or, $r^2 = 49$ $\therefore$ $r = 7$ cm
Putting the value of r in eq^n(ii)
$616 = 2 \times \frac{22}{7} \times 7 \times h$ or, $616 = 44h$ $\therefore$ $h = \frac{616}{44} = 14$ cm
Thus, r = 7 cm and h = 14 cm

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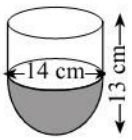
2. एउटा बेलनाको वक्रसतहको क्षेत्रफल 2464 वर्ग से.मि. छ। यसको आधारको अर्धव्यास र उचाइ बराबर छन् भने बेलनाको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
The curved surface area of a cylinder whose height is equal to the radius of the base is 2464 sq. cm. Find the total surface area of the cylinder. [2062 B1]

⇨ Here, let, r be the radius and h the height of the cylinder. Since height = radius i.e. r = h.
By formula, Curved surface area of cylinder = $2\pi rh$
or, $2464\ cm^2 = 2\pi r(r)$ [∵ Putting h = r]
or, $2464\ cm^2 = 2\pi r^2$
$\therefore \quad \pi r^2 = \frac{2464}{2}\ cm^2 = 1232\ cm^2$

Again, by formula,
Total surface area of cylinder $= 2\pi r\,(r + h) = 2\pi r\,(r + r) = 2\pi r \times 2r = 4\pi r^2 = 4 \times 1232\ cm^2$
Thus, the total surface area of the cylinder = $4928\ cm^2$

MODEL 2

3. दिइएको चित्र एउटा अर्धगोला र बेलना मिली बनेको एउटा संयुक्त ठोस वस्तु हो । यदि ठोस वस्तुको पूरा उचाइ 13 cm र अर्धगोलाको व्यास 14 cm भए सो ठोस वस्तुको आयतन निकाल्नुहोस् ।
The given figure is a combined solid made of a cylinder and a hemisphere. If the total height of the solid is 13 cm and the diameter of the hemisphere is 14 cm, find the volume of the solid. [SLC 2066 B]



⇨ Here, diameter = 14 cm so radius (r) $= \frac{d}{2} = \frac{14\ cm}{2} = 7\ cm$

Total height = 13 cm so height of cylinder (h) = 13 cm – 7 cm = 6 cm

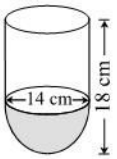
Now, total volume $= V(\text{cylinder}) + V(\text{hemisphere}) = \pi r^2 h_1 + \frac{2}{3}\pi r^3$

$= \pi r^2\left(h_1 + \frac{2}{3}r\right) = \frac{22}{7} \times 7^2\left(6 + \frac{2}{3} \times 7\right)$

$= 154 \times \frac{32}{3} = 1642.67\ cm^3$

Thus, total volume of the solid is $1642.67\ cm^3$.

4. दिइएको चित्र एउटा बेलना र एउटा अर्धगोला मिलेर बनेको ठोस वस्तुको हो । यदि बेलनाको आधारको व्यास 14 से.मि. र उचाइ 18 से.मि. छ भने सो ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
The given figure is a solid object made up of a cylinder and a hemisphere. If the diameter of the base of the cylinder is 14 cm and height 18 cm, find the volume of the solid object. [2070 D]



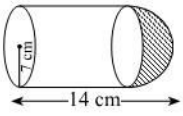
⇨ Here, diameter (d) = 14 cm or, $2r = 14\ cm$ $\therefore \quad r = 7\ cm$
Height of cylinder (h) = 18 cm – 7 cm = 11 cm

We know that, Volume of the solid $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3} \times r + h\right)$

$= \frac{22}{7} \times 7^2\left(\frac{2}{3} \times 7 + 11\right) = 2412.67\ cm^3$

Thus, the volume of the solid is $2412.67\ cm^3$.

5. दिइएको ठोस वस्तु बेलना र अर्धगोला मिलेर बनेको छ। जसको आधारको अर्धव्यास 7 से.मि. र पूरा लम्बाइ 14 से.मि. छ भने सो वस्तुको आयतन पत्ता लगाउनुहोस् ।
The given solid object is made up of a cylinder and a hemisphere whose radius of the base is 7 cm and total length is 14 cm. Find the volume of the object. [2067 S]



⇨ Here, common radius (r) = 7 cm and Total length (ℓ) = 14 cm
Length of cylinder (h) = ℓ – r = 14 cm – 7 cm = 7 cm
We know that,

Total volume $= V(\text{cylinder}) + V(\text{Hemisphere}) = \pi r^2 h + \frac{2}{3}\pi r^3 = \pi r^2\left(h + \frac{2}{3}r\right)$

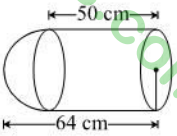
$= \frac{22}{7} \times 7^2\left(7 + \frac{2}{3} \times 7\right) = 22 \times 7 \times 11\frac{2}{3} = 1796\frac{2}{3}\ cm^3$

Thus, the volume of given object is $1796\frac{2}{3}\ cm^3$.

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MODEL 3

6. दिइएको चित्र बेलना र अर्धगोला मिलेर बनेको ठोस वस्तुको हो। यदि सो ठोस वस्तुको पूरा लम्बाई 64 से.मि. र बेलनाको लम्बाई 50 से.मि. छन् भने सो ठोस वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस्।



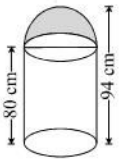
The given figure is a solid object formed by a cylinder and a hemi-sphere. If the total length of that solid object is 64 cm and length of the cylinder is 50 cm, find the total surface area of the solid object. **[2070 B]**

⇨ Here, common radius (r) = 64 cm – 50 cm = 14 cm

We know that, TSA of solid = $2\pi rh + 3\pi r^2 = \pi r(2h + 3r) = \frac{22}{7} \times 14(2 \times 50 + 3 \times 14) = 6248 \text{ cm}^2$

Thus, the TSA of the solid is 6248 cm^2.

7. दिइएको ठोस वस्तु एक अर्धगोला र बेलना मिली बनेको छ। अर्धगोलाको अर्धव्यास र बेलनाको अर्धव्यास बराबर छन्। बेलनाको उचाइ 80 से.मि. र ठोस वस्तुको उचाइ 94 से.मि. छ। सो ठोस बस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस्। **[2071 D]**



Given solid object is made up of a hemisphere and a cylinder. The radius of a hemisphere is equal to the radius of a cylinder. The height of a cylinder is 80 cm and the height of the solid object is 94 cm. Find the total surface area of that solid object.

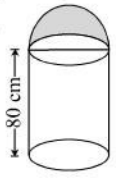
⇨ Here, height of cylinder = 80 cm, height of solid object = 94 cm
Radius of hemisphere = 94 cm – 80 cm = 14 cm
We know that,

TSA of solid object = $3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 14\,(3 \times 14 + 2 \times 80) = 44 \times 202 = 8888 \text{ cm}^2$

Thus, the TSA of solid object is 8888 cm^2.

MODEL 4

8. दिइएको ठोस वस्तु एक अर्धगोला र एक बेलना मिली बनेको छ। अर्धगोलाको अर्धव्यास र बेलनाको अर्धव्यास बराबर छन्। बेलनाको उचाइ 80 से.मि. र अर्धगोलाको आयतन 144π घन से.मि. छ। सो ठोस वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस्।



Given solid object is made up of a hemisphere and a cylinder. The radius of a hemisphere is equal to the radius of a cylinder. The height of a cylinder is 80 cm and the volume of a hemisphere is 144π cm^3. Find the total surface area of that solid object. **[2071 C]**

⇨ Here, height of the cylinder (h) = 80 cm and Volume of hemisphere (V) = 144 π cm^3
We know that,

Volume (hemisphere) = 144 π or, $\frac{2}{3}\pi r^3 = 144\,\pi$ or, $r^3 = \frac{144 \times 3}{2} = 216$

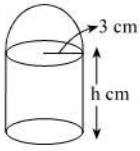
or, $r^3 = 6^3$ ∴ r = 6 cm

Again, TSA (Solid object) = $3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h) = \frac{22}{7} \times 6\,(3 \times 6 + 2 \times 80) = \frac{22}{7} \times 6 \times 178$

$= 3356.57 \text{ cm}^2$

Thus, the total surface area is 3356.57 cm^2.

9. h cm लम्बाइ र 3 cm अर्धव्यास भएको एउटा बेलना र उही अर्धव्यास भएको एउटा अर्धगोला मिलि बनेको ठोस वस्तुको आयतन 792 cm^3 भए, h को मान निकाल्नुहोस्।



A combined solid made up of a cylinder of radius 3 cm and length h cm and a hemisphere with the same radius as the cylinder has volume of 792 cm^3. Find the value of h. **[2065 E]**

⇨ Here, volume of the solid = 792 cm^3, Radius = 3 cm and Height of the cylinder = h cm
We know that,

Volume of the solid = Volume (hemisphere) + Volume (cylinder) = $\frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right)$

or, $792 = \frac{22}{7} \times 3^2\left(\frac{2}{3} \times 3 + h\right)$ or, $\frac{792 \times 7}{22 \times 9} = 2 + h$ or, $28 = 2 + h$

∴ h = 26 cm
Thus, the value of h is 26 cm.

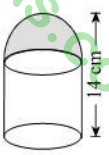
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MODEL 5

10. चित्रमा दिइएको वस्तु बेलना र अर्धगोलाकार वस्तु मिली बनेको ठोस वस्तु हो। यदि उक्त ठोस वस्तुको वक्र सतहको क्षेत्रफल र पूरा उचाइ क्रमशः 528 वर्ग से.मि. र 14 से.मि. भए बेलनाको उचाइ पत्ता लगाउनुहोस्।
Given figure is a solid composed of a cylinder with hemisphere at one end. If the curved surface area and whole height of the solid are 528 sq. cm and 14 cm respectively, find the height of the cylinder. **[2069 S]**



⇨ Here, CSA = 528 cm^2 and (h + r) = 14 cm where h is the height of cylinder.

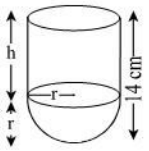
or, $2\pi rh + 2\pi r^2 = 528$ or, $2\pi r(h + r) = 528$ or, $2 \times \frac{22}{7} \times r \times 14 = 528$

or, $88r = 528$ ∴ $r = 6$ cm

Now, $h + r = 14$ cm or, $h + 6 = 14$ cm ∴ $h = 8$ cm

Thus, the height is 8 cm.

11. चित्रमा दिइएको वस्तु बेलना र अर्धगोलाकार वस्तु मिली बनेको ठोस वस्तु हो। उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल र उचाइ क्रमशः 770 व.से.मि. र 14 से.मि. भए बेलनाको उचाइ पत्ता लगाउनुहोस्।
Given figure is a solid composed of a cylinder with hemisphere at one end. If the total surface area and the height of solid are 770 sq. cm and 14 cm respectively. Find the height of the cylinder. **[SLC 2065 B]**



⇨ Here, total height = 14 cm = (h + r) $r + h = 14$ $h = 14 - r$

TSA of the solid = 770 cm^2

We know that; TSA of the solid = CSA(cylinder) + CSA (hemisphere) + Area of base

or, $770 = 2\pi rh + 2\pi r^2 + \pi r^2$ or, $770 = \pi r(2h + 2r + r)$ or, $770 = \frac{22}{7} \times r\{2(h + r) + r\}$

or, $\frac{770 \times 7}{22} = r(2 \times 14 + r)$ or, $245 = 28r + r^2$ or, $r^2 + 28r - 245 = 0$

or, $r^2 + 35r - 7r - 245 = 0$ or, $r(r + 35) - 7(r + 35) = 0$ or, $(r + 35)(r - 7) = 0$

or, $r - 7 = 0$ ∴ $r = 7$

Thus, height of cylinder = 14 – r = (14 – 7) cm = 7 cm

B. QUESTIONS FROM CDC TEXT BOOKS

6.1 बेलना (CYLINDER)

1. तल दिइएका नापअनुसारको बेलनाको वक्र सतह र पूरा सतहको क्षेत्रफल निकाल्नुहोस् :
Find the curved surface and total surface area of the cylinder having given measurements:

(i) अर्धव्यास (r) = 3.5 से.मि. र उचाइ (h) = 5 से.मि. (Radius (r) = 3.5 cm, and height (h) = 5 cm).

⇨ Here, r = 3.5 cm, h = 5 cm

We know that, CSA = $2 \times \frac{22}{7} \times 3.5 \times 5 = 110$ cm^2

TSA = $2\pi r(r + h) = 2 \times \frac{22}{7} \times 3.5\,(3.5 + 5) = 187$ cm^2

Thus, CSA and TSA are 110 cm^2 and 187 cm^2.

(ii) अर्धव्यास (r) = 2.1 से.मि. र उचाइ (h) = 6 से.मि. (Radius (r) = 2.1 cm, and height (h) = 6 cm)

⇨ Here, radius (r) = 2.1 cm and height (h) = 6 cm

We know that, CSA = $2\pi rh = 2 \times \frac{22}{7} \times 2.1 \times 6 = 79.2$ cm^2

TSA = $2\pi r(r + h) = 2 \times \frac{22}{7} \times 2.1(2.1 + 5) = 93.72$ cm^2

Thus, CSA and TSA are 79.20 cm^2 and 93.72 cm^2.

(iii) अर्धव्यास (r) = 2.8 से.मि. र उचाइ (h) = 7 से.मि. (Radius (r) = 2.8 cm, and height (h) = 7 cm)

⇨ Here, radius (r) = 2.8 cm and height (h) = 7 cm

We know that, CSA = $2\pi rh = 2 \times \frac{22}{7} \times 2.8 \times 7 = 123.20$ cm^2

TSA = $2\pi r(r + h) = 2 \times \frac{22}{7} \times 2.8(2.8 + 7) = 172.48$ cm^2

Thus, the CSA and TSA and 123.20 cm^2 and 172.48 cm^2.

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(iv) अर्धव्यास (r) = 4.2 से.मि. र उचाइ (h) = 4.9 से.मि. (Radius (r) = 4.2 cm, and height (h) = 4.9 cm)

⇨ Here, radius (r) = 4.2 cm and height (h) = 4.9 cm

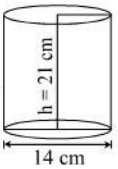
We have, $CSA = 2\pi rh = 2 \times \frac{22}{7} \times 4.2 \times 4.9 = 129.36 \text{ cm}^2$

$TSA = 2\pi r(r + h) = 2 \times \frac{22}{7} \times 4.2(4.2 + 4.9) = 240.24 \text{ cm}^2$

Thus, CSA and TSA are 129.36 cm^2 and 240.24 cm^2.

2. तल दिइएका बेलनाहरूको वक्र सतह र पूरा सतहको क्षेत्रफल निकाल्नुहोस् :
Find the curved surface and total surface area of the given cylinders:

⇨ (a) Here, diameter = 24 cm and height = 21 cm

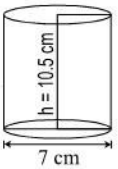


We have, $CSA = \pi dh = \frac{22}{7} \times 14 \times 21 = 924 \text{ cm}^2$

$TSA = \pi d\left(\frac{d}{2} + h\right) = \frac{22}{7} \times 14\left(\frac{14}{2} + 21\right) = 1232 \text{ cm}^2$

Thus, CSA and TSA are 924 cm^2 and 1232 cm^2 respectively.

(b) Here, diameter = 7 cm and height = 10.5 cm

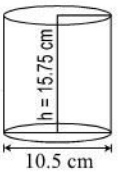


We have, $CSA = \pi dh = \frac{22}{7} \times 7 \times 10.5 = 231 \text{ cm}^2$

$TSA = \pi d\left(\frac{d}{2} + h\right) = \frac{22}{7} \times 7\left(\frac{7}{2} + 10.5\right) = 308 \text{ cm}^2$

Thus, CSA and TSA are 231 cm^2 and 308 cm^2.

(c) Here, diameter = 10.5 cm and height = 15.75 cm



We have, $CSA = \pi dh = \frac{22}{7} \times 10.5 \times 15.75 = 519.75 \text{ cm}^2$

$TSA = \pi d\left(\frac{d}{2} + h\right) = \frac{22}{7} \times 10.5 \times \left(\frac{10.5}{2} + 15.75\right) = 693 \text{ cm}^2$

Thus, CSA and TSA are 519.75 cm^2 and 693 cm^2 respectively.

3. यदि एउटा बेलनाको आधारको अर्धव्यास र उचाइको योगफल 21 से.मि. र वक्र सतहको क्षेत्रफल 616 वर्ग से.मि. भए उक्त बेलनाको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
If the sum of radius and height of a cylinder is 21 cm and curved surface area 616 cm^2, find the total surface area of the cylinder.

⇨ Here, r + h = 21 cm, CSA = 616 cm^2 ∴ $h = 21 - r$

We have, $2\pi rh = 616$ or, $2 \times \frac{22}{7} \times rh = 616$ or, $rh = 616 \times \frac{7}{44} = 98$

or, $r(21 - r) = 98$ or, $21r - r^2 = 98$ or, $-r^2 + 21r - 98 = 0$
or, $r^2 - 21r + 98 = 0$ or, $r^2 - 14r - 7r + 98 = 0$ or, $r(r - 14) - 7(r - 14) = 0$
or, $(r - 14)(r - 7) = 0$
Either, $r - 14 = 0$ or, $r - 7 = 0$
or, $r = 14$ or, $r = 7$
When r = 14 cm then h = 7 cm When r = 7 cm then h = 14 cm

When r = 7 cm and h = 14 cm, $TSA = 2\pi r(r + h) = 2 \times \frac{22}{7} \times 7(7 + 14) = 44 \times 21 = 924 \text{ cm}^2$

When r = 14 cm and r = 7 cm, $TSA = 2\pi r(r + h) = 2 \times \frac{22}{7} \times 14(14 + 7) = 88 \times 21 = 1848 \text{ cm}^2$

Thus, the TSA is 924 cm^2 or 1848 cm^2.

4. वक्र सतहको क्षेत्रफल 1848 वर्ग से.मि. तथा अर्धव्यास र उचाइको योगफल 35 से.मि. भएको कुनै बेलनाको समतल सतह र पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Calculate the plane surface and total surface area of a cylinder having the curved surface area is 1848 cm^2 and the sum of radius and height is 35 cm.

⇨ Here, CSA = 1848 cm^2, r + h = 35 cm ∴ $r = 35 - h$

We have, $2\pi rh = 1848$ or, $2 \times \frac{22}{7} \times rh = 1848$ or, $rh = 1848 \times \frac{7}{44} = 294$

or, $(35 - h)h = 294$ or, $35h - h^2 = 294$ or, $-h^2 + 35h - 294 = 0$
or, $h^2 - 35h + 294 = 0$ or, $h^2 - 14h - 21h + 294 = 0$
or, $h(h - 14) - 21(h - 14) = 0$ or, $(h - 14)(h - 21) = 0$

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Either, $h - 14 = 0$ $\Rightarrow \therefore h = 14$
or, $h - 21 = 0$ $\Rightarrow \therefore h = 21$
When $h = 14$ cm then $r = 35 - 14 = 21$ cm When $h = 21$ cm then $r = 35 - 21 = 14$ cm
When $h = 14$ cm and $r = 21$ cm,

Area of plane surfaces $= 2\pi r^2 = 2 \times \frac{22}{7} \times 21^2 = 2772 \text{ cm}^2$

Area of total surface $= 2\pi r(r + h) = 2 \times \frac{22}{7} \times 21(21 + 14) = 4620 \text{ cm}^2$

When $h = 21$ cm and $r = 14$ cm,

Area of plane surface $= 2\pi r^2 = 2 \times \frac{22}{7} \times 14^2 = 1232 \text{ cm}^2$

Area of total surface $= 2\pi r\,(r + h) = 2 \times \frac{22}{7} \times 14(14 + 21) = 3080 \text{ cm}^2$

Thus, the area of plane surface and TSA are 2772 cm^2 and 4620 cm^2 or 1232 cm^2 and 3080 cm^2

5. उचाइ र अर्धव्यासको फरक 14 से.मि. तथा तिनीहरूको योगफल 42 से.मि. भएको एउटा बेलनाको पूरा सतहको क्षेत्रफल तथा अर्धव्यास र उचाइको अनुपात निकाल्नुहोस् ।
Find the total surface and the ratio of radius and height of a cylinder having the difference between height and radius 14 cm and their sum 42 cm.

⇨ Here, $h - r = 14$ ..... (i) $h + r = 42$ ..... (ii)
Solving (i) and (ii) ;

$h - r = 14$
$h + r = 42$
$- - -$
$-2r = -28$ $\therefore$ $r = 14$ cm

From (i); $h - r = 14$ or, $h - 14 = 14$ $\therefore$ $h = 28$ cm

Now, TSA $= 2\pi r(r + h) = 2 \times \frac{22}{7} \times 14(14 + 28) = 3696 \text{ cm}^2$

And, ratio of radius and height $= \frac{r}{h} = \frac{14}{28} = \frac{1}{2} = 1 : 2$

Thus, TSA and ratio of radius and height are; 3696 cm^2 and 1 : 2 respectively.

6. एउटा बेलनाको आधारको अर्धव्यास र उचाइको अनुपात 1 : 3 र तिनीहरूको योगफल 56 से.मि. भए त्यसको वक्र सतहको क्षेत्रफल र पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
A cylinder has radius of base and height are in the ratio of 1 : 3 and their sum is 56 cm. Find its curved surface area and total surface area.

⇨ Here, let, $r = x$ then $h = 3x$ and $r + h = 56$
or, $x + 3x = 56$ or, $4x = 56$ $\therefore$ $x = 14$
Now, $r = x = 14$ cm and $h = 3x = 3 \times 14 = 42$ cm

We know that, CSA $= 2\pi rh = 2 \times \frac{22}{7} \times 14 \times 42 = 3696 \text{ cm}^2$

We have, TSA $= 2\pi r(r + h) = 2 \times \frac{22}{7} \times 14(14 + 42) = 88 \times 56 = 4928 \text{ cm}^2$

Thus, CSA and TSA are 3696 cm^2 and 4928 cm^2 respectively.

7. एउटा बेलनाकार काठको मुढाको लम्बाइ 1.5 मिटर तथा त्यसको आधारको अर्धव्यास 42 से.मि. भए उक्त काठको मुढाको आयतन कति हुन्छ ?
The length of a cylindrical wooden log is 1.5 m and its radius of base is 42 cm, what is the volume of the wooden log?

⇨ Here, length of log $(h) = 1.5$ m $= 150$ cm and Radius $(r) = 42$ cm

We know that, Volume $= \pi r^2 h = \frac{22}{7} \times 42^2 \times 150 = 831600 \text{ cm}^3$

Thus, the volume is 831600 cm^3.

8. एउटा बेलनाको वक्र सतहको क्षेत्रफल त्यसको आधारको क्षेत्रफलको दुई गुणा छ एवम् उचाइ र अर्धव्यासको योगफल 28 से.मि. छ भने उक्त बेलनाको आयतन निकाल्नुहोस् ।
The curved surface area of a cylinder is twice the area of base and the sum of radius and height is 28 cm. Find the volume of the cylinder.

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⇨ Here, CSA = 2 × area of base; r + h = 28 cm

or, $2\pi rh = 2 \times \pi r^2$ or, $2h = 2r$ ∴ $h = r$

We have, $r + h = 28$ or, $2r = 2h = 28$ [∵ r = h] ∴ $r = h = 14$ cm

Now, volume = $\pi r^2 h = \frac{22}{7} \times 14^2 \times 14 = 8624$ cm^3

Thus, the volume is 8624 cm^3.

9. एउटा बेलनाको वक्र सतहको क्षेत्रफल 924 वर्ग से.मि. तथा त्यसको आधारको अर्धव्यास र उचाइको अनुपात 1 : 3 छ। उक्त बेलनाको आधारको क्षेत्रफल र आयतन निकाल्नुहोस्।

The curved surface area of a cylinder is 924 cm^2 and its ratio of radius and height 1 : 3. Find the area of base and volume.

⇨ Here, CSA = 924 cm^2, $\frac{r}{h} = \frac{1}{3}$ ∴ $h = 3r$

We have, $2\pi rh = 924$ or, $2 \times \frac{22}{7} \times r \times 3r = 924$ or, $r^2 = 49 = 7^2$ ∴ $r = 7$

Now, area of base = $\pi r^2 = \frac{22}{7} \times 7^2 = 154$ cm^2

And volume = Area of base × height = 154 × 3r = 154 × 3 × 7 = 3234 cm^3

Thus, the area of base and volume are 154 cm^2 and 3234 cm^3 respectively.

10. अर्धव्यासको दोब्बर उचाइ भएको एउटा बेलनाको आयतन 17248 घन से.मि. छ भने उक्त बेलनाको वक्र सतहलाई बेर्न न्यूनतम कति वर्ग से.मि. कागजको आवश्यकता पर्दछ, निकाल्नुहोस्।

The volume of a cylinder having height is twice the radius is 17248 cm^3. What minimum square cm of paper is needed to cover the curved surface area of the cylinder ?

⇨ Here, h = 2r

We have, $V = \pi r^2 h$ or, $17248 = \frac{22}{7} \times r^2 \times 2r$ or, $2744 = r^3$

or, $14^3 = r^3$ ∴ $r = 14$ cm ∴ $h = 2r = 2 \times 14 = 28$ cm

Now, CSA = $2\pi rh = 2 \times \frac{22}{7} \times 14 \times 28 = 2464$ cm^2

Thus, the minimum square cm of paper required is 2464 cm^2.

11. कुनै बेलनाको आधारको क्षेत्रफल 308 वर्ग मिटर र त्यसको आयतन 1540 घन मिटर छ। सो बेलनाको आधारको परिधि र वक्र सतहको क्षेत्रफल निकाल्नुहोस्।

The area of a base of a cylinder is 308 m^2 and its volume is 1540 m^3. Find the circumference of base of the cylinder and curved surface area.

⇨ Here, Area of base = 308 m^2 and Volume = 1540 m^3

We have, Area of base × height = Volume

or, $308 \times h = V$ or, $308 \times h = 1540$ ∴ $h = 5$ m

Again, Area of base = 308 m^2

or, $\pi r^2 = 308$ or, $\frac{22}{7} \times r^2 = 308$ or, $r^2 = 98$

∴ $r = \sqrt{98} = 7\sqrt{2}$ m

Now, circumference (c) = $2\pi r = 2 \times \frac{22}{7} \times 7\sqrt{2} = 44\sqrt{2}$ m

And, CSA = $2\pi rh = 2 \times \frac{22}{7} \times 7\sqrt{2} \times 5 = 220\sqrt{2}$ m^2

Thus, the circumference and CSA are $44\sqrt{2}$ m and $220\sqrt{2}$ m^2 respectively.

12. लगभग 500 लिटर पानी अटाउने अर्धव्यास र उचाइ बराबर भएको बेलनाकार पानी ट्याङ्कीको निर्माण गर्नका लागि आवश्यक कर्कटपाताको अनुमानित क्षेत्रफल निकाल्नुहोस्।

Find the approximate area of galvanized steel sheet to construct a cylindrical water tank having equal radius and height to occupy 500 litres of water nearly.

⇨ Here, Capacity = 500 litres = 500 × 1000 cm^3 = 500000 cm^3

Let, r = h then $\pi r^2 h = 500000$ or, $\frac{22}{7} \times r^2 \times r = 500000$ or, $r^3 = 159090.9091$

∴ $r = 54.18$ cm

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We have, CSA $= 2\pi rh = 2 \times \frac{22}{7} \times 54.18 \times 54.18 = 18451.54 \text{ cm}^2$

Area of base $= \pi r^2 = \frac{22}{7} \times (54.18)^2 = 9225.77 \text{ cm}^2$

$\therefore$ The area is $(18451.54 + 9225.77) \text{ cm}^2 = 27677.31 \text{ cm}^2$

Thus, the approximate area of steel sheet is 27677.31 cm^2.

13. लम्बाइ र चौडाइ क्रमशः 21 से.मि. र 14 से.मि. भएको एउटा आयतकार कागजबाट लम्बाइ र चौडाइलाई आधार लिई क्रमशः दुई ओटा बेलना बनाउनुहोस् । ती बेलनाहरूमध्ये कुनको आयतन बढी हुन्छ, पत्ता लगाउनुहोस् ।
Two cylinders have to be made from a paper having length and breadth 21 cm and 14 cm respectively by taking the base as length and breadth. Which cylinder will have more volume ? Find it.

⇨ Here, when circumference of base is 21 cm, then height will be 14 cm.

i.e. $2\pi r = 21$ or, $2 \times \frac{22}{7} \times r = 21$ $\therefore$ $r = 3.34 \text{ cm}, h = 14 \text{ cm}$

We have, Volume (V) $= \pi r^2 h = \frac{22}{7} \times (3.34)^2 \times 14 \text{ cm}^3 = 491.11 \text{ cm}^3$

When circumference of base is 14 cm and height will be 21 cm.

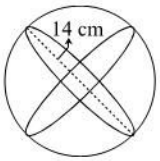
We have, $2\pi r = 14$ or, $r = \frac{14}{2\pi} = \frac{14 \times 7}{2 \times 22} = 2.22 \text{ cm}$

Volume (V) $= \pi r^2 h = \frac{22}{7} \times (2.22)^2 \times 21 = 327.41 \text{ cm}^3$

Which shows that circumference having 21 cm and height 14 cm will have more volume.

6.2 गोलाको सतहको क्षेत्रफल (SURFACE AREA OF SPHERE)

1. तल दिइएका गोला र अर्धगोलाको सतहको क्षेत्रफल र आयतन निकाल्नुहोस् :
Find the surface area and volume of given sphere and hemisphere:



⇨ (a) Here, radius (r) $= \frac{14}{2} \text{ cm} = 7 \text{ cm}$

We know that,

Surface area (A) $= 4\pi r^2 = 4 \times \frac{22}{7} \times 7^2 = 616 \text{ cm}^2$

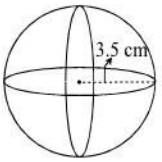
We have, Volume (V) $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 7^3 = 1437.33 \text{ cm}^3$

(b) Here, radius (r) = 3.5 cm

We have,

Surface area $= 4 \times r^2 = 4 \times \frac{22}{7}(3.5)^2 = 154 \text{ cm}^2$

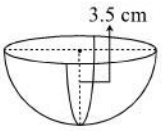
Volume $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (3.5)^3 = 179.67 \text{ cm}^3$



(c) Here, radius (r) = 3.5 cm

We have, Total surface area $= 3\pi r^2 = 3 \times \frac{22}{7} \times 3.5^2 = 115.50 \text{ cm}^3$

$\therefore$ Volume $= \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times (3.5)^3 = 89.83 \text{ cm}^3$



2. अर्धव्यास 21 से.मि. भएको एउटा गोलाको आयतन र सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the volume and surface area of a sphere having radius 21 cm.

⇨ Here, radius (r) = 21 cm

We have, Volume $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7}(21)^3 = 38808 \text{ cm}^3$

Again, Surface area $= 4\pi r^2 = 4 \times \frac{22}{7} \times (21)^2 = 5544 \text{ cm}^2$

Thus, the volume and surface area are 38808 cm^3 and 5544 cm^2 respectively.

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3. एउटा गोलाको सतहको क्षेत्रफल 1386 वर्ग से.मि. छ भने उक्त गोलाको आयतन कति हुन्छ, पत्ता लगाउनुहोस् ।
The surface area of a sphere is 1386 cm². What is the volume of the sphere ? Find it.

⇨ Here, surface area = 1386 cm^2 or, $4\pi r^2 = 1386$ or, $4 \times \frac{22}{7} \times r^2 = 1386$

or, $r^2 = 1386 \times \frac{7}{88} = 110.25$ ∴ $r = 10.50$ cm

Now, Volume $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7}(10.5)^3 = 4851\ cm^3$

Thus, the volume of the sphere is 4851 cm^3.

4. एउटा धातुको गोलाको ठुलो वृत्तको परिधि 88 से.मि. छ भने उक्त गोलाको सतहको क्षेत्रफल कति हुन्छ, निकाल्नुहोस् ।
The circumference of a great circle of a metal sphere is 88 cm. What is the surface area of the sphere ?

⇨ Here, circumference = 88 cm or, $2\pi r = 88$ or, $2 \times \frac{22}{7} \times r = 88$

or, $r = \frac{88 \times 7}{44}$ ∴ $r = 14$ cm

We have, Surface area $= 4\pi r^2 = 4 \times \frac{22}{7} \times 14^2 = 2464\ cm^2$

Thus, the surface area is 2464 cm^2.

5. एउटा अर्धगोलाकार काटिएको फलको वृत्तको परिधि 132 से.मि. छ भने त्यसको पूरा सतहको क्षेत्रफल र आयतन निकाल्नुहोस् ।
The circumference of circle of a hemispherical cut piece of a fruit is 132 cm. Find the total surface area and volume.

⇨ Here, circumference (c) = 132 cm

or, $2\pi r = 132$ or, $2 \times \frac{22}{7} \times r = 132$ ∴ $r = 21$ cm

Now, TSA $= 3\pi r^2 = 3 \times \frac{22}{7} \times 21^2 = 4158\ cm^2$

And, Volume $= \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 21^3 = 19404\ cm^3$

Thus, the TSA and volume of the sphere is 4158 cm^2 and 19404 cm^3.

6. एउटा गोलाको सतहको क्षेत्रफल 5544 वर्ग से.मि. छ भने उक्त गोलाको आयतन निकाल्नुहोस् ।
The surface area of a sphere is 5544 cm². Find the volume of the sphere.

⇨ Here, surface area = 5544 cm^2

or, $4\pi r^2 = 5544$ or, $4 \times \frac{22}{7} \times r^2 = 5544$ or, $r^2 = 5544 \times \frac{7}{88}$

or, $r^2 = 441$ ∴ $r = 21$ cm

Now, Volume (V) $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (21)^3 = 38808\ cm^3$

Thus, the volume of the sphere is 38808 cm^3.

7. एउटा अर्धगोलाको पूरा सतहको क्षेत्रफल 16632 वर्ग से.मि. छ । त्यसको ठुलो वृत्तको परिधिको लम्बाइ र आयतन कति हुन्छ, निकाल्नुहोस् ।
The total surface area of a hemisphere is 16632 cm². What is its length of circumference of great circle and volume ?

⇨ Here, TSA = 16632 cm^2

or, $3\pi r^2 = 16632$ or, $3 \times \frac{22}{7} \times r^2 = 16632$ or, $r^2 = 1764$ ∴ $r = 42$ cm

We have, Circumference $= 2\pi r = 2 \times \frac{22}{7} \times 42 = 264$ cm

And, volume $= \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7}(42)^3 = 7392\ cm^3$

Thus, the circumference & volume are 264 cm and 7392 cm^3.

8. एउटा गोलाको सतहको क्षेत्रफल र आयतनको अनुपात 3 : 7 cm छ । त्यसको ठुलो वृत्तको परिधि र आयतन कति हुन्छ, पत्ता लगाउनुहोस् ।
The surface area and volume of a sphere are in the ratio of 3 : 7 cm. What is the circumference of its great circle and volume ? Find it.

⇨ Here, $\frac{\text{Surface area}}{\text{Volume}} = \frac{3}{7}$ cm or, $\frac{4\pi r^2}{\frac{4}{3}\pi r^3} = \frac{3}{7}$ cm or, $\frac{3}{r} = \frac{3}{7}$ cm ∴ $r = 7$ cm

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Now, circumference (c) = $2\pi r = 2 \times \frac{22}{7} \times 7$ cm = 44 cm

Volume (V) = $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 7^3 = 1437.33$ cm^3

Thus, the circumference and volume are 44 cm and 1437.33 cm^3.

9. एउटा गोलाको सतहको क्षेत्रफल र आयतनको अनुपात 1 : 3 cm छ भने उक्त गोलाको व्यास र आयतन पत्ता लगाउनुहोस् ।
The ratio of surface area and volume of a sphere is 1 : 3 cm. Find the diameter and volume of the sphere.

⇨ Here, $\frac{\text{Surface area}}{\text{Volume}} = \frac{1}{3 \text{ cm}}$ or, $\frac{4\pi r^2}{\frac{4}{3}\pi r^3} = \frac{1}{3 \text{ cm}}$ or, $\frac{3}{r} = \frac{1}{3 \text{ cm}}$ ∴ r = 9 cm

We know that, Diameter = 2r = 2 × 9 cm = 18 cm

And, Volume (V) = $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 9^3 = 3054.86$ cm^3

Thus, the diameter and volume of the sphere are 18 cm and 3054.86 cm^3.

10. यदि पृथ्वीको व्यास 12950 कि.मि. छ भने पृथ्वीको आयतन र सतहको क्षेत्रफल निकाल्नुहोस् ।
The diameter of earth is 12950 km. Find the volume and surface area of the earth.

⇨ Here, diameter of earth = 12950 km

We know that, Volume (V) = $\frac{1}{6}\pi d^3 = \frac{1}{6} \times \frac{22}{7} \times (12950)^3 = 1.137581958 \times 10^{12}$ km^3

Now, surface area = $\pi d^2 = \frac{22}{7} \times (12950)^2 = 527065000$ km^2

Thus, the volume and surface area are; $1.137581958 \times 10^{12}$ km^3 and 527065000 km^2.

11. एउटा गोलाको सतहको क्षेत्रफल 49π वर्ग से.मि. भएमा त्यसको आयतन कति हुन्छ, पत्ता लगाउनुहोस् ।
The surface area of a sphere is 49π cm^2, what is its volume ? Find it.

⇨ Here, Surface area = 49π cm^2 or, $4\pi r^2 = 49\pi$

or, $r^2 = \frac{49}{4}$ ∴ $r = \frac{7}{2}$ cm

Now, Volume (V) = $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times \left(\frac{7}{2}\right)^3 = 179.67$ cm^3

Thus, the volume of the sphere is 179.67 cm^3.

12. अर्धव्यास क्रमशः 4 से.मि., 5 से.मि. र 5 से.मि. भएका तिनओटा गोलालाई पगालेर एउटै गोला बनाउँदा उक्त गोलाको आयतन कति होला ? पत्ता लगाउनुहोस् ।
Three solid spheres of iron whose radii are 4 cm, 5 cm and 5 cm respectively are melted into a single solid sphere. Find the volume of the solid sphere.

⇨ Here, let the radius of the solid sphere be R cm. Then,
We have,
Volume of the solid sphere = Sum of the volume of three spheres of radii 4 cm, 5 cm and 5 cm respectively.

So, $\frac{4}{3}\pi R^3 = \frac{4}{3}\pi(4)^3 + \frac{4}{3}\pi(5)^3 + \frac{4}{3}\pi(5)^3$

Dividing both the sides by $\frac{4}{3}\pi$

or, $R^3 = 4^3 + 5^3 + 5^3$ or, $R^3 = 314$

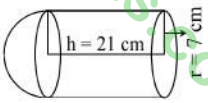
Now, Volume of new sphere = $\frac{4}{3}\pi R^3 = \frac{4}{3} \times \frac{22}{7} \times 314 = 1315.81$ cm^3

Thus, the volume is 1315.81 cm^3.

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6.3 संयुक्त ठोस (COMBINED SOLID)

1. तल दिइएका ठोस वस्तुको सतहको क्षेत्रफल र आयतन निकाल्नुहोस् :
Find the surface area and volume of following solid objects:



⇨ (a) Radius (r) = 7 cm and height (h) = 21 cm

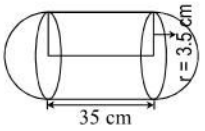
We have,

$$\text{Surface area} = 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 7(3 \times 7 + 2 \times 21)$$

$$= 22 \times 63 = 1386 \text{ cm}^2$$

$$\text{Now, Volume} = \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 7^2\left(\frac{2}{3} \times 7 + 21\right) = 3952.67 \text{ cm}^3$$

Thus, the surface area and volume are 1386 cm^2 and 3952.67 cm^3.



(b) Radius = 3.5 cm and height of cylinder (h) = 35 cm

We know that,

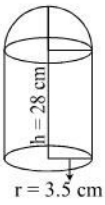
$$\text{Surface area} = 4\pi r^2 + 2\pi rh = 2\pi r(2r + h)$$

$$= 2 \times \frac{22}{7} \times 3.5(2 \times 3.5 + 35) = 924 \text{ cm}^2$$

$$\text{Again, Volume (V)} = \frac{4}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{4}{3}r + h\right) = \frac{22}{7} \times (3.5)^2\left(\frac{4}{3} \times 3.5 + 35\right)$$

$$= \frac{77}{2} \times \frac{119}{3} = 1527.17 \text{ cm}^3$$

Thus, the surface area and volume are 924 cm^2 and 1527.17 cm^3 respectively.



(c) Here, height of cylinder = 28 cm – 3.5 cm ∴ h = 24.5 cm and Radius (r) = 3.5 cm

We know that,

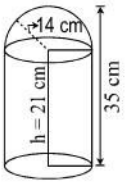
$$\text{Surface area} = 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 3.5(3 \times 3.5 + 2 \times 24.5)$$

$$= 616 \text{ cm}^2$$

$$\text{Again, Volume} = \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times (3.5)^2\left(\frac{2}{3} \times 3.5 + 24.5\right)$$

$$= 1033.08 \text{ cm}^3$$

Thus, the surface area and volume are 616 cm^2 and 1033.08 cm^3 respectively.



(d) Here, height (h) = 21 cm, radius (r) = 14 cm

We know that,

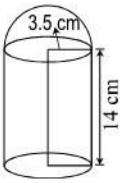
$$\text{Surface area} = 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 14(3 \times 14 + 2 \times 21)$$

$$= 44 \times 84 = 3696 \text{ cm}^2$$

$$\text{Again, Volume} = \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 14^2\left(\frac{2}{3} \times 14 + 21\right)$$

$$= 18685.33 \text{ cm}^3$$

Thus, the surface area and volume are 3696 cm^2 and 18685.33 cm^3 respectively



(e) Here radius (r) = 3.5 cm, height (h) = 14 cm

We know that,

$$\text{Surface area} = 3\pi r^2 + 2\pi rh = \pi r(3r + 2h)$$

$$= \frac{22}{7} \times 3.5(3 \times 3.5 + 2 \times 14) = \frac{847}{2} = 423.50 \text{ cm}^2$$

$$\text{Again, Volume} = \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right)$$

$$= \frac{22}{7} \times (3.5)^2\left(\frac{2}{3} \times 3.5 + 14\right) = \frac{3773}{6} = 628.83 \text{ cm}^3$$

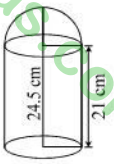
Thus, the surface area and volume are 423.50 cm^2 and 628.83 cm^3 respectively.

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(f) Here, Radius (r) = (24.5 – 21) cm = 3.5 cm, Height of cylinder (h) = 21 cm



We know that,

Surface area $= 3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h)$

$= \frac{22}{7} \times 3.5\,(3 \times 3.5 + 2 \times 21) = \frac{1155}{2} = 577.50 \text{ cm}^2$

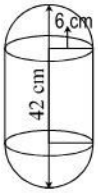
Again, Volume $= \pi r^2 h + \frac{2}{3}\pi r^3 = \pi r^2 \left(h + \frac{2}{3} r\right)$

$= \frac{22}{7} \times 3.5 \left(21 + \frac{2}{3} \times 3.5\right) = \frac{770}{3} = 256.67 \text{ cm}^3$

Thus, the surface area and volume are 577.50 cm^2 and 256.67 cm^3 respectively.

(g) Here, radius (r) = 6 cm

Height of cylinder (h) = (42 – 2 × 6) cm = 30 cm



We know that,

Surface area $= 4\pi r^2 + 2\pi rh = 2\pi r(2r + h) = 2 \times \frac{22}{7} \times 6\,(2 \times 6 + 30)$

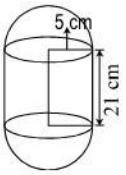
$= 1584 \text{ cm}^2$

Again, Volume (V) $= \frac{4}{3}\pi r^3 + \pi r^2 h = \pi r^2 \left(\frac{4}{3} r + h\right) = \frac{22}{7} \times 6^2 \left(\frac{4}{3} \times 6 + 30\right)$

$= 4299.43 \text{ cm}^3$

Thus, the surface area and volume are 1548 cm^2 and 4299.43 cm^3 respectively.

(h) Here, radius (r) = 5 cm and Height of cylinder (h) = 21 cm



We know that,

Surface area $= 4\pi r^2 + 2\pi rh = 2\pi r(2r + h) = 2 \times \frac{22}{7} \times 5(2 \times 5 + 21) = 974.28 \text{ cm}^2$

Again, Volume $= \pi r^2 h + \frac{4}{3}\pi r^3 = \pi r^2 \left(h + \frac{4}{3} r\right) = \frac{22}{7} \times 5^2 \left(21 + \frac{4}{3} \times 5\right)$

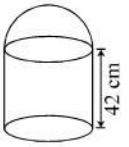
$= 2173.81 \text{ cm}^3$

Thus, the surface area and volume of the solid object are 974.28 cm^2 and 2173.81 cm^3 respectively.

2. उचाइ 42 से.मि. भएको बेलनामाथि एउटा अर्धगोला राखिएको छ, जसको वक्र सतहको क्षेत्रफल 308 वर्ग से.मि. छ। उक्त संयुक्त ठोस वस्तुको आयतन निकाल्नुहोस्।

A hemisphere whose curved surface area 308 cm^2 is placed over a cylinder having height 42 cm. Find the volume of the solid.

⇨ Here, height of cylinder (h) = 42 cm



We have given, CSA (hemisphere) = 308

or, $2\pi r^2 = 308$ or, $2 \times \frac{22}{7} \times r^2 = 308$

or, $r^2 = 49$ ∴ $r = 7$ cm

Now, volume of the solid (V) $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2 \left(\frac{2}{3} r + h\right)$

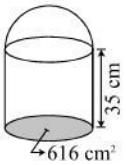
$= \frac{22}{7} \times 7^2 \left(\frac{2}{3} \times 7 + 42\right) = \frac{21560}{3} = 7186.67 \text{ cm}^3$

Thus, the volume of the solid is 7186.67 cm^3.

3. आधारको क्षेत्रफल 616 वर्ग से.मि. भएको बेलनामाथि अर्धगोला राखिएको छ। यदि बेलनाको उचाइ 35 से.मि. भए उक्त संयुक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस्।

A hemisphere is placed over a cylinder whose volume is 616 sq cm. If the height of the cylinder is 35 cm, find the total surface area of the solid object.

⇨ Here, Area of base = 616 cm^2



or, $\pi r^2 = 616$ or, $\frac{22}{7} \times r^2 = 616$

or, $r^2 = 196$ ∴ $r = 14$ cm

Now, total surface area $= 3\pi r^2 + 2\pi rh = \pi r(3r + 2h)$

$= \frac{22}{7} \times 14(3 \times 14 + 2 \times 35) = 4928 \text{ cm}^2$

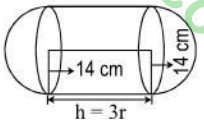
Thus, the total surface area of the solid is 4928 cm^2.

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4. अर्धव्यासको 3 गुणा उचाइ भएको बेलनाको दुवैतिर अर्धगोला राखिएका छन् यदि अर्धगोलाको अर्धव्यास 14 से.मि. भए उक्त संयुक्त ठोस वस्तुको आयतन निकाल्नुहोस् ।

Two hemispheres whose radius 14 cm are placed at the both ends of a cylinder whose height is 3 times the radius. Find the volume of the solid object.



⇨ Here, height of cylinder (h) = 3r = 3 × 14 = 42 cm

We know that, Volume (V) $= \frac{4}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{4}{3}r + h\right)$

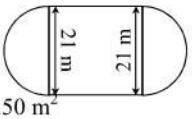
$= \frac{22}{7} \times 14^2\left(\frac{4}{3} \times 14 + 42\right) = \frac{121112}{3} = 37370.67 \text{ cm}^3$

Thus, the volume of the solid is 37370.67 cm^3.

5. आयताकार खेल मैदानको चौडाइको दुवैतिर अर्धवृत्ताकार पोखरीहरू छन्, यदि खेल मैदानको चौडाइ 21 मिटर र पोखरीको गहिराइ 1.5 मिटर भए पोखरीको दुवैतिर कति पानी अटाउँछ ? पत्ता लगाउनुहोस् ।

Two semi circular ponds are on both the sides of a rectangular play ground. If breadth of the playground is 21 m and depth of the pond 1.5 m, how many litres of water can the ponds hold ? Find it.

⇨ Here, diameter of semi circle (d) = 21 m



We know that, Area of two semi circles $= \pi r^2$

$= \pi\left(\frac{d}{2}\right)^2 = \frac{22}{7}\left(\frac{21}{2}\right)^2 = \frac{693}{2} = 346.50 \text{ m}^2$

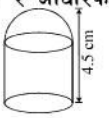
Again, Volume of the ponds = Area of ponds × depth = 346.50 m^2 × 1.5 m

$= 519.75 \text{ m}^3 = 519.75 \times 1000 \ \ell = 519750 \ \ell$

Thus, the ponds hold 519750 ℓ of water.

6. एउटा बेलनाकार ट्याङ्कीको माथिको भाग अर्ध गोलाकार छ । उक्त ट्याङ्कीको कुल उचाइ 4.5 मिटर र आधारको परिधि 22 मिटर छ भने ट्याङ्कीमा कति लिटर पानी अटाउँछ ? पत्ता लगाउनुहोस् ।

The upper part of a cylindrical tank is hemispherical. If the height of the tank is 4.5 m and circumference of base 22 m, how many litres of water, the tank can hold ?



⇨ Here, circumference of base (c) = 22 m or, $2\pi r = 22$

or, $2 \times \frac{22}{7} \times r = 22$ or, $r = \frac{7}{2} = 3.5$ m

Now, Volume $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 3.5^2\left[\frac{2}{3} \times 3.5 + (4.5 - 3.5)\right] = \frac{385}{3}$

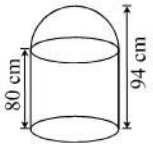
$\therefore$ Volume $= 128.33 \text{ cm}^3$

Thus, the volume of the solid is 128.33 cm^3.

7. एउटा बेलानामाथि अर्धगोला भएको ठोस वस्तुमा बेलनाको अर्धव्यास र अर्धगोलाको अर्धव्यास बराबर छन् । यदि संयुक्त ठोस वस्तुको कुल उचाइ 94 से.मि. र बेलनाको उचाइ 80 से.मि. भए सो ठोस वस्तुको पूरा सतहको क्षेत्रफल र आयतन पत्ता लगाउनुहोस् ।

A hemisphere is on the top of a cylinder in a solid object in which radius of hemisphere and cylinder are equal to each other. If the total height of the combined solid is 94 cm and height of the cylinder is 80 cm. Find the total surface area and volume of the solid.

⇨ Here, radius (r) = total height – height of cylinder = 94 cm – 80 cm = 14 cm



We know that,

TSA of the solid $= 3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h)$

$= \frac{22}{7} \times 14(3 \times 14 + 2 \times 80) = 8888 \text{ cm}^2$

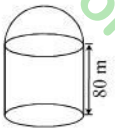
Again, Volume of the solid $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right)$

$= \frac{22}{7} \times 14^2\left(\frac{2}{3} \times 14 + 80\right) = \frac{165088}{3} = 55029.33 \text{ cm}^3$

Thus, the TSA and volume of the solid are 8888 cm^2 and 55029.33 cm^3.

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8. बेलनाको अर्धव्यास र अर्ध गोलाको अर्धव्यास बराबर भएको एउटा ठोस वस्तु छ, जसको पुरा आयतन 130284 घन से.मि. छ। यदि बेलनाको मात्र उचाइ 80 से.मि. र $r^3 = 22r^2 - 441$ भए उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।
A solid is made by a hemisphere and cylinder having equal radii. The volume of the solid is 130284 cm^3. If the height of the cylinder is 80 cm and $r^3 = 22r^2 - 441$ find the total surface area of the solid.



⇨ Here, Volume of the solid = 130284 cm^3

or, $\frac{2}{3}\pi r^3 + \pi r^2 h = 130284$

or, $\pi r^2\left(\frac{2}{3}r + h\right) = 130284$

or, $\frac{22}{7} \times r^2\left(\frac{2}{3}r + 80\right) = 130284$

or, $r^2\left(\frac{2}{3}r + 80\right) = 41454$

or, $r^2 \frac{(2r + 240)}{3} = 41454$

or, $r^2(2r + 240) = 124362$

or, $2r^3 + 240r^2 - 124362 = 0$

$\therefore \quad r^3 + 120r^2 - 62181 = 0$

Using the given condition: $[r^3 = 22r^2 - 441]$

or, $22r^2 - 441 + 120r^2 - 62181 = 0$

or, $142r^2 = 62622$

or, $r^2 = 441$

$\therefore \quad r = 21$

Now, TSA $= 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 21\,(3 \times 21 + 2 \times 80) = 14718\ cm^2$

Wihtout using condition,

or, $r^3 - 21r^2 + 141r^2 - 2961r + 2961r - 62181 = 0$

or, $r^2(r - 21) + 141r(r - 21) + 2961(r - 21) = 0$

or, $(r - 21)(r^2 + 141r + 2961) = 0$

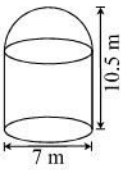
Either, $r - 21 = 0 \quad \therefore \quad r = 21$

or, $r^2 + 141r + 2961 = 0$ which gives (–)ve values so it is impossible. Since all the terms are positive.

Now, TSA $= 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 21\,(3 \times 21 + 2 \times 80) = 14718\ cm^2$

Thus, TSA of the solid is 14718 cm^2.

9. बेलना र अर्धगोलाको संयुक्त उचाइ 10.5 से.मि. तथा बेलनाको आधारको व्यास 7 से.मि. छ। उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल आयतन पत्ता लगाउनुहोस्।
The combined height of cylinder and hemisphere is 10.5 cm and diameter of base of cylinder is 7 cm. Find the total surface area and volume of the solid.



⇨ Here, radius (r) $= \frac{7}{2}$ cm = 3.5 cm and Height of cylinder (h) = (10.5 – 3.5) cm = 7 cm

We know that,

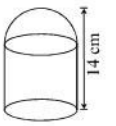
Total surface $= 3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h)$

$= \frac{22}{7} \times \frac{7}{2}\left(3 \times \frac{7}{2} + 2 \times 7\right) = 11 \times 24.5 = 269.50\ cm^2$

Again, Volume $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}\left(\frac{2}{3} \times \frac{7}{2} + 7\right) = \frac{1078}{3} = 359.33\ cm^3$

Thus, the TSA and volume of the solid are 269.50 cm^2 and 359.33 cm^3 respectively.

10. अर्धगोला र बेलनाको अर्धव्यास बराबर भएको ठोस वस्तुमा अर्धव्यास र बेलनाको उचाइको अनुपात 1 : 3 तथा तिनीहरूको योगफल 14 से.मि. छ। सो ठोस वस्तुको पूरा सतहको क्षेत्रफल र आयतन पत्ता लगाउनुहोस्।
In a solid object the radius of hemisphere and cylinder are equal. The ratio of radius and height of a cylinder is 1 : 3 and their sum 14 cm. Find the total surface area and volume of the solid.



⇨ Here, $\frac{r}{h} = \frac{1}{3} \quad \therefore \quad h = 3r \quad$ or, $\quad r + h = 14$

or, $r + 3r = 14 \quad$ or, $\quad 4r = 14 \quad \therefore \quad r = \frac{7}{2} = 3.5$ cm

and $\quad h = 3r = 3 \times \frac{7}{2} = 10.5$ cm

We know that,

TSA $= 3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h) = \frac{22}{7} \times 3.5\,(3 \times 3.5 + 2 \times 10.5) = \frac{693}{2}\ cm^2 = 346.50\ cm^2$

Now, Volume (V) $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7}(3.5)^2\left[\frac{2}{3} \times 3.5 + 10.5\right] = \frac{5929}{12} = 494.08\ cm^3$

Thus, the TSA and volume are 346.50 cm^2 and 494.08 cm^3.

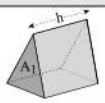
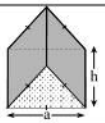
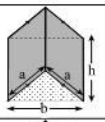
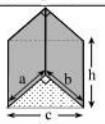
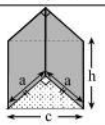
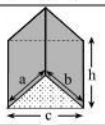
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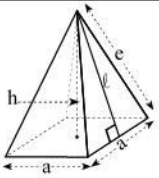
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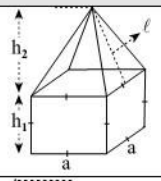
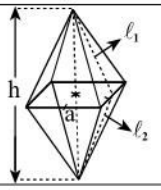
7. प्रिज्म र पिरामिड
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Formulae Key Points

	चित्र (Figure)	आधारको क्षेत्रफल Base area	आयतन Volume	सतहको क्षेत्रफल (Area of surface)	
				छड्के वा आयताकार Lateral	पूरा Total
1a		A_1	$V = A_1h$	$S = Ph$	$A = Ph + 2A_1$
1b		$A_1 = \frac{\sqrt{3}}{4}a^2$	$V = A_1 \times h$ Or $V = \frac{\sqrt{3}}{4}a^2h$	$S = P \times h$ Or $S = 3a \times h$	$A = Ph + 2A_1$ Or $A = 3ah + \frac{\sqrt{3}}{2}a^2$
2.		$A_1 = \frac{b}{4}\sqrt{4a^2 - b^2}$	$V = A_1 \times h$ Or $V = \frac{bh}{4}\sqrt{4a^2 - b^2}$	$S = Ph$ Or $S = (2a + b)h$	$A = Ph + 2A_1$ Or $A = (2a + b)\,h + \frac{b}{2}\sqrt{4a^2 - b^2}$
3.		$A_1 = \frac{1}{2}ab$	$V = A_1h$ Or $V = \frac{1}{2}abh$	$S = Ph$ Or $S = (a + b + c)h$	$A = Ph + 2A_1$ Or $A = (a + b + c)h + ab$
4.		$A_1 = \frac{1}{2}a^2$	$V = \frac{1}{2}a^2h$	$S = (2a + b)h$	$A = (2a + b)h + a^2$
5.		$A_1 = \sqrt{s(s-a)(s-b)(s-c)}$	$V = A_1h$ Or $V = h\sqrt{s(s-a)(s-b)(s-c)}$	$S = Ph$ Or $S = (a + b + c)\,h$	$A = Ph + 2A_1$ Or $A = (a + b + c)h + 2\sqrt{s(s-a)(s-b)(s-c)}$

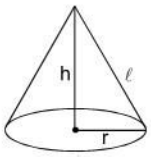
पिरामिड Pyramid	छड्के उचाइ Slant height	ठाडो उचाइ Vertical height	आयतन Volume	सतहको क्षेत्रफल (Surface Area)	
				छड्के (Lateral)	पूरा (Total)
	$\ell = \frac{1}{2}\sqrt{4h^2 + a^2}$ Or $\ell = \frac{1}{2}\sqrt{4e^2 - a^2}$	$h = \frac{1}{2}\sqrt{4\ell^2 - a^2}$ OR $h = \frac{1}{\sqrt{2}}\sqrt{2e^2 - a^2}$	$V = \frac{1}{3}a^2h$	$S = 2a\ell$	$A = 2a\ell + a^2$

संयुक्त ठोसहरू Combined Solid	आयतन Volume	छड्के सतहको क्षेत्रफल Curved Surface Area (CSA or LSA)	पूरा सतहको क्षेत्रफल (TSA) Total Surface Area (TSA)
	$V = a^2\left(h_1 + \frac{h_2}{3}\right)$	**LSA** $= 2a(2h_1 + \ell)$	**TSA** $= 4ah_1 + 2a\ell + a^2$
	$V = \frac{1}{3}a^2h$	$A = 2a(\ell_1 + \ell_2)$	$A = 2a(\ell_1 + \ell_2)$

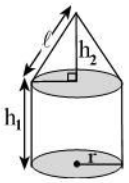
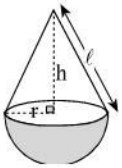
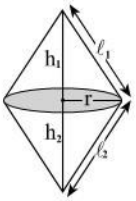
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Cone

सोली Cone	आयतन Volume	वक्रसतहको क्षेत्रफल Curved Surface Area	पूरा सतहको क्षेत्रफल Total surface area
 Cone	$V=\frac{1}{3}\pi r^2h$ or, $V=\frac{1}{3}ah$	$S=\pi r\ell$ or, $S=\frac{\pi d\ell}{2}=\frac{C\ell}{2}$	$A=\pi r\,(r+\ell)$ or, $A=\frac{C}{2}\,(r+\ell)$
	छड्के उचाइ (Slant height) $(\ell)=\sqrt{h^2+r^2}$ आधारको क्षेत्रफल (Area of base) (a) $=\pi r^2$ or $\frac{\pi d^2}{4}$ आधारको परिधि (Circumference of base) (C) $=2\pi r$ or πd		

Combined Solid

S.N.	संयुक्त ठोस Combined Solid	आयतन Volume	वक्रसतहको क्षेत्रफल Curved Surface Area	पूरा सतहको क्षेत्रफल Total surface area
1.		$V=\pi r^2\left(h_1+\frac{h_2}{3}\right)$	$S=\pi r(\ell+2h_1)$	$A=\pi r(\ell+r+2h_1)$
2.		$V=\frac{1}{3}\pi r^2(2r+h)$	$S=\pi r(2r+\ell)$	$A=\pi r(2r+\ell)$
3.		$V=\frac{1}{3}\pi r^2(h_1+h_2)$	$S=\pi r(\ell_1+\ell_2)$	$A=\pi r(\ell_1+\ell_2)$

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 5 (c)]

Q. 5.(c) एउटा सोली आकारको टेन्टको छड्के उचाइ 10 m र आधारको अर्धव्यास 7 m छ। उक्त टेन्ट बनाउन रु. 300 प्रति वर्ग मी. का दरले जम्मा कति खर्च लाग्छ ?

A conical tent has 10 m slant height and the radius of its base is 7 m. Find the cost of cloth required to make the tent at the rate of Rs. 300 per square meters.

⇨ Here, the height of tent (h) = 10 m, radius of base (r) = 7 m and rate of tent making = Rs 300/m^2

We know that, CSA of cone $=\pi r\ell=\frac{22}{7}\times 7\times 10\ m^2=220\ m^2$

We have, cost required = Rs. 300×220 = Rs. 66000

Thus, Rs 66000 is required to make the tent.

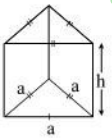
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7.1 प्रिज्म (PRISM)

A. BASIC EXERCISE 7.1

A. VERY SHORT QUESTIONS

1. दिइएको समबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has equilateral triangular base. Find the following:



(a) क्रस सेक्सनको क्षेत्रफल (Area of cross section)
(b) छड्के सतहको क्षेत्रफल (Lateral surface area)
(c) पूरा सतहको क्षेत्रफल (Total surface area) (d) आयतन (Volume)

⇨ Here, length of equal side = a
Height of prism = h

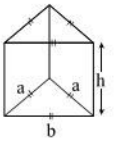
Now, (a) Area of cross section $= \frac{\sqrt{3}}{4} a^2$

(b) Lateral surface area = 3ah

(c) Total surface area $= 2 \times \frac{\sqrt{3}}{4} a^2 + 3ah = \frac{\sqrt{3}}{2} a^2 + 3ah$

(d) Volume $= \frac{\sqrt{3}}{4} a^2 h$

2. दिइएको समद्विबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has isosceles triangular base. Find the following:



(a) क्रस सेक्सनको क्षेत्रफल (Area of cross section)
(b) छड्के सतहको क्षेत्रफल (Lateral surface area)
(c) पूरा सतहको क्षेत्रफल (Total surface area) (d) आयतन (Volume)

⇨ Here, common side of isosceles triangle = a, base = b and height of prism = h
Now,

(a) Area of cross section $= \frac{b}{4}\sqrt{4a^2 - b^2}$ (b) Lateral surface area = (2a + b) × h

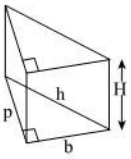
(c) Total surface area $= \frac{2b}{4}\sqrt{4a^2 - b^2} + (2a + b) \times h$ (d) Volume $= \frac{b}{4}\sqrt{4a^2 - b^2} \times h$

3. दिइएको विषमबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has scalene triangular base. Find the following:

(a) आधारको परिमिति (Perimeter of base)
(b) वक्र सतहको क्षेत्रफल (Curved surface area)
(c) क्रस सेक्सनको क्षेत्रफल (Area of cross section) (d) आयतन (volume)
(e) पूरा सतहको क्षेत्रफल (Total surface area)

⇨ Here, height of prism = h
Now, (a) Perimeter of base = a + b + c (b) Curved surface area = (a + b + c) × h
(c) Area of cross section $= \sqrt{s(s-a)(s-b)(s-c)}$ (d) Volume $= \sqrt{s(s-a)(s-b)(s-c)} \times h$
(e) Total surface area $= (a + b + c)\, h + 2\sqrt{s(s-a)(s-b)(s-c)}$

4. दिइएको समकोणी त्रिभुजाकार आधार भएको प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
In the given right-angled triangle based prism, find the following:



(a) आधारको परिमिति (Perimeter of base)
(b) वक्र सतहको क्षेत्रफल (Curved surface area)
(c) क्रस सेक्सनको क्षेत्रफल (Area of cross section)
(d) आयतन (Volume) (e) पूरा सतहको क्षेत्रफल (Total surface area)

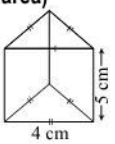
⇨ Here,
(a) Perimeter of base = p + b + h (b) Curved surface area = (p + b + h)H
(c) Area of cross section $= \frac{1}{2} \times b \times p$ (d) Volume $= \frac{1}{2}$ bpH
(e) Total surface area $= 2.\frac{1}{2}$ bpH + (p + b + h)H

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B. SHORT QUESTIONS

MODEL 1

1. दिइएको समबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has equilateral triangular base. Find the following:
(a) क्रस सेक्सनको क्षेत्रफल (Area of cross section) **(b) छड्के सतहको क्षेत्रफल (Lateral surface area)**



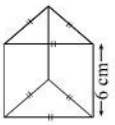
⇨ Here, side of equilateral triangularal base (a) = 4 cm
Height of triangular prism (h) = 5 cm
We know that,

(a) Area of cross section $= \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} 4^2 = 4\sqrt{3}$ cm^2

(b) Lateral surface area = 3ah = 3 × 4 × 5 = 60 cm^2

Thus, area of cross section is $4\sqrt{3}$ cm^2 and lateral surface area is 60 cm^2.

2. यदि एउटा समबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा आधारको क्षेत्रफल र परिमिति क्रमशः $4\sqrt{3}$ cm² र 12 cm भए निम्नलिखित पत्ता लगाउनुहोस् ।
If the area and perimeter of base of an equilateral triangular prism are $4\sqrt{3}$ cm² and 12 cm respectively, find the following:
(a) पूरा सतहको क्षेत्रफल (Total surface area) **(b) आयतन (Volume)**



⇨ Here, area of base of triangular prism = $4\sqrt{3}$ cm^2

or, $\frac{\sqrt{3}}{4} a^2 = 4\sqrt{3}$ or, $a^2 = 4 \times 4$ ∴ a = 4 cm

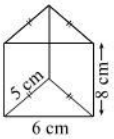
Also, perimeter of base = 12 cm and height of prism = 6 cm
Now,

(a) Total surface area $= 2 \times \frac{\sqrt{3}}{4} a^2 + 3ah = 2 \times 4\sqrt{3} + 12 \times 6 = (72 + 8\sqrt{3})$ cm^2

(b) Volume $= \frac{\sqrt{3}}{4} a^2 h = 4\sqrt{3} \times 6 = 24\sqrt{3}$ cm^3

Thus, TSA is $(72 + 8\sqrt{3})$ cm^2 and volume is $24\sqrt{3}$ cm^3.

3. दिइएको समद्विबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has isosceles triangular base. Find the following:
(a) क्रस सेक्सनको क्षेत्रफल (Area of cross section)
(b) छड्के सतहको क्षेत्रफल (Lateral surface area)



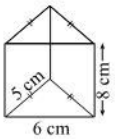
⇨ Here, common side of isosceles triangle (a) = 5 cm
base of isosceles triangle (b) = 6 cm
height of prism (h) = 8 cm
We know that,

(a) Area of cross section $= \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{6}{4}\sqrt{4 \times 5^2 - 6^2} = \frac{6}{4}\sqrt{100 - 36} = \frac{6}{4} \times 8 = 12$ cm^2

(b) Lateral surface area = (2a + b) × h = (2 × 5 + 6) × 8 = 16 × 8 = 128 cm^2

Thus, area of cross scetion is 12 cm^2 and lateral surfacce area is 128 cm^2.

4. यदि दिइएको त्रिभुजाकार प्रिज्मको आधारको क्षेत्रफल र परिमिति क्रमशः 12 cm² र 16 cm भए निम्नलिखित पत्ता लगाउनुहोस् ।
If the area and perimeter of base of a triangular prism are 12 cm² and 16 cm respectively, find the following:
(a) पूरा सतहको क्षेत्रफल (Total surface area) **(b) आयतन (Volume)**



⇨ Here, area of base of an isosceles triangular prism = 12 cm^2 i.e. $\frac{b}{4}\sqrt{4a^2 - b^2} = 12$ cm^2

Perimeter of base of an isosceles triangular prism = 16 cm i.e. 2a + b = 16 cm
Height of prism (h) = 8 cm
We know that,

(a) Total surface area $= \frac{2b}{4}\sqrt{4a^2 - b^2} + (2a + b) \times h = 2 \times 12 + 16 \times 8 = 24 + 128 = 152$ cm^2

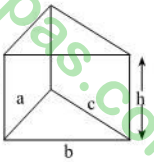
(b) Volume of prism $= \frac{b}{4}\sqrt{4a^2 - b^2} \times h = 12 \times 8 = 96$ cm^3

Thus, TSA is 152 cm^2 and volume is 96 cm^3.

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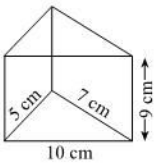
5. दिइएको विषमबाहु त्रिभुजाकार आधार भएको त्रिभुजाकार प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
Given triangular prism has scalene triangular base. Find the following:



(a) आधारको परिमिति (Perimeter of base) (b) वक्र सतहको क्षेत्रफल (Curved surface area)

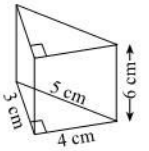
(c) यदि क्रस सेक्सनको क्षेत्रफल 16.25 cm^2 भए आयतन पत्ता लगाउनुहोस् ।
If the area of cross section is 16.25 cm^2 then find the volume.

(d) यदि क्रस सेक्सनको क्षेत्रफल 16.25 cm^2 तथा आधारको परिमिति 22 cm भए पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the area of cross section is 16.25 cm^2 and the perimeter of base is 22 cm then find the total surface area.



⇨ Here, a = 5 cm, b = 7 cm, c = 10 cm and height (h) = 9 cm
We know that,
(a) Perimeter of base = a + b + c = (5 + 7 + 10) cm = 22 cm
(b) Curved surface area = (a + b + c) × h = 22 × 9 = 198 cm^2
(c) If cross sectional area = 16.25 cm^2 then,
Volume = cross sectional area × height = 16.25 × 9 = 146.25 cm^2
(d) Here, cross scetional area = 16.25 cm^2 and perimeter of base = 22 cm
Now, total surface area = 2 × cross scetional area + perimeter × height
= 2 × 16.25 + 22 × 9 = 32.5 + 198 = 230.5 cm^2

6. दिइएको समकोणी त्रिभुजाकार आधार भएको प्रिज्ममा निम्नलिखित पत्ता लगाउनुहोस् ।
In the given right-angled triangle based prism, find the following:



(a) आधारको परिमिति (Perimeter of base) (b) वक्र सतहको क्षेत्रफल (Curved surface area)

(c) क्रस सेक्सनको क्षेत्रफल (Cross section area)

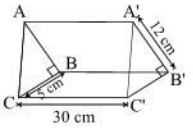
(d) यदि p × b × H = 2 (आयतन) भए आयतन पत्ता लगाउनुहोस् । (If p × b × H = 2 (Volume), then find the volume.)

(e) यदि क्रस सेक्सनको क्षेत्रफल 6 cm^2 तथा आधारको परिमिति 12 cm भए पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the area of cross section is 6 cm^2 and the perimeter of base is 12 cm then find the total surface area.

⇨ Here, p = 3 cm, b = 4 cm, h = 5 cm and H = 6 cm
we know that,
(a) Perimeter of base = p + b + h = (3 + 4 + 5)cm = 12 cm.
(b) Curved surface area = P × H = 12 × 6 = 72 cm^2
(c) Area of cross section = $\frac{1}{2}$ × b × p = $\frac{1}{2}$ × 3 × 4 = 6 cm^2
(d) Here, p × b × H = 2 volume ∴ volume = $\frac{3 \times 4 \times 6}{2}$ = 36 cm^2
(e) Here, area of cross section = 6 cm^2 i.e. $\frac{1}{2}$ bp = 6 cm^2
perimeter of base (p + b + h) = 12 cm
Now, total surface area = 2 × area of cross section + PH = 2 × 6 + 12 × 6 = 12 + 72 = 84 cm^2

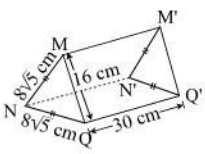
MODEL 2

1. दिइएको त्रिभुजाकार प्रिज्ममा ∠B = 90°, BC = 5 से.मि., A'B' = 12 से.मि. र CC' = 30 से.मि. छन् भने सो प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
In the given triangular Prism, ∠B= 90°, BC = 5 cm, A'B' = 12 cm and CC' = 30 cm, find the volume of the prism. [2070 E]



⇨ Here, area of base = $\frac{1}{2}$ × 5 cm × 12 cm = 30 cm^2
We know that, volume of prism = base area × height = 30 cm^2 × 30 cm = 900 cm^3
Thus, the volume of the prism is 900 cm^3.

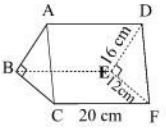
2. दिइएको चित्र समद्विबाहु त्रिभुज आधार भएको प्रिज्म हो । यदि MN = NQ = $8\sqrt{5}$ से.मि., MQ = 16 से.मि. र प्रिज्मको उचाइ QQ' = 30 से.मि. भए उक्त प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
The given figure is an isosceles triangle based prism. If MN = NQ = $8\sqrt{5}$ cm, MQ = 16 cm and the height of the prism QQ' = 30 cm, find the volume of the prism. [2072 MW]



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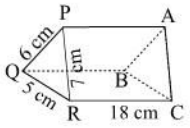
⇨ Here, length of equal side (a) = $8\sqrt{5}$ cm
Length of base side (b) = 16 cm and height of prism (h) = 30 cm
We know that, base area = $\frac{b}{4}\sqrt{4a^2 - b^2} = \frac{16}{4}\sqrt{4 \times (8\sqrt{5})^2 - 16^2} = 3 \times 32 = 96$ cm^2
Now, volume of prsim = base area × height = 96 cm^2 × 30 cm = 2880 cm^3
Thus, the volume of the prism is 2880 cm^3.

3. दिइएको प्रिज्ममा DE ⊥ EF, DE = 16 से.मि., EF = 12 से.मि. र लम्बाइ CF = 20 से.मि. हुँदा यसको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the given prism; Where, DE ⊥ EF, DE = 16 cm, EF = 12 cm and the length of the prism CF = 20 cm. [2067 A]



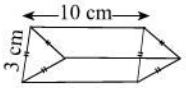
⇨ Here, volume of prism = Base area × height = $\left(\frac{1}{2}\text{DE} \times \text{EF}\right) \times \text{CF} = \frac{1}{2} \times 16 \times 12 \times 20 = 1920$ cm^3
Thus, the volume of the prism is 1920 cm^3.

4. दिइएको त्रिभुजाकार प्रिज्ममा PQ = 6 cm, PR = 7 cm, QR = 5 cm र RC = 18 cm भए सो प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
In the given triangular prism, PQ = 6 cm, PR = 7 cm, QR = 5 cm and RC = 18 cm. Find the volume of the prism. [2068 C]



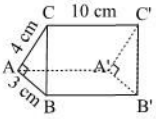
⇨ Here, a = 6 cm, b = 7 cm, c = 5 cm and h = 18 cm So, $s = \frac{(a+b+c)}{2} = \frac{6+7+5}{2} = 9$ cm
Area of base triangle (A) = $\sqrt{s(s-a)(s-b)(s-c)} = \sqrt{9(9-6)(9-7)(9-5)} = \sqrt{9 \times 3 \times 2 \times 4}$
∴ A = 14.69 cm^2
Now, volume of the prism = A × h = 14.69 × 18 = 264.54 cm^3
Thus, the volume of the prism is 264.54 cm^3.

5. दिइएको त्रिभुजाकार प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the given triangular prism. [2067 E]



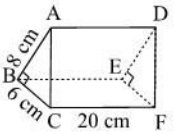
⇨ Here, Area of base of prism = $\frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times 3^2 = \frac{9\sqrt{3}}{4}$
Now, volume of the prism = Area of base × height = $\frac{9\sqrt{3}}{4} \times 10 = \frac{45\sqrt{3}}{2}$ cm^3
Thus, the volume of the prism is $\frac{45\sqrt{3}}{2}$ cm^3.

6. दिइएको प्रिज्मको आयतन पत्ता लगाउनुहोस् । जहाँ AB = 3 cm, AC = 4 cm र CC' = 10 cm छ ।
Find the volume of given triangular prism where AB = 3 cm, AC = 4 cm, and CC' = 10 cm. [SLC 2066 B]



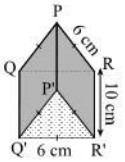
⇨ Here, AB = 3 cm, AC = 4 cm and CC' = 10 cm
We know that, volume of the prism = $\frac{1}{2}$ AC × AB × CC' = $\frac{1}{2} \times 4 \times 3 \times 10 = 60$ cm^3
Thus, the volume of the prism is 60 cm^3.

7. दिइएको त्रिभुजाकार प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the given triangular prism. [SLC 2066 A]



⇨ Here, volume of the given prism
= $\frac{1}{2}$ AB × BC × CF = $\frac{1}{2} \times 8$ cm × 6 cm × 20 cm = 480 cm^3
Thus, the volume is 480 cm^3.

8. दिइएको त्रिभुजाकार प्रिज्मको आयतन निकाल्नुहोस् ।
Find the volume of given triangular prism. [SLC 2066 C]



⇨ Here, length of base (a) = 6 cm and height of prism (h) = 10 cm
We know that,
The volume of equilateral based prism = $\frac{\sqrt{3}}{4}a^2h = \frac{\sqrt{3}}{4} \times 6^2 \times 10 = 90\sqrt{3}$ cm^3
Thus, the volume is $90\sqrt{3}$ cm^3.

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9. एउटा प्रिज्मको उचाइ 15 cm छ र उक्त प्रिज्मको आधार 6 cm, 8 cm र 10 cm भुजाहरू भएको त्रिभुज छ भने सो प्रिज्मको आयतन पत्ता लगाउनुहोस् ।
If a prism is 15 cm high with its base a triangle having sides 6 cm, 8 cm and 10 cm, find its volume. **[2057 E2]**

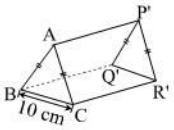
⇨ Here, in the triangular base of prism, $(6\text{ cm})^2 + (8\text{ cm})^2 = (10\text{ cm})^2$
Hence, base triangle is right angled triangle.

Area of base (A) = area of rt. angled triangle $= \frac{1}{2} \times 6\text{ cm} \times 8\text{ cm} = 24\text{ cm}^2$

Height of prism (h) = 15 cm
Thus, volume of prism = A × h = $24\text{ cm}^2 \times 15\text{ cm} = 360\text{ cm}^3$

MODEL 3

10. दिइएको समद्विबाहु त्रिभुज आधार भएको प्रिज्ममा AB = AC = 7.5 से.मि., BC = 10 से.मि. र यसको आयतन 1250 घन से.मि. भए प्रिज्मको उचाइ पत्ता लगाउनुहोस् ।
In the given isosceles triangle based prism, AB = AC = 7.5 cm, BC = 10 cm and its volume is 1250 cu. cm, then find the height of the prism. **[2072 E]**



⇨ Here, length of base (b) = 10 cm, length of equal side (a) = 7.5 cm
Volume of the prism (V) = 1250 cm^3

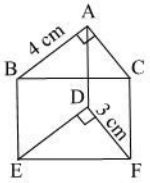
We know that, area of base $= \frac{b}{4}\sqrt{4a^2 - b^2} = \frac{10}{4}\sqrt{4 \times (7.5)^2 - 10^2} = \frac{10}{4} \times \sqrt{125} = \frac{25\sqrt{5}}{2}$

Now, base area × height = volume

or, $\frac{25\sqrt{5}}{2} \times h = 1250$ or, $h = 1250 \times \frac{2}{25\sqrt{5}} = 20\sqrt{5}$ cm

Thus, the height is $20\sqrt{5}$ cm.

11. दिइएको चित्रमा, त्रिभुजाकार प्रिज्मको आयतन 18 घन से.मि., AB = 4 से.मि. र DF = 3 से.मि. भए प्रिज्मको उचाइ निकाल्नुहोस् ।
In the given figure, the volume of a triangular prism is 18 cm³, AB = 4 cm and DF = 3 cm, find the height of prism. **[SLC 2065 E]**

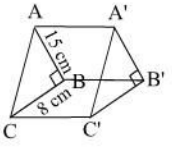


⇨ Here, volume = 18 cm^3, AB = 4 cm and DF = 3 cm
We know that, Volume (prism) $= \frac{1}{2}$AB × AC × height

or, $18 = \frac{1}{2} \times 4 \times 3 \times \text{height}$ or, $\frac{18 \times 2}{4 \times 3} = \text{height}$ ∴ Height = 3 cm

Thus, height of the prism is 3 cm.

12. दिइएको चित्र त्रिभुजाकार प्रिज्म हो, जसको आयतन 1800 घन से.मि. छ । यदि AB = 15 से.मि., BC = 8 से.मि. र ∠ABC = 90° भए प्रिज्मको लम्बाइ पत्ता लगाउनुहोस् ।
Given figure is a triangular prism whose volume is 1,800 cubic cm. If AB = 15 cm, BC = 8 cm and ∠ABC = 90°, find the length of the prism. **[SLC 2065 B]**

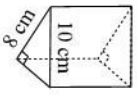


⇨ Here, volume (prism) = 1800 cm^3 and AB = 15 cm and BC = 8 cm
We know that; V(prism) $= \frac{1}{2}$ AB × BC × length

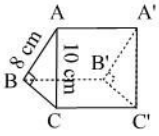
or, $1800 = \frac{1}{2} \times 15 \times 8 \times \text{length}$ ∴ $\text{length} = \frac{1800 \times 2}{15 \times 8} = 30$

Thus, the length is 30 cm.

13. चित्रमा देखाइएको त्रिभुजाकार आधार भएको प्रिज्मको आयतन 480 घन से.मि. भए, प्रिज्मको उचाइ पत्ता लगाउनुहोस् ।
The given diagram is a solid prism of triangular base. If the volume of the prism is 480 cm³, find its height. **[2065 C]**



⇨ Here, from the figure, $BC = \sqrt{AC^2 - AB^2} = \sqrt{10^2 - 8^2}$ ∴ BC = 6 cm
Now, Volume of the prism $= \frac{1}{2}$ AB × BC × height

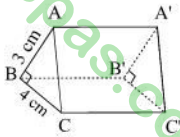


or, $480 = \frac{1}{2} \times 8 \times 6 \times \text{Height}$ or, $\frac{960}{8 \times 6} = \text{Height}$

∴ Height = 20 cm Thus, height of the prism is 20 cm.

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14. चित्रमा देखाइएको प्रिज्मको उचाइ कति बनाइयो भने आयतन 48 cm³ होला ?
What height of the prism shown in the figure makes its volume 48 cm³. [2067 D]

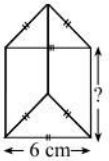


⇨ Here, AB = 3 cm, and BC = 4 cm
We know that, Base area × height = V(Prism)

or, $\frac{1}{2}$ AB × BC × height = 48 or, $\frac{1}{2} \times 3 \times 4 \times \text{height} = 48$

or, height = 8 cm Thus, the height is 8 cm.

15. दिइएको चित्र समबाहु त्रिभुजाकार प्रिज्मको हो। यदि उक्त प्रिज्मको आधारको भुजाको लम्बाइ 6 से.मि र आयतन 162 cm³ छन् भने उचाइ पत्ता लगाउनुहोस् ।
The given figure is of a equilateral triangular prism. If the length of side of the base is 6 cm and volume 162 cubic cm, find the height. [2068 B]



⇨ Here, length of equilateral base (a) = 6 cm

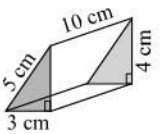
We know that, Volume of the prism = $\frac{\sqrt{3}}{4} a^2 h$

or, $162 = \frac{\sqrt{3}}{4} \times 6^2 \times h$ or, $\frac{162 \times 4}{\sqrt{3} \times 36} = h$

∴ h = 10.39
Thus, the height of the prism is 10.39.

MODEL 4

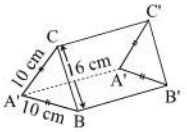
16. चित्रमा दिइएको त्रिभुजाकार प्रिज्मको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the total surface area of a triangular prism given in the figure. [SLC 2066 E]



⇨ Here, area of base (A_1) = $\frac{1}{2}$ 3 cm × 4 cm = 6 cm²

Perimeter of base (P) = 3 cm + 4 cm + 5 cm = 12 cm
We know that, total surface area of prism = $Ph + 2A_1 = 12 \times 10 + 2 \times 6 = 132$ cm²
Thus, the total surface area of given prism is 132 cm².

17. दिइएको त्रिभुजाकार प्रिज्ममा AB = AC = 10 से.मि., BC = 16 से.मि. र यसको पूरा सतहको क्षेत्रफल 816 वर्ग से.मि. छ भने यसको उचाइ पत्ता लगाउनुहोस् ।
In the given triangular prism, AB = AC = 10 cm, BC = 16 cm and its total surface area is 816 sq. cm, find the height of the prism. [2072 W]



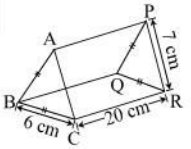
⇨ Here, length of equal side (a) = 10 cm, length of base (b) = 16 cm and
Total surface area (A) = 816 cm²

We know that, base area (A) = $\frac{b}{4}\sqrt{4a^2 - b^2} = \frac{16}{4}\sqrt{4 \times 10^2 - 16^2} = 4 \times 12 = 48$ cm²

Again, perimeter of base (P) = 2a + b = 2 × 10 + 16 = 36 cm
Now, Ph + 2A = TSA or, 36 × h + 2 × 48 = 816
or, 36 × h = 720 ∴ h = 20 cm
Thus, the height of the prism is 20 cm.

MODEL 5

18. दिइएको चित्रमा AB = BC = 6 से.मि. र PR = 7 से.मि. छन्। यदि प्रिज्मको लम्बाइ 20 से.मि. भए, उक्त प्रिज्मको आयताकार सतहहरूको क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure AB = BC = 6 cm and PR = 7 cm. If the length of prism is 20 cm, find the area of rectangular surfaces of the prism. [2072 C]



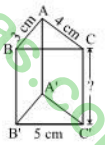
⇨ Here, length of equal side (a) = 6 cm, length of base (b) = 7 cm and height of prism (h) = 20 cm
We know that, lateral surface area = Ph = (2a + b)h = (2 × 6 + 7) × 20 = 19 × 20 = 380 cm²
Thus, the lateral surface area is 380 cm².

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19. दिइएको ठोस त्रिभुजाकार प्रिज्ममा यदि AB = 3 से.मि., AC = 4 से.मि., B'C' = 5 से.मि. र आयताकार सतहहरूको क्षेत्रफल 240 वर्ग से.मि. छन् भने CC' को नाप पत्ता लगाउनुहोस् ।

In the given solid triangular prism, if AB = 3 cm, AC = 4 cm, B'C' = 5 cm and the area of the rectangular surfaces is 240 sq. cm, find the measurement of CC'. **[2071 D]**



⇨ Here, AB = 3 cm, AC = 4 cm, B'C' = 5 cm and Ar. (rectangular surface) = 240 cm^2

We know that, Area of rectangular surface = Ph

or, Ph = 240 or, (AB + BC + AC). CC' = 240

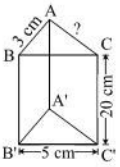
or, (3 + B'C' + 4). CC' = 240 or, (3 + 5 + 4). CC' = 240

or, 12 × CC' = 240 ∴ CC' = 20 cm

Thus, the measurement of CC' is 20 cm.

20. दिइएको ठोस त्रिभुजाकार प्रिज्ममा, AB = 3 से.मि., B'C' = 5 से.मि. र CC' = 20 से.मि. छन् । यदि उक्त प्रिज्मको आयताकार सतहहरूको क्षेत्रफल 240 वर्ग से.मि. छ भने AC को नाप पत्ता लगाउनुहोस् ।

In the given solid triangular prism, AB = 3 cm, B'C' = 5 cm and CC' = 20 cm. If the area of the rectangular surfaces of the prism is 240 sq. cm, find the measurement of AC. **[2071 C]**



⇨ Here, AB = 3 cm, B'C' = 5 cm, CC' = 20 cm & area of rectangular faces = 240 cm^2

We know that, Area of rectangular faces = 240 cm^2

or, Ph = 240 or, (AB + BC + AC). h = 240

or, (3 + 5 + AC) . 20 = 240 or, (8 + AC) = 12

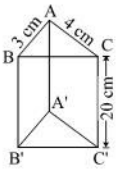
or, AC = 12 – 8 ∴ AC = 4 cm

Thus, the measurement of AC is 4 cm.

21. दिइएको ठोस त्रिभुजाकार प्रिज्ममा AB = 3 से.मि., AC = 4 से.मि. र CC' = 20 से.मि. छन् । यदि उक्त प्रिज्मको आयताकार सतहहरूको क्षेत्रफल 240 वर्ग से.मि. छ भने BC को लम्बाइ निकाल्नुहोस् ।

In the given solid triangular prism, AB = 3 cm, AC = 4 cm and CC' = 20 cm. If the area of the rectangular surfaces of the prism is 240 sq.cm, find the length of BC.

[2071 D]



⇨ Here, AB = 3 cm, AC = 4 cm and CC' = 20 cm

We know that, area of rectangular surface = Ph

or, 240 = (AB + AC + BC) × CC' or, 240 = (3 + 4 + BC) × 20

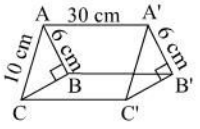
or, 12 = 7 + BC ∴ BC = 5 cm

Thus, the length of BC is 5 cm.

C. LONG QUESTIONS

1. दिइएको त्रिभुजाकार प्रिज्मको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

Find the total surface area of the given triangular prism. **[2057 B2]**



⇨ Here, in the base triangle ABC

$BC = \sqrt{AC^2 - AB^2} = \sqrt{(10^2 - 6^2)\ cm^2} = 8$ cm

Now, $s = \frac{a+b+c}{2} = \frac{8+10+5}{2}$ cm = 12 cm

Area of Δ ABC $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{12\ (12-8)\ (12-10)\ (12-6)}\ cm^2$

$= \sqrt{12 \times 4 \times 2 \times 6} = 24\ cm^2$

Total surface area of given prism = perimeter × height + 2 × area of ABC

= (a + b + c) × 30 cm + 2 × 24 cm^2

= (8 cm + 10 cm + 6 cm) × 30 cm + 48 cm^2

= 720 cm^2 + 48 cm^2 = 768 cm^2

Thus, the total surface area is 768 cm^2.

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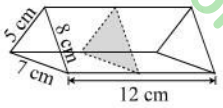
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B. QUESTIONS FROM CDC TEXT BOOKS

1. तलका प्रिज्महरूको क्रस सेक्सन, छड्के सतह र पूरा सतहको क्षेत्रफल निकाल्नुहोस् :
Find the cross section area, lateral surface area and the total surface area of the following prism:

⇨ (a) Here, a = 5 cm, b = 7 cm and c = 8 cm



So, $s = \frac{a+b+c}{2} = \frac{5+7+8}{2} = \frac{20}{2} = 10$ cm

We have,

Cross section area $= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{10(10-5)(10-7)(10-8)}$

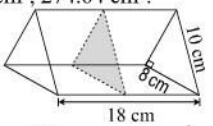
$= \sqrt{10 \times 5 \times 3 \times 2} = 10\sqrt{3}$ cm^2

Lateral surface area $= Ph = (a+b+c)\,h = (5+7+8) \times 12 = 240$ cm^2

Total surface area $= Ph + 2A = 240 + 2 \times 10\sqrt{3} = 240 + 20\sqrt{3} = 274.64$ cm^2

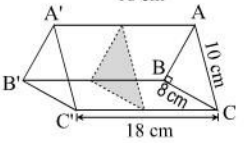
Thus, cross section, lateral surface and total surface area are $10\sqrt{3}$ cm^2, 240 cm^2, 274.64 cm^2.

(b) Here, $AB = \sqrt{AC^2 - BC^2} = \sqrt{10^2 - 8^2} = 6$ cm



(i) Area of cross section $= \frac{1}{2}$ AB × BC

$= \frac{1}{2}$ 6 cm × 8 cm = 24 cm^2



(ii) Area of lateral surface $= Ph$

$= (AB + BC + AC) \times 18$ cm

$= (6$ cm $+ 8$ cm $+ 10$ cm$) \times 18$ cm

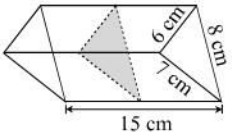
$= 432$ cm^2

(iii) Total surface area $= Ph + 2A = (432 + 2 \times 24)$ cm$^2 = 480$ cm^2

Thus, the CSA = 24 cm^2, LSA = 432 cm^2 and TSA = 480 cm^2.

(c) Here, the sides of a triangular base are:

a = 6 cm, b = 7 cm and c = 8 cm



So, $s = \frac{a+b+c}{2} = \frac{6+7+8}{2} = \frac{21}{2} = 10.5$ cm

(i) Area of cross section $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{10.5\,(10.5-6)\,(10.5-7)\,(10.5-8)}$

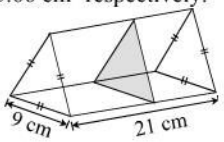
$= \sqrt{10.5 \times 4.5 \times 3.5 \times 2.5} = \sqrt{413.44} = 20.33$ cm^2

(ii) LSA $= Ph = 21 \times 15 = 315$ cm^2

(iii) Total surface area $= Ph + 2A = 315 + 2 \times 20.33 = 355.66$ cm^2

Thus, the cross section area, LSA and TSA are 20.33 cm^2, 315 cm^2 and 355.66 cm^2 respectively.

(d) Here, length of base (a) = 9 cm



(i) Area of cross section $(A_1) = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times 9^2 = 35.07$ cm^2

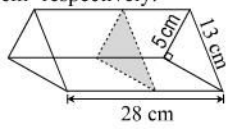
(ii) Lateral surface area $= Ph = 3 \times a \times h = 3 \times 9 \times 21 = 567$ cm^2

(iii) Total surface area $= Ph + 2A_1 = 567 + 2 \times 35.07 = 637.14$ cm^2

Thus, the area of cross section, LSA and TSA are 35.07 cm^2, 567 cm^2 and 637.14 cm^2 respectively.

2. तलका प्रिज्महरूको आयतन निकाल्नुहोस् (Find the volume of the following prisms):

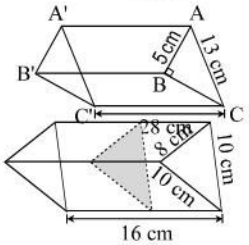
(a) Here, BC $= \sqrt{AC^2 - AB^2} = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = 12$ cm



We have, Volume $= \frac{1}{2}$ AB × BC × CC' $= \frac{1}{2} \times 5 \times 12 \times 28 = 840$ cm^3

Thus, the volume of the prism is 840 cm^3.

(b) Here, let the sides of base are: a = 8 cm, b = 10 cm and c = 10 cm



We know that, $s = \frac{a+b+c}{2} = \frac{8+10+10}{2} = 14$ cm

Area of base $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{14(14-8)(14-10)(14-10)}$

$= \sqrt{14 \times 6 \times 4 \times 4} = 8\sqrt{21}$ cm^2

Now, Volume = Area of base × height $= 8\sqrt{21} \times 16 = 586.57$ cm^3

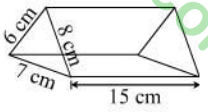
Thus, the volume of the prism is 586.57 cm^3.

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3. आधारको त्रिभुजका भुजाहरू 6 से.मि., 7 से.मि., 8 से.मि. र लम्बाइ 15 से.मि. भएको त्रिभुजाकार प्रिज्मको पूरा सतहको क्षेत्रफल, छड्के सतहको क्षेत्रफल र आयतन निकाल्नुहोस् ।

Find the total surface area, lateral surface area and volume of a triangular prism whose sides of base are 6 cm, 7 cm and 8 cm and length 15 cm.



⇨ Here, the sides of triangular base are 6 cm, 7 cm and 8 cm respectively.
So, a = 6 cm, b = 7 cm and c = 8 cm

We have, $s = \frac{a+b+c}{2} = \frac{6\text{ cm} + 7\text{ cm} + 8\text{ cm}}{2} = \frac{21\text{ cm}}{2} = 10.5\text{ cm}$

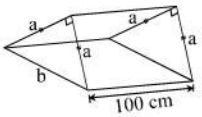
Area of Δr base $= \sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{10.5(10.5-6)(10.5-7)(10.5-8)}$
$= \sqrt{10.5 \times 4.5 \times 3.5 \times 2.5} = \sqrt{413.44} = 20.33\text{ cm}^2$

Now,
(i) LSA = Ph $= (a+b+c)h = (6+7+8) \times 15 = 315\text{ cm}^2$
(ii) TSA $= Ph + 2A_1 = 315 + 2 \times 20.33 = 355.66\text{ cm}^2$
(iii) Volume = base area × height $= 20.33 \times 15 = 304.95\text{ cm}^3$

Thus, the LSA, TSA and volume are 315 cm^2, 355.66 cm^2 and 304.95 cm^3 respectively.

4. आयतन 12000 घन से.मि. भएको समकोणी समद्विबाहु त्रिभुजाकार प्रिज्मको लम्बाइ 100 से.मि. भए आधारका भुजाहरूको नाप निकाल्नुहोस् ।

The length of a prism having right angled isosceles triangular base is 100 cm and volume 12000 cm^3. Find the measure of base sides.



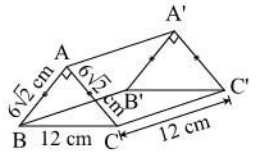
⇨ Here, volume (V) = 12000 cm^3
We know that, V = base area × height or, $12000 =$ base area × 100
or, base area = 120 or, $120 = \frac{1}{2}a^2$
or, $240 = a^2$ ∴ $a = 4\sqrt{15}$ cm

Again, $b = \sqrt{a^2+a^2} = \sqrt{2a^2} = \sqrt{2 \times (4 \times \sqrt{5})^2} = \sqrt{2 \times 16 \times 15} = 4\sqrt{30}$ cm

Thus, the sides are $4\sqrt{15}$ cm, $4\sqrt{15}$ cm and $4\sqrt{30}$ cm respectively.

5. भुजाहरूको नाप $6\sqrt{2}$ से.मि, 12 से.मि. र $6\sqrt{2}$ से.मि. भएको समकोणी समद्विबाहु त्रिभुजाकार प्रिज्मको लम्बाइ 12 से.मि. भए आधारको क्षेत्रफल र छड्के सतहको क्षेत्रफल निकाल्नुहोस् ।

Find the area of base and lateral surface area of a triangular prism having length 12 cm and base is a right angled isosceles triangle having sides $6\sqrt{2}$ cm, 12 cm and $6\sqrt{2}$ cm.



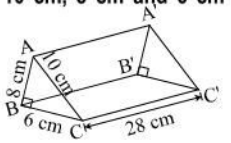
⇨ Here, (i) Area of base $(A_1) = \frac{1}{2}AB \times AC = \frac{1}{2}6\sqrt{2} \times 6\sqrt{2} = 36\text{ cm}^2$

(ii) Lateral surface area $= Ph = (6\sqrt{2} + 6\sqrt{2} + 12) \times 12$
$= 347.65\text{ cm}^2$

Thus, the area of base and LSA are 36 cm^2 and 347.65 cm^2 respectively.

6. भुजाहरूको नापहरू क्रमशः 10 से.मि., 8 से.मि. र 6 से.मि. भएको समकोणी त्रिभुजाकार प्रिज्मको लम्बाइ 28 से.मि. भए सो प्रिज्मको क्रस सेक्सन क्षेत्रफल, छड्के सतहको क्षेत्रफल, पूरा सतहको क्षेत्रफल र आयतन निकाल्नुहोस् ।

Find the cross section area, lateral surface area, total surface area and volume of a triangular prism having length 28 cm and measures of right angled triangular base sides are 10 cm, 8 cm and 6 cm respectively.



⇨ Here, (i) Area of cross section $(A_1) = \frac{1}{2}AB \times BC = \frac{1}{2}8\text{ cm} \times 6\text{ cm}$

∴ Area of triangular base $(A_1) = 24\text{ cm}^2$
(ii) Area of lateral surface $= Ph = (10+8+6) \times 28 = 672\text{ cm}^2$
(iii) Area of total surface $= Ph + 2A_1 = 672 + 2 \times 24 = 720\text{ cm}^2$
(iv) Volume = Base area × height $= 24\text{ cm}^2 \times 28\text{ cm} = 672\text{ cm}^3$

Thus, the CSA, LSA, TSA and volume are 24 cm^2, 672 cm^2, 720 cm^2 and 672 cm^3 respectively.

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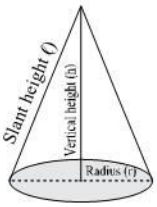
7.2 सोली र पिरामिड (CONE AND PYRAMID)

A. BASIC EXERCISE

सोली (CONE)

A. VERY SHORT QUESTIONS

1. दिइएको सोलीको वृत्ताकार आधार छ । निम्नलिखित सूत्र पत्ता लगाउनुहोस्:
Given cone has circular base. Find the following formulae:



(a) छड्के उचाइलाई h र r को रूपमा (Slant height in terms of h and r)
(b) ठाडो उचाइलाई ℓ र r को रूपमा (Vertical height in terms of ℓ and r)
(c) आधारको व्यासलाई r को रूपमा (Diameter of circular base in terms of r)
(d) आधारको परिधि (Circumference of base) (e) आधारको क्षेत्रफल (Area of base)
(f) वक्रसतहको क्षेत्रफल (Area of curved surface) (g) आयतन (Volume)
(h) पूरा सतहको क्षेत्रफल (Total surface area)

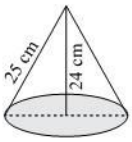
⇨ Here,

(a) Slant height (ℓ) $= \sqrt{h^2 + r^2}$ (b) Vertical height (h) $= \sqrt{\ell^2 - r^2}$
(c) Diameter (d) $= 2r$ (d) Circumference of base (C) $= 2\pi r$
(e) Area of base (A) $= \pi r^2$ (f) Area of curved surface (CSA) $= \pi r\ell$
(g) Volume of cone (V) $= \frac{1}{3}\pi r^2 h$ (h) Total surface area (TSA) $= \pi r\ell + \pi r^2$

B. SHORT QUESTIONS

MODEL 1

1. सँगैको चित्रबाट निम्नलिखित पत्ता लगाउनुहोस् । (From the adjoining figure find the following):



(a) आधारको अर्धव्यास (Radius of base) (b) आधारको व्यास (Diameter of base)
(c) यदि अर्धव्यास 7 cm भए आधारको परिधि पत्ता लगाउनुहोस् ।
If the radius is 7 cm, find the circumference of base.
(d) यदि अर्धव्यास 7 cm भए आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the radius is 7 cm, find the area of base.
(e) यदि अर्धव्यास 7 cm भए वक्र सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the radius is 7 cm, find the curved surface area.

⇨ Here, Vertical height (h) = 24 cm, Slant height (ℓ) = 25 cm
We know that,

(a) Radius of base (r) $= \sqrt{\ell^2 - h^2} = \sqrt{25^2 - 24^2} = \sqrt{625 - 576} = 7$ cm
(b) Diameter of base (d) $= 2r = 2 \times 7 = 14$ cm
(c) Circumference of base (C) $= 2\pi r = 2 \times \frac{22}{7} \times 7 = 44$ cm
(d) Area of base (A) $= \pi r^2 = \frac{22}{7} \times 7 \times 7 = 154$ cm^2
(e) Curved surface area (CSA) $= \pi r\ell = \frac{22}{7} \times 7 \times 25 = 550$ cm^2

2. उचाइ 21 से.मी. भएको एउटा सोलीको आधारको क्षेत्रफल 154 वर्ग से.मी. भए सो सोलीको आयतन कति होला ?
The height of a cone is 21 cm and the area of base of the cone is 154 cm^2. Find the volume.

⇨ Here, height (h) = 21 cm and base area (πr^2) = 154 cm^2
We know that, volume of cone (V) $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times 154 \times 21 = 1078$ cm^3
Thus, volume of cone is 1078 cm^3.

3. एउटा सोलीको आधारको क्षेत्रफल 40 cm^2 र वक्रसतहको क्षेत्रफल 90 cm^2 छन् । पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The area of base of a cone is 40 cm^2 and the curved surface area of the cone 90 cm^2. Find the total surface area.

⇨ Here, area of base (πr^2) = 40 cm^2, Curved surface area ($\pi r\ell$) = 90 cm^2
We know that, Total surface area of cone $= \pi r\ell + \pi r^2 = 90 + 40 = 130$ cm^2
Thus, TSA is 130 cm^2.

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4. एउटा सोलीको आधारको क्षेत्रफल 110 cm^2 र पूरा सतहको क्षेत्रफल 250 cm^2 छन् । वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The area of base of a cone is 110 cm^2 and the total surface area of the cone 250 cm^2. Find the curved surface area.

⇨ Here, area of base (πr^2) = 110 cm^2, Total surface area (TSA) = 250 cm^2
We know that, TSA of cone = πr^2 + CSA of cone
∴ CSA = 250 – 110 = 140 cm^2 Thus, CSA of cone is 140 cm^2.

5. एउटा सोलीको आधारको क्षेत्रफल पूरा सतहको क्षेत्रफल 300 cm^2 को एक तिहाइ छ । वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The area of base of a cone is one-third of the total surface area of the cone 300 cm^2. Find the curved surface area.

⇨ Here, area of base = $\frac{1}{3}$ TSA of cone ∴ Area of base = $\frac{1}{3} \times 300 = 100$ cm^2
We know that, TSA = CSA + Area of base or, 300 = CSA + 100
∴ CSA = 300 – 100 = 200 cm^2 Thus, CSA of cone is 200 cm^2.

6. एउटा सोलीको आधारको क्षेत्रफल यसको वक्र सतहको क्षेत्रफलको आधा छ । यदि पूरा सतहको क्षेत्रफल 450 cm^2 भए आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।
The area of base of a cone is one-half of the curved surface area. If the total surface area is 450 cm^2, find the area of the base.

⇨ Here, area of base (A) = $\frac{1}{2}$ of CSA ∴ CSA = 2A
We know that, TSA = CSA + A or, 450 = 2A + A or, 3A = 450
∴ A = $\frac{450}{3}$ = 150 cm^2 Thus, area of base is 150 cm^2.

7. एउटा सोलीको अर्धव्यासमा बनेको वर्गको क्षेत्रफल 400 cm^2 छ । यदि सो सोलीको उचाइ 21 cm भए सोलीको आयतन पत्ता लगाउनुहोस् ।
The square on the radius of a cone has 400 cm^2 area. If the height of the cone is 21 cm, find the volume of the cone.

⇨ Here, square on radius of cone (r^2) = 400 cm^2, Height of cone (h) = 21 cm
We know that, Volume of cone (V) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 400 \times 21 = 8800$ cm^3
Thus, volume of cone is 8800 cm^3.

8. एउटा सोलीको अर्धव्यासमा बनेको वर्गको क्षेत्रफल 144 cm^2 छ । यदि सो सोलीको उचाइ 14 cm भए सोलीको आयतन पत्ता लगाउनुहोस् ।
The square on the radius of a cone has 144 cm^2 area. If the height of the cone is 14 cm, find the volume of the cone.

⇨ Here square on radius (r^2) = 144 cm^2, Height of cone (h) = 14 cm
We know that, Volume of cone (V) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 144 \times 14 = 2112$ cm^3
Thus, volume of cone is 2112 cm^3.

9. एउटा सोलीको अर्धव्यास र छड्के उचाइको गुणनफल 350 cm^2 छ । सो सोलीको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The product of radius and slant height of a cone is 350 cm^2. Find the curved surface area.

⇨ Here $r \times \ell = 350$ cm^2
We know that, CSA of cone = $\pi r\ell = \frac{22}{7} \times 350 = 1100$ cm^2
Thus, CSA of cone is 1100 cm^2.

10. एउटा सोलीको अर्धव्यास र छड्के उचाइको योगफल 32 cm छ । यदि अर्धव्यास 7 cm भए पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The sum of radius and slant height of a cone is 32 cm. If the radius is 7 cm, find the total surface area.

⇨ Here, $r + \ell = 32$ cm and radius (r) = 7 cm
We know that, Total surfacea area of cone = $\pi r\ell + \pi r^2 = \pi r(\ell + r) = \frac{22}{7} \times 7(32) = 704$ cm^2
Thus, TSA is 704 cm^2.

11. यदि एउटा वेलनाको आयतन 12000 cm^3 भए सो वेलनासँग बराबर अधार र उचाइ हुने सोलीको आयतन पत्ता लगाउनुहोस् ।
If the volume of a cylinder is 12000 cm^3, what is the volume of the cone having the same base and height to the cylinder?

⇨ Here, volume of cylinder = 12000 cm^3
We know that, Volume of cone (V) = $\frac{1}{3} \times$ Volume of cylinder = $\frac{1}{3} \times 12000 = 4000$ cm^3
Thus, volume of cone is 4000 cm^3.

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12. यदि एउटा वेलनाको आयतन 15000 cm³ भए सो वेलनासँग बराबर अधार र उचाइ हुने सोलीको आयतन पत्ता लगाउनुहोस् ।
If the volume of a cylinder is 15000 cm³, what is the volume of the cone having the same base and height to the cylinder?

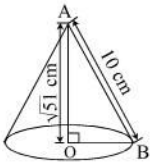
⇨ Here, volume of cylinder = 15000 cm^3

We know that, Volume of cone (V) = $\frac{1}{3}$ × Volume of cylinder = $\frac{1}{3}$ × 15000 = 5000 cm^3

Thus, volume of cone is 5000 cm^3.

MODEL 2

1. सँगै दिइएको चित्रमा ठोस सोलीको उचाइ $\sqrt{51}$ से.मि. र छड्के उचाइ 10 से.मि. भए उक्त सोलीको आयतन पत्ता लगाउनुहोस् ।
In the given figure, the height of a solid cone is $\sqrt{51}$ cm and slant height is 10 cm. Find the volume of the cone. [2072 W]



⇨ Here, height (h) = $\sqrt{51}$ cm and slant height (ℓ) = 10 cm

We know that, Radius (r) = $\sqrt{\ell^2 - h^2} = \sqrt{10^2 - 51} = \sqrt{49}$ ∴ r = 7 cm

Now, V (cone) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 7^2 \times \sqrt{51} = 366.59$ cm^3

Thus, the volume of the cone is 366.59 cm^3.

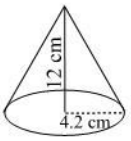
2. एउटा सोलीको आधारको क्षेत्रफल 125 वर्ग से.मि. र उचाइ 9 से.मि. भए सो सोलीको आयतन निकाल्नुहोस् ।
The base area of a cone is 125 sq. cm and its height is 9 cm. Find its volume. [2071 E]

⇨ Here, Area (Base) = 125 cm^2, height = 9 cm

We know that, V (cone) = $\frac{1}{3}$ area of base × height = $\frac{1}{3}$ × 125 × 9 = 375 cm^3

Thus, the volume of the cone is 375 cm^3.

3. यदि दिइएको सोलीको आधारको अर्धव्यास र उचाइ क्रमशः 4.2 से.मि. र 12 से.मि. छन् भने, उक्त सोलीको आयतन पत्ता लगाउनुहोस् ।
If the radius of the base and height of the given cone are 4.2 cm and 12 cm respectively, find the volume of the cone. [SLC 2065 D]

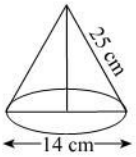


⇨ Here, Radius (r) = 4.2 cm and Height (h) = 12 cm

Volume (V) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 4.2^2 \times 12$

Thus, volume (V) = 221.76 cm^3.

4. दिइएको चित्रमा, सोलीको छड्के उचाइ र आधारको व्यास क्रमशः 25 से.मि. र 14 से.मि. भए उक्त सोलीको आयतन निकाल्नुहोस् ।
In the given diagram, the slant height and diameter of the base of a cone are 25 cm & 14 cm respectively. Find the volume of cone. [2065 E, 2068 C]



⇨ Here, slant height (ℓ) = 25 cm , Diameter (d) = 14 cm

We know that, Vertical height (h) = $\sqrt{\ell^2 - \left(\frac{d}{2}\right)^2} = \sqrt{25^2 - 7^2}$ = 24 cm

Now, volume of cone = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 7^2 \times 24$

Thus, volume of the cone = 1232 cm^3

5. एउटा सोलीको छड्के उचाइ 50 से.मि. र उचाइ 48 से.मि. भए सो सोलीको आयतन पत्ता लगाउनुहोस् ।
The slant height of a cone is 50 cm and its height 48 c.m. Find the volume of the cone. [2067C]

⇨ Here, slant height (ℓ) = 50 cm and Vertical height (h) = 48 cm

Radius (r) = $\sqrt{\ell^2 - h^2} = \sqrt{50^2 - 48^2}$ = 14 cm

We know that, volume of cone (V) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 14^2 \times 48 = 9856$ cm^3

Thus, the volume of the cone is 9856 cm^3.

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MODEL 3

6. एउटा सोलीको आधारको अर्धव्यास र उचाइ 3 : 4 को अनुपातमा छन् र यसको आयतन 324π घन से.मि. भए यसको उचाइ पत्ता लगाउनुहोस् ।
The radius of the base and height of a cone are in the ratio of 3 : 4 and its volume is 324π cu.cm. Find its height. [2072 C]

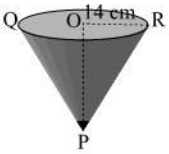
⇨ Here, r : h = 3 : 4 So, r = 3x cm & h = 4x cm

We have, Volume (V) $= \frac{1}{3}\pi r^2 h$ or, $324\pi = \frac{1}{3}\pi (3x)^2 \times 4x$

or, $972 = 9x^2 \times 4x$ or, $27 = x^3$ ∴ $x = 3$ cm

We know that, Height (h) = 4x = 4 × 3 cm = 12 cm. Thus, height is 12 cm.

7. यदि दिइएको सोलीको आयतन 1848 cm^3 र यसको अर्धव्यास 14 cm भए यसको उचाइ कति होला ?
If the volume of the given cone is 1848 cm^3 and its radius is 14 cm, what is its height ? [SLC 2066 A]

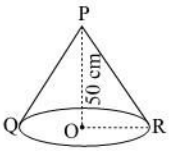


⇨ Here, volume of the cone = 1848 cm^3 & radius (r) = 14 cm

or, $\frac{1}{3}\pi r^2 h = 1848$ or, $\frac{1}{3} \times \frac{22}{7} \times 14^2 \times h = 1848$

or, $h = \frac{1848 \times 3 \times 7}{22 \times 14^2} = 9$ Thus, the height is 9 cm.

8. यदि दिइएको सोलीको आयतन 23100 cm^3 र यसको उचाइ 50 cm भए आधारको अर्धव्यास कति होला ?
If the volume of the given cone is 23100 cm^3 and its height is 50 cm, what is the radius of the base. [SLC Model 2065]



⇨ Here, Volume of the cone (V) = 23100 cm^3 and Vertical height (h) = 50 cm

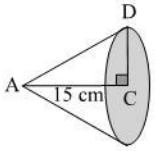
We have, $V = \frac{1}{3}\pi r^2 h$

or, $V = \frac{1}{3} \times \frac{22}{7} \times r^2 \times 50 = 23100$ or, $r^2 = \frac{23100 \times 3 \times 7}{22 \times 50} = 441\ cm^2$

or, $r^2 = 21^2$ ∴ $r = 21$ cm

Thus, the radius of the cone (r) = 21 cm

9. यदि दिइएको सोलीको आयतन 770 cm^3 र यसको उचाइ 15 cm भए आधारको अर्धव्यास कति होला ?
If the volume of the given cone is 770 cm^3. and its height is 15 cm. What is the radius of the base ? [SLC 2066 C]



⇨ Here, volume (cone) = 770 cm^3, height (h) = 15 cm

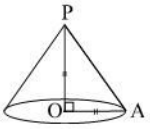
We know that, $V(cone) = \frac{1}{3}\pi r^2 h$

or, $770 = \frac{1}{3} \times \frac{22}{7} \times r^2 \times 15$ or, $\frac{770 \times 21}{22 \times 15} = r^2$

or, $r^2 = 49$ ∴ $r = 7$ cm

Thus, the radius of the cone is 7 cm.

10. सँगै दिइएको सोलीको अर्धव्यास र उचाइ बराबर छ। यदि यसको आयतन 9702 घ.से.मि. छ भने यसको उचाइ पत्ता लगाउनुहोस् ।
In the given cone, its radius and height are equal. If the volume of the cone is 9702 cm^3, find the height of the cone. [2064 E1]



⇨ Here, Radius = Height i.e. r = h and Volume (V) = 9702 cm^3

We know that,

Volume (V) $= \frac{1}{3}\pi r^2 h$ or, $9702 = \frac{1}{3} \times \frac{22}{7} \times h^2 \times h$ [∵ r = h]

or, $\frac{9702 \times 3 \times 7}{22} = h^3$ or, $9261 = h^3$

or, $h^3 = 21^3$ Thus, the height (h) = 21 cm

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11. आधारको अर्धव्यास 5 मिटर भएको एउटा सोलीको पूरा सतहको क्षेत्रफल $282\frac{6}{7}$ वर्ग मिटर भए सोलीको उचाइ पत्ता लगाउनुहोस् । **[2059 D2]**

The total surface area of a cone whose base radius 5 m. is $282\frac{6}{7}$ sq. m. Find the height of the cone.

⇨ Here, by formula, total surface area of cone = $\pi r(r + \ell)$, where r is radius and ℓ is the slant height.

or, $282\frac{6}{7}\ m^2 = \frac{22}{7} \times 5\ m\ (5\ m + \ell)$ or, $\frac{1980}{7}\ m^2 = \frac{110}{7}\ m\ (5\ m + \ell)$

or, $(5\ m + \ell) = \frac{\frac{1980}{7}\ m^2}{\frac{110}{7}\ m}$ or, $5\ m + \ell = \frac{1980}{110}\ m$

or, $5\ m + \ell = 18\ m$ ∴ $\ell = 18\ m - 5\ m = 13\ m$

∴ $h = \sqrt{\ell^2 - r^2} = \sqrt{(13\ m)^2 - (5\ m)^2} = \sqrt{169 - 25}\ m = \sqrt{144}\ m = 12\ m$

Thus, height is 12 m.

12. एउटा सोलीको आयतन र ठाडो उचाइ क्रमशः 23100 घ.से.मि. र 50 से.मि. भए यसको आधारको व्यास पत्ता लगाउनुहोस् ।

If the volume and vertical height of a cone are 23100 cu. cm and 50 cm respectively, find the diameter of its base. **[2067 A]**

⇨ Here, Volume of the cone (V) = 23100 cm^3 and Vertical height (h) = 50 cm

We have, $V = \frac{1}{3}\pi r^2 h$

or, $V = \frac{1}{3} \times \frac{22}{7} \times r^2 \times 50 = 23100$ or, $r^2 = \frac{23100 \times 3 \times 7}{22 \times 50}$

or, $r^2 = 21^2$ ∴ $r = 21$ cm

Now, diameter (d) = $2r = 2 \times 21$ cm = 42 cm

Thus, diameter of base is 21 cm.

MODEL 4

13. एउटा सोलीको आधारको परिधि 88 से.मि. र छड्के उचाइ 30 से.मि. छ भने यसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।

The circumference of base of a cone is 88 cm and slant height 30 cm. Find the curved surface area of the cone. **[2071 C]**

⇨ Here, circumference (base) = 88 cm, slant height (ℓ) = 30 cm

We have, $2\pi r = 88$ or, $2 \times \frac{22}{7} \times r = 88$ or, $r = \frac{88 \times 7}{44}$ ∴ $r = 14$ cm

Now, CSA of cone = $\pi r\ell = \frac{22}{7} \times 14 \times 30 = 1320\ cm^2$

Thus, the CSA of cone is 1320 cm^2.

14. एउटा सोलीको वक्रसतहको क्षेत्रफल 550 वर्ग से.मि. र आधारको अर्धव्यास 7 से.मि. छन् भने उक्त सोलीको उचाइ पत्ता लगाउनुहोस् ।

The curved surface area of a cone is 550 sq. cm and the radius of the base is 7 cm. Find the height of the cone. **[2071 A]**

⇨ Here, CSA (cone) = 550 cm^2 Radius (r) = 7 cm

We have, CSA (cone) = 550 or, $\pi r\ell = 550$

or, $\frac{22}{7} \times 7 \times \ell = 550$ or, $\ell = 25$

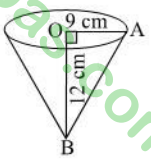
Now, vertical height (h) = $\sqrt{\ell^2 - r^2} = \sqrt{25^2 - 7^2} = 24$

Thus, the vertical height is 24 cm.

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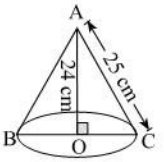
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15. यदि दिइएको सोलीको आधारको अर्धव्यास (OA) = 9 से.मि र उचाइ (OB) = 12 cm छ भने सोलीको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
If the radius of the base of the given cone (OA) = 9 cm and height (OB) = 12 cm, find the curved surface area of the cone. [2068 D]



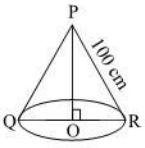
⇨ Here, OA = 9 cm and OB = 12 cm
We have, $AB = \sqrt{OA^2 + OB^2} = \sqrt{9^2 + 12^2}$
$\therefore$ AB = 15 cm i.e. $\ell = 15$ cm
Now, CSA of cone = $\pi r\ell = \frac{22}{7} \times 9 \times 15 = 424.28 \text{ cm}^2$
Thus, the CSA of cone is 424.28 cm^2.

16. सँगै दिइएको चित्र एउटा ठोस सोलीको हो । यदि AO = 24 cm र AC = 25 cm भए उक्त सोलीको वक्र सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The diagram given alongside is of a solid cone. If AO = 24 cm and AC = 25 cm, find the curved surface area of the cone. [2068 E]



⇨ Here, vertical height (h) = 24 cm
Slant height (ℓ) = 25 cm
We have, $r = \sqrt{\ell^2 - h^2} = \sqrt{25^2 - 24^2} = 7$ cm
Now, CSA of cone = $\pi r\ell = \frac{22}{7} \times 7 \times 25 = 550 \text{ cm}^2$
Thus, the CSA of cone is 550 cm^2.

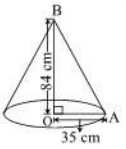
17. दिइएको सोलीको वक्रसतहको क्षेत्रफल 8,800 व.से.मि. छ । यदि यसको छड्के उचाइ 100 से.मि. भए सो सोलीको उचाइ PO पत्ता लगाउनुहोस् ।
The curved surface area of the given cone is 8,800 sq. cm. If the slant height is 100 cm, determine the height PO of the cone. [2065 B]



⇨ Here, CSA of the cone = 8800 cm^2 and Slant height (ℓ) = 100 cm
We know that; CSA (cone) = $\pi r\ell$
or, $8800 = \frac{22}{7} \times r \times 100$ or, $\frac{88 \times 7}{22} = r$
$\therefore$ r = 28 cm
Now, Height (PO) = $\sqrt{\ell^2 - r^2} = \sqrt{100^2 - 28^2} = \sqrt{9216} = 96$ cm
Thus, height PO of the cone is 96 cm.

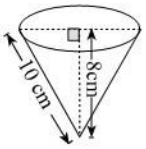
MODEL 5

18. दिइएको सोलीको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् । चित्रमा OA = 35 से.मि. र OB = 84 से.मि. छ ।
Find the total surface area of the given cone. In fig., OA = 35 cm and OB = 84 cm. [2071 D]



⇨ Here, OA = 35 cm and OB = 84 cm
Slant height (ℓ) = $\sqrt{OA^2 + OB^2} = \sqrt{35^2 + 84^2} = \sqrt{1225 + 7056} = \sqrt{8281}$
$\therefore$ ℓ = 91 cm
Now, TSA (cone) = $\pi r(r + \ell) = \frac{22}{7} \times 35\,(35 + 91) = 22 \times 5 \times 126$
$\therefore$ TSA (cone) = 13860 cm^2
Thus, TSA of the cone is 13860 cm^2.

19. दिइएको सोलीको छड्के उचाइ 10 cm र उचाइ 8 cm छ भने पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the given cone whose slant height is 10 cm and height is 8 cm. [2068 B, 2064 S]

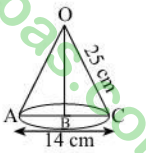


⇨ Here, vertical height (h) = 8 cm and Slant height (ℓ) = 10 cm
We have, radius (r) = $\sqrt{\ell^2 - h^2} = \sqrt{10^2 - 8^2} = 6$ cm
We know that, TSA of cone = $\pi r(r + \ell) = \frac{22}{7} \times 6(6 + 10) = 301.71$
Thus, the TSA of cone is 301.71 cm^2.

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20. सँगै दिइएको चित्र एउटा ठोस सोलीको हो। यदि AC = 14 से.मि. र OC = 25 से.मि. भए उक्त सोलीको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।
The diagram given alongside is of a solid cone. If AC = 14 cm and OC = 25 cm, find the total surface area of the cone. **[2067 S]**



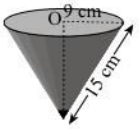
⇨ Here, AC = 14 cm and OC = 25 cm

Radius (r) = $\frac{AC}{2} = \frac{14\text{ cm}}{2}$ = 7 cm and Slant height (ℓ) = 25 cm

We know that, Total surface area of cone = $\pi r(r + \ell) = \frac{22}{7} \times 7(7 + 25) = 22 \times 32$

Thus, total surface area of cone = 704 cm^2

21. दिइएको सोलीको पूरा सतहको क्षेत्रफल निकाल्नुहोस्, जसमा अर्धव्यास 9 cm र छड्के उचाइ 15 cm छ।
Find the total surface area of the given cone where the radius is 9 cm and the slant height 15 cm. **[SLC 2066 E]**

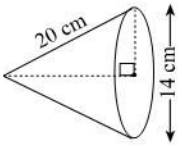


⇨ Here, radius (r) = 9 cm, slant height (ℓ) = 15 cm

We know that, TSA of cone $= \pi r(r + \ell) = \frac{22}{7} \times 9(9 + 15) = 678.86\ cm^2$

Thus, the TSA of cone is 678.86 cm^2.

22. चित्रमा देखाइएको सोलीको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।
Find the total surface area of the cone as shown in the figure. **[2067 D]**



⇨ Here, slant height (ℓ) = 20 cm and Radius (r) = $\frac{d}{2} = \frac{14\text{ cm}}{2}$ = 7 cm

We know that, TSA (cone) = $\pi r(r + \ell) = \frac{22}{7} \times 7(7 + 20) = 594\ cm^2$

Thus, the total surface area of the cone is 594 cm^2.

23. आधारको अर्धव्यास 7 से.मि. र ठाडो उचाइ $\sqrt{51}$ cm भएको सोलीको पूरा सतहको क्षेत्रफल निकाल्नुहोस्। **[2067 E]**
Find the total surface area of the solid cone whose radius of base is 7 cm and the vertical height is $\sqrt{51}$ cm.

⇨ Here, radius (r) = 7 cm and Vertical height (h) = $\sqrt{51}$ cm

Slant height (ℓ) = $\sqrt{r^2 + h^2} = \sqrt{7^2 + (\sqrt{51})^2} = \sqrt{49 + 51} = 10$ cm

Now, we have, TSA = $\pi r(r + \ell) = \frac{22}{7} \times 7(7 + 10) = 22 \times 17 = 374\ cm^2$

Thus, the total surface area is 374 cm^2.

MODEL 6

24. एउटा सोलीको अर्धव्यास र छड्के उचाइ 3 : 5 को अनुपातमा छन्। यदि यसको पूरा सतहको क्षेत्रफल $\frac{2112}{7}$ वर्ग से.मि. भए छड्के उचाइ पत्ता लगाउनुहोस्।

The radius and slant height of a cone are in the ratio of 3 : 5. If its total surface area is $\frac{2112}{7}$ sq.cm, find the slant height. **[2072 E]**

⇨ Here, radius : slant height = r : ℓ = 3 : 5

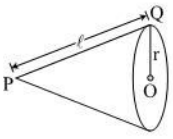
∴ radius (r) = 3x and slant height (ℓ) = 5x

We know that, TSA = $\pi r(r + \ell)$ or, $\frac{2112}{7} = \frac{22}{7} \times 3x\ (3x + 5x)$

or, $\frac{2112}{7} = \frac{22}{7} \times 3x \times 8x$ or, $2112 = 528 \times x^2$ or, $x^2 = 4$

∴ $x = 2$ Now, slant height (ℓ) = 5x = 5 × 2 = 10 cm.

25. एउटा ठोस सोलीको आधारको परिधि 42π से.मि. छ। यदि यसको छड्के उचाइ र आधारको व्यासार्धको योगफल 49 से.मि. भए यसको छड्के उचाइ कति होला। पत्ता लगाउनुहोस्।
The circumference of the base of a solid cone is 42π cm. If the sum of its slant height and the radius of its base is 49 cm, what will be the slant height of the cone ? Find it. **[2072 W]**



⇨ Here, circumference (c) = 42π cm and $\ell + r = 49$ cm

We know that, $c = 2\pi r$ or, $42\pi = 2\pi r$ ∴ $r = 21$ cm

We know that, $\ell + r = 49$ cm or, $\ell + 21\text{ cm} = 49$ cm

∴ $\ell = 28$ cm Thus, the slant height is 28 cm.

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26. एउटा सोलीको पूरा सतहको क्षेत्रफल र वक्र सतहको क्षेत्रफल क्रमशः 704 वर्ग से.मि. र 550 वर्ग से.मि. छ भने सो सोलीको आधारको अर्धव्यास पत्ता लगाउनुहोस् ।
The total surface area and the curved surface area of a cone are 704 sq. cm and 550 sq. cm respectively. Find the radius of the base of the cone. **[2071 B, 2070 D, 2072 FW]**

⇨ Here, TSA (cone) = 704 cm^2 , CSA (cone) = 550 cm^2
We know that, Area of base + CSA (cone) = TSA (cone)
or, Area of base + 550 cm^2 = 704 cm^2 or, Area of base = 154 cm^2
or, $\pi r^2 = 154$ or, $\frac{22}{7} \times r^2 = 154$
or, $r^2 = \frac{154 \times 7}{22} = 49 = 7^2$ ∴ r = 7 cm
Thus, the radius of the base is 7 cm.

27. एउटा सोलीको पूरा सतहको क्षेत्रफल र आधारको व्यास क्रमशः 594 cm^2 र 18 से.मि. भए सो सोलीको छड्के उचाइ पत्ता लगाउनुहोस् ।
The total surface area and the diameter of the base of a cone are 594 sq. cm and 18 cm respectively. Find the slant height of the cone. **[2064 B1]**

⇨ Here, total surface area (A) = 594 cm^2 , Diameter of base (d) = 18 cm
Radius (r) = $\frac{d}{2} = \frac{18 \text{ cm}}{2} = 9$ cm
We know that, TSA = $\pi r(r + \ell)$ or, $594 = \frac{22}{7} \times 9(9 + \ell)$
or, $\frac{594 \times 7}{22 \times 9} = 9 + \ell$ or, $21 = 9 + \ell$
or, $21 - 9 = \ell$ ∴ $\ell = 12$
Thus, the slant height (ℓ) = 12 cm.

28. एउटा सोलीको छड्के उचाइ 5 से.मि. र उचाइ 4 से.मि. भए सो सोलीको वक्र सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
A cone have slant height 5 cm and height 4 cm, find the curved surface area of that cone. **[2064 D2]**

⇨ Here, slant height (ℓ) = 5 cm and height (h) = 4 cm
We know that, $r = \sqrt{\ell^2 - h^2} = \sqrt{5^2 - 4^2} = 3$ cm
Now, curved surface area = $\pi r\ell = \frac{22}{7} \times 3 \times 5 = 47.14$ cm^2.
Thus, the CSA of cone is 47.14 cm^2.

29. एउटा सोलीको पूरा सतहको क्षेत्रफल 814 वर्ग से.मि. छ । यदि यस सोलीको छड्के उचाइ र आधारको व्यासार्धको योगफल 37 से.मि. भए सो सोलीको छड्के उचाइ पत्ता लगाउनुहोस् ।
The total surface area of a cone is 814 square cm. If the sum of its slant height and the radius of its base is 37 cm, find the slant height of the cone. **[2064 A1]**

⇨ Here, total surface area = 814 cm^2 and Slant height + Radius i.e. (ℓ + r) = 37 cm
We know that, TSA = $\pi r(r + \ell)$ or, $814 = \frac{22}{7} \times r \times 37$
or, $\frac{814 \times 7}{22 \times 37} = r$ ∴ r = 7 cm
Now, ℓ + r = 37 cm or, ℓ + 7 cm = 37 cm
∴ ℓ = 30 cm Thus, the slant height (ℓ) = 30 cm.

30. एउटा सोलीको पूरा सतहको क्षेत्रफल 704 वर्ग से.मि. छ । यदि यस सोलीको छड्के उचाइ र आधारको व्यासार्धको योगफल 32 से.मि. भए सो सोलीको छड्के उचाइ पत्ता लगाउनुहोस् ।
The total surface area of a cone is 704 square cm. If the sum of the radius of the base and the slant height of the cone is 32 cm, find the radius of its base. **[2071 S, SLC 2066 B]**

⇨ Here, TSA of cone = 704 cm^2, r + ℓ = 32 cm, r = ?
We know that, TSA = $\pi r(r + \ell)$
or, $704 = \frac{22}{7} \times r \times 32$ or, $r = \frac{704 \times 7}{22 \times 32}$
∴ r = 7 Thus, the radius of the cone is 7 cm.

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31. एउटा सोलीको पूरा सतहको क्षेत्रफल र वक्रसतहको क्षेत्रफल क्रमशः 704 व. से.मि. र 550 व. से.मि. भए सो सोलीको छड्के उचाइ पत्ता लगाउनुहोस् ।
The total surface area and the curved surface area of a cone are 704 sq. cm and 550 sq. cm respectively. Find the slant height of the cone. [2063 D1]

⇨ Here, curved surface area of a cone (s) = 550 cm^2 i.e. $\pi r\ell = 550\ cm^2$ ..... (1)

Total surface area of the cone (s) = $(\pi r^2 + \pi r\ell) = 704\ cm^2$

or, $\pi r^2 + 550\ cm^2 = 704\ cm^2$ or, $\frac{22}{7} \cdot r^2 = (704 - 550)\ cm^2$

or, $r^2 = \frac{154 \times 7}{22}\ cm^2$ or, $r = \sqrt{49\ cm}$ ∴ $r = 7$ cm

Again, $\pi r\ell = 550\ cm^2$

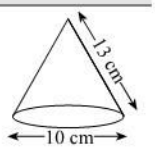
or, $\ell = \frac{550\ cm^2}{\pi r}$ or, $\ell = \frac{550 \times 7\ cm^2}{22 \times 7\ cm} = 25$ cm

Thus, slant height (ℓ) = 25 cm

C. LONG QUESTIONS

MODEL 1

1. दिइएको ठोस सोलीको चित्रमा, आधारको व्यास 10 से.मि. सोलीको छड्के उचाइ 13 से.मि. छ भने पत्ता लगाउनुहोस् :
In the given figure of the solid cone has diameter of the base 10 cm and slanting height 13 cm, find: [2064 D1]



(i) **वक्र सतहको क्षेत्रफल** (area of the curved surface.)
(ii) **पूरा सतहको क्षेत्रफल** (total surface area.)
(iii) **आयतन** ($\pi = 22/7$) (volume of the cone. ($\pi = 22/7$)

⇨ Here, diameter of base (d) = 10 cm and Slant height (ℓ) = 13 cm

∴ Radius (r) = $\frac{d}{2} = \frac{10\ cm}{2} = 5$ cm

We know that, Vertical height (h) = $\sqrt{\ell^2 - r^2} = \sqrt{13^2 - 5^2} = 12$ cm

Now,

(i) Area of curved surface = $\pi r\ell = \frac{22}{7} \times 5 \times 13$

Area of curved surface = $204.28\ cm^2$

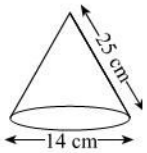
(ii) Total surface area = $\pi r(r + \ell) = \frac{22}{7} \times 5(5 + 13)$

∴ Total surface area = $282.86\ cm^2$

(iii) Volume (V) = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 5^2 \times 12$

∴ Volume (V) = $314.28\ cm^3$

2. दिइएको ठोस सोलीको चित्रमा, आधारको व्यास 14 से.मि. र छड्के उचाइ 25 से.मि. छ भने पत्ता लगाउनुहोस् ।
In the given figure of the solid cone has diameter of the base 14 cm and slanting height 25 cm, find: [2064 D2]



(i) **वक्र सतहको क्षेत्रफल** (area of the curved surface.)
(ii) **पूरा सतहको क्षेत्रफल** (total surface area.)
(iii) **आयतन** ($\pi = 22/7$) (volume of the cone. ($\pi = 22/7$)

⇨ Here, diameter of base (d) = 14 cm and Slant height (ℓ) = 25 cm

∴ Radius (r) = $\frac{d}{2} = \frac{14\ cm}{2} = 7$ cm

We know that, Vertical height (h) = $\sqrt{\ell^2 - r^2} = \sqrt{25^2 - 7^2} = 24$ cm

Now,

(i) Area of curved surface = $\pi r\ell = \frac{22}{7} \times 7 \times 25$

Area of curved surface = $550\ cm^2$

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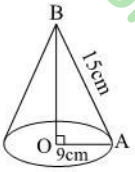
(ii) Total surface area $= \pi r(r + \ell) = \frac{22}{7} \times 7(7 + 25)$

$\therefore$ Total surface area $= 704 \text{ cm}^2$

(iii) Volume (V) $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 7^2 \times 24$

$\therefore$ Volume (V) $= 1232 \text{ cm}^3$

3. चित्रमा OA = 9 cm र AB = 15 cm छ भने सो सोलीको आयतन पत्ता लगाउनुहोस् ।
In the figure, OA = 9 cm and AB = 15 cm. Find the volume of the cone. [2057B1]



⇨ Here, radius of base (r) = 9 cm

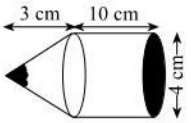
We know that, Vertical height (h) $= \sqrt{\ell^2 - r^2} = \sqrt{15^2 - 9^2} = 12$ cm

Now, Volume (V) $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 9^2 \times 12$

Thus, volume (V) $= 1018.28 \text{ cm}^3$

MODEL 2

4. सँगैको चित्रमा दिइएको पेन्सिल आकारको ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the pencil shaped solid object given alongside.[SLC MODEL 2065]



⇨ Here, common radius (r) $= \frac{4 \text{ cm}}{2} = 2$ cm,

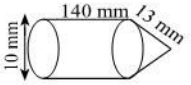
Height of cone (h_1) = 3 cm
Height of cylinder (h_2) = 10 cm

We know that, volume of the cone (V_1) $= 1/3\pi r^2 h_1 = \frac{1}{3} \times \frac{22}{7} \times (2 \text{ cm})^2 \times 3 \text{ cm} = 12.57 \text{ cm}^3$

Again, Volume of the cylinder, (V_2) $= \pi r^2 h_2 = \frac{22}{7} \times (2 \text{ cm})^2 \times 10 \text{ cm} = 125.7 \text{ cm}^3$

Now, Total volume (V) $= V_1 + V_2 = 12.57 \text{ cm}^3 + 125.7 \text{ cm}^3 = 138.27 \text{ cm}^3$
Thus, the volume of the given solid (V) $= 138.27 \text{ cm}^3$

5. सँगैको चित्रमा दिइएको पेन्सिल आकारको सिलिण्डरको आयतन पत्ता लगाउनुहोस् ।
Find the volume of a pencil made of a cylinder and cone as shown in the given diagram. [2057 E1]



⇨ Radius of base circle (r) $= \frac{10 \text{ mm}}{2} = 5$ mm

Height of cylindrical part (h) = 140 mm

Height (h') of the conical part $= \sqrt{(13 \text{ mm})^2 - (5 \text{ mm})^2} = 12$ mm

Now, volume of given pencil

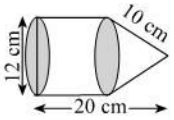
= volume of cylindrical part + volume of conical part

$= \pi r^2 \ h + \frac{1}{3} \times r^2 \ h' = \pi r^2 \left(h + \frac{1}{3} \times h'\right) = \frac{22}{7}(5)^2 \left(140 + \frac{1}{3} \times 12\right) = \frac{22 \times 25 \times 144}{7}$

$= 11314.29$ cu.mm

Thus, the volume of pencil is 11314.29 mm^3.

6. सँगैको चित्रमा दिइएको पेन्सिल आकारको ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the pencil-shaped solid object given alongside. [SLC 2066 C]



⇨ Here, Common radius (r) $= \frac{d}{2} = \frac{12 \text{ cm}}{2} = 6$ cm

Height of the cone (h_1) $= \sqrt{\ell^2 - r^2} = \sqrt{10^2 - 6^2} = 8$ cm
Height of the cylinder (h_2) = 20 cm – 8 cm = 12 cm
Now, total volume (V) = V(cone) + V(cylinder)

$= \frac{1}{3}\pi r^2 h_1 + \pi r^2 h_2 = \pi r^2 \left(\frac{1}{3}h_1 + h_2\right) = \pi \times 6^2 \left(\frac{1}{3} \times 8 + 12\right)$

$= 1659.42 \text{ cm}^3$

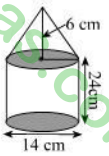
Thus, the total volume of the solid is 1659.42 cm^3.

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7. दिइएको चित्र बेलना र सोली मिली बनेको एउटा ठोस वस्तु हो। उक्त ठोस वस्तुमा बेलनाको उचाइ 24 cm, सोलीको उचाइ 6 cm र आधारको व्यास 14 cm भए ठोस वस्तुको आयतन पत्ता लगाउनुहोस्।

Given figure is a solid object composed of a cylinder and a cone. If the height of the cylinder is 24 cm, height of cone 6 cm and the diameter of the base 14 cm, find the volume of the solid object. **[SLC 2066 A]**



⇨ Here, common radius (r) $= \frac{d}{2} = \frac{14}{2} = 7$ cm

We have, total volume $= V(\text{cone}) + V(\text{cylinder}) = \frac{1}{3}\pi r^2 h_1 + \pi r^2 h_2$

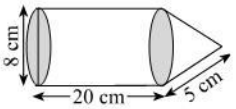
$= \pi r^2 \left(\frac{h_1}{3} + h_2\right) = \frac{22}{7} \times 7^2 \left(\frac{6}{3} + 24\right) = 22 \times 7 \times 26$

$\therefore$ Total volume $= 4004 \text{ cm}^3$

Thus, the total volume of the solid is 4004 cm^3.

8. दिइएको चित्र एउटा सोली र बेलना मिली बनेको संयुक्त ठोस वस्तु हो। उक्त ठोस वस्तुको आयतन पत्ता लगाउनुहोस्।

The given figure is a combined solid made of a cone and a cylinder. Find its volume. **[SLC 2067 D]**



⇨ Here, height of cylinder (h_1) = 20 cm

Common radius (r) $= \frac{d}{2} = \frac{8 \text{ cm}}{2} = 4$ cm

Vertical height of cone (h_2) $= \sqrt{\ell^2 - r^2} = \sqrt{5^2 - 4^2} = 3$ cm

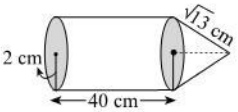
We know that, volume of solid $= V(\text{cylinder}) + V(\text{cone}) = \pi r^2 h_1 + \frac{1}{3}\pi r^2 h_2 = \pi r^2 (h_1 + \frac{1}{3} h_2)$

$= \frac{22}{7} \times 4^2 \times (20 + \frac{1}{3} \times 3) = \frac{22}{7} \times 16 \times 21 = 1056 \text{ cm}^3$

Thus, the volume of the solid is 1056 cm^3.

9. चित्रमा दिइएको पेन्सिल आकारको ठोस वस्तुको आयतन निकाल्नुहोस्।

Find the volume of the given pencil shaped solid object. **[SLC 2067 E]**



⇨ Here, slant height of cone (l) $= \sqrt{13}$ cm

Height of cylinder (h_1) $= 40$ cm

Common radius (r) $= 2$ cm

Vertical height of cone (h_2) $= \sqrt{\ell^2 - r^2} = \sqrt{(\sqrt{13})^2 - 2^2} = \sqrt{13 - 4} = \sqrt{9} = 3$ cm

Now, Volume (solid) $= V(\text{cylinder}) + V(\text{cone}) = \pi r^2 h_1 + \frac{1}{3}\pi r^2 h_2$

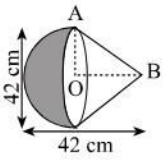
$= \pi r^2 (h_1 + \frac{1}{3} h_2) = \frac{22}{7} \times 2^2 (40 + \frac{1}{3} \times 3)$

$= \frac{22}{7} \times 4 \times 41 = 515.42 \text{ cm}^3$

Thus, the volume of the pencil is 515.42 cm^3.

10. दिइएको चित्र अर्धगोला र सोलीद्वारा बनेको संयुक्त ठोस वस्तु हो, उक्त वस्तुको आयतन पत्ता लगाउनुहोस्।

The given figure is a combined solid formed by a hemisphere and a cone, find its volume. **[SLC 2066 D]**



⇨ Here, common radius $= \frac{d}{2} = \frac{42 \text{ cm}}{2} = 21$ cm

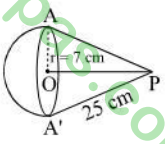
Total volume $= V(\text{hemisphere}) + V(\text{cone})$

$= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 (2r + h) = \frac{1}{3} \times \frac{22}{7} \times 21^2 \{2 \times 21 + (42 - 21)\} = 29106 \text{ cm}^3$

Thus, the total volume of the solid is 29106 cm^3.

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11. सँगैको चित्रमा दिइएको ठोस वस्तुको आयतन निकाल्नुहोस् । जसमा OA = 7 से.मि. र AP = 25 से.मि. छ ।
Find the volume of the solid object given in the adjoining figure in which OA = 7 cm and AP = 25 cm. **[SLC 2065 A, 2068 D, 2060 B1]**



⇨ Here, $OP^2 = AP^2 - OA^2$

$\therefore \quad h = OP = \sqrt{AP^2 - OA^2} = \sqrt{(25\text{ cm})^2 - (7\text{ cm})^2}$

$= \sqrt{625\text{ cm}^2 - 49\text{ cm}^2} = \sqrt{576\text{ cm}^2} = 24\text{ cm}$

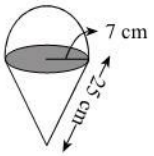
Volume of conical part $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times (7\text{ cm})^2 \times 24\text{ cm} = 1232\text{ cm}^3$

Volume of hemispherical part $= \frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times (7\text{ cm})^3 = \frac{2156}{3}\text{ cm}^3$

Volume of the solid $= 1232\text{ cm}^3 + \frac{2156}{3}\text{ cm}^3 = \frac{3696 + 2156}{3}\text{ cm}^3 = \frac{5852}{3}\text{ cm}^3 = 1950.67\text{ cm}^3$

Thus, the volume of the solid is 1950.67 cm^3.

12. दिइएको चित्रमा माथि अर्धवृत्ताकार हुनेगरी एउटा सोलीमा बरफ भरिएको छ । यदि सोलीको छड्के उचाइ 25 से.मि. र अर्धव्यास 7 से.मि. भए, सो सोलीमा भएको बरफको आयतन निकाल्नुहोस् ।
The given diagram is a cone filled with ice-cream whose upper part is hemisphere. If the slant height of the cone is 25 cm and its radius is 7 cm, find the volume of ice-cream in the cone. **[SLC 2065 C]**



⇨ Here, slant height (ℓ) = 25 cm
Common radius (r) = 7 cm

Height of cone (h) $= \sqrt{\ell^2 - r^2} = \sqrt{25^2 - 7^2} = 24\text{ cm}$

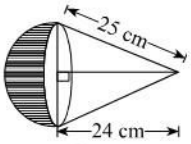
Now, volume of the ice–cream = V(Hemisphere) + V(Cone)

$= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 (2r + h) = \frac{1}{3} \times \frac{22}{7} \times 7^2 (2 \times 7 + 24)$

$= 1950.67\text{ cm}^3$

Thus, volume of ice-cream in cone is 1950.67 cm^3.

13. दिइएको संयुक्त ठोस वस्तुको आयतन पत्ता लगाउनुहोस्, जहाँ सोलीको छड्के उचाइ 25 cm र उचाइ 24 cm छ ।
Find the volume of the given combined solid object, where the slant height and height of the cone is 25 cm and 24 cm respectively. **[SLC 2068 E, 2060 B2]**



⇨ Here, vertical height of cone (h) = 24 cm and Slant height of cone (ℓ) = 25 cm

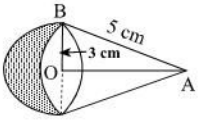
We have, $r = \sqrt{\ell^2 - h^2} = \sqrt{25^2 - 24^2} = \sqrt{49} \quad \therefore \quad r = 7\text{ cm}$

Now, total volume of the solid object $= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 (2r + h) = \frac{1}{3} \times \frac{22}{7} \times 7^2 (2 \times 7 + 24)$

$= 1950.67\text{ cm}^3$

Thus, the volume of the given solid is 1950.67 cm^3.

14. दिइएको ठोस चित्र सोली र अर्धगोला मिलेर बनेको छ । जहाँ AB = 5 cm, OB = 3 cm छन् । सो ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
The given figure is a solid made of cone and hemisphere in which AB = 5 cm, OB = 3 cm. Find the volume of the solid object. **[2062 E1]**



⇨ Here, In rt. angled triangle OBA,

$OA = \sqrt{AB^2 - OB^2} = \sqrt{(5\text{cm})^2 - (3\text{cm})^2} = \sqrt{25 - 9}\text{ cm} = \sqrt{16}\text{ cm} = 4\text{ cm}.$

r = radius of hemisphere = 3cm and h = OA = height of the cone = 4 cm

Volume of given solid $= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 (2r + h)$

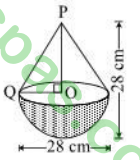
$= \frac{1}{3} \times \frac{22}{7} \times 3^2 (2 \times 3 + 4)\text{ cm}^3$

$= \frac{66}{7} \times 10\text{ cm}^3 = 94.29\text{ cm}^3$

Thus, volume of the solid is 94.29 cm^3.

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15. दिइएको चित्र सोली र अर्धगोलाद्वारा बनेको संयुक्त ठोस वस्तुको हो। उक्त वस्तुको आयतन पत्ता लगाउनुहोस्।
The given figure is a combined solid formed by a cone and hemisphere, find its volume. **[2071 A]**



⇨ Here, common diameter (d) = 28 cm ∴ Common radius (r) $= \frac{d}{2} = \frac{28}{2} = 14$ cm

Height of cone (h) = 28 cm – 14 cm = 14 cm
We know that,

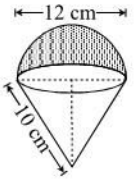
The volume of the combined solid $= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3 = \frac{1}{3}\pi r^2 (h + 2r)$

$= \frac{1}{3} \times \frac{22}{7} \times 14^2(14 + 2 \times 14) = \frac{1}{3} \times \frac{22}{7} \times 14^2 \times 42$

$= 22 \times 14^2 \times 2 = 8624 \text{ cm}^3$

Thus, the volume of the combined solid is 8624 cm^3.

16. दिइएको ठोस वस्तु एउटा सोली र एउटा अर्धगोला मिली बनेको छ। अर्धगोलाको अर्धव्यास र सोलीको अर्धव्यास बराबर छन्। अर्धगोलाको व्यास 12 से.मि. र सोलीको छड्के उचाइ 10 से.मि. छ। सो ठोस वस्तुको आयतन निकाल्नुहोस्।
Given solid object is made up of a cone and a hemisphere. The radius of the hemisphere is equal to the radius of the cone. The diameter of the hemisphere is 12 cm and slant height of the cone is 10 cm. Find the volume of the solid object. **[2071 S]**



⇨ Here, common radius (r) $= \frac{d}{2} = \frac{12}{2} = 6$ cm Slant height of cone (ℓ) = 10 cm

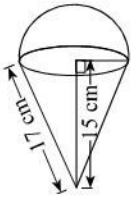
We know that, Height of cone $= \sqrt{\ell^2 - r^2} = \sqrt{10^2 - 6^2} = \sqrt{100 - 36} = \sqrt{64} = 8$ cm
Now, volume of the solid object = V(cone) + V(hemisphere)

$= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3 = \frac{1}{3}\pi r^2 (h + 2r)$

$= \frac{1}{3} \times \frac{22}{7} \times 6^2 (8 + 2 \times 6) = \frac{22}{21} \times 6^2 \times 20 = 754.28 \text{ cm}^3$

Thus, the volume of the solid object is 754.28 cm^3.

17. एउटा सोलीको उचाइ 15 से.मि. र छड्के उचाइ 17 से.मि. छ। उक्त सोलीमा चित्रमा देखाएको जस्तै गरी माथितिर अर्धगोलाकार हुने गरी बरफ भरिएको छ भने बरफको आयतन पत्ता लगाउनुहोस्।
A cone has its height 15 cm and slant height 17 cm. If it is filled up with ice-cream in such a way that its upper part is hemisphere as shown in the figure. Find the volume of the ice-cream. **[2070 E]**



⇨ Here, slant height (ℓ) = 17 cm and vertical height (h) = 15 cm
We know that, radius (r) $= \sqrt{\ell^2 - h^2} = \sqrt{17^2 - 15^2} = 8$ cm

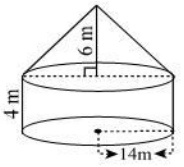
We have, Volume (V) $= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3 = \pi r^2 \left(\frac{1}{3}h + \frac{2}{3}r\right) = \frac{22}{7} \times 8^2 \left(\frac{1}{3} \times 15 + \frac{2}{3} \times 8\right)$

$= 2078 \text{ cm}^3$

Thus, the volume of the solid is 2078 cm^3.

MODEL 3

18. एउटा टेन्ट 4 m उचाइ सम्म 14 m अर्धव्यास भएको बेलना र त्यसभन्दा माथि 6 m उचाइसम्म सोलीको रूपमा छ सो टेन्टको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।
A tent is of the shape of right circular cylinder upto a height of 4 metres with radius 14 metres and then becomes a right circular cone with height of 6 metres. Calculate the total surface area of tent. **[2057 D2]**



⇨ Here, radius of circular base of tent (r) = 14 m
Height of the cylindrical part (h) = 4 m

Slanting length (ℓ) of conical part, $\ell = \sqrt{6^2 + 14^2}$ m = 15.2 m

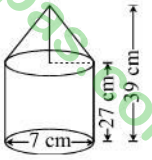
Total surface area of tent $= 2\pi rh + \pi r\ell = \pi r(2h + \ell) = \frac{22}{7} \times 14\,(2 \times 4 + 15.2)\ \text{m}^2$

$= 44 \times 23.2\ \text{m}^2 = 1020.8\ \text{m}^2$

Thus, TSA of the tent is 1020.8 m^2.

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19. सँगै दिइएका ठोसको वक्रसतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the curved surface area of the given figure. **[2059 C2]**



⇨ Here, height of cone (h') = 39 cm – 27 cm = 12 cm

Radius (r) = $\frac{7}{2}$ cm = 3.5 cm

Slant height of conical part (ℓ) = $\sqrt{h'^2 + r^2}$ = $\sqrt{(12\text{ cm})^2 + (3.5)\text{ cm}^2}$ = 12.5 cm

Now, curved surface area of cylindrical part = $2\pi rh = 2 \times \frac{22}{7} \times \frac{7}{2} \times 27\text{ cm}^2$

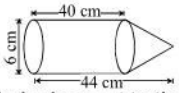
$= 22 \times 27\text{ cm}^2 = 594\text{ cm}^2$

Curved surface area of conical part = $\pi r\ell = \frac{22}{7} \times \frac{7}{2} \times 12.5\text{ cm}^2 = 137.5\text{ cm}^2$

Thus, the curved surface area of given solid = $(594 + 137.5)\text{ cm}^2 = 731.50\text{ cm}^2$

MODEL 4

20. सँगैको चित्रमा पेन्सिल आकारको ठोस वस्तु दिइएको छ । बेलनाको व्यास र सोलीको व्यास बराबर छन् । बेलनाको व्यास 6 से.मि. र लम्बाइ 40 से.मि. छन् । पूरा ठोस वस्तुको लम्बाइ 44 से.मि. छ भने सो वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।



In the adjoining figure, a pencil shaped solid object is given. The diameter of the cylinder is equal to the diameter of the cone. The diameter of the cylinder is 6 cm and length is 40 cm. The length of the whole solid object is 44 cm, find the total surface area of that object. **[2071 E]**

⇨ Here, common radius (r) = $\frac{d}{2} = \frac{6\text{ cm}}{2}$ = 3 cm Height of cylinder (h_1) = 4 cm

Height of cone (h_2) = 44 cm – 40 cm = 4 cm

Slant height of cone (ℓ) = $\sqrt{r^2 + h_2^2} = \sqrt{3^2 + 4^2} = 5$ cm

We know that,

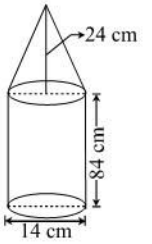
TSA (solid object) = CSA (cylinder) + CSA (cone) + Ar. (base) = $2\pi rh_1 + \pi r\ell + \pi r^2$

$= \pi r(2h_1 + \ell + r) = \frac{22}{7} \times 3(2 \times 40 + 5 + 3) = \frac{22}{7} \times 3 \times 88$

∴ TSA(solid object) = 829.71 cm^2

Thus, the total surface area of given solid is 829.71 cm^2.

21. दिइएको ठोस वस्तु बेलना र सोली मिली बनेको छ । बेलना र सोलीका व्यासहरू बराबर छन् । यदि बेलनाको उचाइ 84 से.मि., सोलीको उचाइ 24 से.मि. र आधारको व्यास 14 से.मि. भए सो ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।



Given solid object is made up of a cylinder and a cone. The diameter of the cylinder and cone are equal. If the height of the cylinder is 84 cm, height of the cone is 24 cm and diameter of the base is 14 cm, then find the total surface area of that solid object. **[2072 E]**

⇨ Here, common radius (r) = $\frac{d}{2} = \frac{14\text{ cm}}{2} = 7$ cm

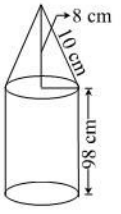
We know that, (ℓ) = $\sqrt{h^2 + r^2} = \sqrt{24^2 + 7^2} = \sqrt{625} = 25$ cm

We have,

TSA = $\pi r\ell + 2\pi rh + \pi r^2 = \pi r(\ell + 2h + r) = \frac{22}{7} \times 7(25 + 2 \times 84 + 7) = 22 \times 200 = 4400\text{ cm}^2$

Thus, the TSA is 4400 cm^2.

22. दिइएको ठोस वस्तु बेलना र सोली मिली बनेको छ । बेलना र सोलीका व्यासहरू बराबर छन् । यदि बेलनाको उचाइ 98 से.मि., सोलीको उचाइ 8 से.मि. र सोलीको छड्के उचाइ 10 से.मि. भए उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।



Given solid object is made up of a cylinder and a cone. The diameters of the cylinder and cone are equal. If the height of the cylinder is 98 cm, height of the cone is 8 cm and slant height of the cone is 10 cm, then find the total surface area of that solid object. **[2072 C]**

⇨ Here, height of cone (h) = 8 cm, Slant height (ℓ) = 10 cm and Height of cylinder (H) = 98 cm

We know that, Radius of cone (r) = $\sqrt{\ell^2 - h^2} = \sqrt{10^2 - 8^2} = 6$ cm

Now, TSA = $\pi r^2 + \pi r\ell + 2\pi rH = \pi r(r + \ell + 2H) = \frac{22}{7} \times 6(6 + 10 + 2 \times 98) = \frac{22}{7} \times 6 \times 212 = 3997.71\text{ cm}^2$

Thus, the TSA of the solid is 3997.71 cm^2.

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23. दिइएको ठोस वस्तु बेलना र सोली मिली बनेको छ। बेलना र सोलीका व्यासहरू बराबर छन्। यदि बेलनाको उचाइ 56 से.मि., सोलीको उचाइ 15 से.मि. र सोलीको छड्के उचाइ 17 से.मि. भए उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्। [2072 FW]



Given solid object is made up of a cylinder and a cone. The diameters of the cylinder and cone are equal. If the height of the cylinder is 56 cm, height of the cone is 15 cm and the slant height of the cone is 17 cm, then find the total surface area of that solid object.

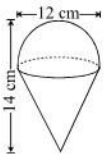
⇨ Here, height of cone (h) = 15 cm, Slant height of cone (ℓ) = 17 cm and height of cylinder (H) = 56 cm

We know that, Common radius (r) = $\sqrt{\ell^2 - h^2} = \sqrt{17^2 - 15^2} = 8$ cm

Now, TSA = $\pi r^2 + 2\pi rH + \pi r\ell = \pi r(r + 2H + \ell) = \frac{22}{7} \times 8(8 + 2 \times 56 + 17) = 3444.57$ cm^2

Thus, the TSA of the solid is 3444.57 cm^2.

