Chemistry

NEW SYLLABUS

Teaching Hours: 150T+50P

Full marks: 100 (75T + 25 P)
Pass Marks: 27T + 8P

I. Introduction

Chemistry is concerned with the physical and chemical characteristics of substances, the nature of matter and the study of chemical reactions. Chemistry, thus, is a powerful process of uncovering and extending our understanding of various chemical phenomena. The power resides in the combination of concepts and experiments involving careful observation and quantitative measurements under controlled conditions. The resulting concepts suggest further experiments and investigations as a result, there will be a modification of the existing concept leading to a creativity of thought. This creativity involves the recognition of a problem; formulation of ideas to solve the problem and ultimately refinement of the original ideas. The present curriculum aims to foster this uniqueness among students by enabling them to study both theoretical and practical aspects of chemistry.

This course is theory-cum-practical. It is intended to consolidate learning in chemistry achieved in the secondary school. Furthermore, it intends to provide a concrete knowledge and appropriate skills for those students, continuing further studies in chemistry and the students not studying the subject beyond this stage. The course seeks to maintain a balance between useful facts, concepts and theories which will facilitate understanding of the properties of substances, reactions and processes. Emphasis is enforced to stimulate, create and sustain students' interest in chemistry.

Chemistry being an experimental science, laboratory is an essential component of its syllabus. The course intends to make students aware of the importance of scientific method for accurate experimental work and develop the abilities to interpret, organize and evaluate data in order to make decisions and solve problems.

II. General Objectives

The general objectives of this course are to:

1. apply appropriate chemical principles, concepts, theories, definitions, laws, models and patterns to interpret, draw conclusion, make generalization, and predictions from chemical facts, observations and experimental data;
2. select appropriate facts to illustrate a given principle, concept, theory, model and pattern;
3. present chemical ideas in a clear and logical form; and
4. select and organize data and perform calculations in which guidance on the method is not supplied.

III. Specific Objectives

After studying the course, the student shall be able to :

1. state and apply fundamental facts and principles of chemistry dealing with the
   i. Methods of preparation: general, laboratory and industrial process of the matters,
   ii. Physical and chemical properties,
   iii. Important applications.
2. perform chemical calculations;
3. identify the mineral resources of Nepal;
4. understand chemical patterns and principles;
5. apply knowledge and understanding of chemistry in familiar and unfamiliar situations;
6. make accurate observations and measurements, being aware of possible sources of error;
7. record the results of experiments accurately and clearly; draw conclusion and make generalization from experiment; and
8. appreciate the scientific, social, economic, environmental and technological contributions and applications of chemistry.

General & Physical Chemistry (Section A)

Unit 1: Chemical Bonding and Shape of Molecules - 3 teaching hours

1. Hybridization and concept of sigma and pi bond
2. Valence shell Electron Pair Repulsion (VSEPR) theory
3. Prediction of molecular geometry (Shape of molecules) on the basis of VSEPR and hybridization. (BeF_2, BF_3, NH_3, H_2O, CH_4, H_2O_2, C_2H_2, C_2H_4, H_2S)

Unit 2: Volumetric Analysis - 8 teaching hours

1. Different ways of expressing the concentration of solutions
   i. Molarity
   ii. Normality
   iii. Molality
   iv. Gram /Litre
   v. Percentage
2. Titration:
   i. Acid-base titration
   ii. Redox titration
3. Primary standard substances, primary standard solution, secondary standard solution, end point, equivalence point, neutral point, indicators
4. Derivation of normality equation
5. Relation between normality and molarity
6. Selection of indicators in acid-base titration and pH curve
7. Solving related numerical problems

Unit 3: Ionic Equilibrium - 12 teaching hou

1. Introduction
2. Ionization of weak electrolyte (Ostwald's dilution law)
3. Degree of ionization and ionization constant
4. Strength of acids and base interm of K_a, K_b and p_{Ka} and p_{Kb} values
5. Acid-base concept
   i. Arrhenius concept of acids and bases.
   ii. Bronsted Lowrry concept of acids and bases
   iii. Lewis concept of acids and bases.
6. Ionization of water, pH and pH-scale
7. Hydrolysis of salts (qualitative concept)
8. Solubility product principle and its application
9. Common ion effects and its application
10. Application of solubility product principle in qualitative analysis
11. Buffer Solution

(Solving numerical problems related with solubility, solubility product, pH and pOH)

Unit 4: Electrochemistry - 10 teaching hou

1. Introduction
2. Electrolysis; strong and weak electrolyte
3. Arrehenius theory of ionization
4. Faraday's laws of electrolysis
5. Criteria of product formation during electrolysis
6. Electrolytic conduction, equivalent and molar conductivities
7. Variation of conductivity with concentration
8. Electrode potential, standard electrode potential, standard hydrogen electrode and its applications
9. Eletrochemical series and its use to predict the feasibility of redox reactions
10. Electrochemical cell (Galvanic cell)
11. EMF of electrochemical cell in the standard state

(Solving related numerical problems)

Unit 5: Energetics of Chemical Reactions - 8 teaching hou

1. Introduction, unit of energy
2. Some thermodynamical terms: system, surrounding, boundary, universe different types of system, state function, sta variables and internal energy
3. Exchange of energy between the system and surrounding
4. Different types of thermodynamic process
5. The first law of thermodynamics
6. Sign convention of heat and work
7. Enthalpy, enthalpy change in chemical reactions
8. Hess's law of constant heat summation
9. Heat of neutralization, heat of solution, heat of combustion, heat of vapourization, heat of formation and bond energy

(Solving related numerical problems)

Unit 6: Chemical Thermodynamics - 6 teaching hou

1. Spontaneous process
2. Second law of thermodynamics
3. Entropy and its physical concept
4. Entropy change in phase transformation
5. Entropy and spontaneity
6. Entropy changes and their calculation
7. Gibb's free energy and prediction for the feasibility of reaction
8. Standard free energy change and equilibrium constant
9. Influence of temperature on spontaneous process

(Calculation involving in standard free energy change and equilibrium constant)

Unit 7: Chemical Kinetics - 10 Teaching hou

1. Concept of reaction rate
2. Average rate and instantaneous rate of a reaction
3. Factors that influences the rate of reaction
4. Rate law equation, rate constant and its units
5. 1^{st} order, 2^{nd} order, 3^{rd} order and zero order reactions
6. Order and molecularity of a reaction
7. Integrated rate law for a first order reaction
8. Half-life of a reaction (first order)
9. Explaining the increase in reaction rate with temperature or collision theory (qualitative concept only)
10. Concept of activation energy as the energy barrier, activated complex and effect of catalyst on the rate of reaction

(Solving related numerical problems)

Unit 8: Aromatic Hydrocarbon - 3 teaching hours

1. Definition, characteristics of aromatic compounds, Huckel's rule, structure of benzene, isomerism and orientation of benzene derivatives
2. Preparation of benzenes from
   i. decarboxylation; ii. phenol; iii. ethyne; iv. chlorobenzene
3. Physical properties of benzene
4. Chemical properties of benzene
   i. Addition reaction : hydrogen, halogen and ozone
   ii. Electrophilic substitution reactions: nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation
   iii. Combustion of benzene and uses

Unit 9: Haloalkanes and Haloarenes

9.1. Haloalkanes: - 8 teaching hours

1. Introduction, classification and isomerism
2. Preparation of monohaloalkanes from alkanes, alkenes and alcohols
3. Physical properties of monohaloalkanes
4. Chemical properties
   - Substitution reactions
   - Elimination reaction (dehydrohalogenation)
   - Grignard's reactions
   - Reduction reactions
   - Wurtz's reaction
5. Polyhaloalkane;
   - Laboratory preparation of trichloromethane from ethanol and proponone
   - Physical properties of trichloromethane
   - Chemical properties: oxidation, reduction, action on Silver Powder, conc. nitric acid, propanone, aqueous alkali, Carbyl amine reaction, Reimer Tiemann's reaction, iodoform reaction, etc

9.2. Haloarenes:

- Preparation of chlorobenzene from
  i. benzene
  ii. benzene diazonium chloride
- Physical properties
- Chemical properties
  - Low reactivity of haloarene as compared to haloalkane in term of nucleophilic substitution reaction
  - Reduction of chlorobenzene
  - Electrophilic substitutre reactons
  - Action with Na, Mg and chloral etc.
  - Uses

Unit 10: Alcohols and Phenols - 10 teaching hours

10.1. Alcohols:

1. Introduction, classification, nomenclature and isomerism
2. Distinction of primary, secondary and tertiary alcohol by Victor Meyer's Method
3. Preparation of monohydric alcohols from i. haloalkane ii. Grignard's reagents using aldehydes and ketones iii. primary amines iv. Ester
4. Industrial preparation ethanol from: i. Oxo-process ii. Fermentation of sugar iii. hydroboration of ethene
5. Physical properties monohydric alcohols
6. Chemical properties of monohydric alcohols
   - Reaction with HX. PX_3, P_2O_5, $SOCl_2$
   - Action with reactive metals like Na, K, Li
   - Esterification process
   - Dehydration of alcohols.
   - Oxidation of primary, secondary and tertiary alcohol with oxidizing agents.
   - Reduction of alcohols (Catalyic dehydrogenation)
   - Laboratory test of ethanol
   - Absolute alcohol, methylated spirit, rectified spirit; alcoholic beverage.
- Preparation and uses of ethane-1, 2-diol (glycol)
- Preparation and uses of Propane-1, 2, 3- triol (glycerol)

10.2. Phenols:

1. Introduction to phenol
2. Preparation of phenol from
   i. chlorobenzene
   ii. Diazonium salt and
   iii. benzene sulphonic acid
3. Physical properties of phenol
4. Chemical properties
   - Acidic nature of phenol

- Action with PCl_5, PX_3, NH_3, Zn, Na, benzene diazonium chloride and phthalic anhydride
- Acylation reaction, Kolbe's reaction, Reimer Tiemann's reaction
- **Electrophilic substitution:** halogenation, nitration, sulphonation, and Friedel Craft's alkylation
- Laboratory test of phenol
- Uses of phenol

Unit 11: Ethers - 4 teaching hours

11.1 Aliphatic Ethers:

1. Introduction, nomenclature classification, isomerism in ether
2. Preparation of ethers from i. alcohol ii. Williamson's etherification process
3. Laboratory preparation of ethoxyethane from ethanol
4. Physical properties of ether
5. Chemical properties of ethoxyethane
   - action with HI, PCl_5, Conc. HCl, Conc. H_2SO_4, air and Cl_2
   - Uses of ethoxyethane

11.2 Aromatic Ether:

- Preparation of methoxybenzene (anisole)
- Halogenation, nitration and sulphonation reactions

Unit 12: Aldehydes and Ketones - 11 teaching hours

12.1 Aliphatic Aldehydes and Ketones

1. Introduction, structure of carbonyl group, nomenclature and isomerism in carbonyl compound
2. Preparation of aldehydes and ketones from
   i. Dehydrogenation and oxidation of alcohol
   ii. Ozonolysis of alkenes
   iii. Acid chloride
   iv. Gem dihaloalkane
   v. Calalytic distillation of fatty acid
   vi. Distillaiton of calcium salt of fatty acid
   vii. Catalytic hydration of alkynes
3. Physical properties
4. Chemical properties
   i. Addition reaction: addition of H_2, HCN, $NaHSO_3$ and Grignand's reagents
   ii. Action with ammonia derivatives; NH_2OH, NH_2-NH_2, phenyl hydrazine, semicarbazides and 2, 4-DNP
   iii. Reduction of aldelydes
   - Oxidation with Tollen's reagent, Fehling's solution
   iv. Aldol condensation reaction; Clemmenson's reduction Wolf-Kishner reduction, Action with PCl_5, action with $LiAlH_4$
   v. Special reaction of methanal; Cannizzaro's reaction, action with ammonia, action with phenol; formalin and its uses

12.2 Aromatic Aldelydes and Ketones:

- Preparation of benzaldelyde from toluene
- Properties of benzaldelyde
- Important reaction of benzaldelyde different from aliphatic aldelydes:
  - Perkin condensation
  - Benzoin condensation
  - Electrophilic substitution reaction
  - Cannizzaro's reaction
- Preparation of acetophenone by Friedel Craft's acylation

Unit 13: Carboxylic Acids - 10 teaching hours

13.1 Aliphatic Carboxylic Acids:

- Introduction, nomenclature, examples
- Preparation of monocarboxylic acids from
  i. aldehydes ii. nitriles iii. Grignard's reagents
  iv. dicarboxylic acid v. sodium alkoxide. vi. trihaloalkanes
- Physical properties of monocarboxylic acids
- Chemical properties: Action with alkalies, metal oxides, metal carbonates, metal bicarbonates, PCl_3, $LiAlH_4$ and dehydration of carboxylic acid, esterification, halogenation
- Effect of constituents on the acidic strength of carboxylic acid
- Laboratory preparation of methanoic acid
- Abnormal behaviour of methanoic acid
- Uses of carboxylic acid

13.2 Derivatives of Carboxylic Acid:

1 Nomenclature, preparation and properties of
i. Acid halides ii. Acid amides
iii. Acid anhydrides and iv. Esters

13.3 Aromatic Carboxylic Acids:
- Preparation of benzoic acid
- Physical and chemical properties
- Uses of benzoic acid

Unit 14: Nitrocompounds:

14.1 Aliphatic Nitrocompounds (Nitroalkane): - 4 teaching hours

1. Introduction and nomenclature
2. Preparation from haloalkane and alkane
3. Physical properties
4. Reduction of nitroalkane
5. Uses

14.2 Aromatic Nitrocompounds:

1. Laboratory preparation of nitrobenzene
2. Physical properties
3. Chemical properties
   - Reduction in different media
   - Electrophilic substitution reactions
   - Uses of nitrobenzene

Unit 15: Amino Compounds (Amines and Aniline)

15.1 Aliphatic Amines: - 7 teaching hours

1. Introduction, nomenclature and classification
2. Separation of primary, secondary and tertiary amines by Hoffmann's method
3. Preparation of primary amines from haloalkane, nitriles, nitroalkanes and amides
4. Physical properties
5. Chemical Properties: basicity of amines, comparative study of basic nature of 1°, 2° and 3° amines, Reaction of Primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid ($NaNO_2$ / HCl)
6. Test of 1°, 2° and 3° amines. (nitrous acid test)

15.2 Aromatic Amine (Aniline):

1. Laboratory preparation of aniline
2. Physical properties
3. Chemical properties: basicity of aniline, comparision of basic nature of aniline with aliphatic amines; alkylation, acylation, diazotization, carbylamine and coupling reaction
4. Electrophilic substitution: Nitration, sulphonation and halogenation
5. Uses of anitne

Unit 16: Molecules of Life - 8 teaching hours

1. **Carbohydrates:** definition, classification of carbohydrates, various examples of carbohydrate of different class, structure of glucose and fructose, function of carbohydrates, sugar and non-sugar
2. **Protein:** definition, amino acid, essential and non-essential amino acids, peptide linkage, hydrolysis of amino acids, denaturation of protein, Zwitter ions, functions of amino acids
3. **Nucleic acid:** definition, basic components of nucleic acid; doule helix, difference between RNA and DNA; biological function of nucleic acid
4. **Lipid:** definition, fatty acids, fat as ester of fatty acid and difference between fats and oils, function of lipid
5. Enzymes and their functions

Unit 17: Chemistry in Service to Mankind - 10 teaching hours

1. **Polymer:** definition, natural and synthetic polymers, homopolymers and co-polymer, Preparation of some polymers; PVC, polyethene polystyrene, Teflon, Nylon-6,6, Bakelite and their uses
2. **Dyes:** definition, natural and synthetic dyes, names and structure of some common drug, drug addiction
3. **Fertilizer:** definition, chemical and organic fertilizers, nitrogen fertilizer, phosphatic fertilizer; fertilizer as pollution
4. **Pesticides:** insecticides, herbicides, weedicides and fungcides (examples and their uses)

Inorganic Chemistry Section C

Unit 18: Heavy Metals -18 teaching hours

1 General Characteristics of Transition Metals

18.1. Copper:

1. Position in periodic table
2. Occurrence and extraction of copper form copper pyrites
3. Properties and uses
4. Chemistry of (i) blue vitriol (ii) black oxide of copper (iii) red oxide of copper

18.2 Zinc:

1. Position in periodic table
2. Occurrence and extraction of zinc from zinc blende
3. Properties and uses
4. Preparation, properties and uses of zinc white and white vitriol
5. Galvanization

18.3 Mercury:

1. Occurrence and extraction of Hg from Cinnabar
2. Properties of mercury

3. Mercury poisoning and uses of Hg
4. Preparation, properties and uses of (i) Calomel (ii) Corrosive Sublimate

18.4. Iron:

1. Occurrence and extraction of iron
2. Varieties of Iron
3. Properties of Iron
4. Manufacture of Steel by
   i. Bessemer process
   ii. Open Hearth process
5. Heat treatment of steel
6. Stainless steel
7. Rusting of iron and its prevention
8. Uses and biological importance of iron
9. Structure and uses of Green vitriol, Ferric chloride, Mohr's salt

18.5. Silver:

1. Extraction of Silver by cyanide process and its uses
2. Preparation and uses of
   i. Silver chloride
   ii. Silver nitrate

Practical

Full Marks: 2
Pass Marks: 1

Students are required to secure the pass marks in the practical paper separately from the theory paper. The following is the list of experiments. The students are required to perform in the practical classes in Grade XII.

A. Experiments based on recovery and preparation of salt.

1. To recover blue vitriol crystal from the given mixture of copper sulphate and Sodium chloride;
2. To recover $CaCO_3$ from the mixture of $CaCO_3$ and $MgCO_3$ (dolomite)
3. To obtain hydrated calcium sulphate form the given marble chips.

B. Experiments on volumetric analysis (Titration)

4. To prepare primary standard solution of Na_2CO_3 and standardize the given acid solution HCl by the standard solution;
5. To determine the strength of approximate 0.1 N NaOH solution with the help of standard decinormal solution of HCl supplied
6. To determine the strength of bench sulphuric acid (H_2SO_4) with the help of standard NaOH or Na_2CO_3 solution and express the concentration in (i) normality (ii) molarity (iii) g/litre (iv) percentage by volume
7. To standardize the given $KMnO_4$ solution with the help of primary standard oxalic solution. (Redox titration) ;
8. To determine the enthalpy of neutralization of a strong acid and strong base;
9. To complete salt analysis by dry and wet ways. (at least 3 salts);
10. To detect foreign elements present in a given organic compounds. (N, S and X);
11. To identify the functional group present in the organic compounds. (OH, -COOH, - CHO, > CO, - NH_2);
12. To test the presence of
    a. Saturated or unsaturated fats,
    b. Carbohydrate,
    c. Proteins,
    d. Phenol.

Note: The experiment no.9 requires 4 practical periods. The experiment no. 10 requires 3 practical periods, the experiment no. 11 requires 3 periods and remaining experiments require 1 period of each. (2 theory periods will be equivalent to 1 practical period.)

Evaluation Scheme

The chemistry theory paper (XII) will consist of three types of questions:

a. Very short-answer questions (weightage of 2 marks of each);
b. Short-answer questions (weightage of 5 marks of each);
c. Long- answer questions (weightage of 10 mark of each.)

According to nature of questions, groups are divided into group 'A', group 'B' and group 'C'.

1. Group 'A' will consist of twenty two (22) very short questions, out of which, examinees are required to answer only fifteen (15) questions.
2. Group 'B' will consist of seven (7) short questions, out of which examinees are required to answer five (5) questions
3. Group 'C' will consist of four (4) questions, out of which examinee are required to answer 2 questions

The weightage of content distribution for the three types of questions form different sections of the curriculum will be as follows:

Units	Teaching hours	V.S.Q.	S.Q.	L.Q.
1	3	1		
2	8	1		
3	12	1		
4	10	1		
5	8	1		
6	6	1		
7	10	1		
8	3	1		
9	8	1		
10	10	1		
11	4	1		
12	11	1		
13	10	1		
14	4	1		
15	7	1		
16	8	1		
17	10	2		
18	18	2		
Total: 18	150	22	7	4

MODEL QUESTION - 2056 (OLD COURSE)

Group 'A'

Attempt any FIFTEEN questions. **[15 × 2 = 30]**

1. Predict the structure of water molecule using VSEPR model.
2. Why is it difficult to undergo nucleophilic substitution in haloarene?
3. Give an example of Reimer Tiemann reaction.
4. Why is the b.p. of ethanol higher than its isomer dimethyl ether?
5. What happens when benzaldehyde is heated with aq. NaOH.
6. Suggest the structure of (A) in the reaction given below:

$$A \xrightarrow[zn/H_2O]{O_3} \text{Methanal + Propanone}$$

7. Give a chemical test to distinguish between methanoic acid and ethanoic acid.
8. Write an example of diazotization reaction.
9. Give two differences between DNA and RNA.
10. List two functions of proteins.
11. Match the following:

A. Aspirin	A. Antibiotic
B. Dettol	B. Antipyretic
C. Paracetamal	C. Antiseptic
D. Chloromycetin	D. Analgesic

12. Name any two insecticides.
13. x gram of $CaCO_3$ reacts completely with 20 mL of 1 molar HCl. Calculate the value of x.

Ans: x = 1 g

14. State Faraday's Law of Electrolysis.
15. Calculate the standard EMF of a cell from the half cell. Ag^{+}/Ag and Ni^{+2}/Ni having standard reduction potential +0.80 V and – 0.25V respectively.

Ans: Emf = 1.05 V

16. Define and give one example of Lewis base.
17. What is the criteria for spontaneity of a reaction?
18. Draw energy profile diagram for catalyzed and uncatalyzed reaction.
19. Write two ways for prevention of corrosion.
20. Give two uses of Zinc.

Group 'B'

Attempt any FIVE questions. **[5×5= 25]**

21. How is Diethyl ether prepared in the laboratory?
22. A primary haloalkane (X) on dehydrohalogenation yields a compound (Y), which when reacted with HCN gives (Z). The compound Z on hydrolysis gives propanoic acid. Identify X, Y and Z.
23. What happens when:
    a. The gas produced by heating chloroform with silver powder is passed into ammoniacal silver nitrate solution.
    b. The product obtained by heating chlorobenzene with aq. NaOH is allowed to react with CO_2 at about 130°C under pressure.
24. For the reaction $2A + B \longrightarrow C$, the following data were obtained.

Expt. No.	Initial conc^n of [A]° mol/L	Conc^n of [B]° mol/L	Initial rate of reaction Mol, L^{-1} s^{-1}
1	0.1	0.2	3×10^2
2	0.3	0.4	3.6×10^3
3	0.3	0.8	1.44×10^4

    a. Find the order of reaction with respect of A, B and over all.
    b. What are the units of rate constant of the reaction?

Ans: (a) 3rd order (b) Mol^{-2} L^{+2} S^{-1}

25. 0.05 g of impure $CaCO_3$ is dissolved into 20 mL of $\frac{N}{5}$ [f = 1.05] HCl solution and excess of HCl solution needs 30 mL of $\frac{N}{10}$ [f=1.15] NaOH solution for complete neutralization. Find the percentage purify of $CaCO_3$.

Ans: 75.01%

26. Define Gibb's free energy and derive an expression to show the relation between ΔG, ΔH and ΔS.
27. How is mercury extracted in pure form from its sulphide ore?