24. दिइएको ठोस वस्तु एक सोली र अर्धगोला मिली बनेको छ। अर्धगोलाको अर्धव्यास र सोलीको अर्धव्यास बराबर छन्। अर्धगोलाको व्यास 12 से.मि. र पुरा ठोस वस्तुको उचाइ 14 से.मि. छ। सो ठोस वस्तुको पूरा सतहको क्षेत्रफल निकाल्नुहोस्।



Given solid object is made up of a hemisphere and a cone. The radius of hemisphere is equal to the radius of the cone. The diameter of a hemisphere is 12 cm and the height of whole solid object is 14 cm. Find the total surface area of that solid object. [2071 B]

⇨ Here, radius of hemisphere (r) = $\frac{d}{2} = \frac{12 \text{ cm}}{2} = 6$ cm

Total height of the solid (H) = 14 cm

Height of cone (h) = H – r = 14 cm – 6 cm = 8 cm

Slant height of cone (ℓ) = $\sqrt{h^2 + r^2} = \sqrt{8^2 + 6^2} = 10$ cm

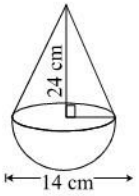
CSA of cone = $\pi r\ell = \frac{22}{7} \times 6 \times 10 = 188.57$ cm^2

CSA of hemisphere = $\frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 6^3 = 226.28$ cm^2

TSA of solid object = CSA (cone + hemisphere) = 188.57 cm^2 + 226.28 cm^2 = 414.85 cm^2

Thus, the total surface area of the solid is 414.85 cm^2.

25. दिइएको ठोस वस्तु सोली र अर्धगोला मिलि बनेको छ। सोली र अर्धगोलाका व्यासहरू बराबर छन्। यदि सोलीको उचाइ 24 से.मि. र अर्धगोलाको व्यास 14 से.मि. भए सो ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।



Given solid object is made up of a cone and a hemisphere. The diameters of cone and hemisphere are equal. If the height of the cone is 24 cm and diameter of the hemisphere is 14 cm, find the total surface area of that solid object. [2072 W]

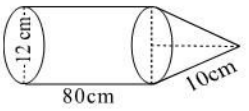
⇨ Here, height (h) = 24 cm and Common radius (r) = $\frac{d}{2} = \frac{14 \text{ cm}}{2} = 7$ cm

We know that, slant height (ℓ) = $\sqrt{h^2 + r^2} = \sqrt{24^2 + 7^2} = 25$ cm

Now, TSA = $\pi r\ell + 2\pi r^2 = \pi r(\ell + 2r) = \frac{22}{7} \times 7(25 + 2 \times 7) = 22 \times 39 = 858$ cm^2

Thus, the TSA is 858 cm^2.

26. दिइएको पेन्सिलको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।



Find the total surface area of the pencil given in the figure. [2060 C, 2068 C]

⇨ Here, r = $\frac{12 \text{ cm}}{2} = 6$ cm, h = 80 cm and ℓ = 10 cm

Total surface area of pencil = $\pi r^2 + 2\pi rh + \pi r\ell = \pi r(r + 2h + \ell)$

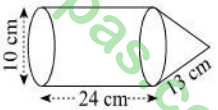
$= \frac{22}{7} \times 6 \text{ cm } (6 \text{ cm} + 2 \times 80 \text{ cm} + 10 \text{ cm})$

$= \frac{132}{7} \text{ cm } (176 \text{ cm}) = 3318.86 \text{ cm}^2$

Thus, TSA of pencil is 3318.86 cm^2.

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27. दिइएको ठोसको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्
Find the total surface area of the given solids. **[2063 E1, 2065 S, 2065 E]**



⇨ Here, r = radius of base $= \frac{10 \text{ cm}}{2} = 5$ cm

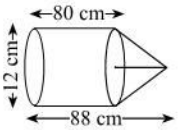
h = height of cylindrical part = 24 cm and ℓ = slant length of cone = 13 cm
We know that,
TSA = Area of base circle + Curved surface area of cylinder + Curved surface area of cone

$= \pi r^2 + 2\pi rh + \pi r\ell = \pi r\,(r + 2h + \ell) = \frac{22}{7} \times 5\,(5 + 2 \times 24 + 13)$

$= \frac{110}{7}(66) = 1037.14 \text{ cm}^2$

Thus, TSA of the given solid is 1037.14 cm^2.

28. दिइएको ठोसको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the solid object given in the figure.[SLC 2065 D]



⇨ Here, common radius (r) $= \frac{d}{2} = \frac{12 \text{ cm}}{2} = 6$ cm

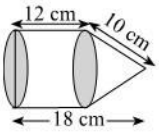
Height of cone (h_1) = 88 cm – 80 cm = 8 cm
Slant height of the cone (ℓ) $= \sqrt{h_1^2 + r^2} = \sqrt{8^2 + 6^2} = 10$ cm
Now, total surface area of the solid = CSA (cylinder) + CSA (cone) + πr^2

$= 2\pi rh + \pi r\ell + \pi r^2 = \pi r(2h + \ell + r)$

$= \frac{22}{7} \times 6\,(2 \times 80 + 10 + 6)$

Thus, total surface area of the solid = 3318.86 cm^2

29. दिइएको ठोसको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the given solid object in the adjoining figure.[SLC 2066 E]

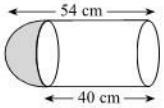


⇨ Here, height of cone (h_1) = 18 cm – 12 cm = 6 cm
Common radius (r) $= \sqrt{\ell^2 - h_1^2} = \sqrt{10^2 - 6^2} = 8$ cm
We know that, TSA of solid object $= \pi r^2 + 2\pi rh + \pi r\ell = \pi r(r + 2h + \ell)$

$= \frac{22}{7} \times 8(8 + 2 \times 12 + 10) = \frac{22}{7} \times 8 \times 42 = 1056 \text{ cm}^2$

Thus, the total surface area of the solid object is 1056 cm^2.

30. दिइएको चित्र एउटा बेलना र उही अर्धव्यास भएको एउटा अर्धगोला मिली बनेको एउटा संयुक्त ठोस वस्तु हो । यदि ठोस वस्तुको पूरा लम्बाइ 54 cm र बेलनाको मात्र लम्बाइ 40 cm भए सो ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The given figure is a combined solid made up of a cylinder and a hemi-sphere having same radius. If the total length of the combined solid is 54 cm and length of the cylinder only is 40 cm, find the total surface area of the solid. **[SLC 2067 A]**



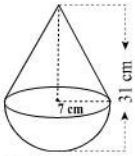
⇨ Here, height or length of cylinder (h) = 40 cm and Radius = 54 cm – 40 cm = 14 cm
We know that,
TSA of the solid = CSA(hemisphere) + CSA(cylinder) + Area of base

$= 2\pi r^2 + 2\pi rh + \pi r^2 = 3\pi r^2 + 2\pi rh = \pi r\,(3r + 2h) = \frac{22}{7} \times 14(3 \times 14 + 2 \times 40)$

$= 5368$

Thus, the TSA of the solid is 5368 cm^2.

31. दिइएका ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
Find the total surface area of the given solids. **[2062 A2, 2063 B1]**



⇨ Here, let r be the radius of hemisphere and h be the height of the cone.
Then, r = 7 cm & h = 31 cm – radius = 31 cm – 7 cm = 24 cm.
ℓ = slant height of the cone $= \sqrt{r^2 + h^2} = \sqrt{7^2 + 24^2} = \sqrt{49 + 576} = \sqrt{625} = 25$ cm
Now, Total surface area = surface area of hemisphere + lateral surface area of cone

$= 2\pi r^2 + \pi r\ell = \pi r(2r + \ell) = \frac{22}{7} \times 7\,(2 \times 7 + 25) = 22 \times 39 = 858 \text{ cm}^2$

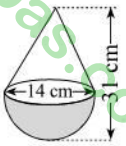
Thus, the TSA of the solid is 858 cm^2.

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32. दिइएको चित्र अर्ध गोलाकार र सोली मिली बनेको एउटा ठोस वस्तु हो। यदि सोलीको आधारको व्यास 14 से.मि. र ठोस वस्तुको पुरा उचाइ 31 से.मि. भए उक्त ठोस वस्तुको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस्।



The given diagram is a solid composed of a hemisphere and a cone. If the diameter of the base of the cone is 14 cm and the total height of the solid is 31 cm, find the total surface area of the solid. **[SLC 2067 C]**

⇨ Here, diameter of base (d) = 14 cm and Radius (r) $= \frac{d}{2} = \frac{14\text{ cm}}{2} = 7$ cm

Height of cone (h) = 31 cm – 7 cm = 24 cm and Slant height (ℓ) $= \sqrt{h^2 + r^2} = \sqrt{24^2 + 7^2} = 25$ cm

We know that,

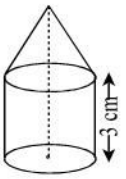
Total surface area = CSA(cone) + CSA(hemisphere) $= \pi r\ell + 2\pi r^2 = \pi r(\ell + 2r) = \frac{22}{7} \times 7(25 + 2 \times 7)$

$= 22 \times 39 = 858\text{ cm}^2$

Thus, the total surface area is 858 cm^2.

MODEL 5

33. एउटा बेलनाको आधारको क्षेत्रफलसँग बराबर हुने गरि (बेलनाको आधार ढाकिने) गरि एउटा सोली चित्रमा दिइएजस्तै गरी राखिएको छ। बेलनाको आधारको क्षेत्रफल 125 cm^2 र बेलनाको उचाइ 3 cm छ। यदि दिइएको पूरा ठोस वस्तुको आयतन 625 cm^3 भए सो ठोस वस्तुको उचाइ पत्ता लगाउनुहोस्।



A cone is placed on a cylinder so that the base of the cone covers exactly the base of the cylinder as shown in the figure. The area of the base of the cylinder is 125 cm^2 and the height of the cylinder is 3 cm. If the volume of the whole solid is 625 cm^3, find the height of the solid. **[2059 B1]**

⇨ Here, volume of cylinder = Area of the base × height = 125 cm^2 × 3 cm = 375 cm^3

By question,

Area of the base of the cone = Area of the base of the cylinder = 125 cm^2

We know that, Volume of the cone $= \frac{1}{3}$ × area of the base × height $= \frac{1}{3} \times 125 \times h = \frac{125h}{3}$

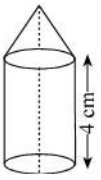
Now, Volume of the cone + volume of the cylinder = volume of the whole solid

or, $\frac{125h}{3} + 375 = 625$ or, $\frac{125h}{3} = 625 - 375$

or, $\frac{125h}{3} = 250$ or, $125h = 750$ $\therefore\ h = \frac{750}{125} = 6$ cm

Thus, height of the whole solid = 6 cm + 3 cm = 9 cm

34. दिइएको चित्रमा बेलनाको आधारको क्षेत्रफल 64 cm^2 र बेलनाको उचाइ 4 cm छन्। पूरा ठोस वस्तुको आयतन 320 cm^3 भए सो ठोस वस्तुको उचाइ पत्ता लगाउनुहोस्।



In the given figure, the base area of the cylinder is 64 cm^2 and the height of the cylinder is 4 cm. If the volume of the whole solid is 320 cm^3, find the height of the solid. **[2067 B, 2057 B]**

⇨ Here, let, height of conical part = h_1 and Height of cylinder = h_2 = 4 cm

From the figure,

Volume of solid = V(Cylinder) + V(Cone)

or, 320 = base area × height + $\frac{1}{3}$ base area × height

or, $320 = 64 \times 4\text{ cm} + \frac{1}{3} \times 64 \times h_1$

or, $320 = 256 + \frac{64}{3} h_1$ $\therefore\ h_1 = 3$

Now, height of the solid = $h_1 + h_2$ = 3 cm + 4 cm = 7 cm

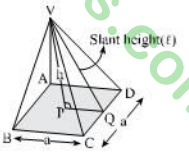
Thus, height of the solid is 7 cm.

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पिरामिड (PYRAMID)

A. VERY SHORT QUESTIONS



1. दिइएको वर्गाकार आधार भएको पिरामिडमा निम्न सूत्रहरू पत्ता लगाउनुहोस् ।
Given pyramid has squared base. Find the following formulae:

(a) छड्के उचाइलाई h र a को रूपमा (Slant height in terms of h and a)
(b) ठाडो उचाइलाई ℓ र a को रूपमा (Vertical height in terms of ℓ and a)
(c) वर्गाकार आधारको लम्बाइलाई ℓ र h को रूपमा (Length of squared base in terms of ℓ and h)
(d) किनाराको लम्बाइलाई ℓ र a को रूपमा (Length of edge in terms of ℓ and a)
(e) आधारको क्षेत्रफल (Area of base)
(f) त्रिभुजाकार सतहहरूको क्षेत्रफल (Area of triangular faces)
(g) आयतन (Volume)
(h) पूरा सतहको क्षेत्रफल (Total surface area)

⇨ Here, length of sides of base = a, height of the pyramid = h
Now,

(a) Slant height $(\ell) = \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$;;; (b) Vertical height $(h) = \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2}$

(c) Length of base $(a) = 2\sqrt{\ell^2 - h^2}$ (d) Length of edge $(e) = \sqrt{\ell^2 + \left(\frac{a}{2}\right)^2}$

(e) Area of base $= a \times a = a^2$ (f) Area of triangular faces $= 2a\ell$

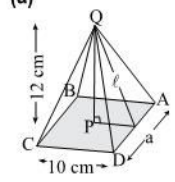
(g) Volume $= \frac{1}{3}a^2h$ (h) Total surface area $= a^2 + 2a\ell$

2. एउटा वर्गाकार पिरामिडको आधारको क्षेत्रफल 40 cm² र एउटा त्रिभुजाकार पाटाको क्षेत्रफल 50 cm² छ । सो पिरामिडको पूरा सतहहरूको क्षेत्रफल पत्ता लगाउनुहोस् ।
A squared base pyramid has base area 40 cm² and area of a triangular face 50 cm². Find the total surface area.

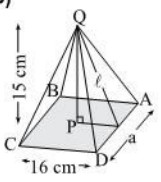
⇨ Here, base area of squared pyramid $(a^2) = 40$ cm², Area of triangular faces $(2a\ell) = 4 \times 50 = 200$ cm²
We know that, total surface area of squared base pyramid $= 2a\ell + a^2 = 200 + 40 = 240$
Thus, required total surface area is 240 cm².

B. SHORT QUESTIONS

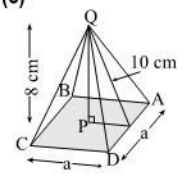
1. दिइएको वर्गाकार आधार भएको पिरामिडमा निम्न पत्ता लगाउनुहोस् ।
Given pyramids have squared base. Find the following:

(a)


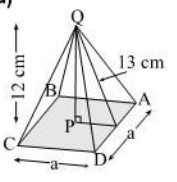
Slant height (ℓ) = ?

(b)


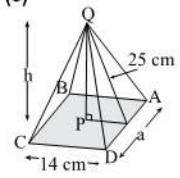
Slant height (ℓ) = ?

(c)


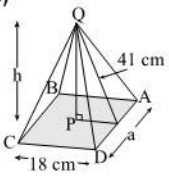
Length of base (a) = ?

(d)


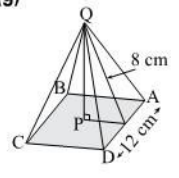
Length of base (a) = ?

(e)


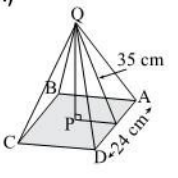
Vertical height (h) = ?

(f)


Vertical height (h) = ?

(g)


Length of edge (QA) = ?

(h)


Length of edge (QA) = ?

⇨ (a) Here, length of a side (a) = 10 cm, vertical height (h) = 12 cm
We know that, slant height $(\ell) = \sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{5^2 + 12^2} = 13$ Thus, slant height = 13 cm.

(b) Here, length of a side (a) = 16 cm, vertical height (h) = 15 cm
We know that, slant height $(\ell) = \sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{8^2 + 15^2} = 17$ Thus, slant height = 17 cm.

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(c) Here, vertical height (h) = 8 cm, slant height (ℓ) = 10 cm

We know that, slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

or, $10 = \sqrt{\left(\frac{a}{2}\right)^2 + 8^2}$ or, $10^2 - 8^2 = \left(\frac{a}{2}\right)^2$ or, $6^2 = \left(\frac{a}{2}\right)^2$

or, $6 = \frac{a}{2}$ $\therefore$ $a = 12$ Thus, length of base is 12 cm.

(d) Here, vertical height (h) = 12 cm, slant height (ℓ) = 13 cm

We know that, slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

or, $13 = \sqrt{\left(\frac{a}{2}\right)^2 + 12^2}$ or, $13^2 - 12^2 = \left(\frac{a}{2}\right)^2$ or, $5^2 = \left(\frac{a}{2}\right)^2$

or, $5 = \frac{a}{2}$ $\therefore$ $a = 10$ Thus, length of base is 10 cm.

(e) Here, length of a side (a) = 14 cm, slant height (ℓ) = 25 cm

We know that, slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

or, $25 = \sqrt{\left(\frac{14}{2}\right)^2 + h^2}$ or, $25^2 = 7^2 + h^2$ or, $h^2 = 625 - 49 = 576$

$\therefore$ $h = \sqrt{576} = 24$ Thus, vertical height is 24 cm.

(f) Here, length of a side (a) = 18 cm, slant height (ℓ) = 41 cm

We know that, slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

or, $41 = \sqrt{\left(\frac{18}{2}\right)^2 + h^2}$ or, $41^2 = 9^2 + h^2$ or, $h^2 = 41^2 - 9^2 = 1600$

$\therefore$ $h = 40$ Thus, vertical height is 40 cm.

(g) Here, length of side of base (a) = 12 cm, slant height (ℓ) = 8 cm

We know that, length of edge (e) = $\sqrt{\ell^2 + \left(\frac{a}{2}\right)^2} = \sqrt{8^2 + \left(\frac{12}{2}\right)^2} = \sqrt{100} = 10$

Thus, length of edge = 10 cm.

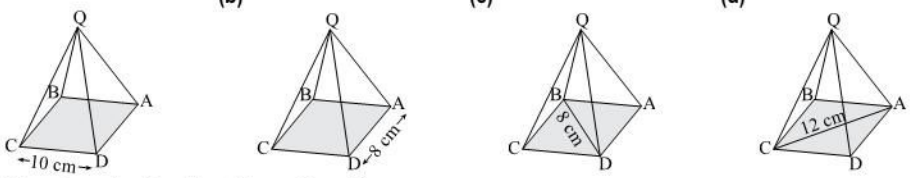
(h) Here, length of side of base (a) = 24 cm, slant height (ℓ) = 35 cm

We know that, length of edge (e) = $\sqrt{\ell^2 + \left(\frac{a}{2}\right)^2} = \sqrt{35^2 + \left(\frac{24}{2}\right)^2} = \sqrt{1369} = 37$

Thus, length of edge = 37 cm.

2. दिइएका वर्गाकार आधार भएका पिरामिडहरूमा आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।
Given pyramids have squared base. Find the area of base:

(a) **(b)** **(c)** **(d)**



⇨ (a) Here, length of a side of base (a) = 10 cm
We know that, area of base of squared base Pyramid = $a^2 = 10^2 = 100$
Thus, area of base is 100 cm^2.

(b) Here, length of a side of base (a) = 8 cm
We know that, area of base of squared base Pyramid = $a^2 = 8^2 = 64$
Thus, area of base is 64 cm^2.

(c) Here, length of diagonal = 8 cm
Let, a be the side of base then $a^2 + a^2 = 8^2$
or, $2a^2 = 64$ $\therefore$ $a^2 = 32$ Thus, area of base is 32 cm^2.

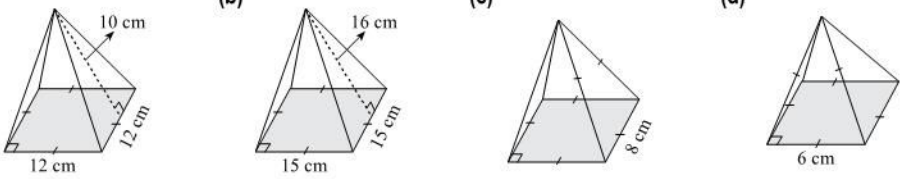
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(d) Here, length of diagonal = 12 cm
Let, a be the side of base then
$a^2 + a^2 = 12^2$
or, $2a^2 = 144$ $\therefore$ $a^2 = \frac{144}{2} = 72$
Thus, area of base is 72 cm^2.

3. दिइएका वर्गाकार आधार भएका पिरामिडहरूमा त्रिभुजाकार सतहहरूको क्षेत्रफल पत्ता लगाउनुहोस् ।
Given pyramids have squared base. Find the area of triangular faces (LSA):

(a) (b) (c) (d)



⇨ (a) Here, length of a side of base (a) = 12 cm, slant height (ℓ) = 10 cm
We know that, lateral surface area of square based pyramid = $2a\ell = 2 \times 12 \times 10 = 240$
Thus, area of triangular faces is 240 cm^2.

(b) Here, length of a side of base (a) = 15 cm, slant height (ℓ) = 16cm
We know that, lateral surface area of square based pyramid = $2a\ell = 2 \times 15 \times 16 = 480$
Thus, area of triangular faces is 480 cm^2.

(c) Here, length of base (a) = 8 cm, length of edge (e) = 8 cm
We have, $e = \sqrt{\ell^2 + \left(\frac{a}{2}\right)^2}$ or, $8 = \sqrt{\ell^2 + \left(\frac{8}{2}\right)^2}$
or, $8^2 - 4^2 = \ell^2$ or, $48 = \ell^2$ $\therefore$ $\ell = 4\sqrt{3}$
Again, lateral surface area = $2a\ell = 2 \times 8 \times 4\sqrt{3} = 64\sqrt{3}$
Thus, area of triangular faces is $64\sqrt{3}$ cm^2.

(d) Here, length of base (a) = 6 cm, length of edge (e) = 6 cm
We have, $e = \sqrt{\ell^2 + \left(\frac{a}{2}\right)^2}$ or, $6 = \sqrt{\ell^2 + \left(\frac{6}{2}\right)^2}$ or, $6^2 - 3^2 = \ell^2$
or, $27 = \ell^2$ $\therefore$ $\ell = 3\sqrt{3}$
Again, lateral surface area = $2a\ell = 2 \times 6 \times 3\sqrt{3} = 36\sqrt{3}$
Thus, area of triangular faces is $36\sqrt{3}$ cm^2.

4. एउटा वर्ग आधार भएको पिरामिडको पूरा सतहको क्षेत्रफल र त्रिभुजाकार सतहहरूको क्षेत्रफल क्रमशः 654 cm^2 र 456 cm^2 छन् । सो पिरामिडको आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।
A squared base pyramid has total surface area 654 cm^2 and lateral surface area 456 cm^2. Find the area of the base.

⇨ Here, total surface area (TSA) = 654 cm^2, Lateral surface area (LSA) = 456 cm^2
We have, total surface area of squared base pyramid = Lateral surface area + area of base
or, 654 = 456 + base area $\therefore$ Base area = 654 – 456 = 198
Thus, required area of base is 198 cm^2.

5. एउटा वर्ग आधार हुने पिरामिडको पूरा सतहको क्षेत्रफल 600 cm^2 छ । यदि पिरामिडको छड्के सतहको क्षेत्रफल आधारको क्षेत्रफलको 2 गुणा भए आधारको लम्बाइ पत्ता लगाउनुहोस् ।
The total surface area of a square based pyramid is 600 cm^2. If the lateral surface area of the pyramid is 2 times the base area, find the base area.

⇨ Here, total surface area (TSA) = 600 cm^2
From question, lateral surface area = 2 × base area (A)
i.e. LSA = 2 × A
We have, TSA = LSA + A or, 600 = 2A + A
or, 600 = 3A $\therefore$ $A = \frac{600}{3} = 200$
Thus, required base area is 200 cm^2.

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6. वर्गाकार आधार हुने पिरामिडको उचाइ 5 cm र आयतन 1500 cm^3 छन् । आधारको भुजाको लम्बाइ पत्ता लगाउनुहोस् ।

The volume of a pyramid having squared base is 1500 cm^3 and height 5 cm. Find the length of base.

⇨ Here, height of squared pyramid (h) = 5 cm, Volume of squared pyramid = 1500 cm^3

or, $\frac{1}{3}a^2h = 1500$ or, $a^2 = \frac{1500 \times 3}{5} = 900$ $\therefore$ $a = \sqrt{900} = 30$

Thus, the length of base is 30 cm.

7. एउटा वर्गाकार आधार भएको पिरामिडको आधारको क्षेत्रफल 49 m^2 र उचाइ 12 m भए त्यसको आयतन पत्ता लगाउनुहोस् ।

Find the volume of a square pyramid, if its base area is 49 m^2 and height 12 m. **[2057 A1]**

⇨ Here, Volume of the pyramid $= \frac{1}{3} \times$ area of base $\times$ height

$= \frac{1}{3} \times 49 \times 12 = 196\ m^3$.

8. एउटा वर्गाकार पिरामिडको आधारको क्षेत्रफल 36 m^2 र उचाइ 10 m भए आयतन कति होला ? **[2057 A2]**

If the area of the base of a square pyramid is 36 m^2 and its height is 10 m, what will be its volume ?

⇨ Here, we know that, volume of pyramid $= \frac{1}{3} \times$ Area of base $\times$ height $= \frac{1}{3} \times 36 \times 10 = 120\ m^3$

9. 81 m^2 आधारको क्षे.फ. भएको वर्गाकार पिरामिडको उचाइ 18 m भए सो पिरामिडको आयतन निकाल्नुहोस् ।

The height of a square pyramid having the area of its base 81 square metres is 18 metres. Find the volume of the pyramid. **[2057 B1]**

⇨ Here, volume of Pyramid $= \frac{1}{3} \times$ Area of base of Pyramid $\times$ height

$= \frac{1}{3} \times 81 \times 18 = 486\ m^3$

10. एउटा पिरामिडको उचाइ 8 m र सो पिरामिडको आधार 12 m भुजा भएको वर्ग छ भने यसको आयतन निकाल्नुहोस् ।

A pyramid of height 8 m has its base is a square with side 12 m. Find its volume. **[2057 E1]**

⇨ Here, Area of squared base (A) = $(12\ m)^2 = 144\ m^2$ and Height of the pyramid (h) = 8 m.

Volume of the pyramid $= \frac{1}{3} \times A \times h$

$= \frac{1}{3} \times 144\ m^2 \times 8\ m^2 = 384\ m^3$

11. 81 वर्ग से.मि. आधार र उचाइ 6 से.मि. भएको पिरामिडको आयतन पत्ता लगाउनुहोस् ।

Find the volume of a pyramid whose base is 81 cm^2 and height is 6 cm. **[2058 C1, 2059 C1]**

⇨ Here, area of pyramid $= \frac{1}{3} \times$ area of base $\times$ height

$= \frac{1}{3} \times 81\ cm^2 \times 6\ cm = 162\ cm^3$

12. 21 वर्ग से.मि. आधार र उचाइ 5 से.मि. भएको पिरामिडको आयतन पत्ता लगाउनुहोस् ।

Find the volume of a pyramid whose base is 21 cm^2 and height is 5 cm. **[2059 C2]**

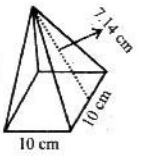
⇨ Here, by formula, Volume of pyramid $= \frac{1}{3} \times$ area of base $\times$ height

$= \frac{1}{3} \times 21\ cm^2 \times 5\ cm$

$= 7\ cm^2 \times 5\ cm = 35\ cm^3$

13. सँगै दिइएको वर्गाकार आधार भएको पिरामिडको वक्र सतहको क्षेत्रफल निकाल्नुहोस् ।

In the adjoining figure, find the lateral surface area of the pyramid with a square base. **[2060 D1]**



⇨ Here, Area of each triangular face $= \frac{1}{2} \times 10\ cm \times 7.14\ cm = \frac{71.4}{2}\ cm^2 = 35.7\ cm^2$

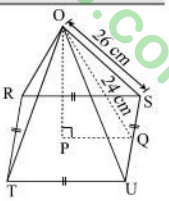
Lateral surface area = 4 $\times$ area of each triangular face = $4 \times 35.7\ cm^2 = 142.8\ cm^2$

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C. LONG QUESTIONS

MODEL 1

1. दिइएको वर्गाकार आधार भएको ठोस पिरामिडको आयतन पत्ता लगाउनुहोस् ।
From the adjoining figure, find the volume of square base solid pyramid. [2071 C]



⇨ Here, OS = 26 cm and OQ = 24 cm

By Pythgoras theorem, $QS = \sqrt{OS^2 - OQ^2} = \sqrt{26^2 - 24^2} = \sqrt{100} = 10$ cm

$\therefore$ SU = 2.QS = 2 × 10 cm = 20 cm

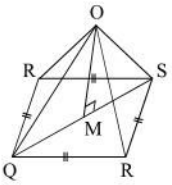
Again, by the Pythagoras theorem, $OP = \sqrt{OQ^2 - PQ^2} = \sqrt{576 - 100} = \sqrt{476}$

$\therefore$ OP = 21.8 cm

We have, volume (Pyramid) $= \frac{1}{3}$ base area × height $= \frac{1}{3} \times (SU)^2 \times OP$

$= \frac{1}{3} \times 20^2 \times 21.8 = 2096.67$ cm^3

2. दिइएको चित्रमा, वर्गाकार आधार भएको पिरामिडको आयतन पत्ता लगाउनुहोस् । जसमा OS = 5 से.मि. र OM = 4 से.मि. छ ।
In the given figure, find the volume of the square based pyramid in which OS = 5 cm and OM = 4 cm. [2071 S]



⇨ Here, OS = 5 cm and OM = 4 cm

By Pythagoras theorem,

$SM = \sqrt{OS^2 - OM^2} = \sqrt{5^2 - 4^2} = 3$ cm $\quad \therefore \quad QS = 2 \times SM = 2 \times 3$ cm $= 6$ cm

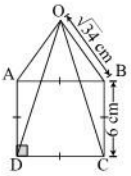
We have, base area (Pyramid) $= \frac{1}{2} d^2 = \frac{1}{2} (QS)^2 = \frac{1}{2} \times (6 \text{ cm})^2 = 18$ cm^2

Now, we know that,

Volume of pyramid (V) $= \frac{1}{3}$ base area × height $= \frac{1}{3} \times 18$ cm$^2 \times 4$ cm $= 24$ cm^3

Thus, the volume of the pyramid is 24 cm^3

3. दिइएको चित्र एउटा वर्गाकार आधार भएको पिरामिड हो । यदि पिरामिडको आधारको भुजा 6 से.मि. र त्रिभुजाकार सतहहरूको छड्के किनाराको लम्बाइ (OB) = $\sqrt{34}$ से.मि. छन् भने उक्त पिरामिडको आयतन पत्ता लगाउनुहोस् ।
The given figure is a square based pyramid. If the side of the base of pyramid is 6 cm and the sloping edge of triangular surface (OB) = $\sqrt{34}$ cm, find the volume of the pyramid. [2072 FW]



⇨ Here, OB = $\sqrt{34}$ cm and BC = 6 cm

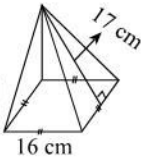
We know that, slant height (ℓ) $= \sqrt{OB^2 - \left(\frac{BC}{2}\right)^2} = \sqrt{34 - 3^2} = 5$ cm

Again, vertical height (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{5^2 - 3^2} = 4$ cm

Now, Volume of pyramid (V) $= \frac{1}{3} a^2 \times h = \frac{1}{3} \times 6^2 \times 4 = 48$ cm^3

Thus, the volume of the pyramid is 48 cm^3.

4. दिइएको चित्र वर्गाकार आधार भएको ठोस पिरामिड हो । यदि पिरामिडको छड्के उचाइ 17 से.मि. र आधारको भुजा 16 से.मि. भए उक्त पिरामिडको आयतन निकाल्नुहोस् ।
Given figure is a square based pyramid. If the slant height of the pyramid is 17 cm and the side of the base 16 cm, determine the the volume of the pyramid. [SLC 2065B]



⇨ Here, slant Height (s) = 17 cm and Length of base (ℓ) = 16 cm

Vertical height (h) $= \sqrt{s^2 - \left(\frac{\ell}{2}\right)^2} = \sqrt{17^2 - 8^2}$ $\quad \therefore$ Vertical height (h) = 15 cm

Now, volume of the pyramid (V) $= \frac{1}{3} \ell^2 h = \frac{1}{3} \times 16^2 \times 15$

Thus, volume of the pyramid (V) $= 1280$ cm^3

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5. दिइएको चित्रमा, एउटा वर्गाकार आधार भएको पिरामिडको ठाडो उचाइ (AB) = 24 से.मि. र किनाराको छड्के लम्बाइ (AC) = 25 से.मि. भए सो पिरामिडको आयतन पत्ता लगाउनुहोस् ।
In the given figure, the vertical height (AB) and length of the slant edge (AC) of the square based pyramid are 24 cm and 25 cm respectively. FInd the volume of the pyramid. **[SLC 2067 A]**



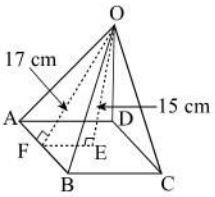
⇨ Here, from the given figure, $BC = \sqrt{AC^2 - AB^2} = \sqrt{25^2 - 24^2} = \sqrt{49} = 7$ cm
$CD = 2BC = 2 \times 7$ cm $= 14$ cm

We know that, Area of base $= \frac{1}{2}(\text{diagonal})^2 = \frac{1}{2}CD^2 = \frac{1}{2} \times 14^2 = 98$ cm

Now, volume of pyramid $= \frac{1}{3}$ base area $\times$ height $= \frac{1}{3} \times 98 \times 24 = 784$ cm^3

Thus, the volume of the pyramid is 784 cm^3.

6. दिइएको वर्गाकार आधार भएको पिरामिडको उचाइ र छड्के उचाइ क्रमशः 15 cm र 17 cm भए उक्त ठोसको आयतन पत्ता लगाउनुहोस् ।
In the given figure of the square based pyramid the slant height and height of the solid are 15 cm and 17 cm respectively, find the volume of the solid. **[SLC 2068 E]**



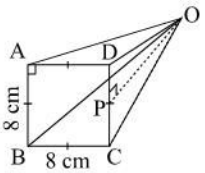
⇨ Here, slant height (ℓ) = 17 cm and Vertical height (h) = 15 cm

We know that, Length of base (a) $= 2\sqrt{\ell^2 - h^2} = 2\sqrt{17^2 - 15^2} = 2 \times 8 = 16$ cm

Now, volume of the pyramid $= \frac{1}{3}a^2h = \frac{1}{3} \times 16^2 \times 15 = 1280$ cm^3

Thus, the volume of the pyramid is 1280 cm^3.

7. चित्रमा देखाइएको वर्गाकार आधार पिरामिडको त्रिभुजाकार सतहहरूको क्षेत्रफल 80 cm^2 भए उक्त पिरामिडको आयतन पत्ता लगाउनुहोस् । जहाँ आधारको भुजाको लम्बाइ 8 cm छ ।
The area of triangular surfaces of the square based pyramid given in the diagram is 80 cm^2. Find the volume of the pyramid. Where the length of the side of base is 8 cm. **[SLC 2068 A]**



⇨ Here, length of base (a) = 8 cm and Area of triangular faces (s) = 2aℓ

or, $2a\ell = 80$ or, $2 \times 8 \times \ell = 80$ $\therefore$ $\ell = 5$

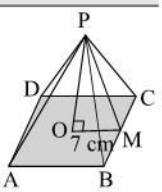
We have, vertical height (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{5^2 - 4^2} = \sqrt{25 - 16} = 3$ cm

We know that, Volume of pyramid $= \frac{1}{3}a^2h = \frac{1}{3} \times 8^2 \times 3 = 64$ cm^3

Thus, the volume of the pyramid is 64 cm^3.

MODEL 2

8. दिइएको वर्गाकार आधार भएको पिरामिडको आयतन 1568 cm^3 र आधारको भुजाको आधा (OM) = 7 cm भए त्रिभुजाकार सतहहरूको क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given square based pyramid, volume of the pyramid is 1568 cm^3 and half of the length of the side of the base (OM) = 7 cm. Calculate the area of triangular faces of the pyramid. **[SLC 2066 D]**



⇨ Here, AB = 2 × OM = 2 × 7 cm = 14 cm

We know that, volume $= \frac{1}{3}\ell^2h$ or, $1568 = \frac{1}{3} \times 14^2 \times h$

or, $\frac{1568 \times 3}{14 \times 14} = h$ $\therefore$ $h = 24$ cm

Now, slant height (s) $= \sqrt{OP^2 + OM^2} = \sqrt{24^2 + 7^2} = 25$ cm
We know, area of triangular faces $= 2s\ell = 2 \times 25 \times 14 = 700$ cm^2
Thus, the area of triangular faces is 700 cm^2.

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MODEL 3

9. चित्रमा दिइएको वर्गाकार आधार भएको ठोस पिरामिडको उचाइ 24 से.मि. र छड्के उचाइ 26 से.मि. छ । भने उक्त पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
In the given figure, the square base solid pyramid has vertical height 24 cm and slant height 26 cm, find its total surface area. **[2070 D]**



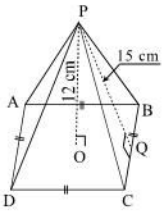
⇨ Here, vertical height (h) = 24 cm and slant height (ℓ) = 26 cm

We know that, length of base (a) $= 2\sqrt{\ell^2 - h^2} = 2\sqrt{26^2 - 24^2} = 2 \times 10 = 20$ cm

Now, TSA $= 2a\ell + a^2 = 2 \times 20 \times 26 + 20^2 = 1040 + 400 = 1440$ cm^2

Thus, the TSA is 1440 cm^2.

10. दिइएको चित्रमा वर्गाकार आधार भएको एउटा पिरामिडको उचाइ 12 से.मि. र छड्के उचाइ 15 से.मि. छन् भने उक्त पिरामिडको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, the height of a square based pyramid is 12 cm and slant height is 15 cm. Find the total surface area of the pyramid. **[2072 MW]**



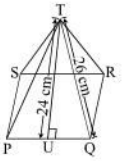
⇨ Here, vertical height (h) = 12 cm and slant height (ℓ) = 15 cm

We have, length of base (a) $= 2\sqrt{\ell^2 - h^2} = 2 \times \sqrt{15^2 - 12^2} = 2 \times 9 = 18$ cm

Now, TSA $= 2a\ell + a^2 = 2 \times 18 \times 15 + 18^2 = 540 + 324 = 864$ cm^2

Thus, the TSA is 864 cm^2.

11. दिइएको चित्र वर्गाकार आधार भएको पिरामिडको हो जसमा QT = 26 से.मि. र छड्के उचाइ (TU) = 24 से.मि भए उक्त पिरामिडको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The given figure is square based pyramid. In which QT = 26 cm and slant height (TU) = 24 cm, find the total surface area of the pyramid. **[2071 E]**



⇨ Here, TU = 24 cm and TQ = 26 cm

Using Pythagoras theorem, Length of UQ $= \sqrt{26^2 - 24^2} = \sqrt{676 - 576} = \sqrt{100}$

$\therefore$ UQ = 10 cm

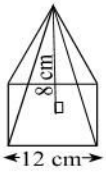
We have, PQ = 2UQ = 2 × 10 cm = 20 cm

We know that, TSA (squared pyramid) $= 2a\ell + a^2 = 2 \times PQ \times TU + PQ^2$

$= 2 \times 20 \times 24 + 20^2 = 960 + 400 = 1360$ cm^2

Thus, the TSA (given pyramid) is 1360 cm^2.

12. दिइएको चित्र वर्गाकार आधार भएको एउटा पिरामिड हो । पिरामिडको उचाइ 8 cm र आधारको लम्बाइ 12 cm भए सो पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Given figure is a square based pyramid. If the height of the pyramid is 8 cm, and length of its base 12 cm, find the total surface area of the pyramid.
[SLC 2066 A, 2058 B1, 2063 C2, 2057 D, S]

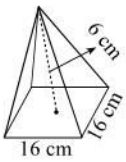


⇨ Here, slant height (s) $= \sqrt{h^2 + \left(\frac{\ell}{2}\right)^2} = \sqrt{8^2 + \left(\frac{12}{2}\right)^2} = \sqrt{64 + 36} = \sqrt{100} = 10$ cm

Now, we know that; Total surface area $= 2s\ell + \ell^2 = 2 \times 10 \times 12 + 12^2 = 384$ cm^2

Thus, total surface area = 384 cm^2

13. पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the total surface area of the pyramid. **[2058 B2, 2061 B1, 2061 S, EO 2065 C]**



⇨ Here, area of squared base (A) = (Side of the base)^2 $= (16 \text{ cm})^2 = 256$ cm^2

Now, slant height $= \sqrt{(6)^2 + \left(\frac{16}{2}\right)^2} = \sqrt{36 + 64} = \sqrt{100} = 10$ cm

Here, four triangular faces of the pyramid are of equal areas.

$\therefore$ Lateral surface area (S) = 4 × area of triangular face $= 4 \times \frac{1}{2} \times 16 \text{ cm} \times 10 \text{ cm} = 320$ cm^2

Thus, total surface area of the pyramid = A + S = 256 cm^2 + 320 cm^2 = 576 cm^2

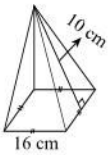
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14. पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the total surface area of the pyramid. **[2061 B2]**



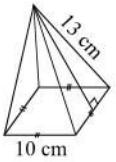
⇨ Here, $OM = \sqrt{PM^2 - OP^2} = \sqrt{17^2 - 15^2} = \sqrt{289 - 225} = \sqrt{64} = 8$ cm
Side of square base $= 2 \times OM = 2 \times 8$ cm $= 16$ cm
$\therefore$ A = Area of square base $= (16 \text{ cm})^2 = 256 \text{ cm}^2$
$\therefore$ S = Area of $\Delta PCD = \frac{1}{2} \times CD \times PM = \frac{1}{2} \times 16 \text{ cm} \times 17 \text{ cm} = 8 \text{ cm} \times 17 \text{ cm} = 136 \text{ cm}^2$
Total surface area of solid pyramid $= A + 4S = 256 \text{ cm}^2 + 4 \times 136 \text{ cm}^2$
$= 256 \text{ cm}^2 + 544 \text{ cm}^2 = 800 \text{ cm}^2$
Thus, TSA of the solid pyramid is 800 cm^2.

15. चित्रमा दिइएको वर्गाकार आधार भएको पिरामिडको आधार भुजाको लम्बाइ 16 से.मि. र छड्के उचाइ 10 से.मि. छन् । त्यस पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure the length of side of the base of a square based pyramid is 16 cm and its slant height is 10 cm. Find total surface area of the pyramid. **[SLC 2065 A]**



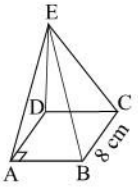
⇨ Here, slant height (s) = 10 cm and length of base (ℓ) = 16 cm
We know that, Total surface area $= 2s\ell + \ell^2 = 2 \times 10 \times 16 + 16^2 = 320 + 256$
Thus, total surface area $= 576 \text{ cm}^2$

16. आधार वर्ग भएको एउटा पिरामिडको त्रिभुजाकार सतहको किनारको लम्बाइ 13 से.मि. र आधारको भुजाको लम्बाइ 10 से.मि. भए सो पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
The given solid is a square based pyramid of side 10 cm. If the length of the edge of its triangular face is 13 cm, find the total surface area of the pyramid. **[2065 C]**



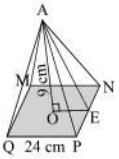
⇨ Here, length of base (ℓ) = 10 cm and Length of edge (e) = 13 cm
Slant height (s) $= \sqrt{e^2 - \left(\frac{\ell}{2}\right)^2} = \sqrt{13^2 - 5^2} = 12$ cm
Now, total surface area $= 2s\ell + \ell^2 = 2 \times 12 \times 10 + 10^2 = 340 \text{ cm}^2$
Thus, TSA $= 340 \text{ cm}^2$.

17. दिइएको चित्र वर्गाकार आधार भएको ठोस पिरामिड हो । उक्त पिरामिडको पूरा सतहको क्षेत्रफल 144 cm² छ । यदि वर्गाकार आधारको भुजा 8 cm भए उक्त पिरामिडको छड्के उचाइ पत्ता लगाउनुहोस् । **[SLC 2065 E]**
In the given figure, the total surface area of the given square based pyramid is 144 cm² and the side of the square base is 8 cm, find the slant height of the pyramid.



⇨ Here, length of base (ℓ) = 8 cm, Slant height = s cm and Total surface area (A) = 144 cm^2
We know that, total surface area $= 2s\ell + \ell^2$
or, $144 = 2s \times 8 + 8^2$ or, $144 = 16s + 64$
or, $80 = 16s$ $\therefore$ $s = 5$
Thus, the slant height (s) = 5 cm.

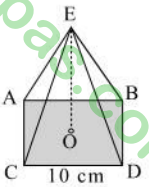
18. दिइएको पिरामिडको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् । जसमा AO उचाइ, AE छड्के उचाइ र 24 cm भुजा भएको वर्गाकार आधार MNPQ छ ।
Calculate the total surface area of the given pyramid in which AO is the height, AE the slant height and the square base MNPQ of side 24 cm. **[SLC 2066 B]**



⇨ Here, vertical height (h) = 9 cm and Length of base (ℓ) = 24 cm
Slant height (s) $= \sqrt{\left(\frac{\ell}{2}\right)^2 + h^2} = \sqrt{\left(\frac{24}{2}\right)^2 + 9^2} = \sqrt{12^2 + 9^2} = 15$ cm
We know that, total surface area $= 2s\ell + \ell^2 = 2 \times 15 \times 24 + 24^2 = 1296 \text{ cm}^2$
Thus, the total surface area is 1296 cm^2.

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19. चित्रमा दिइएको वर्गाकार आधार भएको ठोस पिरामिडको आधारको भुजाको लम्बाइ 10 cm छ र उचाइ 4 cm छ । यसको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
Find the total surface area of the solid pyramid with square base, as given in the adjoining figure, where length of the side = 10 cm, and height is 4 cm. [SLC 2067 E]



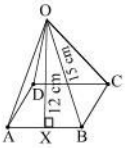
⇨ Here, length of base (a) = 10 cm and Vertical height (h) = 4 cm

Slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{4^2 + \left(\frac{10}{2}\right)^2} = \sqrt{4^2 + 5^2} = \sqrt{41} = 6.40$ cm

We know that, Total surface area $= 2a\ell + a^2 = 2 \times 10 \times 6.40 + 10^2 = 228$ cm^2

Thus the total surface area is 228 cm^2.

20. दिइएको चित्र एउटा आधार वर्ग भएको ठोस पिरामिडको हो । यदि OX = 12 से.मि. र OB = 15 से.मि. भए सो पिरामिडको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।
The given figure is a square based solid pyramid, if OX = 12 cm and OB = 15 cm, find the total surface area of the pyramid. [2069 S]



⇨ Here, slant height (ℓ) = 12 cm and length of edge (e) = 15 cm

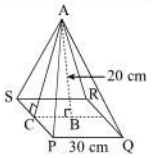
We know that, length of base (a) = $2\sqrt{e^2 - \ell^2} = 2\sqrt{15^2 - 12^2} = 2 \times 9 = 18$ cm

Now, TSA = $2a\ell + a^2 = 2 \times 18 \times 12 + 18^2 = 756$ cm^2

Thus, the TSA of the pyramid is 756 cm^2.

MODEL 4

21. चित्रमा दिइएको वर्गाकार आधार भएको ठोस पिरामिडको आधारको लम्बाइ 30 से.मि. र उचाइ 20 से.मि. छ भने उक्त पिरामिडको आयतन र पूरा सतहहरूको क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure, the solid pyramid having square base has length of its base 30 cm and height 20 cm, find the volume and the total surface area of it. [2069 A]



⇨ Here, length of base (a) = 30 cm and vertical height (h) = 20 cm

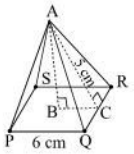
We know that, volume of the pyramid (V) = $\frac{1}{3}a^2h = \frac{1}{3} \times 30^2 \times 20 = 6000$ cm^3

Again, slant height (ℓ) = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{20^2 + 15^2} = \sqrt{625} = 25$ cm

Now, TSA of pyramid = $2a\ell + a^2 = 2 \times 30 \times 25 + 30^2 = 2400$ cm^2.

Thus, the volume and TSA of the solid is 6000 cm^3 and 2400 cm^2.

22. दिइएको वर्गाकार आधार भएको पिरामीडको आधारको भुजाको लम्बाइ 6 से.मि. र छड्के उचाइ 5 से.मि. भए उक्त पिरामीडको आयतन र त्रिभुजाकार सतहहरूको क्षेत्रफल पत्ता लगाउनुहोस् ।
In the figure, the length of side of the square based pyramid is 6 cm and the slant height 5 cm. Find the volume and the area of triangular faces of the given pyramid. [2069 D]



⇨ Here, length of base (a) = 6 cm and slant height (ℓ) = 5 cm

We know that, vertical height (h) = $\sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{5^2 - 3^2} = \sqrt{16} = 4$ cm

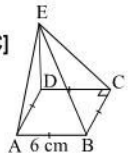
Now (i) Volume of pyramid (V) = $\frac{1}{3}a^2h = \frac{1}{3} \times 6^2 \times 4 = 48$ cm^3

(ii) Area of triangular faces = $2a\ell = 2 \times 6 \times 5 = 60$ cm^2

Thus, the volume and area of triangular faces are 48 cm^3 and 60 cm^2.

MODEL 5

23. दिइएको चित्र वर्गाकार आधार भएको ठोस पिरामिड हो । उक्त पिरामिडको पूरा सतहको क्षेत्रफल 96 cm^2 छ । यदि वर्गाकार आधारको भुजा 6 cm भए उक्त पिरामिडको छड्के उचाइ पत्ता लगाउनुहोस् । [2065 M, 2068 C]
In the given figure the total surface area of the given square based pyramid is 96 cm^2 and the side of the square base is 6 cm, find the slant height of the pyramid.



⇨ Here, total surface area the Pyramid = 96 cm^2 and side length (a) = 6 cm

Let, the height of the triangular face of the pyramid be ℓ. Then,

Area of base = 6×6 cm^2 = 36 cm^2

Area of lateral faces = $2a\ell = 2 \times 6 \times \ell = 12\ell$

Now, total surface area (TS) = $36 + 12\ell$ or, $96 = 36 + 12\ell$ or, $96 - 36 = 12\ell$

or, $60 = 12\ell$ $\therefore$ $\ell = 5$ cm

Thus, the slant height (ℓ) = 5 cm

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24. सँगैको चित्रमा एउटा वर्गाकार आधार भएको पिरामिडको आधारको भुजाको लम्बाइ 12 cm र सो पिरामिडको पूरा सतहको क्षेत्रफल 384 cm² भए पिरामिडको उचाइ पत्ता लगाउनुहोस् ।

In the adjoining figure, the length of a side of the base of the pyramid having a square base is 12 cm and the total surface area of the pyramid is 384 cm². Find the height of the pyramid. [2066 C]



⇨ Here, length of square base (ℓ) = 12 cm and Total surface area (A) = 384 cm²

We know that, TSA = $2s\ell + \ell^2$ or, $384 = 2s \times 12 + 12^2$

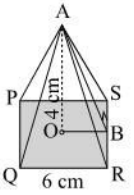
or, $240 = 24s$ ∴ $s = 10$ cm

Now, height (h) $= \sqrt{s^2 - \left(\frac{\ell}{2}\right)^2} = \sqrt{10^2 - \left(\frac{12}{2}\right)^2} = \sqrt{10^2 - 6^2} = 8$ cm

Thus, the height of the pyramid is 8 cm.

25. चित्रमा दिइएको वर्गाकार आधार भएको पिरामिडको आधारको भुजाको लम्बाइ 6 से.मि. र उचाइ 4 से.मि. भए सो पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

The given figure is a square based pyramid whose length of the base is 6 cm. and the vertical height 4 cm. Calculate the total surface area of the pyramid. [2066 E]



⇨ Here, length of base (ℓ) = 6 cm and Height of pyramid (h) = 4 cm

We know that, Slant height (S) $= \sqrt{\left(\frac{\ell}{2}\right)^2 + h^2} = \sqrt{\left(\frac{6}{2}\right)^2 + 4^2}$

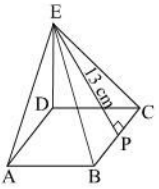
∴ $s = 5$ cm

Now, total surface area = $2s\ell + \ell^2 = 2 \times 5 \times 6 + 6^2 = 60 + 36 = 96$ cm²

Thus, the total surface area of the solid is 96 cm².

26. सँगैको चित्रमा एउटा वर्गाकार आधार भएको पिरामिडको छड्के उचाइ 13 cm र यसको पूरा सतहको क्षेत्रफल 360 cm² भए आधारको परिमिति निकाल्नुहोस् । [2068 B]

In the adjoining figure, the slant height and total surface area of square based pyramid are 13 cm and 360 cm² respectively. Find the perimeter of the base.



⇨ Here, slant height (ℓ) = 13 cm and TSA = 360 cm²

We know that, TSA = $2a\ell + a^2$ or, $360 = 2 \times a \times 13 + a^2$

or, $a^2 + 26a - 360 = 0$ or, $a^2 + 36a - 10a - 360 = 0$

or, $a(a + 36) - 10(a + 36) = 0$ or, $(a + 36)(a - 10) = 0$

Either, $a + 36 = 0 \Rightarrow a = -36$ (Impossible)

or, $a - 10\ 0 \Rightarrow a = 10$

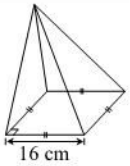
Now, perimeter of base = $4a = 4 \times 10 = 40$ cm

Thus, the perimeter of base is 40 cm.

MODEL 6

27. दिइएको चित्रमा एउटा ठोस वर्गाकार आधार भएको पिरामिडको आधारको भुजाको लम्बाई 16 से.मि. र आयतन 512 घन से.मि. भए उक्त पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

In the given figure, the solid pyramid having square base has length of the base 16 cm and volume 512 cu. cm. Find the total surface area of the pyramid. [2070 E]



⇨ Here, length base (a) = 16 cm and volume (V) = 512 cm³

We know that, $\frac{1}{3}a^2h = V$ or, $\frac{1}{3} \times 16^2 \times h = 512$ ∴ $h = 6$ cm

We have, slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{8^2 + 6^2} = 10$ cm

Now, total surface area = $2a\ell + a^2 = 2 \times 16 \times 10 + 16^2 = 320 + 256 = 576$ cm²

Thus, the total surface area is 576 cm².

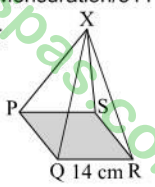
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28. दिइएको चित्रमा एउटा वर्गाकार आधार भएको पिरामिडको आधारको भुजाको लम्बाइ 14 से.मि. र पिरामिडको आयतन 1568 cm^3 भए पिरामिडको पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।

In the given figure if the length of a side of the base of the pyramid having square base is 14 and the volume of the pyramid is 1568 cm^3, find the total surface area of the pyramid. **[2067 B, 2071 A]**



⇨ Here, length of base (a) = 14 cm Volume (V) = 1568 cm^3

We have, volume $= \frac{1}{3}a^2h$ or, $1568 = \frac{1}{3} \times 14^2 \times h$ or, $\frac{1568 \times 3}{14 \times 14} = h$

$\therefore$ h = 24 cm

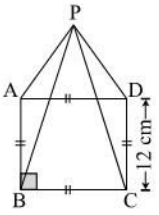
We know that, slant height $(\ell) = \sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{24^2 + \left(\frac{14}{2}\right)^2} = \sqrt{24^2 + 7^2} = 25$ cm

Now, TSA of pyramid $= 2a\ell + a^2 = 2 \times 14 \times 25 + 14^2 = 896$ cm^2

Thus, the total surface area is 896 cm^2.

29. दिइएको चित्र वर्गाकार आधार भएको पिरामिडको हो । यदि उक्त पिरामिडको आयतन 384 घन से.मि. र आधारको भुजा 12 से.मि. भए त्रिभुजाकार सतहहरूको क्षेत्रफल निकालनुहोस् ।

Given figure is a square based pyramid. If the volume of the pyramid is 384 cu.cm and the side of base is 12 cm, find the area of triangular surface. **[2072 E]**



⇨ Here, length of base (a) = 12 cm and volume of pyramid (V) = 384 cm^3

We know that, Volume (V) = 384 or, $\frac{1}{3}a^2h = 384$ or, $\frac{1}{3} \times 12^2 \times h = 384$

or, $48 \times h = 384$ $\therefore$ h = 8

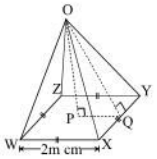
Again, slant height $(\ell) = \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{\left(\frac{12}{2}\right)^2 + 8^2} = \sqrt{100} = 10$ cm

We know that, Area of triangular faces $= 2a\ell = 2 \times 12 \times 10 = 240$ cm^2.

Thus, the area of triangular face is 240 cm^2.

30. दिइएको चित्रमा पिरामिडको छड्के सतहको क्षेत्रफल 144 $\sqrt{2}$ वर्ग से.मि., OP = m cm र WX = 2m cm भए सो पिरामिडको आयतन पत्ता लगाउनुहोस् ।

In the given figure, Lateral surface area of the pyramid is 144 $\sqrt{2}$ sq. cm, OP = m cm and WX = 2m cm, find the volume of the pyramid. **[2071 B]**



⇨ Here, height of the pyramid (h) = m cm and Length of base (WX): a = 2m

We have, slant height $(\ell) = \sqrt{h^2 + \left(\frac{a}{2}\right)^2} = \sqrt{m^2 + (m)^2} = \sqrt{2m^2} = m\sqrt{2}$ cm

We know that, LSA = $144\sqrt{2}$ or, $2a\ell = 144\sqrt{2}$

or, $2 \times 2m \times m\sqrt{2} = 144\sqrt{2}$ or, $4m^2 = 144$

or, $m^2 = 36$ $\therefore$ m = 6 cm

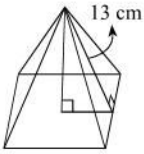
Now, a = 2m = 2 × 6 cm = 12 cm and h = m = 6 cm

We have, Volume (V) $= \frac{1}{3}$ base area × height $= \frac{1}{3}a^2h = \frac{1}{3}(12)^2 \times 6^2$

$\therefore$ Volume = 288 cm^3 Thus, the volume is 288 cm^3.

31. सँगैको चित्र एउटा वर्गाकार आधार भएको पिरामिड हो । यसको छड्के उचाइ 13 से.मि. र पुरासतहको क्षेत्रफल 360 वर्ग से.मि. भए सो पिरामिडको आयतन निकाल्नुहोस् । **[SLC 2067 C]**

The adjoining figure is a square based pyramid. If its slant height is 13 cm and its total surface area 360 square cm, find the volume of the pyramid.



⇨ Here, slant height (ℓ) = 13 cm and TSA = 360 cm^2

We know that, TSA $= 2a\ell + a^2$ or, $360 = 2 \times a \times 13 + a^2$

or, $a^2 + 26a - 360 = 0$ or, $a^2 + 36a - 10a - 360 = 0$

or, $a(a + 36) - 10(a + 36) = 0$ or, $(a + 36)(a - 10) = 0$

Either, $a + 36 = 0 \Rightarrow a = -36$ (Impossible) or, $a - 10\ \ 0 \Rightarrow a = 10$

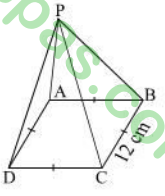
Now, volume of the pyramid $= \frac{1}{3}a^2h = \frac{1}{3} \times 10^2 \times \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \frac{1}{3} \times 10^2 \times \sqrt{13^2 - 5^2} = \frac{1}{3} \times 10^2 \times 12$

$= 400$ cm^3

Thus, the volume of the pyramid is 400 cm^3.

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32. दिइएको चित्र एउटा वर्गाकार आधार भएको पिरामिड हो। उक्त पिरामिडको त्रिभुजाकार सतहहरूको क्षेत्रफल 240 वर्ग से.मि. र आधारको भुजा 12 से.मि. भए सो पिरामिडको आयतन निकाल्नुहोस्।



The given figure is a square based pyramid. The area of triangular surfaces of the pyramid is 240 sq. cm and the side of the base is 12 cm, find the volume of the pyramid. **[2072 W]**

⇨ Here, length of base (a) = 12 cm and area of triangular surface = 240 cm^2

We know that, area of triangular surface = 240 cm^2

or, $2a\ell = 240$ or, $2 \times 12 \times \ell = 240$ ∴ $\ell = 10$ cm

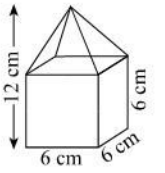
Again, vertical height (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{10^2 - 6^2} = \sqrt{64} = 8$ cm

Now, volume of pyramid (V) $= \frac{1}{3}a^2h = \frac{1}{3} \times 12^2 \times 8 = 384$ cm^3

Thus, the volume of the pyramid is 384 cm^3.

MODEL 7

33. चित्रमा दिइएको ठोस वस्तुको आयतन पत्ता लगाउनुहोस्।



Find the volume of solid object given in the adjoining diagram. **[2057 A2]**

⇨ Here, the solid object given in the figure consists of cubical part and pyramid part.

Here, height of Pyramid (h') = 12 cm – 6 cm = 6 cm

Area of base of Pyramid = 6 cm × 6 cm = 36 cm^2

Volume of Pyramid part $= \frac{1}{3} \times A \times h' = \frac{1}{3} \times 36 \times 6 = 72$ cm^3

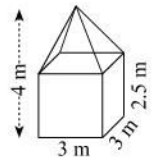
Volume of cubical part = 6 cm × 6 cm × 6 cm = 216 cm^3

∴ Total volume of given solid = Volume of Pyramid & cubical parts

= 72 cm^3 + 216 cm^2 = 288 cm^3

Thus, the volume of the solid object is 288 cm^3.

34. सँगै दिइएको ठोस वस्तुमा प्रिज्मको उचाइ 2.5 m छ र यसमाथि एउटा पिरामिड छ। यदि सो ठोसको पूरा उचाइ 4 m भए उक्त ठोस वस्तुको आयतन पत्ता लगाउनुहोस्।



The given adjoining solid figure is a square based prism of height 2.5 m and a pyramid above it. If the total height of the solid figure is 4 m; find the volume of the solid figure. **[2058 D1]**

⇨ Here, area of base of prism (A) = $(3\text{ m})^2 = 9$ m^2 and and height of prism (h) = 2.5 m

By formula, Volume (V) of prism = A × h = 9 m^2 × 2.5 m = 22.5 m^3

In the given figure, base area of pyramid = base area of prism = 9 m^2

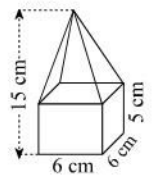
Height (h') of the pyramid = 4 m – 2.5 m = 1.5 m

∴ Volume of pyramid (V') $= \frac{1}{3} \times A \times h' = \frac{1}{3} \times 9 \times 1.5$ $m^3 = 4.5$ m^3

Hence, the volume of the given solid figure = V + V' = 22.5 m^3 + 4.5 m^3 = 27 m^3

Thus, the volume of the solid object is 27 m^3.

35. चित्रमा दिइएको ठोस वस्तुको आयतन पत्ता लगाउनुहोस्।



Find the volume of the solid object given in the figure. **[2059 D1, 2065 D]**

⇨ Here, height of Pyramid (h') = 15 cm – 5 cm = 10 cm

Area of base of Pyramid = 6 cm × 6 cm = 36 cm^2

Volume of Pyramid part $= \frac{1}{3} \times A \times h' = \frac{1}{3} \times 36 \times 10 = 120$ cm^3

Volume of cubical part = 6 cm × 6 cm × 5 cm = 180 cm^3

∴ Total volume of given solid = Volume of Pyramid & cubical parts

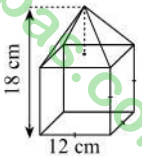
= 120 cm^3 + 120 cm^2 = 300 cm^3

Thus, the volume of the solid object is 300 cm^3.

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36. सँगै दिइएको चित्रमा दिइएजस्तै घन र वर्गाकार आधार भएको पिरामिड मिलेर बनेको ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the solid object made of cube and pyramid with square base, in the given diagram. **[2061 C1]**

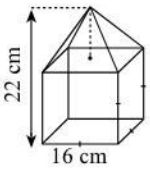


⇨ Here, volume of cube = $(12\text{ cm})^3 = 1728\text{ cm}^3$
h = height of pyramid = 18 cm – 12 cm = 6 cm
A = area of square base = $(12\text{ cm})^2 = 144\text{ cm}^2$

Volume of pyramid = $\frac{1}{3}$ Ah = $\frac{1}{3} \times 144 \times 6\text{ cm}^3 = 288\text{ cm}^3$

Volume of given solid = $1728\text{ cm}^3 + 288\text{ cm}^3 = 2016\text{ cm}^3$
Thus, the volume of the solid object is 2016 cm^3.

37. चित्रमा दिइएजस्तै घन र वर्गाकार आधार भएको पिरामिड मिलेर बनेको ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
Find the volume of the solid object made of cube and pyramid with square base, as given in the figure. **[2061 C2]**

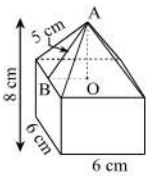


⇨ Here, V_1 = Volume of cubical part = $(16\text{ cm})^3 = 4096\text{ cm}^3$
h = OP = height of pyramid = 22 cm – 16 cm = 6 cm
A = area of squared base = $(16\text{ cm})^2 = 256\text{ cm}^2$

V_2 = Volume of pyramid = $\frac{1}{3} \times A \times h = \frac{1}{3} \times 256\text{ cm}^2 \times 6\text{ cm} = 512\text{ cm}^3$

Volume of the given solid = $V_1 + V_2 = 4096\text{ cm}^3 + 512\text{ cm}^3 = 4608\text{ cm}^3$
Thus, the volume of the solid object is 4608 cm^3.

38. दिइएको ठोस चित्रको माथिल्लो भाग एउटा पिरामिड र तल्लो भाग एउटा प्रिज्म छ । सो संयुक्त ठोस वस्तुको आयतन पत्ता लगाउनुहोस् ।
The upper part of a given solid figure has a pyramid shaped and the lower part is a prism. Find the volume of the given combined solid figure. **[2062 C1]**

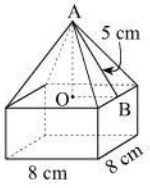


⇨ Here, OB = $\frac{6\text{ cm}}{2} = 3\text{ cm}$.

h = height of pyramid = $\sqrt{AB^2 - OB^2} = \sqrt{5^2 - 3^2}\text{ cm} = 4\text{ cm}$.
If h' be the height of the prism, then h' = 8 cm – h = 8 cm – 4 cm = 4 cm.
A = area of base of prism = 6 cm × 6 cm = 36 cm^2
Volume of prism = A × h' = $36 \times 4\text{ cm}^3 = 144\text{ cm}^3$
Now, base of pyramid = base of prism = A = 36 cm^2
Volume of pyramid = $\frac{1}{3} \times A \times h = \frac{1}{3} \times 36\text{ cm}^2 \times 4\text{ cm} = 48\text{ cm}^3$

∴ Volume of the given solid = volume of prism + volume of pyramid
= $144\text{ cm}^3 + 48\text{ cm}^3 = 192\text{ cm}^3$
Thus, the volume of the solid object is 192 cm^3.

39. दिइएको ठोस वस्तुको माथिल्लो भागमा रहेको प्रिज्मको छड्के उचाइ 5 cm छ र तल्लो भाग प्रिज्मको भुजा 8 cm छ । यदि सो ठोस वस्तुको आयतन 448 cm^3 भए प्रिज्मको उचाइ पत्ता लगाउनुहोस् ।
In the given solid the upper part has a pyramid of slant height 5 cm and the lower part is a prism of side 8 cm. If the volume of the solid figure is 448 cm^3, find the height of the prism. **[2062 D2]**



⇨ Here, in figure, OB = $\frac{8\text{ cm}}{2} = 4\text{ cm}$ and AB = 5 cm

h = The height of the pyramid = $\sqrt{AB^2 - OB^2} = \sqrt{5^2 - 4^2}\text{ cm} = \sqrt{25 - 16}\text{ cm} = \sqrt{9}\text{ cm} = 3\text{ cm}$
Volume of pyramid = $\frac{1}{3} \times A \times h = \frac{1}{3} \times 8 \times 8 \times 3 = \frac{1}{3} \times 64\text{ cm}^2 \times 3\text{ cm} = 64\text{ cm}^3$

Now, volume of prism = volume of solid – volume of pyramid = $448\text{ cm}^3 - 64\text{ cm}^3 = 384\text{ cm}^3$
If h' is the height of prism,
Then, volume of prism = A × h' or, $384\text{ cm}^3 = 64\text{ cm}^2 \times h'$

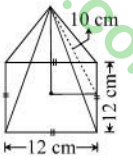
∴ $h' = \frac{384\text{ cm}^3}{64\text{ cm}^2} = 6\text{ cm}$ Thus, the height of the prims is 6 cm.

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B. QUESTIONS FROM CDC TEXT BOOKS

1. निम्नानुसार नापका पिरामिडहरूको पूरा सतहको क्षेत्रफल निकाल्नुहोस्:
Find the total surface area of the pyramid having following measurements:

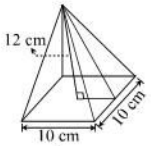


⇨ (a) Here, length of base (a) = 12 cm and Slant height (ℓ) = 10 cm

We know that, TSA $= 2a\ell + a^2 = 2 \times 12 \times 10 + 12^2 = 240 + 144 = 384$ cm^2

Thus, the total surface area is 384 cm^2.

(b) Here, height (h) = 12 cm and Length of base (a) = 10 cm

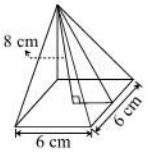


We know that, Slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{5^2 + 12^2} = 13$ cm

Now, Total surface area $= 2a\ell + \ell^2 = 2 \times 10 \times 13 + 10^2 = 260 + 100 = 360$ cm^2

Thus, the total surface area is 360 cm^2.

(c) Here, length of base (a) = 6 cm and Height of pyramid (h) = 8 cm



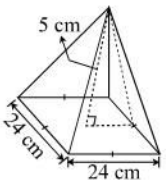
We have, Slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{3^2 + 8^2} = \sqrt{73} = 8.54$ cm

Now, total surface area $= 2a\ell + a^2 = 2 \times 6 \times 8.54 + 6^2 = 138.53$ cm^2

Thus, the TSA is 138.53 cm^2.

2. निम्नानुसारका नाप भएका वर्गाकार पिरामिडहरूको आयतन र पूरा सतहको क्षेत्रफल निकाल्नुहोस्:
Find the volume and total surface area of square based following pyramids:

⇨ (a) Here, length of base (a) = 24 cm and Height (h) = 5 cm



We have, Slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{\left(\frac{24}{2}\right)^2 + 5^2} = \sqrt{12^2 + 5^2} = 13$ cm

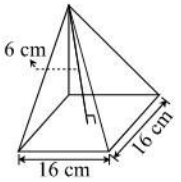
(i) Volume $= \frac{1}{3}a^2h = \frac{1}{3} \times 24^2 \times 5 = 960$ cm^3

(ii) Total surface area $= 2a\ell + a^2 = 2 \times 24 \times 13 + 24^2 = 1200$ cm^2

Thus, the volume and TSA are 960 cm^3 and 1200 cm^2.

(b) Here, length of base (a) = 16 cm and Vertical height (h) = 6 cm

We know that,



(i) Volume (V) $= \frac{1}{3} \times a^2h = \frac{1}{3} \times 16^2 \times 6 = 512$ cm^3

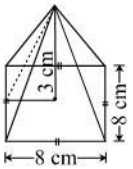
(ii) Slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{8^2 + 6^2} = 10$ cm

Now, TSA $= 2a\ell + a^2 = 2 \times 16 \times 10 + 16^2 = 320 + 256 = 576$ cm^2

Thus, the volume and TSA are 512 cm^3 and 576 cm^2 respectively.

(c) Here, length of base (a) = 8 cm and Height (h) = 3 cm

We have,



(i) Volume (V) $= \frac{1}{3}a^2h = \frac{1}{3} \times 8^2 \times 3 = 64$ cm^3

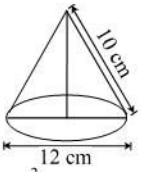
(ii) Slant height (ℓ) $= \sqrt{\left(\frac{a}{2}\right)^2 + h^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = 5$ cm

Now, TSA $= 2a\ell + a^2 = 2 \times 8 \times 5 + 8^2 = 80 + 64 = 144$ cm^2

Thus, the volume and TSA are 64 cm^3 and 144 cm^2 respectively.

3. निम्नानुसार नाप भएका सोलीको आयतन र पूरा सतहको क्षेत्रफल निकाल्नुहोस् :
Find the volume and total surface area of cone having following measure:

⇨ (a) Here diameter (d) = 12 cm $\quad\therefore\quad$ r = 6 cm



Slant height (ℓ) = 10 cm

We know that, Vertical height (h) $= \sqrt{\ell^2 - r^2} = \sqrt{10^2 - 6^2} = 8$ cm

We know that,

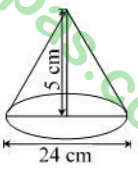
(i) TSA $= \pi r(r + \ell) = \frac{22}{7} \times 6(6 + 10) = \frac{22}{7} \times 6 \times 16 = \frac{2112}{7} = 301.71$ cm^2

(ii) Volume $= \frac{1}{3}\pi r^2h = \frac{1}{3} \times \frac{22}{7} \times 6^2 \times 8 = 301.71$ cm^3

Thus, the volume and TSA are 301.71 cm^3 and 301.71 cm^2.

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(b) Here, vertical height (h) = 5 cm and Radius of base (r) $= \frac{d}{2} = \frac{24\text{ cm}}{2} = 12$ cm



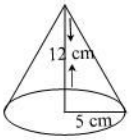
We have, Slant height (ℓ) $= \sqrt{r^2 + h^2} = \sqrt{12^2 + 5^2} = 13$ cm

(i) Volume (V) $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 12^2 \times 5 = 754.28\text{ cm}^3$

(ii) TSA $= \pi r(r + \ell) = \frac{22}{7} \times 12(12 + 13) = \frac{22}{7} \times 12 \times 25 = 942.85\text{ cm}^2$

Thus, volume and TSA are 754.28 cm^3 and 942.85 cm^2 respectively.

(c) Here, radius (r) = 5 cm and height (h) = 12 cm



We know that, Slant height (ℓ) $= \sqrt{r^2 + h^2} = \sqrt{5^2 + 12^2} = 13$ cm

Now,

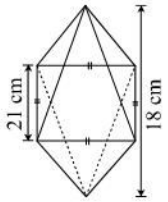
(i) Volume $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 5^2 \times 12 = 314.28\text{ cm}^3$

(ii) TSA $= \pi r(r + \ell) = \frac{22}{7} \times 5(5 + 13) = 282.85\text{ cm}^2$

Thus, the volume and TSA are 314.28 cm^3 and 282.85 cm^2 respectively.

4. निम्नानुसार नापका संयुक्त पिरामिडको आयतन निकाल्नुहोस् :
Find the volume of the following combined pyramids:

⇨ (a) Here, length of square base (a) = 21 cm and Total height (h) = 18 cm



We know that,

Total volume (V) = Upper pyramid + Lower pyramid

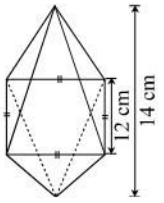
$= \frac{1}{3}a^2h_1 + \frac{1}{3}a^2h_2 = \frac{1}{3}a^2(h_1 + h_2) = \frac{1}{3} \times 21^2 \times h$

$= \frac{1}{3} \times 21^2 \times 18 = 2646\text{ cm}^3$

Thus, the volume of the combined pyramid is 2646 cm^3.

(b) Here, length of square base (a) = 12 cm

Total height ($h_1 + h_2$) = 14 cm



We know that,

Total Volume (V) = Upper pyramid + Lower pyramid

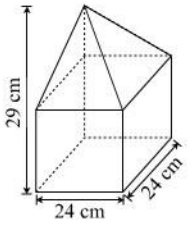
$= \frac{1}{3}a^2h_1 + \frac{1}{3}a^2h_2 = \frac{1}{3}a^2(h_1 + h_2) = \frac{1}{3} \times 12^2 \times 14$

$= 672\text{ cm}^3$

Thus, the total volume of the pyramid is 672 cm^3.

(c) Here, length of square (a) = 24 cm

Height of the pyramid (h) = 29 cm – 24 cm = 5 cm



We know that,

Total volume (V) = V(Pyramid) + V(Cube)

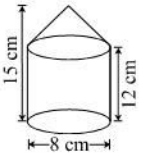
$= \frac{1}{3}a^2h + a^3 = a^2\left(\frac{1}{3}h + a\right) = 24^2\left(\frac{1}{3}h + a\right)$

$= 24^2\left(\frac{1}{3} \times 5 + 24\right) = 14784\text{ cm}^3$

Thus, the volume of the combined solid is 14784 cm^3.

5. तलका ठोस वस्तुहरूको सतहको क्षेत्रफल र आयतन निकाल्नुहोस्:
Find the total surface area and volume of the following solid objects:

⇨ (a) Here, common radius (r) $= \frac{d}{2} = \frac{8\text{ cm}}{2} = 4$ cm



Height of cylinder (h_1) = 12 cm

Height of cone (h_2) = 15 cm – 12 cm = 3 cm

We know that,

(i) Volume of the solid (V) $= \pi r^2 h_1 + \frac{1}{3}\pi r^2 h_2 = \pi r^2\left(h_1 + \frac{1}{3}h_2\right)$

$= \frac{22}{7} \times 4^2\left(12 + \frac{1}{3} \times 3\right) = \frac{22}{7} \times 16 \times 13 = 653.71\text{ cm}^3$

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(ii) Slant height of cone (ℓ) $= \sqrt{(h_2)^2 + r^2} = \sqrt{3^2 + 4^2} = 5$ cm

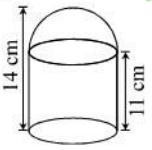
Now, TSA $= \pi r\ell + 2\pi r h_1 + \pi r^2 = \pi r\,(\ell + 2h_1 + r)$

$= \frac{22}{7} \times 4(5 + 2 \times 12 + 4) = \frac{2904}{7} = 414.85$ cm^2

Thus, the volume and TSA of the solid are 653.71 cm^3 and 414.85 cm^2 respectively.

(b) Here, height of cylinder (h) = 11 cm

Common radius (r) = 14 cm – 11 cm = 3 cm



We know that,

Total surface area $= 3\pi r^2 + 2\pi r h = \pi r(3r + 2h) = \frac{22}{7} \times 3(3 \times 3 + 2 \times 12)$

$= \frac{2178}{7} = 311.14$ cm^2

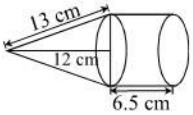
Again, Volume $= \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 3^2\left(\frac{2}{3} \times 3 + 11\right) = \frac{2574}{7}$

$= 367.71$ cm^3

Thus, the TSA and volume are 311.14 cm^2 and 367.71 cm^3 respectively.

(c) Here, Slant height of cone (ℓ) = 13 cm

Height of cone (h_1) = 12 cm and Height of cylinder (h_2) = 6.5 cm



We have, common radius (r) $= \sqrt{13^2 - 12^2} = 5$ cm

We know that,

Total surface area $= \pi r\ell + 2\pi r h_2 + \pi r^2 = \pi r\,(\ell + 2h_2 + r)$

$= \frac{22}{7} \times 5(13 + 2 \times 12 + 5) = 660$ cm^2

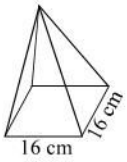
Again, Volume $= \frac{1}{3}\pi r^2 h_1 + \pi r^2 h_2 = \pi r^2\left(\frac{1}{3}h_1 + h_2\right) = \frac{22}{7} \times 5^2\left(\frac{1}{3} \times 12 + 6.5\right) = 825$ cm^3

Thus, the volume and TSA are 825 cm^3 and 660 cm^2 respectively.

6. पूरा सतहको क्षेत्रफल 800 वर्ग से.मि. भएको एउटा वर्गाकार पिरामिडको आधारको भुजा 16 से.मि. छ। उक्त पिरामिडको छड्के सतहको क्षेत्रफल र आयतन निकाल्नुहोस् ।

A square based pyramid having total surface area 800 cm^2 has the length of base 16 cm. Find the lateral surface area and the volume of the pyramid.

⇨ Here, length of base (a) = 16 cm



TSA = 800 cm^2

or, $2a\ell + a^2 = 800$ or, $2 \times 16 \times \ell + 16^2 = 800$

or, $32\ell = 544$ $\therefore$ $\ell = \frac{544}{32} = 17$

(i) We know that,

Lateral surface area $= 2a\ell = 16 \times 17 = 544$ cm^2

(ii) We have, Volume (V) $= \frac{1}{3}a^2 h = \frac{1}{3} \times 16^2 \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \frac{1}{3} \times 16^2 \sqrt{(17)^2 - \left(\frac{16}{2}\right)^2}$

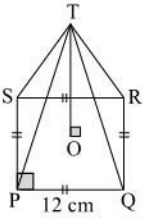
$= \frac{1}{3} \times 16^2 \times 15 = 1280$ cm^3

Thus, the LSA and volume and 544 cm^2 and 1280 cm^3.

7. दिइएको चित्रमा वर्गाकार आधार भएको ठोस पिरामिडको पूरा सतहको क्षेत्रफल 384 वर्ग से.मि. छ र आधारको भुजाको लम्बाइ 12 से.मि. छ भने पिरामिडको आयतन पत्ता लगाउनुहोस् ।

In the given figure, the total surface area of the square based solid pyramid is 384 sq. cm and length of side of the base is 12 cm. Find the volume of the pyramid. **[2072 C]**

⇨ Here, length of base (a) = 12 cm and total surface area = 384 cm^3



We know that, TSA $= 2a\ell + a^2$ or, $2a\ell + a^2 = 384$

or, $2 \times 12 \times \ell + 12^2 = 384$ or, $24\ell + 144 = 384$

or, $24\ell = 240$ $\therefore$ $\ell = 10$ cm

Again, vertical height (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{10^2 - 6^2} = \sqrt{64} = 8$ cm

Now, volume of the pyramid $= \frac{1}{3}a^2 h = \frac{1}{3} \times 12^2 \times 8 = 384$ cm^3

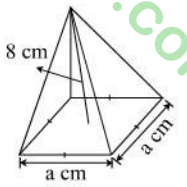
Thus, the volume of the pyramid is 384 cm^3.

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8. आयतन 384 cm³ भएको एउटा वर्गाकार पिरामिडको छड्के सतहको क्षेत्रफल निकाल्नुहोस्, जसको उचाइ 8 cm छ ।
Find the lateral area of the pyramid having volume 384 cm³ and whose height is 8 cm.

⇨ Here, Height (h) = 8 cm



We know that, $\frac{1}{3}a^2h$ = Volume or, $\frac{1}{3} \times a^2 \times 8 = 384$

or, $a^2 = 384 \times \frac{3}{8} = 144$ ∴ $a = 12$ cm

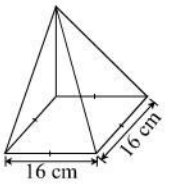
Now, lateral surface area $= 2a\ell = 2 \times 12\sqrt{\left(\frac{a}{2}\right)^2 + h^2}$

$= 24\sqrt{6^2 + 8^2} = 24 \times 10 = 240$ cm²

Thus, the lateral surface area is 240 cm².

9. छड्के सतहको क्षेत्रफल 320 वर्ग से.मि. र वर्गाकार आधार भुजाको नाप 16 से.मि. भएको एउटा पिरामिडको आयतन निकाल्नुहोस् ।
Find the volume of a pyramid having lateral surface area 320 cm² and length of its square base is 16 cm.

⇨ Here, LSA = 320 cm² Length of base (a) = 16 cm



We know that, LSA = 320 or, $2a\ell = 320$

or, $2 \times 16 \times \ell = 320$ or, $\ell = 10$ cm

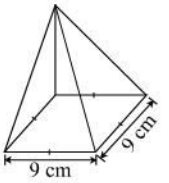
We have, height (h) $= \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{10^2 - 8^2}$ ∴ $h = 6$ cm

Now, Volume (V) $= \frac{1}{3}a^2h = \frac{1}{3} \times 16^2 \times 6 = 512$ cm³

Thus, the volume of the pyramid is 512 cm³.

10. वर्गाकार आधार भएको एउटा पिरामिडको पूरा सतहको क्षेत्रफल 216 वर्ग से.मि. र आधारको भुजा 9 से.मि. छ । उक्त पिरामिडको आयतन निकाल्नुहोस् ।
A pyramid having square base has total surface area 216 cm² and length of base 9 cm. Find the volume of the pyramid.

⇨ Here, length of square base (a) = 9 cm and Total surface area (TSA) = 216 cm²



We have, TSA = 216 or, $2a\ell + a^2 = 216$

or, $2 \times 9 \times \ell + 9^2 = 216$ or, $18\ell = 135$

or, $\ell = \frac{15}{2}$ cm

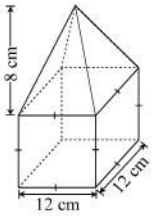
Again, $h = \sqrt{\ell^2 - \left(\frac{a}{2}\right)^2} = \sqrt{\left(\frac{15}{2}\right)^2 - \left(\frac{9}{2}\right)^2} = \sqrt{36}$ ∴ $h = 6$ cm

Now, Volume (V) $= \frac{1}{3}a^2h = \frac{1}{3} \times 9^2 \times 6 = 162$ cm³

Thus, the volume of the pyramid is 162 cm³.

11. एउटा घनाकार ठोस वस्तुमाथि 8 से.मि. ठाडो उचाइ भएको पिरामिड राखिएको छ, यदि घनको भुजाको नाप 12 से.मि. छ भने सो संयुक्त ठोस वस्तुको पुरा आयतन निकाल्नुहोस् ।
A pyramid having vertical height 8 cm is placed on the top of a cubical object. If the measure of the side of the cube is 12 cm, find the total volume of the combined object.

⇨ Here, length of cube (a) = 12 cm and Height of pyramid (h) = 8 cm



We have,

Volume of the combined object = V(Cube) + V(Pyramid)

$= a^3 + \frac{1}{3}a^2h = 12^3 + \frac{1}{3}12^2 \times 8$

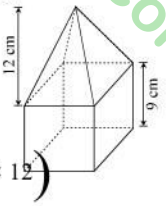
$= 1728 + 384 = 2112$ cm³

Thus, the volume of the combined solid is 2112 cm³.

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12. वर्ग आधार भएको एउटा षड्मुखाकार ठोस वस्तुमाथि 12 cm ठाडो उचाइ भएको एउटा पिरामिड राखिएको छ। यदि उक्त षड्मुखाकार ठोस वस्तुको आधारको क्षेत्रफल 100 cm² तथा उचाइ 9 cm भए संयुक्त ठोस वस्तुको पुरा आयतन निकाल्नुहोस्।
A pyramid having vertical height 12 cm is placed on the top of a square based cuboid-shaped solid object. If the base area of the cuboid is 100 cm² and height is 9 cm, find the volume of the solid object.



⇨ Here, height of the pyramid (h_1) = 12 cm
Height of the cuboid (h_2) = 9 cm and Area of base (A_1) = 100 cm²
We know that, Volume (solid object) = V(Cuboid) + V(Pyramid)

$$= \text{base area} \times h_2 + \frac{1}{3}\text{base area} \times h_1$$

$$= \text{base area}\left(h_2 + \frac{1}{3}h_1\right) = 100\left(9 + \frac{1}{3} \times 12\right)$$

$$= 100 \times 13 = 1300 \text{ cm}^3$$

Thus, the volume of the solid object is 1300 cm³.

13. व्यास 8 से.मि. र उचाइ 21 से.मि. भएको सोलीको आयतन र पूरा सतहको क्षेत्रफल निकाल्नुहोस्।
Find the volume and total surface area of a cone having diameter 8 cm and height 21 cm.

⇨ Here, diameter (d) = 8 cm and height (h) = 21 cm

We have, Slant height (ℓ) $= \sqrt{\left(\frac{d}{2}\right)^2 + h^2} = \sqrt{4^2 + 21^2} = \sqrt{505} = 22.47$ cm

Again, Volume (V) $= \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 4^2 \times 21 = 7392 \text{ cm}^3$

Now, total surface area $= \pi r(r + \ell) = \frac{22}{7} \times 4(4 + 22.47) = 332.76 \text{ cm}^2$

Thus, the volume and TSA area 7392 cm³ and 332.76 cm² respectively.

14. एउटा सोलीको आधारको अर्धव्यास र उचाइको अनुपात 5 : 12 तथा आयतन 314.29 घन से.मि. छ। उक्त सोलीको वक्र सतहको क्षेत्रफल र पूरा सतहको क्षेत्रफल निकाल्नुहोस्।
The ratio of radius of base and height of a cone is 5 : 12 and volume is 314.29 cm³. Find the curved surface area and total surface area.

⇨ Here, $\frac{r}{h} = \frac{5}{12}$ or, $5h = 12r$ $\therefore$ $h = \frac{12r}{5}$

We have, Volume = 314.29 cm³ or, $\frac{1}{3}\pi r^2 h = 314.29$ or, $\frac{1}{3} \times \frac{22}{7} \times r^2 \times \frac{12r}{5} = 314.29$

or, $\frac{88}{35} \times r^3 = 314.29$ or, $r^3 = \frac{220003}{1760}$ $\therefore$ $r = 5$ cm

So, $h = \frac{12r}{5} = \frac{12 \times 5}{5} = 12$ cm

We know that, Slant height (ℓ) $= \sqrt{r^2 + h^2} = \sqrt{5^2 + 12^2} = \sqrt{169} = 13$ cm

Now, CSA $= \pi r\ell = \frac{22}{7} \times 5 \times 13 = 204.28 \text{ cm}^2$

TSA $= \pi r(r + \ell) = \frac{22}{7} \times 5(5 + 13) = 282.85 \text{ cm}^2$.

Thus, CSA and TSA are 204.28 cm² and 282.85 cm².

15. एउटा ठोस कोनको ठाडो उचाइ व्यासको 3 गुणा छ, यदि उक्त कोनको आयतन 54 π घन से.मि. भए पूरा सतहको क्षेत्रफल निकाल्नुहोस्।
The vertical height of a cone is 3 times the diameter. If the volume of the cone is 54 π cm³, find the total surface area of the cone.

⇨ Here, $h = 3d$ or, $h = 3 \times 2r$ $\therefore$ $h = 6r$

We have given, volume = 54π or, $\frac{1}{3}\pi r^2 h = 54\pi$ or, $\frac{1}{3}r^2 \times 6r = 54$

or, $\frac{1}{3}6r^3 = 54$ or, $r^3 = 27$ $\therefore$ $r = 3$ cm

And, $h = 6r = 6 \times 3$ cm = 18 cm

Now, TSA of cone $= \pi r(r + \ell) = \frac{22}{7} \times 3(3 + \sqrt{r^2 + h^2}) = \frac{22}{7} \times 3(3 + \sqrt{3^2 + 18^2})$

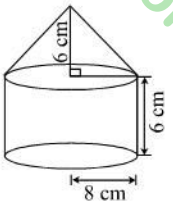
$$= \frac{22}{7} \times 3 \times 21.25 = 200.34 \text{ cm}^2$$

Thus, the TSA of the solid is 200.34 cm².

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16. एउटा बेलनामाथि 6 से.मि. ठाडो उचाइ भएको कोन राखिएको छ, यदि बेलनाको अर्धव्यास 8 से.मि. र उचाइ 6 से.मि. भए उक्त संयुक्त ठोस वस्तुको पुरा आयतन र पूरा सतहको क्षेत्रफल निकाल्नुहोस् ।
A cone having vertical 6 cm is placed over cylinder. If the radius and height of cylinder 8 cm and 6 cm respectively. Find the total volume and total surface area of the combined solid.

⇨ Here, vertical height of cone (h_1) = 6 cm, Height of cylinder (h_2) = 6 cm



Radius of the cylinder (r) = 8 cm

We have, Slant height (ℓ) = $\sqrt{h_1^2 + r^2} = \sqrt{6^2 + 8^2} = 10$ cm

(i) Total volume (V) $= \frac{1}{3}\pi r^2 h_1 + \pi r^2 h_2 = \pi r^2 \left(\frac{1}{3}h_1 + h_2\right)$

$= \frac{22}{7} \times 8^2 \left(\frac{1}{3} \times 6 + 6\right) = 1609 \text{ cm}^3$

(ii) Total surface area $= \pi r^2 + 2\pi rh + \pi r\ell = \pi r\,(r + 2h_2 + \ell)$

$= \frac{22}{7} \times 8(8 + 2 \times 6 + 10) = \frac{22}{7} \times 8 \times 30 = 754.28 \text{ cm}^2$

Thus, the volume and TSA are 1609 cm^3 and 754.28 cm^2.

7.3 ज्यामितीय वस्तुहरू (GEOMETRICAL BODIES)

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 22]

Q. 22. पेम्वाले छोरी डोल्माको विवाह भोजका लागी 150 जनालाई व्यवस्था गरेछन् । उक्त कार्यका लागी उनले सोली आकारको टेन्टमा वस्ने व्यवस्था मिलाएछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि 4 वर्ग मि. ठाउा र सास फेर्न 20 घन मि. हावा चाहिन्छ । सोली आकारको टेन्टको उचाइ कति हुन्छ ? पत्ता लगाउनुहोस् ।
In a marriage ceremony of Pemba's daughter he has to make arrangement for accommodation of 150 persons. For this purpose, he plans to build a conical tent in such a way that each person have 4 sq.m of the space on ground and 20 cu.m of air to breadth. What should be the height of the tent? Find it.

⇨ Here, number of persons = 150, the area for 1 person on base = 4 m^2
Volume for 1 person in the space = 20 m^3
Let, h be the height of conical tent and r be the radius of its base.
So, area of base = 150 × 4 m^2 = 600 m^2
Since, the base is circular so $\pi r^2 = 600$
or, $r^2 = \frac{600}{\pi}\text{ m}^2$
Now, the volume of the cone = 150 × 20 m^3 = 3000 m^3

or, $\frac{1}{3}\pi r^2 h = 3000$ or, $\frac{1}{3}\pi . \frac{600}{\pi} . h = 3000$ or, 200h = 3000

∴ h = 15 m Thus, the height of the tent is 15 m.

A. IMPORTANT QUESTIONS

A. VERY SHORT QUESTIONS

1. एउटा घरको आँगन समलम्ब चतुर्भुज आकारको छ । सो आगँनको क्षेत्रफल निकाल्न कुन सूत्र प्रयोग गर्नुपर्छ ?
The front yard of a house is trapezium shaped. What formula should be applied to find the area by using standard symbols?

⇨ Here, formula to find the area of trapezium is , $A = \frac{1}{2}h\,(p_1 + p_2)$

2. एउटा वङ्गलाको पछाडिको भाग चतुर्भुज आकारको छ । सो भागको क्षेत्रफल निकाल्न कुन सूत्र प्रयोग गर्नुपर्छ ?
The backyard of a bungalow is quadrilateral shaped. What formula should be applied to find the area by using standard symbols?

⇨ Here, formula to find the area of quadrilateral is $A = \frac{1}{2}$ Diagonal $(p_1 + p_2)$ where p_1 and p_2 are perpendiculars.

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B. SHORT QUESTIONS

1. एउटा छाता हरेकको क्षेत्रफल 30 cm² भएका 8 ओटा दुई फरक रङका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । प्रत्येक रङको कपडाको क्षेत्रफल पत्ता लगाउनुहोस् ।
An umbrella is made by stitching 8 triangular pieces of clothes of two different colours each piece having area 30 cm². How much cloth of each colour is required for umbrella?

⇨ Here, area of each piece = 30 cm^2. No. of triangles = 8

So, cloth of each colour = $\frac{8 \times 30}{2} = \frac{240}{2}$ cm^2 = 120 cm^2

2. एउटा छाता हरेकको क्षेत्रफल 42 cm² भएका 10 ओटा दुई फरक रङका त्रिभुजाकार कपडाका टुक्राहरू जोडेर बनाइएको छ । प्रत्येक रङको कपडाको क्षेत्रफल पत्ता लगाउनुहोस् ।
An umbrella is made by stitching 10 triangular pieces of clothes of two different colours each piece having area 42 cm². How much cloth of each colour is required for umbrella?

⇨ Here, area of each piece = 42 cm^2. No. of triangular pieces = 10

Thus, cloth of each colour = $\frac{42 \times 10}{2} = \frac{420}{2}$ cm^2 = 210 cm^2

3. एउटा घनाकार पानी ट्याङ्कीको लम्बाइ 2 m छ । उक्त ट्याङ्कीमा कति लिटर पानी अटाउँछ होला ?
The length of a cubical water tank is 2 m . How many litres of water can be stored in the tank? [1 m^3 = 1000 ℓ]

⇨ Here, length (ℓ) = 2 m

Volume of cubical tank (V) = $\ell^3 = 2^3 = 8$ m^3

Since 1m^3 = 1000 ℓ so, 8 m^3 = 8 × 1000 ℓ = 8000 ℓ

Thus, 8000 ℓ of water can be stored in the tank.

4. एउटा आयताकार ट्याङ्कीको लम्बाइ, चौडाइ र उचाइ क्रमशः 5 m, 5 m र 4 m छन् । सो ट्याङ्कीको क्षमता पत्ता लगाउनुहोस् ।
The length, breadth and height of a rectangular tank are 5 m, 5 m and 4 m respectively. Find the capacity of the tank.

⇨ Here, length (ℓ) = 5 m, breadth (b) = 5 m, height (h) = 4 m

Now, volume (v) = $\ell \times b \times h = 5 \times 5 \times 4 = 100$ m^3

Thus, capacity of the tank is 100 m^3.

5. एउटा पानी सङ्कलन गर्ने ट्याङ्की 16 ओटा रिङहरू प्रयोग गरी बनाइएको छ । यदि एउटा रिङको आयतन 0.5 m³ भए सो ट्याङ्कीमा कति लिटर पानी अटाउँछ होला ?
A water storage tank is made by using 16 circular rings. If the volume of a ring is 0.5 m³, how many litres of water can be stored in the tank?

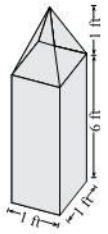
⇨ Here, number of circular rings (n) = 16

Volume of 1 ring (V) = 0.5 m^3

So, total volume of 16 rings = nV = 16 × 0.5 m^3 = 8 m^3 = 8000 ℓ [∵ 1m^3 = 1000ℓ]

Thus, 8000 ℓ of water can be stored in the tank.

6. चित्रमा एउटा पिलर दिइएको छ । यदि माथिल्लो भाग (पिरामिड) को आयतन तल्लो भाग (षड्मुखा) को आयतनको $\frac{1}{18}$ छ र पिरामिडको आयतन $\frac{1}{3}$ घन फिट छ भने पिलरको आयतन पत्ता लगाउनुहोस् ।
The adjoining figure is a pillar. If the volume of upper (pyramid) part is one-eighteenth of the volume of the lower (cuboid) part and volume of the pyramid is $\frac{1}{3}$ cubic feet, find the volume of the pillar.



⇨ Here, volume of pyramid (V_1) = $\frac{1}{18}$ volume of cuboid (V_2)

or, $\frac{1}{3}$ cubic feet = $\frac{1}{18} V_2$ ∴ V_2 = 6 cubic feet

Now, volume of pillar (V) = $V_1 + V_2 = \left(\frac{1}{3} + 6\right)$ cubic feet = $\frac{19}{3}$ cubic feet

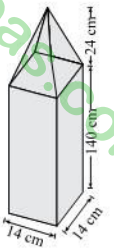
Thus, volume of pillar is $\frac{19}{3}$ cubic feet.

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7. चित्रमा एउटा पिलर दिइएको छ । यदि माथिल्लो भाग (पिरामिड) को आयतनको 35 गुणा र तल्लो भाग (षड्मुखा) को आयतनको 2 गुणा बराबर छन् र पिरामिडको आयतन 1568 घन फिट भए पिलरको आयतन पत्ता लगाउनुहोस् ।

The adjoining figure is a pillar. If 35 times the volume of upper (pyramid) part is twice the volume of the lower (cuboid) part and volume of the pyramid is 1568 cubic feet, find the volume of the pillar.



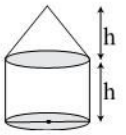
⇨ Here, 35 volume of pyramid (V_1) = 2 volume of cuboid (V_2)

or, $35 \times 1568 = 2\ V_2$ $\quad\therefore\quad V_2 = \dfrac{35 \times 1568}{2} = 27440$ cubic feet.

Now, volume of pillar (V) = $V_1 + V_2$ = (1568 + 27440) cubic feet = 29008 cubic feet.
Thus, volume of pillar is 29008 cubic feet.

8. एउटा टेन्ट h मिटर उचाइ सम्म एउटा समकोणी बेलना र त्यसपछि मैदानबाट 2h मिटर उचाइ सम्म समकोणी सोलीको रूपमा छ । यदि बेलनाकार भागको आयतन 300 m^3 भए सो टेन्टमा भएको हावाको आयतन निकाल्नुहोस् ।

A tent is of the shape of a right circular cylinder up to a height of h metres and then becomes a right circular cone with a height of 2h metres above the ground. Calculate the volume of the air in the tent if the volume of the cylindrical part is 300 m^3.



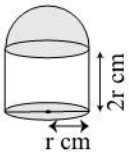
⇨ Here, height of cylinder = height of cone = h m Also, volume of cylinder = 300 m^3

i.e. $\pi r^2 h = 300\ m^3$ $\quad$ or, $\dfrac{1}{3}\pi r^2 h = \dfrac{1}{3} \times 300 = 100\ m^3$

i.e. volume of cone = 100 m^3
So, total volume = V(cylinder) + V(cone) = 300 m^3 + 100 m^3 = 400 m^3
Thus, volume of air in the tent is 400 m^3.

9. अर्धव्यास *r* cm र उचाइ *2r* cm भएको बेलनाकार पानी ट्याङ्कीको माथि अर्धगोलाकार भाग छ । यदि बेलनाकार भागमा 600 लि. पानी अटाउँछ भने उक्त ट्याङ्कीमा कति लिटर पानी अटाउँछ ?

A cylindrical water tank having radius *r* cm and height 2*r* cm has a hemispherical top. If the cylindrical portion can hold 600 ℓ water, how many litres of water can the tank hold?



⇨ Here, radius = r cm, height of cylinder (h) = 2r cm
We know that, volume of cylinder (V_1) = $\pi r^2 h$

or, $600\ \ell = \pi r^2 \times 2r$ $\quad\therefore\quad r^3 = \dfrac{600}{2\pi}\ \ell$

Again, volume of hemisphere (V_2) = $\dfrac{2}{3}\pi r^3 = \dfrac{2}{3}\pi . \dfrac{600}{2\pi}\ \ell$

$\therefore\quad V_2 = 200\ \ell$
So, total volume (V) = $V_1 + V_2 = 600\ \ell + 200\ \ell = 800\ \ell$
Thus, the tank can hold 800 ℓ of water.

10. डोल्माले छोरीको विवाह भोजको लागि 150 जनालाई बस्ने व्यवस्था गरिछन् । उक्त कार्यका लागि उनले सोली आकारको टेन्टमा बस्ने व्यवस्था गरिछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि भुइँमा 4 वर्ग मि. ठाँउ चाहिन्छ । आधारको क्षेत्रफल पत्ता लगाउनुहोस् ।

Dolma makes an arrangement for accommodation of 150 guests in her daughter's marriage ceremony. For this purpose she plans to build a conical tent in such a way that each person have 4 sq.m. of the space on ground. Find the area of the base.

⇨ Here, No. of guests (n) = 150 $\quad$ Area occupied by each person (A) = 4 m^2
So, area of base = nA = 150 × 4 = 600 m^2.

11. हुमलालले छोरी शुभेच्छाको अन्न प्राशनका लागि 96 जनालाई बस्ने व्यवस्था मिलाएछन् । उक्त कार्यका लागि उनले सोली आकारको टेन्टमा बस्ने व्यवस्था गरेछन् । टेन्टमा बस्ने प्रत्येक व्यक्तिका लागि सास फेर्न 44 घन मिटर हावा चाहिन्छ । उक्त टेन्टको आयतन पत्ता लगाउनुहोस् ।

Humlal makes an arrangement for accommodation of 96 guests in his daughter Subheksha's rice feeding ceremony. For this purpose he plans to build a conical tent in such a way that each person have 44 cu.m. of air to breath. Find the volume of the tent.

⇨ Here, No. of guests (n) = 96
Volume occupied by each person (V) = 44 m^3
Thus, total volume of tent = nV = 96 × 44 = 4224 m^3.

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12. अर्पितले आफ्नो विवाह भोजको लागि 120 जनालाई बस्ने व्यवस्था गरेछन् । उक्त कार्यका लागि उनले वर्गाकार आधार भएको पिरामिडको व्यवस्था गरेछन् । भुइँमा बस्ने प्रत्येक व्यक्तिका लागि 4 वर्ग मिटर ठाउँ चाहिन्छ । यदि उक्त टेन्टको कुल उचाइको एक तिहाई 5 m भए जम्मा आयतन निकाल्नुहोस् ।
Arpit makes an arrangement for accommodation of 120 guests in his marriage ceremony. For this purpose he plans to build a square-based pyramid shaped tent in such a way that each person have 4 sq. m. of the space on ground. If the one-third of height of the tent is 5 m, find the total volume.

⇨ Here, No. of guests (n) = 120
Area occupied by each person (V) = 4 m^2
So, area of base = 4 × 120 m^2 = 480 m^2

Again, $\frac{1}{3}$ height = 5 m

∴ height =15 m

Thus, volume of tent = $\frac{1}{3}$ Base area × height = $\frac{1}{3}$ × 480 × 15 = 2400 m^3.

13. रामले आफ्नो विवाह भोजको लागि 100 जनालाई बस्ने व्यवस्था गरेछन् । उक्त कार्यका लागि उनले वर्गाकार आधार भएको पिरामिडको व्यवस्था गरेछन् । भुइँमा बस्ने प्रत्येक व्यक्तिका लागि 5 वर्ग मिटर ठाउँ चाहिन्छ । यदि उक्त टेन्टको कुल उचाइको एक तिहाई 6 m भए जम्मा आयतन निकाल्नुहोस् ।
Ram makes an arrangement for accommodation of 100 guests in his marriage ceremony. For this purpose he plans to build a square-based pyramid shaped tent in such a way that each person have 5 sq. m. of the space on ground. If the one-third of height of the tent is 6 m, find the total volume.

⇨ Here, No. of guests (n) = 100
Area occupied by each person = 5 m^2
So, area of base = 100 × 5 m^2 = 500 m^2

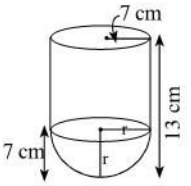
Again, $\frac{1}{3}$ height = 6 m

∴ height =18 m

Thus, volume of tent = $\frac{1}{3}$ Base area × height = $\frac{1}{3}$ × 500 × 18 = 3000 m^3.

C. LONG QUESTIONS

1. एउटा भाँडो अर्धगोलाकार कटौरीको माथि बेलनाकार खोक्रो भाँडो मिली बनेको छ । अर्धगोलाको व्यास 14 cm र भाँडोको पूरा उचाइ 13 cm छ । यसको क्षमता पत्ता लगाउनुहोस् ।
A vessel in the form of hemispherical bowl mounted by a hollow cylinder. The diameter of the sphere is 14 cm and the total height of the vessel is 13 cm. Find its capacity.



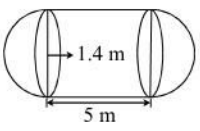
⇨ Here, radius of the hemispherical bowl, r = 7 cm
The height of the cylinder (h) = (13 – 7) cm = 6 cm
Now, total capacity of the bowl= Volume of cylinder + Volume of hemisphere

$$= \left(\pi r^2 h + \frac{2}{3}\pi r^3\right) cm^3 = \pi r^2 \left(h + \frac{2}{3} r\right) cm^3 = \frac{22}{7} \times 7^2 \times \left(6 + \frac{2}{3} \times 7\right) cm^3$$

$$= 22 \times 7 \times \frac{32}{3} cm^3 = \frac{4928}{3} cm^3 = 1642.7 cm^3$$

Thus, the capacity of the vessel is 1642.7 cm^3.

2. एउटा पानी सङ्कलन गर्ने ट्याङ्की बेलना र यसको दुवैतिर अर्धगोलाकार भाग मिलेर बनेको छ । यदि बेलनाको बाहिरी व्यास 1.4 m र यसको लम्बाइ 5 m भए प्रति वर्गमिटर रु. 20 को दरले बाहिरतिर रङ लगाउँदा कति खर्च लाग्ला ?
A storage water tank consists of a cylinder with a hemisphere on either end. If the external diameter of the cylinder be 1.4 m and its length be 5 m, what is the cost of painting it on the outside at the rate of Rs 10 per square meter ?



⇨ Here, diameter (d) = 1.4 m
We have, radius (r) = $\frac{d}{2} = \frac{1.4 \text{ m}}{2}$ = 0.7 m Length of cylinder = 5 m

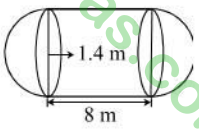
We know that, TSA = $4\pi r^2 + 2\pi rh = 2\pi r(2r + h) = 2 \times \frac{22}{7} \times 0.7\ (1.4 + 5) = 28.16\ m^2$

Rate of painting (R) = Rs 20/m^2
Now, total cost = TSA × Rate = 28.16 × 20 = 563.20
Thus, the total cost of painting is Rs 563.20.

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3. एउटा पानी सङ्कलन गर्ने ट्याङ्कीको बेलना र यसको दुवैतिर अर्धगोलाकार भाग मिलेर बनेको छ। यदि बेलनाको बाहिरी व्यास 1.4 m र यसको लम्बाइ 8 m भए प्रति वर्गमिटर रु. 20 को दरले बाहिरतिर रङ लगाउँदा कति खर्च लाग्ला ?



A storage water tank consists of a cylinder with a hemisphere on either end. If the external diameter of the cylinder be 1.4 m and its length be 8 m, what is the cost of painting it on the outside at the rate of Rs 20 per square meter ?

⇨ Here, diameter (d) = 1.4 m

We have, radius (r) $= \frac{d}{2} = \frac{1.4\text{ m}}{2} = 0.7$ m Length of cylinder = 8 m

We know that, TSA $= 4\pi r^2 + 2\pi rh = 2\pi r(2r + h) = 2 \times \frac{22}{7} \times 0.7\,(1.4 + 8) = 41.36\text{ m}^2$

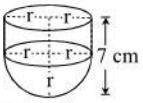
Rate of painting (R) = Rs $20/m^2$

Now, total cost = TSA × Rate = 41.36 × 20 = 827.20

Thus, the total cost of painting is Rs 827.20.

4. अर्धव्यास र उचाइ बराबर भएको एउटा बेलना एउटा अर्धगोला माथि राखिएको छ। यदि सो ठोस वस्तुको पूरा उचाइ 7 cm भए प्रति वर्ग से.मि. रु. 10 को दरले सुनको लेपन लगाउन कति खर्च लाग्ला ?

A cylinder of same height and radius is placed on the top of a hemisphere. Find the cost of gold-coat at the rate is Rs 10 per sq. cm if the length of the shape is 7 cm.



⇨ Here, common radius (r) = 3.5 cm

Height of cylinder (h) = r = 3.5 cm

Now, total surface area $= 3\pi r^2 + 2\pi rh = \pi r(3r + 2h) = \frac{22}{7} \times 3.5(3 \times 3.5 + 2 \times 3.5) = 192.50\text{ cm}^2$

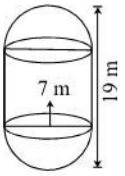
We have given, rate of gold-coat (R) = Rs $10/cm^2$

So, the total cost = Rate × TSA = Rs 10 × 192.50 = Rs 1925

Thus, the total cost is Rs 1925.

5. यदि चित्रमा देखाइएको ठोसको उचाइ 19 cm र बेलनाको पूरा व्यास 7 cm भए सो ठोसको आयतन र पूरा सतहको क्षेत्रफल क्षेत्रफल पत्ता लगाउनुहोस् ।

If the total height of the solid is 19 cm and diameter of the cylinder is 7 cm, find the volume and the total surface area of the solid.



⇨ Here, diameter (d) = 7 cm or, $2r = 7$ cm ∴ $r = 3.5$ cm

We have, height of cylinder (h) = H – 2r = 19 cm – 2 × 3.5 cm = 12 cm

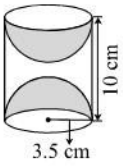
We know that,

Volume of the solid $= \frac{4}{3}\pi r^3 + \pi r^2 h = \pi r^2 \left(\frac{4}{3} r + h\right) = \frac{22}{7} \times 3.5^2 \left(\frac{4}{3} \times 3.5 + 12\text{ cm}\right) = 641.66\text{ cm}^3$

Again, TSA $= 4\pi r^2 + 2\pi rh = 2\pi r(2r + h) = 2 \times \frac{22}{7} \times 3.5\,(2 \times 3.5 + 12) = 418\text{ cm}^2$

Thus, the volume and TSA of the solid are 641.66 cm^3 and 418 cm^2 respectively.

6. एउटा काठको खेलौना एउटा ठोस बेलनाबाट दुवैतिर अर्धगोलाकार भाग निकालिएको रूपमा छ। यदि बेलनाको उचाइ र अर्धव्यास क्रमशः 10 cm र 3.5 cm भए सो खेलौनाको पूरा सतहको क्षेत्रफल पत्ता लगाउनुहोस् ।



A wooden toy is made by scooping-out a hemisphere from each end of a solid cylinder. If the height of the cylinder is 10 cm and its base radius 3.5 cm, find the total surface area of the toy.

⇨ Here, radius (r) = 3.5 cm and height (h) = 10 cm

We know that, TSA $= 4\pi r^2 + 2\pi rh = 2\pi r\,(2r + h) = 2 \times \frac{22}{7} \times 3.5(2 \times 3.5 + 10) = 22 \times 17 = 374\text{ cm}^2$

Thus, the total surface area is 374 cm^2.

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B. QUESTIONS FROM CDC TEXT BOOKS

1A. भित्री लम्बाइ 3 मिटर र उचाइ 2 मिटर भएको वर्गाकार आधारको एउटा ट्याङ्कीमा कति पानी अटाउँछ ?
How many litres of water can hold in a tank having square base of inner length 3 m and height 2 m.

⇨ Here, length (ℓ) = 3 m and height (h) = 2 m
We have, Volume = $\ell^2 \times h = 3^2 \times 2 = 18\ m^3 = 18 \times 1000\ \ell = 18000\ \ell$
Thus, the tank hold 18000 ℓ.

1B. वर्ग आधार भएको पानी ट्याङ्कीको भित्री लम्बाइ र उचाइ क्रमशः 2.5 मिटर र 1.5 मिटर भए सो पानी ट्याङ्कीमा कति पानी अटाउँछ ?
How many litres of water can hold a tank having square base of inner length and height 2.5 m and 1.5 m respectively.

⇨ Here, length (ℓ) = 2.5 m and height (h) = 1.5 m
We have, Volume (V) = $\ell^2\ h = (2.5)^2 \times 1.5 = \frac{75}{8}\ m^3 = \frac{75}{8} \times 1000\ \ell = 9375\ \ell$
Thus, the tank hold 9375 ℓ.

2A. एउटा इनारमा 3.5 फिट व्यास भएको तथा उचाइ 1 फिटका 50 ओटा चक्का राखिएका छन् । यदि सो इनार बनाउन प्रतिचक्का खर्च रु. 1300 पर्छ भने उक्त इनार खन्न कति खर्च लाग्छ ? उक्त इनारमा अधिकतम कति पानी अटाउँछ, निकाल्नुहोस् ।
There are 50 rings in a well. Each ring has a diameter 3.5 feet and height 1 foot. If the cost of making the well per ring is Rs 1300, what is the total cost of making the well ? What is the maximum water is in the well ?



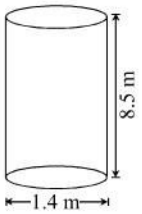
⇨ Here, the total cost of the well = Rs. 50 × Rs. 1300 = Rs. 65000
Volume of each ring $= \frac{1}{4}\pi d^2 h = \frac{1}{4} \times \frac{22}{7} \times 3.5^2 \times 1 = \frac{77}{8}$ cubic feet
Now, Volume of the well $= 50 \times \frac{77}{8}$ cu. feet $= \frac{1925}{4}$ cu. feet
$= 481.25$ cu. feet
We have, 1 cu. feet holds = 28.32 litres
So, $\frac{1925}{4}$ cu. feet hold $= 28.32 \times \frac{1925}{4}$ litres $= 13834.32$ litres
Thus, the maximum water in the tank is 13834.32 ℓ.

2B. एउटा इनारको भित्री व्यास 1 मिटर र उचाइ 16.5 मिटर छ भने सो इनारमा कति लिटर पानी अटाउँछ ?
A well has inner diameter 1 m and height 16.5 m, how many litres of water can hold in the well ?

⇨ Here, diameter (d) = 1 m and height (h) = 16.5 m
We know that, Volume $= \frac{1}{4}\pi d^2 h = \frac{1}{4} \times \frac{22}{7} \times 1^2 \times 16.5 = \frac{363}{28}\ m^3$
We know that, $1 m^3 = 1000\ \ell$ So, $\frac{363}{28}\ m^3 = \frac{363}{28} \times 1000\ \ell = 12964.28\ \ell$
Thus, 12964.28 ℓ water can be held in the tank.

2C. गहिराइ 8.5 मिटर र व्यास 1.4 मिटर भएको कुनै इनारमा कति पानी अटाउँछ होला ? पत्ता लगाउनुहोस् ।
How many litres of water can hold in a tank having diameter 1.4 m and depth 8.5 m ? Find it.

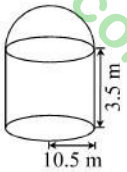
⇨ Here, diameter (d) = 1.4 m Height (h) = 8.5 m
We know that,
Volume (V) $= \frac{1}{4}\pi d^2 h = \frac{1}{4} \times \frac{22}{7} \times (1.4)^2 \times 8.5 = \frac{1309}{100}\ m^3$



We have, 1 m^3 tank contains 1000ℓ.
$\frac{1309}{100}\ m^3$ tank contains $\frac{1309}{100} \times 1000\ell = 13090\ \ell$.
Thus, the total volume of the tank is 13090 ℓ.

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3A. अर्धव्यास 10.5 मिटर र उचाइ 3.5 मिटर नाप भएको पानी ट्याङ्कीको माथिल्लो भाग अर्ध गोलाकार (hemisphere) छ भने उक्त पानी ट्याङ्कीमा कति पानी अटाउँछ ? पत्ता लगाउनुहोस् ।
The upper part of tank having rdius 10.5 m and height 3.5 m is hemisphere. How much water can hold in the tank. Find it.



⇨ Here, radius (r) = 10.5 m and height (h) = 3.5 m
We have,

$$\text{Volume} = \frac{2}{3}\pi r^3 + \pi r^2 h = \pi r^2\left(\frac{2}{3}r + h\right) = \frac{22}{7} \times 10.5^2\left(\frac{2}{3} \times 10.5 + 3.5\right) = \frac{14553}{4}\ \text{m}^3$$

We know that, 1 m^3 tank contains 1000ℓ water.
or, $\frac{14553}{4}$ m^3 tank contains $= \frac{14553}{4} \times 1000\ell$ water = 3638250 litres.
Thus, the tank hold 3638250 litres of water.

3B. एउटा विद्यालयमा आकासे पानी जम्मा गर्न 1.40 मिटर भित्री व्यास र 1.5 मिटर उचाइ भएको बेलनाकार ट्याङ्की निर्माण गरिएको छ । यदि उक्त ट्याङ्कीको माथिल्लो भाग 0.36 मिटर ठाडो उचाइको सोली छ भने सो ट्याङ्कीमा कति पानी अटाउँछ होला ? पत्ता लगाउनुहोस् ।
A cylindrical tank having 1.40 m inner diameter and 1.5 m height is constructed in a school to collect the sky water. If the upper part of the tank is a cone having height 0.36 m, how much water can be held in the tank ? Find it.



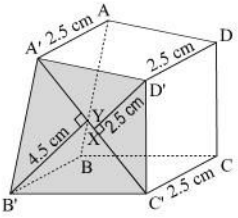
⇨ Here, diameter (d) = 1.4 m and Height of cone (h_1) = 0.36 m
Height of cylinder (h_2) = 1.5 m

We have, Volume of tank $= V(\text{cone}) + V(\text{cylinder}) = \frac{1}{3}\pi r^2 h_1 + \pi r^2 h_2$

$$= \pi r^2\left(\frac{1}{3}h_1 + h_2\right) = \frac{22}{7}\left(\frac{1.4}{2}\right)^2\left(\frac{1}{3} \times 0.36 + 1.5\right) = 2.4948\ \text{m}^3$$

We know that, 1 m^3 tank contains 1000 ℓ water.
2.4948 m^3 tank contains = 2.4948 × 1000 ℓ = 2494.80 ℓ
Thus, 2494.80 ℓ can be held in the tank.

4. सँगैको चित्रमा ABCD ट्याङ्कीको माथिल्लो भाग तथा A'B'C'D' ट्याङ्कीको आधार हो । यसको उचाइ BB' = AA' = CC' = DD' = 2.5 मिटर छ । ट्याङ्कीको आधार A'B'C'D' को विकर्ण A'C' = 6.25 मिटर D'X = 2.5 मिटर र B'Y = 4.5 मिटर छ । उक्त ट्याङ्कीको अध्ययन गरी निम्न लिखित प्रश्नहरूको उत्तर दिनुहोस् :
In the figure ABCD is the upper part of the tank. Its height AA' = BB' = CC' = DD' = 2.5 m. The base of the tank A'B'C'D' has diagonal A'C' = 6.25 m, D'X = 2.5 m and B'Y = 4.5 m. Study the tank and answer the following questions:



(a) ट्याङ्कीको चार भित्ताको जम्मा क्षेत्रफल निकाल्नुहोस् ।
Find the area of four walls of the tank.
(b) प्रति वर्गमिटर रु. 275 का दरले चार भित्तामा प्लास्टर गर्दा लाग्ने ज्याला निकाल्नुहोस् ।
Find the total cost of plastering four walls at the rate of Rs. 275 per square meter.
(c) ट्याङ्कीको आधारको सतहको क्षेत्रफल कति हुन्छ ? **What is the area of base surface of the tank ?**
(d) ट्याङ्कीको आधारमा प्रति वर्गमिटर रु. 250 का दरले प्लास्टर गर्दा कति ज्याला लाग्छ ?
What is the total wages to plaster the base of tank at the rate of Rs. 250 per square meter ?
(e) ट्याङ्कीमा कति पानी अटाउँछ ? **(How much water can hold in the tank ?)**

⇨ Here, perimeter of base = 5.5 m + 5.5 m + 4 m + 4 m = 19 m
(a) We have,
Area of 4 walls = Ph = 19 m × 2.5 m = 47.5 m^2
(b) Total cost = Area × Rate = 47.5 × Rs. 275 = Rs. 13062.50
(c) Area of base = $\frac{1}{2}$ d $(P_1 + P_2) = \frac{1}{2} \times 6.25 \times (2.3 + 4.5) = 21.25\ \text{m}^2$
(d) Total cost = Area of base × Rate = 21.25 × Rs. 250 = Rs. 5312.50
(e) Volume of the tank = base area × height = 21.25 × 2.5 = 53.125 m^3 = 53.125 × 1000 ℓ
= 53125 ℓ
Thus, (a) Area of 4 walls is 47.5 m^2.
(b) Total wage for plastering 4 walls is Rs. 13062.50.
(c) Area of base is 21.25 m^2.
(d) Total wage of plastering base is Rs. 5312.50.
(e) Total water can be held in the tank is 53125 ℓ.

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8. म.स. र ल.स.
HCF and LCM

[4 Marks]

Formulae & Key Points

	अभिव्यञ्जक (Expression)	खण्डित रूप (Factorized form)	विस्तारीत रूप (Expanded form)
1.	$(a+b)^2$	$(a+b)(a+b)$	$a^2+2ab+b^2$ or, $(a-b)^2+4ab$
2.	$(a-b)^2$	$(a-b)(a-b)$	$a^2-2ab+b^2$ or $(a+b)^2-4ab$
3.	a^2-b^2	$(a+b)(a-b)$	–
4.	a^2+b^2	–	$(a+b)^2-2ab$ or $(a-b)^2+2ab$
5.	a^3+b^3	$(a+b)(a^2-ab+b^2)$	$(a+b)^3-3ab(a+b)$
6.	a^3-b^3	$(a-b)(a^2+ab+b^2)$	$(a-b)^3+3ab(a-b)$
7.	$(a+b)^3$	$(a+b)(a+b)(a+b)$	$a^3+b^3+3ab(a+b)$ Or $a^3+3a^2b+3ab^2+b^3$
8.	$(a-b)^3$	$(a-b)(a-b)(a-b)$	$a^3-b^3-3ab(a-b)$ Or $a^3-3a^2b+3ab^2-b^3$
9.	$a^4+a^2b^2+b^4$	$(a^2+ab+b^2)(a^2-ab+b^2)$	–

1. म.स. = साझा गुणनखण्डहरूको गुणनफल (यदि साझा गुणनखण्डहरू नभए म. स. = 1 हुन्छ ।)
   HCF = Product of Common factor (If there is no any common factor then consider 1 is the HCF.)
2. ल.स. = (कम्तीमा 2 ओटा अभिव्यञ्जकमा आउने साझा गुणनखण्डहरू) × बाँकी गुणनखण्डहरू)
   LCM = (Common factors in at least two expressions) × (Remaining factors)
3. यदि दुईओटा अभिव्यञ्जकहरूमात्र भए, पहिलो अभिव्यञ्जक × दोस्रो अभिव्यञ्जक = म.स. × ल.स.
   If there are only two expressions: HCF × LCM = 1st expression × 2nd expression

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 6(a) & 14]

Q. 6. (a) म.स. पत्ता लगाउनुहोस् (Find the HCF of): (x^3-xy^2), $(x-y)$

⇨ Here, F.E. $= x^3-xy^2 = x(x^2-y^2) = x(x-y)(x+y)$ S.E. $= x-y$

$\therefore$ HCF $= x-y$

Q. 14. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): x^4+x^2+169, $x^3+x(x+13)+4x^2$

⇨ Here,

F.E. $= x^4+x^2+169 = (x^2)^2+(13)^2+x^2$
$= (x^2+13)^2-2.x^2.13+x^2$
$= (x^2+13)^2-25x^2$
$= (x^2+13)^2-(5x)^2$
$= (x^2+13-5x)(x^2+13+5x)$
$= (x^2-5x+13)(x^2+5x+13)$

S.E. $= x^3+x(x+13)+4x^2$
$= x^3+x^2+13x+4x^2$
$= x^3+5x^2+13x$
$= x(x^2+5x+13)$

LCM = HCF × remaining factors $= (x^2+5x+13)\times x(x^2-5x+13) = x(x^4+x^2+169)$

A. BASIC EXERCISE 8

A. VERY SHORT QUESTIONS

दिइएका बीजगणितीय अभिव्यञ्जकहरूमा साझा गुणनखण्ड पत्ता लगाउनुहोस् ।
Find the common factor in the given algebraic expressions.

1. (a) $x(a-b)$, $y(b-a)$ (b) $a(a-4)$, $b(4-a)$ (c) $2x(a+5)$, $3y(5+a)$
(d) $4x(a+5)$, $6y(5+a)$ (e) $(x+3)(x+6)$, $(3+x)(2-x)$ (f) $(x+1)(x-2)$, $(x+2)(2-x)$

⇨ (a) Here, first expression $= x(a-b)$
Second expression $= y(b-a) = -y(a-b)$
$\therefore$ CF $= (a-b)$

(b) Here, First exppression $= a(a-4)$
Second expression $= b(4-a) = -b(a-4)$
$\therefore$ CF $= (a-4)$

(c) Here, First expression $= 2x(a+5)$
Second expression $= 3y(5+a)$
$\therefore$ CF $= (a+5)$

(d) Here, First expression $= 4x(a+5) = 2\times 2\times x(a+5)$
Second expression $= 6y(5+a) = 2\times 3\times y(5+a)$
$\therefore$ CF $= 2(a+5)$

(e) Here, First expression $= (x+3)(x+6)$
Second expression $= (3+x)(2-x)$
$\therefore$ CF $= (x+3)$

(f) Here, First expression $= (x+1)(x-2)$
Second expression $= (x+2)(2-x) = -(x+2)(x-2)$
$\therefore$ CF $= (x-2)$

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2. म.स. पत्ता लगाउनुहोस् (Find the HCF of):

(a) $(x + 2)(x + 3)$ and $(x + 3)(x + 4)$ **(b) $(x + 1)(x - 2)$ and $(x - 1)(x + 1)$**
(c) $(x + 5)(x + 6)$ and $(x + 5)(x - 3)$ **(d) $(x + 3)(x + 6)$ and $(x + 3)(x - 2)$**

⇨ (a) Here, First expression = $(x + 2)(x + 3)$
Second expression = $(x + 3)(x + 4)$
$\therefore$ CF = $(x + 3)$

(b) Here, First expression = $(x + 1)(x - 2)$
Second expression $(x - 1)(x + 1)$
$\therefore$ CF = $(x + 1)$

(c) Here, First expression = $(x + 5)(x + 6)$
Second expression = $(x + 5)(x - 3)$
$\therefore$ CF = $(x + 5)$

(d) Here, First expression = $(x + 3)(x + 6)$
Second expression = $(x + 3)(x - 2)$
$\therefore$ CF = $(x + 3)$

3. म.स. पत्ता लगाउनुहोस् (Find the HCF of):

(a) $3x$ and $6x$ **(b) $5y$ and $10y$** **(c) $6ab$ and $3ab$** **(d) a^2b and $2ab$** **(e) $2x^2$ and $4x$**
(f) x^2y and xy^2 **(g) $2xy$ and $3xz$** **(h) $4xp$ and $3pq$** **(i) $5ab$ and $10bc$**

⇨ (a) Here, First expression = $3x$
Second expression = $6x = 2 \times 3x$
$\therefore$ HCF = $3x$

(b) Here, First expression = $5y$
Second expression = $10y = 2 \times 5y$
$\therefore$ HCF = $5y$

(c) Here, First expression = $6ab = 2 \times 3ab$
Second expression = $3ab$
$\therefore$ HCF = $3ab$

(d) Here, First expression = $a^2b = a \times a \times b$
Second expression = $2ab$
$\therefore$ HCF = ab

(e) Here, First expression = $2x^2 = 2 \times x \times x$
Second expression = $4x = 2 \times 2 \times x$
$\therefore$ HCF = $2x$

(f) Here, First expression = $x^2y = x \times x \times y$
Second expression = $xy^2 = x \times y \times y$
$\therefore$ HCF = xy

(g) Here, First expression = $2xy$
Second expression = $3xz$
$\therefore$ HCF = x

(h) Here, First expression = $4xp$
Second expression = $3pq$
$\therefore$ HCF = p

(i) Here, First expression = $5ab$
Second expression = $10bc = 2 \times 5 \times bc$
$\therefore$ HCF = $5b$

ल.स. पत्ता लगाउनुहोस् (Find the LCM of):

4. (a) a^2 and a^3 **(b) a^2 and $2a$** **(c) a^3 and $3a$** **(d) $4x$ and 2** **(e) $9x$ and 3**
(f) $6x$ and 2 **(g) $2x$ and $3x$** **(h) $5a$ and $10a$** **(i) ab and a^2b** **(j) ab^2 and ab**
(k) $2a$ and $4a^2$ **(ℓ) a^2b and a^2b^2**

⇨ (a) Here, First expression = $a^2 = a \times a$
Second expression = $a^3 = a \times a \times a$
$\therefore$ LCM = a^3

(b) Here, First expression = $a^2 = a \times a$
Second expression = $2a = 2 \times a$
$\therefore$ LCM = $a \times a \times 2 = 2a^2$

(c) Here, First expression = $a^3 = a \times a \times a$
Second expression = $3a = 3 \times a$
$\therefore$ LCM = $a \times a \times a \times 3 = 3a^3$

(d) Here, First expression = $4x = 2 \times 2 \times x$
Second expression = 2
$\therefore$ LCM = $2 \times 2 \times x = 4x$

(e) Here, First expression = $9x = 3 \times 3 \times x$
Second expression = 3
$\therefore$ LCM = $3 \times 3 \times x = 9x$

(f) Here, First expression = $6x = 2 \times 3 \times x$
Second expression = 2
$\therefore$ LCM = $2 \times 3 \times x = 6x$

(g) Here, First expression = $2x = 2 \times x$
Second expression = $3x = 3 \times x$
$\therefore$ LCM = $x \times 2 \times 3 = 6x$

(h) Here, First expression = $5a = 5 \times a$
Second expression = $10a = 2 \times 5 \times a$
$\therefore$ LCM = $5a \times 2 = 10a$

(i) Here, First expression = $ab = a \times b$
Second expression = $a^2b = a \times a \times b$
$\therefore$ LCM = $a \times b \times a = a^2b$

(j) Here, First expression = $ab^2 = a \times b \times b$
Second expression = $ab = a \times b$
$\therefore$ LCM = $a \times b \times b = ab^2$

(k) Here, First expression = $2a = 2 \times a$
Second expression = $4a^2 = 2 \times 2 \times a \times a$
$\therefore$ LCM = $2a \times 2 \times a = 4a^2$

(ℓ) Here, First expression = $a^2b = a \times a \times b$
Second expression = $a^2b^2 = a \times a \times b \times b$
$\therefore$ LCM = $a \times a \times b \times b = a^2b^2$

5. ल.स. पत्ता लगाउनुहोस् (Find the LCM of):

(a) $(x + 3)(x - 2)$ and $(x - 2)(x + 5)$ **(b) $(x + 4)(x - 8)$ and $(x - 4)(x + 4)$**

⇨ (a) Here, First expression = $(x + 3)(x - 2)$
Second expression = $(x - 2)(x + 5)$
$\therefore$ LCM = $(x - 2)(x + 3)(x + 5)$

(b) Here, First expression = $(x + 4)(x - 8)$
Second expression = $(x - 4)(x + 4)$
$\therefore$ LCM = $(x + 4)(x - 8)(x - 4)$

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B. SHORT QUESTIONS

1. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^4 + 4$ and $3x^2 - 6x + 6$ [2057 A2]

⇨ Here,
First expression = $x^4 + 4 = (x^2 + 2)^2 - 2.x^2.2 = (x^2 + 2)^2 - 4x^2 = (x^2 + 2)^2 - (2x)^2$
= $(x^2 + 2 + 2x)(x^2 + 2 - 2x) = (x^2 + 2x + 2)(x^2 - 2x + 2)$
Second expression = $3x^2 - 6x + 6 = 3(x^2 - 2x + 2)$.
Thus, the HCF is $(x^2 - 2x + 2)$.

2. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $8x^2 - 12x + 18$ and $8x^3 + 27$ [2057 B2]

⇨ Here, first expression: $8x^2 - 12x + 18 = 2(4x^2 - 6x + 9)$
and second expression: $8x^3 + 27 = (2x)^3 + 3^3 = (2x + 3)(4x^2 - 6x + 9)$
Thus, the HCF is $4x^2 - 6x + 9$.

3. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^2 - y^2$ and $x^2 - 2xy + y^2$. [2057 C2]

⇨ Here, first expression: $x^2 - y^2 = (x + y)(x - y)$
and second expression: $x^2 - 2xy + y^2 = (x - y)^2$
Thus, the HCF is $(x - y)$.

4. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^3 + 27$, $x^2 - 9$ [2057 D2]

⇨ Here, first expression: $x^3 + 27 = x^3 + 3^3 = (x + 3)(x^2 - 3x + 9)$
and second expression: $x^2 - 9 = x^2 - 3^2 = (x + 3)(x - 3)$
Thus, the HCF is $(x + 3)$.

5. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $a^2 - b^2$ and $a^2 + 2ab + b^2$ [2057 E2]

⇨ Here, first expression: $a^2 - b^2 = (a + b)(a - b)$
and second expression: $a^2 + 2ab + b^2 = (a + b)^2$
Thus, the HCF is $(a + b)$.

6. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $4a^3 + 8a^2$ and $5a^3 - 20a$ [2058 A2]

⇨ Here, first expression = $4a^3 + 8a^2 = 4a^2(a + 2) = 2 \times 2 \times a \times a \times (a + 2)$
Second expression = $5a^3 - 20a = 5a(a^2 - 4) = 5a(a^2 - 4) = 5a(a + 2)(a - 2)$
Thus, the HCF is $a \times (a + 2) = a(a + 2)$

7. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^4 + x^2 + 1$ and $x^2 - x + 1$ [2058 B2]

⇨ Here, first expression = $x^4 + x^2 + 1 = (x^2)^2 + 2.x^2.1 + 1^2 - x^2$
= $(x^2 + 1)^2 - x^2 = (x^2 + 1 + x)(x^2 + 1 - x) = (x^2 + x + 1)(x^2 - x + 1)$
Second expression = $(x^2 - x + 1)$
Thus, the HCF is $(x^2 - x + 1)$.

8. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^2 - 3x + 3y - y^2$ and $y^2 + xy - 3y$ [2058 D2]

⇨ Here, First expression = $x^2 - 3x + 3y - y^2 = x^2 - y^2 - 3x + 3y$
= $(x + y)(x - y) - 3(x - y) = (x - y)(x + y - 3)$
Second expression = $y^2 + xy - 3y = xy + y^2 - 3y = y(x + y - 3)$
Thus, HCF = $(x + y - 3)$

9. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $a^2 + b^2 + ab$, $b^3 - a^3$ [2058 E2]

⇨ Here, first expression = $a^2 + b^2 + ab = a^2 + ab + b^2$
Second expression = $b^3 - a^3 = -(a^3 - b^3) = -(a - b)(a^2 + ab + b^2)$
Thus, the HCF is $a^2 + ab + b^2$.

10. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $a^2 - 4ab + 4b^2$ and $2a^3b - 8ab^3$ [2059 A2]

⇨ Here, first expression = $a^2 - 4ab + 4b^2 = (a - 2b)^2$
Second expression = $2a^3b - 8ab^3 = 2ab(a^2 - 4b^2) = 2ab(a + 2b)(a - 2b)$
Thus, the HCF is $(a - 2b)$.

11. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $(x - y)^2 + 4xy$ and $2x^3 + 4x^2y + 2xy^2$. [2059 B1]

⇨ Here, first expression = $(x - y)^2 + 4xy = x^2 - 2xy + y^2 + 4xy$
= $x^2 + 2xy + y^2 = (x + y)^2$
Second expression = $2x^3 + 4x^2y + 2xy^2 = 2x(x^2 + 2xy + y^2) = 2x(x + y)^2$
Thus, the HCF is $(x + y)^2$.

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12. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^3 - 8y^3$ and $x^2 + 2xy + 4y^2$ [2059 C1]

⇨ Here, first expression = $x^3 - 8y^3 = x^3 - (2y)^3 = (x - 2y)(x^2 + 2xy + 4y^2)$
Second expression = $x^2 + 2xy + 4y^2$
Thus, the HCF is $(x^2 + 2xy + 4y^2)$.

13. म.स. पत्ता लगाउनुहोस् (Find the HCF of):$a^3 + 8b^3$ and $a^2 - 2ab + 4b^2$ [2059 C2]

⇨ Here, first expression = $a^3 + 8b^3 = a^3 + (2b)^3 = (a + 2b)(a^2 - 2ab + 4b^2)$
Second expression = $a^2 - 2ab + 4b^2$
Thus, the HCF is $a^2 - 2ab + 4b^2$.

14. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $a^2 - 1$ and $a^3 + 1$ [2059 D1]

⇨ Here, first expression = $a^2 - 1 = a^2 - (1)^2 = (a + 1)(a - 1)$
Second expression = $a^3 + 1 = a^3 + (1)^3 = (a + 1)(a^2 - a + 1)$ Thus, the HCF is $(a + 1)$.

15. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $4x^2 - 2x$, $8x^3 - 2x$ [2059 E1]

⇨ Here, first expression = $4x^2 - 2x = 2x(2x - 1)$
Second expression = $8x^3 - 2x = 2x(4x^2 - 1) = 2x\{(2x)^2 - (1)^2\} = 2x(2x + 1)(2x - 1)$
Thus, the HCF is $2x(2x - 1)$.

16. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $x^2 - xy$ and $x^3y - xy^3$ [2059 E2, 2060 E2]

⇨ Here, first expression = $x^2 - xy = x(x - y)$
Second expression = $x^3y - xy^3 = xy(x^2 - y^2) = xy(x + y)(x - y)$
Thus, the HCF = $x(x - y)$

17. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $3m^3 - 27m$ and $m^3 + 27$ [2060 B2]

⇨ Here, first expression = $3m^3 - 27m = 3m(m^2 - 9) = 3m(m^2 - 3^2) = 3m(m + 3)(m - 3)$
and second expression = $m^3 + 27 = m^3 + 3^3 = (m + 3)(m^2 - 3m + 9)$
Thus, the HCF is $(m + 3)$.

18. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $12x^4 - 27x^2y^2$ and $2x^2 - xy - 3y^2$ [2060 C]

⇨ Here, first expression = $12x^4 - 27x^2y^2 = 3x^2(4x^2 - 9y^2)$
$= 3x^2\{(2x)^2 - (3y)^2\} = 3x^2(2x + 3y)(2x - 3y)$
and second expression = $2x^2 - xy - 3y^2 = 2x^2 - 3xy + 2xy - 3y^2$
$= x(2x - 3y) + y(2x - 3y) = (2x - 3y)(x + y)$
Thus, the HCF is $(2x - 3y)$.

19. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $4x^2 - 9y^2$; $8x^3 + 27y^3$ [2060 D1]

⇨ Here, first expression = $4x^2 - 9y^2 = (2x)^2 - (3y)^2 = (2x + 3y)(2x - 3y)$
and second expression = $8x^3 + 27y^3 = (2x)^3 + (3y)^3 = (2x + 3y)(4x^2 - 6xy + 9y^2)$
Thus, the HCF is $(2x + 3y)$.

20. म.स. पत्ता लगाउनुहोस् (Find the HCF of):$8m^3 - 27n^3$; $8m^2 + 12mn + 18n^2$ [2060 D2]

⇨ Here, first expression = $8m^3 - 27n^3 = (2m)^3 - (3n)^3 = (2m - 3n)\{(2m)^2 + 2m.3n + (3n)^2\}$
$= (2m - 3n)(4m^2 + 6mn + 9n^2)$
and second expression = $8m^2 + 12mn + 18n^2 = 2(4m^2 + 6mn + 9n^2)$
Thus, the HCF is $(4m^2 + 6mn + 9n^2)$

21. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $(x - 2y)^2$ and $2x^3y - 8xy^3$ [2060 E1]

⇨ Here, first expression = $(x - 2y)^2$
Second expression = $2x^3y - 8xy^3 = 2xy(x^2 - 4y^2) = 2xy\{x^2 - (2y)^2\} = 2xy(x + 2y)(x - 2y)$
Thus, the HCF is $(x - 2y)$.

22. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $3x(x^2 + 2xy + y^2)$ and $6y(x^2 - y^2)$ [2057 A1]

⇨ Here, First expression = $3x(x^2 + 2xy + y^2) = 3x(x + y)^2$
Second expression = $6y(x^2 - y^2) = 2 \times 3y(x + y)(x - y)$
Thus, the LCM is $2 \times 3 \times xy(x + y)(x + y)(x - y) = 6xy(x + y)(x^2 - y^2)$.

23. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $x^2 - 9$ and $3x + 9$ [2057 C1]

⇨ Here, first expression: $x^2 - 9 = x^2 - 3^2 = (x + 3)(x - 3)$
and second expression: $3x + 9 = 3(x + 3)$
Thus, the LCM is $3(x + 3)(x - 3)$.

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C. LONG QUESTIONS

MODEL 1

1. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $y^2 - 10y + 24 + 6x - 9x^2$, $2y^4 - 18x^2y^2 - 48xy^2 - 32y^2$ [2071 A]

⇨ Here, First Exp. $= y^2 - 10y + 24 + 6x - 9x^2$

$= y^2 - 2.y.5 + 5^2 - 1 + 2.1.3x - (3x)^2 = (y-5)^2 - [1^2 - 2.1.3x + (3x)^2]$

$= (y-5)^2 - (1-3x)^2 = (y - 5 + 1 - 3x)(y - 5 - 1 + 3x)$

$= (y - 3x - 4)(y + 3x - 6)$

Second Exp. $= 2y^4 - 18x^2y^2 - 48xy^2 - 32y^2$

$= 2y^2(y^2 - 9x^2 - 24x - 16) = 2y^2[y^2 - (9x^2 + 24x + 16)]$

$= 2y^2[y^2 - \{(3x)^2 + 2.3x.4 + 4^2\}] = 2y^2[y^2 - (3x+4)^2]$

$= 2y^2(y + 3x + 4)(y - 3x - 4)$

Thus, HCF is $(y - 3x - 4)$.

2. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $(1 - x^2)(1 - y^2) + 4xy$, $1 - 2x + y - x^2y + x^2$ [2071 E]

⇨ Here, First Exp. $= (1 - x^2)(1 - y^2) + 4xy$

$= 1(1 - y^2) - x^2(1 - y^2) + 4xy = 1 - y^2 - x^2 - x^2y^2 + 4xy$

$= 1 + 2xy + x^2y^2 - x^2 + 2xy - y^2 = (1 + xy)^2 - (x^2 - 2xy + y^2)$

$= (1 + xy)^2 - (x - y)^2 = (1 + xy + x - y)(1 + xy - x + y)$

Second Exp. $= 1 - 2x + y - x^2y + x^2$

$= 1 - 2x + x^2 + y - x^2y = (1 - x)^2 + y(1 - x^2)$

$= (1 - x)^2 + y(1 + x)(1 - x) = (1 - x)(1 - x + y + xy)$

Thus, HCF is $(1 - x + y + xy)$.

3. म.स. पत्ता लगाउनुहोस् (Find the HCF of): $1 + 4k + 4k^2 - 16k^4$, $1 + 2k - 8k^3 - 16k^4$ [2071 S]

⇨ Here, First Exp. $= 1 + 4k + 4k^2 - 16k^4$

$= (1 + 2k)^2 - (4k^2)^2 = (1 + 2k + 4k^2)(1 + 2k - 4k^2)$

Second Exp. $= 1 + 2k - 8k^3 - 16k^4 = (1 + 2k) - 8k^3(1 + 2k) = (1 + 2k)(1 - 8k^3)$

$= (1 + 2k)\{1^3 - (2k)^3\} = (1 + 2k)(1 - 2k)(1 + 2k + 4k^2)$

Thus, the required HCF is $(1 + 2k + 4k^2)$.

4. म.स. निकाल्नुहोस् (Find the HCF): $(x^3 - x^2 + x - 1)$ and $2x^3 - x^2 + x - 2$ [2061 A2]

⇨ Here,

1st exp.

$x^3 - x^2 + x - 1$

$= x^2(x - 1) + 1(x - 1)$

$= (x - 1)(x^2 + 1)$

2nd exp.

$2x^3 - x^2 + x - 2$

$= 2x^3 - 2 - x^2 + x = 2(x^3 - 1) - x(x - 1)$

$= 2(x - 1)(x^2 + x + 1) - x(x - 1)$

$= (x - 1)\{2(x^2 + x + 1) - x\}$

$= (x - 1)(2x^2 + 2x + 2 - x)$

$= (x - 1)(2x^2 + x + 2)$

Thus, HCF is $x - 1$

5. म.स. निकाल्नुहोस् (Find the HCF): $x^3 - 8y^3$ and $x^4 + 4x^2y^2 + 16y^4$ [2061 B2]

⇨ Here,

first exp:

$x^3 - 8y^3$

$= x^3 - (2y)^3$

$= (x - 2y)\{x^2 + x.2y + (2y)^2\}$

$= (x - 2y)(x^2 + 2xy + 4y^2)$

Second exp:

$x^4 + 4x^2y^2 + 16y^4$

$= (x^2)^2 + (4y^2)^2 + 4x^2y^2$

$= (x^2 + 4y^2)^2 - 2.x^2.4y^2 + 4x^2y^2$

$= (x^2 + 4y^2)^2 - 8x^2y^2 + 4x^2y^2$

$= (x^2 + 4y^2)^2 - 4x^2y^2 = (x^2 + 4y^2)^2 - (2xy)^2$

$= (x^2 + 2xy + 4y^2)(x^2 - 2xy + 4y^2)$

Thus, HCF $= (x^2 + 2xy + 4y^2)$

6. म.स. निकाल्नुहोस् (Find the HCF): $x^4 + 4x^2 + 16$ and $x^3 - 8$ [2061 C1]

⇨ Here,

first exp:

$x^4 + 4x^2 + 16$

$= (x^2)^2 + 4^2 + 4x^2$

$= (x^2 + 4)^2 - 2x^2 . 4 + 4x^2$

$= (x^2 + 4)^2 - 8x^2 + 4x^2$

$= (x^2 + 4)^2 - 4x^2$

$= (x^2 + 4)^2 - (2x)^2$

$= (x^2 + 4 + 2x)(x^2 + 4 - 2x)$

$= (x^2 + 2x + 4)(x^2 - 2x + 4)$

Second exp:

$x^3 - 8$

$= x^3 - 2^3$

$= (x - 2)(x^2 + 2x + 4)$

Thus, HCF $= x^2 + 2x + 4$

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7. म.स. निकाल्नुहोस् (Find the HCF): $16x^4 - 4x^2 - 4x - 1$ and $8x^3 - 1$ [2062 A2]

⇨ Here,

first Exp:
$16x^4 - 4x^2 - 4x - 1$
$= 16x^4 - (4x^2 + 4x + 1)$
$= (4x^2)^2 - \{(2x)^2 + 2.\ 2x.\ 1 + 1^2\}$
$= (4x^2)^2 - (2x + 1)^2$
$= (4x^2 + 2x + 1)(4x^2 - 2x - 1)$

Second Exp:
$8x^3 - 1$
$= (2x)^3 - 1^3$
$= (2x - 1)\{(2x)^2 + 2x.\ 1 + 1^2\}$
$= (2x - 1)(4x^2 + 2x + 1)$

Thus, HCF $= (4x^2 + 2x + 1)$

8. म.स. निकाल्नुहोस् (Find the HCF): $a^3 - 1$ and $a^4 + a^2 + 1$ [SLC 2066 D]

⇨ Here,

1^{st} exp:
$a^3 - 1$
$= a^3 - 1^3$
$= (a - 1)(a^2 + a + 1)$

2^{nd} exp:
$a^4 + a^2 + 1$
$= (a^2)^2 + 2.a^2.1 + 1^2 - a^2 = (a^2 + 1)^2 - (a)^2$
$= (a^2 + 1 + a)(a^2 + 1 - a)$
$= (a^2 + a + 1)(a^2 - a + 1)$

Thus, HCF $= (a^2 + a + 1)$.

MODEL 2

9. म.स. निकाल्नुहोस् (Find the HCF of) : $8x^3 + 4x^2 + 2x$, $16x^4 + 4x^2 + 1$ and $8x^3 - 1$ [2072 E]

⇨ Here,

first Exp:
$8x^3 + 4x^2 + 2x$
$= 2x(4x^2 + 2x + 1)$

Second Exp:
$16x^4 + 4x^2 + 1$
$= (4x^2)^2 + 2.4x^2.1 + 1 - 4x^2$
$= (4x^2 + 1)^2 - (2x)^2$
$= (4x^2 + 2x + 1)(4x^2 - 2x + 1)$

Third Exp:
$8x^3 - 1$
$= (2x)^3 - 1^3$
$= (2x - 1)\{(2x)^2 + 2x.1 + 1\}$
$= (2x - 1)(4x^2 + 2x + 1)$

Thus, the HCF is $(4x^2 + 2x + 1)$.

10. म.स. निकाल्नुहोस् (Find the HCF of) : $m^3 - 8n^3$, $2m^2 - 5mn + 2n^2$, $2m^2 - 8n^2$ [2072 C]

⇨ Here,

first Exp:
$m^3 - 8n^3$
$= m^3 - (2n)^3$
$= (m - 2n)\{m^2 + m.2n + (2n)^2\}$
$= (m - 2n)(m^2 + 2mn + 4n^2)$

Second Exp:
$2m^2 - 5mn + 2n^2$
$= 2m^2 - 4mn - mn + 2n^2$
$= 2m(m - 2n) - n(m - 2n)$
$= (m - 2n)(2m - n)$

Third Exp:
$2m^2 - 8n^2$
$= 2(m^2 - 4n^2)$
$= 2\{m^2 - (2n)^2\}$
$= 2(m + 2n)(m - 2n)$

Thus, the HCF is $(m - 2n)$.

11. म.स. निकाल्नुहोस् (Find the HCF of): $5x^2 - 125$, $x^2 - 10x + 25$ and $2x^2 - 10x$ [2072 W]

⇨ Here,

first Exp:
$5x^2 - 125$
$= 5(x^2 - 25) = 5(x^2 - 5^2)$
$= 5(x + 5)(x - 5)$

Second Exp:
$x^2 - 10x + 25$
$= x^2 - 2.x.5 + 5^2$
$= (x - 5)^2 = (x - 5)(x - 5)$

Third Exp:
$2x^2 - 10x$
$= 2x(x - 5)$

Thus, the HCF is $(x - 5)$.

12. म.स. निकाल्नुहोस् (Find the HCF of): $x^2 + 2xy + y^2$, $x^2 - y^2$ and $x^3 + y^3$ [2072 MW]

⇨ Here,

first Exp:
$x^2 + 2xy + y^2$
$= (x + y)^2$
$= (x + y)(x + y)$

Second Exp:
$x^2 - y^2$
$= (x + y)(x - y)$

Third Exp:
$x^3 + y^3$
$= (x + y)(x^2 - xy + y^2)$

Thus, the HCF is $(x + y)$.

13. म.स. निकाल्नुहोस् (Find the HCF of): $(m + n)^2 - 4mn$, $m^3 - n^3$ and $m^2 + mn - 2n^2$ [2072 FW]

⇨ Here,

first Exp:
$(m + n)^2 - 4mn$
$= m^2 + 2mn + n^2 - 4mn$
$= m^2 - 2mn + n^2$
$= (m - n)^2$
$= (m - n)(m - n)$

Second Exp:
$m^3 - n^3$
$= (m - n)(m^2 + mn + n^2)$

Third Exp:
$m^2 + mn - 2n^2$
$= m^2 + 2mn - mn - 2n^2$
$= m(m + 2n) - n(m + 2n)$
$= (m - n)(m + 2n)$

Thus, the HCF is $(m - n)$.

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14. म.स. निकाल्नुहोस् (Find the HCF): $x^2 + y^2 + 2xy - 1$, $y^2 - x^2 + 2y + 1$ and $x^2 - y^2 + 2x + 1$ [SLC 2068 D]

⇨ Here,

1st exp.	2nd exp.	3rd exp.
$x^2 + y^2 + 2xy - 1$	$y^2 - x^2 + 2y + 1$	$x^2 - y^2 + 2x + 1$
$= x^2 + 2xy + y^2 - 1$	$= y^2 + 2y + 1 - x^2$	$= x^2 + 2x + 1 - y^2$
$= (x + y)^2 - 1^2$	$= (y + 1)^2 - x^2$	$= (x + 1)^2 - (y)^2$
$= (x + y + 1)(x + y - 1)$	$= (y + 1 + x)(y + 1 - x)$	$= (x + 1 + y)(x + 1 - y)$
	$= (x + y + 1)(y - x + 1)$	$= (x + y + 1)(x - y + 1)$

Thus, the HCF is $(x + y + 1)$.

15. म.स. निकाल्नुहोस् (Find the HCF): $9m^2 - 4n^2 - 4nr - r^2$, $r^2 - 4n^2 - 9m^2 - 12mn$ and $9m^2 + 6mr + r^2 - 4n^2$ [SLC 2066 B]

⇨ Here,

1st exp.	2nd exp.	3rd exp.
$9m^2 - 4n^2 - 4nr - r^2$	$r^2 - 4n^2 - 9m^2 - 12\,mn$	$9m^2 + 6mr + r^2 - 4n^2$
$= 9m^2 - (4n^2 + 4nr + r^2)$	$= r^2 - (4n^2 + 12\,mn + 9m^2)$	$= (3m)^2 + 2.3m.r + r^2 - (2n)^2$
$= (3m)^2 - (2n + r)^2$	$= r^2 - (2n + 3m)^2$	$= (3m + r)^2 - (2n)^2$
$= (3m + 2n + r)(3m - 2n - r)$	$= (r + 2n + 3m)(r - 2n - 3m)$	$= (3m + r + 2n)(3m + r - 2n)$

Thus, HCF = $(3m + r + 2n)$.

16. म.स. निकाल्नुहोस् (Find the HCF): $a^2 + 2ab + b^2 - c^2$, $b^2 + 2bc + c^2 - a^2$ and $c^2 + 2ca + a^2 - b^2$ [SLC 2065 A]

⇨ Here, $a^2 + 2ab + b^2 - c^2$, $b^2 + 2bc + c^2 - a^2$ and $c^2 + 2ca + a^2 - b^2$

1st Exp.	2nd Exp.	3rd Exp.
$a^2 + 2ab + b^2 - c^2$	$b^2 + 2bc + c^2 - a^2$	$c^2 + 2ac + a^2 - b^2$
$= (a + b)^2 - c^2$	$= (b + c)^2 - a^2$	$= (c + a)^2 - b^2$
$= (a + b + c)(a + b - c)$	$= (b + c + a)(b + c - a)$	$= (c + a + b)(c + a - b)$

Thus, HCF = $(a + b + c)$.

17. म.स. निकाल्नुहोस् (Find the HCF): $9x^2 - 4y^2 - 8yz - 4z^2$, $4z^2 - 4y^2 - 9x^2 - 12xy$ and $9x^2 + 12xz + 4z^2 - 4y^2$ [2065 B]

⇨ Here,

first Exp.	Second Exp.
$9x^2 - 4y^2 - 8yz - 4z^2$	$4z^2 - 4y^2 - 9x^2 - 12xy$
$= 9x^2 - (4y^2 + 8yz + 4z^2)$	$= 4z^2 - (4y^2 + 9x^2 + 12xy)$
$= (3x)^2 - \{2(y + z)\}^2$	$= (2z)^2 - (2y + 3x)^2$
$= \{3x + 2(y + z)\}\{3x - 2(y + z)\}$	$= (2z + 2y + 3x)(2z - 2y - 3x)$
$= (3x + 2y + 2z)(3x - 2y - 2z)$	$= (3x + 2y + 2z)(2z - 3x - 2y)$

Third Exp. $9x^2 + 12xz + 4z^2 - 4y^2$

$= (3x + 2z)^2 - (2y)^2 = (3x + 2z + 2y)(3x + 2z - 2y) = (3x + 2y + 2z)(3x - 2y + 2z)$

Thus, HCF = $(3x + 2y + 2z)$

18. म.स. निकाल्नुहोस् (Find the HCF): $2x^3 - 16$, $x^2 - 4x + 4$, $x^2 - 3x + 2$ [2058 C2]

⇨ Here,

First Exp.	Second Exp.	Third Exp.
$2x^3 - 16$	$x^2 - 4x + 4$	$x^2 - 3x + 2$
$= 2(x^3 - 8)$	$= (x - 2)^2$	$= x^2 - 2x - x + 2$
$= 2(x^3 - 2^3)$	$= (x - 2)(x - 2)$	$= x(x - 2) - 1(x - 2)$
$= 2(x - 2)(x^2 + 2x + 4)$		$= (x - 2)(x - 1)$

Thus, HCF = $(x - 2)$

19. म.स. निकाल्नुहोस् (Find the HCF): $4x^2 - 9$, $2x^2 + x - 3$ and $8x^3 + 27$ [2067 C]

⇨ Here,

1st exp.	2nd exp.	3rd exp.
$4x^2 - 9$	$2x^2 + x - 3$	$8x^3 + 27$
$= (2x)^2 - 3^2$	$= 2x^2 + 3x - 2x - 3$	$= (2x)^3 + 3^3$
$= (2x + 3)(2x - 3)$	$= x(2x + 3) - 1(2x + 3)$	$= (2x + 3)(4x^2 - 6x + 9)$
	$= (2x + 3)(x - 1)$	

Thus, the HCF = $2x + 3$

20. म.स. निकाल्नुहोस् (Find the HCF): $3x^2 - 8x + 4$, $2x^2 - 5x + 2$, $x^4 - 8x$ [SLC 2065 C]

⇨ Here,

first Exp.	Second Exp.	Third Exp.
$3x^2 - 8x + 4$	$2x^2 - 5x + 2$	$x^4 - 8x$
$= 3x^2 - 6x - 2x + 4$	$= 2x^2 - 4x - x + 2$	$= x(x^3 - 8)$
$= 3x(x - 2) - 2(x - 2)$	$= 2x(x - 2) - 1(x - 2)$	$= x\{(x)^3 - (2)^3\}$
$= (x - 2)(3x - 2)$	$= (x - 2)(2x - 1)$	$= x(x - 2)(x^2 + 2x + 4)$

Thus, the HCF = $x - 2$

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21. म.स. निकाल्नुहोस् (Find the HCF): $5a^3 - 20a$, $a^3 - 3a^2 - 10a$ and $a^3 - a^2 - 2a + 8$ **[SLC 2065 D]**

⇨ Here,

first Exp.
$5a^3 - 20a$
$= 5a(a^2 - 4)$
$= 5a(a + 2)(a - 2)$

2nd Exp.
$a^3 - 3a^2 - 10a$
$= a(a^2 - 3a - 10)$
$= a(a^2 - 5a + 2a - 10)$
$= a\{a(a - 5) + 2(a - 5)\}$
$= a(a - 5)(a + 2)$

3rd Exp.
$a^3 - a^2 - 2a + 8$
$= (a^3 + 8) - a(a + 2)$
$= (a + 2)(a^2 - 2a + 4) - a(a + 2)$
$= (a + 2)(a^2 - 2a + 4 - a)$
$= (a + 2)(a^2 - 3a + 4)$

Thus, the HCF = $(a + 2)$

22. म.स. निकाल्नुहोस् (Find the HCF): $m^3 - m^2 - m + 1$, $2m^4 - 2m$ and $3m^2 + 3m - 6$ **[SLC 2066 C]**

⇨ Here,

1st exp.
$m^3 - m^2 - m + 1$
$= m^2(m - 1) - 1(m - 1)$
$= (m - 1)(m^2 - 1)$
$= (m - 1)(m + 1)(m - 1)$

2nd exp.
$2m^4 - 2m$
$= 2m(m^3 - 1)$
$= 2m(m - 1)(m^2 + m + 1)$

3rd exp.
$3m^2 + 3m - 6$
$= 3(m^2 + m - 2)$
$= 3(m^2 + 2m - m - 2)$
$= 3\{m(m + 2) - 1(m + 2)\}$
$= 3(m + 2)(m - 1)$

Thus, the HCF = $(m - 1)$

23. म.स. निकाल्नुहोस् (Find the HCF): $(a + b)^2 - 4ab$, $a^3 - b^3$ and $a^2 + ab - 2b^2$ **[SLC 2066 A]**

⇨ Here,

1st exp.
$(a + b)^2 - 4ab$
$= (a - b)^2$
$= (a - b)(a - b)$

2nd exp.
$a^3 - b^3$
$= (a - b)(a^2 + ab + b^2)$

3rd exp.
$a^2 + ab - 2b^2$
$= a^2 + 2ab - ab - 2b^2$
$= a(a + 2b) - b(a + 2b)$
$= (a + 2b)(a - b)$

Thus, the HCF = $(a - b)$

24. म.स. निकाल्नुहोस् (Find the HCF): $x^3 - 2x^2 - 3x$, $x^3 - 9x$ and $x^4 - 27x$. **[2061 D1]**

⇨ Here,

First exp:
$x^3 - 2x^2 - 3x$
$= x(x^2 - 2x - 3)$
$= x(x^2 - 3x + x - 3)$
$= x(\{x(x - 3) + 1(x - 3)\}$
$= x(x - 3)(x + 1)$

Second exp:
$x^3 - 9x$
$= x(x^2 - 9)$
$= x(x^2 - 3^2)$
$= x(x + 3)(x - 3)$

Third exp:
$x^4 - 27x$
$= x(x^3 - 27)$
$= x(x^3 - 3^3)$
$= x(x - 3)(x^2 + 3x + 9)$

Thus, HCF = $x(x - 3)$

25. म.स. निकाल्नुहोस् (Find the HCF): $2x^3 - x^2 - x$, $4x^3 - x$ and $8x^4 + x$ **[2061 D2]**

⇨ Here,

first exp:
$2x^3 - x^2 - x$
$= x(2x^2 - x - 1)$
$= x(2x^2 - 2x + x - 1)$
$= x\{2x(x - 1) + 1(x - 1)\}$
$= x(x - 1)(2x + 1)$

Second exp:
$4x^3 - x$
$= x(4x^2 - 1)$
$= x\{(2x)^2 - 1^2\}$
$= x(2x + 1)(2x - 1)$

Third exp:
$8x^4 + x$
$= x(8x^3 + 1)$
$= x\{(2x)^3 + 1^3\}$
$= x(2x + 1)(4x^2 - 2x + 1)$

Thus, HCF = $x(2x + 1)$

26. म.स. निकाल्नुहोस् (Find the HCF): $8m^4 + 27mn^3$, $8m^3n + 2m^2n^2 - 15mn^3$ and $4m^3n - 9mn^3$ **[2066 E, 2066 S]**

⇨ Here,

first exp:
$8m^4 + 27mn^3$
$= m(8m^3 + 27n^3)$
$= m\{(2m)^3 + (3n)^3\}$
$= m(2m + 3n)(4m^2 - 6mn + 9n^2)$

2nd exp:
$8m^3n + 2m^2n^2 - 15mn^3$
$= mn(8m^2 + 2mn - 15n^2)$
$= mn(8m^2 + 12mn - 10mn - 15n^2)$
$= mn\{4m(2m + 3n) - 5n(2m + 3n)\}$
$= mn(2m + 3n)(4m - 5n)$

3rd exp: $4m^3n - 9mn^3$
$= mn(4m^2 - 9n^2) = mn\{(2m)^2 - (3n)^2\}$
$= mn(2m + 3n)(2m - 3n)$

Thus, HCF = $m(2m + 3n)$

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27. म.स. निकाल्नुहोस् (Find the HCF): $4x^4 + 16x^3 - 20x^2$, $3x^3 + 14x^2 - 5x$ and $x^4 + 125x$ [SLC 2067 E]

⇨ Here,

First Exp.
$4x^4 + 16x^3 - 20x^2$
$= 4x^2 (x^2 + 4x - 5)$
$= 4x^2 (x^2 + 5x - x - 5)$
$= 4x^2 \{x(x + 5) - 1(x + 5)\}$
$= 4x^2 (x + 5) (x - 1)$

Second Exp.
$3x^3 + 14x^2 - 5x$
$= x (3x^2 + 14x - 5)$
$= x (3x^2 + 15x - x - 5)$
$= x\{3x(x + 5) - 1(x + 5)\}$
$= x (x + 5) (3x - 1)$

Third exp.
$x^4 + 125x$
$= x (x^3 + 125)$
$= x (x^3 + 5^3)$
$= x (x + 5) (x^2 - 5x + 25)$

Thus, HCF = $x(x + 5)$

28. म.स. निकाल्नुहोस् (Find the HCF): $8x^3 + 27y^3$, $16x^4 + 36x^2y^2 + 81y^4$ and $4x^3 - 6x^2y + 9xy^2$ [SLC 2065 E]

⇨ Here,

first Exp.
$8x^3 + 27y^3$
$= (2x)^3 + (3y)^3$
$= (2x + 3y) (4x^2 - 6xy + 9y^2)$

Second Exp.
$16x^4 + 36x^2y^2 + 81y^4$
$= (4x^2)^2 + (9y^2)^2 + 36x^2y^2$
$= (4x^2 + 9y^2)^2 - 72x^2y^2 + 36x^2y^2$
$= (4x^2 + 9y^2)^2 - (6xy)^2$
$= (4x^2 + 9y^2 + 6xy) (4x^2 + 9y^2 - 6xy)$
$= (4x^2 + 6xy + 9y^2) (4x^2 - 6xy + 9y^2)$

Third Exp. $4x^3 - 6x^2y + 9xy^2 = x(4x^2 - 6xy + 9y^2)$

Thus, HCF = $4x^2 - 6xy + 9y^2$

29. म.स. निकाल्नुहोस् (Find the HCF): $x^3y + y^4$, $x^4 + x^2y^2 + y^4$, $2ax^3 - 2ax^2y + 2axy^2$ [SLC 2065 S]

⇨ Here,

first exp.
$x^3y + y^4$
$= y(x^3 + y^3)$
$= y(x + y) (x^2 - xy + y^2)$

Second exp.
$x^4 + x^2y^2 + y^4$
$= (x^2)^2 + 2x^2y^2 + (y^2)^2 - x^2y^2$
$= (x^2 + y^2)^2 - (xy)^2$
$= (x^2 + y^2 + xy) (x^2 + y^2 - xy)$
$= (x^2 + xy + y^2) (x^2 - xy + y^2)$

Third exp.
$2ax^3 - 2ax^2y + 2axy^2$
$= 2ax(x^2 - xy + y^2)$

Thus, HCF = Common factors = $x^2 - xy + y^2$

30. म.स. निकाल्नुहोस् (Find the HCF): $z^4 + z$, $z^5 + z^3 + z$ and $z^3 - z^2 + z$ [SLC 2068 E]

⇨ Here,

First exp.
$z^4 + z$
$= z(z^3 + 1)$
$= z(z + 1) (z^2 - z + 1)$

Second exp.
$z^5 + z^3 + z$
$= z(z^4 + z^2 + 1)$
$= z(z^4 + 2z^2 + 1 - z^2)$
$= z\{(z^2 + 1)^2 - z^2\}$
$= z(z^2 + 1 + z) (z^2 + 1 - z)$
$= z(z^2 + z + 1) (z^2 - z + 1)$

Third exp.
$z^3 - z^2 + z$
$= z(z^2 - z + 1)$

Thus, the HCF = $z(z^2 - z + 1)$.

31. म.स. निकाल्नुहोस् (Find the HCF): $m^3 - n^3$, $m^4 + m^2n^2 + n^4$ and $m^3 + m^2n + mn^2$ [SLC 2068 A]

⇨ Here,

first exp.
$m^3 - n^3$
$= (m - n) (m^2 + mn + n^2)$

Second exp.
$m^4 + m^2n^2 + n^4$
$= (m^2)^2 + 2m^2n^2 + (n^2)^2 - m^2n^2$
$= (m^2 + n^2)^2 - (mn)^2$
$= (m^2 + n^2 + mn) (m^2 + n^2 - mn)$
$= (m^2 + mn + n^2) (m^2 - mn + n^2)$

Third exp.
$m^3 + m^2n + mn^2$
$= m(m^2 + mn + n^2)$

Thus, HCF = $m^2 + mn + n^2$.

32. म.स. निकाल्नुहोस् (Find the HCF): $y^3 - 1$, $y^4 + y^2 + 1$ and $y^3 + 1 + 2y^2 + 2y$ [SLC 2068 B]

⇨ Here,

First exp:
$y^3 - 1$
$= (y - 1) (y^2 + y + 1)$

Second exp:
$y^4 + y^2 + 1$
$= (y^2)^2 + 2.y^2.1 + 1^2 - y^2$
$= (y^2 + 1)^2 - y^2$
$= (y^2 + 1 + y) (y^2 + 1 - y)$
$= (y^2 + y + 1) (y^2 - y + 1)$

Third exp:
$y^3 + 1 + 2y^2 + 2y$
$= (y + 1) (y^2 - y + 1) + 2y(y + 1)$
$= (y + 1) (y^2 - y + 1 + 2y)$
$= (y + 1) (y^2 + y + 1)$

$\therefore$ HCF = $y^2 + y + 1$

Thus, the HCF is $y^2 + y + 1$.

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Model 3

33. ल.स. पत्ता लगाउनुहोस् (Find the LCM of) : $(1 - x^2)(1 - y^2) + 4xy$, $1 - 2x + y - x^2y + x^2$ [2071 E]

⇨ Here, First Exp. $= (1 - x^2)(1 - y^2) + 4xy$

$= 1(1 - y^2) - x^2(1 - y^2) + 4xy = 1 - y^2 - x^2 + x^2y^2 + 4xy$

$= 1 + 2xy + x^2y^2 - x^2 + 2xy - y^2 = (1 + xy)^2 - (x^2 - 2xy + y^2)$

$= (1 + xy)^2 - (x - y)^2 = (1 + xy + x - y)(1 + xy - x + y)$

Second Exp. $= 1 - 2x + y - x^2y + x^2 = 1 - 2x + x^2 + y - x^2y$

$= (1 - x)^2 + y(1 - x^2) = (1 - x)^2 + y(1 + x)(1 - x) = (1 - x)(1 - x + y + xy)$

Thus, LCM $= (1 - x + y + xy)(1 + xy + x - y)(1 - x))$

34. ल.स. निकाल्नुहोस् (Find the LCM of): $x^4 + x^2y^2 + y^4$ and $x^3 - y^3$ [2061 E1]

⇨ Here,

first exp:

$x^4 + x^2y^2 + y^4$

$= (x^2)^2 + (y^2)^2 + x^2y^2 = (x^2 + y^2)^2 - 2x^2y^2 + x^2y^2$

$= (x^2 + y^2)^2 - x^2y^2 = (x^2 + y^2)^2 - (xy)^2$

$= (x^2 + y^2 + xy)(x^2 + y^2 - xy)$

$= (x^2 + xy + y^2)(x^2 - xy + y^2)$

Second exp:

$x^3 - y^3$

$= (x - y)(x^2 + xy + y^2)$

Thus, LCM $= (x - y)(x^2 + xy + y^2)(x^2 - xy + y^2) = (x - y)(x^4 + x^2y^2 + y^4)$

35. ल.स. निकाल्नुहोस् (Find the LCM of): $a^4 + a^2b^2 + b^4$ and $a^3 + b^3$ [2061 E2]

⇨ Here,

first exp:

$a^4 + a^2b^2 + b^4$

$= (a^2)^2 + (b^2)^2 + a^2b^2$

$= (a^2 + b^2)^2 - 2a^2b^2 + a^2b^2$

$= (a^2 + b^2)^2 - a^2b^2 = (a^2 + b^2)^2 - (ab)^2$

$= (a^2 + b^2 + ab)(a^2 + b^2 - ab)$

$= (a^2 + ab + b^2)(a^2 - ab + b^2)$

Second exp:

$a^3 + b^3$

$= (a + b)(a^2 - ab + b^2)$

Thus, LCM $= (a + b)(a^2 - ab + b^2)(a^2 + ab + b^2) = (a + b)(a^4 + a^2b^2 + b^4)$

36. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $6x^2 - x - 1$ and $54x^4 + 2x$. [2062 B1]

⇨ Here,

1st exp:

$6x^2 - x - 1$

$= 6x^2 - 3x + 2x - 1$

$= 3x(2x - 1) + 1(2x - 1)$

$= (3x + 1)(2x - 1)$

2nd exp:

$54x^4 + 2x$

$= 2x(27x^3 + 1)$

$= 2x\{(3x)^3 + (1)^3\}$

$= 2x[(3x + 1)\{(3x)^2 - 3x + 1\}]$

$= 2x(3x + 1)(9x^2 - 3x + 1)$

Thus, LCM $= 2x(3x + 1)(2x - 1)(9x^2 - 3x + 1)$

37. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $2x^2 - x - 1$ and $24x^4 + 3x$ [2062 B2]

⇨ Here,

1st exp.

$2x^2 - x - 1$

$= 2x^2 - 2x + x - 1$

$= 2x(x - 1) + 1(x - 1)$

$= (2x + 1)(x - 1)$

2nd exp.

$24x^4 + 3x$

$= 3x(8x^3 + 1)$

$= 3x\{(2x)^3 + (1)^3\}$

$= 3x(2x + 1)(4x^2 - 2x + 1)$

Thus, LCM $= 3x(2x + 1)(x - 1)(4x^2 - 2x + 1)$

38. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $x^3 - 3x^2 - x + 3$ and $x^3 - x^2 - 9x + 9$ [2062 C1]

⇨ Here,

1st exp.

$x^3 - 3x^2 - x + 3$

$= x^2(x - 3) - 1(x - 3)$

$= (x^2 - 1)(x - 3)$

$= (x - 1)(x + 1)(x - 3)$

2nd exp.

$x^3 - x^2 - 9x + 9$

$= x^2(x - 1) - 9(x - 1)$

$= (x^2 - 9)(x - 1)$

$= (x - 3)(x + 3)(x - 1)$

Thus, LCM $= (x - 1)(x - 3)(x + 3)(x + 1) = (x^2 - 1)(x^2 - 9)$

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39. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $x^3 + 2x^2 - x - 2$ and $x^3 + x^2 - 4x - 4$ [2062 C2]

⇨ Here,

1st exp.	2nd exp.
$x^3 + 2x^2 - x - 2$	$x^3 + x^2 - 4x - 4$
$= x^2(x + 2) - 1(x + 2)$	$= x^2(x + 1) - 4(x + 1)$
$= (x^2 - 1)(x + 2)$	$= (x^2 - 4)(x + 1)$
$= (x - 1)(x + 1)(x + 2)$	$= (x - 2)(x + 2)(x + 1)$

Thus, LCM $= (x + 1)(x - 1)(x + 2)(x - 2) = (x^2 - 1)(x^2 - 4)$

Model 4

40. ल.स.पत्ता लगाउनुहोस् (Find the LCM of): $x^2 - 4y^2$, $x^2 + xy - 2y^2$ and $(x - 2y)^2 + 8xy$ [2072 S]

⇨ Here,

first Exp:	Second Exp:	Third Exp:
$x^2 - 4y^2$	$x^2 + xy - 2y^2$	$(x - 2y)^2 + 8xy$
$= x^2 - (2y)^2$	$= x^2 + 2xy - xy - 2y^2$	$= (x - 2y)^2 + 4.x.2y$
$= (x + 2y)(x - 2y)$	$= x(x + 2y) - y(x + 2y)$	$= (x + 2y)^2$
	$= (x - y)(x + 2y)$	$= (x + 2y)(x + 2y)$

Thus, the LCM is $(x + 2y)(x - 2y)(x - y)(x + 2y)$

41. ल.स. निकाल्नुहोस् (Find the LCM of): $x^2 + 2xy + y^2 - z^2$, $y^2 + 2yz + z^2 - x^2$ and $z^2 + 2xz + x^2 - y^2$ [Model 2065]

⇨ Here,

1st Exp.	2nd Exp.	3rd Exp.
$x^2 + 2xy + y^2 - z^2$	$y^2 + 2yz + z^2 - x^2$	$z^2 + 2xz + x^2 - y^2$
$= (x + y)^2 - z^2$	$= (y + z)^2 - x^2$	$= (z + x)^2 - y^2$
$= (x + y + z)(x + y - z)$	$= (y + z + x)(y + z - x)$	$= (z + x + y)(z + x - y)$

Thus, LCM $= (x + y + z)(x + y - z)(y + z - x)(z + x - y)$

42. ल.स. पत्ता लगाउनुहोस् (Find the LCM of): $x^3 - 9x$, $x^4 - 2x^3 - 3x^2$ and $x^3 - 27$. [2062 D1, 2062 D2]

⇨ Here,

1st exp.	2nd exp.	3rd exp.
$x^3 - 9x$	$x^4 - 2x^3 - 3x^2$	$x^3 - 27$
$= x(x^2 - 9)$	$= x^2(x^2 - 2x - 3)$	$= (x)^3 - (3)^3$
$= x\{x^2 - (3)^2\}$	$= x^2(x^2 + x - 3x - 3)$	$= (x - 3)(x^2 + 3x + 9)$
$= x(x - 3)(x + 3)$	$= x.x\{x(x + 1) - 3(x + 1)\}$	
	$= x.x(x - 3)(x + 1)$	

Thus, the required LCM $= x \times x(x - 3)(x + 3)(x + 1)(x^2 + 3x + 9)$

$= x^2(x^2 - 9)(x + 1)(x^2 + 3x + 9)$

43. ल.स. निकाल्नुहोस् (Find the LCM of): $a^4 + a^2 + 1$, $a^3 - 1$ and $a^3 - a^2 + a$ [2067 A]

⇨ Here,

first exp.	Second exp.	Third exp.
$a^4 + a^2 + 1$	$a^3 - 1$	$= a^3 - a^2 + a$
$= (a^2)^2 + 2.a^2.1 + 1^2 - a^2$	$= a^3 - 1^3$	$= a(a^2 - a + 1)$
$= (a^2 + 1)^2 - a^2$	$= (a - 1)(a^2 + a + 1)$	
$= (a^2 + 1 + a)(a^2 + 1 - a)$		
$= (a^2 + a + 1)(a^2 - a + 1)$		

Thus, LCM $= a(a^2 - a + 1)(a^2 + a + 1)(a - 1)$

$= a(a - 1)(a^2 + a + 1)(a^2 - a + 1) = a(a^3 - 1)(a^2 - a + 1)$

or, $a(a - 1)(a^4 + a^2 + 1)$

Model 5

44. म.स. र ल.स. निकाल्नुहोस्: (Find the HCF and LCM of): $x^4 + (2b^2 - a^2)x^2 + b^4$ and $x^4 + 2ax^3 + a^2x^2 - b^4$ [2067 S]

⇨ Here,

first exp.	Second exp.
$x^4 + (2b^2 - a^2)x^2 + b^4$	$x^4 + 2ax^3 + a^2x^2 - b^4$
$= x^4 + b^4 + (2b^2 - a^2)x^2$	$= x^2(x^2 + 2ax + a^2) - b^4$
$= (x^2)^2 + (b^2)^2 + (2b^2 - a^2)x^2$	$= x^2(x + a)^2 - b^4$
$= (x^2 + b^2)^2 - 2x^2b^2 + 2b^2x^2 - a^2x^2$	$= \{x(x + a)\}^2 - b^4$
$= (x^2 + b^2)^2 - a^2x^2$	$= (x^2 + ax)^2 - (b^2)^2$
$= (x^2 + b^2 + ax)(x^2 + b^2 - ax)$	$= (x^2 + ax + b^2)(x^2 + ax - b^2)$
$= (x^2 + ax + b^2)(x^2 - ax + b^2)$	

Thus, HCF $= x^2 + ax + b^2$ and LCM $= (x^2 + ax + b^2)(x^2 + ax - b^2)(x^2 - ax + b^2)$

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8.1 महत्तम समापवर्तक (HIGHEST COMMON FACTOR)

B. QUESTIONS FROM CDC TEXT BOOK

1. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : 3x + 9 and 5x + 15

⇨ Here, first exp: $3x + 9 = 3(x + 3)$ Second exp: $5x + 15 = 5(x + 3)$
Thus, the HCF is $(x + 3)$.

2. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : 4x + 16 and 5x + 20

⇨ Here, first exp: $4x + 16 = 4(x + 4)$ Second exp: $5x + 20 = 5(x + 4)$
Thus, the HCF is $(x + 4)$.

3. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : 5x + 30 and 3x + 18

⇨ Here, first exp: $5x + 30 = 5(x + 6)$ Second exp: $3x + 18 = 3(x + 6)$
Thus, the HCF is $(x + 6)$.

4. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : 6x + 18 and 4x + 12

⇨ Here, first exp: $6x + 18 = 6(x + 3)$ Second exp: $4x + 12 = 4(x + 3)$
Thus, the HCF is $2(x + 3)$.

5. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : 7x + 28 and 9x + 36

⇨ Here, first exp: $7x + 28 = 7(x + 4)$ Second exp: $9x + 36 = 9(x + 4)$
Thus, the HCF is $(x + 4)$.

6. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $3x^2 + 6x + 3$ and $4x^2 + 8x + 4$

⇨ Here, first exp: $3x^2 + 6x + 3 = 3(x^2 + 2x + 1) = 3(x + 1)^2$
Second exp: $4x^2 + 8x + 4 = 4(x^2 + 2x + 1) = 4(x + 1)^2$
Thus, the HCF is $(x + 1)^2$.

7. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $y^3 + 6y^2 + 9y$ and $2y^3 + 12y^2 + 18y$

⇨ Here,
first exp: $y^3 + 6y^2 + 9y$
$= y(y^2 + 6y + 9)$
$= y(y^2 + 2.y.3 + 3^2)$
$= y(y + 3)^2$
Second exp: $2y^3 + 12y^2 + 18y$
$= 2y(y^2 + 6y + 9)$
$= 2y(y^2 + 2.y.3 + 3^2)$
$= 2y(y + 3)^2$
Thus, the HCF is $y(y + 3)^2$.

8. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3y + 2x^2y^2 + xy^3$ and $2x^3 + 4x^2y + 2xy^2$

⇨ Here,
first exp: $x^3y + 2x^2y^2 + xy^3$
$= xy(x^2 + 2xy + y^2)$
$= xy(x + y)^2$
Second exp: $2x^3 + 4x^2 + 2xy^2$
$= 2x(x^2 + 2xy + y^2)$
$= 2x(x + y)^2$
Thus, the HCF is $x(x + y)^2$.

9. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + 2x^2 + x$ and $x^2y + 2xy + y$

⇨ Here,
first exp: $x^3 + 2x^2 + x$
$= x(x^2 + 2x + 1)$
$= x(x + 1)^2$
Second exp: $x^2y + 2xy + y$
$= y(x^2 + 2x + 1)$
$= y(x + 1)^2$
Thus, the HCF is $(x + 1)^2$.

10. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $5x^2 + 10x + 5$ and $7x^3 + 14x^2 + 7x$

⇨ Here,
first exp: $5x^2 + 10x + 5$
$= 5(x^2 + 2x + 1)$
$= 5(x + 1)^2$
Second exp: $7x^3 + 14x^2 + 7x$
$= 7x(x^2 + 2x + 1)$
$= 7x(x + 1)^2$
Thus, HCF is $(x + 1)^2$.

11. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 - xy^2$ and $x^2y - 2xy^2 + y^3$

⇨ Here,
first exp: $x^3 - xy^2$
$= x(x^2 - y^2)$
$= x(x + y)(x - y)$
Second exp: $x^2y - 2xy^2 + y^3$
$= y(x^2 - 2xy + y^2)$
$= y(x - y)^2$
Thus, the HCF is $(x - y)$.

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12. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $7x^3 + 14x^2y + 7xy^2$ and $3x^2 - 3y^2$

⇨ Here,

first exp: $7x^3 + 14x^2y + 7xy^2$
$= 7x(x^2 + 2xy + y^2)$
$= 7x(x + y)^2$

Second exp: $3x^2 - 3y^2$
$= 3(x^2 - y^2)$
$= 3(x + y)(x - y)$

Thus, the HCF is $(x + y)$.

13. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $11x^2 - 44xy + 44y^2$ and $3x^2y - 12y^3$

⇨ Here,

first exp: $11x^2 - 44xy + 44y^2$
$= 11(x^2 - 4xy + 4y^2)$
$= 11(x - 2y)^2$

Second exp: $3x^2y - 12y^3$
$= 3y(x^2 - 4y^2)$
$= 3y(x + 2y)(x - 2y)$

Thus, the HCF is $(x - 2y)$.

14. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 - xy$ and $x^2 - y^2$

⇨ Here,

first exp: $x^2 - xy = x(x - y)$

Second exp: $x^2 - y^2 = (x + y)(x - y)$

Thus, the HCF is $(x - y)$.

15. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x(x^2 + 2x + 1)$ and $x^3y - xy^3$

⇨ Here,

first exp: $x(x^2 + 2x + 1)$
$= x(x + 1)^2$

Second exp: $x^3y - xy^3$
$= xy(x^2 - y^2)$
$= xy(x + y)(x - y)$

Thus, the HCF is x.

16. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $a^2 - b^2 - 2bc - c^2$ and $a^3 - 3ab(a - b) - b^3 - c^3$

⇨ Here,

first exp:
$a^2 - b^2 - 2bc - c^2$
$= a^2 - (b^2 + 2bc + c^2)$
$= a^2 - (b + c)^2$
$= (a + b + c)(a - b - c)$

Second exp:
$a^3 - 3ab(a - b) - b^3 - c^3$
$= (a - b)^3 - c^3$
$= (a - b - c)[(a - b)^2 + (a - b)c + c^2]$
$= (a - b - c)(a^2 - 2ba + b^2 + ac - bc - c^2)$

Thus, the HCF is $(a - b - c)$.

17. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $a^2 - 2ac + c^2 - b^2$ and $b^2 - 2bc + c^2 - a^2$

⇨ Here,

first exp: $a^2 - 2ac + c^2 - b^2$
$= (a - c)^2 - b^2$
$= (a - c + b)(a - c - b)$

Second exp: $b^2 - 2bc + c^2 - a^2$
$= (b - c)^2 - a^2$
$= (b - c + a)(b - c - a)$

Thus, the HCF is $(a + b - c)$.

18. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 - y^2 - 2yz - z^2$ and $y^2 - z^2 - 2zx - x^2$

⇨ Here,

first exp: $x^2 - y^2 - 2yz - z^2$
$= x^2 - (y^2 + 2yz + z^2)$
$= x^2 - (y + z)^2$
$= (x + y + z)(x - y - z)$

Second exp: $y^2 - z^2 - 2zx - x^2$
$= y^2 - (z^2 + 2zx + x^2)$
$= y^2 - (z + x)^2$
$= (y + z + x)(y - z - x)$
$= (x + y + z)(y - z - x)$

Thus, the HCF is $(x + y + z)$.

19. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 - y^2 + 2yz - z^2$ and $y^2 - z^2 + 2zx - x^2$

⇨ Here,

first exp: $x^2 - y^2 + 2yz - z^2$
$= x^2 - (y^2 - 2yz + z^2)$
$= x^2 - (y - z)^2$
$= (x + y - z)(x - y + z)$

Second exp: $y^2 - z^2 + 2zx - x^2$
$= y^2 - (z^2 - 2zx + x^2)$
$= y^2 - (z - x)^2$
$= (y + z - x)(y - z + x)$
$= (y + z - x)(x + y - z)$

Thus, the HCF is $(x + y - z)$.

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20. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 - y^2 + 2y - 1$ and $x^3 - 3xy(x - y) - y^3 + 1$

⇨ Here,

first exp:

$x^2 - y^2 + 2y - 1$
$= x^2 - (y^2 - 2y + 1)$
$= x^2 - (y - 1)^2$
$= (x + y - 1)(x - y + 1)$

Second exp:

$x^3 - 3xy(x - y) - y^3 + 1$
$= (x - y)^3 + 1$
$= (x - y + 1)\{(x - y)^2 - (x - y)1 + 1^2\}$
$= (x - y + 1)(x^2 - 2xy + y^2 - x + y + 1)$
$= (x - y + 1)(x^2 - 2xy + y^2 - x + y + 1)$

Thus, the HCF is $(x - y + 1)$.

21. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 + (b - a)x - ab$ and $x^2 - (a - b)x - ab$

⇨ Here,

first exp: $x^2 + (b - a)x - ab$
$= x^2 + bx - ax - ab$
$= x(x + b) - a(x + b)$
$= (x + b)(x - a)$

Second exp: $x^2 - (a - b)x - ab$
$= x^2 - ax + bx - ab$
$= x(x - a) + b(x - a)$
$= (x - a)(x + b)$

Thus, the HCF is $(x - a)(x + b)$.

22. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^2 + (a - b)x - ab$ and $b^2 - 2bx + x^2$

⇨ Here,

first exp: $x^2 + (a - b)x - ab$
$= x^2 + ax - bx - ab$
$= x(x + a) - b(x + a)$
$= (x - b)(x + a)$

Second exp: $b^2 - 2bx + x^2$
$= (b - x)^2$
$= (x - b)^2$

Thus, the HCF is $(x - b)$.

23. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + x^2 + x + 1$ and $x^3 - x^2 - x + 1$

⇨ Here,

first exp: $x^3 + x^2 + x + 1$
$= x^2(x + 1) + 1(x + 1)$
$= (x + 1)(x^2 + 1)$

Second exp: $x^3 - x^2 - x + 1$
$= x^2(x - 1) - 1(x - 1)$
$= (x - 1)(x^2 - 1)$
$= (x - 1)(x + 1)(x - 1)$

Thus, the HCF is $(x + 1)$.

24. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + x^2 + x + 1$ and $x^3 - x^2 + x - 1$

⇨ Here,

first exp: $x^3 + x^2 + x + 1$
$= x^2(x + 1) + 1(x + 1)$
$= (x + 1)(x^2 + 1)$

Second exp: $x^3 - x^2 + x - 1$
$= x^2(x - 1) + 1(x - 1)$
$= (x - 1)(x^2 + 1)$

Thus, the HCF is $(x^2 + 1)$.

25. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + x^2 - x - 1$ and $x^3 + x^2y + xy^2$

⇨ Here,

first exp: $x^3 + x^2 - x - 1$
$= x^2(x + 1) - 1(x + 1)$
$= (x + 1)(x^2 - 1)$
$= (x + 1)(x + 1)(x - 1)$

Second exp:
$x^3 + x^2y + xy^2$
$= x(x^2 + xy + y^2)$

Thus, the HCF is 1.

26. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^4 + x^2 + 1$, $x^3 + 1$ and $x^3 - x^2 + x$

⇨ Here,

first exp:
$x^4 + x^2 + 1$
$= (x^2)^2 + 2.x^2.1 + 1^2 - x^2$
$= (x^2 + 1)^2 - x^2$
$= (x^2 + 1 + x)(x^2 + 1 - x)$
$= (x^2 + x + 1)(x^2 - x + 1)$

Second exp:
$x^3 + 1$
$= (x + 1)(x^2 - x + 1)$

Third exp:
$x^3 - x^2 + x$
$= x(x^2 - x + 1)$

Thus, the HCF is $(x^2 - x + 1)$.

27. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $a^4 + a^2b^2 + b^4$, $a^3 + b^3$ and $a^3 - a^2b + ab^2$

⇨ Here,

first exp:
$a^4 + a^2b^2 + b^4$
$= (a^2)^2 + 2.a^2.b^2 + (b^2)^2 - a^2b^2$
$= (a^2 + b^2 + ab)(a^2 + b^2 - ab)$
$= (a^2 + ab + b^2)(a^2 - ab + b^2)$

Second exp:
$a^3 + b^3$
$= (a + b)(a^2 - ab + b^2)$

Third exp:
$a^3 - a^2b + ab^2$
$= a(a^2 - ab + b^2)$

Thus, the HCF is $(a^2 - ab + b^2)$.

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28. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^4 - 3x^2 + 1$, $x^3 - x^2 - x$ and $x^3 - 2x^2 + x$

⇨ Here,

first exp:
$x^4 - 3x^2 + 1$
$= (x^2)^2 - 2.x^2.1 + 1^2 - x^2$
$= (x^2 - 1)^2 - x^2$
$= (x^2 - 1 + x)(x^2 - 1 - x)$
$= (x^2 + x - 1)(x^2 - x - 1)$

Second exp:
$x^3 - x^2 - x$
$= x(x^2 - x - 1)$

Third exp:
$x^3 - 2x^2 + x$
$= x(x^2 - 2x + 1)$
$= x(x - 1)^2$

Thus, the HCF is 1.

29. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + 2x^2 + 2x + 1$, $x^3 - 1$ and $x^4 + x^2 + 1$

⇨ Here,

first exp:
$x^3 + 2x^2 + 2x + 1$
$= x^3 + 1 + 2x(x + 1)$
$= (x + 1)(x^2 - x + 1) + 2x(x + 1)$
$= (x + 1)(x^2 - x + 1 + 2x)$
$= (x + 1)(x^2 + x + 1)$

Second exp:
$x^3 - 1$
$= (x - 1)(x^2 + x + 1)$

Third exp:
$x^4 + x^2 + 1$
$= (x^2)^2 + 2.x^2.1 + 1^2 - x^2$
$= (x^2 + 1)^2 - x^2$
$= (x^2 + 1 + x)(x^2 + 1 - x)$
$= (x^2 + x + 1)(x^2 - x + 1)$

Thus, the HCF is $(x^2 + x + 1)$.

30. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^4 + x^3y + x^2y^2$, $x^4 + x^2y^2 + y^4$ and $x^3 - y^3$

⇨ Here,

first exp:
$x^4 + x^3y + x^2y^2$
$= x^4 + x^2y^2 + x^3y$
$= x^2(x^2 + y^2 + xy)$

Second exp:
$x^4 + x^2y^2 + y^4$
$= (x^2)^2 + 2 . x^2 . y^2 + (y^2)^2 - x^2y^2$
$= (x^2 + y^2)^2 - (xy)^2$
$= (x^2 + y^2 + xy)(x^2 + y^2 - xy)$

Third exp:
$x^3 - y^3$
$= (x - y)(x^2 + xy + y^2)$

Thus, the HCF is $(x^2 + xy + y^2)$.

31. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + 2x^2 + 4x$, $x^4 + 4x^2 + 16$ and $x^3 - 8$

⇨ Here,

first exp:
$x^3 + 2x^2 + 4x$
$= x(x^2 + 2x + 4)$

Second exp:
$x^4 + 4x^2 + 16$
$= (x^2)^2 + 2.x^2.4 + (4)^2 - 4x^2$
$= (x^2 + 4)^2 - (2x)^2$
$= (x^2 + 4 + 2x)(x^2 - 2x + 4)$
$= (x^2 + 2x + 4)(x^2 - 2x + 4)$

Third exp:
$x^3 - 8 = x^3 - 2^3$
$= (x - 2)(x^2 + 2x + 4)$

Thus, the HCF is $x^2 + 2x + 4$.

32. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $27x^3 + 125y^3$, $9x^3 - 15x^2y + 25xy^2$

⇨ Here,

first exp: $27x^3 + 125y^3$
$= (3x)^3 + (5y)^3$
$= (3x + 5y)(9x^2 - 15xy + 25y^2)$

Second exp: $9x^3 - 15x^2y + 25xy^2$
$= x(9x^2 - 15xy + 25y^2)$

Thus, the HCF is $(9x^2 - 15xy + 15y^2)$

33. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $16x^4 + 100x^2y^2 + 625y^4$, $4x^3 - 10x^2y + 25xy^2$ and $8x^3 + 125y^3$

⇨ Here,

first exp:
$16x^4 + 100x^2y^2 + 625y^4$
$= (4x^2)^2 + 2.4x^2.25y^2 + (25y^2)^2 - 100x^2y^2$
$= (4x^2 + 25y^2)^2 - (10xy)^2$
$= (4x^2 + 25y^2 + 10xy)(4x^2 + 25y^2 - 10xy)$
$= (4x^2 + 10xy + 25y^2)(4x^2 - 10xy + 25y^2)$

Second exp:
$4x^3 - 10x^2y + 25xy^2$
$= x(4x^2 - 10xy + 25y^2)$

Third exp:
$8x^3 + 125y^3 = (2x)^3 + (5y)^3$
$= (2x + 5y)\{(2x)^2 - 2x.5y + (5y)^2\}$
$= (2x + 5y)(4x^2 - 10xy + 25y^2)$

Thus, the HCF is $4x^2 - 10xy + 25y^2$.

34. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^4 - 7x^2 + 1$, $x^3 + 3x^2 + x$ and $x^4 - 11x^2 + 1$

⇨ Here,

first exp:
$x^4 - 7x^2 + 1$
$= (x^2)^2 + 2.x^2.1 + 1^2 - 9x^2$
$= (x^2 + 1)^2 - (3x)^2$
$= (x^2 + 1 + 3x)(x^2 + 1 - 3x)$
$= (x^2 + 3x + 1)(x^2 - 3x + 1)$

Second exp:
$x^3 + 3x^2 + x$
$= x(x^2 + 3x + 1)$

Third exp:
$x^4 - 11x^2 + 1$
$= (x^2)^2 - 2.x^2.1 + 1^2 - 9x^2$
$= (x^2 - 1)^2 - (3x)^2$
$= (x^2 - 1 + 3x)(x^2 - 1 - 3x)$
$= (x^2 + 3x - 1)(x^2 - 3x - 1)$

Thus, the HCF is 1.

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35. म.स. पत्ता लगाउनुहोस् (Find the HCF of) : $x^3 + 64y^3$, $x^4 + 16x^2y^2 + 256y^4$ and $4x^3 - 16x^2y + 64y^2x$

⇨ Here,

first exp:
$x^3 + 64y^3$
$= x^3 + (4y)^3$
$= (x + 4y)\{(x^2 - x.4y + (4y)^2\}$
$= (x + 4y)(x^2 - 4xy + 16y^2)$

Second exp:
$x^4 + 16x^2y^2 + 256y^4$
$= (x^2)^2 + 2.x^2.16y^2 + (16y^2)^2 - 16x^2y^2$
$= (x^2 + 16y^2)^2 - (4xy)^2$
$= (x^2 + 16y^2 + 4xy)(x^2 + 16y^2 - 4xy)$
$= (x^2 + 4xy + 16y^2)(x^2 - 4xy + 16y^2)$

Third exp:
$4x^3 - 16x^2y + 64y^2x$
$= 4x(x^2 - 4xy + 16y^2)$

Thus, the HCF is $(x^2 - 4xy + 16y^2)$.

8.2 लघुत्तम समापवर्तक (LOWEST COMMON FACTOR)

B. QUESTIONS FROM CDC TEXT BOOK

1. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 4$ and $2x^3 - 4x^2 + 4x$

⇨ Here,

first exp: $x^4 + 4$
$= (x^2)^2 + 2^2$
$= (x^2 + 2)^2 - 2.x^2.2$
$= (x^2 + 2)^2 - (2x)^2$
$= (x^2 + 2 + 2x)(x^2 + 2 - 2x)$
$= (x^2 + 2x + 2)(x^2 - 2x + 2)$

Second exp: $2x^3 - 4x^2 + 4x$
$= 2x(x^2 - 2x + 2)$

Thus, the LCM is $2x(x^2 - 2x + 2)(x^2 + 2x + 2)$.

2. ल.स. निकाल्नुहोस् (Find the LCM): $x^3 + 8$ and $x^3 - 2x^2 + 4x$

⇨ Here,

first exp: $x^3 + 8$
$= x^3 + 2^3$
$= (x + 2)(x^2 - 2x + 4)$

Second exp: $x^3 - 2x^2 + 4x$
$= x(x^2 - 2x + 4)$

$\therefore$ LCM $= (x^2 - 2x + 4).x.(x + 2)$

Thus, the LCM is $x(x + 2)(x^2 - 2x + 4)$.

3. ल.स. निकाल्नुहोस् (Find the LCM): $x^3 - 1$, $x^3 - x^2 + x$ and $x^4 + x^2 + 1$

⇨ Here,

first exp:
$x^3 - 1$
$= x^3 - 1^3$
$= (x - 1)(x^2 + x + 1)$

Second exp:
$x^3 - x^2 + x$
$= x(x^2 - x + 1)$

Third exp:
$x^4 + x^2 + 1$
$= (x^2)^2 + 2.x^2.1 + 1^2 - x^2$
$= (x^2 + 1)^2 - x^2$
$= (x^2 + 1 + x)(x^2 + 1 - x)$
$= (x^2 + x + 1)(x^2 - x + 1)$

Thus, LCM $= (x^2 + x + 1)(x^2 - x + 1)x(x - 1) = x(x - 1)(x^2 + x + 1)(x^2 - x + 1)$

4. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 2ax^3 + a^2x^2$ and $x^3 + ax^2 + b^2x$

⇨ Here,

first exp: $x^4 + 2ax^3 + a^2x^2$
$= x^2(x^2 + 2ax + a^2)$
$= x^2(x + a)^2$
$= x.x(x + a)(x + a)$

Second exp: $x^3 + ax^2 + b^2x$
$= x(x^2 + ax + b^2)$

$\therefore$ LCM $= x.(x^2 + ax + b^2)(x + a)(x + a).x = x^2(x + a)(x + a)(x^2 + ax + b^2)$

5. ल.स. निकाल्नुहोस् (Find the LCM): $y^4 + (2b^2 - a^2)y^2 + b^4$ and $y^3 - ay^2 + b^2y$

⇨ Here,

first exp: $y^4 + (2b^2 - a^2)y^2 + b^4$
$= y^4 + 2b^2y^2 - a^2y^2 + b^4$
$= y^4 + 2b^2y^2 + b^4 - a^2y^2$
$= (y^2)^2 + 2.y^2.b^2 + (b^2)^2 - (ay)^2$
$= (y^2 + b^2)^2 - (ay)^2$
$= (y^2 + b^2 + ay)(y^2 + b^2 - ay)$

Second exp: $y^3 - ay^2 + b^2y$
$= y(y^2 - ay + b^2)$
$= y(y^2 + b^2 - ay)$

$\therefore$ LCM $= y(y^2 + b^2 - ay)(y^2 + b^2 + ay) = y(y^2 + b^2 + ay)(y^2 + b^2 - ay)$

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6. ल.स. निकाल्नुहोस् (Find the LCM): $\left(\frac{x^2}{y^2}\right)^2 + 1 + \left(\frac{y^2}{x^2}\right)^2$ and $\left(\frac{x}{y}\right)^3 + \left(\frac{y}{x}\right)^3$

⇨ Here,

first exp: $\left(\frac{x^2}{y^2}\right)^2 + 1 + \left(\frac{y^2}{x^2}\right)^2$

$= \left(\frac{x^2}{y^2}\right)^2 + 2.\frac{x^2}{y^2}.\frac{y^2}{x^2} + \left(\frac{y^2}{x^2}\right)^2 - 1$

$= \left(\frac{x^2}{y^2} + \frac{y^2}{x^2}\right)^2 - 1^2$

$= \left(\frac{x^2}{y^2} + \frac{y^2}{x^2} + 1\right)\left(\frac{x^2}{y^2} + \frac{y^2}{x^2} - 1\right)$

$= \left(\frac{x^2}{y^2} + 1 + \frac{y^2}{x^2}\right)\left(\frac{x^2}{y^2} - 1 + \frac{y^2}{x^2}\right)$

Second exp: $\left(\frac{x}{y}\right)^3 + \left(\frac{y}{x}\right)^3$

$= \left(\frac{x}{y} + \frac{y}{x}\right)\left(\frac{x^2}{y^2} - \frac{x}{y}.\frac{y}{x} + \frac{y^2}{x^2}\right)$

$= \left(\frac{x}{y} + \frac{y}{x}\right)\left(\frac{x^2}{y^2} - 1 + \frac{y^2}{x^2}\right)$

$\therefore$ LCM $= \left(\frac{x^2}{y^2} - 1 + \frac{y^2}{x^2}\right)\left(\frac{x}{y} + \frac{y}{x}\right)\left(\frac{x^2}{y^2} + 1 + \frac{y^2}{x^2}\right) = \left(\frac{x}{y} + \frac{y}{x}\right)\left(\frac{x^2}{y^2} + 1 + \frac{y^2}{x^2}\right)\left(\frac{x^2}{y^2} - 1 + \frac{y^2}{x^2}\right)$

7. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 1 + \frac{1}{x^4}$, $x^3 + \frac{1}{x^3}$ and $x^3 + x + \frac{1}{x}$

⇨ Here,

first exp: $x^4 + 1 + \frac{1}{x^4}$

$= (x^2)^2 + 2.x^2.\frac{1}{x^2} + \left(\frac{1}{x^2}\right)^2 - 1$

$= \left(x^2 + \frac{1}{x^2}\right)^2 - 1$

$= \left(x^2 + \frac{1}{x^2} + 1\right)\left(x^2 + \frac{1}{x^2} - 1\right)$

$= \left(x^2 + 1 + \frac{1}{x^2}\right)\left(x^2 - 1 + \frac{1}{x^2}\right)$

Second exp: $x^3 + \frac{1}{x^3} = x^3 + \left(\frac{1}{x}\right)^3$

$= \left(x + \frac{1}{x}\right)\left(x^2 - x.\frac{1}{x} + \frac{1}{x^2}\right)$

$= \left(x + \frac{1}{x}\right)\left(x^2 - 1 + \frac{1}{x^2}\right)$

Third exp: $x^3 + x + \frac{1}{x}$

$= x\left(x^2 + 1 + \frac{1}{x^2}\right)$

$\therefore$ LCM $= \left(x^2 + 1 + \frac{1}{x^2}\right)\left(x^2 - 1 + \frac{1}{x^2}\right)\left(x + \frac{1}{x}\right).x$

$= x\left(x + \frac{1}{x}\right)\left(x^2 + 1 + \frac{1}{x^2}\right)\left(x^2 - 1 + \frac{1}{x^2}\right)$

8. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 - 5x^2y^2 + 4y^4$, $x^3 + 8y^3$ and $x^3 - 8y^3$

⇨ Here,

first exp: $x^4 - 5x^2y^2 + 4y^4$

$= (x^2)^2 - 2.x^2.2y^2 + (2y^2)^2 - x^2y^2$

$= (x^2 - 2y^2)^2 - (xy)^2$

$= (x^2 - 2y^2 + xy)(x^2 - 2y^2 - xy)$

$= (x^2 + xy - 2y^2)(x^2 - xy - 2y^2)$

Second exp: $x^3 + 8y^3$

$= x^3 + (2y)^3$

$= (x + 2y)\{x^2 - x.2y + (2y)^2\}$

$= (x + 2y)(x^2 - 2xy + 4y^2)$

Third exp: $x^3 - 8y^3$

$= x^3 - (2y)^3 = x^3 - (2y)^3$

$= (x - 2y)\{x^2 + x.2y + (2y)^2\}$

$= (x - 2y)(x^2 + 2xy + 4y^2)$

$\therefore$ LCM $= (x^2 + 2xy + 4y^2)(x^2 - 2xy + 4y^2)(x - 2y)(x^2 + xy - 2y^2)(x^2 - xy - 2y^2)(x + 2y)$

$= (x + 2y)(x - 2y)(x^2 + 2xy + 4y^2)(x^2 - 2xy + 4y^2)(x^2 + xy - 2y^2)(x^2 - xy - 2y^2)$

9. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 64y^4$, $2x^3 + 8x^2y + 16xy^2$ and $x^3 - 4x^2y + 8xy^2$

⇨ Here,

first exp: $x^4 + 64y^4$

$= (x^2)^2 + (8y^2)^2 + 2.x^2.8y^2 - 2.x^2.8y^2$

$= (x^2 + 8y^2)^2 - (4xy)^2$

$= (x^2 + 4xy + 8y^2)(x^2 - 4xy + 8y^2)$

Second exp: $2x^3 + 8x^2y + 16xy^2$

$= 2x(x^2 + 4xy + 8y^2)$

Third exp: $x^3 - 4x^2y + 8xy^2$

$= x(x^2 - 4xy + 8y^2)$

$\therefore$ LCM $= x(x^2 - 4xy + 8y^2)(x^2 + 4xy + 8y^2)2 = 2x(x^2 - 4xy + 8y^2)(x^2 + 4xy + 8y^2)$

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10. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 4y^4$, $x^3 + 2x^2y + 2xy^2$ and $x^3 - 2x^2y + 2xy^2$

⇨ Here,

first exp:
$x^4 + 4y^4$
$= (x^2)^2 + (2y^2)^2$
$= (x^2 + 2y^2)^2 - 2.x^2.2y^2$
$= (x^2 + 2y^2)^2 - (2xy)^2$
$= (x^2 + 2y^2 + 2xy)(x^2 + 2y^2 - 2xy)$
$= (x^2 + 2xy + 2y^2)(x^2 - 2xy + 2y^2)$

Second exp:
$x^3 + 2x^2y + 2xy^2$
$= x(x^2 + 2xy + 2y^2)$

Third exp:
$x^3 - 2x^2y + 2xy^2$
$= x(x^2 - 2xy + 2y^2)$

$\therefore$ LCM $= x(x^2 - 2xy + 2y^2)(x^2 + 2xy + 2y^2) = x(x^2 - 2xy + 2y^2)(x^2 + 2xy + 2y^2)$

11. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 - 64$, $x^3 + 4x^2 + 16x$ and $4x^2 + 16x + 64$

⇨ Here,

first exp: $x^4 - 64$
$= (x^2)^2 - 8^2$
$= (x^2 + 8)(x^2 - 8)$

Second exp: $x^3 + 4x^2 + 16x$
$= x(x^2 + 4x + 16)$

Third exp: $4x^2 + 16x + 64$
$= 4(x^2 + 4x + 16)$

$\therefore$ LCM $= 4.x(x^2 + 4x + 16)(x^2 + 8)(x^2 - 8) = 4x(x^2 + 8)(x^2 - 8)(x^2 + 4x + 16)$

12. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 9x^2 + 81$, $3x^2 + 9x + 27$ and $x^3 + 27$

⇨ Here,

first exp:
$x^4 + 9x^2 + 81$
$= (x^2)^2 + 2.x^2.9 + 9^2 - 9x^2$
$= (x^2 + 9)^2 - (3x)^2$
$= (x^2 + 3x + 9)(x^2 - 3x + 9)$

Second exp:
$3x^2 + 9x + 27$
$= 3(x^2 + 3x + 9)$

Third exp:
$x^3 + 27$
$= x^3 + 3^3$
$= (x + 3)(x^2 - 3x + 9)$

$\therefore$ LCM $= 3(x^2 + 3x + 9)(x^2 - 3x + 9)(x + 3) = 3(x + 3)(x^2 + 3x + 9)(x^2 - 3x + 9)$

13. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 8x^2 + 144$, $x^3 + x(x + 12) + 3x^2$ and $x^3 + 12x + 4x^2$

⇨ Here,

first exp:
$x^4 + 8x^2 + 144$
$= (x^2)^2 + 2.x^2.12 + 12^2 - 16x^2$
$= (x^2 + 12)^2 - (4x)^2$
$= (x^2 + 12 + 4x)(x^2 + 12 - 4x)$
$= (x^2 + 4x + 12)(x^2 - 4x + 12)$

Second exp:
$x^3 + x(x + 12) + 3x^2$
$= x^3 + x^2 + 12x + 3x^2$
$= x^3 + 4x^2 + 12x$
$= x(x^2 + 4x + 12)$

Third exp:
$x^3 + 12x + 4x^2$
$= x^3 + 4x^2 + 12x$
$= x(x^2 + 4x + 12)$

$\therefore$ LCM $= x(x^2 + 4x + 12)(x^2 - 4x + 12)$

14. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 - 8x^2 + 196$, $x^3 + x(x + 14) + 5x^2$ and $2x^2 + 12x + 28$

⇨ Here,

first exp:
$x^4 - 8x^2 + 196$
$= (x^2)^2 + 2.x^2.14 + 14^2 - 36x^2$
$= (x^2 + 14)^2 - (6x)^2$
$= (x^2 + 14 + 6x)(x^2 + 14 - 6x)$
$= (x^2 + 6x + 14)(x^2 - 6x + 14)$

Second exp:
$x^3 + x(x + 14) + 5x^2$
$= x^3 + x^2 + 14x + 5x^2$
$= x^3 + 6x^2 + 14x$
$= x(x^2 + 6x + 14)$

Third exp:
$2x^2 + 12x + 28$
$= 2(x^2 + 6x + 14)$

$\therefore$ LCM $= 2x(x^2 + 6x + 14)(x^2 - 6x + 14)$

15. ल.स. निकाल्नुहोस् (Find the LCM): $a^2 + 2ab + b^2 - c^2$, $b^2 + 2bc + c^2 - a^2$ and $c^2 + 2ac + a^2 - b^2$

⇨ Here,

First Exp.
$a^2 + 2ab + b^2 - c^2$
$= (a + b)^2 - c^2$
$= (a + b + c)(a + b - c)$

Second Exp.
$b^2 + 2bc + c^2 - a^2$
$= (b + c)^2 - a^2$
$= (b + c + a)(b + c - a)$

Third Exp.
$c^2 + 2ac + a^2 - b^2$
$= (c + a)^2 - b^2$
$= (c + a + b)(c + a - b)$

Thus, LCM $= (a + b + c)(a + b - c)(b + c - a)(a + c - b)$

16. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 - 6x^2y^2 + y^4$, $x^3 + 2x^2y - xy^2$ and $x^2y - 2xy^2 - y^3$

⇨ Here,

first exp:
$x^4 - 6x^2y^2 + y^4$
$= (x^2)^2 - 2x^2y^2 + (y^2)^2 - 4x^2y^2$
$= (x^2 - y^2)^2 - (2xy)^2$
$= (x^2 - y^2 + 2xy)(x^2 - y^2 - 2xy)$
$= (x^2 + 2xy - y^2)(x^2 - 2xy - y^2)$

Second exp:
$x^3 + 2x^2y - xy^2$
$= x(x^2 + 2xy - y^2)$

Third exp:
$x^2y - 2xy^2 - y^3$
$= y(x^2 - 2xy - y^2)$

$\therefore$ LCM $= xy(x^2 + 2xy - y^2)(x^2 - 2xy - y^2)$

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17. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + x^2 + 1$, $x^3 - 1$ and $x^6 - 1$

⇨ Here,

first exp:	Second exp:	Third exp:
$x^4 + x^2 + 1$	$x^3 - 1$	$x^6 - 1$
$= (x^2)^2 + 2.x^2.1 + 1^2 - x^2$	$= (x - 1)(x^2 + x + 1)$	$= (x^3)^2 - 1$
$= (x^2 + 1)^2 - x^2$		$= (x^3 + 1)(x^3 - 1)$
$= (x^2 + 1 + x)(x^2 + 1 - x)$		$= (x + 1)(x^2 - x + 1)(x - 1)(x^2 + x + 1)$
$= (x^2 + x + 1)(x^2 - x + 1)$		$= (x + 1)(x - 1)(x^2 + x + 1)(x^2 - x + 1)$

$\therefore$ LCM $= (x - 1)(x^2 + x + 1)(x^2 - x + 1)(x + 1) = (x + 1)(x - 1)(x^2 + x + 1)(x^2 - x + 1)$

18. ल.स. निकाल्नुहोस् (Find the LCM): $x^6 - 16x^4$, $x^5 + 6x^4 + 8x^3$ and $x^4 + 8x^3 + 16x^2$

⇨ Here,

first exp:	Second exp:	Third exp:
$x^6 - 16x^4$	$x^5 + 6x^4 + 8x^3$	$x^4 + 8x^3 + 16x^2$
$= x^4(x^2 - 16)$	$= x^3(x^2 + 6x + 8)$	$= x^2(x^2 + 8x + 16)$
$= x^4(x^2 - 4^2)$	$= x^3(x^2 + 4x + 2x + 8)$	$= x^2(x^2 + 2.x.4 + 4^2)$
$= x^4(x - 4)(x + 4)$	$= x^3\{x(x + 4) + 2(x + 4)\}$	$= x^2(x + 4)^2$
	$= x^3(x + 4)(x + 2)$	$= x^2(x + 4)(x + 4)$

$\therefore$ LCM $= x^4(x + 4)(x - 4)(x + 2)(x + 4) = x^4(x + 2)(x + 4)(x + 4)(x - 4)$

19. ल.स. निकाल्नुहोस् (Find the LCM): $x^4 + 4x^2 + 16$, $x^3 + 2x^2 + 4x$ and $x^3 - 8$

⇨ Here,

first exp:	Second exp:	Third exp:
$x^4 + 4x^2 + 16$	$x^3 + 2x^2 + 4x$	$x^3 - 8$
$= (x^2)^2 + 2.x^2.4 + 4^2 - 4x^2$	$= x(x^2 + 2x + 4)$	$= x^3 - 2^3$
$= (x^2 + 4)^2 - 4x^2$		$= (x - 2)(x^2 + 2.x + 2^2)$
$= (x^2 + 4)^2 - (2x)^2$		$= (x - 2)(x^2 + 2x + 4)$
$= (x^2 + 4 + 2x)(x^2 + 4 - 2x)$		
$= (x^2 + 2x + 4)(x^2 - 2x + 4)$		

$\therefore$ LCM $= (x^2 + 2x + 4)(x - 2)(x^2 - 2x + 4)x = x(x - 2)(x^2 - 2x + 4)(x^2 + 2x + 4)$

20. ल.स. निकाल्नुहोस् (Find the LCM): $x^3 - 4x^2 + 12x$, $x^4 + 8x^2 + 144$

⇨ Here,

first exp:	Second exp:
$x^3 - 4x^2 + 12x$	$x^4 + 8x^2 + 144$
$= x(x^2 - 4x + 12)$	$= (x^2)^2 + 2.x^2.12 + 12^2 - 16x^2$
	$= (x^2 + 12)^2 - (4x)^2$
	$= (x^2 + 12 + 4x)(x^2 + 12 - 4x)$
	$= (x^2 + 4x + 12)(x^2 - 4x + 12)$

$\therefore$ LCM $= x(x^2 - 4x + 12)(x^2 + 4x + 12)$

C. OTHER IMPORTANT QUESTIONS

1. दुईओटा अभिव्यञ्जकहरूको म.स. $(x + 1)$ र तिनीहरूको ल.स. $x^6 - 1$ छ। यदि तिनीहरूमध्ये एउटा $x^3 + 1$ भए अर्को पत्ता लगाउनुहोस्।
The HCF of two expressions is $(x + 1)$ and their LCM is $x^6 - 1$. If one of them is $x^3 + 1$ find the other.

⇨ Here, HCF $= (x + 1)$ LCM $= (x^6 - 1)$ 1st exp. $(x^3 + 1)$ 2nd exp. $= ?$

We know that, 1st exp. × 2nd exp. = HCF × LCM

or, $(x^3 + 1) \times$ 2nd exp. $= (x + 1) \times (x^6 - 1)$

or, 2nd exp. $= \dfrac{(x + 1)(x^3 + 1)(x^3 - 1)}{(x^3 + 1)} = (x^3 - 1)(x + 1)$

or, 2nd exp. $= x^4 - x + x^3 - 1$ Thus, 2nd exp. $= x^4 + x^3 - x - 1$

2. म.स. निकाल्नुहोस् (Find the HCF): $x^3 + (a + b)x^2 + (ab + 1)x + b$ and $6x^3 + (ab + 1)x^2 + (a + b)x + 1$

⇨ Here,

1st exp. $x^3 + (a + b)x^2 + (ab + 1)x + b$	2nd exp. $bx^3 + (ab + 1)x^2 + (a + b)x + 1$
$= x^3 + ax^2 + bx^2 + abx + x + b$	$= bx^3 + abx^2 + x^2 + ax + bx + 1$
$= x^3 + bx^2 + ax^2 + abx + x + b$	$= bx^3 + x^2 + abx^2 + ax + bx + 1$
$= x^2(x + b) + ax(x + b) + 1(x + b)$	$= x^2(bx + 1) + ax(bx + 1) + 1(bx + 1)$
$= (x + b)(x^2 + ax + 1)$	$= (bx + 1)(x^2 + ax + 1)$

Thus, HCF $= x^2 + ax + 1$

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9. साधारण मूलक र सर्ड
Radical and Surd

सर्ड र सर्डको सरलीकरण (SURDS AND SIMPLIFICATION OF SURDS)

A. BASIC EXERCISE 9.1

A. VERY SHORT QUESTIONS

1. तलका मध्य कुन-कुन आनुपातिक सङ्ख्या हुन् ?(Which of the following are the rational numbers?)

(a) $\sqrt{2}, 0.3\dot{3}, \frac{2}{5}$ and $\sqrt{7}$ (b) $\sqrt{5}, 0.2\dot{2}, \frac{3}{7}$ and $\sqrt{3}$

⇨ (a) Here rational number $= \frac{2}{5}$ (b) Here rational number $= \frac{3}{7}$

2. तलका मध्य कुन कुन सर्ड हुन् ? (Which of the following is a surd?)

(a) $\sqrt{2}, 0.3\dot{3}, \frac{2}{5}$ and $\sqrt{4}$ (b) $\sqrt{3}, 0.2\dot{2}, \frac{3}{7}$ and $\sqrt{9}$

⇨ (a) Here, surd $= \sqrt{2}$ (b) Here, surd $= \sqrt{3}$

3. तलका मध्य कुन-कुन अनानुपातिक सङ्ख्या हुन् ?(Which of the given numbers are irrational numbers?)

(a) $\sqrt{4}, \sqrt[3]{27}, 7, \frac{3}{5}$ and $\sqrt{5}$ (b) $\sqrt{36}, \frac{\sqrt{4}}{65}, -1, 7, \sqrt{3}, 0.8$

⇨ (a) Here, irrational number $= \sqrt{5}$ (b) Here, irrational number $= \sqrt{3}$

4. तलका सर्डहरूलाई जोड्नुहोस् (Add the following surds):

(a) $3\sqrt{2} + 4\sqrt{2}$ (b) $4\sqrt{5} + 2\sqrt{5} + \sqrt{5}$ (c) $4\sqrt[3]{3} + 2\sqrt[3]{3} + \sqrt[3]{3}$

(d) $\sqrt{18} + \sqrt{8}$ (e) $\sqrt{125} + \sqrt{45}$ (f) $3\sqrt{2} + \frac{2}{\sqrt{2}}$

⇨ (a) Here, $3\sqrt{2} + 4\sqrt{2} = (3 + 4)\sqrt{2} = 7\sqrt{2}$

(b) Here, $4\sqrt{5} + 2\sqrt{5} + \sqrt{5} = (4 + 2 + 1)\sqrt{5} = 7\sqrt{5}$

(c) Here, $4\sqrt[3]{3} + 2\sqrt[3]{3} + \sqrt[3]{3} = (4 + 2 + 1)\sqrt[3]{3} = 7\sqrt[3]{3}$

(d) Here, $\sqrt{18} + \sqrt{8} = \sqrt{3 \times 3 \times 2} + \sqrt{2 \times 2 \times 2} = 3\sqrt{2} + 2\sqrt{2} = (3 + 2)\sqrt{2} = 5\sqrt{2}$

(e) Here, $\sqrt{125} + \sqrt{45} = \sqrt{5 \times 5 \times 5} + \sqrt{3 \times 3 \times 5} = 5\sqrt{5} + 3\sqrt{5} = (5 + 3)\sqrt{5} = 8\sqrt{5}$

(f) Here, $3\sqrt{2} + \frac{2}{\sqrt{2}} = 3\sqrt{2} + \frac{\sqrt{2} \times \sqrt{2}}{\sqrt{2}} = 3\sqrt{2} + \sqrt{2} = 4\sqrt{2}$

5. तलका सर्डहरूको घटाऊ गर्नुहोस् (Subtract the following surds):

(a) $4\sqrt{3} - \sqrt{3}$ (b) $18\sqrt[3]{13} - 5\sqrt[3]{13}$ (c) $14\sqrt[4]{5} - 2\sqrt[4]{5}$

⇨ (a) Here, $4\sqrt{3} - \sqrt{3} = (4 - 1)\sqrt{3} = 3\sqrt{3}$

(b) Here, $18\sqrt[3]{13} - 5\sqrt[3]{13} = (18 - 5)\sqrt[3]{13} = 13\sqrt[3]{13}$

(c) Here, $14\sqrt[4]{5} - 2\sqrt[4]{5} = (14 - 2)\sqrt[4]{5} = 12\sqrt[4]{5}$

6. तलका सर्डहरूको भागफल निकाल्नुहोस् (Divide the following surds):

(a) $4\sqrt{3} \div \sqrt{3}$ (b) $5\sqrt{26} \div 8\sqrt{13}$ (c) $6\sqrt{34} \div 9\sqrt{17}$

⇨ (a) Here, $4\sqrt{3} \div \sqrt{3} = \frac{4\sqrt{3}}{\sqrt{3}} = 4$ (b) Here, $5\sqrt{26} \div 8\sqrt{13} = \frac{5\sqrt{2} \times \sqrt{13}}{8\sqrt{13}} = \frac{5\sqrt{2}}{8}$

(c) Here, $6\sqrt{34} \div 9\sqrt{17} = \frac{2 \times 3 \times \sqrt{17} \times \sqrt{2}}{3 \times 3 \times \sqrt{17}} = \frac{2\sqrt{2}}{3}$

7. हरको अनुपातीकरण गर्नुहोस् (Rationalize the denominator):

(a) $\frac{\sqrt{3}}{\sqrt{2}}$ (b) $\frac{2}{\sqrt{5}}$ (c) $\frac{6}{\sqrt{12}}$ (d) $\frac{1}{\sqrt{2} - 1}$ (e) $\frac{6}{\sqrt{7} - \sqrt{5}}$ (f) $\frac{4 + \sqrt{5}}{4 - \sqrt{5}}$

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⇨ (a) Here, $\frac{\sqrt{3}}{\sqrt{2}} = \frac{\sqrt{3}}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{6}}{2}$ (b) Here, $\frac{2}{\sqrt{5}} = \frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$

(c) Here, $\frac{6}{\sqrt{12}} = \frac{6}{\sqrt{12}} \times \frac{\sqrt{12}}{\sqrt{12}} = \frac{6\sqrt{12}}{12} = \frac{\sqrt{12}}{2} = \frac{\sqrt{2} \times \sqrt{2} \times \sqrt{3}}{\sqrt{2} \times \sqrt{2}} = \sqrt{3}$

(d) Here, $\frac{1}{\sqrt{2}-1} = \frac{1}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = \frac{\sqrt{2}+1}{(\sqrt{2})^2-(1)^2} = \frac{\sqrt{2}+1}{2-1} = \sqrt{2}+1$

(e) Here, $\frac{6}{\sqrt{7}-\sqrt{5}} = \frac{6}{\sqrt{7}-\sqrt{5}} \times \frac{\sqrt{7}+\sqrt{5}}{\sqrt{7}+\sqrt{5}} = \frac{6(\sqrt{7}+\sqrt{5})}{(\sqrt{7})^2-(\sqrt{5})^2} = \frac{6(\sqrt{7}+\sqrt{5})}{7-5} = \frac{6(\sqrt{7}+\sqrt{5})}{2} = 3(\sqrt{7}+\sqrt{5})$

(f) Here, $\frac{4+\sqrt{5}}{4-\sqrt{5}} = \frac{4+\sqrt{5}}{4-\sqrt{5}} \times \frac{4+\sqrt{5}}{4+\sqrt{5}} = \frac{(4+\sqrt{5})^2}{(4)^2-(\sqrt{5})^2} = \frac{(4)^2+2.4.\sqrt{5}+(\sqrt{5})^2}{16-5} = \frac{16+8\sqrt{5}+5}{11} = \frac{21+8\sqrt{5}}{11}$

B. SHORT QUESTIONS

Model 1

1. सरल गर्नुहोस् (Simplify): $3\sqrt{27} + 2\sqrt{12} - 2\sqrt{3}$ [2059 E1]

⇨ Here, $3\sqrt{27} + 2\sqrt{12} - 2\sqrt{3} = 3\sqrt{3 \times 3 \times 3} + 2\sqrt{2 \times 2 \times 3} - 2\sqrt{3}$

$= 3 \times 3\sqrt{3} + 2 \times 2\sqrt{3} - 2\sqrt{3} = 9\sqrt{3} + 4\sqrt{3} - 2\sqrt{3} = 13\sqrt{13} - 2\sqrt{3} = 11\sqrt{3}$

2. सरल गर्नुहोस् (Simplify): $4\sqrt{45} - 3\sqrt{20} + 8\sqrt{5}$ [2059 E2]

⇨ Here, $4\sqrt{45} - 3\sqrt{20} + 8\sqrt{5} = 4\sqrt{9 \times 5} - 3\sqrt{4 \times 5} + 8\sqrt{5}$

$= 12\sqrt{5} - 6\sqrt{5} + 8\sqrt{5} = 20\sqrt{5} - 6\sqrt{5} = 14\sqrt{5}$

3. सरल गर्नुहोस् (Simplify): $\sqrt{27} + \sqrt{75} - 8\sqrt{3}$ [2058 D1, 2060 C2]

⇨ Here, $\sqrt{27} + \sqrt{75} - 8\sqrt{3} = \sqrt{3 \times 3 \times 3} + \sqrt{5 \times 5 \times 3} - 8\sqrt{3} = 3\sqrt{3} + 5\sqrt{3} - 8\sqrt{3}$

$= 8\sqrt{3} - 8\sqrt{3} = 0$

4. सरल गर्नुहोस् (Simplify): $\sqrt{12} - \sqrt{75} + \sqrt{48}$ [2057 E2]

⇨ Here, $\sqrt{12} - \sqrt{75} + \sqrt{48} = \sqrt{2 \times 2 \times 3} - \sqrt{5 \times 5 \times 3} + \sqrt{4 \times 4 \times 3} = 2\sqrt{3} - 5\sqrt{3} + 4\sqrt{3}$

$= \sqrt{3}(2 - 5 + 4) = \sqrt{3}$

5. सरल गर्नुहोस् (Simplify): $3\sqrt{2} + \sqrt[4]{2500} + \sqrt[4]{64} + 6\sqrt{8}$ [2057 D2]

⇨ Here, $3\sqrt{2} + \sqrt[4]{2500} + \sqrt[4]{64} + 6\sqrt{8}$

$= 3\sqrt{2} + \sqrt[4]{5 \times 5 \times 5 \times 5 \times 4} + \sqrt[4]{2 \times 2 \times 2 \times 2 \times 4} + 6\sqrt{2 \times 2 \times 2}$

$= 3\sqrt{2} + 5\sqrt[4]{4} + 2\sqrt[4]{4} + 6 \times 2\sqrt{2}$

$= 3\sqrt{2} + 7\sqrt[4]{4} + 12\sqrt{2} = \left(15\sqrt{2} + 7\sqrt[4]{4}\right)$

6. मान निकाल्नुहोस् (Evaluate): $\sqrt[3]{128} + 2\sqrt[3]{54} - 2\sqrt[3]{250}$ [SLC 2065 E]

⇨ Here, $\sqrt[3]{4^3 \times 2} + 2\sqrt[3]{3^3 \times 2} - 2\sqrt[3]{5^3 \times 2} = 4\sqrt[3]{2} + 2 \times 3\sqrt[3]{2} - 2 \times 5\sqrt[3]{2} = (4 + 6 - 10)\sqrt[3]{2} = 0$

7. मान निकाल्नुहोस् (Evaluate): $\sqrt[3]{16} + \sqrt[3]{54} - \sqrt[3]{250}$ [SLC 2066 D]

⇨ Here, $\sqrt[3]{16} + \sqrt[3]{54} - \sqrt[3]{250}$

$= \sqrt[3]{2^3 \times 2} + \sqrt[3]{3^3 \times 2} - \sqrt[3]{5^3 \times 2}$

$= 2\sqrt[3]{2} + 3\sqrt[3]{2} - 5\sqrt[3]{2} = (2 + 3 - 5)\sqrt[3]{2} = 0$

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Model 2

8. सरल गर्नुहोस् (Simplify) : $\dfrac{\sqrt[3]{625}-\sqrt[3]{40}}{3\sqrt[3]{5}}$ [2072 C]

⇨ Here, $\dfrac{\sqrt[3]{625}-\sqrt[3]{40}}{3\sqrt[3]{5}}$

$=\dfrac{\sqrt[3]{5\times5\times5\times5}-\sqrt[3]{2\times2\times2\times5}}{3\sqrt[3]{5}}$

$=\dfrac{5\sqrt[3]{5}-2\sqrt[3]{5}}{3\sqrt[3]{5}}$

$=\dfrac{\sqrt[3]{5}\,(5-2)}{3\sqrt[3]{5}}=1$

9. सरल गर्नुहोस् (Simplify): $\dfrac{\sqrt{45a^2+2a\sqrt{5}}}{\sqrt{125a^2}}$ [2072 W]

⇨ Here, $\dfrac{\sqrt{45a^2+2a\sqrt{5}}}{\sqrt{125a^2}}$

$=\dfrac{\sqrt{9\times5\times a^2}+2a\sqrt{5}}{\sqrt{25\times5\times a^2}}$

$=\dfrac{3a\sqrt{5}+2a\sqrt{5}}{5a\sqrt{5}}$

$=\dfrac{\sqrt{5}(3a+2a)}{5a\times\sqrt{5}}$

$=\dfrac{5a}{5a}$

$=1$

10. सरल गर्नुहोस् (Simplify): $\dfrac{\sqrt[4]{81a^4}-\sqrt[3]{8a^3}}{\sqrt{a^2}}$ [2072 FW]

⇨ Here, $\dfrac{\sqrt[4]{81a^4}-\sqrt[3]{8a^3}}{\sqrt{a^2}}$

$=\dfrac{\sqrt[4]{3^4\times a^4}-\sqrt[3]{2^3\times a^3}}{\sqrt{a^2}}$

$=\dfrac{3a-2a}{a}$

$=\dfrac{a}{a}$

$=1$

11. सरल गर्नुहोस् (Simplify):

$\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}+\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ [2059 21]

⇨ Here, $\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}+\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

$=\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}\times\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}}+\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}\times\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

$=\dfrac{(\sqrt{3}+\sqrt{2})^2}{3-2}+\dfrac{(\sqrt{3}-\sqrt{2})^2}{3-2}$

$=\dfrac{3+2\sqrt{3}\sqrt{2}+2+3-2\sqrt{3}\sqrt{2}+2}{1}$

$=10$

12. सरल गर्नुहोस् (Simplify):

$\dfrac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}+\sqrt{a-b}}$ [2058 A1]

⇨ Here, $\dfrac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}+\sqrt{a-b}}$

$=\dfrac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}+\sqrt{a-b}}\times\dfrac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}-\sqrt{a-b}}$

$=\dfrac{(\sqrt{a+b}-\sqrt{a-b})^2}{a+b-a+b}$

$=\dfrac{a+b-2\sqrt{a+b}\sqrt{a-b}+a-b}{2b}$

$=\dfrac{2a-2\sqrt{a^2-b^2}}{2b}$

$=\dfrac{a-\sqrt{a^2-b^2}}{b}$

13. सरल गर्नुहोस् (Simplify):

$\dfrac{\sqrt{x}+\sqrt{a}}{\sqrt{x}-\sqrt{a}}-\dfrac{\sqrt{x}-\sqrt{a}}{\sqrt{x}+\sqrt{a}}$ [2058 A2]

⇨ Here, $\dfrac{\sqrt{x}+\sqrt{a}}{\sqrt{x}-\sqrt{a}}-\dfrac{\sqrt{x}-\sqrt{a}}{\sqrt{x}+\sqrt{a}}$

$=\dfrac{(\sqrt{x}+\sqrt{a})^2-(\sqrt{x}-\sqrt{a})^2}{(\sqrt{x}-\sqrt{a})(\sqrt{x}+\sqrt{a})}$

$=\dfrac{(x+2\sqrt{x}\sqrt{a}+a)-(x-2\sqrt{x}\sqrt{a}+a)}{x-a}$

$=\dfrac{4\sqrt{x}\sqrt{a}}{x-a}$

$=\dfrac{4\sqrt{xa}}{x-a}$

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9.1 सर्डहरू (SURDS)

B. QUESTIONS FROM CDC TEXT BOOK

1. तल दिइएका सर्डहरूको क्रम लेख्नुहोस् (Write the order of the following surds):

(a) $\sqrt[8]{4}$
⇨ Its order is 8.

(b) $\sqrt[3]{25}$
⇨ Its order is 3.

(c) $\sqrt[7]{11}$
⇨ Its order is 7.

(d) $3\sqrt[n]{x}(n > 1)$
⇨ Its order is n.

2. तल दिएका सर्डहरूलाई सरल रूपमा व्यक्त गर्नुहोस् (Express the following surds in the simplified form):

(a) $\sqrt{18}$
⇨ $\sqrt{18}$
$= \sqrt{2 \times 3 \times 3}$
$= 3\sqrt{2}$

(b) $\sqrt{72}$
⇨ Here, $\sqrt{72}$
$= \sqrt{3 \times 3 \times 2 \times 2 \times 2}$
$= 3 \times 2\sqrt{2}$
$= 6\sqrt{2}$

(c) $\sqrt[3]{16x}$
⇨ Here, $\sqrt[3]{16x}$
$= \sqrt[3]{2 \times 2 \times 2 \times 2 \times x}$
$= 2\sqrt[3]{2x}$

(d) $\sqrt{36a^3}$
⇨ Here, $\sqrt{36a^3}$
$= \sqrt{6 \times 6 \times a \times a \times a}$
$= 6a\sqrt{a}$

(e) $\sqrt[3]{81a^4b^7}$

⇨ Here, $\sqrt[3]{81a^4b^7} = \sqrt[3]{3 \times 3 \times 3 \times 3 \times a \times a \times a \times a \times b \times b \times b \times b \times b \times b \times b}$

$= 3 \times a \times b \times b\sqrt[3]{3 \times a \times b} = 3ab^2\sqrt[3]{3ab}$

3. तल दिएका सर्डहरूलाई पूर्ण सर्डका रूपमा व्यक्त गर्नुहोस् (Express the following surds into the complete surds):

(a) $4\sqrt{5}$
⇨ Here, $4\sqrt{5}$
$= \sqrt{4 \times 4 \times 5}$
$= \sqrt{80}$

(b) $2\sqrt[3]{6}$
⇨ Here, $2\sqrt[3]{6}$
$= \sqrt[3]{2 \times 2 \times 2 \times 6}$
$= \sqrt[3]{48}$

(c) $\frac{2a}{b}\sqrt[4]{\frac{b^4}{8a^3}}$
⇨ Here, $\frac{2a}{b}\sqrt[4]{\frac{b^4}{8a^3}}$
$= \sqrt[4]{\frac{2a}{b} \times \frac{2a}{b} \times \frac{2a}{b} \times \frac{2a}{b} \times \frac{b^4}{8a^3}}$
$= \sqrt[4]{2a}$

(d) $(a + b)\sqrt{\frac{a-b}{a+b}}$
⇨ Here, $(a + b)\sqrt{\frac{a-b}{a+b}}$
$= \sqrt{(a+b)^2 \times \frac{(a-b)}{(a+b)}}$
$= \sqrt{(a + b)(a - b)}$
$= \sqrt{a^2 - b^2}$

4. तलका प्रत्येक सर्डहरूलाई एउटै क्रमको मूल चिह्न प्रयोग गरी लेख्नुहोस् :
Write the following surds into the surds of the same order:

(a) $\sqrt{3}, \sqrt[3]{5}, \sqrt[4]{8}$

⇨ Here, $\sqrt{3}, \sqrt[3]{5}, \sqrt[4]{8}$
The orders are 2, 3, 4

2	2, 3, 4
	1, 3, 2

∴ LCM $= 2 \times 3 \times 2 = 12$

$\sqrt{3} = \sqrt[2 \times 6]{3^6} = \sqrt[12]{729}$

$\sqrt[3]{5} = \sqrt[3 \times 4]{5^4} = \sqrt[12]{625}$

$\sqrt[4]{8} = \sqrt[4 \times 3]{8^3} = \sqrt[12]{512}$

Thus, the surds of same order: $\sqrt[12]{729}$, $\sqrt[12]{625}$, $\sqrt[12]{512}$.

(b) $\sqrt[4]{x^2}, \sqrt[3]{x^4}, \sqrt[6]{x^3}$

⇨ Here, $\sqrt[4]{x^2}, \sqrt[3]{x^4}, \sqrt[6]{x^3}$
The orders are 4, 3, 6
The LCM 4, 3, 6

2	4, 3, 6
3	2, 3, 3
	2, 1, 1

∴ LCM $= 2 \times 3 \times 2 = 12$

∴ $\sqrt[4]{x^2} = \sqrt[4 \times 3]{x^{2 \times 3}} = \sqrt[12]{x^6}$

$\sqrt[3]{x^3} = \sqrt[3 \times 4]{x^{4 \times 4}} = \sqrt[12]{x^{16}}$

$\sqrt[6]{x^3} = \sqrt[6 \times 2]{x^{3 \times 2}} = \sqrt[12]{x^6}$

Thus, the surds in the same order are; $\sqrt[12]{x^6}, \sqrt[12]{x^{16}}, \sqrt[12]{x^6}$.

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9.2 सर्डहरूको सरलीकरण (SIMPLIFICATION OF SURDS)

B. QUESTIONS FROM CDC TEXT BOOK

1. सरल गर्नुहोस् (Simplify):

(a) $4\sqrt{2} + 5\sqrt{2} + 7\sqrt{2}$

⇨ Here, $4\sqrt{2} + 5\sqrt{2} + 7\sqrt{2}$

$= (4 + 5 + 7)\sqrt{2} = 16\sqrt{2}$

(b) $5\sqrt[3]{7} + 8\sqrt[3]{7} + 5\sqrt[3]{7}$

⇨ Here, $5\sqrt[3]{7} + 8\sqrt[3]{7} + 5\sqrt[3]{7}$

$= (5 + 8 + 5)\sqrt[3]{7} = 18\sqrt[3]{7}$

(c) $25\sqrt[7]{192} + 45\sqrt[7]{192} + 20\sqrt[7]{192}$

⇨ Here, $25\sqrt[7]{192} + 45\sqrt[7]{192} + 20\sqrt[7]{192}$

$= (25 + 45 + 20)\sqrt[7]{192} = 90\sqrt[7]{192}$

(d) $25\sqrt[9]{37} + 251\sqrt[9]{37} + 49\sqrt[9]{37}$

⇨ Here, $25\sqrt[9]{37} + 251\sqrt[9]{37} + 49\sqrt[9]{37}$

$= (25 + 251 + 49)\sqrt[9]{37} = 325\sqrt[9]{37}$

2. सरल गर्नुहोस् (Simplify):

(a) $\sqrt{45} + \sqrt{245} - \sqrt{500} + \sqrt{625}$

⇨ Here, $\sqrt{45} + \sqrt{245} - \sqrt{500} + \sqrt{625}$

$= \sqrt{9 \times 5} + \sqrt{49 \times 5} - \sqrt{100 \times 5} + \sqrt{25 \times 25}$

(b) $7\sqrt[3]{16} + 2\sqrt[3]{54} + 3\sqrt[3]{128} - 4\sqrt[3]{250}$

⇨ Here, $7\sqrt[3]{16} + 2\sqrt[3]{54} + 3\sqrt[3]{128} - 4\sqrt[3]{250}$

$= 7\sqrt[3]{8 \times 2} + 2\sqrt[3]{27 \times 2} + 3\sqrt[3]{64 \times 2} - 4\sqrt[3]{125 \times 2}$

$= 7 \times 2\sqrt[3]{2} + 2 \times 3\sqrt[3]{2} + 3 \times 4\sqrt[3]{2} - 4 \times 5\sqrt[3]{2}$

$= 14\sqrt[3]{2} + 6\sqrt[3]{2} + 12\sqrt[3]{2} - 20\sqrt[3]{2}$

$= (14 + 6 + 12 - 20)\sqrt[3]{2} = 12\sqrt[3]{2}$

(c) $2\sqrt{72} - \sqrt{18} + 3\sqrt{98}$

⇨ Here, $2\sqrt{72} - \sqrt{18} + 3\sqrt{98} = 2\sqrt{36 \times 2} - 5\sqrt{9 \times 2} + 3\sqrt{2 \times 49}$

$= 2 \times 6\sqrt{2} - 5 \times 3\sqrt{2} + 3 \times 7\sqrt{2} = (12 - 15 + 21)\sqrt{2} = 18\sqrt{2}$

3. गुणन गर्नुहोस् (Multiply):

(a) $\sqrt{2} \times \sqrt{5}$

⇨ Here, $\sqrt{2} \times \sqrt{5}$

$= \sqrt{10}$

(b) $\sqrt{3} \times \sqrt{11}$

⇨ Here, $\sqrt{3} \times \sqrt{11} = \sqrt{33}$

(c) $\sqrt[3]{2} \times \sqrt{2}$

⇨ Here, $\sqrt[3]{2} \times \sqrt{2}$

$= \sqrt[3 \times 2]{2^2} \times \sqrt[2 \times 3]{2^3}$

$= \sqrt[6]{4} \times \sqrt[6]{8}$

$= \sqrt[6]{32}$

(d) $\sqrt[4]{4} \times \sqrt{2}$

⇨ Here, $\sqrt[4]{4} \times \sqrt{2}$

$= \sqrt[4]{4} \times \sqrt[4]{2^2}$

$= \sqrt[4]{4 \times 4}$

$= \sqrt[4]{2 \times 2 \times 2 \times 2} = 2$

4. सरल गर्नुहोस् (Simplify):

(a) $3\sqrt{18} \times 2\sqrt{12}$

⇨ Here, $3\sqrt{18} \times 2\sqrt{12}$

$= 3 \times 2\sqrt{18} \times \sqrt{12}$

$= 3 \times 2\sqrt{2 \times 9} \times \sqrt{3 \times 4}$

$= 3 \times 2 \times 3\sqrt{2} \times 2\sqrt{3}$

$= 36 \times \sqrt{2 \times 3}$

$= 36\sqrt{6}$

(b) $5\sqrt{12} \times 7\sqrt{6}$

⇨ Here, $5\sqrt{12} \times 7\sqrt{6}$

$= 5 \times 7 \times \sqrt{12 \times 6}$

$= 35 \times \sqrt{2 \times 36}$

$= 35 \times 6\sqrt{2}$

$= 210\sqrt{2}$

(c) $(\sqrt{3} + \sqrt{2})(\sqrt{3} - \sqrt{2})$

⇨ Here, $(\sqrt{3} + \sqrt{2})(\sqrt{3} - \sqrt{2})$

$= (\sqrt{3})^2 - (\sqrt{2})^2$

$= 3 - 2$

$= 1$

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(d) $(4\sqrt{5}-7\sqrt{2})(3\sqrt{5}+4\sqrt{2})$

⇨ Here, $(4\sqrt{5}-7\sqrt{2})(3\sqrt{5}+4\sqrt{2})$

$= 4\times3\sqrt{5\times5}+4\times4\sqrt{5\times2}-7\times3\sqrt{2\times5}-7\times4\sqrt{2\times2}$

$= 12\times5+4\times4\sqrt{10}-21\sqrt{10}-28\times2 = 60+16\sqrt{10}-21\sqrt{10}-56 = 4-5\sqrt{10}$

(e) $27\sqrt{24}\div9\sqrt{12}$

⇨ Here, $27\sqrt{24}\div9\sqrt{12}$

$= \frac{27}{9}\sqrt{\frac{24}{12}} = 3\sqrt{2}$

(f) $\frac{\sqrt{8}\times\sqrt{78}\times\sqrt{3}}{\sqrt{26}\times\sqrt{24}}$

⇨ Here, $\frac{\sqrt{8}\times\sqrt{78}\times\sqrt{3}}{\sqrt{26}\times\sqrt{24}} = \sqrt{\frac{8\times78\times3}{26\times24}} = \sqrt{3}$

9.3 आनुपातीकरण (RATIONALIZATION)

B. QUESTIONS FROM CDC TEXT BOOK

1. हरहरूको आनुपातीकरण गर्नुहोस् (Rationalize the denominiator of):

(a) $\frac{5}{\sqrt{5}}$

⇨ Here, $\frac{5}{\sqrt{5}}$

$= \frac{\sqrt{5}\times\sqrt{5}}{\sqrt{5}}$

$= \sqrt{5}$

(b) $\frac{14}{\sqrt{7}}$

⇨ Here, $\frac{14}{\sqrt{7}}$

$= \frac{2\times\sqrt{7}\times\sqrt{7}}{\sqrt{7}}$

$= 2\sqrt{7}$

(c) $\frac{12}{\sqrt{72}}$

⇨ Here, $\frac{12}{\sqrt{72}}$

$= \frac{12}{\sqrt{2\times36}} = \frac{12}{6\sqrt{2}}$

$= \frac{6\times\sqrt{2}\times\sqrt{2}}{6\sqrt{2}}$

$= \sqrt{2}$

(d) $\frac{3\sqrt[3]{4}}{\sqrt[3]{9}}$

⇨ Here, $\frac{3\sqrt[3]{4}}{\sqrt[3]{9}} = \frac{3\sqrt[3]{4}\times\sqrt[3]{3}}{\sqrt[3]{9}\times\sqrt[3]{3}}$

$= \frac{3\sqrt[3]{12}}{\sqrt[3]{27}} = \frac{3\sqrt[3]{12}}{3} = \sqrt[3]{12}$

2. हरहरूको आनुपातीकरण गर्नुहोस् (Rationalize the denominiator of):

(a) $\frac{5}{3+\sqrt{2}}$

⇨ Here, $\frac{5}{3+\sqrt{2}}$

$= \frac{5}{3+\sqrt{2}}\times\frac{3-\sqrt{2}}{3-\sqrt{2}}$

$= \frac{5(3-\sqrt{2})}{3^2-(\sqrt{2})^2} = \frac{5(3-\sqrt{2})}{9-2}$

$= \frac{5}{7}(3-\sqrt{2})$

(b) $\frac{3\sqrt{2}}{\sqrt{6}+\sqrt{3}}$

⇨ Here, $\frac{3\sqrt{2}}{\sqrt{6}+\sqrt{3}}$

$= \frac{3\sqrt{2}}{\sqrt{6}+\sqrt{3}}\times\frac{\sqrt{6}-\sqrt{3}}{\sqrt{6}-\sqrt{3}}$

$= \frac{3\sqrt{2}(\sqrt{6}-\sqrt{3})}{6-3} = \frac{3\sqrt{2}(\sqrt{6}-\sqrt{3})}{3}$

$= \sqrt{12}-\sqrt{6}$

(c) $\frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}+\sqrt{5}}$

⇨ Here, $\frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}+\sqrt{5}}$

$= \frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}+\sqrt{5}}\times\frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}-\sqrt{5}}$

$= \frac{(\sqrt{7}-\sqrt{5})^2}{7-5} = \frac{(\sqrt{7})^2-2\sqrt{7}\sqrt{5}+(\sqrt{5})^2}{2}$

$= \frac{7-2\sqrt{35}+5}{2} = \frac{12-2\sqrt{35}}{2}$

$= 6-\sqrt{35}$

(d) $\frac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

⇨ Here, $\frac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

$= \frac{7\sqrt{3}-5\sqrt{2}}{\sqrt{16\times3}+\sqrt{2\times9}} = \frac{7\sqrt{3}-5\sqrt{2}}{4\sqrt{3}+3\sqrt{2}}\times\frac{4\sqrt{3}-3\sqrt{2}}{4\sqrt{3}-3\sqrt{2}}$

$= \frac{(7\sqrt{3}-5\sqrt{2})(4\sqrt{3}-3\sqrt{2})}{(4\sqrt{3})^2-(3\sqrt{2})^2}$

$= \frac{7\times4\sqrt{9}-7\times3\sqrt{6}-5\times4\sqrt{6}+5\times3\sqrt{4}}{16\times3-9\times2}$

$= \frac{28\times3-21\sqrt{6}-20\sqrt{6}+15\times2}{48-18}$

$= \frac{84-41\sqrt{6}+30}{30} = \frac{114-41\sqrt{6}}{30}$

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3. सरल गर्नुहोस् (Simplify):

(a) $\frac{\sqrt{5+\sqrt{3}}}{\sqrt{5-\sqrt{3}}}+\frac{\sqrt{5-\sqrt{3}}}{\sqrt{5+\sqrt{3}}}$ [2057 C1]

⇨ Here, $\frac{\sqrt{5+\sqrt{3}}}{\sqrt{5-\sqrt{3}}}+\frac{\sqrt{5-\sqrt{3}}}{\sqrt{5+\sqrt{3}}}=\frac{\sqrt{5+\sqrt{3}}}{\sqrt{5-\sqrt{3}}}\times\frac{\sqrt{5+\sqrt{3}}}{\sqrt{5+\sqrt{3}}}+\frac{\sqrt{5-\sqrt{3}}}{\sqrt{5}+\sqrt{3}}\times\frac{\sqrt{5-\sqrt{3}}}{\sqrt{5-\sqrt{3}}}$

$=\frac{(\sqrt{5+\sqrt{3}})^2}{5-3}+\frac{(\sqrt{5-\sqrt{3}})^2}{5-3}=\frac{5+2\sqrt{5}\sqrt{3}+3+5-2\sqrt{5}\sqrt{3}+3}{2}=\frac{16}{2}=8$

(b) $\frac{x+\sqrt{x^2-1}}{x-\sqrt{x^2-1}}-\frac{x-\sqrt{x^2-1}}{x+\sqrt{x^2-1}}$

⇨ Here, $\frac{x+\sqrt{x^2-1}}{x-\sqrt{x^2-1}}-\frac{x-\sqrt{x^2-1}}{x+\sqrt{x^2-1}}=\frac{(x+\sqrt{x^2-1})^2-(x-\sqrt{x^2-1})^2}{(x-\sqrt{x^2-1})(x+\sqrt{x^2-1})}$

$=\frac{\{x^2+2.x\sqrt{x^2-1}+(\sqrt{x^2-1})^2\}-\{x^2-2x\sqrt{x^2-1}+(\sqrt{x^2-1})^2\}}{(x)^2-(\sqrt{x^2-1})^2}$

$=\frac{(x^2+2x\sqrt{x^2-1}+x^2-1)-(x^2-2x\sqrt{x^2-1}+x^2-1)}{(x)^2-(x^2-1)}$

$=\frac{x^2+2x\sqrt{x^2-1}+x^2-1-x^2+2x\sqrt{x^2-1}-x^2+1}{x^2-x^2+1}=\frac{4x\sqrt{x^2-1}}{1}=4x\sqrt{x^2-1}$

(c) $\frac{2+\sqrt{3}}{2-\sqrt{3}}+\frac{2-\sqrt{3}}{2+\sqrt{3}}+\frac{\sqrt{3}-1}{\sqrt{3}+1}$

⇨ Here, $\frac{2+\sqrt{3}}{2-\sqrt{3}}+\frac{2-\sqrt{3}}{2+\sqrt{3}}+\frac{\sqrt{3}-1}{\sqrt{3}+1}=\frac{2+\sqrt{3}}{2-\sqrt{3}}\times\frac{2+\sqrt{3}}{2+\sqrt{3}}+\frac{2-\sqrt{3}}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}+\frac{\sqrt{3}-1}{\sqrt{3}+1}\times\frac{\sqrt{3}-1}{\sqrt{3}-1}$

$=\frac{2^2+2.2\sqrt{3}+3}{2^2-3}+\frac{2^2-2.2\sqrt{3}+3}{2^2-3}+\frac{3-2\sqrt{3}+1}{3-1}=\frac{7+4\sqrt{3}}{1}+\frac{7-4\sqrt{3}}{1}+\frac{4-2\sqrt{3}}{2}$

$=7+4\sqrt{3}+7-4\sqrt{3}+2-\sqrt{3}=16-\sqrt{3}$

4. (a) यदि $\frac{3+2\sqrt{2}}{3-\sqrt{2}}=a+b\sqrt{2}$ भए a र b का मानहरू पत्ता लगाउनुहोस् ।

If $\frac{3+2\sqrt{2}}{3-\sqrt{2}}=a+b\sqrt{2}$ then find the values of a and b.

⇨ Here, $\frac{3+2\sqrt{2}}{3-\sqrt{2}}=a+b\sqrt{2}$ or, $\frac{3+2\sqrt{2}}{3-\sqrt{2}}\times\frac{3+\sqrt{2}}{3+\sqrt{2}}=a+b\sqrt{2}$

or, $\frac{3^2+2.3.\sqrt{2}+3\sqrt{2}+2^2}{3^2-2}=a+b\sqrt{2}$ or, $\frac{13+9\sqrt{2}}{7}=a+b\sqrt{2}$

or, $\frac{13}{7}+\frac{9}{7}\sqrt{2}=a+b\sqrt{2}$ Equating corresponding terms then $a=\frac{13}{7}$ and $b=\frac{9}{7}$.

(b) यदि $a=\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ र $b=\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ भए $(a+b)^2$ को मान पत्ता लगाउनुहोस् ।

If $a=\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ and $b=\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ then find the value of $(a+b)^2$.

⇨ Here, $(a+b)=\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}+\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}=\frac{(\sqrt{3}+\sqrt{2})^2+(\sqrt{3}-\sqrt{2})^2}{(\sqrt{3}-\sqrt{2})(\sqrt{3}+\sqrt{2})}=\frac{3+2\sqrt{3}\sqrt{2}+2+3-2\sqrt{3}\sqrt{2}+2}{3-2}$

$\therefore \quad a+b=\frac{10}{1}$ i.e. $(a+b)^2=10^2=100$

Thus, the value of $(a+b)^2$ is 100.

(c) यदि $x=6-\sqrt{35}$ भए $x+\frac{1}{x}$ र $x^2+\frac{1}{x^2}$ को मान पत्ता लगाउनुहोस् ।

If $x=6-\sqrt{35}$ then find the value of $x+\frac{1}{x}$ and $x^2+\frac{1}{x^2}$.

⇨ Here, $x+\frac{1}{x}=6-\sqrt{35}+\frac{1}{6-\sqrt{35}}=6-\sqrt{35}+\frac{1}{6-\sqrt{35}}\times\frac{6+\sqrt{35}}{6+\sqrt{35}}=6-\sqrt{35}+\frac{6+\sqrt{35}}{36-35}$

$=6-\sqrt{35}+6+\sqrt{35}=12$

Now, $x^2+\frac{1}{x^2}=x^2+\left(\frac{1}{x}\right)^2=\left(x+\frac{1}{x}\right)^2-2x.\frac{1}{x}=\left(x+\frac{1}{x}\right)^2-2=12^2-2=144-2=142$

Thus, required values are 12 and 142 respectively.

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9.4 साधारण मूलक समीकरण (EQUATIONS INVOLVING SURDS)

A. BASIC EXERCISE 9.2

A. VERY SHORT QUESTIONS

हल गर्नुहोस् (Solve the following):

1. (a) $\sqrt{x-9}=4$ **(b)** $\sqrt{x+13}=5$ **(c)** $\sqrt{x-11}=3$ **(d)** $\sqrt{x+7}=3$

⇨ (a) Here, $\sqrt{x-9}=4$

Squaring on both sides, we get

$(\sqrt{x-9})^2=4^2$

or, $x-9=16$

$\therefore\ x=16+9=25$

(b) Here, $\sqrt{x+13}=5$

Squaring on both sides, we get

$(\sqrt{x+13})^2=5^2$

or, $x+13=25$

$\therefore\ x=25-13=12$

(c) Here, $\sqrt{x-11}=3$

Squaring on both sides, we get

$(\sqrt{x-11})^2=3^2$

or, $x-11=9$

$\therefore\ x=11+9=20$

(d) Here, $\sqrt{x+7}=3$

Squaring on both sides, we get

$(\sqrt{x+7})^2=3^2$

or, $x+7=9$

$\therefore\ x=9-7=2$

B. SHORT QUESTIONS

Model 1

1. हल गर्नुहोस् (Solve): $\sqrt{5x-9}=4$ [2072 C]

⇨ Here, $\sqrt{5x-9}=4$

Squaring on both sides; $(\sqrt{5x-9})^2=4^2$

or, $5x-9=16$

or, $5x=25$

$\therefore\ x=5$

2. हल गर्नुहोस् (Solve): $\sqrt{3x+13}=5$ [Model 2065]

⇨ Here, $\sqrt{3x+13}=5$

Squaring both sides; $(\sqrt{3x+13})^2=5^2$

or, $3x=25-13$

or, $3x=12$

$\therefore\ x=4$

7. हल गर्नुहोस् (Solve): $\sqrt{6x-5}-7=0$ [SLC2066 B]

⇨ Here, $\sqrt{6x-5}=7$

Squaring on both sides,

or, $6x-5=49$

or, $6x=54$

$\therefore\ x=9$

Thus, the value of x is 9.

3. हल गर्नुहोस् (Solve): $\sqrt{2x+1}-3=0$ [SLC 2066 A]

⇨ Here $\sqrt{2x+1}=3$

Squaring both the sides,

or, $2x+1=9$

or, $2x=8$

$\therefore\ x=4$

8. हल गर्नुहोस् (Solve): $\sqrt{7x+2}-3=0$ [SLC 2068 E]

⇨ Here, $\sqrt{7x+2}=3$

Squaring on both the sides;

or, $7x+2=9$

or, $7x=7$

$\therefore\ x=1$

4. हल गर्नुहोस् (Solve): $\sqrt{3x+1}-5=0$ [SLC 2068 A]

⇨ Here, $\sqrt{3x+1}-5=0$

or, $\sqrt{3x+1}=5$

Squaring on both the sides, $3x+1=25$

or, $3x=24$

$\therefore\ x=8$

9. हल गर्नुहोस् (Solve): $4-\sqrt{3y-2}=0$ [SLC 2068 B]

⇨ Here, $4-\sqrt{3y-2}=0$

or, $\sqrt{3y-2}=4$

Squaring on both the sides then,

$3y-2=16$

or, $3y=18$ $\therefore\ y=6$

5. हल गर्नुहोस् (Solve): $\sqrt{3x-2}-4=0$ [SLC 2067 E]

⇨ Here, $\sqrt{3x-2}-4=0$

or, $\sqrt{3x-2}=4$

squaring on both the sides, $3x-2=4^2$

or, $3x=18$

$\therefore\ x=6$

10. हल गर्नुहोस् (Solve): $\sqrt{7y+2}-3=1$ [SLC 2068 D]

⇨ Here, $\sqrt{7y+2}-3=1$

or, $\sqrt{7y+2}=4$

Squaring both the sides then, $7y+2=16$

or, $7y=14$

$\therefore\ y=2$

6. हल गर्नुहोस् (Solve): $4\sqrt{2x+3}=3$ [2064 C1]

⇨ Here, $4\sqrt{2x+3}=3$

or, $16(2x+3)=9$

or, $32x+48=9$

or, $32x=9-48$

or, $32x=-39$

$\therefore\ x=-\frac{39}{32}$

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11. हल गर्नुहोस् (Solve): $\sqrt{2a-1}=3$ [SLC 2066 E]

⇨ Here, $\sqrt{2a-1}=3$

Squaring on both the sides,

or, $2a-1=9$

or, $2a=10$

$\therefore a=5$

12. हल गर्नुहोस् (Solve): $4-\sqrt[3]{3y+4}=0$ [SLC 2065 D]

⇨ Here, $4-\sqrt[3]{3y+4}=0$

or, $\sqrt[3]{3y+4}=4$

Cubing both the sides, $3y+4=64$

or, $3y=60$

$\therefore y=20$

13. हल गर्नुहोस् (Solve): $\sqrt[3]{2t-1}+4=7$ [SLC 2067 D]

⇨ Here, $\sqrt[3]{2t-1}+4=7$

or, $\sqrt[3]{2t-1}=3$

Squaring on both the sides,

$(\sqrt[3]{2t-1})^3=3^3$

or, $2t-1=27$

or, $2t=28$

$\therefore t=14$

14. हल गर्नुहोस् (Solve): $\sqrt{x-7}=\sqrt{x}-1$ [2059 A1]

⇨ Here, $\sqrt{x-7}=\sqrt{x}-1$

or, $(\sqrt{x-7})^2=(\sqrt{x}-1)^2$

or, $x-7=(\sqrt{x})^2-2\sqrt{x}\,.\,1+(1)^2$

or, $x-7=x-2\sqrt{x}+1$

or, $x-7-x-1=-2\sqrt{x}$

or, $-8=-2\sqrt{x}$

or, $\sqrt{x}=\frac{-8}{-2}$

or, $\sqrt{x}=4$

Again, squaring on both sides $(\sqrt{x})^2=4^2$

$\therefore x=16$

15. हल गर्नुहोस् (Solve): $\sqrt{x+3}=\sqrt{x}+1$ [2063 E1]

⇨ Here, $\sqrt{x+3}=\sqrt{x}+1$

or, $(\sqrt{x+3})^2=(\sqrt{x}+1)^2$

or, $x+3=(\sqrt{x})^2+2\sqrt{x}\,.\,1+1^2$

or, $x+3=x+2\sqrt{x}+1$

or, $x+3-x-1=2\sqrt{x}$

or, $2=2\sqrt{x}$

or, $\sqrt{x}=\frac{2}{2}$

or, $\sqrt{x}=1$

Squaring on both sides, we get $(\sqrt{x})^2=1^2$

$\therefore x=1$

16. हल गर्नुहोस् (Solve): $x+\sqrt{x^2-20}=10$ [SLC 2066 D]

⇨ Here, $x+\sqrt{x^2-20}=10$

or, $\sqrt{x^2-20}=10-x$

or, $x^2-20=100-20x+x^2$

or, $20x=120$

$\therefore x=6$

17. हल गर्नुहोस् (Solve): $\sqrt{x-7}+\sqrt{x}=7$ [SLC 2065 C, 2058 A1]

⇨ Here, $\sqrt{x-7}=7-\sqrt{x}$

Squaring both the sides;

or, $(\sqrt{x-7})^2=(7-\sqrt{x})^2$

or, $x-7=49-14\sqrt{x}+x$

or, $14\sqrt{x}=56$

or, $\sqrt{x}=4$

$\therefore x=16$

18. हल गर्नुहोस् (Solve): $\frac{1}{2\sqrt[3]{3x-1}}=1$ [SLC 2067 B]

⇨ Here, $\frac{1}{2\sqrt[3]{3x-1}}=1$

or, $2\sqrt[3]{3x-1}=1$

or, $(2\sqrt[3]{3x-1})^3=1^3$

or, $8(3x-1)=1$

or, $3x-1=\frac{1}{8}$

or, $3x=1+\frac{1}{8}$

or, $3x=\frac{9}{8}$ $\therefore x=\frac{3}{8}$

19. हल गर्नुहोस् (Solve): $2x-\sqrt{4x^2-15}=3$ [SLC 2067 C]

⇨ Here, $2x-\sqrt{4x^2-15}=3$

or, $2x-3=\sqrt{4x^2-15}$

Squaring on both the sides,

$4x^2-12x+9=4x^2-15$

or, $-12x=-24$

$\therefore x=2$

20. हल गर्नुहोस् (Solve): $\sqrt{x^2+5}-1=x$ [SLC 2065 E]

⇨ Here, $\sqrt{x^2+5}-1=x$

or, $\sqrt{x^2+5}=1+x$

Squaring both the sides;

$x^2+5=1+2x+x^2$

or, $5=1+2x$

or, $4=2x$

$\therefore x=2$

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21. हल गर्नुहोस् (Solve): $\sqrt{9x^2-20} = 3x-2$ [SLC2065B]

⇨ Here, squaring the both sides,

$9x^2 - 20 = (3x-2)^2$

or, $9x^2 - 20 = 9x^2 - 12x + 4$

or, $12x = 24$

∴ $x = 2$

22. हल गर्नुहोस् (Solve): $\sqrt{x+8} - 2 = \sqrt{x}$ [2064 B1]

⇨ Here, $\sqrt{x+8} - 2 = \sqrt{x}$

or, $\sqrt{x+8} = 2 + \sqrt{x}$

or, $x + 8 = (2+\sqrt{x})^2$

or, $x + 8 = 4 + 4\sqrt{x} + x$

or, $8 - 4 = 4\sqrt{x}$

or, $4 = 4\sqrt{x}$

or, $\sqrt{x} = 1$

∴ $x = 1$

23. Solve : $2\sqrt{x} - \sqrt{4x-11} = 1$ [2063 A1, 2063 S]

⇨ Here, $2\sqrt{x} - \sqrt{4x-11} = 1$

or, $2\sqrt{x} - 1 = \sqrt{4x-11}$

Squaring on both sides, we get

$(2\sqrt{x}-1)^2 = (\sqrt{4x-11})^2$

or, $(2\sqrt{x})^2 - 2.2\sqrt{x} + 1 = 4x - 11$

or, $4x - 4\sqrt{x} + 1 = 4x - 11$

or, $-4\sqrt{x} = 4x - 11 - 4x - 1$

or, $-4\sqrt{x} = -12$

or, $\sqrt{x} = 3$

Squaring on both sides, we get, $(\sqrt{x})^2 = (3)^2$

∴ $x = 9$

24. हल गर्नुहोस् (Solve): $\sqrt{x} = 3 - \sqrt{x-3}$ [2063 D1]

⇨ Here, $\sqrt{x} = 3 - \sqrt{x-3}$

or, $\sqrt{x} - 3 = -\sqrt{x-3}$

Squaring on the both sides, we get

$(\sqrt{x}-3)^2 = (-\sqrt{x-3})^2$

or, $(\sqrt{x})^2 - 2.3\sqrt{x} + (3)^2 = \sqrt{(x-3)}^2$

or, $x - 6\sqrt{x} + 9 = x - 3$

or, $-6\sqrt{x} = x - x - 3 - 9$

or, $-6\sqrt{x} = -12$

or, $\sqrt{x} = 2$

Again squaring on the both sides, we get

$(\sqrt{x})^2 = 2^2$

∴ $x = 4$

25. हल गर्नुहोस् (Solve): $y - 2\sqrt{y} + 1 = 0$ [2064 C1]

⇨ Here, $y - 2\sqrt{y} + 1 = 0$

or, $(y+1)^2 = (2\sqrt{y})^2$

or, $y^2 + 2y + 1 = 4y$

or, $y^2 - 2y + 1 = 0$

or, $(y-1)^2 = 0$

or, $y - 1 = 0$

∴ $y = 1$

Model 2

26. हल गर्नुहोस् (Solve) : $\frac{x-9}{\sqrt{x}+3} = 1$ [2072 FW]

⇨ Here, $\frac{x-9}{\sqrt{x}+3} = 1$

or, $\frac{\sqrt{x^2}-3^2}{\sqrt{x}+3} = 1$

or, $\frac{(\sqrt{x}+3)(\sqrt{x}-3)}{(\sqrt{x}+3)} = 1$

or, $\sqrt{x} - 3 = 1$

or, $\sqrt{x} = 4$

∴ $x = 16$

27. हल गर्नुहोस् (Solve): $\frac{\sqrt{x}-3}{\sqrt{x}} = \frac{2}{5}$ [2064 D1]

⇨ Here, $\frac{\sqrt{x}-3}{\sqrt{x}} = \frac{2}{5}$

or, $5(\sqrt{x}-3) = 2\sqrt{x}$

or, $5\sqrt{x} - 15 = 2\sqrt{x}$

or, $5\sqrt{x} - 2\sqrt{x} = 15$

or, $3\sqrt{x} = 15$

or, $\sqrt{x} = 5$

∴ $x = 25$

28. हल गर्नुहोस् (Solve): $\frac{x-1}{\sqrt{x}+1} = 1$ [2058 D2]

⇨ Here, $\frac{x-1}{\sqrt{x}+1} = 1$

or, $\frac{(\sqrt{x})^2 - 1^2}{\sqrt{x}+1} = 1$

or, $\frac{(\sqrt{x}+1)(\sqrt{x}-1)}{(\sqrt{x}+1)} = 1$

or, $\sqrt{x} - 1 = 1$

or, $\sqrt{x} = 2$

Squaring on both sides $(\sqrt{x})^2 = 2^2$

∴ $x = 4$

29. हल गर्नुहोस् (Solve): $\frac{2(x+3)}{\sqrt{x}+1} = \frac{2}{3}(\sqrt{x}-1)$ [2059 B1]

⇨ Here, $\frac{2(x+3)}{\sqrt{x}+1} = \frac{2}{3}(\sqrt{x}-1)$

or, $\frac{2x+6}{\sqrt{x}+1} = \frac{2(\sqrt{x}-1)}{3}$

or, $6x + 18 = 2(\sqrt{x}-1)(\sqrt{x}+1)$

or, $6x + 18 = 2\{(\sqrt{x})^2 - 1^2\}$

or, $6x + 18 = 2(x-1)$

or, $6x + 18 = 2x - 2$

or, $6x - 2x = -2 - 18$

or, $4x = -20$

∴ $x = -5$

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C. LONG QUESTIONS

Model 1

1. हल गर्नुहोस् (Solve): $\frac{x-1}{\sqrt{x}+1} = 4 + \frac{\sqrt{x}-1}{2}$ [2057 C1, 2058 E2]

⇨ Here, $\frac{x-1}{\sqrt{x}+1} = 4 + \frac{\sqrt{x}-1}{2}$

or, $\frac{(\sqrt{x})^2 - (1)^2}{\sqrt{x}+1} = \frac{8+\sqrt{x}-1}{2}$

or, $\frac{(\sqrt{x}+1)(\sqrt{x}-1)}{(\sqrt{x}+1)} = \frac{\sqrt{x}+7}{2}$

or, $\sqrt{x} - 1 = \frac{\sqrt{x}+7}{2}$

or, $2\sqrt{x} - 2 = \sqrt{x} + 7$

or, $2\sqrt{x} - \sqrt{x} = 7 + 2$

or, $\sqrt{x} = 9$

or, $(\sqrt{x})^2 = 9^2$

∴ $x = 81$

Thus, $x = 81$ is the solution.

2. हल गर्नुहोस् (Solve): $\frac{y-1}{\sqrt{y}-1} - 5 = \frac{\sqrt{y}+1}{2}$ [2064 C1]

⇨ Here, $\frac{y-1}{\sqrt{y}-1} - 5 = \frac{\sqrt{y}+1}{2}$

or, $\frac{(\sqrt{y})^2 - 1^2}{(\sqrt{y}-1)} - 5 = \frac{\sqrt{y}+1}{2}$

or, $\frac{(\sqrt{y}+1)(\sqrt{y}-1)}{(\sqrt{y}-1)} - 5 = \frac{\sqrt{y}+1}{2}$

or, $\sqrt{y} + 1 - 5 = \frac{\sqrt{y}+1}{2}$

or, $\sqrt{y} - 4 = \frac{\sqrt{y}+1}{2}$

or, $2\sqrt{y} - 8 = \sqrt{y} + 1$

or, $2\sqrt{y} - \sqrt{y} = 8 + 1$

or, $\sqrt{y} = 9$

or, $(\sqrt{y})^2 = (9)^2$

∴ $y = 81$

Thus, $y = 81$ is the solution.

3. हल गर्नुहोस् (Solve): $\frac{x-1}{\sqrt{x}+1} = 2 + \frac{\sqrt{x}+1}{3}$ [2067 E]

⇨ Here, $\frac{x-1}{\sqrt{x}+1} = 2 + \frac{\sqrt{x}+1}{3}$

or, $\frac{(\sqrt{x})^2 - (1)^2}{\sqrt{x}+1} = 2 + \frac{\sqrt{x}+1}{3}$

or, $\frac{(\sqrt{x}+1)(\sqrt{x}-1)}{(\sqrt{x}+1)} = 2 + \frac{\sqrt{x}+1}{3}$

or, $\sqrt{x} - 1 = 2 + \frac{\sqrt{x}+1}{3}$

or, $\sqrt{x} - 1 - 2 = \frac{\sqrt{x}+1}{3}$

or, $\sqrt{x} - 3 = \frac{\sqrt{x}+1}{3}$

or, $3\sqrt{x} - 9 = \sqrt{x} + 1$

or, $2\sqrt{x} = 10$

or, $\sqrt{x} = 5$ ∴ $x = 25$

Thus,, $x = 25$ is the solution.

4. हल गर्नुहोस् (Solve): $\frac{\sqrt{x}-5}{3} + 2 = \frac{x-1}{\sqrt{x}+1}$ [SLC 2068 D]

⇨ Here, $\frac{\sqrt{x}-5}{3} + 2 = \frac{x-1}{\sqrt{x}+1}$

or, $\frac{\sqrt{x}-5+6}{3} = \frac{(\sqrt{x})^2 - 1^2}{\sqrt{x}+1}$

or, $\frac{\sqrt{x}+1}{3} = \frac{(\sqrt{x}+1)(\sqrt{x}-1)}{(\sqrt{x}+1)}$

or, $\frac{\sqrt{x}+1}{3} = \frac{\sqrt{x}-1}{1}$

or, $\sqrt{x} + 1 = 3\sqrt{x} - 3$

or, $4 = 2\sqrt{x}$

or, $\sqrt{x} = 2$

∴ $x = 4$

Thus, $x = 4$ is the solution.

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5. हल गर्नुहोस् (Solve): $\frac{5y-4}{\sqrt{5y}+2} = 2 + \frac{\sqrt{5y}-3}{2}$ [2063 D1]

⇨ Here, $\frac{5y-4}{\sqrt{5y}+2} = 2 + \frac{\sqrt{5y}-3}{2}$

or, $\frac{(\sqrt{5y})^2 - 2^2}{\sqrt{5y}+2} = \frac{4+\sqrt{5y}-3}{2}$

or, $\frac{(\sqrt{5y}+2)(\sqrt{5y}-2)}{\sqrt{5y}+2} = \frac{\sqrt{5y}+1}{2}$

or, $\sqrt{5y} - 2 = \frac{\sqrt{5y}+1}{2}$

or, $2\sqrt{5y} - 4 = \sqrt{5y} + 1$

or, $2\sqrt{5y} - \sqrt{5y} = 5$

or, $\sqrt{5y} = 5$

or, $(\sqrt{5y})^2 = 5^2$

or, $5y = 25$

Thus, $y = 5$

6. हल गर्नुहोस् (Solve): $\frac{3x-4}{2+\sqrt{3x}} - \frac{\sqrt{3x}-2}{2} = 2$ [2063 B1, 2064 D1, 2063 B2]

⇨ Here, $\frac{3x-4}{2+\sqrt{3x}} - \frac{\sqrt{3x}-2}{2} = 2$

or, $\frac{3x-4}{\sqrt{3x}+2} = 2 + \frac{\sqrt{3x}-2}{2}$

or, $\frac{(\sqrt{3x})^2 - 2^2}{(\sqrt{3x}+2)} = \frac{4+\sqrt{3x}-2}{2}$

or, $\frac{(\sqrt{3x}+2)(\sqrt{3x}-2)}{(\sqrt{3x}+2)} = \frac{\sqrt{3x}+2}{2}$

or, $\sqrt{3x} - 2 = \frac{\sqrt{3x}+2}{2}$

or, $2\sqrt{3x} - 4 = \sqrt{3x} + 2$

or, $2\sqrt{3x} - \sqrt{3x} = 2 + 4$

or, $\sqrt{3x} = 6$

Squaring on both sides, $(\sqrt{3x})^2 = 6^2$

or, $3x = 36$ Thus, $x = 12$

7. हल गर्नुहोस् (Solve): $\frac{y-25}{5+\sqrt{y}} = 4 + \frac{\sqrt{y}-5}{5}$ [2063 E2]

⇨ Here, $\frac{y-25}{5+\sqrt{y}} = 4 + \frac{\sqrt{y}-5}{5}$

or, $\frac{(\sqrt{y})^2 - 5^2}{\sqrt{y}+5} = \frac{20+\sqrt{y}-5}{5}$

or, $\frac{(\sqrt{y}+5)(\sqrt{y}-5)}{(\sqrt{y}+5)} = \frac{\sqrt{y}+15}{5}$

or, $\sqrt{y} - 5 = \frac{\sqrt{y}+15}{5}$

or, $5\sqrt{y} - 25 = \sqrt{y} + 15$

or, $5\sqrt{y} - \sqrt{y} = 15 + 25$

or, $4\sqrt{y} = 40$

or, $\sqrt{y} = 10$

∴ $y = 100$

8. हल गर्नुहोस् (Solve): $\frac{5x-4}{\sqrt{5x}+2} = 2 - \frac{\sqrt{5x}+2}{2}$ [2063 D2]

⇨ Here, $\frac{5x-4}{\sqrt{5x}+2} = 2 - \frac{\sqrt{5x}+2}{2}$

or, $\frac{(\sqrt{5x})^2 - 2^2}{\sqrt{5x}+2} = \frac{4-(\sqrt{5x}+2)}{2}$

or, $\frac{(\sqrt{5x}+2)(\sqrt{5x}-2)}{(\sqrt{5x}+2)} = \frac{4-\sqrt{5x}-2}{2}$

or, $2\sqrt{5x} - 4 = 2 - \sqrt{5x}$

or, $2\sqrt{5x} + \sqrt{5x} = 2 + 4$

or, $3\sqrt{5x} = 6$

or, $\sqrt{5x} = \frac{6}{3}$

or, $\sqrt{5x} = 2$

or, $(\sqrt{5x})^2 = 2^2$

or, $5x = 4$

∴ $x = \frac{4}{5}$

9. हल गर्नुहोस् (Solve): $\frac{x-4}{2+\sqrt{x}} = 2 + \frac{\sqrt{x}-2}{2}$ [2063 E1]

⇨ Here, $\frac{x-4}{2+\sqrt{x}} = 2 + \frac{\sqrt{x}-2}{2}$

or, $\frac{(\sqrt{x})^2 - 2^2}{\sqrt{x}+2} = \frac{4+\sqrt{x}-2}{2}$

or, $\frac{(\sqrt{x}+2)(\sqrt{x}-2)}{(\sqrt{x}+2)} = \frac{\sqrt{x}+2}{2}$

or, $\sqrt{x} - 2 = \frac{\sqrt{x}+2}{2}$

or, $2\sqrt{x} - 4 = \sqrt{x} + 2$

or, $2\sqrt{x} - \sqrt{x} = 2 + 4$

or, $\sqrt{x} = 6$

Squaring on both sided, we get $(\sqrt{x})^2 = 6^2$

Thus, $x = 36$

10. हल गर्नुहोस् (Solve): $\frac{5x-9}{3+\sqrt{5x}} = 1 + \frac{\sqrt{5x}-3}{2}$ [2064 D2]

⇨ Here, $\frac{5x-9}{3+\sqrt{5x}} = 1 + \frac{\sqrt{5x}-3}{2}$

or, $\frac{(\sqrt{5}\,x)^2 - 3^2}{3+\sqrt{5x}} = 1 + \frac{\sqrt{5x}-3}{2}$

or, $\frac{(\sqrt{5x}+3)(\sqrt{5x}-3)}{(3+\sqrt{5x})} = \frac{2+\sqrt{5x}-3}{2}$

or, $\sqrt{5x} - 3 = \frac{\sqrt{5x}-1}{2}$

or, $2\sqrt{5x} - 6 = \sqrt{5x} - 1$

or, $2\sqrt{5x} - \sqrt{5x} = 6 - 1$

or, $\sqrt{5x} = 5$

or, $(\sqrt{5x})^2 = (5)^2$

or, $5x = 25$

∴ $x = 5$

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11. हल गर्नुहोस् (Solve): $\sqrt{x} + \sqrt{x+13} = \frac{91}{\sqrt{x+13}}$

⇨ Here, $\sqrt{x} + \sqrt{x+13} = \frac{91}{\sqrt{x+13}}$

or, $\frac{\sqrt{x}+\sqrt{x+13}}{1} = \frac{91}{\sqrt{x+13}}$

or, $\sqrt{x}\sqrt{x+13} + (\sqrt{x+13})^2 = 91$

or, $\sqrt{x^2+13x} + x + 13 = 91$

or, $\sqrt{x^2+13x} = 91 - 13 - x$

or, $\sqrt{x^2+13x} = 78 - x$

Squaring on both sides, $(\sqrt{x^2+13x})^2 = (78-x)^2$

or, $x^2 + 13x = (78)^2 - 2.78.x + x^2$

or, $x^2 + 13x = 6084 - 156x + x^2$

or, $x^2 + 13x + 156x - x^2 = 6084$

or, $169x = 6084$

or, $x = \frac{6084}{169}$

Thus, $x = 36$

14. हल गर्नुहोस् (Solve): $\sqrt{y} + \sqrt{y - \sqrt{1-y}} = 1$

⇨ Here, $\sqrt{y} + \sqrt{y - \sqrt{1-y}} = 1$

or, $\sqrt{y - \sqrt{1-y}} = 1 - \sqrt{y}$

or, $y - \sqrt{1-y} = 1 - 2.1.\sqrt{y} + y$

[Squaring both sides]

or, $y - \sqrt{1-y} = 1 - 2\sqrt{y} + y$

or, $-\sqrt{1-y} = 1 - 2\sqrt{y}$

or, $(-\sqrt{1-y})^2 = (1-2\sqrt{y})^2$

or, $1 - y = 1 - 2.1.2\sqrt{y} + (2\sqrt{y})^2$

or, $1 - y = 1 - 4\sqrt{y} + 4y$

or, $4\sqrt{y} = 4y + y$

or, $4\sqrt{y} = 5y$

or, $16y = 25y^2$

or, $25y^2 - 16y = 0$

or, $y(25y - 16) = 0$

Either, $y = 0$

or, $25y - 16 = 0$

or, $25y = 16$

or, $y = \frac{16}{25}$

$y = 0$ does not satisfy the given equations.

Thus, the value of y is $\frac{16}{25}$.

12. हल गर्नुहोस् (Solve): $\sqrt{x} + \sqrt{5+x} = \frac{15}{\sqrt{5+x}}$

⇨ Here, $\sqrt{x} + \sqrt{5+x} = \frac{15}{\sqrt{5+x}}$

or, $\sqrt{x}(\sqrt{5+x}) + (\sqrt{5+x})^2 = 15$

or, $\sqrt{x}(\sqrt{5+x}) + 5 + x = 15$

or, $\sqrt{5x+x^2} + x = 15 - 5$

or, $\sqrt{5x+x^2} + x = 10$

or, $\sqrt{5x+x^2} = 10 - x$

or, $(\sqrt{5x+x^2})^2 = (10-x)^2$

or, $5x + x^2 = 100 - 2 . 10 . x + x^2$

or, $5x + x^2 = 100 - 20x + x^2$

or, $5x + 20x + x^2 - x^2 = 100$

or, $25x = 100$

or, $x = \frac{100}{25}$

Thus, $x = 4$

13. हल गर्नुहोस् (Solve): $\frac{\sqrt{x}+\sqrt{a}}{\sqrt{x}-\sqrt{a}} = 4\sqrt{2} + \frac{\sqrt{x}-\sqrt{a}}{\sqrt{x}+\sqrt{a}}$

⇨ Here, $\frac{\sqrt{x}+\sqrt{a}}{\sqrt{x}-\sqrt{a}} = 4\sqrt{2} + \frac{\sqrt{x}-\sqrt{a}}{\sqrt{x}+\sqrt{a}}$

or, $\frac{\sqrt{x}+\sqrt{a}}{\sqrt{x}-\sqrt{a}} - \frac{\sqrt{x}-\sqrt{a}}{\sqrt{x}+\sqrt{a}} = 4\sqrt{2}$

or, $\frac{(\sqrt{x}+\sqrt{a})^2 - (\sqrt{x}-\sqrt{a})^2}{(\sqrt{x}-\sqrt{a})(\sqrt{x}+\sqrt{a})} = 4\sqrt{2}$

or, $\frac{(x + 2\sqrt{x}.\sqrt{a} + a) - (x - 2\sqrt{x}\sqrt{a} + a)}{(\sqrt{x})^2 - (\sqrt{a})^2} = 4\sqrt{2}$

or, $\frac{x + 2\sqrt{xa} + a - x + 2\sqrt{xa} - a}{x - a} = 4\sqrt{2}$

or, $\frac{4\sqrt{xa}}{x-a} = 4\sqrt{2}$

or, $\frac{\sqrt{xa}}{x-a} = \sqrt{2}$

or, $\frac{xa}{(x-a)^2} = 2$

or, $xa = 2(x^2 - 2xa + a^2)$

or, $xa = 2x^2 - 4xa + 2a^2$

or, $0 = 2x^2 - 5xa + 2a^2$

or, $0 = 2x^2 - 4xa - xa + 2a^2$

or, $2x(x - 2a) - a(x - 2a) = 0$

or, $(x - 2a)(2x - a) = 0$

Either, $x - 2a = 0$

$\therefore \quad x = 2a$

or, $2x - a = 0$

or, $2x = a$

$\therefore \quad x = \frac{a}{2}$

Thus, the value of x is 2a or $\frac{a}{2}$.

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B. QUESTIONS FROM CDC TEXT BOOK

हल गर्नुहोस् र जाँच्नुहोस्: (Solve and test):

1A. $\sqrt{x-5} = 3$

⇨ Here, $\sqrt{x-5} = 3$

Squaring both the sides then, $(\sqrt{x-5})^2 = 3^2$

or, $x - 5 = 9$

∴ $x = 14$

Testing

$\sqrt{x-5} = 3$

or, $\sqrt{14-5} = 3$

or, $\sqrt{9} = 3$

∴ $3 = 3$ (True)

1B. $7 - \sqrt{x-4} = 3$

⇨ Here, $7 - \sqrt{x-4} = 3$

$7 - 3 = \sqrt{x-4}$

Squaring on both the sides, $4^2 = (\sqrt{x-4})^2$

or, $16 = x - 4$ or, $20 = x$

∴ $x = 20$

Testing

$7 - \sqrt{x-4} = 3$

or, $7 - \sqrt{20-4} = 3$

or, $7 - \sqrt{16} = 3$

or, $7 - 4 = 3$

∴ $3 = 3$ (True)

1C. $\sqrt[3]{4x-7} = 5$

⇨ Here, $\sqrt[3]{4x-7} = 5$

Cubing on both the sides,

$(\sqrt[3]{4x-7})^3 = (5)^3$

or, $4x - 7 = 125$

or, $4x = 132$

∴ $x = 33$

Testing

$\sqrt[3]{4x-7} = 5$

or, $\sqrt[3]{4 \times 33 - 7} = 5$

or, $\sqrt[3]{132-7} = 5$

or, $\sqrt[3]{125} = 5$

∴ $5 = 5$ (True)

1D. $13 - \sqrt[3]{5x-4} = 7$

⇨ Here, $13 - \sqrt[3]{5x-4} = 7$

or, $13 - 7 = \sqrt[3]{5x-4}$

or, $6 = \sqrt[3]{5x-4}$

Cubing on both the sides, $6^3 = (\sqrt[3]{5x-4})^3$

or, $216 = 5x - 4$

or, $220 = 5x$

∴ $x = 44$

Testing

$13 - \sqrt[3]{5x-4} = 7$

or, $13 - \sqrt[3]{5 \times 44 - 4} = 7$

or, $13 - \sqrt[3]{216} = 7$

or, $13 - 6 = 7$

∴ $7 = 7$ (True)

2A. $\sqrt{x+25} = 1 + \sqrt{x}$

⇨ Here, $\sqrt{x+25} = 1 + \sqrt{x}$

Squaring on both the sides,

or, $(\sqrt{x+25})^2 = (1+\sqrt{x})^2$

or, $x + 25 = 1 + 2\sqrt{x} + x$

or, $24 = 2\sqrt{x}$

or, $\sqrt{x} = 12$

∴ $x = 144$

Testing

$\sqrt{x+25} = 1 + \sqrt{x}$

or, $\sqrt{144+25} = 1 + \sqrt{144}$

or, $\sqrt{169} = 1 + 12$

∴ $13 = 13$ (True)

2B. $\sqrt{x+9} + \sqrt{x} = 9$

⇨ Here, $\sqrt{x+9} + \sqrt{x} = 9$

or, $\sqrt{x+9} = 9 - \sqrt{x}$

Squaring on both the sides,

$x + 9 = 9^2 - 2.9.\sqrt{x} + x$

or, $9 = 81 - 18\sqrt{x}$

or, $18\sqrt{x} = 72$

∴ $x = 16$

Testing

$\sqrt{x+9} + \sqrt{x} = 9$

or, $\sqrt{16+9} + \sqrt{16} = 9$

or, $\sqrt{25} + \sqrt{16} = 9$

or, $5 + 4 = 9$

∴ $9 = 9$ (True)

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2C. $\sqrt{x-4}+3=\sqrt{x+11}$

⇨ Here, $\sqrt{x-4}+3=\sqrt{x+11}$

Squaring on both the sides; $(\sqrt{x-4}+3)^2=(\sqrt{x+11})^2$

or, $x-4+6\sqrt{x-4}+9=x+11$

or, $5+6\sqrt{x-4}=11$

or, $6\sqrt{x-4}=6$

or, $\sqrt{x-4}=1$

or, $x-4=1$ $\quad\therefore\quad x=5$

Thus, the value of x is 5.

Testing

$\sqrt{x-4}+3=\sqrt{x+11}$

or, $\sqrt{5-4}+3=\sqrt{5+11}$

or, $\sqrt{1}+3=\sqrt{16}$

or, $4=4$ (True)

2D. $\sqrt{9x-8}=3\sqrt{x+3}-5$

⇨ Here, $\sqrt{9x-8}=3\sqrt{x+3}-5$

Squaring on both the sides; $(\sqrt{9x-8})^2=(3\sqrt{x+3}-5)^2$

or, $9x-8=(3\sqrt{x+3})^2-2.3\sqrt{x+3}.5+5^2$

or, $9x-8=9(x+3)-30\sqrt{x+3}+25$

or, $9x-8=9x+27-30\sqrt{x+3}+25$

or, $30\sqrt{x+3}=60$

or, $\sqrt{x+3}=2$

or, $(\sqrt{x+3})^2=2^2$

or, $x+3=4$

$\therefore\quad x=1$

Thus, the value of x is 1.

Testing

$\sqrt{9x-8}=3\sqrt{x+3}-5$

or, $\sqrt{9\times1-8}=3\sqrt{1+3}-5$

or, $\sqrt{1}=3\times2-5$

or, $1=6-5$

$\therefore\quad 1=1$ (True)

3A. $\sqrt{x-1}+\sqrt{x}=\dfrac{2}{\sqrt{x}}$

⇨ Here, $\sqrt{x-1}=\dfrac{2}{\sqrt{x}}-\sqrt{x}$

Squaring on both the sides;

$(\sqrt{x-1})^2=\left(\dfrac{2}{\sqrt{x}}\right)^2-2.\dfrac{2}{\sqrt{x}}\times\sqrt{x}+(\sqrt{x})^2$

or, $x-1=\dfrac{4}{x}-4+x$

or, $3=\dfrac{4}{x}$

or, $3x=4$

$\therefore\quad x=\dfrac{4}{3}$

Testing

$\sqrt{x-1}=\dfrac{2}{\sqrt{x}}-\sqrt{x}$

or, $\sqrt{\dfrac{4}{3}-1}=\dfrac{2}{\sqrt{\frac{4}{3}}}-\sqrt{\dfrac{4}{3}}$

or, $\sqrt{\dfrac{1}{3}}=\dfrac{2\sqrt{3}}{2}-\sqrt{\dfrac{4}{3}}$

or, $\dfrac{1}{\sqrt{3}}=\sqrt{3}-\dfrac{2}{\sqrt{3}}$

or, $\dfrac{1}{\sqrt{3}}=\dfrac{3-2}{\sqrt{3}}$

$\therefore\quad \dfrac{1}{\sqrt{3}}=\dfrac{1}{\sqrt{3}}$ (True)

3B. $\dfrac{x-1}{\sqrt{x}-1}=3+\dfrac{\sqrt{x}+1}{2}$

⇨ Here, $\dfrac{x-1}{\sqrt{x}-1}=3+\dfrac{\sqrt{x}+1}{2}$

or, $\dfrac{(\sqrt{x})^2-1^2}{\sqrt{x}-1}=3+\dfrac{\sqrt{x}+1}{2}$

or, $\dfrac{(\sqrt{x}+1)(\sqrt{x}-1)}{\sqrt{x}-1}=3+\dfrac{\sqrt{x}+1}{2}$

or, $\sqrt{x}+1=\dfrac{6+\sqrt{x}+1}{2}$

or, $2\sqrt{x}+2=7+\sqrt{x}$ $\quad$ or, $\sqrt{x}=5$

$\therefore\quad x=25$

Thus, the value of x is 25.

Testing

$\dfrac{x-1}{\sqrt{x}-1}=3+\dfrac{\sqrt{x}+1}{2}$

or, $\dfrac{25-1}{\sqrt{25}-1}=3+\dfrac{\sqrt{25}+1}{2}$

or, $\dfrac{24}{5-1}=3+\dfrac{5+1}{2}$

or, $\dfrac{24}{4}=3+3$

$\therefore\quad 6=6$ (True)

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3C. $\sqrt{x^2-3x+3}+\sqrt{x^2-x+1}=2$

⇨ Here, $\sqrt{x^2-3x+3}+\sqrt{x^2-x+1}=2$

or, $\sqrt{x^2-3x+3}=2-\sqrt{x^2-x+1}$

Squaring on the both sides,

or, $x^2-3x+3=(2-\sqrt{x^2-x+1})^2$

or, $x^2-3x+3=2^2-2.2.\sqrt{x^2-x+1}+(\sqrt{x^2-x+1})^2$

or, $x^2-3x+3=4-4\sqrt{x^2-x+1}+x^2-x+1$

or, $-2x-2=-4\sqrt{x^2-x+1}$

or, $-2(x+1)=-4\sqrt{x^2-x+1}$

or, $(x+1)=2\sqrt{x^2-x+1}$

or, $x^2+2x+1=4(x^2-x+1)$

or, $x^2+2x+1=4x^2-4x+4$

or, $3x^2-6x+3=0$ or, $x^2-2x+1=0$

or, $(x-1)^2=0$ ∴ $x=1$

Thus, the value of x is 1.

Testing x = 1

$\sqrt{x^2-3x+3}+\sqrt{x^2-x+1}=2$

or, $\sqrt{1^2-3\times1+3}+\sqrt{1^2-1+1}=2$

or, $\sqrt{1}+\sqrt{1}=2$

or, $1+1=2$

∴ $2=2$ (True)

3D. $\dfrac{\sqrt{x+4}+\sqrt{x-4}}{\sqrt{x+4}-\sqrt{x-4}}=2$

⇨ Here, $\dfrac{\sqrt{x+4}+\sqrt{x-4}}{\sqrt{x+4}-\sqrt{x-4}}=2$

or, $\dfrac{\sqrt{x+4}+\sqrt{x-4}}{\sqrt{x+4}-\sqrt{x-4}}=\dfrac{2}{1}$

or, $2\sqrt{x+4}-2\sqrt{x-4}=\sqrt{x+4}+\sqrt{x-4}$

or, $\sqrt{x+4}=3\sqrt{x-4}$

Squaring both the sides; $x+4=9(x-4)$

or, $x+4=9x-36$

or, $40=8x$ ∴ $x=5$

Testing x = 5

$\dfrac{\sqrt{5+4}+\sqrt{5-4}}{\sqrt{5+4}-\sqrt{5-4}}=\dfrac{2}{1}$

or, $\dfrac{\sqrt{9}+\sqrt{1}}{\sqrt{9}-\sqrt{1}}=\dfrac{2}{1}$

or, $\dfrac{3+1}{3-1}=\dfrac{2}{1}$

or, $\dfrac{4}{2}=\dfrac{2}{1}$

∴ $2=2$ (True)

4. $\sqrt{x^2-2x-4}-\sqrt{x^2-3x-3}=1$ लाई हल गर्दा x को मान 4 र $-\frac{4}{3}$ आउँछ भनी देखाउनुहोस्। $x=-\frac{4}{3}$ ले समीकरणलाई सन्तुष्ट गर्दैन किन ? कारण खोज्नुहोस्।

Show that the value of x is is 4 and $-\frac{4}{3}$ when $\sqrt{x^2-2x-4}-\sqrt{x^2-3x-3}=1$ is solved. Why $x=-\frac{4}{3}$ does not satisfy the equation, find the reason.

⇨ Here, $\sqrt{x^2-2x-4}-\sqrt{x^2-3x-3}=1$

Squaring on both the sides, $(\sqrt{x^2-2x-4})^2=(1+\sqrt{x^2-3x-3})^2$

or, $x^2-2x-4=1+2.1.\sqrt{x^2-3x-3}+x^2-3x-3$

or, $x^2-2x-4=1+2\sqrt{x^2-3x-3}+x^2-3x-3$

or, $x-2=2\sqrt{x^2-3x-3}$

Squaring on both the sides; $(x-2)^2=(2\sqrt{x^2-3x-3})^2$

or, $x^2-4x+4=4(x^2-3x-3)$

or, $3x^2-8x-16=0$

or, $3x(x-4)+4(x-4)=0$

Either, $x-4=0$

∴ $x=4$

or, $x^2-4x+4=4x^2-12x-12$

or, $3x^2-12x+4x-16=0$

or, $(x-4)(3x+4)=0$

or, $3x+4=0$

or, $3x=-4$

∴ $x=-\dfrac{4}{3}$

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Testing

At x = 4

$\sqrt{x^2-2x-4}-\sqrt{x^2-3x-3}=1$

or, $\sqrt{4^2-2\times4-4}-\sqrt{4^2-3\times4-3}=1$

or, $\sqrt{4}-\sqrt{1}=1$

or, $2-1=1$

$\therefore$ $1=1$ (True)

At $x=-\frac{4}{3}$

$\sqrt{x^2-2x-4}-\sqrt{x^2-3x-3}=1$

or, $\sqrt{\frac{16}{9}+2\times\frac{4}{3}-4}-\sqrt{\frac{16}{9}+3\times\frac{4}{3}-3}=1$

or, $\sqrt{\frac{4}{9}}-\sqrt{\frac{25}{9}}=1$

or, $\frac{2}{3}-\frac{5}{3}=1$

or, $-\frac{3}{3}=1$

or, $-1=1$ (false)

Reason given equation has highest degree 1. So it will have just one or single value of x.

$\therefore$ $x=4$.

5. $\frac{x-1}{\sqrt{x}+1}=4+\frac{\sqrt{x}-1}{2}$ लाई समाधान गर्दा $x=81$ भनी प्रमाणित गर्नुहोस् । उक्त समीकरण हल गर्दा आउने x को कुन मान उक्त समीकरणका लागि समाधान हुँदैन, किन ? कारण लेख्नुहोस् ।

Prove that $x=81$ is the solution of $\frac{x-1}{\sqrt{x}+1}=4+\frac{\sqrt{x}-1}{2}$, which value obtained by solving the equation does not satisfy the equation ? Why write the reason.

⇨ Here, $\frac{x-1}{\sqrt{x}+1}=4+\frac{\sqrt{x}-1}{2}$

or, $\frac{x-1}{\sqrt{x}+1}=\frac{8+\sqrt{x}-1}{2}$

or, $\frac{x-1}{\sqrt{x}+1}=\frac{\sqrt{x}+7}{2}$

or, $2x-2=x+7\sqrt{x}+\sqrt{x}+7$

or, $x-9=8\sqrt{x}$

Squaring on both the sides,

$(x-9)^2=(8\sqrt{x})^2$

or, $x^2-18x+81=64x$

or, $x^2-82x+81=0$

or, $x^2-81x-x+81=0$

or, $x(x-81)-1(x-81)=0$

or, $(x-81)(x-1)=0$

Either, $x-81=0$

$\therefore$ $x=81$

or, $x-1=0$ $\therefore$ $x=1$

Testing: x = 81

$\frac{x-1}{\sqrt{x}+1}=4+\frac{\sqrt{x}-1}{2}$

or, $\frac{81-1}{\sqrt{81}+1}=4+\frac{\sqrt{81}-1}{2}$

or, $\frac{80}{9+1}=4+\frac{9-1}{2}$ or, $\frac{80}{10}=4+\frac{8}{2}$

or, $8=4+4$

$\therefore$ $8=8$ (True)

Testing: x = 1

$\frac{x-1}{\sqrt{x}+1}=4+\frac{\sqrt{x}-1}{2}$

or, $\frac{1-1}{\sqrt{1}+1}=4+\frac{\sqrt{1}-1}{2}$

or, $\frac{0}{2}=4+\frac{0}{2}$ or, $0=4+0$ (False)

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10. घाताङ्क (Indices)

10.1 घाताङ्ककको सरलीकरण (SIMPLIFICATION OF INDICES)

A. BASIC EXERCISE 10.1

A. VERY SHORT QUESTIONS

1. (a) $5m$ को घाताङ्क कति हुँदा त्यसको मान $1^{(a+b)}$ हुन्छ ? (What index of $(5m)$ makes the value equal to $1^{(a+b)}$?)

⇨ Here, $(5m)^0 = 1^{(a+b)}$ or, $1 = 1^{a+b}$

Thus, index of 5 m is zero to make it $1^{(a+b)}$.

(b) 6 को घाताङ्क कति हुँदा त्यसको मान $\frac{1}{36}$ हुन्छ ?

What is the power of 6 so that its value becomes $\frac{1}{36}$?

⇨ Here, $6^{-2} = \frac{1}{6^2} = \frac{1}{36}$ So, the power of 6 is -2 to become $\frac{1}{36}$

2. (a) a को घाताङ्क कति हुँदा $\frac{1}{a^2}$ हुन्छ ? (What index of a will be $\frac{1}{a^2}$?)

⇨ Here, $a^{-2} = \frac{1}{a^2}$. Thus, index of a is -2 to become $\frac{1}{a^2}$

(b) p को घाताङ्क कति हुँदा $\frac{1}{p^3}$ हुन्छ ? (What index of p will be $\frac{1}{p^3}$?)

⇨ Here, $p^{-3} = \frac{1}{p^3}$. Thus, index of p is -3 to become $\frac{1}{p^3}$.

3. गुणनफल पत्ता लगाउनुहोस् (Find the product):

(a) $x^5 \times x^3$ (b) $a^8 \times a^{-6}$ (c) $a^3 \times \frac{1}{a^{-4}}$ (d) $a^8 \times \frac{1}{a^4}$

⇨ (a) Here, $x^5 \times x^3 = x^{5+3} = x^8$ (b) Here, $a^8 \times a^{-6} = a^{8-6} = a^2$

(c) Here, $a^3 \times \frac{1}{a^{-4}} = a^3 \times a^4 = a^{3+4} = a^7$ (d) Here, $a^8 \times \frac{1}{a^4} = a^{8-4} = a^4$

4. (a) a को मान कति हुँदा x^2 सँग $\sqrt[a]{x^8}$ बराबर हुन्छ ? (For what value of a makes $\sqrt[a]{x^8}$ equal to x^2 ?)

(b) a को मान कति हुँदा x^3 सँग $\sqrt[3]{x^n}$ बराबर हुन्छ ? (For what value of a makes $\sqrt[3]{x^n}$ equal to x^3 ?)

(c) x को मान कति हुँदा $\sqrt[1/x]{a^5}$ सँग a बराबर हुन्छ ? (For what value of x makes $\sqrt[1/x]{a^5}$ equal to a ?)