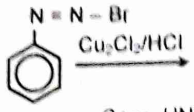
Group 'C'

Attempt any TWO questions. **[2×10 = 20]**

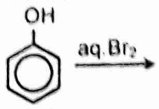
28. How is nitrobenzene prepared in laboratory? Give its reduction in different media.

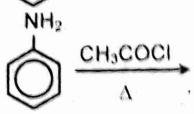
29. a. Write the major product of following reactions:

i. $CH_3COOH \xrightarrow[\Delta]{P_2O_5}$

ii. 

iii. $CHCl_3 \xrightarrow{\text{Conc. } HNO_3}$

iv. 

v. 

b. How would you convert?
i. 1 – propanol into 2 – propanol
ii. Nitrobenzene into phenol

30. a. Define specific conductance and molar conductance. How do they vary with dilution?
b. Find the pH of 0.01M acetic acid solution. (Given, $K_a = 1.85 \times 10^{-5}$)

Ans: 3.

31. Write short note on any TWO:
a. Characteristics of Transition elements.
b. Hoffmann's method of separation of mixture of amines
c. Manufacture of steel by Open-Hearth process.
d. Application of common ion effect in qualitative analysis

CHAPTER BASED QUESTIONS

GENERAL & PHYSICAL CHEMISTRY (SECTION A)

UNIT 1: CHEMICAL BONDING AND SHAPE OF MOLECULES

FORMULAE

VSEPR Theory

No. of e⁻ pair in valance shell	Shape	Bond angle	Example
2	Linear	180°	BeF_2, $BeCl_2$
3	Trigonal	120°	BF_3, BCl_3
4	Tetrahedral	109° 28' (109.5°)	CH_4, CCl_4, NH_4^+
5	Trigonal bipyramidal	90°, 120°	PCl_5
6	Octahedral	90°	SF_6
7	Pentagonal bipyramidal	72°, 90°	IF_7

Variation of bond angle with change in E.N. of central atom

Group 15	Bond angle	E.N.
NH_3	107° 48'	Decrease ↓
PH_3	93° 36'	
AsH_3	91° 48'	
SbH_3	91° 18'	

Group 16	Bond angle	E.N.
H_2O	104° 28'	Decrease ↓
H_2S	92°	
H_2Se	91°	
H_2Te	90°	

Group 17	Bond angle	E.N.
PF_3	97°	↓
PCl_3	100°	
PBr_3	101.5°	
PI_3	102°	Increase

Hybridization

Hybridization	Geometry	Bond angle	Examples
sp	Linear	180°	C_2H_2, CO_2, BeF_2, $BeCl_2$
sp^2	Trigonal planar	120°	C_2H_4, C_6H_6, BF_3
sp^3	Tetrahedral	109° 28' (109.5°)	CH_4, CH_3X
sp^3d	Trigonal bipyramidal	90°, 120°	PX_5
sp^3d^2	Octahedral	90°	SF_6
sp^3d^3	Pentagonal bipyramidal	72°, 90°	IF_7

Very Short Answer Questions [2 marks]

1. **2077 Set P Q.No. 4** What is the mode of hybridization of B in BF_3. Predict the geometry of such molecule. [1+1]
2. **2077 Set V Q.No. 1** Write an example of a molecule having trigonal pyramidal geometry. What is the mode of hybridization on central atom of the molecule? [1+1]
3. **2077 Set W Q.No. 1** Why has ammonia got trigonal pyramidal geometry though nitrogen shows sp^3 hybridization? [2]
4. **2076 GIE Set A Q.No. 1** C in CH_4 gets sp^3 hybridization. Give reason. [2]
5. **2076 GIE Set B Q.No. 1** Predict the mode of hybridization in BF_3 and write any two features of such hybridization. [1+1]
6. **2076 Set B Q.No. 1** How would you confirm that B in BF_3 gets sp^2 hybridization?
7. **2076 Set C Q.No. 1** C in C_2H_2 gets sp hybridization, why?
8. **2075 GIE Q.No. 1** State any two proper conditions for hybridization. What is the mode of hybridization of C in C_2H_2? [1+1]
9. **2075 Set A Q.No. 1** Predict the mode of hybridization of B in BF_3. Mention any two features of this hybridization [1+1]

10. 2075 Set B Q.No. 1 Predict the mode of hybridization. [1+1]
    i. carbon in ethyne
    ii. oxygen in water
11. 2074 Supp. Q.No. 1 Write two important features of hybrid orbitals [2]
12. 2074 Set A Q.No. 1 Which kinds of hybridization results into tetrahedral geometry? Give an example of such hybridization. [1+1]
13. 2074 Set B Q.No. 1 Which kinds of hybridization results into linear geometry. Give an example of such hybridization. [1+1]
14. 2073 Supp Q.No. 1 What kinds of hybridization results into trigonal planar geometry. Give an example of it. [1+1]
15. 2073 Set C Q.No. 1 How would you predict the geometry of ammonia molecule on the basis of VSEPR theory? [2]
16. 2073 Set D Q.No. 1 Ammonia molecule has got trigonal pyramidal geometry even though nitrogen of ammonia gets sp^3 hybridization. Give reason. [2]
17. 2072 Supp. Q.No. 1 Predict the mode of hybridization in the central atom of the molecules having (i) trigonal plannar (ii) tetra-hedral structure with an example of each. [1+1]
18. 2072 Set C Q.No. 1 Define hybridization and write any two features of tetrahedral hybridization. [1+1]
19. 2072 Set D Q.No. 1 What are the features of tetrahedral hybridization? Write an example of it. [1+1]
20. 2072 Set E Q.No. 1 State the mode of hybridization in B of BF_3 and C of C_2H_6. [1+1]
21. 2071 Supp. Q.No. 1 What is the mode of hybridization in carbon of acetylene? Write any two correct features of this hybridization. [1+1]
22. 2071 Set C Q.No. 1 Predict the geometry of molecules having:
    a. sp^3 hybridization
    b. sp hybridization with an example of each. [1+1]
23. 2071 Set D Q.No. 1 Write any two features of sp^3 hybrid orbital with an example. [1+1]
24. 2070 Supp. Q.No. 1 Which kinds of hybridization results into tetrahedral geometry? Mention any one character of such hybridization. [1+1]
25. 2070 Set C Q.No. 1 What is meant by hybrid orbital? Write an example of it. [1+1]
26. 2070 Set D Q.No. 1 Why do NH_3 and BF_3 have dissimilar geometries? [2]
27. 2069 Supp. Set B Q.No. 1 State the mode of hybridization of C_2H_6 and mention any two features of this hybridization. [2]
28. 2069 Set A Q.No. 1 Nitrogen of ammonia gets sp^3 hybridization but ammonia molecule has trigonal pyramid geometry. Give reason. [2]
29. 2069 Set B Q.No. 1 What is the mode of hybridization of B in BF_3? Write any two important features of this hybridization. [1+1]
30. 2068 Q.No. 1 Write any two important characters of tetrahedral hybridization. [1+1]
31. 2067 Q.No. 1 Mention one example of each: [1+1]
    i. Tetrahedral Hybridization
    ii. Trigonal Hybridization
32. 2066 Q. No. 1 What is the mode of hybridization of the central atom whose molecular geometry is tetrahedral? And, give an example of its. [2]
33. 2065 Q.No. 1 Predict the mode of hybridization in
    i. C of C_2H_4 ii. B of BF_3 [2]
34. 2063 Q.No. 1 Define hybridization. Draw the orbital picture of a hydrocarbon showing tetrahedral structure. [2]
35. 2061 Q.No. 1 The bond angle at the central atom in NF_3 is 103°, whereas in BF_3 is 120°. What factor accounts for the difference in bond angles? [2]
36. 2060 Q.No. 1 How would you interpret that all four C – H bonds of methane are identical? [2]
37. 2059 Q.No. 1 Draw the molecular orbital picture of ethane. [2]
38. 2058 Q.No. 1 Draw the orbital picture of ethyne indicating sigma and pi bonds. [2]
39. 2057 Q.No. 1 How do you predict the molecular geometry of NH_3 based on VSEPR model? [2]
40. 2056 Q.No. 1 Draw the shapes of sp and sp^2 hybrid orbitals. [2]
41. 2053 Q.No. 2 Identify the hybridization of the indicated atom in each of the following molecules. [2]
    a. Be in BeF_2 b. B in BF_3 c. N in NH_3
42. 2052 Q.No. 1 Predict the structure of methane based on hybridization. [2]
43. 2064 Q.No. 1 Why is H-O-H bond angle in water molecule comparatively higher than H-S-H bond angle in H_2S molecule? [2]
44. 2062 Q.No. 1 How do you predict the molecular geometry of NH_3 based on VSEPR model? [2]

Short Answer Questions [5 marks]

45. 2056 Q.No. 24 Using VSEPR theory, explain the shapes of BeF_2 and BF_3. [5]
46. 2055 Q.No. 23 Explain the state of hybridization in ethyne molecule. [5]
47. 2054 Q.No. 24 What do you understand by sp^2 hybridization? Using any example explain the molecular geometry involved. [5]

Write short notes on

48. 2061 Q.No. 31(iv) 2055 Q.No. 31(a) VSEPR model [5]

UNIT 2: VOLUMETRIC ANALYSIS

Very Short Answer Questions [2 marks]

FORMULAE

1. Principel of Volumetric Analysis
   No. of gram equivalent of Acid = No. of gram equivalent of Base

$$\text{No. of gram equivalent} = \frac{\text{Weigth of substance}}{\text{Equivalent weight of substance}} = \frac{W}{E}$$

2. Concetration

i. $g/L = \frac{\text{Weigth of Solution (g)}}{\text{Volume of solution (L)}}$

ii. $\%\ \frac{w}{v} = \frac{\text{Weigth of Solution (g)}}{\text{Volume of solution (mL)}} \times 100$

iii. $\% \frac{w}{w} = \frac{\text{Weigth of Solution (g)}}{\text{Wegith of solution (g)}} \times 100$

iv. Normality (N) $= \frac{\text{Weigth of Solution (g)}}{\text{Gram equivalent weigth of solution}} \times \frac{1}{\text{Volume of solution (mL)}} \times 1000$

$W = \frac{NEV}{1000}$

v. Molarity (M) $= \frac{\text{Weigth of Solution (g)}}{\text{Gram molecular weigth of solution}} \times \frac{1}{\text{Volume of solution (mL)}} \times 1000$

$W = \frac{MMwV}{1000}$

vi. Molality (m) $= \frac{\text{Weigth of Solution (g)}}{\text{Molecular weigth of solution}} \times \frac{1}{\text{Weight of solution (g)}} \times 1000$

vii. ppm $= \frac{\text{Weigth of Solute (g)}}{\text{Volume of solution (mL)}} \times 10^6$

3. Relation between different concentration

i. G/L = Normality × Equivalent weight of solute

ii. G/L = Molarity × Molecular weight of solute

iii. Normality (N) = Molarity (M) × basicify (For acid)
= Molarity (M) × basicify (For base)

iv. Normality (N) = Molarity $\times \frac{\text{Molecular weight}}{\text{Equivalent weight}}$ (for salt)

v. Equivalent weight of acid $= \frac{\text{Molecular weight of acid}}{\text{Basicity}}$

vi. Equivalent weight of base $= \frac{\text{Molecular weight of acid}}{\text{Acidity}}$

vii. Equivalent weight of salt $= \frac{\text{Molecular weight of acid}}{\text{Total + ve charge present in basic radical}}$

viii. Normality (N) $= \frac{\% \frac{w}{w} \times \text{specific gravity} \times 10}{\text{Equivalent weight}}$

viii. Molarity (M) $= \frac{\% \frac{w}{w} \times \text{specific gravity} \times 10}{\text{Molecular weight}}$

4. Standard Solution

i. Normal solution = 1N Molar solution = 1M

ii. Decinormal solution $= \frac{N}{10}$ Decimolar $= \frac{M}{10}$

iii. Seminormal solution $= \frac{N}{2}$ Semimolar $= \frac{M}{2}$

iv. Centinormal solution $= \frac{N}{100}$ Centimolar $= \frac{M}{100}$

5. % purity $= \frac{\text{Calculated weight}}{\text{Given weight}} \times 100$

6. Normality equation: $V_1N_1 = V_2N_2$

7. Molarity equation: $V_1M_1 = V_2M_2$

8. Normality of resultant mixture (N) $= \frac{V_1N_1 + V_2N_2 + \ldots}{V_1 + V_2 + \ldots}$

9. Normality of resultant acid solution (N_mV_m)
$= V_1N_1 + V_2N_2 + V_3N_3 + \ldots$

10. Molarity of resultant mixture (M) $= \frac{V_1M_1 + V_2M_2 + \ldots}{V_1 + V_2 + \ldots}$

1. **2077 Set V Q.No. 3** What volume of water should be added to 50 mL of semi normal NaOH solution to make it exactly deci-normal. [2]
Ans: 200 mL

2. **2076 GIE Set A Q.No. 2** Distinguish between titrant and titrand. [2]

3. **2076 GIE Set B Q.No. 2** Oxalic acid is taken as primary standard substance, why?

4. **2076 Set B Q.No. 2** Distinguish between decinormal and decimolar solution.

5. **2076 Set C Q.No. 2** Distinguish between titration error and normality factor.

6. **2075 GIE Q.No. 2** Differentiate between end point and equivalence point of a reaction. [1+1]

7. **2075 Set A Q.No. 2** Differentiate between normality and molarity.

8. **2075 Set B Q.No. 2** Distinguish between Primary standard solution and secondary standard solution. [1+1]

9. **2074 Supp. Q.No. 2** Define the terms: [1+1]
i. Primary standard solution ii. Acidimetry

10. **2074 Set A Q.No. 2** Define the terms; [1+1]
i. Normality factor
ii. Secondary standard solution

11. **2074 Set B Q.No. 2** How is end point differed from equivalence point? [2]

12. **2073 Supp Q.No. 2** What is the importance of calculating normality factor of solutions during titration? [2]

13. **2073 Set C Q.No. 2** Define the terms: [1+1]
i. Normality factor
ii. Secondary standard solution

14. **2073 Set D Q.No. 2** Why is crystal oxalic acid regarded as a good substance for the preparation of primary standard solution? [2]

15. **2072 Supp. Q.No. 2** How would you convert 500 cc of 2 N H_2SO_4 into
i. gram/liter ii. Normality [1+1]
Ans: (i) 196 g/L (ii) 4 N

16. **2072 Set C Q.No. 2** Distinguish between end point and equivalence point of reaction. [1+1]

17. **2072 Set D Q.No. 2** Which one has higher concentration and why? [1+1]
a. 80 g/litre NaOH solution and 3 M NaOH solution.
b. 5.3 g/litre Na_2CO_3 and $\frac{N}{10}$ Na_2CO_3 solution.
Ans: (a) 3 M NaOH > 80 g/litre NaOH
(b) 5.3 g/litre $Na_2CO_3 = \frac{N}{10}$ Na_2CO_3

18. **2072 Set E Q.No. 2** A sample of Na_2CO_3 weighing 0.53 g is added to 101 m^2 of 0.1N H_2SO_4 solution. Will the resulting solution be acidic, basic or neutral? [2]
Ans: Acidic

19. **2070 Supp. Q.No. 2** Define the term [1+1]
i. Semi normal solution
ii. Alkalimetry

20. **2070 Set C Q.No. 2** Define secondary standard solution with a suitable example. [1+1]

21. **2067 Q.No. 17** Write an example of redox titration. Why is it called so? [1+1]

22. **2066 Q. No. 17** What is the normality of 20 cc of phosphoric acid (H_3PO_4)?

23. 2065 Q.No. 17 What is normality? How is it related with molarity? [2]
24. 2054 Q.No. 3 What do you mean by equivalent weight of an element? [2]
25. 2053 Q.No. 3 What are the requisites for a substance to be a primary standard? [2]
26. 2052 Q.No. 3 Define decinormal solution. [2]

Short Answer Questions [5 marks]

27. 2077 Set W Q.No. 9 Define molality of solution. Calculate molality of one liter of 93% H_2SO_4 solution (weight by volume). The density of the solution is 1.84 g mL^{-1}. [1+4]
Ans: 10.41 mol/Kg

28. 2076 GIE Set A Q.No. 23 "All standard solutions are not primary standard solutions." Comment the statement. How many ml of a 0.1 MHCl are required to react completely with 1gm mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amount of the two. [1+4]
Ans: 202.6 m^2

29. 2076 GIE Set B Q.No. 23 Define normality factor. 0.18 g of a divalent metal was completely dissolved in 250 cc of acid solution containing 4.9 g H_2SO_4 per liter. 50 cc of the residual acid solution required 20 cc of N/10 alkali for complete neutralization. Calculate the atomic weight of metal. [1+4]
Ans: 36 amu

30. 2076 Set B Q.No. 23 Are all standard solutions, primary standard solutions or not? Give reason. 1 g of a divalent metal was dissolved in 25 mL of 2N H_2SO_4 (f = 1.01). The excess acid required 15.1mL of 1N NaOH (f = 0.8) for complete neutralization. Find the atomic weight of the metal. [1+4]
Ans: Atomic weight = 52.05 amu

31. 2076 Set C Q.No. 23 It is better to express concentration in molality rather than molarity, Why? x g of a metal (equivalent weight = 12) was completely dissolved in 100 cc of $\frac{N}{2}$ HCl solution. The volume was then made upto 500cc. It is found that 25 cc of the diluted acid solution required 17.5 cc of $\frac{N}{10}$ NaOH for complete neutralization. Find the value of X. [1+4]
Ans: 0.18 g

32. 2075 GIE Q.No. 23 Define deci-normal solution. 12 g of commercial zinc is made to react with excess dil. H_2SO_4. The total volume of H_2 gas was found to be 4.2 litres at 570 mmHg pressure and 279 K temperature. Determine the percentage purity of the zinc. [1+4]
Ans: 74.48%

33. 2075 Set A Q.No. 23 Define end point. 12 g of commercial zinc is made to react with excess dilute H_2SO_4. The total volume of H_2 gas liberated was found to be 4.2 litres at 570 mmHg pressure and 279 K. Determine the percentage purity of the zinc. (Atomic mass of Zn = 65) [1+4]
Ans: 74.48%

34. 2075 Set B Q.No. 25 What is meant by normality factor? How many mL of conc. HNO_3 of specific gravity 1.41 containing 69% by mass are required to prepare 500 mL of 0.5 N HNO_3? [1+4]
Ans: 16.19 mL

35. 2074 Supp. Q.No. 24 Define the terms:
i. Titration error ii. Unknown solution
What volume of 10 M HCl and 3M HCl should be mixed to obtain one litre of 6 M HCl solution? [1+1+3]
Ans: 0.4 L of 10 M HCl and 0.57 L of 3 M HCl

36. 2074 Set A Q.No. 24 Define titration error. 0.012 g of a divalent metal is completely dissolved in 40 cc of $\frac{N}{10}$ HCl. The excess of acid required 15 cc of $\frac{N}{5}$ NaOH for neutralization. Find the atomic weight of the metal. [1+4]
Ans: 24 a.m.u.

37. 2074 Set B Q.No. 24 Define the terms;
i. Titration error ii. Standard solution
Calculate the volume of 1M NaOH required to neutralize 200 cc of 2M HCl. What mass of sodium chloride are produced from the neutralization reaction? [1+1+1+2]
Ans: 23.5 g NaCl

38. 2073 Supp Q.No. 24 What is meant by acidity of base? 500 cc of 2 N. Na_2CO_3 are mixed with 400 cc of 3N H_2SO_4 and volume was diluted to one litre. Will the resulting solution acidic, basic or neutral? Also, calculate the molarity of the dilute solution. [1+2+2]
Ans: 0.1 M, Acidic

39. 2073 Set C Q.No. 24 What is meant by acidity of base? 500 cc of 2N Na_2CO_3 are mixed with 400 cc of 3N H_2SO_4 and volume was diluted to one litre. Will the resulting solution acidic, basic or neutral? Also calculate the molarity of the dilute solution. [1+2+2]
Ans: 0.1 M, Acidic

40. 2073 Set D Q.No. 24 Define redox titration.
10 g of NaOH was added to 200 cc of $\frac{N}{2}$ (f = 1.5) H_2SO_4. The volume was diluted to two litres. Predict whether the dilute solution is acidic, basic or neutral and also calculate the resulting molarity of the dilute solution. [1+2+2]
Ans: Basic, 0.05 M

41. 2072 Supp. Q.No. 25 What is meant by acidimetry? A solution of conc. HCl contain 38% HCl by mass:
i. What is the molarity of this solution if the density of the solution is 1.19 g/cc?
ii. What volume of the conc. HCl is required to neutralize one liter of 0.1 M NaOH solution? [1+2+2]
Ans: 12.38 N, 8.077mL

42. 2072 Set D Q.No. 25 What is meant by normality factor? How many mL of conc. HNO_3 of specific gravity 1.41 containing 69% by mass are required to prepare 500 mL of 0.5N HNO_3? [1+4]
Ans: 16.19 mL

43. 2072 Set E Q.No. 26 Define normality and molarity. Write their relationship. A commercial sample of sulphuric acid has specific gravity 1.8. 10 mL of this acid was diluted upto 1 litre with water. 10 mL of diluted acid required 30 mL of $\frac{N}{10}$ NaOH for complete neutralization. Calculate the percentage purity of H_2SO_4 in the commercial sample. [2+3]
Ans: 81.66%

44. 2071 Supp. Q.No. 25 What is meant by normality factor? What volume of 95% sulphuric acid (density = 1.85g/cc) and what mass of water must be taken to prepare 100 cc of 15% solution of sulphuric acid (density = 1.1g/cc)? [1+4]
Ans: Volume = 9.36 cc, Mass = 90.64 g

45. 2071 Set C Q.No. 25 Differentiate between primary standard and secondary standard solution. What volume of 12 M NaOH and 2 M NaOH should be mixed to get 2 litres of 9 M NaOH solution? [2+3]
Ans: 1.4 litre of 12 M NaOH, 0.6 litre of 2 M NaOH

46. 2070 Set C Q.No. 23 0.8 g of a divalent metal was dissolved in 100 cc of 1.28 N HCl and the solution was diluted to 200 cc. Then 50 cc of this solution required 54.6 cc of 0.22 N NaOH for neutralization. Find the atomic weight of the metal. [5]
Ans: 20 amu

47. 2066 Q. No. 25 What are Primary and Secondary standard solutions? Calculate the resulting normality of a solution prepared by mixing 20 mL of 0.8 M NaOH with 25 mL of 0.4 M H_2SO_4 solutions. [2+3]
Ans: 0.088N

48. 2069 Set A Q.No. 26 Define the terms: [1×5]
i. End point ii. Equivalence point
iii. Indicators iv. Basicity of acid
v. Acidimetry

Long Answer Questions [10 marks]

49. 2064 Q.No. 30(i) Define the terms:
a. gram equivalent weight
b. equivalent point of reaction
c. end point of titration [5]

50. 2064 Q.No. 30(ii) Define indicator. Explain how are indicators selected in acid base titration? [5]

51. 2062 Q.No. 30(b) Define indicator. How is a suitable indicator selected for a particular titration? [5]

Write Short Notes on

52. 2069 Set B Q.No. 33d /2069 Supp. Set B Q.No. 33 c
Selection of indictors in acid base titration. [5]