⇨ (a) Here, $\sqrt[a]{x^8} = x^2$

or, $x^{\frac{8}{a}} = x^2$

i.e. $\frac{8}{a} = 2 \Rightarrow a = \frac{8}{2} = 4$

$\therefore \quad a = 4$

(b) Here, $\sqrt[3]{x^n} = x^3$

or, $x^{\frac{n}{3}} = x^3$

or, $\frac{n}{3} = 3$

$\therefore \quad n = 9$

(c) Here, $\sqrt[\frac{1}{x}]{a^5} = a$

or, $a^{\frac{5}{\frac{1}{x}}} = a$ or, $\frac{5}{\frac{1}{x}} = 1$

or, $5x = 1$ $\therefore \quad x = \frac{1}{5}$

5. गणना गर्नुहोस् (Evaluate):

(a) $(216)^{\frac{2}{3}}$ (b) $(625)^{\frac{3}{4}}$ (c) $(256)^{\frac{3}{4}}$ (d) $(125)^{\frac{2}{3}}$

⇨ (a) Here $(216)^{\frac{2}{3}} = (6^3)^{\frac{2}{3}} = 6^{3 \times \frac{2}{3}} = 6^2 = 36$ (b) Here, $(625)^{\frac{3}{4}} = (5^4)^{\frac{3}{4}} = 5^{4 \times \frac{3}{4}} = 5^3 = 125$

(c) Here, $(256)^{\frac{3}{4}} = (4^4)^{\frac{3}{4}} = 4^{4 \times \frac{3}{4}} = 4^3 = 64$ (d) Here, $(125)^{\frac{2}{3}} = (5^3)^{\frac{2}{3}} = 5^{3 \times \frac{2}{3}} = 5^2 = 25$

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B. SHORT QUESTIONS

Model 1

1. मान पत्ता लगाउनुहोस् (Find the value of): $\left(\frac{27}{8}\right)^{-1/3}\left[\left(\frac{81}{16}\right)^{1/4} \div \left(\frac{4}{25}\right)^{-1/2}\right]$ **[2060 C1]**

⇨ Here, $\left(\frac{27}{8}\right)^{-1/3}\left[\left(\frac{81}{16}\right)^{1/4} \div \left(\frac{4}{25}\right)^{-1/2}\right] = \left(\frac{8}{27}\right)^{\frac{1}{3}}\left[\left(\frac{81}{16}\right)^{\frac{1}{4}} \div \left(\frac{25}{4}\right)^{\frac{1}{2}}\right]$

$= \left(\frac{2}{3}\right)^{3\times\frac{1}{3}}\left[\left(\frac{3}{2}\right)^{4\times\frac{1}{4}} \div \left(\frac{5}{2}\right)^{2\times\frac{1}{2}}\right] = \frac{2}{3}\left[\frac{3}{2}\times\frac{2}{5}\right] = \frac{2}{3}\times\frac{3}{5} = \frac{2}{5}$

2. मान पत्ता लगाउनुहोस् (Find the value of): $\left(\frac{25}{16}\right)^{-1/2}\left[\left(\frac{125}{64}\right)^{1/3} \div \left(\frac{8}{27}\right)^{-1/3}\right]$ **[2060 C2]**

⇨ Here, $\left(\frac{25}{16}\right)^{-1/2}\left[\left(\frac{125}{64}\right)^{1/3} \div \left(\frac{8}{27}\right)^{-1/3}\right]$

$= \left(\frac{16}{25}\right)^{\frac{1}{2}}\left[\left(\frac{125}{64}\right)^{\frac{1}{3}} \div \left(\frac{27}{8}\right)^{\frac{1}{3}}\right] = \left(\frac{4}{5}\right)^{2\times\frac{1}{2}}\left[\left(\frac{5}{4}\right)^{3\times\frac{1}{3}} \div \left(\frac{3}{2}\right)^{3\times\frac{1}{3}}\right] = \frac{4}{5}\left[\frac{5}{4} \div \frac{3}{2}\right]$

$= \frac{4}{5}\left[\frac{5}{4}\times\frac{2}{3}\right] = \frac{4}{5}\times\frac{5}{6} = \frac{4}{6} = \frac{2}{3}$

3. सरल गर्नुहोस् (Simplify): $\frac{14^6 \times 15^5}{35^6 \times 6^5}$ **[2057 B1]**

⇨ Here, $\frac{14^6 \times 15^5}{35^6 \times 6^5} = \frac{(7\times2)^6 \times (5\times3)^5}{(7\times5)^6 \times (2\times3)^5} = \frac{7^6 \times 2^6 \times 5^5 \times 3^5}{7^6 \times 5^6 \times 2^5 \times 3^5} = \frac{2^6 \times 5^5}{5^6 \times 2^5} = \frac{2^{6-5}}{5^{6-5}} = \frac{2}{5}$

Model 2

4. सरल गर्नुहोस् (Simplify): $(64x^3 \div 27a^{-3})^{\frac{-2}{3}}$ **[2060 A2]**

⇨ Here, $(64x^3 \div 27a^{-3})^{\frac{-2}{3}} = \left(\frac{64x^3}{27a^{-3}}\right)^{-2/3} = \left(\frac{64x^3a^3}{27}\right)^{-2/3} = \left(\frac{27}{64x^3a^3}\right)^{2/3}$

$= \left\{\left(\frac{3}{4xa}\right)^3\right\}^{2/3} = \left(\frac{3}{4xa}\right)^2 = \frac{9}{16x^2a^2}$

5. सरल गर्नुहोस् (Simplify): $(8x^3 \div 27a^{-3})^{-2/3}$ **[2064 D1]**

⇨ Here, $\left(\frac{8x^3}{27a^{-3}}\right)^{-2/3} = \left(\frac{8x^3a^3}{27}\right)^{-2/3} = \left(\frac{27}{8x^3a^3}\right)^{2/3} = \left(\frac{3}{2xa}\right)^{3\times2/3}$

$= \left(\frac{3}{2xa}\right)^2 = \frac{9}{4x^2a^2}$

6. सरल गर्नुहोस् (Simplify): $\left(\frac{b^x}{c^x}\right)^y\left(\frac{c^y}{a^y}\right)^x\left(\frac{a^x}{b^x}\right)^y$ **[2060 B1]**

⇨ Here, $\left(\frac{b^x}{c^x}\right)^y\left(\frac{c^y}{a^y}\right)^x\left(\frac{a^x}{b^x}\right)^y = \frac{b^{xy}}{c^{xy}} \cdot \frac{c^{xy}}{a^{xy}} \cdot \frac{a^{xy}}{b^{xy}} = 1$

7. सरल गर्नुहोस् (Simplify): $\sqrt[a+b]{x^{a^2-b^2}} \cdot \sqrt[b+c]{x^{b^2-c^2}} \cdot \sqrt[c+a]{x^{c^2-a^2}}$ **[2058 C1]**

⇨ Here, $\sqrt[a+b]{x^{a^2-b^2}} \cdot \sqrt[b+c]{x^{b^2-c^2}} \cdot \sqrt[c+a]{x^{c^2-a^2}}$

$= \left(x^{a^2-b^2}\right)^{\frac{1}{a+b}} \cdot \left(x^{b^2-c^2}\right)^{\frac{1}{b+c}} \cdot \left(x^{c^2-a^2}\right)^{\frac{1}{c+a}}$

$= x^{\frac{(a+b)(a-b)}{(a+b)}} \cdot x^{\frac{(b+c)(b-c)}{(b+c)}} \cdot x^{\frac{(c+a)(c-a)}{(c+a)}} = x^{a-b} \cdot x^{b-c} \cdot x^{c-a}$

$= x^{a-b+b-c+c-a} = x^0 = 1$

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Model 3

8. सरल गर्नुहोस् (Simplify): $\frac{1}{1+x^{a-b}}+\frac{1}{1+x^{b-a}}$ [2059 D1, 2062 D1, C1]

⇨ Here, $\frac{1}{1+x^{a-b}}+\frac{1}{1+x^{b-a}}=\frac{1}{1+\frac{x^a}{x^b}}+\frac{1}{1+\frac{x^b}{x^a}}=\frac{1}{\frac{x^b+x^a}{x^b}}+\frac{1}{\frac{x^a+x^b}{x^a}}=\frac{x^b}{x^a+x^b}+\frac{x^a}{x^a+x^b}$

$=\frac{x^b+x^a}{x^a+x^b}=\frac{x^a+x^b}{x^a+x^b}=1$

9. सरल गर्नुहोस् (Simplify): $\frac{1}{1-a^{x-y}}+\frac{1}{1-a^{y-x}}$ [2059 D2, 2062 C2, E1, E2, 2065 A]

⇨ Here, $\frac{1}{1-a^{x-y}}+\frac{1}{1-a^{y-x}}=\frac{1}{1-a^x.a^{-y}}+\frac{1}{1-a^y.a^{-x}}=\frac{1}{1-\frac{a^x}{a^y}}+\frac{1}{1-\frac{a^y}{a^x}}=\frac{1}{\frac{a^y-a^x}{a^y}}+\frac{1}{\frac{a^x-a^y}{a^x}}$

$=\frac{a^y}{a^y-a^x}+\frac{a^x}{a^x-a^y}=\frac{a^y}{a^y-a^x}-\frac{a^x}{a^y-a^x}=\frac{a^y-a^x}{a^y-a^x}=1$

10. मान निकाल्नुहोस् (Evaluate): $(1-x^{m-n})^{-1}+(1-x^{n-m})^{-1}$

⇨

Here, $\frac{1}{1-x^{m-n}}+\frac{1}{1-x^{n-m}}=\frac{1}{1-x^{m-n}}+\frac{1}{1-x^{n-m}}=\frac{1}{1-x^m.x^{-n}}+\frac{1}{1-x^n.x^{-m}}$

$=\frac{1}{1-\frac{x^m}{x^n}}+\frac{1}{1-\frac{x^n}{x^m}}=\frac{1}{\frac{x^n-x^m}{x^n}}+\frac{1}{\frac{x^m-x^n}{x^m}}=\frac{x^n}{x^n-x^m}+\frac{x^m}{x^m-x^n}$

$=\frac{x^n}{x^n-x^m}-\frac{x^m}{x^n-x^m}=\frac{x^n-x^m}{x^n-x^m}=1$

Model 4

11. मान निकाल्नुहोस् (Evaluate): $\frac{21\times5^x-25\times5^{x-2}}{5^{x+2}-5^{x+1}}$ [2072 E]

⇨ Here, $\frac{21\times5^x-25\times5^{x-2}}{5^{x+2}-5^{x+1}}=\frac{21\times5^x-25\times5^x.5^{-2}}{5^x\times5^2-5^x\times5^1}=\frac{5^x\left(21-25\times\frac{1}{25}\right)}{5^x(5^2-5)}=\frac{21-1}{25-5}=1$

12. मान निकाल्नुहोस् (Evaluate): $\frac{25^x-5^{2x-1}}{4\times25^x}$ [2072 FW]

⇨ Here, $\frac{25^x-5^{2x-1}}{4\times25^x}=\frac{5^{2x}-5^{2x}.5^{-1}}{4\times5^{2x}}=\frac{5^{2x}\left(1-\frac{1}{5}\right)}{4\times5^{2x}}=\frac{\frac{4}{5}}{\frac{4}{1}}=\frac{4}{5}\times\frac{1}{4}=\frac{1}{5}$

13. मान निकाल्नुहोस् (Evaluate): $\frac{2^{x-1}+4\times2^x}{2^{x-1}}$ [2072 C]

⇨ Here, $\frac{2^{x-1}+4\times2^x}{2^{x-1}}=\frac{2^x.2^{-1}+4\times2^x}{2^x\times2^{-1}}=\frac{2^x(2^{-1}+4)}{2^x\times2^{-1}}=\frac{\left(\frac{1}{2}+4\right)}{\frac{1}{2}}=\frac{\frac{9}{2}}{\frac{1}{2}}=9$

14. मान निकाल्नुहोस् (Evaluate): $\frac{5^{y-1}-3\times5^y}{5^{y-1}}$ [2072 W]

⇨ Here, $\frac{5^{y-1}-3\times5^y}{5^{y-1}}=\frac{5^y\times5^{-1}-3\times5^y}{5^y\times5^{-1}}=\frac{5^y\left(\frac{1}{5}-3\right)}{5^y\times\frac{1}{5}}=\frac{-\frac{14}{5}}{\frac{1}{5}}=-14$

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15. मान निकाल्नुहोस् (Evaluate) : $\frac{3^{m-1}+2\times 3^m}{3^{m-1}}$ **[2072 MW]**

⇨ Here, $\frac{3^{m-1}+2\times 3^m}{3^{m-1}}=\frac{3^m\times 3^{-1}+2\times 3^m}{3^m\times 3^{-1}}=\frac{3^m\left(\frac{1}{3}+2\right)}{3^m\times\frac{1}{3}}=\frac{\frac{7}{3}}{\frac{1}{3}}=\frac{7}{3}\times\frac{3}{1}=7$

16. मान निकाल्नुहोस् (Evaluate): $\frac{15^{n+2}-75\times 15^{n-1}}{110\times 15^n}$ **[2071 C]**

⇨ Here, $\frac{15^{n+2}-75\times 15^{n-1}}{110\times 15^n}=\frac{15^n\times 15^2-75\times 15^n.15^{-1}}{110\times 15^n}=\frac{15^n\left(15^2-75\times\frac{1}{15}\right)}{110\times 15^n}=\frac{225-5}{110}=2$

17. मान निकाल्नुहोस् (Evaluate): $\frac{4^{x+1}+64\times 4^{x-1}}{4^{x+1}+4^x}$ **[2071 A]**

⇨ Here, $\frac{4^{x+1}+64\times 4^{x-1}}{4^{x+1}+4^x}=\frac{4^x.4^1+64\times 4^x\times 4^{-1}}{4^x.4^1+4^x}=\frac{4^x\left(4^1+64\times\frac{1}{4}\right)}{4^x(4+1)}=\frac{4+16}{5}=4$

18. मान निकाल्नुहोस् (Evaluate) : $\frac{2^{5n}\times 2^{n-2}-2^{5n-1}}{2^{5n-1}\times 2^n-2^{5n}}$ **[2071 B]**

⇨ Here, $\frac{2^{5n}\times 2^{n-2}-2^{5n-1}}{2^{5n-1}\times 2^n-2^{5n}}=\frac{2^{5n}\times 2^n\times 2^{-2}-2^{5n}\times 2^{-1}}{2^{5n}\times 2^{-1}\times 2^n-2^{5n}}=\frac{2^{5n}(2^n\times 2^{-2}-2^{-1})}{2^{5n}(2^{-1}\times 2^n-1)}=\frac{2^{-1}(2^n\times 2^{-1}-1)}{(2^n\times 2^{-1}-1)}=2^{-1}=\frac{1}{2}$

19. मान निकाल्नुहोस् (Evaluate) : $\frac{6^{7a+2}-48\times 6^{7a-1}}{168\times 6^{7a-1}}$ **[2071 E]**

⇨ Here, $\frac{6^{7a+2}-48\times 6^{7a-1}}{168\times 6^{7a-1}}=\frac{6^{7a}.6^2-48\times 6^{7a}\times 6^{-1}}{168\times 6^{7a}\times 6^{-1}}=\frac{6^{7a}\left(6^2-48\times\frac{1}{6}\right)}{168\times 6^{7a}\times\frac{1}{6}}=\frac{36-8}{28}=\frac{28}{28}=1$

20. मान निकाल्नुहोस् (Evaluate): $\frac{4^{x+1}\times 2+6\times 2^{2x+1}}{4^{x+1}\times 3-2\times 8^{\frac{2x}{3}}}$ **[2071 S]**

⇨ Here, $\frac{2^{2x+2}\times 2+6\times 2^{2x+1}}{2^{2x+2}\times 3-2\times 2^{3\times\frac{2x}{3}}}=\frac{2^{2x}\times 2^2\times 2+6\times 2^{2x}\times 2^1}{2^{2x}\times 2^2\times 3-2\times 2^{2x}}=\frac{2^{2x}(4\times 2+6\times 2)}{2^{2x}(4\times 3-2)}=\frac{20}{10}=2$

21. मान निकाल्नुहोस् (Evaluate): $\frac{7^{q+2}+4\times 7^q}{7^{q+1}\times 8-3\times 7^q}$ **[2071D]**

⇨ Here, $\frac{7^{q+2}+4\times 7^q}{7^{q+1}\times 8-3\times 7^q}=\frac{7^q\times 7^2+4\times 7^q}{7^q\times 7\times 8-3\times 7^q}=\frac{7^q(7^2+4)}{7^q(7\times 8-3)}=\frac{53}{53}=1$

Model 5

22. सरल गर्नुहोस् (Simplify): $\sqrt{4m^2n^6}\times\sqrt[3]{8m^3n^{12}}$ **[2072E]**

⇨ Here, $\sqrt{4m^2n^6}\times\sqrt[3]{8m^3n^{12}}=\sqrt{4m^2n^6}\times\sqrt[3]{(2mn^4)^3}=\sqrt{(2mn^3)^2}\times\sqrt[3]{(2mn^4)^3}=2mn^3\times 2mn^4=4m^2n^7$

23. सरल गर्नुहोस् (Simplify): $\sqrt[3]{2.m^2.p^{-1}.q^5}\times\sqrt[3]{4.m.p^4.q^{-2}}$ **[2072MW]**

⇨ Here, $\sqrt[3]{2.m^2.p^{-1}.q^5}\times\sqrt[3]{4.m.p^4.q^{-2}}=\sqrt[3]{(2m^2p^{-1}q^5)(4mp^4q^{-2})}=\sqrt[3]{2\times 4m^3p^3q^3}=\sqrt[3]{(2mpq)^3}=2mpq$

24. सरल गर्नुहोस् (Simplify) : $\sqrt[3]{16pq^5r^{-3}}\times\sqrt[3]{32p^{-1}qr^6}$ **[2071D]**

⇨ Here, $\sqrt[3]{16pq^5r^{-3}}\times\sqrt[3]{32p^{-1}qr^6}=\sqrt[3]{(16pq^5r^{-3})\times(32p^{-1}qr^6)}=\sqrt[3]{16\times 32\times p^{1-1}\times q^{5+1}\times r^{-3+6}}$

$=\sqrt[3]{512\times p^0\times q^6\times r^3}=\sqrt[3]{8^3\times 1\times q^6\times r^3}=8q^2r$

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25. सरल गर्नुहोस् (Simplify): $\sqrt[3]{24p^5q^{-2}} \times \sqrt[3]{9p^{-2}q^{14}}$ **[2071E]**

⇨ Here, $\sqrt[3]{24p^5q^{-2}} \times \sqrt[3]{9p^{-2}q^{14}} = \sqrt[3]{(24p^5q^{-2}) \times (9p^{-2}q^{14})} = \sqrt[3]{24 \times 9 \times p^{5-2}\, q^{-2+14}}$

$= \sqrt[3]{216 \times p^3 \times q^{12}} = \sqrt[3]{6^3 \times p^3 \times q^{12}} = 6pq^4$

26. सरल गर्नुहोस् (Simplify): $\sqrt[3]{\dfrac{81x^9y^{12}}{3x^6y^9}}$ **[2071E]**

⇨ Here, $\sqrt[3]{\dfrac{81x^9y^{12}}{3x^6y^9}} = \sqrt[3]{27x^3y^3} = \sqrt[3]{(3xy)^3} = 3xy$

27. सरल गर्नुहोस् (Simplify): $\sqrt[4]{343m^6n^7} \div \sqrt[4]{7^{-1}m^{-2}n^3}$ **[2071C]**

⇨ Here, $\sqrt[4]{343m^6n^7} \div \sqrt[4]{7^{-1}m^{-2}n^3} = \sqrt[4]{\dfrac{343m^6n^7}{7^{-1}m^{-2}n^3}} = \sqrt[4]{7^{3+1}\, m^{6+2}\, n^{7-3}} = \sqrt[4]{7^4m^8n^4} = 7m^2n$

28. सरल गर्नुहोस् (Simplify): $\sqrt[4]{216a^7b^5} \times \sqrt[4]{6^{-1}a^{-1}b}$ **[2071S]**

⇨ Here, $\sqrt[4]{216a^7b^5} \times \sqrt[4]{6^{-1}a^{-1}b} = \sqrt[4]{\dfrac{216a^7b^5}{6^{-1}a^{-1}b}} = \sqrt[4]{6^{3+1}\, a^{7+1}\, b^{5-1}} = \sqrt[4]{6^4a^8b^4} = 6a^2b$

29. सरल गर्नुहोस् (Simplify): $3\sqrt[4]{112m^{11}n^{-2}} \div \sqrt[4]{576m^3n^2}$ **[2071B]**

⇨ Here, $3\sqrt[4]{112m^{11}n^{-2}} \div \sqrt[4]{576m^3n^2} = 3\sqrt[4]{\dfrac{112\, m^{11}\, n^{-2}}{576m^3n^2}} = 3\sqrt[4]{\dfrac{16m^8}{81n^4}} = 3\sqrt[4]{\dfrac{2^4m^8}{3^4n^4}} = 3\left(\dfrac{2m^2}{3n}\right) = \dfrac{2m^2}{n}$

C. LONG QUESTIONS

Model 1

1. सरल गर्नुहोस् (Simplify): $\left(\dfrac{x^{a^2+b^2}}{x^{ab}}\right)^{a+b} \times \left(\dfrac{x^{b^2+c^2}}{x^{bc}}\right)^{b+c} \times \left(\dfrac{x^{c^2+a^2}}{x^{ca}}\right)^{c+a}$ **[2057 D2, 2059 C2]**

⇨ Here, $\left(\dfrac{x^{a^2+b^2}}{x^{ab}}\right)^{a+b} \times \left(\dfrac{x^{b^2+c^2}}{x^{bc}}\right)^{b+c} \times \left(\dfrac{x^{c^2+a^2}}{x^{ca}}\right)^{c+a}$

$= \left(x^{a^2-ab+b^2}\right)^{a+b} \times \left(x^{b^2-bc+c^2}\right)^{b+c} \times \left(x^{c^2-ca+a^2}\right)^{c+a}$

$= x^{(a+b)\left(a^2-ab+b^2\right)} \times x^{(b+c)\left(b^2-bc+c^2\right)} \times x^{(c+a)\left(c^2-ca+a^2\right)}$

$= x^{a^3+b^3} \times x^{b^3+c^3} \times x^{c^3+a^3}$ $= x^{a^3+b^3+b^3+c^3+c^3+a^3}$

$= x^{2a^3+2b^3+2c^3}$ $= x^{2\left(a^3+b^3+c^3\right)}$

2. सरल गर्नुहोस् (Simplify): $\left(\dfrac{x^{l^2+m^2}}{x^{-lm}}\right)^{l-m} \cdot \left(\dfrac{x^{m^2+n^2}}{x^{-mn}}\right)^{m-n} \cdot \left(\dfrac{x^{n^2+l^2}}{x^{-nl}}\right)^{n-l}$ **[2062 B1]**

⇨ Here, $\left(\dfrac{x^{\ell^2+m^2}}{x^{-\ell m}}\right)^{\ell-m} \cdot \left(\dfrac{x^{m^2+n^2}}{x^{-mn}}\right)^{m-n} \cdot \left(\dfrac{x^{n^2+\ell^2}}{x^{-n\ell}}\right)^{n-\ell}$

$= \left(x^{\ell^2+m^2+\ell m}\right)^{\ell-m} \cdot \left(x^{m^2+n^2+mn}\right)^{m-n} \cdot \left(x^{n^2+\ell^2+n\ell}\right)^{n-\ell}$

$= x^{(\ell-m)\,(\ell^2+\ell m+m^2)} \cdot x^{(m-n)\,(m^2+mn+n^2)} \cdot x^{(n-\ell)\,(n^2+n\ell+\ell^2)}$

$= x^{\ell^3-m^3} \cdot x^{m^3-n^3} \cdot x^{n^3-\ell^3}$ $= x^{\ell^3-m^3+m^3-n^3+n^3-\ell^3}$

$= x^0$

$= 1$

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3. सरल गर्नुहोस् (Simplify): $\left(\frac{x^{a^2+b^2}}{x^{-ab}}\right)^{a-b} \cdot \left(\frac{x^{b^2+c^2}}{x^{-bc}}\right)^{b-c} \cdot \left(\frac{x^{c^2+a^2}}{x^{-ca}}\right)^{c-a}$ [2062 B2, 2059 C1]

⇨ Here, $\left(\frac{x^{a^2+b^2}}{x^{-ab}}\right)^{a-b} \times \left(\frac{x^{b^2+c^2}}{x^{-bc}}\right)^{b-c} \times \left(\frac{x^{c^2+a^2}}{x^{-ca}}\right)^{c-a}$

$= \left(x^{a^2+b^2+ab}\right)^{a-b} \times \left(x^{b^2+c^2+bc}\right)^{b-c} \times \left(x^{c^2+a^2+ca}\right)^{c-a}$

$= x^{(a-b)(a^2+ab+b^2)} \times x^{(b^2+bc+c^2)(b-c)} \times x^{(c-a)(c^2+ca+a^2)}$

$= x^{a^3-b^3} \times x^{b^3-c^3} \times x^{c^3-a^3} = x^{a^3-b^3+b^3-c^3+c^3-a^3}$

$= x^0 = 1$

4. सरल गर्नुहोस् (Simplify): $\left(\frac{x^{a+b}}{x}\right)^{a-b} \times \left(\frac{x^{b+c}}{x}\right)^{b-c} \times \left(\frac{x^{c+a}}{x}\right)^{c-a}$ [2058 A1, 2062 S]

⇨ Here, $\left(\frac{x^{a+b}}{x}\right)^{a-b} \times \left(\frac{x^{b+c}}{x}\right)^{b-c} \times \left(\frac{x^{c+a}}{x}\right)^{c-a} = \frac{x^{a^2-b^2}}{x^{a-b}} \times \frac{x^{b^2-c^2}}{x^{b-c}} \times \frac{x^{c^2-a^2}}{x^{c-a}}$

$= \frac{x^{a^2-b^2+b^2-c^2+c^2-a^2}}{x^{a-b+b-c+c-a}} = \frac{x^0}{x^0} = \frac{1}{1} = 1$

5. सरल गर्नुहोस् (Simplify): $\left(\frac{a^x}{a^y}\right)^{x+y-z} \times \left(\frac{a^y}{a^z}\right)^{y+z-x} \times \left(\frac{a^z}{a^x}\right)^{z+x-y}$ [2063 E1]

⇨ Here, $\left(\frac{a^x}{a^y}\right)^{x+y-z} \times \left(\frac{a^y}{a^z}\right)^{y+z-x} \times \left(\frac{a^z}{a^x}\right)^{z+x-y}$

$= \left(a^{x-y}\right)^{x+y-z} \times \left(a^{y-z}\right)^{y+z-x} \times \left(a^{z-x}\right)^{z+x-y}$

$= a^{x^2-y^2-z(x-y)} \times a^{y^2-z^2-x(y-z)} \times a^{z^2-x^2-y(z-x)}$

$= a^{x^2-y^2-zx+yz} \times a^{y^2-z^2-xy+zx} \times a^{z^2-x^2-yz+xy}$

$= a^{x^2-y^2+y^2-z^2+z^2-x^2-zx+yz-xy+zx-yz+xy} = a^0 = 1$

6. सरल गर्नुहोस् (Simplify): $\left(\frac{x^q}{x^r}\right)^{q+r-p} \times \left(\frac{x^r}{x^p}\right)^{r+p-q} \times \left(\frac{x^p}{x^q}\right)^{p+q-r}$ [2064 E1]

⇨ Here, $\left(\frac{x^q}{x^r}\right)^{q+r-p} \times \left(\frac{x^r}{x^p}\right)^{r+p-q} \times \left(\frac{x^p}{x^q}\right)^{p+q-r} = x^{(q-r)(q+r-p)} x^{(r-p)(r+p-q)} x^{(p-q)(p+q-r)}$

$= x^{q^2-r^2-pq+pr} x^{r^2-p^2-qr+pq} x^{p^2-q^2-pr+qr} = x^{q^2-r^2-pq+pr+r^2-p^2-qr+pq+p^2-q^2-pr+qr}$

$= x^0 = 1$

7. सरल गर्नुहोस् (Simplify): $\left(\frac{x^{l+m}}{x^{l-m}}\right)^{n-l} \cdot \left(\frac{x^{m+n}}{x^{m-n}}\right)^{l-m} \cdot \left(\frac{x^{n+l}}{x^{n-l}}\right)^{m-n}$ [2060 D2]

⇨ Here, $\left(\frac{x^{\ell+m}}{x^{\ell-m}}\right)^{n-\ell} \cdot \left(\frac{x^{m+n}}{x^{m-n}}\right)^{\ell-m} \cdot \left(\frac{x^{n+\ell}}{x^{n-\ell}}\right)^{m-n}$

$= \left(x^{\ell+m-\ell+m}\right)^{n-\ell} \cdot \left(x^{m+n-m+n}\right)^{\ell-m} \cdot \left(x^{n+\ell-n+\ell}\right)^{m-n}$

$= \left(x^{2m}\right)^{n-\ell} \cdot \left(x^{2n}\right)^{\ell-m} \cdot \left(x^{2\ell}\right)^{m-n}$

$= x^{2mn-2\ell m} \cdot x^{2n\ell-2mn} \cdot x^{2\ell m-2n\ell}$

$= x^{2mn-2\ell m+2n\ell-2mn+2\ell m-2n\ell} = x^0 = 1$

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8. सरल गर्नुहोस् (Simplify): $\left(a^{\frac{1}{x-y}}\right)^{\frac{1}{x-z}} \cdot \left(a^{\frac{1}{y-z}}\right)^{\frac{1}{y-x}} \cdot \left(a^{\frac{1}{z-x}}\right)^{\frac{1}{z-y}}$ **[2063 C1, C2]**

⇨ $\left(a^{\frac{1}{x-y}}\right)^{\frac{1}{x-z}} \cdot \left(a^{\frac{1}{y-z}}\right)^{\frac{1}{y-x}} \cdot \left(a^{\frac{1}{z-x}}\right)^{\frac{1}{z-y}} = \left(a^{\frac{1}{(x-y)(x-z)}}\right) \cdot \left(a^{\frac{1}{(y-z)(y-x)}}\right) \cdot \left(a^{\frac{1}{(z-x)(z-y)}}\right)$

$= a^{-\frac{1}{(x-y)(z-x)}} \cdot a^{-\frac{1}{(y-z)(x-y)}} \cdot a^{-\frac{1}{(z-x)(y-z)}} = a^{-\left[\frac{1}{(x-y)(z-x)} + \frac{1}{(y-z)(x-y)} + \frac{1}{(z-x)(y-z)}\right]}$

$= a^{-\left[\frac{y-z+z-x+x-y}{(x-y)(z-x)(y-z)}\right]} = a^{-\left[\frac{0}{(x-y)(z-x)(y-z)}\right]}$

$= a^0 = 1$

9. सरल गर्नुहोस् (Simplify): $\left\{(x^m \cdot x^n)^{m-n}\left(\frac{x^p}{x^n}\right)^{n+p}\right\} \times \left(\frac{x^p}{x^m}\right)^{p+m}$ **[2064 D1]**

⇨ Here, $\left\{(x^m \cdot x^n)^{m-n}\left(\frac{x^p}{x^n}\right)^{n+p}\right\} \times \left(\frac{x^p}{x^m}\right)^{p+m} = x^{(m+n)(m-n)} x^{(p-n)(n+p)} x^{(p-m)(p+m)}$

$= x^{m^2-n^2} x^{p^2-n^2} x^{p^2-m^2} = x^{m^2-n^2+p^2-n^2+p^2-m^2} = x^{2p^2-2n^2}$

Model 2

10. सरल गर्नुहोस् (Simplify): $\sqrt[xy]{\frac{a^x}{a^y}} \cdot \sqrt[yz]{\frac{a^y}{a^z}} \cdot \sqrt[zx]{\frac{a^z}{a^x}}$ **[2057 B1]**

⇨ Here, $\sqrt[xy]{\frac{a^x}{a^y}} \cdot \sqrt[yz]{\frac{a^y}{a^z}} \cdot \sqrt[zx]{\frac{a^z}{a^x}} = \left(\frac{a^x}{a^y}\right)^{\frac{1}{xy}} \cdot \left(\frac{a^y}{a^z}\right)^{\frac{1}{yz}} \cdot \left(\frac{a^z}{a^x}\right)^{\frac{1}{zx}}$

$= \left(a^{x-y}\right)^{\frac{1}{xy}} \cdot \left(a^{y-z}\right)^{\frac{1}{yz}} \cdot \left(a^{z-x}\right)^{\frac{1}{zx}} = a^{x\cdot\frac{1}{xy} - y\frac{1}{xy}} \cdot a^{y\cdot\frac{1}{yz} - z\frac{1}{yz}} \cdot a^{z\cdot\frac{1}{zx} - x\frac{1}{zx}}$

$= a^{\frac{1}{y}-\frac{1}{x}} \cdot a^{\frac{1}{z}-\frac{1}{y}} \cdot a^{\frac{1}{x}-\frac{1}{z}} = a^{\frac{1}{y}-\frac{1}{x}+\frac{1}{z}-\frac{1}{y}+\frac{1}{x}-\frac{1}{z}}$

$= a^0 = 1$

11. सरल गर्नुहोस् (Simplify): $\sqrt[y^2z^2]{\frac{a^{y^2/z^2}}{a^{z^2/y^2}}} \times \sqrt[z^2x^2]{\frac{a^{z^2/x^2}}{a^{x^2/z^2}}} \times \sqrt[x^2y^2]{\frac{a^{x^2/y^2}}{a^{y^2/x^2}}}$ **[2066 B]**

⇨ Here, $\sqrt[y^2z^2]{\frac{a^{y^2/z^2}}{a^{z^2/y^2}}} \times \sqrt[z^2x^2]{\frac{a^{z^2/x^2}}{a^{x^2/z^2}}} \times \sqrt[x^2y^2]{\frac{a^{x^2/y^2}}{a^{y^2/x^2}}} = a^{\left(\frac{y^2}{z^2}-\frac{z^2}{y^2}\right)\frac{1}{y^2z^2}} a^{\left(\frac{z^2}{x^2}-\frac{x^2}{z^2}\right)\frac{1}{z^2x^2}} a^{\left(\frac{x^2}{y^2}-\frac{y^2}{x^2}\right)\frac{1}{x^2y^2}}$

$= a^{\frac{y^4-z^4}{y^2z^2}\times\frac{1}{y^2z^2}} a^{\frac{z^4-x^4}{x^2z^2}\times\frac{1}{z^2x^2}} a^{\frac{x^4-y^4}{y^2x^2}\times\frac{1}{x^2y^2}} = a^{\frac{y^4-z^4}{y^4z^4}} a^{\frac{z^4-x^4}{z^4x^4}} a^{\frac{x^4-y^4}{x^4y^4}}$

$= a^{\frac{y^4}{y^4z^4}-\frac{z^4}{y^4z^4}+\frac{z^4}{z^4x^4}-\frac{x^4}{z^4x^4}+\frac{x^4}{x^4y^4}-\frac{y^4}{x^4y^4}} = a^{\frac{1}{z^4}-\frac{1}{y^4}+\frac{1}{x^4}-\frac{1}{z^4}+\frac{1}{y^4}-\frac{1}{x^4}}$

$= a^0 = 1$

12. सरल गर्नुहोस् (Simplify): $\sqrt[ab]{\frac{x^{\frac{a}{b}}}{x^{\frac{b}{a}}}} \times \sqrt[bc]{\frac{x^{\frac{b}{c}}}{x^{\frac{c}{b}}}} \times \sqrt[ca]{\frac{x^{\frac{c}{a}}}{x^{\frac{a}{c}}}}$ **[2061 A1, 2063 A2, 2064 B1, B2]**

⇨ Here, $\sqrt[ab]{\frac{x^{\frac{a}{b}}}{x^{\frac{b}{a}}}} \times \sqrt[bc]{\frac{x^{\frac{b}{c}}}{x^{\frac{c}{b}}}} \times \sqrt[ca]{\frac{x^{\frac{c}{a}}}{x^{\frac{a}{c}}}} = \left(x^{\frac{a}{b}-\frac{b}{a}}\right)^{\frac{1}{ab}} \times \left(x^{\frac{b}{c}-\frac{c}{b}}\right)^{\frac{1}{bc}} \times \left(x^{\frac{c}{a}-\frac{a}{c}}\right)^{\frac{1}{ca}}$

$= x^{\frac{a}{b}\cdot\frac{1}{ab}-\frac{b}{a}\cdot\frac{1}{ab}} \times x^{\frac{b}{c}\cdot\frac{1}{bc}-\frac{c}{b}\cdot\frac{1}{bc}} \times x^{\frac{c}{a}\cdot\frac{1}{ca}-\frac{a}{c}\cdot\frac{1}{ca}} = x^{\frac{1}{b^2}-\frac{1}{a^2}} \times x^{\frac{1}{c^2}-\frac{1}{b^2}} \times x^{\frac{1}{a^2}-\frac{1}{c^2}}$

$= x^{\frac{1}{b^2}-\frac{1}{a^2}+\frac{1}{c^2}-\frac{1}{b^2}+\frac{1}{a^2}-\frac{1}{c^2}} = x^0 = 1$

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Model 3

13. सरल गर्नुहोस् (Simplify): $\frac{1}{1+x^{a-b}+x^{c-b}}+\frac{1}{1+x^{b-c}+x^{a-c}}+\frac{1}{1+x^{c-a}+x^{b-a}}$ **[2058 D1, 2066 C, 2066 E]**

⇨ Here, $\frac{1}{1+x^{a-b}+x^{c-b}}+\frac{1}{1+x^{b-c}+x^{a-c}}+\frac{1}{1+x^{c-a}+x^{b-a}}$

$=\frac{1}{1+\frac{x^a}{x^b}+\frac{x^c}{x^b}}+\frac{1}{1+\frac{x^b}{x^c}+\frac{x^a}{x^c}}+\frac{1}{1+\frac{x^c}{x^a}+\frac{x^b}{x^a}}$ $=\frac{x^b}{x^b+x^a+x^c}+\frac{x^c}{x^c+x^b+x^a}+\frac{x^a}{x^a+x^b+x^c}$

$=\frac{x^b}{x^a+x^b+x^c}+\frac{x^c}{x^a+x^b+x^c}+\frac{x^a}{x^a+x^b+x^c}$ $=\frac{x^b+x^c+x^a}{x^a+x^b+x^c}=\frac{x^a+x^b+x^c}{x^a+x^b+x^c}=1$

14. सरल गर्नुहोस् (Simplify): $\frac{1}{1+a^{x-y}+a^{z-y}}+\frac{1}{1+a^{y-z}+a^{x-z}}+\frac{1}{1+a^{z-x}+a^{y-x}}$ **[2058 D2]**

⇨ Here, $\frac{1}{1+a^{x-y}+a^{z-y}}+\frac{1}{1+a^{y-z}+a^{x-z}}+\frac{1}{1+a^{z-x}+a^{y-x}}$

$=\frac{1}{1+\frac{a^x}{a^y}+\frac{a^z}{a^y}}+\frac{1}{1+\frac{a^y}{a^z}+\frac{a^x}{a^z}}+\frac{1}{1+\frac{a^z}{a^x}+\frac{a^y}{a^x}}$ $=\frac{a^y}{a^y+a^x+a^z}+\frac{a^z}{a^z+a^y+a^x}+\frac{a^x}{a^x+a^z+a^y}$

$=\frac{a^y}{a^x+a^y+a^z}+\frac{a^z}{a^x+a^y+a^z}+\frac{a^x}{a^x+a^y+a^z}$ $=\frac{a^y+a^z+a^x}{a^x+a^y+a^z}$

$=\frac{a^x+a^y+a^z}{a^x+a^y+a^z}$ $=1$

15. सरल गर्नुहोस् (Simplify): $\frac{1}{1+x^{p-q}+x^{r-q}}+\frac{1}{1+x^{q-r}+x^{p-r}}+\frac{1}{1+x^{r-p}+x^{q-p}}$ **[2061 B2]**

⇨ Here, $\frac{1}{1+x^{p-q}+x^{r-q}}+\frac{1}{1+x^{q-r}+x^{p-r}}+\frac{1}{1+x^{r-p}+x^{q-p}}$

$=\frac{1}{1+\frac{x^p}{x^q}+\frac{x^r}{x^q}}+\frac{1}{1+\frac{x^q}{x^r}+\frac{x^p}{x^r}}+\frac{1}{1+\frac{x^r}{x^p}+\frac{x^q}{x^p}}$ $=\frac{x^q}{x^q+x^p+x^r}+\frac{x^r}{x^r+x^q+x^p}+\frac{x^p}{x^p+x^q+x^r}$

$=\frac{x^q}{x^p+x^q+x^r}+\frac{x^r}{x^p+x^q+x^r}+\frac{x^p}{x^p+x^q+x^r}$ $=\frac{x^q+x^r+x^p}{x^p+x^q+x^r}=\frac{x^p+x^q+x^r}{x^p+x^q+x^r}=1$

16. सरल गर्नुहोस् (Simplify): $\frac{p^2}{(p-y)^y}-\frac{2p}{(p-y)^{y-1}}+\frac{1}{(p-y)^{y-2}}$ **[2061 D1]**

⇨ Here, $\frac{p^2}{(p-y)^y}-\frac{2p}{(p-y)^{y-1}}+\frac{1}{(p-y)^{y-2}}$ $=\frac{p^2}{(p-y)^y}-\frac{2p}{(p-y)^y.(p-y)^{-1}}+\frac{1}{(p-y)^y(p-y)^{-2}}$

$=\frac{p^2}{(p-y)^y}-\frac{2p(p-y)}{(p-y)^y}+\frac{(p-y)^2}{(p-y)^y}$ $=\frac{p^2-2p(p-y)+(p-y)^2}{(p-y)^y}$

$=\frac{(p-p+y)^2}{(p-y)^y}$ $=\frac{y^2}{(p-y)^y}$

17. सरल गर्नुहोस् (Simplify): $\frac{p^2}{(y-p)^y}-\frac{2p}{(y-p)^{y-1}}+\frac{1}{(y-p)^{y-2}}$ **[2061 D2]**

⇨ Here, $\frac{p^2}{(y-p)^y}-\frac{2p}{(y-p)^{y-1}}+\frac{1}{(y-p)^{y-2}}$ $=\frac{p^2}{(y-p)^y}-\frac{2p}{(y-p)^y(y-p)^{-1}}+\frac{1}{(y-p)^y(y-p)^{-2}}$

$=\frac{p^2}{(y-p)^y}-\frac{2p(y-p)}{(y-p)^y}+\frac{(y-p)^2}{(y-p)^y}$ $=\frac{p^2-2p(y-p)+(y-p)^2}{(y-p)^y}$

$=\frac{\{p-(y-p)\}^2}{(y-p)^y}$ $=\frac{(p-y+p)^2}{(y-p)^y}$ $=\frac{(2p-y)^2}{(y-p)^y}$

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18. सरल गर्नुहोस् (Simplify): $\dfrac{m+(mn^2)^{1/3}+(m^2n)^{1/3}}{m-n}\left(1-\dfrac{n^{1/3}}{m^{1/3}}\right)$ **[2062 K]**

⇨ Here, $\dfrac{m+(mn^2)^{1/3}+(m^2n)^{1/3}}{m-n}\left(1-\dfrac{n^{1/3}}{m^{1/3}}\right)$ $= \dfrac{m+m^{1/3}n^{2.1/3}+m^{2.1/3}n^{1/3}}{(m^{1/3})^3-(n^{1/3})^3}\times\dfrac{(m^{1/3}-n^{1/3})}{m^{1/3}}$

$= \dfrac{m^{1/3}(m^{2/3}+n^{2/3}+m^{1/3}n^{1/3})}{(m^{1/3}-n^{1/3})(m^{2/3}+n^{2/3}+m^{1/3}n^{1/3})}\times\dfrac{(m^{1/3}-n^{1/3})}{m^{1/3}}$ $= \dfrac{m^{1/3}}{m^{1/3}-n^{1/3}}\times\dfrac{m^{1/3}-n^{1/3}}{m^{1/3}} = 1$

19. सरल गर्नुहोस् (Simplify): $\left(\dfrac{p+(pq^2)^{\frac{1}{3}}+(p^2q)^{\frac{1}{3}}}{p-q}\right)\times\left(1-\dfrac{q^{\frac{1}{3}}}{p^{\frac{1}{3}}}\right)$ **[2067 B]**

⇨ Here, $\left[\dfrac{p+(pq^2)^{\frac{1}{3}}+(p^2q)^{\frac{1}{3}}}{p-q}\right]\times\left[1-\dfrac{q^{\frac{1}{3}}}{p^{\frac{1}{3}}}\right]$ $= \dfrac{\left[p+p^{\frac{1}{3}}q^{\frac{2}{3}}+p^{\frac{2}{3}}q^{\frac{1}{3}}\right]}{(p-q)}\times\dfrac{\left(p^{\frac{1}{3}}-q^{\frac{1}{3}}\right)}{p^{\frac{1}{3}}}$

$= \dfrac{p^{\frac{1}{3}}\left(p^{\frac{2}{3}}+q^{\frac{2}{3}}+p^{\frac{1}{3}}q^{\frac{1}{3}}\right)\left(p^{\frac{1}{3}}-q^{\frac{1}{3}}\right)}{(p-q)\,p^{\frac{1}{3}}}$ $= \dfrac{\left[\left(p^{\frac{1}{3}}\right)^2+\left(q^{\frac{1}{3}}\right)^2+p^{\frac{1}{3}}.q^{\frac{1}{3}}\right]\left(p^{\frac{1}{3}}-q^{\frac{1}{3}}\right)}{(p-q)}$

$= \dfrac{\left(p^{\frac{1}{3}}\right)^3-\left(q^{\frac{1}{3}}\right)^3}{p-q}$ $= \dfrac{p-q}{p-q} = 1$

Model 4

20. सरल गर्नुहोस् (Simplify): $\dfrac{\left(1-\dfrac{b}{a}\right)^{\frac{b}{a-b}}\left(1+\dfrac{a}{b}\right)^{\frac{a}{a-b}}}{\left(\dfrac{a}{b}-1\right)^{\frac{b}{a-b}}\left(\dfrac{b}{a}+1\right)^{\frac{a}{a-b}}}$ **[2064 A1]**

⇨ Here, $\dfrac{\left(1-\dfrac{b}{a}\right)^{\frac{b}{a-b}}\left(1+\dfrac{a}{b}\right)^{\frac{a}{a-b}}}{\left(\dfrac{a}{b}-1\right)^{\frac{b}{a-b}}\left(\dfrac{b}{a}+1\right)^{\frac{a}{a-b}}}$ $= \dfrac{\left(\dfrac{a-b}{a}\right)^{\frac{b}{a-b}}\left(\dfrac{b+a}{b}\right)^{\frac{a}{a-b}}}{\left(\dfrac{a-b}{b}\right)^{\frac{b}{a-b}}\left(\dfrac{b+a}{a}\right)^{\frac{a}{a-b}}}$

$= \left(\dfrac{\dfrac{a-b}{a}}{\dfrac{a-b}{b}}\right)^{\frac{b}{a-b}}\left(\dfrac{\dfrac{b+a}{b}}{\dfrac{b+a}{a}}\right)^{\frac{a}{a-b}}$ $= \left(\dfrac{a-b}{a}\times\dfrac{b}{a-b}\right)^{\frac{b}{a-b}}\left(\dfrac{b+a}{b}\times\dfrac{a}{b+a}\right)^{\frac{a}{a-b}}$

$= \left(\dfrac{b}{a}\right)^{\frac{b}{a-b}}\times\left(\dfrac{a}{b}\right)^{\frac{a}{a-b}}$ $= \left(\dfrac{b}{a}\right)^{\frac{b}{a-b}}\times\left(\dfrac{b}{a}\right)^{-\frac{a}{a-b}}$

$= \left(\dfrac{b}{a}\right)^{\frac{b}{a-b}-\frac{a}{a-b}}$ $= \left(\dfrac{b}{a}\right)^{\frac{b-a}{a-b}}$ $= \left(\dfrac{b}{a}\right)^{-\frac{(a-b)}{(a-b)}}$ $= \left(\dfrac{b}{a}\right)^{-1} = \dfrac{a}{b}$

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21. सरल गर्नुहोस् (Simplify): $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}}$ **[2063 B1, 2065 E]**

⇨ Here, $\dfrac{\left(a^2-\frac{1}{b^2}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b^2-\frac{1}{a^2}\right)^b\left(b+\frac{1}{a}\right)^{a-b}} = \dfrac{\left\{\left(a+\frac{1}{b}\right)\left(a-\frac{1}{b}\right)\right\}^a\cdot\left(a-\frac{1}{b}\right)^{b-a}}{\left\{\left(b+\frac{1}{a}\right)\left(b-\frac{1}{a}\right)\right\}^b\left(b+\frac{1}{a}\right)^{a-b}}$

$= \dfrac{\left(a+\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^{b-a}}{\left(b+\frac{1}{a}\right)^b\left(b-\frac{1}{a}\right)^b\left(b+\frac{1}{a}\right)^{a-b}} = \dfrac{\left(a+\frac{1}{b}\right)^a\cdot\left(a-\frac{1}{b}\right)^{a+b-a}}{\left(b+\frac{1}{a}\right)^{b+a-b}\cdot\left(b-\frac{1}{a}\right)^b}$

$= \dfrac{\left(a+\frac{1}{b}\right)^a\left(a-\frac{1}{b}\right)^b}{\left(b+\frac{1}{a}\right)^a\left(b-\frac{1}{a}\right)^b} = \dfrac{\left(\frac{ab+1}{b}\right)^a\left(\frac{ab-1}{b}\right)^b}{\left(\frac{ab+1}{a}\right)^a\left(\frac{ab-1}{a}\right)^b} = \dfrac{\frac{(ab+1)^a}{b^a}\times\frac{(ab-1)^b}{b^b}}{\frac{(ab+1)^a}{a^a}\times\frac{(ab-1)^b}{a^b}}$

$= \dfrac{(ab+1)^a}{b^a}\times\dfrac{(ab-1)^b}{b^b}\times\dfrac{a^a}{(ab+1)^a}\times\dfrac{a^b}{(ab-1)^b} = \dfrac{a^a\cdot a^b}{b^a\cdot b^b} = \dfrac{a^{a+b}}{b^{a+b}} = \left(\dfrac{a}{b}\right)^{a+b}$

22. सरल गर्नुहोस् (Simplify): $\dfrac{\left(y+\frac{1}{x}\right)^{x+y}\left(x-\frac{1}{y}\right)^{x+y}}{\left(x^2-\frac{1}{y^2}\right)^x\left(y^2-\frac{1}{x^2}\right)^y}$ **[2063 D1]**

⇨ Here, $\dfrac{\left(y+\frac{1}{x}\right)^{x+y}\left(x-\frac{1}{y}\right)^{x+y}}{\left(x^2-\frac{1}{y^2}\right)^x\left(y^2-\frac{1}{x^2}\right)^y} = \dfrac{\left(\frac{xy+1}{x}\right)^{x+y}\cdot\left(\frac{xy-1}{y}\right)^{x+y}}{\left(\frac{x^2y^2-1}{y^2}\right)^x\cdot\left(\frac{x^2y^2-1}{x^2}\right)^y}$

$= \dfrac{\left(\frac{x^2y^2-1}{xy}\right)^{x+y}}{\left(\frac{x^2y^2-1}{y^2}\right)^x\cdot\left(\frac{x^2y^2-1}{x^2}\right)^y} = \dfrac{\left(\frac{x^2y^2-1}{xy}\right)^x\cdot\left(\frac{x^2y^2-1}{xy}\right)^y}{\left(\frac{x^2y^2-1}{y^2}\right)^x\cdot\left(\frac{x^2y^2-1}{x^2}\right)^y}$

$= \left(\dfrac{\frac{x^2y^2-1}{xy}}{\frac{x^2y^2-1}{y^2}}\right)^x\times\left(\dfrac{\frac{x^2y^2-1}{xy}}{\frac{x^2y^2-1}{x^2}}\right)^y = \left(\dfrac{y}{x}\right)^x\times\left(\dfrac{x}{y}\right)^y = \left(\dfrac{x}{y}\right)^{-x}\times\left(\dfrac{x}{y}\right)^y = \left(\dfrac{x}{y}\right)^{y-x} = \left(\dfrac{y}{x}\right)^{x-y}$

Model 5

23. यदि p + q + r = 0 भए प्रमाणित गर्नुहोस् (If p + q + r = 0, then prove that):

$$\frac{1}{1+x^p+x^{-q}}+\frac{1}{1+x^q+x^{-r}}+\frac{1}{1+x^r+x^{-p}}=1$$ **[2066 A]**

⇨ Here, LHS $= \dfrac{1}{1+x^p+x^{-q}}+\dfrac{1}{1+x^q+x^{-r}}+\dfrac{1}{1+x^r+x^{-p}} = \dfrac{x^q}{x^q(1+x^p+x^{-q})}+\dfrac{1}{1+x^q+x^{-r}}+\dfrac{1}{1+x^r+x^{-p}}$

$= \dfrac{x^q}{x^q+x^{p+q}+1}+\dfrac{1}{1+x^q+x^{-r}}+\dfrac{1}{1+x^r+x^{-p}} = \dfrac{x^q}{1+x^q+x^{-r}}+\dfrac{1}{1+x^q+x^{-r}}+\dfrac{1}{1+x^r+x^{-p}}$

$= \dfrac{x^q+1}{1+x^q+x^{-r}}+\dfrac{1}{1+x^r+x^{-p}} = \dfrac{x^r(x^q+1)}{x^r(1+x^q+x^{-r})}+\dfrac{1}{1+x^r+x^{-p}}$

$= \dfrac{x^{q+r}+x^r}{x^r+x^{q+r}+1}+\dfrac{1}{1+x^r+x^{-p}} = \dfrac{x^{q+r}+x^r}{1+x^r+x^{-p}}+\dfrac{1}{1+x^r+x^{-p}}$

$= \dfrac{x^{q+r}+x^r+1}{1+x^r+x^{-p}} = \dfrac{1+x^r+x^{-p}}{1+x^r+x^{-p}} = 1$

Thus, LHS = RHS Proved.

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24. यदि pqr = 1 भए प्रमाणित गर्नुहोस् (If pqr = 1, prove that): $\frac{1}{1+p+q^{-1}}+\frac{1}{1+q+r^{-1}}+\frac{1}{1+r+p^{-1}}=1$ [2070 D]

⇨ Here, we have, pqr = 1, or, $p=\frac{1}{qr}$ ∴ $p^{-1}=qr$

$$\text{LHS} = \frac{1}{1+p+\frac{1}{q}}+\frac{1}{1+q+\frac{1}{r}}+\frac{1}{1+r+\frac{1}{p}} = \frac{1}{1+\frac{1}{qr}+\frac{1}{q}}+\frac{1}{1+q+\frac{1}{r}}+\frac{1}{1+r+qr}$$

$$= \frac{1}{\frac{qr+1+r}{qr}}+\frac{1}{\frac{r+qr+1}{r}}+\frac{1}{1+r+qr} = \frac{qr}{qr+r+1}+\frac{r}{qr+r+1}+\frac{1}{qr+r+1} = \frac{qr+r+1}{qr+r+1}$$

= 1 = RHS Hence Proved.

25. यदि xyz = 1 भए प्रमाणित गर्नुहोस् (If xyz = 1, prove that): $\frac{1}{1+x+y^{-1}}+\frac{1}{1+y+z^{-1}}+\frac{1}{1+z+x^{-1}}=1$ [2070 A]

⇨ Here, we have, xyz = 1, or, $x=\frac{1}{yz}$

∴ $x^{-1} = yz$

$$\text{LHS} = \frac{1}{1+x+\frac{1}{y}}+\frac{1}{1+y+\frac{1}{z}}+\frac{1}{1+z+\frac{1}{x}} = \frac{1}{1+\frac{1}{yz}+\frac{1}{y}}+\frac{1}{1+y+\frac{1}{z}}+\frac{1}{1+z+yz}$$

$$= \frac{1}{\frac{yz+1+z}{yz}}+\frac{1}{\frac{z+yz+1}{z}}+\frac{1}{1+z+yz} = \frac{yz}{yz+z+1}+\frac{z}{yz+z+1}+\frac{1}{yz+z+1} = \frac{yz+z+1}{yz+z+1}$$

= 1 = RHS Hence Proved.

26. यदि efg = 1 भए प्रमाणित गर्नुहोस् (If efg = 1, prove that):

$\frac{1}{1+e+f^{-1}}+\frac{1}{1+f+g^{-1}}+\frac{1}{1+g+e^{-1}}=1$ [2070 E]

⇨ Here, we have, efg = 1, or, $e=\frac{1}{fg}$

∴ $e^{-1} = fg$

$$\text{LHS} = \frac{1}{1+e+\frac{1}{f}}+\frac{1}{1+f+\frac{1}{g}}+\frac{1}{1+g+\frac{1}{e}} = \frac{1}{1+\frac{1}{fg}+\frac{1}{f}}+\frac{1}{1+f+\frac{1}{g}}+\frac{1}{1+g+fg}$$

$$= \frac{1}{\frac{fg+1+g}{fg}}+\frac{1}{\frac{g+fg+1}{g}}+\frac{1}{1+g+fg} = \frac{fg}{fg+g+1}+\frac{g}{fg+g+1}+\frac{1}{fg+g+1} = \frac{fg+g+1}{fg+g+1}$$

= 1 = RHS Hence Proved.

B. QUESTIONS FROM CDC TEXT BOOK

मान पत्ता लगाउनुहोस् (Find the value of):

1A. $\left(\frac{8}{27}\right)^{-\frac{1}{3}}\times\left(\frac{32}{243}\right)^{\frac{1}{5}}$

⇨ Here, $\left(\frac{8}{27}\right)^{-\frac{1}{3}}\times\left(\frac{32}{243}\right)^{\frac{1}{5}} = \left(\frac{2^3}{3^3}\right)^{-\frac{1}{3}}\times\left(\frac{2^5}{3^5}\right)^{\frac{1}{5}} = \left(\frac{2}{3}\right)^{-1}\times\left(\frac{2}{3}\right)^{1} = \left(\frac{2}{3}\right)^{-1+1} = \left(\frac{2}{3}\right)^{0} = 1$

1B. $\left(\frac{5^2}{5^3}\right)^4\times\left(\frac{5^3}{5^4}\right)^2\times\left(\frac{5^4}{5^2}\right)^3$

⇨ Here, $\left(\frac{5^2}{5^3}\right)^4\times\left(\frac{5^3}{5^4}\right)^2\times\left(\frac{5^4}{5^2}\right)^3 = \frac{5^8}{5^{12}}\times\frac{5^6}{5^8}\times\frac{5^{12}}{5^6} = \frac{5^{8+6+12}}{5^{12+8+6}} = \frac{5^{26}}{5^{26}} = 1$

सरल गर्नुहोस् (Simplify):

2A. $\frac{x^{a-b}.y^{c-b}}{x^{2b-a}.y^c}$

⇨ Here, $\frac{x^{a-b}.y^{c-b}}{x^{2b-a}.y^c} = \frac{x^{a-b}.y^{c-b}}{x^{2b-a}y^c} = x^{a-b-2b+a}\ y^{c-b-c} = x^{2a-3b}y^{-b} = \frac{x^{2a-3b}}{y^b}$

2B. $\frac{a^{-4}b^{-5}c^{-6}}{ab^{-2}c^3}$

⇨ Here, $\frac{a^{-4}b^{-5}c^{-6}}{ab^{-2}c^3} = \frac{b^2}{a^4b^5c^6\times ac^3} = \frac{b^2}{a^{4+1}b^5c^{6+3}} = \frac{b^2}{a^5b^5c^9} = \frac{1}{a^5b^3c^9}$

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2C. $\frac{2^{n+1}+2^n}{3\times 2^{n+2}-5\times 2^n}$

⇨ Here, $\frac{2^{n+1}+2^n}{3\times 2^{n+2}-5\times 2^n}=\frac{2^n(2^1+1)}{2^n(3\times 2^2-5)}=\frac{3}{12-5}=\frac{3}{7}$

2D. $\frac{3^{n+1}-3^n}{3^{n+2}-3^{n+1}}$

⇨ Here, $\frac{3^{n+1}-3^n}{3^{n+2}-3^{n+1}}=\frac{3^n(3^1-1)}{3^n(3^2-3)}=\frac{2}{6}=\frac{1}{3}$

सरल गर्नुहोस् (Simplify):

3A. $\left(\frac{x^a}{x^b}\right)^{a^2+ab+b^2}\times\left(\frac{x^b}{x^c}\right)^{b^2+bc+c^2}\times\left(\frac{x^c}{x^a}\right)^{c^2+ca+a^2}$

⇨ Here, $\left(\frac{x^a}{x^b}\right)^{a^2+ab+b^2}\times\left(\frac{x^b}{x^c}\right)^{b^2+bc+c^2}\times\left(\frac{x^c}{x^a}\right)^{c^2+ca+a^2}$

$=x^{(a-b)(a^2+ab+b^2)}\,x^{(b-c)(b^2+bc+c^2)}\,x^{(c-a)(c^2+ca+a^2)}$

$=x^{a^3-b^3}x^{b^3-c^3}x^{c^3-a^3}=x^{a^3-b^3+b^3-c^3+c^3-a^3}=x^0=1$

3B. $\left(\frac{x^a}{x^b}\right)^{\frac{1}{ab}}\times\left(\frac{x^b}{x^c}\right)^{\frac{1}{bc}}\times\left(\frac{x^c}{x^a}\right)^{\frac{1}{ca}}$

⇨ Here, $\left(\frac{x^a}{x^b}\right)^{\frac{1}{ab}}\times\left(\frac{x^b}{x^c}\right)^{\frac{1}{bc}}\times\left(\frac{x^c}{x^a}\right)^{\frac{1}{ca}}=x^{(a-b)\frac{1}{ab}}x^{(b-c)\frac{1}{bc}}x^{(c-a)\frac{1}{ca}}=x^{\frac{a-b}{ab}}x^{\frac{b-c}{bc}}x^{\frac{c-a}{ca}}$

$=x^{\frac{a-b}{ab}+\frac{b-c}{bc}+\frac{c-a}{ca}}=x^{\frac{ca-bc+ab-ca+bc-ab}{abc}}=x^{\frac{0}{abc}}=x^0=1$

3C. $\left(\frac{1}{x^{a-b}}\right)^{\frac{1}{a-c}}\times\left(\frac{1}{x^{b-c}}\right)^{\frac{1}{b-c}}\times\left(\frac{1}{x^{c-a}}\right)^{\frac{1}{c-b}}$

⇨ Here, $\left(\frac{1}{x^{a-b}}\right)^{\frac{1}{a-c}}\times\left(\frac{1}{x^{b-c}}\right)^{\frac{1}{b-c}}\times\left(\frac{1}{x^{c-a}}\right)^{\frac{1}{c-b}}$

$=\left(x^{\frac{1}{(a-b)(a-c)}}\right).\left(x^{\frac{1}{(b-c)(b-a)}}\right).\left(x^{\frac{1}{(c-a)(c-b)}}\right)=x^{-\frac{1}{(a-b)(c-a)}}.x^{-\frac{1}{(b-c)(a-b)}}.x^{-\frac{1}{(c-a)(b-c)}}$

$=x^{-\left[\frac{1}{(a-b)(c-a)}+\frac{1}{(b-c)(a-b)}+\frac{1}{(c-a)(b-c)}\right]}=x^{-\left[\frac{b-c+c-a+a-b}{(a-b)(c-a)(b-c)}\right]}=x^{-\left[\frac{0}{(a-b)(c-a)(b-c)}\right]}=x^0=1$

3D. $\frac{\left(x^2-\frac{1}{y^2}\right)^p\times\left(x-\frac{1}{y}\right)^{q-p}}{\left(y^2-\frac{1}{x^2}\right)^q\times\left(y+\frac{1}{x}\right)^{p-q}}$

⇨ Here, $\frac{\left(x^2-\frac{1}{y^2}\right)^p\left(x-\frac{1}{y}\right)^{q-p}}{\left(y^2-\frac{1}{x^2}\right)^q\left(y+\frac{1}{x}\right)^{p-q}}=\frac{\left\{\left(x+\frac{1}{y}\right)\left(x-\frac{1}{y}\right)\right\}^p.\left(x-\frac{1}{y}\right)^{q-p}}{\left\{\left(y+\frac{1}{x}\right)\left(y-\frac{1}{x}\right)\right\}^q\left(y+\frac{1}{x}\right)^{p-q}}$

$=\frac{\left(x+\frac{1}{y}\right)^p\left(x-\frac{1}{y}\right)^p\left(x-\frac{1}{y}\right)^{q-p}}{\left(y+\frac{1}{x}\right)^q\left(y-\frac{1}{x}\right)^q\left(y+\frac{1}{x}\right)^{p-q}}=\frac{\left(x+\frac{1}{y}\right)^p.\left(x-\frac{1}{y}\right)^{p+q-p}}{\left(y+\frac{1}{x}\right)^{q+p-y}.\left(y-\frac{1}{x}\right)^q}$

$=\frac{\left(x+\frac{1}{y}\right)^p\left(x-\frac{1}{y}\right)^q}{\left(y+\frac{1}{x}\right)^p\left(y-\frac{1}{x}\right)^q}=\frac{\left(\frac{xy+1}{y}\right)^p\left(\frac{xy-1}{y}\right)^q}{\left(\frac{xy+1}{x}\right)^p\left(\frac{xy-1}{x}\right)^q}=\frac{\frac{(xy+1)^p}{y^p}\times\frac{(xy-1)^q}{y^q}}{\frac{(xy+1)^p}{x^p}\times\frac{(xy-1)^q}{x^q}}$

$=\frac{(xy+1)^p}{y^p}\times\frac{(xy-1)^q}{y^q}\times\frac{x^p}{(xy+1)^p}\times\frac{x^q}{(xy-1)^q}=\frac{x^p.p^q}{y^p.y^q}=\frac{x^{p+q}}{y^{p+q}}=\left(\frac{x}{y}\right)^{p+q}$

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4. यदि $a + b + c = 0$ भए प्रमाणित गर्नुहोस्: $\frac{1}{1+x^a+x^{-b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = 1$

If $a + b + c = 0$ then prove that: $\frac{1}{1+x^a+x^{-b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = 1$ [2065 C]

⇨ Here, LHS $= \frac{1}{1+x^a+x^{-b}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}}$

$= \frac{x^b}{x^b(1+x^a+x^{-b})} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = \frac{x^b}{x^b+x^{a+b}+1} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}}$

$= \frac{x^b}{1+x^b+x^{-c}} + \frac{1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} \left(\because \begin{matrix} a+b+c=0 \\ a+b=-c \end{matrix}\right)$

$= \frac{x^b+1}{1+x^b+x^{-c}} + \frac{1}{1+x^c+x^{-a}} = \frac{x^c(x^b+1)}{x^c(1+x^b+x^{-c})} + \frac{1}{1+x^c+x^{-a}}$

$= \frac{x^{b+c}+x^c}{x^c+x^{b+c}+1} + \frac{1}{1+x^c+x^{-a}} = \frac{x^{b+c}+x^c}{1+x^c+x^{-a}} + \frac{1}{1+x^c+x^{-a}} \left(\because \begin{matrix} a+b+c=0 \\ b+c=-a \end{matrix}\right)$

$= \frac{x^{-a}+x^c+1}{1+x^c+x^{-a}} = \frac{1+x^c+x^{-a}}{1+x^c+x^{-a}} = 1$

Thus, LHS = RHS Proved.

5. यदि $abc = 1$ भए प्रमाणित गर्नुहोस्: $\frac{1}{1+a+b^{-1}} + \frac{1}{1+b+c^{-1}} + \frac{1}{1+c+a^{-1}} = 1$

If $abc = 1$ then show that: $\frac{1}{1+a+b^{-1}} + \frac{1}{1+b+c^{-1}} + \frac{1}{1+c+a^{-1}} = 1$

⇨ Here, LHS $= \frac{1}{1+a+b^{-1}} + \frac{1}{1+b+c^{-1}} + \frac{1}{1+c+a^{-1}}$

$= \frac{b}{b(1+a+b^{-1})} + \frac{1}{1+b+ab} + \frac{a}{a(1+c+a^{-1})}$ [$\because abc = 1$ and $c^{-1} = ab$]

$= \frac{b}{b+ab+1} + \frac{1}{b+ab+1} + \frac{a}{a+ca+1} = \frac{b}{b+ab+1} + \frac{1}{b+ab+1} + \frac{ab}{b(a+ca+1)}$

$= \frac{b}{b+ab+1} + \frac{1}{b+ab+1} + \frac{ab}{ab+abc+b}$

$= \frac{b}{b+ab+1} + \frac{1}{b+ab+1} + \frac{ab}{ab+1+b}$

$= \frac{b+1+ab}{b+ab+1}$

$= \frac{b+ab+1}{b+ab+1} = 1$ = RHS **Proved.**

6. यदि $a = x^{q+r}.y^p$, $b = x^{r+p}.y^q$ र $c = x^{p+q}.y^r$ भए प्रमाणित गर्नुहोस्: $a^{q-r}.b^{r-p}.c^{p-q} = 1$

If $a = x^{q+r}.y^p$, $b = x^{r+p}.y^q$ and $c = x^{p+q}.y^r$ Prove that $a^{q-r}.b^{r-p}.c^{p-q} = 1$

⇨ Here, LHS $= a^{q-r}.b^{r-p}.c^{p-q} = (x^{q+r}.y^p)^{q-r} . (x^{r+p}.y^q)^{r-p} . (x^{p+q}.y^r)^{p-q}$

$= x^{(q+r)(q-r)} . y^{p(q-r)} . x^{(r+p)(r-p)} . y^{q(r-p)} . x^{(p+q)(p-q)} . y^{r(p-q)}$

$= x^{(q^2-r^2)} . y^{pq-pr} . x^{(r^2-p^2)} . y^{qr-pq} . x^{p^2-q^2} . y^{pr-qr}$

$= x^{(q^2-r^2)} . x^{(r^2-p^2)} . x^{p^2-q^2} \times y^{pq-pr} . y^{qr-pq} . y^{pr-qr}$

$= x^{q^2-r^2+r^2-p^2+p^2-q^2} \times y^{pq-pr+qr-pq+pr-qr} = x^0 \times y^0 = 1 \times 1 = 1$ = RHS Proved

7. यदि $2abc = 1$ र $a^3 + b^3 + c^3 = 1$ भए प्रमाणित गर्नुहोस्: $x^{a^2b^{-1}c^{-1}} . x^{a^{-1}b^2c^{-1}} . x^{a^{-1}b^{-1}c^2} = x^2$

If $2abc = 1$ and $a^3 + b^3 + c^3 = 1$ then prove that: $x^{a^2b^{-1}c^{-1}} . x^{a^{-1}b^2c^{-1}} . x^{a^{-1}b^{-1}c^2} = x^2$

⇨ Here, LHS $= x^{a^2b^{-1}c^{-1}} . x^{a^{-1}b^2c^{-1}} . x^{a^{-1}b^{-1}c^2} = x^{\frac{a^2}{bc}} . x^{\frac{b^2}{ac}} . x^{\frac{c^2}{ab}} = x^{\frac{a^2}{bc}+\frac{b^2}{ac}+\frac{c^2}{ab}}$

$= x^{\frac{a^3+b^3+c^3}{abc}} = x^{\frac{2(a^3+b^3+c^3)}{2abc}} = x^{\frac{2\times 1}{1}} = x^2$ = RHS Proved.

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10.2 घाताङ्कयुक्त समीकरण (EXPONENTIAL EQUATION)

A. BASIC EXERCISE 10.2

A. VERY SHORT QUESTIONS

1. यदि $m^{2a} = m^b$ भए a लाई b को रूपमा व्यक्त गर्नुहोस् । (If $m^{2a} = m^b$ then express a in terms of b.)

⇨ Here, $m^{2a} = m^b$ or, $2a = b$ ∴ $a = \frac{b}{2}$

2. यदि $(\sqrt{a})^{\sqrt{a}} = 4^4$ भए a को मान निकाल्नुहोस् । (If $(\sqrt{a})^{\sqrt{a}} = 4^4$ then find the value of *a.*)

⇨ Here, $(\sqrt{a})^{\sqrt{a}} = 4^4$ or, $(\sqrt{a})^{\sqrt{a}} = (\sqrt{16})^{\sqrt{16}}$ ∴ $a = 16$

3. यदि $(a^m \times a^n) \div a^p = a^x$ भए x लाई m, n र p को रूपमा व्यक्त गर्नुहोस् ।

If $(a^m \times a^n) \div a^p = a^x$ then express x in terms of m, n and p.

⇨ Here, $(a^m \times a^n) \div a^p = a^x$ or, $a^{m+n-p} = a^x$ ∴ $x = m + n - p$

4. यदि $(a^m \div a^n) \times a^p = a^x$ भए x लाई m, n र p को रूपमा व्यक्त गर्नुहोस् ।

If $(a^m \div a^n) \times a^p = a^x$ then express *x* in terms of *m*, *n* and *p*.

⇨ Here, $(a^m \div a^n) \times a^p = a^x$ or, $a^{m-n+p} = a^x$ ∴ $x = m - n + p$

5. यदि $a^m \times a^n = a^{3m}$ भए m लाई n को रूपमा व्यक्त गर्नुहोस् । (If $a^m \times a^n = a^{3m}$ then express *m* in terms of *n.*)

⇨ Here, $a^m \times a^n = a^{3m}$ or, $a^{m+n} = a^{3m}$ or, $m + n = 3m$

i.e. $n = 2m$ ∴ $m = \frac{n}{2}$

B. SHORT QUESTIONS

Model 1

1. हल गर्नुहोस् (Solve) : $3^{2x+1} = 9^{2x-1}$ [2057 C1]

⇨ Here, $3^{2x+1} = 9^{2x-1}$ or, $3^{2x+1} = 3^{2(2x-1)}$ or, $3^{2x+1} = 3^{4x-2}$

Equating the exponents $2x + 1 = 4x - 2$

or, $4x - 2x = 1 + 2$ or, $2x = 3$ Thus, $x = \frac{3}{2} = 1\frac{1}{2}$

2. हल गर्नुहोस् (Solve) : $4^{2x-1} = 2^{x+1}$ [2058 A2]

⇨ Here, $4^{2x-1} = 2^{x+1}$ or, $2^{2(2x-1)} = 2^{x+1}$ or, $2(2x - 1) = x + 1$

or, $4x - 2 = x + 1$ or, $4x - x = 1 + 2$ or, $3x = 3$

Thus, $x = \frac{3}{3} = 1$

3. हल गर्नुहोस् (Solve) : $27^x = 3^{x+4}$ [2058 E1]

⇨ Here, $27^x = 3^{x+4}$ or, $(3^3)^x = 3^{x+4}$ or, $3^{3x} = 3^{x+4}$

or, $3x = x + 4$ or, $3x - x = 4$ or, $2x = 4$

Thus, $x = \frac{4}{2} = 2$

4. हल गर्नुहोस् (Solve) : $25^{x+3} = \frac{1}{0.04}$ [2061 E1]

⇨ Here, $25^{x+3} = \frac{1}{0.04}$ or, $25^{x+3} = \frac{100}{4}$ or, $25^{x+3} = 25$

or, $25^{x+3} = 25^1$ or, $x + 3 = 1$ or, $x = 1 - 3$

Thus, $x = -2$

Model 2

5. हल गर्नुहोस् (Solve) : $2^{x+1} - 2^x - 8 = 0$ [2058 C2]

⇨ Here, $2^{x+1} - 2^x = 8.$ or, $2^x . 2 - 2^x = 8$ or, $2^x(2 - 1) = 2^3$

or, $2^x = 2^3$ Thus, $x = 3$

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6. हल गर्नुहोस् (Solve) : $2^{x+3} + 2^{x+1} = 80$ [2060 D1]

⇨ Here, $2^{x+3} + 2^{x+1} = 80$ or, $2^x.2^3 + 2^x2^1 = 80$ or, $2^x(2^3 + 2) = 80$

or, $2^x.10 = 80$ or, $2^x = 8$ or, $2^x = 2^3$

Thus, $x = 3$

7. हल गर्नुहोस् (Solve) : $3^{x+2} + 3^{x+1} = 1\frac{1}{3}$ [2059 C2]

⇨ Here, $3^{x+2} + 3^{x+1} = 1\frac{1}{3}$ or, $3^x.3^2 + 3^x.3^1 = \frac{4}{3}$ or, $3^x(9+3) = \frac{4}{3}$

or, $3^x \times 12 = \frac{4}{3}$ or, $3^x = \frac{4}{36}$ or, $3^x = \frac{1}{9}$

or, $3^x = \frac{1}{3^2}$ or, $3^x = 3^{-2}$ Thus, $x = -2$

8. हल गर्नुहोस् (Solve) : $2^y + 2^{y-2} = 5$ [2059 D2]

⇨ Here, $2^y + 2^{y-2} = 5$ or, $2^y + 2^y.2^{-2} = 5$ or, $2^y(1 + 2^{-2}) = 5$

or, $2^y\left(1 + \frac{1}{2^2}\right) = 5$ or, $2^y\left(1 + \frac{1}{4}\right) = 5$ or, $2^y\left(\frac{5}{4}\right) = 5$

or, $2^y(5) = 20$ or, $2^y = \frac{20}{5}$ or, $2^y = 4$

or, $2^y = 2^2$ Thus, $y = 2$

9. हल गर्नुहोस् (Solve) : $2^{x+2} + \frac{2^{x+3}}{2} = 1$ [2059 A1]

⇨ Here, $2^{x+2} + \frac{2^{x+3}}{2} = 1$ or, $2^{x+2} + 2^{x+3-1} = 1$ or, $2^{x+2} + 2^{x+2} = 1$

or, $2^x.2^2 + 2^x.2^2 = 1$ or, $2^x(2^2 + 2^2) = 1$ or, $2^x(4+4) = 1$

or, $2^x.8 = 1$ or, $2^x = \frac{1}{8}$ or, $2^x = \frac{1}{2^3}$

or, $2^x = 2^{-3}$ Thus, $x = -3$

10. यदि $a = b^x$, $b = c^y$ र $c = a^z$ भए $xyz = 1$ हुन्छ भनी प्रमाणित गर्नुहोस् ।
If $a = b^x$, $b = c^y$ and $c = a^z$, prove that $xyz = 1$. [2059 S]

⇨ Here, $a = b^x$, $b = c^y$ and $c = = a^z$

Taking, $a = b^x$ or, $a = (c^y)^x$ [$\because b = c^y$] or, $a = c^{xy}$

or, $a = (a^z)^{xy}$ [$\because c = a^z$] or, $a = a^{xyz}$ or, $a^1 = a^{xyz}$

$\therefore$ $xyz = 1$ Proved.

C. LONG QUESTIONS

Model 1

1. हल गर्नुहोस् (Solve): $3^{x+3} + \frac{1}{3^x} - 28 = 0$ [2061 C1, 2061 C2, 2068 B, 2069 B]

⇨ Here, $3^{x+3} + \frac{1}{3^x} - 28 = 0$ or, $3^x.3^3 + \frac{1}{3^x} - 28 = 0$

or, $\frac{(3^x)^2.27 + 1 - 28.3^x}{3^x} = 0$ or, $27(3^x)^2 - 28.3^x + 1 = 0$

Putting $3^x = a$, Then, $27a^2 - 28a + 1 = 0$

or, $27a^2 - 27a - a + 1 = 0$ or, $27a(a-1) - 1(a-1) = 0$

or, $(a-1)(27a-1) = 0$ Either, $a - 1 = 0$

or, $a = 1$ or, $3^x = 1$

or, $3^x = 3^0$ $\therefore$ $x = 0$ or, $27a - 1 = 0$

or, $27a = 1$ or, $a = \frac{1}{27}$

or, $a = \frac{1}{3^3}$ or, $3^x = 3^{-3}$

$\therefore$ $x = -3$ Thus, $x = 0, -3$

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2. हल गर्नुहोस् (Solve): $2^{x+3} + \frac{1}{2^x} - 9 = 0$ [2061 C2]

⇨ Here, $2^{x+3} + \frac{1}{2^x} - 9 = 0$ or, $2^x . 2^3 + \frac{1}{2^x} - 9 = 0$

or, $\frac{(2^x)^2 . 8 + 1 - 9.2^x}{2^x} = 0$ or, $8(2^x)^2 - 9.2^x + 1 = 0$

Putting, $2^x = P$ Then, $8P^2 - 9P + 1 = 0$

or, $8P^2 - 8P - P + 1 = 0$ or, $8P(P - 1) - 1(P - 1) = 0$

or, $(P - 1)(8P - 1) = 0$ $\therefore$ $P = 1$ or, $P = \frac{1}{8}$

If $P = 1$, then, $2^x = 1$ or, $2^x = 2^0$ $\therefore$ $x = 0$

and If $P = \frac{1}{8}$, then, $2^x = \frac{1}{2^3}$ or, $2^x = 2^{-3}$ $\therefore$ $x = -3$.

Thus, the required values are $0, -3$

3. हल गर्नुहोस् (Solve): $7^x + \frac{343}{7^x} = 56$ [SLC 2065 B, 2072 MW]

⇨ Here, $7^x + \frac{343}{7^x} = 56$ Let, $7^x = a$ then, $a + \frac{343}{a} = 56$

or, $\frac{a^2 + 343}{a} = 56$ or, $a^2 + 343 = 56a$

or, $a^2 - 56a + 343 = 0$ or, $a^2 - 7a - 49a + 343 = 0$

or, $a(a - 7) - 49(a - 7) = 0$ or, $(a - 7)(a - 49) = 0$

Either, $a - 7 = 0$ or, $a - 49 = 0$

$\therefore$ $a = 7$ $\therefore$ $a = 49$

or, $7^x = 7$ or, $7^x = 7^2$

$\therefore$ $x = 1$ $\therefore$ $x = 2$

Thus, $x = 1$ or 2 are the solutions of given equation.

4. हल गर्नुहोस् (Solve): $4^x + \frac{1}{4^x} = 16\frac{1}{16}$ [Model 2065, 2068 E, 2069 C]

⇨ Here, $4^x + \frac{1}{4^x} = 16\frac{1}{16}$ Let, $4^x = a$,

or, $a + \frac{1}{a} = 16\frac{1}{16}$ or, $16a^2 + 16 = 257a$

or, $16a^2 - 257a + 16 = 0$ or, $16a^2 - 256a - a + 16 = 0$

or, $16a(a - 16) - 1(a - 16) = 0$ or, $(a - 16)(16a - 1) = 0$

Either, $a - 16 = 0$ .....(i) or, $16a - 1 = 0$ .....(i)

From equation (i), $a - 16 = 0$ $\therefore$ $a = 16$

Substituting $a = 16$ in $a = 4^x$, Then, $16 = 4^x$

or, $4^x = 4^2$ $\therefore$ $x = 2$

From equation (ii), $16a - 1 = 0$ or, $16a = 1$

or, $a = \frac{1}{16}$ Substituting $a = 4^x$

Then, $4^x = 4^{-2}$ $\therefore$ $x = -2$

5. हल गर्नुहोस् (Solve): $2^x + \frac{1}{2^x} = 4\frac{1}{4}$ [2067 C]

⇨ Here, $2^x + \frac{1}{2^x} = 4\frac{1}{4}$ Let, $2^x = a$ then,

$a + \frac{1}{a} = \frac{17}{4}$ or, $\frac{a^2 + 1}{a} = \frac{17}{4}$

or, $4a^2 + 4 = 17a$ or, $4a^2 - 17a + 4 = 0$

or, $4a^2 - 16a - a + 4 = 0$ or, $4a(a - 4) - 1(a - 4) = 0$

or, $(a - 4)(4a - 1) = 0$

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Either, $a - 4 = 0$ or, $4a - 1 = 0$

or, $a = 4$ or, $a = \frac{1}{4}$

or, $2^x = 4$ or, $2^x = \frac{1}{2^2}$

or, $2^x = 2^2$ or, $2^x = 2^{-2}$

$\therefore$ $x = 2$ $\therefore$ $x = -2$

Thus, $x = \pm 2$

6. हल गर्नुहोस् (Solve): $7^x + 7^{-x} = 7\frac{1}{7}$ **[2067S, 2070S]**

⇨ Here, $7^x + 7^{-x} = 7\frac{1}{7}$ or, $7^x + \frac{1}{7^x} = 7\frac{1}{7}$

Let, 7^x be a then, $a + \frac{1}{a} = 7\frac{1}{7}$ or, $\frac{a^2 + 1}{a} = \frac{50}{7}$

or, $7a^2 + 7 = 50a$ or, $7a^2 - 50a + 7 = 0$

or, $7a^2 - 49a - a + 7 = 0$ or, $7a(a - 7) - 1(a - 7) = 0$

or, $(a - 7)(7a - 1) = 0$

Either, $a - 7 = 0$ or, $7a - 1 = 0$

or, $a = 7$ or, $7a = 1$

or, $7^x = 7^1$ or, $7 \times 7^x = 1$

$\therefore$ $x = 1$ or, $7^{x+1} = 7^0$

or, $x + 1 = 0$

$\therefore$ $x = -1$

Thus, $x = 1$ or -1 is the solution.

7. हल गर्नुहोस् (Solve): $\frac{3^{2x} + 1}{3^x} = \frac{82}{9}$ **[2071 A]**

⇨ Here, $\frac{3^{2x} + 1}{3^x} = \frac{82}{9}$ or, $9.3^{2x} + 9 = 3^x . 82$ or, $9.(3^x)^2 + 9 = 3^x.82$

Let, $3^x = a$ then, $9a^2 + 9 = a.82$ or, $9a^2 - 82a + 9 = 0$ or, $9a^2 - 81a - a + 9 = 0$

or, $9a(a - 9) - 1(a - 9) = 0$ or, $(a - 9)(9a - 1) = 0$

Either, $a - 9 = 0$ $\therefore$ $a = 9$

or, $9a - 1 = 0$ $\therefore$ $a = \frac{1}{9}$

Now, $3^x = 9$ or, $3^x = 3^2$ $\therefore$ $x = 2$

and $3^x = \frac{1}{9}$ or, $3^x = 3^{-2}$ $\therefore$ $x = -2$

Thus, $x = 2$ or -2

Model 2

8. हल गर्नुहोस् (Solve): $5.4^{x+1} - 16^x = 64$ **[2062 A1]**

⇨ Here, $5.4^{x+1} - 16^x = 64$ or, $5.4^x . 4 - (4^2)^x = 64$

or, $20.4^x - (4^x)^2 = 64$ If we putting, $4^x = a$, then, we have

$20a - a^2 = 64$ or, $a^2 - 20a + 64 = 0$

or, $a^2 - 16a - 4a + 64 = 0$ or, $a(a - 16) - 4(a - 16) = 0$

or, $(a - 16)(a - 4) = 0$ or, $(4^x - 16)(4^x - 4) = 0$

Either, $4^x - 16 = 0$ or, $4^x = 16$

or, $4^x = 4^2$ or, $x = 2$

or, $4^x - 4 = 0$ or, $4^x = 4^1$

$\therefore$ $x = 1$ Thus, $x = 1$ or 2

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9. हल गर्नुहोस् (Solve): $4.3^{x+1} - 9^x = 27$ [2062 A2]

⇨ Here, $4.3^{x+1} - 9^x = 27$
or, $4.3^x.3 = 27 + (3^2)^x$
Let, $3^x = a$ ..... (i)
or, $a^2 - 12a + 27 = 0$
or, $a(a-9) - 3(a-9) = 0$
or, $a - 9 = 0$ ..... (ii)
From First equation (ii)
∴ $a = 9$
$3^x = 3^2$
From second equation (iii)
∴ $a = 3$
$3^x = 3^1$
Thus, $x = 2$ or 1

or, $4.3^{x+1} = 27 + 9^x$
or, $12.3^x = 27 + (3^x)^2$
Now, $12a = 27 + a^2$
or, $a^2 - 9a - 3a + 27 = 0$
or, $(a-9)(a-3) = 0$
or, $a - 3 = 0$ ..... (iii)
$a - 9 = 0$
Putting the value of a in equation (i)
∴ $x = 2$
$a - 3 = 0$
Putting the value of a in equation (i)
∴ $x = 1$

10. हल गर्नुहोस् (Solve): $3.2^{x+1} - 4^x = 8$ [2065 D, 2072 C]

⇨ Here, $3.2^{x+1} - 4^x = 8$
Let, $2^x = a$ then, $3.a.2 - a^2 = 8$
or, $a^2 - 6a + 8 = 0$
or, $a(a-4) - 2(a-4) = 0$
∴ $a = 4$ or 2
or, $2^x = 4$ or, $2^x = 2$
or, $2^x = 2^2$ or, $2^x = 2^1$

or, $3.2^x.2^1 - 2^{2x} = 8$
or, $6a - a^2 = 8$
or, $a^2 - 4a - 2a + 8 = 0$
or, $(a-4)(a-2) = 0$

Thus $x = 2$ or 1

11. हल गर्नुहोस् (Solve): $4^x - 6 . 2^{x+1} + 32 = 0$ [2066 D]

⇨ Here, $4^x - 6.2^{x+1} + 32 = 0$
Let, $2^x = a$ then, $a^2 - 6.a.2 + 32 = 0$
or, $a^2 - 8a - 4a + 32 = 0$
or, $(a-8)(a-4) = 0$
Either, $a - 8 = 0$
or, $2^x = 2^3$
∴ $x = 3$
Thus, $x = 3$ or 2

or, $2^{2x} - 6.2^x.2 + 32 = 0$
or, $a^2 - 12a + 32 = 0$
or, $a(a-8) - 4(a-8) = 0$

or, $a - 4 = 0$
or, $a = 4$
or, $2^x = 2^2$ ∴ $x = 2$

12. हल गर्नुहोस् (Solve): $9^a - 10 \times 3^a + 9 = 0$ [2069 B]

⇨ Here, $9^a - 10 \times 3^a + 9 = 0$
or, $(3^a)^2 - 10 \times 3^a + 9 = 0$
or, $x^2 - 9x - x + 9 = 0$
or, $(x-9)(x-1) = 0$
Either, $x - 9 = 0$
or, $3^a = 9$
or, $3^a = 3^2$
∴ $a = 2$
Thus, $a = 2$ or 0 is the solution.

or, $3^{2a} - 10 \times 3^a + 9 = 0$
Let, 3^a be x then, $x^2 - 10x + 9 = 0$
or, $x(x-9) - 1(x-9) = 0$

or, $x - 1 = 0$
or, $x = 1$
or, $3^a = 3^0$
∴ $a = 0$

13. हल गर्नुहोस् (Solve): $16^p - 5 \times 4^{p+1} + 64 = 0$ [2072 E, 2069 S]

⇨ Here, $16^p - 5 \times 4^{p+1} + 64 = 0$
or, $(4^p)^2 - 5 \times 4^p \times 4 + 64 = 0$
or, $a^2 - 20a + 64 = 0$
or, $a(a-16) - 4(a-16) = 0$
either $a - 16 = 0$
or, $a = 16$
or, $4^p = 4^2$
∴ $p = 2$
Thus, $p = 2$ or 1 is the solution.

or, $(4^2)^p - 5 \times 4^p \times 4 + 64 = 0$
Let 4^p be a then, $a^2 - 5 \times a \times 4 + 64 = 0$
or, $a^2 - 16a - 4a + 64 = 0$
or, $(a-16)(a-4) = 0$
or, $a - 4 = 0$
or, $a = 4$
or, $4^p = 4^1$
∴ $p = 1$

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14. हल गर्नुहोस् (Solve): $5^{x+1} = 26 - 5^{1-x}$ [2072 W, 2072 FW]

⇨ Here, $5^{x+1} = 26 - 5^{1-x}$

or, $5^x \times 5 = 26 - \frac{1}{5^x} \times 5$

or, $5a = \frac{26a - 5}{a}$ or,

or, $5a^2 - 26a + 5 = 0$

or, $5a(a-5) - 1(a-5) = 0$

Either, $a - 5 = 0$

or, $a = 5$

or, $5^x = 5^1$

$\therefore \quad x = 1$

Thus, $x = 1$ or -1 is the solution.

or, $5^x . 5^1 = 26 - 5^1 \times 5^{-x}$

Let, 5^x be a then, $a \times 5 = 26 - \frac{5}{a}$

$5a^2 = 26a - 5$

or, $5a^2 - 25a - a + 5 = 0$

or, $(a-5)(5a-1) = 0$

or, $5a - 1 = 0$

or, $5a = 1$

or, $a = \frac{1}{5}$

or, $5^x = 5^{-1}$ $\quad \therefore \quad x = -1$

Model 3

15. हल गर्नुहोस् (Solve): $2^{p-2} + 2^{3-p} = 3$ [2071 B, C, D, S]

⇨ Here, $2^{p-2} + 2^{3-p} = 3$

or, $\frac{2^p}{4} + \frac{8}{2^p} = 3$ let, $2^p = a$ then

or, $a^2 + 32 = 12a$

or, $a^2 - 8a - 4a + 32 = 0$

Either, $a - 8 = 0$

or, $a = 8$

$\therefore \quad 2^p = 8$

or, $2^p = 2^3$

$\therefore \quad p = 3$

or, $\frac{a}{4} + \frac{8}{a} = 3$

or, $a^2 - 12a + 32 = 0$

or, $a(a-8) - 4(a-8) = 0$

or, $a - 4 = 0$

or, $a = 4$

$\therefore \quad 2^p = 4$

or, $2^p = 2^2$

$\therefore \quad p = 2$

or, $\frac{a^2 + 32}{4a} = 3$

or, $a^2 - 12a + 32 = 0$

or, $(a-8)(a-4) = 0$

Thus, $p = 2$ or 3 is the solution.

16. हल गर्नुहोस् (Solve): $3^{x+2} + 3^{2-x} = 82$ [2071 E]

⇨ Here, $3^{x+2} + 3^{2-x} = 82$

or, $3^x . 3^2 + 3^2 . 3^{-x} = 82$

Let, $3^x = a$ then,

or, $9a + \frac{9}{a} = 82$

or, $9a^2 - 82a + 9 = 0$

or, $(a-9)(9a-1) = 0$

Either, $a - 9 = 0$

or, $9a = 1$

or, $x = 2$

Thus, $x = 2$ or -2 is the solution.

or, $3^x . 3^2 + \frac{3^2}{3^x} = 82$

$a.3^2 + \frac{3^2}{a} = 82$

or, $\frac{9a^2 + 9}{a} = 82$

or, $9a^2 - 81a - a + 9 = 0$

or, $9a - 1 = 0$

or, $3^x = 3^2$

or, $3^x = 3^{-2}$

or, $9a^2 + 9 = 82a$

or, $9a(a-9) - 1(a-9) = 0$

or, $a = 9$

or, $9.3^x = 1$

$\therefore \quad x = -2$

17. हल गर्नुहोस् (Solve): $5^{1-x} + 5^{x-1} = 5\frac{1}{5}$ [2068 A]

⇨ Here, $5^{1-x} + 5^{x-1} = 5\frac{1}{5}$

Let, $5^x = a$ then, $\frac{5}{a} + \frac{a}{5} = \frac{26}{5}$

or, $25 + a^2 = 26a$

or, $a^2 - 25a - a + 25 = 0$

or, $(a-25)(a-1) = 0$

Either, $a - 25 = 0$

or, $5^x = 5^2$

or, $5^x = 5^0$

$\therefore \quad x = 2$

Thus, $x = 2$ or 0 are the solutions.

or, $\frac{5}{5^x} + \frac{5^x}{5} = 5\frac{1}{5}$

or, $\frac{25 + a^2}{5a} = \frac{26}{5}$

or, $a^2 - 26a + 25 = 0$

or, $a(a-25) - 1(a-25) = 0$

or, $a - 1 = 0$

or, $5^x = 1$

$\therefore \quad x = 0$

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B. QUESTIONS FROM CDC TEXT BOOK

हल गर्नुहोस् (Solve):

1A. $3^{2y} - 4 \times 3^y + 3 = 0$

⇨ Here, $3^{2y} - 4 \times 3^y + 3 = 0$

or, $(3^y)^2 - 4 \times 3^y + 3 = 0$

Let, 3^y be a then,

$a^2 - 4a + 3 = 0$

or, $a^2 - 3a - a + 3 = 0$

or, $a(a-3) - 1(a-3) = 0$

or, $(a-3)(a-1) = 0$

Either, $a - 3 = 0$ or, $a - 1 = 0$

or, $3^y = 3^1$ or, $3^y = 1$

∴ $y = 1$ or, $3^y = 3^0$

∴ $y = 0$

Thus, the value of y is 1 or 0.

1C. $5^{2x} - 6 \times 5^{x+1} + 125 = 0$

⇨ Here, $5^{2x} - 6 \times 5^{x+1} + 125 = 0$

or, $(5^x)^2 - 6 \times 5^x.5^1 + 125 = 0$

Let, 5^x be a then,

$a^2 - 6a.5 + 125 = 0$

or, $a^2 - 30a + 125 = 0$

or, $a^2 - 25a - 5a + 125 = 0$

or, $a(a-25) - 5(a-25) = 0$

or, $(a-25)(a-5) = 0$

Either, $a - 25 = 0$ or, $a - 5 = 0$

or, $5^x = 25$ or, $5^x = 5$

or, $5^x = 5^2$ or, $5^x = 5^1$

∴ $x = 2$ ∴ $x = 1$

Thus, the solution is x = 1 or 2.

1E. $4^y - 24 \times 2^y = -128$

⇨ Here, $4^y - 24 \times 2^y = -128$

or, $(2^2)^y - 24 \times 2^y + 128 = 0$

or, $(2^y)^2 - 24 \times 2^y + 128 = 0$

Let, 2^y be a then,

$a^2 - 24a + 128 = 0$

or, $a^2 - 16a - 8a + 128 = 0$

or, $a(a-16) - 8(a-16) = 0$

or, $(a-16)(a-8) = 0$

Either, $a - 16 = 0$ or, $a - 8 = 0$

or, $a = 16$ or, $a = 8$

or, $2^y = 16$ or, $2^y = 8$

or, $2^y = 2^4$ or, $2^y = 2^3$

∴ $y = 4$ ∴ $y = 3$

Thus, y = 3 or 4 is the solution.

1B. $4^x - 6 \times 2^{x-1} + 2 = 0$

⇨ Here, $4^x - 6 \times 2^{x-1} + 2 = 0$

or, $(2^2)^x - 6 \times 2^x .2^{-1} + 2 = 0$

or, $(2^x)^2 - \frac{6}{2} \times 2^x + 2 = 0$

Let, 2^x be a then,

$a^2 - 3a + 2 = 0$

or, $a^2 - 2a - a + 2 = 0$

or, $a(a-2) - 1(a-2) = 0$

or, $(a-2)(a-1)$

Either, $a - 2 = 0$ or, $a - 1 = 0$

or, $2^x = 2$ or, $2^x = 1$

or, $2^x = 2^1$ or, $2^x = 2^0$

∴ $x = 1$ ∴ $x = 0$

Thus, the solution is x = 0 or 1.

1D. $3^{2x} - 4 \times 3^x + 3 = 0$

⇨ Here, $3^{2x} - 4 \times 3^x + 3 = 0$

or, $(3^x)^2 - 4 \times 3^x + 3 = 0$

Let, 3^x be a then,

$a^2 - 4a + 3 = 0$

or, $a^2 - 3a - a + 3 = 0$

or, $a(a-3) - 1(a-3) = 0$

or, $(a-3)(a-1) = 0$

Either, $a - 3 = 0$ or, $a - 1 = 0$

or, $3^x = 3$ or, $3^x = 1$

or, $3^x = 3^1$ or, $3^x = 3^0$

∴ $x = 1$ ∴ $x = 0$

Thus, x = 1 or 0 is the solution.

2A. हल गर्नुहोस् (Solve): $3^x + \frac{1}{3^x} = 9\frac{1}{9}$ [SLC 2066 S]

⇨ Here, $3^x + \frac{1}{3^x} = 9\frac{1}{9}$

Let, $3^x = a$ then,

$a + \frac{1}{a} = 9\frac{1}{9}$

or, $\frac{a^2+1}{a} = \frac{82}{9}$

or, $9a^2 + 9 = 82a$

or, $9a^2 - 82a + 9 = 0$

or, $9a^2 - 81a - a + 9 = 0$

or, $9a(a-9) - 1(a-9) = 0$

or, $(a-9)(9a-1) = 0$

Either, $a - 9 = 0$

∴ $a = 9$ or, $9a = 1$

∴ $a = \frac{1}{9}$

Putting the value of a then,

$3^x = 9$ and $3^x = \frac{1}{9}$

or, $3^x = 3^2$ or, $3^x = \frac{1}{3^2}$

∴ $x = 2$ or, $3^x = 3^{-2}$

∴ $x = -2$ Thus, $x = \pm 2$

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2B. हल गर्नुहोस् (Solve): $5^x + 5^{-x} = 25\frac{1}{25}$ [2067 A, 2069 A]

⇨ Here, $5^x + 5^{-x} = 25\frac{1}{25}$

or, $5^x + \frac{1}{5^x} = \frac{626}{25}$

Let, $5^x = a$ then, $a + \frac{1}{a} = \frac{626}{25}$

or, $\frac{a^2+1}{a} = \frac{626}{25}$

or, $25a^2 + 25 = 626a$

or, $25a^2 - 626a + 25 = 0$

or, $25a^2 - 625a - a + 25 = 0$

or, $25a(a-25) - 1(a-25) = 0$

or, $(a-25)(25a-1) = 0$

Either, $a - 25 = 0$ ..... (i)

or, $25a - 1 = 0$ ..... (ii)

From (i), $a - 25 = 0$ or, $a = 25$

or, $5^x = 5^2$ ∴ $x = 2$

From (ii) $25a - 1 = 0$

or, $25a = 1$ or, $a = \frac{1}{25}$

or, $5^x = 5^{-2}$ ∴ $x = -2$

Thus, $x = \pm 2$

2C. $4^{x-1} + 4^{-x} = 1$

⇨ Here, $4^{x-1} + 4^{-x} = 1$

or, $\frac{4^x}{4} + 4^{-x} = 1$

or, $\frac{4^x}{4} + \frac{1}{4^x} = 1$

Let, 4^x be a then, $\frac{a}{4} + \frac{1}{a} = 1$

or, $\frac{a^2+4}{4a} = 1$

or, $a^2 + 4 = 4a$

or, $a^2 + 4 = 4a$

or, $a^2 - 4a + 4 = 0$

or, $(a-2)^2 = 0$

or, $a - 2 = 0$

or, $a = 2$

or, $4^x = 2$

or, $2^{2x} = 2^1$

or, $2x = 1$

∴ $x = \frac{1}{2}$

Thus, $x = \frac{1}{2}$ is the solution.

2D. हल गर्नुहोस् (Solve) : $5^{a+1} + 5^{2-a} = 126$ [2069 E]

⇨ Here, $5^{a+1} + 5^{2-a} = 126$

Let, 5^a be x then, $x \times 5 + \frac{25}{5^a} = 126$

or, $\frac{5x^2+25}{x} = 126$

or, $5x^2 + 25 = 126x$

or, $5x^2 - 125x - x + 25 = 0$

or, $(x-25)(5x-1) = 0$

Either, $x - 25 = 0$

or, $5^a = 25$

or, $5^a = 5^2$

∴ $a = 2$

Thus, $a = 2$ or -1 is the solution.

or, $5^a \times 5^1 + 5^2 \times 5^{-a} = 126$

or, $5x + \frac{25}{x} = 126$

or, $5x^2 + 25 = 126x$

or, $5x^2 - 126x + 25 = 0$

or, $5x(x-25) - 1(x-25) = 0$

or, $5x - 1 = 0$

or, $5x = 1$

or, $x = \frac{1}{5}$

or, $5^a = 5^{-1}$

∴ $a = -1$

3. $4 \times 3^{x+1} - 9^x = 27$ लाई हल गर्दा आउने x का मानहरूले $3^{2x} - 4 \times 3^{x+1} + \frac{81}{3} = 0$ लाई पनि सन्तुष्ट गर्छन् भनी प्रमाणित गर्नुहोस् ।

Prove that the value of x obtained by solving $4 \times 3^{x+1} - 9^x = 27$ also satisfy the equation $3^{2x} - 4 \times 3^{x+1} + \frac{81}{3} = 0$.

⇨ Here, $4.3^{x+1} - 9^x = 27$

or, $4.3^x.3 = 27 + (3^2)^x$

Let, $3^x = a$ ..... (i)

or, $a^2 - 12a + 27 = 0$

or, $a(a-9) - 3(a-9) = 0$

or, $a - 9 = 0$ ..... (ii)

From equation (ii) $a - 9 = 0$

Putting the value of a in equation (i)

$3^x = 3^2$

or, $4.3^{x+1} = 27 + 9^x$

or, $12.3^x = 27 + (3^x)^2$

Now, $12a = 27 + a^2$

or, $a^2 - 9a - 3a + 27 = 0$

or, $(a-9)(a-3) = 0$

or, $a - 3 = 0$ ..... (iii)

∴ $a = 9$

∴ $x = 2$

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From equation (iii) $a - 3 = 0$

$\therefore \quad a = 3$

$3^x = 3^1$

Hence, $x = 2$ or 1

When $x = 2$ then,

$$\text{LHS} = 3^{2x} - 4 \times 3^{x+1} + \frac{81}{3} = 3^{2\times 2} - 4 \times 3^{2+1} + \frac{81}{3} = 3^4 - 4 \times 3^3 + \frac{81}{3}$$

$$= 81 - 108 + 27 = 0 = \text{RHS}$$

When $x = 1$ then,

$$\text{LHS} = 3^{2x} - 4 \times 3^{x+1} + \frac{81}{3} = 3^2 - 4 \times 3^2 + 27 = 9 - 36 + 27 = 0 = \text{RHS}$$

Thus, the values of $x = 2$ or 1, satisfies given equation.

Putting the value of a in equation (i)

$\therefore \quad x = 1$

11. बीजीय भिन्न (Algebraic Fraction)

SEE MODEL QUESTIONS ISSUED BY CDC [Q. NO. 15]

Q. 15. सरल गनुहोस् (Simplify): $\frac{1}{x-2} - \frac{4}{x^2-4}$

⇨ Here, $\frac{1}{(x-2)} - \frac{4}{(x^2-4)} = \frac{1}{x-2} - \frac{4}{(x-2)(x+2)} = \frac{x+2-4}{(x-2)(x+2)} = \frac{x-2}{(x-2)(x+2)} = \frac{1}{x+2}$

11.1 बीजीय भिन्न प्रयोग भएका सरलीकरण
SIMPLIFICATION OF RATIONAL ALGEBRAIC FRACTIONS

A. BASIC EXERCISE 11

A. VERY SHORT QUESTIONS

सरल गर्नुहोस् (Simplify):

1. $\frac{a^2}{a-b} + \frac{b^2}{b-a}$

⇨ Here, $\frac{a^2}{a-b} + \frac{b^2}{b-a}$

$= \frac{a^2}{a-b} - \frac{b^2}{a-b}$

$= \frac{a^2-b^2}{a-b}$

$= \frac{(a+b)(a-b)}{a-b}$

$= (a+b)$

2. $\frac{x}{y(x-y)} - \frac{y}{x(x-y)}$

⇨ Here, $\frac{x}{y(x-y)} - \frac{y}{x(x-y)}$

$= \frac{x^2-y^2}{xy(x-y)}$

$= \frac{(x+y)(x-y)}{xy(x-y)}$

$= \frac{x+y}{xy}$

3. $\frac{a^2-b^2}{(a-b)^2} - \frac{2b}{a-b}$

⇨ Here, $\frac{a^2-b^2}{(a-b)^2} - \frac{2b}{a-b}$

$= \frac{(a+b)(a-b)}{(a-b)(a-b)} - \frac{2b}{a-b}$

$= \frac{(a+b)}{a-b} - \frac{2b}{a-b}$

$= \frac{a+b-2b}{a-b}$

$= \frac{a-b}{a-b} = 1$

4. $\frac{m^3}{m-n} + \frac{n^3}{n-m}$

⇨ Here, $\frac{m^3}{m-n} + \frac{n^3}{n-m}$

$= \frac{m^3}{m-n} - \frac{n^3}{m-n}$

$= \frac{m^3-n^3}{m-n}$

$= \frac{(m-n)(m^2+mn+n^2)}{m-n}$

$= m^2 + mn + n^2$

5. $\frac{x^3y}{x-y} + \frac{xy^3}{y-x}$

⇨ Here, $\frac{x^3y}{x-y} + \frac{xy^3}{y-x}$

$= \frac{x^3y}{x-y} - \frac{xy^3}{x-y}$

$= \frac{xy(x^2-y^2)}{x-y}$

$= \frac{xy(x+y)(x-y)}{x-y}$

$= xy(x+y)$

6. $\frac{x^2y}{x-y} + \frac{xy^2}{y-x}$

⇨ Here, $\frac{x^2y}{x-y} + \frac{xy^2}{y-x}$

$= \frac{x^2y}{x-y} - \frac{xy^2}{x-y}$

$= \frac{xy(x-y)}{(x-y)} = xy$

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7. $\frac{5x}{x-y} + \frac{2x}{y-x}$

⇨ Here, $\frac{5x}{x-y} + \frac{2x}{y-x}$

$= \frac{5x}{x-y} - \frac{2x}{x-y}$

$= \frac{5x - 2x}{x-y}$

$= \frac{3x}{x-y}$

8. $\frac{3a}{a-b} - \frac{2a}{b-a}$

⇨ Here, $\frac{3a}{a-b} - \frac{2a}{b-a}$

$= -\frac{3a}{b-a} - \frac{2a}{b-a}$

$= \frac{-3a-2a}{b-a}$

$= -\frac{5a}{b-a} = \frac{5a}{a-b}$

9. $\frac{a+b}{b} + \frac{a-b}{b}$

⇨ Here, $\frac{a+b}{b} + \frac{a-b}{b}$

$= \frac{a+b+a-b}{b}$

$= \frac{2a}{b}$

10. $\frac{2}{x+2} + \frac{x}{x+2}$

⇨ Here, $\frac{2}{x+2} + \frac{x}{x+2}$

$= \frac{2+x}{x+2}$

$= 1$

11. $\frac{m^2-4m}{m^2-6m}$

⇨ Here, $\frac{m^2-4m}{m^2-6m}$

$= \frac{m(m-4)}{m(m-6)}$

$= \frac{m-4}{m-6}$

12. $\frac{a^2-4a}{a^2-3a}$

⇨ Here, $\frac{a^2-4a}{a^2-3a}$

$= \frac{a(a-4)}{a(a-3)}$

$= \frac{a-4}{a-3}$

13. $\frac{4a+10b}{2a+5b}$

⇨ Here, $\frac{4a+10b}{2a+5b}$

$= \frac{2(2a+5b)}{2a+5b}$

$= 2$

14. $\frac{a^3-b^3}{a^2-b^2}$

⇨ Here, $\frac{a^3-b^3}{a^2-b^2}$

$= \frac{(a-b)(a^2+ab+b^2)}{(a+b)(a-b)}$

$= \frac{a^2+ab+b^2}{a+b}$

15. $\frac{a^2-b^2}{a^2-2ab+b^2}$

⇨ Here, $\frac{a^2-b^2}{a^2-2ab+b^2}$

$= \frac{(a+b)(a-b)}{(a-b)^2}$

$= \frac{(a+b)}{(a-b)}$

x को मान कति हुँदा तलका अभिव्यञ्जकहरू अपरिभाषित हुन्छन् ?

For what value of x the following algebraic expressions are undefined?

16. $\frac{x^3}{x^2-4}$

⇨ Here, $\frac{x^3}{x^2-4} = \frac{x^3}{(x)^2-(2)^2}$.

So at $x = \pm 2$, the expression becomes undefined.

17. $\frac{5x^3}{x^2-9}$

⇨ Here, $\frac{5x^3}{x^2-9} = \frac{5x^3}{x^2-3^2}$.

So at $x = \pm 3$, the expression becomes undefined.

18. $\frac{x^2-5x}{x^2-49}$

⇨ Here, $\frac{x^2-5x}{x^2-49} = \frac{x(x-5)}{(x)^2-(7)^2}$.

So at $x = \pm 7$, the expression becomes undefined.

B. SHORT QUESTIONS

1. सरल गर्नुहोस् (Simplify): $\frac{x^2-xy}{x^2+xy} \div \frac{x^2(x-y)}{x^3+x^2y}$ **[2058 B1]**

⇨ Here, $\frac{x^2-xy}{x^2+xy} \div \frac{x^2(x-y)}{x^3+x^2y} = \frac{x^2-xy}{x^2+xy} \times \frac{x^3+x^2y}{x^2(x-y)} = \frac{x(x-y)}{x(x+y)} \times \frac{x^2(x+y)}{x^2(x-y)} = 1$

2. सरल गर्नुहोस् (Simplify): $\frac{a^2-b^2}{a^2b+ab^2} \div \frac{a^2b-ab^2}{a^2b^2}$ **[2058 B2]**

⇨ Here, $\frac{a^2-b^2}{a^2b+ab^2} \div \frac{a^2b-ab^2}{a^2b^2} = \frac{a^2-b^2}{a^2b+ab^2} \times \frac{a^2b^2}{a^2b-ab^2} = \frac{(a+b)(a-b)}{ab(a+b)} \times \frac{a^2b^2}{ab(a-b)} = 1$

3. सरल गर्नुहोस् (Simplify): $\frac{a^2}{a-b} + \frac{b^2}{b-a}$ **[2059 C1]**

⇨ Here, $\frac{a^2}{a-b} + \frac{b^2}{b-a} = \frac{a^2}{a-b} - \frac{b^2}{a-b} = \frac{a^2-b^2}{a-b} = \frac{(a+b)(a-b)}{a-b} = (a+b)$

4. सरल गर्नुहोस् (Simplify): $\frac{x^2}{x-y} + \frac{y^2}{y-x}$ **[2059 C2]**

⇨ Here, $\frac{x^2}{x-y} + \frac{y^2}{y-x} = \frac{x^2}{x-y} - \frac{y^2}{x-y} = \frac{x^2-y^2}{x-y} = \frac{(x+y)(x-y)}{x-y} = (x+y)$

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5. सरल गर्नुहोस् (Simplify): $\frac{2x}{2x-3y}+\frac{3y}{3y-2x}$ [2060 D1]

⇨ Here, $\frac{2x}{2x-3y}+\frac{3y}{3y-2x}=\frac{2x}{2x-3y}-\frac{3y}{2x-3y}=\frac{2x-3y}{2x-3y}=1$

6. सरल गर्नुहोस् (Simplify): $\frac{4a}{4a-5b}+\frac{5b}{5b-4a}$ [2060 D2]

⇨ Here, $\frac{4a}{4a-5b}+\frac{5b}{5b-4a}=\frac{4a}{4a-5b}-\frac{5b}{4a-5b}=\frac{4a-5b}{4a-5b}=1$

7. सरल गर्नुहोस् (Simplify): $\frac{x}{x^2+2xy+y^2}+\frac{y}{x^2-y^2}$ [2062 B2]

⇨ Here, $\frac{x}{x^2+2xy+y^2}+\frac{y}{x^2-y^2}=\frac{x}{(x+y)^2}+\frac{y}{(x-y)(x+y)}=\frac{x(x-y)+y(x+y)}{(x+y)(x+y)(x-y)}$

$=\frac{x^2-xy+xy+y^2}{(x+y)(x+y)(x-y)}=\frac{x^2+y^2}{(x+y)(x+y)(x-y)}=\frac{x^2+y^2}{(x+y)^2(x-y)}$

8. सरल गर्नुहोस् (Simplify): $\frac{1}{b(a-b)}-\frac{1}{a^2-ab}$ [2062 E1]

⇨ Here, $\frac{1}{b(a-b)}-\frac{1}{a^2-ab}=\frac{1}{b(a-b)}-\frac{1}{a(a-b)}=\frac{(a-b)}{ab(a-b)}=\frac{1}{ab}$

9. सरल गर्नुहोस् (Simplify): $\frac{1}{y(x-y)}-\frac{1}{x^2-xy}$ [2062 E2]

⇨ Here, $\frac{1}{y(x-y)}-\frac{1}{x^2-xy}=\frac{1}{y(x-y)}-\frac{1}{x(x-y)}=\frac{x-y}{xy(x-y)}=\frac{1}{xy}$

10. सरल गर्नुहोस् (Simplify): $\frac{81m^2}{9m-7n}+\frac{49n^2}{7n-9m}$ [2061 C1]

⇨ Here, $\frac{81m^2}{9m-7n}+\frac{49n^2}{7n-9m}=\frac{81m^2}{9m-7n}-\frac{49n^2}{9m-7n}=\frac{81m^2-49n^2}{9m-7n}$

$=\frac{(9m)^2-(7n)^2}{9m-7n}=\frac{(9m+7n)(9m-7n)}{(9m-7n)}=(9m+7n)$

11. सरल गर्नुहोस् (Simplify): $\frac{x^2}{y(x-y)}+\frac{y^2}{x(y-x)}$ [2061 E1]

⇨ Here, $\frac{x^2}{y(x-y)}+\frac{y^2}{x(y-x)}=\frac{x^2}{y(x-y)}-\frac{y^2}{x(x-y)}=\frac{x^3-y^3}{xy(x-y)}$

$=\frac{(x-y)(x^2+xy+y^2)}{xy(x-y)}=\frac{x^2+xy+y^2}{xy}$

12. सरल गर्नुहोस् (Simplify): $\frac{x^2}{y(x+y)}+\frac{y^2}{x(x+y)}$ [2061 E2]

⇨ Here, $\frac{x^2}{y(x+y)}+\frac{y^2}{x(x+y)}=\frac{x^3+y^3}{xy(x+y)}=\frac{(x+y)(x^2-xy+y^2)}{xy(x+y)}=\frac{x^2-xy+y^2}{xy}$

13. सरल गर्नुहोस् (Simplify): $\frac{m^2}{m-n}+\frac{n^2}{n-m}$ [2061 S]

⇨ Here, $\frac{m^2}{m-n}+\frac{n^2}{n-m}=\frac{m^2}{m-n}-\frac{n^2}{m-n}=\frac{m^2-n^2}{m-n}=\frac{(m+n)(m-n)}{m-n}=(m+n)$

14. सरल गर्नुहोस् (Simplify): $\frac{a}{a^2-2ab+b^2}-\frac{b}{a^2-b^2}$ [2062 B1]

⇨ Here, $\frac{a}{a^2-2ab+b^2}-\frac{b}{a^2-b^2}=\frac{a}{(a-b)^2}-\frac{b}{(a-b)(a+b)}=\frac{a}{(a-b)(a-b)}-\frac{b}{(a-b)(a+b)}$

$=\frac{a(a+b)-b(a-b)}{(a-b)(a-b)(a+b)}=\frac{a^2+ab-ab+b^2}{(a+b)(a-b)(a-b)}=\frac{a^2+b^2}{(a+b)(a-b)(a-b)}=\frac{a^2+b^2}{(a+b)(a-b)^2}$

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15. सरल गर्नुहोस् (Simplify): $\frac{a-b}{a+b}-\frac{a+b}{a-b}+\frac{2ab}{a^2-b^2}$ [2061 A1]

⇨ Here, $\frac{a-b}{a+b}-\frac{a+b}{a-b}+\frac{2ab}{a^2-b^2}=\frac{(a-b)^2-(a+b)^2}{(a+b)(a-b)}+\frac{2ab}{a^2-b^2}$

$=\frac{a^2-2ab+b^2-a^2-2ab-b^2}{a^2-b^2}+\frac{2ab}{a^2-b^2}=\frac{-4ab}{a^2-b^2}+\frac{2ab}{a^2-b^2}=\frac{-4ab+2ab}{a^2-b^2}=\frac{-2ab}{a^2-b^2}$

16. सरल गर्नुहोस् (Simplify): $\frac{a+b}{a-b}-\frac{a-b}{a+b}-\frac{2ab}{a^2-b^2}$ [2061 A2]

⇨ Here, $\frac{a+b}{a-b}-\frac{a-b}{a+b}-\frac{2ab}{a^2-b^2}$

$=\frac{(a+b)^2-(a-b)^2}{(a-b)(a+b)}-\frac{2ab}{a^2-b^2}=\frac{a^2+2ab+b^2-a^2+2ab-b^2}{a^2-b^2}-\frac{2ab}{a^2-b^2}$

$=\frac{4ab}{a^2-b^2}-\frac{2ab}{a^2-b^2}=\frac{4ab-2ab}{a^2-b^2}=\frac{2ab}{a^2-b^2}$

17. सरल गर्नुहोस् (Simplify): $\frac{x^2+y^2}{xy}-\frac{x^2}{y(x+y)}-\frac{y^2}{x(x+y)}$ [2061 B1]

⇨ Here, $\frac{x^2+y^2}{xy}-\frac{x^2}{y(x+y)}-\frac{y^2}{x(x+y)}=\frac{x^2+y^2}{xy}-\left[\frac{x^2}{y(x+y)}+\frac{y^2}{x(x+y)}\right]=\frac{x^2+y^2}{xy}-\frac{x^3+y^3}{xy(x+y)}$

$=\frac{x^2+y^2}{xy}-\frac{(x+y)(x^2-xy+y^2)}{xy(x+y)}=\frac{x^2+y^2}{xy}-\frac{x^2-xy+y^2}{xy}=\frac{x^2+y^2-x^2+xy-y^2}{xy}=\frac{xy}{xy}=1$

18. सरल गर्नुहोस् (Simplify): $\frac{a^2+b^2}{ab}-\frac{b^2}{a(a+b)}-\frac{a^2}{b(a+b)}$ [2061 B2]

⇨ Here, $\frac{a^2+b^2}{ab}-\frac{b^2}{a(a+b)}-\frac{a^2}{b(a+b)}=\frac{a^2+b^2}{ab}-\left[\frac{b^2}{a(a+b)}+\frac{a^2}{b(a+b)}\right]$

$=\frac{a^2+b^2}{ab}-\frac{b^3+a^3}{ab(a+b)}=\frac{a^2+b^2}{ab}-\frac{(b+a)(b^2-ba+a^2)}{ab(a+b)}$

$=\frac{a^2+b^2}{ab}-\frac{b^2-ba+a^2}{ab}=\frac{a^2+b^2-b^2+ba-a^2}{ab}=\frac{ba}{ab}=1$

19. सरल गर्नुहोस् (Simplify): $\left(1-\frac{1}{p}\right)\left(1-\frac{1}{p-1}\right)\left(1+\frac{2}{p-2}\right)$ [2061 D1]

⇨ Here, $\left(1-\frac{1}{p}\right)\left(1-\frac{1}{p-1}\right)\left(1+\frac{2}{p-2}\right)$

$=\left(\frac{p-1}{p}\right)\left(\frac{p-1-1}{p-1}\right)\left(\frac{p-2+2}{p-2}\right)=\left(\frac{p-1}{p}\right)\cdot\frac{(p-2)}{(p-1)}\cdot\frac{p}{(p-2)}=1$

20. सरल गर्नुहोस् (Simplify): $\left(1-\frac{2}{m}\right)\left(1-\frac{1}{m-2}\right)\left(1+\frac{3}{m-3}\right)$ [2061 D2]

⇨ Here, $\left(1-\frac{2}{m}\right)\left(1-\frac{1}{m-2}\right)\left(1+\frac{3}{m-3}\right)$

$=\left(\frac{m-2}{m}\right)\left(\frac{m-2-1}{m-2}\right)\left(\frac{m-3+3}{m-3}\right)=\frac{(m-2)}{m}\cdot\frac{(m-3)}{(m-2)}\cdot\frac{m}{(m-3)}=1$

21. यदि $x=y^2+z^2$, $y=z^2+x^2$ र $z=x^2+y^2$ भए $\frac{x}{x+1}+\frac{y}{y+1}+\frac{z}{z+1}=1$ हुन्छ भनी प्रमाणित गर्नुहोस् ।

If $x=y^2+z^2$, $y=z^2+x^2$ and $z=x^2+y^2$, prove that: $\frac{x}{x+1}+\frac{y}{y+1}+\frac{z}{z+1}=1$.

⇨ Here, LHS $=\frac{x}{x+1}+\frac{y}{y+1}+\frac{z}{z+1}=\frac{x^2}{x^2+x}+\frac{y^2}{y^2+y}+\frac{z^2}{z^2+z}$

$=\frac{x^2}{x^2+(y^2+z^2)}+\frac{y^2}{y^2+(z^2+x^2)}+\frac{z^2}{z^2+(x^2+y^2)}$

$=\frac{x^2}{x^2+y^2+z^2}+\frac{y^2}{x^2+y^2+z^2}+\frac{z^2}{x^2+y^2+z^2}=\frac{x^2+y^2+z^2}{x^2+y^2+z^2}=1=$ RHS Proved.

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22. यदि $x^2 = y + z$, $y^2 = z + x$ र $z^2 = x + y$ भए $\frac{1}{x+1} + \frac{1}{y+1} + \frac{1}{z+1} = 1$ हुन्छ भनी प्रमाणित गर्नुहोस् ।

If $x^2 = y + z$, $y^2 = z + x$ and $z^2 = x + y$, prove that: $\frac{1}{x+1} + \frac{1}{y+1} + \frac{1}{z+1} = 1$

⇨ Here, LHS $= \frac{1}{x+1} + \frac{1}{y+1} + \frac{1}{z+1}$

$= \frac{x}{x^2+x} + \frac{y}{y^2+y} + \frac{z^2}{z^2+z}$

$= \frac{x}{(y+z)+x} + \frac{y}{(z+x)+y} + \frac{z}{(x+y)+z}$

$= \frac{x}{x+y+z} + \frac{y}{x+y+z} + \frac{z}{x+y+z}$

$= \frac{x+y+z}{x+y+z} = 1 =$ RHS Proved.

C. LONG QUESTIONS

Model 1

1. सरल गर्नुहोस् (Simplify): $\frac{1}{(x-3)(x+2)} + \frac{3}{(x+2)(4-x)} + \frac{2}{(x-3)(x-4)}$ [2060 C]

⇨ Here, $\frac{1}{(x-3)(x+2)} + \frac{3}{(x+2)(4-x)} + \frac{2}{(x-3)(x-4)}$

$= \frac{1}{(x-3)(x+2)} - \frac{3}{(x+2)(x-4)} + \frac{2}{(x-3)(x-4)}$

$= \frac{x-4-3(x-3)+2(x+2)}{(x+2)(x-3)(x-4)}$

$= \frac{x-4-3x+9+2x+4}{(x+2)(x-3)(x-4)}$

$= \frac{9}{(x+2)(x-3)(x-4)}$

2. सरल गर्नुहोस् (Simplify): $\frac{2(a-3)}{(a-4)(a-5)} + \frac{a-1}{(3-a)(a-4)} + \frac{a-2}{(5-a)(a-3)}$ [2057 E1]

⇨ Here, $\frac{2(a-3)}{(a-4)(a-5)} + \frac{a-1}{(3-a)(a-4)} + \frac{a-2}{(5-a)(a-3)}$

$= \frac{2(a-3)}{(a-4)(a-5)} - \frac{a-1}{(a-3)(a-4)} - \frac{a-2}{(a-5)(a-3)}$

$= \frac{2(a-3)^2 - (a-1)(a-5) - (a-2)(a-4)}{(a-3)(a-4)(a-5)}$

$= \frac{2(a^2-6a+9) - (a^2-5a-a+5) - (a^2-4a-2a+8)}{(a-3)(a-4)(a-5)}$

$= \frac{2a^2-12a+18-a^2+6a-5-a^2+6a-8}{(a-3)(a-4)(a-5)} = \frac{5}{(a-3)(a-4)(a-5)}$

3. सरल गर्नुहोस् (Simplify): $\frac{a+b}{2ab}(a+b-c) + \frac{b+c}{2bc}(b+c-a) + \frac{c+a}{2ca}(c+a-b)$ [SLC 2067 S]

⇨ Here, $\frac{a+b}{2ab}(a+b-c) + \frac{b+c}{2bc}(b+c-a) + \frac{c+a}{2ca}(c+a-b)$

$= \frac{c(a+b)(a+b-c)}{2abc} + \frac{a(b+c)(b+c-a)}{2abc} + \frac{b(c+a)(c+a-b)}{2abc}$

$= \frac{1}{2abc}[c(a+b)(a+b-c) + a(b+c)(b+c-a) + b(c+a)(c+a-b)]$

$= \frac{1}{2abc}[c(a^2+2ab+b^2-ca-bc) + a(b^2+2bc+c^2-ab-ca) + b(c^2+2ca+a^2-bc-ab)]$

$= \frac{1}{2abc}[ca^2+2abc+b^2c-c^2a-bc^2+ab^2+2abc+c^2a-a^2b-ca^2+bc^2+2abc+a^2b-b^2c-ab^2]$

$= \frac{1}{2abc} \times 6abc = 3$

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4. सरल गर्नुहोस् (Simplify): $\frac{1}{a^2-5a+6}-\frac{2}{a^2-4a+3}-\frac{1}{a^2-3a+2}$ **[2064 C1]**

⇨ Here, $\frac{1}{(a-3)(a-2)}-\frac{2}{(a-3)(a-1)}-\frac{1}{(a-1)(a-2)}$

$=\frac{a-1-2(a-2)-1(a-3)}{(a-3)(a-2)(a-1)}$

$=\frac{a-1-2a+4-a+3}{(a-3)(a-2)(a-1)}=\frac{-2a+6}{(a-3)(a-2)(a-1)}$

$=\frac{-2(a-3)}{(a-3)(a-2)(a-1)}=\frac{-2}{(a-2)(a-1)}$

$=\frac{2}{(1-a)(a-2)}$

$= a^2-5a+6$
$= a^2-3a-2a+6$
$= a(a-3)-2(a-3)$
$= (a-3)(a-2)$
$= a^2-4a+3$
$= a^2-3a-a+3$
$= a(a-3)-1(a-3)$
$= (a-3)(a-1)$
$= a^2-3a+2 = a^2-a-2a+2$
$= a(a-1)-2(a-1)$
$= (a-1)(a-2)$

5. सरल गर्नुहोस् (Simplify): $\frac{1}{1+x^{a-b}+x^{c-b}}+\frac{1}{1+x^{b-c}+x^{a-c}}+\frac{1}{1+x^{c-a}+x^{b-a}}$ **[2066 E]**

⇨ Here, $\frac{1}{1+x^{a-b}+x^{c-b}}+\frac{1}{1+x^{b-c}+x^{a-c}}+\frac{1}{1+x^{c-a}+x^{b-a}}$

$=\frac{1}{1+\frac{x^a}{x^b}+\frac{x^c}{x^b}}+\frac{1}{1+\frac{x^b}{x^c}+\frac{x^a}{x^c}}+\frac{1}{1+\frac{x^c}{x^a}+\frac{x^b}{x^a}}=\frac{x^b}{x^b+x^a+x^c}+\frac{x^c}{x^c+x^b+x^a}+\frac{x^a}{x^a+x^b+x^c}$

$=\frac{x^b}{x^a+x^b+x^c}+\frac{x^c}{x^a+x^b+x^c}+\frac{x^a}{x^a+x^b+x^c}=\frac{x^b+x^c+x^a}{x^a+x^b+x^c}=\frac{x^a+x^b+x^c}{x^a+x^b+x^c}=1$

Model 2

6. सरल गर्नुहोस् (Simplify): $\frac{a+2}{1+a+a^2}-\frac{a-2}{1-a+a^2}-\frac{2a^2}{1+a^2+a^4}$ **[2058 B2]**

⇨ Here, $\frac{a+2}{1+a+a^2}-\frac{a-2}{1-a+a^2}-\frac{2a^2}{1+a^2+a^4}=\frac{(a+2)(1-a+a^2)-(a-2)(1+a+a^2)}{(1+a+a^2)(1-a+a^2)}-\frac{2a^2}{1+a^2+a^4}$

$=\frac{a-a^2+a^3+2-2a+2a^2-a-a^2-a^3+2+2a+2a^2}{1+a^2+a^4}-\frac{2a^2}{1+a^2+a^4}$

$=\frac{4+2a^2}{1+a^2+a^4}-\frac{2a^2}{1+a^2+a^4}=\frac{4+2a^2-2a^2}{1+a^2+a^4}=\frac{4}{1+a^2+a^4}$

7. सरल गर्नुहोस् (Simplify): $\frac{y-2}{y^2-2y+4}+\frac{y+2}{y^2+2y+4}-\frac{16}{y^4+4y^2+16}$ **[2059 B2]**

⇨ Here, $\frac{y-2}{y^2-2y+4}+\frac{y+2}{y^2+2y+4}-\frac{16}{y^4+4y^2+16}$

$=\frac{(y-2)(y^2+2y+4)+(y+2)(y^2-2y+4)}{(y^2-2y+4)(y^2+2y+4)}-\frac{16}{y^4+4y^2+16}$

$=\frac{y^3-2^3+y^3+2^3}{(y^2-2y+4)(y^2+2y+4)}-\frac{16}{(y^2-2y+4)(y^2+2y+16)}$

$=\frac{2y^3}{(y^2-2y+4)(y^2+2y+4)}-\frac{16}{(y^2-2y+4)(y^2+2y+4)}$

$=\frac{2y^3-16}{(y^2-2y+4)(y^2+2y+4)}=\frac{2(y^3-8)}{(y^2-2y+4)(y^2+2y+4)}$

$=\frac{2(y^3-2^3)}{(y^2-2y+4)(y^2+2y+4)}=\frac{2(y-2)(y^2+2y+4)}{(y^2-2y+4)(y^2+2y+4)}=\frac{2(y-2)}{y^2-2y+4}$

8. सरल गर्नुहोस् (Simplify): $\frac{x+3}{x^2+3x+9}+\frac{x-3}{x^2-3x+9}-\frac{54}{x^4+9x^2+81}$ **[2059 B1, 2065 B]**

⇨ Here, $\frac{x+3}{x^2+3x+9}+\frac{x-3}{x^2-3x+9}-\frac{54}{x^2+9x^2+81}$

$=\frac{(x+3)(x^2-3x+9)+(x-3)(x^2+3x+9)}{(x^2+3x+9)(x^2-3x+9)}-\frac{54}{x^4+9x^2+81}$

$=\frac{(x^3+3^3)+(x^3-3^3)}{x^4+9x^2+81}-\frac{54}{x^4+9x^2+81}=\frac{x^3+27+x^3-27}{x^4+9x^2+81}-\frac{54}{x^4+9x^2+81}$

$=\frac{2x^3-54}{x^4+9x^2+81}=\frac{2(x^3-27)}{(x^4+9x^2+81)}=\frac{2(x^3-3^3)}{x^4+9x^2+81}=\frac{2(x-3)(x^2+3x+9)}{(x^2+3x+9)(x^2-3x+9)}=\frac{2(x-3)}{x^2-3x+9}$

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9. सरल गर्नुहोस् (Simplify): $\frac{3a+1}{9a^2+3a+1}+\frac{3a-1}{9a^2-3a+1}-\frac{2}{81a^4+9a^2+1}$ [2064 E1]

⇨ Here, $\frac{3a+1}{9a^2+3a+1}+\frac{3a-1}{9a^2-3a+1}-\frac{2}{81a^4+9a^2+1}$

$=\frac{(3a+1)(9a^2-3a+1)+(3a-1)(9a^2+3a+1)}{(9a^2+3a+1)(9a^2-3a+1)}-\frac{2}{81a^4+9a^2+1}$

$=\frac{(3a)^3+1^3+(3a)^3-1^3}{(9a^2)^2+(3a)^2+1}-\frac{2}{81a^4+9a^2+1}$ $=\frac{27a^3+27a^3}{81a^4+9a^2+1}-\frac{2}{81a^4+9a^2+1}$

$=\frac{2(27a^3-1)}{81a^4+9a^2+1}$ $=\frac{2(3a-1)(9a^2+3a+1)}{(9a^2+3a+1)(9a^2-3a+1)}$ $=\frac{2(3a-1)}{(9a^2-3a+1)}$

10. सरल गर्नुहोस् (Simplify): $\frac{a+c}{a^2+ac+c^2}+\frac{a-c}{a^2-ac+c^2}+\frac{2c^3}{a^4+a^2c^2+c^4}$ [SLC 2065 E, S, 2067 E]

⇨ Here, $\frac{a+c}{a^2+ac+c^2}+\frac{a-c}{a^2-ac+c^2}+\frac{2c^3}{a^4+a^2c^2+c^4}=\frac{(a+c)(a^2-ac+c^2)+(a-c)(a^2+ac+c^2)}{(a^2-ac+c^2)(a^2+ac+c^2)}+\frac{2c^3}{a^4+a^2c^2+c^4}$

$=\frac{a^3+c^3+a^3-c^3}{(a^2-ac+c^2)(a^2+ac+c^2)}+\frac{2c^3}{(a^2-ac+c^2)(a^2+ac+c^2)}$

$=\frac{2a^3+2c^3}{(a^2-ac+c^2)(a^2+ac+c^2)}$

$=\frac{2(a^3+c^3)}{(a^2-ac+c^2)(a^2+ac+c^2)}$

$=\frac{2(a+c)(a^2-ac+c^2)}{(a^2-ac+c^2)(a^2+ac+c^2)}=\frac{2(a+c)}{a^2+ac+c^2}$

Rough

$a^4+a^2c^2+c^4$
$=(a^2)^2+2a^2c^2+(c^2)^2-a^2c^2$
$=(a^2+c^2)^2-(ac)^2$
$=(a^2+c^2+ac)(a^2+c^2-ac)$
$=(a^2+ac+c^2)(a^2-ac+c^2)$

11. सरल गर्नुहोस् (Simplify): $\frac{m+n}{m^2+mn+n^2}+\frac{m-n}{m^2-mn+n^2}+\frac{2n^3}{m^4+m^2n^2+n^4}$ [SLC 2066 A]

⇨ Here, $\frac{(m+n)(m^2-mn+n^2)+(m-n)(m^2+mn+n^2)}{(m^2+mn+n^2)(m^2-mn+n^2)}+\frac{2n^3}{m^4+m^2n^2+n^4}$

$=\frac{m^3+n^3+m^3-n^3}{(m^2+mn+n^2)(m^2-mn+n^2)}+\frac{2n^3}{m^4+m^2n^2+n^4}$

$=\frac{2m^3}{(m^2+mn+n^2)(m^2-mn+n^2)}+\frac{2n^3}{(m^2+mn+n^2)(m^2-mn+n^2)}$

$=\frac{2(m^3+n^3)}{(m^2+mn+n^2)(m^2-mn+n^2)}=\frac{2(m+n)(m^2-mn+n^2)}{(m^2+mn+n^2)(m^2-mn+n^2)}=\frac{2(m+n)}{(m^2+mn+n^2)}$

12. सरल गर्नुहोस् (Simplify): $\frac{1}{8(1-\sqrt{a})}-\frac{1}{8(1+\sqrt{a})}+\frac{2\sqrt{a}}{8(1-a)}$ [2062 E1]

⇨ Here, $\frac{1}{8(1-\sqrt{a})}-\frac{1}{8(1+\sqrt{a})}+\frac{2\sqrt{a}}{8(1-a)}$ $=\frac{1+\sqrt{a}-1+\sqrt{a}}{8(1-\sqrt{a})(1+\sqrt{a})}+\frac{2\sqrt{a}}{8(1-a)}$

$=\frac{2\sqrt{a}}{8(1-a)}+\frac{2\sqrt{a}}{8(1-a)}$ $=\frac{2\sqrt{a}+2\sqrt{a}}{8(1-a)}$

$=\frac{4\sqrt{a}}{8(1-a)}$ $=\frac{\sqrt{a}}{2(1-a)}$

13. सरल गर्नुहोस् (Simplify): $\frac{1}{8(\sqrt{x}-1)}+\frac{1}{8(\sqrt{x}+1)}+\frac{2\sqrt{x}}{8(x-1)}$ [2062 E2]

⇨ Here, $\frac{1}{8(\sqrt{x}-1)}+\frac{1}{8(\sqrt{x}+1)}+\frac{2\sqrt{x}}{8(x-1)}$ $=\frac{\sqrt{x}+1+\sqrt{x}-1}{8(\sqrt{x}-1)(\sqrt{x}+1)}+\frac{2\sqrt{x}}{8(x-1)}$

$=\frac{2\sqrt{x}}{8(x-1)}+\frac{2\sqrt{x}}{8(x-1)}=\frac{2\sqrt{x}+2\sqrt{x}}{8(x-1)}=\frac{4\sqrt{x}}{8(x-1)}=\frac{\sqrt{x}}{2(x-1)}$

14. सरल गर्नुहोस् (Simplify) : $\frac{(x-y)^2-z^2}{x^2-(y+z)^2}+\frac{(y-z)^2-x^2}{y^2-(z+x)^2}+\frac{(z-x)^2-y^2}{z^2-(x+y)^2}$ [2070 E]

⇨ Here, $\frac{(x-y)^2-z^2}{x^2-(y+z)^2}+\frac{(y-z)^2-x^2}{y^2-(z+x)^2}+\frac{(z-x)^2-y^2}{z^2-(x+y)^2}$

$=\frac{(x-y+z)(x-y-z)}{(x+y+z)(x-y-z)}+\frac{(y-z+x)(y-z-x)}{(y+z+x)(y-z-x)}+\frac{(z-x+y)(z-x-y)}{(z+x+y)(z-x-y)}$

$=\frac{x-y+z}{x+y+z}+\frac{y-z+x}{x+y+z}+\frac{z-x+y}{x+y+z}=\frac{x-y+z+y-z+x+z-x+y}{x+y+z}=\frac{x+y+z}{x+y+z}=1$

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B. QUESTIONS FROM CDC TEXT BOOK

सरल गर्नुहोस् (Simplify):

1A. $\frac{1}{a+2}+\frac{1}{a+3}$

⇨ Here, $\frac{1}{a+2}+\frac{1}{a+3}$

$= \frac{a+3+a+2}{(a+2)(a+3)}$

$= \frac{2a+5}{(a+2)(a+3)}$

1B. $\frac{3}{a-6}+\frac{1}{a+2}$

⇨ Here, $\frac{3}{a-6}+\frac{1}{a+2}$

$= \frac{3a+6+a-6}{(a-6)(a+2)}$

$= \frac{4a}{(a-6)(a+2)}$

1C. $\frac{a+x}{a-x}-\frac{a-x}{a+x}$

⇨ Here, $\frac{a+x}{a-x}-\frac{a-x}{a+x}$

$= \frac{(a+x)^2-(a-x)^2}{(a+x)(a-x)}$

$= \frac{a^2+2ax+x^2-(a^2-2ax+x^2)}{(a+x)(a-x)}$

$= \frac{a^2+2ax+x^2-a^2+2ax-x^2}{(a+x)(a-x)}$

$= \frac{4ax}{a^2-x^2}$

1D. $\frac{1}{2x-3y}-\frac{x+y}{4x^2-9y^2}$

⇨ Here, $\frac{1}{2x-3y}-\frac{x+y}{4x^2-9y^2}$

$= \frac{1}{2x-3y}-\frac{x+y}{(2x+3y)(2x-3y)}$

$= \frac{2x+3y-x-y}{(2x+3y)(2x-3y)}$

$= \frac{x+2y}{(2x+3y)(2x-3y)}$

1E. $\frac{3}{(x^2-4)}+\frac{1}{(x-2)^2}$

⇨ Here, $\frac{3}{(x^2-4)}+\frac{1}{(x-2)^2}$

$= \frac{3}{(x+2)(x-2)}+\frac{1}{(x-2)(x-2)}$

$= \frac{3(x-2)+x+2}{(x+2)(x-2)(x-2)} = \frac{3x-6+x+2}{(x+2)(x-2)(x-2)}$

$= \frac{4x-4}{(x+2)(x-2)(x-2)} = \frac{4(x-1)}{(x+2)(x-2)^2}$

1F. $\frac{x^2+xy+y^2}{x+y}+\frac{x^2-xy+y^2}{x-y}$

⇨ Here, $\frac{x^2+xy+y^2}{x+y}+\frac{x^2-xy+y^2}{x-y}$

$= \frac{(x-y)(x^2+xy+y^2)+(x+y)(x^2-xy+y^2)}{(x+y)(x-y)}$

$= \frac{x^3-y^3+x^3+y^3}{x^2-y^2}$

$= \frac{2x^3}{x^2-y^2}$

2A. $\frac{x^2+5xy-4y^2}{x^2-16y^2}-\frac{2xy}{2x^2+8xy}$

⇨ Here, $\frac{x^2+5xy-4y^2}{x^2-16y^2}-\frac{2xy}{2x^2+8xy}$

$= \frac{x^2+5xy-4y^2}{(x)^2-(4y)^2}-\frac{2xy}{2x(x+4y)}$

$= \frac{x^2+5xy-4y^2}{(x+4y)(x-4y)}-\frac{2xy}{2x(x+4y)}$

$= \frac{2x(x^2+5xy-4y^2)-2xy(x-4y)}{2x(x+4y)(x-4y)}$

$= \frac{2x^3+10x^2y-8xy^2-2x^2y+8xy^2}{2x(x+4y)(x-4y)}$

$= \frac{2x^3+8x^2y}{2x(x+4y)(x-4y)}$

$= \frac{2x^2(x+4y)}{2x(x+4y)(x-4y)}$

$= \frac{x}{x-4y}$

2B. $\frac{a^3+b^3}{(a^2-ab+b^2)}-\frac{a^3-b^3}{a^2+ab+b^2}$

⇨ Here, $\frac{a^3+b^3}{(a^2-ab+b^2)}-\frac{a^3-b^3}{a^2+ab+b^2}$

$= \frac{(a+b)(a^2-ab+b^2)}{(a^2-ab+b^2)}-\frac{(a-b)(a^2+ab+b^2)}{(a^2+ab+b^2)}$

$= a+b-(a-b)$

$= a+b-a+b$

$= 2b$

2D. $\frac{x^2}{x-x^3}-\frac{x}{1+x^2}$

⇨ Here, $\frac{x^2}{x-x^3}-\frac{x}{1+x^2}$

$= \frac{x^2}{x(1-x^2)}-\frac{x}{1+x^2} = \frac{x}{1-x^2}-\frac{x}{1+x^2}$

$= \frac{x(1+x^2)-x(1-x^2)}{(1+x^2)(1-x^2)}$

$= \frac{x+x^3-x+x^3}{(1+x^2)(1-x^2)} = \frac{2x^3}{1-x^4}$

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2C. $\frac{4a^2+b^2}{4a^2-b^2}-\frac{2a-b}{2a+b}$

⇨ Here, $\frac{4a^2+b^2}{4a^2-b^2}-\frac{2a-b}{2a+b}=\frac{4a^2+b^2}{(2a)^2-b^2}-\frac{2a-b}{2a+b}$

$=\frac{4a^2+b^2}{(2a+b)(2a-b)}-\frac{2a-b}{2a+b}$

$=\frac{4a^2+b^2-(2a-b)^2}{(2a+b)(2a-b)}$

$=\frac{4a^2+b^2-(4a^2-2.2a.b+b^2)}{(2a+b)(2a-b)}$

$=\frac{4a^2+b^2-4a^2+4ab-b^2}{(2a+b)(2a-b)}=\frac{4ab}{4a^2-b^2}$

3A. $\frac{1}{x+y}-\frac{1}{x-y}+\frac{2x}{xy-y^2}$

⇨ Here, $\frac{1}{x+y}-\frac{1}{x-y}+\frac{2x}{xy-y^2}$

$=\frac{x-y-(x+y)}{(x+y)(x-y)}+\frac{2x}{xy-y^2}$

$=\frac{x-y-x-y}{(x+y)(x-y)}+\frac{2x}{y(x-y)}$

$=\frac{-2y\times y+2x\times(x+y)}{y(x-y)(x+y)}$

$=\frac{-2y^2+2x^2+2xy}{y(x-y)(x+y)}=\frac{2(x^2-y^2+xy)}{y(x-y)(x+y)}$

$=\frac{2(x^2-y^2+xy)}{y(x^2-y^2)}$

3B. $\frac{5}{1+2y}-\frac{3y}{1-2y}-\frac{4-13y}{1-4y^2}$

⇨ Here, $\frac{5}{1+2y}-\frac{3y}{1-2y}-\frac{4-13y}{1-4y^2}$

$=\frac{5(1-2y)-3y(1+2y)}{(1+2y)(1-2y)}-\frac{4-13y}{1-4y^2}$

$=\frac{5-10y-3y-6y^2}{1-4y^2}-\frac{4-13y}{1-4y^2}$

$=\frac{5-10y-3y-6y^2-4+13y}{1-4y^2}$

$=\frac{1-6y^2}{1-4y^2}$

3C. $\frac{2a}{2a+3b}+\frac{3b}{2a-3b}+\frac{8b^2}{4a^2-9b^2}$

⇨ Here, $\frac{2a}{2a+3b}+\frac{3b}{2a-3b}+\frac{8b^2}{4a^2-9b^2}$

$=\frac{4a^2-6ab+6ab+9b^2}{4a^2-9b^2}+\frac{8b^2}{4a^2-9b^2}$

$=\frac{2a(2a-3b)+3b(2a+3b)}{(2a+3b)(2a-3b)}+\frac{8b^2}{4a^2-9b^2}$

$=\frac{4a^2+9b^2+8b^2}{4a^2-9b^2}=\frac{4a^2+17b^2}{4a^2-9b^2}$

3D. $\frac{1}{2(a-b)}-\frac{1}{2(a+b)}-\frac{b}{a^2-b^2}$

⇨ Here, $\frac{1}{2(a-b)}-\frac{1}{2(a+b)}-\frac{b}{a^2-b^2}$

$=\frac{a+b-(a-b)}{2(a-b)(a+b)}-\frac{b}{a^2-b^2}$

$=\frac{a+b-a+b}{2(a^2-b^2)}-\frac{b}{a^2-b^2}$

$=\frac{2b}{2(a^2-b^2)}-\frac{b}{a^2-b^2}$

$=\frac{2b-2b}{2(a^2-b^2)}$

$=\frac{0}{2(a^2-b^2)}=0$

4A. $\frac{2}{x^2-3x+2}+\frac{2}{x^2-x-2}-\frac{4}{x^2-1}$

⇨ Here, $\frac{2}{x^2-3x+2}+\frac{2}{x^2-x-2}-\frac{4}{x^2-1}$

$=\frac{2}{(x-1)(x-2)}+\frac{2}{(x-2)(x+1)}-\frac{4}{(x+1)(x-1)}$

$=\frac{2(x+1)+2(x-1)-4(x-2)}{(x-1)(x-2)(x+1)}$

$=\frac{2x+2+2x-2-4x+8}{(x-1)(x-2)(x+1)}=\frac{8}{(x^2-1)(x-2)}$

Rough

- x^2-3x+2

$=x^2-2x-x+2$

$=x(x-2)-1(x-2)$

$=(x-2)(x-1)$

- x^2-x-2

$=x^2-2x+-2$

$=x(x-2)+1(x-2)$

$=(x-2)(x+1)$

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4B. $\dfrac{a}{a^2+5a+6}+\dfrac{15}{a^2+9a+14}-\dfrac{12}{a^2+10a+21}$

⇨ Here, $\dfrac{a}{a^2+5a+6}+\dfrac{15}{a^2+9a+14}-\dfrac{12}{a^2+10a+21}$

$=\dfrac{a}{a^2+2a+3a+6}+\dfrac{15}{a^2+7a+2a+14}-\dfrac{12}{a^2+7a+3a+21}$

$=\dfrac{a}{a(a+2)+3(a+2)}+\dfrac{15}{a(a+7)+2(a+7)}-\dfrac{12}{a(a+7)+3(a+7)}$

$=\dfrac{a}{(a+3)(a+2)}+\dfrac{15}{(a+7)(a+2)}-\dfrac{12}{(a+7)(a+3)}$

$=\dfrac{a(a+7)+15(a+3)-12(a+2)}{(a+3)(a+2)(a+7)}$

$=\dfrac{a^2+7a+15a+45-12a-24}{(a+3)(a+2)(a+7)}$

$=\dfrac{a^2+10a+21}{(a+3)(a+2)(a+7)}=\dfrac{a^2+7a+3a+21}{(a+3)(a+2)(a+7)}=\dfrac{a(a+7)+3(a+7)}{(a+3)(a+2)(a+7)}$

$=\dfrac{(a+7)(a+3)}{(a+3)(a+2)(a+7)}=\dfrac{1}{(a+2)}$

4C. $\dfrac{x}{(x+3)(x-1)}+\dfrac{x-1}{(x+3)(2-x)}+\dfrac{(x-3)}{(x-2)(x-1)}$

⇨ Here, $\dfrac{x}{(x+3)(x-1)}+\dfrac{x-1}{(x+3)(2-x)}+\dfrac{(x-3)}{(x-2)(x-1)}$

$=\dfrac{x}{(x+3)(x-1)}-\dfrac{x-1}{(x+3)(x-2)}+\dfrac{x-3}{(x-3)(x-1)}=\dfrac{x(x-2)-(x-1)^2+(x-3)(x+3)}{(x+3)(x-1)(x-2)}$

$=\dfrac{x^2-2x-(x^2-2x+1)+x^2-9}{(x+3)(x-1)(x-2)}=\dfrac{x^2-2x-x^2+2x-1+x^2-9}{(x+3)(x-1)(x-2)}=\dfrac{x^2-10}{(x+3)(x-1)(x-2)}$

4D. $\dfrac{1}{a^2-5a+6}-\dfrac{2}{a^2-4a+3}+\dfrac{3}{a^2-3a+2}$

⇨ Here, $\dfrac{1}{a^2-5a+6}-\dfrac{2}{a^2-4a+3}+\dfrac{3}{a^2-3a+2}$

$=\dfrac{1}{a^2-3a-2a+6}-\dfrac{2}{a^2-3a-a+3}+\dfrac{3}{a^2-2a-a+2}$

$=\dfrac{1}{a(a-3)-2(a-3)}-\dfrac{2}{a(a-3)-1(a-3)}+\dfrac{3}{a(a-2)-1(a-2)}$

$=\dfrac{1}{(a-2)(a-3)}-\dfrac{2}{(a-1)(a-3)}+\dfrac{3}{(a-1)(a-2)}$

$=\dfrac{a-1-2(a-2)+3(a-3)}{(a-2)(a-3)(a-1)}=\dfrac{a-1-2a+4+3a-9}{(a-2)(a-3)(a-1)}$

$=\dfrac{2a-6}{(a-2)(a-3)(a-1)}=\dfrac{2(a-3)}{(a-2)(a-3)(a-1)}=\dfrac{2}{(a-2)(a-1)}$

4E. $\dfrac{1}{4(1-\sqrt{y})}+\dfrac{1}{4(1+\sqrt{y})}+\dfrac{2\sqrt{y}}{4(1-y)}$

⇨ Here, $\dfrac{1}{4(1-\sqrt{y})}+\dfrac{1}{4(1+\sqrt{y})}+\dfrac{2\sqrt{y}}{4(1-y)}=\dfrac{1+\sqrt{y}+1-\sqrt{y}}{4(1-\sqrt{y})(1+\sqrt{y})}+\dfrac{\sqrt{y}}{4(1-y)}$

$=\dfrac{2}{4(1-y)}+\dfrac{2\sqrt{y}}{4(1-y)}=\dfrac{2+2\sqrt{y}}{4(1-y)}=\dfrac{2(1+\sqrt{y})}{4(1+\sqrt{y})(1-\sqrt{y})}=\dfrac{1}{2(1-\sqrt{y})}$

5A. $\dfrac{a}{(a-b)(a-c)}+\dfrac{b}{(b-c)(b-a)}+\dfrac{c}{(c-a)(c-b)}$

⇨ Here, $\dfrac{a}{(a-b)(a-c)}+\dfrac{b}{(b-c)(b-a)}+\dfrac{c}{(c-a)(c-b)}=\dfrac{-a}{(a-b)(c-a)}-\dfrac{b}{(a-b)(b-c)}-\dfrac{c}{(c-a)(b-c)}$

$=\dfrac{-a(b-c)-b(c-a)-c(a-b)}{(a-b)(b-c)(c-a)}=\dfrac{-ab+ca-bc+ab-ca+bc}{(a-b)(b-c)(c-a)}=\dfrac{0}{(a-b)(b-c)(c-a)}=0$

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5B. $\frac{x+y}{(p-q)(p-r)} + \frac{x+y}{(q-r)(q-p)} + \frac{x+y}{(r-p)(r-q)}$

⇨ Here, $\frac{x+y}{(p-q)(p-r)} + \frac{x+y}{(q-r)(q-p)} + \frac{x+y}{(r-p)(r-q)}$

$= \frac{-(x+y)}{(p-q)(r-p)} - \frac{x+y}{(q-r)(p-q)} - \frac{x+y}{(r-p)(q-r)}$

$= \frac{-(x+y)(q-r) - (x+y)(r-p) - (x+y)(p-q)}{(p-q)(q-r)(r-p)}$

$= \frac{-(qx - rx + qy - ry) - (rx - px + ry - py) - (px - qx + py - qy)}{(p-q)(q-r)(r-p)}$

$= \frac{-qx + rx - qy + ry - rx + px - ry + py - px + qx - py + qy}{(p-q)(q-r)(r-p)}$

$= \frac{0}{(p-q)(q-r)(r-p)} = 0$

5C. $\frac{ax^2+b}{2x-1} + \frac{4ax^3}{1-4x^2} + \frac{ax^2-b}{2x+1}$

⇨ Here, $\frac{ax^2+b}{2x-1} + \frac{4ax^3}{1-4x^2} + \frac{ax^2-b}{2x+1} = \frac{ax^2+b}{2x-1} - \frac{4ax^3}{4x^2-1} + \frac{ax^2-b}{2x+1}$

$= \frac{ax^2+b}{2x-1} - \frac{4ax^3}{(1+2x)(2x-1)} + \frac{ax^2-b}{2x+1}$

$= \frac{ax^2+b}{(2x-1)} - \frac{4ax^3}{(2x+1)(2x-1)} + \frac{ax^2-b}{2x+1}$

$= \frac{(ax^2+b)(2x+1) - 4ax^3 + (ax^2-b)(2x-1)}{(2x-1)(2x+1)}$

$= \frac{2ax^3 + 2bx + ax^2 + b - 4ax^3 + 2ax^3 - ax^2 - 2bx + b}{(2x-1)(2x+1)} = \frac{2b}{4x^2-1}$

6. $\frac{p(x)}{q(x)} + \frac{r(x)}{s(x)}$ परिभाषित कुन अवस्थामा हुन्छ, लेख्नुहोस् । उक्त भिन्नको सरलीकृत रूप के हुन्छ ? प्रस्तुत गर्नुहोस् ।

In what case $\frac{p(x)}{q(x)} + \frac{r(x)}{s(x)}$ is defined ? Write it. What is the simplified form of the fraction ? Represent it.

⇨ Here, if $q(x) \neq 0$ and $s(x) \neq 0$ then $\frac{p(x)}{q(x)} + \frac{r(x)}{s(x)}$ is defined.

The simplified form is given by; $\frac{p(x)\,s(x) + r(x)\,q(x)}{q(x)\,s(x)}$

7. $\frac{1}{x-y} + \frac{1}{x+y} + \frac{2x}{x^2+y^2} + \frac{4x^3}{x^4+y^4} = \frac{8x^7}{x^8-y^8}$ हुन्छ भनी प्रमाणित गर्नुहोस् ।

Prove that: $\frac{1}{x-y} + \frac{1}{x+y} + \frac{2x}{x^2+y^2} + \frac{4x^3}{x^4+y^4} = \frac{8x^7}{x^8-y^8}$

⇨ Here, LHS $= \frac{1}{x-y} + \frac{1}{x+y} + \frac{2x}{x^2+y^2} + \frac{4x^3}{x^4+y^4}$

$= \frac{x+y+x-y}{(x+y)(x-y)} + \frac{2x}{x^2+y^2} + \frac{4x^3}{x^4+y^4}$

$= \frac{2x}{x^2-y^2} + \frac{2x}{x^2+y^2} + \frac{4x^3}{x^4+y^4}$

$= \frac{2x(x^2+y^2) + 2x(x^2-y^2)}{(x^2-y^2)(x^2+y^2)} + \frac{4x^3}{x^4+y^4}$

$= \frac{2x^3 + 2xy^2 + 2x^3 - 2xy^2}{x^4-y^4} + \frac{4x^3}{x^4+y^4}$

$= \frac{4x^3(x^4+y^4) + 4x^3(x^4-y^4)}{(x^4-y^4)(x^4+y^4)}$

$= \frac{4x^7 + 4x^3y^4 + 4x^7 - 4x^3y^4}{(x^4)^2 - (y^4)^2} = \frac{8x^7}{x^8-y^8}$ = RHS Proved.

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12
समीकरण (Equations)

12.1 युगपत् रेखीय समीकरण सम्बन्धी शाब्दिक समस्या
VERBAL PROBLEMS LEADING TO SIMULTANEOUS EQUATION

A. BASIC EXERCISE 12.1

A. VERY SHORT QUESTIONS

1. (a) यदि $aw + bw = a^2 - b^2$ भए w को मान पत्ता लगाउनुहोस् । (If $aw + bw = a^2 - b^2$ then what is the value of w ?)

⇨ Here, $aw + bw = a^2 - b^2$ or, $w(a + b) = (a + b)(a - b)$ ∴ $w = \frac{(a+b)(a-b)}{(a+b)} = a - b$

(b) यदि $aq - bq = a^2 - b^2$ भए q को मान पत्ता लगाउनुहोस् । (If $aq - bq = a^2 - b^2$ then find the value of q.)

⇨ Here, $aq - bq = a^2 - b^2$ or, $q(a - b) = (a + b)(a - b)$ ∴ $q = \frac{(a+b)(a-b)}{(a-b)} = (a + b)$

2. (a) समीकरण $y = \frac{4x+4}{3}$ मा यदि $x = 2$ भए y कति हुन्छ ?

In an equation $y = \frac{4x+4}{3}$ if $x = 2$ then what is the value of y ?

⇨ Here, $y = \frac{4x+4}{3}$ for $x = 2$, $y = \frac{4\times2+4}{3} = \frac{8+4}{3} = 4$ Thus, $y = 4$ for $x = 2$.

(b) समीकरण $y = \frac{5x-2}{3}$ मा यदि $x = 4$ भए y कति हुन्छ ?

In an equation $y = \frac{5x-2}{3}$ if $x = 4$ then what is the value of y ?

⇨ Here, $y = \frac{5x-2}{3}$ For $x = 4$, $y = \frac{5\times4-2}{3} = \frac{18}{3} = 6$ Thus, $y = 6$ for $x = 4$.

B. SHORT QUESTIONS

Model 1

1. यदि दुई सङ्ख्याहरूको योग 10 र तिनीहरूको अन्तर 2 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If the sum of two number is 10 and their difference is 2, find the numbers. [2072 MW]

⇨ Here, sum of the numbers = 10 and difference = 2
Let, one number be x then other number will be $(10 - x)$.
By the question, $x - (10 - x) = 2$ or, $x - 10 + x = 2$
or, $2x = 12$ ∴ $x = 6$
Thus, the numbers are 6 and $(10 - 6) = 4$.

2. कुनै एउटा सङ्ख्या अर्को सङ्ख्याको दोब्बर छ । यदि तिनीहरूको योग 30 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
A number is twice the other. If their sum is 30, find the numbers. [2065 C]

⇨ Here, let, the number be $2x$ then, the other number will be x.
By the question; $x + 2x = 30$
or, $3x = 30$ ∴ $x = 10$
Thus, the numbers are 20 and 10.

3. दुईओटा धनात्मक सङ्ख्याहरूको योगफल 29 छ । यदि एउटा अर्को भन्दा 5 ले बढी छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two positive numbers is 29. If one of them is 5 more than that of the other, find the numbers. [2068 D]

⇨ Here, let, one number be x then other number will be $(x - 5)$.
By the question; $x + x - 5 = 29$
or, $2x = 34$ ∴ $x = 17$
Thus, the one number is 17 and the other number is $(17 - 5) = 12$.

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4. दुई सङ्ख्याहरूको योग 17 र अन्तर 3 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If the sum of two numbers is 17 and their difference is 3, find the numbers. [2065 E, 2072 W]

⇨ Here, let, the numbers are; x and 17 – x
Then, x – (17 – x) = 3
or, x – 17 + x = 3 or, 2x = 20 ∴ x = 10
Thus, the numbers are 10 and 7.

5. दुईजना शिक्षकहरूको हालको उमेरको योगफल 54 वर्ष छ । यदि एकजना शिक्षकको उमेर अर्को भन्दा 4 वर्षले बढी छ भने उनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The sum of the present age of two teachers is 54 years. If the age of one teacher is 4 years more than the other, find their present ages. [2068 E]

⇨ Here, let the age of one teacher = x
Then the age of other teacher = x – 4
By the questions; x + x – 4 = 54
or, 2x = 58 ∴ x = 29
Thus, the age of teachers are; 29 yrs & (29 – 4) = 25 years respectively.

6. दुईओटा धनात्मक सङ्ख्याहरूका योगफल 60 र फरक 12 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two positive numbers is 60 and their difference is 12. Find the numbers. [2071 B]

⇨ Here, let the numbers be x and y (x > y) then x + y = 60 ..... (i) and x – y = 12 ..... (ii)
Solving (i) and (ii) then,

$$\begin{array}{r} x + y = 60 \\ x - y = 12 \\ \hline 2x \quad = 72 \end{array}$$

∴ x = 36
From (i): x + y = 60 or, 36 + y = 60 ∴ y = 24
Thus, the two numbers are 36 and 24.

Model 2

7. एक जना मानिसको उमेरबाट उसको उमेरको पाँचखण्डको दुई खण्ड घटाउँदा 24 वर्ष हुन्छ भने उक्त मानिसको उमेर पत्ता लगाउनुहोस् ।
From the age of a person if two fifth of his age is subtracted, the result becomes 24 years. Find the age of the person. [2071 E]

⇨ Here, let, the age of a person be x years.
By the question, $x - \frac{2x}{5} = 24$ or, $\frac{3x}{5} = 24$
or, $x = 24 \times \frac{5}{3}$ ∴ x = 40
Thus, the age of the person is 40 years.

8. दुई दाजुभाईको उमेरको योगफल 31 वर्ष छ र तिनीहरूको उमेरको फरक 5 वर्ष छ भने तिनीहरूको अहिलेको उमेर पत्ता लगाउनुहोस् ।
The sum of the ages of two brothers is 31 years and the difference of their ages is 5 years. Find their present ages. [2070 E]

⇨ Here, let, the age of one of brothers be x years then the age of another brother will be (31 – x) years.
By the question, x – (31 – x) = 5 or, x – 31 + x = 5
or, 2x = 36 ∴ x = 18
Thus, the age of two brothers are 18 yrs and 31 – 18 = 13 years.

9. आमाको उमेरको $\frac{1}{6}$ भाग छोरीको उमेर छ । यदि तिनीहरूको उमेरको अन्तर 35 वर्ष भए आमाको उमेर पत्ता लगाउनुहोस् ।
$\frac{1}{6}$ **of the age of a mother is the age of her daughter. If the difference of their ages be 35 years, find the age of the mother.** [2067 C]

⇨ Here, let, the age of mother be x yrs.
Then, age of daughter will be $\frac{x}{6}$ yrs.
By the question, $x - \frac{x}{6} = 35$ or, $\frac{5x}{6} = 35$ ∴ x = 42
Thus, the age of mother be 42 yrs.

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10. बाबुको उमेरको $\frac{1}{5}$ भाग छोराको उमेर छ। यदि तिनीहरूको उमेरको योगफल 42 वर्ष भए बाबुको उमेर निर्धारण गर्नुहोस्।

$\frac{1}{5}$ of the age of father is the age of his son. If the sum of their ages is 42 years, determine the age of the father. [2071A]

⇨ Here, let, father's age = x years and son's age = $\frac{x}{5}$ years.

By the question, $x + \frac{x}{5} = 42$ or, $\frac{6x}{5} = 42$

$\therefore \quad x = 42 \times \frac{5}{6} = 35$

Thus, the age of father is 35 years.

C. LONG QUESTIONS

Model 1

1. दुई वर्षपछि बाबुको उमेर छोराको उमेरको छ गुणा हुनेछ। तीन वर्ष पहिले बाबुको उमेर दुई वर्ष पछिको छोराको उमेरको पाँच गुणा थियो भने बाबु र छोराको अहिलेको उमेर पत्ता लगाउनुहोस्।

Two years hence, a father will be six times as old as his son. Three years ago, the father was five times as old as his son will be two years hence, find the present ages of father and son. [2071D]

⇨ Here, let, father's present age be x years and son's present age be y years.

From the first condition, $x + 2 = 6(y + 2)$

or, $x + 2 = 6y + 12$ or, $x - 6y = 10$ ..... (i)

From the second condition, $x - 3 = 5(y + 2)$

or, $x - 3 = 5y + 10$ or, $x - 5y = 13$ ..... (ii)

Solving equation (i) and (ii),

$x - 6y = 10$

$x - 5y = 13$

$- \quad + \quad -$

$-y = -3$ $\therefore \quad y = 3$

Putting $y = 3$ in (i) then,

or, $x - 6y = 10$ or, $x - 6 \times 3 = 10$ or, $x - 18 = 10$ $\therefore \quad x = 28$

Thus, the present ages of father and son are 28 yrs and 3 yrs.

2. एक वर्षपछि बाबुको उमेर छोराको उमेरको पाँच गुणा हुनेछ। चार वर्ष पहिले बाबुको उमेर, चार वर्षपछिको छोराको उमेरको तीन गुणा थियो भने बाबु र छोराको अहिलेको उमेर पत्ता लगाउनुहोस्।

One year hence, a father will be five times as old as his son. Four years ago, the father was three times as old as his son will be four years hence. Find the present ages of the father and son. [2071C]

⇨ Here, let, father's age be x years and son's present age be y years.

From the first condition, $x + 1 = 5(y + 1)$ or, $x + 1 = 5y + 5$

$\therefore \quad x - 5y = 4$ ..... (i)

From the second condition, $x - 4 = 3(y + 4)$ or, $x - 4 = 3y + 12$

or, $x - 3y = 16$ ..... (ii)

Solving equation (i) and (ii);

$x - 5y = 4$

$x - 3y = 16$

$- \quad + \quad -$

$-2y = -12$ $\therefore \quad y = 6$

Putting the value of y in (i);

$x - 5 \times 6 = 4$ or, $x = 30 + 4$ $\therefore \quad x = 34$

Thus, the present ages of father and son are 34 years and 6 years respectively.

3. दुईजना दाजुभाइको अहिलेको उमेर क्रमशः 15 वर्ष र 22 वर्ष छ। कति वर्षपछि तिनीहरूको उमेरको गुणनफल 408 वर्ष हुन्छ ? पत्ता लगाउनुहोस्।

The present ages of two brothers are respectively 15 years and 22 years. After how many years the product of their ages will be 408 years? [2065 C]

⇨ Here, let, in x years the product of their ages will be 408 years.

$\therefore \quad (15 + x)(22 + x) = 408$ or, $330 + 15x + 22x + x^2 = 408$

or, $x^2 + 37x - 78 = 0$ or, $x^2 + 39x - 2x - 78 = 0$

or, $x(x + 39) - 2(x + 39) = 0$ or, $(x + 39)(x - 2) = 0$

$\therefore \quad x = -39$ (Impossible) and $x = 2$

Thus, in 2 years their product of ages will be 408 years.

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4. बाबु र छोराको हालको उमेरको योग 44 वर्ष छ। 8 वर्षपछि बाबुको उमेर छोराको उमेरको दुई गुणा हुनेछ भने तिनीहरूको हालको उमेर पत्ता लगाउनुहोस्।
The sum of the ages of the father and son is 44 years. After 8 years, the age of the father will be twice as old as the age of the son. Find their present ages. **[2066 C]**

⇨ Here, let, the present ages of father and his son are x yrs and y yrs respectively.
then, $x + y = 44$ …… (i)
Case II: $x + 8 = 2(y + 8)$ or, $x - 2y = 8$ ……. (ii)
Solving equation (i) and (ii) then,
$x + y = 44$
$x - 2y = 8$
$- \quad + \quad -$
$3y = 36$ $\therefore \ y = 12$
Putting the value of y in (i) then, $x + y = 44$ or, $x + 12 = 44$ $\therefore \ x = 32$
Thus, the present ages of father and son are 32 yrs and 12 yrs respectively.

5. 6 वर्ष अघि एउटा मानिसको उमेर उसको छोराको उमेरको 6 गुणा बढी थियो। अब 4 वर्षपछि उसको उमेरको तीनगुणा छोराको उमेरको 8 गुणासँग बराबर हुन्छ। उनीहरूको हालको उमेर पत्ता लगाउनुहोस्।
6 years ago a man's age was six times the age of his son. 4 years hence, thrice his age will be equal to eight times his son's age. What are their present ages ? **[2058 S, 2057 C1, 2060 A1]**

⇨ Here, suppose, man's present age = x yrs. and son's age = y yrs.
6 years ago man's age = (x – 6) yrs and 6 years ago son's age = (y – 6) yrs.
Now, $(x - 6) = 6\,(y - 6)$ or, $x - 6 = 6y - 36$
or, $x - 6y = -36 + 6$ or, $x - 6y = -30$ ..... (i)
Again, $3(x + 4) = 8\,(y + 4)$ or, $3x + 12 = 8y + 32$
or, $3x - 8y = 32 - 12$ or, $3x - 8y = 20$ ..... (ii)
Multiplying eq^n (i) by 3 and subtracting eq^n (ii)
$3x - 18y = -90$
$3x - 8y = 20$
$- \quad + \quad -$
$-10y = -110$ $\therefore \ y = \dfrac{-110}{-10} = 11$
Putting $y = 11$ in eq^n (i), $x - 6 \times 11 = -30$
or, $x - 66 = -30$ $\therefore \ x = -30 + 66 = 36$
Thus, man's present age = 36 yrs and son's present age = 11 yrs

6. 5 वर्ष अघि एउटा मानिसको उमेर छोरीको उमेरको 5 गुणा थियो। 3 वर्ष पछि उसको उमेरको 2 गुणा छोरीको उमेरको 6 गुणासँग बराबर हुन्छ। उनीहरूको हालको उमेर कति-कति होला ?
5 years ago a man's age was 5 times the age of his daughter's. 3 years hence, twice his age will be equal to 6 times his daughter's age. What are their present ages ? **[2065 D]**

⇨ Here, let, the present ages of a man and his daughter are x yrs and y yrs respectively.
First condition, $x - 5 = 5(y - 5)$
or, $x - 5 = 5y - 25$ or, $x - 5y = -20$ ..... (i)
Second condition, $2(x + 3) = 6(y + 3)$ or, $2x + 6 = 6y + 18$
or, $2x - 6y = 12$ ..... (ii)
Solving (i) × 2 and (ii)
$2x - 10y = -40$
$2x - 6y = 12$
$- \quad + \quad -$
$-4y = -52$
$\therefore \ y = 13$
Putting the value of y in (i); $x - 5y = -20$
or, $x - 5 \times 13 = -20$ or, $x = -20 + 65$ $\therefore \ x = 45$
Thus, their present ages are 45 yrs and 13 yrs respectively.

7. एक वर्ष पछि बाबुको उमेर छोराको उमेरको 5 गुणा हुनेछ। दुई वर्ष अघि बाबुको उमेर छोराको अब 4 वर्षपछि हुने उमेरको 3 गुणा थियो। उनीहरूको अहिलेको उमेर पत्ता लगाउनुहोस्।
A year hence, a father will be 5 times as old as his son. Two years ago, the father was 3 times as old as his son will be 4 years hence. Find their present ages. **[2064B1, 2057D1, D2]**

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⇨ Here, suppose, father's present age = x yrs and son's present age = y yrs.
First case, $x + 1 = 5(y + 1)$ or, $x + 1 = 5y + 5$
or, $x - 5y = 4$ ..... (i)
According to question, $x - 2 = 3(y + 4)$ or, $x - 2 = 3y + 12$
or, $x - 3y = 14$ ..... (ii)
Subtracting (i) from eq^n (ii),
$x - 3y = 14$
$x - 5y = 4$
$- \quad + \quad -$
$2y = 10$ $\therefore \ y = \frac{10}{2} = 5$
Putting the value of y in (i), we get, $x - 5y = 4$
or, $x - 5 \times 5 = 4$ or, $x = 25 + 4 = 29$
Thus, father's present age = 29 yrs and son's present age = 5yrs.