Numerical Problems

53. 2072 Set C Q.No. 25 What is meant by redox titration? 4 g of a divalent metal was dissolved in 100 cc of 2M H_2SO_4 (f = 1.01).The excess acid required 30 cc of 1 N NaOH for complete neutralization. Find the atomic mass of the metal. [1+1]
Ans: 21.62 amu

54. 2071 Supp. Q.No. 2 Calculate the normality and molarity of 5% of NaOH solution. [1+1]
Ans: 1.25 M or N NaOH

55. 2071 Set C Q.No. 2 What mass of 90% pure $CaCO_3$ is required to neutralize 2 litre deci-normal solution of HCl?[1+1]
Ans: 11.11 g

56. 2071 Set D Q.No. 25 Define acidimetry. A solution of conc. hydrochloric acid contain 38% HCl by mass [1+4]
a. What is the molarity of this solution if the density of the solution is 1.19g/cc?
b. What volume of the conc. HCl is required to neutralize 1 litre of 0.1 M NaOH solution?
Ans: (a) 12.38 N (b) 8.077 mL

57. 2071 Set D Q.No. 2 How many moles of H_2SO_4 are required to neutralize 4 litres of 2N NaOH solution? [1+1]
Ans: 4 mol

58. 2070 Supp. Q.No. 25 Define acidity of a base giving example. 0.8 g of a divalent metal was dissolved in 100 cc 1.28 N HCl and the solution was diluted to 200 cc. 50 cc this dilute solution required 54.6 cc of 0.22 N NaOH neutralization: Calculate the atomic mass of the metal.
Ans: 20

59. 2070 Set D Q.No. 26 Define normality, 0.8 g of divalent was dissolved in 100 mL of 1.28 N HCl.and the solution diluted to 200 mL. Then, 50 mL of the solution required 5 mL of 0.22 N NaOH for neutralization. Find the atomic metal. [1
Ans: 20

60. 2070 Set D Q.No. 2 What volume of water should be add to 500 mL of 2 N (f = 0.98) Na_2CO_3 to make it exactly $\frac{N}{10}$?
Ans: 9300

61. 2069 Set A Q.No. 2 x cc of 5 N HCl was diluted to one litre normal solution. Calculate the value of x.
Ans: 200

62. 2069 Set B Q.No. 2 What mass of Na_2CO_3 is required make 50 cc of its seminormal solution?
Ans: 1.32

63. 2069 Supp. Set B Q.No. 2 What volume of 5% NaOH a required to neutralize 2 litres of decinormal H_2SO_4?
Ans: 0.16 li

64. 2068 Q.No. 17 Convert the followings: [1
i 2.5 M H_3PO_4 into Normality.
ii. 4.9 M H_2SO_4 into gram/litre.
Ans. 7.5 N, 480.2 g

65. 2068 Q.No. 30 Define the terms: [5
i. Primary standard solution. ii. Normality factor.
iii. Acidity of a base iv. Alkalimetry.
What is meant by redox titration? Write an example of it. 4 g of NaOH was added to 20 cc of 2 N H_2SO_4 solution a the volume was diluted to one litre. Predict whether the dilu solution is acidic, basic or neutral and also calculate th resulting normality of the dilute solution in term of g/litre.
Ans: 0.06 N, 2.4 g

66. 2067 Q.No. 25 Define:
i. Acidity of base ii. End point
What volumes of $\frac{N}{2}$ and $\frac{N}{10}$ HCl must be mixed to give liters of $\frac{N}{5}$ HCl. [2+3=5]
Ans: 0.5 L of $\frac{N}{2}$ HCl and 1.5 L of $\frac{N}{10}$ HC

67. 2065 Q.No. 25 Define decinormal solution. 3 g of a trivale metal was completely dissolved with 750 mL of 1N HCl. Th residual solution further required 1000 mL of $\frac{N}{2}$ NaOH for th complete neutralization. Find the atomic mass of the metal [1
Ans: 36

68. 2064 Q.No. 30(iii) 0.715 g of Na_2CO_3 .x H_2O requir 20 mL of seminormal hydrochloric acid solution for comple reaction. Find the value of x.
Ans: x =

69. 2063 Q.No. 18 0.315 g of a dibasic acid required 50 m decinormal sodium hydroxide solution for comple neutralisation. Find the molecular mass of the acid.
Ans: Molecular mass = 126

70. **2063 Q.No. 26** Define normality and molarity of a solution. Find their relationship for a given solution. 1 g of NaOH is added to 2 litres of x M H_2SO_4 solution, so that the pH of the resulting solution is 7. Find the value of x. [1+1+1+2]
Ans: $x = 6.25 \times 10^{-3}$ M

71. **2062 Q.No. 13** Define normal solution. What is the normality of 500 mL solution of sodium hydroxide containing 30 g NaOH? [2]
Ans: 1.5 N

72. **2061 Q.No. 30**
a. Provide a short definition of each of the following terms:
i. equivalent weight ii. standard solution
iii. neutralization point iv. primary standard
v. indicator.
b. 7.35 g of a dibasic acid was dissolved in water and diluted to 250 mL. 25 mL of this solution was neutralized by 15 mL of 1 N NaOH solution. What is equivalent weight and molecular weight of the acid? [5+5]
Ans: Equivalent weight = 49, Molecular weight = 98 amu

73. **2060 Q.No. 13** 5 g of a diacidic base is completely neutralized by 50 mL 2 N HCl. Find the molecular weight of the base. [2]
Ans: Molecular weight = 100 amu

74. **2059 Q.No. 13** What volume of decinormal solution of HCl is required to neutralize 25 mL NaOH solution containing 8g NaOH in one litre solution? [2]
Ans: 50 mL

75. **2059 Q.No. 26** x g of a metal (equivalent weight = 12) was completely dissolved in 100 cc of $\frac{N}{2}$ HCl. The volume was then made up to 500 cc. 25 cc of this diluted acid required 17.5 cc $\frac{N}{10}$ NaOH for complete neutralization. Find the value of x. [5]
Ans: x = 0.18g

76. **2058 Q.No. 13** x g of Ca_2CO_3 reacts completely with 20 mL of 1M HCl. Calculate the value of x. [2]
Ans: x = 1 g

77. **2057 Q.No. 13** What volume of water must be added to 40 mL of 0.25 (N) acid solution in order to make it exactly decinormal? **Ans: 60mL** [2]

78. **2057 Q.No. 30**
a. Define molar solution, end point and indicator. Calculate the molarity of 5% H_2SO_4 solution.
b. 7.5 g of a dibasic acid dissolved in water and the solution made up to 250 cc. 25 cc of this acid requires 16.3 cc (1 N) NaOH for complete neutralisation. Calculate the molecular weight of the acid. [5+5]
Ans: (a) Molarity = 0.5 M (b) Molecular weight = 92.02 amu

79. **2056 Q.No. 21** 100 mL of 0.1 M HCl is mixed with 50 mL of 0.1M KOH. Calculate the concentration of acid in terms of gm/litre in the resulting solution. [5]
Ans: Gram/Litre = 1.2045 g/L

80. **2055 Q.No. 1** Find the equivalent weight of H_3PO_4 in the reaction $Ca(OH)_2 + H_3PO_4 \longrightarrow CaHPO_4 + 2H_2O$. [2]
Ans: 49

81. **2055 Q.No. 21** 20 mL of a sulphuric acid solution neutralizes 0.265 g of Na_2CO_3. Calculate the normality of the acid solution. [5]
Ans: Normality = 0.25 N

82. **2054 Q.No. 27** x g of magnesium (equivalent weight = 12) reacts with 20 mL of N (f = 0.95) acid. Calculate the weight of x. [5]
Ans: Weight of x = 0.228 g

83. **2053 Q.No. 19** 25 cc of an alkali solution is mixed with 8 cc of 0.75 N acid solution for complete neutralization, it further requires 15 cc of 0.8 N acid solution. Find the strength of the given alkali solution. [2]
Ans: 0.72N

84. **2052 Q.No. 19** If 20 mL of 0.5 N NaOH is mixed with 30 mL of 0.3 N HCl, is the resulting solution acidic or basic? Calculate the normality with respect to the acidic or basic final solution. [2]
Ans: Normality = 0.02N, Basic

UNIT 3: IONIC EQUILIBRIUM

FORMULAE

1. pH and pOH
$pH = -\log [H^+]$
$pH = -\log [OH^+]$
$pH + pOH = 14$
2. Ostwald's Dilution Law
$K_a = \frac{\alpha^2 C}{1-\alpha}$ where, C = Conc^n in molarity
$\alpha = \frac{\text{No. of moles ionized}}{\text{Total no. of moles taken}}$ = Degree of ionization
$K_a = \alpha^2 C (1 - \alpha \approx 1)$
$\alpha = \sqrt{\frac{Ka}{C}}$
3. Solubility product
$K_{sp} = [A]^x [B]^y$
Solubility in mol L^{-1} = $\frac{\text{Solubility of salt in g/L}}{\text{Molecular weight of salt}}$
Solubility of g/L = Solubility in mol L × Molecular weight

Very Short Answer Questions [2 marks]

1. **2077 Set P Q.No. 3** What is the pH of 10^{-9}M HCl? [2]
Ans: pH = 3

2. **2077 Set W Q.No. 5** Calculate the pH of 1×10^{-3}M KOH. [2]
Ans: pH = 11

3. **2076 GIE Set A Q.No. 3** Find the pH of 1×10^{-6} N of H_2SO_4. [2]
Ans: 6

4. **2076 GIE Set B Q.No. 3** Is the solution acidic, basic or neutral in which concentration of hydroxy ion is 3.33×10^{-10} molL^{-1}? [2]
Ans: 4.52, Acidic in nature

5. **2076 Set B Q.No. 3** Find the pH of 1×10^{-5} N H_2SO_4. [2]
Ans: pH = 5

6. **2076 Set C Q.No. 3** **2064 Q.No. 15(i)** Write the conjugate acid and base of NH_3. [1+1]

7. **2075 GIE Q.No. 3** Is the solution acidic basic or neutral in which concentration of hydroxyl ion is 3.33×10^{-10} mol L^{-1}? [2]
Ans: Acidic

8. **2075 Set A Q.No. 3** Is the solution acidic, basic or neutral in which the hydrogen ion concentration in 3×10^{-5} molL^{-1}? [2]
Ans: Acidic

9. **2075 Set B Q.No. 3** Calculate the pH of the solution by disolving 1 g of NaOH in 1 litre of its solution. [2]
Ans: 12.4

10. 2074 Supp. Q.No. 3 Is an aqueous solution containing hydroxyl ions concentration 3.33×10^{-10} mol L^{-1} acidic, basic or neutral? [2]
Ans: Acidic

11. 2074 Set A Q.No. 3 Is an aqueous solution containing hydrogen ion concentration 3×10^{-5} mol L^{-1} acidic, basic or neutral? [2]
Ans: Acidic

12. 2074 Set B Q.No. 3 Is an aqueous solution containing hydroxyl ion concentration 3.33×10^{-1} mol L^{-1} acidic, basic or neutral? [2]
Ans: Basic

13. 2073 Supp Q.No. 3 Define [1+1]
i. ionic product of water ii. pH of solution

14. 2073 Set C Q.No. 3 State Ostwald's dilution law and mention its limitation. [1+1]

15. 2073 Set D Q.No. 3 Define: [1+1]
i. Degree of ionization ii. Ostwald's dilution law

16. 2072 Supp. Q.No. 3 What are the limitation of Lewis acid and base? [1+1]

17. 2072 Set C Q.No. 3 Calculate the pH of 0.1 N H_2SO_4. [2]
Ans: pH = 1

18. 2072 Set D Q.No. 3 Define Lewis concept of base and point out its limitation. [1+1]

19. 2072 Set E Q.No. 3 Define Bronsted concept of acid and base with an example of each. [2]

20. 2071 Supp. Q.No. 3 Give an example of each of the following [0.5×4]
i. Lewis acid ii. Lewis base
iii. Acidic salt iv. Bronsted-Lowry acid

21. 2071 Set C Q.No. 3 Define the term: [1+1]
a. Degree of ionization b. Bronsted Lowry acid

22. 2071 Set D Q.No. 3 What happens when HCl gas is passed through a saturated solution of NaCl and why? [2]

23. 2070 Supp. Q.No. 3 State Ostwald's dilution law. What is its limitation? [1+1]

24. 2070 Set D Q.No. 3 Define Lewis acid and Lewis base giving one example of each. [1+1]

25. 2069 Set B Q.No. 3 Write suitable examples to show water acts as Bronsted-Lowry acid and base. [2]

26. 2069 Supp. Set B Q.No. 3 Define pH of a solution and write the relation between pH and pOH. [1+1]

27. 2067 Q.No. 14 Whether the aqueous solution of $CaCl_2$ is acidic basic or neutral. Given reason. [2]

28. 2065 Q.No. 14 49 g of H_2SO_4 is present in 1000 mL of its solution. What is the pH of the solution? [2]
Ans: pH = 0

29. 2064 Q.No. 15(ii) Predict whether the aqueous solution of $CuSO_4$ acidic, basic or neutral. [1]

30. 2062 Q.No. 15 Water is a Lewis base as well as a Bronsted acid. Explain. [2]

31. 2062 Q.No. 18 Explain the fact that the aqueous solution of sodium carbonate is basic, while the aqueous solution of sodium chloride is neutral. [2]

32. 2061 Q.No. 15 Define Lewis acid and Lewis base. Give ... example of each.

33. 2060 Q.No. 14 Calculate the pH of an aqueous solution ... containing 10^{-7} moles of NaOH per litre.
Ans: pH = 7

34. 2059 Q.No. 15 Why is aqueous solution of $FeCl_3$ acidic?

35. 2058 Q.No. 16 Define Lewis acid and base giving ... example from each.

36. 2058 Q.No. 26 Two litres of 1M HCl is mixed with one litre ... 1M NaOH solution. Calculate the strength of the salt formed and the pH of the resulting solution.
Ans: Strength = 0.33M, pH = 0

37. 2057 Q.No. 15 What happens when dry HCl gas is passed through saturated solution of sodium chloride?

38. 2057 Q.No. 16 Why is aq. Na_2CO_3 basic?

39. 2055 Q.No. 4 Explain why sodium chloride precipitates from a saturated salt solution when hydrogen chloride gas is passed into the solution?

40. 2055 Q.No. 2 10^{-2} mole of KOH is dissolved in 10 litres of water. What will be the pH of the solution?
Ans: pH =

41. 2054 Q.No. 2 What will be the H^+ ion concentration of a solution having pH 5.5?
Ans: 3.16×10^{-6} mol

42. 2054 Q.No. 5 What do you understand by equilibrium state in a reversible reaction?

43. 2054 Q.No. 8 What will happen when HCl gas is passed over a saturated solution of NaCl, also explain the principle involved?

Short Answer Questions [5 marks]

44. 2077 Set V Q.No. 9 Point out the limitation of Ostwald's dilution law. The solubility product of $BaSO_4$ is 1×10^{-11}. Will precipitate occur or not if equal volume of 2×10^{-3} M $BaCl_2$ solution and 2×10^{-4} M Na_2SO_4 solution are mixed? [1+4]
Ans: Precipitate will occur

45. 2075 GIE Q.No. 25 What is meant by Lewis acid and base? Point out it's limitations. [3+2]

46. 2075 Set A Q.No. 25 All Bronsted bases are also Lewis bases but all Bronsted acids are not Lewis acids. Explain. 80 mL of 0.01 M $AgNO_3$ are mixed with 20 mL of 0.001 M NaCl solution. Will any AgCl precipitate or not? [Ksp for AgCl = 1.5×10^{-10}] [1+4]
Ans: ppt will occur

47. 2070 Supp. Q.No. 24 200 mL of an aqueous solution of HCl (pH = 2) is mixed with 300 mL of an aqueous solution of NaOH (pH = 12). What will be the pH of resulting mixture solution? [5]
Ans: 11.3

48. 2069 Set B Q.No. 28 Define degree of ionization. Calculate the pH of 1.0 M solution of acetic acid. To what volume one litre of this solution be diluted so that the pH of the solution that is formed will be twice of original value [Ka = 1.8×10^{-5}] [1+2+2]
Ans: pH = 2.37; V = 233.08

49. 2065 Q.No. 30 a Define the following terms and give one example of each:
i. Bronsted Lowry acid and base.
ii. Lewis acid and base. [2.5+2.5]

50. 2062 Q.No. 30(a) Write a concise account of solubility product principle. [5]

51. 2062 Q.No. 26 Explain Bronsted and Lewis concepts of acid and base with suitable examples. [5]

Long Answer Questions [10 marks]

52. 2076 Set C Q.No. 32 State Ostwald's dilution law. What is the limitation of this law? Define the terms

i. Ionic product of water ii. Common ion effect
iii. Degree of ionization iv. pH value

What will be the resultant pH when 200 mL of aqueous solution of HCl (pH = 2) is mixed with 300 mL of an aqueous solution of NaOH (pH = 12)? [1+1+1+1+1+1+4]

Ans: Resultant pH = 11.30

53. 2075 Set B Q.No. 30 How is a strong electrolyte differed from a weak electrolyte? Derive the mathematical equation for Ostwald's dilution law. Point out its limitation. Calculate pH of the solution obtained by mixing 150 mL of 0.2N HCl and 150 mL of 0.1 N NaOH solution. [2+3+1+4]

Ans: 1.30

54. 2073 Supp Q.No. 32 State solubility product principle and common ion effect. What are its main applications? If the volume of 25 cm^3 of 0.05 M $Ba(NO_3)_2$ are mixed with 25 cm^3 of 0.02 M NaF. Will any BaF_2 precipitate? (Ksp of BaF_2 = 1.7×10^{-6} at 298K) [2+4+4]

Ans: 1.7×10^{-8}

55. 2073 Set C Q.No. 32 What is the common-ion effect? Explain its main applications. The solubility product constant (K_{sp}) of $Ca(OH)_2$ at 25°C is 4.42×10^{-5}. A 500 mL of saturated solution of $Ca(OH)_2$ is mixed with an equal volume of 0.4 M NaOH. What mass of $Ca(OH)_2$ is precipitated out? [2+4+4]

Ans: 0.75813 g/L

56. 2073 Set D Q.No. 32 State solubility product constant. What is the proper condition of precipitation of salt from its solution? Explain application of the solubility product principle and common ion effect. What is the minimum volume of water required to dissolve 1 g of calcium sulphate at 298 K? (given, solubility product (Ksp) for $CaSO_4 = 9.1 \times 10^{-6}$] [1+1+4+4]

Ans: 2.45×10^3mL

57. 2072 Supp. Q.No. 32 State Ostwald's dilution law. What is the limitation of this law? Define the terms (i) ionic product of water (ii) common ion effect (iii) degree of ionization (iv) pH value. What will be the resultant pH when 200 mL of an aqueous solution of HCL (pH = 2) is mixed with 300 mL of an aqueous solution of NaOH (pH = 12)? [1+1+1+1+1+1+4]

Ans: 11.30

58. 2072 Set D Q.No. 30 What is meant by the terms:

i. common ion effect
ii. solubility product constant (K_{sp})

Explain the common ion effect and solubility product principle in qualitative salt analysis. What will be the resulting pH of a solution prepared by mixing 200 mL of aquous solution of HCl (pH = 2) with 300 mL of an aquous solution of NaOH (pH = 12)? [2+4+2+2]

Ans: pH = 11.30

Write short notes on (5 Marks)

59. 2076 GIE Set A Q.No. 33iii 2074 Set A Q.No. 33d 2074 Set B Q.No. 33c 2070 Set C Q.No. 33 c Application of solubility product principle and common in effect in qualitative salt analysis. [5]

60. 2076 GIE Set B Q.No. 33i 2074 Supp. Q.No. 33(ii) 2066 Q. No. 31 iv Solubility product principle and its application. [5]

61. 2076 Set B Q.No. 33iv 2076 Set C Q.No. 33iii 2060 Q.No. 31(i) Lewis concept of acid and base. [5]

62. 2072 Set C Q.No. 33c Application of solubility principle and common-ion effect in salt analysis. [5]

63. 2069 Set A Q.No. 33 c 2059 Q.No. 31(b) 2058 Q.No. 31(a) Solubility product principle [5]

64. 2061 Q.No. 31(iii) pH and pH scale. [5]

65. 2057 Q.No. 31(a) Common ion effect [5]

66. 2056 Q.No. 31(a) Law of mass action [5]

Numerical Problems

67. 2072 Set E Q.No. 27 Define the terms: [1+1+3]

i. Degree of ionization. ii. Ostwald's dilution law.

Calculate the pH of a saturated solution of $Mg(OH)_2$, Ksp for $Mg(OH)_2$ is 8.9×10^{-12}.

Ans: pH=10.35

68. 2071 Supp. Q.No. 32 Write short note on solubility product and its application in analytical chemistry. The solubility product (Ksp) of $Ca(OH_2)$ at 25°C is 4.42×10^{-5}. A 500 mL of a saturated solution of $Ca(OH_2)$ is mixed with an equal volume of 0.4 M NaOH. How much $Ca(OH)_2$ is precipited? [5+5]

Ans: 0.75813 g/ litre

69. 2071 Set C Q.No. 30 2071 Set D Q.No. 32 State the following terms:

a. Ostwald's Dilution Law b. Degree of dissociation
c. Ionic product of water d. Common ion effect
e. pH value of a solution

Why is Ostwald's dilution law not applicable to strong electrolyte? What mass of KOH should be dissolved in one litre of solution to prepare a solution having pH is 12 at 25°C? (Atomic weight of K = 39) [1+1+1+1+1+1+4]

Ans: 0.56 g

70. 2070 Set C Q.No. 3 Calculate the pH of 1g/litre NaOH solution. [2]

Ans: 12.4

71. 2070 Set D Q.No. 27 What is meant by degree of ionization? 0.41 kg of NaOH is placed in 100 mL of 0.1N H_2SO_4. Find the pH of the resulting solution. [1+4]

Ans: 11.4

72. 2069 Set A Q.No. 3 What is pH of solution of NaOH whose concentration is 0.4g/ liter? [2]

Ans: pH = 12

73. 2069 Supp. Set B Q.No. 27 What are the limitations of Lewis concept of acid and base? A 500 mL of a saturated solution of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH. What mass of $Ca(OH)_2$ is precipitated. K_{sp} of $Ca(OH)_2$ is 4.42×10^{-5}. [2+3]

Ans: 0.75813 g/ L

74. 2068 Q.No. 13 Calculate the strength in gm/litre of NaOH whose pH values is 11. [2]

Ans. 4×10^{-3} g L^{-1}

75. **2068 Q.No. 26** Define solubility product principle. 0.00143 g of AgCl dissolve in one litre of water at 25°C to form a saturated solution. What is the solubility product of the salt? (Ag = 108, Cl = 35.5) [2+3]
Ans: 9.92×10^{-11}

76. **2067 Q.No. 29** Define the terms [6+4]
i. Common ion effect ii. pH of a solution
iii. Lewis base iv. Degree of ionization
v. Ionic product of water vi. Ostwald's dilution law
A sample of AgCl is treated with 5 mL of 2M Na_2CO_3 solution to produce Ag_2CO_3. The remaining solution contained 0.003 g of Cl^- per litre. Calculate solubility product of AgCl. (Ksp of $Ag_2CO_3 = 8.2\times10^{-12}$).
Ans: 1.71×10^{-10}

77. **2066 Q. No. 14** The pH of a solution of KOH is 10. Calculate the hydroxyl ion concentration. [2]
Ans: 10^{-4}M

78. **2065 Q.No. 30 b** What is ionic product of water? The pH of 0.1 M HCN solution is 5.2. What is value of ionization constant (Ka) for the acid? [1+4]
Ans: 3.969×10^{-10}

79. **2064 Q.No. 16** Define pH. Calculate the pH of 0.1M H_2SO_4. [2]
Ans: pH = 0.699

80. **2064 Q.No. 26** What is meant by solubility product of sparingly soluble electrolyte? The solubility of AgCl in water at 298 K is 1.43×10^{-3} g L^{-1}, calculate its solubility in 0.5M KCl solution. [2+3]
Ans: 1.984×10^{-10} mol L^{-1}

81. **2063 Q.No. 13** Calculate the hydroxide ion concentration of a solution having pH 10.5.
Ans: 3.16×10^{-4} mol/litre

82. **2063 Q.No. 25** What are ionization constant and degree of ionization of a weak electroyte? How do they vary with temperature? Calculate the pH of 0.1M acetic acid solution having K_a 1.8×10^{-5}. [2+1+2]
Ans: pH = 2.87

83. **2061 Q.No. 13** The solubility of CaF_2 in water at 18°C is 2.05 $\times 10^{-4}$ mole per litre. Calculate its solubility product. [5]
Ans: 3.446×10^{-11} mol/L

84. **2060 Q.No. 15** The solubility product constant of $BaSO_4$ in water at 25°C is 1×10^{-10} $mole^2L^{-2}$. Calculate the solubility of $BaSO_4$ in g/L. [Ba = 137] [2]
Ans: Solubility of $BaSO_4 = 2.33 \times 10^{-3}$ g/L

85. **2060 Q.No. 26** Define ionic product of water. Why does Kw of water increases with temperature? 10 cc $\frac{N}{2}$ HCl, 30 cc $\frac{N}{10}$ HNO_3 and 60 cc $\frac{N}{5}$ H_2SO_4 are mixed together. Find the pH of the mixture. [1+1+3]
Ans: pH of the mixture = 0.698

86. **2059 Q.No. 16** Calculate the pH value of 0.04 N HNO_3 solution, assuming HNO_3 to be completely ionized. [2]
Ans: pH = 1.39

87. **2059 Q.No. 30** Explain Bronsted Lowry concept of acids and bases. Calculate the degree of ionization of HCN having concentration 0.01 M (K_a of HCN = 4.8×10^{-10}). Also calculate H^+ ion concentration and pH. [3+4+3]
Ans: $H^+ = 2.2 \times 10^{-6}$, pH = 5.65

88. **2058 Q.No. 15** Calculate the hydrogen ion concentration of solution whose pH is 9.5.
Ans: 3.16×10^{-10}

89. **2057 Q.No. 25** Define solubility product. The solubility of CaF_2 in water at 18°C is 2.05×10^{-4} mol/litre. Calculate its solubility product. [1+4]
Ans: 3.446×10^{-11} mol^2 L^{-2}

90. **2056 Q.No. 5** The pH of HCl solution is 3. Calculate the strength of HCl in terms of molarity.
Ans: pH = 0.01

91. **2056 Q.No. 22** The solubility product of CuS is 8.0×10^{-45} at a certain temperature. Find its solubility at this temperature.
Ans: 8.94×10^{-23} mol L^{-1}

92. **2055 Q.No. 22** The solubility product of chalk is 9.3×10^{-9}. Calculate its solubility in gram per litre.
Ans: Solubility = 3.49×10^{-2} gm

93. **2054 Q.No. 22** The solubility of CaF_2 in water at 18°C is 2.05 $\times 10^{-4}$ mole per litre, Calculate its solubility product.
Ans: 3.446×10^{-11} mol/litre

UNIT 4: ELECTROCHEMISTRY

FORMULAE

1. Faraday's First Law
   $m = ZIt$
   $Q = It$
   $1F = 6.022 \times 10^{23} \times 1.6 \times 10^{-19}$ C = 96500C
2. Faraday's Second Law
   $\frac{m_1}{m_2} = \frac{E_1}{E_2} = \ldots$
   Relation between equivalent weight and electro chemical equivalent
   $Z = \frac{E}{F} = \frac{E}{96500}$
3. Electrolytic conductance
   $R \propto \frac{l}{A}$
   $R = \rho \frac{l}{A}$
   $\text{Ohm} = \rho \frac{cm}{cm^2}$
   $\therefore \rho = \text{Ohm cm}$
   $\kappa = \frac{1}{\rho}$ where, κ = Specfic conductivity
   $\kappa = \text{Ohm}^{-1}\,cm^{-1}$
   $= \text{Simenes}\,cm^{-1}$
   $= Scm^{-1}$
4. Equivalent conductivity (λ) = $\kappa \times V$
   $\lambda = \kappa \times \frac{1000}{N} = \kappa V$
   $= \text{Ohm}^{-1}\,cm^{-1}\,cm^3\,eqv^{-1}$
   $= \text{Ohm}^{-1}\,cm^2\,eqv^{-1}$
   $= Scm^2\,eqv^{-1}$
5. Molar conductivity (μ) $= \kappa \times V$
   $= \kappa \times \frac{1000}{M}$
   $= \text{Ohm}^{-1}\,cm^2\,mol^{-1}$
   $= Scm^2\,mol^{-1}$
6. Cell constant = $\frac{l}{A} = cm^{-1}$
7. Relation between μ and λ
   $\mu = Z \times \lambda$
8. Galvanic cell: $E°\text{ cell} = E°_R - E°_L$

Very Short Answer Questions [2 marks]

1. **2077 Set 'A' Q.No. 4** What products would you expect at cathode and anode when aqueous NaCl is electrolysed using platinum electrode? [2]

2. **2076 GIE Set A Q.No. 4** How many grams of Chromium are produced by 4.8×10^4 coulombs according to the following reactions.
$CrO_3 + 6H^+ + 6e \rightarrow Cr(s) + 3H_2O$ [2]
Ans: 4.31 g

3. **2076 GIE Set B Q.No. 4** Define one Faraday. How many coloumbs of electricity are required to produce 2.7 gm of aluminium from molten Al_2O_3? [1+1]
Ans: 28950 C

4. **2076 Set B Q.No. 4** How many coulombs are required to produce [1+1]
   i. 27 g of silver from $AgNO_3$?
   ii. 50 g of Aluminum from Al_2O_3?
   (Atomic weight of Ag = 108, Atomic weight of Al = 27)
Ans: (i) 24125 C (ii) 536111 C

5. **2076 Set C Q.No. 4** How many coulombs are required to produce [1+1]
   i. 80 g of calcium from molten $CaCl_2$?
   ii. 50 g of Aluminum from molten Al_2O_3?
Ans: (i) 386000 C (ii) 536111 C

6. **2075 GIE Q.No. 4** Can $CuSO_4$ solution be stored in a Zinc Vessel? [2]
$E^0 Cu^{2+}/Cu = 0.34$ V $E^0 Zn^{2+}/Zn = -0.76$ V

7. **2075 Set A Q.No. 4** Why does silver nitrate solution become bluish when copper rod is dipped into it? [2]
[Given $E^\circ Cu^{2+}/Cu = 0.34$V and $E^\circ Ag^+/Ag = 0.80$ V]

8. **2075 Set B Q.No. 4** A solution contains 1 g of NaCl in 200 cm^3 and its specific conductance is found to be 2.55×10^{-2} $ohm^{-1} cm^{-1}$. Calculate its molar conductance. [2]
Ans: 300 S cm^2 mol^{-1}

9. **2074 Supp. Q.No. 5** How many coulombs are required to produce 50 g of Al when electrode reaction is
$Al^{+++} + 3e^- \longrightarrow Al$ (Atomic mass of Al = 27)? [2]
Ans: 535575 coulomb

10. **2074 Set A Q.No. 5** How many coulombs are required to deposit 126 gram of Cu from $CuSO_4$ solution? (Atomic mass of Cu = 63.5) [2]
Ans: 382140 coulomb charges

11. **2074 Set B Q.No. 5** How many coloumbs of electricity are required to deposit 33 g of Ca from molten $CaCl_2$? [2]
Ans: 159225 coulomb charges

12. **2073 Supp Q.No. 4** Two metallic element X and Y have the following standard electrode potential.
X = +0.40V
Y = –0.80V
What would you expect to occur if X is added to an aqueous solution of salt of Y? Give reason. [2]

13. **2073 Set C Q.No. 4** Predict whether the following reaction will occur spontaneously or not, Why? [1+1]
$Pb^{2+} + 2Ag \longrightarrow 2Ag^+ + Pb$
given, $E^\circ_{Ag^+}/Ag = 0.80$ V; $E^\circ_{Pb^{+2}}/Pb = -0.13$ V
Ans: Non Spontaneous

14. **2073 Set D Q.No. 4** Predict whether the following reaction will occur spontaneously or not, Why? [1+1]
$Pb^{2+} + 2Ag \longrightarrow 2Ag^+ + Pb$
given, $E^\circ_{Ag^+}/Ag = 0.80$ V; $E^\circ_{Pb^{2+}}/Pb = -0.13$ V
Ans: Non-spontaneous

15. **2072 Supp. Q.No. 4** What is meant by single electrode potential? How is it measured? [1+1]

16. **2072 Set C Q.No. 4** Calculate the number of coulombs required to deposit 40 g of aluminium from molten Al_2O_3. [2]
Ans: 428460 Coulomb charge

17. **2072 Set D Q.No. 4** Why does $AgNO_3$ solution become bluish when copper rod is dipped in it? (The standard reduction potential of Cu and Ag are +0.3V and +0.8V respectively). [1+1]

18. **2072 Set E Q.No. 4** What is meant by standard hydrogen electrode? Write an important use of it. [1+1]

19. **2071 Supp. Q.No. 4** How many coulombs of electric charge are required to deposit? [1+1]
   i. 4.6 g of sodium
   ii. 3 mole of aluminium
   (Atomic mass of Al = 27 and Na = 23.)
Ans: (i) 19300 C (ii) 868500 C

20. **2071 Set C Q.No. 4** What is meant by single electrode potential? Name any two factors that affect the magnitude of single electrode potential. [1+1]

21. **2071 Set D Q.No. 4** How would you justify that value of one Faraday is 96500 coulumbs? [2]

22. **2070 Supp. Q.No. 4** **2070 Set C Q.No. 4** Mention important application of standard hydrogen electrode giving example. [2]

23. **2069 Set A Q.No. 4** What do you mean by electrolytic conduction? [2]

24. **2069 Supp. Set B Q.No. 4** Standard hydrogen electrode acts as both an anode or cathode. Give reason. [2]

25. **2068 Q.No. 14** Define the term: [1+1]
   i. electrochemical equivalent
   ii. equivalent conductance

26. **2067 Q.No. 13** Can a solution of 1M $CuSO_4$ be stored in a vessel made up of Nickel? If not why? [2]
Given: $E^\circ Ni^{++}/Ni = -0.25$ V; $E^\circ Cu^{2+}/Cu = +34$ V

27. **2066 Q. No. 13** Will the reaction occur:
$Zn^{++} + 2Fe^{++} \longrightarrow Zn + 2Fe^{+++}$
Given standard reduction potentials are:
$E^\circ_{Zn^{++}/Zn} = -0.76$V, $E^\circ_{Fe^{3+}/Fe} = +0.80$ V. Given reason. [2]
Ans: – 1.56 V

28. **2065 Q.No. 13** Can a solution of 1M $CuSO_4$ be stored in a vessel made of nickel metal? If not, why? [2]
Given: $E^\circ_{Ni^{++}/Ni} = -0.25$ V; $E^\circ Cu^{++}/Cu = 0.34$ V
Ans: No

29. **2064 Q.No. 13** How is single electrode potential originated? [2]

30. **2063 Q.No. 15** What is meant by: [2]
   i. One ampere current is passing through a solution.
   ii. The standard reduction potential of Cu^{++}/Cu is 0.34V.

31. **2060 Q.No. 18** Define the terms: [2]
   i. Cell constant ii. Molar conductivity.

32. 2058 Q.No. 14 Construct a galvanic cell in which the cell reaction is:
$Fe(S) + H_2SO_4(aq) \longrightarrow FeSO_4(aq) + H_2(g)$ [2]

33. 2057 Q.No. 14 Define standard electrode potential. [2]

34. 2056 Q.No. 8 How does specific conductance decreases and equivalent conductance increases with dilution? [2]

35. 2055 Q.No. 3 State Faraday's Second Law. [2]

36. 2054 Q.No. 4 Define the term electrochemical equivalent. [2]

37. 2053 Q.No. 4 2052 Q.No. 4 What is E.C.E. (Electro-chemical Equivalent)? [2]

Short Answer Questions [5 marks]

38. 2077 Set P Q.No. 9 Define the terms
i. Equivalent conductance
ii. Standard electrode potential.
The cost of electricity required to deposit 1 g of Mg is Rs. 6. How much would it cost to deposit 10 g of Al? (At. wt of Al = 27) [2+3]
Ans: 55 Rupees

39. 2076 GIE Set A Q.No. 24 What is meant by standard electrode potential? The standard electrode potential for Mg^{+2}/Mg and Cu^{+2}/Cu are –2.37 V and +0.34V respectively. [1+4]
i. Draw a standard cell rotation.
ii. Identify the anode and the cathode as the current drawn from it.
iii. Write the cell reactions taking place at the electrodes.
iv. Calculate the standard cell potential.
Ans: +2.71 V

40. 2076 GIE Set B Q.No. 24 Define electrochemical cell. The standard electrode potential of Cu^{+2}/Cu and Zn^{+2}/Zn electrodes are +0.34V and –0.76V respectively.
i. Write the cell notation indicating anode and cathode.
ii. Write the cell reaction. [1+1+1+1+1]
iii. Calculate the emf of the cell
iv. Predict the feasibility of the reaction with reason.
Ans: (iii) +1.10 V (iv) Fisible

41. 2076 Set B Q.No. 24 2076 Set C Q.No. 24 Mention the important applications of standard hydrogen electrode. The standard electrode potential for Fe^{+3}/Fe^{+2} and I_2/I^- are + 0.77 V and +0.54 V respectively.
i. Draw the standard cell notation.
ii. Identify the anode and cathode as the current drawn from it.
iii. Write the cell reaction taking place at the electrodes.
iv. Calculate standard cell potential. [1+1+1+1+1]
Ans: (iv) E^oCell: +0.23 V

42. 2075 GIE Q.No. 24 State and explain Faraday's 1st law of electrolysis. An electrolytic cell contains a solution of $CuSO_4$ and anode of impose copper. How many Kg of copper will be deposited at cathode by 150 ampere passing for 12 hours? [2+3]
Ans: 2.13192 Kg

43. 2075 Set A Q.No. 24 What is meant by (i) molar conductivity and (ii) Electro-chemical equivalent? How long a current of 3 ampere has to be passed through a solution of $AgNO_3$ to coat a metal of surface area 80 cm^2 with 0.005 mm thick layer (Density of Ag = 10.5 g/cm^2) [2+3]
Ans: 125 sec.

44. 2075 Set B Q.No. 23 What is meant by standard hydrogen electrode? Write its important application. The standard electrode potentials are given as
E^o Zn/Zn^{+2} = –0.76V
E^o Fe^{+3}/Fe^{+2} = + 0.77V
i. Construct a cell notation for a galvanic cell indicating anode and cathode.
ii. Calculate the e.m.f. at 1M solution of ions.
iii. Will the reaction $Zn^{2+} + 2Fe^{2+} \longrightarrow Zn + 2Fe^{3+}$ Occur? [2+
Ans: +1.53V

45. 2074 Supp. Q.No. 23 What is meant by hydrogen electrode? Mention it's an important use. The standard electrode potentials are given as:
E^oMg^{++}/Mg = – 2.37 V, E^oCu^{++}/Cu = + 0.34V
i. Construct a cell notation for an electrochemical cell.
ii. Write the reactions taking place at anode and cathode.
iii. Calculate the emf of the cell. [2+3]
Ans: +2.71V

46. 2074 Set A Q.No. 23 What is meant by primary reference electrode? Mention its one important use.
The standard electrode potential of copper and silver are [E^oCu^{++}/Cu = +0.34 V and E^o Ag^+/Ag = +0.80V]
i. Construct cell notation for an electrochemical cell.
ii. Calculate the emf at 1M solution of its ions.
iii. Will the reaction occur?
$Cu + 2\,Ag^+ \longrightarrow Cu^{++} + 2\,Ag$? Give reason. [2+3]
Ans: 0.46 V

47. 2074 Set B Q.No. 23 Name a primary reference electrode and mention its one important use. For a cell;
$Mg(s)/Mg^{++}(1M)//Cu^{++}(1M)/Cu(s)$
E^o Mg^{++}/Mg = -2.37 V and E^oCu^{++}/Cu = +0.34 V [2+3]
i. Indicate cathode and anode.
ii. Write the reaction taking place at electrode.
iii. Calculate the emf at 1M solution of its ions.
Ans: +2.71 V

48. 2073 Supp Q.No. 23 How do molar and equivalent conductivity vary with concentration for weak electrolyte? A solution contains 2 g of anhydrous $BaCl_2$ in 400cm^3. Its conductivity is found to be 5.8 × 10^{-3} cm^{-1}. Calculate the molar conductivity of $BaCl_2$. (Atomic weight of Ba=137) [3+2]
Ans: 241.66 S cm^2 mol^{-1}

49. 2073 Set C Q.No. 23 How does molar conductivity vary with concentration for weak electrolyte? Give reason for its variations. A solution contains 2 g of anhydrous $BaCl_2$ in 400 cm^3, its conductivity is found to be 5.8 × 10^{-3} S cm^{-1}. Calculate the molar conductivity of $BaCl_2$ (Atomic weight of Ba = 137) [3+2]
Ans: 241.66 S cm^2 mol^{-1}

50. 2073 Set D Q.No. 23 State Faraday's laws of electrolysis. Establish relationship between electro-chemical equivalent and chemical equivalent. 0.197 g of copper is deposited by a current of 0.2 A in 50 minutes. Calculate its electrochemical equivalent. [2+1+2]
Ans: 3.2×10^{-4} g

51. 2072 Set D Q.No. 23 Define the term: [2+1.5+1.5]
i. Electrochemical equivalent.
ii. Standard electrode potential.
How many coulombs are required to produce:
i. 80 g of aluminium from molten Al_2O_3?
ii. 24 g of magnesium from $MgCl_2$? **Ans: 856920C, 193000C**

52. **2071 Supp. Q.No. 23** **2071 Set D Q.No. 23** What is meant by electrochemical cell? Design a Galvanic cell in which the reaction $Zn(s) + 2Ag^+(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$, takes place. Further predict. [1+2+1+1+1]
   i. Which of the electrode is negatively charged?
   ii. The carriers of the current in the cell.
   iii. Individual reaction at each electrode.

53. **2070 Set D Q.No. 28** Represent graphically the variation of equivalent conductivity of strong electrolyte and weak electrolyte with concentration. Why do equivalent conductivity of strong electrolyte and weak electrolyte vary differently with dilution? [2+3]

54. **2069 Set B Q.No. 27** Give any two differences between electrochemical and electrolytic cell. You are given zinc rod, copper rod, zinc sulphate and copper sulphate solutions and standard electrode potential of zinc and copper are –0.76V and 0.34V respectively.
   a. Represent an electrochemical cell indicating anode and cathode
   b. Write net cell reactions
   c. What will be the emf of the cell? [2+1+1+1]
   Ans: 1.10 V

55. **2068 Q.No. 24** What is meant by standard electrode potential? The standard electrode potential for the following electrode are; [1+2+1+1]
   $Zn^{++} + 2e^- \longrightarrow Zn$, $E^o = -0.76V$
   $Fe^{+++} + e^- \longrightarrow Fe^{++}$, $E^o = 0.77V$
   i. Represent a suitable galvanic cell and point out which one will be cathode?
   ii. With 1 M solutions of the ions what will be emf?
   iii. Will the reaction $Zn^{++} + 2Fe^{++} \longrightarrow Zn + 2Fe^{+++}$ occur? Give reason.
   Ans. (ii) 1.53 Volt

56. **2064 Q.No. 31(i)** Write short notes on Variation of electrolytic conductances with concentration. [5]

57. **2063 Q.No. 24** State and explain Faraday's second law of electrolysis. Show that the electric charge carried by transfer of 1 mole of electron is one Faraday. [5]

58. **2061 Q.No. 26** Distinguish between (a) electrolytic and voltaic cells b) oxidation and oxidizing agent. [5]
   Four metals, labelled A, B, C and D react with each other and with acids in the following way: B displaces only C from solution. Only A and D displace hydrogen from 1M HCl. None of the metals will displace D from solution. Arrange the four metals in an activity series with hydrogen.
   Ans: D > A > H > B > C

59. **2060 Q.No. 27** How is single electrode potential originated? Predict which one of the following reactions occur spontaneously? [5]
   i. $2Fe^{+2} + Sn^{+4} \longrightarrow 2Fe^{+3} + Sn^{+2}$
   ii. $2Fe^{+3} + Sn^{+2} \longrightarrow 2Fe^{+2} + Sn^{+4}$
   Given standard reduction potentials of Fe^{3+}/Fe^{2+} and Sn^{4+}/Sn^{2+} are + 0.77V and + 0.15V respectively.