8. 14 वर्षअघि आमाको उमेर छोरीको उमेरको 4 गुणा थियो । हालको आमाको उमेर छोरीको 4 वर्षपछि हुने उमेरको दुई गुणा छ भने आमा र छोरीको हालको उमेर कति-कति होला ? पत्ता लगाउनुहोस् ।
14 years ago the age of the mother was 4 times the age of her daughter. The present age of the mother is 2 times the age of her daughter will be 4 years hence. What are their present ages ? Find it. **[2066 B]**

⇨ Here, let the present ages of mother and her daughter are x yrs and y yrs respectively.
Case I: $x - 14 = 4(y - 14)$ or, $x - 14 = 4y - 56$
or, $x - 4y = -42$ ..... (i)
Case II: $x = 2(y + 4)$ or, $x - 2y = 8$ ..... (ii)
Solving equation (i) and (ii)
$x - 4y = -42$
$x - 2y = 8$
$- \quad + \quad -$
$-2y = -50$ $\therefore \ y = 25$
Putting the value of y in (i); $x - 2y = 8$ or, $x - 2 \times 25 = 8$
$\therefore \ x = 58$
Thus, the present ages of mother and her daughter are 58 yrs and 25 yrs resp.

9. आमाको हालको उमेर उनको छोरीको उमेरको चारगुणा छ । यदि छोरीको 20 वर्षपछिको उमेर आमाको 25 वर्ष अघिको उमेरसँग बराबर भए आमा र छोरीको हालको उमेर पत्ता लगाउनुहोस् ।
The present age of the mother is four times of the age of her daughter. If the age of the daughter after 20 years is equal to the age of the mother before 25 years. Find the present ages of mother and daughter. **[2062 E2]**

⇨ Here, let, present age of the mother = x yrs and present age of her daughter = y yrs.
By question $x = 4y$ ..... (i)
Again, by question, $x - 25 = y + 20$
or, $x - y = 20 + 25$ or, $x - y = 45$ ..... (ii)
Substituting the value of x in (ii) from (i), we get $4y - y = 45$
or, $3y = 45$ $\therefore \ y = \frac{45}{3} = 15$
Putting the value of y in (i), we get $x = 4 \times 15 = 60$
Thus, mother's age = 60 yrs, daughter's age = 15 yrs.

10. आमाले छोरीलाई "5 वर्ष अघि म तिमी भन्दा 5 गुणा जेठी थिए तर 10 वर्षपछि म तिमी भन्दा दुई गुणा मात्र जेठी हुनेछु" भन्नुभयो भने आमा र छोरीको हालको उमेर पत्ता लगाउनुहोस् ।
A mother says to her daughter "5 years ago I was 5 times as old as you were but 10 years hence I shall be only twice as old as you will." Find the present ages of mother and daughter. **[2067 B]**

⇨ Here, let, the present ages of mother and daughter be x yrs and yrs respectively.
Case I: $x - 5 = 5(y - 5)$ or, $x - 5 = 5y - 25$
or, $x - 5y = -20$ ..... (i)
Case II: $x + 10 = 2(y + 10)$ or, $x + 10 = 2y + 20$
or, $x - 2y = 10$ ..... (ii)
Solving equation (i) and (ii) then
$x - 5y = -20$
$x - 2y = 10$
$- \quad + \quad -$
$-3y = -30$ $\therefore \quad y = 10$
From (i); $x - 5y = -20$ or, $x - 5 \times 10 = -20$
or, $x - 50 = -20$ $\therefore \quad x = 30$
Thus, the present ages of mother and her daughter are 30 yrs and 10 yrs.

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11. बाबुको हालको उमेर छोरीको 5 वर्षपछि हुने उमेरको तेब्बर छ । यदि 2 वर्षअघि बाबुको उमेर छोरीको 8 वर्षपछि हुने उमेरको दोब्बर थियो भने तिनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The present age of the father is thrice as old as the age of the daughter 5 years hence. If 2 years ago, the age of the father was twice as old as the age of the daughter 8 years hence, find their present ages. [2068 C]

⇨ Here, let, the present ages of father and daughter are x yrs and y yrs respectively.
First case: $x = 3(y + 5)$ or, $x - 3y = 15$ ..... (i)
Second case: $x - 2 = 2(y + 8)$ or, $x - 2 = 2y + 16$
or, $x - 2y = 18$ ..... (ii)
Solving equation (i) and (ii);
$x - 3y = 15$
$x - 2y = 18$
$- + -$
$-y = -3$
$\therefore y = 3$
Putting the value of y in equation (i) then, $x - 3 \times 3 = 15$ $\therefore x = 24$
Thus, their present ages are 24 yrs and 3 yrs.

12. बाबुको हालको उमेर छोराको 3 वर्षपछि हुने उमेरको दोब्बर छ । यदि 2 वर्ष पछि बाबुको उमेर छोराको 1 वर्ष अघिको उमेरको तेब्बर हुनेछ भने तिनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The present age of the father is twice as old as the age of the son 3 years hence. If 2 years hence, the age of the father will be thrice as old as the age of the son 1 year ago. Find their present ages. [2068 B]

⇨ Here, let the present ages of father and son are x yrs and y yrs. respectively.
First case: $x = 2(y + 3)$ or, $x - 2y = 6$ ..... (i)
Second case: $x + 2 = 3(y - 1)$ or, $x - 3y = -3 - 2$
or, $x - 3y = -5$ ..... (ii)
Solving equation (i) and (ii) then,
$x - 2y = 6$
$x - 3y = -5$
$- + +$
$y = 11$
$\therefore y = 11$
Putting the value of y in equation (i),
$x - 2y = 6$
or, $x - 2 \times 11 = 6$
$\therefore x = 28$
Thus, their present ages are 28 yrs & 11 yrs.

Model 2

13. दुई अङ्कको एउटा सङ्ख्या छ । यदि अङ्कहरूको स्थान बदल्दा बन्ने सङ्ख्या उक्त सङ्ख्यामा जोड्दा जोडफल 121 हुन्छ र सोही सङ्ख्या घटाउदा 27 बाँकी हुन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
A number consists of two digits. If the number formed by reversing its digits is added to it, the sum is 121 and same number is subtracted from it, the remainder is 27. Find the number. [2071S]

⇨ Here, let, two digits number be $10x + y$ where x and y are the digits in ten's place and unit place respectively.
From the first condition, $10x + y + 10y + x = 121$
or, $11x + 11y = 121$ $\therefore$ $x + y = 11$ ..... (i)
From the second condition, $10x + y - 10y - x = 27$
or, $9x - 9y = 27$ $\therefore$ $x - y = 3$ ..... (ii)
Solving equation (i) and (ii) then,
$x + y = 11$
$x - y = 3$
$- + -$
$2y = 8$ $\therefore$ $y = 4$
Putting the value of y in (ii) then, $x - 4 = 3$ $\therefore$ $x = 7$
Now, the required number $= 10x + y = 10 \times 7 + 4 = 74$
Thus, the two digits number is 74.

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14. दुई अङ्कको कुनै सङ्ख्या यसका अङ्कहरूको योगफलको चार गुणा भन्दा 3 ले बढी छ। त्यो सङ्ख्यामा 36 जोड्यो भने अङ्कहरूको स्थान बदलिन्छ भने त्यो सङ्ख्या पत्ता लगाउनुहोस्।

A number of two digits exceeds four times the sum of its digits by 3. If 36 is added to the number, the digits are reversed. Find the number. **[2060 B1, B2,C]**

⇨ Here, let, $10x + y$ be the number.

Then, $10x + y = 4(x + y) + 3$

or, $10x + y = 4x + 4y + 3$

or, $10x + y - 4x - 4y = 3$

or, $6x - 3y = 3$

or, $3(2x - y) = 3$

$\therefore \quad 2x - y = 1$ ..... (i)

Again, $10x + y + 36 = 10y + x$

or, $10x + y + 36 - 10y - x = 0$

or, $9x - 9y = -36$

or, $x - y = -4$ ..... (ii)

Subtracting (ii) from (i),

$2x - y = 1$

$x - y = -4$

$- \quad + \quad +$

$x = 5$

Putting the value of x in (ii),

We get $5 - y = -4$

or, $5 + 4 = y$

$\therefore \quad y = 9$

Thus, the required number $= 10x + y = 10 \times 5 + 9 = 59$

15. दुई अङ्कले बनेको सङ्ख्यामा अङ्कहरूको योगफल 7 छ। यदि सो सङ्ख्याबाट 27 घटाउँदा उक्त सङ्ख्याका अङ्कहरूको स्थान बदलिन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस्।

The sum of the digits of a two-digit number is 7. If 27 is subtracted from the number, the digits in the number are reversed, find the number. **[Model 2065]**

⇨ Here, let, the two digit number $= 10x + y$ where x and y are its digits.

From the first condition; $x + y = 7$ .....(i)

From the 2nd condition; $10x + y - 27 = 10y + x$

or, $10x - x + y - 10y = 27$

or, $9x - 9y = 27$

or, $9(x - y) = 27$

i.e. $x - y = 3$ .....(ii)

Solving equation (i) and (ii),

$x + y = 7$

$x - y = 3$

$2x = 10$

$\therefore \quad x = 5$

Putting, $x = 5$ in (i); $x + y = 7$

or, $5 + y = 7$

$\therefore \quad y = 2$

Thus, required two digit number $= 10x + y = 10 \times 5 + 2 = 50 + 2 = 52$

16. दुई अङ्कहरू मिली बनेको एउटा सङ्ख्या छ। ती अङ्कहरूको योगफल 16 हुन्छ। त्यस सङ्ख्यामा 18 घटाउँदा अङ्कहरूको स्थान बदलिन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस्।

A number consists of two digits. The sum of its digits is 16. If 18 is subtracted from the number, the digits interchange their places. Find the number. **[2065 A]**

⇨ Here, let, the two digits number $= 10x + y$

First case, $x + y = 16$ ..... (i)

Second case, $10x + y - 18 = 10y + x$

or, $9x - 9y = 18$

$\therefore \quad x - y = 2$ ..... (ii)

Solving (i) and (ii);

$x + y = 16$

$x - y = 2$

$2x = 18$

$\therefore \quad x = 9$

From (i) $x + y = 16$

or, $9 + y = 16$

$\therefore \quad y = 7$

Thus, the two digits number $= 10x + y = 10 \times 9 + 7 = 97$

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17. एउटा सङ्ख्या दुई अङ्कले बनेको छ जसको योगफल 9 हुन्छ । यदि सो सङ्ख्याको तीनगुणा उक्त सङ्ख्याको स्थान बदल्दा बन्ने सङ्ख्याको आठ गुणासँग बराबर हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
A number consists of two digits whose sum is 9. If three times the number is equal to eight times the number formed by interchanging the digits, find the number. **[2065 B]**

⇨ Here, let, the number is $10x + y$
By the first condition;
$x + y = 9$ ..... (i)
By the second condition
$3(10x + y) = (10y + x)8$ or, $30x + 3y = 80y + 8x$
or, $22x = 77y$ or, $2x = 7y$
$\therefore \quad 2x - 7y = 0$ ..... (ii)
Solving (i) × 2 and (ii) then;
$2x + 2y = 18$
$2x - 7y = 0$
$\underline{\quad + \quad - \quad}$
$9y = 18$
$\therefore \quad y = 2$
Putting the value of y in (i) then,
$x + y = 9$ or, $x + 2 = 9$
$\therefore \quad x = 7$
Thus, the required number $= 10x + y = 10 \times 7 + 2 = 70 + 2 = 72$

18. एउटा 2 अङ्कको सङ्ख्या यसका अङ्कहरूको योगको 3 गुणा छ । उक्त सङ्ख्याका अङ्कहरू उल्ट्याउँदा बन्ने सङ्ख्या र 9 को योगफल सुरुको उक्त सङ्ख्याको 3 गुणा हुन्छ । उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
A two digit number is 3 times the sum of its digits. The sum of the number formed by reversing its digits and 9 is equal to 3 times the original number. Find that number. **[2067 D]**

⇨ Here, let, the two digits number be $10x + y$.
Case I: $3(x + y) = 10x + y$ or, $3x + 3y = 10x + y$
or, $7x - 2y = 0$ ..... (i)
Case II: $10y + x + 9 = 3(10x + y)$ or, $10y + x + 9 = 30x + 3y$
or, $29x - 7y = 9$ ..... (ii)
Solving equation (i) × 7 and (ii) × 2 then,
$49x - 14y = 0$
$58x - 14y = 18$
$\underline{- \quad + \quad - \quad}$
$-9x \quad = -18$
$\therefore \quad x = 2$
From (i); $7x - 2y = 0$ or, $7 \times 2 = 2y$
$\therefore \quad y = 7$
Thus, the number is $10x + y = 10 \times 2 + 7 = 27$

19. दुई अङ्कको एउटा सङ्ख्यामा अङ्कहरूको योग 12 छ । यदि सो सङ्ख्याबाट 36 घटाइयो भने सङ्ख्याको अङ्कहरूको स्थानमानमा परिवर्तन हुन्छ । सुरुको सङ्ख्या पत्ता लगाउनुहोस् ।
The sum of the digits of a two digit number is 12. If 36 is subtracted from the number, the number so formed is a number obtained by reversing its digits. Find the original number. **[2066 E]**

⇨ Here, let, the two digits number $= 10x + y$
By the question, $x + y = 12$ ..... (i)
2^{nd} condition is, $10x + y - 36 = 10y + x$ or, $9x - 9y = 36$
$\therefore \quad x - y = 4$ ..... (ii)
Solving equation (i) and (ii),
$x + y = 12$
$\underline{x - y = 4}$
$2x = 16$
$\therefore \quad x = 8$
Putting the value of x in equation (i) then,
$x + y = 12$ or, $8 + y = 12$
$\therefore \quad y = 4$
Now, the two digits number $= 10x + y = 10 \times 8 + 4 = 84$
Thus, the two digits number is 84.

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Model 3

20. यदि एउटा भिन्नको अंशमा 3 जोड्दा भिन्नको मान 1 हुन्छ। उक्त भिन्नको हरमा 3 जोड्दा भिन्नको मान $\frac{1}{4}$ हुन्छ। सो भिन्नको मान कति हुन्छ ? पत्ता लगाउनुहोस्।

If 3 is added to the numerator of a fraction, the value of the fraction becomes 1. When 3 is added to the denominator of the fraction, the value of the fraction becomes $\frac{1}{4}$. What is the value of the fraction? Find it. **[2070 A]**

⇨ Here, let, the fraction be $\frac{x}{y}$.

First case: $\frac{x+3}{y} = 1$

or, $x + 3 = y$

or, $x - y = -3$ ..... (i)

Second case: $\frac{x}{y+3} = \frac{1}{4}$

or, $4x = y + 3$

or, $4x - y = 3$ ..... (ii)

Solving equation (i) and (ii) then,

$x - y = -3$

$4x - y = 3$

$- \quad + \quad -$

$-3x = -6$

$\therefore \quad x = 2$

Putting the value of $x = 2$ in (i) then, $x - y = -3$

or, $2 - y = -3$ or, $5 = y$

Thus, the fraction is $\frac{2}{5}$.

21. एउटा भिन्नको अंशलाई 4 ले गुणा गरेर हरबाट 2 घटाइयो भने नतिजा 4 हुन्छ। यदि सो भिन्नको अंशमा 10 जोडी हरलाई दोब्बर गरी 2 घटाउँदा $\frac{5}{4}$ हुन्छ भने उक्त भिन्न पत्ता लगाउनुहोस्।

If the numerator of a fraction is multiplied by 4 and the denominator is reduced by 2, the result is 4. If the numerator of the fraction is increased by 10 and 2 subtracted from the double of the denominator the result is $\frac{5}{4}$. Find the fraction. **[2062 A2]**

⇨ Here, let, $\frac{x}{y}$ be the required fraction then, $\frac{4x}{y-2} = 4$

or, $\frac{x}{y-2} = 1$ or, $x = y - 2$

or, $x - y = -2$ ..... (i)

Again, we have $\frac{x+10}{2y-2} = \frac{5}{4}$ or, $4x + 40 = 10y - 10$

or, $4x - 10y = -10 - 40$ or, $2(2x - 5y) = -50$

or, $2x - 5y = \frac{-50}{2}$ $\therefore \quad 2x - 5y = -25$ ..... (ii)

Multiplying (i) by 2 and subtracting from (ii) we get,

$2x - 5y = -25$

$2x - 2y = -4$

$- \quad + \quad +$

$-3y = -21$ $\therefore \quad y = \frac{-21}{-3} = 7$

Putting the value of y in (i) we get,

$x - 7 = -2$ or, $x = -2 + 7 = 5$

Thus, the required fraction is $\frac{x}{y} = \frac{5}{7}$

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Model 4

22. 1 ओटा कलम र 3 ओटा कापिको संयुक्त मूल्य रु. 210 पर्छ। त्यस्तै खाले 3 ओटा कलम र 5 ओटा कापिको संयुक्त मूल्य रु. 430 पर्छ। 1 ओटा कलम र 1 ओटा कापिको संयुक्त मूल्य कति पर्दछ ? पत्ता लगाउनुहोस्।

The combined price of 1 pen and 3 copies is Rs. 210. The combined price of 3 pen and 5 copies of same quality is Rs. 430. What is the combined price of 1 pen and 1 copy? Find it. **[2070 D]**

⇨ Here, let, the price of a pen be Rs. x and the price of a copy be Rs. y.

First case: $x + 3y = 210$ ..... (i) | Second case: $3x + 5y = 430$ ..... (ii)

Solving equation (i) and (ii) then,

$3x + 9y = 630$

$3x + 5y = 430$

$- \quad - \quad -$

$4y = 200$

$\therefore \quad y = 50$

Putting the value of y in (i) then, $x + 3 \times 50 = 210$

or, $x + 150 = 210$ or, $x = 210 - 150$

$\therefore \quad x = 60$

Now, the price of 1 pen and 1 copy $= x + y = 60 + 50 = 110$

Thus, the required priced is Rs. 110.

23. रामसँग भएका गुच्चाहरूमध्ये एउटा गुच्चा सीतालाई दिँदा दुबैजनासँग बराबर सङ्ख्यामा गुच्चाहरू हुन्छ। यदि सीतासँग भएका गुच्चाहरूमध्ये एउटा गुच्चा रामलाई दिँदा रामसँग सीताकोभन्दा दोब्बर गुच्चाहरू हुन्छ भने सुरूमा उनीहरूसँग भएको गुच्चाको सङ्ख्या पत्ता लगाउनुहोस्।

If Ram gives one of the marbles from what he possesses to Sita then they will have equal number of marbles. If Sita gives one of the marbles from what she possesses to Ram, then Ram will have double of the marbles with what Sita is left with. Find the number of marbles possessed by each initially.[2066 D]

⇨ Here, let, the marbles with Ram = x and the marbles with Sita = y

Then, case I: $x - 1 = y + 1$ or, $x - y = 2$ ..... (i)

Case II: $x + 1 = 2(y - 1)$ or, $x - 2y = -3$ ..... (ii)

Solving (i) and (ii) then,

$x - y = 2$

$x - 2y = -3$

$- \quad + \quad +$

$y = 5$

Putting the value of y in above (i) then, $x - 5 = 2$ $\therefore \quad x = 7$

Thus, Ram has 7 marbles and Sita has 5 marbles.

B. QUESTIONS FROM CDC TEXT BOOK

1A. दुई ओटा धनात्मक सङ्ख्याको योगफल 60 र अन्तर 20 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस्।

The sum of two numbers is 60 and difference is 20. Find the numbers.

⇨ Here, let, the numbers be x and y.

Then,

and $x - y = 20$ ..... (ii)

Solving equation (i) and (ii);

$x + y = 60$

$x - y = 20$

$- \quad + \quad -$

$2y = 40 \quad \therefore \quad y = 20$

Putting $y = 20$ in equation (i) then,

$x + y = 60$

or, $x + 20 = 60$

$\therefore \quad x = 40$

Thus, the two numbers are 40 and 20.

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1B. यदि एउटा सङ्ख्या अर्को सङ्ख्याको तिन गुणा छ र तिनीहरूको योगफल 24 छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If one number is three times the other and their sum is 24, find the numbers.

⇨ Here, let, the numbers be x and y then,

$x = 3y$

$\therefore \quad x - 3y = 0$ ..... (i)

Also,

Solving equations (i) and (ii),

$x - 3y = 0$

$x + y = 24$

$- \quad - \quad -$

$-4y = -24 \quad \therefore \quad y = 6$

Putting the value of y in (i) then,

$x = 3y$

$\therefore \quad x = 3 \times 6 = 18$

Thus, the numbers are 18 and 6.

2A. एउटा आयताकार चउरको परिमिति 54 मिटर छ । यसको आकार घटाउँदा नयाँ लम्बाइ र चौडाइ पहिलेको लम्बाइ र चौडाइको $\frac{3}{5}$ र $\frac{3}{4}$ गुणासँग बराबर हुन्छ । यदि आयताकार चउरको नयाा परिमिति 36 मिटर छ भने चौरको लम्बाइ र चौडाइ सुरुमा कति थियो ? पत्ता लगाउनुहोस् ।
The perimeter of a rectangular ground is 54 metre. When its side is reduced then new length and breadth are $\frac{3}{5}$ and $\frac{3}{4}$ times of the previous length and breadth. If the perimeter of new ground is 36 m, what was the length and breadth of the ground in the beginning ? Find it.

⇨ Here, let, the length and breadth in the beginning are x m and y m respectively.

First case: perimeter = 54 m

or, $2(L + B) = 54$

or, $2(x + y) = 54$

or, $2x + 2y = 54$ ..... (i)

Second case: $2(\ell + b) = 36$

or, $2\left(\frac{3}{5}L + \frac{3}{4}B\right) = 36$

or, $2\frac{(12x + 15y)}{20} = 36$

or, $12x + 15y = 360$

or, $4x + 5y = 120$ ..... (ii)

Solving (i) and (ii) then,

$4x + 4y = 108$

$4x + 5y = 120$

$- \quad - \quad -$

$-y = -12$

$\therefore \quad y = 12$

Putting y = 2 in (i) then,

$2x + 2y = 54$

or, $2x + 2 \times 12 = 54$

or, $2x = 30$

$\therefore \quad x = 15$

Thus, the initial length and breadth were 15 m and 12 m respectively.

2B. एउटा आयताकार खेतको परिमिति 240 मिटर छ । चौडाइभन्दा लम्बाइ 20 मिटरले बढी छ भने त्यस खेतको क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।
The perimeter of a rectangular field is 240 m. If the length is 20 m more than the breadth, what is the area of the field ? Find it.

⇨ Here, let, the length and breadth of the field be x m and y m respectively.

First case:

$2(\ell + b) = 240$

or, $2(x + y) = 240$

$\therefore \quad x + y = 120$ ..... (i)

Second case:

$\ell = 20 + b$

or, $x = 20 + y$

$\therefore \quad x - y = 20$ ..... (ii)

Solving (i) and (ii) then,

$x + y = 120$

$x - y = 20$

$- \quad + \quad -$

$2y = 100$

$\therefore \quad y = 50$ m

Putting value of y in equation (ii) then,

$x = y + 20$

or, $x = 50 + 20 \quad \therefore \quad x = 70$ m

Now, area of the field = $\ell \times b = 70 \times 50 = 3500$ m^2

Thus, the area of the field is 3500 m^2.

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3A. यदि 3 ओटा कलम र 5 ओटा कापीको मूल्य रु. 430 पर्छ। त्यस्तै 2 ओटा कलम र 1 ओटा कापीको मूल्य रु. 170 पर्छ। एउटा कलम र एउटा कापीको छुट्टा छुट्टै मूल्य कति हुन्छ ? पत्ता लगाउनुहोस्।
The cost of 3 pen and 5 copy is Rs. 430. Similarly the cost of 2 pen and 1 copy is Rs. 170. What are the separate price of a copy and a pen ?

⇨ Here, let, the price of a pen and a copy be Rs x and Rs y respectively.

Then, first case: $3x + 5y = 430$ …… (i)
Second case: $2x + 1y = 170$ ……. (ii)
Solving equation (i) and (ii) then,
$3x + 5y = 430$
$10x + 5y = 850$
$- \quad - \quad -$
$-7x = -420 \quad \therefore \quad x = 60$

Putting the value of x in (ii) then,
$2 \times 60 + y = 170$
or, $120 + y = 170$
$\therefore \quad y = 50$

Thus, the price of a pen is Rs 60 and the price of the copy is Rs 50.

3B. यदि 4 ओटा किताब र 2 ओटा कापीको मूल्य रु. 440 पर्छ। एउटा किताब र 3 ओटा कापीको मूल्य रु. 240 पर्छ। एउटा किताब र एउटा कापीको छुट्टा छुट्टै मूल्य कति पर्छ ? पत्ता लगाउनुहोस्।
The price of 4 books and 2 copies is Rs. 440. The price of a 1 book and 3 copies is Rs. 240. What are the separate price of a book and a pen? Find it.

⇨ Here, let, the price of a book and a pen be Rs. x and Rs. y respectively.

Then, first case: $4x + 2y = 440$
or, $2x + y = 220$ …….. (i)
Second case: $x + 3y = 240$ …….. (ii)
Solving equations (i) and (ii) then,
$2x + y = 220$
$2x + 6y = 480$
$- \quad - \quad -$
$-5y = -260 \quad \therefore \quad y = 52$

Putting the value of y in equation (ii) then,
$x + 3y = 240$
or, $x + 3 \times 52 = 240$
or, $x + 156 = 240$
$\therefore \quad x = 84$

Thus, the price of a book be Rs 84 and the price of a pen is Rs 52.

4A. यदि एउटा भिन्नको अंशलाई 4 ले गुणन गरी हरबाट 2 घटाइयो भने नतिजा 4 हुन्छ। उक्त भिन्नको हर र अंश प्रत्येकबाट 3 घटाउँदा भिन्नको मान 1/2 हुन्छ भने उक्त भिन्न कति होला ? पत्ता लगाउनुहोस्।
If the numerator of a fraction is multiplied by 4 and denominator is reduced by 2 then the result is 4. If 3 is reduced from both the numerator and denominator then the value of the fraction will be $\frac{1}{2}$, what is the fraction ? Find it.

⇨ Here, let, the fraction be $\frac{x}{y}$.

Then, first case: $\frac{x \times 4}{y - 2} = 4$
or, $4x = 4y - 8$
or, $4x - 4y = -8$
$\therefore \quad x - y = -2$ …… (i)
Second case: $\frac{x - 3}{y - 3} = \frac{1}{2}$
or, $2x - 6 = y - 3$
or, $2x - y = 3$ …… (ii)

Solving (i) and (ii) then;
$x - y = -2$
$2x - y = 3$
$- \quad + \quad -$
$-x = -5$
$\therefore \quad x = 5$
Putting the value of x in equation (i) then,
$x - y = -2$
or, $5 - y = -2$
$\therefore \quad y = 7$

Thus, the fraction be $\frac{5}{7}$.

4B. एउटा भिन्नको अंशलाई 3 ले गुणन गरी हरबाट 2 घटाइयो भने नतिजा 3 हुन्छ। यदि सो भिन्नको अंशमा 4 जोडी हरलाई दोब्बर गरी 2 घटाउँदा नतिजा 1 हुन्छ भने उक्त भिन्न पत्ता लगाउनुहोस्।
If the numerator of a fraction is multiplied by 3 and denominator is reduced by 2 then the result is 3. If 4 is added to the numerator and 2 is subtracted from twice the denominator then the result is 1. Find the fraction.

⇨ Here, let, the fraction be $\frac{x}{y}$ then,

First case: $\frac{x \times 3}{y - 2} = 3$

or, $\frac{x}{y - 2} = 1$

$\therefore \quad x = y - 2$

Putting $y = 4$ in (i) then, $x = y - 2 = 4 - 2 = 2$

Thus, the fraction be $\frac{x}{y} = \frac{2}{4} = \frac{1}{2}$.

Second case: $\frac{x + 4}{2y - 2} = 1$
or, $x + 4 = 2y - 2$
or, $y - 2 + 4 = 2y - 2$
$\therefore \quad y = 4$

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5A. यदि तिन वर्षअघि एक जना बाबु र उनको छोराको उमेरको योगफल 48 वर्ष थियो । अबको तिन वर्षपछि उसको बाबु र छोराको उमेरको अनुपात 3 : 1 हुन्छ । हालको बाबु र छोराको उमेर कति होला ? पत्ता लगाउनुहोस् ।
Three years ago the sum of ages of father and his son was 48 years and three years hence, the ratio of ages of father and son in the ratio of 3 : 1 what are the ages of father and son ? Find it.

⇨ Here, let, present ages of father and son be x years and y years respectively.

First case:
$x - 3 + y - 3 = 48$
or, $x + y = 54$ ..... (i)
Second case:
$(x + 3) : (y + 3) = 3 : 1$
or, $\frac{x+3}{y+3} = \frac{3}{1}$
or, $x + 3 = 3y + 9$
or, $x - 3y = 6$ ..... (ii)

Solving equation (i) and (ii) then,
$x + y = 54$
$x - 3y = 6$
$- \quad + \quad -$
$4y = 48$
$\therefore \quad y = 12$
Putting $y = 12$ in equation (i) then,
$x + y = 54$
or, $x + 12 = 54$
$\therefore \quad x = 42$

Thus, the present ages are 42 yrs and 12 yrs.

5B. दुई जना विद्यार्थीहरूको हालको उमेरको अनुपात 5 : 7 छ । यदि आठ वर्षअघि उनीहरूको उमेरको अनुपात 7 : 13 थियो भने हालको उमेर कति कति हुन्छ ? पत्ता लगाउनुहोस् ।
The ratio of present ages of two students are in the ratio of 5 : 7. If the ratio of their ages 8 years ago was 7 : 13, what are their present ages ? Find it.

⇨ Here, present ages of two students are in the ratio 5:7.
Suppose, present age of first students = 5x and present age of second student = 7x
Now, according to the question, $\frac{5x-8}{7x-8} = \frac{7}{13}$
or, $65x - 104 = 49x - 56$
or, $65x - 49x = -56 + 104$
or, $16x = 48$
$\therefore \quad x = \frac{48}{16} = 3$

Thus, present age of first student = $5x = 5 \times 3 = 15$ years.
And present age of second student = $7x = 7 \times 3 = 21$ years.

6A. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योगफल 8 छ । यदि सो सङ्ख्यामा 18 घटाइयो भने अङ्कहरूको स्थान बदलिन्छ । उक्त सङ्ख्या कति हुन्छ ? पत्ता लगाउनुहोस् ।
The sum of digits in a two digit number is 8. If 18 is subtracted from the number then the digits will altered. What is the numbers ?

⇨ Here, let, the two digits number be $10x + y$.
First case:
$x + y = 8$ ..... (i)
Second case:
$10x + y - 18 = 10y + x$
or, $9x - 9y = 18$
$\therefore \quad x - y = 2$ ..... (ii)

Solving equations (i) and (ii) then,
$x + y = 8$
$x - y = 2$
$- \quad + \quad -$
$2y = 6$
$\therefore \quad y = 3$
Putting $y = 3$ in equation (i) then, $x + y = 8$
or, $x + 3 = 8$
$\therefore \quad x = 5$

Thus, the two digit number is $10x + y = 10 \times 5 + 3 = 53$.

6B. दुई अङ्कको एउटा कुनै सङ्ख्या त्यसका अङ्कहरूको योगफलको 6 गुणा छ । यदि त्यो सङ्ख्याबाट 9 घटाइयो भने त्यसका अङ्कहरूको स्थान बदलिन्छ । त्यो सङ्ख्या कति हो, पत्ता लगाउनुहोस् ।
A two digit number is 6 times the sum of its digits. If 9 is subtracted from the number then its digits will interchange, what is the number ? Find it. **[2071 A]**

⇨ Here, let the two digit number be $10x + y$.
First case:
$10x + y = 6(x + y)$
or, $10x + y = 6x + 6y$
$\therefore \quad 4x - 5y = 0$ ..... (i)
or, $10x + y - 9 = 10y + x$
or, $9x - 9y = 9$
$\therefore \quad x - y = 1$ ..... (ii)

Solving (i) and (ii) then,
$4x - 5y = 0$
$4x - 4y = 4$
$- \quad + \quad -$
$-y = -4$
$\therefore \quad y = 4$
Putting $y = 4$ in (ii) then,
$x - y = 1$
or, $x - 4 = 1$ $\therefore \quad x = 5$

Now, the two digits number = $10x + y = 10 \times 5 + 4 = 54$
Thus, the two digits number is 54.

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12.2 वर्ग समीकरणका शाब्दिक समस्याहरू
VERBAL PROBLEMS ON QUADRATIC EQUATION

A. BASIC EXERCISE 12.2

A. VERY SHORT QUESTIONS

1. (a) वर्ग समीकरण $ax^2 + bx + c = 0$ का मूलहरू के-के हुन् ?
What are the roots of a quadratic equation $ax^2 + bx + c = 0$?

⇨ Here, $ax^2 + bx + c = 0$ So, required roots are $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

(b) वर्ग समीकरण $\ell y^2 + my + n = 0$ का मूलहरू लेख्नुहोस् ?
Write down the roots of a quadratic equation $\ell y^2 + my + n = 0$.

⇨ Here, $\ell y^2 + my + n = 0$ So, required roots are $y = \frac{-m \pm \sqrt{m^2 - 4\ell n}}{2\ell}$

2. (a) यदि $\frac{x^2}{49} = 1$ भए x का मानहरू पत्ता लगाउनुहोस् । (If $\frac{x^2}{49} = 1$, find the values of x.)

⇨ Here, $\frac{x^2}{49} = 1$ or, $x^2 = 49$ or, $x = \sqrt{49}$ ∴ $x = \pm 7$

(b) यदि $\frac{1}{x^2} = \frac{1}{9}$ भए x का मूलहरू पत्ता लगाउनुहोस् । (If $\frac{1}{x^2} = \frac{1}{9}$, find the roots of x.)

⇨ Here, $\frac{1}{x^2} = \frac{1}{9}$ or, $x^2 = 9$ or, $x = \sqrt{9}$ ∴ $x = \pm 3$

B. SHORT QUESTIONS

Model 1

1. यदि एउटा प्राकृतिक सङ्ख्याको वर्गबाट 17 घटाउँदा परिणाम 152 हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
If 17 is subtracted from the square of a natural number, the result is 152. Find the number. [2070 C]

⇨ Here, let, the natural number be x.
Then, $x^2 - 17 = 152$ or, $x^2 = 169$
or, $x^2 = (\pm 13)^2$ ∴ $x = 13$ since natural number is (+ve)
Thus, the natural number is 13.

2. कुनै सङ्ख्याको वर्गबाट 4 घटाउँदा 21 हुन्छ भने सो सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If 4 is subtracted from the square of a number, the result is 21. Find the numbers. [2066 D]

⇨ Here, let, the number be x, then,
$x^2 - 4 = 21$ or, $x^2 = 25$ ∴ $x = \pm 5$
Thus, the numbers are ± 5.

3. यदि एउटा धनात्मक सङ्ख्याको वर्गमा 39 घटाउँदा 130 बाँकी रहन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If 39 is subtracted from the square of a number, the result is 130, find the positive number. [2067 B]

⇨ Here, let, the positive number be x then,
$x^2 - 39 = 130$ or, $x^2 = 169$ or, $x^2 = (\pm 13)^2$
∴ $x = 13$ Thus, the positive number is 13.

4. यदि एउटा सङ्ख्याको वर्गमा 3 जोड्दा योगफल 28 हुन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If 3 is added to the square of a number, the sum will be 28. Find the number. [2065 D]

⇨ Here, let, the number be x then,
$x^2 + 3 = 28$ or, $x^2 = 25$ ∴ $x = \pm 5$

5. यदि एउटा सङ्ख्याको वर्गमा 11 जोड्दा योगफल 75 हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
If 11 is added to the square of a number, then the sum is 75. Find the number. [2066 E]

⇨ Here, let, the number be x then,
$x^2 + 11 = 75$ or, $x^2 = 75 - 11$ or, $x^2 = 64$
∴ $x = \pm 8$ Thus, the required number is ± 8.

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6. यदि धनात्मक सङ्ख्याको वर्गको आधाबाट 15 घटाउँदा परिणाम 35 हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् । [2068 B]
If 15 is subtracted from the half of the square of a positive number, the result is 35. Find the number.

⇨ Here, let, the positive number be x then,

$\frac{x^2}{2} - 15 = 35$ or, $\frac{x^2}{2} = 50$ or, $x^2 = 100$

$\therefore$ $x = 10$ Thus, the positive number is 10.

7. यदि एउटा प्राकृतिक सङ्ख्याको वर्गको आधाबाट 4 घटाउँदा परिणाम 14 हुन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
If 4 is subtracted from the half of the square of a natural number, the result is 14. Find the number.[2066 B]

⇨ Here, let, the number be x then,

$\frac{1}{2}x^2 - 4 = 14$ or, $\frac{1}{2}x^2 = 18$ or, $x^2 = 36$

$\therefore$ $x = \pm 6$ Thus, the number is 6.

8. 11 लाई दुई भागमा विभाजन गर्नुहोस् ताकि तिनीहरूको गुणनफल 24 होस् ।
Divide 11 into two parts so that their product will be 24. [2067 D]

⇨ Here, let, one part be x then other part be $(11 - x)$ and Product = 24

or, $x(11 - x) = 24$ or, $11x - x^2 = 24$ or, $x^2 - 11x + 24 = 0$

or, $x^2 - 8x - 3x + 24 = 0$ or, $x(x - 8) - 3(x - 8) = 0$ or, $(x - 8)(x - 3) = 0$

Either, $x - 8 = 0 \Rightarrow x = 8$ or, $x - 3 = 0 \Rightarrow x = 3$

Thus, the numbers are 8, 3 or 3, 8.

9. यदि दुईओटा सङ्ख्याहरूको योगफल 20 र तिनीहरूको अन्तर 4 भए ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
If the sum of two numbers is 20 and their difference is 4, find the numbers. [2067 A]

⇨ Here, let, one number be x then other number = $20 - x$

$\therefore$ Difference = 4 So, $x - (20 - x) = 4$ or, $x - 20 + x = 4$

or, $2x = 24$ $\therefore$ $x = 12$

Thus, the numbers are; 12 and $(20 - 12) = 8$

10. यदि एउटा सङ्ख्याको वर्गबाट 3 घटायो भने 6 बाँकी रहन्छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If 3 is subtracted from the square of a number and the result is 6. Find the number. [SLC Model 2065]

⇨ Here, let, the required number = x then

By question, $x^2 - 3 = 6$ or, $x^2 = 6 + 3$ or, $x^2 = 9 = (\pm 3)^2$

$\therefore$ $x = \pm 3$ Thus, the required numbers are ± 3.

11. यदि एउटा प्राकृतिक सङ्ख्याको दोब्बर सो सङ्ख्याको वर्गसँग बराबर छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If the double of a natural number is equal to the square of the number, find the number. [2066 C]

⇨ Here, let, the number be x

Then, $2x = x^2$ or, $x^2 - 2x = 0$ or, $x(x - 2) = 0$

Either, $x = 0$ or $x - 2 = 0$ $\therefore$ $x = 2$

Thus, the required number is 2.

Model 2

12. दुई दाजुभाईको उमेरको योगफल 31 वर्ष छ र तिनीहरूको उमेरको फरक 5 वर्ष छ भने तिनीहरूको अहिलेको उमेर पत्ता लगाउनुहोस् ।
The sum of the ages of two brothers is 31 years and the difference of their ages is 5 years. Find their present ages. [2070 E]

⇨ Here, let, the age of one of brother be x years then the age of another brother will be $(31 - x)$ years.

By the questions, $x - (31 - x) = 5$ or, $x - 31 + x = 5$

or, $2x = 36$ $\therefore$ $x = 18$

Thus, the age of two brothers are 18 yrs and $31 - 18 = 13$ years.

13. एउटा मानिसको 20 वर्षअघि र 20 वर्षपछिको उमेरको गुणनफल 500 हुन्छ भने उसको हालको उमेर पत्ता लगाउनुहोस् ।
The product of the ages of a man 20 years before and 20 years hence is 500. Find the present age of the man.[2071C]

⇨ Here, let, the present age of a man be x years.

Age of a man before 20 years = $(x - 20)$ yrs and Age of man after 20 years = $(x + 20)$ yrs

By the question, $(x - 20)(x + 20) = 500$ or, $x^2 - 20^2 = 500$

or, $x^2 - 400 = 500$ or, $x^2 = 900$ $\therefore$ $x = \pm 30$

Thus, the present age of the man is 30 yrs.

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14. दुईओटा सङ्ख्याहरूको योगफल 21 छ। यदि ती सङ्ख्याहरूको वर्गको योगफल 261 हुन्छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस्।

The sum of two numbers is 21. If the sum of the square of the numbers is 261, find the numbers. [2071D]

⇨ Here, let, one number be x and another number be $21 - x$.

By the question, $x^2 + (21 - x)^2 = 261$

or, $x^2 + 21^2 - 2.21.x + x^2 = 261$ or, $x^2 + 441 - 42x + x^2 = 261$

or, $2x^2 - 42x + 180 = 0$ or, $x^2 - 21x + 90 = 0$

or, $x^2 - 15x - 6x + 90 = 0$ or, $x(x - 15) - 6(x - 15) = 0$

or, $(x - 15)(x - 6) = 0$

Either, $x - 15 = 0$ or, $x - 6 = 0$

$\therefore$ $x = 15$ $\therefore$ $x = 6$

Thus, the numbers are 15 and 6 or 6 and 15.

C. LONG QUESTIONS

Model 1

1. बाबु र छोराको अहिलेको उमेर क्रमशः 40 वर्ष र 8 वर्ष छ। कति वर्ष पहिले उनीहरूको उमेरको गुणनफल 105 थियो ? पत्ता लगाउनुहोस्।

The present ages of a father and his son are 40 years and 8 years respectively. How many years ago, the product of their ages was 105? Find it. [2070E]

⇨ Here, let, x years ago the product of their ages was 105.

By the questions, $(40 - x)(8 - x) = 105$

or, $320 - 40x - 8x + x^2 = 105$ or, $x^2 - 48x + 215 = 0$

or, $x^2 - 43x - 5x + 215 = 0$ or, $x(x - 43) - 5(x - 43) = 0$

or, $(x - 43)(x - 5) = 0$

Either, $x - 43 = 0$ or, $x - 5 = 0$

$\therefore$ $x = 43$ (Impossible) $\therefore$ $x = 5$

Thus, the required time is 5 years.

2. अहिले बाबुको उमेर 45 वर्ष र छोराको उमेर 15 वर्ष छ। कति वर्ष पहिले उनीहरूको उमेरको गुणनफल 259 थियो ? पत्ता लगाउनुहोस्।

The present age of father is 45 years and son's age is 15 years. Find how many years ago the product of their ages was 259 ? [2071B]

⇨ Here, let, x years ago their age product was 29.

From the question,

$(45 - x)(15 - x) = 259$ or, $675 - 45x - 15x + x^2 = 259$

or, $x^2 - 60x + 416 = 0$ or, $x^2 - 52x - 8x + 416 = 0$

or, $x(x - 52) - 8(x - 52) = 0$ or, $(x - 52)(x - 8) = 0$

Either, $x - 52 = 0$ or, $x - 8 = 0$

$\therefore$ $x = 52$ $\therefore$ $x = 8$

$\therefore$ $x = 52$ is not possible so $x = 8$. Thus, the required time is 8 years.

3. दाजु र भाइको हालको उमेर क्रमशः 13 वर्ष र 7 वर्ष छ। कति वर्षपछि तिनीहरूको उमेरको गुणनफल 280 हुन्छ ? पत्ता लगाउनुहोस्।

The present ages of elder and younger brother are 13 years and 7 years respectively. In how many years will the product of their ages be 280 ? Find it. [2058 B1]

⇨ Here, present age of elder brother = 13 yrs.

and present age of younger brother = 7 yrs.

After x years elder brother's age = $(13 + x)$ yrs.

and after x years younger brother's age = $(7 + x)$ yrs.

Then, $(13 + x)(7 + x) = 280$ or, $91 + 13x + 7x + x^2 = 280$

or, $x^2 + 20x + 91 - 280 = 0$ or, $x^2 + 20x - 189 = 0$

or, $x^2 + 27x - 7x - 189 = 0$ or, $x(x + 27) - 7(x + 27) = 0$

or, $(x + 27)(x - 7) = 0$

Either, $x + 27 = 0$ or, $x - 7 = 0$

$\therefore$ $x = -27$ or, $x = 7$

Here, value of x cannot be negative, therefore, only $x = 7$ is possible value.

Thus, after 7 years, product of their ages is 280.

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Model 2

4. दुई दाजुभाइको हालको उमेरको गुणनफल 160 छ र 4 वर्षअघि दाजुको उमेर भाइको उमेरको दुईगुणा थियो भने तिनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The product of the present ages of two brothers is 160 and 4 years ago elder brother was twice as old as his younger brother. Find their present ages. [2072 E]

⇨ Here, let, the present age of the elder brother be x years and that of this younger brother be y years.
First case: $xy = 160$ …….. (i)
Second case: $(x - 4) = 2(y - 4)$ or, $x - 4 = 2y - 8$
or, $x - 2y = -4$ …… (ii)
Now, $xy = 160$ or, $(2y - 4)y = 160$
or, $2y^2 - 4y = 160$ or, $y^2 - 2y = 80$
or, $y^2 - 2y - 80 = 0$ or, $y^2 - 2y - 80 = 0$
or, $y^2 - 10y + 8y - 80 = 0$ or, $y(y - 10) + 8(y - 10) = 0$
or, $(y - 10)(y + 8) = 0$
Either, $y - 10 = 0$ or, $y + 8 = 0$
$\therefore$ $y = 10$ or, $y = -8$ (impossible)
From (ii) $x = 2y - 4 = 2 \times 10 - 4 = 16$
Thus, their present ages are 16 years and 10 years.

5. दुईजना दाजुभाइहरूको उमेरको फरक 6 वर्ष छ । यदि दुई वर्ष पछिको उनीहरूको उमेरको गुणनफल 280 हुनेछ भने उनीहरूको अहिलेको उमेर पत्ता लगाउनुहोस् ।
The difference of the ages of two brothers is 6 years. If after two years the product of their ages will be 280, find their present ages. [2071 E]

⇨ Here, let, the present age of two brother's be x and y years.
From the first condition, $x - y = 6$ $\therefore$ $x = y + 6$ ..... (i)
From the second condition, $(x + 2)(y + 2) = 280$
or, $xy + 2x + 2y + 4 = 280$ $\therefore$ $xy + 2x + 2y - 276 = 0$ ..... (ii)
Putting $x = y + 6$ in equation (ii) then,
$(y + 6)y + 2(y + 6) + 2y - 276 = 0$
or, $y^2 + 6y + 2y + 12 + 2y - 276 = 0$ or, $y^2 + 10y - 264 = 0$
or, $y^2 + 22y - 12y - 264 = 0$ or, $y(y + 22) - 12(y + 22) = 0$
or, $(y + 22)(y - 12) = 0$
Either, $y + 22 = 9$ or, $y - 12 = 0$
$\therefore$ $y = -22$ (impossible) $\therefore$ $y = 12$
Now, from (i); $x = y + 6$ $\therefore$ $x = 12 + 6 = 18$
Thus, the present ages of two brothers' are 18 yrs and 12 yrs.

6. दुई दाजुभाईको हालको उमेरको अन्तर 4 वर्ष छ । 5 वर्ष अघि यदि तिनीहरूको उमेरको गुणनफल 96 भए तिनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
The difference of the present ages of two brothers is 4 years. 5 years ago, if the product of their ages was 96, find their present ages. [2063 D1]

⇨ Here, let, the present age of younger brother be x,
Then, present age of elder brother will be $x + 4$ where, $x > 6$
Now, since 5 years ago, product of their age is 96
i.e. $(x - 5)(x + 4 - 5) = 96$ or, $(x - 5)(x - 1) = 96$
or, $x^2 - 5x - x + 5 - 96 = 0$ or, $x^2 - 6x - 91 = 0$
or, $x^2 - 13x + 7x - 91 = 0$ or, $x(x - 13) + 7(x - 13) = 0$
or, $(x - 13)(x + 7) = 0$ Either, $x - 13 = 0$
or, $x + 7 = 0$ $\therefore$ $x = 13$ or, $x = -7$
Thus, their present ages are 13 years and $13 + 4 = 17$ years respectively.

7. दाजु र भाइको उमेरको अन्तर 4 वर्ष र गुणनफल 221 हुन्छ भने ती दुई भाइको उमेर पत्ता लगाउनुहोस् ।
The difference of the ages of two brothers is 4 years and the product of their ages is 221. Determine the ages of the two brothers. [2060 D1, E1, 2065 A]

⇨ Here, let, x and y be the ages of two brothers such that, $x - y = 4$ .....(i) and $xy = 221$ ..... (ii)
We have, $x + y = \sqrt{(x - y)^2 + 4xy} = \sqrt{4^2 + 4 \times 221} = \sqrt{16 + 884} = \sqrt{900} = 30$
$\therefore$ $x + y = 30$ ..... (iii)

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Adding (i) and (iii), we get,

$$\begin{array}{r} x - y = 4 \\ \underline{x + y = 30} \\ 2x \quad = 34 \end{array} \qquad \therefore \quad x = 17$$

Putting the value of x in (i), we have

$17 - y = 4$ or, $17 - 4 = y$ $\therefore$ $y = 13$

Thus, the required ages are 17 yrs and 13 yrs.

8. दुई दिदी-बहिनीको अहिलेको उमेरको फरक 5 वर्ष र तिनीहरूको उमेरको गुणनफल 84 छ। दिदी-बहिनीको हालको उमेर पत्ता लगाउनुहोस्।

The difference of the ages of two sisters 5 years and the product of their ages is 84. Find the present ages of two sisters. **[2063 C1]**

⇨ Here, let, present age of elder sister = x and present age of younger sister = y

Then, $x - y = 5$ ..... (1) or, $xy = 84$ or, $y = \frac{84}{x}$ .... (2)

Putting the value of y from equation (2) in equation (1), we get,

$x - \frac{84}{x} = 5$ or, $x^2 - 84 = 5x$

or, $x^2 - 5x - 84 = 0$ or, $x^2 - 12x + 7x - 84 = 0$

or, $x(x - 12) + 7(x - 12) = 0$ or, $(x - 12)(x + 7) = 0$

Either, $x - 12 = 0$ or, $x + 7 = 0$

$\therefore$ $x = 12$ or, $x = -7$

Since, $x = -7$ is impossible, $x = 12$ is only the possible value.

Putting $x = 12$ in equation (2), we get; $y = 7$

Thus, 12 yrs. and 7 yrs. are the ages of two sisters.

9. दिदी र भाइको हालको उमेरको अन्तर 6 वर्ष छ। तिनीहरूको उमेरको गुणनको सङ्ख्यात्मक मान उमेरको योगफलको 4 गुणा हुन्छ भने दिदी र भाइको हालको उमेर पत्ता लगाउनुहोस्। **[2064 D1]**

The difference of the present ages of sister and her younger brother is 6 years. The product of ages of numerical value is equal to 4 times the sum of their ages, find the present ages of the sister and her brother.

⇨ Here, let, the present ages of sister be x yrs and brother be $(x - 6)$ years

By the question, $x(x - 6) = (x + x - 6)4$ or, $x^2 - 6x = (2x - 6)4$

or, $x^2 - 6x = 8x - 24$ or, $x^2 - 6x - 8x + 24 = 0$

or, $x^2 - 14x + 24 = 0$ or, $x^2 - 12x - 2x + 24 = 0$

or, $x(x - 12) - 2(x - 12) = 0$ or, $(x - 12)(x - 2) = 0$

or, $(x - 12)(x - 2) = 0$

Either, $x - 12 = 0$ $\therefore$ $x = 12$

or, $x - 2 = 0$ $\therefore$ $x = 2$ (Impossible)

Thus, the present ages of sister is 12 years and brother is $(12 - 6)$ yrs = 6 yrs.

Model 3

10. दाजु र भाइको उमेरको योगफल 30 वर्ष र उनीहरूको उमेरको गुणनफल 221 हुन्छ भने दाजु र भाइको हालको उमेर पत्ता लगाउनुहोस्।

The sum of the present ages of elder and younger brothers is 30 years and the product of their ages is 221, find their present ages. **[2063 B1]**

⇨ Here, let, present age of elder brother = x and present age of younger brother = y

By questions, $x + y = 30$ ..... (1)

And, $xy = 221$ or, $y = \frac{221}{x}$ ..... (2)

Substituting for y from (2) in (1), we get

$x + \frac{221}{x} = 30$ or, $\frac{x^2 + 221}{x} = 30$

or, $x^2 + 221 = 30x$ or, $x^2 - 30x + 221 = 0$

or, $x^2 - 17x - 13x + 221 = 0$ or, $x(x - 17) - 13(x - 17) = 0$

or, $(x - 17)(x - 13) = 0$ Either, $x - 17 = 0$ $\therefore$ $x = 17$

or, $x - 13 = 0$ or, $x = 13$

Since, age of elder brother is greater than that of younger brother,

So, $x = 17$ is only the possible value.

Now, when $x = 17$, from (1), $y = 13$

Thus, elder brother is 17 yrs. old and younger is 13 yrs. old

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11. दिदी र बहिनीको उमेरको योगफल 28 वर्ष र उनीहरूको उमेरको गुणनफल 187 हुन्छ भने, दिदी र बहिनीको हालको उमेर पत्ता लगाउनुहोस् ।

The sum of the present ages of elder and younger sisters is 28 years and the product of their ages is 187, find their present ages. [2063 B2]

⇨ Here, let, present age of elder sister = x and present age of younger sister = y

Then, $xy = 187$ or, $y = \frac{187}{x}$ ..... (1)

Again, $x + y = 28$ ..... (2)

Putting the value of y in equation (2) from equation (1) we get,

$x + \frac{187}{x} = 28$ or, $\frac{x^2 + 187}{x} = 28$

or, $x^2 + 187 = 28x$ or, $x^2 - 28x + 187 = 0$

or, $x^2 - 17x - 11x + 187 = 0$ or, $x(x - 17) - 11(x - 17) = 0$

or, $(x - 17)(x - 11) = 0$ ∴ $x = 17$ or $x = 11$

Since, age of elder sister should be greater than that of younger,

So, $x = 17$ is only the possible value.

Now, when $x = 17$, then $y = \frac{187}{17} = 11$

Thus, elder sister's present age = 17 yrs and younger sister's present age = 11 yrs.

Model 4

12. आमाको हालको उमेर छोरीको एकवर्ष पछिको उमेरको वर्गसँग बराबर छ । यदि छोरीको 10 वर्षपछिको उमेर आमाको 10 वर्ष पहिलेको उमेरभन्दा 1 वर्ष कम हुनेछ भने उनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।

The present age of mother is equal to the square of the age of her daughter after one year. If the age of daughter in 10 years hence will be 1 year less than the age of her mother in 10 years ago, then find their present ages. [2072 MW]

⇨ Here, let, the present age of mother be x years and daughter be y years.

Case I: $x = (y + 1)^2$ ..... (i)

Case II: $y + 10 = (x - 10) - 1$ or, $y + 10 = x - 11$

or, $y = x - 21$ ∴ $x = y + 21$ ..... (ii)

From (i) and (ii), $(y + 1)^2 = y + 21$ or, $y^2 + 2y + 1 = y + 21$

or, $y^2 + y - 20 = 0$ or, $y^2 + 5y - 4y - 20 = 0$

or, $y(y + 5) - 4(y + 5) = 0$ or, $(y + 5)(y - 4) = 0$

Either, $y + 5 = 0$ or, $y - 4 = 0$

or, $y = -5$ (impossible) ∴ $y = 4$

Now, from (i), $x = (4 + 1)^2 = 5^2 = 25$

Thus, their present ages are 4 yrs and 25 yrs.

13. दुई दिदीबहिनीको हालको उमेरको गुणनफल 150 छ । 5 वर्षअघि दिदीको उमेर बहिनीको उमेरको दोब्बर भए तिनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।

The product of the present ages of two sisters is 150. 5 years ago, elder sister was twice as old as her younger sister. Find their present ages. [2061 C1]

⇨ Here, let, present age of elder sister = x and present age of younger sister = y

Then, $xy = 150$ ..... (1)

According to given condition, $x - 5 = 2(y - 5)$

or, $x - 5 = 2y - 10$ or, $x - 2y + 5 = 0$ ..... (2)

Now, substituting $y = \frac{150}{x}$, from (1), in (2) we get,

$x - 2 \times \frac{150}{x} + 5 = 0$ or, $x^2 - 300 + 5x = 0$

or, $x^2 + 5x - 300 = 0$ or, $x^2 + 20x - 15x - 300 = 0$

or, $x(x + 20) - 15(x + 20) = 0$ or, $(x + 20)(x - 15) = 0$

∴ $x = -20$ or, $x = 15$

Since, age can not be negative, so, $x = -20$ is neglected.

Now putting $x = 15$ in $y = \frac{150}{x}$, we get $y = \frac{150}{15} = 10$

Thus, elder sister's present age = 15 yrs, and younger's present age = 10 yrs.

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14. 6 वर्ष अघि एउटा मानिसको उमेर उसको छोराको उमेरभन्दा 6 गुणा बढी थियो । हालको बाबु र छोराको उमेरको गुणनफल 396 छ भने उनीहरूको हालको उमेर पत्ता लगाउनुहोस् ।
6 years ago, a man's age was 6 times the age of his son. The product of the present ages of the father and his son is 396. What are their present ages ? [2063 A1]

⇨ Here, let, Man's present age = x and Son's present age = y

By question, $x - 6 = 6(y - 6)$
or, $x - 6y = -36 + 6$
or, $x - 6y = -36$
or, $x - 6y = -30$ ..... (1)

Again, $xy = 396$
or, $y = \frac{396}{x}$ ..... (2)

Putting the value of y from (2) in equation (1), we get

$x - 6 \times \frac{396}{x} = -30$
or, $\frac{x^2 - 2376}{x} = -30$
or, $x^2 - 2376 = -30x$
or, $x^2 + 30x - 2376 = 0$
or, $x^2 + 66x - 36x - 2376 = 0$
or, $x(x + 66) - 36(x + 66) = 0$
or, $(x - 36)(x + 66) = 0$
Either, $x - 36 = 0$,
or, $x + 66 = 0$
$\therefore x = 36$
or, $x = -66$

Since, age of a man can not be negative, $x = -66$ is impossible.
$\therefore x = 36$ is only the possible value.
From (2), we have, $y = 11$
Thus, man's age = 36 yrs, his son's age = 11 yrs.

Model 5

15. कुनै दुईओटा क्रमागत जोर सङ्ख्याहरूको गुणनफल 168 छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The product of two consecutive even numbers is 168. Find the numbers. [2064 C1]

⇨ Here, let, one number be x then other number will be (x + 2).

By the question, $x(x + 2) = 168$
or, $x^2 + 2x = 168$
or, $x^2 + 2x - 168 = 0$
or, $x^2 + 14x - 12x - 168 = 0$
or, $x(x + 14) - 12(x + 14) = 0$
or, $(x + 14)(x - 12) = 0$
Either, $x + 14 = 0$
$\therefore x = -14$ (Impossible)
or, $x - 12 = 0$
$\therefore x = 12$
Now, $x + 2 = 12 + 2 = 14$
Thus, the required numbers are 12 and 14.

16. दुई धनात्मक सङ्ख्याहरूको गुणनफल 56 छ । यदि तिनीहरूको अन्तर 10 भए, ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The product of two positive numbers is 56. If their difference is 10, find the numbers. [2067 C]

⇨ Here, let, the positive numbers are; x and y where x > y.

So, $xy = 56$ ..... (i)
By the second condition; $x - y = 10$
or, $x = y + 10$ ..... (ii)
From (i), $xy = 56$
or, $(y + 10)y = 56$
or, $y^2 + 10y - 56 = 0$
or, $y^2 + 14y - 4y - 56 = 0$
or, $y(y + 14) - 4(y + 14) = 0$
or, $(y + 14)(y - 4) = 0$
Either, $y + 14 = 0 \Rightarrow y = -14$ (impossible)
or, $y - 4 = 0 \Rightarrow y = 4$
From (ii), $x = y + 10 = 4 + 10 = 14$
Thus, the positive numbers are 14 and 4.

17. दुईओटा सङ्ख्याहरूको योग 21 छ र ती सङ्ख्याहरूका वर्गहरूको योग 261 छ भने सङ्ख्याहरू निकाल्नुहोस् ।
The sum of two numbers is 21 and the sum of their squares is 261. Find the numbers. [2059 A1]

⇨ Here, suppose, x and y are two numbers.

Where, $x + y = 21$ ..... (1) and $x^2 + y^2 = 261$ ..... (2)
Putting $y = 21 - x$ from equation (1) in the question (2)
$x^2 + (21 - x)^2 = 261$
or, $x^2 + 441 - 42x + x^2 = 261$
or, $2x^2 - 42x + 180 = 0$
or, $2(x^2 - 21x + 90) = 0$
or, $x^2 - 15x - 6x + 90 = 0$
or, $x(x - 15) - 6(x - 15) = 0$
or, $(x - 6)(x - 15) = 0$

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Either, $x - 6 = 0$ $\therefore$ $x = 6$
or, $x - 15 = 0$ $\therefore$ $x = 15$
If $x = 6$, from equation (1), $6 + y = 21$ $\therefore$ $y = 21 - 6 = 15$
If $x = 15$, from equation (1),
$15 + y = 21$ $\therefore$ $y = 21 - 15 = 6$
Thus, the required numbers are 6 and 15 or 15 and 6

Model 6

18. दुई अङ्कको सङ्ख्यामा अङ्कहरूको योगफल 7 र गुणनफल 12 छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of digits of two digit number is 7 and their product is 12. Find the numbers. [2058 D1]

⇨ Here, suppose, two digit number = $10x + y$
By question, $x + y = 7$ ..... (1) and $xy = 12$ ..... (2)
From equation (2), Putting $y = \frac{12}{x}$ in equation (1)

$x + \frac{12}{x} = 7$ or, $\frac{x^2 + 12}{x} = 7$
or, $x^2 + 12 = 7x$ or, $x^2 - 7x + 12 = 0$
or, $x^2 - 4x - 3x + 12 = 0$ or, $x(x - 4) - 3(x - 4) = 0$
or, $(x - 4)(x - 3) = 0$ $\therefore$ $x = 4$ or $x = 3$

If $x = 4$, from equation (2), we have, $4 \times y = 12$ $\therefore$ $y = \frac{12}{4} = 3$

If $x = 3$, from equation (2), we have, $3 \times y = 12$ $\therefore$ $y = \frac{12}{3} = 4$

Therefore, if $x = 4$ and $y = 3$; The required number $= 10x + y = 10 \times 4 + 3 = 43$
Again if $x = 3$ and $y = 4$; The required number $= 10x + y = 10 \times 3 + 4 = 34$
Thus, the required two digit numbers are 34 and 43.

19. दुई अङ्कको सङ्ख्यामा त्यसका अङ्कहरूको गुणनफल 14 छ र त्यो सङ्ख्यामा 45 घटाउँदा त्यसको विपरीत सङ्ख्या बन्दछ भने सो सङ्ख्या कति थियो ? पत्ता लगाउनुहोस् ।
In two digits number, the product of two digits is 14 and if 45 is subtracted from the number, the number will be reversed. What was the number ? Find it. [2059 B2]

⇨ Here, suppose, two digit number $= 10x + y$
By the question, $xy = 14$ ..... (1)
or, $10x + y - 45 - 10y - x = 0$
or, $9(x - y) = 45$
$\therefore$ $x - y = 5$ ..... (2)
Again, $10x + y - 45 = 10y + x$
or, $9x - 9y - 45 = 0$
or, $x - y = \frac{45}{9}$

Putting, $y = \frac{14}{x}$ from equation (1) in the equation (2)

$x - \frac{14}{x} = 5$ or, $\frac{x^2 - 14}{x} = 5$
or, $x^2 - 14 = 5x$ or, $x^2 - 5x - 14 = 0$
or, $x^2 - 7x + 2x - 14 = 0$ or, $x(x - 7) + 2(x - 7) = 0$
or, $(x - 7)(x + 2) = 0$ $\therefore$ $x = 7$ and $x = -2$

Then taking positive value $x = 7$ and $y = \frac{14}{7} = 2$.

$\therefore$ $10x + y = 10 \times 7 + 2 = 70 + 2 = 72$
Thus, the required number is 72.

20. दुई अङ्कको एउटा सङ्ख्यामा अङ्कहरूको गुणनफल 18 छ । उक्त सङ्ख्याबाट 63 घटाउँदा सो सङ्ख्याका अङ्कहरू बदलिन्छन् भने त्यो सङ्ख्या पत्ता लगाउनुहोस् ।
A number consists of two digits whose product is 18. If 63 is subtracted from the number, the digits are interchanged. Find the number. [2061 B1, 2062 C2]

⇨ Here, let, $10x + y$ be two digits number
Now, $xy + 18$ ..... (i)
or, $10x + y - 10y - x = 63$
or, $x - y = \frac{63}{9}$
and $10x + y - 63 = 10y + x$
or, $9x - 9y = 63$
$\therefore$ $x - y = 7$ ..... (ii)

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Putting $y = \frac{18}{x}$ from (i), in (ii), we get $x - \frac{18}{x} = 7$

or, $x^2 - 18 = 7x$ or, $x^2 - 7x - 18 = 0$
or, $x^2 - 9x + 2x - 18 = 0$ or, $x(x - 9) + 2(x - 9) = 0$
or, $(x - 9)(x + 2) = 0$ Either, $x - 9 = 0$ $\therefore$ $x = 9$
or, $x + 2 = 0$ $\therefore$ $x = -2$
Taking positive value only

When $x = 9$, from (i), we have, $y = \frac{18}{9} = 2$

Thus, the required number $= 10x + y = 10 \times 9 + 2 = 92$

21. दुई अङ्कको एउटा सङ्ख्याका अङ्कहरूको गुणनफल 8 छ । त्यस सङ्ख्यामा 18 थप्दा सो सङ्ख्याका अङ्कहरूको स्थान बदलिन्छ भने सङ्ख्या पत्ता लगाउनुहोस् ।
A two digit number is such that the product of the digits is 8. When 18 is added to the number the digits interchange their places. **[2062 C1]**

⇨ Here, let, two digit number $= 10x + y$
Here, $xy = 8$ ..... (i) Again, $10x + y + 18 = 10y + x$
or, $10x + y + 18 - 10y - x = 0$ or, $9x - 9y = -18$
or, $x - y = -2$ ..... (ii)
We know that, $(x + y)^2 = (x - y)^2 + 4xy = (-2)^2 + 4.8 = 4 + 32 = 36$
$\therefore$ $x + y = \sqrt{36} = 6$ ..... (iii)

Now adding eq^n (ii) and (iii), we get,
$x - y = -2$
$x + y = 6$
$2x = 4$ $\therefore$ $x = 2$
Again, Putting the value of x in (iii) we get
$2 + y = 6$ or, $y = 6 - 2$ $\therefore$ $y = 4$
Thus, the required two digit number is $10x + y = 10.\ 2 + 4 = 24$

22. दुई अङ्कले बनेको एउटा धनात्मक सङ्ख्यामा दशको स्थानमा पर्ने अङ्क एकको स्थानमा पर्ने अङ्क भन्दा 5 ले बढी छ । यदि ती दुई अङ्कहरूको गुणनफल 36 छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
In a positive number of two digits, the ten's place digit exceeds the unit place digit by 5. If the product of the digits is 36, find the number. **[2068 D]**

⇨ Here, let, the two digits number is $10x + y$.
First case: $x = y + 5$ ..... (i)
Second case: $xy = 36$ or, $(y + 5)\, y = 36$
or, $y^2 + 5y - 36 = 0$ or, $y^2 + 9y - 4y - 36 = 0$
or, $y(y + 9) - 4(y + 9) = 0$ or, $(y - 4)(y + 9) = 0$
Either, $y - 4 = 0$ or, $y + 9 = 0$
$\therefore$ $y = 4$ or, $y = -9$ (impossible)
Putting the value of y in equation (i)
$x = y + 5$ or, $x = 4 + 5$
$\therefore$ $x = 9$
Now, two digits number $= 10x + y = 10 \times 9 + 4 = 94$
Thus, the two digits number is 94.

23. दुई अङ्कले बनेको एउटा प्राकृतिक सङ्ख्यामा एकको स्थानमा पर्ने अङ्क, दशको स्थानमा पर्ने अङ्क भन्दा 4 ले बढी छ । यदि ती दुई अङ्कहरूको गुणनफल 21 छ भने सो सङ्ख्या पत्ता लगाउनुहोस् ।
In a two digits natural number, the digit at unit place is 4 more than that of the digit at ten's place. If the product of the digits is 21, find the number. **[2068 E]**

⇨ Here, let, the two digits number be $10x + y$
First case: $y = x + 4$ ..... (i)
Second case: $xy = 21$ or, $x(x + 4) = 21$
or, $x^2 + 4x - 21 = 0$ or, $x^2 + 7x - 3x - 21 = 0$
or, $x(x + 7) - 3(x + 7) = 0$ or, $(x + 7)(x - 3) = 0$
Either, $x + 7 = 0$ or, $x - 3 = 0$
$\therefore$ $x = -7$ (Impossible) $\therefore$ $x = 3$
From (i) $y = x + 4$ $\therefore$ $y = 3 + 4 = 7$
Thus, the two digits number $= 10x + y = 10 \times\ 3 + 7 = 30 + 7 = 37$

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24. दुई अङ्कको एउटा सङ्ख्या त्यसका अङ्कहरूको योगको चारगुणा छ। यदि अङ्कहरूको गुणनफल 18 भए त्यो सङ्ख्या पत्ता लगाउनुहोस्।
A number of two digits is equal to four times the sum of the digits. If the product of the digits is 18, find the number. **[2061 D1]**

⇨ Here, let, $10x + y$ be the two digits number such that

$10x + y = 4(x + y)$ or, $10x + y - 4x - 4y = 0$

or, $6x - 3y = 0$ or, $2x - y = 0$ ..... (1)

and $xy = 18$ or, $y = \frac{18}{x}$ ..... (2)

Putting the value of y in (1), we get

$2x - \frac{18}{x} = 0$ or, $2x^2 - 18 = 0$

or, $x^2 = \frac{18}{2}$ or, $x^2 = 9$

or, $x^2 = 3^2$ $\therefore$ $x = 3$ (Taking positive value only)

From (1), $2 \times 3 - y = 0$ $\therefore$ $y = 6$

Thus, the required number $= 10x + y = 10 \times 3 + 6 = 36$

25. दुई अङ्कले बनेको एक सङ्ख्या त्यसका अङ्कहरूको योगफलको 4 गुणा र गुणनफलको 3 गुणा छ भने त्यो सङ्ख्या पत्ता लगाउनुहोस्। **[2067 E]**
A two digit number is four times the sum and three times the product of its digits. Find the number.

⇨ Here, let, the two digit number be $10x + y$.

First case;

$10x + y = 4(x + y)$ or, $10x + y = 4x + 4y$

or, $6x = 3y$ $\therefore$ $y = 2x$

From the second condition,

$10x + y = 3xy$ or, $10x + 2x = 3x \times 2x$

or, $12x = 6x^2$ or, $x^2 = 2x$

or, $x^2 - 2x = 0$ or, $x(x - 2) = 0$

$\therefore$ $x = 2$

When $x = 2$ then $y = 2x = 2 \times 2 = 4$

Now, the two digit number $= 10x + y = 10 \times 2 + 4 = 24$

Thus, the two digit number is 24.

26. 10 र 100 को बिचमा पर्ने एउटा सङ्ख्या यसका अङ्कहरूको योगफलको चारगुणा छ। यदि दुई अङ्कहरूको गुणनफल 8 छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस्।
A number between 10 and 100 is four times the sum of its digits. If the product of two digits is 8, find the number. **[2072 W]**

⇨ Here, let, x and y be the digits in ten's place and y the digit in unit place.

Then, the number $= 10x + y$

First case: $10x + y = 4(x + y)$ or, $6x - 3y = 0$

$\therefore$ $y = 2x$ ..... (i)

Second case: $xy = 8$ or, $x(2x) = 8$

or, $2x^2 = 8$ $\therefore$ $x = 2$

From (i), $y = 2x = 2 \times 2 = 4$

Now, the number $= 10x + y = 10 \times 2 + 4 = 24$

Thus, the required no. is 24.

Model 7

27. एउटा समकोण त्रिभुजका समकोण बनाउने भुजाहरू त्यसको कर्णभन्दा 5 से.मि. र 10 से.मि. ले क्रमशः कम छन् भने त्रिभुजका भुजाहरूको लम्बाइ पत्ता लगाउनुहोस्।
The sides of a right angled triangle containing the right angle are less than its hypotenuse by 5 cm and 10 cm respectively. Find the lengths of the sides of the triangle. **[2063 E1]**

⇨ Here, let, p and b be the sides of a right angled triangle containing the right angle. Let, h be the hypotenuse of the triangle.

By question, $p = h - 5$ cm and $b = h - 10$ cm

By Pythagoras theorem, $h^2 = p^2 + b^2$ or, $h^2 = (h - 5)^2 + (h - 10)^2$

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or, $h^2 = h^2 - 10h + 25 + h^2 - 20h + 100$ or, $h^2 = 2h^2 - 30h + 125$

or, $2h^2 - 30h + 125 - h^2 = 0$ or, $h^2 - 30h + 125 = 0$

or, $h^2 - 25h - 5h + 125 = 0$ or, $h(h - 25) - 5(h - 25) = 0$

or, $(h - 25)(h - 5) = 0$

Either, $h - 25 = 0$ or, $h - 5 = 0$

$\therefore$ $h = 25$ $\therefore$ $h = 5$

When $h = 5$, then $b = 5 - 10 = -5$ which is impossible, since side of a triangle can not be negative.

Therefore, $h = 25$ is only the possible value.

$\therefore$ $p = 25$ cm $- 5$ cm $= 20$ cm and $b = 25$ cm $- 10$ cm $= 15$ cm

Thus, sides of the required triangle are 25 cm, 20 cm and 15 cm respectively.

Model 8

28. एउटा कोठाको लम्बाइ त्यस कोठाको चौडाइभन्दा 2 मि. लामो छ। यदि कोठाको क्षेत्रफल 63 वर्ग मि. छ भने कोठाको लम्बाइ र चौडाइ पत्ता लगाउनुहोस्।

The length of a room is 2 m longer than its breadth. If the area of the room is 63 sq.m., calculate the length and breadth of the room. **[2059 C1]**

⇨ Here, suppose, breadth (b) of room = x m

Length (ℓ) of room = $(x + 2)$ m Area of room (A) = $63\ m^2$

By formula, $A = \ell \times b$ or, $63 = (x + 2)\,x$

or, $63 = x^2 + 2x$ or, $x^2 + 2x - 63 = 0$

or, $x^2 + 9x - 7x - 63 = 0$ or, $x(x + 9) - 7(x + 9) = 0$

or, $(x + 9)(x - 7) = 0$ $\therefore$ $x = 7$ and $x = -9$

But the breadth of a room can not be negative. Therefore, $x = -9$ is impossible.

$\therefore$ breadth (b) = x m = 7 m

length (ℓ) = x + 2 m = (7 + 2) m = 9 m

Thus, length and breadth are 7 m and 9 m respectively.

29. यदि एउटा आयताकार चोकको क्षेत्रफल 63 वर्ग मि. र परिमिति 32 मिटर छ, लम्बाइ र चौडाइ पत्ता लगाउनुहोस्।

If the area of a rectangular courtyard is 63 square m and perimeter 32 m, find the length and breadth of the courtyard. **[2059 D2, 2064 E2]**

⇨ Here, suppose, ℓ and b be the length and breadth of the rectangular courtyard respectively.

Then, area of courtyard = $\ell \times b$

or, $63\ m^2 = \ell\, b$ $\therefore$ $\ell\, b = 63\ m^2$ ..... (1)

Perimeter of courtyard = $2(\ell + b)$ or, $32\ m = 2(\ell + b)$

or, $\ell + b = \frac{32}{2}\ m$ $\therefore$ $\ell + b = 16$ m ..... (2)

We know that, $\ell - b = \sqrt{(\ell + b)^2 - 4\ell b} = \sqrt{(16\ m)^2 - 4 \times 63\ m^2} = \sqrt{4\ m^2} = 2$ m

$\therefore$ $\ell - b = 2$ m .....(3)

Adding equations (2) and (3),

$\ell + b = 16$ m

$\ell - b = 2$ m

$2\ell = 18$ m $\therefore$ $\ell = \frac{18}{2}\ m = 9$ m

Putting the value of ℓ in equation (2), $9\ m + b = 16\ m$

$\therefore$ $b = 16\ m - 9\ m = 7$ m

Thus, length = 9 m and breadth = 7 m

30. दुई अङ्कले बनेको एउटा सङ्ख्यामा अङ्कहरूको योग 10 छ। यदि उक्त सङ्ख्यामा 36 जोड्दा उक्त अङ्कहरूको स्थान बदलिन्छ भने सो सङ्ख्या पत्ता लगाउनुहोस्।

In a number consisting of two digits, the sum of the digits is 10. If 36 is added to the number, the place of the digits interchanged. Find the original number. **[SLC 2065 E]**

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⇨ Here, let, the two digit number be $10x + y$. Then, $x + y = 10$ ..... (i)
By the second condition, $10x + y + 36 = 10y + x$ or, $9x - 9y = -36$
$\therefore \quad x - y = -4$ ..... (ii)
Solving equation (i) and (ii) then,
$x + y = 10$
$x - y = -4$
$2x = 6 \quad \therefore \quad x = 3$
Putting the value of x in (i) then,
$x + y = 10$ or, $3 + y = 10 \quad \therefore \quad y = 7$
Now, the number $= 10x + y = 10 \times 3 + 7 = 37$ Thus, the number is 37.

31. दुई दिदी-बहिनीको उमेरको अन्तर 5 वर्ष छ र तिनीहरूको उमेरको गुणनफल 204 हुन्छ भने ती दुई दिदी-बहिनीको उमेर पत्ता लगाउनुहोस् ।
The difference of the ages of two sisters is 5 years and the product of their ages is 204. Calculate the ages of the two sisters. [2060 D2]

⇨ Here, let, x and y be the ages of two sisters such that
$x - y = 5$ ..... (i) $xy = 204$ ..... (ii)
We have, an identity, $x + y = \sqrt{(x-y)^2 + 4xy} = \sqrt{5^2 + 4 \times 204} = \sqrt{25 + 816} = \sqrt{841}$
$\therefore \quad x + y = 29$ ..... (iii)
Adding equations (i) and (iii), we have
$x - y = 5$
$x + y = 29$
$2x = 34 \quad \therefore \quad x = \frac{34}{2} = 17$
Putting the value of x in (i), we get $17 - y = 5$
or, $17 - 5 = y$ or, $y = 12$
Thus, the required ages are 12 yrs and 17 yrs

32. एउटा आयतको लम्बाइ सो आयतको चौडाइभन्दा 3 से. मि. बढी छ । यदि सो आयतको क्षेत्रफल 88 वर्ग से. मि. छ भने सो आयतको परिमिति पत्ता लगाउनुहोस् । (The length of a rectangle is 3 cm more than its breadth. If the area of the rectangle is 88 cm^2, find its perimeter.) [2062 D2]

⇨ Here, let, the breadth of rectangle (b) = x cm and length of the rectangle (ℓ) = (x + 3) cm.
We have, the area of rectangle is (A) = 88 cm^2
Now, we know that, Area of rectangle (A) $= \ell \times b$
or, $88\ cm^2 = x\ cm \times (x + 3)\ cm$ or, $88\ cm^2 = (x^2 + 3x)\ cm^2$
or, $x^2 + 3x - 88 = 0$ or, $x^2 + 11x - 8x - 88 = 0$
or, $x(x + 11) - 8(x + 11) = 0$ or, $(x - 8)(x + 11) = 0$
So, either, $x = 8$ or $x = -11$ Since, length is always positive, we neglect $x = -11$
$\therefore$ The breadth of rectangle (b) = 8 cm.
$\therefore$ The Length of rectangle (ℓ) $= x + 3 = 11$cm.
We know, $P = 2(\ell + b) = 2(11cm + 8\ cm) = 2 \times 19\ cm = 38\ cm$
Thus, perimeter is 38 cm.

33. यदि एउटा आयताकार जग्गाको क्षेत्रफल 660 वर्ग मि. र यसको परिमिति 104 मिटर छ भने लम्बाइ र चौडाइ पत्ता लगाउनुहोस् । [2061 E1]
Find the length and breadth of the rectangular plot whose area is 660 sq.m and its perimeter is 104 m.

⇨ Here, suppose, length (ℓ) = x and breadth (b) = y
Here, area $= \ell \times b$ or, $660 = xy$ $\therefore \quad y = \frac{660}{x}$ ..... (1)
Again, perimeter $p = 2(\ell + b)$ or, $104 = 2(x + y)$
or, $\frac{104}{2} = x + y$ or, $52 = x + y$ ..... (2)
Putting the value y from (1) in (2), we get,
$52 = x + \frac{660}{x}$ or, $52x = x^2 + 660$
or, $x^2 - 52x + 660 = 0$ or, $x^2 - 30x - 22x + 660 = 0$
or, $x(x - 30) - 22(x - 30) = 0$ or, $(x - 30)(x - 22) = 0$
$\therefore \quad x = 30$ or, $x = 22$
When x = 30, from (2), we have
$52 = 30 + y \quad \therefore \quad y = 52 - 30 = 22$
Thus, breadth = 22 or 30.

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34. एउटा आयाताकार ट्याङ्कीको उचाइ 2 मी. छ र यसको लम्बाइ चौडाइभन्दा 3 मि. ले बढी छ। यदि उक्त ट्याङ्कीमा 80 घ.मि. पानी अटाउँछ भने उक्त ट्याङ्कीको लम्बाइ र चौडाइ पत्ता लगाउनुहोस् ।
The height of a tank is 2 m and its length is 3 m more than its breadth. If 80 cu. m of water can be stored in the tank, find the length and breadth of the tank. [2067 A]

⇨ Here, let, breadth of the tank (ℓ) = x m then
Length of the tank (b) = (x + 3) m
Height of the tank (h) = 2 m
We know that, Volume (V) = 80
or, $\ell \times b \times h = 80$ or, $x(x + 3)\, 2 = 80$
or, $2x^2 + 6x - 80 = 0$ or, $x^2 + 3x - 40 = 0$
or, $x^2 + 8x - 5x - 40 = 0$ or, $x(x + 8) - 5(x + 8) = 0$
or, $(x - 5)(x + 8) = 0$
Either, $x - 5 = 0 \Rightarrow x = 5$
or, $x + 8 = 0 \Rightarrow x = -8$ (Impossible)
Now, breadth of the tank = x m = 5 m
Length of the tank = (x + 3) m = (5 + 3) m = 8 m
Thus, the length and breadth of the tank are 8 m and 5 m.

B. QUESTIONS FROM CDC TEXT BOOK

1A. यदि एउटा सङ्ख्याको वर्गबाट 4 घटाउँदा 21 बाँकी रहन्छ भने उक्त सङ्ख्या कति होला ? पत्ता लगाउनुहोस् ।
If 4 is subtracted from the square of a number, the result is 21. Find the numbers. [2066 D]

⇨ Here, let, the number be x, then,
$x^2 - 4 = 21$ or, $x^2 = 25$ $\therefore$ $x = \pm 5$
Thus, the numbers are ± 5.

1B. यदि एउटा सङ्ख्याको वर्गमा 18 जोड्दा 214 हुन्छ भने सो सङ्ख्या कति होला ? पत्ता लगाउनुहोस् ।
If 18 is added to the square of a number then the result is 214. Find the number.

⇨ Here, let, the number be x then,
$x^2 + 18 = 214$ or, $x^2 = 196$
$\therefore$ $x = \pm 14$
Thus, the number is ± 14.

1C. यदि एउटा सङ्ख्या र त्यसैको व्युत्क्रमको योगफल $\frac{37}{6}$ छ भने उक्त सङ्ख्या पत्ता लगाउनुहोस् ।
If sum of a number and its reciprocal is $\frac{37}{6}$, find the number.

⇨ Here, let, the number be x then,
$x + \frac{1}{x} = \frac{37}{6}$ or, $\frac{x^2 + 1}{x} = \frac{37}{6}$
or, $6x^2 + 6 = 37x$ or, $6x^2 - 37x + 6 = 0$
or, $6x^2 - 36x - x + 6 = 0$ or, $6x(x - 6) - 1(x - 6) = 0$
or, $(x - 6)(6x - 1) = 0$
Either, $x - 6 = 0$ or, $6x - 1 = 0$
$\therefore$ $x = 6$ or, $6x = 1$
Thus, the number is 6 or $\frac{1}{6}$. $\therefore$ $x = \frac{1}{6}$

2A. कुनै दुईओटा क्रमागत जोर सङ्ख्याहरूको गुणनफल 1056 हुन्छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The product of two consecutive numbers 1056. Find the numbers.

⇨ Here, let, the numbers be x and x + 2.
Then, $x(x + 1) = 1056$ or, $x^2 + x - 1056 = 0$
or, $x^2 + 33x - 32x - 1056 = 0$ or, $x(x + 33) - 32(x + 33) = 0$
or, $(x + 33)(x - 32) = 0$
Either, $x + 33 = 0$ or, $x - 32 = 0$
$\therefore$ $x = 32$
Thus, the numbers are 32 and 33.

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2B. दुई ओटा क्रमागत सङ्ख्याहरूको वर्गको योगफल 340 हुन्छ भने ती सङ्ख्याहरू पत्ता लगाउनुहोस् ।
The sum of two consecutive even numbers is 340, find the numbers.

⇨ Here, let, the two consecutive even numbers be x and x + 2.

Then, $x^2 + (x+2)^2 = 340$ or, $x^2 + x^2 + 4x + 4 = 340$
or, $2x^2 + 4x - 336 = 0$ or, $x^2 + 2x - 168 = 0$
or, $x^2 + 14x - 12x - 168 = 0$ or, $x^2 + 14x - 12x - 168 = 0$
or, $x(x+14) - 12(x+14) = 0$ or, $(x+14)(x-12) = 0$
Either, $x + 14 = 0$ or, $x - 12 = 0$
$\therefore \quad x = 12$

Thus, the two numbers are 12 and 14.

3A. दुई अङ्कले बनेको एउटा सङ्ख्यामा एकको स्थानमा पर्ने अङ्क दसको स्थानको अङ्क भन्दा 4 ले बढी छ । यदि दुई अङ्कहरूको गुणनफल 21 छ भने सो सङ्ख्या कति हुन्छ ? पत्ता लगाउनुहोस् ।
In a two digits natural number, the digit at unit place is 4 more than that of the digit at ten's place. If the product of the digits is 21, find the number. **[2068 E]**

⇨ Here, let, the two digits number be 10x + y
First case: $y = x + 4$ ..... (i)
Second case: $xy = 21$ or, $x(x+4) = 21$
or, $x^2 + 4x - 21 = 0$ or, $x^2 + 7x - 3x - 21 = 0$
or, $x(x+7) - 3(x+7) = 0$ or, $(x+7)(x-3) = 0$
Either, $x + 7 = 0$ or, $x - 3 = 0$
$\therefore \quad x = -7$ (Impossible) $\therefore \quad x = 3$
From (i) $y = x + 4$ $\therefore \quad y = 3 + 4 = 7$
Thus, the two digits number $= 10x + y = 10 \times 3 + 7 = 30 + 7 = 37$

3B. अङ्कहरूको योगफलको चार गुणा भएको दुई अङ्कको एउटा सङ्ख्या छ, यदि अङ्कहरूको गुणन फल 18 भए त्यो सङ्ख्या कति हुन्छ ? पत्ता लगाउनुहोस् ।
A number of two digits is equal to four times the sum of the digits. If the product of the digits is 18, find the number. **[2061 D1]**

⇨ Here, let, 10x + y be the two digits number such that
$10x + y = 4(x + y)$ or, $10x + y - 4x - 4y = 0$
or, $6x - 3y = 0$ or, $2x - y = 0$ ..... (1)
and $xy = 18$ or, $y = \frac{18}{x}$ ..... (2)

Putting the value of y in (1), we get
$2x - \frac{18}{x} = 0$ or, $2x^2 - 18 = 0$
or, $x^2 = \frac{18}{2}$ or, $x^2 = 9$
or, $x^2 = 3^2$ $\therefore \quad x = 3$ (Taking positive value only)
From (1), $2 \times 3 - y = 0$ $\therefore \quad y = 6$
Thus, the required number $= 10x + y = 10 \times 3 + 6 = 36$

4A. दुई जना दाजु र भाइको हालको उमेरको योगफल 34 वर्ष र उनीहरूको उमेरको गुणन फल 288 छ भने तिनीहरूको हालको उमेर कति हुन्छ ? पत्ता लगाउनुहोस् ।
The sum of present ages of two brothers is 34 years and the product of their ages is 288. What are their present ages ?

⇨ Here, let, the present ages of two brothers be x years and y years respectively.

First case: $x + y = 34$ ..... (i)
Second case: $xy = 288$
We have, $x - y = \sqrt{(x+y)^2 - 4xy}$
$= \sqrt{34^2 - 4 \times 288}$
$\therefore \quad x - y = 2$ ..... (ii)

Solving equation (i) and (ii) then,
$x + y = 34$
$x - y = 2$
$2y = 32$
$\therefore \quad y = 16$
From (i), $x + y = 34$
or, $x + 16 = 34$
$\therefore \quad x = 18$

Thus, the ages are 18 yrs and 16 yrs.

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4B. बाबु र छोराको हालको उमेर क्रमशः 42 वर्ष र 16 वर्ष छ। कति वर्ष अघि तिनीहरूको उमेरको गुणनफल 272 थियो होला ? पत्ता लगाउनुहोस्।

The present ages of a father and his son are 42 years and 16 years respectively. Find how many years ago the product of their ages was 192 ? [2064 A1]

⇨ Here, let, x years ago the product of ages was 192.
Present ages of father = 42 yrs
Age of father x years ago = (42 – x) yrs
Present ages of son = 16 years
Age of son x years ago = (16 – x) years
By the questions, (42 – x) (16 – x) = 192
or, $672 - 16x - 42x + x^2 = 192$ or, $x^2 - 58x + 672 = 192$
or, $x^2 - 58x + 480 = 0$ or, $x^2 - 48x - 10x + 480 = 0$
or, $x(x - 48) - 10(x - 48) = 0$ or, $(x - 48)(x - 10) = 0$
Either, $x - 48 = 0$ $\therefore$ $x = 48$ (Impossible)
or, $x - 10 = 0$ $\therefore$ $x = 10$
Thus, 10 years ago the product of their ages was 192.

4C. दुई जना साथीहरूको अहिलेको उमेर 32 वर्ष र 35 वर्ष छ। कति वर्षपछि तिनीहरूको उमेरको गुणन फल 1404 हुन्छ ? पत्ता लगाउनुहोस्।

The present ages of two friends are 32 yrs and 35 yrs. How many years later the product of their ages will be 1404 ? Find it.

⇨ Here, let, x years later their product of ages will be 1404.
By the question, $(32 + x)(35 + x) = 1404$ or, $1120 + 32x + 35x + x^2 = 1404$
or, $x^2 + 67x - 284 = 0$ or, $x^2 + 71x - 4x - 284 = 0$
or, $x(x + 71) - 4(x + 71) = 0$ or, $(x + 71)(x - 4) = 0$
Either, $x + 71 = 0$ or, $x - 4 = 0$
$\therefore$ $x = 4$
Thus, the required time is 4 year.

5A. एउटा समकोणी त्रिभुजको कर्ण 13 मिटर छ। यदि बाँकी दुई भुजाहरूको नापको फरक 7 मिटर भए बाँकी भुजाहरूको लम्बाइ पत्ता लगाउनुहोस्।

The hypotenuse of a right angled triangle is 13 m. If the difference between two sides is 7 m, find the length of the remaining sides.

⇨ Here, let, the two sides are x and y. Then, $x - y = 7$ $\therefore$ $x = 7 + y$ ..... (i)
We have, $x^2 + y^2 = h^2$ or, $(7 + y)^2 + y^2 = 13^2$
or, $49 + 14y + y^2 + y^2 = 169$ or, $2y^2 + 14y - 120 = 0$
or, $y^2 + 7y - 60 = 0$ or, $y^2 + 12y - 5y - 60 = 0$
or, $y(y + 12) - 5(y + 12) = 0$ or, $(y - 5)(y + 12) = 0$
Either, $y - 5 = 0$ or, $y + 12 = 0$
$\therefore$ $y = 5$
Putting $y = 5$ in (i) then, $x = 7 + 5 = 12$
Thus, the remaining sides of right angled triangle are 5 m and 12 m.

5B. एउटा आयताकार जग्गाको क्षेत्रफल 88 वर्ग मिटर र परिमिति 38 मिटर छ। उक्त जग्गाको लम्बाइ र चौडाइ कति हुन्छ ? पत्ता लगाउनुहोस्।

The area of a rectangular land is 88 square metre and perimeter is 38 m. What is the length and breadth of the land ?

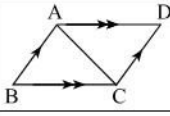
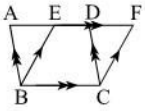
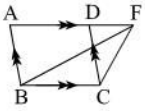
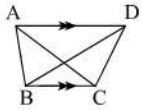
⇨ Here, let, the length and breadth of the land be x m and y m.
Then, case I: Area = 88 or, $\ell \times b = 88$
or, $xy = 88$ ..... (i)
Case II: Perimeter = 38 or, $2(\ell + b) = 38$
or, $2(x + y) = 38$ or, $x + y = 19$
$\therefore$ $x = 19 - y$ ..... (ii)
From (i) and (ii) $(19 - y)y = 88$ or, $19y - y^2 = 88$
or, $y^2 - 19y + 88 = 0$ or, $y^2 - 11y - 8y + 88 = 0$
or, $y(y - 11) - 8(y - 11) = 0$ or, $(y - 11(y - 8) = 0$
Either, $y - 11 = 0$ or, $y - 8 = 0$
$\therefore$ $y = 11$ $\therefore$ $y = 8$
When $y = 11$ then $x = 8$
When $y = 8$ then $x = 11$
Thus, the length and breadth of the room are 11 m and 8 m.

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13. त्रिभुज र चतुर्भुज
Triangle and Quadrilateral

Important Formulae

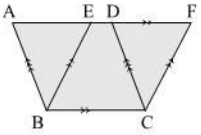
	Figure	Statement	Result
1.		एउटा समानान्तर चतुर्भुजको विकर्णले यसलाई बराबर क्षेत्रफल हुने दुई त्रिभुजहरूमा विभाजन गर्दछ । The diagonal of a parallelogram divides the parallelogram into two equal parts.	Ar.(ΔABC) = Ar.(ΔACD)
2.		एउटै आधार र उही समानान्तर रेखाहरूबिचमा रहेका समानान्तर चतुर्भुजहरूको क्षेत्रफल बराबर हुन्छन् । Parallelograms on the same base and between the same parallels are equal in area.	Ar.(□ABCD) = Ar.(□EBCF)
3.		एउटै आधार र उही समानान्तर रेखाहरूबिच रहेका त्रिभुज र समानान्तर चतुर्भुजमा त्रिभुजको क्षेत्रफल समानान्तर चतुर्भुजको क्षेत्रफलको आधा हुन्छ । If a triangle and a parallelogram are on the same base and between the same parallels, the area of the triangle is equal to half that of the parallelogram.	$\frac{1}{2}$ Ar.(□ABCD) = Ar.(ΔBCF)
4.		एउटै आधार र उही समानान्तर रेखाहरूबिच रहेका त्रिभुजका क्षेत्रफल बराबर हुन्छ । Triangles on the same base and between the same parallels are equal in area.	Ar.(ΔABC) = Ar.(ΔBCD)

13.1 त्रिभुज र चतुर्भुजको क्षेत्रफल [AREA OF TRIANGLE AND QUADRILATERAL]

A. BASIC EXERCISE

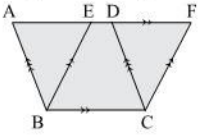
A. VERY SHORT QUESTIONS

1. (a) दिइएको चित्रमा एउटै आधार र उही समानान्तर रेखाहरूबीच रहेका दुई समानान्तर चतुर्भुजहरूको नाम लेख्नुहोस् ।
In the adjoining figure, name two parallelograms which are on the same base and between the same parallel lines.



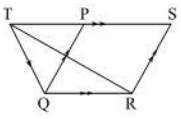
⇨ Here, ABCD and EBCF are the two parallelograms which are on same base BC and between the same parallel lines AF and BC.

(b) यदि समानान्तर चतुर्भुज ABCD को क्षेत्रफल 25 cm² भए समानान्तर चतुर्भुज EBCF को क्षेत्रफल पत्ता लगाउनुहोस् ।
If the area of parallelogram ABCD is 25 cm², find the area of parallelogram EBCF.



⇨ Here, Ar.(□ ABCD) = Ar.(□ EBCF) [//^{gm} between the same base and between the same parallel's]
or, 25 cm² = Ar.(□EBCF)
∴ Area of //^{gm} EBCF = 25 cm²

2. (a) सँगैको चित्रमा एउटै आधार र उही समानान्तर रेखाहरूबीच बनेका त्रिभुज र समानान्तर चतुर्भुजको नाम लेख्नुहोस् ।
In the adjoining figure, name the triangle and parallelogram on the same base and between the same parallels.

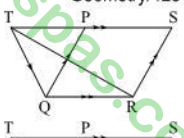


⇨ Here, ΔTQR and //^{gm} PQRS are on the same base QR and between the same parallels TS and QR.

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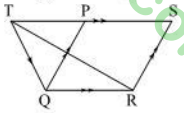
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(b) त्रिभुज TQR र समानान्तर चतुर्भुज PQRS को सम्बन्ध लेख्नुहोस् ।
What is the relation between triangle TQR and parallelogram PQRS?



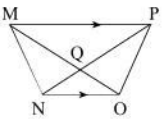
⇨ Here, Area of $\Delta TQR = \frac{1}{2}$ area of $//^{gm}$ PQRS.

(c) यदि त्रिभुज TQR को क्षेत्रफल 15 cm² भए समानान्तर चतुर्भुज PQRS को क्षेत्रफल कति हुन्छ ?
If the area of ΔTQR is 15 cm², what is the area of the parallelogram PQRS?



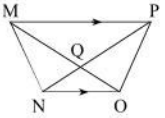
⇨ Here, Area of $//^{gm}$ PQRS = 2 × Area of ΔTQR = 2 × 15 cm² = 30 cm²

3. (a) सँगैको चित्रमा एउटै आधार र उही समानान्तर रेखाहरूबीच बनेका त्रिभुजहरूको नाम लेख्नुहोस् ।
In the adjoining figure, name the triangles on the same base and between the same parallels.



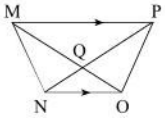
⇨ Here, ΔMNO and ΔPNO are on the same base NO and between the same parallels MP and NO.

(b) यदि ΔMNO को क्षेत्रफल 24 cm² भए ΔPNO को क्षेत्रफल पत्ता लगाउनुहोस् ।
If the area of ΔMNO is 24 cm², find the area of ΔPNO.



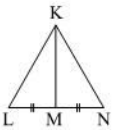
⇨ Here, area of ΔMNO = area of ΔPNO = 24 cm² ∴ Area of ΔPNO = 24 cm²

(c) यदि ΔMNP को क्षेत्रफल 40 cm² भए ΔMOP को क्षेत्रफल पत्ता लगाउनुहोस् ।
If the area of ΔMNP is 40 cm², find the area of ΔMOP.



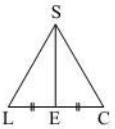
⇨ Here, area of ΔMNP = area of ΔMOP [Δs on the same base and between the same parallels]
∴ Area of ΔMOP = 40 cm²

4. (a) त्रिभुज KLN को भुजा LN को मध्यबिन्दु M हो । यदि ΔKLN को क्षेत्रफल 30 वर्ग से.मि. छ भने; ΔKMN को क्षेत्रफल कति हुन्छ ?
M is the mid-point of LN of ΔKLN. If the area of ΔKLN is 30 cm², what will be the area of ΔKMN?



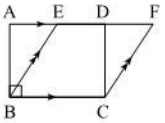
⇨ Here, area of ΔKMN = $\frac{1}{2}$ area of ΔKLN [median KM divides ΔKLN in to 2 equal parts]
Thus, the area of ΔKMN = $\frac{1}{2}$ × 30 = 15 cm²

(b) त्रिभुज SLC को भुजा LC को मध्यबिन्दु E छ । यदि ΔSEC को क्षेत्रफल 20 cm² भए ΔSLC को क्षेत्रफल कति हुन्छ ?
E is the mid-point of LC of ΔSLC. If the area of ΔSEC is 20 cm², what will be the area of ΔSLC?



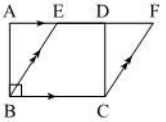
⇨ Here, area of ΔSEC = $\frac{1}{2}$ area of ΔSLC [median SE divides ΔSLC in to 2 equal parts]
or, 20 cm² = $\frac{1}{2}$ × Ar. (ΔSLC) ∴ Area of ΔSLC = 20 × 2 cm² = 40 cm²

5. (a) सँगैको चित्रमा BC // AF छ । यदि समानान्तर चतुर्भुज EBCF को क्षेत्रफल 16 cm² भए आयत ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the adjoining figure, BC // AF. If area of parallelogram EBCF = 16 cm², find the area of rectangle ABCD.



⇨ Here, Area of rectangle ABCD = Ar. (Parm. EBCF)
[∵ Both are on the same base BC and between the same parallels AF and BC.]
∴ Area of rectangle ABCD = 16 cm²

(b) सँगैको चित्रमा BC // AF छ । यदि आयत ABCD को क्षेत्रफल 18 cm² भए समानान्तर चतुर्भुज EBCF को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the adjoining figure, BC // AF. If area of rectangle ABCD = 18 cm², find the area of parallelogram EBCF.



⇨ Here, Area of parm. EBCF = Ar. rectangle ABCD
[∵ Both are on the same base BC and between the same parallels AF and BC.]
∴ Area of parm. EBCF = 18 cm²

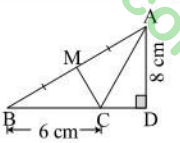
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B. SHORT QUESTIONS

Model 1

1. दिइएको चित्रमा AB को मध्यबिन्दु M हो र AD ⊥ BD छ। यदि BC = 6 से.मि. र AD = 8 से.मि. छन् भने ΔAMC को क्षेत्रफल पत्ता लगाउनुहोस्।
In the given figure, M is the mid-pint of AB and AD ⊥ BD. If BC = 6 cm and AD = 8 cm, find the area of ΔAMC. [2072 E]



⇨ Here, In ΔABC, base (BC) = 6 cm and height (AD) = 8 cm

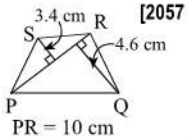
We know that, Ar. (ΔABC) $= \frac{1}{2}$ BC × AD $= \frac{1}{2}$ 6 cm × 8 cm = 24 cm^2

Now, Ar. (ΔAMC) $= \frac{1}{2}$ Ar. (ΔABC) $= \frac{1}{2}$ × 24 cm^2 = 12 cm^2

Thus, the area of ΔAMC is 12 cm^2.

Model 2

2. चतुर्भुज PQRS मा PR = 10 cm, PR मा क्रमशः S र Q बाट खिचिएका लम्बहरूको लम्बाइ 3.4 cm र 4.6 cm भए चतुर्भुज PQRS को क्षेत्रफल पत्ता लगाउनुहोस्।
PQRS is a quadrilateral in which PR = 10 cm, perpendiculars from S and Q on PR are 3.4 cm and 4.6 cm respectively. Calculate the area of the quadrilateral. [2057 C1]

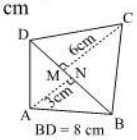


⇨ Here, Area of quadrilateral PQRS

$= \frac{1}{2}$ × PR × (sum of perpendiculars from S and Q upon PR)

$= \frac{1}{2}$ × 10 × (3.4 + 4.6) = 5 × 8 = 40 cm^2

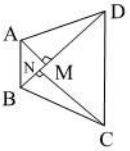
3. दिइएको चतुर्भुज को क्षेत्रफल निकाल्नुहोस्।
Calculate the area of the given quadrilateral. [2057 D1]



⇨ Here, area of given quadrilateral

$= \frac{1}{2}$ (sum of perpendiculars from A and C upon BD) × BD $= \frac{1}{2}$ (3 + 6) × 8 = 9 × 4 = 36 cm^2

4. दिइएको चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् जसमा, AM र CN, BD मा लम्ब छन् र 4 AM = 2CN = BD = 12 cm छ।
Find the area of the given quadrilateral ABCD where AM and CN are perpendiculars to BD and 4AM = 2CN = BD = 12 cm. [2061 A1]



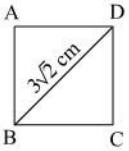
⇨ Here, BD = 12 cm, 4AM = 12 cm

∴ AM $= \frac{12}{4}$ = 3 cm and CN $= \frac{12}{2}$ = 6 cm

∴ Area of quad. ABCD $= \frac{1}{2}$ × BD × (AM + CN) $= \frac{1}{2}$ × 12 × (3 + 6) cm^2 = 6 × 9 cm^2 = 54 cm^2

Model 3

5. दिइएको चित्रमा ABCD वर्ग हो। यदि विकर्ण BD = $3\sqrt{2}$ से.मि. भए ABCD को क्षेत्रफल पत्ता लगाउनुहोस्।
In the given figure, ABCD is a square. If diagonal BD = $3\sqrt{2}$ cm, find the area of ABCD. [2060 A1]



⇨ Here, if a be the side of the square ABCD, then area of ABCD = a^2 = ?

BD^2 = BC^2 + CD^2 or, $(3\sqrt{2}$ cm$)^2 = a^2 + a^2$

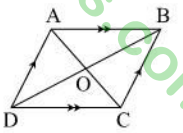
or, 18cm^2 = 2a^2 ∴ a^2 $= \frac{18}{2}$ cm^2 = 9cm^2

∴ Area of ABCD = a^2 = 9cm^2

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Model 4

6. सँगैको चित्रमा, समानान्तर चतुर्भुज ABCD को क्षेत्रफल 60 वर्ग से.मि. छ । ΔADC र ΔCOD को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the adjoining figure, area of a parallelogram ABCD is 60 sq. cm. Find the area of ΔADC and ΔCOD. **[2071 S]**



⇨ Here, Ar. (Parm. ABCD) = 60 cm²

(i) Area of ΔADC = $\frac{1}{2}$ Ar. (Parm. ABCD) [Being AC is the diagonal of parallelogram]

= $\frac{1}{2} \times 60$ cm²

∴ Area of ΔADC = 30 cm²

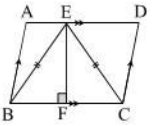
(ii) Area of ΔCOD = $\frac{1}{2}$ Area of ΔADC [Being DO is the median of ΔADC]

= $\frac{1}{2} \times 30$ cm²

∴ Area of ΔCOD = 15 cm²

Thus, the area of ΔADC and ΔCOD are 30 cm² and 15 cm².

7. दिइएको चित्रमा BE = EC, EF ⊥ BC, BE = 10 से.मि. र AD = 16 से.मि. भए समानान्तर चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।
In the given figure, BE = EC, EF ⊥ BC, BE = 10 cm and AD = 16 cm. Find the area of parallelogram ABCD. **[2071 C]**



⇨ Here, BE = 10 cm and AD = 16 cm

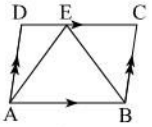
So, BC = AD = 16 cm

We have, EF = $\sqrt{BE^2 - \left(\frac{1}{2}BC\right)^2} = \sqrt{10^2 - \left(\frac{1}{2} \times 16\right)^2} = \sqrt{10^2 - 8^2} = 6$ cm

Now, area of parallelogram = BC × EF = 16 cm × 6 cm = 96 cm²

Thus, the area of parallelogram is 96 cm².

8. दिइएको चित्रमा ABCD एउटा समानान्तर चतुर्भुज हो र DC को मध्यबिन्दु E हो । यदि स.च. ABCD को क्षेत्रफल 24 cm² भए चतुर्भुज ABCE को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, ABCD is a parallelogram and E is the midpoint of DC. If area of the parallelogram ABCD is 24 cm², find the area of quadrilateral ABCE. **[2067 D]**



⇨ Here, (i) Ar. (ΔAEB) = $\frac{1}{2}$ parm. ABCD [Being both are on same base and between the same parallels.]

= $\frac{1}{2} \times 24$ cm² = 12 cm²

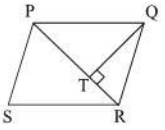
(ii) Ar. (ΔBEC) = $\frac{1}{2}$ (ΔAEB) [Being 2EC = AB and having same height]

= $\frac{1}{2} \times 12$ cm² = 6 cm²

(iii) Quad. ABCE = ΔAEB + ΔBEC = 12 cm² + 6 cm² = 18 cm²

Thus, the area of quad. ABCE is 18 cm².

9. समानान्तर चतुर्भुज PQRS मा QT ⊥ PR छ । यदि त्रिभुज PSR को क्षेत्रफल $16\sqrt{3}$ वर्ग से.मि. र PR = 8 से.मि. भए QT को लम्बाइ पत्ता लगाउनुहोस् ।
In the parallelogram PQRS, QT ⊥ PR. If the area of the triangle PSR is $16\sqrt{3}$ sq cm and PR = 8 cm, find the length of QT. **[2069 E]**



⇨ Here, we have given, Ar (ΔPSR) = $16\sqrt{3}$ cm² and PR = 8 cm

Ar. (ΔPSR) = Ar. (ΔPQR) or, $16\sqrt{3}$ = Ar. (ΔPQR)

or, $16\sqrt{3} = \frac{1}{2}$ PR × QT or, $16\sqrt{3} = \frac{1}{2} \times 8 \times$ QT

∴ QT = $4\sqrt{3}$ cm

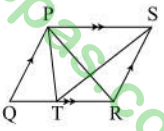
Thus, the length of QT is $4\sqrt{3}$ cm.

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10. समानान्तर चतुर्भुज PQRS मा ΔPTS को क्षेत्रफल 20 वर्ग से.मि. र ΔPTR को क्षेत्रफल 18 वर्ग से.मि. भए ΔPTQ को क्षेत्रफल पत्ता लगाउनुहोस् ।

In a parallelogram, area of ΔPTS = 20 cm² and area of ΔPTR = 18 cm². Find the area of ΔPTQ. **[2071 D]**



⇨ Here, ΔPTS = 20 cm² and ΔPTR = 18 cm²

(i) ΔPRS = ΔPTS (in area) [Being both are on same base and between the same parallels]

∴ ΔPRS = 20 cm²

(ii) ΔPQR = ΔPRS (in area) [Being PR is the diagonal of parallelogram]

∴ ΔPQR = 20 cm²

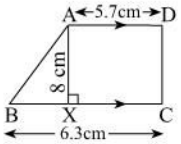
(iii) Area of ΔPQT = Area of (ΔPQR – ΔPTR) = 20 cm² – 18 cm² = 2 cm²

Thus, Area of ΔPQT is 2 cm².

Model 5

11. दिइएको चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।

Calculate the area of the given quadrilateral ABCD. **[2057 C2]**



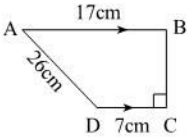
⇨ Here, height = 8 cm and Parallel sides are; 5.7 cm and 6.3 cm

Area of quadrilateral ABCD $= \frac{1}{2} \times$ height (Sum of parallel sides)

$= \frac{1}{2} \times 8$ cm (5.7 cm + 6.3 cm) $= 4$ cm $\times$ 12 cm $= 48$ cm²

12. दिइएको चित्र एउटा समलम्ब चतुर्भुज ABCD को जसमा AB // CD र ∠BCD = 90° छ । यदि CD = 7 से.मि. AB = 17 से.मि. र AD = 26 से.मि. भए समलम्ब चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।

The given figure is a trapezium ABCD in which AB // CD and ∠BCD = 90°. If CD = 7 cm, AB = 17 cm and AD = 26 cm, calculate the area of the trapezium ABCD. **[2061 B1]**



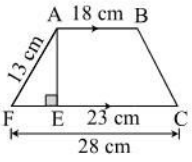
⇨ Here, BC $= \sqrt{26^2 - (17-7)^2} = \sqrt{676 - 100} = \sqrt{576} = 24$ cm

We know that, Area of trapezium ABCD $= \frac{1}{2} \times$ BC $\times$ (AB + CD) $= \frac{1}{2} \times 24$ cm $\times$ (17 cm + 7 cm)

$= 12$ cm $\times 24$ cm $= 288$ cm²

13. दिइएको चित्रमा AB // FC, AB = 18 से.मि., FC = 28 से.मि., EC = 23 से.मि., AF = 13 से.मि., AE ⊥ FC भए चित्र ABCF को क्षेत्रफल पत्ता लगाउनुहोस् ।

In the figure AB // FC, AB = 18 cm, FC = 28 cm, EC = 23 cm, AF = 13 cm and AE ⊥ FC, find the area of figure ABCF. **[2061 C1]**



⇨ Here, EF = 28 cm – 23 cm = 5 cm

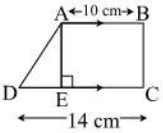
AE $= \sqrt{AF^2 - EF^2} = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = \sqrt{144} = 12$ cm

By formula, Area trapezium ABCF $= \frac{1}{2}$(AB + FC) $\times$ AE $= \frac{1}{2}$(18 cm + 28 cm) $\times$ 12 cm

$= \frac{1}{2} \times 46 \times 12$ cm² $= 276$ cm²

14. दिइएको समलम्ब चतुर्भुज ABCD मा ABCE एउटा आयत हो । यदि AB = 10 से.मि., DC = 14 से.मि., AD = 5 से.मि. भए समलम्ब चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।

In the given trapezium ABCD, ABCE is a rectangle. If AB = 10 cm, DC = 14 cm, AD = 5 cm, find the area of trapezium ABCD. **[2061 D1]**



⇨ Here, DE = DC – EC = DC – AB = (14 – 10) cm = 4 cm

AE $= \sqrt{AD^2 - DE^2} = \sqrt{5^2 - 4^2} = \sqrt{25 - 16} = \sqrt{9} = 3$ cm

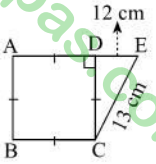
By formula, we have,

Area of trapezium ABCD $= \frac{1}{2} \times$ AE (AB + DC) $= \frac{1}{2} \times 3$ (10 + 14) $= \frac{1}{2} \times 3 \times 24 = 36$ cm²

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15. दिइएको चित्रमा ABCD एउटा वर्ग र ABCE एउटा समलम्ब चतुर्भुज हुन्। यदि $\angle EDC = 90°$, DE = 12 से.मि. र CE = 13 से.मि. भए समलम्ब चतुर्भुज ABCE को क्षेत्रफल पत्ता लगाउनुहोस्।

In the figure, ABCD is a square and ABCE is a trapezium. If $\angle EDC = 90°$, DE = 12 cm and CE = 13 cm; find the area of trapezium ABCE. [2062 C1]



⇨ Here, In rt. angled ΔCDE, $CD = \sqrt{CE^2 - DE^2} = \sqrt{13^2 - 12^2}$ cm $= \sqrt{25} = 5$ cm

$AB = BC = AD = CD$, $BC = AD = 5$ cm

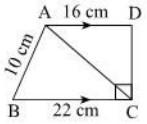
Area of trapezium ABCE $= \frac{1}{2}$ (sum of parallel sides) × height

$= \frac{1}{2}(AE + BC) \times CD = \frac{1}{2}(AD + DE + BC) \times CD$

$= \frac{1}{2}(5\text{ cm} + 12\text{ cm} + 5\text{ cm}) \times 5\text{ cm} = \frac{1}{2}(22\text{ cm}) \times 5\text{ cm} = 55\text{ cm}^2$

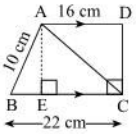
16. दिइएको चित्रमा, ABCD एउटा समलम्ब चतुर्भुज हो। यदि AB = 10 से.मि., AD = 16 से.मि., BC = 22 से.मि., AD // BC र DC ⊥ AD भए त्रिभुज ADC को क्षेत्रफल निकाल्नुहोस्।

In the given figure, ABCD is a trapezium. If AB = 10 cm, BC = 22 cm, AD = 16 cm, AD // BC and DC ⊥ AD, calculate the area of ΔADC. [2065 E]



⇨ Here, draw AE ⊥ BC then, BE = BC − EC = 22 cm − 16 cm = 6 cm

$AE = \sqrt{AB^2 - BE^2} = \sqrt{10^2 - 6^2} = 8$ cm

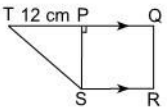


Now, Area of $\Delta ADC = \frac{1}{2} AD \times AE = \frac{1}{2} 16 \times 8$

Thus, Area of $\Delta ADC = 64\text{ cm}^2$

17. सँगै दिइएको चित्रमा PQRS एउटा वर्ग र TQRS एउटा समलम्ब चतुर्भुज हुन्। यदि वर्ग PQRS को क्षेत्रफल 25 cm² र TP = 12 cm भए समलम्ब चतुर्भुज TQRS को क्षेत्रफल निकाल्नुहोस्।

In the adjoining figure, PQRS is a square and TQRS is a trapezium. If the area of the square PQRS is 25 sq.cm and TP = 12 cm, find the area of trapezium TQRS. [2062 C2]



⇨ Here, area of square PQRS = PS^2

or, $25\text{cm}^2 = PS^2$ ∴ $PS = \sqrt{25\text{ cm}^2} = 5$ cm

∴ TQ = TP + PQ = 12 cm + 5 cm = 17 cm and SR = PS = 5 cm

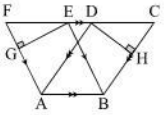
Area of trapezium TQRS $= \frac{1}{2}$ (sum of parallel sides) × height $= \frac{1}{2} \times (TQ + SR) \times PS$

$= \frac{1}{2} \times (17\text{ cm} + 5\text{ cm}) \times 5\text{ cm} = 55\text{ cm}^2$

Model 6

18. दिइएको चित्रमा FC // AB, AD // BC, AF // BE, EG ⊥ AF र DH ⊥ BC छन्। यदि EG = 5 से.मि., AF = 12 से.मि. र BC = 6 से.मि. छन् भने DH को नाप पत्ता लगाउनुहोस्।

In the given figure, FC // AB, AD // BC, AF // BE, EG ⊥ AF and DH ⊥ BC. If EG = 5 cm, AF = 12 cm and BC = 6 cm, find the measurement of DH. [2072 C]



⇨ Here, EG = 5 cm, AF = 12 cm and BC = 6 cm

We know that, Area of □ABEF = area of □ABCD or, AF × GE = BC × DH

or, 12 × 5 = 6 × DH ∴ DH = 10 cm

Thus, the measure of DH is 10 cm.

19. क्षेत्रफल बराबर भएका दुईओटा समानान्तर चतुर्भुजहरूमध्ये एउटाको उचाइ 6 cm र अर्कोको उचाइ 9 cm छ। पहिलो समानान्तर चतुर्भुजको आधारको लम्बाइ 12 cm भए दोस्रोको आधारको लम्बाइ पत्ता लगाउनुहोस्।

The areas of two parallelograms are equal and their altitudes are 6 cm and 9 cm. If the base of the first parallelogram is 12 cm, find the base of the second parallelogram. [2061 E1]

⇨ Here, p_1 = altitude of first parallelogram = 6 cm, b_1 = base of first parallelogram = 12 cm

p_2 = altitude of 2nd parallelogram = 9 cm and b_2 = base of 2nd parallelogram = ?

Here, area of second parm. = Area of first parm.

or, $b_2 \times p_2 = b_1 \times p_1$ or, $b_2 \times 9\text{ cm} = 12\text{ cm} \times 6\text{ cm}$

$\therefore\ b_2 = \frac{12 \times 6\text{ cm}^2}{9\text{ cm}} = 8$ cm

Thus, base of 2nd parallelogram is 8 cm.

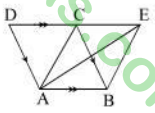
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Model 7

20. दिइएको चित्रमा **ABCD** एउटा समानान्तर चतुर्भुज हो। यदि **ΔABE** को क्षेत्रफल **18** वर्ग से.मि. भए **ΔADC** को क्षेत्रफल कति हुन्छ ? पत्ता लगाउनुहोस् ।

In the given figure, ABCD is a parallelogram, if area of ΔABE is 18 sq. cm then what is the area of ΔADC ? Find it. **[2071 E]**



⇨ Here,

(i) Area of ΔABC = Area of ΔABE [Being both are on same base and between the same parallels.]

∴ Area of ΔABC = 18 cm^2

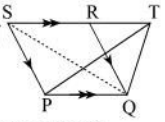
(ii) Area of ΔADC = Area of ΔABC [Being ABCD is a parallelogram]

∴ Area of ΔADC = 18 cm^2

Thus, the area of ΔADC is 18 cm^2.

21. दिइएको चित्रमा समानान्तर चतुर्भुज **PQRS** को क्षेत्रफल **32** cm^2 भए **ΔSPQ** र **ΔPQT** को क्षेत्रफल पत्ता लगाउनुहोस् । **[2068 C]**

In the figure, the area of parallelogram PQRS is 32 cm^2. Find the area of ΔSPQ and ΔPQT.



⇨ Here, (i) Ar. (ΔSPQ) = $\frac{1}{2}$ (Parm. PQRS) [Being both are on the same base and between the same parallels]

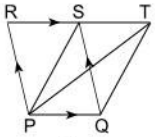
or, Ar. (ΔSPQ) = $\frac{1}{2} \times 32$ ∴ Ar. (ΔSPQ) = 16 cm^2

(ii) Ar. (ΔPQT) = Ar. (ΔPSQ) [Being both are on the same base and between the same parallels]

∴ Ar. (ΔPQT) = 16 cm^2 Thus, the area of ΔPQT is 16 cm^2.

22. चित्रमा समानान्तर चतुर्भुज **PQSR** र त्रिभुज **PQT** एउटै आधार र उही समानान्तर रेखाहरूको बीचमा छन् । यदि **ΔTPQ** को क्षेत्रफल **50 sq. cm** भए **ΔPRS** को क्षेत्रफल निकाल्नुहोस् ।

In the given figure ▱ PQSR and ΔPQT stand same base and same parallel lines. The area of ΔTPQ is 50 cm^2. Find the area of ΔPRS. **[2062 E1]**



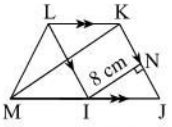
⇨ Here, Area of ΔSPQ = Area of ΔTPQ = 50 cm^2 [∵ Triangles standing on the same base and between same parallels.]

Area of ΔPRS = Area of ΔSPQ [Diagonal SP bisects the, parallelogram PQRS.]

= 50 cm^2

23. दिइएको चित्रमा, **ΔLMK** को क्षेत्रफल **24** cm^2 र **IN = 8 cm** छ भने **IL** को लम्बाइ पत्ता लगाउनुहोस् ।

In the given figure, area of ΔLMK = 24 cm^2 & IN = 8 cm, find the length of IL. **[2068 B]**



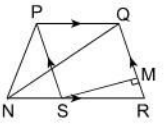
⇨ Here, (i) Ar. (ΔLMK) = $\frac{1}{2}$ Ar. (parm. LIJK) [Being both are on the same base & between same parallels]

or, 24 = $\frac{1}{2} \times$ IL × IN or, 24 = $\frac{1}{2} \times$ IL × 8

∴ IL = 6 Thus, the length of IL is 6 cm

24. सँगैको चित्रमा **PS = 5 cm** र **SM = 8 cm** छन् भने **ΔPQN** को क्षेत्रफल निकाल्नुहोस् ।

In the adjoining figure, PS = 5 cm and SM = 8 cm. Calculate the area of ΔPQN. **[2062 D1, 2066 S]**



⇨ Here, Area of parallelogram PQRS = QR × SM = 5 cm × 8 cm = 40 cm^2

Now, area of ΔPQN = $\frac{1}{2}$ × area of parm. PQRS

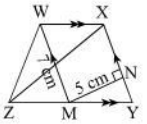
[∵ Being both are on the same base and between the same parallels]

= $\frac{1}{2} \times 40\ cm^2 = 20\ cm^2$

Thus, area of ΔPQN is 20 cm^2.

25. सँगैको चित्रमा **WM // XY, WX // YZ, MN ⊥ XY, WM = 7 cm** र **MN = 5 cm** छ भने **ΔWXZ** को क्षेत्रफल पत्ता लगाउनुहोस् ।

In given figure, WM // XY, WX // YZ, MN ⊥ XY, WM = 7 cm and MN = 5 cm, find the area of ΔWXZ. **[SLC 2066 D]**



⇨ Here, (i) Area of parallelogram WXYM = WM × MN = 7 cm × 5 cm = 35 cm^2

(ii) Area of ΔWXZ = $\frac{1}{2}$ Area of parm. WXYM

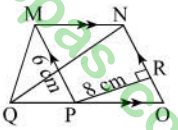
[Being both are on the same base and between the same parallels]

∴ Area of ΔWXZ = $\frac{1}{2} \times 35 = 17.5\ cm^2$

Thus, the area of ΔWXZ is 17.5 cm^2.

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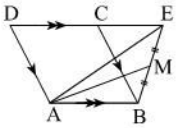
26. सँगैको चित्रमा MP = 6 cm र PR = 8 cm छन् भने ΔMNQ को क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure, MP = 6 cm, and PR = 8 cm. Calculate the area of ΔMNQ. **[SLC 2066 E]**



⇨ Here, MP = 6 cm and PR = 8 cm
(i) Area of parallelogram MNOP = MP × PR = 6 cm × 8 cm = 48 cm^2
(ii) Area of ΔMNQ = $\frac{1}{2}$ Ar. of parm MNOP = $\frac{1}{2}$ × 48 cm^2 = 24 cm^2
[Being both are on the same base and between the same parallels]
Thus, the area of ΔMNQ is 24 cm^2.

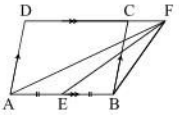
Model 8

27. दिइएको चित्रमा DE // AB, AD // BC र BE को मध्यबिन्दु M छन् । यदि ΔAME को क्षेत्रफल 12 वर्ग से.मि. भए चित्र ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given diagram, DE // AB, AD // BC and M is the middle point of BE. If the area of ΔAME is 12 sq. cm, find the area of figure ABCD. **[2070 C]**



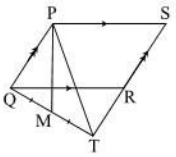
⇨ Here, Ar. (ΔAME) = 12 cm^2
(i) Ar. (ΔABE) = 2 Ar. (ΔAME) = 2× 12 cm^2 = 24 cm^2
(ii) Ar. (▱ABCD) = 2 × Ar. (ΔABE) = 2 × 24 cm^2 = 48 cm^2
Thus, the area of parm. ABCD is 48 cm^2.

28. दिइएको चित्रमा AB को मध्यबिन्दु E हो । यदि ΔEBF को क्षेत्रफल 8 वर्ग से.मि. भए समानान्तर चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, E is the mid-point of AB. If the area of ΔEBF is 8 sq. cm. Find the area of the parallelogram ABCD. **[2072 FW]**



⇨ Here, Ar. (ΔEBF) = 8 cm^2
(i) Ar. (ΔABF) = 2 × Ar. (ΔEBF) = 2 × 8 cm^2 = 16 cm^2
(ii) Ar. (▱ABCD) = 2 Ar. (ΔABF) = 2 × 16 cm^2 = 32 cm^2
Thus, the area of ▱ABCD is 32 cm^2.

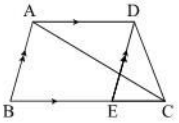
29. दिइएको चित्रमा PS // QR, PQ // ST र QT को मध्यबिन्दु M छन् । यदि ▱PQRS को क्षेत्रफल 60 वर्ग से.मि. छ भने ΔPMT को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, PS // QR, PQ // ST and M is the mid-point of QT. If the area of ▱PQRS is 60 sq. cm, find the area of ΔPMT. **[2072 W]**



⇨ Here, Ar. (▱PQRS) = 60 cm^2
(i) Ar. (ΔPQT) = $\frac{1}{2}$ Ar. (▱PQRS) = $\frac{1}{2}$ × 60 cm^2 = 30 cm^2
(ii) Ar. (ΔPMT) = $\frac{1}{2}$ Area (ΔPQT) = $\frac{1}{2}$ × 30 cm^2 = 15 cm^2
Thus, the area of ΔPMT is 15 cm^2.

Model 9

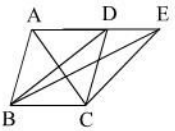
30. दिइएको चित्रमा समलम्ब चतुर्भुज ABCD को क्षेत्रफल 100 वर्ग से.मि. र ΔADC को क्षेत्रफल 40 वर्ग से.मि. छ भने ΔDEC को क्षेत्रफल कति होला ?
In the given figure the area of trapezium ABCD is 100 square cm and area of ΔADC is 40 square cm, what is the area of ΔDEC. **[2067 E]**



⇨ Here, (i) Parm. ABED = 2ΔADC [Being both are on the same base and the same parallels].
∴ Parm. ABED = 2 × 40 cm^2 = 80 cm^2
(ii) ΔDEC = Trapezium ABCD – Parm. ABED = 100 cm^2 – 80 cm^2 = 20 cm^2
Thus, the area of ΔDEC is 20 cm^2.

Model 10

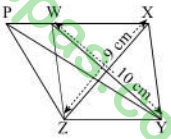
31. चित्रमा ABCD एउटा समबाहु चतुर्भुज हो जसमा विकर्ण AC = 20 cm र विकर्ण BD = 28 cm छ । यदि AD लाई E सम्म लम्ब्याइएको छ भने ΔBCE को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the figure, ABCD is a rhombus in which the diagonal AC = 20 cm and the diagonal BD = 28 cm. If AD is produced to E, find the area of the ΔBCE. **[2065 B]**



⇨ Here, Diagonal (AC) = d_1 = 20 cm and diagonal (BD) = d_2 = 28 cm
We know that, Area of a rhombus ABCD = $\frac{1}{2}d_1 \times d_2 = \frac{1}{2}$ × 20 cm × 28 cm = 280 cm^2
Now, area of ΔBCE = $\frac{1}{2}$ Area of rhombus ABCD = $\frac{1}{2}$ × 280 cm^2 = 140 cm^2

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32. चित्रमा **WXYZ** एउटा समबाहु चतुर्भुज हो जसमा **XW** लाई **P** बिन्दुसम्म बढाइएको छ । **WY = 10** से.मि. र **XZ = 9** से.मि. भए **ΔPYZ** को क्षेत्रफल निकाल्नुहोस् ।



In the figure, WXYZ is a rhombus in which XW is produced to the point P. If WY = 10 cm and XZ = 9 cm, find the area of the ΔPYZ. **[2067 C]**

⇨ Here, in the rhombus WXYZ, $d_1 = WY = 10$ cm and $d_2 = XZ = 9$ cm

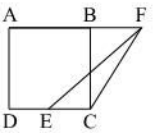
We know that, Area of rhombus $= \frac{1}{2} d_1 \times d_2 = \frac{1}{2} 10 \text{ cm} \times 9 \text{ cm} = 45 \text{ cm}^2$

Now, area of $\Delta PYZ = \frac{1}{2}$ Area of rhombus $WXYZ = \frac{1}{2} \times 45 \text{ cm}^2 = 22.5 \text{ cm}^2$

Thus, the area of ΔPYZ is 22.5 cm^2.

Model 11

33. दिइएको चित्रमा **ABCD** एउटा वर्ग हो, जसको परिमिति **40 cm** छ र **AB** लाई **F** बिन्दुसम्म बढाइएको छ । यदि **DC** को मध्यबिन्दु **E** भए **ΔEFC** को क्षेत्रफल पत्ता लगाउनुहोस् ।



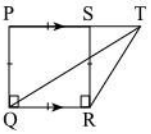
In the figure, ABCD is a square whose perimeter is 40 cm and AB is produced to the point F. If E is the middle point of DC, find the area of the ΔEFC. **[2066 B]**

⇨ Here, side of square $= \frac{P}{4} = \frac{40 \text{ cm}}{4} = 10 \text{ cm}$

Area of $\Delta FEC = \frac{1}{2} EC \times BC = \frac{1}{2} \left(\frac{1}{2} DC \right) \times BC = \frac{1}{2} \times \frac{1}{2} \times 10 \times 10 = 25 \text{ cm}^2$

Thus, the area of ΔFEC is 25 cm^2.

34. दिइएको चित्रमा **PQRS** एक वर्ग हो जसको प्रत्येक भुजा **4 cm** छ । **ΔQRT** को क्षेत्रफल निकाल्नुहोस् ।



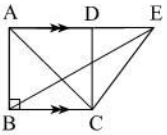
In the given figure, PQRS is a square whose each side is 4 cm. Find the area of ΔQRT **[2066 C]**

⇨ Here, $QR = RS = 4$ cm

We know that, Area of $\Delta QRT = \frac{1}{2} QR \times RS = \frac{1}{2} \times 4 \text{ cm} \times 4 \text{ cm} = 8 \text{ cm}^2$

Thus, the area of ΔQRT is 8 cm^2.

35. चित्रमा **AE // BC** एउटै आधार **BC** र उही समानान्तर रेखाहरूबीच वर्ग **ABCD** र **ΔEBC** छन् । यदि **AC = 6 cm** भए **ΔEBC** को क्षेत्रफल निकाल्नुहोस् ।



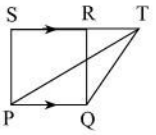
In the figure, AE // BC, square ABCD and ΔEBC are standing on the same base BC between the same parallels. If AC = 6 cm, find the area of ΔEBC. **[2065]**

⇨ Here, Length of diagonal (AC) = 6 cm

We know that, Area of a square $ABCD = \frac{1}{2} d^2 = \frac{1}{2} \times (6 \text{ cm})^2 = \frac{1}{2} \times 36 \text{ cm}^2 = 18 \text{ cm}^2$

Thus, Ar.$(\Delta EBC) = \frac{1}{2}$ Ar. (Sq. ABCD) $= \frac{1}{2} \times 18 \text{ cm}^2 = 9 \text{ cm}^2$

36. दिइएको चित्रमा **PQRS** एउटा वर्ग हो । यदि **PQ // ST** र **SQ = $3\sqrt{2}$** से.मि. भए **ΔPQT** को क्षेत्रफल निकाल्नुहोस् ।



In the given diagram, PQRS is a square. If PQ // ST and SQ = $3\sqrt{2}$ cm then find the area of ΔPQT. **[2065 C]**

⇨ Here, (i) $PR = SQ = 3\sqrt{2}$ cm [Diagonals of a square]

(ii) Ar. (Square PQRS) $= \frac{1}{2} SQ \times PR = \frac{1}{2} \times 3\sqrt{2} \times 3\sqrt{2} = 9 \text{ cm}^2$

(iii) Ar. $(\Delta PQT) = \frac{1}{2}$ Ar. (Sq. PQRS) $= \frac{1}{2} \times 9 \text{ cm}^2 = 4.5 \text{ cm}^2$

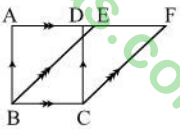
Thus, Ar.$(\Delta PQT) = 4.5 \text{ cm}^2$

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Model 12

37. दिइएको चित्रमा ABCD वर्ग र EBCF समानान्तर चतुर्भुज हुन् । यदि AB = 4 से.मि. भए समानान्तर चतुर्भुज EBCF को क्षेत्रफल निकाल्नुहोस् ।
In the given figure, ABCD is a square and EBCF is a parallelogram. If AB = 4 cm, find the area of parallelogram EBCF. **[2071 A]**



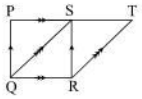
⇨ Here, AB = 4 cm

∴ AB = BC = CD = 4 cm [Being the sides of a square.]

We have, Area of parallelogram = BC × CD = 4 cm × 4 cm = 16 cm^2

Thus, the area of parallelogram is 16 cm^2.

38. दिइएको चित्रमा वर्ग PQRS र समानान्तर चतुर्भुज SQRT एउटै आधार QR मा रहेका छन् । यदि QS = $4\sqrt{2}$ से.मि. भए समानान्तर चतुर्भुज SQRT को क्षेत्रफल निकाल्नुहोस् ।
In the given figure, square PQRS and parallelogram SQRT are standing on the same base QR. If QS = $4\sqrt{2}$ cm, find the area of parallelogram SQRT. **[2071B]**



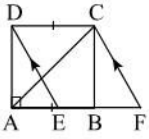
⇨ Here, QS = $4\sqrt{2}$ cm

(i) Area of square PQRS = $\frac{1}{2}(QS)^2 = \frac{1}{2}(4\sqrt{2})^2 = \frac{1}{2}16 \times 2 = 16$ cm^2

(ii) Area of parallelogram SQRT = Area of square PQRS = 16 cm^2

Thus, the area of parallelogram is 16 cm^2.

39. सँगैको चित्रमा AF // DC, ED // FC र ABCD एउटा वर्ग छन् । यदि AC = $5\sqrt{2}$ से.मि. छ भने समानान्तर चतुर्भुज DEFC को क्षेत्रफल निकाल्नुहोस् ।
In the adjoining figure, AF // DC, ED // FC and ABCD is a square. If AC = $5\sqrt{2}$ cm, find the area of the parallelogram DEFC. **[SLC 2065 D]**



⇨ Here, AC = $5\sqrt{2}$ cm

Area of a square ABCD = $\frac{1}{2}(AC)^2 = \frac{1}{2} \times (5\sqrt{2})^2 = 25$ cm^2

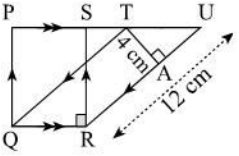
Area of parm. DEFC = Area of square ABCD

[Being both are on same base and between the same parallels.]

Thus, area of parm. DEFC = 25 cm^2

Model 13

40. दिइएको चित्रमा, यदि RU = 12 cm र TA = 4 cm भए, आयत PQRS को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, if RU = 12 cm and TA = 4 cm, find the area of the rectangle PQRS. **[2068 A]**



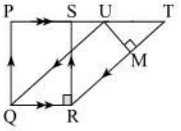
⇨ Here, (i) Area of parm QRUT = b × h = 12 cm × 4 cm = 48 cm^2

(ii) Being on the same base & between the same parallels,

Area of rectangle PQRS = parm. QRUT = 48 cm^2

Thus, the area of rectangle PQRS is 48 cm^2.

41. चित्रमा, यदि PQ = 10 cm, QR = 6 cm र RT = 15 cm भए UM को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, if PQ = 10 cm, QR = 6 cm and RT = 15 cm, find the length of UM. **[2068 D]**



⇨ Here, PQ = 10 cm, QR = 6 cm & RT = 15 cm

Rectangle PQRS and parm. UQRT are on the same base and between the same parallels.

So, Ar. (rectangle PQRS) = Ar. (parm. UQRT) or, PQ × QR = RT × UM

or, 10 cm × 6 cm = 15 cm × UM or, UM = $\frac{10 \text{ cm} \times 6 \text{ cm}}{15 \text{ cm}}$

∴ UM = 4 cm Thus, the length of UM is 4 cm.

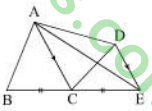
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Model 14

42. दिइएको चित्रमा AC // DE र BC = EC छन् । यदि ΔACE को क्षेत्रफल 24 वर्ग से.मि. छ भने चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।



In the given figure, AC // DE and BC = EC. If the area of ΔACE is 24 sq. cm, find the area of the quadrilateral ABCD. **[2070 E]**

⇨ Here, Ar. (ΔACE) = 24 cm^2

(i) Ar. (ΔABC) = Ar. (ΔACE) = 24 cm^2 [Being AC is the median of ΔABE.]

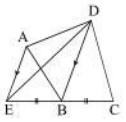
(ii) Ar. (ΔACD) = Ar. (ΔACE) [Being both are on same base and between the same parallels.]

Ar. (ΔACD) = 24 cm^2

(iii) Ar. (Quad ABCD) = Ar. (ΔACD + ΔABC) = 24 cm^2 + 24 cm^2 = 48 cm^2

Thus, the area of quad. ABCD is 48 cm^2.

43. दिइएको चित्रमा AE // DB / EB = CB छन् । यदि ΔABD को क्षेत्रफल 25 वर्ग से.मि. छ भने ΔCDE को क्षेत्रफल कति होला ? पत्ता लगाउनुहोस् ।



In the given figure, AE // DB and EB = CB. If the area of ΔABD is 25 square cm, what will be the area of ΔCDE? Find it. **[2070 B]**

⇨ Here, Ar. (ΔABD) = 25 cm^2

(i) Ar. (ΔEBD) = Ar. (ΔABD) = 25 cm^2

[Being both are on the same base and between the same parallels.]

∴ Ar. (ΔEBD) = 25 cm^2

(ii) Ar. (ΔCED) = 2 Ar. (ΔEBD) [Being DB is the median of ΔDEC.]

= 2 × 25 cm^2

∴ Ar. (ΔCED) = 50 cm^2 Thus, the area of ΔCED is 50 cm^2.

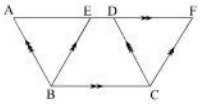
C. LONG QUESTIONS (THEORETICAL PROBLEMS)

Model 1

1. एउटै आधार र उही समानान्तर रेखाहरूबीच रहेका स.च.हरूको क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

Prove that the parallelograms on the same base and between the same parallels are equal in area.
[2057 A1, 2057 D2, 2058 D1, 2057 D2,20 58 B1, 2060 S, 2059 B1, 2059 B2, 2060 C1, 2065 D, 2066 E]

⇨ Here, **Given:** Parallelograms ABCD and EBCF are on the same base BC and between the same parallels AF and BC.



To prove: Parallelogram ABCD = Parallelogram EBCF

Proof:

	Statements		Reasons
1.	In ΔABE and ΔDCF	1.	
	(i) AB = DC (S)		(i) Opposite sides of parallelogram ABCD
	(ii) ∠BAE = ∠CDF (A)		(ii) Corresponding angles in AB // DC
	(iii) ∠AEB = ∠DFC (A)		(iii) Corresponding angles in EB // FC
2.	∴ ΔABE ≅ ΔDCF	2.	AAS fact
3.	ΔABE = ΔDCF	3.	Area of congruent triangles are equal.
4.	ΔABE + trapezium EBCD = ΔDCF +trapezium EBCD	4.	Addition axiom
5.	∴ □ABCD = □EBCF	5.	Whole part axiom (From statement 4)

Proved

2. एउटै आधार र उही समानान्तर रेखाहरूबीच रहेका समानान्तर चतुर्भुज र त्रिभुजमा समानान्तर चतुर्भुजको क्षेत्रफल त्रिभुजको दुई गुणा हुन्छ भनी प्रमाणित गर्नुहोस् ।

Prove that the area of a triangle is equal to one half of the area of a parallelogram standing on the same base and between the same parallels. **[2068 C, 2060 C2, 2058 C2, 2057 B1, 2057 E2, 2065 C, 2066 C]**

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⇨ Here, **Given:** ΔQRT and parallelogram PQRS are on the same base QR and between the same parallels TS and QR.



To prove: $\Delta QRT = \frac{1}{2}$ parallelogram PQRS

Construction: Draw RM parallel to QT to meet TS at M on TS.

Proof:

	Statements		Reasons
1.	TQRM is a parallelogram.	1.	Being the opposite sides parallel.
2.	$\Delta QRT = \frac{1}{2} \square TQRM$	2.	The diagonal TR bisects the parallelogram $\square$TQRM.
3.	$\square TQRM = \square PQRS$	3.	Both parallelograms are standing on the same base QR and between same parallels, TS and QR.
4.	$\therefore \Delta QRT = \frac{1}{2} \square PQRS$	4.	From the statements (2) and (3)

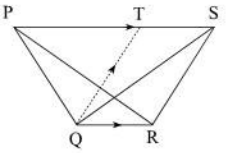
Proved

3. एउटै आधार र उही समानान्तर रेखाहरू बीच रहेका त्रिभुजहरूको क्षेत्रफल बराबर हुन्छ भनी सिद्ध गर्नुहोस् ।

Prove that the Triangles on the same base and between the same parallels are equal in area.

[2067 S, 2068 B, 2065 M, 2057 B2, 2058C1, 2057 A2, 2060 E2, 2066B]

⇨ Here, **Given:** ΔPQR and ΔSQR are on the same base QR and between same parallels PS and QR.



To prove: Area of ΔPQR = Area of ΔSQR

Construction: Draw QT // RS meeting PS at T.

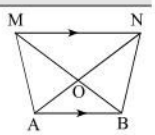
Proof :

	Statements		Reasons
1.	TQRS is a parallelogram	1.	Opposite sides are parallel (by given and construction)
2.	$\Delta SQR = \frac{1}{2}$ parm.TQRS	2.	Diagonals SQ bisects parallelogram TQRS.
3.	$\Delta PQR = \frac{1}{2}$ parm.TQRS	3.	They stand on same base QR and between same parallel, PS and QR
4.	$\therefore \Delta PQR = \Delta SQR$	4.	From the statements (2) and (3)

Proved

Model 2

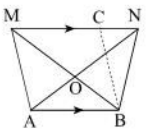
4. दिइएको चित्रमा ΔAMB र ΔANB एउटै आधार AB मा र उही समानान्तर रेखाहरू MN र AB बीच रहेका छन् भने प्रमाणित गर्नुहोस्:



In the figure, triangles AMB and ANB are standing on the same base AB and between parallel lines AB and MN prove that : **[2060 E2]**

(i) ΔAMB को क्षेत्रफल = ΔANB को क्षेत्रफल (Area of ΔAMB = Area of ΔANB)

(ii) ΔAOM को क्षेत्रफल = ΔBON को क्षेत्रफल (Area of ΔAOM = Area of ΔBON)



⇨ Here, **Given:** ΔAMB and ΔANB are standing on the same base AB and between the same parallels MN and AB.

To prove: (i) Area of ΔAMB = Area of ΔANB

(ii) Area of ΔAOM = Area of ΔBON

Construction: Draw CB // AM.

Proof:

Statements	Reasons
1. Area of $\Delta AMB = \frac{1}{2}$ Parm. ABCM	1. Diagonal BM bisects the Parm. ABCM.
2. Area of $\Delta ANB = \frac{1}{2}$ Parm. ABCM	2. Triangle and parallelogram standing on the same base and between the same parallels.
3. Area of ΔAMB = Area of ΔANB	3. From statements (1) and (2).
4. Area of (ΔAMB – ΔAOB) = Area of (ΔANB – ΔAOB) $\therefore$ Area of ΔAOM = Area of ΔBON	4. Subtracting ΔAOB from the both sides of statement (3).

Proved.

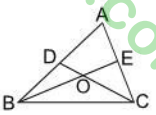
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Model 3

5. दिइएको ΔABC मा BE र CD दुई मध्यिकाहरू बिन्दु O मा प्रतिच्छेदन भएका छन्। सिद्ध गर्नुहोस्: ΔBOC को क्षेत्रफल = चतुर्भुज ADOE को क्षेत्रफल

In the given triangle ABC, two medians BE and CD intersect at O. Prove that : area of ΔBOC = area of the quadrilateral ADOE. [2058 B2]



⇨ Here, **Given :** In ΔABC, two medians BE and CD intersect at O.

To prove: area of ΔBOC = area of quadrilateral ADOE

Construction: Join DE.

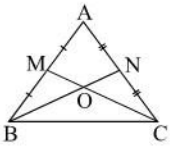
Proof:

Statements	Reasons
1. DE // BC	1. D is the mid-point of AB and E is the mid-point of AC.
2. Area of ΔBDC = Area of ΔBEC	2. Triangles standing on the same base and between two parallels.
3. Area of ΔABE = Area of ΔBEC	3. Triangles being of equal bases and height
4. Area of ΔBDC = Area of ΔABE	4. From statements 2 and 3.
5. Area of ΔBDC – Area of ΔBOD = Area of ΔABE – Area of ΔBOD	5. Subtracting ΔBOD from both sides of the statement (4)
∴ Area of ΔBOC = Area of Quad. ADOE	

Proved.

6. दिइएको ΔABC मा BN र CM दुई मध्यिकाहरू बिन्दु O मा प्रतिच्छेदन भएका छन्। सिद्ध गर्नुहोस्: ΔBOC को क्षेत्रफल = चतुर्भुज AMON को क्षेत्रफल

In the given triangle ABC, medians BN and CM are intersected at O. Prove that area of ΔBOC = area of quadrilateral AMON. [2068 E]



⇨ Here, **Given:** In triangle ABC, BN and CM are the medians and they are intersected at O.

To prove: Ar. (ΔBOC) = Ar. (quad. AMON)

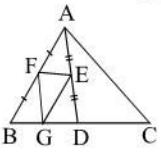
Proof:

Statements	Reasons
1. $\Delta BMC = \frac{1}{2}\Delta ABC$	1. Being CM is median.
2. $\Delta ABN = \frac{1}{2}\Delta ABC$	2. Being BN is median.
3. ΔABN = ΔBMC	3. From (1) & (2).
4. ΔABN – ΔMOB = ΔBMC – ΔMOB	4. Subtracting ΔMOB.
5. ΔBOC = Quad. AMON	5. From statements 4.

Proved.

7. दिइएको चित्रमा ΔABC को भुजा BC को मध्यबिन्दु D, AD को मध्यबिन्दु E, AB को मध्यबिन्दु F र BD को कुनै बिन्दु G भए ΔABC = 8ΔEFG हुन्छ भनी प्रमाणित गर्नुहोस्।

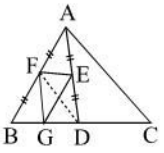
In the given figure ΔABC, D is the mid-point of BC, E is the mid-point of AD, F is the mid-point of AB and G is any point of BD. Prove that ΔABC = 8 ΔEFG in area. [SLC 2065 A]



⇨ Here,**Given:** D is the mid-point of BC, E is the mid-point of AD , F is the midpoint of AB and G is any point of BD.

To prove: ΔABC = 8ΔEFG in area.

Construction: Join FD



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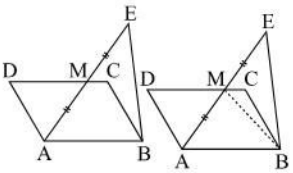
Proof:

Statements	Reasons
1. $\Delta FEG = \Delta FED$	1. Both are on the same base and between the same parallels & by mid-point theorem.
2. $\Delta FED = \frac{1}{2}\Delta AFD$	2. Being FE is the median of ΔAFD
3. $\Delta AFD = \frac{1}{2}\Delta ABD$	3. Being DF is the median of ΔABD
4. $\Delta ABD = \frac{1}{2}\Delta ABC$	4. Being AD is the median of ΔABC
5. $\Delta FEG = \frac{1}{2}\Delta AFD = \frac{1}{2}\times\frac{1}{2}\Delta ABD = \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\Delta ABC$	5. From (1), (2), (3) & (4)
6. $\Delta FEG = \frac{1}{8}\Delta ABC \quad \therefore 8\Delta FEG = \Delta ABC$	6. From (5)

Proved.

8. चित्रमा **AE** को मध्यबिन्दु **M** भए **ΔABE** को क्षेत्रफल र समानान्तर चतुर्भुज **ABCD** को क्षेत्रफल बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।

In the figure, M is the mid-point of AE, then prove that area of ΔABE is equal to the area of parallelogram ABCD. **[2068 D]**



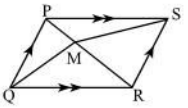
⇨ Here, **Given:** M is the mid-point of AE, ABCD is a parallelogram.
To prove: Ar. (ΔABE) = Ar. (parm. ABCD)
Construction: Join MB
Proof:

Statements	Reasons
1. $2\Delta AMB$ = parm. ABCD	1. Being both are on the same base and between the same parallels.
2, $2\Delta AMB = \Delta ABE$	2. Being BM is the median of ΔEAB.
3. ΔABE = parm. ABCD	3. From (1) and (2)

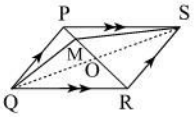
Proved.

9. सँगैको चित्रमा **PQRS** एउटा स.च. हो । विकर्ण **PR** को कुनै बिन्दु **M** सँग **Q** र **S** जोडिएको छ । सिद्ध गर्नुहोस् : **ΔPQM = ΔPSM** (क्षेत्रफलमा)

In the adjoining diagram, PQRS is a parallelogram, Q and S are joined to any point M on the diagonal PR of the parallelogram. Prove that : area of the ΔPQM = area of the ΔPSM. **[2058 A1]**



⇨ Here, **Given:** PQRS is a parallelogram and Q and S are joined to any point M on PR.
To prove: area of ΔPQM = area of ΔPSM.
Construction: Draw QS such that it meets PR at O.
Proof:



	Statements		Reasons
1.	OP is the median of ΔPQS.	1.	Being the diagonals of a parm. bisect to each other i.e. OQ = OS
2.	area of ΔPOQ = area of ΔPOS	2.	Being OP is the median of ΔPQS.
3.	area of ΔMOQ = area of ΔMOS	3.	Being OM is the median of ΔMQS.
4.	area of (ΔPOQ – ΔMOQ) = area of (ΔPOS – ΔMOS)	4.	Subtracting (2) from (1).
5.	area of ΔPQM = area of ΔPSM	5.	From statement (4).

Proved.

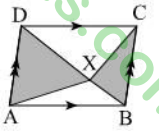
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Model 4

10. दिइएको, ▱ABCD भित्र X कुनै एउटा बिन्दु छ भने ΔXCD र ΔXAB का क्षेत्रफलको योगफल ▱ABCD को क्षेत्रफलको आधा हुन्छ भनी प्रमाणित गर्नुहोस् ।

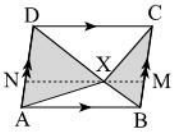
In given figure ABCD is a parallelogram. X is any point within it. Prove that the sum of area of ΔXCD and ΔXAB is equal to half of the area of ▱ABCD. **[2066 A]**



⇨ Here, **Given:** X is any point on parallelogram ABCD. ΔDAX and ΔXBC are drawn

To Prove: ΔXAB + ΔXDC = 1/2 ABCD

Construction: Draw AB//MXN.



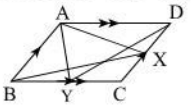
Proof:

Statements	Reasons
1. $\Delta XAB = \frac{1}{2}$ *parm* ABMN	1. Both are standing on the same base AB and between the same parallels
2. $\Delta XDC = \frac{1}{2}$ *parm* MNDC	2. Same as reason (1)
3. $\Delta XAB + \Delta XDC = \frac{1}{2}$ ▱ABMN + $\frac{1}{2}$ ▱MNCD = 1/2 ▱ABCD	3. Adding (1) and (2) and from whole part axiom.

Proved

11. स.च. ABCD भित्र भुजा CD मा X छ र भुजा AD मा Y छ । प्रमाणित गर्नुहोस् ΔAXB र ΔBYC क्षेत्रफलमा बराबर हुन्छन् ।

ABCD is a parallelogram and X and Y are any points on CD and AD respectively. Prove that ΔAXB and ΔBYC are equal in area. **[2057D1 and D2,2060 D2, 2058 S]**



⇨ Here, **Given:** in // gm ABCD, AB // DC and AD // BC.

To prove : ΔABX = ΔBYC

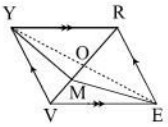
Proof :

Statements	Reasons
1. $\Delta ABX = \frac{1}{2}$ //gm ABCD	1. Both stands on the same base AB and between the same parallels AB and DC
2. $\Delta BYC = \frac{1}{2}$ //gm ABCD	2. Both stand on the same base BC and AD // BC
3. ∴ ΔABX = ΔBYC	3. From (1) and (2).

Proved

12. दिइएको चित्रमा VERY एउटा समानान्तर चतुर्भुज हो । यदि विकर्ण VR को कुनै बिन्दु M भए ΔVMY र ΔVME को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, VERY is a parallelogram. If M is any point on diagonal VR then prove that ΔVMY and ΔVME are equal in area. **[2071C]**



⇨ Here, **Given:** VERY is a parallelogram. M is any point on diagonal VR.

To prove: ΔVMY = ΔVME (in area)

Construction: Join YE so that YE and VR are intersected at O.

Proof:

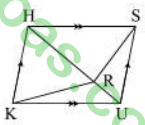
Statements	Reasons
1. O is the mid-point of YE.	1. Diagonals of a parallelogram bisect to each other.
2. ΔMOY = ΔMOE & ΔVOY = ΔVOE	2. Being MO & VO are the medians of ΔMEY & ΔVEY.
3. ΔVOY – ΔMOY = ΔVOE – ΔMOE	3. From (2) subtraction axiom.
4. ΔVMY = ΔVME (in area)	4. From (3) comparision axiom.

Proved.

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13. दिइएको चित्रमा **KUSH** एउटा समानान्तर चतुर्भुज हो । यदि **UH** को कुनै बिन्दु **R** भए **ΔKHR** र **ΔSHR** को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, KUSH is a parallelogram. R is any point on diagonal UH. Then prove that ΔKHR and ΔSHR are equal in area. **[2071 A]**

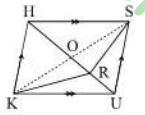


⇨ Here, **Given:** KUSH is a parallelogram.

To prove: Ar. (ΔKHR) = Ar. (ΔSHR)

Construction: Join KS.

Proof:

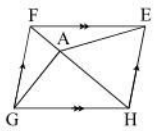


Statements	Reasons
1. O is the midpoint of KS.	1. Diagonals of parallelogram bisect to each other.
2. Ar. (ΔSOR) = Ar. (ΔKOR) and Ar. (ΔHOS) = Ar. (ΔHOK)	2. Being OR and OH are the medians of ΔKRS and ΔHKS.
3. ΔSOR + ΔHOS = ΔKOR + ΔHOK	3. Addition axiom in (2).
4. Ar. (ΔSHR) = Ar. (ΔKHR)	4. From (3) comparision axiom.

Proved.

14. दिइएको चित्रमा **GHEF** एउटा समानान्तर चतुर्भुज हो । यदि विकर्ण **HF** मा कुनै बिन्दु **A** छ भने **ΔFAG** र **ΔFAE** को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, GHEF is a parallelogram. If A is any point on a diagonal HF, prove that ΔFAG and ΔFAE are equal in area. **[2071S]**



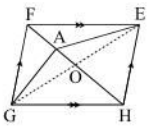
⇨ Here,

Given: GHEF is a parallelogram. A is any point on a diagonal HF.

To prove: ΔFAG = ΔFAE (In area)

Construction: Join EG so that EG and FH are intersected at O.

Proof:

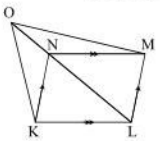


Statements	Reasons
1. O is the midpoint of GE.	1. Diagonals of parallelogram bisect to each other.
2. ΔGOF = ΔEOF & ΔGOA = ΔEOA (In area)	2. Being FO and AO are the medians of ΔEFG and ΔEAG.
3. ΔGOF – ΔGOA = ΔEOF – ΔEOA	3. Subtraction axiom in (2).
4. ΔFAG = ΔFAE (In area)	4. From (3) comparision axiom.

Proved.

15. दिइएको चित्रमा **KLMN** एउटा समानान्तर चतुर्भुज हो । यदि विकर्ण **LN** लाई लम्व्याएर **O** सम्म पुऱ्याइएको छ भने **ΔKON** र **ΔMON** को क्षेत्रफलहरू बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।

In the given figure, KLMN is a parallelogram. Diagonal LN is produced to O. Then prove that ΔKON and ΔMON are equal in area. **[2071 D, E]**

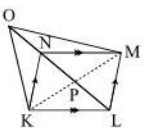


⇨ Here, **Given:** KLMN is a parallelogram, diagonal LN is produced O.

To prove: ΔKON = ΔMON (in area)

Construction: Join KM so that LN and KM are intersected at P.

Proof:



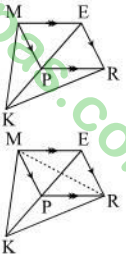
Statements	Reasons
1. P is the mid-point of NL.	1. Diagonals of a parallelogram bisect to each other.
2. ΔKPO = ΔMPO and ΔKPN = ΔMPN	2. Being OP and NP are the medians of ΔOKM and ΔNKM.
3. ΔKPO – ΔKPN = ΔMPO – ΔMPN	3. Subtraction axiom in (2).
4. ΔOKN = ΔONM	4. From (3) comparision axiom.

Proved.

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16. दिइएको चित्रमा **PREM** एउटा समानान्तर चतुर्भुज हो। विकर्ण **EP** लाई बिन्दु **K** सम्म लम्ब्याइएको छ। **ΔK PM** र **ΔKPR** को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस्।
In the given figure, PREM is a parallelogram. Diagonal EP is produced to point K. Prove that ΔKPM and ΔKPR are equal in area. **[2071 B]**

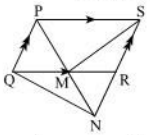


⇨ Here, **Given:** PREM is a parallelogram.
To prove: Ar. (ΔKPM) = Ar. (ΔKPR)
Construction: Join MR so that MR and PE are intersected at O.
Proof:

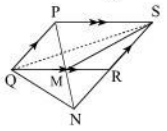
Statements	Reasons
1. O is the midpoint of MR.	1. Diagonals of parallelogram bisect to each other.
2. ΔKMO = ΔKRO and ΔMOP = ΔROP (in area)	2. Being KO and PO are the medians of ΔMKR and ΔMPR.
3. ΔKMO – ΔMOP = ΔKRO – ΔROP	3. Subtraction axiom in (2).
4. ΔKPM = ΔKPR	4. From (3) comparision axiom.