Write Short Notes on (5 marks)

60. **2062 Q.No. 31(d)** Faraday's laws of electrolysis. [5]

Numerical Problems

61. **2072 Supp. Q.No. 23** **2071 Set C Q.No. 23** Define weak electrolytic cell giving an example of it. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation. [1+2+2]
   $CrO_3(aq) + 6H^+ + 6e^- \longrightarrow Cr(s) + H_2O$
   Calculate:
   i. How many gram of Cr will be plated out by 2400 coulomb?
   ii. How long will it take to plate out 1.5 g of Cr by using 12.5 amphere current? (Atomic mass of Cr = 52)
   Ans: (i) 0.21 g (ii) 22.26 min

62. **2072 Set C Q.No. 23** Define the terms: [2+3]
   i. Standard electrode potential
   ii. Electrochemical series
   The standard electrode potentials are given as:
   $E^\circ_{Zn/Zn^{+2}} = -0.76$ V $\quad E^\circ_{Fe^{+3}/Fe^{+2}} = +0.77$ V
   i. Construct a cell notation for a galvanic cell indicating anode and cathode.
   ii. Calculate the e.m.f. at 1 M solution of ions.
   iii. Will the reaction $Zn^{2+} + 2Fe^{2+} \longrightarrow Zn + 2Fe^{3+}$ occur?
   Ans: (ii) + 1.53 V, (iii) No

63. **2072 Set E Q.No. 28** State Faraday's laws of electrolysis? Silver is electrodeposited on a metal plate of surface area 800 cm^2 by passing 0.2 ampere of current for 3 hours. Calculate the thickness of Ag deposited. (Given specific gravity of Ag = 10.47 and atomic mass = 108) [2+3]
   Ans: 2.875×10^{-4} cm

64. **2070 Supp. Q.No. 23** **2070 Set C Q.No. 24** State Faraday's 2nd law of electrolysis. Equal amount current was passed through an aqueous solution of tri-valent metallic salt and dil. H_2SO_4. The volume of H_2 liberated was 96.5 mL at 27°C and 765 mm Hg pressure. The weight of the metal deposited was 0.74g. Calculate the atomic weight of the metal. [1+4]
   Ans: 283.61 amu

65. **2070 Set D Q.No. 4** How many number of coulombs are required to deposit 81 g of Aluminium when the electrode reaction is: $Al^{+++} + 3e^- \longrightarrow Al$? [2]
   Ans: 868,500 coulombs

66. **2069 Set A Q.No. 25** Distinguish between electrochemical equivalent and chemical equivalent. A metallic spoon is coated with silver by passing a current of 5 ampere through $AgNO_3$ solution for 5 hrs. What is the thickness of silver plating if the area of the spoon is 12 cm^2 (density of silver is 10.5 g cm^{-3})? [1+4]
   Ans: 0.8 cm

67. **2069 Set B Q.No. 4** Convert the following:
   i. Charge of 4.0×10^{12} electrons into coulombs.
   ii. Chemical equivalent of Magnesium into Electro chemical equivalent. [1+1]
   Ans: (i) 6.4×10^{-7} coulombs (ii) 1.24×10^{-4}

68. **2069 Supp. Set B Q.No. 26** State Faraday's first law of electrolysis and write the mathematical relation between electrochemical equivalent and chemical equivalent. 1.52 g of a trivalent metal Ⓜ was deposited at cathode by passing a current of 2.5 ampere through its salt solution (metal sulphate) for 30 minutes. What is the atomic mass of Ⓜ? [1+4]
   Ans: 97.78 amu

69. 2067 Q.No. 24 Define one Faraday's electricity. How many grams of silver could be plated out on a serving tray by passing electricity through a solution of Ag (I) salt for 8 hours at a current of 9 ampere? What is the area of the tray, if thickness of the silver platting is 0.002 cm? Density of silver is 10g/cm³. (Atomic mass of Ag = 107.8). [1+4]
Ans: Weight of Ag = 289.55 g; Area of tray = 14477.59 cm²

70. 2066 Q. No. 24 Define:
i. Electrochemical cell
ii. Equivalent Conductance
A current of 2.5 amphere passes through the solution of a metal sulphate for 30 minutes and deposits 1.52 g of metal at cathode. Find the equivalent weight of the metal. [1+1+3]
Ans: 32.6 g

71. 2065 Q.No. 24 State Faraday's 1st Law of electrolysis. What current strength is required to deposit whole copper from 1 litre of 1M $CuSO_4$ solution by passing electricity through it in 10 minute? [1.5+3.5]
Ans: 321.66 ampere

72. 2064 Q.No. 14 Calculate the equivalent conductance of 0.1N KCl solution having specific resistance 83.3 Ohm cm^{-1}. [2]
Ans: 120 ohm^{-1} cm^2 eq^{-1}

73. 2062 Q.No. 14 Calculate the equivalent conductivity of 0.12 N solution of an electrolyte, whose conductivity is 0.024 S cm^{-1}. [2]
Ans: 200m^{-1} cm^2 eqv^{-1} (200 Scm^2 eqv^{-1})

74. 2059 Q.No. 14 Find out the molar conductivity of 0.01 M acetic acid having specific conductivity 1.46×10^{-4} ohm^{-1} cm^{-1} mol^{-1}. [2]
Ans: 14.6 ohm^{-1} cm^2 mol^{-1}

75. 2058 Q.No. 30 State and explain Faraday's laws of electrolysis. How long a current of 3 ampere has to be passed through a solution of $AgNO_3$ to coat a metal surface of 80 cm^2 with 0.005 mm thick layer? (density of Ag = 10.5 g/cc). [10]
Ans: 125.37 sec

76. 2057 Q.No. 26 You are given standard reduction potential of Cu^{+2}/Cu and Fe^{+2}/Fe as + 0.34V and – 0.44V respectively.
a. Construct a galvanic cell indicating anode and cathode
b. Write the cell reaction and calculate the standard emf of the cell. [5]
Ans: Standard EMF of the cell = 0.78V

77. 2056 Q.No. 4 How many coulombs of electricity are required to discharge 0.1 mole of Na^+? [1 Faraday = 96500 coulomb.][2]
Ans: 9650 Coulomb

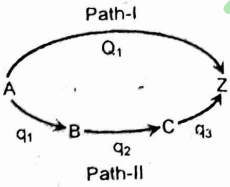
UNIT 5: ENERGETICS OF CHEMICAL REACTIONS

FORMULAE

1. Internal Energy: $\Delta E = E_P - E_R$
2. First Law of Thermodynamics
   $q = \Delta E + w$ $\quad w = P\Delta V$
   $\Delta V = V_{final} - V_{initial}$ $\quad q = \Delta E + P\Delta V$
2. Enthalpy (H) = E + PV
   $\Delta H = \Delta E + P\Delta V$
   PV = nRT (Ideal gas equation)

At constant T and P
$P\Delta V = \Delta nRT$
So, $\Delta H = \Delta E + \Delta nRT$
$\Delta H = H_P - H_R$

3. Hess's law of constant heat summation
   $Q_2 = q_1 + q_2 + q_3$
   $Q_1 = Q_2$



4. Bond energy
   $\Delta H = \Sigma(\text{Bond energy})_{reactant} - \Sigma(\text{Bond energy})_{product}$
   1J = 10^7 erg
   1 L atm = 101.3J
   1 calorine = 4.184 J
   1.987 cal = 0.0821 L atm

Very Short Answer Questions [2 marks]

1. 2077 Set P Q.No. 2 State Hess's law of constant heat summation. [2]
2. 2077 Set V Q.No. 2 Calculate the enthalpy of formation in the following reactions:
   i. $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$, $\Delta H = -136$ Kcal
   ii. $H_2(g) + I_2(g) \longrightarrow 2HI(g)$, $\Delta H = -24.8$ Kcal. [1+1]
   Ans: (i) – 68 Kcal (ii) – 12.4 Kcal
3. 2076 GIE Set A Q.No. 5 Point out limitations of first law of thermodynamics. [2]
4. 2076 GIE Set B Q.No. 5 State first law of thermodynamics. Write the limitations of this law. [1+1]
5. 2076 Set B Q.No. 5 Define state function. Write any two examples of it. [1+1]
6. 2076 Set C Q.No. 5 State the first law of thermodynamics. [2]
7. 2075 GIE Q.No. 5 2074 Set A Q.No. 4 2074 Set B Q.No. 6 2069 Supp. Set B Q.No. 6 State the first law of thermodynamics and point out its limitation. [1+1]
8. 2075 Set A Q.No. 5 Define the term 'internal energy'. why is the internal energy of a system a state function? [1+1]
9. 2075 Set B Q.No. 5 Define enthalpy of formation giving an example of it. [2]
10. 2074 Supp. Q.No. 4 Distinguish between extensive and intensive properties with an example of each. [2]
11. 2073 Supp Q.No. 5 Define enthalpy of combustion. Enthalpy of combustion of carbon to CO_2 is –393 kJ/mol. Calculate heat released upon formation of 33 g of CO_2 form carbon and oxygen. [1+1]
    Ans: -294.75 kJ
12. 2073 Set C Q.No. 5 Define standard enthalpy of formation. If heat change for the following reaction is 1648 kJ, what is the standard enthalpy of formation of Fe_2O_3?
    $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$ [2]
    Ans: –824.
13. 2073 Set D Q.No. 5 What is meant by enthalpy of reaction? If standard enthalpy of formation of ammonia is 46 kJ mol^{-1}, what is the enthalpy change of the following reaction? $N_2(g)$ + $3H_2(g) \longrightarrow 2NH_3(g)$ [1+1]
    Ans: –92 kJ mol^{-1}

14. **2072 Supp. Q.No. 5** Calculate the standard enthalpy of formation of water in the following reaction: [1+1]
$2H_2(g) + O_2(g) \longrightarrow 2H_2O\ (l),\ \Delta H = -136$ Kcal
Ans: –68 K Cal/ Mole

15. **2072 Set C Q.No. 5** Distinguish between enthalpy of combustion and enthalpy of formation. [1+1]

16. **2072 Set D Q.No. 5** What is meant by state function? Give its example. [1+1]

17. **2072 Set E Q.No. 5** Distinguish between intensive and extensive property with examples: [1+1]

18. **2072 Set E Q.No. 6** The enthalpy of reaction for $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ is –92.4 kJ. Calculate the enthalpy of formation of ammonia. [2]
Ans: –46.2 kJ

19. **2071 Supp. Q.No. 5** Distinguish between extensive and intensive properties giving one example of each. [1+1]

20. **2071 Set C Q.No. 5** Calculate the standard enthalpy of formation of water in the following reaction:
$2H_2(g) + O_2(g) \longrightarrow 2H_2O\ (l),\ \Delta H = -136$ Kcal [2]
Ans: –68 k Cal/ mole

21. **2071 Set D Q.No. 5** Define state function and give any two correct examples of it. [1+1]

22. **2070 Supp. Q.No. 5** State the first law of thermodynamics and write its mathematical relation. [1+1]

23. **2070 Set C Q.No. 6** Define the terms: [1+1]
i. Extensive properties ii. Internal energy

24. **2070 Set D Q.No. 5** State first law of thermodynamics. [2]

25. **2069 Set A Q.No. 6** **2069 Set B Q.No. 5** Calculate the enthalpy of formation of NH_3 from the following equation.
$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g),\ \Delta H = -186kJ.$ [2]
Ans: ΔH_f = – 93 kJ

26. **2069 Supp. Set B Q.No. 5** Under what conditions, [1+1]
i. reaction occur spontaneously
ii. free energy change become zero.

27. **2067 Q.No. 16** State the first law of thermodynamics. [2]

28. **2065 Q.No. 16** State Hess's Law of constant heat summation.[2]

29. **2062 Q.No. 16(i)** Define the terms: Enthalpy of a reaction. [2]

30. **2059 Q.No. 17** How is free energy change of a reaction related to enthalpy change and entropy change? [2]

31. **2058 Q.No. 17** Draw energy profile diagrams for exothermic and endothermic reactions. [2]

32. **2055 Q.No. 6** Define exothermic and endothermic reaction.[2]

33. **2055 Q.No. 7** State Hess's law of constant heat summation.[2]

34. **2054 Q.No. 7** State whether the following properties are extensive properties or intensive properties
a. Entropy b. Temperature. [2]

Short Answer Questions [5 marks]

35. **2076 GIE Set A Q.No. 25** State and explain Hess's law of constant heat of summation. Write its major applications. [2+3]

36. **2076 Set B Q.No. 25** Define bond dissociation energy. The bond dissociation energy of H_2 (g) and Cl_2 (g) are 435 KJ/mol and 243 KJ/mol respectively. The enthalpy of formation of HCl (g) = –92 KJ/mol. Calculate the bond dissociation energy of HCl (g). [1+4]
Ans: +431 KJ/mol

37. **2076 Set C Q.No. 25** State enthalpy of combustion. If heat of formation of CO_2, H_2O and $C_6H_{12}O_6$ are – 395 KJ mol^{-1}, –269.4 KJ mol^{-1} and –1169 KJ mol^{-1} respectively. Calculate the heat of combustion of glucose. [1+4]
Ans: –2815 kJ

38. **2075 Set B Q.No. 24** State Hess's law of constant heat summation. Heat of combustion of benzene (C_6H_6) is –3280 kJ. Heat of formation of CO_2 and water are – 395 kJ and – 286 kJ respectively. Calculate the heat of formation of benzene. [1+4]
Ans: +52 kJ

39. **2074 Supp. Q.No. 25** State enthalpy of combustion. If heat of formation of CO_2, H_2O and $C_6H_{12}C_6$ are –395 KJ mol^{-1}, –269.4 KJ mol^{-1} and –1169 KJ mol^{-1} respectively. Calculate the heat of combustion of glucose. [1+4]
Ans: –2815 kJ

40. **2074 Set A Q.No. 25** What is meant by enthalpy of combustion? If heat of formation of CO_2, H_2O and $C_6H_{12}O_6$ are –395 kJ mol^{-1}, –269 kJ mol^{-1} and –1169 kJ mol^{-1} respectively. Calculate the heat of combustion of glucose ($C_6H_{12}O_6$) [1+4]
Ans: –2815 kJ

41. **2074 Set B Q.No. 25** Define bond enthalpy. The bond enthalpies of gases H_2, Cl_2 and HCl are 104 Kcal mol^{-1}, 58 Kcal mol^{-1} and 103 Kcal mol^{-1} respectively. Calculate enthalpy of formation of HCl (g). [1+4]
Ans: –22 Kcal

42. **2072 Set E Q.No. 32a** State first law of thermodynamics. What are its advantages and limitations? The enthalpies of formation of CO_2(g), H_2O(l) and CH_4 (g) are –393.5, –286.2 and –74.8 kJ mol^{-1} respectively. Calculate the enthalpy of combustion of methane. [1+1+1+2]
Ans: 891.1 kJ/mol

43. **2072 Set D Q.No. 24** Define heat of formation. Heat of combustion of methane, carbon and hydrogen are –210 KCal, –94KCal and –68 KCal respectively. Calculate the heat of formation of methane. [1+4]
Ans: –20 K Cal

44. **2068 Q.No. 25** Mention the important applications of Hess's Law of constant heat summation. The standard heat of formation of SO_2 (g) and SO_3(g) are –296.6 kJ and –396 kJ respectively. Calculate ΔH for the reaction:
$SO_2(g) + \frac{1}{2}O_2(g) \longrightarrow SO_3(g)$ [2+3]
Ans ΔH = –99.4 kJ

45. **2052 Q.No. 25** State and explain first law of: Thermodynamics, and, hence deduce H = E + PV, where all the symbols have their usual meanings. [5]

Long Answer Questions [10 marks]

46. **2063 Q.No. 30(a)** Define enthalpy of a reaction. State and explain Hess's Law of constant heat summation. [5]

Write Short Notes on [5marks]

47. **2075 GIE Q.No. 33i** **2075 Set A Q.No. 33i** **2073 Supp Q.No. 33iv** **2073 Set C Q.No. 33iii** **2073 Set D Q.No. 33iii** **2072 Supp. Q.No. 33i** **2071 Supp. Q.No. 33a** **2070 Set D Q.No. 33d** Hess's law of constant heat summation. [5]

Numerical Problems

48. **2076 GIE Set B Q.No. 30**

a. Define enthalpy of a reaction. State and explain Hess's law of constant heat summation.

b. The standard enthalpy of formation of H_2O (l), CO_2 (g) and C_6H_6(l) are –286, –393.5 and +49.02 $KJmol^{-1}$ respectively. Calculate the standard enthalpy of combustion of C_6H_6 (l) at the given temperature. [2+4+4]

Ans: –3268.02 kg

49. **2072 Set C Q.No. 24** Write any two applications of Hess's law. Heat of formation of ethyl alcohol, water and carbondioxide are –64.1 K Cal, –68.5 K Cal and –95 K Cal. Calculate the heat of combustion of ethyl alcohol. [1+4]

Ans: –331.4 KCal

50. **2070 Set C Q.No. 25** State Hess' law of constant heat summation. Calculate the enthalpy of formation of benzene, if enthalpy of combustion of benzene and carbon are –3280 kJ/mol and –395 kJ/ mol respectively. The enthalpy of formation of water is -285 kJ/mol. [1+4]

Ans: 55 kJ mol^{-1}

51. **2069 Set A Q.No. 24** Define enthalpy of combustion. Enthalpy of formation of benzene is 55kJ, enthalpy of formation of water and carbondioxide are –395 kJ and –285 kJ respectively. Calculate the enthalpy of combustion of benzene. [1+4]

Ans: ΔH = –2950 kJ

52. **2069 Supp. Set B Q.No. 28** What is meant by enthalpy of combustion? Enthalpy of formation of benzene is 55 kJ, enthalpy of formation of water and carbondioxides are –395 kJ and – 285 kJ respectively. Calculate the enthalpy of combustion of benzene. [2+3]

Ans: –2950 kJ mol^{-1}

53. **2066 Q. No. 26** Define Hess's Law of constant heat summation. Calculate the heat of combustion of glucose from the following data: [1+4]

$C(s) + O_2(g) \longrightarrow CO_2(g)$, $\Delta H = -395$ kJ

$H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$, $\Delta H = -269$ kJ

$6C(s) + 6H_2(g) + 3O_2(g) \longrightarrow C_6H_{12}O_6(s)$, $\Delta H = -1169$ kJ

Ans: –2815 kJ

54. **2063 Q.No. 30(b)** The standard enthalpy of formation of H_2O (*l*), CO_2 (g) and C_6H_6 (*l*) are –286, –393.5 and + 49.02 kJ mol^{-1} respectively at 298 K. Calculate the standard enthalpy of combustion of C_6H_6 (*l*) at the given temperature. [5]

Ans: – 3268.02 kJ

55. **2062 Q.No. 24** What is meant by enthalpy of formation? Calculate the enthalpy of formation of ethane at 298K, if the enthalpies of combustion of C, H and C_2H_6 are – 94.14, –68.47 and –373.3 K cal. respectively. [5]

Ans: – 20.39 kcal

56. **2056 Q.No. 28**

i. Distinguish between: [5+5]
   a. Internal energy and enthalpy
   b. Exothermic and endothermic reaction.

ii. Calculate the heat of formation of naphthalene from the following data:

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -94.405$ K cal.

$H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$ $\Delta H = -68.3$ K cal

$C_{10}H_8(s) + 12O_2(g) \longrightarrow 10CO_2(g) + 4H_2O(l)$ $\Delta H = -1231.6$ K cal (Naphthalene)

Ans: Heat of formation of naphthalene = 14.35 k cal

57. **2054 Q.No. 23** Calculate the standard heat of formation of CH_4 (g) from the following informations.

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(1)$ $\Delta H = -890.3$ kJ

$C(\text{graphite}) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$ $\Delta H = -571.7$ kJ [5]

Ans: Standard heat of formation of CH_4 is –74.9 kJ/mol

58. **2053 Q.No. 25(b)** Estimate the enthalpy change for the reaction [5]

$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl$

Given: bond energy of H–H = 435 J/mol
bond energy of Cl–Cl = 243 kJ/mol
bond energy of H–Cl = 430 kJ/mol

Ans: –182 kJ/mol

UNIT 6: CHEMICAL THERMODYNAMICS

FORMULAE

1. Entropy (S)

$\Delta S = S_{final} - S_{initial}$

$= S_{product} - S_{reactant}$

$\Delta S = \frac{q_{rev}}{T} = \frac{\Delta H}{T}$ (at constant T)

Entropy of fusion: $\Delta S_{fus} = \frac{\Delta H_{fus}}{T_m}$

Entropy of vapourization: $\Delta S_{vap} = \frac{\Delta H_{vap}}{T_b}$

Entropy of sublimation: $\Delta S_{sub} = \frac{\Delta H_{sub}}{T_b}$

2. Gibb's free energy (G)

$G = H - T\Delta S$

$\Delta G = \Delta H - T\Delta S$

$\Delta G = \Sigma \Delta G_{product} - \Sigma \Delta G_{reactant}$

At standard condtion (25°C)

$\Delta G° = \Sigma \Delta G°_{product} - \Sigma \Delta G°_{reactant}$

3. Gibb's Helmholtz equation

$\Delta G = \Delta H - T\Delta S$

if		
	ΔG = –ve	spontaneous
	ΔG = +ve	non spontaneous
	ΔG = 0	at equilibrium

Standard free energy change and equilibrium constant

$\Delta G° = -RT \ln K$

$\Delta G° = -2.303\ RT \log K$

Very Short Answer Questions [2 marks]

1. **2077 Set W Q.No. 3** What is meant by molar entropy? Write its unit. [1+1]

2. **2076 GIE Set A Q.No. 6** Calculate entropy change (ΔS) and free energy change (ΔG) for the conversion of ice into water at equilibrium condition when enthalpy change (ΔH) is 10 KJ/mol. [2]

Ans: 0.01 J/mol

3. **2076 GIE Set B Q.No. 6** Predict spontaneity and non-spontaneity in terms of ΔG when ΔH and ΔS are positive. [1+1]

4. 2076 Set B Q.No. 6 2076 Set C Q.No. 6 Calculate entropy change (ΔS) and free energy change (ΔG) for the conversion of ice into water at equilibrium condition when enthalpy change (ΔH) is 9 KJ/mol. [2]
Ans: ΔS = 32.96 J/mol, ΔG = 1.92 J/mol

5. 2075 GIE Q.No. 6 2075 Set A Q.No. 6 Predict spontaneity and non spontaneity in term of ΔG, when ΔH and ΔS are positive [1+1]

6. 2075 Set B Q.No. 6 Give reason; [1+1]
   i. Gases have the highest absolute entropy among the three state of matter.
   ii. Decrease of enthalpy is the sole criterion for feasibility of a process.

7. 2074 Supp. Q.No. 6 2074 Set B Q.No. 6 How would you apply the relation $-\Delta G = T\Delta S_{total}$ to predict whether the process is spontaneous or non-spontaneous? [2]

8. 2074 Set A Q.No. 6 Apply the relation $-\Delta G = T\Delta S_{total}$ to predict whether the process is spontaneous or non-spontaneous? [2]

9. 2073 Supp Q.No. 6 2073 Set C Q.No. 6 2073 Set D Q.No. 6 Under what conditions the reaction expected to occur,
   i. spontaneous.
   ii. non-spontaneous
   if ΔH and Δ S are positive for the reaction? [1+1]

10. 2072 Supp. Q.No. 6 Mention the proper conditions of a chemical reaction to become spontaneous if its ΔH and ΔS are positive. [2]

11. 2072 Set C Q.No. 6 2071 Set C Q.No. 6 How would you predict the spontaneity of a system in term of free-energy change? [2]

12. 2071 Supp. Q.No. 6 Predict the criteria of spontaneity in light of free-energy change. [2]

13. 2071 Set D Q.No. 6 Predict the criteria of spontaneity in light of entropy change. [2]

14. 2070 Supp. Q.No. 6 Distinguish spontaneous and non spontaneous process giving an example of each. [1+1]

15. 2070 Set C Q.No. 5 What is meant by spontaneous process? Write an example for it. [2]

16. 2070 Set D Q.No. 6 How would you predict the spontaneity using the relation?
$T\Delta S_{total} = -\Delta G_{sys.}$ [2]

17. 2069 Set A Q.No. 5 Define Gibb's free-energy change. Write the mathematical relation to predict the spontaneity. [2]

18. 2069 Set B Q.No. 6 Give the physical meaning of entropy. Write its unit. [1+1]

19. 2068 Q.No. 15 Name the two criteria which must be met for a process to be spontaneous regardless of the temperature. [1+1]

20. 2066 Q. No. 16 Comment the statement "The decrease of enthalpy is not the sole criterian for the feasibility of the process." [2]

21. 2063 Q.No. 14 Define thermodynamic efficiency of heat engine. How is second law of thermodynamics stated in the light of this term? [2]

22. 2062 Q.No. 16 (ii) Define the terms: Standard free energy of a reaction. [1]

23. 2061 Q.No. 14 In order for a reaction to occur spontaneously, what is the criterion? [2]

24. 2060 Q.No. 17 What is entropy? State the effect of increased temperature on the entropy of a substance. [2]

25. 2057 Q.No. 17 What is the physical concept of entropy? [2]

Short Answer Questions [5 marks]

26. 2069 Set B Q.No. 26 Define Gibb's free energy. How is spontaneity of a reaction predicted in light of free energy change, enthalpy change and entropy change? [1+4]

27. 2067 Q.No. 26 What is meant by free-energy change? Write the relation between entropy and enthalpy change. How does this relation help in predicting the spontaneity of a reaction? [1+2+2=5]

28. 2065 Q.No. 26 What is free energy change? How it is related with enthalpy change and entropy change? How would you predict whether a reaction is spontaneous, non spontaneous and equilibrium in term of free energy change? [1+2+2]

29. 2064 Q.No. 24 Define Gibb's free energy. How is the feasibility of exothermic and endothermic reactions predicted in the light of free energy change and entropy change? [1+4]

30. 2061 Q.No. 27 State and explain second law of thermodynamics. How does free energy change depend on the equilibrium constant? [5]

31. 2060 Q.No. 25 Define free energy. Derive an expression to relate Gibbs free energy change with work. [5]

32. 2059 Q.No. 24 State second law of thermodynamics. How would you explain the law in the light of entropy change? [5]

33. 2058 Q.No. 25 Discuss the criteria of spontaneity, non spontaneity and equilibrium of exothermic and endothermic reactions on the basis of free energy and entropy change. [5]

34. 2057 Q.No. 24 State and explain second law of thermodynamics. [5]

Long Answer Questions [10 marks]

35. 2070 Set D Q.No. 32 a How is the free energy change of a reaction related with the enthalpy change and entropy change? Discuss the criteria of spontaneity and non-spontaneity of a reaction on the basis of its energy change. [2+3]

Numerical Problems

36. 2072 Set D Q.No. 6 Calculate ΔS and ΔG for conversion of ice into water when they are equilibrium at 0°C(ΔH = 4kJ/mole)[1+1]
Ans; ΔS = 14.65 J mol^{-1} k^{-1}; ΔG = 0.55 J mol^{-1}

37. 2064 Q.No. 17 The latent heat of fusion of ice is 336 Jg^{-1}. Calculate the molar entropy of fusion of ice at its normal melting point. [2]
Ans: 22.15 $Jmol^{-1}$ K^{-1}

Write Short notes on [5 marks]

38. 2077 Set P Q.No. 12ii Gibb's free energy change and prediction for spontaneity of reaction. [5]

39. 2072 Set E Q.No. 33(iv) Prediction for the feasibility of reaction in terms of ΔG and ΔS. [5]

40. 2071 Set C Q.No. 33 a /2071 Set D Q.No. 33 a Second Law of thermodynamics [5]

41. 2070 Supp. Q.No. 33 a Spontaneity in light of entropy change, enthalpy change and free-energy change. [5]

UNIT 7: CHEMICAL KINETICS

FORMULAE

1. Rate of reaction $= \frac{\text{Decrease in conc}^n \text{ of reactant}}{\text{Time interval}}$
$= \frac{\text{Increase in conc}^n \text{ of product}}{\text{Time interval}}$

2. $aA + bB \longrightarrow cC + dD$
Equivalent rate $= -\frac{d[A]}{a\,dt} = -\frac{d[B]}{b\,dt} = \frac{d[C]}{c\,dt} = \frac{d[D]}{d\,dt}$

3. Order of reaction
$aA + bB \longrightarrow$ product
Rate $\propto [A]^a [B]^b$ (Theoretical)
Rate $\propto [A]^m [B]^n$ (Experimental)

4. Rate law
$aA + bB \longrightarrow$ product
Rate $= K [A]^m [B]^n$

5. Unit of rate constant
For zero order = mol L^{-1} s^{-1} or mol L^{-1} min^{-1}
For 1st order = $time^{-1}$
For 2nd order = L mol^{-1} s^{-1} or L mol^{-1} min^{-1}
For 3rd order = L^2 mol^{-2} s^{-1} or L^2 mol^{-2} min^{-1}

6. First order reaction
$K_1 = \frac{2.303}{t} \log \frac{a}{a-x}$
Half life period $t_{\frac{1}{2}} = \frac{0.693}{K_1}$

7. Second order reaction
$K_2 = \frac{1}{t} \frac{a}{a(a-x)}$
Half life period $t_{\frac{1}{2}} = \frac{1}{K_2 a}$

8. Thrid order reaction
$K_3 = \frac{1}{2t} \frac{x(2a-x)}{a^2(a-x^2)}$
Half life period $t_{\frac{1}{2}} = \frac{3}{2K_3 a^2}$

Very Short Answer Questions [2 marks]

1. **2076 GIE Set A Q.No. 7** For a reaction, x + y ⟶ z. The rate of reaction is doubled when concentration of 'x' is doubled but there is no effect in rate with change of concentration of 'y'. [1+1]
   i. write rate law equation.
   ii. find the unit of rate constant.

2. **2076 GIE Set B Q.No. 7** For a reaction A + B ⟶ C. The rate reaction w.r. to 'A' is 2nd order and w.r. to 'B' is 1st order. (i) Write the rate law equation. (ii) How many time will the rate increase when the concentration of both (A and B) are doubled? [1+1]
   Ans: 8 times

3. **2076 Set B Q.No. 7** **2076 Set C Q.No. 7** You are given a rate law equation, Rate = K $[A]^2$ [B]. By how many times will the rate increase or decrease for the reaction if
   i. Concentration of Ⓐ is doubled while that of Ⓑ made constant.
   ii. Concentration of Ⓐ is kept constant that of Ⓑ is doubled? [1+1]
   Ans: (i) 4 times (ii) 2 times

4. **2075 GIE Q.No. 7** For a reaction, $2N_2O_5$ (g) ⟶ $4NO_2$ (g) + O_2 (g). If the rate of formation of Oxygen is 2×10^{-1} mol $L^{-1}Sec^{-1}$, what will be the rate of disappearance of N_2O_5? [2]
   Ans: 4×10^{-1}

5. **2075 Set A Q.No. 7** A reaction is I[st] order w.r. to A and II[nd] order w.r. to B. [1+1]
   i. Write the rate law equation.
   ii. How many times will the rate increase when the concentration of B is tripled?
   Ans: 9 times

6. **2075 Set B Q.No. 7** A hypothetical reaction P + Q ⟶ Z is a third order reaction. Write its possible rate law expression. [2]

7. **2074 Supp. Q.No. 7** For a reaction, 2 N_2O_5 ⟶ $4NO_2 + O_2$, The rate of disappearance of N_2O_5 is 4×10^{-6} mol L^{-1} S^{-1} what will be the rate of formation of NO_2? [2]
   Ans: 8×10^{-6} mol $L^{-1}S^{-1}$

8. **2074 Set A Q.No. 7** **2074 Set B Q.No. 7** For a reaction, 2 HI ⟶ $H_2 + I_2$
   If the rate of formation of I_2 is 9.1×10^{-6} mol L^{-1} S^{-1}, What will be the rate of disappearance of HI? [2]
   Ans: $2 \times 9.1 \times 10^{-6}$ mol $L^{-1}S^{-1}$

9. **2073 Supp Q.No. 7** A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is [1+1]
   i. doubled
   ii. reduced to half?
   Ans: (i) n^4 × initial rate (ii) $\frac{n^2}{4}$ × initial rate

10. **2073 Set C Q.No. 7** Draw an energy profile diagram to show influence of catalyst in the rate of chemical reaction. [2]

11. **2073 Set D Q.No. 7** What are the essential conditions for the effective collision of reacting species? [2]

12. **2072 Supp. Q.No. 7** Write the rate expression of each components in the following reaction:
   $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
   What is the unit of reaction rate? [1.5+0.5]

13. **2072 Set C Q.No. 7** What is meant by instantaneous rate of reaction? Write the expression for the rate of the following reaction:
   $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$ [1+1]

14. **2072 Set D Q.No. 7** Define the terms [1+1]
   i. activated complex ii. rate of reaction

15. **2072 Set E Q.No. 7** The following hypothetical reaction is second order, A + B ⟶ Z. Write possible rate law expression. [2]

16. **2071 Supp. Q.No. 7** Define 1st order reaction and write the unit of rate constant in the first order reaction. [1+1]
   Ans: $k = S^{-1}$

17. **2071 Set C Q.No. 7** Identify reaction orders if the units of rate constant are: [1+1]
   a. min^{-1} b. $molL^{-1}$ min^{-1}

18. **2071 Set D Q.No. 7** Rate of reaction is doubled when concentration of A is doubled but there is no effect in rate with change in concentration of B. [1+1]
   a. Write rate law
   b. Find out unit of the reaction.

19. **2070 Supp. Q.No. 7** For a hypothetical reaction A+B⟶Z. The rate of above reaction is doubled when concentration of A is doubled but there is no effect of change of concentration of B. [1+1]
   i. Write down the rate law.
   ii. What is the unit of rate constant?

20. **2070 Set C Q.No. 7** For the reaction P + Q ⟶ product is a third order. Write the possible rate law expressions for the above reaction. [2]

21. **2070 Set D Q.No. 7** Draw energy profile diagram for catalyzed and uncatalyzed reactions. [2]

22. **2069 Set A Q.No. 7** What is meant by effective collision of reacting species? Mention any one condition for a collision. [1+1]

23. **2069 Set B Q.No. 7** Write the rate law for a first order reaction. What is the unit of the reaction? [1+1]

24. **2069 Supp. Set B Q.No. 7** Define
   i. effective collison ii. proper orientation [1+1]

25. **2068 Q.No. 16** Define the half-life period of a reaction. The half-life periods of two reactions A and B are 3.21×10^2 min. and 569 min. respectively. Which of these is a faster reaction? [1+1]
   Ans. Reaction A is faster

26. **2067 Q.No. 15** What is the order of reaction whose rate constant has same unit as the rate of reaction? [2]

27. **2066 Q. No. 15** Write the rate expression for the following reaction: $2\ N_2O_5 \longrightarrow 4NO_2 + O_2$ [2]

28. **2065 Q.No. 15** Write the possible rate Law equations of the following Second order reaction: [2]
   P + Q ⟶ Product

29. **2064 Q.No. 18** Draw a labeled energy profile diagram to show the influence of catalyst in the rate of chemical reaction. [2]

30. **2063 Q.No. 17** Define zero order reaction and find the unit of its rate constant. [2]
   Ans: Mol L^{-1} s^{-1}

31. **2062 Q.No. 17** What is half life period of a reaction? Calculate the half life period of a first order reaction when the rate constant is 5 $year^{-1}$. [2]
   Ans: 0.1386 years

32. **2061 Q.No. 16** How does a Catalyst increase rate of reaction? [2]

33. **2059 Q.No. 18** Give one example of a reaction where order and molecularity are equal. [2]

34. **2058 Q.No. 18** Identify the order of the reaction if the unit of its rate constant is L mol^{-1} s^{-1}. [2]

35. **2057 Q.No. 18** Give the rate law for a reaction which is second order in A and zero order in B. [2]

36. **2056 Q.No. 3** Give the factors which influence the rate of a reaction. [2]

37. **2056 Q.No. 7** Calculate the half-life period of a first order reaction when the rate constant is 5 $year^{-1}$. [2]
   Ans: 0.1386 years

38. **2055 Q.No. 5** The reaction X + Y ⟶ products is a second order reaction. Write three different rate law expressions which may be true to the above reaction. [2]

39. **2054 Q.No. 6** What is meant by rate of a chemical reaction? [2]

40. **2053 Q.No. 11** What is an activation energy? [2]

41. **2053 Q.No. 16** Define the half life of a reaction. [2]

42. **2052 Q.No. 5** Give a chemical reaction to show reaction of first order. [2]

Short Answer Questions [5 marks]

43. **2076 GIE Set B Q.No. 25** How do concentration, temperature, catalyst and surface area of reactants affect the rate of reaction? Why is rate law an experimental parameter? [4+1]

44. **2073 Supp Q.No. 26** Define the terms.
   i. Half-life period of a reaction.
   ii. First order reaction.
   A first order reaction is 90% complete in 30 minutes. How long would it take to be 99% complete? [2+3]
   Ans: 60 minute

45. **2073 Set C Q.No. 26** Define (i) rate law (ii) Half-life period of a reaction.
   In a first order reaction 40% of reactant gets converted into product in 30 minutes. What time would it require to convert 75% into product? **Ans: 86.36 minute** [1+1+3]

46. **2073 Set D Q.No. 26** Define rate law. The reaction P+Q⟶Z is first order with respect to Ⓟ and zero order with respect to ◎. If so, fill in the blanks in the following. [1+4]

Expt	[P] M	[Q] M	initial rate of formation [Z] M min^{-1}
I	0.1	0.1	2×10^{-2}
II	–	0.2	4×10^{-2}
III	0.4	0.4	–
IV	–	0.2	2×10^{-2}

Ans: (II) [P] = 0.2 (III) Rate = 8.0×10^{-2} (IV) [P] = 0.1

47. **2072 Supp. Q.No. 24** Define the terms:
   i. rate law
   ii. order of a reaction
   iii. molecularity of a reaction
   A first order reaction will take 100 minutes to complete 60% of reactant into product. What time will it take to complete 75% of the reactant into product? [1+1+1+2]
   Ans: 151.35 minute

48. **2072 Set E Q.No. 32b** For the reaction $Cl_2+2NO\longrightarrow2NOCl$, the data obtained are:

Expt No.	Initial Concentration of		Initial rate of reaction mol L^{-1} s^{-1}
	$[Cl_2]$ mol L^{-1}	[NO] mol L^{-1}	
1	0.020	0.010	2.40×10^{-4}
2	0.020	0.030	2.16×10^{-3}
3	0.040	0.030	4.32×10^{-3}

Determine:
   i. Order of reaction with respect to Cl_2 and NO and the overall reaction.
   ii. If the concentration of Cl_2 is [0.50] $molL^{-1}$ and NO is [0.40] $molL^{-1}$, What is the rate? [3+2]
   Ans: (i) 1 and 2 respectively, overall order= 3 (ii) 9.6 $molL^{-1}s^{-1}$

49. 2065 Q.No. 31 iv Describe Factors affecting on reaction rate.[5]

50. 2059 Q.No. 25 Define the rate of chemical reaction. How do concentration, temperature, catalyst and surface area of reactants affect the rate of reaction? [1+4]

51. 2058 Q.No. 24 Define rate of reaction. Distinguish between order and molecularity of a reaction. [5]

Long Answer Questions [10 marks]

52. 2077 Set P Q.No. 11 Define
   i. activation energy
   ii. rate law
   iii. zero-order reaction
   iv. half life of reaction.

   How does surface area and concentration of reactants affect the rate of chemical reaction?

   The experimental data for the reaction $2A + B_2 \rightarrow 2AB$, are as below:

Expt. no.	(A) molL^{-1}	(B) molL^{-1}	Rate molL^{-1}sec^{-1}
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

   Calculate the rate of formation of AB when the initial concentrations of (A) and (B) are 2.00 molL^{-1} and 4.00 molL^{-1} respectively. [6+4]

   Ans: 3.2×10^{-4} s^{-1}; 1.28×10^{-3} mol L^{-1}s^{-1}

53. 2077 Set V Q.No. 12 Define the terms:
   i. half-life period of reaction
   ii. rate law
   iii. instantaneous rate
   iv. zero-order reaction

   How do surface area of reactant and catalyst affect the rate of chemical reaction?

   The experimental data for the reaction $2A + B_2 \rightarrow 2AB$, are as below:

Expt. no.	(A) molL^{-1}	(B) molL^{-1}	Rate molL^{-1}sec^{-1}
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

   Find overall order of reaction and rate constant. [4+2+4]

   Ans: Overall reaction order = 1st order, Rate constant = 3.2×10^{-4} s^{-1}

54. 2077 Set W Q.No. 12 Define the terms:
   i. activation energy
   ii. half life of a reaction
   iii. rate law
   iv. molecularity of reaction
   v. effective collision
   vi. order of reaction.

   99% of first order reaction is completed in 32 minutes. What time will it take to complete 99.9% of reaction? [1+1+1+1+1+1+4]

   Ans: 4.83 × 10^{1} minute

55. 2076 GIE Set A Q.No. 32

a. Differentiate between order and molecularity of a reaction. Why is larger value of molecularity of a reaction rare? Give an example of pseudo first order reaction.

b. The following hypothetical data were obtained from a reaction $p + Q \rightarrow Z$.

Expt.	(P) molL^{-1}	(Q) molL^{-1}	rate of formation of (Z) molL^{-1} s^{-1}
1	0.1	0.1	7×10^{-3}
2	0.3	0.2	8.4×10^{-2}
3	0.3	0.4	3.36×10^{-1}
4	0.4	0.1	2.80×10^{-2}

   i. Write rate law equation.
   ii. Calculate overall order of reaction.
   iii. What will be the rate of disappearance of Q, if [P] = 0.4 molL^{-1} and Q = 0.5 molL^{-1}? [4+2+1+1+2]

   Ans: (ii) 3rd order (iii) 0.7 mol L^{-1} s^{-1}

56. 2076 Set B Q.No. 32 Define the terms (i) activation energy (ii) order of reaction (iii) molecularity of reaction (iv) effective collision (v) rate law equation.

   Why does powder sugar dissolve faster than grain sugar?

   The following data were obtained for a hypothetical reaction $x + y \longrightarrow z$

Expt.	[x] mol L^{-1}	[y] mol L^{-1}	formation of z mol L^{-1} s^{-1}
1	0.20	0.20	3×10^{-3}
2	0.40	0.20	1.2×10^{-2}
3	0.20	0.40	6×10^{-3}
4	0.60	0.20	9×10^{-3}

   Calculate the rate constant and find out rate of disappearance of y when [x] = 0.2 mol L^{-1} and [y] = 0.4 mol L^{-1}. [5+1+2+2]

   Ans: Rate constant (k) = 0.375 L^{2}mol^{-2}s^{-1}, Rate of disappearance of y = 6×10^{-3} mol L^{-1}s^{-1}

57. 2075 GIE Q.No. 32 2075 Set A Q.No. 32 Define rate law. What are the effects of (i) concentration (ii) temperature (iii) Catalyst and (iv) surface area of reactants on rate of reaction? Why is order of reaction an experimental parameter? The reaction between Ⓧ and Ⓨ is of 1st order w.r. to Ⓧ and zero order w.r. to Ⓨ. Fill in the banks in the following table. [1+4+1+4]

Expt. No.	[x] mol L^{-1}	[y] mol L^{-1}	initial rate mol L^{-1} min^{-1}
1	0.1	0.1	2×10^{-2}
2	-	0.2	4×10^{-2}
3	0.4	0.4	-
4	-	0.2	2×10^{-2}

   Ans: (ii) [X] = 0.2, (iii) Rate = 8×10^{-2} (iv) [X] = 0.1

58. 2074 Supp. Q.No. 32 Define:
   i. Rate law equation
   ii. Half life period for a reaction

   How is order of a reaction different from molecularity of reaction?

   The following rate data were obtained for the reaction $2A + B \longrightarrow C$

Exp.No.	[A] mol L^{-1}	[B] mol L^{-1}	Initial rate of formation of C mol L^{-1}
1	0.1	0.1	6.0×10^{-3}
2	0.3	0.2	7.2×10^{-2}
3	0.3	0.4	2.88×10^{-4}
4	0.4	0.1	2.4×10^{-2}

   Calculate the rate of formation of C, When [A] = 0.5 mol L^{-1} and [B] = 0.2 mol L^{-1}. [2+4+4]

   Ans: 0.12 mol^{2} L^{-2} s^{-1}

59. **2074 Set A Q.No. 32** Define the terms;
i. Rate Law equation
ii. Activated complex.
How is order of reaction differed from molecularity of reaction?
The following data were obtained for the reaction $2A + B \longrightarrow C$

Experiment	[A] mol L^{-1}	[B] mol L^{-1}	[Initial rate] mol $L^{-1}s^{-1}$
1	0.1	0.1	6.0×10^{-3}
2	0.3	0.2	7.2×10^{-2}
3	0.3	0.4	2.88×10^{-4}
4	0.4	0.1	2.4×10^{-2}

Calculate the rate of formation of C when [A] = 0.5 mol L^{-1} and [B] = 0.2 mol L^{-1} [2+4+4]
Ans: 0.12 mol $L^{-1}s^{-1}$

60. **2074 Set B Q.No. 32** Define
i. Activation energy
ii. Rate law equation
What are the difference between order and molecularity of reaction? From the following data for the reaction between (A) and (B). [2+4+4]
$2A + B_2 \longrightarrow 2AB$

Experiment	[A] mol L^{-1}	[B] mol L^{-1}	[Initial rate] mol L^{-1}
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

Calculate the rate of formation of AB When [A] = 2 mol L^{-1} and [B] = 4 mol L^{-1}.
Ans: 1.28×10^{-3} mol L^{-1} s^{-1}

61. **2070 Set C Q.No. 32 a** Distinguish between order and molecularity of reaction. What is meant by second order reaction? Write its units. [2+2+1]

62. **2069 Set A Q.No. 30a** Define rate law and rate of a reaction. How does temperature, catalyst, concentration of reactant and surface area of reactant affect the rate of reaction? [2+4]

63. **2063 Q.No. 31(i)** Write short notes on Effect of temperature and catalyst on the rate of reaction. [5]

64. **2054 Q.No. 27(a)** In a reaction $H_2 + I_2 \rightleftharpoons 2HI$ the rate of disappearance of I_2 is found to be 10^{-6} mole per litre per second. What would be corresponding rate of appearance HI. [5]
Ans: 2×10^{-6} mol L^{-1} s^{-1}

Write short notes on [5 marks]

65. **2072 Set D Q.No. 33a** Order and Molecularity of reaction [5]

66. **2067 Q.No. 31 ii** **2054 Q.No. 30(b)** Collision theory of reactions rate [5]

Numerical Problems

67. **2072 Set C Q.No. 30** Give any four points of difference between molecularity and order of a chemical reaction. What is meant by pseudo first order reaction? Write an example of it. [4+2+1.5+1+1.5]
The experimental data for the reaction $2A + B \longrightarrow C$ is

Expt no.	Initial Concentration of		Rate of reaction
	[A] mol L^{-1}	[B] mol L^{-1}	mol L^{-1} sec^{-1}
1	0.1	0.1	7×10^{-3}
2	0.3	0.2	8.4×10^{-2}
3	0.3	0.4	3.36×10^{-1}
4	0.4	0.1	2.8×10^{-2}

Determine:
i. Over all order of reaction
ii. Rate law equation
iii. Calculate the rate of formation of C when concentration of [A] and [B] are 0.6 mol L^{-1} and 0.3 mol L^{-1} respectively.
Ans: (i) 3, (ii) Rate = $k[A]^1 [B]^2$ (iii) 0.378 mol^2 L^{-2} s^{-1}

68. **2071 Supp. Q.No. 24** Define the term. [1+1+1+2]
i. rate law equation
ii. instantaneous rate
What will be the initial rate of a reaction if its rate constant is 1×10^{-3} min^{-1} and the concentration of the reactant is 0.2 mol L^{-1}? How much the reactant will be converted into the product in 500 minute?
Ans: 0.078 mol L^{-1}

69. **2071 Set C Q.No. 24** Define the term:
a. rate law
b. order of reaction
c. activated complex
The rate of a first order reaction is 1.5×10^2 mol L^{-1} min^{-1} at 0.5 M concentration of the reaction. What is the half-life of the reaction? [5]
Ans: 2.31×10^{-3} min

70. **2071 Set D Q.No. 24** What is instantaneous rate of reaction? How do concentration and surface area of reactant affect the rate of reaction? A first order reaction will take 100 minutes to complete 60% of reactant into product. What time will it take to complete 90% of reactant into product? [1+2+2]
Ans: 251.31 min

71. **2070 Supp. Q.No. 32** How does (i) temperature (ii) concentration of reactant and (iii) catalyst affect the rate of reaction? Write any three points to distinguish order from molecularity of a reaction. For a first order reaction, it takes 4 minute for initial concentration of 0.8 mol/L to become 0.2 mol/L. What time will it take to become the concentration to 0.04 mol/L? [6 + 4]
Ans: 8.65 minute

72. **2070 Set C Q.No. 32 b** The following rate data were obtained at 303 K for the reaction
$2A + B \longrightarrow C + D$

Experiment	[A] mol L^{-1}	[B] mol L^{-1}	Initial rate of formation of [D] mol L^{-1} min^{-1}
1	0.1	0.1	6.0×10^{-3}
2	0.3	0.2	7.2×10^{-2}
3	0.3	0.4	2.88×10^{-1}
4	0.4	0.1	2.4×10^{-2}

i. What is the rate law?
ii. Write the order with respect to each reactant and overall order.
iii. Find the unit of the overall reaction. [1+2+2]
Ans: (i) $\frac{dx}{dt} = K[A][B]^2$ (ii) order of reaction w.r. to A = 1; order of reaction w.r. to B = 2; overall order of reaction = 3

73. **2070 Set D Q.No. 32 b** For a reaction, $2X + Y \longrightarrow X_2Y$, the following data were obtained by experiment.