Proved.

17. दिइएको चित्रमा **PQRS** एउटा स.च. हो। **PM** र **SR** लाई **N** सम्म लम्ब्याइएको छ तथा **Q** र **N** जोडिएको छ। सिद्ध गर्नुहोस् : **ΔSMR** को क्षेत्रफल = **ΔQMN** को क्षेत्रफल।
In the given figure PQRS is a parallelogram. PM and SR are produced to meet at N; Q and N are joined. Prove that : area of ΔSMR = area of ΔQMN. **[2057 A1, 2060 B2]**



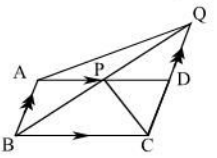
⇨ Here, **Given:** PQRS is a parallelogram, PM and SR are produced to meet at N. QN and SM are joined.
To prove: area of ΔSMR = area of ΔQMN,
Construction: Join QS.
Proof:



Statements	Reasons
1. Area of ΔQSM = Area of ΔPQM	1. These triangles stand on the same base QM and between the same parallels PS and QM.
2. Area of ΔQSR = Area of ΔPQS	2. Diagonal QS bisects the parallelogram.
3. Area of ΔPQN = Area of ΔPQS	3. These triangles stand on the same base PQ and between same parallels PQ and SN.
4. Area of ΔQSR = Area of ΔPQN	4. From statements 2 and 3.
5. Area of (ΔQSR – ΔQSM) = Area of (ΔPQN – ΔPQM)	5. From statements 4 and 1 (On subtraction)
∴ Area of ΔSMR = Area of ΔQMN	

Proved

18. दिइएको चित्रमा **ABCD** एउटा समानान्तर चतुर्भुज हो। **ΔAPQ** को क्षेत्रफल = **ΔPDC** को क्षेत्रफल हुन्छ भनी प्रमाणित गर्नुहोस्।
In the adjoining diagram ABCD is a parallelogram, prove that area of ΔAPQ = area of ΔPDC. **[SLC 2065 E]**



⇨ Here, **Given:** ABCD is a parallelogram.
To prove: Area of ΔAPQ = Area of ΔPDC
Proof:

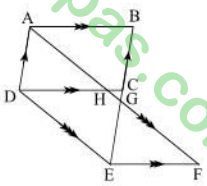
Statements	Reasons
1. Ar. (ΔABQ) = $\frac{1}{2}$Ar. (□ABCD)	1. Being both are on the same base and between the same parallels.
2. Ar. (ΔBPC) = $\frac{1}{2}$Ar. (□ABCD)	2. Same as reason (1)
3. Ar. (ΔAPB + ΔCDP) = $\frac{1}{2}$ Ar. (□ABCD)	3. Subtracting both the sides of statement (2) from parm. ABCD.
4. Ar.(ΔAPB) + Ar. (ΔCDP) = Ar. (ΔABQ)	4. From (1) and (3)
5. Ar.(ΔAPB) + Ar.(ΔCDP) = Ar.(ΔAPB) + Ar. (ΔAPQ)	5. From (4) and whole part axiom
6. Ar. (ΔCDP) = Ar. (ΔAPQ)	6. From (5)

Proved.

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19. दिइएको चित्रमा **AB // DC // EF** त्यस्तै **AD // BE** र **AF // DE** भए स.च. **DEFH** = स.च. **ABCD** हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, if AB // DC // EF, AD // BE and AF // DE, prove that parm. DEFH = parm. ABCD. **[2067 A]**



⇨ Here, **Given:** AB // CD // EF, AD // BE and AF // DE

To prove: Parm. DEFH = Parm. ABCD

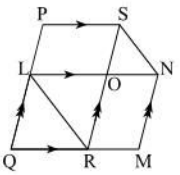
Proof:

Statements	Reasons
1. Parm. ABCD = Parm. GADE	1. Being both are on the same base and between the same parallels.
2. Parm. GADE = Parm. DEFH	2. Same as reason 1
3. Parm. ABCD = Parm. DEFH	3. From (1) & (2) equal quantities axiom.

Proved.

20. सँगैको चित्रमा **PQRS** र **LQMN** बराबर क्षेत्रफल भएका समानान्तर चतुर्भुजहरू हुन् । प्रमाणित गर्नुहोस् **LR // SN** छ ।

In the adjoining figure, PQRS and LQMN are two parallelograms equal in area. Prove that LR // SN. **[2068 A]**



⇨ Here, **Given:** in the figure PQRS and LQMN are two parallelograms.

To prove: LR // SN

Construction: Join LS and RN.

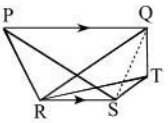
Statements	Reasons
1. $\square$PLOS = $\square$ORMN	1. Subtracting $\square$LQRO from the both sides of $\square$PQRS = $\square$QMNL
2. $2\Delta LOS = 2\Delta ORN$ $\therefore \Delta LOS = \Delta ORN$	2. Being LS and RN are the diagonals of parallelograms and from RS.
3. $\Delta LNS = \Delta RNS$	3. Adding ΔONS in statements (2)
4. LR // SN	4. From (3) triangles on same base and between the same lines are of equal area.

Proved

Model 5

21. सँगैको चित्रमा **PQ // RS** र **ΔPRS** को क्षेत्रफल = **ΔQRT** को क्षेत्रफल दिइएको छ । प्रमाणित गर्नुहोस् : **RQ // ST**

In the adjoining figure, it is given that PQ // RS and area of ΔPRS = area of ΔQRT. Prove that : RQ // ST. **[2062 D1]**



⇨ **Given :** Here, PQ // RS and area of ΔPRS = area of ΔQRT

To prove : RQ // ST.

Construction : Join QS.

Proof:

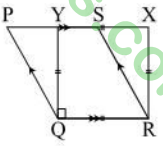
Statements	Reasons
1. Area of ΔPRS = Area of ΔQRT	1. Given
2. Area of ΔPRS = Area of ΔRQS	2. Triangles standing on the same base and between the same parallels.
3. Area of ΔQRT = Area of ΔRQS	3. From the statements (1) and (2).
4. PQ // ST	4. From (3), triangles stand on the same base QR and same side of the base are of equal area.

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B. QUESTIONS FROM CDC TEXT BOOKS

1. दिइएको चित्रमा **PQRS** एउटा स.च. हो र **QRXY** एउटा वर्ग हो भने प्रमाणित गर्नुहोस्: स.च. **PQRS** को क्षे.फ. = वर्ग **QRXY** को क्षे.फ. हुन्छ ।
In the figure, PQRS is a parallelogram and QRXY is a square then prove that area of parallelogram PQRS = area of square QRXY.

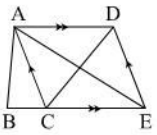


⇨ Here, **Given:** PQRS is a parallelogram and QRXY is a square.
To prove: Ar. (Parm. PQRS) = Ar. (Sq. QRXY)
Proof :

	Statements		Reasons
1.	Area of parm PQRS = QR × QY	1.	Being the area of parallelogram = base × height.
2.	Area of parm PQRS = QR × QR = QR^2	2.	Being QR = QY and from (1).
3.	Area of square QRXY = QR^2	3.	Being area of square is $(base)^2$.
4.	Ar. (Parm. PQRS) = Ar. (Sq. QRXY)	4.	From (2) and (3).

Proved.

2. दिइएको चित्रमा **ABCD** एउटा चतुर्भुज हो । जसको विकर्ण **AC** सँग समानान्तर हुने गरी **DE** खिचिएको छ र **BC** भुजालाई लम्ब्याएर **E** सम्म पुऱ्याइएको छ । **A** र **E** जोडिएको अवस्थामा चतुर्भुज **ABCD** को क्षे.फ. = **ΔABE** को क्षे.फ. हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure ABCD is a quadrilareal whose diagonal AC is parallel to DE and side BC is produced to E. In the condition of joining A and E, prove that area of quadrilateral ABCD = area of ΔABE.

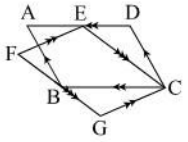


⇨ Here, **Given:** ABCD is a qudrialteral. AC // DE
To prove: Area of quad. ABCD = Area of ΔABE
Proof :

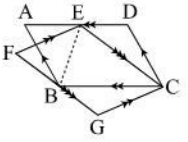
	Statements		Reasons
1.	ΔACD = ΔACE (in area)	1.	Being both are on the same base and between same parallels.
2.	Ar. (ΔACD + ΔABC) = Ar. (ΔACE + ΔABC)	2.	Adding ΔABC on both the sides.
3.	Ar. (Quad. ABCD) = Ar. (ΔABE)	3.	From (2) whole part axiom.

Proved.

3. दिइएको चित्रमा **ABCD** र **EFGC** दुई ओटा स.च. हुन् भने, स.च. **ABCD** को क्षेत्रफल = स.च. **EFGC** को क्षेत्रफल हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure ABCD and EFGC are two parallelograms prove that area of parallelogram ABCD = area of parallelogram EFGC. **[2066 D]**



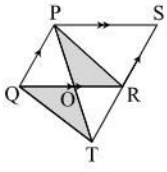
⇨ Here,
Given: ABCD and EFGC are two parallelograms
To prove: Ar. (Parm. ABCD) = Ar. (Parm. EFGC)
Construction: Join BE
Proof :



	Statements		Reasons
1.	$\Delta EBC = \frac{1}{2}$ parm. ABCD	1.	Being both are on the same base and between same parallels.
2.	$\Delta EBC = \frac{1}{2}$ parm. EFGC	2.	Being both are on the same base and between same parallels.
3.	$\frac{1}{2}$ parm. ABCD = $\frac{1}{2}$ parma. EFGC $\therefore$ parm. ABCD = parm = EFGC	3.	From (1) and (2).

Proved.

4. दिइएको चित्रमा स.च. **PQRS** को भुजा **SR** लाई **T** सम्म लम्ब्याइएको छ । भुजा **QR** को कुनै बिन्दु **O** बाट जाने गरी **PO** लाई पनि **T** सम्म लम्ब्याइएको छ । प्रमाणित गर्नुहोस् : **ΔPOR = ΔQOT** हुन्छ ।
In the given figure, the side SR of parallelogram PQRS is produced to T. PO is also extended through O of side QR. Prove that ΔPOR = ΔQOT.



⇨ Here,
Given: PQRS is a parallelogram. **To prove:** ΔPQR = ΔQOT

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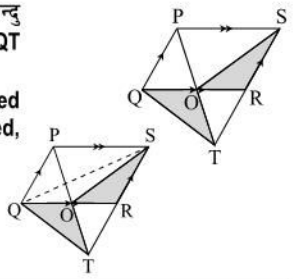
Proof :

	Statements		Reasons
1.	$\Delta PQT = \frac{1}{2}$ Parm. PQRS	1.	Being both are on the same base and between same parallels.
2.	$\Delta PQR = \frac{1}{2}$ parm. PQRS	2.	Being both are on the same base and between same parallels.
3.	$\Delta PQT = \Delta PQR$	3.	From (1) and (2)
4.	$\Delta PQT - \Delta PQO = \Delta PQR - \Delta PQO$	4.	Subtracting ΔPQO from both sides of statement (3)
5.	$\Delta QOT = \Delta POR$	5.	From (4) comparision axiom.

Proved.

5. दिइएको चित्रमा **PQRS** एउटा समानान्तर चतुर्भुज हो, जसमा भुजा **QR** को कुनै बिन्दु **O** बाट **PO** लाई **T** सम्म र **SR** लाई पनि उही बिन्दु **T** सम्म लम्ब्याइएको छ । **QT** जोडेको छ भने **ΔQOT = ΔROS** हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure PQRS is a parallelogram in which PO is extended through O of side QR and SR also extended up to T. QT is also joined, prove that ΔQOT = ΔROS



⇨ Here, **Given:** PQRS is a parallelogram.

To prove: $\Delta QOT = \Delta ROS$

Construction: Join QS

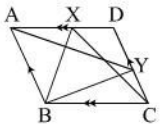
Proof :

Statements	Reasons
1. area of ΔQSO = area of Δ PQO	1. These triangles stand on the same base QO and between the same parallels PS and QO.
2. area of ΔQSR = area of Δ PQS	2. Diagonal QS bisects the parallelogram.
3. area of Δ PQT = area of Δ PQS	3. These triangles stand on the same base PQ and between same parallels PQ and ST.
4. area of Δ QSR = area of ΔPQT	4. From statements 2 and 3.
5. area of ($\Delta QSR - \Delta QSO$) = area of ($\Delta PQT - \Delta PQO$)	5. From statements 4 and 1 (On subtraction)
$\therefore$ area of ΔSOR = area of ΔQOT	

Proved

6. सँगैको चित्रमा **ABCD** एउटा स.च. हो, जसका भुजा **AD** को **X** बिन्दु तथा भुजा **CD** को **Y** बिन्दुबाट त्रिभुजहरू **XBC** र **YAB** बनेका छन् भने **ΔABY = ΔABX + ΔCDX** हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, ABCD is a parallelogram. If X and Y are any points on AD and CD making triangles XBC and YAB respectively, prove that: ΔABY = ΔABX + ΔCDX **[SLC 2065 B]**



⇨ Here, **Given:** ABCD is a parallelogram. X and Y are any points on DA and CD respectively.

To prove: $\Delta AYB = \Delta ABX + \Delta CDX$

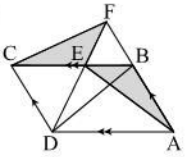
Proof:

Statements	Reasons
1. $\Delta BXC = \frac{1}{2}$ ▱ABCD	1. Being both are on same base and between the same parallels.
2. $\Delta CDX + \Delta AXB = \frac{1}{2}$▱ABCD	2. Subtracting the statement (i) from ▱ABCD in both sides
3. $\Delta AYB = \frac{1}{2}$▱ABCD	3. Same as reason 1.
4. $\Delta AYB = \Delta CDX + \Delta AXB$	4. From 3 and 4.

Proved.

7. सँगैको चित्रमा **ABCD** एउटा स.च. हो । भुजा **BC** मा कुनै बिन्दु **E** छ । **DE** र **AB** लाई **F** सम्म लम्ब्याइएको छ र **CF** पनि जोडिएको छ भने **ΔCEF = ΔABE** हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the figure ABCD is a parallelogram. The side BC has any point E. DE and AB are produced upto F. CF is also joined then prove that: ΔCEF = ΔABE



⇨ Here,

Given: ABCD is a parallelogram. **To prove:** Ar. (ΔCEF) = Ar. (ΔABE)

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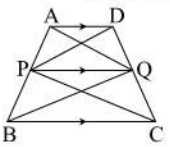
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Proof :

	Statements		Reasons
1.	$\Delta CFB = \Delta DBF$	1.	Being both are on the same base and between same parallels.
2.	$\Delta CEF = \Delta EDB$	2.	Subtracting ΔEBF from both sides of statement (1)
3.	$\Delta EDB = \Delta ABE$	3.	Being both are on the same base and between the same parallels.
4.	$\Delta CEF = \Delta ABE$	4.	From (2) and (3).

Proved.

8. दिइएको चित्रमा **ABCD** एउटा समलम्ब चतुर्भुज हो जसमा **AD // PQ // BC** छन् । **ΔAQB** को क्षेत्रफल र **ΔDPC** को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure, ADCB is the trapezium where AD // PQ // BC, prove that : area of ΔABQ = area of ΔDCP. **[2059 A1]**

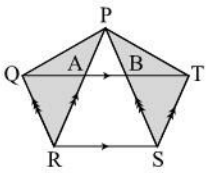


⇨ Here, **Given :** in the trapezium ADCB, AD // PQ // BC
To prove : area of ΔABQ = area of ΔDCP
Proof :

Statements	Reasons
1. area of ΔAQP = area of ΔDPQ	1. Triangles standing on the same base and between the same parallels.
2. area of ΔPQB = area of ΔQPC	2. Triangles standing on the same base and between the same parallels.
3. area of ($\Delta AQP + \Delta PQB$) = area of ($\Delta DPQ + \Delta QPC$) ∴ area of ΔAQB = area of ΔDPC	3. From the statements (1) and (2) (Addition axiom)

Proved.

9. सँगैको त्रिमा **PQRST** एउटा पञ्चभुज हो, जसमा **QT // RS, QR // PS** तथा **TS // PR** छन् । **ΔPQR** को क्षेत्रफल र **ΔPTS** को क्षेत्रफल बराबर हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the figure, PQRST is pentagon in which QT // RS, QR // PS and TS // PR. Prove that the area of ΔPQR and ΔPTS are equal.

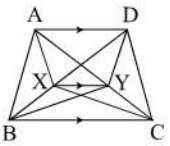


⇨ Here, **Given :** PQRST is a pentagon. QT // RS, QR // PS and TS // PR
To prove : Ar. (ΔPQR) = Ar. (ΔPTS)
Proof :

Statements	Reasons
1. $\Delta PQR = \frac{1}{2}$ Parm. BQRS	1. Being both are on same base and between the same parallels.
2. $\Delta PST = \frac{1}{2}$ parm. ARST	2. Being both are on same base and between the same parallels.
3. Parm. BQRS = Parm. ARST	3. Being both are on same base and between the same parallels.
4. $\Delta PQR = \Delta PST$	4. From (1), (2) and (3)

Proved.

10. चित्रमा **ABCD** एउटा समलम्ब चतुर्भुज हो, जसमा विकर्णहरू **AC** र **BD** का बिन्दुहरू **Y** र **X** क्रमशः **AD // XY // BC** हुने गरी जोडिएका छन् । **ΔAXC** को क्षेत्रफल र **ΔBYD** को क्षेत्रफल हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the figure ABCD is a trapezium whose diagaonls AC and BD have two points Y and X are joined such that AD // XY // BC. Prove that Ar. (ΔAXG) and Ar. (ΔBYD) are equal.



⇨ Here, **Given :** ABCD is a trapezium and AD // XY // BC
To prove : Ar. (ΔAXC) = Ar. (ΔBYD)
Proof :

Statements	Reasons
1. $\Delta AXY = \Delta DXY$	1. Being both are on the same base and between the same parallels.
2. $\Delta XYC = \Delta BXY$	2. Being both are on the same base and between the same parallels.
3. $\Delta AXY + \Delta XYC = \Delta DXY + \Delta BXY$	3. Adding (1) and (2).
4. $\Delta AXC = \Delta BYD$	4. From (3) whole part axiom.

Proved.

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14. वृत्त (Circle)

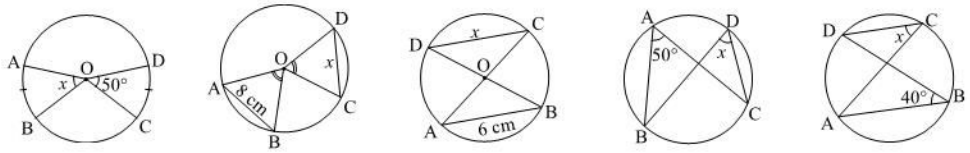
14.1 केन्द्रीय कोण र परिधि कोण (CENTRAL ANGLE AND ANGLE AT CIRCUMFERENCE)

A. BASIC EXERCISE

A. VERY SHORT QUESTIONS

1. तलका चित्रहरूबाट x को मान पत्ता लगाउनुहोस् (From the following figure, find the value x):

(a) (b) (c) (d) (e)



⇨ (a) Here, x = 50° [Equal arcs of a circle substends equal angle at the centre.]

(b) Here, x = 8 cm [Equal central angles substends equal chords.]

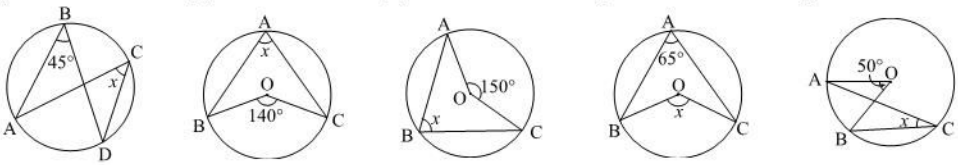
(c) Here, ∠AOB = ∠COD [Vertically opposite angles.]

∴ x = 6 cm [Equal central angles substend equal chords.]

(d) Here, x = 50° [Angles in the same segment of a circle are equal.]

(e) Here, x = 40° [Angles in the same segment of a circle are equal.]

(f) (g) (h) (i) (j)



(f) Here, x = 45° [Angles in the same segment of a circle are equal.]

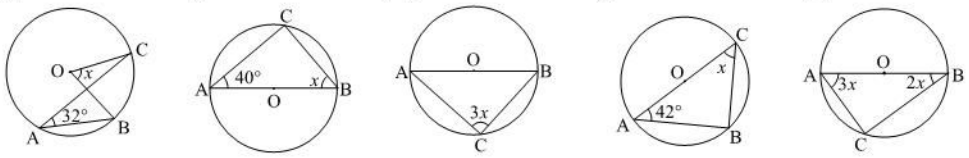
(g) Here, $x = \frac{140°}{2} = 70°$ [Inscribed angle is half of central angle standing on the same arc.]

(h) Here, $x = \frac{150°}{2} = 75°$ [Inscribed angle is half of central angle standing on the same arc.]

(i) Here, x = 65° × 2 = 130° [Central angle is double of inscribed angle standing on the same arc.]

(j) Here, $x = \frac{50°}{2} = 25°$ [Inscribed angle is half of central angle standing on the same arc.]

(k) (l) (m) (n) (o)



(k) Here, x = 2 × 32° = 64° [Central angle is twice of inscribed angle standing on the same arc.]

(ℓ) Here, ∠C = 90° [Angle at semi circle]

So, x + 40° = 90° ∴ x = 90° − 40° = 50°

(m) Here, ∠ACB = 90° [Angle at semi circle]

or, 3x = 90° ∴ $x = \frac{90°}{3} = 30°$

(n) Here, ∠ABC = 90° [Angle at semi circle]

So, x + 42° = 90° ∴ x = 90° − 42° = 48°

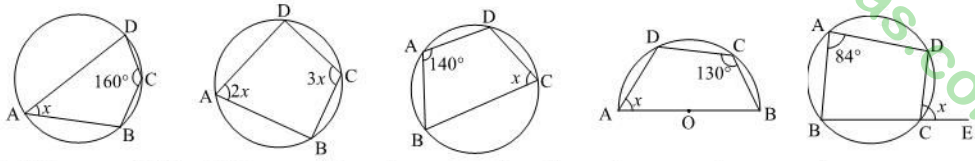
(o) Here, ∠ACB = 90° [Angle at semi circle]

So, 3x + 2x = 90° or, 5x = 90° ∴ $x = \frac{90°}{5} = 18°$

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(p) **(q)** **(r)** **(s)** **(t)**



(p) Here, $x + 160° = 180°$ [Opposite angles of cyclic quad. are supplementary.]

$\therefore \quad x = 180° - 160° = 20°$

(q) Here, $2x + 3x = 180°$ [Opposite angles of cyclic quad. are supplementary.]

or, $5x = 180°$ $\therefore \quad x = \dfrac{180°}{5} = 36°$

(r) Here, $x + 140° = 180°$ [Opposite angles of cyclic quad. are supplementary.]

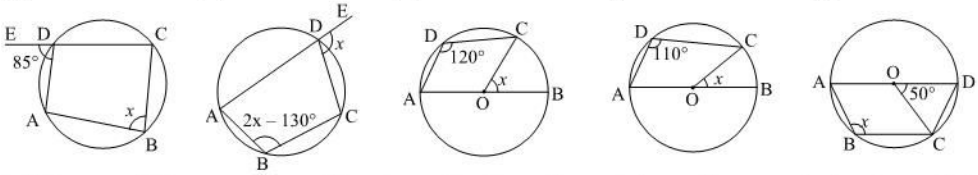
$\therefore \quad x = 180° - 140° = 40°$

(s) Here, $x + 130° = 180°$ [Opposite angles of cyclic quad. are supplementary.]

$\therefore \quad x = 180° - 130° = 50°$

(t) Here, $x = 84°$ [Exterior angle of a cyclic quad. is equal to opposite interior angle.]

(u) **(v)** **(w)** **(x)** **(y)**



(u) Here, $x = 85°$ [Exterior angle of a cyclic quad. is equal to opposite interior angle.]

(v) Here, $x = 2x - 130°$ [Exterior angle of a cyclic quad. is equal to opposite interior angle.]

or, $130° = 2x - x$ $\therefore \quad x = 130°$

(w) Here, Reflex $\angle AOC = 2 \times 120°$ [Both are on same arc.]

or, $\angle AOB + \angle BOC = 240°$ or, $180° + x = 240°$

$\therefore \quad x = 240° - 180° = 60°$

(x) Here, Reflex $\angle AOC = 2 \times 110° = 220°$ [Both are on same arc.]

or, $\angle AOB + \angle BOC = 220°$ or, $180° + x = 220°$

$\therefore \quad x = 220° - 180° = 40°$

(y) Here, OD = OC [radius]

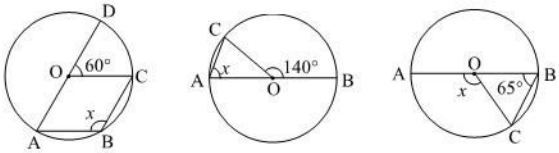
$\therefore \quad 2\angle ODC + 50° = 180°$ [Sum of $\angle$s of Δ]

or, $\angle ODC = \dfrac{180° - 50°}{2} = 65°$

Now, $x + \angle ODC = 180°$ [Sum of opposite angles of cyclic quad.]

or, $x + 65° = 180°$ $\therefore \quad x = 180° - 65° = 115°$

(z) **(aa)** **(ab)**



(z) Here, $2\angle ODC + 60° = 180°$ [OC = OD]

$\therefore \quad \angle ODC = \dfrac{180° - 60°}{2} = 60°$

Now, $x + \angle ODC = 180°$ [Sum of opposite angles of cyclic quad.]

or, $x + 60° = 180°$ $\therefore \quad x = 180° - 60° = 120°$

(aa) Here, $x = \dfrac{140°}{2} = 70°$ [Inscribed angle is half of central angle standing on the same arc.]

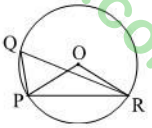
(ab) Here, $x = 65° \times 2 = 130°$ [Central angle is twice of inscribed angle standing on the same arc.]

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B. SHORT QUESTIONS

Model 1

1. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । ∡POR केन्द्रीय कोण र ∡PQR परिधि कोण हुन् । यदि ∡OPR = 28° भए ∡PQR को मान पत्ता लगाउनुहोस् ।



In the given figure, O is the centre of the circle. ∡POR and ∡PQR are inscribed angles on the centre and on the circumference respectively. If ∡OPR = 28°, find ∡PQR. **[Model 2065]**

⇨ Here, ∡OPR = 28°

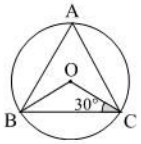
(i) ∡ORP = ∡OPR = 28° [∵ OP = OR]

(ii) ∡POR = 180° – (∡ORP + ∡OPR) = 180° – (28° + 28°)

∴ ∡POR = 180° – 56° = 124°

We have, $\angle PQR = \frac{1}{2} \times \angle POR = \frac{1}{2} \times 124° = 62°$ Thus, ∡PQR = 62°

2. दिइएको चित्रमा O वृत्तको केन्द्र हो । ∡BOC केन्द्रिय कोण र ∡BAC परिधिका कोणहरू हुन् । यदि ∡OCB = 30° भए ∡BAC को मान पत्ता लगाउनुहोस् ।



In the given figure, O is the centre of the circle, ∡BOC and ∡BAC are inscribed angles on the centre and on the circumference respectively. If ∡OCB = 30°, find ∡BAC. **[2063 C1, 2067 E]**

⇨ Here, (i) 2 ∡ OCB + ∡BOC = 180° [Sum of angles of isosceles triangle BOC]

or, 2 × 30° + ∡BOC = 180° ∴ ∡BOC = 120°

(ii) $\angle BAC = \frac{1}{2} \angle BOC = \frac{1}{2} \times 120° = 60°$ [Being both are on the same arc.]

Thus, the value of ∡BAC is 60°.

3. दिइएको चित्रमा 'O' वृत्तको केन्द्रबिन्दु हो । यदि ∡QPR = 40° भए ∡OQR को नाप पत्ता लगाउनुहोस् ।



In the given figure, O is the centre of a circle. If ∡QPR = 40°, find the measurement of ∡OQR. **[SLC 2065 D]**

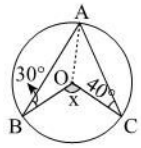
⇨ Here, (i) ∡QOR = 2∡QPR [Being both are on same arc.]

∴ ∡QOR = 2 × 40° = 80°

(ii) 2∡OQR + ∡QOR = 180° [Sum of ∡s of ΔQOR]

or, 2∡OQR + 80° = 180° ∴ ∡OQR = 50°

4. चित्रमा वृत्तको केन्द्रबिन्दु O छ । ∡ABO = 30°, ∡ACO = 40° र ∡BOC = x भए, x को मान पत्ता लगाउनुहोस् ।



In the adjoining figure, O is centre of a circle. ∡ABO = 30°, ∡ACO = 40° and ∡BOC = x. Find the value of x. **[2066 A, 2071 S]**

⇨ Here, join A and O.

(i) ∡BAO = ∡ABO = 30° [Being OA = OB]

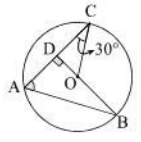
(ii) ∡OAC = ∡ACO = 40° [Being OA = OC]

(iii) ∡BAC = ∡BAO + ∡OAC = 30° + 40° = 70° [Adding (i) & (ii)]

(iv) ∡BOC = 2∡BAC = 2 × 70° = 140° [Being central angle and inscribed angle on the same arc]

∴ x = 140° Thus, x = 140°

5. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि BD ⊥ AC र ∡ACO = 30° भए ∡BAC को नाप पत्ता लगाउनुहोस् ।



In the given figure, O is the centre of the circle. If BD ⊥ AC and ∡ACO = 30°, find the measure of ∡BAC. **[2068 C]**

⇨ Here, (i) ∡BOC = ∡ODC + ∡ACO [Being exterior and opposite interior angles of ΔCDO]

or, ∡BOC = 90° + 30° ∴ ∡BOC = 120°

(ii) $\angle BAC = \frac{1}{2} \angle BOC = \frac{1}{2} \times 120°$ [Being both are on same arc.]

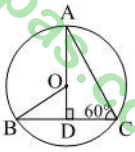
∴ ∡BAC = 60° Thus, value of ∡BAC = 60°.

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6. दिइएको चित्रमा 'O' वृत्तको केन्द्रबिन्दु छ, AD ⊥ BC र ∠ACD = 60° भए ∠DBO को मान पत्ता लगाउनुहोस् ।

In the given figure 'O' is the center of the circle, AD ⊥ BC and ∠ACD = 60°. Find the value of ∠DBO. **[2068 A]**



⇨ Here, (i) ∠AOB = 2∠ACB = 2 × 60° = 120° [Being on same arc.]

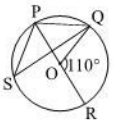
(ii) ∠AOB = ∠DBO + ∠ODB [Exterior angle and opposite interior angles of Δ]

or, 120° = ∠DBO + 90°

∴ ∠DBO = 30° Thus, the value of ∠DBO is 30°.

7. चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠QOR = 110° भए ∠PSQ को मान निकाल्नुहोस् ।

In the given figure O is the centre of the circle. If ∠QOR = 110°, calculate the value of the ∠PSQ. **[2065 B]**



⇨ Here, (i) ∠POQ = 180° – ∠QOR (Angles formed in a straight line at a point)

or, ∠POQ = 180° – 110°

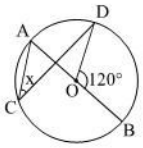
∴ ∠POQ = 70°

(ii) $\angle PSQ = \frac{1}{2} \angle POQ$ (Being angles based on same arc.)

or, $\angle PSQ = \frac{1}{2} \times 70°$ ∴ ∠PSQ = 35°

8. सँगै दिइएको चित्रमा केन्द्रबिन्दु O भएको वृत्तको व्यास AB हो र ∠BOD = 120° छ भने x को मान निकाल्नुहोस् ।

In the figure alongside, AB is the diameter of a circle with centre O, ∠BOD = 120°; find the value of x. **[2059 C1, 2069 D, 2071 A]**



⇨ Here, ∠AOD + ∠BOD = 180° [∵ ∠AOB is a straight angle.]

or, ∠AOD + 120° = 180°

or, ∠AOD = 180° – 120° = 60°

Again, 2x = ∠AOD [Angles at circumference and centre standing on same arc]

or, 2x = 60° ∴ x = 30°

9. दिइएको चित्रमा O वृत्तको केन्द्र हो । यदि ∠QOS = 128° भए ∠PRS को मान पत्ता लगाउनुहोस् ।

In the given figure, O is the centre of the circle. If ∠QOS = 128°, find ∠PRS. **[2068 E]**



⇨ Here, (i) ∠POS + ∠SOQ = 180° [Being both are on the straight line]

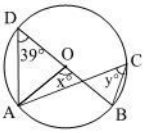
or, ∠POS + 128° = 180° ∴ ∠POS = 52°

(ii) $\angle PRS = \frac{1}{2} \angle POS = \frac{1}{2} \times 52° = 26°$ [Being on same arc.]

Thus, the measure of ∠PRS is 26°.

10. सँगै दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु र DB व्यास हो भने x° र y° को मानहरू निकाल्नुहोस् ।

In the given figure, DB is a diameter and O is the centre of the circle. Find the values of x° and y°. **[2064 E1]**



⇨ Here, (i) ∠AOB = 2∠ADO [Being both are on the same arc]

or, x° = 2 × 39° ∴ x° = 78°

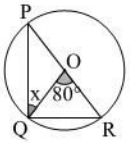
(ii) ∠ACB = ∠ADO [Being angles at the circumference being on same arc.]

or, y ° = 39°

Thus, the value of x° and y° are 78° and 39°.

11. सँगैको चित्रमा वृत्तको केन्द्रबिन्दु O छ । x को मान निकाल्नुहोस् ।

In the adjoining figure, O is centre of a circle, find the value of x. **[2066 D]**



⇨ Here,

(i) ∠OPQ = ∠OQP = x [Being OQ = OP]

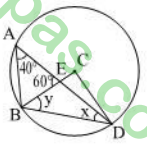
(ii) ∠QOR = 2∠QPO [Being both are on same arc.]

or, 80° = 2 × x ∴ x = 40°

Thus, the value of x is 40°.

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12. दिइएको चित्रमा C वृत्तको केन्द्र, ∡DAB = 40°, ∡AEB = 60°, ∡CBD = y° र ∡ADB = x° भए x र y को मानहरू पत्ता लगाउनुहोस् ।
In the figure, C is the centre of the circle, ∡DAB = 40°, ∡AEB = 60°, ∡CBD = y° and ∡ADB = x°, find the values of x and y. **[2064 C1]**



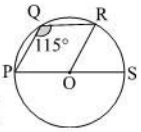
⇨ Here, (i) ∡BCD = 2∡BAD
[Being central angle and angle at the circumference on same arc.]
or, ∡BCD = 2 × 40° ∴ ∡BCD = 80°

(ii) 2y° + ∡BCD = 180° [Being ΔBCD is an isosceles triangle.]
or, 2y° + 80° = 180° or, 2y° = 100°
∴ y = 50°

(iii) x° + y° = ∡AEB [Ext. angle of Δ = Int. opp. angle]
or, x° + 50° = 60° ∴ x° = 10°

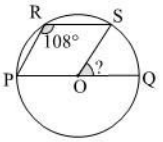
Thus, the value of x° and y° are 10° and 50°.

13. चित्रमा 'O' वृत्तको केन्द्रबिन्दु हो । यदि ∡PQR = 115° भए, ∡ROS को मान पत्ता लगाउनुहोस् ।
In given figure, 'O' is the centre of circle. If ∡PQR = 115°, find the value of ∡ROS. **[2066 S]**



⇨ Here, Reflex ∡POR = 2∡PQR [Being both are on same arc.]
or, ∡POS + ∡ROS = 2 × 115° or, 180° + ∡ROS = 230°
∴ ∡ROS = 50° Thus, the value of ∡ROS is 50°.

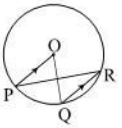
14. सँगैको चित्रमा O वृत्तको केन्द्र हो । यदि ∡PRS = 108° भए ∡SOQ को मान पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If ∡PRS = 108°, find ∡SOQ. **[2068 D]**



⇨ Here, ∡PRS = 108°

(i) Reflex angle POS = 2∡PRS (Being both are on same arc $\overset{\frown}{PQS}$)
or, ∡POQ + ∡SOQ = 2 × 108° or, 180° + ∡SOQ = 216°
∴ ∡SOQ = 36° Thus, the measure of ∡SOQ is 36°.

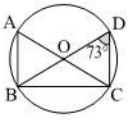
15. सँगै दिइएको वृत्तमा केन्द्रबिन्दु O छ । यदि OP // RQ र ∡OPR = 30° भए ∡POQ को नाप पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If OP // RQ and ∡OPR = 30°, find the measurement of ∡POQ. **[2071D, 2072 MW]**



⇨ Here, OP // RQ and ∡OPR = 30°
(i) ∡PRQ = ∡OPR [Being OP // RQ] ∴ ∡PRQ = 30°
(ii) ∡POQ = 2∡PRQ [Being both are on same arc.]
= 2 × 30° ∴ ∡POQ = 60°
Thus, the measurement of ∡POQ is 60°.

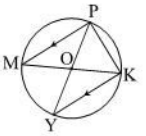
Model 2

16. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∡BDC = 73° भए ∡ACB को मान पत्ता लगाउनुहोस् ।
In the figure, O is the centre of the circle. If ∡BDC = 73°, find the value of ∡ACB. **[2071 C]**



⇨ Here, ∡BDC = 73°, ∡ACB = ?
(i) ∡BAC = ∡BDC = 73 [Being angles on same arc.]
(ii) ∡BAC + ∡ACB = 90° [Being the AC is a diagonal.]
or, 73° + ∡ACB = 90° ∴ ∡ACB = 17°
Thus, the value of ∡ACB is 17°.

17. सँगै दिइएको वृत्तको केन्द्रबिन्दु O हो । यदि ∡PKM = 60° र PM // KY भए ∡MPY को मान पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle. If ∡PKM = 60° and PM // KY then find the value of ∡MPY. **[2071 E]**



⇨ Here, ∡PKM = 60° and PM // KY
(i) ∡PMK = 90° − ∡PKM = 90° − 60° [Being MK is a diameter.]
∴ ∡PMK = 30°
(ii) ∡PYK = ∡PMK [Being angles in same arc.] ∴ ∡PYK = 30°
(iii) ∡MPY = ∡PYK [Alternate angles in parallel line] ∴ ∡MPY = 30°
Thus, the value of ∡MPY is 30°.

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18. दिइएको वृत्तको केन्द्रबिन्दु O हो । ∡PKM = 60° र PM // KY भए ∡PYK को मान पत्ता लगाउनुहोस् ।
In the figure, O is the centre of the circle. If ∡PKM = 60° and PM // KY then find the value of ∡PYK. **[2072 W]**



⇨ Here, ∡MKP = 60°

(i) ∡MKY + ∡MKP = 90° [Being PY is a diameter.]

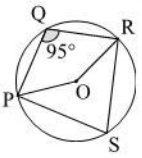
or, ∡MKY + 60° = 90° ∴ ∡MKY = 30°

(ii) ∡OYK = ∡MKY [Being OY = OK] ∴ ∡OYK = 30°

Thus, the measure of ∡PYK is 30°.

Model 3

19. दिइएको चित्रमा O केन्द्रबिन्दु भएको वृत्त छ, ∡PQR = 95° भए ∡PSR र ∡POR को नाप पत्ता लगाउनुहोस् ।
In the given figure, 'O' is the center of the circle. If ∡PQR = 95°, find the measures of ∡PSR and ∡POR. **[2068 A]**



⇨ Here, (i) ∡PQR + ∡PSR = 180° [Being opposite sides of a cyclic quadrilateral]

or, 95° + ∡PSR = 180° ∴ ∡PSR = 85°

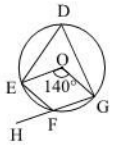
(ii) ∡POR = 2∡PSR [Being on same arc]

= 2 × 85°

∴ ∡POR = 170°

Thus, the measure of ∡PSR and ∡POR are 85° and 170° respectively.

20. सँगै दिइएको चित्रमा DEFG एउटा चक्रीय चतुर्भुज हो । जसमा O वृत्तको केन्द्रबिन्दु हो । यदि ∡GOE = 140° छ भने, ∡EFH को मान निकाल्नुहोस् ।
In the adjoining figure DEFG is a cyclic quadrilateral, where O is the centre of the circle. If ∡GOE = 140°, find the value of ∡EFH. **[2065 A]**



⇨ (i) $\angle EDG = \frac{1}{2}\angle EOG$ [Being the central angle and angle at the circumference standing on same arc.]

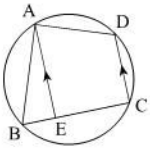
or, $\angle EDG = \frac{1}{2} \times 140° = 70°$

(ii) ∡EDG = ∡EFH [Exterior angle and opposite interior angle of a cyclic quadrilateral]

∴ ∡EFH = 70°

Thus, measure of ∡EFH is 70°.

21. दिइएको चित्रमा AB = AE, AE // DC र ∡ABE = 72° भए ∡BAD को नाप पत्ता लगाउनुहोस् ।
In the given figure, AB = AE, AE // DC and ∡ABE = 72°, find the measure of ∡BAD. **[2064 E1]**



⇨ Here, (i) ∡ABE = ∡AEB = 72° [Being AB = AE]

(ii) ∡AEB = ∡BCD [Corresponding angles in AE//CD]

or, 72° = ∡BCD

∴ ∡BCD = 72°

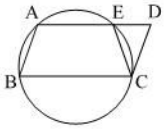
(iii) ∡BAD + ∡BCD = 180° [Opposite angles of cyclic quadrilateral]

or, ∡BAD + 72° = 180° or, ∡BAD = 180° – 72°

∴ ∡BAD = 108°

Thus, the measure of ∡BAD is 108°.

22. दिइएको चित्रमा, ABCD समानान्तर चतुर्भुज र ABCE चक्रीय चतुर्भुज हो । यदि ∡ADC = 52° भए ∡AEC को मान कति होला ?
In the figure, ABCD is parallelogram and ABCE a cyclic quadrilateral. If ∡ADC = 52°, what will be the value of ∡AEC? **[MODEL 2065]**



⇨ Here, ∡ADC = 52°

(i) ∡ABC = ∡ADC = 52° [∵ ABCD is a parallelogram.]

(ii) ∡ABC + ∡AEC = 180° [Opposite angles of cyclic quad.]

or, ∡AEC = 180° – 52° = 128°

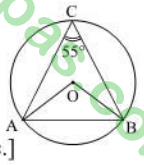
Thus, ∡AEC = 128°.

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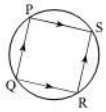
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23. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो। यदि ∡ACB = 55° भए ∡OAB को मान पत्ता लगाउनुहोस्।
In the given figure, O is the centre of circle, if ∡ACB = 55°, find the value of ∡OAB. **[2065S]**



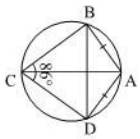
⇨ Here, ∡ACB = 55°
(i) ∡AOB = 2∡ACB [Being central angle and angle at the circumference on same arc.]
or, ∡AOB = 2 × 55°
∴ ∡AOB = 110°
(ii) 2∡OAB + ∡AOB = 180° [Being the sum of interior angles of isosceles ΔOAB]
or, 2∡OAB + 110° = 180°
or, 2∡OAB = 70°
∴ ∡OAB = 35°
Thus, the value of ∡OAB = 35°.

24. दिइएको चित्रमा PQRS एउटा चक्रीय चतुर्भुज हो। यदि PQRS एउटा समानान्तर चतुर्भुज भए ∡SPQ को मान पत्ता लगाउनुहोस्।
In the given figure PQRS is a cyclic quadrilateral. If PQRS is a parallelogram, find the value of ∡SPQ. **[2060 B1, B2, 2068 S, 2069 D, 2072 W]**



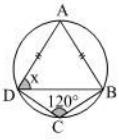
⇨ Here, (i) ∡SPQ = ∡SRQ [∵ Opp. angles of Parm. PQRS.]
(ii) ∡SPQ + ∡SRQ = 180° [∵ Opp. angles of cyclic quadrilateral are supplementary]
or, ∡SPQ + ∡SPQ = 180°
or, 2∡SPQ = 180°
∴ ∡SPQ = 90° Thus, ∡SPQ = 90°

25. दिइएको चित्रमा, ABCD एउटा चक्रीय चतुर्भुज हो। यदि AB = AD र ∡BCD = 86° भए ∡ACD को मान निकाल्नुहोस्।
In the given figure, ABCD is the cyclic quadrilateral. If AB = AD and ∡BCD = 86°, find the value of ∡ACD. **[2063 C1, 2064 A1]**



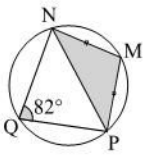
⇨ Here, ∡BAD = 180° − ∡BCD [∵ Opposite angles of a cyclic quadrilateral.]
= 180° − 86° = 94°
∴ ∡ABD = ∡ADB [∵ AB = AD]
Now, ∡ABD + ∡ADB + ∡BAD = 180°
or, ∡ABD + ∡ABD + 94° = 180° or, 2∡ABD = 180° − 94°
or, 2∡ABD = 86° ∴ $\angle ABD = \frac{86°}{2} = 43°$
∴ ∡ACD = ∡ABD [∵ Angles at circumference standing on same arc.]
∴ ∡ACD = 43°
Thus, value of ∡ACD is 43°.

26. दिइएको चित्रमा AD = AB र ∡DCB = 120° भए x को मान पत्ता लगाउनुहोस्।
In adjoining figure, if AD = AB and ∡DCB = 120°, find the value of x. **[SLC 2066 D]**



⇨ Here, (i) ∡DAB + ∡DCB = 180°
[Being the sum of opposite angles of a cyclic quadrilateral]
or, ∡DAB + 120° = 180°
∡DAB = 60°
(ii) 2∡ADB + ∡DAB = 180° [Sum of ∡s of isosceles ΔABD]
or, 2 × x + 60° = 180° or, 2x = 120°
∴ x = 60° Thus, the value of x is 60°.

27. दिइएको चित्रमा PQNM एउटा चक्रीय चतुर्भुज हो। यदि MN = MP र ∡NQP = 82° भए ∡MNP को मान पत्ता लगाउनुहोस्।
In the given figure, PQNM is a cyclic quadrilateral. If MN = MP and ∡NQP = 82°, find the value of ∡MNP. **[2067 C]**

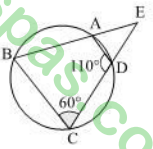


⇨ Here, MN = MP and ∡NQP = 82°
(i) ∡NMP = 180° − ∡NQP [Being opposite angles of cyclic quadrilateral]
∴ ∡NMP = 180° − 82° = 98°
(ii) 2∡MNP + ∡NMP = 180° [Being MN = MP in ΔMNP]
or, 2∡MNP + 98° = 180° or, 2∡MNP = 82°
∴ ∡MNP = 41°
Thus, the measure of ∡MNP is 41°.

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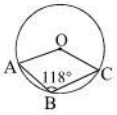
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28. दिइएको चित्रमा यदि ∠ADC = 110° र ∠BCE = 60° भए ∠BEC को मान पत्ता लगाउनुहोस् ।
In the given figure, if ∠ADC = 110° & ∠BCE = 60°, find ∠BEC. **[2068 D]**



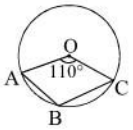
⇨ Here, ∠BCE = 60° and ∠ADC = 110°
(i) ∠BCE = ∠EAD [Being exterior and opposite interior angle of cyclic quadrilateral]
or, 60° = ∠EAD ∴ ∠EAD = 60°
(iii) ∠BEC + ∠EAD = ∠ADC [Being exterior angle and opposite interior angle of ΔAED]
or, ∠BEC + 60° = 110° ∴ ∠BEC = 50°
Thus, the measure of ∠BEC is 50°.

29. सँगै दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो भने O मा बनेको अधिक कोण र बृहत् कोण पत्ता लगाउनुहोस् ।
In the given circle alongside O is the centre. Find the obtuse angle and reflex angle formed at O. **[2061 E1, 2062 B1, 2063 A2]**



⇨ Here, Reflex ∠AOC = 2∠ABC
[∵ Angles at the centre and circumference,standing on the same arc.]
= 2 × 118° = 236°
Obtuse ∠AOC = 360° – reflex ∠AOC = 360° – 236° = 124°

30. दिइएको वृत्तमा 'O' वृत्तको केन्द्रबिन्दु हो र ∠AOC = 110° भए ∠ABC को मान कति हुन्छ ?
In the given circle, O is its centre and ∠AOC = 110°, what will be the value of ∠ABC ? **[2059 E1, E2]**



⇨ Here, ∠AOC (reflex) = 360° – 110° = 250°

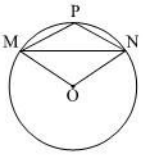
$\therefore \quad \angle ABC = \frac{1}{2} \angle AOC \text{ (reflex)}$

[∵ Angle at circumference and angle at the centre standing on the same arc.]

$= \frac{1}{2} \times 250° = 125°$

Thus, ∠ABC = 125°

31. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠ONM = 28° भए ∠MPN को मान कति होला ?
In the given figure, O is the centre of the circle, if ∠ONM = 28°, what will be the value of ∠MPN ? **[2064 D1]**



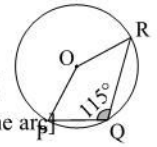
⇨ Here, (i) 2∠ONM + ∠MON = 180° [Being the sum of isosceles ΔMON]
or, 2 × 28° + ∠MON = 180° or, ∠MON = 180° – 56°
∴ ∠MON = 124°

(ii) $\angle MPN = \frac{1}{2}$ Reflex ∠MON [Being central angle and angle at circumference an same arc.]

$= \frac{1}{2} \times (360° - \angle MON) = \frac{1}{2} \times (360° - 124°) = \frac{1}{2} \times 236° = 118°$

Thus, the measure of ∠MPN is 118°

32. दिइएको वृत्तको केन्द्रबिन्दु O हो । यदि ∠PQR = 115° भए अधिक कोण POR पत्ता लगाउनुहोस् ।
The centre of the given circle is O. If ∠PQR = 115°, find the obtuse angle POR. **[2066 C]**



⇨ Here, (i) 2∠PQR = Reflex ∠POR [Being central angle and inscribed angle on same arc]
or, 2 × 115° = Reflex ∠POR
∴ Reflex ∠POR = 230°
(ii) Reflex ∠POR + Obtuse ∠POR = 360° [Angles at a point]
or, 230° + Obtuse ∠POR = 360°
∴ Obtuse ∠POR = 130°
Thus, the obtuse ∠POR is 130°.

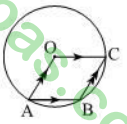
33. दिइएको चित्रमा केन्द्रबिन्दु O भएको वृत्त छ । यदि OPQR एउटा समानान्तर चतुर्भुज भए ∠OPQ को मान निकाल्नुहोस् ।
O is the centre of the circle given in the diagram. If OPQR is a parallelogram, find the value of ∠OPQ. **[SLC 2065 C]**



⇨ Here, join OQ.
(i) PO = QR, OR = PQ [Sides of a parallelogram]
(ii) PO = OQ = OR [Radii of a circle]
(iii) ΔPOQ and ΔQOR are equilateral Δs [From (i) and (ii)]
(iv) ∠OPQ = 60° [Angle of an equilateral ΔPOQ]

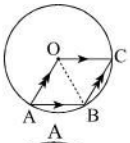
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34. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो र OABC एउटा समानान्तर चतुर्भुज हो भने ∡ABC को मान निकाल्नुहोस् ।
In the given figure, if O is the centre of the circle and OABC is a parallelogram, find the value of ∡ABC. **[2068 B, 2067 A]**

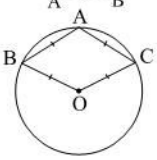


⇨ Here, join OB. OABC is rhombus and ΔOAB and ΔOBC both are equilateral triangle because OA = OC = OB, AB = OC and OA = BC

(i) ∡ABO = 60° [Angles of an equilateral triangle]
(ii) ∡OBC = 60° [Angles of an equilateral triangle]
(iii) ∡ABC = ∡ABO + ∡OBC = 60° + 60° = 120°



35. दिइएको चित्रमा, O वृत्तको केन्द्र हो । यदि ABOC एउटा समबाहु चतुर्भुज हो भने ∡BAC को मान पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle. If ABOC is a rhombus, find the value of ∡BAC. **[2072 E]**

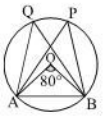


⇨ Here, ABOC is a rhombus.

(i) ∡BAC = ∡BOC = x [Being the opposite angles of rhombus.]
(ii) Reflex ∡BOC = 2∡BAC [Being both are on same arc.]
or, Reflex ∡BOC = 2 × x = 2x
(iii) Reflex ∡BOC + ∡BOC = 360° [Being the parts of a complete angle.]
or, 2x + x = 360°
or, 3x = 360°
∴ x = 120°
Thus, the measure of ∡BAC is 120°.

Model 4

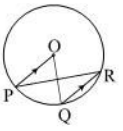
36. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∡AOB = 80° भए ∡AQB + ∡APB को मान कति हुन्छ ? पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle. If ∡AOB = 80° then what is the value of ∡AQB + ∡APB ? Find it. **[2071 B]**



⇨ Here, ∡AOB = 80° and ∡APB = ∡AQB [Being both are on same arc.]

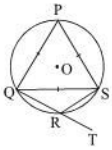
(i) $\angle APB = \angle AQB = \frac{1}{2}\angle AOB$ ∴ $\angle APB = \angle AQB = \frac{1}{2} \times 80° = 40°$
(ii) ∡APB + ∡AQB = 40° + 40° = 80°

37. सँगै दिइएको वृत्तमा केन्द्रबिन्दु O छ । यदि OP // RQ र ∡OPR = 30° भए ∡POQ को नाप पत्ता लगाउनुहोस् ।
In the adjoining figure, O is the centre of the circle. If OP // RQ and ∡OPR = 30°, find the measurement of ∡POQ. **[2071 D]**



⇨ Here, OP // RQ and ∡OPR = 30°
(i) ∡PRQ = ∡OPR [Being OP // RQ] ∴ ∡PRQ = 30°
(ii) ∡POQ = 2∡PRQ [Being both are on same arc.]
= 2 × 30° ∴ ∡POQ = 60°
Thus, the measurement of ∡POQ is 60°.

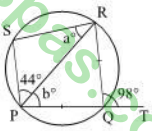
38. दिइएको चित्रमा, PQRS एउटा चक्रीय चतर्भुज हो । यदि ΔPQS समबाहु त्रिभुज भए ∡SRT को मान कति होला ?
In the given figure, PQRS is a cyclic quadrilateral. If ΔPQS is an equilateral triangle, what will be the value of ∡SRT ? **[2064 C1]**



⇨ Here, (i) ∡QPS = 60° [Being an angle of an equilateral triangle PQS]
(ii) ∡SRT = ∡QPS [Being exterior angle and opposite angle of cyclic quadrilateral.
∴ ∡SRT = 60°
Thus, the value of ∡SRT is 60°.

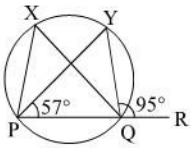
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39. दिइएको चित्रमा, PQRS एक चक्रीय चतुर्भुज हो। $\measuredangle RQT = 98°$, $\measuredangle SPR = 44°$ र PQ = QR भए a र b को मान निकाल्नुहोस्।
In the given figure, PQRS is a cyclic quadrilateral. If $\measuredangle RQT = 98°$, $\measuredangle SPR = 44°$ and PQ = QR, find the values of a and b. **[2064 D1]**



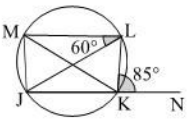
⇨ Here, (i) $\measuredangle PSR = \measuredangle RQT = 98°$ [Being exterior angle and opposite angle of a cyclic quadrilateral]
(ii) $\measuredangle PSR + \measuredangle SPR + \measuredangle SRP = 180°$ [Being sum angles of ΔSPR]
or, $98° + 44° + a° = 180°$ or, $142° + a° = 180°$
or, $a° = 180° - 142°$ ∴ $a° = 38°$
(iii) $\measuredangle PRQ = \measuredangle RPQ = b°$ [Being PQ = QR]
(iv) $\measuredangle PRQ + \measuredangle RPQ = \measuredangle RQT$ [Exterior and opposite interior angles of ΔPRQ]
or, $b° + b° = 98°$ or, $2b° = 98°$
∴ $b° = 49°$
Thus, the value of a and b are 38° and 49°.

40. दिइएको चित्रमा $\measuredangle YPQ = 57°$ र $\measuredangle YQR = 95°$ भए $\measuredangle PXQ$ को मान पत्ता लगाउनुहोस्।
In the given figure, if $\measuredangle YPQ = 57°$ and $\measuredangle YQR = 95°$, find the value of the $\measuredangle PXQ$. **[2063 D1]**



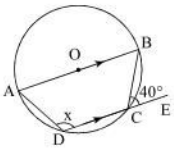
⇨ Here, in ΔYPQ, $\measuredangle YPQ + \measuredangle PYQ = \measuredangle YQR$
[∵ In a triangle, Ext. angle = Sum of Opp. interior angles.]
or, $\measuredangle PYQ = \measuredangle YQR - \measuredangle YPQ$
or, $\measuredangle PYQ = 95 - 57° = 38°$
Now, $\measuredangle PXQ = \measuredangle PYQ$ [∵ Angles at same arc]
∴ $\measuredangle PXQ = 38°$

41. दिइएको चित्रमा $\measuredangle JML$ र $\measuredangle MKL$ पत्ता लगाउनुहोस्।
In the given figure, find $\measuredangle JML$ and $\measuredangle MKL$. **[2067 D]**



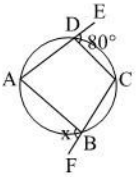
⇨ Here, (i) $\measuredangle JML = \measuredangle LKN$
[Being exterior angle and opposite of cyclic quadrilateral]
or, $\measuredangle JML = 85°$
(ii) $\measuredangle MJL + \measuredangle MLJ + \measuredangle JML = 180°$ [Being the sum of angles of ΔJML]
or, $\measuredangle MJL + 60° + 85° = 180°$ or, $\measuredangle MJL + 145° = 180°$
∴ $\measuredangle MJL = 35°$
(iii) $\measuredangle MKL = \measuredangle MJL$ [Being both are on same arc]
∴ $\measuredangle MKL = 35°$
Thus, the measure of $\measuredangle JML$ and $\measuredangle MKL$ are 85° and 35°.

42. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु हो। यदि AB // DC, $\measuredangle BCE = 40°$ र $\measuredangle ADC = x$ छन् भने x को मान पत्ता लगाउनुहोस्।
In the adjoining figure, O is the centre of the circle. If AB // DC, $\measuredangle BCE = 40°$, and $\measuredangle ADC = x$, find the value of x. **[2063 E1]**



⇨ Here, (i) $\measuredangle ABC = \measuredangle BCE$ [Alternate angles in parallel lines]
∴ $\measuredangle ABC = 40°$
(ii) $\measuredangle ABC + \measuredangle ADC = 180°$ [Opposite angles of a cyclic quadrilateral]
or, $40° + \measuredangle x = 180°$ or, $x = 180° - 40°$
∴ $x = 140°$
Thus, the value of x is 140°.

43. चित्रमा, A, B, C र D एउटा चक्रीय चतुर्भुज ABCD का शीर्षबिन्दुहरू हुन्। यदि $\measuredangle EDC = 80°$ र $\measuredangle ABF = x°$ भए x को मान पत्ता लगाउनुहोस्।
In the given figure, A, B, C and D are the vertices of a cyclic quadrilateral ABCD and $\measuredangle EDC = 80°$ and $\measuredangle ABF = x°$; find the value of x. **[2058 B2]**



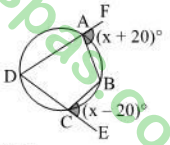
⇨ Here, $\measuredangle ADC = 180° - 80° = 100°$ and $\measuredangle ABC = 180° - x°$
Then, $\measuredangle ADC + \measuredangle ABC = 180°$ [Being opposite angles of a cyclic quadrilateral.]
or, $100° + 180° - x° = 180°$ or, $100° + 180° - 180° = x°$
or, $x° = 100°$ ∴ $x = 100$

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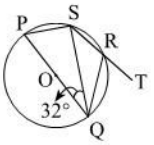
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44. दिइएको चित्रमा ABCD एक चक्रीय चतुर्भुज हो। जसमा ∠FAB = (x + 20)° र ∠BCE = (x – 20)° भए x को मान निकाल्नुहोस् ।
In the given figure, ABCD is a cyclic quadrilateral. If ∠FAB = (x + 20)° and ∠BCE = (x – 20)°, find the value of x. **[SLC 2066 C]**



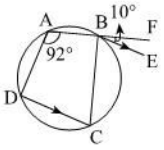
⇨ Here, (i) ∠DAB = ∠BCE [Exterior angle and opposite interior angle of cyclic quad. ABCD]
∴ ∠DAB = (x – 20)°
(ii) ∠DAB + ∠FAB = 180° [Adjacent angles in a straight line]
or, (x – 20)° + (x + 20)° = 180° or, x – 20 + x + 20 = 180°
or, 2x = 180° ∴ x = 90°
Thus, the value of x is 90°.

45. दिइएको चित्रमा वृत्तको केन्द्रबिन्दु O हो। PQ वृत्तको व्यास यदि ∠PQS = 32° भए ∠QRT को नाप कति हुन्छ ?
In the given figure alongside, O is the centre of a circle. PQ is a diameter of the circle. If ∠PQS = 32°, what will be the measurement of ∠QRT ? **[2064 D2]**



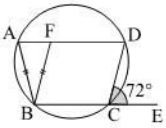
⇨ Here, (i) ∠QPS = 90° – ∠PQS = 90° – 32° [Being PQ is a diameter]
∴ ∠QPS = 58°
(ii) ∠QRT = ∠QPS [Being exterior and opposite interior angle of a cyclic quadrilateral]
∴ ∠QRT = 58°

46. दिइएको चित्रमा ABCD एउटा चक्रीय चतुर्भुज हो जसमा AB लाई F सम्म बढाइएको छ। यदि DC // BE, ∠DAB = 92° र ∠FBE = 10° भए ∠ADC को मान निकाल्नुहोस् ।
In the given figure, ABCD is a cyclic quadrilateral in which AB is produced to F. If DC // BE, ∠DAB = 92° and ∠FBE = 10°, evaluate the ∠ADC. **[2065 B]**



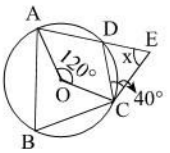
⇨ Here, (i) ∠DCB = 180° – ∠DAB = 180° – 92° = 88°
[Being the opposite angles of a cyclic quadrilateral]
(ii) ∠EBC = ∠DCB = 88° [Being the alternate angles in // lines]
(iii) ∠ADC = ∠FBC [Exterior angle and opposite interior angle of a cyclic quadrilateral.]
∴ ∠ADC = 10° + 88° = 98°

47. दिइएको चित्रमा ABCD चक्रीय चतुर्भुज हो। यदि AB = BF र ∠DCE = 72° भए ∠ABF को मान निकाल्नुहोस् ।
In the given figure, ABCD is a cyclic quadrilateral, if AB = BF and ∠DCE = 72°, find ∠ABF. **[2067 E]**



⇨ Here, (i) ∠BAF = ∠DCE [Being exterior angle and opposite interior angle of cyclic quadrilateral]
∴ ∠BAF = 72°
(ii) 2∠BAF + ∠ABF = 180° [Sum of angles of isosceles triangle]
or, 2 × 72° + ∠ABF = 180° or, ∠ABF = 180° – 144°
∴ ∠ABF = 36°
Thus, the value of ∠ABF = 36°.

48. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु र ABCD एउटा चक्रीय चतुर्भुज हो। यदि ∠AOC = 120°, ∠DCE = 40° र ∠DEC = (x)° भए, x को मान निकाल्नुहोस् ।
In the given diagram O is the centre of circle and ABCD is a cyclic quadrilateral. If ∠AOC = 120°, ∠DCE = 40° and ∠DEC = (x)°, find the value of x. **[2065 E]**



⇨ Here, (i) $\angle ABC = \frac{1}{2} \angle AOC$ [Being angle at the circumference and central angle on the same arc]

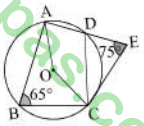
or, $\angle ABC = \frac{1}{2} \times 120°$ ∴ ∠ABC = 60°

(ii) ∠CDE = ∠ABC = 60° [Being ABCD is a cyclic quadrilateral]
(iii) ∠CDE + 40° + x = 180° [Sum of ∠s of ΔDCE]
or, 60° + 40° + x = 180° or, 100° + x = 180°
∴ x = 80°

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49. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु र ABCD एउटा चक्रीय चतुर्भुज हो। यदि ∠ABC = 65° र ∠CED = 75° भए ∠DCE को मान निकाल्नुहोस्।

In the given diagram, O is the centre of the circle and ABCD is a cyclic quadrilateral. If ∠ABC = 65° and ∠CED = 75°, find the value of ∠DCE. **[2066 E]**



⇨ Here, (i) ∠CDE = ∠ABC = 65° [Being exterior and opposite interior angle of a cyclic quadrilateral ABCD]

(ii) ∠CDE + E + ∠DCE = 180° [Sum of ∠S of ∠DCE]

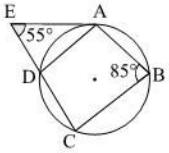
or, 65° + 75° + ∠DCE = 180° or, ∠DCE = 180° – 140°

∴ ∠DCE = 40°

Thus, the value of ∠DCE is 40°.

50. दिइएको चित्रमा O वृत्तको केन्द्र हो। यदि ∠ABC = 85° र ∠AED = 55° भए ∠EAD पत्ता लगाउनुहोस्।

If the given figure, O is the centre of circle. If ∠ABC = 85° and ∠AED = 55°, find ∠EAD. **[2068 B]**



⇨ Here, (i) ∠ABC + ∠ADC = 180° [Being the opposite angles of cyclic quadrilateral.]

or, 85° + ∠ADC = 180°

∴ ∠ADC = 95°

(ii) ∠ADC = ∠DEA + ∠EAD [Being exterior angle and opposite interior angle of ΔEDA]

or, 95° = 55° + ∠EAD

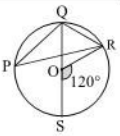
∴ ∠EAD = 40°

Thus, the measure of ∠EAD is 40°.

Model 5

51. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो। यदि ∠SOR = 120° भए ∠QPR को मान पत्ता लगाउनुहोस्।

In the given figure, O is the centre of the circle. If ∠SOR = 120°, then find the value of ∠QPR. **[2071 A]**



⇨ Here, ∠SOR = 120°

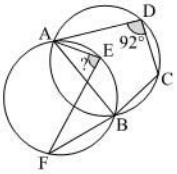
(i) ∠QOR = 180° – ∠SOR = 180° – 120° = 60° [Being the parts of straight angle.]

(ii) $\angle QPR = \frac{1}{2}\angle QOR = \frac{1}{2} \times 60° = 30°$ [Being the angles of same arc.]

Thus, the value of ∠QPR is 30°.

52. दिइएको चित्रमा दुईओटा वृत्तहरूका बिन्दुहरू A र B मा प्रतिच्छेदन भएका छन् र CBF एउटा सीधारेखा हो। यदि ∠ADC = 92° भए ∠AEF को नाप पत्ता लगाउनुहोस्।

In the given figure, two circles intersect at the points A and B and CBF is a straight line. If ∠ADC = 92°, find the size of ∠AEF. **[2072 E]**



⇨ Here, ∠ADC = 92°

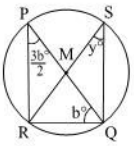
(i) ∠ABF = ∠ADC = 92° [Being exterior angle and opposite interior angle.]

(ii) ∠AEF = ∠ABF [Being both are on same arc.]

∴ ∠AEF = 92° Thus, the measure of ∠AEF is 92°.

53. दिइएको चित्रमा, M वृत्तको केन्दबिन्दु हो। यदि ∠PQR = b° र $\angle RPQ = \frac{3b°}{2}$ र ∠RSQ = y° भए y को मान पत्ता लगाउनुहोस्।

In the given figure, M is the centre of the circle. If ∠PQR = b°, $\angle RPQ = \frac{3b°}{2}$ and ∠RSQ = y°, find the value of y. **[2064 A1]**



⇨ Here, (i) ∠R = 90° [Being M is the centre of circle.]

(ii) ∠RPQ + ∠RQP = 90° [Being acute angles of rt. ∠d Δ.]

or, $\frac{3b°}{2} + b° = 90°$ or, $\frac{5b°}{2} = 90°$

or, $b° = 90° \times \frac{2}{5}$ ∴ b° = 36°

(iii) ∠S = ∠P [Being angles at the circumference being on same arc]

or, $y° = \frac{3b°}{2}$ or, $y° = \frac{3 \times 36°}{2}$

Thus, y° = 54°

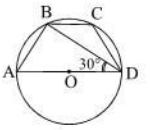
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54. चित्रमा PQ वृत्तको व्यास हो । $\angle RSQ = 28°$ भए $\angle PQR$ को मान निकाल्नुहोस् ।
In the figure, PQ is a diameter of the circle. If $\angle RSQ = 28°$, find the value of $\angle PQR$.



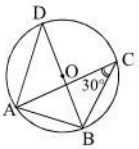
⇨ Here, (i) $\angle RPQ = \angle RSQ = 28°$ [∵ Being both are on same arc.]
(ii) $\angle RPQ + \angle PQR = 90°$ [∵ Being angles at diameter.]
or, $28° + \angle PQR = 90°$ ∴ $\angle PQR = 60°$
Thus, value of $\angle PQR$ is 60°.

55. दिइएको वृत्तमा 'O' केन्द्रबिन्दु र ABCD चक्रीय चतुर्भुज हुन् । यदि $\angle ADB = 30°$ भए $\angle BCD$ को मान कति होला ?
In the given circle, O is its centre and ABCD is a cyclic quadrilateral. If $\angle ADB = 30°$, what will be the value of $\angle BCD$? [2058 A2]



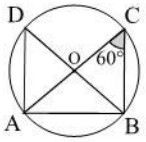
⇨ Here, $\angle ABD = 90°$ [∵ being the angle at the semi circle]
$\angle A + \angle B + \angle D = 180°$ [∵ sum of the three internal angles of a triangle.]
or, $\angle A + 90° + 30° = 180°$ or, $\angle A = 180° - 120° = 60°$
Now, $\angle A + \angle C = 180°$ [Being the opposite angles of a cyclic quadrilateral.]
∴ $\angle C = 180° - \angle A = 180° - 60° = 120°$
Thus, value of $\angle BCD$ is 120°.

56. दिइएको चित्रमा BD, वृत्तको व्यास हो र $\angle ACB = 30°$ भए $\angle DBA$ को मान कति होला ?
In the given figure, BD is a diameter of the circle ABCD and $\angle ACB = 30°$. What is the value of $\angle DBA$? [2058 D2, Model 2063]



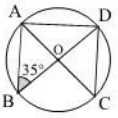
⇨ Here, $\angle ADB = \angle ACB$ [Angles at the circumference standing on the same arc.]
∴ $\angle ADB = 30°$
In ΔADB, $\angle BAD + \angle ADB + \angle DBA = 180°$
or, $90° + 30° + \angle DBA = 180°$
or, $120° + \angle DBA = 180°$
∴ $\angle DBA = 180° - 120° = 60°$
Thus, value of $\angle DBA$ is 60°.

57. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि $\angle ACB = 60°$ भए $\angle DBA$ को मान निकाल्नुहोस् ।
In the given figure, O is the centre of the circle. If $\angle ACB = 60°$, find $\angle DBA$. [2067 D]



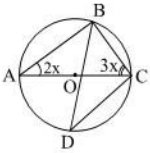
⇨ Here, (i) $\angle ADB = \angle ACB$ [Both are on same arc]
∴ $\angle ADB = 60°$
(ii) $\angle DBA + \angle ADB = 90°$ [Being BD is a diameter]
or, $\angle DBA + 60° = 90°$
∴ $\angle DBA = 30°$
Thus, the measure of $\angle DBA$ is 30°.

58. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । $\angle ABD = 35°$ भए $\angle CAD$ को मान पत्ता लगाउनुहोस् ।
In the given figure, 'O' is the center of the circle. If $\angle ABD = 35°$, find the value of $\angle CAD$. [2067 B]



⇨ Here, (i) $\angle ACD = \angle ABD$ [Being both are in same arc]
∴ $\angle ACD = 35°$
(ii) $\angle CAD + \angle ACD = 90°$ [Being AC is a diameter]
or, $\angle CAD + 35° = 90°$ ∴ $\angle CAD = 55°$

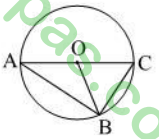
59. सँगै दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । AC व्यास हो । यदि $\angle BAC = 2x$ र $\angle ACB = 3x$ भए $\angle BDC$ को मान पत्ता लगाउनुहोस् ।
In the figure, O is the centre of the circle. AC is the diameter. If $\angle BAC = 2x$ and $\angle ACB = 3x$, find the value of $\angle BDC$. [2063 A1]



⇨ Here, $\angle BAC + \angle ABC + \angle BCA = 180°$
or, $2x + 90° + 3x = 180°$ [∵ $\angle ABC = 90°$, being angle in semi-circle.]
or, $5x = 180° - 90°$ or, $5x = 90°$
∴ $x = \frac{90°}{5} = 18°$ Now, $\angle BAC = 2 \times 18° = 36°$
Thus, $\angle BDC = \angle BAC = 36°$. [∵ Angles of circumference standing on the same arc.]

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60. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु हो । यदि $2\measuredangle A = \measuredangle C = x°$ भए $\measuredangle OBC$ को मान निकाल्नुहोस् ।
In the given figure O is the centre of circle. If $2\measuredangle A = \measuredangle C = x°$, find the value of $\measuredangle OBC$. **[2065 B, E]**



⇨ Here, (i) $\measuredangle A + \measuredangle C = 90°$ [Being AC is diameter]
or, $\measuredangle A + 2\measuredangle A = 90°$ or, $3\measuredangle A = 90°$ ∴ $\measuredangle A = 30°$
(ii) $\measuredangle OBC = \measuredangle C = 2\measuredangle A = 2 \times 30° = 60°$ [Being OB = OC and given]
∴ $\measuredangle OBC = 60°$
Thus, value of $\measuredangle OBC$ is 60°.

61. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो, जसमा $\measuredangle OQP = 48°$ छ । यदि चाप PR = चाप RQ भए $\measuredangle RSQ$ को नाप पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle in which $\measuredangle OQP = 48°$. If the arc PR = the arc RQ, calculate the measure of the $\measuredangle RSQ$. **[2066 B]**



⇨ Here, (i) $\measuredangle POQ = 180° - 2\measuredangle OQP$ [Being OP = OQ in ΔOPQ]
$= 180° - 2 \times 48° = 84°$

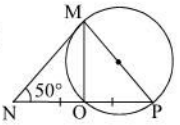
(ii) $\measuredangle PSQ = \frac{1}{2}\measuredangle POQ$ [Being both are on same arc]

$= \frac{1}{2} \times 84° = 42°$

(iii) $\measuredangle RSQ = \frac{1}{2}\measuredangle PSQ$ [Being $\overset{\frown}{PR} = \overset{\frown}{RQ}$]

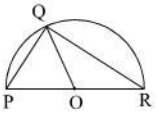
$= \frac{1}{2} \times 42 = 21°$ Thus, the measure of $\measuredangle RSQ$ is 21°.

62. दिइएको चित्रमा वृत्तको व्यास MP छ । NP को मध्यबिन्दु O तथा $\measuredangle PNM = 50°$ छ भने $\measuredangle MPN$ को मान पत्ता लगाउनुहोस् ।
In the given figure, MP is a diameter of the circle, O is the mid point of NP and $\measuredangle PNM = 50°$, find the value of $\measuredangle MPN$. **[2064 B1]**



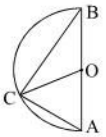
⇨ Here, (i) $\measuredangle MOP = 90°$ [Angle at the circumference of semi-circle]
(ii) MN = MP [From (i) $\perp_r$ drawn through vertex to the base has bisected the base]
(iii) $\measuredangle MNO = \measuredangle MPN$ [From (ii) base angles of an isosceles triangle.]
or, $50° = \measuredangle MPN$
∴ $\measuredangle MPN = 50°$
Thus, the value of $\measuredangle MPN$ is 50°

63. O केन्द्रबिन्दु भएको अर्धवृत्त PQR मा PQ = 6 cm, QR = 8 cm भए, OQ को मान निकाल्नुहोस् ।
In the semicircle PQR of centre O. PQ = 6 cm, QR = 8 cm. Find the length of OQ. **[2062 E1]**



⇨ Here, (i) $\measuredangle PQR = 90°$ [∵ Angle in semi circle]
(ii) $PR^2 = PQ^2 + QR^2$ [∵ Pythagoras theorem]
∴ $PR = \sqrt{PQ^2 + QR^2} = \sqrt{(6\text{ cm})^2 + (8\text{ cm})^2} = \sqrt{36 + 64}\text{ cm} = \sqrt{100}\text{ cm} = 10\text{ cm}$
(iii) $OR = \frac{PR}{2} = \frac{10\text{ cm}}{2} = 5\text{ cm}$
(iv) OQ = OR = 5 cm
Thus, the length of OQ is 5 cm.

64. O केन्द्रबिन्दु भएको अर्धवृत्त ACB मा OC = 5 cm, AC = 8 cm भए, BC को मान निकाल्नुहोस् ।
In the semicircle ACB of centre O, OC = 5 cm, AC = 8 cm. Find the length of BC. **[2062 E2]**

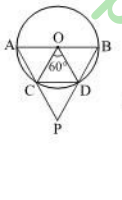


⇨ Here, (i) OA = OB = OC [∵ radius of same circle]
(ii) OA = OB = OC = 5 cm [∵ Given]
(iii) AB = 2AO = 2 × 5 cm = 10 cm
$\measuredangle ACB = 90°$ [∵ Angle in semi-circle]
$AC^2 + BC^2 = AB^2$ [In rt. angled triangle ACB]
or, $(8\text{ cm})^2 + BC^2 = (10\text{ cm})^2$
or, $BC^2 = 100\text{ cm}^2 - 64\text{ cm}^2 = 36\text{ cm}^2$
∴ $BC = \sqrt{36\text{ cm}^2} = 6\text{ cm}$
Thus, length of BC is 6 cm.

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65. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∡COD को मान 60° भए ∡APB को मान निकाल्नुहोस् ।
In the given diagram, O is the centre of the circle. If ∡COD = 60°, find the value of ∡APB. **[2065 C]**



⇨ Here, join BC

(i) $\angle CBP = \frac{1}{2}\angle COD = \frac{1}{2} \times 60° = 30°$

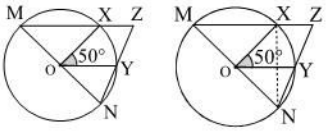
[Being central angle and angle at the circumference on the same arc]

(ii) ∡ACB = 90° [Since AB is a diameter]

(iii) ∡CBP + ∡BPC = ∡ACB [Being exterior and interior angles of a triangle]

or, 30° + ∡BPC = 90° ∴ ∡BPC = 60°

66. दिइएको चित्रमा 'O' वृत्तको केन्द्रबिन्दु हो । ∡XOY = 50° भए ∡XZY को मान पत्ता लगाउनुहोस् ।
In the figure 'O' is the center of circle. ∡XOY = 50°, find the value of ∡XZY. **[2067 B]**



⇨ Here, join XN

(i) $\angle XNZ = \frac{1}{2}\angle XOY$ [Being both are on same arc.]

$\therefore \angle XNZ = \frac{1}{2} \times 50° = 25°$

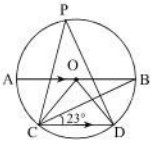
(ii) ∡XZY + ∡XNZ = ∡MXN [Being exterior angle and opposite interior angle of ΔXNZ]

or, ∡XZY + 25° = 90° [Being MN is a diameter.]

∴ ∡XZY = 65°

Thus, the value of ∡XZY is 65°.

67. दिइएको चित्रमा, O केन्द्रबिन्दु भएको एउटा वृत्त हो । यदि AB // CD र ∡BCD = 23° भए ∡CPD को मान पत्ता लगाउनुहोस् ।
Given diagram is a circle with centre O. If AB // CD and ∡BCD = 23°, calculate the value of the ∡CPD. **[2063 D1]**



⇨ Here, ∡BCD = ∡ABC = 23° [∵ Alternate angles and AB // CD]

∡DOB = 2 ∡BCD and, ∡AOC = 2 ∡ABC [Angles central and circumference standing on the same arc.]

∴ ∡DOB = 2 × 23° = 46° and ∡AOC = 2 × 23° = 46°

Now, ∡COD + ∡DOB + ∡AOC = 180°

or, ∡COD + 46° + 46° = 180°

∴ ∡COD = 180° – 2 × 46° = 88°

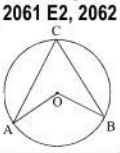
$\therefore \angle CPD = \frac{1}{2}\angle COD = \frac{1}{2}\, 88° = 44°$

Thus, value of ∡CPD is 44°.

B. LONG QUESTIONS THEORETICAL QUESTIONS

Model 1

1. वृत्तको एउटै चापमा आधारित केन्द्रीय कोण परिधि कोणको दोब्बर हुन्छ भनी प्रमाणित गर्नुहोस् ।
Prove that the angle at the center is twice the angle at the circumference subtended by the same arc. [2060 D2, 2057 B2, 2057 D1, 2057 D2, 2060 B1 and B2 and 2059 A1 and A2 and 2058 B2, 2061 E1, 2063 E1, E2, 2061 E2, 2062 B2, 2065 A, 2065 B, 2066 A]



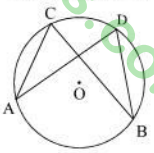
⇨ Here, **Given:** O is the centre of the circle. ∡AOB and ∡ACB are the central angle and angle at the circumference standing on arc AB.
To prove: ∡AOB = 2 ∡ACB
Proof:

Statements	Reasons
1. ∡AOB = $\overset{\frown}{AB}$°	1. Central angle is equal to the degree measure of opposite arc.
2. ∡ACB = 1/2 $\overset{\frown}{AB}$°	2. Angle at the circumference is one half of the degree measure of opposite arc.
3. $\overset{\frown}{AB}$° = 2∡ACB	3. From statement (2)
4. ∡AOB = 2 ∡ACB	4. From statement (1) and (3) **Proved.**

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2. एउटै चापमा (वृत्तखण्डमा) आधारित परिधिका कोणहरू बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।
Prove that the angles at the circumference of the circle standing on the same arc are equal. **[2057 C2, 2062 B1]**



⇨ Here, **Given:** O is the centre of the circle. $\angle ACB$ and $\angle ADB$ are the angle at the circumference standing on same arc AB.

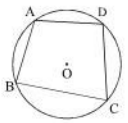
To prove: $\angle ACB = \angle ADB$

Proof:

Statements	Reasons
1. $\angle ACB = \frac{1}{2}\overset{\frown}{AB}°$	1. Angle at the circumference is one half of the degree measure of opposite arc.
2. $\angle ADB = \frac{1}{2}\overset{\frown}{AB}°$	2. Angle at the circumference is one half of the degree measure of opposite arc.
3. $\angle ACB = \angle ADB$	3. From (1) and (2)

Proved.

3. चक्रीय चतुर्भुजको सम्मुख कोणहरूको योग दुई समकोण हुन्छ भनी सिद्ध गर्नुहोस् ।
Prove that the opposite angles of a cyclic quadrilateral are supplementary.
[2060 A1, A2, 2058 D1, 2057 B1, 2057 S, 2058 B1, Model 2063, 2060 S, 2058 S, 2066 D]



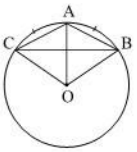
⇨ Here, **Given:** O is the centre of the circle. ABCD is the cyclic quadrilateral.
To prove: $\angle BAD + \angle BCD = 180°$ and $\angle ABC + \angle ADC = 180°$
Proof:

Statements	Reasons
1. $\angle BAD = \frac{1}{2}\overset{\frown}{BCD}°$	1. Angle at the circumference is one half of the degree measure of opposite arc.
2. $\angle BCD = \frac{1}{2}\overset{\frown}{BAD}°$	2. Angle at the circumference is one half of the degree measure of opposite arc.
3. $\angle BAD + \angle BCD = \frac{1}{2}(\overset{\frown}{BCD}° + \overset{\frown}{BAD}°)$ or, $\angle BAD + \angle BCD = \frac{1}{2}$ circumference	3. Adding (1) and (2) $\overset{\frown}{BCD}° + \overset{\frown}{BAD}°$ = circumference
4. $\angle BAD + \angle BCD = \frac{1}{2} \times 360° = 180°$	4. Being circumference = 360°
5. Similarly $\angle ABD + \angle ADC = 180°$	5. Proceeding as above.

Proved.

Model 2

4. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि $\overset{\frown}{AC} = \overset{\frown}{AB}$ र $\angle ABO$ को अर्धक BC भए, ΔABO समबाहु त्रिभुज हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the figure, O is the centre of the circle. If $\overset{\frown}{AC} = \overset{\frown}{AB}$ and BC is an angle bisector of $\angle ABO$, prove that ΔABO is an equilateral triangle. **[2064 A1]**



⇨ Here, **Given:** $\overset{\frown}{AC} = \overset{\frown}{AB}$, $\angle ABC = \angle CBO$

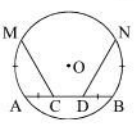
To prove: ΔABO is equilateral triangle.

Proof:

Statement	Reason
1. $2\angle ABC = \angle AOC$	1. Being central angle and angle at the circumference standing on same arc.
2. $\angle ABO = 2\angle ABC$	2. Being BC is the bisector $\angle ABO$.
3. $\angle AOC = \angle AOB$	3. Being both are on same arc.
4. $\angle AOB = \angle ABO$	4. From (1), (2) and (3).
5. ΔOAB is an equilateral triangle.	5. Being AO = BO and from (4).

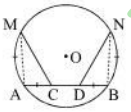
Proved.

5. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु हो । जीवा AB मा कुनै दुई बिन्दुहरू C र D छन् । AC = BD र $\overset{\frown}{AM} = \overset{\frown}{BN}$ भए, $\angle ACM = \angle BDN$ हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure, O is the centre of a circle. C and D are two points on the chord. If AC = BD and $\overset{\frown}{AM} = \overset{\frown}{BN}$, prove that $\angle ACM = \angle BDN$. **[2063 B1]**



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⇨ Here, **Given:** AC = BD, $\overset{\frown}{AM} = \overset{\frown}{BN}$



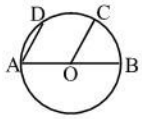
To prove: ∡ACM = ∡BDN
Construction: Join AM and BN
Proof:

Statements	Reasons
1. $\overset{\frown}{AM} = \overset{\frown}{BN}$	1. Given
2. $\overset{\frown}{AM} + \overset{\frown}{MN} = \overset{\frown}{BN} + \overset{\frown}{MN}$, or, $\overset{\frown}{AMN} = \overset{\frown}{BNM}$	2. By adding $\overset{\frown}{MN}$ on both sides of statement (1).
3. ∡MAB (or ∡MAC) = ∡ABN (or ∡DBN)	3. Equal arcs subtend equal angles at circumference.
4. In ΔAMC and ΔDBN (i) AM = BN (ii) ∡MAC = ∡DBN (iii) AC = BD	4. (i) $\overset{\frown}{AM} = \overset{\frown}{BN}$ (ii) By statement (3) (iii) Given
5. ΔAMC ≅ ΔDBN	5. By S.A.S. congruency
6. ∡ACM = ∡BDN	6. Corresponding angles of congruent triangles.

Proved.

6. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु, AB व्यास र $\overset{\frown}{BC} = \overset{\frown}{CD}$ भए सिद्ध गर्नुहोस्: AD // OC

In the given figure, O is the centre of the circle, AB the diameter and $\overset{\frown}{BC} = \overset{\frown}{CD}$.
Prove that: AD // OC. **[2057 B2, 2063 A1]**

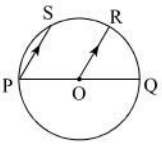


⇨ Here, **Given:** 'O' is centre of the circle, AB be the diameter and $\overset{\frown}{BC} = \overset{\frown}{CD}$.
To prove: AD // OC.
Proof:

Statements	Reasons
1. ∡BOC = $\overset{\frown}{BC}$	1. Angle at the centre is equal to the degree measure of its opposite arc.
2. ∡DAB = $\frac{1}{2}\overset{\frown}{BD}$	2. Angle at the circumference is equal to half of degree measure of its opposite arc.
3. ∡DAB = $\frac{1}{2}.2\overset{\frown}{BC} = \overset{\frown}{BC}$	3. $\overset{\frown}{BC} = \overset{\frown}{CD}$ (given)
4. ∡BOC = ∡DAB	4. Statements 1 and 3.
5. AD // OC	5. From statement 4, corresponding angles are equal.

7. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु, PQ व्यास र PS // OR छ। $\overset{\frown}{SR} = \overset{\frown}{RQ}$ हुन्छ भनी सिद्ध गर्नुहोस्।

In the given figure, O is the centre of circle, PQ is the diameter and PS // OR.
Prove that: $\overset{\frown}{SR} = \overset{\frown}{RQ}$ **[SLC 2066 C]**



⇨ Here, **Given:** (i) O is the centre of circle. (ii) PQ is a diameter. (iii) PS // OR

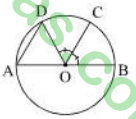
To Prove: $\overset{\frown}{SR} = \overset{\frown}{RQ}$
Proof:

Statements	Reasons
1. ∡SPQ = ∡ROQ	1. Corresponding angles in parallel lines.
2. ∡SPQ ≡ $\frac{1}{2}\overset{\frown}{SRQ}$ and	2. From the relation between inscribed angle and opposite arc.
3. ∡ROQ ≡ $\overset{\frown}{RQ}$	3. From the relation between central angle and opposite arc.
4. $\frac{1}{2}\overset{\frown}{SRQ} = \overset{\frown}{RQ}$	4. From (2) and (3).
5. $\frac{1}{2}(\overset{\frown}{SR} + \overset{\frown}{RQ}) = \overset{\frown}{RQ}$ or, $\frac{1}{2}\overset{\frown}{SR} = \frac{1}{2}\overset{\frown}{RQ}$ ∴ $\overset{\frown}{SR} = \overset{\frown}{RQ}$	5. Simplifying in (4).

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8. दिइएको वृत्तमा AB व्यास, OC र OD व्यासार्धहरू हुन्, जहाँ ∠BOC = ∠COD छन् भने AD // OC हुन्छ भनी सिद्ध गर्नुहोस् ।

In the adjoining figure, AB is the diameter. OC and OD are radii where ∠BOC = ∠COD, prove that AD // OC. **[2063 A2]**



⇨ Here, **Given:** AB is the diameter, OC and OD are radii and ∠BOC = ∠COD

To prove : AD // OC

Proof :

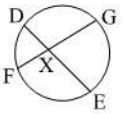
Statements	Reasons
1. $\angle BOC = \angle COD$	1. Given
2. $\angle BOC = \frac{1}{2}\ \angle BOD$	2. From statement (1).
3. $\angle BAD$ (or $\angle OAD$) $= \frac{1}{2}\ \angle BOD$	3. From the relation between circumference angle and central angle standing on the same arc.
4. $\angle BOC = \angle OAD$	4. From statements (2) and (3).
5. AD // OC	5. From statement (4), corresponding angles are equal.

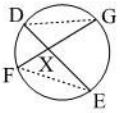
Proved.

9. दिएको वृत्तमा जीवाहरू DE र FG वृत्तभित्र X बिन्दुमा प्रतिछेदित छन् भने सिद्ध गर्नुहोस् :

In the given circle, chords DE and FG intersect within the circle at X, prove that:

$\angle DXF = 1/2\ (\overset{\frown}{DF} + \overset{\frown}{GE})$ **[2058 C1]**





⇨ Here, **Given:** Chords DE and FG intersect within the circle at X.

To prove: $\angle DXF = \frac{1}{2}(\overset{\frown}{DF} + \overset{\frown}{GE})$

Construction : Join DG and EF.

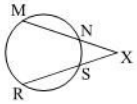
Proof:

Statements	Reasons
1. $\angle DXF = \angle DGX + \angle GDX$	1. In ΔDGX, exterior angle is equal to the sum of two opposite interior angles.
2. $\angle DGF$ (or $\angle DGX$) $= \frac{1}{2}\overset{\frown}{DF}$	2. Angle at the circumference is equal to half of the degree measure of its opposite arc.
3. $\angle GDE$ (or $\angle GDX$) $= \frac{1}{2}\overset{\frown}{GE}$	3. Angle at the circumference is equal to half of the degree measure of its opposite arc.
4. $\angle DXF = \frac{1}{2}\overset{\frown}{DF} + \frac{1}{2}\overset{\frown}{GE} = \frac{1}{2}(\overset{\frown}{DF} + \overset{\frown}{GE})$	4. From the statements 1, 2 and 3.

Proved

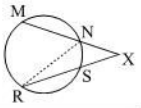
10. चित्रमा वृत्तका जीवाहरू MN र RS बाह्य बिन्दु X मा काटिएका छन् भने सिद्ध गर्नुहोस् :

In the given figure, chords MN and RS of a circle intersect externally at X. Prove that : $\angle MXR = \frac{1}{2}(\overset{\frown}{MR} - \overset{\frown}{NS})$ **[2058 C2, 2065 B]**



⇨ Here, **Given:** Chords MN and RS of a circle intersect externally at X.

To prove: $\angle MXR = \frac{1}{2}(\overset{\frown}{MR} - \overset{\frown}{NS})$ **Construction:** Join NR.



Proof:

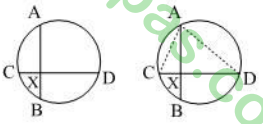
Statements	Reasons
1. $\angle MNR = \frac{1}{2}\overset{\frown}{MR}$	1. Angle at circumference is equal to half of degree measure of its opposite arc.
2. $\angle NRS = \frac{1}{2}\overset{\frown}{NS}$	2. Angle at circumference is equal to half of degree measure of its opposite arc.
3. $\angle MNR = \angle NRX + \angle NXR$ or, $\angle NXR = \angle MNR - \angle NRS$	3. Ext. angle in a triangle is equal to the sum of two opposite interior angles.
4. $\angle MXR = \frac{1}{2}\overset{\frown}{MR} - \frac{1}{2}\overset{\frown}{NS} = \frac{1}{2}(\overset{\frown}{MR} - \overset{\frown}{NS})$	4. Putting values from (1) and (2) in (3) and $\angle NXR = \angle MXR$.

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11. दिइएको चित्रमा दुई जीवाहरू AB र CD बिन्दु X मा लम्ब हुने गरी काटिएका छन् भने, प्रमाणित गर्नुहोस्: $\overset{\frown}{AD} - \overset{\frown}{CA} = \overset{\frown}{BD} - \overset{\frown}{BC}$

In the given figure, two chords AB and CD intersect at right angles at X. Prove that: $\overset{\frown}{AD} - \overset{\frown}{CA} = \overset{\frown}{BD} - \overset{\frown}{BC}$ **[2060 B1]**



⇨ Here, **Given:** Chords AB and CD intersect at X. AB ⊥ CD.

To prove: $\overset{\frown}{AD} - \overset{\frown}{CA} = \overset{\frown}{BD} - \overset{\frown}{BC}$ **Construction:** Join AC and AD.

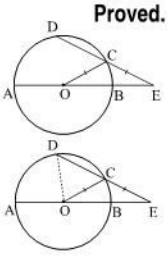
Proof:

Statements	Reasons
1. $\angle BAC + \angle ACD = \angle AXD$	1. Ext. angle = sum of int. opp. angles
2. $\angle DAB + \angle ADC = \angle AXC$	2. Ext. angle = sum of int. opp. angles
3. $\angle AXD = \angle AXC = 90°$	3. AB ⊥ CD.
4. $\angle CAB + \angle ACD = \angle DAB + \angle ADC$	4. From statements (1), (2) and (3).
5. $2\angle CAB + 2\angle ACD = 2\angle DAB + 2\angle ADC$	5. Multiplying the statement (4) by 2 on both sides.
6. $\overset{\frown}{BC} + \overset{\frown}{AD} = \overset{\frown}{BD} + \overset{\frown}{CA}$ $\therefore \overset{\frown}{AD} - \overset{\frown}{CA} = \overset{\frown}{BD} - \overset{\frown}{BC}$	6. Double of every inscribed angle is equal to the degree measure of its opp. arc.

Proved.

12. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो जसमा त्रिभुज OCE एउटा समद्विबाहु त्रिभुज छ । प्रमाणित गर्नुहोस्: $\overset{\frown}{BC} = 1/3 \cdot \overset{\frown}{AD}$

In the given figure, O is the centre of a circle in which triangle OCE is an isosceles triangle. Prove that: $\overset{\frown}{BC} = 1/3. \overset{\frown}{AD}$ **[2063 E1]**



⇨ Here, **Given:** O is centre, OC = CE

To prove: $\overset{\frown}{BC} = 1/3. \overset{\frown}{AD}$ **Construction:** Join OD.

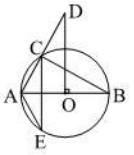
Proof :

Statements	Reasons
1. $\angle CEO = \angle COE$	1. OC = CE
2. $\angle DCO = \angle CEO + \angle COE$	2. Ext. angle = Sum of opp. interior angle.
3. $\angle DCO = \angle COE + \angle COE = 2\angle COE$	3. From statements (1) and (2).
4. $\angle ODC = \angle DCO$	4. OD = OC = radius.
5. $\angle ODC = 2\angle COE$	5. From statements (3) and (4).
6. $\angle ODC + \angle DEO$ (or CEO) = $\angle AOD$	6. Sum of opp. interior angles = Exterior angle
7. $2\angle COE + \angle COE = \angle AOD$ or, $3\angle COE = \angle AOD$ or, $\angle COE = 1/3.\angle AOD$	7. From (5) and (6).
8. $\angle COB = 1/3.\angle AOD$	8. $\angle COE = \angle COB$
9. $\angle AOD = \overset{\frown}{AD}$, $\angle COB = \overset{\frown}{BC}$	9. From the relation between central angle and its opposite arc.
10. $\overset{\frown}{BC} = 1/3. \overset{\frown}{AD}$	10. From statements (8) and (9).

Model 3

13. चित्रमा केन्द्रबिन्दु O, व्यास AB र DO ⊥ AB भए $\angle AEC = \angle ODA$ हुन्छ भनी सिद्ध गर्नुहोस् ।

In the given figure, O is the centre of the circle, AB the diameter and DO ⊥ AB, prove that $\angle AEC = \angle ODA$. **[2057 B1]**



⇨ Here, **Given:** O is the centre and AB is diameter of circle AEB. Also, DO ⊥ AB.

To prove: $\angle AEC = \angle ODA$.

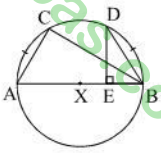
Proof:

Statements	Reasons
1. In ΔACB and ΔADO, (i) $\angle ACB = \angle AOD$ (ii) $\angle BAC = \angle DAO$ (iii) $\angle ODA = \angle ABC$	1. (i) Both are right angles. (ii) Common angle. (iii) Remaining angles in a triangle.
2. $\angle AEC = \angle ABC$	2. Angles standing on the same arcs.
3. $\angle AEC = \angle ODA$	3. From statement 2 and 1 (iii)

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14. दिइएको चित्रमा वृत्तको केन्द्रबिन्दु X हो । वृत्तको व्यास AB हो । DE ⊥ AB र $\overset{\frown}{AC} = \overset{\frown}{BD}$, भए ∡ABC = ∡BDE हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure, 'X' is the centre of a circle. AB is a diameter of the circle. DE ⊥ AB and $\overset{\frown}{AC} = \overset{\frown}{BD}$, prove that: ∡ABC = ∡BDE. **[2064 S]**

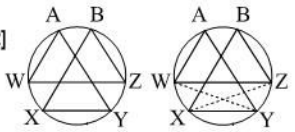


⇨ Here, **Given:** AB is the diameter DE ⊥ AB and $\overset{\frown}{AC} = \overset{\frown}{BD}$
To prove: ∡ABC = ∡BDE
Proof:

Statements	Reasons
1. $\overset{\frown}{AC} + \overset{\frown}{CD} = \overset{\frown}{CD} + \overset{\frown}{BD}$ i.e. $\overset{\frown}{ACD} = \overset{\frown}{CDB}$	1. From given adding $\overset{\frown}{CD}$ on both the sides.
2. ∡EBD = ∡CAB	2. From (1) corresponding arcs are equal.
3. ∡DEB = ∡ACB = 90°	3. AB is diameter and given
4. ΔDEB ~ ΔACB	4. From (2) and (3) A.A. fact
5. ∡ABC = ∡BDE	5. Corresponding angles of similar triangles.

Model 4

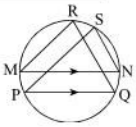
15. दिइएको चित्रमा ∡WAY = ∡XBZ भए WZ // XY हुन्छ भनी प्रमाणित गर्नुहोस् ।
Given figure is a circle in which ∡WAY = ∡XBZ, prove that WZ // XY. **[2058 E2]**



⇨ Here, **Given:** in the circle, ∡WAY = ∡XBZ
To prove: WZ // XY
Construction: Join ZX and WY.
Proof:

Statements	Reasons
1. $\angle WAY = \frac{1}{2}\overset{\frown}{WXY}$	1. Angle at the circumference is equal to half of the degree measure of its opposite arc.
2. $\angle XBZ = \frac{1}{2}\overset{\frown}{XYZ}$	2. Angle at the circumference is equal to half of the degree measure of its opposite arc.
3. ∡WAY = ∡XBZ	3. Given
4. $\overset{\frown}{WXY} = \overset{\frown}{XYZ}$	4. Statement 1, 2 and 3.
5. $\overset{\frown}{WX} = \overset{\frown}{YZ}$	5. Subtracting the same arc $\overset{\frown}{XY}$ from the both sides of (4).
6. ∡XZW = ∡YXZ	6. The angles at the circumference subtended by equal arcs are equal.
7. WZ // XY	7. The alternate angles are equal (from statement 6) **Proved.**

16. दिइएको चित्रमा MN // PQ भए ∡MRQ = ∡PSN हुन्छ भनी सिद्ध गर्नुहोस् ।
In the given figure, MN // PQ. Prove that ∡MRQ = ∡PSN. **[2058 E1, 2066 S]**



⇨ Here, **Given:** In the figure MN // PQ
To Prove: ∡MRQ = ∡PSN
Proof:

Statements	Reasons
1. $\overset{\frown}{MP} = \overset{\frown}{NQ}$	1. Corresponding arcs made by parallel lines.
2. $\overset{\frown}{MP} + \overset{\frown}{PQ} = \overset{\frown}{NQ} + \overset{\frown}{PQ}$ or, $\overset{\frown}{MPQ} = \overset{\frown}{NQP}$	2. Adding $\overset{\frown}{PQ}$ on statement 1.
3. $2\angle R \equiv \overset{\frown}{MPQ}$ and $2\angle S \equiv \overset{\frown}{NQP}$	3. From the relation between inscribed angle and opposite arc.
4. ∡R = ∡S	4. From (3) and (4) equal quantities axiom.

17. दिइएको चित्रमा ∡AEC = ∡BFD छ । सिद्ध गर्नुहोस् ।
In the figure, ∡AEC = ∡BFD. Prove that : (i) ∡ABC = ∡BCD (ii) AB // CD **[2059 B1]**



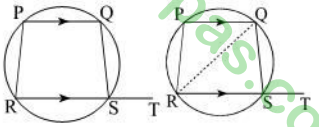
⇨ Here, **Given:** In the given figure, ∡AEC = ∡BFD
To prove: ∡ABC = ∡BCD and AB // CD
Proof:

Statements	Reasons
1. ∡AEC = ∡BFD	1. Given
2. ∡AEC = ∡ABC	2. Angles in the circumference standing on the same arc.
3. ∡BFD = ∡BCD	3. Angles in the circumference standing on the same arc.
4. ∡ABC = ∡BCD	4. From the statements (1), (2) and (3)
5. AB // CD	5. From the statement (4), alternate angles are equal.

Proved.

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18. एउटा चक्रीय चतुर्भुज हो जसमा PQ // RS र RS लाई T सम्म लम्ब्याइएको छ । सिद्ध गर्नुहोस्: PR = RS
PQRS is a cyclic quadrilateral in which PQ // RS and RS is extended to T. Prove that: PR = QS [2065 S]

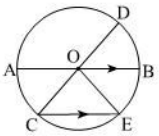


⇨ **Given:** Here, PQRS is a cyclic quadrilateral in which PQ // RS and RS is extended to T.
To prove: PR = QS
Construction: Join QR.
Proof:

Statements	Reasons
1. $\measuredangle PQR = \measuredangle QRS$	1. Alternate angles formed in parallel lines.
2. $2\measuredangle PQR \equiv \overset{\frown}{PR}$	2. Being inscribed angle and opposite arc.
3. $2\measuredangle QRS \equiv \overset{\frown}{QS}$	3. Being inscribed angle and opposite arc.
4. $\overset{\frown}{PR} = \overset{\frown}{QS} \quad \therefore \overset{\frown}{PR} = \overset{\frown}{QS}$	4. From (i), (ii) and (iii)
5. PR = QS	5. Being the corresponding arcs are equal in (4).

Proved.

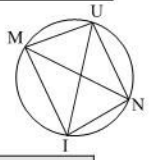
19. चित्रमा केन्द्रबिन्दु O भएको वृत्तका दुई व्यासहरू AB र CD हुन् । यदि जीवा CE व्यास AB सँग समानान्तर र $\measuredangle BOC$ अधिक कोण हुन् भने चाप DBE को मध्यबिन्दु B हुन्छ भनी सिद्ध गर्नुहोस् ।
In the figure, AB and CD are two diameters of a circle with centre at O. If the chord CE is parallel to AB and $\measuredangle BOC$ is obtuse prove that B is the point of arc DBE. [2062 C1]



⇨ **Given:** Here, O is centre, AB and CD are diameters and AB // CE.
To prove: $\overset{\frown}{DB} = \overset{\frown}{BE}$
Proof :

Statements	Reasons
1. $\measuredangle BOD = \measuredangle OCE$	1. OB // CE and corresponding angles.
2. $\measuredangle OEC = \measuredangle OCE$	2. OC = OE = radius
3. $\measuredangle BOD = \measuredangle OEC$	3. From the statement (1) and (2).
4. $\measuredangle BOE = \measuredangle OEC$	4. OB // CE and alternate angles.
5. $\measuredangle BOD = \measuredangle BOE$	5. From the statements (4) and (3)
6. $\overset{\frown}{DB} = \overset{\frown}{BE}$	6. From (5) and relation between angle at centre and its opposite arc.

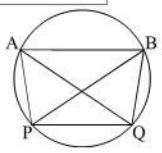
20. दिइएको चित्रमा यदि MN = IU भए, प्रमाणित गर्नुहोस् : (i) MU = IN (ii) MI // UN
In the given figure if MN = IU, prove that : (i) MU = IN (ii) MI // UN [2072 E]



⇨ **Given:** Here, MN = IU
To prove: (i) MU = IN (ii) MI // UN
Proof :

Statements	Reasons
1. $\overset{\frown}{IMU} = \overset{\frown}{MIN}$	1. The corresponding major arcs of equal chord.
2. $\overset{\frown}{MU} = \overset{\frown}{IN}$	2. Subtracting $\overset{\frown}{MI}$ from both the sides of (1).
3. MU = IN	3. The corresponding chord of equal arcs.
4. $\measuredangle MIU = \measuredangle IUN$	4. Being the corresponding angles of equal arcs from (2)
5. MI // UN	5. Alternate angles are equal in (4).

21. दिइएको चित्रमा यदि AQ = PB भए, प्रमाणित गर्नुहोस् : (i) AP = BQ (ii) AB // PQ
In the given figure, if AQ = PB, prove that : (i) AP = BQ (ii) AB // PQ [2072 C]



⇨ **Given:** Here, AQ = PQ
To prove: (i) AP = BQ (ii) AB // PQ
Proof :

Statements	Reasons
1. $\overset{\frown}{PAB} = \overset{\frown}{QBA}$	1. The corresponding major arcs of equal chords.
2. $\overset{\frown}{AP} = \overset{\frown}{BQ}$	2. Subtracting $\overset{\frown}{AB}$ from both the sides of (1).
3. AP = BQ	3. The corresponding chord of equal arcs.
4. $\measuredangle AQP = \measuredangle BAQ$	4. Being the corresponding angles of equal arcs from (2)
5. AB // PQ	5. Alternate angles are equal in (4).

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22. दिइएको चित्रमा यदि EG = FH भए प्रमाणित गर्नुहोस् । (i) EH = FG (ii) EF // HG
In the given figure if EG = FH, prove that: (i) EH = FG (ii) EF // HG [2072 W]

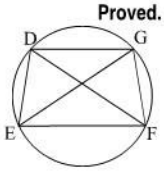


⇨ **Given:** Here, EG = FH
To prove: (i) EH = FG (ii) EF // HG
Proof :

Statements	Reasons
1. $\overset{\frown}{EFG} = \overset{\frown}{FEH}$	1. The corresponding major arcs of equal chords.
2. $\overset{\frown}{EH} = \overset{\frown}{FG}$	2. Subtracting $\overset{\frown}{EF}$ from both the sides of (1).
3. EH = FG	3. The corresponding chord of equal arcs.
4. $\measuredangle EGH = \measuredangle FEG$	4. Being the corresponding angles of equal arcs from (2)
5. EF // HG	5. Alternate angles are equal in (4).

Proved.

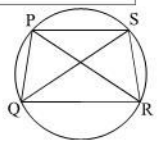
23. दिइएको चित्रमा, यदि DF = EG भए प्रमाणित गर्नुहोस् :
In the given figure, if DF = EG, prove that:
(i) DE = GF (ii) DG // EF [2072 MW]



⇨ **Given:** Here, DF = EG
To prove: (i) DE = GF (ii) DG // EF
Proof :

Statements	Reasons
1. $\overset{\frown}{DEF} = \overset{\frown}{EFG}$	1. The corresponding major arcs of equal chords.
2. $\overset{\frown}{DE} = \overset{\frown}{FG}$	2. Subtracting $\overset{\frown}{EF}$ from both the sides of (1).
3. DE = FG	3. The corresponding chord of equal arcs.
4. $\measuredangle DFE = \measuredangle FDG$	4. Being the corresponding angles of equal arcs from (2)
5. DG // EF	5. Alternate angles are equal in (4).

24. दिइएको चित्रमा, यदि PR = QS भए प्रमाणित गर्नुहोस् । (i) PQ = SR (ii) PS // QR
In the given figure, if PR = QS, prove that. (i) PQ = SR (ii) PS // QR [2072 FW]

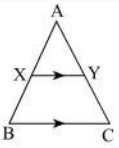


⇨ **Given:** Here, PR = QS
To prove: (i) PQ = SR (ii) PS // QR
Proof :

Statements	Reasons
1. $\overset{\frown}{PQR} = \overset{\frown}{QRS}$	1. Being the corresponding major arcs of equal chords.
2. $\overset{\frown}{PQ} = \overset{\frown}{SR}$	2. Subtracting $\overset{\frown}{QR}$ from both the sides of (1).
3. PQ = SR	3. The corresponding chords of equal arcs.
4. $\measuredangle PRQ = \measuredangle SQR$	4. Being the corresponding angles of equal arcs from (2)
5. PS // QR	5. Being the alternate angles are equal in (4).

Model 5

25. समद्विबाहु ΔABC को आधारमा BC सँग समानान्तर हुने गरी रेखित XY रेखाले बराबर भुजाहरूलाई बिन्दु X र Y मा काटेका छन् भने चार बिन्दुहरू X, B, C र Y चक्रीय हुन्छन् भनी प्रमाणित गर्नुहोस् ।
ΔABC is an isosceles triangle and XY // BC. If XY cuts AB at X and AC at Y, prove that four points X, B, C and Y are concyclic. [2058 S]



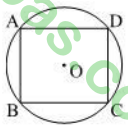
⇨ **Given:** Here, ΔABC is an isosceles triangle.
To prove: X, B, C and Y are concyclic
Proof:

Statements	Reasons
1. $\measuredangle B = \measuredangle C$	1. Base angles of isosceles Δ.
2. $\measuredangle B = \measuredangle AXY$	2. Corresponding $\measuredangle$s in XY // BC.
3. $\measuredangle C = \measuredangle AXY$	3. From (1) and (2).
4. X, B, C and Y are concyclic.	4. From (3), exterior angle and opposite interior angle of a quadrilateral are equal.

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26. यदि ABCD एउटा चक्रीय समानान्तर चतुर्भुज हो भने ABCD आयत हुन्छ भनी प्रमाणित गर्नुहोस् ।
If ABCD is a cyclic parallelogram prove that ABCD is a rectangle. **[2062 E1]**

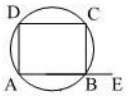


⇨ **Given :** Here, ABCD is a cyclic parallelogram.
To prove: ABCD is a rectangle.
Proof :

Statements	Reasons
1. $\measuredangle ABC = \measuredangle ADC$	1. Opp. angles of a parallelogram.
2. $\measuredangle ABC + \measuredangle ADC = 180°$	2. Opp. angles of a cyclic quadrilateral.
3. $\measuredangle ADC + \measuredangle ADC = 180°$ or, $2\measuredangle ADC = 180°$ $\therefore \measuredangle ADC = \frac{180°}{2} = 90°$	3. From statements (1) and (2)
4. ABCD is a rectangle.	4. ABCD is a parallelogram and $\measuredangle ADC$ is a rt. angle.

Proved.

27. कुनै चक्रीय चतुर्भुजको कुनै एउटा भुजा लम्ब्याउँदा बन्ने बाह्य कोण त्यो चतुर्भुजको बाह्य कोणको भित्री विपरीत कोणसँग बराबर हुन्छ भनी सिद्ध गर्नुहोस् ।
If one side of a cyclic quadrilateral is produced, prove that the exterior angle is equal to the opposite interior angle of the quadrilateral. **[2060 D1, 2057 C1]**

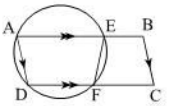


⇨ **Given :** Here, Quad. ABCD inscribed in a circle, AB produced to E
To prove : $\measuredangle CBE = \measuredangle ADC$
Proof :

Statements	Reasons
1. $\measuredangle ABC + \measuredangle CBE = 180°$	1. St. angle.
2. $\measuredangle ABC + \measuredangle ADC = 180°$	2. Opp. $\measuredangle^S$ of a cyclic quad.
3. $\measuredangle ABC + \measuredangle CBE = \measuredangle ABC + \measuredangle ADC$	3. from (1) and (2)
4. $\therefore \measuredangle CBE = \measuredangle ADC$	4. Subtracting $\measuredangle ABC$ from both sides.

Proved.

28. सँगैको चित्रमा ABCD एउटा समानान्तर चतुर्भुज हो । वृत्तले AB लाई E र DC लाई F मा काटेका छन् भने प्रमाणित गर्नुहोस्: $\measuredangle EFD = \measuredangle ABC$
In the adjoining figure, ABCD is a parallelogram. The inscribed circle cuts AB at E and CD at F. Prove that: $\measuredangle EFD = \measuredangle ABC$ **[2064 B2]**

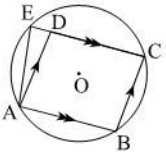


⇨ **Given:** Here, ABCD is a parallelogram.
To prove: $\measuredangle EFD = \measuredangle ABC$
Proof:

Statement	Reason
1. $\measuredangle B = \measuredangle D$	1. Opposite angles of a parm.
2. $\measuredangle A + \measuredangle D = 180°$	2. Corresponding angles in AB // CD.
3. $\measuredangle A + \measuredangle EFD = 180°$	3. Opposite angles of a cyclic quadrilateral.
4. $\measuredangle A + \measuredangle D = \measuredangle A + \measuredangle EFD$ $\therefore \measuredangle D = \measuredangle EFD$	4. From (2) and (3)
5. $\measuredangle B = \measuredangle EFD$ i.e. $\measuredangle ABC = \measuredangle EFD$	5. From (1) and (4).

Proved.

29. दिइएको चित्रमा ABCD एउटा समानान्तर चतुर्भुज हो र EABC चक्रीय चतुर्भुज हो । प्रमाणित गर्नुहोस्: **AE = AD**
In the given figure, ABCD is a parallelogram and EABC is a cyclic quadrilateral, prove that : AE = AD **[2068 C]**



⇨ **Given:** Here, ABCD is a parallelogram and EABC is a cyclic quadrilateral.
To prove: AE = AD
Proof:

Statements	Reasons
1. $\measuredangle E = 180° - \measuredangle B$	1. From the relation between opposite angles of cyclic quadrilateral
2. $\measuredangle B = \measuredangle ADC$	2. Being the opposite angles of a parallelogram.
3. $\measuredangle EDA = 180° - \measuredangle ADC$	3. Being adjacent angles in a straight line.
4. $\measuredangle EDA = 180° - \measuredangle B$	4. From (2) and (3)
5. $\measuredangle E = \measuredangle EDA$	5. From (1) and (4)
6. AE = AD	6. From (5)

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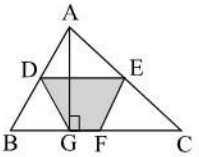
30. दिइएको चित्रमा ∠APB अर्धक PC हो भने XY // AB हुन्छ भनी प्रमाणित गर्नुहोस् ।
If PC is the bisector of ∠APB then prove that XY // AB. **[2065 C, 2067 B]**



⇨ **Given:** Here, PC is the bisector of ∠APB.
To prove: XY // AB
Construction: Join PQ

Statements	Reasons
1. ∠APC = ∠CPB = ∠AQC	1. From given and ∠APC = ∠AQC
2. XYQP is a cyclic quad.	2. As ∠XPY = ∠XQY
3. ∠YPQ = ∠YXQ	3. Angles at arc YQ
4. ∠BPQ = ∠BAQ	4. Angles at arc BQ
5. ∠YXQ = ∠BAQ	5. From (3) and (4)
6. XY // AB	6. From (5) **Proved.**

31. दिइएको चित्रमा △ABC को भुजा AB, AC र BC का मध्यबिन्दुहरू क्रमशः D, E र F तथा AG ⊥ BC भए DEFG एउटा चक्रीय चतुर्भुज हो भनी प्रमाणित गर्नुहोस् ।
In the given figure, if D, E and F are the mid-points of sides AB, AC and BC respectively and AG ⊥ BC then prove that DEFG is a cyclic quadrilateral. **[2066 E]**



⇨ **Given:** (i) D, E and F are the mid-points of AB, AC & BC
(ii) AG ⊥ BC
To Prove: DEFG is a cyclic quadrilateral
Proof:

Statements	Reasons
1. DE // BC and EF // AB	1. From give mid-point theorem.
2. DBFE is a parallelogram.	2. From the statement 1.
3. ∠B = ∠DEF	3. Being the opposite angle of parm. DBCF.
4. BD = DG	4. Being D is the mid-point of hypotenuse.
5. ∠B = ∠DGB	5. From (4)
6. ∠DGB = ∠DEF	6. From (3) & (5)
7. DEFG is a cyclic quad.	7. From (6) the exterior and interior angle are equal.

Proved

Model 6

32. दिइएको चित्रमा दुईओटा वृत्तहरू बिन्दु M र N मा प्रतिच्छेदित छन् । PQ र RS बिन्दु M बाट पार भएका छन् । R, P, S र Q क्रमशः बिन्दु N सँग जोडिएका छन् भने ∠PNR = ∠SNQ हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure, two circles are intersecting at M and N. PQ and RS pass through M. R, P, S and Q are joined to N. Prove that: ∠PNR = ∠SNQ. **[2057 S, 2062 S, 2064 E1, E2]**

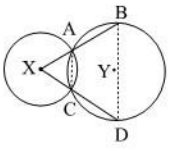


⇨ Here, **Given:** Two circles are intersecting at M and N. PQ and RS pass through M, R, P, S and Q.
To prove: ∠PNR = ∠SNQ
Proof:

Statements	Reasons
1. ∠PMR = ∠SMQ	1. Vertically opposite angles.
2. ∠PMR = ∠PNR	2. Both are angles at the circumference standing on same arc.
3. ∠SMQ = ∠SNQ	3. Both are angles at the circumference standing on same arc.
4. ∠PNR = ∠SNQ	4. From (1), (2) and (3).

Proved.

33. दिइएको चित्रमा X र Y केन्द्रबिन्दु भएका दुई वृत्तहरू A र C मा प्रतिच्छेदित भएका छन् । XA र XC लाई अर्को वृत्तको B र D सम्म लम्ब्याइएको छ । सिद्ध गर्नुहोस् : AB = CD.
In the given figure X and Y are the centres of the circles which intersect at A and C. XA and XC are produced to meet the other circle at B and D. Prove that: AB = CD. **[2057 A2]**



⇨ **Given:** Here, X and Y are the centres of the circles which are intersected at A and C. XA and XC are produced to meet the other circle at B and D.
To prove: AB = CD

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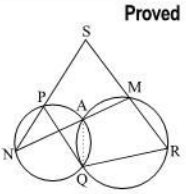
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Construction: Join AC and BD.
Proof:

Statements	Reasons
1. $\measuredangle XAC = \measuredangle CDB$ & $\measuredangle XCA = \measuredangle ABD$	1. Being ACDB is a cyclic quadrilateral.
2. $\measuredangle XAC = \measuredangle XCA$	2. Being XA = XC radii of same circle.
3. $\measuredangle CDB = \measuredangle ABD$	3. From (1) and (2)
4. XB = XD AB = CD	4. Being the base angles of ΔXBD are equal in (3)

Proved

34. दिइएको चित्रमा **NPS, MAN** र **RMS** सरल रेखाहरू हुन् भने **PQRS** एउटा चक्रीय चतुर्भुज हुन्छ भनी प्रमाणित गर्नुहोस् ।
In the given figure, NPS, MAN and RMS are straight lines. Prove that PQRS is a cyclic quadrilateral. **[2069 B]**



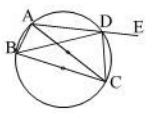
⇨ Here, **Given:** NPS, MAN and RMS are straight lines.
To prove: PQRS is a cyclic quadrilateral
Construction: Join A & Q.
Proof:

Statements	Reasons
1. $\measuredangle NPQ = \measuredangle NAQ$	1. Being the inscribed angles on same arc.
2. $\measuredangle NAQ = \measuredangle MRQ$	2. Being exterior angle & opposite interior angle of a cyclic quadrilateral.
3. $\measuredangle NPQ = \measuredangle MRQ$	3. From the statements (1) and (2).
4. PQRS is a cylic quadrilateral.	4. Being exterior angle and opposite interior angle of a quad. PQRS are equal in (3).

Proved.

Model 7

35. दिइएको चित्रमा **AC = BC** र **ABCD** एउटा चक्रीय चतुर्भुज हो भने **DC** ले $\measuredangle BDE$ लाई आधा गर्दछ भनी प्रमाणित गर्नुहोस् ।
In the given figure, AC = BC and ABCD is a cyclic quadrilateral. Prove that DC bisects $\measuredangle BDE$. **[2059 E2]**

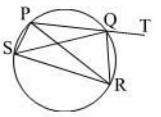


⇨ Here, **Given:** In the cyclic quadrilateral ABCD, AC = BC
To prove: DC is the bisector of $\measuredangle BDE$.
Proof:

Statements	Reasons
1. $\measuredangle BAC = \measuredangle ABC$	1. AC = BC
2. $\measuredangle BAC = \measuredangle BDC$	2. Angles at the circumference standing on the same arc.
3. $\measuredangle ABC = \measuredangle BDC$	3. From the statement (1) and (2).
4. $\measuredangle ABC = \measuredangle CDE$	4. In a cyclic quadrilateral an exterior angle is equal to the internal angle opposite to its adjcent angle.
5. $\measuredangle BDC = \measuredangle CDE$	5. From the statements (3) and (4)
6. DC is the bisector of $\measuredangle BDE$	6. From the statement (5).

Proved.

36. दिइएको चित्रमा $\measuredangle SQT$ को अर्धक **QR** हो र **PQRS** एउटा चक्रीय चतुर्भुज हो । ΔPRS एउटा समद्विबाहु त्रिभुज हो भनी प्रमाणित गर्नुहोस् ।
In the figure, QR is a bisector of $\measuredangle SQT$ & PQRS is a cyclic quadrilateral. Prove that ΔPSR is an isosceles triangle. **[2059E1, 2063C1, C2]**



⇨ Here, **Given:** In the given cyclic quadrilateral PQRS, QR is the bisector of $\measuredangle SQT$.
To prove: PR = SR (or ΔPSR is an isosceles triangle)

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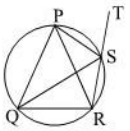
Proof:

Statements	Reasons
1. $\angle SQR = \angle RQT$	1. QR is bisector of $\angle SQT$
2. $\angle SQR = \angle SPR$	2. Angles at the circumference standing on the same arc.
3. $\angle SPR = \angle RQT$	3. From statements (1) and (2)
4. $\angle PSR = \angle RQT$	4. If one of the sides of a cyclic quad. is produced the exterior angle is equal to an interior angle opposite to its adjacent angle.
5. $\angle SPR = \angle PSR$	5. From the statements (3) and (4)
6. PR = SR	6. From statement (5)

Proved.

37. दिइएको चित्रमा PQRS चक्रीय चतुर्भुज हो । RS लाई T सम्म लम्ब्याइएको छ । यदि PS, $\angle QST$ को अर्धक भए ΔPQR समद्विबाहु त्रिभुज हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, PQRS is a cyclic quadrilateral. RS is produced to T. If PS is an angle bisector of $\angle QST$, prove that ΔPQR is an isosceles triangle. **[Model 2065]**



⇨ Here, **Given:** PQRS is a cyclic quadrilateral in which PS is an angle bisector of $\angle QST$

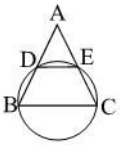
To prove: ΔPQR is an isosceles triangle.

Proof:

	Statements		Reasons
1.	$\angle PST = \angle PSQ$, $\angle PST = \angle PQR$	1.	Given and exterior and opposite interior angle of cyclic quadrilateral.
2.	$\angle PSQ = \angle PQR$	2.	From the statement (1)
3.	$\angle PSQ = \angle PRQ$	3.	Angle at the circumference on same arc PQ.
4.	$\angle PQR = \angle PRQ$	4.	From the statements (2) and (3)
5.	$\therefore$ ΔPQR is an isosceles triangle	5.	Base angles are equal (4)

38. दिइएको चित्रमा ABC एउटा त्रिभुज हो जसमा AB = AC छ । बिन्दु B र C भएर गएको एउटा वृत्तले भुजा AB र AC लाई क्रमशः बिन्दु D र E मा काटेका छन् । प्रमाणित गर्नुहोस् : AD = AE

In the given figure, ABC is a triangle in which AB = AC. Also a circle passing through B and C intersects the sides AB and AC at the points D and E respectively. Prove that AD = AE. **[2059 C2]**



⇨ Here, **Given:** In the figure, AB = AC, and BCED is a cyclic quadrilateral.

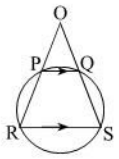
To prove : AD = AE

Proof :

Statements	Reasons
1. $\angle ADE = \angle BCE$	1. In a cyclic quadrilateral an exterior angle is equal to the interior angle opposite to its adjacent angle.
2. $\angle AED = \angle DBC$	2. In a cyclic quadrilateral an exterior angle is equal to the interior angle opposite to its adjacent angle.
3. $\angle ABC = \angle ACB$ or, $\angle DBC = \angle ECB$	3. AB = AC
4. $\angle ADE = \angle AED$	4. From the statements 1, 2 and 3.
5. AD = AE	5. From statement (4).

39. lbOPsf] चित्रमा जीवाहरू RP र SQ बिन्दु O मा भेट्ने गरी लम्ब्याइएको छ । यदि PQ // RS भए, सिद्ध गर्नुहोस्: OP = OQ

In the given diagram, chords RP & SQ of the circle are produced to meet at O. If PQ // RS, prove that : OP = OQ. **[2068 B]**



⇨ Here, **Given:** PQ // SR,

To prove: OP = OQ

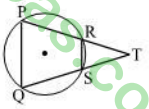
Proof:

Statements	Reasons
1. $\angle PRS = \angle OPQ$	1. Corresponding angles in PQ // RS.
2. $\angle PRS = \angle OQP$	2. In a cyclic quadrilateral an exterior angle is equal to the interior angle opposite to its adjecent angle.
3. $\angle OPQ = \angle OQP$	3. From (1) and (2).
4. OP = OQ	4. From (3).

Proved.

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40. समद्विबाहु ΔTPQ मा TP = TQ छ । यदि P र Q भएर गएको एउटा वृत्तले TP र TQ लाई क्रमशः बिन्दुहरू R र S मा काटेको छ । सिद्ध गर्नुहोस् : PQ // RS
TPQ is an isosceles triangle in which TP = TQ. If a circle passing through P & Q intersects the sides TP & TQ at the points R & S respectively. Prove that: PQ || RS. **[2060 C]**

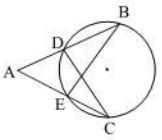


⇨ **Given:** Here, PT = TQ,
To prove: QP // SR
Proof:

Statements	Reasons
1. ∡RST = ∡TPQ	1. Side QS of cyclic quad. QSPR is produced to T.
2. ∡PQT = ∡TPQ	2. TP = TQ
3. ∡RST = ∡PQT	3. From (1) and (2).
4. PQ // SR	4. From statement (3), corresponding angles are equal.

Proved.

41. दिइएको चित्रमा **AB = AC** भए प्रमाणित गर्नुहोस् : **BE = DC.**
In given figure, if AB = AC, prove that BE = DC. **[2066 B]**



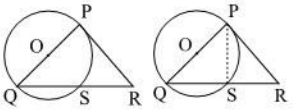
⇨ Here, **Given:** AB = AC
To Prove: BE = DC
Proof:

Statements	Reasons
1. In ΔAEB and ΔADC (i) ∡ BAE = ∡DAC (ii) AB = AC (iii) ∡ABE = ∡DCA	1. (i) Common angles (ii) Given (iii) Both are on same arc DE
2. ΔAEB ≅ ΔADC	2. By ASA fact
3. BE = DC	3. Corresponding sides of ≅ ΔS.

Proved.

Model 8

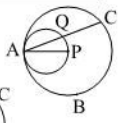
42. दिइएको चित्रमा समद्विबाहु त्रिभुज **PQR** का भुजा **PQ = PR** छन् । यदि **PQ** व्यास हुने गरी एउटा वृत्त खिचिएको छ भने **QS = RS** हुन्छ भनी सिद्ध गर्नुहोस् ।
In the given diagram, PQR is an isosceles triangle with PQ = PR. A circle is drawn with PQ as a diameter. Prove that QS = RS. **[2061 D1]**



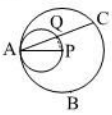
⇨ Here, **Given:** PQ = PR, PQ is a diameter.
To prove: QS = RS **Construction:** Join PS.
Proof:

Statements	Reasons
1. In ΔPSQ and ΔPSR (i) ∡PSQ = ∡PSR = 90° (ii) PQ = PR (iii) PS = PS	1. (i) ∡PSQ is an angle in semi-circle (ii) Given (iii) Common side
2. ΔPSQ ≅ ΔPSR	2. R.H.S. congruency.
3. QS = RS	3. Corresponding sides of congruent triangles.

43. चित्रमा **AP** वृत्त **ABC** को अर्धव्यास र वृत्त **APQ** को व्यास हो भने प्रमाणित गर्नुहोस् : **AQ = QC**
In the figure., AP is a radius of circle ABC and diameter of circle APQ. Prove that: AQ = QC



⇨ Here, **Given:** AP is radius of circle ABC and diameter of another circle AQP.
To prove: AQ = QC
Construction: Join QP
Proof:



Statements	Reasons
1. AQP = 90°	1. Angle in the semi circle.
2. AQ = QC	2. The perpendicular PQ from the centre P upon the chord AC bisects the chord.

Proved.

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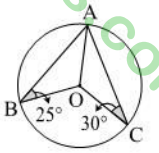
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B. QUESTIONS FROM CDC TEXT BOOKS

1A. सँगैका चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠OBA = 25° र ∠OCA = 30° भए ∠BOC को मान पत्ता लगाउनुहोस् ।

In the figure O is the centre of circle. If ∠OBA = 25° and ∠OCA = 30° then find the value of ∠BOC.



⇨ Here,

(i) ∠BAO = ∠ABO = 25° (Being OB = OA.)

(ii) ∠OAC = ∠OCA = 30° (Being OA = OC.)

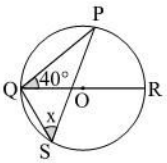
(iii) ∠BOC = 2∠BAC (Being both are on same arc.)

= 2(∠BAO + ∠CAO) = 2(25° + 30°) = 55° × 2

Thus, the value of ∠BOC is 110°.

1B. सँगैका चित्रमा O वृत्तको केन्द्रबिन्दु हो । यदि ∠PQR = 40° र ∠PSQ = x° भए X° को मान पत्ता लगाउनुहोस् ।

In the adjoining figure O is the centre of circle. If ∠PQR = 40° and ∠PSQ = x° then find the value of x.



⇨ Here, Join P & R

(i) ∠PRQ = ∠PSQ = x° (Being both arc on same arc.)

(ii) ∠PRQ + ∠PQR = 90° (Being QR is a diameter.)

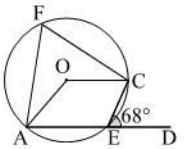
or, x + 40° = 90°

∴ x = 50°

Thus, the value of x is 50°.

1C. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु हो । FAEC एउटा चक्रीय चतुर्भुज हो, यदि ∠CED = 68° छ भने (i) ∠AFC (ii) बृहत कोण ∠AOC को मान पत्ता लगाउनुहोस् ।

In the given figure, O is the centre of circle. FAEC is a cyclic quadrilateral. If ∠CED = 68° then find the (i) ∠AFC (ii) Obtuse angle AOC.



⇨ Here,

(i) ∠AFC = ∠CED = 68° [Being exterior angle and opposite interior angle of a cyclic quadrilateral.]

∴ ∠AFC = 68°

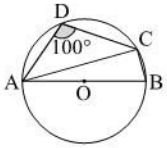
(ii) ∠AOC = 2∠AFC [Being both are on same arc.]

or, ∠AOC = 2 × 68° = 136°

Thus, the value of ∠AFC is 68° and ∠AOC is 136°.

1D. दिइएको चित्रमा AOB वृत्तको व्यास हो । यदि ∠ADC = 100° भए ∠BAC को मान पत्ता लगाउनुहोस् ।

In the given figure AOB is the diameter of circle. If ∠ADC = 100° then find the value of ∠BAC.



⇨ Here,

(i) ∠ADC + ∠ABC = 180° [Being the opposite angles of cyclic quadrilateral.]

or, 100° + ∠ABC = 180°

∴ ∠ABC = 80°

(ii) ∠ABC + ∠BAC = 90° [Being AB is a diameter.]

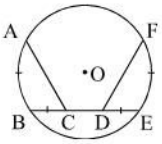
or, 80° + ∠BAC = 90°

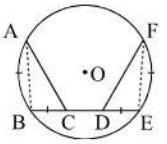
∴ ∠BAC = 10°

Thus, the value of ∠BAC is 10°.

2. सँगैको चित्रमा BC = DE र $\overset{\frown}{AB} = \overset{\frown}{FE}$ भए ∠ACB = ∠FDE हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the adjoining figure, BC = DE and $\overset{\frown}{AB} = \overset{\frown}{FE}$ then prove that ∠ACB = ∠FDE.





⇨ Here, **Given :** BC = DE and $\overset{\frown}{AB} = \overset{\frown}{FE}$

To prove: ∠ACB = ∠FDE

Construction: Join AB and EF.

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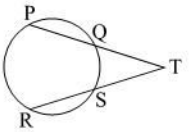
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Proof :

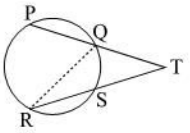
Statements	Reasons
1. $\overset{\frown}{BA} = \overset{\frown}{EF}$	1. Given
2. $\overset{\frown}{BA} + \overset{\frown}{AF} = \overset{\frown}{EF} + \overset{\frown}{AF}$ or, $\overset{\frown}{BAF} = \overset{\frown}{EFA}$	2. By adding $\overset{\frown}{AF}$ on both sides of statement (1).
3. $\angle ABE$ (or $\angle ABC$) = $\angle BEF$ (or $\angle DEF$)	3. Equal arcs subtend equal angles at circumference.
4. In ΔBAC and ΔDEF (i) BA = EF (ii) $\angle ABC = \angle DEF$ (iii) BC = ED	4. (i) $\overset{\frown}{BA} = \overset{\frown}{EF}$ (ii) By statement (3) (iii) Given
5. $\Delta BAC \cong \Delta DEF$	5. By S.A.S. congruency
6. $\angle BCA = \angle EDF$	6. Corresponding angles of congruent triangles.

Proved.

3. सँगैको चित्रमा, जीवा PQ र RS वृत्तको बाह्य बिन्दु T मा परस्पर काटिएका छन् भने $\angle QTS = \frac{1}{2}(\overset{\frown}{PR} - \overset{\frown}{QS})$ हुन्छ भनी प्रमाणित गर्नुहोस् ।



In the adjoining figure chord PQ and RS are intersected at an external point T then prove that: $\angle QTS = \frac{1}{2}(\overset{\frown}{PR} - \overset{\frown}{QS})$



⇨ Here, **Given :** PQ and RS are the chords of a circle.

To prove: $\angle QTS = \frac{1}{2}(\overset{\frown}{PR} - \overset{\frown}{QS})$

Construction: Join Q and R.

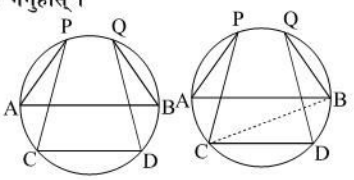
Proof:

Statements	Reasons
1. $\angle PQR = \frac{1}{2}\overset{\frown}{PR}$	1. Angle at circumference is equal to half of degree measure of its opposite arc.
2. $\angle QRS = \frac{1}{2}\overset{\frown}{QS}$	2. Angle at circumference is equal to half of degree measure of its opposite arc.
3. $\angle PQR = \angle QRT + \angle QTR$ or, $\angle QTR = \angle PQR - \angle QRS$	3. Ext. angle in a triangle is equal to the sum of two opposite interior angles.
4. $\angle PTR = \frac{1}{2}\overset{\frown}{PR} - \frac{1}{2}\overset{\frown}{QS} = \frac{1}{2}(\overset{\frown}{PR} - \overset{\frown}{QS})$	4. Putting values from (1) and (2) in (3) and $\angle QTR = \angle PTR$.

Proved.

4. दिइएको चित्रमा यदि $\angle APC = \angle BQD$ छ भने AB // CD हुन्छ भनी प्रमाणित गर्नुहोस् ।

In the given figure, $\angle APC = \angle BQD$. Prove that : AB // CD [2065 D]



⇨ Here, **Given :** in the given figure, $\angle APC = \angle BQD$

To prove : AB // CD

Construction: Join BC.

Proof :

Statements	Reasons
1. $\angle APC = \angle BQD$	1. Given
2. $\angle APC = \angle ABC$	2. Angles in the circumference standing on the same arc.
3. $\angle BQD = \angle BCD$	3. Angles in the circumference standing on the same arc.
4. $\angle ABC = \angle BCD$	4. From the statements (1), (2) and (3)
5. AB // CD	5. From the statement (4), alternate angles are equal.

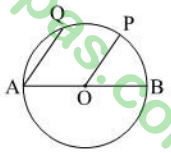
Proved.

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5. सँगैको चित्रमा O वृत्तको केन्द्र हो । यदि $\overset{\frown}{PQ} = \overset{\frown}{PB}$ भए AQ // OP हुन्छ भनी प्रमाणित गर्नुहोस्:

In the given figure, O is the centre of the circle, if $\overset{\frown}{PQ} = \overset{\frown}{PQ}$ then Prove that: AQ // OP.



⇨ Here, **Given:** 'O' is centre of the circle, AB be the diameter and $\overset{\frown}{BP} = \overset{\frown}{PQ}$.

To prove: AQ // OP.

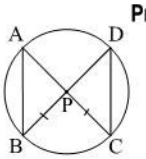
Proof:

Statements	Reasons
1. $\measuredangle BOP \equiv \overset{\frown}{BP}$	1. Angle at the centre is equal to the degree measure of its opposite arc.
2. $\measuredangle QAB \equiv \frac{1}{2}\overset{\frown}{BQ}$	2. Angle at the circumference is equal to half of degree measure of its opposite arc.
3. $\measuredangle QAB \equiv \frac{1}{2}.2\overset{\frown}{BP} = \overset{\frown}{BP}$	3. $\overset{\frown}{BP} = \overset{\frown}{PQ}$ (given)
4. $\measuredangle BOP = \measuredangle QAB$	4. Statements 1 and 3.
5. AQ // OP	5. From statement 4, corresponding angles are equal.

Proved.

6. दिइएको चित्रमा जीवा AC र BD परस्पर बिन्दु P मा काटिएका छन् । यदि PB = PC भए सिद्ध गर्नुहोस् ।

In the given figure, chords AC and BD are intersected at P. If PB = PC then prove that:



(i) जीवा AB = जीवा DC (Chord AB = Chord DC) **(ii) जीवा AC = जीवा BD (Chord AC = Chord BD)**

(iii) चाप ABC = चाप BCD (Chord ABC = Chord BCD)

⇨ Here **Given:** PB = PC

To prove: AB = DC, AC = BD and $\overset{\frown}{ABC} = \overset{\frown}{BCD}$

Construction: Join B & C.

Proof:

Statements	Reasons
1. $\measuredangle PBC = \measuredangle PCB$	1. Being the base angles of an isosceles ΔPBC.
2. $\measuredangle PBC \nabla \cong \frac{1}{2}\overset{\frown}{CD}$ and $\measuredangle PCB \cong \frac{1}{2}\overset{\frown}{AB}$	2. From the relation between arc and inscribed angles.
3. $\frac{1}{2}\overset{\frown}{CD} = \frac{1}{2}\overset{\frown}{AB} \quad \therefore \overset{\frown}{CD} = \overset{\frown}{AB}$	3. From (1) and (2)
4. CD = AB	4. Correpsonding chords of (3)
5. $\measuredangle ABP = \measuredangle PCD$	5. Being both are on same arc.
6. $\measuredangle ABC = \measuredangle BCD$	6. Adding (1) and (5)
7. AC = BD	7. Being the corresponding chords of equal angles from (6).
8. $\overset{\frown}{CD} + \overset{\frown}{BC} = \overset{\frown}{AB} + \overset{\frown}{BC}$ $\therefore \overset{\frown}{BCD} = \overset{\frown}{ABC}$	8. Adding $\overset{\frown}{BC}$ on both the sides of (3).

Proved.

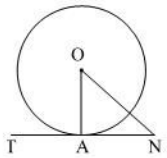
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14.2 स्पर्शरेखा (TANGENT)

A. BASIC EXERCISE

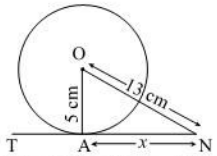
A. VERY SHORT QUESTIONS

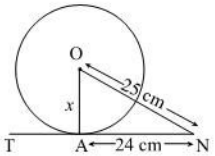
1. सँगैको चित्रबाट निम्नलिखित प्रश्नहरू उत्तर दिनुहोस् (From the adjoining figure, answer the following questions):
   (a) स्पर्श रेखा र स्पर्श बिन्दुका नाम लेख्नुहोस् ।
   Name the tangent and point of contact.
   (b) OA र TAN को सम्बन्ध लेख्नुहोस र ∠OAN को मान पत्ता लगाउनुहोस् ।
   Write the relation between OA & TAN and find the value of ∠OAN.
   (c) ON लाई OA र AN को रूपमा व्यक्त गर्नुहोस् ।
   Express ON in terms of OA and AN.

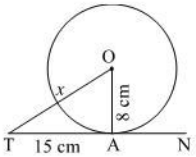


⇨ (a) Tangent is TAN and point of contact is point A.
(b) OA ⊥ TAN and ∠OAN = 90°
(c) ON = $\sqrt{OA^2 + AN^2}$

2. तलका चित्रहरूबाट x को मान पत्ता लगाउनुहोस् ।
   From the following figures, find the value of x.
   (a) (b) (c)





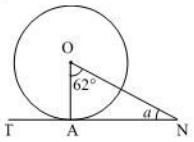


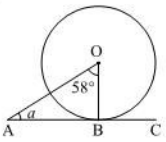
⇨ (a) Here, OA = 5 cm, ON = 13 cm
We have, $AN^2 + OA^2 = ON^2$
or, $x^2 + 5^2 = 13^2$ ∴ $x = \sqrt{169 - 25} = \sqrt{144} = 12$ cm

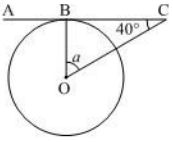
(b) Here, ON = 25 cm, AN = 24 cm, OA = x
We have, $OA^2 + AN^2 = ON^2$ or, $x^2 + 24^2 = 25^2$ or, $x^2 = 625 - 576 = 49$
∴ $x = \sqrt{49} = 7$ cm

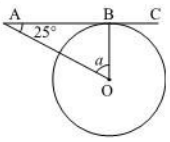
(c) Here, OA = 8 cm, OT = x, AT = 15 cm
We have, $OA^2 + AT^2 = OT^2$ or, $x^2 = 8^2 + 15^2 = 64 + 225 = 289$
∴ $x = \sqrt{289} = 17$ cm

3. तलका चित्रहरूबाट a को मान पत्ता लगाउनुहोस् । (From the following figures, find the value of a.)
   (a) (b) (c) (d)









⇨ (a) Here, (i) ∠OAN = 90° [∵ OA⊥TN]
(ii) ∠OAN + ∠ANO + ∠AON = 180° [∵ Sum of ∠s of a triangle]
or, 90° + a + 62° = 180° ∴ a = 180° – 152° = 28°
Thus, the value of a is 28°.

(b) Here, (i) ∠ABO = 90° [∵ OB ⊥ AC]
(ii) ∠AOB + ∠ABO + ∠BAO = 180° [∵ Sum of ∠s of a triangle]
or, 58° + 90° + a = 180° or, a =180° – 148° = 32°
Thus, the value of a is 32°.

(c) Here, (i) ∠OBC = 90° [∵ OB ⊥ AC]
(ii) ∠OBC + ∠BOC + ∠BCO = 180° [∵ Sum of ∠s of a triangle]
or, 90° + a + 40° = 180° ∴ a = 180° – 130° = 50°
Thus, the value of a is 50°.

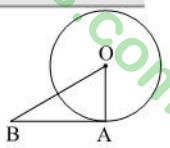
(d) Here, (i) ∠ABO = 90° [∵ OB ⊥ AC]
(ii) ∠ABO + ∠AOB + ∠BAO = 180° [Sum of ∠s of a triangle]
or, 90° + a + 25° = 180° ∴ a = 180° – 115° = 65°
Thus the value of a is 65°.

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B. SHORT QUESTIONS

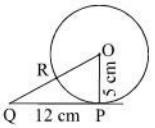
Model 1

1. दिइएको चित्रमा O वृत्तको केन्द्र र AB स्पर्शरेखा हो । यदि OB = 13 से.मि. र OA = 5 से.मि. भए AB को लम्बाई पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle and AB is tangent to the circle. If OB = 13 cm and OA = 5 cm, find the length of AB. **[2071 S]**



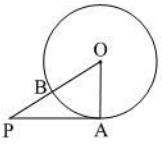
⇨ Here, OB = 13 cm and OA = 5 cm
(i) $\measuredangle OAB = 90°$ [Being OA is radius and AB is tangent at A.]
(ii) $OB^2 = OA^2 + AB^2$ [By Pythagoras theorem in ΔAOB.]
or, $13^2 = 5^2 + AB^2$ or, $169 - 25 = AB^2$
or, $144 = AB^2$ or, $12^2 = AB^2$
$\therefore$ AB = 12 cm Thus, the measure of AB is 12 cm.

2. दिइएको वृत्तमा O केन्द्रबिन्दु, PQ स्पर्शरेखा र P स्पर्शबिन्दु हुन् । यदि OP = 5 से.मि. र PQ = 12 से.मि. छ भने QR को नाप पत्ता लगाउनुहोस् ।
In the given circle with centre O, PQ is the tangent and P the point of contact. If OP = 5 cm and PQ = 12 cm, find the length of QR. **[2063 A1, 2064 A2]**



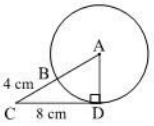
⇨ (i) Here, $OQ = \sqrt{PQ^2 + OP^2} = \sqrt{12^2 + 5^2} = \sqrt{144 + 25} = \sqrt{169} = 13$ cm.
(ii) QR = OQ – OR = 13 cm – 5 cm [$\because$ OR = OP = 5 cm]
$\therefore$ QR = 8 cm
Thus, the length of QR is 8 cm.

3. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु, PA स्पर्शरेखा, A स्पर्शबिन्दु, OB = 3 cm, र PA = 4 cm भए OP को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of circle, PA is a tangent, where A is the point of contact, OB = 3 cm, and PA = 4 cm. Find the length of OP. **[SLC 2066 C]**



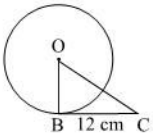
⇨ Here, (i) OB = OA = 3 cm [Being radii of same circle]
$\therefore$ OA = 3 cm
(ii) $OP = \sqrt{OA^2 + AP^2} = \sqrt{3^2 + 4^2} = 5$ cm [Being ΔOAP is a right $\measuredangle$d Δ]
Thus, the measure of OP is 5 cm.

4. दिइएको चित्रमा A वृत्तको केन्द्रबिन्दु, CD स्पर्शरेखा BC = 4 से.मि. र CD = 8 से.मि. AB को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, A is the centre of the circle, CD is a tangent, BC = 4 cm and CD = 8 cm. Find the length of AB. **[2064 B1]**



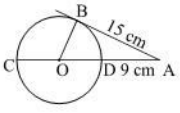
⇨ Here, let, AB be x cm then AD will be also x cm.
(i) AC = BC + AB = 4 cm + x cm = (x + 4) cm
(ii) $AC^2 = AD^2 + CD^2$ [Pythagoras Theorem]
or, $(x + 4)^2 = x^2 + 8^2$ or, $x^2 + 8x + 16 = x^2 + 64$
or, $8x = 48$ $\therefore$ $x = 6$
Thus, the length of AB is 6 cm.

5. चित्रमा O वृत्तको केन्द्र र CB वृत्तको बिन्दु B मा एउटा स्पर्शरेखा हो । यदि वृत्तको व्यास 18 cm र BC = 12 cm छन् भने OC को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, 'O' is the centre of the circle and CB is tangent to the circle at B. If the diameter of the circle is 18 cm and BC = 12 cm, find the length of OC. **[2068 D]**



⇨ Here, diameter = 18 cm So, radius (OB) = $\frac{d}{2} = \frac{18 \text{ cm}}{2} = 9$ cm
We have, $OC = \sqrt{OB^2 + BC^2} = \sqrt{9^2 + 12^2} = \sqrt{225}$ $\therefore$ OC = 15 cm
Thus, the length of OC is 15 cm.

6. दिइएको चित्रमा O वृत्तको केन्द्र, AB स्पर्शरेखा र B स्पर्शबिन्दु हो । CD लाई A बिन्दुसम्म बढाइएको छ । यदि AB = 15 cm र AD = 9 cm भए OB को लम्बाइ पत्ता लगाउनुहोस् ।
In the given figure, O is the centre of the circle, AB is a tangent and B is the point of contact. CD is produced up to the point A. If AB = 15 cm and AD = 9 cm, find the length of OB. **[2068 E, 2067 C]**

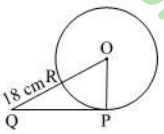


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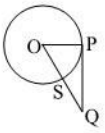
⇨ Here, let, OB = OD = x then OA = (x + 9) cm Since OB ⊥ AB, so OB = $\sqrt{OA^2 - AB^2}$
or, $x = \sqrt{(x+9)^2 - 15^2}$ or, $x^2 = (x+9)^2 - 225$
or, $x^2 = x^2 + 18x + 81 - 225$ or, $18x = 144$ ∴ $x = 8$
Thus, the length of OB is 8 cm.

7. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु र OQ एउटा स्पर्शरेखा हो जसमा P स्पर्श बिन्दु हो। यदि OQ = 25 से.मि. र QR = 18 से.मि. भए PQ को लम्बाइ पत्ता लगाउनुहोस्।
In the given figure, O is the centre of the circle and OQ the tangent where P is the point of contact. If OQ = 25 cm and QR = 18 cm, find the length of PQ. [2067A]



⇨ Here, OQ = 25 cm, QR = 18 cm
(i) OR = OQ − QR = 25 cm − 18 cm = 7 cm ∴ OP = OR = 7 cm
(ii) PQ = $\sqrt{OQ^2 - OP^2} = \sqrt{25^2 - 7^2}$ [Being OP ⊥ PQ]
∴ PQ = 24 cm Thus, the length of PQ is 24 cm

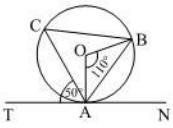
8. दिइएको चित्रमा वृत्तको केन्द्रबिन्दु O छ। स्पर्स रेखा PQ को लम्बाई 8 से.मि. र अर्धव्यास OS को लम्बाई 6 से.मि. छ भने QS को लम्बाई पत्ता लगाउनुहोस्।
In the given diagram, O is the centre of the circle. If the length of the tangent PQ is 8 cm and the length of radius OS is 6 cm, find the length of QS. [2067 S]



⇨ Here, (i) OS = OP = 6 cm and PQ = 8 cm [Being P is point of contact and PQ is a tangent]
(ii) OQ = $\sqrt{OP^2 + PQ^2} = \sqrt{6^2 + 8^2} = 10$ cm
(iii) SQ = OQ − OS = 10 cm − 6 cm = 4 cm
Thus, length of QS is 4 cm.

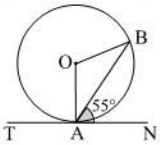
Model 2

9. सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो। स्पर्शरेखा TAN, ∠TAC = 50° र ∠AOB = 110° भए
In the adjoining figure O is the centre of a circle. If TAN, the tangent, ∠TAC = 50° and ∠AOB = 110° then [2060 E1]
(i) ∠CAO को नाप निकाल्नुहोस् (Find the measure of ∠CAO.)
(ii) ∠ACB को नाप निकाल्नुहोस् (Find the measure of ∠ACB.)



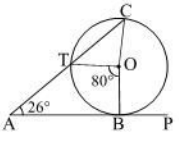
⇨ Here, (i) ∠OAT = 90° [∵ OA is radius, TAN is tangent]
∠CAO = ∠OAT − ∠CAT = 90° − 50° = 40°
(ii) $\angle ACB = \frac{1}{2} \angle AOB = \frac{1}{2} \times 110° = 55°$
[∵ Angles at the circumference and at the centre subtended by the same arc]

10. दिइएको चित्रमा O वृत्तको केन्द्र हो। स्पर्श बिन्दु A मा TAN स्पर्शरेखा हो। ∠BAN = 55° भए ∠OBA को मान पत्ता लगाउनुहोस्।
In the given figure, O is the centre of the circle and TAN is the tangent of A. If ∠BAN = 55°, find ∠OBA. [2067 E]



⇨ Here, (i) ∠OAB = 90° − ∠BAN = 90° − 55° = 35° [Being OA ⊥ TAN]
(ii) ∠OBA = ∠OAB [Being OA = OB]
∴ ∠OBA = 35°
Thus, the measure of ∠OBA is 35°.

11. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु, AP स्पर्शरेखा, B स्पर्शबिन्दु र ATC एउटा सरलरेखा हो। यदि ∠BOT = 80° र ∠BAT = 26° भए ∠OCT को नाप पत्ता लगाउनुहोस्।
In the given diagram, O is the centre of the circle, AP the tangent, B the point of contact and ATC is a straight line. If ∠BOT = 80° and ∠BAT = 26°, calculate the measure of the ∠OCT. [2061 B2]

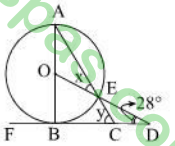


⇨ Here, (i) ∠OBA = 90° [∵ OB is radius, AP is tangent at B]
(ii) ∠OTA + ∠TAB + ∠OBA + ∠TOB = 360° [∵ Sum of all angles of a quad.]
or, ∠OTA + 26° + 90° + 80° = 360°
or, ∠OTA + 196° = 360°
∴ ∠OTA = 360° − 196° = 164°
(iii) ∠OTC = 180° − ∠OTA = 180° − 164° = 16° [∵ Linear pair]
(iv) ∠OCT = ∠OTC = 16° [∵ OC = OT = radius]
Thus, measure of ∠OTC is 16°.

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12. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो। FBD स्पर्शरेखा, B स्पर्शबिन्दु र ∡ODB = 28°, भए x र y का मानहरू निकाल्नुहोस्।

In the figure, O is the centre of the circle. If FBD is a tangent with B the point of contact and ∡ODB = 28°, find x and y. [2061 C1]



⇨ Here, (i) ∡OBD = 90° [∵ OB is radius and FD is the tangent.]

(ii) ∡BOD = 180° – (28° + 90°) = 62° [∵ Sum of all angles of a triangle.]

(iii) $\angle OAE = \frac{1}{2}\ \angle BOE$ (or $\angle BOD) = \frac{1}{2} \times 62° = 31°$

[∵ Angles at circumference and angle at the, centre standing on the same arc.]

(iv) ∡OEA = ∡OAE [∵ OE = OA = radius]

∴ x = 31°

(v) ∡CED = ∡OEA = 31° [∵ Vertically opp. angles]

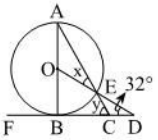
(vi) ∡BCE = ∡CDE + ∡CED [∵ Ext. angle = Sum of opp. int. angles]

∴ y = 28° + 31° = 59°.

Thus, value of x & y are 31° & 59° respectively.

13. सँगैको चित्रमा O वृत्तको केन्द्रबिन्दु हो। FBD स्पर्शरेखा, B स्पर्श बिन्दु र ∡ODB = 32° भए x र y को मानहरू निकाल्नुहोस्।

In the adjoining figure, O is the centre of the circle, FBD is a tangent at the point 'B' and ∡ODB = 32°, find the values of x and y. [2065 A]



⇨ Here, (i) OB ⊥ BD [Being OB and BD are radius and tangent.]

(ii) ∡BOD = 90° – ∡ODB = 90° – 32° [From right ΔOBD]

∴ ∡BOD = 58°

(iii) $\angle BAC = \frac{1}{2}\ \angle BOD$ [Angle at centre and circumference standing on same arc]

or, $\angle BAC = \frac{1}{2} \times 58°$ ∴ ∡BAC = 29°

(iv) x = ∡BAC [Being OA = OE]

∴ x = 29°

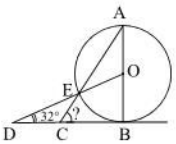
(v) y = 90° – ∡BAC [Being ΔABC is a right angled triangle.]

∴ y = 90° – 29° = 61°

Thus, x = 29° र y = 61°

14. दिइएको चित्रमा एउटा वृत्तको केन्द्रबिन्दु O हो। DB एउटा स्पर्शरेखा र B स्पर्शबिन्दु हो। यदि ∡ODB = 32° भए ∡ACB को मान पत्ता लगाउनुहोस्।

In the given figure, O is the centre of a circle. DB is a tangent and B is a point of contact. If ∡ODB = 32°, find the value of ∡ACB. [2062 E1]



⇨ Here, (i) OB ⊥ BD [Being OB and BD are radius and tangents]

(ii) ∡BOD = 90° – ∡ODB = 90° – 32° [From right ΔOBD]

∴ ∡BOD = 58°

(iii) $\angle BAC = \frac{1}{2}\ \angle BOD$ [Angle at centre and circumference standing on same arc]

or, $\angle BAC = \frac{1}{2} \times 58°$ ∴ ∡BAC = 29°

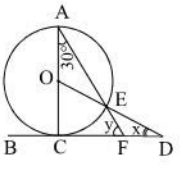
(iv) ∡ACB = 90° – ∡BAC = 90° – 29° [From right angled ΔBAC]

∴ ∡ACB = 61°

Thus, the measure of ∡ACB is 61°.

15. दिइएको चित्रमा, O वृत्तको केन्द्रबिन्दु हो, BCD स्पर्शरेखा, C स्पर्शबिन्दु र ∡CAF = 30° भए x र y का मानहरू पत्ता लगाउनुहोस्।

In the figure O is the centre of the circle, if BCD is a tangent with C the point of contact and ∡CAF = 30°, find x and y. [2061 C2]



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⇨ Here, (i) $\angle ACF = 90°$ [∵ OC is radius and BF is tangent at C]
(ii) $\angle CAF + \angle ACF + \angle AFC = 180°$ [∵ Sum of all the angles of a triangle]
or, $30° + 90° + y = 180°$ or, $120° + y = 180°$
or, $y = 180° - 120° = 60°$
(iii) $\angle OEA = \angle OAE = 30°$ [∵ OA = OE = radius]
(iv) $\angle FED = \angle OEA = 30°$ [∵ Vertically opp. angles]
(v) $y = \angle FED + x$ [∵ Ext. angle = sum of two opp. int. axgles]
or, $60° = 30° + x$ ∴ $x = 60° - 30° = 30°$
Thus, $x = 30°$ and $y = 60°$.