Experiment	[X] mol L^{-1}	[Y] mol L^{-1}	Rate, mol $L^{-1}s^{-1}$
1	0.10	0.10	1.3×10^{-4}
2	0.10	0.20	2.6×10^{-4}
3	0.20	0.20	1.04×10^{-3}

i. Find the order of reaction with respect to X, Y and overall reaction.
ii. Find the value of rate constant with its units.
iii. What is the initial rate of the reaction when the initial concentration of X and Y are 1M and 0.5 M respectively. [2.5 +1+1.5]

Ans: (i) order of R_x" w.r.to X = 2; Order of R_x" w.r. to Y = 1; Overall order of R_x" = 3 (ii) k = 0.13 $mol^{-2} L^2. s^{-1}$ (iii) 6.5×10^{-2} mol. s^{-1}

74. **2069 Set A Q.No. 30b** From the following experimental data for the reaction: [2+2]

$2A + B_2 \longrightarrow 2AB$

Experiment	[A], $molL^{-1}$	[B], $molL^{-1}$	Rate, mol $L^{-1}s^{-1}$
1	0.5	0.5	1.6×10^{-4}
2	0.5	1	3.2×10^{-4}
3	1	1	3.2×10^{-4}

i. Find overall order of reaction.
ii. Find the rate constant.

Ans: (i) 1st order (ii) $3,2\times 10^{-4}$ sec^{-1}

75. **2069 Set B Q.No. 32** [5 + 5]

a. Define the terms:
i. First order reaction ii. Rate law
iii. Effective collision iv. Activation energy
v. Half-life period of a reaction vi. Instantaneous rate.

b. The following data are given for the reaction

$2x + y \longrightarrow$ product (Z)

Expt. No.	[X], $molL^{-1}$	[Y], $molL^{-1}$	Rate of formation of (Z) mol $L^{-1}s^{-1}$
1	0.1	0.1	7.0×10^{-3}
2	0.3	0.2	8.4×10^{-2}
3	0.3	0.4	3.36×10^{-1}
4	0.4	0.1	2.8×10^{-2}

i. Calculate the order of reaction with respect to X and Y.
ii. Half-life of reaction with respect to X.
iii. The rate of formation of 'Z'

when [X] = 0.6 mol L^{-1}; [Y] = 0.3 mol L^{-1}

Ans: (i) Order of reaction w.r. to X = 1; and w.r. to Y = 2 (ii) 0.099 s (iii) 0.378 mol L^{-1} s^{-1}

76. **2069 Supp. Set B Q.No. 30** Define the terms: [5+5]

i. activation energy ii. First order reaction
iii. rate law iv. half life - period of a reaction
v. Molecularity vi. Instantaneous rate.

For a hypothetical reaction

$2M + N \longrightarrow$ product; The following data are given.

Expt. No.	Initial conc of M (mol L^{-1})	Initial conc of N (mol L^{-1})	Initial rate (mol L^{-1} sec^{-1})
I	0.10	0.20	3×10^2
II	0.30	0.40	3.6×10^3
III	0.30	0.80	1.44×10^4
IV	0.30	1.60	A
V	0.60	0.80	B
VI	0.10	0.40	C

From the above data:

i. Find the overall order of the reaction.
ii. Calculate the value of A, B and C.

Ans: (i) 1 w.r.t. M and 2 w.r.t. N, overall order = (1 + 2) = 3 (ii) $A = 5.76\times 10^4$ mol $L^{-1}S^{-1}$; $B = 2.88\times 10^4$ mol $L^{-1}s^{-1}$; $C = 1.2\times 10^3$ mol L^{-1}

77. **2066 Q. No. 30** What is the rate law of reaction? How does order of a reaction differ from molecularity of a reaction? For the reaction $A + B \longrightarrow P$, is given below as a function of different initial concentration of A and B.

[A] mol L^{-1}	[B] mol L^{-1}	Rate mol L^{-1} min^{-1}
0.01	0.01	0.005
0.02	0.01	0.010
0.01	0.02	0.005

i. Determine the order of reaction with respect to A and B respectively.
ii. What is overall order of reaction?
iii. Write rate Law equation.
iv. Find value of rate constant.
v. What is the half-life of A? [1+4+1+1+1+1]

Ans: (i) 1 w.r.to A and 0 w.r.to B (ii) 1 (iii) Rate = k [A] (iv) (v) 1.386 min

78. **2064 Q.No. 25** Define instantaneous rate of reaction. Compare the rate of reaction of all the components of the following reaction:

$2N_2O_5\,(g) \longrightarrow 4NO_2\,(g) + O_2\,(g)$

Find the rate of each component in mol s^{-1}, when 2.24 litre O_2 at NTP are produced in 30 minutes. [1+4]

Ans: Rate of disappearance of $N_2O_5 = 1.11\times 10^{-4}$ mol s^{-1} Rate of formation of $NO_2 = 2.22\times 10^{-4}$ mol s^{-1} Rate of formation of $O_2 = 5.55\times 10^{-5}$ mol s^{-1}

79. **2063 Q.No. 16** The half life period of first order reaction is 5 hours. Find the time required to complete 87.5% of the reaction.

Ans: t = 9.003 hours

80. **2062 Q.No. 25** The rate of a reaction, A + B ⟶ product is given below as a function of different initial concn. of A and B.

Expt.	[A] mol L^{-1}	[B] mol L^{-1}	Initial rate mol L^{-1} min^{-1}
1.	0.01	0.01	0.005
2.	0.02	0.01	0.010
3.	0.01	0.02	0.005

i. Determine the order of reaction with respect to A and B
ii What is the half life of A in the reaction? [5]

Ans: Reaction is 1st order with respect to A and zero order with respect to B. Half life of A = 1.386 minutes

81. **2061 Q.No. 25** Suppose that the rate law for the reaction $A \longrightarrow B$ has been found to be of the form Rate = $k[A]^m$. From the following data, determine the overall order of the reaction and the order with respect to A. [5]

Initial Concentration of A (M)	Initial Rate (M/Sec)
0.05	3×10^{-5}
0.10	12×10^{-5}
0.20	48×10^{-5}

Ans: Order of reaction with respect to A is 2 and the over all order of the reaction is also

82. **2060 Q.No. 16** What is meant by order of a reaction? State the order of reaction having rate constant 2×10^{-2} mol $L^{-1}s^{-1}$

Ans: Zero order

83. **2060 Q.No. 30** For the gaseous reaction,

$A_{(g)} + B_{(g)} \longrightarrow C_{(g)} + D_{(g)}$

It is found that, rate = $K[A]^2[B]^1$

How many times does the rate of reaction increase or decrease if (a) the partial pressure of both A and B are doubled, (b) the partial pressure of A doubles but that of B remains constant. (c) the volume of reacting vessel is doubled (d) an inert gas is added which doubles the overall pressure while the partial pressure of A and B remains constant. (e) the temperature rises by 30°C. [10]

Ans: (a) Rate increases by 8 folds (b) rate increases by 4 folds (c) rate decreases by 4 folds (d) no change in the rate of reaction (e) rate increases by 8 to 27 folds.

84. **2055 Q.No. 28**

a. List the factors that affect the rate of a reaction.

b. Hydrogen and nitrogen oxide react according to the following equation.

$2H_2(g) + 2NO(g) \longrightarrow H_2O(g) + N_2(g)$

Experiments were performed at 800°C in order to determine the order of reaction and the following results were obtained.

Initial concentration of nitrogen oxide (mol litre^{-1})	Initial concentration of hydrogen (mol litre^{-1})	Initial rate of production of nitrogen (mol litre^{-1} sec^{-1})
6×10^{-3}	1×10^{-3}	3×10^{-3}
6×10^{-3}	2×10^{-3}	6×10^{-3}
6×10^{-3}	3×10^{-3}	9×10^{-3}
1×10^{-3}	6×10^{-3}	0.5×10^{-3}
2×10^{-3}	6×10^{-3}	2.0×10^{-3}
3×10^{-3}	6×10^{-3}	4.5×10^{-3}

a. What is the order of this reaction with respect to (i) nitrogen oxide (ii) hydrogen?

b. Write the rate equation for the reaction of nitrogen oxide with hydrogen.

c. What is the unit of rate constant, k?

d. Why are chemists interested in obtaining order of reaction and rate equations? [10]

Ans: (a) The reaction is 1st order with respect to H_2 and 2nd order with respect to nitrogen oxide (c) $Mol^{-2} L^2 Sec^{-1}$

85. **2053 Q.No. 25(a)** What is meant by the term rate of reaction? How is it expressed? [2.5]

Write short notes on [5 marks]

86. **2075 Set B Q.No. 33ii** Order and molecularity of reaction. [5]

87. **2068 Q.No. 31iv** Rate of chemical reaction and Rate Law [5]

ORGANIC CHEMISTRY (SECTION B)

UNIT 8: AROMATIC HYDROCARBON

Very Short Answer Questions [2 marks]

1. **2076 GIE Set A Q.No. 8** How is sodiumbenzoate converted to benzene hexachloride? [2]

2. **2076 GIE Set B Q.No. 8** What happen's when
   i. Sodium benzoate is heated with sodalime.
   ii. Chlorobenzene is heated with $LiAlH_4$? [1+1]

3. **2076 Set B Q.No. 8** Write down correct reactions for the conversion of ethyne into BHC. [2]

4. **2075 GIE Q.No. 8** Identify the major products Ⓐ and Ⓑ in the following reaction sequence.

$$\text{Chlorobenzene} \xrightarrow[\Delta]{LiAlH_4} \text{Ⓐ} \xrightarrow[\Delta]{Ni/H_2} \text{Ⓑ}$$ [1+1]

5. **2075 Set A Q.No. 8** Identify the major products Ⓐ and Ⓑ in the following reaction sequence

$$\text{Sodium benzoate} \xrightarrow[\Delta]{NaOH+CaO} \text{Ⓐ} \xrightarrow[\Delta]{H_2/Ni} \text{Ⓑ}$$ [1+1]

6. **2075 Set B Q.No. 8** Identify Ⓐ and Ⓑ in the following reaction sequence. [1+1]

$$\text{Ⓐ} \xrightarrow[\Delta]{NaOH/CaO} \text{Ⓑ} \xrightarrow[light]{Cl_2} C_6H_6Cl_6$$

7. **2074 Supp. Q.No. 8** $CaC_2 \xrightarrow{H_2O} A \xrightarrow[\Delta]{\text{Red hot Cu}} B$

Identify A and B in the above reaction. [1+1]

8. **2074 Set A Q.No. 8** Identify the major product (A) and (B) in the following reaction sequence. [1+1]

$$\text{Chlorobenzene} \xrightarrow[\Delta]{LiAlH_4} (A) \xrightarrow[AlCl_3]{CH_3Cl/\Delta} (B)$$

9. **2074 Set B Q.No. 8** Identify the major product (A) and (B) in the following reaction sequence. [1+1]

$$\text{Sodium benzoate} \xrightarrow[\Delta]{NaOH/CaO} (A) \xrightarrow[light]{Cl_2} (B)$$

10. **2073 Supp Q.No. 8** How is benzene obtained form toluene? [2]

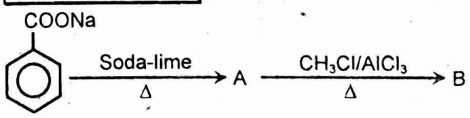
11. **2073 Set C Q.No. 8** What happens when: [1+1]
   i. Sodium benzoate is heated with soda-lime.
   ii. Benzene is heated with hydrogen in presence of nickel powder.

12. **2072 Supp. Q.No. 8** What are aromatic compounds according to Huckel's rule? [2]

13. **2072 Set C Q.No. 8** How would you prepare benzene from:
   i. ethyne ii. sodium benzoate [1+1]

14. **2072 Set D Q.No. 8** State Huckel's rule for aromaticity. [2]

15. **2072 Set E Q.No. 8**



Identify A and B of the above reaction. [1+1]

16. **2071 Supp. Q.No. 8** What are aromatic compounds according to Huckel's rule? [2]

17. **2071 Set C Q.No. 8** Write resonance hybrid structure of arene containing meta director and ortho director substituents of each. [1+1]

18. **2071 Set D Q.No. 8** State Huckel's rule for aromaticity. [2]

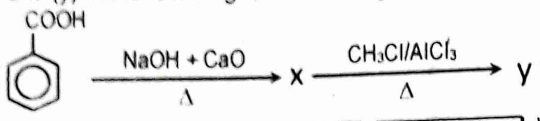
19. **2070 Supp. Q.No. 8** Why is benzene called aromatic compound according to Huckel's rule? [2]

20. **2070 Set C Q.No. 8** What happens when: [1+1]
   i. Sodium benzoate is heated with soda-lime.
   ii. Phenol is heated with zinc dust.

21. 2070 Set D Q.No. 8 What happens when:
   i. Benzene is heated with acetic anhydride in presence of anhydrous $AlCl_3$.
   ii. Sodium benzoate is heated with sodalime. [1+1]

22. 2069 Set A Q.No. 32d Give the example of Friedel Craft's alkylation [1]

23. 2069 Set B Q.No. 8 2069 Supp. Set B Q.No. 8 Identify (x) and (y) in the following reaction and give their names. [2]



24. 2062 Q.No. 5(i) 2060 Q.No. 5(ii) 2057 Q.No. 5 Write an example of each of the following reactions giving appropriate conditions: Friedel-Craft acylation [2]

25. 2054 Q.No. 17 Explain with any one example of electrophilic substitution in aromatic compounds. [2]

Short Answer Questions [5 marks]

26. 2056 Q.No. 30 b-(ii) Show your acquaintance with the following: Friedel Craft's reaction [5]

Write short notes on [5 marks]

27. 2053 Q.No. 28(a) 2062 Q.31(a) Friedel-Craft's reaction [5]

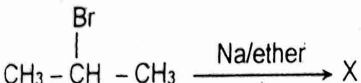
UNIT 9: HALOALKANES AND HALOARENES

9.1. HALOALKANES

Very Short Answer Questions [2 marks]

1. 2077 Set W Q.No. 2 How does chloroform react with (i) acetone (ii) silver powder. [1+1]

2. 2076 GIE Set B Q.No. 9 Identify the compounds (x) and write its IUPAC name. [2]



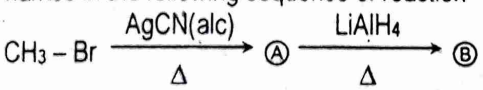
3. 2074 Supp. Q.No. 9 What happens when [2]
   i. chlorobenzene is treated with chloral
   ii. trichloromethane is heated with conc. Nitric acid

4. 2074 Set A Q.No. 9 What happens when chloroform is
   i. exposed to atmospheric air
   ii. heated with silver powder [1+1]

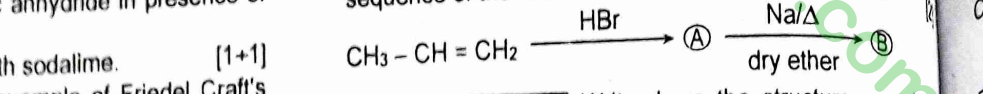
5. 2074 Set B Q.No. 9 Why is chloroform stored in dark coloured bottle containing ethanol? [2]

6. 2073 Supp Q.No. 9 An alkene Ⓐ undergoes addition with HBr to give Ⓑ. When Ⓑ is heated with sodium in presence of dry ether give 2,3–dimethylbutane. Identify Ⓐ and Ⓑ. [1+1]

7. 2073 Set C Q.No. 9 Identify Ⓐ and Ⓑ and give their IUPAC names in the following sequence of reaction [1+1]



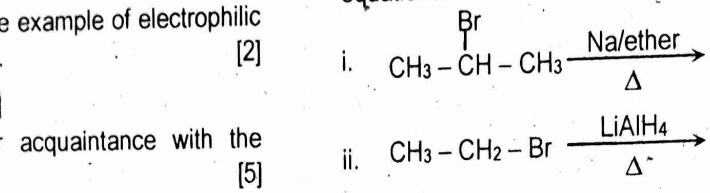
8. 2073 Set D Q.No. 9 Identify Ⓐ and Ⓑ in the following sequence of the reaction and give their IUPAC name. [2]



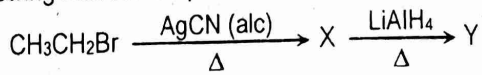
9. 2072 Supp. Q.No. 9 Write down the structure and IUPAC name of secondary haloalkane of C_3H_7X. What happens when the secondary haloalkane is heated with Na in presence of dry ether? [1+1]

10. 2072 Set C Q.No. 9 A haloalkane Ⓜ reacts with aq. NaOH to give isopropyl alcohol. What major product would you get when Ⓜ is heated with Na in presence of dry ether? [2]

11. 2072 Set D Q.No. 9 Give the major products in the following equations: [1+1]



12. 2071 Supp. Q.No. 9 Give the IUPAC name of X and Y in the following reaction sequence. [1+1]

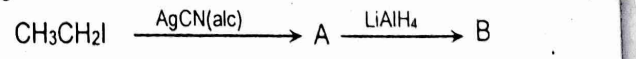


Ans: x = Ethylisocyanide, y = N–methylethanamine

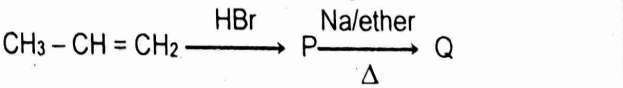
13. 2071 Set C Q.No. 9 Starting from iodomethane, how would you prepare: [1+1]
   i. Ethane ii. Ethene

14. 2071 Set D Q.No. 9 Write down the structure of secondary haloalkane of C_3H_7X. What happen when the secondary haloalkane is heated with Na in presence of dry ether? [1+1]

15. 2070 Supp. Q.No. 9 Identify the major products A and B and give their IUPAC name. [1+1]



16. 2070 Set C Q.No. 9 Write down the IUPAC name of major products P and Q in the following reaction sequence [2]



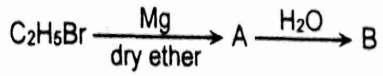
17. 2070 Set D Q.No. 9 Convert 1-bromopropane to 2-bromopropane. [2]

18. 2069 Set A Q.No. 9 Convert 1-chloropropane into 2-chloropropane [2]

19. 2069 Set A Q.No. 13 i Write an example of each of carboxylamine reaction. [1]

20. 2069 Supp. Set B Q.No. 9 What happens when [1+1]
   i. chlorobenzene is treated with chloral in acidic medium.
   ii. chloroethane is heated with alcoholic KOH

21. 2068 Q.No. 2 Identify the major products A and B in the following reaction. [1+1]



2. **2066 Q. No. 2** Identify A and B in the following reaction: [2]

$$CH_3 - CH_2 - Br \xrightarrow[\Delta]{\text{alc KOH}} A \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3} B$$

Ans: A ⇒ $CH_2 = CH_2$, B ⇒ HCHO

3. **2065 Q.No. 2** Identify 'A' and write its IUPAC name in the following reaction

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!CH\!-\!Br + Na \xrightarrow[\Delta]{\text{dry ether}} A + NaBr$$ [2]

4. **2065 Q.No. 2 ii** What happens when chloroform is heated with Silver powder? [2]

5. **2063 Q.No. 2** Identify (x) and (y) in the following reaction: [2]

$$(x) \xrightarrow{Mg/\text{ether}} (y) \xrightarrow[\text{(ii) } H_2O/H^+]{\text{(i) } CO_2} \text{Propanoic acid.}$$

6. **2062 Q.No. 2** A primary holoalkane (x), if allowed to react with KCN yields a compound (y), which on acidic hydrolysis gave propanoic acid. Identify (x) and (y). [2]

7. **2060 Q.No. 2** Convert bromoethane to ethyne. [2]

8. **2058 Q.No. 2** Why does chloroform not give white precipitate with aqueous silver nitrate? [2]

9. **2056 Q.No. 15** Why is chloroform stored in a dark brown bottle? [2]

10. **2056 Q.No. 19** Give the uses of chloroform. [2]

Short Answer Questions [5 marks]

11. **2077 Set P Q.No. 8** Give the laboratory method of preparation of trichloromethane from ethanol. Why does trichloromethane not give white ppt. with silver nitrate solution? [4+1]

12. **2077 Set V Q.No. 10** Write down the laboratory method preparation of trichloromethane from ethanol. What product would you obtain when trichloromethane is treated with acetone? [4+1]

13. **2076 GIE Set A Q.No. 29** An aliphatic haloalkane Ⓐ is heated with aq. KOH to give Ⓑ. The compound Ⓑ reacts with $SOCl_2$ to produce Ⓒ. The compound Ⓒ further reacts with AgCN to yield Ⓓ. On reduction of compound Ⓓ with $LiAlH_4$ produces Ⓔ. The compound Ⓐ undergoes wurtz reaction to give an alkane of molecular formula C_4H_{10}. Identify Ⓐ, Ⓑ, Ⓒ, Ⓓ and Ⓔ. Also write reactions involved. [4+1]

14. **2076 Set B Q.No. 28** How is trichloromethane prepared in the laboratory? Why is chloroform stored in a dark room air tied bottle containing a little ethyl alcohol? [4+1]

15. **2076 Set C Q.No. 28** How is trichloromethane prepared in the laboratory? Why is it discouraged to use chloroform as an anesthesia? [5]

16. **2075 Set B Q.No. 27** Write down the chemical reaction for the preparation of trichloromethane from acetone. How would you convert trichloromethane into
i. chloretone ii. methane iii. formic acid. [2+1+1+1]

17. **2074 Supp. Q.No. 27** How is trichloromethane prepared in the laboratory from propanone? What product would you expect when trichloromethane is condensed with acetone? Give IUPAC name of the product. [4+1]

18. **2073 Supp Q.No. 28** Write chemical reactions for the preparation of trichloromethane from propanone. How does trichloromethane react with
i. Phenol
ii. Silver powder
iii. Conc. nitric acid [2+1+1+1]

19. **2072 Set C Q.No. 27** Describe laboratory method of preparation of chloroform. How does chloroform react with acetone? [4+1]

20. **2072 Set D Q.No. 27** Give the chemical reaction for the preparation of trichloromethane from ethanal. What happens when it is heated with silver powder? Identify the product Ⓐ and write its IUPAC name. [2+1+2]

$$CHCl_3 \xrightarrow[\text{alkali}]{\text{acetone}} Ⓐ$$

21. **2072 Set E Q.No. 24** How is trichloromethane prepared in the laboratory from propanone in pure and dry state? Write its action with oxygen. [4+1]

22. **2071 Supp. Q.No. 27** How would you obtain [1+1+1+1+1+1]
i. ethane from bromoethane
ii. ethylene from trichloromethane

Identify the major product Ⓐ and Ⓑ in the following reaction sequence.

$$C_2H_5Br \xrightarrow[\Delta]{Mg/\text{ether}} Ⓐ \xrightarrow{H_2O/H^+} Ⓑ$$

Give reactions to convert Ⓐ into ethanoic acid.