Model 3

16. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो। यदि MN एउटा स्पर्शरेखा र PQ = QR भए $\angle QRM$ को मान पत्ता लगाउनुहोस्।
In the given figure, O is the centre of the circle, MN is a tangents. If PQ = QR, find $\angle QRM$. **[2068 C]**

⇨ Here, PQ = QR
(i) $\angle Q = 90°$ [Being PR is a diameter]
(ii) $\angle QPR = 45°$ [Being an acute angle of right angled isosceles triangle]
(iii) $\angle QRM = \angle QPR$ ∴ $\angle QRM = 45°$
Thus, the measure of $\angle QRM = 45°$.

17. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु हो। TP र TQ उक्त वृत्तमा स्पर्शरेखाहरू हुन् जसमा P र Q स्पर्शबिन्दुहरू छन्। यदि $\angle POQ = 134°$ भए $\angle PTQ$ को नाप पत्ता लगाउनुहोस्।
In the given figure, O is the centre of the circle. TP and TQ are the tangents to the circle where P and Q are the points of contact. If $\angle POQ = 134°$, calculate the measure of the $\angle PTQ$. **[2066 B]**

⇨ Here, $\angle PTQ + \angle TPO + \angle OQT + \angle POQ = 360°$ [Sum of $\angle S$ of quad PTQO]
or, $\angle PTQ + 90° + 90° + 134° = 360°$ [Being OP ⊥ PT & OQ ⊥ TQ]
or, $\angle PTQ = 46°$ Thus, the measure of $\angle PTQ$ is 46°.

18. दिइएको चित्रमा O वृत्तको केन्द्र हो। PM र PN स्पर्शरेखाहरू हुन्। $\angle MON = 158°$ भए $\angle MPN$ को मान निकाल्नुहोस्।
In the figure, O is centre of the circle. PM and PN are two tangents. If $\angle MON = 158°$, find $\angle MPN$. **[2068 B]**

⇨ Here, (i) $\angle PMO = 90°$ & $\angle PNO = 90°$ [The radius is perpendicular at point of contact of tangent]
(ii) $\angle MPN + \angle PMO + \angle PNO + \angle MON = 360°$ [Sum of angles of quadrilateral]
or, $\angle MPN + 90° + 90° + 158° = 360°$ or, $\angle MPN = 360° - 338°$
∴ $\angle MPN = 22°$
Thus, the value of $\angle MPN$ is 22°.

Model 4

19. दिइएको चित्रमा O वृत्तको केन्द्रबिन्दु, TS स्पर्शरेखा, Q स्पर्शबिन्दु हो। यदि PR // QS भए $\Delta PQR \sim \Delta OSQ$ हुन्छ भनी प्रमाणित गर्नुहोस्।
In the figure, O is the centre of a circle, TS is a tangent with the point of contact Q and PR // OS. Prove that: $\Delta PQR \sim \Delta OSQ$. **[2061 A1]**

⇨ Here, (i) $\angle PRQ = \angle OQS$ [∵ Both are rt. angles]
(ii) $\angle QPR = \angle QOS$ [∵ PR // QS and corresponding angles]
(iii) $\Delta PQR \sim \Delta OSQ$ [∵ By A.A. similarity]

20. दिइएको चित्रमा O वृत्तको केन्द्र हो। DE स्पर्शरेखा र C स्पर्शबिन्दु हो। यदि AB // OD भए, सिद्ध गर्नुहोस्: $\Delta ABC \sim \Delta OCD$.
In the given figure, O is the centre of a circle, DE is a tangent with the point of contact C. If AB // OD, prove that $\Delta ABC \sim \Delta OCD$. **[2061 A2]**

⇨ Here, (i) $\angle ABC = \angle OCD$ [∵ Both are rt. angles]
(ii) $\angle BAC = \angle DOC$ [∵ AB // DO, corres. angle]
(iii) $\Delta ABC \sim \Delta OCD$ [∵ By A.A similarity test]

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प्रयोगात्मक परीक्षण
Experimental Verification

[4 Marks = 1 Long Question]

Important Rules

1. Big, neat and clean figures must be drawn. The minimum size of the figure is to be given in the question.
2. Two figures of different measures must be drawn.
3. The required measurement must be shown in the table.
4. The conclusion with respect to measurement table must be written.

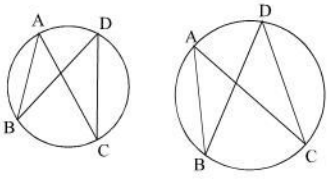
A. BASIC EXERCISE

Model 1

1. एउटै वृत्तखण्डमा बनेका परिधिकोणहरू बराबर हुन्छन् भनी प्रमाणित गर्नुहोस् ।
Verify experimentally that the angles in the same segment of a circle are equal.

[2057 S, 2068 E, 2066 D, C, 2057 B1, C2, E1, S, 2058 A2, A1, C1, D1, D2, S, 2059 C2, D1, 2060 D2, 2061 D1, D2, S, 2063 M, 2064 S, 2067 D]

⇨



Here, Experimental verification

(i) Draw two circles with radii of different measurements.

(ii) In every figure, draw ∠BAC and ∠BDC at the circumference.

(iii) Measure the angles with protractor as shown in the following table.

Table:

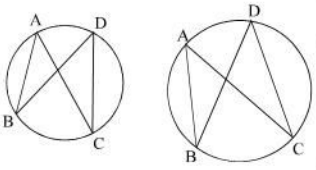
Figure	∠BAC	∠BDC	Remarks
1.	.....	.....	∠BAC = ∠BDC
2.	.....	.....	∠BAC = ∠BDC

Conclusion : In every figure, angles ∠BAC and ∠BDC are equal. Hence, angles in the same arc of a circle are equal.

2. एउटै चापमा आधारित परिधिका कोणहरू बराबर हुन्छन् भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (अर्धव्यासहरू कम्तीमा 3 से.मि. भएका दुईओटा वृत्तहरू आवश्यक छन् ।)
Verify experimentally that the angles at the circumference of a circle standing on the same arc are equal. (Two circles of radii not less than 3 cm are necessary.)

[2060 C1, 2060 S, 2059 C1 and 2060 D1, 2061 A1 and A2, 2064 A1, A2, 2064 A1, A2, 2067 A, 2067 A]

⇨



Here, experimental verification

(i) Draw two circles with radii of different measurements.

(ii) In every figure, draw ∠BAC and ∠BDC at the circumference.

(iii) Measure the angles with protractor as shown in the following table.

Table:

Figure	∠BAC	∠BDC	Remarks
1.	.....	.....	∠BAC = ∠BDC
2.	.....	.....	∠BAC = ∠BDC

Conclusion: In every figure, angles ∠BAC and ∠BDC are equal. Hence, angles in the same arc of a circle are equal.

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3. कुनै वृत्तको एउटै चापमा आधारित केन्द्रीय कोण परिधि कोणको दुई गुणा हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तिमा 3 cm अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छ ।)

Verify experimentally that the central angle is equal to the double of the angle at the circumference, both standing on the same arc of a circle. (Two circles of radii not less than 3 cm are necessary.) **[2065 M, 2060 C2, 2057 A2]**

⇨

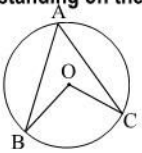


Fig. (i)

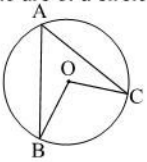


Fig. (ii)

Here, Experimental verification:

Measurement Table :

Figure	∠BAC	∠BOC	Remarks
(i)	.....	.....	$2\angle BAC = \angle BOC$
(ii)	.....	.....	$2\angle BAC = \angle BOC$

Conclusion: From the above table, it is concluded that central angle is equal to the double of the angle at the circumference standing on the same arc of a circle. **Proved.**

4. कुनै वृत्तको एउटै चापमा बनेको परिधिकोण केन्द्रमा बनेको कोणको आधा हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (अर्धव्यासहरू कम्तीमा 3 cm भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally that the circumference angle is half of the angle at the centre standing on the same arc. (Two circles of radii not less than 3 cm arc necessary.) **[2068 D, 2059, C1, 2063 C1, 2066 S, 2066 B]**

⇨

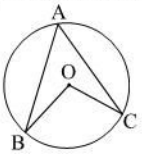


Fig. (i)

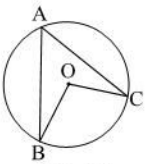


Fig. (ii)

Here, Experimental verification:

Measurement Table :

Figure	∠BAC	∠BOC	Remarks
(i)	.....	.....	$\angle BAC = \frac{1}{2}\angle BOC$
(ii)	.....	.....	$\angle BAC = \frac{1}{2}\angle BOC$

Conclusion: From the above table, it is concluded circumference angle is half of the angle at the centre standing on the same arc. **Proved.**

5. चक्रीय चतुर्भुज DEFG मा ∠D + ∠F = 180° र ∠E + ∠G = 180° हुन्छ भनी प्रयोगद्वारा देखाउनुहोस् । (अर्धव्यास 3 से.मि. भन्दा बढी भएका फरक-फरक नापका दुईओटा मात्र वृत्त बनाउनुपर्नेछ ।)

In the cyclic quadrilateral DEFG, verify experimentally that, ∠D + ∠F = 180° and ∠E + ∠G = 180°. (Two circles of radii more than 3 cm are necessary.) **[2061B1, B2, 2061 E2, E2, 2063 B1, B2]**

⇨ Here, experimental verification:

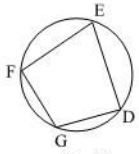


Fig. (1)

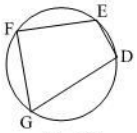


Fig. (2)

Fig	∠D	∠F	∠D + ∠F	∠E	∠G	∠E + ∠G	Result
1	....	....	.... + ...= 180°	....	....	.... + ...= 180°	$\angle D + \angle F = 180°, \angle E + \angle G = 180°$
2	....	....	.... + ...= 180°	....	....	.... + ...= 180°	$\angle D + \angle F = 180°, \angle E + \angle G = 180°$

Conclusion: According to the above table, in every cyclic quad. DEFG ∠D + ∠F and ∠E + ∠G are equal to 180°.

6. एउटा चक्रीय चतुर्भुजका सम्मुख कोणहरूको योगफल दुई समकोण हुन्छन् भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (3 cm भन्दा कम अर्धव्यास नहुने दुई वृत्तहरू आवश्यक छन् ।)

Verify experimentally that the sum of the opposite angles of a cyclic quadrilateral is two right angles. (Two circles of radii not less than 3 cm are necessary.) **[2068 B, 2066 A, E, 2061 B1, B2, E1, E2, EO 2065 C]**

⇨ Here, experimental verification:

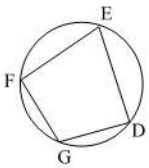


Fig. (1)

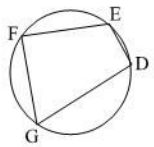


Fig. (2)

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Measurement table:

Fig	∠D	∠F	∠D + ∠F	∠E	∠G	∠E + ∠G	Result
1	....	....	.... + ...= 180°	....	....	.... + ...= 180°	∠D + ∠F =180°, ∠E + ∠G =180°
2	....	....	.... + ...= 180°	....	....	.... + ...= 180°	∠D + ∠F =180°, ∠E + ∠G =180°

Conclusion: According to the above table, in every cyclic quad. DEFG, ∠D + ∠F and ∠E + ∠G are equal to 180°.

7. एउटा चक्रीय चतुर्भुज ABCD मा ∠A + ∠C = 180° हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (फरक-फरक आकारका दुईओटा चित्रहरू आवश्यक छन् तर वृत्तको अर्धव्यास 3 cm भन्दा धेरै हुनुपर्नेछ । **[2061 B1, B2, 2061 E2, E2, 2063 B1, B2]**

Prove experimentally that the ∠A + ∠C = 180° in a cyclic quadrilateral ABCD. (Two figures of different sizes are necessary but the radius of the circle should be greater than 3 cm.)

⇨ Here, two circles with centre at O and radius more than 3 cm are drawn. The cyclic quadrilateral ABCD is drawn as shown in the following fig. (1) and fig. (2) :

To verify: ∠A + ∠C = 180°

Measurements of ∠A and ∠C are shown in the table below :

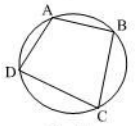


Fig. (1)

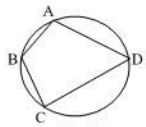


Fig. (2)

	∠A	∠C	Result
Fig. (1)	.....	.....	∠A + ∠C = 180°
Fig. (2)	.....	.....	∠A + ∠C = 180°

Conclusion : In any cyclic quadrilateral ABCD, ∠A + ∠C = 180°.

8. P, Q, R र S चक्रीय चतुर्भुजका शीर्षबिन्दुहरू भए ∠PQR र ∠PSR परिपूरक हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 cm अर्धव्यास भएका दुई वृत्तहरूको आवश्यकता पर्दछ ।)

Verify experimentally that ∠PQR and ∠PSR are supplementary if P, Q, R and S are concyclic. (Two circles of radii more than 3 cm are necessary.) **[2065 A]**

⇨ Here, experimental verification:

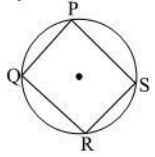


Fig (i)

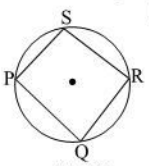


Fig (ii)

Measurement table:

Fig.	∠PQR	∠PSR	Result
(i)	85°	95°	∠PQR + ∠PSR = 180°
(ii)	90°	90°	∠PQR + ∠PSR = 180°

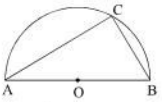
Conclusion: In any cyclic quadrilateral PQRS, ∠PQR + ∠PSR = 180°.

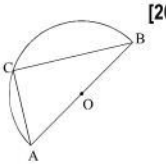
9. अर्धवृत्तमा बनेको परिधिकोण एक समकोण हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 cm अर्धव्यास भएका दुईओटा वृत्तहरू आवश्यक छन् ।)

Verify experimentally that the inscribed angle on the semicircle is one right angle. (Two circles of radii more than 3 cm are necessary.) **[2060 E1 and E2]**

⇨ Here, experimental verification.

Figure	∠ACB	Remarks
(i)	90°	∠ACB = 90°
(ii)	90°	∠ACB = 90°





Conclusion: The angle in a semicircle is a right angle.

10. चक्रीय चतुर्भुजको कुनै एउटा भुजा लम्ब्याउँदा बन्ने बाहिरीकोण त्यसको आसन्न भित्री कोणको सम्मुख कोणसँग बराबर हुन्छ भनी प्रयोगद्वारा सिद्ध गर्नुहोस् । (कम्तीमा 3 cm अर्धव्यास भएका दुईओटा वृत्त आवश्यक छन् ।)

Verify experimentally that an exterior angle of a cyclic quadrilateral is equal to its opposite interior angle. (Two circles of radii more than 3 cm. are necessary) **[2068 A, 2063 A1, A2, 2059 B1, 2060 B2]**

⇨

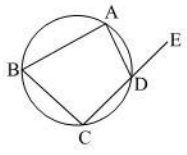


Fig (i)

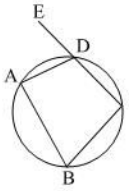


Fig (ii)

Here, experimental verification:

(i) Construct two circles each of radius more than 3 cm.

(ii) In every figure, construct a cyclic quadrilateral ABCD and produce CD to E.

(iii) Now measure ∠ADE and ∠ABC by a protractor and put on the following table.

Figure	∠ADE	∠ABC	Result
(i)	.....	.....	∠ADC = ∠ABC
(ii)	.....	.....	∠ADC = ∠ABC

Conclusion: According to the table, in every figure ∠ADE and ∠ABC are equal. Hence, if one side of a cyclic quadrilateral is produced the exterior angle so formed is equal to its interior opposite angle.

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15. रचना
Construction

[4 Marks]

Key Points

- सर्वप्रथम रचना गर्नुपर्ने चित्रको नामकरण के छ (जस्तै ΔABC वा ΔPQR वा ΔXYZ) यसमा पूरा ध्यान दिनुहोस् । यदि नामकरण फरक परेमा पूरा नम्बर पाउनुहुने छैन ।

  At first attention should be given to the name of figure. (eg. ΔABC or ΔPQR or ΔXYZ) If the naming of figure is different from questions then you will not get full marks.
- बनाउनुपर्ने चित्रको रफ डिजाइन गर्नु भएमा रचना गर्नुपर्ने चित्र बनाउन सरल हुन्छ ।

  If rough sketch of figure is drawn then it will be easy to construct the figure.
- स्पष्ट र सकेसम्म मसिनो रेखा खिच्नुहोस् । मोटो रेखा भएमा अङ्क घट्न सक्छ ।

  Draw a clear and thin line. If the line is thick then the mark will be reduced.
- चित्रको नामकरण उचित स्थानमा गर्नुहोस् । (Label the name of figure in appropriate position.)
- आफूले रचना गरेको चित्रलाई प्रयोगात्मक र सान्दर्भिक रूपमा जाँच्नुहोस् ।

  Test your construction experimentally and theoretically.
- तपाईंले तयार गरेको रचनामा सिसाकलमले नामकरण गर्नुहोस् ।

  Name the figure of the construction by using pencil.
- रचनाका चरणहरू उल्लेख गर्नुपर्दैन । (It is not necessary to explain the steps of construction.)
- चित्र तयार भैसकेपछि अन्तिममा आवश्यक चित्र जस्तै ΔABC वा अन्य यो हो भनेर किटान गरी लेख्नुहोस् ।
  At the end of the construction the required triangle or other should be mentioned clearly.

15.1 त्रिभुज र चतुर्भुजहरूको रचना
CONSTRUCTION OF TRIANGLE AND QUADRILATERAL

A. BASIC EXERCISE 15.1

LONG QUESTIONS

Model 1

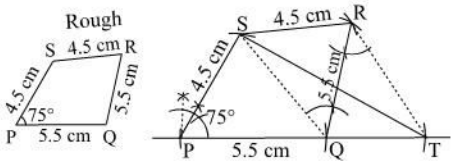
1. PQ = QR = 5.5 से.मि., RS = SP = 4.5 से.मि. र ∠SPQ = 75° भएको चतुर्भुज PQRS को क्षेत्रफलसँग बराबर हुने गरी ΔPST को रचना गर्नुहोस् । [2071 B]

Construct a ΔPST equal in area to the quadrilateral PQRS having PQ = QR = 5.5 cm, RS = SP = 4.5 cm and ∠SPQ = 75°.

⇨ Here, PQ = QR = 5.5 cm, RS = SP = 4.5 cm and ∠SPQ = 75°

ΔPST is the required triangle whose area is equal to the given quadrilateral PQRS.

∴ ΔPST = Quad. ABCD (in area.)



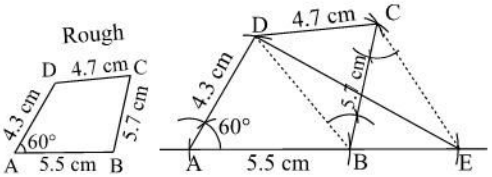
2. AB = 5.5 से.मि., BC = 5.7 से.मि., CD = 4.7 से.मि., DA = 4.3 से.मि. र ∠DAB = 60° भएको चतुर्भुज ABCD को रचना गरी उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुने गरी ΔDAE को रचना गर्नुहोस् ।

Construct a quadrilateral ABCD having AB = 5.5 cm, BC = 5.7 cm, CD = 4.7 cm, DA = 4.3 cm and ∠DAB = 60°. Construct a triangle DAE whose area is equal to given quadrilateral. [2071A]

⇨ Here, AB = 5.5 cm, BC = 5.7 cm, CD = 4.7 cm, DA = 4.3 cm and ∠DAB = 60°.

ΔDAE is the require triangle whose area is equal to the given quadrilateral ABCD.

∴ ΔDAE = Quad. ABCD (in area.)



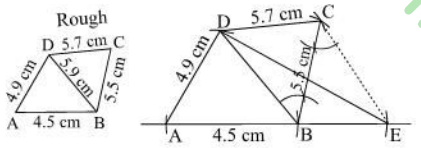
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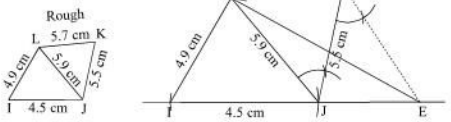
3. **AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm, DA = 4.9 cm र विकर्ण BD = 5.9 cm भएको चतुर्भुजको रचना गरी उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुनेगरी ΔDAE को रचना गर्नुहोस् ।**
Construct a quadrilateral having AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm, DA = 4.9 cm and diagonal BD = 5.9 cm. Also construct a triangle DAE whose area is equal to given quadrilateral. **[2071C]**

⇨ Here, AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm, DA = 4.9 cm and BD = 5.9 cm.
ΔDAE is the required triangle whose area is equal to the given quadrilateral ABCD.
∴ ΔDAE = Quad. ABCD (in area)



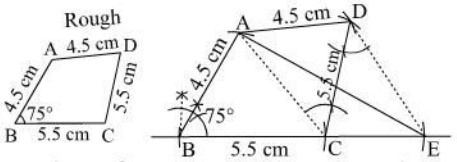
4. **IJ = 4.5 से.मि., JK = 5.5 से.मि., KL = 5.7 से.मि., LI = 4.9 से.मि. र विकर्ण JL = 5.9 से.मि. भएको चतुर्भुज IJKL को रचना गरी उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुने गरी ΔLIE को रचना गर्नुहोस् ।**
Construct a quadrilateral IJKL having IJ = 4.5 cm, JK = 5.5 cm, KL = 5.7 cm, LI = 4.9 cm and diagonal JL = 5.9 cm. Construct a triangle LIE whose area is equal to the given quadrilateral. **[2071D]**

⇨ Here, IJ = 4.5 cm, JK = 5.5 cm, KL = 5.7 cm, LI = 4.9 cm and JL = 5.9 cm
ΔLIT is the required triangle whose area is equal to the given quadrilateral IJKL.
∴ ΔLIE = Quadrilateral IJKL (in area)



5. **BC = CD = 5.5 से.मि., DA = AB = 4.5 से.मि. र ∠ABC = 75° भएको चतुर्भुज ABCD को क्षेत्रफलसँग बराबर हुनेगरी एउटा ΔABE को रचना गर्नुहोस् .**
Construct a ΔABE equal in area to the quadrilateral ABCD having BC = CD = 5.5cm, DA = AB = 4.5cm and ∠ABC = 75°. **[2071 S]**

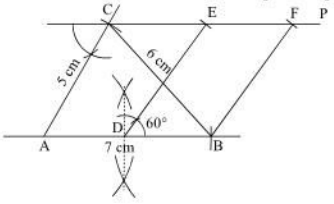
⇨ Here, BC = CD = 5.5 cm, DA = AB = 4.5 cm and ∠ABC = 45°
ΔABE is the required triangle whose area is equal to the area of quadrilateral ABCD.
∴ ΔABE = Quadrilateral ABCD (in area).



6. **a = 7 cm, b = 6 cm र c = 5 cm भएको एउटा त्रिभुज ABC रचना गरी उक्त त्रिभुजसँग क्षेत्रफलमा बराबर हुनेगरी तथा एउटा कोण 60° भएको समानान्तर चतुर्भुजको रचना गर्नुहोस् ।**
Construct a triangle in which a = 7 cm, b = 6 cm and c = 5 cm and also construct a parallelogram whose area is equal to the area of triangle ABC and one angles 60°. **[2067 B]**

⇨ Here, a = 7 cm, b = 6 cm and c = 5 cm

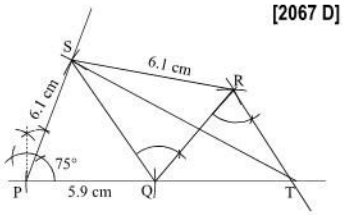
ΔABC is given triangle whose area is equal to the area of parm EDBF.



7. **PQ = QR = 5.9 cm, RS = PS = 6.1 cm र ∠QPS = 75° भएको एउटा चतुर्भुजका PQRS रचना गरी उक्त चतुर्भुजको क्षेत्रफलसँग बराबर हुने गरी ΔPST को रचना गर्नुहोस् ।**
Construct a quadrilateral PQRS having PQ = QR = 5.9 cm, RS = PS = 6.1 cm and ∠QPS = 75° and then construct ΔPST which equal in area to the given quadrilateral. **[2067 D]**

⇨ Here, PQ = QR = 5.9 cm, RS = PS = 6.1 cm and ∠QPS = 75°

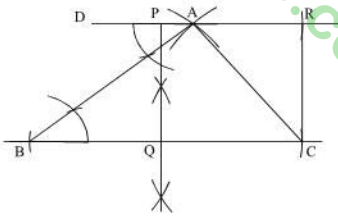
PQRS is given quadrilateral whose area is equal to area of ΔPST.



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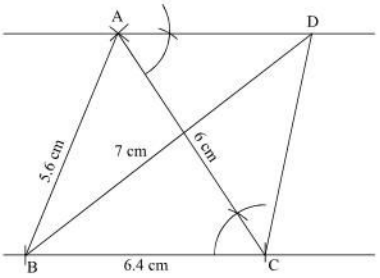
Model 2

8. AB = 6 cm, BC = 7 cm र CA = 4 cm भएको त्रिभुज ABC को रचना गर्नुहोस् र सो त्रिभुजको क्षेत्रफलसँग बराबर हुने गरी एउटा आयतको रचना पनि गर्नुहोस् ।
Construct a triangle ABC in which AB = 6 cm, BC = 7 cm and CA = 4 cm. Also construct a rectangle equal in area to the triangle. [2060 B1]



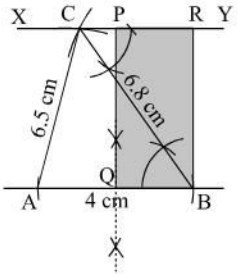
⇨ Here, AB = 6 cm, BC = 7 cm and CA = 4 cm
∴ PQCR is the required rectangle whose area is equal to the ΔABC.

9. भुजाहरू a = 6.4 cm, b = 6 cm र c = 5.6 cm भएको ΔABC को रचना गर्नुहोस् । साथै ΔABC सँग बराबर क्षेत्रफल हुने गरी एउटा भुजा 7 cm भएको अर्को त्रिभुजको रचना गर्नुहोस् ।
Construct ΔABC having sides a = 6.4 cm, b = 6 cm and c = 5.6 cm. Also construct another triangle equal in area to the ΔABC and having its one side 7 cm. [2065 E]



⇨ Here, a = 6.4 cm, b = 6 cm and c = 5.6 cm
ΔABC is the given triangle and ΔDBC is the required triangle whose area is equal to the area of ΔABC.

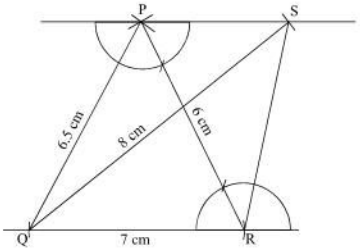
10. भुजाहरू AB = 4 cm, BC = 6.8 cm र CA = 6.5 cm भएको त्रिभुज ABC को रचना गरी उक्त त्रिभुजसँग बराबर क्षेत्रफल हुने एउटा आयतको रचना गर्नुहोस् ।
Construct a triangle ABC having sides AB = 4 cm, BC = 6.8 cm and CA = 6.5 cm, then construct a rectangle equal in area of ΔABC. [2066 C]



⇨ Here, AB = 4 cm, BC = 6.8 cm and CA = 6.5 cm
∴ PQBR is the required rectangle whose area is equal to the area of ΔABC.

Model 3

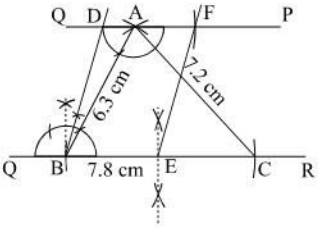
11. एउटा त्रिभुज PQR को रचना गर्नुहोस् जसमा PQ = 6.5 cm, QR = 7 cm र PR = 6 cm छन् । त्रिभुज PQR को क्षेत्रफलसँग बराबर हुने त्रिभुज SQR को रचना गर्नुहोस् जसको एउटा भुजाको नाप 8 cm छ ।
Construct a triangle PQR in which PQ = 6.5 cm, QR = 7 cm and PR = 6 cm. Also construct a triangle SQR having a side 8 cm and equal in area to the triangle PQR. [2068 E]



⇨ Here, PQ = 6.5 cm, QR = 7 cm, PR = 6 cm
ΔPQR is the given triangle and ΔSQR is the required triangle whose area is equal to area of ΔPQR.

Model 4

12. a = 7.8 cm, b = 7.2 cm र c = 6.3 cm हुने एउटा ΔABC को रचना गरी त्यसको क्षेत्रफलसँग बराबर हुने एउटा समानान्तर चतुर्भुज DBEF को रचना गर्नुहोस् जसको एउटा ∠DBC = 75° छ ।
Construct a triangle ABC in which a = 7.8 cm, b= 7.2 cm and c = 6.3 cm. Then construct a parallelogram DBEF equal in area to ΔABC having ∠DBC = 75°. [2061 D1]



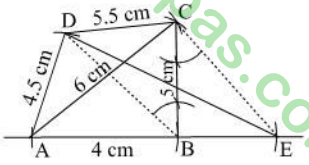
⇨ Here, a = 7.8 cm, b= 7.2 cm and c = 6.3 cm
∴ DBEF is the required parallelogram whose area is equivalent to area of ΔABC.

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13. एउटा चतुर्भुज ABCD को रचना गर्नुहोस् जहाँ, AB = 4 cm, BC = 5 cm, CD = 5.5 cm, DA = 4.5 cm र विकर्ण AC = 6 cm छन् । साथै सो चतुर्भुजसँग बराबर क्षेत्रफल हुने गरी एउटा त्रिभुज ADE को रचना गर्नुहोस् ।

Construct a quadrilateral ABCD in which AB = 4 cm, BC = 5 cm, CD = 5.5 cm, DA = 4.5 cm and diagonal AC = 6 cm. Also construct a triangle ADE equal in area to the quadrilateral. **[2067 E]**

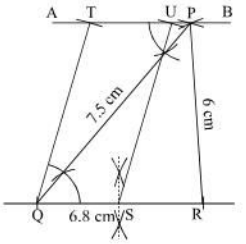


⇨ Here, AB = 4 cm, BC = 5 cm and CD = 5.5 cm, DA = 4.5 cm

ΔADE is required triangle whose area is equal to the given quadrilateral ABCD.

14. **PQ = 7.5 cm, QR = 6.8 cm र RP = 6 cm हुने एउटा ΔPQR को रचना गरी त्यसको क्षेत्रफलसँग बराबर हुने एउटा समानान्तर चतुर्भुज TQSU को रचना गर्नुहोस् जसको एउटा भुजा TQ = 6.4 cm छ ।**

Construct a triangle PQR in which PQ = 7.5 cm, QR = 6.8 cm and RP = 6 cm. Then construct a parallelogram TQSU equal in area to PQR having a side TQ = 6.4 cm. **[2061 D2]**



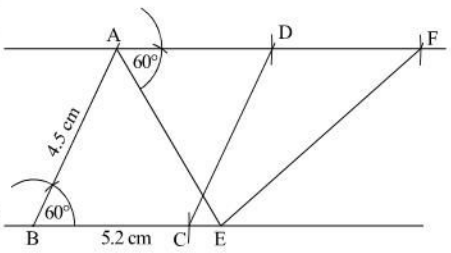
⇨ Here, PQ = 7.5 cm, QR = 6.8 cm and RP = 6 cm

∴ TQSU is the the required parallelogram which is equivalent to ΔPQR.

Model 5

15. एउटा समानान्तर चतुर्भुज ABCD को रचना गर्नुहोस् जसमा AB = 4.5 cm, BC = 5.2 cm, र ∠ABC = 60° छन् । सो समानान्तर चतुर्भुजको क्षेत्रफलको बराबर हुने गरी त्रिभुज EAF को रचना गर्नुहोस् जसमा ∠EAF = 60° छ ।

Construct a parallelogram ABCD, in which AB = 4.5 cm, BC = 5.2 cm and ∠ABC = 60°. Construct a triangle EAF equal in area to the parallelogram in which ∠EAF = 60°. **[2068 C]**

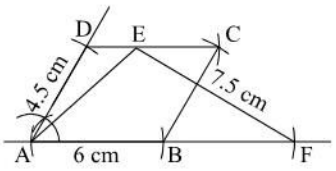


⇨ Here, AB = 4.5 cm, BC = 5.2 cm and ∠ABC = 60°

ΔEAF is the required triangle whose area is equal to the area of given parallelogram.

16. एउटा समानान्तर चतुर्भुज ABCD को रचना गर्नुहोस् जसमा AB = 6 cm, BC = 4.5 cm र ∠DAB = 60° छ । समानान्तर चतुर्भुजको क्षेत्रफलसँग बराबर हुने गरी त्रिभुज AEF को पनि रचना गर्नुहोस् । जसमा FE = 7.5 cm छ ।

Construct a parallelogram ABCD in which AB = 6 cm, BC = 4.5 cm and ∠DAB = 60°. Also construct a triangle AEF equal in area to the parallelogram in which FE = 7.5 cm. **[2068 C]**

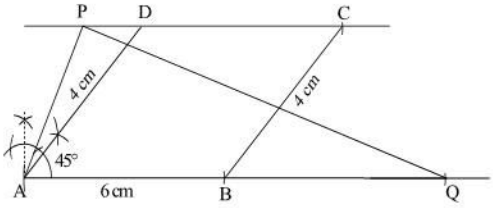


⇨ Here, AB = 6 cm, BC = 4.5 cm and ∠DAB = 60°

ΔEAF is the required triangle whose area is equal to the area of given parallelogram.

17. समानान्तर चतुर्भुज ABCD को रचना गर्नुहोस् जसमा AB = 6 से.मि., BC = 4 से.मि. र ∠BAD = 45° छन् । □ ABCD को क्षेत्रफलसँग बराबर हुने एउटा त्रिभुज APQ को रचना गर्नुहोस् जसको एउटा कोण 60° छ ।

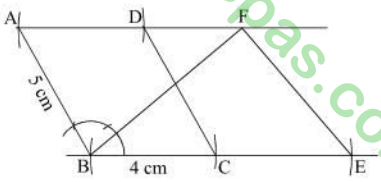
Construct a parallelogrram ABCD in which AB = 6 cm, BC = 4 cm and ∠BAD = 45°. Construct a triangle APQ having one angle is 60° and equal in area with □ ABCD. **[2067 C]**



⇨ ABCD is given parallelogram whose area is equal to area of ΔAPQ.

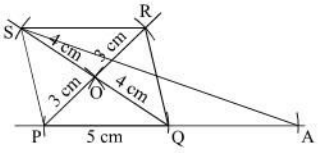
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18. समानान्तर चतुर्भुज ABCD को रचना गर्नुहोस् जसमा AB = 5 cm, BC = 4 cm र ∠B = 120° छन् । माथिको समानान्तर चतुर्भुजसँग क्षेत्रफलमा बराबर हुनेगरी एउटा त्रिभुजको रचना पनि गर्नुहोस् ।
Construct a parallelogram ABCD having AB = 5 cm, BC = 4 cm and ∠B = 120°. Also construct an equivalent triangle. **[2065 A]**



⇨ Here,
ΔFBE is the required triangle whose area is equal to the area of a parallelogram.

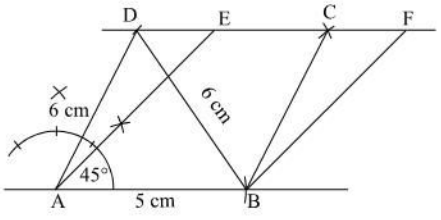
19. समानान्तर चतुर्भुज PQRS को रचना गर्नुहोस् जसमा PQ = 5 cm, विकर्ण PR = 6 cm र विकर्ण QS = 8 cm छ । उक्त समानान्तर चतुर्भुज PQRS को क्षेत्रफलसँग बराबर क्षेत्रफल हुने एउटा त्रिभुज PSA रचना गर्नुहोस् ।
Construct a parallelogram PQRS in which PQ = 5 cm, diagonal PR = 6 cm, and diagonal QS = 8 cm. Construct a triangle PSA whose area is equal to the area of parallelogram PQRS. **[2066 B]**



⇨ Here, PQ = QA
So, ΔPSA is the required triangle whose area is equal to the area of parallelogram PQRS.

Model 6

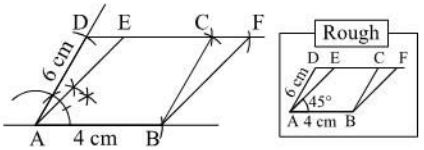
20. एउटा समानान्तर चतुर्भुज ABCD को रचना गर्नुहोस् जसमा AB = 5 cm, AD = 6 cm र विकर्ण BD = 6 cm छ । समानान्तर चतुर्भुज ABCD को क्षेत्रफलको बराबर एउटा अर्को समानान्तर चतुर्भुजको रचना गर्नुहोस् जसको एउटा कोणको नाप 45° छ ।
Construct a parallelogram ABCD in which AB = 5 cm, AD = 6 cm and diagonal BD = 6 cm. Construct another parallelogram equal in area to the parallelogram ABCD having the measurement of one angle 45°. **[2068 D]**



⇨ Here, AB = 5 cm, AD = 6 cm and BD = 6 cm
ABCD is the given parallelogram.
EABF is another parallelogram whose area is equal to the given parallelogram.

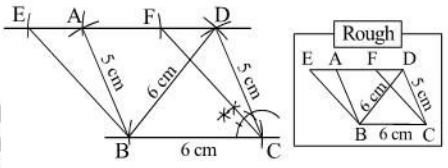
B. QUESTIONS FROM CDC TEXT BOOKS

1A. भुजाहरू AB = 4 cm, AD = 6 cm र ∠BAD = 60° भएको समानान्तर चतुर्भुजसँग बराबर क्षेत्रफल हुने एउटा कोण 45° भएको समानान्तर चतुर्भुज रचना गर्नुहोस् ।
Construct a parallelogram having an angle 45° and equal area to the parallelogram whose sides AB = 4 cm, AD = 6 cm and ∠BAD = 60°.



⇨ Here, required parallelogram has an angle 45° and
given parallelogram have AB = 4 cm, AD = 6 cm and ∠BAD = 60°.
EABF is the required parallelogram whose area is equal to area of given parallelogram ABCD.

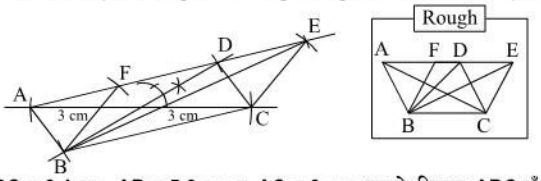
1B. एउटा समानान्तर चतुर्भुजमा AB = 5 cm, AD = 6 cm र विकर्ण BD = 6 cm छ । उक्त समानान्तर चतर्भुजसँग बराबर क्षेत्रफल हुने एउटा कोण 45° भएको समानान्तर चतभुर्जको रचना गर्नुहोस् ।
A parallelogram in whicdh AB = 5 cm, AD = 6 cm and diagonal BD = 6 cm construct a parallelogram having and angle 45° and whose area is equal to the parallelogram.



⇨ Here, required parallelogram having an angle 45° and
given parallelogram have AB = 5 cm, AD = 6 cm and diagonal BD = 6 cm.
EBCF is the required parallelogram whose area is equal to area of given parallelogram ABCD.

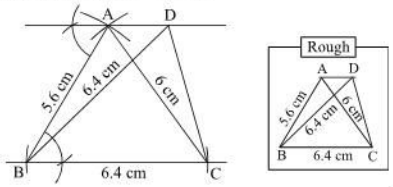
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1C. एउटा समानान्तर चतुर्भुजमा दुई ओटा विकर्णहरू क्रमशः 6 cm, 4.8 cm र तिनीहरूका बिचको कोण 30° छ। उक्त समानान्तर चतुर्भुजसँग बराबर क्षेत्रफल हुने गरी एउटा विकर्ण 7.2 cm भएको समानातर चतुर्भुजको रचना गर्नुहोस्।
Two diagonals of a parallelogram are 6 cm and 4.8 cm respectively and angle between them is 30°. Construct a parallelogram having a diagonal 7.2 cm and equal area to the parallelogram having a side 7 cm.



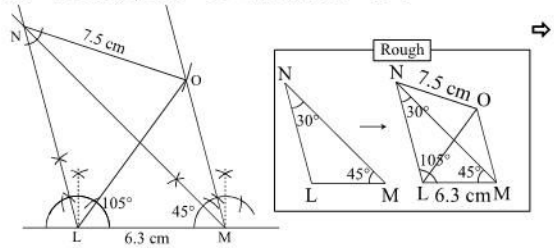
⇨ Here, parallelogram having a diagonal 7.2 cm, AC = 6 cm and diagonal BD = 4.8 cm.
FBCE is the required parallelogram whose area is equal to the given parallelogram.

2A. BC = 6.4 cm, AB = 5.6 cm र AC = 6 cm भएको त्रिभुज ABC सँग बराबर क्षेत्रफल हुने त्रिभुज रचना गर्नुहोस्, जसको एउटा भुजा 7 cm छ।
Construct a triangle having a side 7 cm and whose area is equal to the triangle ABC having BC = 6.4 cm, AB = 5.6 cm and AC = 6 cm.



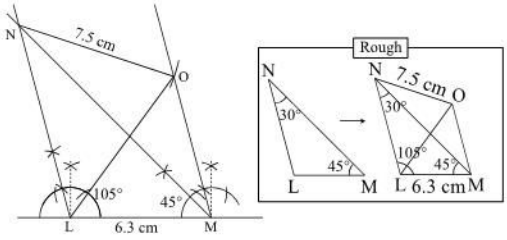
⇨ Here, BC = 6.4 cm, AB = 5.6 cm and AC = 6 cm a side = 7 cm
ΔDBC is the required triangle whose area is equal to the given ΔABC.

2B. LM = 6.3 cm, ∠LNM = 30° र ∠LMN = 45° भएको त्रिभुजको क्षेत्रफलसँग बराबर क्षेत्रफल हुने ΔOLM को रचना गर्नुहोस्, जसमा ON = 7.5 cm छ।
Construct a triangle OLM in which ON = 7.5 cm whose area is equal to a triangle having LM = 6.3 cm, ∠LNM = 30° and ∠LMN = 45°.



⇨ Here, LM = 6.3 cm, ∠LNM = 30° and ∠LMN = 45°, OM = 7.5 cm
The rough sketch of ΔLMN is shown alongside.
So, ∠L = 180° – (∠N + ∠M)
= 180° – (30° + 45°) = 105°
ΔOLM is the required Δ whose area is equal to the area of ΔLMN.

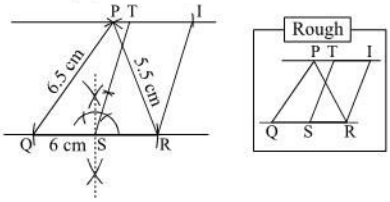
2C. PQ = 6.5 cm, QR = 7 cm र PR = 6 cm भएको त्रिभुजको क्षेत्रफलसँग बराबर हुने गरी एउटा भुजाको लम्बाइ 8 cm भएको एउटा त्रिभुजको रचना गर्नुहोस्।
Construct a triangle having a side 8 cm and whose area is equal to a triangle having PQ = 6.5 cm, QR = 7 cm and PR = 6 cm.



⇨ Here, PQ = 6.5 cm, QR = 7 cm and PR = 6 cm a side is 8 cm
ΔSQR is the required Δ whose area is equal to the area of ΔPQR.

3A. PQ = 6.5 cm, QR = 6 cm र PR = 5.5 cm भएको एउटा त्रिभुजसँग बराबर क्षेत्रफल हुने ∠TSR = 75° भएको समानान्तर चतुर्भुज RSTI रचना गर्नुहोस्।
Construct a parallelogram RSTI having ∠TSR = 75° and whose area is equal to a triangle having PQ = 6.5 cm, QR = 6 cm and PR = 5.5 cm.

⇨



Here, PQ = 6.5 cm, QR = 6 cm and PR = 5.5 cm and ∠TSR = 75°
Parallelogram RSTI is the required parallelogram whose area is equal to the area of ΔPQR.

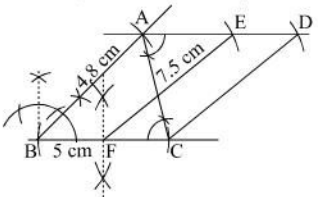
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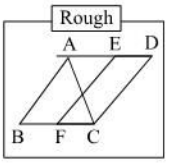
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3B. ∡ABC मा b = 5 cm, c = 4.8 cm र ∡ABC = 45° छ। उक्त त्रिभुजसँग बराबर क्षेत्रफल हुने र एउटा भुजा CD = 7.5 cm भएको समानान्तर चतुर्भुज CDEF को रचना गर्नुहोस् ।

Construct a parallelogram CDEF having a side CD = 7.5 cm and whose area is equal to a triangle ABC having b = 5 cm, c = 4.8 cm and ∡ABC = 45°.

⇨





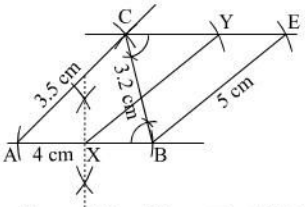
Here, b = 5 cm, c = 4.8 cm and ∡ABC = 45° and CD = 7.5 cm

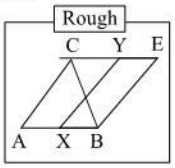
CDEF is the required parallelogram whose area is equal to the area of ΔABC.

3C. AB = 4 cm, BC = 3.2 cm र AC = 3.5 cm भएको ∡ABC को क्षेत्रफलसँग बराबर हुने गरी BE = 5 cm भएको समानान्तर चतुर्भुज BXYE को रचना गर्नुहोस् ।

Construct a parallelogram BXYE having BE = 5 cm and whose area is equal to the area of ΔABC having AB = 4 cm, BC = 3.2 cm and AC = 3.5 cm.

⇨





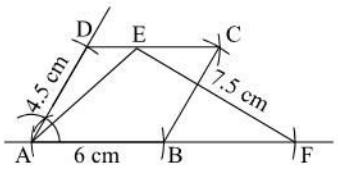
Here, AB = 4 cm, BC = 3.2 cm and AC = 3.5 cm and BE = 5 cm

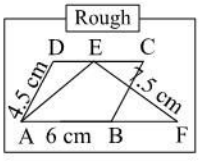
Thus, Parallelogram BXYE is the required parallelogram whose area is equal to the area of ΔABC.

4A. AB = 6 cm, BC = 4.5 cm र ∡DAB = 60° भएको समानान्तर चतुर्भुजसँग बराबर क्षेत्रफल हुने ∡AEF को रचना गर्नुहोस्, जसमा FE = 7.5 cm छ ।

Construct a ΔAEF in which EF = 7.5 cm and whose area is equal to the area of a parallelogram having AB = 6 cm, BC = 4.5 cm and ∡DAB = 60°.

⇨





Here, AB = 6 cm, BC = 4.5 cm and ∡DAB = 60° and EF = 7.5 cm

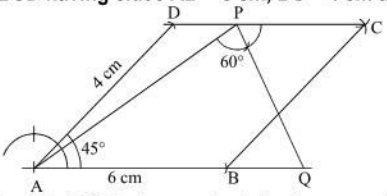
Since the opposite sides C of parallelogram are equal to so AD = BC = 4.5 cm.

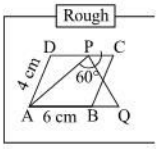
Thus, ΔAEF is the required triangle whose area is equal to the area of given parallelogram ABCD.

4B. भुजाहरू AB = 6 cm, BC = 4 cm र ∡BAD = 45° भएको समानान्तर चतुर्भुज ABCD सँग बराबर क्षेत्रफल हुने गरी ΔAPQ को रचना गर्नुहोस्, जसमा ∡APQ = 60° छ ।

Construct a triangle APQ in which ∡APQ = 60° and whose area is equal to the area of a parallelogram ABCD having sides AB = 6 cm, BC = 4 cm and ∡BAD = 45°.

⇨





Here, AB = 6 cm, BC = 4 cm and ∡BAD = 45° and ∡APQ = 60°

Since the opposite sides of a parallelogram are equal to each other.

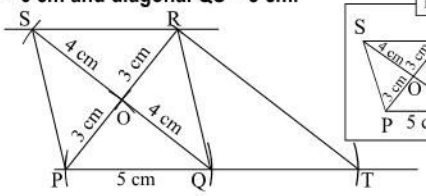
So, AD = BC = 4 cm.

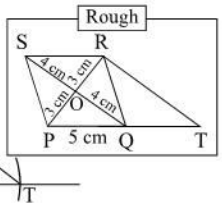
Thus, ΔAPQ is the required Δ whose area is equal to Area of Parm. ABCD.

4C. PQ = 5 cm, विकर्ण PR = 6 cm र विकर्ण QS = 8 cm भएको समानान्तर चतुर्भुज PQRS सँग बराबर क्षेत्रफल हुने त्रिभुजको रचना गर्नुहोस् ।

Construct a triangle whose area is equal to a parallelogram PQRS having PQ = 5 cm, diagonal PR = 6 cm and diagonal QS = 8 cm.

⇨





Here, PQ = 5 cm, diagonal PR = 6 cm and diagonal QS = 8 cm

Thus, ΔPTR is the required triangle whose area is equal to the parallelogram PQRS.

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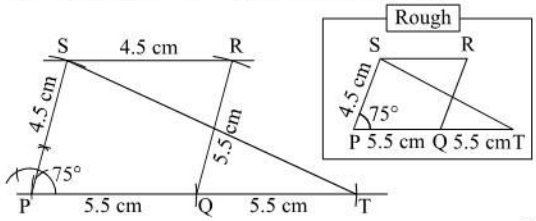
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5A. भुजाहरू PQ = QR = 5.5 cm, RS = SP = 4.5 cm र SPQ = 75° भएको चतुर्भुज PQRS सँग बराबर क्षेत्रफल हुने ΔPST को रचना गर्नुहोस् ।

Construct a ΔPST whose area is equal to the area of a quadrilateral PQRS having sides PQ = QR = 5.5 cm, RS = SP = 4.5 cm and ∠SPQ = 75°.

⇨



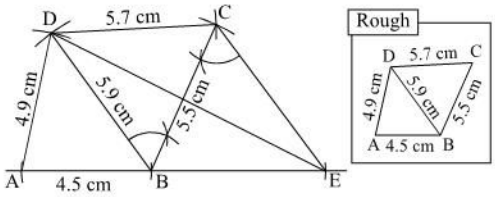
Here, PQ = QR = 5.5 cm, RS = SP = 4.5 cm and ∠SPQ = 75°

ΔPST is the required triangle whose area is equal to the area of parallelogram PQRS.

5B. AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm र DA = 4.9 cm र विकर्ण BD = 5.9 cm भएको चतुर्भुज ABCD को क्षेत्रफलसँग बराबर हुने ΔDAE को रचना गर्नुहोस् ।

Construct a ΔDAE whose area is equal to a quadrilateral ABCD having AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm and DA = 4.9 cm and diagonal BD = 5.9 cm.

⇨



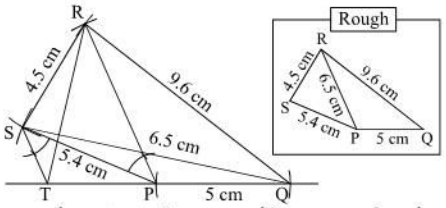
Here, AB = 4.5 cm, BC = 5.5 cm, CD = 5.7 cm and DA = 4.9 cm and diagonal BD = 5.9 cm

ΔADE is the required triangle whose area is equal to the area of quadrilateral ABCD.

5C. PQ = 5 cm, QR = 9.6 cm, RS = 4.5 cm, SP = 5.4 cm र QS = 6.5 cm भएको चतुर्भुज PQRS को बराबर क्षेत्रफल हुने ΔQRT को रचना गर्नुहोस् ।

Construct a ΔQRT whose area is equal to a quadrilateral PQRS having PQ = 5 cm, QR = 9.6 cm, RS = 4.5 cm, SP = 5.4 cm and QS = 6.5 cm.

⇨



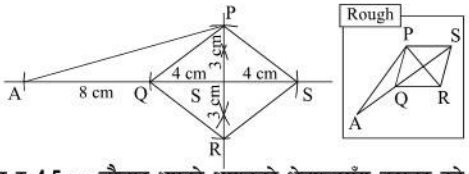
Here, PQ = 5 cm, QR = 9.6 cm, RS = 4.5 cm, SP = 5.4 cm and QS = 6.5 cm.

ΔQRT is the required triangle whose area is equal to the area of quadrilateral PQRS.

5D. समबाहु चतुर्भुज PQRS को रचना गर्नुहोस्, जसमा विकर्णहरू PR = 6 cm र QS = 8 cm छन् । सो समबाहु चतुर्भुजसँग बराबर क्षेत्रफल हुने ΔPSA को रचना गर्नुहोस् ।

Construct a rhombus PQRS in which diagonals PR = 6 cm and QS = 8 cm. Also construct ΔPSA whose area is equal to the rhombus PQRS.

⇨



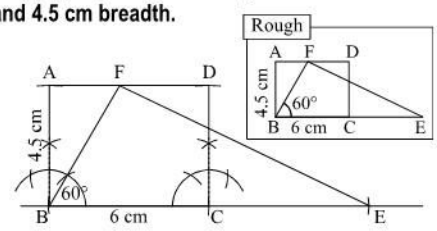
Here, PR = 6 cm and QS = 8 cm

ΔPSA is a triangle whose area is equal to the area of rhombus PQRS.

5E. 6 cm लम्बाइ र 4.5 cm चौडाइ भएको आयतको क्षेत्रफलसँग बराबर हुने एउटा कोण 60° भएको त्रिभुजको रचना गर्नुहोस् ।

Construct a triangle having an angle 60° and whose area is equal to a rectangle having 6 cm length and 4.5 cm breadth.

⇨



Here, 6 cm length and 4.5 cm breadth

Rectangle ABCD is the given rectangle and ΔBFE is the required triangle whose area is equal to the area of rectangle ABCD.

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Unit VI त्रिकोणमिति (Trigonometry)

16. त्रिकोणमिति Trigonometry

[6 Marks]

Formulae and Key Points

त्रिभुजको क्षेत्रफल (Area of triangle)

* $\Delta = \frac{1}{2}$ ab sin C or, $\Delta = \frac{1}{2}$ bc sin A or, $\Delta = \frac{1}{2}$ ac sin B

त्रिकोणमितीय अनुपातहरूका मानहरू (Values of Trigonometric Ratios)

Angles	sin	cos	tan	cosec	sec	cot
0°	0	1	0	∞	1	∞
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$	2	$\frac{2}{\sqrt{3}}$	$\sqrt{3}$
45°	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1	$\sqrt{2}$	$\sqrt{2}$	1
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$	$\frac{2}{\sqrt{3}}$	2	$\frac{1}{\sqrt{3}}$
90°	1	0	∞	1	∞	0

16.1 त्रिभुज र चतुर्भुजको क्षेत्रफल

AREA OF TRIANGLE AND QUADRILATERAL

A. BASIC EXERCISE 16.1

A. SHORT QUESTIONS

Model 1

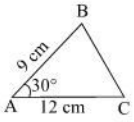
1. ΔABC का भुजाहरू a = 4 से.मि., b = 6 से.मि. र ∠C = 60° छन् भने ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In a ΔABC, the sides a = 4 cm, b = 6 cm and ∠C = 60°. Find the area of ΔABC. [2071 A]

⇨ Here, a = 4 cm, b = 6 cm and ∠C = 60°

We have, area of $\Delta ABC = \frac{1}{2}$ ab sin C $= \frac{1}{2} \times 4 \times 6 \times \sin 60° = \frac{1}{2} \times 4 \times 6 \times \frac{\sqrt{3}}{2} = 6\sqrt{3}$

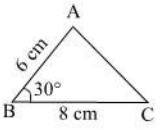
Thus, the area of ΔABC is $6\sqrt{3}$ cm².

2. सँगैको ΔABC मा, AB = 9 से.मि., AC = 12 से.मि. र ∠BAC = 30° भए ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the adjoining ΔABC, AB = 9 cm, AC = 12 cm and ∠BAC = 30°, find the area of ΔABC. [2057 A2, D2, 2062 B1]



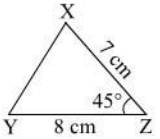
⇨ Here, area of $\Delta ABC = \frac{1}{2} \times AB \times AC \times \sin 30° = \frac{1}{2} \times 9 \times 12 \times \frac{1}{2} = 27$ cm².

3. सँगैको ΔABC मा, AB = 6 से.मि., BC = 8 से.मि. र ∠ABC = 30° भए ΔABC को क्षेत्रफल निकाल्नुहोस् ।
In the adjoining ΔABC, AB = 6 cm, BC = 8 cm and ABC= 30°, find the area of ΔABC. [2057 D1, 2057S]



⇨ Here, area of $\Delta ABC = \frac{1}{2} \times AB \times BC \times \sin 30° = \frac{1}{2} \times 6$ cm $\times 8$ cm $\times \frac{1}{2} = 12$ cm²

4. सँगै दिइएको चित्रमा, ΔXYZ को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, find the area of ΔXYZ. [2060 C]



⇨ Here, area of $\Delta XYZ = \frac{1}{2} \times XZ \times YZ \sin 45° = \frac{1}{2} \times 7 \times 8 \times \frac{1}{\sqrt{2}} = 14\sqrt{2}$ cm²

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5. दिइएको त्रिभुजमा PQ = $4\sqrt{2}$ cm, PR = 8 cm, र ∠QPR = 45° छन् भने ΔPQR को क्षेत्रफल निकाल्नुहोस् ।
In the given triangle, PQ = $4\sqrt{2}$ cm, PR = 8 cm and ∠QPR = 45°, find the area of ΔPQR. **[2066 C]**

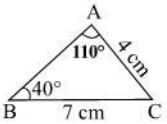


⇨ Here, PQ = $4\sqrt{2}$ cm, PR = 8 cm and ∠QPR = 45°

Area of ΔPQR $= \frac{1}{2}$ PQ × PR. sin ∠QPR $= \frac{1}{2} \times 4\sqrt{2} \times 8 \times \sin 45° = 2\sqrt{2} \times 8 \times \frac{1}{\sqrt{2}} = 16$ cm^2

Thus, the area of ΔPQR is 16 cm^2.

6. चित्रमा दिइएको ΔABC मा AC = 4 से.मि., BC = 7 से.मि. ∠A = 110° र ∠B = 40° भए ΔABC को क्षेत्रफल निकाल्नुहोस् ।
The given ΔABC, AC = 4 cm, BC = 7 cm, ∠A = 110° and ∠B = 40°. Determine the area of the ΔABC. **[2057 B2]**

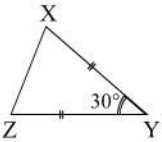


⇨ Here, in the figure, ∠ACB = 180° − 110° − 40° = 30°.

Area of ΔABC $= \frac{1}{2} \times$ AC × BC × sin ∠ACB $= \frac{1}{2} \times 4$ cm × 7 cm × sin 30°

$= 14$ cm^2 $\times \frac{1}{2}$ $= 7$ cm^2

7. चित्र ΔXYZ मा XY = YZ = 12 cm र ∠XYZ = 30° भए ΔXYZ को क्षेत्रफल निकाल्नुहोस् ।
In the given ∠XYZ, XY = YZ = 12 cm, ∠XYZ = 30°, find the area of ΔXYZ. **[2068 E]**

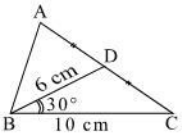


⇨ Here, XY = YZ = 12 cm & ∠XYZ = 30°

We have, area of ΔXYZ $= \frac{1}{2}$XY × YZ × sin ∠XYZ $= \frac{1}{2} \times 12 \times 12 \times \sin 30° = 36$ cm^2

Thus, the area of ΔXYZ is 36 cm^2.

8. दिइएको चित्रमा BD एउटा मध्यिका हो । यदि BD = 6 cm, BC = 10 cm र ∠DBC = 30° भए ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure BD is a median. If BD = 6 cm, BC = 10 cm and ∠DBC = 30°, find the area of ΔABC. **[2061 A1]**



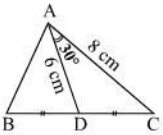
⇨ Here, area of ΔBDC $= \frac{1}{2} \times$ BC × BD × sin ∠DBC $= \frac{1}{2} \times 10$ cm × 6 cm × sin 30°

$= 5$ cm × 6 cm × $\frac{1}{2}$ $= 15$ cm^2

Area of ΔBAD = area of ΔBDC = 15 cm^2 [∵ Median BD bisects the ΔABC]

Thus, Area of ΔABC = 2 × 15 cm^2 = 30 cm^2

9. दिइएको चित्रमा AD मध्यिका हो । यदि ∠CAD = 30°, AD = 6 से.मि. र AC = 8 से.मि. भए ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, AD is a median. If ∠CAD = 30°, AD = 6 cm and AC = 8 cm, calculate the area of the ΔABC. **[2060 A2]**



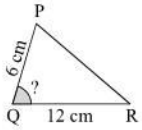
⇨ Here, ΔABD = ΔADC (∵ Median AD bisects the ΔABC)

ΔADC $= \frac{1}{2} \times$ AD × AC sin 30° $= \frac{1}{2} \times 6$ cm × 8 cm × $\frac{1}{2}$ $= 12$ cm^2

Now, ΔABC = 2 ΔADC $= 2 \times 12$ cm^2 $= 24$ cm^2

Model 2

10. दिइएको चित्रमा, यदि PQ = 6 से.मि., QR = 12 से.मि. र ΔPQR को क्षेत्रफल $18\sqrt{3}$ वर्ग से.मि. छ भने ∠PQR को नाप पत्ता लगाउनुहोस् ।
In the given figure, if PQ = 6 cm, QR = 12 cm and the area of ΔPQR is $18\sqrt{3}$ sq. cm, find the measurement of ∠PQR. **[2071 D]**



⇨ Here, PQ = 6 cm, QR = 12 cm and ar. (ΔPQR) = $18\sqrt{3}$ cm^2

We know that, Area of ΔPQR $= \frac{1}{2}$ PQ × QR. sin ∠PQR

or, $18\sqrt{3} = \frac{1}{2} \times 6 \times 12 \sin$ ∠PQR or, $\frac{18\sqrt{3} \times 2}{6 \times 12} = \sin$ ∠PQR

or, sin ∠PQR $= \frac{\sqrt{3}}{2}$ or, sin ∠PQR = sin 60°

∴ ∠PQR = 60°

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11. ΔABC मा AB = 4 से.मि. र BC = 6 से.मि. छ । यदि ΔABC को क्षेत्रफल 6 वर्ग से.मि. छ भने ∠ABC को नाप पत्ता लगाउनुहोस् ।

In ΔABC, AB = 4 cm, and BC = 6 cm. If area of ΔABC is 6 sq. cm find the measure of ∠ABC. [2071S]

⇨ Here, AB = 4 cm, BC = 6 cm and Ar. (ΔABC) = 6 cm²

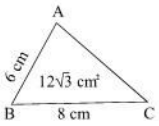
We know that, Area of $\Delta ABC = \frac{1}{2} AB \times BC \times \sin \angle ABC$

or, $6\ cm^2 = \frac{1}{2} \times 4\ cm \times 6\ cm \times \sin \angle ABC$ or, $\frac{6 \times 2}{4 \times 6} = \sin \angle ABC$

or, $\frac{1}{2} = \sin \angle ABC$ or, $\sin 30° = \sin \angle ABC$

∴ ∠ABC = 30° Thus, the measure of ∠ABC is 30°.

12. सँगै दिइएको चित्रमा, AB = 6 से.मि., BC = 8 से.मि. र ΔABC को क्षेत्रफल $12\sqrt{3}$ व. से.मि. भए ∠ABC को नाप पत्ता लगाउनुहोस् ।



In the figure given alongside, if AB = 6 cm, BC = 8 cm and the area of the ΔABC is $12\sqrt{3}$ sq. cm, find the value of ∠ABC. [2067 A]

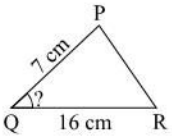
⇨ Here, AB = 6 cm, BC = 8 cm, Ar(ΔABC) = $12\sqrt{3}$ cm²

We have, Area of $\Delta ABC = \frac{1}{2} AB \times BC \sin B$ or, $12\sqrt{3} = \frac{1}{2} 6 \times 8 \times \sin B$

or, $\frac{\sqrt{3}}{2} = \sin B$ or, $\sin B = \sin 60°$

∴ B = 60° Thus, value of ∠ABC = 60°.

13. सँगैको चित्रमा PQ = 7 cm, QR = 16 cm र ΔPQR को क्षेत्रफल = $28\sqrt{3}$ cm² छ भने ∠PQR को मान पत्ता लगाउनुहोस् ।



In the adjoining figure PQ = 7 cm, QR = 16 cm and the area of ΔPQR = $28\sqrt{3}$ cm², find the value of ∠PQR. [2068 C]

⇨ Here, PQ = 7 cm, QR = 16 cm and ΔPQR = $28\sqrt{3}$ cm²

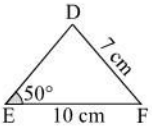
We know that, Ar. (ΔPQR) = $\frac{1}{2}$ PQ × QR × sin ∠Q

or, $28\sqrt{3} = \frac{1}{2} \times 7 \times 16 \times \sin \angle Q$ or, $\frac{\sqrt{3}}{2} = \sin \angle Q$

or, $\sin 60° = \sin \angle Q$ ∴ ∠Q = 60°

Thus, the value of ∠Q is 60°.

14. दिइएको त्रिभुज DEF मा, DF = 7 cm, EF = 10 cm, ΔDEF को क्षेत्रफल = $\frac{35}{2}\sqrt{3}$ cm² र ∠DEF = 50° भए ∠EDF को मान पत्ता लगाउनुहोस् ।



In the given triangle DEF; DF = 7 cm, EF = 10 cm, area of ΔDEF = $\frac{35}{2}\sqrt{3}$ cm² and ∠DEF = 50°, find the value of ∠EDF. [2067 B]

⇨ Here, EF = 10 cm, DF = 7 cm and ∠E = 50°

Area of $\Delta DEF = \frac{1}{2} \times DF \times EF \times \sin \angle F$ or, $\frac{35}{2}\sqrt{3} = \frac{1}{2} \times 7 \times 10 \times \sin \angle F$

or, $\frac{\sqrt{3}}{2} = \sin \angle F$ or, $\sin 60° = \sin \angle F$

∴ ∠F = 60°

Now, ∠EDF = 180° − ∠E − ∠F = 180° − 50° − 60° ∴ ∠EDF = 70°

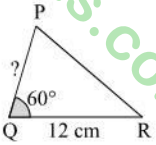
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Model 3

15. दिइएको चित्रमा, ∠PQR = 60°, QR = 12 से.मि. र ΔPQR को क्षेत्रफल $18\sqrt{3}$ वर्ग से.मि. छ भने भुजा PQ को लम्बाइ पत्ता लगाउनुहोस् ।

In the given figure, ∠PQR = 60°, QR = 12 cm and the area of ΔPQR is $18\sqrt{3}$ sq. cm. Find the length of the side PQ. [2071 E]



⇨ Here, ∠PQR = 60°, QR = 12 cm, Ar. (ΔPQR) = $18\sqrt{3}$ cm²

We know that,

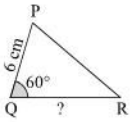
Area of $\Delta PQR = \frac{1}{2} PQ \times QR \times \sin \angle PQR$ or, $18\sqrt{3} = \frac{1}{2} PQ \times 12 \times \sin 60°$

or, $18\sqrt{3} = \frac{1}{2} PQ \times 12 \times \frac{\sqrt{3}}{2}$ or, $\frac{18 \times 4}{12} = PQ$

∴ PQ = 6 cm Thus, the length of PQ is 6 cm.

16. दिइएको चित्रमा, यदि PQ = 6 से.मि., ∠PQR = 60° र ΔPQR को क्षेत्रफल $18\sqrt{3}$ वर्ग से.मि. भए भुजा QR को लम्बाइ पत्ता लगाउनुहोस् ।

In the given figure, if PQ = 6 cm, ∠PQR = 60° and the area of ΔPQR is $18\sqrt{3}$ sq. cm, find length of the side QR. [2071 C]



⇨ Here, PQ = 6 cm, ∠PQR = 60° and Ar. (ΔPQR) = $18\sqrt{3}$ cm²

We know that, Area of $\Delta PQR = \frac{1}{2} PQ \times QR \sin \angle PQR$

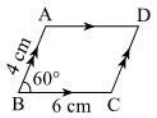
or, $18\sqrt{3} = \frac{1}{2} \times 6 \text{ cm} \times QR \times \sin 60°$ or, $18\sqrt{3} = \frac{1}{2} \times 6 \text{ cm} \times QR \times \frac{\sqrt{3}}{2}$

∴ QR = 12 cm Thus, the length of QR is 12 cm.

Model 4

17. दिइएको चित्रमा समानान्तर चतुर्भुजको क्षेत्रफल निकाल्नुहोस् ।

Find the area of parallelogram given in the figure. [2058 B1, 2057 E2]



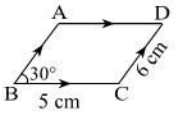
⇨ Here, area of ΔABC $= \frac{1}{2} \times AB \times BC \times \sin 60° = \frac{1}{2} \times 4 \times 6 \times \frac{\sqrt{3}}{2} = 6\sqrt{3}$ cm²

Area of ΔABC = area of ΔADC [∵ the diagonal AC bisects the parallelogram]

∴ Area of parallelogram ABCD = 2 × area of ΔABC $= 2 \times 6\sqrt{3}$ cm² $= 12\sqrt{3}$ cm²

18. दिइएको चित्रमा समानान्तर चतुर्भुज ABCD को क्षेत्रफल निकाल्नुहोस् ।

In the given figure ABCD is a parallelogram, find the area of parallelogram ABCD. [2058 E1, 2057 E2]



⇨ Here, AD = BC [∵ Opposite sides of a parallelogram.]

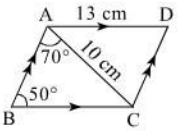
∴ AD = 5 cm

Now, area of $\Delta ABD = \frac{1}{2} \times AB \times AD \times \sin 30° = \frac{1}{2} \times 5 \text{ cm} \times 6 \text{ cm} \times \frac{1}{2} = \frac{15}{2}$ cm²

∴ Area of parallelogram ABCD = 2 × area of $\Delta ABD = 2 \times \frac{15}{2}$ cm² = 15 cm²

19. समानान्तर चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।

Find the area of parallelogram ABCD. [2058 D2]



⇨ Here, ∠ACB = 180° – 70° – 50° = 180° – 120° = 60°

And, BC = AD [∵ Opposite sides of parallelogram]

∴ BC = 13 cm

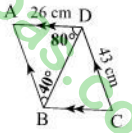
Now, area of $\Delta ACB = \frac{1}{2} \times AC \times BC \times \sin \angle ACB = \frac{1}{2} \times 10 \text{ cm} \times 13 \text{ cm} \times \sin 60° = \frac{65}{2}\sqrt{3}$ cm²

Area of parallelogram ABCD = 2 × area of $\Delta ABC = 2 \times \frac{65}{2}\sqrt{3}$ cm² $= 65\sqrt{3}$ cm²

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20. समानान्तर चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् ।
Calculate the area of the given parallelogram ABCD. [2059 C1]



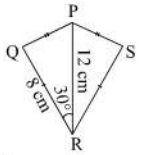
⇨ Here, AB = DC = 43 cm [∵ Opposite sides of a parallelogram.]
$\measuredangle BAD + 80° + 40° = 180°$ [∵ Sum of all internal angles of a triangle.]
∴ $\measuredangle BAD = 180° - 80° - 40° = 60°$

Now, area of $\Delta ABD = \frac{1}{2} \times AB \times AD \times \sin 60° = \frac{1}{2} \times 43 \text{ cm} \times 26 \text{ cm} \times \frac{\sqrt{3}}{2} = (279.5)\sqrt{3} \text{ cm}^2$

∴ Area of parallelogram ABCD = $2 \times \Delta ABD = 2 \times (279.5)\sqrt{3} \text{ cm}^2 = 559\sqrt{3} \text{ cm}^2$

Model 5

21. दिइएको चतुर्भुजको क्षेत्रफल पत्ता लगाउनुहोस् जहाँ, PQ = PS, QR = SR = 8 cm; PR = 12 cm र $\measuredangle PRQ = 30°$ छन् ।
Find the area of the given quadrilateral in which PQ = PS, QR = SR = 8 cm; PR = 12 cm and $\measuredangle PRQ = 30°$. [2059 A2]

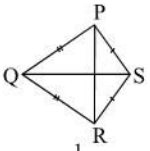


⇨ Here, quadrilateral PQRS is a kite. Therefore, area of ΔPQR = area of ΔPRS

By formula, Area of $\Delta PQR = \frac{1}{2} QR \times PR \times \sin \measuredangle PRQ = \frac{1}{2} \times 8 \times 12 \times \sin 30° = 48 \text{ cm}^2 \times \frac{1}{2} = 24 \text{ cm}^2$

Now, area of quadrilateral PQRS = 2 × area of ΔPQR = $2 \times 24 \text{ cm}^2 = 48 \text{ cm}^2$

22. दिइएको चतुर्भुज PQRS को क्षेत्रफल पत्ता लगाउनुहोस् । जसमा PQ = QR, PS = RS = 3 cm, QS = 5 cm र $\measuredangle QSR = 30°$ छन् ।
Find the area of the given quadrilateral PQRS in which PQ = QR, PS = RS = 3 cm, QS = 5 cm and $\measuredangle QSR = 30°$. [SLC 2065 A]



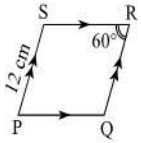
⇨ Here, PQRS is a kite.

So, Ar. (Kite PQRS) = 2Ar. (ΔQSR) = $2 \times \frac{1}{2} QS \times SR \times \sin \measuredangle QSR = QS \times SR \times \sin 30° = 5 \times 3 \times \frac{1}{2}$

∴ Ar. (Kite PQRS) = 7.5 cm².

Model 6

23. सँगैको चित्र $60\sqrt{3}$ व.से.मि. क्षेत्रफल भएको एउटा समानान्तर चतुर्भुज PQRS हो । यदि $\measuredangle SRQ = 60°$ र PS = 12 से.मि. भए PQ को लम्बाइ निकाल्नुहोस् ।
Adjoining figure is a parallelogram PQRS of area $60\sqrt{3}$ cm². If $\measuredangle SRQ = 60°$, and PS = 12 cm, calculate the length of PQ. [2061 B1]

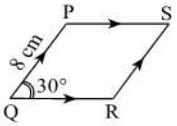


⇨ Here, we know that, Area of PQRS = SR × QR × sin 60°

or, $60\sqrt{3} \text{ cm}^2 = PQ \times PS \times \frac{\sqrt{3}}{2}$ or, $60\sqrt{3} \text{ cm}^2 = PQ \times 12 \text{ cm} \times \frac{\sqrt{3}}{2}$

or, $60\sqrt{3} \text{ cm}^2 = 6\sqrt{3} \text{ cm} \times PQ$ ∴ $PQ = \frac{60\sqrt{3}\text{cm}^2}{6\sqrt{3}\text{cm}} = 10 \text{ cm}$

24. दिइएको समानान्तर चतुर्भुज PQRS को क्षेत्रफल 48 वर्ग से.मि. छ । यदि $\measuredangle PQR = 30°$ र PQ = 8 से.मि. भए QR को नाप निकाल्नुहोस् ।
The area of the given parallelogram PQRS is 48 cm². If the $\measuredangle PQR = 30°$ and PQ = 8 cm, find the length of QR. [2062 E1]

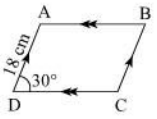


⇨ Area of parallelogram PQRS = 48 cm²

or, $PQ \times QR \times \sin 30° = 48 \text{ cm}^2$ or, $8 \text{ cm} \times QR \times \frac{1}{2} = 48 \text{ cm}^2$

or, $4 \text{ cm} \times QR = 48 \text{ cm}^2$ ∴ $QR = \frac{48 \text{ cm}^2}{4 \text{ cm}} = 12 \text{ cm}$

25. सँगैको चित्र 180 वर्ग से.मि. क्षेत्रफल भएको एउटा समानान्तर चतुर्भुज ABCD हो । यदि AD = 18 से.मि. र $\measuredangle ADC = 30°$ भए DC को लम्बाइ निकाल्नुहोस् ।
The figure is a parallelogram ABCD of area 180 square cm. If AD = 18 cm and $\measuredangle ADC = 30°$, calculate the length of DC. [2062 A1]



⇨ Here, area of parallelogram ABCD = AD × DC × sin ∠ADC

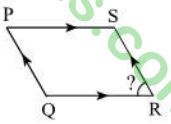
or, $180 \text{ cm}^2 = 18 \text{ cm} \times DC \times \sin 30°$ or, $180 \text{ cm}^2 = 18 \text{ cm} \times DC \times \frac{1}{2}$

or, $180 \text{ cm}^2 = 9 \text{ cm} \times DC$ ∴ $DC = \frac{180 \text{ cm}^2}{9 \text{ cm}} = 20 \text{ cm}$

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Model 7

26. दिइएको समानान्तर चतुर्भुज PQRS को क्षेत्रफल 14 वर्ग से.मि. छ यदि SR = 4 से.मि. र QR = 7 से.मि. भए ∠QRS को मान निकाल्नुहोस् ।
The area of the given parallelogram PQRS is 14 square cm. If SR = 4 cm, QR = 7 cm, find the value of the ∠QRS. [2059 B2]



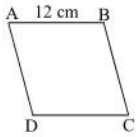
⇨ Here, area of $\Delta QSR = \frac{1}{2}$ × area of parallelogram PQRS

or, $7\ cm^2 = \frac{1}{2} \times 4\ cm \times 7\ cm \times \sin \angle QRS$ or, $7\ cm^2 = 14\ cm^2 \times \sin \angle QRS$

or, $\sin \angle QRS = \frac{7\ cm^2}{14\ cm^2} = \frac{1}{2}$ or, $\sin \angle QRS = \sin 30°$

∴ $\angle QRS = 30°$

27. सँगैको चित्र एउटा समबाहु चतुर्भुज ABCD हो । यदि AB = 12 से.मि. र समबाहु चतुर्भुज ABCD को क्षेत्रफल 72 वर्ग से.मि. छन् भने ∠BAD को नाप पत्ता लगाउनुहोस् ।
The figure is a rhombus ABCD. If AB = 12 cm and area of the rhombus ABCD = 72 cm², find the measure of ∠BAD. [2062 D1]

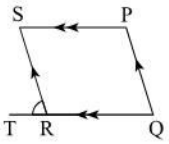


⇨ Here, since, figure is rhombus, AD = AB = 12 cm.
We know that, Area of ABCD = AB × AD × sin ∠BAD

or, $72\ cm^2 = 12\ cm \times 12\ cm \times \sin \angle BAD$ or, $72\ cm^2 = 144\ cm^2 \times \sin \angle BAD$

or, $\sin \angle BAD = \frac{72\ cm^2}{144\ cm^2} = \frac{1}{2}$ ∴ $\angle BAD = 30°$

28. दिइएको चित्रमा PQRS एउटा समानान्तर चतुर्भुज हो जसमा QR लाई T बिन्दुसम्म बढाइएको छ । यदि समानान्तर चतुर्भुजको क्षेत्रफल $27\sqrt{3}$ cm², भुजा QP = 6 cm र भुजा PS = 9 cm भए ∠SRT को नाप पत्ता लगाउनुहोस् ।
In the given figure, PQRS is a parallelogram in which QR is produced to the point T. If the area of the parallelogram is $27\sqrt{3}$ sq. cm, the side QP = 6 cm and the side PS = 9 cm, determine the measure of the ∠SRT. [SLC 2065 B]



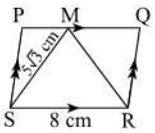
⇨ Here, from the figure,
Area of parallelogram PQRS = PQ × QR × sin Q

or, $27\sqrt{3} = 6 \times 9 \times \sin Q$ or, $\frac{27\sqrt{3}}{6 \times 9} = \sin Q$

or, $\sin Q = \frac{\sqrt{3}}{2} = \sin 60°$ ∴ $\angle Q = 60°$

Thus, $\angle SRT = \angle Q = 60°$

29. दिइएको चित्रमा 60 वर्ग से.मि. क्षेत्रफल भएको समानान्तर चतुर्भुज PQRS र त्रिभुज MRS एउटै आधार SR मा रहेका छन् । यदि $SM = 5\sqrt{3}$ से.मि. र SR = 8 से.मि. भए ∠MSR को मान निकाल्नुहोस् ।
In the given figure, parallelogram PQRS of area 60 square cm and the triangle MRS are standing on the same base SR. If $SM = 5\sqrt{3}$ cm and SR = 8 cm, evaluate the ∠MSR. [2067 C]



⇨ Here, $SM = 5\sqrt{3}$ cm and SR = 8 cm

(i) $\Delta MSR = \frac{1}{2}$ parm. PQRS [Being both are on same base and between the same parallels]

∴ $\Delta MSR = \frac{1}{2} \times 60\ cm^2 = 30\ cm^2$

(ii) Area of $\Delta MSR = \frac{1}{2}$ MS × SR × sin ∠MSR

or, $30 = \frac{1}{2} \times 5\sqrt{3} \times 8 \times \sin \angle MSR$ or, $30 = 20\sqrt{3} \sin \angle MSR$

or, $\sin \angle MSR = \frac{\sqrt{3}}{2}$ or, $\sin \angle MSR = \sin 60°$

∴ $\angle MSR = 60°$

Thus, the value of ∠MSR is 60°.

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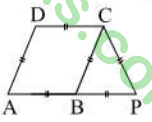
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Model 8

30. दिइएको चित्रमा ΔBPC एउटा समबाहु त्रिभुज हो र ABCD एउटा समबाहु चतुर्भुज हो । यदि APCD को क्षेत्रफल $27\sqrt{3}$ cm² को भए AB को नाप पत्ता लगाउनुहोस् ।

In the given diagram, ΔBPC is an equilateral triangle and ABCD is a rhombus. If the area of APCD is $27\sqrt{3}$ cm², find the length of AB. **[2065 C]**



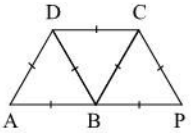
⇨ Here, join BD. Area of quadrilateral APCD = $27\sqrt{3}$

or, $3 \times \text{Ar.}(\Delta ABD) = 27\sqrt{3}$ [$\because \Delta ABD = \Delta BCD = \Delta BPC$]

or, $\text{Ar.}(\Delta ABD) = 9\sqrt{3}$

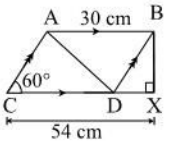
or, $\frac{\sqrt{3}}{4} \times AB^2 = 9\sqrt{3}$ $\left[\text{Area of equilateral } \Delta = \frac{\sqrt{3}}{4}a^2\right]$

or, $AB^2 = 36$ $\therefore$ AB = 6 cm



31. तलको संयुक्त चित्रको क्षेत्रफल पत्ता लगाउनुहोस् ।

Find the area of the following combined figure.



⇨ Here, DX = CX – CD = 54 – 30 = 24 cm

$\measuredangle BDX = \measuredangle ACD = 60°$

From ΔBDX,

$\tan \measuredangle BDX = \frac{BX}{DX}$ or, $\tan 60° = \frac{BX}{24}$

or, $\sqrt{3} = \frac{BX}{24}$ $\therefore$ $BX = 24\sqrt{3}$

Now,

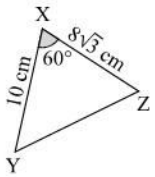
Area of trapezium ABXC $= \frac{1}{2} BX\,(AB + CX) = \frac{1}{2}\, 24\sqrt{3}\,(30 + 54) = 12\sqrt{3} \times 84 = 1008\sqrt{3}$ cm²

Thus, the area of trapezium ABXC is $1008\sqrt{3}$ cm².

B. QUESTIONS FROM CDC TEXT BOOKS

1. तलका त्रिभुजहरूको क्षेत्रफल पत्ता लगाउनुहोस् (Find the area of following triangles):

⇨ **(a)** Here, XY = 10 cm, $XZ = 8\sqrt{3}$ cm, $\measuredangle X = 60°$



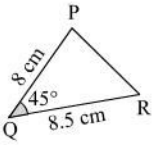
We have,

Area of ΔXYZ $= \frac{1}{2} XY \times XZ \times \sin \measuredangle X = \frac{1}{2}\, 10 \times 8\sqrt{3} \times \sin 60°$

$= \frac{1}{2}\, 10 \times 8\sqrt{3} \times \frac{\sqrt{3}}{2} = 20 \times 3 = 60$ cm²

Thus, the area of ΔXYZ is 60 cm².

(b) Here, PQ = 8 cm, QR = 8.5 cm and $\measuredangle PQR = 45°$



We have,

Area of ΔPQR $= \frac{1}{2} PQ \times QR \times \sin\theta = \frac{1}{2} \times 8 \text{ cm} \times 8.5 \text{ cm} \times \sin 45°$

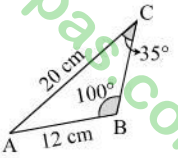
$= \frac{1}{2}\, 8 \text{ cm} \times 8.5 \text{ cm} \times \frac{1}{\sqrt{2}} = 17\sqrt{2}$ cm².

Thus, the area of ΔPQR is $17\sqrt{2}$ cm².

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(c) Here, (i) $\angle BAC = 180° - \angle B - \angle C = 180° - 35° - 100° = 45°$



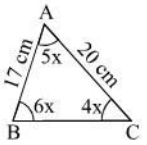
(ii) Area of $\Delta ABC = \frac{1}{2} AB \times AC \sin A$

$= \frac{1}{2} \times 12 \times 20 \times \sin 45° = \frac{12 \times 20}{2} \times \frac{1}{\sqrt{2}}$

$= 60\sqrt{2}$ cm^2

Thus, the area of ΔABC is $60\sqrt{2}$ cm^2.

(d) Here, from the figure,



(i) $\angle A + \angle B + \angle C = 180°$ [Sum of angles of Δ.]

or, $5x + 6x + 4x = 180°$

or, $15x = 180°$

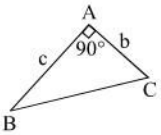
or, $x = 12°$

(ii) $\angle A = 5x = 5 \times 12° = 60°$

Now, Area of $\Delta ABC = \frac{1}{2} BA \times AC \sin A = \frac{1}{2} 17 \times 20 \times \sin 60° = \frac{1}{2} \times 17 \times 20 \times \frac{\sqrt{3}}{2} = 147.22$ cm^2

Thus, the area of ΔABC is 147.22 cm^2.

निम्नलिखित प्रश्नहरूमा थाहा नभएको मान पत्ता लगाउनुहोस् :
In each of the following questions, find the value of unknown item:



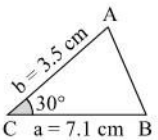
2A. b = 2.7 cm, c = 4 cm, $\angle A = 90°$ र ΔABC को क्षेत्रफल = ?
b = 2.7 cm, c = 4 cm, $\angle A = 90°$ and area of ΔABC = ?

⇨ Here, b = 2.7 cm, c = 4 cm, $\angle A = 90°$

We know that,

Area of $\Delta ABC = \frac{1}{2} bc \sin A = \frac{1}{2} \times 2.7 \times 4 \times \sin 90° = 5.4$ cm^2

Thus, the area of ΔABC is 5.4 cm^2.



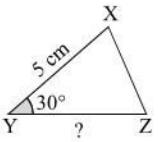
2B. a = 7.1 cm, b = 3.5 cm, $\angle C = 30°$ र ΔABC को क्षेत्रफल = ?
a = 7.1 cm, b = 3.5 cm, $\angle C = 30°$ and area of ΔABC = ?

⇨ Here, a = 7.1 cm b= 3.5 cm $\angle C = 30°$

We know that,

Area of ΔABC $V = \frac{1}{2} ab \sin 30° = \frac{1}{2} \times 7.1 \times 3.5 \times \frac{1}{2} = 6.21$ cm^2

Thus, the area of ΔABC is 6.21 cm^2.



2C. XY = 5 m, $\angle Y = 30°$, ΔXYZ को क्षेत्रफल = 21 m^2 र YZ = ?
XY = 5 m, $\angle Y = 30°$, area of ΔXYZ = 21 m^2 and YZ = ?

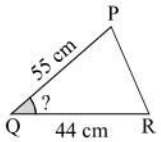
⇨ Here, XY = 5 m $\angle Y = 30°$ area of $\Delta XYZ = 21$ m^2

We know that,

Area of $\Delta XYZ = \frac{1}{2} XY \times YZ \times \sin 30°$ or, $21 \text{ cm}^2 = \frac{1}{2} \times 5 \text{ cm} \times YZ \times \frac{1}{2}$

or, $84 \text{ cm}^2 = 5 \text{ cm} \times YZ$ $\therefore$ YZ = 16.6 cm

Thus, the measure of YZ is 16.6 cm.



2D. ΔPQR को क्षेत्रफल = 1047.89 cm^2, QR = 44 cm, PQ = 55 cm र $\angle Q$ = ?
Area of ΔPQR = 1047.89 cm^2, QR = 44 cm, PQ = 55, cm and $\angle Q$ = ?

⇨ Here, Area of $\Delta PQR = 1047.89$ cm^2, QR = 44 cm, PQ = 55, cm

We know that,

Area of $\Delta PQR = \frac{1}{2} PQ \times QR \times \sin\theta$ or, $1047.89 = \frac{1}{2} 55 \times 44 \times \sin\theta$

or, $2095.78 = 55 \times 44 \times \sin\theta$ or, $0.866 = \sin\theta$

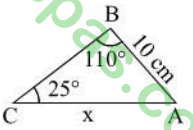
or, $\sin\theta = \sin 60°$ $\therefore$ $\theta = 60°$

Thus, the value of $\angle PQR$ is 60°.

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2E. $\angle B = 110°$, $\angle C = 25°$, AB = 10 cm, ΔABC को क्षेत्रफल = 100 cm² र AC = ?
$\angle B = 110°$, $\angle C = 25°$, AB = 10 cm ΔABC area of ΔABC = 100 cm² and AC = ?



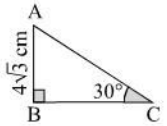
⇨ Here, $\angle B = 110°$, $\angle C = 25°$, AB = 10 cm ΔABC area of ΔABC = 100 cm²
We have,
In ΔABC, $\angle A + \angle B + \angle C = 180°$ or, $\angle A + 110° + 25° = 180°$
or, $\angle A = 180° - 110° - 25°$ ∴ $\angle A = 45°$
We know that,

Area of $\Delta ABC = \frac{1}{2} AB \times AC \times \sin A$ or, $100 = \frac{1}{2} \times 10 \times AC \times \sin 45°$

or, $100 = 5 \times AC \times \frac{1}{\sqrt{2}}$ or, $20\sqrt{2} = AC$

Thus, the measure of AC is $20\sqrt{2}$ cm.

3A. दिइएको ΔABC मा $\angle ABC = 90°$, $\angle ACB = 30°$ र AB = $4\sqrt{3}$ cm भए ΔABC को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given ΔABC, $\angle ABC = 90°$, $\angle ACB = 30°$ and AB = $4\sqrt{3}$ cm. Find the area of ΔABC.



⇨ Here, $\angle ABC = 90°$

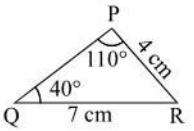
(i) $\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{AB}{BC} = \frac{4\sqrt{3}}{BC}$

or, $\frac{1}{\sqrt{3}} = \frac{4\sqrt{3}}{BC}$ ∴ BC = 12 cm

(ii) Area of $\Delta ABC = \frac{1}{2} AB \times BC = \frac{1}{2} \times 4\sqrt{3} \times 12 = 24\sqrt{3}$ cm²

Thus, the area of ΔABC is $20\sqrt{3}$ cm².

3B. ΔPQR मा PR = 4 cm, QR = 7 cm, $\angle P = 110°$ र $\angle Q = 40°$ भए ΔPQR को क्षेत्रफल पत्ता लगाउनुहोस् ।
In ΔPQR, PR = 4 cm, QR = 7 cm, $\angle P = 110°$ and $\angle Q = 40°$ then find the area of ΔPQR.

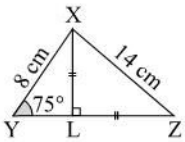


⇨ Here, PR = 4 cm, QR = 7 cm, $\angle P = 110°$ and $\angle Q = 40°$
We know that, $\angle P + \angle Q + \angle R = 180°$ or, $110° + 40° + \angle R = 180°$
or, $150° + \angle R = 180°$ ∴ $\angle R = 30°$
We have,

Area of $\Delta PQR = \frac{1}{2} PR \times QR \times \sin R = \frac{1}{2} \times 4 \times 7 \times \sin 30° = \frac{1}{2} \times 28 \times \frac{1}{2} = 7$ cm²

Thus, the area of ΔPQR is 7 cm².

3C. दिइएको चित्रमा $\angle Y = 75°$, XY = 8 cm, XZ = 14 cm, XL ⊥ YZ र XL = LZ भए ΔXYZ को क्षेत्रफल पत्ता लगाउनुहोस् ।
In the given figure, $\angle Y = 75°$, XY = 8 cm, XZ = 14 cm, XL ⊥ YZ and XL = LZ then find the area of ΔXYZ.



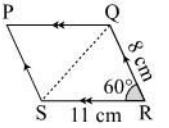
⇨ Here, ΔXLZ is a right angled isosceles triangle.
So, $\angle Z = 45°$
We have,
$\angle XYZ = 180° - XY - \angle Z = 180° - 75° - 45°$
∴ $\angle XYZ = 60°$
Now,

Area of $\Delta XYZ = \frac{1}{2} XY \times XZ \sin x = \frac{1}{2} 8 \times 14 \times \sin 60° = 56 \times \frac{\sqrt{3}}{2} = 28\sqrt{3}$ cm²

Thus, the area of ΔXYZ is $28\sqrt{3}$ cm².

4. तल दिइएका समानान्तर चतुर्भुजहरूको क्षेत्रफल पत्ता लगाउनुहोस् **(Find the area of given parallelogram):**

⇨ (a) Here, area of parallelogram PQRS = SR × QR × sin 60°



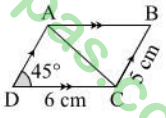
$= 11 \text{ cm} \times 8 \text{ cm} \times \frac{\sqrt{3}}{2}$

$= 44\sqrt{3}$ cm²

Thus, the area of the parm. is $44\sqrt{3}$ cm².

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(b) Here, AD = BC = 5 cm [Being opposite sides of parallelogram.]

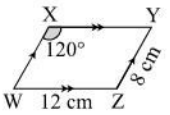


Area of parallelogram $= AD \times DC \times \sin D = 5 \times 6 \times \sin 45°$

$= 5 \times 6 \times \frac{1}{\sqrt{2}} = 15\sqrt{2}$ cm^2

Thus, the area of the parallelogram is $15\sqrt{2}$ cm^2.

(c) Here, XW = YZ = 8 cm



We have, $\measuredangle X + \measuredangle W = 180°$

or, $120° + \measuredangle W = 180°$

$\therefore \quad \measuredangle W = 60°$

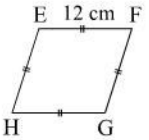
We know that,

Area of parallelogram $= XW \times WZ \times \sin W = 8 \times 12 \times \sin 60° = 8 \times 12 \times \frac{\sqrt{3}}{2} = 48\sqrt{3}$ cm^2

Thus, the area of parallelogram is $48\sqrt{3}$ cm^2.

5A. EFGH एउटा समबाहु चतुर्भुज हो जसको क्षेत्रफल 72 cm², EF = 12 cm भए $\measuredangle$EFG र $\measuredangle$FGH को मान निकाल्नुहोस् ।

EFGH is a rhombus whose area is 72 cm² and EF = 12 cm. Find the value of $\measuredangle$EFG and $\measuredangle$FGH.



⇨ Here, Area of rhombus $= (EF)^2 \sin \measuredangle F$

or, $72 = 12^2 \times \sin F$ or, $\frac{1}{2} = \sin F$

or, $\sin 30° = \sin F$ $\therefore \quad \measuredangle F = 30°$

We have, $\measuredangle EFG + \measuredangle FGH = 180°$

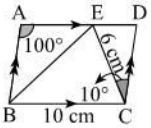
or, $30° + \measuredangle FGH = 180°$

$\therefore \quad \measuredangle FGH = 150°$

Thus, the values of $\measuredangle$EFG and $\measuredangle$FGH are 30° and 150° respectively.

5B. दिइएको चित्रबाट समानान्तर चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस् जहाँ BC = 10 cm, CE = 6 cm, $\measuredangle$DCE = 10° र $\measuredangle$BAD = 100° छन् ।

Find the area of a parallelogram ABCD from the given figure where BC = 10 cm, CE = 6 cm, $\measuredangle$DCE = 10° and $\measuredangle$BAD = 100°. **[SLC 2066 D]**



⇨ Here,

(i) $\measuredangle DCB = \measuredangle BAD = 100°$ [Being the opposite $\measuredangle$s of a parallelogram]

(ii) $\measuredangle BCE = \measuredangle BCD - \measuredangle DCE = 100° - 10° = 90°$

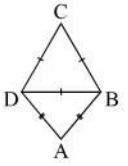
(iii) Area of $\Delta BCE = \frac{1}{2} BC \times CE \sin \measuredangle BCE = \frac{1}{2} 10 \text{ cm} \times 6 \text{ cm} \times \sin 90° = 30 \text{ cm}^2 \times 1 = 30 \text{ cm}^2$

Thus, the area of $\Delta BCE = 30$ cm^2

(iv) Now, area of parallelogram ABCD $= 2\Delta BCE = 2 \times 30 \text{ cm}^2 = 60 \text{ cm}^2$.

6A. चित्रमा ΔABD समद्विबाहु र ΔBCD समबाहु त्रिभुज हुन् । यदि $\measuredangle$ADC = 105°, AB = $4\sqrt{2}$ cm, BC = 8 cm भए ABD को क्षेत्रफल कति हुन्छ ?

In given figure ΔABD is isosceles triangle and ΔBCD is equilateral triangle. If $\measuredangle$ADC = 105°, AB = $4\sqrt{2}$ cm, BC = 8 cm then find the area of ABCD.



⇨ Here, From the figure,

(i) Area of $\Delta BCD = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times 8^2 = 16\sqrt{3}$ cm^2

(ii) $\measuredangle BDA = \measuredangle ADC - \measuredangle BDC = 105° - 60° = 45°$

We have, $\measuredangle BAD = 180° - 2\measuredangle BDA = 180° - 2 \times 45° = 90°$

(iii) Area of $\Delta ABD = \frac{1}{2} \times 4\sqrt{2} \times 4\sqrt{2} \sin 90° = \frac{1}{2} \times 16 \times 2 \times 1 = 16$ cm^2

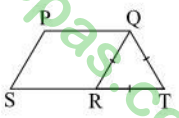
Now, area of quadrilateral ABCD $=$ Area of ΔABC + Area of $\Delta ABD = 16\sqrt{2}$ cm^2 + 16 cm^2

$= 43.71$ cm^2

Thus, the area of quadrilateral ABCD is 43.71 cm^2.

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6B. दिइएको चित्रमा PQRS एउटा समानान्तर चतुर्भुज हो र QRT एउटा समबाहु त्रिभुज हो। यदि SP = $4\sqrt{3}$ cm र SR = 8 cm भए समलम्ब चतुर्भुज PQTS को क्षेत्रफल निकाल्नुहोस्।
In the figure, PQRS is a parallelogram and QRT is an equilateral triangle. If SP = $4\sqrt{3}$ cm and SR = 8 cm, find the area of trapezium PQTS.



⇨ Here,

(i) $\measuredangle PSR = \measuredangle QRT = 60°$

$\therefore \measuredangle PSR = 60°$

(ii) Area of parallelogram PQRS $= PS \times SR \times \sin \measuredangle S = 4\sqrt{3} \times 8 \times \sin 60°$

$= 4\sqrt{3} \times 8 \times \sin 60° = 48 \text{ cm}^2$

(iii) Area of equilateral $\Delta QRT = \frac{\sqrt{3}}{4} a^2 = \frac{\sqrt{3}}{4} \times (QR)^2 = \frac{\sqrt{3}}{4} \times (SP)^2 = \frac{\sqrt{3}}{4} \times (4\sqrt{3})^2$

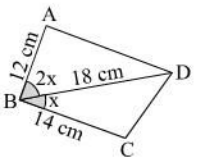
$= 12\sqrt{3} \text{ cm}^2$

Now area of trapezium = Area of parallelogram + Area of Δ

$= 48 \text{ cm}^2 + 12\sqrt{3} \text{ cm}^2 = 68.78 \text{ cm}^2$

Thus, the area of the trapezium is 68.78 cm^2.

6C. सँगैको चित्रमा AB = 12 cm, BD = 18 cm, BC = 14 cm, $\measuredangle CBD = \frac{1}{2} \measuredangle ABD$ र ΔABD को क्षेत्रफल 54 वर्ग से.मि. भए चतुर्भुज ABCD को क्षेत्रफल पत्ता लगाउनुहोस्।
In the adjoining figure, AB = 12 cm, BD = 18 cm, BC = 14 cm, $\measuredangle CBD = \frac{1}{2} \measuredangle ABD$ and ΔABD is 54 sq cm. Find the area of quadrilateral ABCD.



⇨ Here, Area of $\Delta ABD = \frac{1}{2} AB \times BD \times \sin 2x$

or, $54 = \frac{1}{2} \times 12 \times 18 \times \sin 2x$ or, $\frac{1}{2} = \sin 2x$

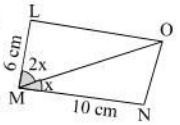
or, $2x = 30°$ $\therefore$ $x = 15°$

Again, Area of $\Delta BCD = \frac{1}{2} BD \times BC \times \sin x = \frac{1}{2} \times 18 \times 14 \times \sin 15° = 32.61 \text{ cm}^2$

Now, area of quad. ABCD = $\Delta ABD + \Delta BCD = 54 + 32.61 = 86.61 \text{ cm}^2$

Thus, the area of quadrilateral ABCD is 86.61 cm^2.

6D. दिइएको चतुर्भुज LMNO मा $\measuredangle LMO = 2\measuredangle OMN$, OM = MN = 10 cm, LM = 6 cm, $\measuredangle MON = 75°$ भए चतुर्भुज LMNO को क्षेत्रफल कति हुन्छ ?
In the figure, LMNO is a quadrilateral. If $\measuredangle LMO = 2\measuredangle OMN$, OM = MN = 10 cm, LM = 6 cm, $\measuredangle MON = 75°$, find the area of quadrilateral LMNO.



⇨ Here, we have, $\measuredangle OMN + 2\measuredangle MON = 180°$ or, $\measuredangle OMN + 2 \times 75° = 180°$

or, $x + 150° = 180°$ $\therefore$ $x = 30°$

Now, Area of quad. LMNO = Ar. (ΔLMO) + Ar. (ΔMON)

$= \frac{1}{2} LM \times MO \times \sin 2x + \frac{1}{2} MO \times MN \times \sin x$

$= \frac{1}{2} MO (LM \times \sin 2x + MN \times \sin x) = \frac{1}{2} \times 10(6 \times \sin 60° + 10 \times \sin 30°)$

$= 5\left(6 \times \frac{\sqrt{3}}{2} + 10 \times \frac{1}{2}\right) = 5(3\sqrt{3} + 5) = 50.98 \text{ cm}^2$

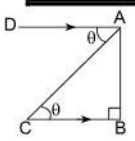
Thus, the area of quad. LMNO is 50.98 cm^2.

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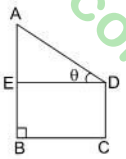
16.2 उचाइ र दूरी (HEIGHT AND DISTANCE)

Key Points

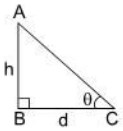
1. सँगैको चित्रमा,
In the adjoining figure,
उन्नतांश कोण = अवनति कोण हुन्छ ।
Angle of elevation
= Angle of Depression.
($\measuredangle DAC = \measuredangle ACB = \theta$)



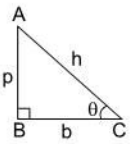
2. सँगैको चित्रमा,
In the adjoining figure,
(i) ED = BC
(ii) AE = AB – EB = AB – CD



3. सँगैको चित्रमा,
In the adjoining figure,
(i) $h = d \tan\theta$
(ii) $p = b \tan\theta$
(iii) $b = \frac{p}{\tan\theta}$



4. सँगैको चित्रमा,
In the adjoining figure,
(i) $h = \frac{p}{\sin\theta}$ or $\frac{b}{\cos\theta}$
(ii) $p = h \sin\theta$ & $b = h \cos\theta$



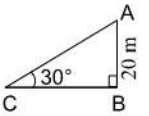
A. BASIC EXERCISE 16.2

A. LONG QUESTIONS

Model 1

1. नदीको एक किनारामा 20 m अग्लो टावर छ र नदीको अर्को किनाराबाट टावरको टुप्पोमा हेर्दा उन्नतांश कोण 30° रहेछ भने नदीको चौडाइ पत्ता लगाउनुहोस् ।
A tower on the bank of a river is of 20 m height and the angle of elevation of the top of the tower from the opposite bank is 30°. Find the breadth of the river. [2057 C2, 2066 E]

⇨ Here, let, AB be the tower and $\measuredangle ACB$ be the angle of elevation.
Then, AB = 20 m and $\measuredangle ACB = 30°$.
In rt. angled triangle ABC,

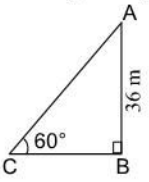


$\tan \measuredangle ACB = \frac{AB}{CB}$ or, $\tan 30° = \frac{20}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{20}{CB}$

or, $CB = 20\sqrt{3}$ ∴ $CB = 34.64$ m
Thus, width of the river = 34.64 m.

2. नदीको एक किनारामा 36 m अग्लो स्तम्भ छ । नदीको अर्को किनाराबाट स्तम्भको टुप्पो हेर्दा उन्नतांश कोण 60° रहेछ भने नदीको चौडाइ पत्ता लगाउनुहोस् ।
A tower on the bank of a river is of 36 m height and the angle of elevation of the top of the tower from the opposite bank is 60°. Find the breadth of the river. [2058 D1]

⇨ Here, suppose, AB is the tower of height 36 metre and ACB is angle of elevation of the top of the tower.
Here, AB = 36 m and ACB = 60°, breadth of the river (CB) = ?
Now in rt. angled triangle ABC,



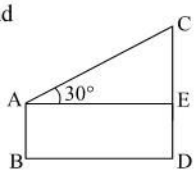
$\tan ACB = \frac{AB}{CB}$ or, $\tan 60° = \frac{36\text{ m}}{CB}$ or, $\sqrt{3} = \frac{36\text{ m}}{CB}$

or, $\sqrt{3}\ CB = 36$ m or, $CB = \frac{36\text{ m}}{\sqrt{3}} = \frac{36\text{ m}}{1.7321} = 20.78$ m

Thus, breadth of the river = 20.78 m

3. घरको छतबाट केही मिटर टाढा रहेको रुखको टुप्पोमा हेर्दा 30° को उन्नतांश कोण बन्दछ । यदि उक्त घर र रुखको उचाइ क्रमश: 6 m र 18 m छ भने घर र रूखबीचको दुरी पत्ता लगाउनुहोस् । [Model 2065]
The angle of elevation from the roof of a house to the top of a tree is found to be 30°. If the heights of the house and tree are 6 m and 18 m respectively, find the distance between the house and the tree.

⇨ Here, let, AB = 6 m be the height of a house, CD = 18 m be the height of tree and $\measuredangle CAE = 30°$ be the angle of elevation.
We know that;



$\tan\theta = \frac{CE}{AE}$ or, $\tan 30° = \frac{12}{AE}$ or, $\frac{1}{\sqrt{3}} = \frac{12}{BD}$

or, $BD = 12\sqrt{3}$ m ∴ $BD = 20.78$ m
Thus, the distance between house and the tree is 20.78 m.

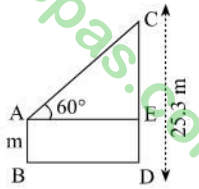
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4. एकजना अवलोकनकर्ताले एउटा खम्बाको टुप्पाको उन्नतांश कोण **60°** पाउँछ । यदि उक्त खम्बाको उचाइ र अवलोकनकर्ताको उचाइ क्रमशः **25.3 m** र **1.3 m** छन् भने अवलोकनकर्ता र खम्बाको बीचको दूरी पत्ता लगाउनुहोस् ।

An observer finds the angle of elevation of the top of a pole to be 60°. If the height of the pole and the observer are 25.3 m and 1.3 m respectively. Find the distance between the observer and the pole. **[SLC 2065 D]**



⇨ Here, let, AB = 1.3 m height of an observer and CD = 25.3 m be the height of the pole.
Let, $\measuredangle CAE = 60°$ be an angle of elevation.
Then, CE = CD – AB = 25.3 m – 1.3 m = 24 m

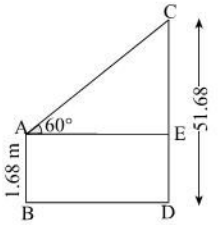
Now, $\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{24}{AE}$

$\therefore$ $AE = \frac{24}{\sqrt{3}} = 8\sqrt{3}$ m Thus , the distance between the observer and the pole is $8\sqrt{3}$ m.

5. **1.68 m** उचाइ भएको मानिसले एउटा **51.68 m** अग्लो स्तम्भको टुप्पो हेर्दा उन्नतांश कोण **60°** पाउँछ भने सो मानिस स्तम्भको फेदबाट कति दूरीमा रहेछ ? पत्ता लगाउनुहोस् ।

A man of height 1.68 m observes a pillar of height 51.68 m and find the angle of elevation of the top of the pillar to be 60°. How far is the man from the base of the pillar ? Find it. **[2068 A]**

⇨ Here, let, AB = 1.68 m be the height of a man
CD = 51.68 m be the height of a pillar
AE = BD be the distance between man and tower.
From the figure, CE = CD – ED = 51.68 – AB = 51.68 – 1.68
$\therefore$ CE = 50 m
Now, from right angled triangle ACE,



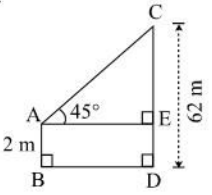
$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{50}{AE}$

or, $AE = \frac{50}{\sqrt{3}} = 28.86$ m Thus, the height of tower is 28.86 m.

6. **2** मि. अग्लो मानिसले आफ्नो ठीक अगाडि रहेको **62** मि. अग्लो एउटा खम्बाको टुप्पोमा हेर्दा **45°** को उन्नतांश कोण पाएछ भने खम्बा र मानिसबीचको दूरी पत्ता लगाउनुहोस् ।

A person of height 2 m observes the angle of elevation of the top of a pole 62 m high which is in front of him and finds it to be 45°. Find the distance between the person and the pole. **[2065 A, 2057 B2]**

⇨ Here, let, AB = 2 m be the height of a man and CD = 62 m be the height of the pole. Let, $\measuredangle CAE = 45°$ be an angle of elevation.
$\therefore$ BD = AE is the required distance.
From the right angled triangle CAE,
From the figure, CE = CD – AB = (62 – 2) m = 60 m



We know that, $\tan\theta = \frac{p}{b}$ or, $\tan 45° = \frac{CE}{AE}$

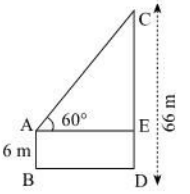
or, $1 = \frac{60\text{ m}}{AE}$ $\therefore$ AE = 60 m

Thus, distance between person & pole is 60 m.

7. **6 m** अग्लो घरको छानाबाट **66 m** अग्लो मन्दिरको टुप्पोमा हेर्दा उन्नतांश कोण **60°** पाइयो भने घर र मन्दिर बीचको दूरी पत्ता लगाउनुहोस् ।

From the roof of a house 6 m high, the angle of elevation of the top of a temple 66 m high is observed to be 60°. Find the distance between the house and the temple. **[2066 A]**

⇨ Here, let, AB = 6 m be the height of the roof of a house.
CD = 66 m be the height of temple.
$\measuredangle CAE = 60°$ be the angle of elevation.
We know that; CE = CD – ED = 66 m – 6m = 60 m
Again, from right angled ΔACE,



$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{60}{AE}$

or, $AE = \frac{60}{\sqrt{3}} = 20\sqrt{3}$ m Thus, the distance between the house & the temple is $20\sqrt{3}$ m.

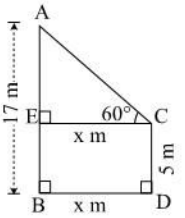
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8. घरको छानाबाट एउटा रूखको टुप्पो अवलोकन गर्दा उन्नतांश कोण 60° पाइयो। घर र रूखको उचाइ क्रमशः 5 मि. र 17 मि. भए घर र रुखबीचको दुरी पत्ता लगाउनुहोस्।

The angle of elevation of the top of a tree as observed from the roof of a house is found to be 60°. The height of the house and the tree are 5 m and 17 m respectively. Find the distance between the house and the tree. [2067 C]

⇨ Here, let, CD = 5 m be the height of a house and AB = 17 m be the height of a tree. Let, EC = BD = x m be the distance between house and tree. ∠ACE = 60° be angle of elevation.



From right angled triangle AEC,

$\tan \angle ACE = \frac{AE}{EC}$ or, $\tan 60° = \frac{AB - EB}{x}$ or, $\sqrt{3} = \frac{17 - CD}{x}$

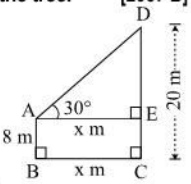
or, $\sqrt{3}\, x = 17 - 5$ or, $x = \frac{12}{\sqrt{3}} = \frac{4 \times \sqrt{3} \times \sqrt{3}}{\sqrt{3}} = 4\sqrt{3}$ m

Thus, the distance between the house and the tree is $4\sqrt{3}$ m.

9. एउटा घरको छतबाट केही मिटर टाढा रहेको रुखको टुप्पोमा हेर्दा 30° को उन्नतांश कोण बन्दछ। यदि उक्त घर र रुखको उचाइ क्रमशः 8 मि. र 20 मि. छन् भने घर र रुखबीचको दूरी पत्ता लगाउनुहोस्।

The angle of elevation from the roof of a house to the top of a tree is found to be 30°. If the height of the house and tree are 8 m and 20 m respectively, find the distance between the house and the tree. [2067 B]

⇨ Here, let, AB = 8 m be the height of a house. CD = 20 m be the height of a tree.
AE = BC = x m be the distance between house and tree.
Let ∠DAE be angle of an elevation.



Then, from the right angled triangle DAE,

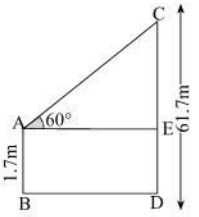
$\tan \angle DAE = \frac{DE}{AE}$ or, $\tan 30° = \frac{DC - EC}{x}$ or, $\frac{1}{\sqrt{3}} = \frac{20 - 8}{x}$

or, $x = 12\sqrt{3}$ Thus, the distance between house and tree is $12\sqrt{3}$ m.

10. 1.7 मिटर अग्लो मानिसले आफ्नो अगाडि रहेको खम्बाको टुप्पोमा हेर्दा उन्नतांश कोण 60° पाउँछ। यदि उक्त खम्बाको उचाइ 61.7 मिटर भए खम्बा र मानिसबीचको दूरी पत्ता लगाउनुहोस्।

A man of height 1.7 m observes the angle of elevation of the top of a pole situated in front of him and finds it to be 60°. If the height of the pole is 61.7 m, find the distance between pole and the man. [2068 E]

⇨ Here, let, AB = 1.7 m be the height of a man.
CD = 61.7 m be the height of a pole.
∠CAE = 60° be the angle of elevation
AE = BD be the distance between man & pole.
So, CE = CD − ED = 61.7 − AB = 61.7 − 1.7 = 60
Now, from right angled triangle ACE,



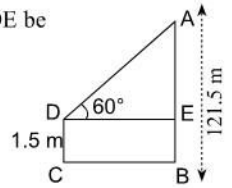
$\tan \theta = \frac{p}{b}$ i.e. $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{60}{AE}$

or, $AE = \frac{60}{\sqrt{3}} = 20\sqrt{3}$ m Thus, the distance between the man and pole is $20\sqrt{3}$ m.

11. 1.5 m अग्लो मानिसले आफ्नो अगाडि रहेको एउटा खम्बाको टुप्पामा हेर्दा 60° को उन्नतांश कोण पाएछ। यदि खम्बाको उचाइ 121.5 m भए, खम्बा र मानिसबीचको दूरी पत्ता लगाउनुहोस्।

A man of height 1.5 m, observes the angle of elevation of the top of a pole situated in front of him and finds to be 60°. If the height of pole is 121.5 m, find the distance between the pole and the man. [2057 A1]

⇨ Here, let, CD be the height of man and AB be the height of the pole. Let, DE be line perpendicular to AB. Here, angle of elevation ∠ADE is 60°.



From right angled triangle,

$\tan 60° = \frac{AE}{DE}$ or, $\sqrt{3} = \frac{AB - BE}{DE}$

or, $\sqrt{3} = \frac{121.5 - 1.5}{DE}$ or, $\sqrt{3} = \frac{120}{DE}$

or, $\sqrt{3}\ DE = 120$ or, $DE = \frac{120}{\sqrt{3}} = 69.28$ m

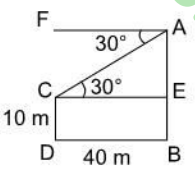
Thus, the required distance between the pole and the man is 69.28 m.

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12. एउटा स्तम्भको टुप्पोबाट स्तम्भदेखि 40 मिटर टाढा रहेको 10 मिटर अग्लो घरको छतमा हेर्दा 30° को अवनति कोण पाइयो भने स्तम्भको उचाइ पत्ता लगाउनुहोस् ।

From the top of a tower, the angle of depression to the roof of a house 10 m high and 40 m away from the tower, was observed and found to be 30°. Find the height of the tower. **[2061 A1]**

⇨ Here, in the figure, CD is 10 m high house, AB is tower and CE ⊥ AB. Since angle of depression from A is 30°, ∠ACE = 30°. Here, CD = 10 m, BD = 40 m.



From rt. angled triangle AEC,

$\tan 30° = \frac{AE}{EC}$ or, $\frac{1}{\sqrt{3}} = \frac{AE}{40}$ ∴ AE = 23.09 m

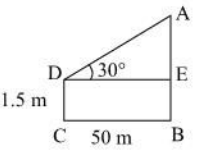
Now, height of tower = AB = AE + BE = AE + CD (∵ BE = CD)
= 23.09 m + 10 m = 33.09 m

Model 2

13. एकजना मानिस खम्बाको फेदबाट 50 मिटर पर उभिएको छ । त्यहाँबाट खम्बाको टुप्पो हेर्दा उसले 30° को उन्नतांश कोण पाएछ । यदि जमिनबाट उसको आँखा 1.5 मिटर माथि छ भने उक्त खम्बाको उचाइ निकाल्नुहोस् ।

A man stands 50 m from the foot of a pole. He finds the angle of elevation to be 30° while observing the top of the pole. If his eye is 1.5 m above the ground, find the height of the pole. **[2060 A1, 2059 D1]**

⇨ Here, let, CD be the height of the man and AB be height of tower.
Let, DE be line perpendicular to AB.
In right angled triangle ADE,



$\tan \angle ADE = \frac{AE}{DE}$ or, $\tan 30° = \frac{AE}{BC}$ [∵ DE = CB = 50 m]

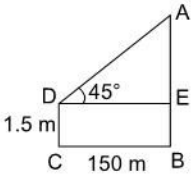
∴ $AE = BC \times \tan 30° = 50 \times \frac{1}{\sqrt{3}} = 28.87$ m

∴ AB = AE + BE = 28.87 + 1.5 = 30.37 m.
Thus, height of tower = 30.37 m

14. 1.5 मि. अग्लो मानिसले चउरमा रहेको एउटा खम्बाबाट 150 मि. को दुरीमा उभिएर खम्बाको टुप्पो हेर्दा 45° को उन्नतांश कोण पाएछ भने खम्बाको उचाइ पत्ता लगाउनुहोस् ।

A man of height 1.5 m, standing 150 m away from a pole, found the angle of elevation to be 45° while observing the pole. Find the height of the pole. **[2060 A2]**

⇨ Here, let, CD and AB represent the man and pole respectively.
Let, DE be drawn perpendicular to AB.
From rt. angled ΔADE,



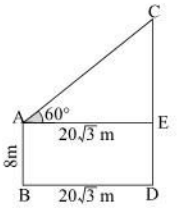
$\tan \angle ADE = \frac{AE}{DE}$ or, $\tan 45° = \frac{AE}{CB}$ or, $1 = \frac{AE}{150 \text{ m}}$

∴ AE = 150 m
Thus, AB = AE + BE = 150 m + CD = 150 m + 1.5 m = 151.5 m

15. एउटा अवलोकनकर्ताले 8 मिटर अग्लो घरको टुप्पोबाट स्तम्भको टुप्पोमा अवलोकन गर्दा उन्नतांश कोण 60° पाउँछ । यदि स्तम्भ र घरको दूरी $20\sqrt{3}$ मिटर भए स्तम्भको उचाइ पत्ता लगाउनुहोस् ।

An observer from the top of a house of 8 m high and finds the angle elevation of the top of the tower to be 60°. If the distance between the tower and the house is $20\sqrt{3}$ m, find the height of the tower. **[2068 C]**

⇨ Here, let, AB = 8 m be the height of a house CD be the height of the tower.
AE = BD = $20\sqrt{3}$ m be the distance between house and tower.
∠CAE = 60° be the angle of elevation.
Then, from the right angled ΔAEC



$\tan \theta = \frac{p}{b}$ i.e. $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{CE}{20\sqrt{3}}$

∴ CE = 60 m
Now, CD = CE + ED = 60 m + 8 m = 68 m
Thus, the height of the tower is 68 m.

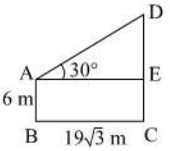
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16. 6 मि. अग्लो घरको छानाबाट एउटा धरहराको टुप्पोको उन्नतांश कोण अवलोकन गर्दा 30° पाइयो। यदि घर र धरहराको दूरी $19\sqrt{3}$ मि. भए धरहराको उचाइ पत्ता लगाउनुहोस् ।

From the roof of a house of 6 m tall, the angle of elevation of the top of a tower was observed and found to be 30°. If the distance between the house and the tower was $19\sqrt{3}$ m, determine the height of the tower. **[2065 B]**

⇨ Here, let, AB = 6 m be the height of a roof of a house and CD be the tower.
Let, AE = BC = $19\sqrt{3}$ m be the distance between house and a tower.
Let, ∠DAE = 30° be an angle of the elevation.



Then, $\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{DE}{AE}$

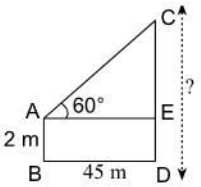
or, $\frac{1}{\sqrt{3}} = \frac{DE}{19\sqrt{3}}$ ∴ DE = 19 m

Thus, height of the tower = DC = DE + EC = 19 m + 6 m = 25 m

17. 2 m अग्लो एकजना मानिसले एउटा स्तम्भको टुप्पामा हेर्दा 60° को कोण बनाउदछ । यदि सो मानिस र स्तम्भको दूरी 45 m भए स्तम्भको उचाइ पत्ता लगाउनुहोस् ।

A man of 2 meters height, observes the angle of elevation of the top of the tower and finds to be 60°. If the distance between the man and the tower is 45 meters, find the height of the tower. **[2061 C2]**

⇨ Here, let, AB be the man and CD be the tower. Draw AE ⊥ CD.
Then, ∠CAE = 60°, AB = 2 m and AE = BD = 45 m.
From ΔACE, we have



$\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{CE}{45}$

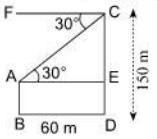
∴ CE = $45\sqrt{3}$ = 77.94 m
Now, ED = AB = 2 m and CD = CE + ED = 77.94 m + 2 m = 79.94 m
Thus, height of the tower is 79.94 m

Model 3

18. दुई सीधा खम्बाहरू 60 मिटरको दूरीमा छन् । पहिलो खम्बाको टुप्पोको अवनति कोण 150 मिटर उचाइ भएको दोस्रो खम्बाको टुप्पोबाट हेर्दा 30° पाएछ भने पहिलो खम्बाको उचाइ पत्ता लगाउनुहोस् ।

Two vertical poles are fixed 60 m apart. The angle of depression of the top of the first pole as seen from the top of the second which is 150 m high is 30°. Find the height of the first pole. **[2062 C2]**

⇨ Here, in figure AB is first pole, CD is second pole of height 150 m and BD is distance between the poles which is 60 m. AE is the horizontal line drawn through A. So, ∠CAE is equal to angle of depression which is 30°, i.e. ∠CAE = 30°.



In rt. angled triangle AEC,

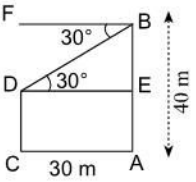
$\tan 30° = \frac{CE}{AE}$ or, $\frac{1}{\sqrt{3}} = \frac{CE}{60\text{ m}}$ ∴ $CE = 60 \times \frac{1}{\sqrt{3}} = 34.64$ m

Thus, height of first pole = AB = ED = CD – CE = 150 m – 34.64 m = 115.36 m.

19. फरक उचाइमा रहेका दुई रुखहरूका बीचको समतल दूरी 30 मिटर छ । दोस्रो रूखको टुप्पाबाट पहिलो रूखको टुप्पामा हेर्दा अवनति कोण 30° पाएछ । यदि दोस्रो रुखको उचाइ 40 मिटर छ भने पहिलो रुखको उचाइ कति हुन्छ ?

The horizontal distance between two trees of different heights is 30 m. The angle of depression of the top of the first tree when seen from the top of the second tree is 30°. If the height of the second tree is 40 m, find the height of the first tree. **[2059 C2]**

⇨ Here, suppose, AB and CD are two trees on the same horizontal AC.
DE be the line drawn parallel to AC.
The angle of depression of D from B is 30°.
∴ ∠BDE = 30°, AB = 40 m and AC = 30 m
In ΔBED,



$\tan 30° = \frac{BE}{ED}$ or, $\frac{1}{\sqrt{3}} = \frac{BE}{AC}$ [∵ DE = AC]

or, $BE = \frac{AC}{\sqrt{3}} = \frac{30\text{ m}}{\sqrt{3}} = 17.3$ m

Thus, Height of first tree = CD = AB – BE = 40 m – 17.3 m = 22.7 m

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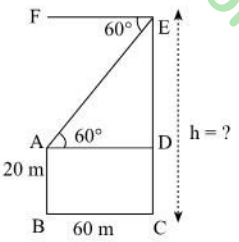
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20. एउटा स्तम्भको टुप्पोबाट स्तम्भदेखि 60 m टाढा रहेको 20 m अग्लो घरको छतमा हेर्दा 60° को अवनती कोण पाइयो भने स्तम्भको उचाइ निकाल्नुहोस् ।

From the top of tower the angle of depression to the roof of a house 20 m high & 60 m away from the tower was observed & found to be 60°. Find the height of the tower. **[2066 B, 2061 A2]**

⇨ Here, let, AB = 20 m be the height of a house. AD = BC = 60 m be the distance between house and the tower.
$\measuredangle FEA = 60°$ be angle depression of the top of house from the top of tower.
We have, $\measuredangle FEA = \measuredangle DAE = 60°$ [Being alternate angles]
From right angled ΔDAE,



$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{DE}{AD}$ or, $\sqrt{3} = \frac{DE}{60}$

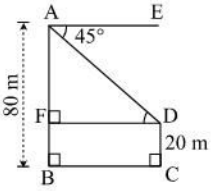
$\therefore$ $DE = 60\sqrt{3}$ m

Now, EC = DE + DC = $(60\sqrt{3} + 20)$m = 123.92 m Thus, the height of the tower is 123.92 m

21. 80 मिटर अग्लो एउटा स्तम्भको टुप्पोबाट त्यस स्तम्भको ठीक अगाडि रहेको 20 मिटर अग्लो खम्बाको टुप्पोमा अवलोकन गर्दा अवनती कोण 45° पाइयो भने स्तम्भ र खम्बाको बीचको दूरी पत्ता लगाउनुहोस् ।

From the top of a tower of 80 m high, the angle of depression of the top of a pole of 20 m high lying in front of the tower is observed and found to be 45°. Find the distance between the tower and the pole.[2068 D]

⇨ Here, let, AB = 80 m be the height of a tower, CD = 20 m be the height of a pole and $\measuredangle EAC = 45°$ be angle of depression.
From the figure, $\measuredangle ACF = \measuredangle EAC$
$\therefore$ $\measuredangle ACF = 45°$ and AF = AB – FB = 80 – CD = 80 – 20 = 60 m
From the right angled triangle



$\tan\theta = \frac{p}{b}$ or, $\tan\measuredangle ACF = \frac{AF}{FC}$

or, $\tan 45° = \frac{60}{FC}$ or, $1 = \frac{60}{FC}$

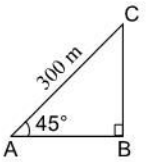
$\therefore$ FC = 60 m
Thus, the distance between the tower and the pole is 60 m.

Model 4

22. एकजना मानिसले चङ्गा उडाइरहेको थियो । यदि धागोको लम्बाइ 300 मि. थियो र यसले क्षितिजसँग 45° को कोण बनाएको थियो भने चङ्गा क्षितिजबाट कति उचाइमा उडिरहेको थियो ?

A man was flying his kite. The string was 300 m long and formed an angle of 45° with horizontal. What was the height of kite above the horizontal ? **[2059 D2]**

⇨ Here, suppose, AB be horizontal line, AC be the length of string and BC be the height of kite above the horizontal line.
Here, AC = 300 m and $\measuredangle BAC = 45°$
In the rt. angled triangle ABC,



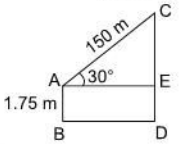
$\sin 45° = \frac{BC}{AC}$ or, $\frac{1}{\sqrt{2}} = \frac{BC}{300\text{ m}}$

$\therefore$ $BC = \frac{300}{\sqrt{2}}$ m $= \frac{300 \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}}$ m $= \frac{300\sqrt{2}}{2}$ m $= 150\sqrt{2}$ m Thus, height of kite is $150\sqrt{2}$ m.

23. 1.75 मिटर अग्लो एउटा केटाले उडाइरहेको एउटा चङ्गामा धागोको लम्बाइ 150 मिटर हुँदा क्षितिजसँग यसले 30° को कोण बनाउँदछ भने जमीनदेखि चङ्गासम्मको उचाइ कति हुन्छ ?

A boy who is 1.75 m tall, is flying a kite, when the length of the string of kite is 150 m, it makes an angle of 30° with the horizon. What is the height of the kite from the ground ? **[2061 D2]**

⇨ Here, in the figure, AB is the height of boy, CD is the height of kite from the ground. Draw AE ⊥ CD. Since, the string makes 30° with the horizon, $\measuredangle CAE = 30°$.
From ΔAEC, we have,



$\sin 30° = \frac{CE}{AC}$ or, $\frac{1}{2} = \frac{CE}{150}$ $\therefore$ $CE = \frac{150}{2} = 75\text{m}$

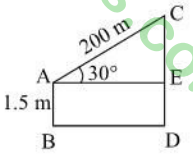
Now, CD = CE + ED = 75 m + AB = 75 m + 1.75 m = 76.75 m
Thus, the height of the kite from the ground is 76.75 m.

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24. 1.5 मिटर उचाइ भएको एउटा केटाले चङ्गा उडाइ राखेको छ । धागोको लम्बाइ 200 मिटर भएको बेला चङ्गाको धागोले क्षितिजसँग 30° को कोण बनाउँछ भने, जमिनबाट चङ्गाको उचाइ निकाल्नुहोस् ।

A boy of height 1.5 m is flying a kite. When the length of string is 200 m, it makes an angle of 30° with the horizontal, find the height of the kite from the ground. **[SLC 2065 C]**



⇨ Here, let, AB = 1.5 m be the height of a man and AC = 200 m be the length of string of the kite.
Let, ∠CAE = 30° be an angle of elevation.

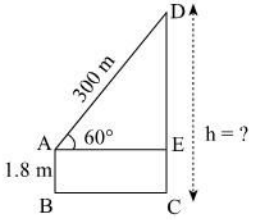
From the figure, $\sin\theta = \frac{p}{h}$ or, $\sin 30° = \frac{CE}{AC}$ or, $\frac{1}{2} = \frac{CE}{200}$ ∴ CE = 100 m

Now, height of the kite from ground = CE + ED = 100 m + 1.5 m = 101.50 m
Thus, height of the kite from ground is 101.50 m.

25. 1.8 मिटर उचाइ भएको एउटा केटाले चङ्गा उडाइ रहँदा चङ्गाको धागोले क्षितिजसँग 60° को कोण बनाउँछ । यदि धागोको लम्बाइ 300 मिटर भए जमिनबाट सो चङ्गा कति उचाइमा छ, पत्ता लगाउनुहोस् ।

The thread of a kite makes an angle of 60° with the horizon while a boy of height 1.8 m flying a kite. If the length of the thread is 300 m, find the height of the kite from the ground. **[2066 D]**

⇨ Here, let, AB = 1.8 m be the height of a man
Let, AD = 300 m be the thread of a kite
∠DAE = 60° be the angle of elevation
Then, we have,



$\sin\theta = \frac{p}{h}$ or, $\sin 60° = \frac{DE}{AD}$ or, $\frac{\sqrt{3}}{2} = \frac{DE}{300}$

∴ $DE = 150\sqrt{3}$ m

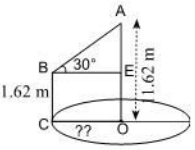
Now, CD = DE + CE = $150\sqrt{3}$ m + 1.8 m = 261.60 m
Thus, the height of kite from the ground is 261.60 m.

Model 5

26. वृत्ताकार पोखरीको केन्द्रमा पानीको सतहदेखि माथि 11.62 मि. अग्लो खम्बा छ । पोखरीको किनारको कुनै बिन्दुबाट 1.62 मि. अग्लो मानिसले खम्बाको टुप्पो अवलोकन गर्दा उन्नतांश कोण 30° पायो भने सो पोखरीको व्यास निकाल्नुहोस् ।

At the centre of a circular pond, there is a pole of 11.62 m height above the surface of the water. From a point on the edge of the pond, a man of 1.62 m height observed the angle of elevation of the top of the pole and found to be 30°. Find the diameter of the pond. **[2061 E1]**

⇨ Here, in the alongside figure, O is the centre of circular pond. AO is a pole,
BC is a man, BE ⊥ AO and ∠ABE = angle of elevation.
Here, BC = 1.62 m, AO = 11.62 m and ∠ABE = 30°
Now, AE = AO – EO = AO – BC = 11.62 m – 1.62 m = 10 m
From ΔABE,



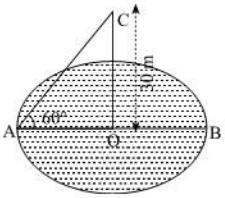
$\tan 30° = \frac{AE}{BE}$ or, $\frac{1}{\sqrt{3}} = \frac{10}{BE}$ or, BE = 17.32 m

∴ Radius = CO = 17.32 m and diameter = 2 × radius = 2 × 17.32 = 34.64 m
Thus, diameter of the pond is 34.64 m

27. एउटा वृत्ताकार पोखरीको केन्द्रमा एउटा खम्बा ठाडो उभ्याइएको छ । खम्बाको टुप्पो पानीको सतहबाट 30 m उचाइमा छ र पोखरीको परिधिको एक बिन्दुबाट यसको उन्नतांश कोण 60° भए उक्त पोखरीको अर्धव्यासको लम्बाइ निकाल्नुहोस् ।

A circular pond has a pole standing vertically at its centre. The top of the pole is 30 m above the water surface & the angle of elevation of it from a point on the circumference is 60°. Find the length of radius of pond. **[SLC 2066 C]**

⇨ Here, let, AB be the diameter of the pond and O be its centre.
Let, OC = 30 m be the height of pole from water level
And, ∠CAO = 60° be the angle of elevation.
From right angled ΔAOC,



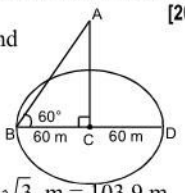
$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{30\text{ m}}{AO}$ or, $\sqrt{3} = \frac{30\text{ m}}{AO}$

∴ $AO = 10\sqrt{3}$ m Thus, the radius of the pond is $10\sqrt{3}$ m.

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28. एउटा वृत्ताकार पोखरीको व्यास 120 m छ । उक्त पोखरीको बीचमा गाडिएको खम्बाको टुप्पोमा सो पोखरीको किनाराबाट हेर्दा 60° को उन्नतांश कोण बन्दछ भने पानीको सतहदेखि खम्बाको टुप्पोसम्मको उचाइ पत्ता लगाउनुहोस् ।
The diameter of a circular pond is 120 m. The angle of elevation of the top of the pillar, situated in the middle of the pond, observed from the edge of the pond and found to be 60°. Find the height of the pillar above the surface of the water. **[2062 E1]**



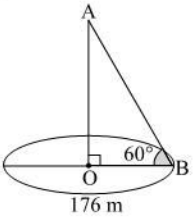
⇨ Here, in figure, AC is the pillar and BD is the diameter. C is the centre and $BC = \frac{BD}{2} = \frac{120}{2}\text{ m} = 60\text{ m}$ is the radius.
The angle of elevation of A observed from B is $\angle ABC = 60°$.
In rt. angled ΔABC,

$\tan 60° = \frac{AC}{BC}$ or, $\sqrt{3} = \frac{AC}{60\text{ m}}$ ∴ $AC = 60 \times \sqrt{3}\text{ m} = 103.9\text{ m}$

Thus, the height of the pillar is 103.9 m

29. एउटा वृत्ताकार पोखरीको परिधि 176 मि. छ र यसको बीचमा एउटा खम्बा गाडिएको छ । एउटा व्यक्तिले पोखरीको किनाराको कुनै पनि ठाउँबाट खम्बाको टुप्पोको उन्नतांश कोण 60° पाएछ भने सो खम्बाको पानीमाथिको उचाइ पत्ता लगाउनुहोस् ।
The circumference of a circular pond is 176 m and a pillar is fixed at the centre of the pond. If a person finds the angle of elevation of 60° of the top of the pillar from any point on the bank of the pond, find the height of the pillar above the water level. **[2067 A]**

⇨ Here, let, O be the centre of pond, AO be the height of the pillar. OB = r = distance between pillar and the bank. $\angle ABO = 60°$ be an angle of elevation of the top of pillar from the bank.
By the question, Circumference = 176



or, $2\pi r = 176$ or, $2 \times \frac{22}{7} \times r = 176$ or, $r = \frac{176 \times 7}{2 \times 22}$

∴ $r = 28\text{ cm}$ ∴ $OB = 28\text{ m}$

From the right angled ΔAOB, $\tan\theta = \frac{AO}{OB} = \frac{p}{b}$

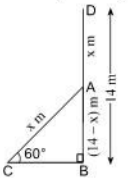
or, $\tan 60° = \frac{AO}{28}$ or, $\sqrt{3} = \frac{AO}{28}$ ∴ $AO = 28\sqrt{3}$

Thus, the height of pillar is $28\sqrt{3}$ m.

Model 6

30. एउटा 14 m अग्लो रूख हावाले भाँचिएर टुप्पोले जमिनमा छुँदा जमिनसँग 60° को कोण बनेको छ । रूखको भाँचिएको भागको लम्बाइ पत्ता लगाउनुहोस् ।
A tree of 14 metres height is broken by the wind so that its top touches the ground and makes an angle 60° with the ground. Find the length of the broken part of the tree. **[2057 D1]**

⇨ Here, let, AC be the length of the broken part of the tree and AB be the vertical part of the tree. Let, AC make 60° with CB. i.e. $\angle ACB = 60°$. Suppose, AC = x then AB = (14 – x) m.
In rt. angled Δ ACB,



$\sin\angle ACB = \frac{AB}{AC}$ or, $\sin 60° = \frac{14 - x}{x}$ or, $\frac{\sqrt{3}}{2} = \frac{14 - x}{x}$

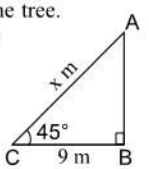
or, $\sqrt{3}x = 28 - 2x$ or, $\sqrt{3}x + 2x = 28$ or, $x(\sqrt{3} + 2) = 28$

or, $x \times (1.73 + 2) = 28$ or, $x \times 3.73 = 28$ ∴ $x = \frac{28}{3.73} = 7.5\text{ m}$.

Thus, length of broken part is 7.5 m

31. हुरीले गर्दा एउटा सीधा रूख भाँचिएर टुप्पोले फेदबाट 9 m टाढाको समतल बिन्दुमा छुँदा 45° को कोण बनाउँदछ भने त्यो रूख भाँचिनुभन्दा पहिलेको उचाइ पत्ता लगाउनुहोस् ।
The upper part of a straight tree broken by the wind makes an angle of 45° with plain surface at a point 9 m from the foot of the tree. Find the height of the tree before it was broken. **[2058 E1]**

⇨ Here, let, AC be the length of the broken part of the tree and AB be the vertical part of the tree. Let, AC makes an angle of 45° with CB i.e. $\angle ACB = 45°$ and CB = 9 m. Suppose, AC = x
Now, in the right angled ΔABC.



$\cos 45° = \frac{CB}{AC}$ or, $\frac{1}{\sqrt{2}} = \frac{9}{x}$ or, $x = 9\sqrt{2}$

∴ $AC = 9\sqrt{2}\text{ m} = 12.73$

Again, $\tan 45° = \frac{AB}{CB}$ or, $1 = \frac{AB}{9\text{ m}}$ ∴ $AB = 9\text{ m}$

Thus, the height of tree before it was broken = AB + AC = 9 m + 12.73 m = 21.73 m

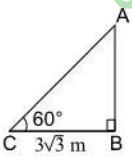
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32. हुरीले गर्दा एउटा सीधा रुख भाँचिएर यसको टुप्पोले फेदबाट $3\sqrt{3}$ मि. टाढा जमिनमा 60° को कोण बनाउँछ भने भाँचिनुभन्दा पहिलेको रुखको उचाइ पत्ता लगाउनुहोस् ।

The top of a tree which is broken by the wind makes an angle of 60° with the ground at a distance $3\sqrt{3}$ m from the foot of the tree. Find the height of the tree before it was broken. **[2060 E1]**

⇨ Here, let, AC be the length of the broken part and AB be the vertical part of the tree. Let AC makes an angle of 60° with CB i.e. $\measuredangle ACB = 60°$.



Here, $CB = 3\sqrt{3}$ m Now, $\tan 60° = \frac{AB}{CB}$

or, $\sqrt{3} = \frac{AB}{3\sqrt{3}\text{ m}}$ $\therefore$ $AB = 3(\sqrt{3})^2\text{ m} = 9\text{ m}$

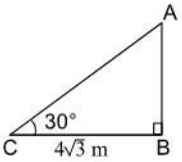
And, $AC = \sqrt{AB^2 + BC^2} = \sqrt{(9\text{ m})^2 + (3\sqrt{3}\text{ m})^2} = \sqrt{81\text{ m}^2 + 27\text{ m}^2} = \sqrt{108}\text{ m} = 10.39\text{ m}$

Thus, Height of the tree before it was broken $= AB + AC = 9\text{ m} + 10.39\text{ m} = 19.39\text{ m}$

33. हुरीले एउटा सीधा रुख भाँचिदा यसको टुप्पोले फेदबाट $4\sqrt{3}$ मि. टाढा जमिनमा छोएर 30° को कोण बनाउँछ भने भाँचिनुभन्दा पहिलेको रुखको उचाइ पत्ता लगाउनुहोस् ।

The top of a tree broken by the wind makes an angle of 30° with the ground at a distance of $4\sqrt{3}$ m. from the foot of the tree. Determine the height of the tree before it was broken. **[2060 E2]**

⇨ Here, let, AC be the length of the broken part and AB be the vertical part of the tree. Here, AC makes 30° with the ground.



$\therefore$ $\measuredangle ACB = 30°$ or, $\tan 30° = \frac{AB}{BC}$ or, $\frac{1}{\sqrt{3}} = \frac{AB}{4\sqrt{3}\text{ m}}$

$\therefore$ $AB = \frac{4\sqrt{3}}{\sqrt{3}}\text{ m} = 4\text{ m}$

Again, $\sin 30° = \frac{AB}{AC}$ or, $\frac{1}{2} = \frac{4\text{ m}}{AC}$ $\therefore$ $AC = 8\text{ m}$

Thus, the height of the tree before it was broken $= AB + AC = 4\text{ m} + 8\text{ m} = 12\text{ m}$

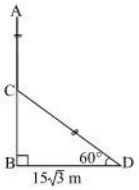
34. यदि हावाले भाँचिएको एउटा रूखको टुप्पोले उक्त रूखको फेदबाट $15\sqrt{3}$ मिटर पर जमीनसँग 60° को कोण बनाउँदछ भने भाँचिनुभन्दा पहिले सो रूखको उचाइ पत्ता लगाउनुहोस् ।

If the top of a tree which is broken by the wind makes an angle of 60° with the ground at a distance of $15\sqrt{3}$ m from the foot of the tree, find the height of the tree before it was broken. **[2068 B]**

⇨ Here, let, AB = height of tree before broken. $\measuredangle CDB = 60°$ be an angle of elevation

The point C be the point of broken. $\therefore$ $BD = 15\sqrt{3}$ m and $AC = CD$

From right angled triangle,



$\cos \measuredangle D = \frac{BD}{CD}$ or, $\cos 60° = \frac{15\sqrt{3}}{CD}$ or, $\frac{1}{2} = \frac{15\sqrt{3}}{CD}$

$\therefore$ $CD = 30\sqrt{3}$ m

Again, $\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{BC}{BD}$ or, $\sqrt{3} = \frac{BC}{15\sqrt{3}}$

$\therefore$ $BC = 45$ m

Now, height of tree before broken $= AB = AC + BC = CD + BC = 30\sqrt{3} + 45 = 96.96$ m

Thus, the height of tree before broken is 96.96 m.

Model 7

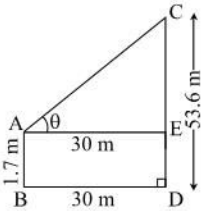
35. 1.7 मि. अग्लो एउटा मानिसले आफू अगाडि रहेको **53.6 मि.** अग्लो रूखको टुप्पोमा रहेको चरा हेर्दछ । यदि रूख र मानिस बीचको दूरी **30 मि.** छ भने सो मानिसले बनाएको उन्नतांश कोण पत्ता लगाउनुहोस् ।

A man 1.7 m tall, observes a bird sitting on the top of a tree of height 53.6 m in front of him. If the distance between the man and the tree is 30 m, find the angle of elevation made by the man. **[2071D]**

⇨ Here, let, AB = 1.7 m be the height of a man and CD = 53.6 m be the height of the tree.

Let, $AE = BD = 30$ m be the distance between man and tree.

Let, $\measuredangle CAE = \theta$ be angle of elevation



From the figure alongside, $\tan\theta = \frac{p}{b} = \frac{CE}{AE}$

or, $\tan\theta = \frac{CD - ED}{30} = \frac{53.6 - 1.7}{30} = \frac{51.9}{30}$ or, $\tan\theta = 1.73$

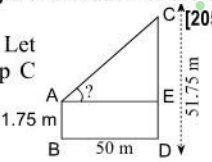
or, $\tan\theta = \tan 60°$ $\therefore$ $\theta = 60°$

Thus, the required angle of elevation is 60°.

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36. 1.75 m अग्लो एकजना मानिस 51.75 m उचाइको एउटा धरहराबाट 50 m पर खडा भएको छ भने उनको आँखाबाट धरहराको टुप्पाको उन्नतांश कोण पत्ता लगाउनुहोस् ।

A man 1.75 m tall is 50 m away from a tower 51.75 m high. What is the angle of elevation of the top of the tower, from his eyes ? **[2058 B1]**



⇨ Here, let AB be the position of man and CD be the position of the tower. Let AE be the line perpendicular to CD. Here, angle of elevation of the top C from the eye of observer at A is ∠CAE.

Here, AB = 1.75 m, BD = 50 m and CD = 51.75 m,

Here, CE = (CD – ED) = (CD – AB) = (51.75 – 1.75) = 50 m

In the right angled ΔAED, $\tan \angle CAE = \frac{CE}{AE} = \frac{50\text{ m}}{50\text{ m}} = 1 = \tan 45°$ [∵ AE = DB = 50 m]

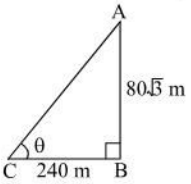
or, $\tan \angle CAE = \tan 45°$ ∴ $\angle CAE = 45°$

Thus, angle of elevation is 45°.

37. एउटा मानिसले $80\sqrt{3}$ m अग्लो स्तम्भको टुप्पोलाई फेदबाट 240 m परदेखि हेर्दा बन्ने उन्नतांश कोण पत्ता लगाउनुहोस् ।

A man observes the top of a tower of $80\sqrt{3}$ m height from 240 m far from the foot of the tower, find the angle of elevation. **[2067 D]**

⇨ Here, let AB = $80\sqrt{3}$ m be the height of a tower and BC = 240 m be the distance between man and tower. ∠ACB = θ be angle of elevation



We know that, $\tan\theta = \frac{AB}{BC}$ or, $\tan\theta = \frac{80\sqrt{3}}{240}$ or, $\tan\theta = \frac{\sqrt{3}}{3}$

or, $\tan\theta = \frac{1}{\sqrt{3}}$ or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Thus, the angle of elevation is 30°.

Model 8

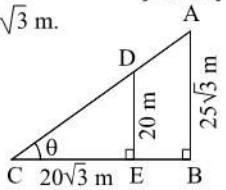
38. 20 मिटर अग्लो स्तम्भको छायाँको लम्बाइ $20\sqrt{3}$ मी भएको समयमा $25\sqrt{3}$ मिटर अग्लो स्तम्भको छायाँको लम्बाइ पत्ता लगाउनुहोस् ।

The length of shadow of a pole having 20 m height is $20\sqrt{3}$ m. Find the length of the shadow of a pole of height $25\sqrt{3}$ m at the same time. **[2073 PU]**

⇨ Here, let, DE = 20 m be the height of pole whose length of shadow (CE) = $20\sqrt{3}$ m.

Let, AB = $25\sqrt{3}$ m be the another pole whose length of shadow (BC) = ?

Let, θ be the angle of elevation.



Now, From right angled ΔDEC, $\tan\theta = \frac{DE}{CE} = \frac{20\text{m}}{20\sqrt{3}\text{m}} = \frac{1}{\sqrt{3}}$

or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Again, from right angled ΔABC,

$\tan\theta = \frac{AB}{CB}$ or, $\tan 30° = \frac{25\sqrt{3}\text{ m}}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{25\sqrt{3}\text{ m}}{CB}$

∴ CB = 75 m. Thus, the length of shadow is 75 m.

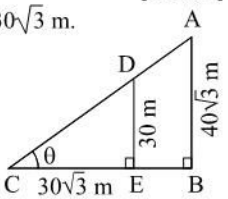
39. 30 मि. अग्लो एउटा घरको छायाको लम्बाइ 30 $\sqrt{3}$ मि. भएको समयमा $40\sqrt{3}$ मि. अग्लो घरको छायाको लम्बाइ पत्ता लगाउनुहोस् ।

The length of shadow of a house having 30 m height is 30 $\sqrt{3}$ m. Find the length of shadow of the house having the height $40\sqrt{3}$ m at the same time. **[2073 MA]**

⇨ Here, let, DE = 30 m be the height of house whose length of shadow (CE) = $30\sqrt{3}$ m.

Let, AB = $40\sqrt{3}$ m be the another house whose length of shadow (BC) = ?

Let, θ be the angle of elevation.



Now, from right angled ΔDEC, $\tan\theta = \frac{DE}{CE} = \frac{30\text{ m}}{30\sqrt{3}\text{ m}} = \frac{1}{\sqrt{3}}$

or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Again, from right angled ΔABC,

$\tan\theta = \frac{AB}{CB}$ or, $\tan 30° = \frac{40\sqrt{3}\text{ m}}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{40\sqrt{3}\text{ m}}{CB}$

∴ CB = 120 m. Thus, the length of shadow is 120 m.

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40. 25 फीट अग्लो एउटा खम्बाको छायाँको लम्बाइ $25\sqrt{3}$ फीट भएको बेला $15\sqrt{3}$ फीट अग्लो रूखको छायाँको लम्बाइ कति होला ? पत्ता लगाउनुहोस् ।

The length of shadow of a pole 25 feet high is $25\sqrt{3}$ feet. What will be the length of the shadow of a tree $15\sqrt{3}$ feet high at the same time? Find it. **[2073 PA]**

⇨ Here, let, DE = 25 feet be the height of pole whose length of shadow (CE) = $25\sqrt{3}$ feet.
Let, AB = $15\sqrt{3}$ feet be the another pole whose length of shadow (BC) = ?
Let, θ be the angle of elevation.
Now, From right angled ΔDEC,

$$\tan\theta = \frac{DE}{CE} = \frac{25}{25\sqrt{3}} = \frac{1}{\sqrt{3}}$$

or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Again, from right angled ΔABC,

$\tan\theta = \frac{AB}{CB}$ or, $\tan 30° = \frac{15\sqrt{3}}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{15\sqrt{3}}{CB}$

∴ CB = 45 ft. Thus, the length of shadow is 45 ft.

41. 12 मिटर अग्लो एउटा खम्बाको छायाँको लम्बाइ $12\sqrt{3}$ मिटर भएको बेला $8\sqrt{3}$ मिटर अग्लो रुखको छायाँको लम्बाइ कति होला ? पत्ता लगाउनुहोस् ।

The length of shadow of a pole 12 meter high is $12\sqrt{3}$ meter. What will be the length of the shadow of a tree $8\sqrt{3}$ meter high at the same time? Find it. **[2073 MP]**

⇨ Here, let, DE = 12 m be the height of pole whose length of shadow (CE) = $12\sqrt{3}$ m.
Let, AB = $8\sqrt{3}$ m be the another pole whose length of shadow (BC) = ?
Let θ be the angle of elevation.
Now, from right angled ΔDEC,

$$\tan\theta = \frac{DE}{CE} = \frac{12\text{ m}}{12\sqrt{3}\text{ m}} = \frac{1}{\sqrt{3}}$$

or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Again, from right angled ΔABC,

$\tan\theta = \frac{AB}{CB}$ or, $\tan 30° = \frac{8\sqrt{3}\text{ m}}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{8\sqrt{3}\text{ m}}{CB}$

∴ CB = 24 m. Thus, the length of shadow is 24 m.

42. 16 फीट अग्लो रुखको छायाँको लम्बाइ $16\sqrt{3}$ फीट भएको समयमा $20\sqrt{3}$ फीट अग्लो रुखको छायाँको लम्बाइ पत्ता लगाउनुहोस् ।

When the length of shadow of a tree 16 ft high is $16\sqrt{3}$ ft. Find the length of the shadow of a tree of height $20\sqrt{3}$ ft. **[2073 SP]**

⇨ Here, let, DE = 16 m be the height of a tree whose length of shadow (CE) = $16\sqrt{3}$ ft.
Let, AB = $20\sqrt{3}$ ft be the another a tree whose length of shadow (BC) = ?
Let θ be the angle of elevation.
Now, from right angled ΔDEC,

$$\tan\theta = \frac{DE}{CE} = \frac{16\text{ ft}}{16\sqrt{3}\text{ ft}} = \frac{1}{\sqrt{3}}$$

or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Again, from right angled ΔABC,

$\tan\theta = \frac{AB}{CB}$ or, $\tan 30° = \frac{20\sqrt{3}\text{ ft}}{CB}$ or, $\frac{1}{\sqrt{3}} = \frac{20\sqrt{3}\text{ ft}}{CB}$

∴ CB = 60 ft.
Thus, the length of shadow is 60 ft.

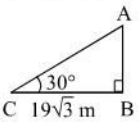
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B. QUESTIONS FROM CDC TEXT BOOKS

1A. अवलोकन बिन्दुबाट $19\sqrt{3}$ m दुरीमा रहेको एउटा खम्बाको टुप्पोमा हेर्दा उन्नतांश कोण 30° पाइयो भने खम्बाको उचाइ पत्ता लगाउनुहोस् ।

The angle of elevation of the top of a tower is $19\sqrt{3}$ m away from the point of observation is 30°. Find the height of the tower.



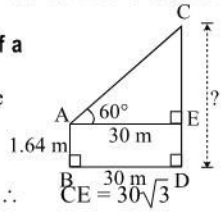
⇨ Here, let, AB be the height of a tower and $\angle ACB = 30°$ be the angle of elevation.
$BC = 19\sqrt{3}$ m be the distance between the tower and point of observation.
We know that,

$\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{AB}{BC}$ or, $\frac{1}{\sqrt{3}} = \frac{AB}{19\sqrt{3}}$ $\therefore$ $AB = 19$ m

Thus, the height of the tower is 19 m.

1B. एक जना मानिसले 30 m को दुरीमा रहेको रुखको टुप्पोमा हेर्दा उन्नतांश कोण 60° पाउँछ । यदि मानिसको उचाइ 1.64 m भए रुखको उचाइ पत्ता लगाउनुहोस् ।

A man is standing 30 m away from a tree found the angle of elevation of top of a tree is found to be 60°. If the man is 1.64 m tall, find the height of the tree.



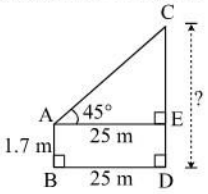
⇨ Here, let, AB = 1.64 m be the height of a man. Let, AE = BD = 30 m be the distance between the man and tree. $\angle CAE = 60°$ be the angle of elevation.
From the right angled ΔAEC,

$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{CE}{30}$ $\therefore$ $CE = 30\sqrt{3}$

Now, $CD = CE + ED = 30\sqrt{3} + 1.64$ $\therefore$ $CD = 53.60$ m
Thus, the height of the tree is 53.60 m.

1C. 1.7 m अग्लो मानिसले 25 m को दुरीमा रहको स्तम्भको टुप्पोमा हेर्दा उन्नतांश कोण 45° पायो भने स्तम्भको उचाइ पत्ता लगाउनुहोस् ।

A man having height 1.7 m is standing 25 m away a tower found the angle of elevation 45°. Find the height of the tower.



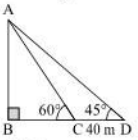
⇨ Here, let, AB = 1.7 m be the height of a man. Let, AE = BD = 25 m be the distance between the man and tower. Let, $\angle CAE = 45°$ be angle of elevation.
From a right angled ΔAEC,

$\tan\theta = \frac{p}{b}$ or, $\tan 45° = \frac{CE}{AE}$ or, $1 = \frac{CE}{25}$

$\therefore$ $CE = 25$ m
Now, height of the tower = $CE + ED = 25\text{ m} + AB = 25\text{ m} + 1.7\text{ m} = 26.70$ m
Thus, the height of the tower is 26.70 m.

1D. एक जना सर्वेक्षकले गुम्बाको उचाइ नाप्न चाहन्छन् । यदि उक्त गुम्बाको टुप्पोलाई 40 मिटर फरकमा रहेका दुई ओटा बिन्दुबाट अवलोकन गर्दा क्रमशः 45° र 60° को कोण पाएछ भने गुम्बाको उचाइ कति होला ?

A man wants to measure the height of a monastery. If the top of the monastery is observed from the two points, having distance 40 m then the angle 45° and 60° respectively are found. Find the height of the monastery are found.



⇨ Here, let AB be the height of monastery. CD = 40 m be the distance between two points. $\angle ACB = 60°$ and $\angle ADC = 45°$ be the angle of elevation.
From the right angled ΔABC,

$\tan\theta = \frac{p}{b}$

or, $\tan 60° = \frac{AB}{BC}$

or, $\sqrt{3} = \frac{AB}{BC}$

$\therefore$ $AB = \sqrt{3}\,BC$

Again, from right angled ΔABD,

$\tan\theta = \frac{p}{b}$ or, $\tan 45° = \frac{AB}{BD}$

or, $BC + 40 = \sqrt{3}\,BC$ or, $40 = (\sqrt{3} - 1)BC$

or, $BC = \frac{40}{\sqrt{3} - 1}$ $\therefore$ $BC = 20 + 20\sqrt{3}$

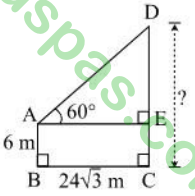
Now, height of monastery (Gumba) = $AB = \sqrt{3}\,BC = \sqrt{3}\,(20 + 20\sqrt{3}) = 20\sqrt{3} + 60 = 94.64$ m
Thus, the height of the monastery (Gumba) is 94.64 m.

1E. 6 m अग्लो घरको छानाबाट एउटा स्मारक स्तम्भको टुप्पो अवलोकन गर्दा उन्नतांश कोण 60° पाइयो । यदि घर र स्मारकबिचको दुरी $24\sqrt{3}$ m भएमा स्मारकको उचाइ पत्ता लगाउनुहोस् ।

From a roof of a house 6 m tall, the angle of elevation of the top of a monument was observed and found to be 60°. If the distance between the house and monument was $24\sqrt{3}$ m. Determine the height of the monument.

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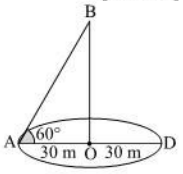


⇨ Here, let, AB = 6 m be the height of the house.
AE = BC = $24\sqrt{3}$ m be the distance between house and the monument.
Let, ∠DAE = 60° be the angle of elevation.
From the right angled triangle AED.

$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{DE}{AE}$ or, $\sqrt{3} = \frac{DE}{24\sqrt{3}}$

$\therefore$ DE = 72 m
Now, the height of monument = DE + EC = 72 m + 6 m = 78 m
Thus, the height of the monument is 78 m.

2A. 60 m व्यास भएको एउटा वृत्ताकार खेतको बिचमा एउटा स्तम्भ गाडिएको छ । उक्त खेतको परिधिको एउटा बिन्दुबाट सो स्तम्भको टुप्पोमा हेर्दा 60° को कोण बन्दछ भने उक्त स्तम्भको उचाइ पत्ता लगाउनुहोस् ।
A pillar is fixed in the centre of a circular meadow with diameter of 60 metres. The angle of elevation of its top was found to be 60°, when observed from a point of the circumference of circular meadow. Find the height of the pillar from the ground. **[2060 D1]**



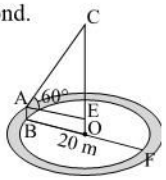
⇨ Here, let, O be the centre of circular meadow and OB be the vertical pillar.
Let, A be the point on the circumference of circular meadow such that ∠BAO = 60°.

Now, OA = radius = $\frac{60\text{ m}}{2}$ = 30 m. From ΔAOB, $\tan 60° = \frac{OB}{OA}$

or, $\sqrt{3} = \frac{OB}{30\text{ m}}$ $\therefore$ OB = $30\sqrt{3}$ m = 30 × 1.73 m = 51.96 m

Thus, height of pillar is 51.96 m.

2B. एउटा वृत्ताकार पोखरीको वरिपरि 1.68 m अग्लो पर्खाल लगाइएको छ । उक्त पोखरीको बिचमा रहेको खम्बाको टुप्पोमा पर्खालबाट हेर्दा 60° को उन्नतांश कोण बन्दछ । यदि पोखरीको व्यास 20 m भए पानीको सतहदेखि माथिको खम्बाको उचाइ पत्ता लगाउनुहोस् ।
There is a wall having height 1.68 m all around the circular pond. From the wall the top of a vertical pole at the centre of the pond is observed and found to be 60°. If the diameter of the pond is 20 m, find the height of the pole above the surface of the water.



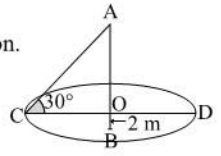
⇨ Here, let AB = 1.68 m be the height of wall and BF = 20 m be the diameter of the pond.
∠CAE = 60° be the angle of elevation.
From the right angled ΔAEC,

$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{CE}{AE}$ or, $\sqrt{3} = \frac{CE}{BO}$

or, $\sqrt{3} = \frac{CE}{10\text{ m}}$ [$\because$ BF = 20 m] $\therefore$ CE = $10\sqrt{3}$ m

Now, height of the pole = CE + EO = $10\sqrt{3}$ + 1.68 = 19.00
Thus, the height of the pole is 19 m.

2C. 120 m व्यास भएको वृत्ताकार पोखरीको ठिकबिचमा एउटा खम्बा ठाडो पारेर गाडिएको छ । पोखरीको सतहको परिधिबाट उक्त खम्बाको टुप्पोमा हेर्दा 30° को कोण बनेको पाइयो । यदि पोखरीको गहिराइ 2 m भए खम्बाको उचाइ पत्ता लगाउनुहोस् ।
A pillar is fixed in the centre of a circular pond with diameter 120 meters. The angle of elevation of its top was found to be 30° when observed from a point of the circumference of the pond. If there is 2 m part of the pole inside the water, find the height of the pole.



⇨ Here, let, AB be the height of a pole and ∠ACO = 30° be the angle of elevation.
OB = 2 m be the part of pole inside the water.
CD = 120 m be the diameter of the pond.
From a right angled ΔACO,

$\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{AO}{OC}$

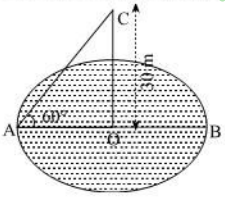
or, $\frac{1}{\sqrt{3}} = \frac{AO}{60}$ [$\because$ CD = 120 m] or, $AO = \frac{60}{\sqrt{3}} = 20\sqrt{3}$

Now, height of the pole = AO + OB = $(20\sqrt{3} + 2)$ m = 36.64 m
Thus, the height of the pole is 36.64 m.

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2D. एउटा वृत्ताकार पोखरीको केन्द्रमा एउटा खम्बा ठाडो उभ्याइएको छ । पानीको सतहदेखि खम्बाको टुप्पोको उचाइ 30 m छ र पोखरीको परिधिमा एउटा बिन्दुबाट खम्बाको टुप्पोमा 60° को कोण भएमा पोखरीको अर्धव्यास र परिमिति पत्ता लगाउनुहोस् ।

A circular pond has a pole standing vertically at its centre. The top of the pole is 30 m above the water surface and angle of elevation of the top of the pole from a point on the circumference is 60°. Find the radius and perimeter of the pond.



⇨ Here, let AB be the diameter of the pond and O be its centre.
Let, OC = 30 m be the height of pole from water level
And, $\angle CAO = 60°$ be the angle of elevation.
From right angled ΔAOC,

$\tan\theta = \frac{p}{b}$ or, $\tan 60° = \frac{30\text{ m}}{AO}$ or, $\sqrt{3} = \frac{30\text{ m}}{AO}$

$\therefore \quad AO = 10\sqrt{3}$ m

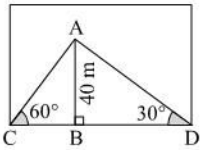
Thus, the radius of the pond is $10\sqrt{3}$ m.

Again, perimeter of the pond $= 2\pi r = 2 \times \frac{22}{7} \times 10\sqrt{3} = 108.87$ m

Thus, the perimeter of the pond is 108.87 m.

2E. एउटा आयताकार चउरको लम्बाइ पट्टिको डिलमा एउटा 40 m अग्लो सुरिलो रुख छ । यदि उक्त आयताकार चउरको लम्बाइको दुई किनाराको बिन्दुबाट उक्त रुखको टुप्पोमा हेर्दा क्रमशः 60° र 30° को उन्नतांश कोणहरू बनेको पाइयो भने उक्त चउरको लम्बाइ पत्ता लगाउनुहोस् ।

A straight-tree having height 40 m is in the edge of a rectangular ground along the length. If from the both edges of the ground, the top of the tree is observed and found the angles of elevation 60° and 30° respectively, find the length of the ground.



⇨ Here, let AB = 40 m be the height of the tree.
$\angle ACB = 60°$ and $\angle ADB = 30°$ be the angles of elevation.

From the right angled ΔABC,

$\tan\theta = \frac{p}{b}$

or, $\tan 60° = \frac{AB}{BC}$

or, $\sqrt{3} = \frac{40}{BC}$

$\therefore \quad BC = \frac{40}{\sqrt{3}}$ m

From the right angled ΔABD,

$\tan\theta = \frac{p}{b}$

or, $\tan 30° = \frac{40}{BD}$

or, $\frac{1}{\sqrt{3}} = \frac{40}{BD}$

$\therefore \quad BD = 40\sqrt{3}$ m

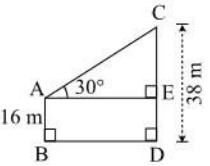
Now, length of the ground $= BC + BD = \frac{40}{\sqrt{3}} + 40\sqrt{3} = 92.37$ m

Thus, the length of the ground is 92.37 m.

3A. एउटा 16 m अग्लो घरको छतबाट 38 m अग्लो रुखको टुप्पोमा हेर्दा 30° को उन्नतांश कोण बन्दछ भने उक्त रुख र घरबिचको दुरी पत्ता लगाउनुहोस् ।

The angle of elevation from the roof of the house 16 m high to the top of the tree 38 m high is found to be 30°. Find the distance between the house and the tree.

⇨ Here, let, AB = 16 m be the height of a house and CD = 38 m be the height of the tree.
Let $\angle CAE = 30°$ be an angle of elevation.
Then, CE = CD – AB = 38 – 16 = 22 m ($\because$ DE = AB)
From the right angled ΔAEC,



$\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{CE}{AE} = \frac{22}{AE}$

or, $\frac{1}{\sqrt{3}} = \frac{22}{AE}$ $\therefore \quad AE = 22\sqrt{3}$

Thus, the distance between house and the tree is $22\sqrt{3}$ m.

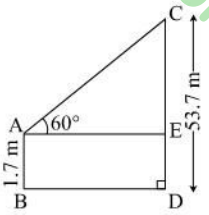
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3B. 1.7 मि. अग्लो एउटा मानिसले आफू अगाडि रहेको रुखको टुप्पोमा रहेको चरालाई अवलोकन गर्दछ र उन्नतांश कोण 60° पाउँछ । यदि रुखको उचाइ 53.7 मि. छ भने रुख र मानिसबीचको दूरी निकाल्नुहोस् ।

A man 1.7 m tall observes a bird sitting on the top of a tree in front of him and finds the angle of elevation to be 60°. If the height of the tree is 53.7 m, find the distance between the man and the tree.

⇨ Here, let AB = 1.7 m be the height of a man, CD = 53.7 m be the height of a tree. Let, ∠CAE = 60° be the an angle of elevation.



From the figure, $\tan\theta = \frac{CE}{AE}$

or, $\tan 60° = \frac{CD - ED}{AE} = \frac{53.7 - AB}{AE} = \frac{53.7 - 1.7}{AE}$

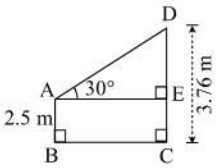
or, $\sqrt{3} = \frac{52}{AE}$ or, $AE = \frac{52}{\sqrt{3}}$ ∴ AE = 30.02 m

Thus, the distance between them is 30.02 m.

3C. एउटा 2.5 मिटर अग्लो पर्खालबाट 3.76 मिटर उचाइ भएको स्तम्भ x मिटर दुरीमा छ, यदि स्तम्भको टुप्पोमा पर्खालबाट अवलोकन गर्दा 30° को उन्नतांश कोण पाइयो भने पर्खाल र स्तम्भबिचको दुरी पत्ता लगाउनुहोस् ।

From a wall having height 2.5 m, a tower having height 3.76 m is at a distant of x metre. If the top of the tower is observed from the wall then an angle of elevation 30° is found, find the distance between wall and the tower.

⇨ Here, let AB = 2.5 m be the height of wall.
Let CD = 3.76 m be the height of the tower.
Let AE = BC = x m be the distance between the wall and the tower.
Then, DE = DC − EC = DC − AB = 3.76 − 2.5 ∴ DE = 1.26 m
From the right angled triangle DAE,



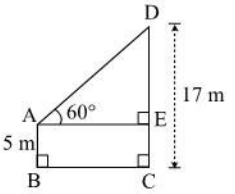
or, $\tan 30° = \frac{p}{b} = \frac{DE}{AE} = \frac{1.26}{x}$ or, $\tan 30° = \frac{1.26}{x}$

or, $\frac{1}{\sqrt{3}} = \frac{1.26}{x}$ ∴ x = 2.18 Thus, the distance is 2.18 m.

3D. एउटा घर र रुखको उचाइ क्रमशः 5 m र 17 m छ । यदि घरको छानाबाट रुखको टुप्पोमा हेर्दा 60° को उन्नतांश कोण पाइयो भने रुख र घरबिचको दुरी पत्ता लगाउनुहोस् ।

The height of a house and a tree are 5 m and 17 m respectively. If the top of the tree is observed from the roof of the house then an angle of elevation of 60° is found, find the distance between the tree and the house.

⇨ Here, let AB = 5 m be the height of a house.
Let CD = 17 m be the height of the tree.
∠DAE = 60° be an angle of elevation.
From the right angled ΔAED,



or, $\tan\theta = \frac{p}{b}$ So, $\tan 60° = \frac{DE}{AE} = \frac{DC - EC}{AE} = \frac{17\text{ m} - AB}{AE}$

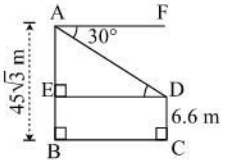
or, $\sqrt{3} = \frac{17\text{ m} - 5\text{ m}}{AE}$ or, $AE = \frac{12}{\sqrt{3}}\text{ m}$ ∴ $AE = 4\sqrt{3}$

Thus, the distance between the tower and house is $4\sqrt{3}$ m.

4A. $45\sqrt{3}$ m अग्लो एउटा स्तम्भको टुप्पोबाट 6.6 m अग्लो घरको टुप्पोमा हेर्दा 30° को अवनति कोण बन्छ भने स्तम्भ र घर बिचको दुरी पत्ता लगाउनुहोस् ।

From a top a tower $45\sqrt{3}$ m tall a top of a house having 6.6 m height is observed and an angle of depression 30° is found. Find the distance between house and tower.

⇨ Here, let AB = $45\sqrt{3}$ m be the height of a tower.
Let CD = 6.6 m be $45\sqrt{3}$ m the height of a house.
∠FAD = 30° be an angle of depression. Let ED = BC be the distance between the house and the tower.
We have, ∠ADE = ∠FAD = 30°



From right ∠d ΔAED, AE = AB − EB = $45\sqrt{3}$ − CD = $45\sqrt{3}$ − 6.6 ∴ AE = 71.34 m

We know that, $\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{AE}{ED} = \frac{71.34}{ED}$

or, $\frac{1}{\sqrt{3}} = \frac{71.34}{ED}$ ∴ ED = 123.56 m

Thus, the distance between the tower and house is 123.56 m.

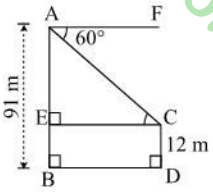
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4B. 91 m अग्लो धरहराको टुप्पोबाट समतलमा रहेको 12 m अग्लो घरको छतमा हेर्दा 60° को अवनति कोण पाइयो भने धरहरा र घरबिचको दुरी पत्ता लगाउनुहोस् ।

From the top of a tower 91 m high, the angle of depression of the top of a house 12 m high on the same level of the ground was observed and found to be 60°. Find the distance between the tower and house.

⇨ Here, let AB = 91 m be the height of a tower. CD = 12 m be the height of a house. Let ∠FAC = 60° be an angle of depression.



From the adjoining figure, AE = AB – CD = 91 m – 12 m = 79 m

From right angled ΔAEC,

$\tan\theta = \frac{p}{b} = \frac{AE}{EC}$ or, $\tan 60° = \frac{79}{EC}$

or, $\sqrt{3} = \frac{79}{EC}$ or, $EC = \frac{79}{\sqrt{3}} = 45.61$ m

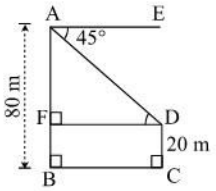
Thus, the distance between them is 45.61 m.

4C. 80 m अग्लो एउटा भवनको छतबाट नजिकै रहको 20 m अग्लो स्तम्भको टुप्पोमा अवलोकन गर्दा 45° को अवनति कोण पाइयो भने स्तम्भ र भवनबिचको दुरी पत्ता लगाउनुहोस् ।

From the top of a building of 80 m high, the angle of depression of the top of a tower of 20 m high lying close to the building is observed and found to be 45°. Find the distance between the tower and building.

⇨ Here, let AB = 80 m be the height of a building.

Let, CD = 20 m be the height of tower. Let ∠EAD = 45° be an angle of depression.



From the adjoining figure, ∠EAD = ∠ADF = 45°

AF = AB – FB = AB – CD = 80 m – 20 m = 60 m

From the right angled ΔAFD,

$\tan\theta = \frac{p}{b} = \frac{AF}{FD}$ or, $\tan 45° = \frac{60\text{ m}}{FD}$

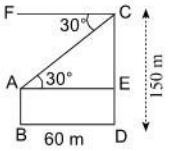
or, $1 = \frac{60\text{ m}}{FD}$ ∴ FD = 60 m

Thus, the distance between tower and building is 60 m.

4D. दुई सिधा खम्बाहरू 60 मिटरको दुरीमा छन् । पहिलो खम्बाको टुप्पोको अवनति कोण, 150 m उचाइ भएको दोस्रो खम्बाको टुप्पोबाट हेर्दा 30° को पाइयो भने पहिलो खम्बाको उचाइ पत्ता लगाउनुहोस् ।

Two vertical poles are fixed 60 m apart. The angle of depression of the top of the first pole as seen from the top of the second which is 150 m high is 30°. Find the height of the first pole. **[2062 C2]**

⇨ Here, in figure AB is first pole, CD is second pole of height 150 m and BD is distance between the poles which is 60 m. AE is the horizontal line drawn through A. So, ∠CAE is equal to angle of depression which is 30°, i.e. ∠CAE = 30°.



In rt. angled triangle AEC,

$\tan 30° = \frac{CE}{AE}$ or, $\frac{1}{\sqrt{3}} = \frac{CE}{60\text{ m}}$ ∴ $CE = 60 \times \frac{1}{\sqrt{3}} = 34.64$ m

Now, height of first pole = AB = ED = CD – CE = 150 m – 34.64 m = 115.36 m.

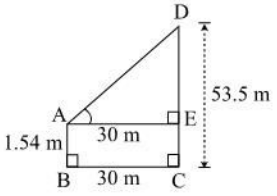
5A. 1.54 मिटर अग्लो मानिसले 30 m को दुरीमा रहेको 53.5 m स्तम्भको टुप्पो अवलोकन गर्दा बन्ने उन्नतांश कोण पत्ता लगाउनुहोस् ।

A man 1.54 m tall observes a tower of 53.5 m at a distance of 30 m. Find the angle of elevation.

⇨ Here, let AB = 1.54 m be the height of a man.

Let CD = 53.5 m be the height of a tower.

Let AE = BC = 30 m be the distance between the man and tower.



From the adjoining figure, DE = CD – CE = 53.5 – AB = 53.5 – 1.54

∴ DE = 51.96 m

From the right angled ΔAED, $\tan\theta = \frac{p}{b}$

or, $\tan\angle DAE = \frac{DE}{AE} = \frac{51.96}{30} = 1.732 = \tan 60°$

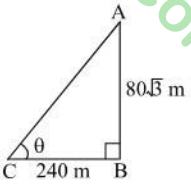
∴ ∠DAE = 60°

Thus, the angle of elevation is 60°.

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5B. अवलोकन बिन्दुबाट 240 m पर रहेको $80\sqrt{3}$ m अग्लो धरहराको टुप्पो अवलोकन गर्दा बन्ने उन्नतांश कोण पत्ता लगाउनुहोस् ।

A man observes the top of a tower $80\sqrt{3}$ m height from 240 m far from the foot of the tower, find the angle of elevation.



⇨ Here, let AB = $80\sqrt{3}$ m be the height of a tower and BC = 240 m be the distance between man and tower.
$\measuredangle ACB = \theta$ be angle of elevation
We know that,

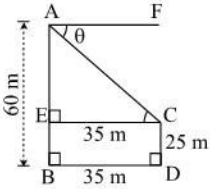
$\tan\theta = \frac{AB}{BC}$ or, $\tan\theta = \frac{80\sqrt{3}}{240}$ or, $\tan\theta = \frac{\sqrt{3}}{3}$

or, $\tan\theta = \frac{1}{\sqrt{3}}$ or, $\tan\theta = \tan 30°$ ∴ $\theta = 30°$

Thus, the angle of elevation is 30°.

5C. एक जना मानिस स्तम्भको टुप्पोबाट अगाडि रहेको घरको छत अवलोकन गर्दछ । स्तम्भ र घरको उचाइ क्रमशः 60 m र 25 m छ र ती दुईबिचको दुरी 35 m छ भने मानिसले बनाएको अवनति कोण निकाल्नुहोस् । **[2071 B]**

A man observes top of a house from the top of tower. The height of tower and house are 60 m and 25 m respectively and distance between them 35 m. Find the angle of depression made by the man.



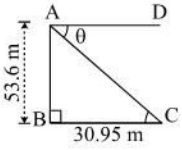
⇨ Here, let AB = 60 m be height of a tower. Let, CD 25 m be the height of the house, let $\measuredangle FAC = \theta$ be angle of depression, from the figure.
∴ EC = BD = 35 cm
$\measuredangle ECA = \measuredangle FAC = \theta$
AE = AB – EB = 60 m – 25 m = 35 m
From the right angled ΔAEC,

$\tan\theta = \frac{AE}{EC} = \frac{35}{EC}$ or, $\tan\theta = \frac{35}{35} = 1$ or, $\tan\theta = \tan 45°$

∴ $\theta = 45°$ Thus, the angle of depression is 45°.

5D. निमाले 53.6 m अग्लो रूखको टुप्पोबाट भुइँमा रहेको बाघ अवलोकन गर्दछ । यदि रूख र बाघबिचको दुरी 30.95 m भए रूखको टुप्पोबाट निमाले बाघ हेर्दा बन्ने अवनति कोण पत्ता लगाउनुहोस् ।

Neema observes a tiger in a ground from the top of a 53.6 m tall tree. If the distance between the tree and the tiger is 30.95 m then find the angle of depression formed when the tiger is observed from the top of the tree.



⇨ Here, let AB = 53.6 m be the height of a tree. Let, BC = 30.95 m be the distance between the tree and tiger. Let, $\measuredangle DAC = \theta$ be angle of depression.
From the adjoining figure, $\measuredangle ACB = \measuredangle DAC = \theta$
From right angled ΔABC,

$\tan\theta = \frac{p}{b}$ or, $\tan\theta = \frac{AB}{BC} = \frac{53.6}{30.95} = 1.7318$

∴ $\tan\theta = \tan 60°$ ∴ $\theta = 60°$

Thus, the angle of depression is 60°.

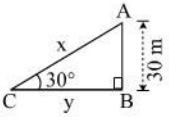
5E. 30 m अग्लो विद्यालय भवनको छतमा जानको निमित्त 30° को झुकावमा च्याम्प बनाउनु पर्‍यो भने,

To reach the top of a 30 m tall school building a ramp (ladder) should be made at an inclination of 30°.

(i) सो च्याम्पको लम्बाइ कति होला ? **(What is the length of the ramp ?)**

(ii) विद्यालय भवन र च्याम्पको फेद बिचको दुरी कति होला ?

What is the distance between the school building and the bottom of the ramp ?



⇨ Here, let AB = 30 m be the height of a building. Let, AC = x m be the length of ramp and BC = y m be the distance between the bottom of building and the bottom of the ramp. From the adjoining figure,

$\sin 30° = \frac{30\text{ m}}{x}$ or, $\frac{1}{2} = \frac{30\text{ m}}{x}$ ∴ x = 60 m

Again, $\tan\theta = \frac{p}{b}$ or, $\tan 30° = \frac{30\text{ m}}{y}$ or, $\frac{1}{\sqrt{3}} = \frac{30\text{ m}}{y}$

∴ $y = 30\sqrt{3}$ m Thus, length of ramp is 60 m and distance between their foot is $30\sqrt{3}$ m.

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Unit VIII तथ्याङ्कशास्त्र (Statistics)

17. मध्यक, मध्यिका र चतुर्थांश
Mean, Median and Quartiles

Important Formulae

वर्गीकृत तथ्याङ्कको मध्यक (Mean of Grouped Data)

1. प्रत्यक्ष विधि (Direct method): $\bar{X} = \frac{\Sigma fm}{N}$

2. छोटकरी विधि (Shortcut method): $\bar{X} = A + \frac{\Sigma fd}{N}$

   Where, A = कल्पित मध्यक (Assumed mean) & d = x – A or m – A

3. पद विचलन विधि (Step deviation method) : $\bar{X} = A + \frac{\Sigma fd'}{N} \times h$

   a = कल्पित मध्यक (Assumed mean), $d' = \frac{x - A}{h}$ or $\frac{m - A}{h}$ & h = वर्गान्तरको आकार (Class size)

वर्गीकृत तथ्याङ्कको मध्यिका र चतुर्थांशहरू (Median and quartiles of Grouped Data)

मध्यिका श्रेणी (Median Class) = $\left(\frac{N}{2}\right)^{th}$ item

मध्यिका (Median) = $L + \frac{i}{f}\left(\frac{N}{2} - c.f.\right)$

पहिलो चतुर्थांश श्रेणी (First quartile Class) = $\left(\frac{N}{4}\right)^{th}$ item

पहिलो चतुर्थांश (First quartile) : $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - c.f.\right)$

तेस्रो चतुर्थांश श्रेणी (Third quartile Class) = $\left(\frac{3N}{4}\right)^{th}$ item

तेस्रो चतुर्थांश (Third quartile) : $Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - c.f.\right)$

17.1 वर्गीकृत तथ्याङ्कको मध्यक (MEAN OF GROUPED DATA)

BASIC EXERCISE 17.1

A. VERY SHORT QUESTIONS

1. (a) **एउटा वर्गीकृत तथ्याङ्कमा 20 जना विद्यार्थीहरूले गणितमा प्राप्त गरेका अङ्कहरूको योगफल 800 छ भने औसत प्राप्ताङ्क निकाल्नुहोस् ।**
   In a grouped data, the sum of the marks obtained by 20 students in mathematics is 800. Find the average mark.

   ⇨ Here, N = 20, Σfx = 800 We know that, $\bar{x} = \frac{\Sigma fx}{N} = \frac{800}{20} = 40$

   (b) **यदि एउटा वर्गीकृत श्रेणीमा पदहरूको सङ्ख्या (N) = 25 र Σfx = 750 भए मध्यक पत्ता लगाउनुहोस् ।**
   If the number of terms (N) = 25 and Σfx = 750 in a continuous series, find the mean.

   ⇨ Here, N = 25, Σfx = 750 We know that, $\bar{x} = \frac{\Sigma fx}{N} = \frac{750}{25} = 30$

2. (a) **कुनै तथ्याङ्कको Σfm = 320 र मध्यक 16 भए N को मान निकाल्नुहोस् ।**
   If the mean of a grouped data having Σfm = 320 is 16, find the value of N.

   ⇨ Here, Σfm = 320, $\bar{x}$ = 16, N = ?
   We know that,
   $\bar{x} = \frac{\Sigma fx}{N}$ or, $16 = \frac{320}{N}$ ∴ $N = \frac{320}{16} = 20$

   (b) **यदि एउटा निरन्तर श्रेणीमा मध्यक ($\bar{x}$) = 50 र Σfx = 1000 भए पदहरूको सङ्ख्या (N) पत्ता लगाउनुहोस् ।**
   If in a continuous series, mean ($\bar{x}$) = 50 and Σfx = 1000, find the number of terms (N).

   ⇨ Here, $\bar{x}$ = 50, Σfx = 1000, N = ?
   We know that,
   $\bar{x} = \frac{\Sigma fx}{N}$ or, $50 = \frac{1000}{N}$ ∴ $N = \frac{1000}{50} = 20$

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3. (a) कुनै वर्गीकृत तथ्याङ्कको $\sum f = 15$ र मध्यक 50 भए $\sum fm$ पत्ता लगाउनुहोस् ।
In a grouped data $\sum f = 15$ and the mean is 50, find $\sum fm$.

⇨ Here, $\sum f = 15$ and mean is 50.

We know that, mean $(\bar{x}) = \frac{\sum fm}{\sum f}$ or, $50 = \frac{\sum fm}{15}$ $\therefore$ $\sum fm = 750$

(b) यदि अङ्कगणितीय मध्यक $(\bar{x}) = 20$ तथा $\Sigma f = 10$भए, Σfm को मान पत्ता लगाउनुहोस् ।
If arithmetic mean $(\bar{x})$ is 20 and $\Sigma f = 10$, find the value of Σfm.

⇨ Here, $\bar{x} = 20$, $\sum f = 10$

We know that, $\frac{\sum fm}{\sum f} = \bar{x}$ or, $\frac{\sum fm}{10} = 20$ $\therefore$ $\sum fm = 200$

Thus, the value of $\sum fm$ is 200.

4. a को मान पत्ता लगाउनुहोस् । (Find the value of a.)

(a) $\bar{x} = 20$, $\Sigma fx = 420$ and $N = a$ **(b) $\bar{x} = 12$, $N = 40$ and $\Sigma fx = a$**
(c) $\bar{x} = a$, $N = 30$ and $\Sigma fx = 600$ **(d) $\bar{x} = 20$, $\sum fx = a$ and $\sum f = 30$**

⇨ (a) Here, $\bar{x} = 20$, $\Sigma fx = 420$ and $N = a$

We know that, $\bar{x} = \frac{\Sigma fx}{N}$ or, $20 = \frac{420}{a}$ $\therefore$ $a = \frac{420}{20} = 21$

Thus, the value of a is 21.

(b) Here, $\bar{x} = 12$, $N = 40$ and $\Sigma fx = a$

We know that,

$\bar{x} = \frac{\Sigma fx}{N}$ or, $12 = \frac{a}{40}$ $\therefore$ $a = 12 \times 40 = 480$

Thus, the value of a is 480.

(c) Here, $\bar{x} = a$, $N = 30$ and $\Sigma fx = 600$

We know that, $\bar{x} = \frac{\Sigma fx}{N}$ or, $a = \frac{600}{30} = 20$

Thus, the value of a is 20.

(d) Here, $\bar{x} = 20$, $\Sigma fx = a$ and $\Sigma f = 30$

We know that, $\bar{x} = \frac{\Sigma fx}{\Sigma f}$ or, $20 = \frac{a}{30}$ $\therefore$ $a = 20 \times 30 = 600$

Thus, the value of a is 600.

B. SHORT QUESTIONS

Model 1

1. एउटा निरन्तर श्रेणीमा मध्यक $(\bar{x}) = 19 + 2m$ र $\Sigma fx = 133 + 14m$ भए पदहरूको सङ्ख्या पत्ता लगाउनुहोस् ।
In a continuous series, mean $(\bar{x}) = 19 + 2m$ and $\Sigma fx = 133 + 14m$, find the number of terms. **[2072 E]**

⇨ Here, $(\bar{x}) = 19 + 2m$ and $\sum fx = 133 + 14\,m$

We know that, $\bar{x} = \frac{\sum fx}{N}$ or, $19 + 2m = \frac{133 + 14\,m}{N}$

or, $N = \frac{133 + 14m}{19 + 2m} = \frac{7(19 + 2m)}{19 + 2m}$ $\therefore$ $N = 7$

Thus, the number of terms is 7.

2. एउटा निरन्तर श्रेणीमा मध्यक $(\bar{X}) = 15 + a$ र $\Sigma fx = 420 + 28a$ भए पदहरूको सङ्ख्या (N) पत्ता लगाउनुहोस् ।
In a continuous series, mean $(\bar{X}) = 15 + a$ and $\Sigma fx = 420 + 28a$, find the number of terms (N). **[2072 FW]**

⇨ Here, $(\bar{x}) = 15 + a$ and $\sum fx = 420 + 28a$

We know that, $\bar{x} = \frac{\sum fx}{N}$ or, $15 + a = \frac{420 + 28a}{N}$

or, $15 + a = \frac{28(15 + a)}{N}$ $\therefore$ $N = 28$

Thus, the value of N is 28.

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3. एउटा वर्गीकृत तथ्याङ्कमा 50 जना विद्यार्थीहरूले गणितमा प्राप्त गरेका अङ्कहरूको योगफल 3000 छ भने औसत प्राप्ताङ्क निकाल्नुहोस् ।
In a grouped data, the sum of the marks obtained by 50 students in mathematics is 3000. Find the average mark. **[2068 B]**

⇨ Here, $\sum f = 50$, $\sum fm = 3000$, $\bar{x} = ?$
We have, $\bar{x} = \frac{\sum fm}{\sum f} = \frac{3000}{50} = 60$
Thus, the average marks is 60.

4. यदि $\bar{x} = 50$ र $\sum fx = 750$ भए पदको सङ्ख्या (N) पत्ता लगाउनुहोस् ।
If $\bar{x} = 50$ and $\sum fx = 750$, find the number of terms (N). **[Model 2065]**

⇨ Here, $\bar{x} = 50$ and $\sum fx = 750$
By formula, $\bar{x} = \frac{\sum fx}{N}$ or, $50 = \frac{750}{N}$ ∴ $N = 15$

5. यदि $\bar{x} = 35$ र $\sum fx = 455$ भए पदहरूको सङ्ख्या (N) पत्ता लगाउनुहोस् ।
If $\bar{x} = 35$ and $\sum fx = 455$, find the number of terms (N). **[2065 D]**

⇨ Here, $\bar{x} = 35$, $\sum fx = 455$
We know that, $\bar{x} = \frac{\sum fx}{N}$ or, $35 = \frac{455}{N}$
or, $N = \frac{455}{35}$ ∴ $N = 13$

6. कुनै वर्गीकृत तथ्याङ्कको $\sum f = 15$ र मध्यक 50 भए $\sum fm$ पत्ता लगाउनुहोस् ।
In a grouped data $\sum f = 15$ and the mean is 50, find $\sum fm$. **[2068 C]**

⇨ Here, $\sum f = 15$ and mean is 50.
We know that, mean $(\bar{x}) = \frac{\sum fm}{\sum f}$ or, $50 = \frac{\sum fm}{15}$ ∴ $\sum fm = 750$

7. अङ्कगणितीय मध्यक $(\bar{x})$ 20 तथा $\Sigma f = 10$ भए, Σfm को मान पत्ता लगाउनुहोस् ।
If arithmetic mean $(\bar{x})$ is 20 and $\Sigma f = 10$, find the value of Σfm. **[2067 S]**

⇨ Here, $\bar{x} = 20$, $\sum f = 10$
We know that, $\frac{\sum fm}{\sum f} = \bar{x}$ or, $\frac{\sum fm}{10} = 20$ ∴ $\sum fm = 200$
Thus, the value of $\sum fm$ is 200.

Model 2

8. एउटा निरन्तर श्रेणीमा यदि $\bar{X} = 20$, $\sum fx = 420$ र $N = 18 + 2a$ भए a को मान पत्ता लगाउनुहोस् ।
In a continuous series, if $\bar{X} = 20$, $\Sigma fx = 420$ and $N = 18 + 2a$, find the value of a. **[2072 MW]**

⇨ Here, $\bar{X} = = 20$, $\sum fx = 420$ and $N = 18 + 2a$
We know that, $\bar{X} = \frac{\sum fx}{N}$ or, $20 = \frac{420}{18 + 2a}$
or, $18 + 2a = 21$ or, $2a = 3$
∴ $a = \frac{3}{2} = 1.5$
Thus, the value of a is 1.5.

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9. कुनै निरन्तर श्रेणीमा पदहरूको सङ्ख्या (N) = 25, मध्यक $(\bar{x}) = 9$ र $(\Sigma fx) = 175 + a$ भए 'a' को मान निकाल्नुहोस् । **In a continuous series, number of terms (N) = 25, mean $(\bar{x}) = 9$ and $(\Sigma fx) = 175 + a$, find the value of 'a'.** [2071 B]

⇨ Here, N = 25, $\bar{x} = 9$ and $\Sigma fx = 175 + a$

We know that,

$\bar{x} = \frac{\Sigma fx}{N}$ or, $9 = \frac{175 + a}{25}$

or, $225 = 175 + a$ ∴ $a = 50$

Thus, a = 50.

10. एउटा निरन्तर श्रेणीमा $\Sigma f = 30 + 2p$, $\Sigma fx = 100p + 280$ र मध्यक $(\bar{x}) = 40$ भए, p को मान पत्ता लगाउनुहोस् । **In a continuous series if $\Sigma f = 30 + 2p$, $\Sigma fx = 100p + 280$, and $(\bar{x}) = 40$, calculate the value of p.** [2071A]

⇨ Here, $\Sigma f = 30 + 2p$, $\Sigma fx = 100p + 280$, & $\bar{x} = 40$

We know that, $\bar{x} = \frac{\Sigma fx}{\Sigma f}$ or, $40 = \frac{100p + 280}{30 + 2p}$

or, $1200 + 80p = 100p + 280$ or, $920 = 20p$

∴ p = 46 Thus, the value of p is 46.

11. कुनै निरन्तर श्रेणीमा पदहरूको सङ्ख्या (N) = 50 + a, मध्यक $(\bar{x}) = 20$ र पदहरूको योगफल $\Sigma fx = 1200$ भए a को मान पत्ता लगाउनुहोस् ।

In a continuous series, the number of terms (N) = 50 + a, mean $(\bar{x}) = 20$ and the sum of terms $\Sigma fx = 1200$, find the value of a. [2068 E]

⇨ Here, N = 50 + a, $\bar{x} = 20$ and $\Sigma fx = 1200$

We know that; $\bar{x} = \frac{\Sigma fx}{N}$ or, $20 = \frac{1200}{50 + a}$

or, $1000 + 20a = 1200$ or, $20a = 200$ ∴ $a = 10$

Thus, the value of a is 10.

12. कुनै श्रेणीमा पदहरूको सङ्ख्या (N) = 10, मध्यक मान $\left(\bar{x}\right) = 30 + a$ र पदहरूको योगफल $(\Sigma fx) = 400$ भए a को मान पत्ता लगाउनुहोस् ।

In a series, the number of terms (N) = 10, mean $\left(\bar{x}\right) = 30 + a$ and sum of terms $(\Sigma fx) = 400$, find the value of a. [2068 A]

⇨ Here, N= 10, $\bar{x} = 30 + a$ and $\Sigma fx = 400$

We know that, $\bar{x} = \frac{\Sigma fx}{N}$ or, $30 + a = \frac{400}{10}$

or, $30 + a = 40$ ∴ $a = 10$ Thus, the value of a is 10.

13. एउटा निरन्तर श्रेणीमा यदि मध्यक $(\bar{X}) = 32$, $\Sigma fx = K$ र $\Sigma f = 20$ भए K को मान निकाल्नुहोस् ।

In a continuous series, if mean $(\bar{X}) = 32$, $\Sigma fx = K$ and $\Sigma f = 20$, find the value of K. [2068 D]

⇨ Here, $\bar{x} = 32$, $\Sigma fx = k$ and $\Sigma f = 20$

We know that, $\bar{x} = \frac{\Sigma fx}{\Sigma f}$ or, $32 = \frac{k}{20}$ ∴ $k = 640$

Thus, the value of k is 640.

Model 3

14. केही मानिसहरूको मध्यक तौल 56 kg र तिनीहरूको तौलको योग 392 kg भए ती मानिसहरूको सङ्ख्या पत्ता लगाउनुहोस् ।

The mean weight of some men is 56 kg and the sum of their weight is 392 kg. Find the number of men. [2065 A, B]

⇨ Here, mean $(\bar{x}) = 56$ kg Sum of weights $(\Sigma x) = 392$ kg

No. of men (N) = ? We know that; $\bar{x} = \frac{\Sigma x}{N}$

or, $56 = \frac{392}{N}$ ∴ $N = \frac{392}{56} = 7$

Thus, the no. of men is 7.

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C. LONG QUESTIONS

Model 1

1. दिइएका आँकडाका आधारमा मध्यक पत्ता लगाउनुहोस् (Compute the mean from the table given below):[2057 A1]

Marks	10-20	20-30	30-40	40-50	50-60	60-70
No. of students	2	5	7	6	3	2

⇨ Here, calculation of mean

CI	m	f	fm
10-20	15	2	30
20-30	25	5	125
30-40	35	7	245
40-50	45	6	270
50-60	55	3	165
60-70	65	2	130
		$N = 25$	$\Sigma fm = 965$

Here, $\Sigma fm = 965$, $N = 25$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\Sigma fm}{N}$$

$$= \frac{965}{25}$$

$$= 38.6$$

Thus, mean $(\bar{x})$ is 38.6.

2. दिइएका आँकडाका आधारमा मध्यक पत्ता लगाउनुहोस् (Calculate mean from the following data) : [2062E1]

x	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
f	5	7	8	4	6

⇨ Here, calculation of mean

CI	m	f	fm
0 - 10	5	5	25
10 - 20	15	7	105
20 - 30	25	8	200
30 - 40	35	4	140
40 - 50	45	6	270
		$\Sigma f = 30$	$\Sigma fm = 740$

We know that,

$$\text{Mean} = \frac{\Sigma fm}{N}$$

$$= \frac{740}{30}$$

$$= 24.6$$

Thus, mean of the given data is 24.6.

Model 2

3. दिइएको आँकडाबाट 10 श्रेणीको अन्तरमा बारम्बारता तालिका बनाई मध्यक पनि निकाल्नुहोस् ।
Construct a frequency table of class interval of 10 from the given data and find the mean: [2059 B1]
23, 5, 17, 28, 39, 52, 16, 21, 29, 25, 41, 33, 9, 19, 34, 59, 7, 11, 51, 31, 22, 41, 32, 55, 18.

⇨ Here, calculation of mean

CI	m	f	fm
0-10	5	3	15
10-20	15	5	75
20-30	25	6	150
30-40	35	5	175
40-50	45	2	90
50-60	55	4	220
		$\Sigma f = 25$	$\Sigma fm = 725$

By formula,

$$\text{Mean } (\bar{x}) = \frac{\Sigma fm}{N}$$

$$= \frac{725}{25}$$

$$= 29$$

Thus, mean $(\bar{x})$ is 29.

4. दिइएको आँकडाबाट 10 श्रेणीको अन्तरमा बारम्बार तालिका बनाई मध्यक निकाल्नुहोस् : [2059 B2]
Find the mean by constructing a frequency table of class interval of 10 from the data given below :
7, 47, 36, 39, 31, 19, 41, 49, 9, 51, 29, 22, 59, 17, 49, 21, 24, 12, 31, 8, 36, 18, 32, 16, 23

⇨ Here, calculation of mean

CI	m	f	fm
0-10	5	3	15
10-20	15	5	75
20-30	25	5	125
30-40	35	6	210
40-50	45	4	180
50-60	55	2	110
		$N = 25$	$\Sigma fm = 715$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\Sigma fm}{N}$$

$$= \frac{715}{25}$$

$$= 28.6$$

Thus, mean $(\bar{x})$ is 28.6.

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Model 3

5. यदि मध्यक $(\bar{x}) = 32.5$ भए तलको तथ्याङ्कबाट छुटेको बारम्बारता पत्ता लगाउनुहोस् ।

If mean $(\bar{x}) = 32.5$, then find the missing frequency from the given data. [2072 C]

Marks obtained	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	5	15	20	?	20	10

⇨ Here, $\bar{x} = 32.5$, Let, the missing frequency be a.

Calculation of missing frequency:

Marks	f	m	fm
0–10	5	5	25
10–20	15	15	225
20–30	20	25	500
30–40	a	35	35a
40–50	20	45	900
50–60	10	55	550
	$\sum f = 70 + a$		$\sum fm = 35a + 2200$

We know that, Mean $(\bar{x}) = \frac{\sum fm}{N}$

or, $32.5 = \frac{35a + 2200}{70 + a}$

or, $2275 + 32.5a = 35a + 2200$

or, $75 = 2.5a$

$\therefore \quad a = 30$

Thus, the value of a is 30.

6. तल दिइएको तथ्याङ्कको मध्यक 39 भए m को मान निकाल्नुहोस् :

If the mean of the data given below is 39, calculate the value of m : [2060 E1]

Wages in (Rs)	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65
No. of workers	4	6	12	m	3

⇨ Here, calculation of missing frequency,

CI	m	f	fm
15-25	20	4	80
25-35	30	6	180
35-45	40	12	480
45-55	50	m	50m
55-65	60	3	180
		$N = 25 + m$	$\sum fm = 920 + 50m$

By formula, we have Mean $= \frac{\sum fm}{N}$

or, $39 = \frac{920 + 50m}{25 + m}$

or, $975 + 39m = 920 + 50m$

or, $975 - 920 = 50m - 39m$

or, $55 = 11m$

Thus, value of m is 5.

7. तल दिइएको तथ्याङ्कको मध्यक 36 भए P को मान पत्ता लगाउनुहोस् :

The mean of the data given below is 36, determine the value of P : [2060 E2]

Age (in years)	10-20	20-30	30-40	40-50	50-60
No. of teachers	3	8	15	P	4

⇨ Here, calculation of mean

Age in yrs	x	f	fx
10-20	15	3	45
20-30	25	8	200
30-40	35	15	525
40-50	45	P	45P
50-60	55	4	220
		$N = 30 + P$	$\sum fx = 990 + 45P$

By formula, Mean $= \frac{\sum fx}{N}$

or, $36 = \frac{990 + 45P}{30 + P}$

or, $1080 + 36P = 990 + 45P$

or, $1080 - 990 = 45P - 36P$

or, $90 = 9P$

Thus, value of P is 10.

B. QUESTIONS FROM CDC TEXT BOOKS

तल दिइएका वर्गाङ्कित तथ्याङ्कको मध्यक पत्ता लगाउनुहोस् (Find the mean of given continues data):

1A.

उमेर (वर्षमा) (Age (in yrs))	0-10	10-20	20-30	30-40	40-50
मानिसहरू सङ्ख्या (No. of people)	10	20	60	30	20

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⇨ Here, calculation of mean:

Age	f	m	fm
0-10	10	5	50
10-20	20	15	300
20-30	60	25	1500
30-40	30	35	1050
40-50	20	45	900
	N = 140		$\sum fm = 3800$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

$$= \frac{3800}{140} = 27.14$$

Thus, the mean is 27.14 years.

1B.

तौल (कि.ग्रा.) (Weight (kg))	0-10	10-20	20-30	30-40	40-50	50-60
मानिसहरू सङ्ख्या (No. of people)	2	8	11	12	11	6

⇨ Here, calculation of mean:

Weight	f	m	fm
0-10	2	5	10
10-20	8	15	120
20-30	11	25	275
30-40	12	35	420
40-50	11	45	495
50-60	6	55	330
	N = 50		$\sum fm = 1650$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

$$= \frac{1650}{50} = 33$$

Thus, the mean is 33 kg.

1C.

प्राप्ताङ्क (Marks obtained)	47.5-52.5	52.5-57.5	57.5-62.5	62.5-67.5	67.5-72.5	72.5-77.5
विद्यार्थी सङ्ख्या (No. of student)	5	12	15	14	10	4

⇨ Here, calculation of mean:

Marks	f	m	fm
47.5-52.5	5	50	250
52.5-57.5	12	55	660
57.5-62.5	15	60	900
62.5-67.5	14	65	910
67.5-72.5	10	70	700
72.5-77.5	4	75	300
	$\sum f = 60$		$\sum fm = 3720$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

$$= \frac{3720}{60} = 62$$

Thus, the mean is 62 marks.

1D.

खर्च (रु. लाखमा) (Expenditure (in lakh))	0-10	10-20	20-30	30-40	40-50	50-60
विद्यालय सङ्ख्या (No. of schools)	4	12	15	14	10	4

⇨ Here, calculation of mean:

Exp.	f	m	fm
0-10	4	5	20
10-20	12	15	180
20-30	15	25	375
30-40	14	35	490
40-50	10	45	450
50-60	4	55	220
	$\sum f = 59$		$\sum fm = 1515$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N} = \frac{1515}{59} = 25.67$$

Thus, the mean is Rs 25.67 Lakh

2A. तल दिइएका आँकडाबाट 10 श्रेणीको अन्तरमा बारम्बारता तालिका बनाई मध्यक निकाल्नुहोस् :
Construct a frequency table of class interval 10 from the given data and find the mean:
7, 8, 36, 36, 47, 18, 31, 32, 39, 16, 23, 19, 9, 41, 49, 22, 29, 51, 17, 49, 59, 12, 21, 24, 31,

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⇨ Here, construction of frequency table and calculation of mean.

The smallest term = 7 and the largest term = 59

Marks	Tallies	f	m	fm
0-10	𝍸	3	5	15
10-20	𝍸	5	15	75
20-30	𝍸	5	25	125
30-40	𝍸 |	6	35	210
40-50	𝍸	4	45	180
50-60	||	2	55	110
		N = 25		$\sum fm = 715$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

$$= \frac{715}{25}$$

$$= 28.60$$

Thus, the mean is 28.60.

2B. तल 60 जना विद्यार्थीहरूको 75 पूर्णाङ्कको एउटा परीक्षाको प्राप्ताङ्क विवरण दिइएको छ । यस आँकडालाई 10 श्रेणीको अन्तरमा बारम्बारता तालिका बनाई मध्यक पत्ता लगाउनुहोस् ।

The marks obtained by 60 students in an examination of 75 full marks is given below. Construct a frequency table of class interval 10 of the data and find the mean.

6, 78, 68, 25, 36, 38, 10, 17, 48, 35, 38, 39, 58, 60, 35, 40, 35, 45, 56, 50, 31, 46, 33, 48, 60, 35, 41, 42, 46, 50, 25, 38, 23, 45, 28, 28, 32, 30, 23, 25, 31, 29, 35, 10, 50, 60, 35, 31, 35, 48, 72, 41, 42, 55, 9, 5, 19, 35, 46, 30

⇨ Here, the smallest term = 6, the largest term = 78 and Class interval = 10

Construction of frequency table and calculation of mean.

Marks	Tallies	f	m	fm
0-10	𝍸	3	5	15
10-20	𝍸	4	15	60
20-30	𝍸 |||	8	25	200
30-40	𝍸 𝍸 𝍸 𝍸	20	35	700
40-50	𝍸 𝍸 |||	13	45	585
50-60	𝍸 |	6	55	330
60-70	𝍸	4	65	260
70-80	||	2	75	150
		N = 60		$\sum fm = 2300$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

$$= \frac{2300}{60}$$

$$= 38.33$$

Thus, the mean is 38.33.

3A. तल दिइएको आँकडाको मध्यक 41 भए 'a' को मान पत्ता लगाउनुहोस् ।

If the mean of the given data is 41 then find the value of a.

प्राप्ताङ्क (Marks obtained)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
विद्यार्थी सङ्ख्या (No. of students)	1	4	a	14	11	11	3	1

⇨ Here, $(\bar{x}) = 41$, Calculation: missing frequency

Marks	No. of students	m	fm
0-10	1	5	5
10-20	4	15	60
20-30	a	25	25a
30-40	14	35	490
40-50	11	45	495
50-60	11	55	605
60-70	3	65	195
70-80	1	75	75
	N = 45 + a		$\sum fm = 1925 + 25a$

We know that,

$$\text{Mean } (\bar{x}) = \frac{\sum fm}{N}$$

or, $41 = \frac{1925 + 25a}{45 + a}$

or, $1845 + 41a = 1925 + 25a$

or, $16a = 80$

$\therefore \quad a = 5$

Thus, the value of a is 5.

3B. तल दिइएको तथ्याङ्कको मध्यक 31 भए 'k' को मान पत्ता लगाउनुहोस् :

The mean of the given data is 31, find the value of k:

प्राप्ताङ्क (Marks obtained)	0-10	10-20	20-30	30-40	40-50	50-60
विद्यार्थी सङ्ख्या (No. of students)	4	6	k	20	6	4

⇨ Here, calculation of missing frequency:

Marks obtained	f	m	fm
0-10	4	5	20
10-20	6	15	90
20-30	k	25	25k
30-40	20	35	700
40-50	6	45	270
50-60	4	55	220
	N = 40 + a		$\sum fm = 1300 + 25k$

We know that, Mean $(\bar{x}) = \frac{\sum fm}{N}$

or, $31 = \frac{1300 + 25k}{40 + k}$

or, $1240 + 31k = 1300 + 25k$

or, $6k = 60 \quad \therefore \quad k = 10$

Thus, the value of k is 10.

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17.2 मध्यिका र चतुर्थांशहरू (MEDIAN AND QUARTILES)

A. BASIC EXERCISE 17.2

A. VERY SHORT QUESTIONS

1. **दिइएको तथ्याङ्कबाट (i) मध्यिका श्रेणी (ii) प्रथम चतुर्थांशीय श्रेणी र (iii) तेस्रो चतुर्थांशीय श्रेणी पत्ता लगाउनुहोस् ।**
Find (i) median class, (ii) first quartile class and (iii) third quartile class from the following data.

(a)

Class Interval	0-5	5-10	10-15	15-20	20-25	25-30
Cumulative Frequency	2	6	14	15	18	20

⇨ Here, N = 20

(i) $\left(\frac{N}{2}\right) = \left(\frac{20}{2}\right) = 10^{th}$ item.

In *c.f.*, the term just greater than 10 is 14 and corresponding class is 10-15.

∴ Median class = 10-15

(ii) Value of $\frac{N}{4} = \frac{20}{4} = 5^{th}$ item.

In *c.f.*, the term just greater than 5 is 6 and corresponding class is 5-10.

∴ First quartile class is 5-10.

(iii) Value of $\frac{3N}{4} = 3 \times 5 = 15^{th}$ item.

In *c.f.* the term just greater than or equal to 15 is 15 and corresponding class is 15-20.

∴ Third quartile class = 15-20.

(b)

Class	4-12	12-20	20-28	28-36	36-44	44-52	52-60
Cumulative Frequency	8	12	15	18	22	24	28

⇨ Here, N = 28

(i) Value of $\frac{N}{2} = \frac{28}{2} = 14^{th}$ item.

In *c.f.*, the term just greater than 14 is 15 and the corresponding class is 20-28.

∴ Median class = 20-28

(ii) Value of $\frac{N}{4} = \frac{28}{4} = 7^{th}$ item.

In *c.f.*, the term just greater than 7 is 8 and the corresponding class is 4-12.

∴ First quartile class = 4-12.

(iii) Value of $\frac{3N}{4} = 3 \times 7 = 21^{st}$ item.

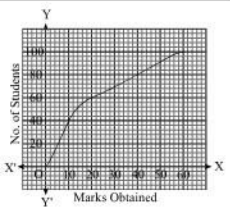
In *c.f.*, the term just greater than 21 is 22 and the corresponding class is 36-44.

∴ Third quartile class = 36-44.

B. SHORT QUESTIONS

Model 1

1. दिइएको सञ्चित बारम्बारता बक्रबाट मध्यिका श्रेणी पत्ता लगाउनुहोस् ।
Find the median class from the adjoining cumulative frequency curve. **[2066 B]**

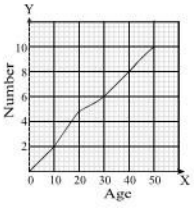


⇨ Here, from the figure, N = 100

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{100}{2}\right)^{th}$ item

$= 50^{th}$ item = 10-20

2. दिइएको सञ्चित बारम्बारता बक्रबाट मध्यिका श्रेणी पत्ता लगाउनुहोस् ।
Find the median class from the given cumulative frequency curve. **[2066 D]**



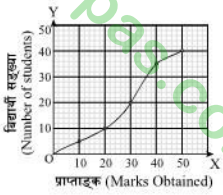
⇨ Here, N = 10

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{10}{2}\right)^{th}$ item

$= 5^{th}$ item = 20 - 30

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3. दिइएको सञ्चित बारम्बारताको वक्रचित्रबाट मध्यिकाको मान निकाल्नुहोस् ।
Find the median from the given cumulative frequency curve. **[2068 B]**



⇨ Here, N = 40

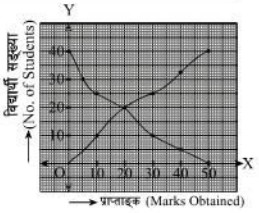
We have, median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{40}{2}\right)^{th}$ item

$= 20^{th}$ item $= 30$

Thus, the median is 30.

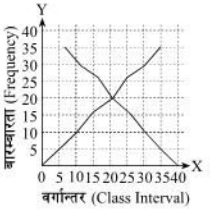
Model 2

4. दिइएको ग्राफमा दुईओटा सञ्चित बारम्बारताका वक्र रेखाहरू ('भन्दा कम' र 'भन्दा बढी') आपसमा काटिएका छन् । मध्यिका र मध्यिका श्रेणी पत्ता लगाउनुहोस् ।
In the graph given alongside, two cumulative frequency curves ('is less than' and 'is more than') are intersected at a point, find the median and its class. **[2067 A]**



⇨ Here, from the graph,
Both the ogives are intersected at a point (20, 20).
So, median = 20 and median class = 20-30

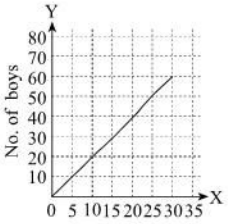
5. सँगैको सञ्चित बारम्बारता वक्रबाट मध्यिकाको मान र मध्यिका श्रेणी पत्ता लगाउनुहोस् जहाँ **5-10** एउटा वर्गान्तर हो ।
Find the median class and value of median from the adjoining cumulative frequency curve, where 5 - 10 is a class. **[2065 A, B, 2066 E]**



⇨ Here, from the graph,
Median class = 20-25 and the median = 20

Model 3

6. दिइएको लेखाचित्रबाट पहिलो चतुर्थांश पर्ने श्रेणी पत्ता लगाउनुहोस् ।
Find the first quartile class from the given graph. **[2065 D, 2066 D, 2071 E]**



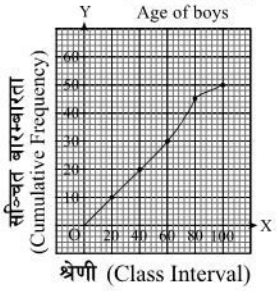
⇨ Here, N = 60

First quartile class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{60}{4}\right)^{th}$ item

$= 15^{th}$ item

From the graph, first quartile class = 5-10

7. सँगैको लेखाचित्रबाट पहिलो चतुर्थांश पर्ने श्रेणी पत्ता लगाउनुहोस् ।
From the alongside diagram, find the class in which first quartile lies. **[2067 D]**



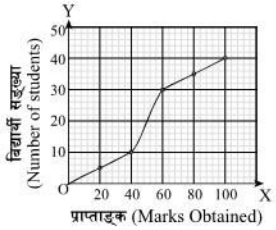
⇨ Here, from the given graph N = 50

First quartile class $= \left(\frac{N}{4}\right)^{th}$ item

$= \left(\frac{50}{4}\right)^{th}$ item

$= 12.5^{th}$ item = 20-40

8. दिइएको सञ्चित बारम्बारताको वक्रचित्रबाट पहिलो चतुर्थांश (Q_1) पर्ने श्रेणी पत्ता लगाउनुहोस् ।
From the given cumulative frequency curve, find the first quartile class (Q_1). **[2068 E]**



⇨ Here, from the graph, N = 40

Q_1 class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{40}{4}\right)^{th}$ item

$= 10^{th}$ item = 40-60

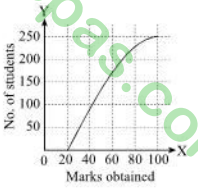
Thus, the first quartile class is 40-60.

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Model 4

9. दिइएको लेखाचित्रबाट तेस्रो चतुर्थांशको श्रेणी पत्ता लगाउनुहोस् ।
From the given graph, find the third quartile class. **[2065 B, 2071 A, 2071 C, 2071 S]**

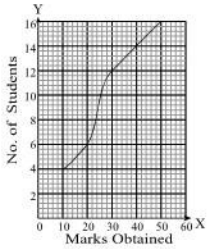


⇨ Here, from the graph;
No. of students (N) = 250

We know that; Q_3 class $= \left(\frac{3N}{4}\right)^{th}$ item $= 187.50^{th}$ item

From the graph its corresponding class = 60-80

10. दिइएको सञ्चित बारम्बारता बक्रबाट तेस्रो चतुर्थांश (Q_3) श्रेणी पत्ता लगाउनुहोस् ।
Find the third quartile class (Q_3) from the given cumulative frequency curve. **[2066 C]**



⇨ Here, N = 16

Third quartile $(Q_3) = \left(\frac{3N}{4}\right)^{th}$ item $= \left(3 \times \frac{16}{4}\right)^{th}$ item
$= 12^{th}$ item = 30-40

Model 5

11. तलको तालिकाबाट मध्यिका श्रेणी र रीत श्रेणी पत्ता लगाउनुहोस् ।
Find the median class and modal class from the following table. **[2062 Kapilbastu]**

x	5-15	15-25	25-35	35-45	45-55
c.f	3	8	17	20	22

⇨ Here, N = 22

We have, Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{22}{2}\right)^{th}$ item $= 11^{th}$ item $\quad \therefore$ Median class = 25-35

Here, frequency is maximum at class 25-35. So, Modal Class = 25-35.
Thus, the median class is 25-35.

12. दिइएको तालिकाबाट मध्यिका श्रेणी निकाल्नुहोस् : (Find the median class from the table given below:) **[2058S]**

Marks Obtained	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	2	5	7	6	3	2

⇨ Here,

Marks	10-20	20-30	30-40	40-50	50-60	60-70
f	2	5	7	6	3	2
cf	2	7	14	20	23	25

N = 26

We know that, Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{25}{2}\right)^{th}$ item $= 12.5^{th}$ item = 30-40

Thus, the median class is 30-40.

Model 6

13. एउटा निरन्तर श्रेणीमा मध्यिका पर्ने श्रेणी = 18 – 24, बारम्बारताको योग (N) = 40, मध्यिका पर्ने श्रेणीभन्दा अघिल्लो श्रेणीको सञ्चित बारम्बारता (c.f.) = 19 र मध्यिका पर्ने श्रेणीको बारम्बारता (f) = 3 भए मध्यिका मान निकाल्नुहोस् ।
In a continuous series, the class where median lies = 18 – 24, the sum of frequencies (N) = 40, the cumulative frequency of the pre-median class (c.f.) = 19 and the frequency of the median class (f) = 3, calculate the value of median. **[2072 C]**

⇨ Here, median class = 18-24, N = 40, cf = 19, f = 3

$$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 18 + \frac{6}{3}(20 - 19) = 18 + 2 = 20$$

Thus, the median is 20.

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14. एउटा निरन्तर श्रेणीमा मध्यिका पर्ने श्रेणी = 12-16, बारम्बारताको योग (N) = 24, मध्यिका पर्ने श्रेणीभन्दा अघिल्लो श्रेणीको सञ्चित बारम्बारता (c.f.) = 9, मध्यिका पर्ने श्रेणीको बारम्बारता (f) = p र मध्यिका मान (Md) = 14.4 भए p को मान पत्ता लगाउनुहोस् ।

In a continuous series, the class where median lies = 12-16, the sum of frequencies (N) = 24, the cumulative frequency of pre-median class (c.f.) = 9, the frequency of the class where median lies (f) = p and the median value (Md) = 14.4, find the value of p. [2072 W]

⇨ Here, median class = 12 - 16, N = 24, cf = 9, f = p, Md = 14.4

We know that, $\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$ or, $14.4 = 12 + \frac{4}{p}\left(\frac{24}{2} - 9\right)$

or, $2.4 = \frac{4}{p} \times 3$ or, $p = \frac{4 \times 3}{2.4}$

$\therefore \quad p = 5$ Thus, the value of p is 5.

C. LONG QUESTIONS

Model 1

1. तल दिइएको तथ्याङ्कबाट मध्यिका पत्ता लगाउनुहोस् **(Find the median from the data given below):** [2071D]

Class interval	10-20	20-30	30-40	40-50	50-60
Frequency	3	2	4	5	6

⇨ Here, Calculation of median

C.I.	f	cf
10-20	3	3
20-30	2	5
30-40	4	9
40-50	5	14
50-60	6	20
	N = 20	

Position Median $= \left(\frac{N}{2}\right)^{th} = \left(\frac{20}{2}\right)^{th}$ class $= 10^{th}$ class

$\therefore$ Median lies in (40-50).

We know that,

$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 40 + \frac{10}{5}(10 - 9) = 40 + 2 = 42$

Thus, the median is 42.

2. दिइएको तालिकाबाट मध्यिका पत्ता लगाउनुहोस्: **(Find the median from the given table) :** [2065 M]

Marks obtained	0-5	5-10	10-15	15-20	20-25	25-30	30-35
Number of Students	11	16	15	6	8	5	4

⇨ Here, cumulative Frequency table:

CI	f	cf
0-5	11	11
5-10	16	11 + 16 = 27
10-15	15	27 + 15 = 42
15-20	6	42 + 6 = 48
20-25	8	48 + 8 = 56
25-30	5	56 + 5 = 61
30-35	4	61 + 4 = 65
	N = 65	

Median Class $= \left(\frac{N}{2}\right)^{th}$ class $= \left(\frac{65}{2}\right)^{th}$ class

$= 32.5^{th} = (10 - 15)$ class

We know that;

$\text{Median} = L + \frac{\frac{N}{2} - \text{c.f.}}{f} \times h = 10 + \frac{\frac{65}{2} - 27}{15} \times 5$

$= 10 + \frac{32.5 - 27}{15} \times 5 = 10 + \frac{5.5 \times 5}{15} = 10 + 1.83$

$\therefore$ Median = 11.83

Thus, the median is 11.83.

3. दिइएको तालिकाबाट मध्यिका पत्ता लगाउनुहोस्: **(Find the median from the given table) :** [2065 D]

Marks Obtained	0-10	10-20	20-30	30-40	40-50	50-60
No. of students	4	8	12	20	18	6

⇨ Here, calculation of median

Marks	f	c.f.
0-10	4	4
10-20	8	12
20-30	12	24
30-40	20	44
40-50	18	62
50-60	6	68
	N = 68	

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{68}{2}\right)^{th}$ item

$= 34^{th}$ item = 30-40

$\therefore$ Median $= L + \frac{i}{f}\left(\frac{N}{2} - \text{c.f.}\right) = 30 + \frac{10}{20}(34 - 24)$

$= 30 + 5$

$\therefore$ Median $= 35$

Thus, median is 35.

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4. तलको तालिकाबाट मध्यिकाको गणना पत्ता लगाउनुहोस: **(Compute the median of the data given below):** **[2061 E2]**

Marks obtained	35-45	45-55	55-65	65-75	75-85
No. of students	7	8	10	9	6

⇨ Here, calculation of median

Marks	*f*	c.*f.*
35-45	7	7
45-55	8	15
55-65	10	25
65-75	9	34
75-85	6	40
	N = 40	

Here, $\frac{N}{2} = \frac{40}{2} = 20$

The median lies in the class corresponding to c.f. = 25. It means median lies in 55-65.

By formula, we know that, Median $= \ell + \frac{N/2 - \text{c.f.}}{f} \times h$

Median $= 55 + \frac{20 - 15}{10} \times 10 = 55 + 5 = 60$

Thus, the median is 60.

Model 2

5. कुनै परीक्षामा विद्यार्थीको गणित विषयमा निम्नानुसार प्राप्ताङ्क छ भने:
The following marks are obtained by students in Mathematics in an examination :
51, 20, 60, 34, 48, 61, 79, 25, 39, 52, 43, 46, 37, 40, 67, 76, 71, 33, 44, 55 **[2069 B]**
(i) 10 को श्रेणी अन्तरमा हुने बारम्बारता तालिका बनाउनुहोस् । (Make frequency table of class interval 10.)
(ii) मध्यिका पत्ता लगाउनुहोस् । (Find the median.)

⇨ Here, the calculation of frequency table.
The smallest term = 20 and the largest term = 79

Marks	Tallies	*f*	*cf*
20-30	||	2	2
30-40	||||	4	6
40-50	𝍸	5	11
50-60	||||	4	15
60-70	||	2	17
70-80	|||	3	20
		N = 20	

We have median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{20}{2}\right)^{th}$ item
$= 10^{th}$ item = 40 - 50

We know that,

Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 40 + \frac{10}{5}\left(\frac{20}{2} - 6\right) = 40 + 2 \times 4 = 48$

Thus, the median is 48.

Model 3

6. तल दिइएको तथ्याङ्कबाट मध्यिका निकाल्नुहोस्: **(Calculate the median from the data given below:)** **[2062 D2]**

Marks obtained	0–10	0–20	0–30	0–40	0–50
No. of students	4	12	24	44	62

⇨ Here, calculation of median

Marks	frequency (f)	c.*f.*
0 – 10	4	4
10 – 20	8	12
20 – 30	12	24
30 – 40	20	44
40 – 50	18	62
	N = ∑f = 62	

$\frac{N}{2} = \frac{62}{2} = 31.$

The median is the value of $\left(\frac{N}{2}\right)^{th}$ or 31^{th} class lies in item which lies in class-interval 30 – 40.

By formula, Median $= \ell + \frac{N/2 - \text{c.f.}}{f} \times h$

$\therefore$ Median $= 30 + \frac{31 - 24}{20} \times 10 = 30 + \frac{7}{2}$
$= 30 + 3.5 = 33.5$

Thus, median is 33.5.

7. तल दिइएको तथ्याङ्कबाट मध्यिका निकाल्नुहोस्: **(Calculate the median from the data given below):** **[2062D1]**

Wages (in Rs)	15–25	15–35	15–45	15–55	15–65
No. of workers	4	10	22	27	30

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⇨ Here,

Wages	frequency (f)	c.f.
15 – 25	4	4
25 – 35	6	10
35 – 45	12	22
45 – 55	5	27
55 – 65	3	30
	$N = \sum f = 30$	

Here, $\frac{N}{2} = \frac{30}{2} = 15$.

The median is the value of $\left(\frac{N}{2}\right)^{th}$ or 15^{th} item which lies in 35 – 45 class-interval.

By formula, Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$

$\therefore$ Median $= 35 + \frac{10}{12}(15 - 10) = 35 + \frac{50}{12} = 35 + 4.17 = 39.17$ Thus, median is 39.17.

Model 4

8. दिइएको तथ्याङ्कको मध्यिका 32 भए P को मान पत्ता लगाउनुहोस्:
The median of the given data is 32, find the value of P: [2070 C]

Class interval	0-10	10-20	20-30	30-40	40-50
Frequency	2	3	4	P	6

⇨ Here, Calculation of median

Class	f	c.f.
0-10	2	2
10-20	3	5
20-30	4	9
30-40	P	9 + P
40-50	6	15 + P
	N = 15 + P	

We know that, Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$

or, $32 = 30 + \frac{10}{P}\left(\frac{15 + P}{2} - 9\right)$ or, $2 = \frac{10}{P} \times \frac{P - 3}{2}$

or, $2P = 5P - 15$ or, $15 = 3P$ $\therefore$ $P = 5$

Thus, the value of P is 5.

9. तल दिइएको आँकडाको मध्यिका (Md) = 45 भए K को मान पत्ता लगाउनुहोस्
In the data given below the median (Md) = 45, find the value of K: [2070 D]

X	10-20	20-30	30-40	40-50	50-60	60-70	70-80
f	4	7	9	18	K	7	3

⇨ Here, median = 45 so median class = 40 – 50 Calculation of median

x	f	c.f.
10-20	4	4
20-30	7	11
30-40	9	20
40-50	18	38
50-60	k	38 + k
60-70	7	45 + k
70-80	3	48 + k
	N = 48 + k	

We know that, Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$

or, $45 = 40 + \frac{10}{18}\left(\frac{48 + k}{2} - 20\right)$ or, $5 = \frac{10}{18}\left(\frac{48 + k - 40}{2}\right)$

or, $1 = \frac{1}{18}(k + 8)$ or, $18 = k + 8$ $\therefore$ $k = 10$

Thus, the value of k is 10.

10. यदि तल दिइएको तथ्याङ्कको मध्यिका 24 भए y को मान पत्ता लगाउनुहोस् ।
If the Median of following data is 24, find the value of y: [2066 C, 2060 C2]

Class Interval	0-10	10-20	20-30	30-40	40-50
Frequency	4	12	y	9	5

⇨ Here, calculation of median.

Cl	f	c.f.
0-10	4	4
10-20	12	16
20-30	y	16 + y
30-40	9	25 + y
40-50	5	30 + y
	N = 30 + y	

Median is 24 so the median class = 20-30

$\therefore$ Median $= L + \frac{i}{f}\left(\frac{N}{2} - c.f.\right)$

or, $24 = 20 + \frac{10}{y}\left(\frac{30 + y}{2} - 16\right)$

or, $4 = \frac{10}{y}\frac{(30 + y - 32)}{2}$

or, $4 = \frac{5}{y}(30 + y - 32)$ or, $4y = 5(y - 2)$ or, $4y = 5y - 10$

$\therefore$ $y = 10$ Thus, the value of y is 10.

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Model 5

11. तल दिइएको तथ्याङ्कबाट पहिलो चतुर्थांश निकाल्नुहोस् (Calculate the first quartile from the given data): [2071 C]

Class	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	4	6	10	20	10	6

⇨ Here, Calculation of first quartile:

x	*f*	*cf*
0-10	4	4
10-20	6	10
20-30	10	20
30-40	20	40
40-50	10	50
50-60	6	56
	N = 56	

Position of Q_1 class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{56}{4}\right)^{th}$ item $= 14^{th}$ item

$\therefore$ Q_1 class = 20-30

We know that, $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - cf\right) = 20 + \frac{10}{10}(14 - 10)$

$= 20 + 4 = 24$

Thus, the first quartile is 24.

12. तल दिइएको तथ्याङ्कबाट प्रथम चतुर्थांश (Q_1) पत्ता लगाउनुहोस् :
Find the first quartile (Q_1) from the data given below: **[2071A]**

Class interval	10-20	20-30	30-40	40-50	50-60
Frequency	3	5	6	5	5

⇨ Here, Calculation of first quartile

x	*f*	c.*f*.
10-20	3	3
20-30	5	8
30-40	6	14
40-50	5	19
50-60	5	24
	N = 24	

Position of Q_1 class $= \left(\frac{N}{4}\right)^{th}$ class $= \left(\frac{24}{4}\right)^{th}$ class $= 6^{th}$ class

$\therefore$ Q_1 class = 20-30

We have, $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - cf\right) = 20 + \frac{10}{5}(6 - 3)$

$= 20 + 2 \times 3$

$\therefore$ $Q_1 = 26$

Thus, the first quartile is 26.

13. तलको तालिकाबाट पहिलो चतुर्थांश (Q_1) पत्ता लगाउनुहोस्:
Compute the first quartile (Q_1) from the data given below: **[2068 B]**

Weight (in kg)	8-10	10-12	12-14	14-16	16-18	18-20
No. of Children	6	4	3	5	7	5

⇨ Here, calculation of the first quartile

CI	*f*	*cf*
8-10	6	6
10-12	4	10
12-14	3	13
14-16	5	18
16-18	7	25
18-20	5	30
	N = 30	

For Q_1 class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{30}{4}\right)^{th}$ item

$= 7.5^{th}$ item = 10-12

So, L = 10, I = 2, f = 4, $\frac{N}{4} = 7.5$, cf = 6

We have, $Q_1 = L + \frac{i}{f}\left(\frac{N}{4} - cf\right) = 10 + \frac{2}{4}(7.5 - 6) = 10.75$

Thus, the first quartile is 10.75.

14. तलको तालिकाबाट पहिलो चतुर्थांश (Q_1) पत्ता लगाउनुहोस्:
Find the first quartiles (Q_1) from the following data: **[2065 S]**

Marks obtained	0-20	20-40	40-60	60-80	80-100
No. of students	5	12	21	10	8

⇨ Here, calculation of first quartile:

CI	*f*	*cf*
0-20	5	5
20-40	12	17
40-60	21	38
60-80	10	48
80-100	8	56
	N = 56	

We know that,

First quartile class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{56}{4}\right)^{th}$ item

$= 14^{th}$ item = 20-40

Now, first quartile $= L + \frac{i}{f}\left(\frac{N}{4} - cf\right) = 20 + \frac{20}{12}(14 - 5)$

$= 20 + 15$

Thus, first quartile $= 35$

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Model 6

15. तल दिइएको तथ्याङ्कबाट तेस्रो चतुर्थांश (Q_3) पत्ता लगाउनुहोस् :
Find the third quartile (Q_3) from the data given below: [2071B]

Class interval	15-35	35-55	55-75	75-95	95-115
Frequency	9	6	8	9	8

⇨ Here, Calculation of first quartile:

x	f	cf
15-35	9	9
35-55	6	15
55-75	8	23
75-95	9	32
95-115	8	40
	N = 40	

Position of Q_3 class $= 3\left(\frac{N}{4}\right)^{th}$ item $= \left(3 \times \frac{40}{4}\right)^{th}$ item

$= 30^{th}$ item $= (75\text{-}95)$

We know that, $Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right) = 75 + \frac{20}{9}(30 - 23)$

$= 75 + \frac{20}{9} \times 7 = 75 + 15.55 = 90.55$

Thus, the third quartile (Q_3) is 90.55.

16. तलको तथ्याङ्काबाट तेस्रो चतुर्थांश (Q_3) पत्ता लगाउनुहोस्: **(Find the third quartile (Q_3) from the given data):** [2065 E]

Marks Obtained	0-6	6-12	12-18	18-24	24-30	30-36
No. of students	5	6	4	5	3	2

⇨ Here, calculation of third quartile;

CI	f	c.f.
0-6	5	5
6-12	6	11
12-18	4	15
18-24	5	20
24-30	3	23
30-36	2	25
	N = 25	

Q_3 class $= \left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 25}{4}\right)^{th}$ item

$= 18.75^{th}$ item $= 18\text{-}24$

We know that;

Third quartile $(Q_3) = L + \frac{i}{f}\left(\frac{3N}{4} - c.f.\right) = 18 + \frac{6}{5}(18.75 - 15)$

$= 18 + 4.50$

$\therefore$ Third quartile $(Q_3) = 22.50$

Thus, Q_3 is 22.50.

Model 7

17. एउटा परीक्षामा विद्यार्थीहरूले प्राप्त गरेका प्राप्ताङ्कहरू तल दिइएको छ ।
The following are the marks obtained by students in Math in an examination: [2057 E2]
51, 22,63, 35, 46, 57, 79, 21, 39, 51, 32, 43, 52, 59, 38, 45, 40, 32, 60, 63
(i) वर्गान्तर 10 हुने गरी एउटा बारम्बारता तालिका बनाउनुहोस् । (Make a frequency table of class interval 10.)
(ii) पहिलो चतुर्थांश पत्ता लगाउनुहोस् । (Find the first quartile).

⇨ Here, construction of frequency table

C.I	f	c.f.
20-30	2	2
30-40	5	7
40-50	4	11
50-60	5	16
60-70	3	19
70-80	1	20
	N = 20	

Value of $\frac{N}{4} = \frac{20}{4} = 5$.

The c.f. just greater than 5 is 7 and the quartile class is 30 – 40.
So, L = 30, h = 10 f = 5, cf = 2.
We know that,

$Q_1 = L + \left(\frac{N}{4} - c.f.\right) \times \frac{h}{f} = 30 + (5 - 2) \times \frac{10}{5} = 30 + 3 \times 2 = 36$

Thus, required Q_1 is 36.

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18. कुनै परीक्षामा विद्यार्थीहरूले गणित विषयमा निम्न अनुसार अंक प्राप्त गरेका छन् :

The following are the marks obtained by students in mathematics in an examination: **[2057 E1]**

15, 12, 23, 35, 46, 57, 18, 12, 39, 51, 32,43, 25, 59, 18, 38, 45,40,32,33

(i) **10 को श्रेणी अन्तरमा हुने बारम्बारता तालिका बनाउनुहोस् । Make a frequency table of class interval 10.**

(ii) तेस्रो चतुर्थांश पत्ता लगाउनुहोस् । **(Find the third quartile.)**

⇨ Here,

CI	*f*	c.*f.*
10 – 20	5	5
20 – 30	2	7
30 – 40	6	13
40 – 50	4	17
50 – 60	3	20
	N = 20	

Here, N = 20 and $\frac{3N}{4} = 3 \times \frac{20}{4} = 15$.

Third quartile 'Q_3' lies in the class interval corresponding to c.f. = 17 which is 40 – 50

We know that, $Q_3 = L + \frac{i}{f}\left(\frac{3N}{4} - \text{c.f.}\right) = 40 + \frac{10}{4}(15 - 13)$

$= 40 + 5 = 45$

Thus, third quartile (Q_3) is 45.

Model 8

19. तल दिइएको आँकडाको पहिलो चतुर्थांश (Q_1) = 25 भए y को मान पत्ता लगाउनुहोस् :

The first quartile (Q_1) = 25 of the data given below, find the value of y: **[2070 A]**

X	0-10	10-20	20-30	30-40	40-50	50-60
f	9	11	y	20	30	16

⇨ Here, first quartile (Q_1) = 25 So, the first quartile class = 20 – 30

Calculation of first quartile

x	*f*	C.f.
0-10	9	9
10-20	11	20
20-30	y	20 + y
30-40	20	40 + y
40-50	30	70 + y
50-60	16	86 + y
	N = 86 + y	

We know that, First quartile $= L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

or, $25 = 20 + \frac{10}{y}\left(\frac{86 + y}{4} - 20\right)$

or, $5 = \frac{10}{y}\left(\frac{86 + y - 80}{4}\right)$ or, $1 = \frac{2}{y} \times \frac{6 + y}{4}$

or, $2y = 6 + y$

$\therefore \quad y = 6$ Thus, the value of y is 6.

20. तल दिइएको तथ्याङ्कको प्रथम चतुर्थांश **(Q_1) = $25\frac{1}{3}$** भए m को मान पत्ता लगाउनुहोस् :

In the data given below, the first quartile (Q_1) = $25\frac{1}{3}$, find the value of m: **[2070 B]**

Class interval	20-24	24-28	28-32	32-36	36-40
Frequency	2	m	6	3	1

⇨ Here, first quartile (Q_1) = $25\frac{1}{3}$ So, the first quartile class = 24 – 28

Calculation of first quartile

x	*f*	C.*f.*
20-24	2	2
24-28	m	2 + m
28-32	6	8 + m
32-36	3	11 + m
36-40	1	12 + m
	N =12 + m	

We know that,

First quartile $= (Q_1) = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

or, $25\frac{1}{3} = 24 + \frac{4}{m}\left(\frac{12 + m}{4} - 2\right)$

or, $\frac{76}{3} - 24 = \frac{4}{m}\left(\frac{12 + m - 8}{4}\right)$ or, $\frac{4}{3} = \frac{4}{m}\left(\frac{m + 4}{4}\right)$

or, $4m = 3m + 12$ $\therefore \quad m = 12$

Thus, the value of m is 12.

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B. QUESTIONS FROM CDC TEXT BOOKS

तल दिइएको तथ्याङ्कका आधारमा मध्यिका पत्ता लगाउनुहोस् (Find the median on the basis of given data):

1A.

उमेर (वर्षमा) (Age (in yrs))	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
मानिसहरू सङ्ख्या (No. of people)	3	4	7	5	6	5	2	2

⇨ Here calculation of median:

Age (In yrs)	f	cf
10-15	3	3
15-20	4	7
20-25	7	14
25-30	5	19
30-35	6	25
35-40	5	30
40-45	2	32
45-50	2	34
	N = 34	

For median,

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= 17^{th}$ item $= 25\text{-}30$

We know that,

$$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$$

$$= 25 + \frac{5}{5}(17 - 14) = 25 + 3 = 28$$

Thus, the median is 28 yrs.

1B.

हप्ता घर खर्च (Weekly home exp. (Rs))	500-1500	1500-2500	2500-3500	3500-4500	4500-5500
परिवारको सङ्ख्या (No. of families)	3	5	9	3	2

⇨ Here, calculation of median:

Exp. (Rs)	f	cf
500-1500	3	3
1500-2500	5	8
2500-3500	9	17
3500-4500	3	20
4500-5500	2	22
	N = 22	

For median,

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= 11^{th}$ item $= 2500\text{-}3000$

We know that,

$$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 2500 + \frac{1000}{9}(11 - 8)$$

$$= 2500 + \frac{1000}{9} \times 3 = 2500 + 333.33 = 2833.33$$

Thus, the median is Rs 2833.33.

1C.

उमेर वर्षमा (Age (In yrs))	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
कामदारको सङ्ख्या (No. of workers)	5	3	2	5	3	1	2	1

⇨ Here, calculation of median

Age	f	cf
20-25	5	5
25-30	3	8
30-35	2	10
35-40	5	15
40-45	3	18
45-50	1	19
50-55	2	21
55-60	1	22
	N = 22	

For median,

Median class $= \left(\frac{N}{2}\right)^{th}$ item $= 11^{th}$ item $= 35 - 40$

We know that,

$$\text{Median} = L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 35 + \frac{5}{5}(11 - 10) = 35 + 1 = 36$$

Thus, the median is 36 yrs.

तल दिइएको तालिकाका आधारमा पहिलो चतुर्थांश (Q_1) पत्ता लगाउनुहोस् :

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Find the first quartile (Q_1) on the basis of the given data:

2A.

दैनिक खर्च (रु.) (Daily exp. (Rs))	50-100	100-150	150-200	200-250	250-300	300-350
कामदारको सङ्ख्या (No. of workers)	10	25	145	220	70	30

⇨ Here, calculation of first quartile:

Daily Exp.	f	cf
50-100	10	10
100-150	25	35
150-200	145	180
200-250	220	400
250-300	70	470
300-350	30	500
	N = 500	

We have,

For first quartile class, $\left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{500}{4}\right)^{th}$ item

$= 125^{th}$ item $= 150 - 200$

We know that,

First quartile $(Q_1) = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

$= 150 + \frac{50}{145}(125 - 35)$

$= 150 + 31.034 = 181.034$

Thus, the median is Rs 181.03.

2B.

मूल्य (रु.) (Price (Rs))	0-50	50-100	100-150	150-200	200-250	250-300
किताबको सङ्ख्या (No. of books)	3	7	10	8	6	1

⇨ Here, calculation of first quartile:

Price (Rs)	f	cf
0-50	3	3
50-100	7	10
100-150	10	20
150-200	8	28
200-250	6	34
250-300	1	35
	N = 35	

We have, For Q_1 class,

$\left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{35}{4}\right)^{th}$ item $= 8.75^{th}$ item $=$ 50-100

We know that,

First quartile $(Q_1) = L + \frac{i}{f}\left(\frac{N}{4} - cf\right) = 50 + \frac{50}{7}(8.75 - 3)$

$= 50 + 41.07 = 91.07$

Thus, the first quartile is Rs 91.07.

2C.

उचाइ (से.मि.) (Height (cm))	0-10	10-20	20-30	30-40	40-50	50-60	60-70
बिरुवाहरूको सङ्ख्या (No. of plants)	3	2	15	4	5	6	3

⇨ Here, calculation of first quartile

Height	f	cf
0-10	3	3
10-20	2	5
20-30	15	20
30-40	4	24
40-50	5	29
50-60	6	35
60-70	3	38
	N = 38	

We have,

For first quartile class, $\left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{38}{4}\right)^{th}$ item $= 9.5^{th}$ item $= 20 - 30$

We know that,

First quartile $(Q_1) = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$

$= 20 + \frac{10}{15}(9.5 - 5)$

$= 20 + \frac{2}{3} \times 4.5 = 23$

Thus, the first quartile (Q_1) is 23.

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तल दिइएका तथ्याङ्कका आधारमा तेस्रो चतुर्थांश (Q_3) पत्ता लगाउनुहोस् :

Find the third quartile (Q_3) on the basis of given data:

3A.

प्राप्ताङ्क (Marks obtained)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
विद्यार्थीको सङ्ख्या (No. of students)	5	8	7	12	28	20	10	10

⇨ Here, calculation of third quartile

Marks	f	cf
0-10	5	5
10-20	8	13
20-30	7	20
30-40	12	32
40-50	28	60
50-60	20	80
60-70	10	90
70-80	10	100
	N = 100	

We have, For third quartile,

$$\text{Third quartile } (Q_3) = \left(\frac{3N}{4}\right)^{th} \text{ item} = 3\left(\frac{100}{4}\right)^{th} \text{ item}$$
$$= 75^{th} \text{ item} = 50 - 60$$

We know that,

$$\text{Third quartile } (Q_3) = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right) = 50 + \frac{10}{20}(75 - 60) = 50 + 7.5$$
$$= 57.50$$

Thus, the third quartile is 57.50.

3B.

उमेर (वर्षमा) (Age in yrs)	0-10	10-20	20-30	30-40	40-50
मानिसहरूको सङ्ख्या (No. of men)	4	8	12	20	18

⇨ Here, calculation of third quartiles:

Age (in yrs)	f	cf
0-10	4	4
10-20	8	12
20-30	12	24
30-40	20	44
40-50	18	62
	N = 62	

We have, Third quartile class $= \left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 62}{4}\right)^{th}$ item

$= 46.5^{th}$ item $= 40 - 50$

We know that,

$$\text{Third quartile } (Q_3) = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right) = 40 + \frac{10}{18}(46.5 - 44)$$
$$= 40 + 1.388 = 41.39$$

Thus, the third quartile is 41.39 yrs.

4. दिइएको तथ्याङ्कलाई 5 को वर्गान्तरको तालिका बनाई पहिलो चतुर्थांश र तेस्रो चतुर्थांश पत्ता लगाउनुहोस् ।

Making a frequency table of class interval 5, find the first quartile and third quartile of the data of given:

10, 4, 16, 32, 34, 24, 17, 5, 16, 9, 32, 29, 24, 18, 23, 28, 5, 24, 2, 18, 6, 27, 17, 8, 16, 33, 19, 16, 18, 14, 31, 29, 30, 18, 21, 13, 21, 16, 19, 24, 20, 14, 20, 26, 16, 1, 15, 8, 23, 10

⇨ Here, the smallest term = 1 & the largest term = 34

Construction of frequency table and calculation of first quartile and third quartile:

Marks	Tallies	f	cf
0-5	𝍸	4	4
5-10	𝍸	5	9
10-15	𝍸	5	14
15-20	𝍸 𝍸 𝍸	15	29
20-25	𝍸 𝍸	10	39
25-30	𝍸 |	6	45
30-35	𝍸	5	50
		N = 50	

We have, First quartile $= \left(\frac{N}{4}\right)^{th}$ item

$= \left(\frac{50}{4}\right)^{th}$ item

$= 12.5^{th}$ item $= 10 - 15$

We know that,

$$\text{First quartile } (Q_1) = L + \frac{i}{f}\left(\frac{N}{4} - cf\right)$$
$$= 10 + \frac{5}{5}(12.5 - 9)$$
$$= 10 + 3.5 = 13.5$$

Thus, the first quartile is 13.5.

Again, third quartile class $= \left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 50}{4}\right)^{th}$ item $= 37.5^{th}$ item $= 20 - 25$

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Now, third quartile $(Q_3) = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right) = 20 + \frac{5}{10}(37.5 - 29) = 20 + \frac{1}{2} \times 8.5 = 24.25$

Thus, the third quartile is 24.25.

5. तल तालिकामा दिइएको तथ्याङ्कको मध्यिका पत्ता लगाउनुहोस् (Find the median of the data given below):

प्राप्ताङ्क (Marks obtained)	0-19	20-39	40-59	60-79	80-89
विद्यार्थी सङ्ख्या (No. of students)	14	23	26	21	16

⇨ Here, correction factor $= \frac{20 - 19}{2} = 0.5$

Marks	*f*	*cf*
–0.5-19.5	14	14
19.5-39.5	23	37
39.5-59.5	26	63
59.5-79.5	21	84
79.5-89.5	16	100
	N = 100	

We have, Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{100}{2}\right)^{th}$ item

$= 50^{th}$ item $= 39.5 - 59.5$

We know that, Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$

$= 39.50 + \frac{20}{26}(50 - 37)$

$= 39.50 + \frac{10}{13} \times 13$

$= 49.50$

Thus, the median is 49.50.

6. तल दिइएको तथ्याङ्कको मध्यिका 35 भए छुटेको बारम्बारता पत्ता लगाउनुहोस् :

If the median of the data given below is 35, find the missing frequency:

X	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f	10	20	35	40	?	25	15

⇨ Here, calculation of median:

x	*f*	*cf*
0-10	10	10
10-20	20	30
20-30	35	65
30-40	40	115
40-50	a	115 + a
50-60	25	140 + a
60-70	15	155 + a
	N = 155 + a	

We have,

Median is 35 so the median class = 30-40

We know that,

Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right)$

or, $35 = 30 + \frac{10}{40}\left(\frac{155 + a}{2} - 65\right)$

or, $5 = \frac{1}{4}\left(\frac{155 + a - 130}{2}\right)$

or, $40 = a + 25$

$\therefore \quad a = 15$

Thus, the value of a is 15.

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7. तल तालिकामा दिइएको तथ्याङ्ककको तेस्रो चतुर्थांश पत्ता लगाउनुहोस् :

Find the third quartile from the data given below:

X	10 भन्दा कम less than 10	20 भन्दा कम less than 20	30 भन्दा कम less than 30	40 भन्दा कम less than 40	50 भन्दा कम less than 50	60 भन्दा कम less than 60	70 भन्दा कम less than 70	80 भन्दा कम less than 80
f	5	13	20	32	60	80	90	100

⇨ Here,

x	*cf*	*f*
0-10	5	5
10-20	13	8
20-30	20	7
30-40	32	12
40-50	60	28
50-60	80	20
60-70	90	10
70-80	100	10
		N = 100

We have,

$$\text{Third quartile class} = \left(\frac{3N}{4}\right)^{th} \text{item} = \left(\frac{3 \times 100}{4}\right)^{th} \text{item}$$

$$= 75^{th} \text{ item} = 50 - 60$$

We know that,

$$\text{Third quartile} = L + \frac{i}{f}\left(\frac{3N}{4} - cf\right)$$

$$= 50 + \frac{10}{20}(75 - 60)$$

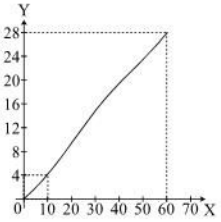
$$= 50 + \frac{1}{2} \times 15$$

$$= 57.50$$

Thus, the median of the given data is 57.50.

8. दिइएको सञ्चित बारम्बारता वक्रबाट निम्न मानहरू पत्ता लगाउनुहोस् :

From the following cumulative frequency curve, find the value of the following:



(a) मध्यिका पर्ने श्रेणी (Median class)

(b) तल्लो चतुर्थांश पर्ने श्रेणी (Lower quartile class)

(c) माथिल्लो चतुर्थांश पर्ने श्रेणी (Upper quartile class)

⇨ Here, from the given graph Sum of frequencies (N) = 28

(a) We have, Median class $= \left(\frac{N}{2}\right)^{th}$ item $= \left(\frac{28}{2}\right)^{th}$ item $= 14^{th}$ item = 20-30

(b) We have, Lower quartile class $= \left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{28}{4}\right)^{th}$ item $= 7^{th}$ item = 10-20

(c) We have, Third quartile class $= \left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 28}{4}\right)^{th}$ item $= 21^{st}$ item = 30-40

9. एउटा कम्पनीमा काम गर्ने 50 जना कामदारहरूले एक महिनामा पाउने बोनस रकम दिइए अनुसार छ : बोनस (रु. मा):

In a company the bonus received 50 workers in a month as given below: Bonus (in Rs)

990, 880, 940, 950, 890, 850, 1020, 920, 1020, 760, 830, 970, 860, 850, 920, 810, 890, 1040, 820, 930, 870, 910, 980, 1030, 910, 850, 1000, 1060, 1080, 980, 900, 860, 870, 770, 850, 880, 930, 870, 800, 960, 1030, 930, 940, 880, 870, 1080, 920, 770, 990, 1000

उक्त तथ्याङ्कलाई 10 अथवा 20 को वर्गान्तर तालिका बनाउनुहोस् । उक्त तथ्याङ्ककको

Make a frequency table taking a class interval of 10 or 20. From the data.

(क) मध्यक र मध्यिका कति हुन्छ ? पत्ता लगाउनुहोस् । **(Find the mean and median)**

(ख) मध्यक र मध्यिकाको अन्तर निकाल्नुहोस् । **(Find the difference of mean and median)**

(ग) मध्यकभन्दा कम र बढी बोनस पाउने कति कति जना छन् ? पत्ता लगाउनुहोस् ।

How many are there getting the bonus less than mean and more than mean ? Find it.

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⇨ Here, the smallest term = 760 and the largest term = 1080

Construction of frequency table and calculation of mean and median.

CI	Tallies	*f*	*cf*	m	*fm*
760-780	|||	3	3	770	2310
780-800	–	0	3	790	0
800-820	||	2	5	810	1620
820-840	||	2	7	830	1660
840-860	||||	4	11	850	3400
860-880	卌 |	6	17	870	5220
880-900	卌	5	22	890	4450
900-920	|||	3	25	910	2730
920-940	卌 |	6	31	930	5580
940-960	|||	3	34	950	2850
960-980	||	2	36	970	1940
980-1000	||||	4	40	990	3960
1000-1020	||	2	42	1010	2020
1020-1040	||||	4	46	1030	4120
1040-1060	|	1	47	1050	1050
1060-1080	|	1	48	1070	1070
1080-1100	||	2	50	1090	2180
		N = 50			$\sum$fm = 46160

(a) We have, Mean $= \frac{\sum fm}{N} = \frac{46160}{50} = 923.20$

For median, Median class $= \left(\frac{N}{2}\right)^{th}$ item $= 25^{th}$ item $= 900 - 920$

We know that, Median $= L + \frac{i}{f}\left(\frac{N}{2} - cf\right) = 900 + \frac{20}{3}(25 - 22) = 900 + 20$

$\therefore$ Median $= 920$

(b) Difference between mean and median = Mean – Median = 923.2 – 920 = 3.2

(c) Less than mean = 28

More than mean = 50 – 28 = 22.

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Unit VIII सम्भाव्यता (Probability)

18. सम्भाव्यता

Probability

[4 Marks]

Important Formulae

1. $P(E) = \frac{n(E)}{n(S)}$; P(E) = घटना E को सम्भाव्यता (Probability of an event E)

   n(E) = अनुकूल परिमाण सङ्ख्या (No. of Favourable Events)

   n(S) = कुल परिमाण सङ्ख्या (No. of Exhaustive Events)

2. प्रयोगाश्रित सम्भाव्यता (Empirical Probability) = $\frac{\text{परिमाण संख्या (No. of events)}}{\text{कूल परीक्षण संख्या (Total no. of experiments)}}$

3. यदि A र B दुईओटा पारस्परिक निषेधक घटनाहरू भए, (If A and B are two mutually exclusive events then):

   (a) P(A वा B) = P(A or B) = $P(A \cup B)$ = P(A) + P(B)

   (b) P(A र B) = P(A and B) = $P(A \cap B)$ = P(A) × P(B)

4. यदि A र B दुईओटा पारस्परिक निषेधक घटनाहरू होइनन् भने, (If A and B are two mutually non-exclusive events)

   P(A वा B) = P(A or B) = $P(A \cup B)$ = P(A) + P(B) – $P(A \cap B)$

5. यदि A र B दुईओटा अनाश्रित घटनाहरू हुन् भने, P(A र B) = P(A) × P(B)

   If A and B are independent events, P(A and B) = P(A) × P(B)

6. यदि A एउटा घटना भए घटना A नघट्ने सम्भाव्यता : $P(\bar{A}) = 1 - P(A)$

   If A is an event then the probability of not A : $P(\bar{A}) = 1 - P(A)$

7. यदि A र B दुइओटा घटनाहरू भए कम्तीमा एउटा घटना घट्ने सम्भाव्यता = $1 - [P(\bar{A}) \times P(\bar{B})]$

   If A and B are two events then the probability of at least one event = $1 - [P(\bar{A}) \times P(\bar{B})]$

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8.

घटना सम्बन्धी पदावली (Terminology of the event)	समतुल्य सङ्केत (Equivalent notation)
A but not B	$A \cap \bar{B}$
neither A nor B	$\bar{A} \cap \bar{B}$
At least one of A, B or C	$A \cup B \cup C$
Exactly one of A and B	$(A \cap \bar{B}) \cup (\bar{A} \cap B)$
All three of A, B and C	$A \cap B \cap C$
Exactly two of A, B and C	$(A \cap B \cap \bar{C}) \cup (A \cap \bar{B} \cap C) \cup (\bar{A} \cap B \cap C)$

9. एउटा समस्यालाई दुईजनाले समाधान गर्ने सम्भाव्यता क्रमशः P(A) र P(B) छन् भने,

The probability of solving a problem by two are P(A) and P(B) respectively.

(i) त्यो समस्या समाधान हुने सम्भाव्यता (Probability of solving the problem) = $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

(ii) दुवैले त्यो समस्या समाधान गर्ने सम्भाव्यता (Probability of solving the problem by both) = $P(A \cap B) = P(A) \times P(B)$

(iii) कम्तीमा एकजनाले उक्त समस्या समाधान गर्ने सम्भाव्यता = $1 - [P(\bar{A}) \times P(\bar{B})]$

The probability that at least one of them will solve the problem = $1 - [P(\bar{A}) \times P(\bar{B})]$

10. सङ्ख्याहरू (Numbers)

(i) प्राकृतिक सङ्ख्याहरू (Counting Numbers): **N** = {1, 2, 3, 4, 5, ……..}

(ii) पूर्ण सङ्ख्याहरू (Whole Numbers): **W** = {0, 1, 2, 3, 4, 5, ……..}

(iii) पूर्णाङ्कहरू (Integers) : **I** = { ……. – 3, – 2, – 1, 0, 1, 2, 3,.. ...}

(iv) जोर सङ्ख्याहरू (Even Numbers) : **E** = { 2, 4, 6, 8, ……..}

(v) बिजोर सङ्ख्याहरू (Odd Numbers) : **O** = { 1, 3, 5, 7, 9, ……..}

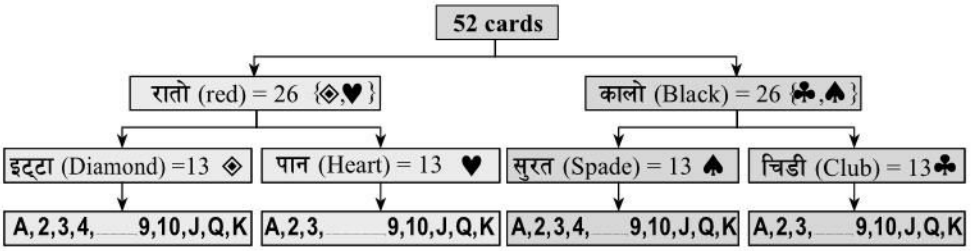
(vi) रुढ सङ्ख्याहरू (Prime Numbers) : **P** = { 2, 3, 5, 7, 11, 13, 17, 19,……..}

(vii) संयुक्त सङ्ख्याहरू (Composite Numbers) : **C** = { 4, 6, 8, 9, 10, 12, 14, 15,……..}

(viii) वर्ग सङ्ख्याहरू (Square Numbers) : **Sq.** = { 1, 4, 9, 16, 25, 36, 49, ……}

(ix) घन सङ्ख्याहरू (Cube Numbers) : **Cu.** = { 1, 8, 27, 64, 125, 216, ……}

11. ताससम्बन्धी जानकारी (Information about cards)



A → एक्का (Ace), K → राजा वा बादशाह (King),

Q → रानी वा मिस्सी (Queen), J → गुलाम (Jack)

K, Q र J लाई अनुहार भएका तासहरू भनिन्छ । त्यसैले एक प्याक तासमा 12 ओटा अनुहारहरू भएका तासहरू हुन्छन् ।

K, Q and J are known as face cards. So there are 12 face cards in a pack.

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18.1 पारस्परिक निषेधक घटनाहरूको जोड सिद्धान्त

(Addition Law of Mutually Exclusive Events)

A. BASIC EXERCISE 18.1

Short Questions

Model 1

1. राम्रोसँग फिटिएको 52 पत्तीको एक प्याकेट तासबाट नहेरीकन एक पत्ती निकालिएको छ। सो तास रातो रानी अथवा कालो तास हुने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।

A card is drawn from a well-shuffled pack of 52 cards at random. What is the probability of the card being a red queen or black card ? Find it. **[2071 E]**

⇨ Here, n(Red Queen) = 2, n(Black card) = 26, n(S) = 52

We know that,

P(Red queen or black card) = P(Red queen) + P(black)

$$= \frac{n(\text{red queen})}{n(S)} + \frac{n(\text{black card})}{n(S)} = \frac{2}{52} + \frac{26}{52} = \frac{28}{52} = \frac{7}{13}$$

Thus, the probability of getting red queen or black card is $\frac{7}{13}$.

2. राम्रोसँग फिटिएको 52 पत्तीको एक प्याकेट तासबाट नहेरीकन एक पत्ती निकाल्दा रातो एक्का वा अनुहार भएको रातो तास पर्ने सम्भाव्यता निकाल्नुहोस् ।

Find the probability of getting a red ace or a red faced card when a card is drawn randomly from a well-shuffled pack of 52 cards. **[2071 D, C]**

⇨ Here, n(red ace) = 2, n(red face cards) = 6 and n(S) = 52

We know that,

$$P(\text{red ace or red face card}) = \frac{n(\text{red ace})}{n(S)} + \frac{n(\text{red face card})}{n(S)} = \frac{2}{52} + \frac{6}{52} = \frac{8}{52} = \frac{2}{13}$$

Thus, the probability of getting a red ace or red faced card is $\frac{2}{13}$.

3. राम्ररी फिटिएको 52 पत्तीको एक प्याकेट तासबाट नहेरीकन एउटा तास थुत्दा सो तास सुरत वा इँट चित्र भएको पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।

A card is drawn randomly from a well shuffled pack of playing cards having 52 cards. What is the probability of getting spade or diamond? Find it. **[2071 A]**

⇨ Here, n(spade) = 13, n(diamond) = 13 n(sample space) = 52

We know that,

P(spade or diamond) = P(spade) + P(diamond)

$$= \frac{n(\text{spade})}{n(S)} + \frac{n(\text{diamond})}{n(S)} = \frac{13}{52} + \frac{13}{52} = \frac{26}{52} = \frac{1}{2}$$

Thus, the P(spade or diamond) is $\frac{1}{2}$.

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4. 52 पत्ती भएको तासको एक प्याकेटबाट नहेरीकरन एउटा पत्ती निकाल्दा गुलाम अथवा एक्का पर्ने सम्भाव्यता कति हुन्छ ?
What is the probability of getting a jack or ace from a well shuffled pack of 52 cards ? **[Model 2065]**

⇨ Here, total no. of cards, n(S) = 52, No. of Jack, n(J) = 4, No. of Ace; n(A) = 4

We have, $P(J \text{ or } A) = P(J) + P(A) = \frac{n(J)}{n(S)} + \frac{n(Ace)}{n(S)} = \left(\frac{4}{52} + \frac{4}{52}\right) = \frac{8}{52} = \frac{2}{13}$

Thus, P(J or A) is $\frac{2}{13}$.

5. 52 पत्ती भएको राम्ररी फिटिएको तासको एक गड्डीबाट नहेरीकन एउटा पत्ती थुत्दा सो पत्ती अनुहार भएको वा एक्का पर्ने सम्भाव्यता कति हुन्छ ?
What is the probability of getting a face card or an ace from a well shuffled pack of 52 cards when a card is drawn at random? **[2066 A, 2067 A, 2066 S]**

⇨ Here, We know that;

$P(\text{face cards or ace}) = P(\text{Face cards}) + P(\text{Ace})$

$= \frac{n(\text{Face cards})}{n(s)} + \frac{n(Ace)}{n(S)} = \frac{12}{52} + \frac{4}{52} = \frac{16}{52} = \frac{4}{13}$

6. तासको एउटा प्याकबाट एउटा तास थुतियो । यो तास बादशाह वा एक्का पर्ने सम्भाव्यता कति हुन्छ ?
From a well stuffled pack of playing card, a card is drawn at random. What is the probability that the card drawn is a king or ace ? **[2057 D2]**

⇨ Here, $P(\text{King}) = \frac{\text{Number of kings}}{\text{Total number of cards}} = \frac{4}{52} = \frac{1}{13}$

$P(\text{ace}) = \frac{\text{Number of aces}}{\text{Total number of cards}} = \frac{4}{52} = \frac{1}{13}$.

$\therefore P(\text{King or ace}) = P(\text{king}) + P(\text{ace}) = \frac{1}{13} + \frac{1}{13} = \frac{2}{13}$

Thus, P(King or Ace) is $\frac{2}{13}$.

7. राम्ररी फिटिएको 52 पत्ती तासबाट एउटा तास झिकिएको छ । एउटा एक्का वा एउटा रानी पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।
A card is drawn at a random from a well shuffled pack of 52 cards. Find the probability that it is an ace or a queen. **[2059 C1]**

⇨ Here, $P(\text{an ace}) = \frac{\text{number of aces in the packet}}{\text{Total number of cards in the packet}} = \frac{4}{52} = \frac{1}{13}$

And $P(\text{a queen}) = \frac{\text{number of queens in the packet}}{\text{Total number of cards in the packet}} = \frac{4}{52} = \frac{1}{13}$

Now, $P(\text{an ace or a queen}) = P(\text{an ace}) + P(\text{a queen}) = \frac{1}{13} + \frac{1}{13} = \frac{2}{13}$

8. 52 पत्ती भएको एक प्याकेट तासबाट एउटा पत्ती निकाल्दा बादशाह अथवा कालो तास पर्ने सम्भाव्यता कति हुन्छ ?
A card is drawn from well shuffled pack of 52 cards. What is the probability that card so drawn is either a king or a black ? **[2065 E]**

⇨ Here, n(Sample space) = n(S) = 52

Let, K and B denote king and black cards. Then n(K) = 4, n(B) = 26 and $n(K \cap B) = 2$

We know that;

$P(K \text{ or } B) = P(K) + P(B) - P(K \cap B) = \frac{n(K)}{n(S)} + \frac{n(B)}{n(S)} - \frac{n(K \cap B)}{n(S)} = \frac{4}{52} + \frac{26}{52} - \frac{2}{52} = \frac{28}{52}$

$\therefore P(K \text{ or } B) = \frac{7}{13}$

Thus, the P(K or B) is $\frac{7}{13}$.

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Model 2

9. नमुना क्षेत्र भनेको के हो ? एउटा डाइस उफार्दा 1, 3 अथवा 5 पल्टने सम्भाव्यता निकाल्नुहोस् ।

What is the sample space ? When a fair dice is thrown, calculate the probability of getting 1, 3 or 5. [2057 D1]

⇨ Here, each possible outcome of an experiment is called a sample point and the set of all possible sample points is called the sample spaces.

Now, P (getting 1, 3 or 5) $= \frac{\text{number of odd numbered faces}}{\text{number of all faces of a die}} = \frac{3}{6} = \frac{1}{2}$

10. एउटा सिक्कालाई दुईपटक उफार्दा दुवैपटक H आउने सम्भाव्यता कति होला ?

Find the probability of getting both time H when a coin is thrown twice. [2066 D]

⇨ Here, when a dice is thrown twice then,

The sample space = {HT, TH, TT, HH}

$\therefore$ n(S) = 4 $\quad$ $P(HH) = \frac{n(HH)}{n(S)} = \frac{1}{4}$

Thus, the probability of getting both time H is $\frac{1}{4}$.

Model 3

11. 1 देखि 22 सम्म लेखिएका सङ्ख्या पत्तीहरूबाट एउटा पत्ती नहेरिकन थुत्दा 5 वा 7 ले भाग जाने पत्ती पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

From a numbered cards, numbered from 1 to 22, a card is drawn at randomly. Find the probability of getting a card whose number is divisible by 5 or 7. [2071 S]

⇨ Here, let A = set of number divisible by 5

B = set of number divisible by 7

S = {1, 2, 3, ..., 22}

$\therefore$ A = {5, 10, 15, 20} and B = {7, 14, 21}

$\therefore$ n(A) = 4, n(B) = 3 and n(S) = 22

We know that, $P(A \text{ or } B) = P(A) + P(B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{4}{22} + \frac{3}{22}$

Thus, the required probability is $\frac{7}{22}$.

12. 1 देखि 30 सम्म लेखिएका संख्या पत्तीहरूबाट नहेरीकन एउटा पत्ती निकाल्दा 5 अथवा 9 ले निशेष भाग जाने संख्या पत्ती पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

A number card numbered from 1 to 30 is drawn randomly, find the probability of getting a card having the number which is divisible by 5 or 9. [2057 A1]

⇨ Here, the numbers between 1 and 30 which are exactly divisible by 5 or 9 are,

5, 10,15, 20, 25, 30, 9, 18 and 27

$\therefore$ P(divisible by 5 or 9) $= \frac{\text{number of number cards divisible by 5 or 9}}{\text{number of all available numbered cards}} = \frac{6+3}{30} = \frac{9}{30} = \frac{3}{10}$

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13. 3 देखि 32 सम्म लेखिएका सङ्ख्यापत्तीहरूबाट नहेरिकन एउटा सङ्ख्या पत्ती थुत्दा वर्ग सङ्ख्या वा घन सङ्ख्या पर्ने सम्भाव्यता निकाल्नुहोस् ।

Find the probability of occurring squared number or cubed number while drawing a flash card from the set of cards numbered from 3 to 32. **[2063 C1]**

⇨ Here, n(S) = number of numbers from 3 to 32 = 30

The square number from 3 to 32 are 4, 9, 16, 25 $\quad\therefore\quad$ n (square) = 4

The cube from 3 to 32 are 8, 27 $\quad\therefore\quad$ n (cube) = 2

The probability of occurring squared and cubed number while drawing a flash card is

$$P(\text{square or cube}) = \frac{n(\text{square})}{n(s)} + \frac{n(\text{cube})}{n(s)} = \frac{4}{30} + \frac{2}{30} = \frac{6}{30} = \frac{1}{5}$$

14. 6 देखि 39 सम्मको सङ्ख्या पत्तिहरूको समूहबाट नहेरिकन एउटा पत्ति थुत्दा सो पत्ति रुढसङ्ख्या वा घनसङ्ख्या हुने सम्भाव्यता निकाल्नुहोस् ।

A number card is drawn randomly from the set of numbered cards, numbered from 6 to 39. Find the probability that the card may be a prime number or a cubed number. **[2065 B]**

⇨ Here, sample space (S) = {6, 7, 8, ..., 39}

$\therefore$ n(S) = 34

Let, A = prime number then, A = {7, 11, 13, 17, 19, 23, 29, 31, 37}

$\therefore$ n(A) = 9

Let, B = cubed numbers then, B = {8, 27}

$\therefore$ n(B) = 2

Since, $A \cap B = \phi$

$$\text{So, } P(A \text{ or } B) = P(A) + P(B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{9}{34} + \frac{2}{34}$$

$$\therefore \quad P(A \text{ or } B) = \frac{11}{34}$$

15. 7 देखि 27 सम्म अङ्कित गरिएका सङ्ख्या पत्तीहरूबाट नहेरीकन एउटा पत्ती थुत्दा सो पत्ती रूढ सङ्ख्या वा जोर सङ्ख्या पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

From the number cards, numbered from 7 to 27 a card is drawn at random. Find the probability of getting the card of a prime or an even number. **[Model 2063, 2066 B]**

⇨ Here, let A and B denote the set of prime numbers and even numbers.

S = {7, 8, 9, ..., 27} $\quad\therefore\quad$ n(S) = 21

Then, A = {7, 11, 13, 17, 19, 23}

$\therefore$ n(A) = 6

B = {8, 10, 12, 14, 16, 18, 20, 22, 24, 26}

$\therefore$ n(B) = 10

We know that;

$$P(A \text{ or } B) = P(A) + P(B) = \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} = \frac{6}{21} + \frac{10}{21} = \frac{16}{21}$$

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16. 4 देखि 40 सम्म अङ्कित गरिएको नम्बर पत्तीबाट नहेरिकन एउटा पत्ती झिक्दा सो पत्ती 5 अथवा 8 को गुणाङ्क हुने सम्भाव्यता पत्ता लगाउनुहोस् ।

When a card is a drawn from the number cards numbered from 4 to 40, find the probability that the card is a multiple of 5 or 8. **[2065 C]**

⇨ Here, sample space (S) = {4, 5, 6, ..., 40} $\therefore$ n(S) = 37

Let, A = {Multiples of 5} = {5, 10, 15, 20, 25, 30, 35, 40} $\therefore$ n(A) = 8

Let, B = {Multiples of 8} = {8, 16, 24, 32, 40} $\therefore$ n(B) = 5

And, $A \cap B = \{40\}$ $\therefore$ $n(A \cap B) = 1$

Now, $P(A \text{ or } B) = P(A) + P(B) - P(A \cap B)$

$$= \frac{n(A)}{n(S)} + \frac{n(B)}{n(S)} - \frac{n(A \cap B)}{n(S)}$$

$$= \frac{8}{37} + \frac{5}{37} - \frac{1}{37}$$

$\therefore$ $P(\text{multiple of 5 or 8}) = \frac{12}{37}$

Model 4

17. एउटा बाकसमा 3 ओटा राता 2 ओटा नीला र 5 ओटा सेता बलहरू छन् । उक्त बाकसबाट नहेरीकन एउटा बल निकाल्दा नीला वा सेता बल पर्ने सम्भाव्यता कति होला ?

There are three red, two blue and five white balls in a box. A ball is taken out randomly. What is the probability of a ball being blue or white ? **[2058 D1]**

⇨ Here, total number of balls = 3 red + 2 blue + 5 white = 10 balls

Now, P (blue) $= \frac{\text{Number of blue balls}}{\text{Total number of balls}} = \frac{2}{10} = \frac{1}{5}$

Again, P (white) $= \frac{\text{Number of white balls}}{\text{Total number of balls}} = \frac{5}{10} = \frac{1}{2}$

Here, getting a blue ball and getting a white ball are two mutually exclusive events.

Thus, P (blue or white) = P (blue) + P (white) $= \frac{1}{5} + \frac{1}{2} = \frac{2+5}{10} = \frac{7}{10}$

18. एउटा टोकरीमा 5 ओटा पहेंला, 3 ओटा नीला र 2 ओटा हरिया बलहरू छन् । उक्त टोकरीबाट नहेरीकन एउटा बल झिक्दा नीलो रङको बल नपर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

A basket contains 5 yellow, 3 blue and 2 green balls. If a ball is drawn randomly from the basket, find the probability of not getting a blue ball. **[2067 B]**

⇨ Here, no. of yellow balls = 5 No. of blue balls = 3

No. of green balls = 2 No. of non blue balls = 5 + 2 = 7

No. of total balls i.e. n(S) = 5 + 3 + 2 = 10

We have, P(non blue balls) $= \frac{n(\text{non blue balls})}{n(S)} = \frac{7}{10}$

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Model 5

19. एउटा घनाकार डाइस र सिक्कालाई एकैपटक उफार्दा डाइसमा '5' र सिक्कामा टाउको पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

A cubical dice and a coin are thrown together at once, find the probability of getting '5' on dice and 'head' on coin. **[2068 E]**

⇨ Here, S in dice = {1, 2, 3, 4, 5, 6}, $\therefore$ $n(S_1)$ in dice = 6

S in coin = {H, T}, $\therefore$ $n(S_2)$ in coin = 2

We have P(5 and H) = $P(5) \times P(H) = \frac{n(5)}{n(S_1)} \times \frac{n(H)}{n(S_2)} = \frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$

Thus, the probability of getting 5 on die and head on coin is $\frac{1}{12}$.

20. एउटा डाइस र एउटा सिक्का एकैपटक माथि उफार्दा डाइसमा 3 आउने र सिक्कामा टाउको पर्ने सम्भाव्यता पत्ता लगाउनुहोस् ।

Find the probability of getting 3 on dice and head on the coin when a dice is rolled and coin is tossed simultaneously. **[2065 A]**

⇨ Here, for a dice; sample space = {1, 2, 3, 4, 5, 6} $\therefore$ $P(3) = \frac{n(3)}{n(S)} = \frac{1}{6}$

For a coin, sample space = {H, T} $\therefore$ $P(H) = \frac{n(H)}{n(S)} = \frac{1}{2}$

P(3 and H) = $P(3) \times P(H) = \frac{1}{6} \times \frac{1}{2}$ $\therefore$ $P(3 \text{ and } H) = \frac{1}{12}$

21. एउटा तासको प्याकेटबाट एउटा पत्ती नहेरीकन झिक्दा बादशाह नपर्ने र एउटा डाइसलाई एक पटक उफार्दा 6 नपर्ने सम्भाव्यता निकाल्नुहोस् ।

A card is drawn randomly from a pack of cards and a dice is thrown once, determine the probability of not getting a card of king as well as 6 on the dice. **[2058 C1]**

⇨ Here, P (getting king) i.e. $P(K) = \frac{\text{Number of kings in a packet}}{\text{Total number of cards in the packet}} = \frac{4}{52} = \frac{1}{13}$

$\therefore P(\overline{K}) = 1 - P(K) = 1 - \frac{1}{13} = \frac{12}{13}$

Again, P (getting 6) i. e. $P(6) = \frac{\text{Number of faces numbered in a dice}}{\text{Total number of faces in the dice}} = \frac{1}{6}$

$\therefore P(\overline{6}) = 1 - P(6) = 1 - \frac{1}{6} = \frac{5}{6}$

Here, the events 'not getting king' and 'not getting 6' are independent events.

Therefore, $P(\overline{K} \text{ and } \overline{6}) = P(\overline{K}) \times P(\overline{6}) = \frac{12}{13} \times \frac{5}{6} = \frac{10}{13}$

22. 52 पत्ती भएको एक गड्डी तासबाट एउटा पत्ती थुत्दा र त्यस्तै 2 ओटा राता र 3 ओटा नीला गुच्चा भएको बाकसबाट एउटा गुच्चा एकैसाथ निकाल्दा नीलो गुच्चा र बादशाह आउने सम्भावना पत्ता लगाउनुहोस् ।

A card is drawn at random from a pack of 52 cards and at the same time a marble is drawn at random from a bag containing 2 red marbles and 3 blue marbles. Find the probability of getting a blue marble and a king. **[2058 B1]**

⇨ Here, P(a king) $= \frac{\text{Number of kings in a pack of cards}}{\text{Total number of cards in a pack of cards}} = \frac{4}{52} = \frac{1}{13}$

Again, total number of marbles = 2 red + 3 blue = 5

$\therefore$ P (a blue marble) $= \frac{\text{Number of blue marbles}}{\text{Total number of marbles}} = \frac{3}{5}$

Therefore, P (a blue marble and a king)

= P (a blue marble) × P (a king) $= \frac{3}{5} \times \frac{1}{13} = \frac{3}{65}$

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Model 6

23. X र Y दुई पारस्परिक निषेधित घटनाहरू हुन्। यदि $p(X) = \frac{1}{8}$ र $P(Y) = \frac{5}{24}$ भए (i) $P(X \cup Y)$ र (ii) $P(\overline{X \cup Y})$ पत्ता लगाउनुहोस्।

X and Y are two mutually exclusive events. If $P(X) = \frac{1}{8}$ and $P(Y) = \frac{5}{24}$, find (i) $P(X \cup Y)$ and (ii) $P(\overline{X \cup Y})$. **[2072 C]**

⇨ Here, $P(X) = \frac{1}{8}$ and $P(Y) = \frac{5}{24}$

We know that, $P(X \cup Y) = P(X) + P(Y) = \frac{1}{8} + \frac{5}{24} = \frac{1}{3}$

Now, $P(\overline{X \cup Y}) = 1 - P(X \cup Y) = 1 - \frac{1}{3} = \frac{2}{3}$

Thus, the required probabilities are $\frac{1}{3}$ and $\frac{2}{3}$.

24. B र C दुई पारस्परिक निषेधित घटनाहरू हुन्। यदि $3P(B) = 12P(C) = 0.6$ भए (i) $P(B \cup C)$ र (ii) $P(\overline{B \cup C})$ पत्ता लगाउनुहोस्।

B and C are two mutually exclusive events. If $3P(B) = 12P(C) = 0.6$ then find (i) $P(B \cup C)$ and (ii) $P(\overline{B \cup C})$. **[2072 FW]**

⇨ Here, $3P(B) = 12\ P(C) = 0.6$

So, $P(B) = \frac{0.6}{3}$ $\therefore$ $P(B) = \frac{1}{5}$ $P(C) = \frac{0.6}{12}$ $\therefore$ $P(C) = \frac{1}{20}$

We know that, $P(B \cup C) = P(B) + P(C) = \frac{1}{5} + \frac{1}{20} = \frac{1}{4}$

Again, $P(\overline{B \cup C}) = 1 - P(B \cup C) = 1 - \frac{1}{4} = \frac{3}{4}$

Thus, the required probabilities are $\frac{1}{4}$ and $\frac{3}{4}$.

Model 7

25. "ASSOCIATIVE" शब्दका अक्षर पत्तीहरूबाट नहेरिकन एउटा अक्षर थुत्दा A वा I पर्ने सम्भाव्यता निकाल्नुहोस्।

Find the probability of occurring the letter A or I while drawing a letter card from the cards of the words "ASSOCIATIVE". **[2064 S]**

⇨ Here, sample space = {A, S, S, O, C, I, A, T, I, V, E}

$\therefore$ n (S) = 11, n(A) = 2 and n(I) = 2

We know that, $P(A \text{ or } I) = P(A) + P(I) = \frac{n(A)}{n(S)} + \frac{n(I)}{n(S)} = \frac{2}{11} + \frac{2}{11} = \frac{4}{11}$

Thus, the required probability is $\frac{4}{11}$.

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B. QUESTIONS FROM CDC TEXT BOOKS

1. A र B दुई ओटा पारस्परिक निषेधक घटनाहरू हुन्, यदि n(A) = 6 र n(B) = 3 तथा n(S) = 18 भए P(A ∪ B) को मान निकाल्नुहोस् ।

   A and B are two mutually exclusive events. If n(A) = 6, n(B) = 3 and n(S) = 18 then find the value of P(A ∪ B).

⇨ Here, n(A) = 6 and n(B) = 3

We know that, $n(A \cup B) = n(A) + n(B) = 6 + 3 \quad \therefore n(A \cup B) = 9$

Thus, the n(A ∪ B) is 9.

2. एउटा झोलामा 5 ओटा सेता, 3 ओटा राता र 4 ओटा काला उस्तै र उत्रै बलहरू राखिएका छन् । नहेरिकन एउटा बल निकाल्ने हो भने सेतो अथवा रातो बल पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।

   A bag contains 5 white, 3 red and 4 black balls of similar shape and size. If a ball is drawn randomly then what is the probability of getting white or red ball ?

⇨ Here, let, W, R and B be the white, red and black balls respectively.

Then, n(W) = 5, n(R) = 3 and n(B) = 4 and n(S) = 5 + 3 + 4 = 12

We have, $P(W \text{ or } R) = P(W) + P(R) = \frac{n(W)}{n(S)} + \frac{n(R)}{n(S)} = \frac{5}{12} + \frac{3}{12} = \frac{8}{12} = \frac{2}{3}$

Thus, the required probability is $\frac{2}{3}$.

3. एउटा बाकसमा 1 देखि 20 सम्म अङ्कित अङ्कहरू भएको उस्तै र उत्रै 20 ओटा बलहरू राखिएका छन् । नहेरिकन एउटा बल निकाल्दा 3 ले निशेष भाग लाग्ने अथवा 5 ले निशेष भाग लाग्ने बलहरू पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।

   20 balls of same size and shapes are kept in a box written from 1 to 20. If a ball is drawn randomly then find the then what is the probability of getting a ball exactly divisible by 3 or 5 exactly ?

⇨ Here, Numbers divisible by 3 = {3, 6, 9, 12, 15, 18}

Numbers divisible by 5 = {5, 10, 15, 20}

So, P(Divisible by 3 or 5) = P(Divisible by 3) + P(Divisible by) 5 – P(common)

$= \frac{n(D(3))}{n(S)} + \frac{n(D(5))}{n(5)} - \frac{n(common)}{n(S)} = \frac{6}{20} + \frac{4}{20} - \frac{1}{20} = \frac{9}{20}$

Thus, the required probability is $\frac{9}{20}$.

4. एक सेट 52 पत्ती तासलाई राम्ररी फिटेर कुनै एउटा तासको पत्ती थुत्दा एक्का (A) अथवा बादशाह (K) अथवा मिस्सी (Q) पर्ने सम्भाव्यता कति हुन्छ, निकाल्नुहोस् ।

   A card is drawn at a random from a well shuffled pack of 52 cards, what is the probability of getting ace (A) or king (K) or Queen (Q) ?

⇨ Here, let A, K and Q be ace, king and queen respectively.

Then, P(A or K or Q) = P(A) + P(K) + P(Q)

$= \frac{n(A)}{n(S)} + \frac{n(K)}{n(S)} + \frac{n(Q)}{n(S)} = \frac{4}{52} + \frac{4}{52} + \frac{4}{52} = \frac{12}{52} = \frac{3}{13}$

Thus, the required probability is $\frac{5}{13}$.

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5. एउटा डाइसलाई एक पटक उफार्दा 1 वा 3 वा 5 पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।
When a fair dice is thrown, calculate the probability of getting 1 or 3 or 5.

⇨ Here, $n(S) = 6$

We have, $P(1 \text{ or } 3 \text{ or } 5) = P(1) + P(3) + P(5) = \frac{n(1)}{n(S)} + \frac{n(3)}{n(S)} + \frac{n(5)}{n(S)} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

Thus, the required probability is $\frac{1}{2}$.



6. दिइएको चक्कामा K, Q, J र A अङ्कित चारओटा बराबर भाग देखाइएको छ । उक्त चक्कालाई घुमाउँदा निम्नअनुसारको स्थानमा सुइरो पर्ने सम्भाव्यता निकाल्नुहोस् :
(i) A मा नपर्ने सम्भाव्यता (ii) K वा Q वा J मा पर्ने सम्भाव्यता
In the given disc the four equal parts A, Q, J and A are shown what is the probability of stopping the needle on the indicated portion when the disc is rotated ?
(i) not stopping at A (ii) stopping at K or Q or J

⇨ Here, total number of portions: $n(S) = 4$

(i) $P(\text{not stopping at A}) = \frac{n(\text{not A})}{n(S)} = \frac{3}{4}$

(ii) $P(\text{Stopping at K or Q or J}) = P(K) + P(Q) + P(J) = \frac{n(K)}{n(S)} + \frac{n(Q)}{n(S)} + \frac{n(J)}{n(S)} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$

7. कक्षा 3 मा पढ्ने एउटा विद्यार्थीको पैसा राख्ने थैलीमा निम्नअनुसारका सिक्काहरू छन् ।
There are following coins in a money bag of a student studying in class 3.

सिक्का (Coins)	सङ्ख्या (Number)
25 पैसा (सुका) 25 Paisa (Suka)	12
50 पैसा (मोहर) 50 Paisa (Mohar)	8
रु. 1 (डबल) Re 1 (Dable)	10

उक्त थैलीबाट नहेरी कुनै एउटा सिक्का निकाल्दा **(A coin is drawn from the money bag.)**

(i) 25 पैसाको सिक्का पर्ने सम्भाव्यता कति हुन्छ ? **(What is the probability of getting 25 paisa coin ?)**

(ii) मोहर पर्ने सम्भाव्यता कति हुन्छ ? **(What is the probability of getting a mohar ?)**

(iii) डबल पर्ने सम्भाव्यता कति हुन्छ ? **(What is the probability of getting dable ? (Re. 1 coin))**

(iv) मोहर अथवा डबल पर्ने सम्भाव्यता कति हुन्छ ?
What is the probability of getting Mohar or dable ? (Re. 1 coin)

⇨ Here,

Coins	Number
25 Paisa (Suki)	12
50 Paisa (Mohar)	8
Re. 1 (Dable)	10
	30

(i) $P(\text{Suki}) = \frac{n(\text{Suki})}{n(S)} = \frac{12}{30} = \frac{2}{5}$

(ii) $P(\text{Mohar}) = \frac{n(\text{Mohar})}{n(S)} = \frac{8}{30} = \frac{4}{15}$

(iii) $P(\text{Re. 1 coin}) = \frac{n(\text{Re 1 coin})}{n(S)} = \frac{10}{30} = \frac{1}{3}$

(iv) $P(\text{Mohar or Re. 1 coin}) = P(\text{Mohar}) + P(\text{Re 1 coin})$

$= \frac{n(\text{Mohar})}{n(S)} + \frac{n(\text{Re. 1 coin})}{n(S)} = \frac{8}{30} + \frac{10}{30} = \frac{18}{30} = \frac{3}{5}$

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8. एउटा डाइसलाई एक पटक उर्फादा निम्नानुसारको सम्भाव्यता निकाल्नुहोस् :

A dice is tossed one time, find the probability of getting:

(i) 3 अथवा 6 पर्ने सम्भाव्यता (Probability of 3 or 6)

(ii) रुढ सङ्ख्या पर्ने सम्भाव्यता (Probability of prime number)

(iii) संयुक्त सङ्ख्या पर्ने सम्भाव्यता (Probability of composite number)

(iv) 2 भन्दा ठुलो सङ्ख्या पर्ने सम्भाव्यता (Probability of greater than 2)

(v) 7 को गुणाङ्कको सङ्ख्या पर्ने सम्भाव्यता (Probability of multiples of 7)

⇨ Here, S = {1, 2, 3, 4, 5, 6} $\therefore$ n(S) = 6

(i) $P(3 \text{ or } 6) = P(3) + P(6) = \frac{n(3)}{n(S)} + \frac{n(6)}{n(S)} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$

(ii) $P(\text{Prime}) = \frac{n(\text{Prime})}{n(S)} = \frac{3}{6} = \frac{1}{2}$

(iii) $P(\text{Composite}) = \frac{n(\text{Composite})}{n(S)} = \frac{2}{6} = \frac{1}{3}$

(iv) $P(>2) = \frac{n(>2)}{n(S)} = \frac{4}{6} = \frac{2}{3}$ (v) $P(m(7)) = \frac{n(m(7))}{n(S)} = \frac{0}{6} = 0$

9. सम्भाव्यताको अङ्ग्रेजी शब्द **"PROBABILITY"** का एक एक अक्षर लेखिएका एघार ओटा पत्तीहरूबाट नहेरी एउटा पत्ती निकाल्दा **B** अथवा **A** अथवा **T** अङ्कित पत्ती पर्ने सम्भाव्यता कति हुन्छ ? पत्ता लगाउनुहोस् ।

Find the probability of occurring the letters B or A or T while drawing a letter card from 11 cards of the word "PROBABILITY".

⇨ Here, Sample space = {P, R, O, B, A, B, I, L, I, T, Y} $\therefore$ n(S) = 11

We know that,

$$P(\text{B or A or T}) = P(B) + P(A) + P(T)$$
$$= \frac{n(B)}{n(S)} + \frac{n(A)}{n(S)} + \frac{n(T)}{n(S)}$$
$$= \frac{2}{11} + \frac{1}{11} + \frac{1}{11} = \frac{4}{11}$$

Thus, the required probability is $\frac{4}{11}$.

10. गणितको अङ्ग्रेजी शब्द **"MATHEMATICS"** का 11 ओटा अक्षरहरू अङ्कित पत्तीहरूबाट नहेरिकन एउटा पत्ती निकाल्दा **M** अथवा **A** अथवा **T** अङ्कित पत्ती पर्ने सम्भाव्यता कति हुन्छ, निकाल्नुहोस् ।

Find the probability of occurring the letters M or A or T while drawing a letter card from 11 cards of the word "MATHEMATICS".

⇨ Here, Sample space (S) = {M, A, T, H, E, M, A, T, I, C, S} $\therefore$ n(S) = 11

We know that,

$$P(\text{M or A or T}) = P(M) + P(A) + P(T)$$
$$= \frac{n(M)}{n(S)} + \frac{n(A)}{n(S)} + \frac{n(T)}{n(S)} = \frac{2}{11} + \frac{2}{11} + \frac{2}{11} = \frac{6}{11}$$

Thus, the required probability is $\frac{6}{11}$.

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18.2 सम्भाव्यताको गुणन सिद्धान्त र वृक्षचित्र

Multiplication Law and Tree Diagram of Probability

A. BASIC EXERCISE 18.2

Short Questions

Model 1

1. 44 ओटा उस्तै र उत्रै टेबुलटेनिस बलहरू भएको बाकसमा 33 ओटा काला र बाँकी राता बलहरू रहेछन् । दुईओटा बलहरू एकपछि अर्को पुनः नराख्ने गरी निकाल्दा आउने सबै परिणामहरूको सम्भाव्यतालाई वृक्ष चित्रमा प्रस्तुत गर्नुहोस् ।

A box contains 44 table tennis balls having the same shape and size. Among them, 33 are black and remaining are red balls. Two balls are drawn randomly one after another without replacement, show the probabilities of all possible outcomes in a tree-diagram. **[2072 E]**

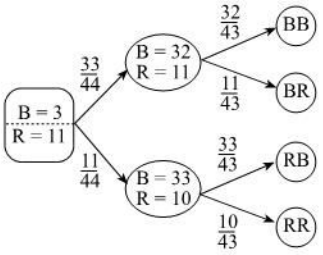
⇨ Here, total no. of tennis balls 44

No. of black balls = 33 and

No. of red balls = 44 – 33 = 11

Let B and R be the black ball and red ball respectively.

Now, the tree diagrams of all the possible outcomes.



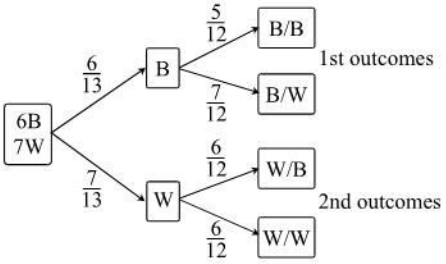
2. एउटा बाकसमा 6 ओटा काला र 7 ओटा सेता रङका एउटै आकार र प्रकारका गुच्चाहरू राखिएका छन् । पुनः नराख्ने गरी प्रत्येक पटक एक-एक गरी दुईओटा गुच्चाहरू निकाल्दा हुन आउने सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् ।

There are 6 black and 7 white marbles of same size and shape are kept in a box. Two marbles are drawn one at a time randomly without replacement. Show the probability by drawing a tree-diagram. **[2071 B]**

⇨ Here, let B and W denote the set of red balls and black balls respectively.

∴ n(B) = 6, n(W) = 7 and n(S) = 7 + 6 = 13

The tree diagram is shown alongside.



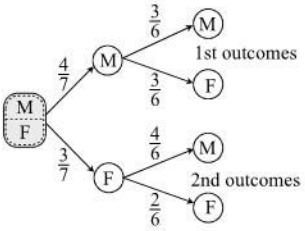
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Model 2

3. एउटा परिवारमा 4 जना पुरुष र 3 जना महिला छन् । दुई दिन लगातार एक जनालाई नदोहोरिने गरी निश्चित काममा लगाइयो । दुवै दिन पुरुष पर्ने सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् .

There are 4 male and 3 female members in a family. A member is sent for 2 days continuously in certain work without repetition. Represent the probability for getting both days male in a tree diagram. [2071 S]

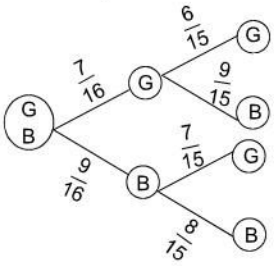
⇨ Here, let, M and F are the events getting male and female respectively.
Showing the required probabilities in a tree diagram.



4. एउटा भाँडोमा 7 ओटा हरिया र 9 ओटा काला उत्रै र उस्तै बलहरू छन् । सो भाँडोबाट नहेरिकन दुईओटा बलहरू एकपछि अर्को पुनः नराखि झिक्दा हुन सक्ने सबै सम्भाव्यतालाई वृक्षचित्रमा प्रस्तुत गर्नुहोस् र दुवै काला बलहरू पर्ने सम्भाव्यता पनि निकाल्नुहोस् ।

An urn contains 7 green and 9 black balls of the same shape and size. Two balls are drawn at random one after the other without replacement. Draw a tree diagram showing all the probabilities and also find the probability of getting both black balls. [2065 B]

⇨ Here, let G and B denote green and black balls then,
n(G) = 7 and n(B) = 9
Showing the required probabilities in a tree diagram.

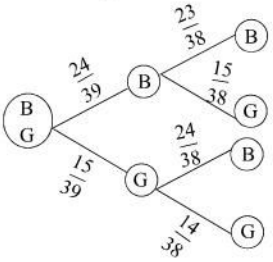


Now, $P(BB) = \frac{9}{16} \times \frac{8}{15} = \frac{3}{10}$

5. 24 केटा र 15 केटीहरू भएको कक्षाबाट दुई जना विद्यार्थीहरू गोला प्रथाबाट छान्दा केटा र केटी पर्ने सबै सम्भाव्यताहरूलाई एउटा वृक्ष चित्रमा प्रस्तुत गर्नुहोस् ।

From a class having 24 boys and 15 girls, two students are selected randomly. Show all the probabilities of being a boy and a girl on a tree diagram. [2066 S]

⇨ Here, n(B) = Number of boys = 24 and
n(G) = Number of girls = 15
Total students = 24 + 15 = 39
Showing the required probabilities in a tree diagram.



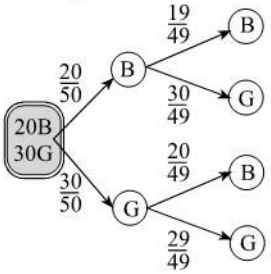
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6. 20 जना केटा र 30 जना केटीहरू भएको एउटा कक्षाबाट गोला प्रथाबाट 2 जना विद्यार्थीहरूको नाम छान्दा केटा अथवा केटी पर्ने सम्भाव्यतालाई वृक्षचित्र तयार पारी देखाउनुहोस् ।
A class contains 20 boys and 30 girls. If two students are selected at random, show the probability of selecting a boy and a girl on a tree diagram. **[2065 C]**

⇨ Here, let, B and G denote sets of boys and girls then,
n(B) = 20 and n(G) = 30
Then probabilities is shown in the tree diagram.

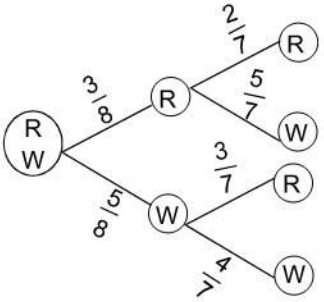


Model 3

7. 3 ओटा राता र 5 ओटा सेता बल राखिएको झोलाबाट एउटा बल झिकियो । फेरि यो बललाई झोलामा नराखी दोस्रो बल झिकियो । सम्भाव्यता वृक्षचित्र खिच्नुहोस् र दुवै बल रातो रङका हुने सम्भाव्यता निकाल्नुहोस् ।
A ball is drawn from a bag containing three red and five white balls randomly and not replaced. Then another ball is drawn. Write the sample space of the experiment using tree diagram and find the probability of getting two red balls. **[2057D1]**

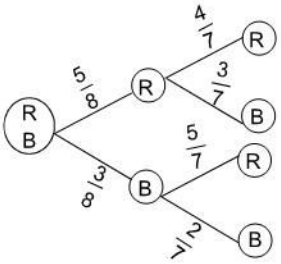
⇨ Here, let R and W denote a red and a white ball respectively. The probability tree diagram is shown as in the alongside.

From the tree diagram, $P(R/R) = P(RR) = \frac{3}{8} \times \frac{2}{7} = \frac{3}{28}$



8. एउटा झोलामा 5 ओटा राता र 3 ओटा निला बलहरू छन् । एउटा बल नहेरीकन सो झोलाबाट झिकी त्यही राखियो । त्यसपछि अर्को बल झिकियो भने दुवै बल नीलो रङका बलहरू आउने सम्भाव्यता पत्ता लगाउनुहोस् ।
A bag contains 5 red balls and 3 blue balls. A ball is drawn at random and replaced. After that another balls is drawn. Find the probability that both balls are blue.[2057 B2]

⇨ Here, let, R and B denote a red and a blue ball respectively. The probability tree diagram is shown as in the alongside.



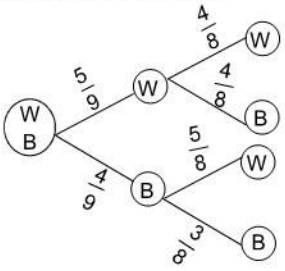
From the tree diagram, $P(BB) = \frac{3}{8} \times \frac{2}{7} = \frac{3}{28}$

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9. एउटा झोलामा 5 ओटा सेता बलहरू र 4 ओटा काला बलहरू राखिएका छन् । दुईओटा बलहरू एकपछि अर्को गरी अनायसी झिकिएका छन् । सो सम्भाव्यतालाई वृक्षचित्रमा देखाउनुहोस् र साथै दुवै सेता बलहरू पर्ने सम्भाव्यता पत्ता लगाउनुहोस् । [2060 C]

There are 5 white balls and 4 black balls in a bag. Two balls are drawn randomly one after the other. Show the probability in a tree diagram and also find the probability of getting two white balls.

⇨ Here, let, W and B denote the events getting a ball of white and a ball of black respectively. The probability tree diagram is shown in the adjoining figure.



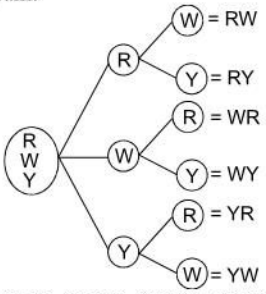
From the tree diagram $P(WW) = P_1(W) \times P_2(W) = \frac{5}{9} \times \frac{4}{8} = \frac{5}{18}$

Model 4

10. एउटा भाँडोमा एउटा रातो, एउटा सेतो र एउटा पहेँलो गरी तीनओटा मिठाइहरू छन् । उक्त भाँडोबाट नहेरीकन एउटा मिठाइ तान्ने र उक्त मिठाई भाँडोमा नराखी पुनः अर्को मिठाइ तान्ने परीक्षणको सबै परिणामको वृक्षचित्र प्रयोग गरी नमूना क्षेत्र लेख्नुहोस् । [2057 C1, C2, 2058 S]

There is one red, one white and one yellow sweet in a pot. A sweet is taken out randomly and not replaced. Then another sweet is drawn. Write the sample space of the experiment using a tree diagram.

⇨ Here, let, R, W and Y denote red sweet, white sweet and yellow sweet respectively. The probability is shown in the adjoining tree diagram.

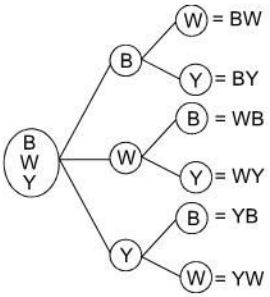


Now, Sample space (S) = {(R,W), (R,Y), (W,R), (W,Y), (Y,R), (Y,W)}

11. एउटा बाकसमा एउटा कालो, एउटा सेतो र एउटा पहेँलो गरी 3 ओटा गुच्चाहरू राखिएका छन् । उक्त बाकसबाट नहेरीकन एउटा गुच्चा झिक्ने र उक्त गुच्चा बाकसमा पुनः नराखी अर्को गुच्चा तानी परीक्षणको सबै परिणामको वृक्षचित्र प्रयोग गरी नमुना क्षेत्र बनाउनुहोस् ।

There is one black, one white and one yellow marbles in a box. One marble is taken out randomly without replacement another marble is drawn. Write the sample space of the experiment using a tree diagram. [2063 A1]

⇨ Here, let, B, W and Y denote black marble, white marble and yellow marble respectively. The probability of all possible outcomes is shown in tree diagram alongside :



The sample space = {BW, BY, WB, WY, YB,YW}.

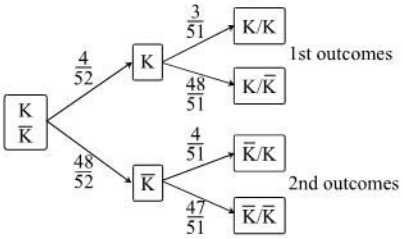
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Model 5

12. राम्रो फिटिएको 52 पत्तीको एक प्याकेट तासबाट नहेरीकन एक पछि अर्कोगरी दुईओटा तासहरू (पुनः नराखीकन) झिक्दा राजा आउन सक्ने वा नसक्ने सबै परिणामहरूको सम्भाव्यतालाई एउटा वृक्षचित्रमा देखाउनुहोस् ।
Two cards are drawn randomly in succession without replacement from a well-shuffled pack of 52 cards. Show the probability of all the possible outcomes of getting or not getting a king in a tree diagram. **[2071 C]**

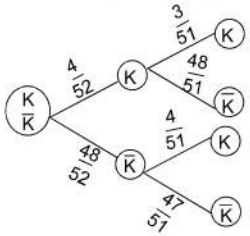
⇨ Here, let, K and $\overline{K}$ denote the events getting king and not getting king respectively.

$n(K) = 4$, $n(\overline{K}) = 48$ & $n(S) = 52$
The probabilities of all the outcomes are shown alongside.



13. राम्रो फिटेको 52 पत्ती तासको प्याकेटबाट दुईओटा तास एकपछि अर्को (फिर्ता नराख्ने गरी) थुत्दा दुवै तास राजा नै पर्ने सम्भाव्यता कति हुन्छ ? वृक्षचित्र बनाई पत्ता लगाउनुहोस् ।
Two cards are drawn from a well–shuffled deck of 52 cards. Find the probability that both cards are king (the first card is not replaced) by drawing a tree diagram. **[2059 E1]**

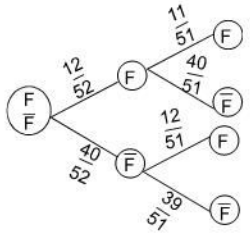
⇨ Here, let, K and $\overline{K}$ denote the events getting a card of king and not getting a card of king respectively.
The probability tree diagram is shown in the adjoining figure.



From the tree diagram, $P(KK) = \frac{4}{52} \times \frac{3}{51} = \frac{1}{221}$

14. एउटा तासको प्याकेटबाट नहेरीकन पुनः नराख्ने गरी क्रमशः दुईओटा तास झिक्दा दुवैपल्ट चित्र भएको तास पर्ने सम्भाव्यता निकाल्नुहोस् ।
From a packet of cards, two cards are drawn in succession at random without replacement. Find the probability that the cards so drawn are face cards. **[2060 B1]**

⇨ Here, let, F and $\overline{F}$ denote a face card and a non face card respectively. The probability is shown in the adjoining tree diagram.



From the Tree diagram, $P(FF) = \frac{12}{52} \times \frac{11}{51} = \frac{11}{221}$

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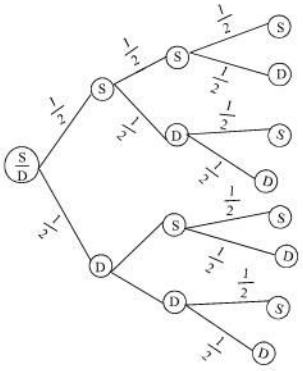
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Model 6

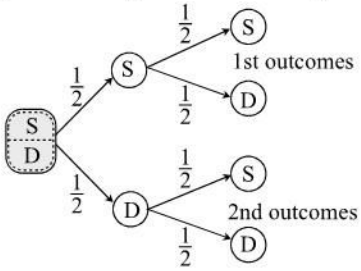
15. एक दम्पतिका तिनजना छोरा-छोरी छन् । सम्भाव्य परिणामहरूलाई वृक्षचित्रमा देखाउनुहोस् ।
A couple has three children. Show all the possible outcomes in tree diagram. **[2068 E]**

⇨ Here, let, S and D denote son and daughter then the possible outcomes are shown in the following tree diagram.



16. एउटा विवाहित दम्पतीबाट दुईओटा बच्चाहरू जन्मिएका थिए । तीमध्ये कमसेकम एकजना छोरी हुन सक्ने सम्भाव्यता वृक्षचित्रमा प्रस्तुत गर्नुहोस् ।
Two children were given birth by a married couple. Represent the probability of giving birth of a daughter in a tree-diagram. **[2071 A]**

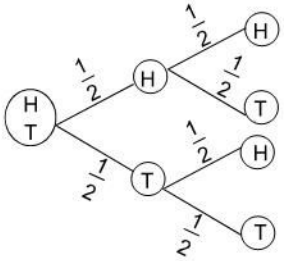
⇨ Here, let, S and D denote the son and daughter.
Then, the probability of giving birth of daughter is shown alongside.



Model 7

17. एउटा सिक्कालाई दुईपटक उछाल्दा बन्ने सम्भाव्यतालाई वृक्ष चित्रमा प्रस्तुत गर्नुहोस् र दुवै पटक नै टाउको (Head) पर्ने सम्भाव्यता निकाल्नुहोस् ।
A coin is tossed two times and represent the probabilities in a tree diagram. Find the probabilities of getting heads two times. **[2059 B1]**

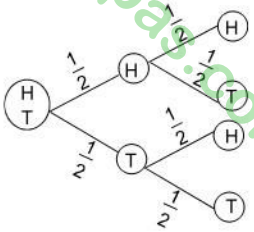
⇨ Here, let, H and T denote the events getting a face of head and a face of tail respectively.
The probability tree diagram is shown in the adjoining figure.
From the tree diagram,



$$P(HH) = P_1(H) \times P_2(H) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

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18. एउटा सिक्का दुईपटक उफारिएको छ। एउटा वृक्षचित्र खिच्नुहोस् र नमुना क्षेत्र लेख्नुहोस् ।
A coin is tossed two times in succession; draw a tree diagram and write the sample space. [2060 C1, 2060 C2]

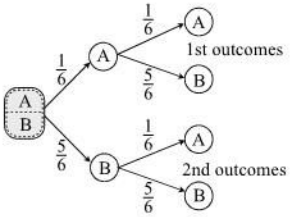


⇨ Here, let, H and T denote the head and tail of a coin respectively.
The probability tree diagram may be shown in the adjoining figure.

Sample space (S)= {(H,H),(H,T),(T,H),(T,T)}

Model 8

19. एउटा घनाकार डाइसलाई दुईपटक गुडाउँदा पाँच आउने वा नआउने सबै परिणामहरूको सम्भाव्यतालाई एउटा वृक्षचित्रमा देखाउनुहोस् ।
A cubical dice is rolled two times. Show the probabilities of all the possible outcomes of getting or not getting 5 in a tree diagram [2071 E]



⇨ Here, let, A and B are the events getting 5 and not 5. Showing the required probabilities in a tree diagram.

B. QUESTIONS FROM CDC TEXT BOOKS

1. एउटा सिक्का र एउटा डाइस एकसाथ उफार्दा सिक्कामा पछिल्लो भाग (T) र डाइसमा 3 आउने सम्भाव्यता निकाल्नुहोस् ।
A coin and a dice are thrown together at once. Find the probability of getting tail on the coin and 3 on the dice.

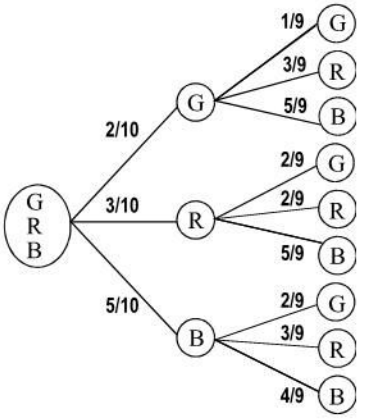
⇨ Here, In a coin sample space $(S_1) = \{H, T\}$ $\therefore$ $n(S_1) = 2$
In a dice sample space $(S_2) = \{1, 2, 3, 4, 5, 6\}$ $\therefore$ $n(S_2) = 6$

Now, $P(\text{Tail and } 3) = P(\text{Tail}) \times P(3) = \frac{n(\text{Tail})}{n(S_1)} \times \frac{n(3)}{n(S_2)} = \frac{1}{2} \times \frac{1}{6}$

Thus, the required probability is $\frac{1}{12}$.

2. एउटा बाकसमा 2 ओटा हरिया, 3 ओटा राता र 5 ओटा काला उस्तै र उत्रै बलहरू राखिएका छन् । त्यसबाट नहेरिकन एउटा बल निकाली पुनः त्यसमा नराखी अर्को बल नहेरी निकाल्दा निम्नअनुसारका बलहरू आउने सम्भाव्यता पत्ता लगाउनुहोस् :
A box contains 2 green, 3 red and 5 black balls of same size and shape. If one ball is drawn at random and another ball is also drawn without replacing the first ball. Find the probability of getting following balls:
(i) दुवै एउटै रङका (Both are of same colour.)
(ii) दुई ओटा भिन्ना भिन्नै रङका (Two balls are of different colour.)
(iii) कम्तीमा एउटा बल रातो अथवा कालो रङका (Atleast one red or black ball.)

⇨ Here, No. of green balls = 2, No. of red balls = 3 and No. of black balls = 5 ,
Total = 10
Drawing a tree diagram of given information:



From the tree diagram
(i) P(Both same colour)
= P(GG) or P(RR) or P(BB)
$= \frac{2}{10} \times \frac{1}{9} + \frac{3}{10} \times \frac{2}{9} + \frac{5}{10} \times \frac{4}{9}$
$= \frac{2 + 6 + 20}{10 \times 9} = \frac{28}{10 \times 9} = \frac{14}{45}$

(ii) P(Difference colours) = 1 – P(Same colour)
$= 1 - \frac{14}{45} = \frac{31}{45}$

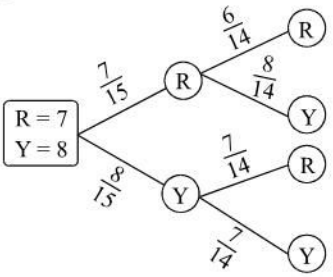
(iii) P(Atleast one red or black) = 1 – P(GG)
$= 1 - \frac{2}{10} \times \frac{1}{9} = 1 - \frac{1}{45} = \frac{44}{45}$

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3. एउटा झोलामा राखिएका 7 ओटा राता र 8 ओटा पहेँला उस्तै र उस्तै बलहरूमा दुई ओटा बलहरू पालैपालो निकाल्दा दुवै पटक रातो अथवा पहेँलो बल आउने सम्भाव्यतालाई वृक्षचित्रमा प्रस्तुत गरी निकाल्नुहोस् । (पहिले निकालिएको बल पुनः झोलामा नराख्ने ।)
From a bag containing 7 red and 8 yellow balls of same shape and size two balls are drawn one after the other. Draw a tree diagram showing all the probabilities and also find the probability of getting both red or yellow. (the ball drawn first is not replaced in the bag.)

⇨ Here, let R and Y be the set of red and yellow balls respectively.
The tree diagram is shown alongside:



From the tree diagram,

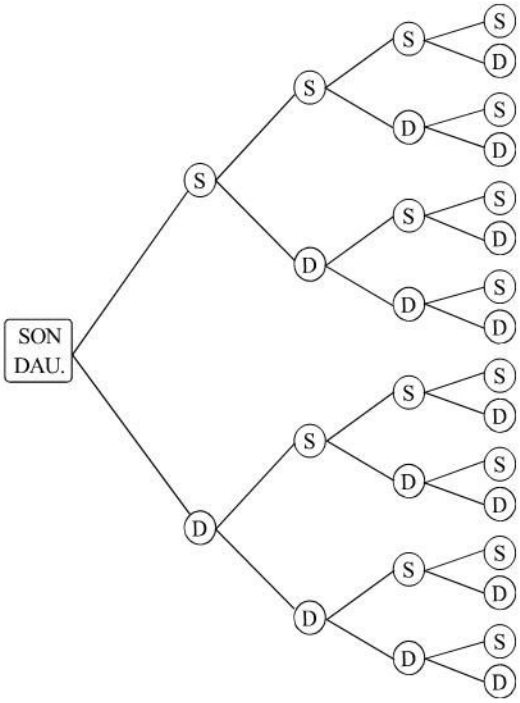
$$\text{P(Both red or yellow)} = \text{P(Both red)} + \text{P(Both Yellow)}$$
$$= \frac{7}{15}\times\frac{6}{14}+\frac{8}{15}\times\frac{7}{14}=\frac{7}{15}$$

Thus, the required probability is $\frac{7}{15}$.

4. एउटा परिवारमा 4 जना बच्चाहरू छन् । प्रत्येक जन्ममा छोरा वा छोरी हुने सम्भावना बराबर छ । उक्त परिवारमा जन्मेका बच्चाहरूमा 4 जना छोरा वा छोरी हुने सम्भाव्यतालाई वृक्षचित्रमा प्रस्तुत गर्नुहोस् ।
Four children are born in a family. There is equal chance of being son or daughter girl in every birth. Show the probability of having son or daughters in a tree diagram.

⇨ Here, let, S and D denote the son and daughter. Using a tree diagram,

The probability tree diagram is shown alongside.



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5. राम्ररी फिटिएको 52 पत्तीको 1 सेट तासबाट नहेरिकन एउटा तास झिकेर पुनः त्यसमा नराखी नहेरीकनै दोस्रो तास झिक्दा हुने सम्भावित घटनालाई वृक्षचित्रमा देखाई निम्न प्रश्नहरूको जवाफ दिनुहोस् :

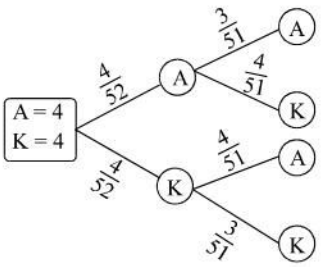
(i) दुवै पटक एक्का पर्ने सम्भाव्यता कति हुन्छ ?

(ii) एक एक ओटा एक्का वा बादशाह पर्ने सम्भाव्यता कति हुन्छ ?

Two cards are drawn one after the another (without replacement) from a well shuffled pack of 52 playing cards. Show the possible events in a tree diagram and answer the following questions.

(i) What is the probability of getting both the ace.

(ii) What is the probability of getting one ace and king.



⇨ Here, let, A and K denote the set of aces and kings in a pack of 52 cards then the tree diagram of getting ace and king is shown below:

(i) $P(AA) = \frac{4}{52} \times \frac{3}{51} = \frac{1}{221}$

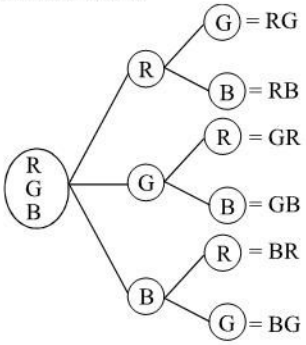
(ii) $P(AK) \text{ or } P(KA) = \frac{4}{52} \times \frac{4}{51} + \frac{4}{52} \times \frac{4}{51} = \frac{8}{663}$

Thus, the required probabilities are $\frac{1}{121}$ and $\frac{8}{663}$ respectively.

6. एउटा झोलामा रातो, हरियो र कालो एक एक ओटा उस्तै र उत्रै गुच्चाहरू राखिएका छन् । उक्त झोलाबाट नहेरिकन एउटा गुच्चा निकाल्ने र पुनः त्यसमा नराखी अर्को गुच्चा निकाल्दा हुने सबै सम्भाव्यताहरूलाई वृक्षचित्रमा प्रस्तुत गर्नुहोस् ।

From the bag containing one red, one green and one black ball of the same shape and size, two balls are drawn randomly in succession without replacement. Show the probabilities of all outcomes in a tree diagram.

⇨ Here, let, R, G and B be the red, green and black balls respectively.
Then the probability tree diagram is shown above:



7. एउटा झोलामा एक एक ओटा रातो, सेतो र कालो बलहरू राखिएका छन् । तीमध्ये एउटा बल झिकेर त्यही बल नदोहोरिने गरी क्रमशः अरु बल झिक्दा हुने सम्भाव्यतालाई तालिका र वृक्षचित्रमा प्रस्तुत गर्नुहोस् ।

A bag contains one red, one white and one black ball. Among them draw a ball and then draw other ball without repeating first. Show all the possible outcomes in table and tree diagram.

⇨ Here, let, R, W and B denote the red, white and black ball respectively.
Tree diagram,

W	B
RW	RB
WR	WB
BW	BR