23. **2071 Set C Q.No. 27** A haloalkane Ⓟ reacts with aq. KOH to give Ⓠ. The compound Ⓠ on oxidation with $K_2Cr_2O_7 + H^+$ gives Ⓡ and Ⓡ undergoes Clemmenson reduction to peoduce Ⓢ. The compound Ⓟ react with sodium in presence of dry ether to form 2, 3– dimethylbutane, write chemical reactions involved and identify P, Q, R and S. [5]

24. **2071 Set D Q.No. 27** How would you obtain:
a. ethane from bromoethane
b. ethyne from trichloromethane

Identify the major product Ⓐ and Ⓑ in the following reaction sequence:

$$C_2H_5Br \xrightarrow[\Delta]{Mg/\text{ether}} Ⓐ \xrightarrow{H_2O/H^+} Ⓑ$$

Give reactions to convert Ⓐ into ethanoic acid. [1+1+1+1+1]

25. **2070 Supp. Q.No. 26** How is trichloromethane prepared in the laboratory? Write its action on acetone. [4 + 1]

46. 2070 Set C Q.No. 29 An organic compound Ⓐ reacts with HCN to give Ⓑ. On hydrolysis of Ⓑ in acidic medium gives Ⓒ. Compound Ⓐ also produces propane when treated with zinc -amalgam and HCl. Identify Ⓐ, Ⓑ and Ⓒ with reaction and give their IUPAC names. What product would you expect when A is treated with trichloromenthane in alkaline medium? [5]

47. 2070 Set D Q.No. 24 Write any three methods of preparation of iodoethane. What happens when iodoethane is heated with: [5]
   i. Sodium in presence of dry ether
   ii. alc. NaOH

48. 2069 Set B Q.No. 23 Starting from trichoromethane, how would you prepare:
   i. ethyne ii. Methane
   iii. Chloropicrin iv. Carbonyl chloride
   v. Chloretone [5]

49. 2069 Supp. Set B Q.No. 23 A secondary halolkane Ⓐ gives compound Ⓑ when heated with alc.KOH. Ⓑ on ozonolysis produces ethanal and methanal as major products. Identify Ⓐ and Ⓑ, also write chemical reaction. What product would you expect when Ⓐ is heated with sodium in presence of dry ether? [4+1]

50. 2068 Q.No. 22 How is trichloromethane prepared in the laboratory? Give a chemical equation for the conversion of chloroform into ethyne. [4+1]

51. 2066 Q. No. 22
   a. Give the chemical reactions for the Laboratory Preparation of trichloromethane.
   b. Why is trichloromethane stored in dark-brown air tied bottle? [3+2]

52. 2065 Q.No. 21 Starting from Methyl magnesium bromide (CH_3MgBr) how would you prepare: [5×1= 5]
   i. ethanol ii. propan-2-ol
   iii. ethanoic acid iv. 2-methylpropan-2-ol

53. 2065 Q.No. 22 How is trichloromethane prepared in laboratory? How does it react with propanone? [4+1]

54. 2064 Q.No. 31(ii) Write short notes on Laboratory preparation of chloroform. [5]

55. 2062 Q.No. 21 Write the chemical reactions involved in the laboratory preparation of chloroform from ethanol. Why does chloroform not give white precipitate with aqueous $AgNO_3$? Write two important uses of chloroform. [5]

56. 2055 Q.No. 27 How is trichloromethane (chloroform) prepared in the laboratory? [5]

57. 2053 Q.No. 21 Describe the laboratory preparation of chloroform. [5]

58. 2052 Q.No. 24(a) What happens when Chloroform is allowed to react with NaOH solution? [2.5]

Long Answer Questions [10 marks]

59. 2077 Set V Q.No. 11ii An aliphatic haloalkane Ⓐ gives compound Ⓑ when heated with alc.NaOH. The compound Ⓑ reacts with HBr to give major product Ⓒ. On heating the compound Ⓒ with sodium in presence of dry ether yields 2,3-dimethylbutane. What product would you expect when the compound Ⓑ is subjected to ozonolysis? [4

60. 2070 Set C Q.No. 31 b Give a suitable chemical reaction for the laboratory preparation of trichloromethane. What happens when chloromethane reacts with [5×1
   i. phenol ii. nitric acid
   iii. Silver powder iv. atmospheric air

61. 2063 Q.No. 28 Describe the preparation of pure and dry chloroform in the laboratory. Give its action upon:
   a. heated silver
   b. aq. KOH
   c. aniline in presence of alc. KOH. [5+

62. 2061 Q.No. 28 How is Grignard reagent prepared? What precautions should be taken for preparation of Grignard reagents? How does CH_3CH_2MgBr react with

   a. $CH_3-\overset{\overset{O}{\|}}{C}-Cl$ b. H_2O

   c. $H-\overset{\overset{O}{\|}}{C}-H$ d. CO_2

   Show the final product after aqueous work-up. [2+2+1.5×

63. 2053 Q.No. 27 An organic compound A on catalytic reduction gives B, B on chlorination gives C, C on heating with sodium metal in presence of ether gives D, D on chlorination gives 2–chlorobutane as a major product. Give names for A, B, C and D. [5

Write short notes on [5 marks]

64. 2076 GIE Set B Q.No. 33ii 2072 Supp. Q.No. 33ii 2071 Supp. Q.No. 33b 2071 Set C Q.No. 33 b 2071 Set D Q.No. 33 b 2069 Supp. Set B Q.No. 33 d Laboratory preparation of trichloromethane. [5

65. 2053 Q.No. 28(c); 2055 Q.31(d); 2056 31(c); 2056 Q.31 (d); 2057 Q.31 (d); 2058 Q.31 (d)
   a. Markovnikor's rule b. Inductive effect
   c. Wurtz reaction d. Inductive effect
   e. Laboratory preparation of chloroform [5

9.2. HALOARENES

Very Short Answer Questions [2 marks]

1. 2076 GIE Set A Q.No. 9 Explain, why are haloarenes less reactive towards nucleophilic substitution reactions?

2. 2076 Set B Q.No. 9 Why is haloarene less reactive than benzene in electrophilic substitution reaction?

3. 2076 Set C Q.No. 9 Explain, why is chlorobenzene less reactive than benzene in electrophilic substitution reaction?

4. 2075 GIE Q.No. 9 Why is haloarene less reactive towards nucleophilic substitution reaction than haloalkane?

2075 Set A Q.No. 9 Why is haloarene less reactive towards nucleophilic substitution reaction than haloalkane? [2]

2075 Set B Q.No. 9 What products would you expect when [1+1]
i. Benzene diazonium chloride is heated with copper powder in presence of HCl.
ii. Chlorobenzene is heated with 2,2,2–trichloroethanal.

2072 Set E Q.No. 9 Why is nucleophilic substitution difficult in haloarenes? [2]

2069 Set A Q.No. 8ii How would you obtain benzene from chlorobenzene? [1]

2069 Set B Q.No. 9 What happens when chlorobenzene is: [1+1]
i. treated with chloral in acidic medium.
ii. heated with Ni-Al in alkaline medium.

10. 2067 Q.No. 2 How would you convert chlorobenzene into: [1+1]
i. DDT ii. Toluene

11. 2064 Q.No. 2 Why is nucleophilic substitution reaction in chlorobenzene difficult as compared to chloroethane? [2]

12. 2063 Q.No. 3(ii) Write the action of Monohydroxy benzene with trichloromethane in presence of alcohoiic NaOH. [2]

13. 2059 Q.No. 2 Why is it difficult to undergo nucleophilic substitution in haloarene? [2]

14. 2056 Q.No. 18a Write the name of the following components according to the IUPAC rule. [1]

Short Answer Questions [5 marks]

15. 2069 Set A Q.No. 27 Write any three methods of preparation of chlorobenzene. How does it react with?
a. chloral and
b. Melthyl chloride in the presence of sodium metal and dry ether. [3+2]

16. 2060 Q.No. 23 Write two chemical reactions for the preparation of chlorobenzene. Why does it give ortho and para products during electrophilic substitution reaction? Give its action on chloral. [5]

Long Answer Questions [10 marks]

17. 2059 Q.No. 29 (b-i) Predict the major products of the following reactions:

$$Ar\,N_2Cl \xrightarrow[\Delta]{Cu_2Br_2/HBr} \ldots\ldots\ldots \quad [1]$$

UNIT 10: ALCOHOLS AND PHENOLS

10.1. ALCOHOLS

Very Short Answer Questions [2 marks]

1. 2076 GIE Set B Q.No. 10 Write reactions for the conversion of cane sugar into ethyl alcohol. [2]
2. 2076 GIE Set B Q.No. 12 An organic compound, C_3H_6O gives positive Tollen's test. Identify the compound and write the reaction involved. [1+1]
3. 2075 GIE Q.No. 10 Give reactions for the conversion of propan-1-ol into propan-2-ol. [2]
4. 2075 Set A Q.No. 10 Give reactions for the conversion of cane sugar into ethyl alcohol. [2]
5. 2075 Set B Q.No. 10 Write a structural formula of 3° alcohol of $C_4H_{10}O$. How is this alcohol prepared by using Grignard reagent? [1+1]
6. 2074 Supp. Q.No. 10 Starting from cane sugar, how would you obtain ethyl alcohol? [2]
7. 2072 Supp. Q.No. 10 What is the structure of isomeric alcohol of C_3H_8O that gives iodoform test? Write the test reaction. [1+1]
8. 2072 Set C Q.No. 10 Write a structural formula of secondary alcohol of C_3H_8O and give its method of preparation using Grignard reagent. [1+1]
9. 2072 Set D Q.No. 10 Write down the structural formula and IUPAC name of tert-butyl alcohol. [1+1]
10. 2072 Set E Q.No. 10 Prepare butan –2–ol and 2-methylpropan –2–ol by using CH_3MgBr. [1+1]
11. 2071 Supp. Q.No. 10 Name any suitable secondary alcohol that gives iodoform test and write the test reaction. [1+1]
12. 2071 Set C Q.No. 10 Write structure of tertiary alcohols of $C_4H_{10}O$ and give their IUPAC names. [1+1]
13. 2070 Supp. Q.No. 10 Write down the secondary and tertiary alcohols of $C_4H_{10}O$ and give their IUPAC names. [1+1]
14. 2070 Set C Q.No. 10 A dihydric alcohol $C_2H_6O_2$ Ⓐ undergoes step wise oxidation with $K_2Cr_2O_7/H^+$ to give a dicarboxylic acid $C_2H_2O_4$ Ⓑ as final product. Identify Ⓐ and Ⓑ with reactions and give their IUPAC name. [2]
15. 2070 Set D Q.No. 10 What is the laboratory test of ethanol? [2]
16. 2069 Set A Q.No. 32b Give the example of Esterification [1]
17. 2069 Supp. Set B Q.No. 10 Give a suitable chemical test of ethanol that distinguishes it from propanol. [2]
18. 2067 Q.No. 3 Name the isomer of C_3H_8O which undergoes idoform test. [2]
19. 2066 Q. No. 3 How would you obtain ethanol from Cane sugar? Write reaction only. [2]
20. 2065 Q.No. 3i What happens when: Ethanol is heated with iodine in presence of aq. NaOH? [2]
21. 2064 Q.No. 4 Convert ethanol to propanoic acid. [2]
22. 2062 Q.No. 3(i) Write the action of: Propan– 2– ol with PCl_5 [1]
23. 2061 Q.No. 3 Alcohols of low molecular weight are moderately soluble in water, whereas ethers of about the same molecular weight are not. Explain. [2]
24. 2060 Q.No. 3 Identify the organic compounds A, B, C and D.

$$(CH_3)_2CHOH \xrightarrow{PCl_5} A \xrightarrow{\text{alc. KOH}} B \xrightarrow{\text{ozonolysis}} C+D \quad [2]$$

25. 2059 Q.No. 3 2058 Q.No. 3 Write a chemical reaction for the preparation of primary alcohol by Oxo process. [2]
26. 2059 Q.No. 4 Why is the boiling point of ethanol higher than its isomer methoxymethane? [2]
27. 2056 Q.No. 16 What is fermentation? [2]
28. 2055 Q.No. 16 Why is boiling point of ethanol greater than that of ethoxyethane? [2]
29. 2054 Q.No. 11(b) Give the IUPAC name of the following compounds: $CH_2 = CH\,CH_2\,OH$ [1]

Short Answer Questions [5 marks]

30. 2076 GIE Set A Q.No. 27 Starting from Grignard's reagent, how would you prepare i. propan -1-ol, ii. propan-2-ol. Which one of them has higher boiling point and why? Give the chemical test to distinguish them. [2+1+2]

31. 2076 GIE Set B Q.No. 28 An organic compound gives H_2 gas when reacts with sodium. On treatment with alkaline iodine yields yellow precipitate and on dehydration with P_2O_5 forms an alkene (C_2H_4). Name the compound and write the reactions involved. [5]

32. 2076 Set B Q.No. 27 Starting from CH_3MgI how would you prepare
    i. propan-2-ol
    ii. 2-methylpropan-2-ol
    Give the chemical test to distinguish them. Why are lower member of alcohol highly soluble in water? [2+2+1]

33. 2076 Set C Q.No. 27 Starting from Grignard's reagent, how would you prepare (i) propan-1-ol (ii) propan-2-ol. Mention the chemical test to distinguish them. Write down the structural formula of neo-pentyl alcohol and its IUPAC name. [1+1+2+1]

34. 2075 GIE Q.No. 29 An organic compound gives H_2 gas with Sodium metal. On treatment with alkaline iodine gives yellow ppt and on oxidation with CeO_2/H^+ form an aldehyde (C_2H_4O). Name the compound and write reactions involved. How would you convert the compound into ethene? [4+1]

35. 2075 Set A Q.No. 29 An organic compound Ⓜ gives H_2 gas with sodium metal. On treatment with alkaline iodine gives yellow ppt and on oxidation with CeO_2/H^+ forms an aldehyde (C_2H_4O). Name the compound Ⓜ and write reactions involved. What happens when Ⓜ is heated with P_2O_5? [4+1]

36. 2072 Set E Q.No. 31a Distinction of 1°, 2 ° and 3° alcohol by Victor-Meyer's method. [5]

37. 2072 Set E Q.No. 23 A monohydric alcohol reacts with PBr_3 to give 'B'. The compound B, if heated with alc. KOH gives 'C'. C on ozonlysis produces ethanal and methanal as major products. The compound 'A" responses iodoform test. Identify A, B and C with reactions involved. What happens when 'B' is heated with sodium in presence of dry ether. [5]

38. 2072 Set E Q.No. 25 How is ethanol prepared from (i) ethyne (ii) 1, 1 – dichloroethane. Convert ethanol to propanone. What is the laboratory test of carbonyl compounds? [1+1+2+1]

39. 2070 Set C Q.No. 28 Write down the Isomeric alcohols of C_3H_8O and IUPAC name. Explain Victor-Meyer's method to distinguish them. [2+3]

40. 2069 Set A Q.No. 29 Write the functional isomers of C_3H_6O with their IUPAC name. Also, give a chemical test to distinguish them which one gives Iodoform test and why? [1+1+1+2]

41. 2069 Set A Q.No. 32 Describe Victor Meyer's method to distinguish primary, secondary and tertiary alcohols. [5]

42. 2069 Set B Q.No. 25 An Organic Compound (A) reacts with PBr_3 to give (B). Compound (B) produces (C) when heated with alc. KOH. The compound (C) undergoes ozonolysis to yield ethanal and methanal as major products. The compound 'A' responses Iodoform test. Identify A, B, C, and the reactions involved. How is (A) obtained from CH_3MgBr. [5]

43. 2069 Supp. Set B Q.No. 25 Write chemical reaction for the preparation of
    i. ethanol
    ii. propan –2 – ol from methyl magnesium bromide.
    How would you distinguish them by Victor Meyer's method?

44. 2067 Q.No. 21 Write down the isomers of monohydric alcohols from C_3H_8O and give their IUPAC name. What chemical test would you apply to distinguish them? Write the chemical reaction for it. How would you convert the one isomer to the other and vice versa? [1+1+1+2]

45. 2067 Q.No. 31 iv Write short notes on fermentation of ethyl alcohol.

46. 2066 Q. No. 21 Write down the oxidation of Primary, Secondary and Tertiary alcohols. How would you convert Propan-1- ol into Propon-2- ol? [3]

47. 2065 Q.No. 29 b Write the Victor Meyer's test for distinction of primary, secondary and tertiary alcohols.

48. 2064 Q.No. 21 What is meant by Grignard's reagent? How could you convert a primary alcohol to Grignard's reagent? By using a suitable Grignard's reagent how would you synthesise:
    i. 2-methylpropan -2- ol ii. ethanoic acid?

49. 2063 Q.No. 22(v) What action takes place when: Ethanol heated with conc. H_2SO_4 at about 160-170° C?

50. 2061 Q.No. 21 Write down the oxidation products of primary, secondary and tertiary alcohols.

51. 2060 Q.No. 21 Describe Victor Meyer's method for the distinction between 1°, 2° and 3° alcohols.

52. 2060 Q.No. 22

i. Consider a reaction. [2.5+2]

$$A \xrightarrow[\Delta]{PBr_3} B \xrightarrow{KCN} C \xrightarrow[\Delta]{H_2O/H^+} D \xrightarrow[\Delta]{P_2O_5} E$$

The compound A is a primary alcohol which gives positive iodoform test. Identify the organic compounds A, B, C, D and E.

ii. Convert the above compound D into ethanoic acid.

53. 2059 Q.No. 21 A secondary alcohol (X) reacts with PCl_5 to give an alkyl halide (Y), which on dyhydrohalogenation yields an alkene (Z). The alkene (Z) upon ozonolysis gives a mixture of ethanal and methanal. Identify X, Y and Z. Suggest your answer with chemical reaction.

54. 2052 Q.No. 24(b); 2053 Q.No. 23(c) What happens when
    a. Ethyl alcohol is treated with acetic acid
    c. Ethanol is heated with conc H_2SO_4

Long Answer Questions [10 marks]

55. 2077 Set W Q.No. 11a What are the oxidation products of primary, secondary and tertiary alcohols?

56. **2076 GIE Set B Q.No. 31a** Write Victor Meyer's test for the distinction of 1°, 2° and 3° alcohol. [5]

57. **2075 GIE Q.No. 30** Explain Victor-Meyer's test for the distinction of 1°, 2° and 3° alcohol. How is 2-bromopropane converted into 1-bromopropane? Write an example of each of:
i. Reimer-Tiemann reaction
ii. Wurtz reaction
iii. Iodoform reaction [5+2+3]

58. **2075 Set A Q.No. 30** Explain Victor-Meyer's test for the distinction of primary, secondary and tertiary alcohol. How is 1-chloropropane converted into 2-chloropropane? Write an example of each. [5+2+3]
i. Carbylamine reaction
ii. Reimer-Tiemann reaction
iii. Cannizzaro's reaction

59. **2075 Set B Q.No. 32** Describe Victor Meyer's method to distinguish propan-2-ol and 2-methylpropan-2-ol. Give a reaction to show that the H-atom of the -OH in alcohol is weakly acidic. Convert the followings.
i. propan -1-ol into propan -2-ol
ii. ethanal into propanone [5+1+2+2]

60. **2074 Supp. Q.No. 31** Write down a structural formula and its IUPAC name of $C_4H_{10}O$. How would you apply Victor Meyer's method for the distinction of propan-1-ol from propan-2-ol? Write an example of:
i. Oxo-Process ii. Baeyer's test
Convert propan-2-ol into propan-1-ol. [2+4+2+2]

61. **2074 Set A Q.No. 31** Write example of each of primary, secondary and tertiary alcohols. How are they distinguished by Victor Meyer's method? Give an example of, [2+4+2+2]
i. Oxo-process ii. Dehydration of alcohol
How would you convert popan-1-ol into propan-2-ol?

62. **2074 Set B Q.No. 31** Write down the structural formula of tertiary alcohol and its IUPAC name of $C_4H_{10}O$. How would you apply Victor Meyer's method for the distinction of propan-1-ol from propan-2-ol? Write an example of;
i. Oxo-process ii. Baeyer's test
Convert propan -2-ol into propan-1-ol. [2+4+2+2]

63. **2073 Supp Q.No. 31a** What are the oxidation products of primary, secondary and tertiary alcohols?

64. **2073 Set C Q.No. 31** What are the oxidation products of primary, secondary and tertiary alcohol? Write down suitable methods for the conversion of [5+2.5+2.5]
i. ethanol to propanol
ii. Chloroform to dimethyl amine.

65. **2073 Set D Q.No. 31** How would you distinguish propan-2-ol from 2-methylpropan-2-ol by using Victor Meyer's method. Write down suitable method for the conversion of:
i. Chloroform into dimethylamine
ii. Ethanamine into methanamine [5+2.5+2.5]

66. **2072 Supp. Q.No. 31b** Write Victor-Meyer's method for the distinction of 1°, 2° and 3° alcohol. [5]

67. **2072 Set C Q.No. 32** Describe Victor Meyer's method to distinguish propan –2 – ol and 2-methylpropan –2 – ol. Give a reaction to show that the H-atom of the -OH in alcohol is weakly acidic. Convert the followings. [5+1+2+2]
i. Propan –1 – ol into Propan –2 – ol
ii. Ethanal into propanone.

68. **2072 Set D Q.No. 32** Describe Victor Meyer's method to distinguish propan–2-ol and 2-methylpropan-2-ol. Why is phenol more acidic than alcohol? How would you convert ethanal into propanone and vice-versa? [5+1+4]

69. **2070 Supp. Q.No. 31 a** Explain the chemical method of distinction of primary alcohol, secondary alcohol and tertiary alcohol introduced by Victor Meyer's. [5]

70. **2069 Set B Q.No. 30 a** How would you distinguish between propan-1-ol and propan-2-ol by Victor-Meyer's method? Give suitable method of conversion of propan-1-ol into propan-2-ol. [3+2+1+1]

71. **2068 Q.No. 28a** How will you make a distinction of primary, secondary and tertiary alcohol by the Victor Meyer's Method? [5]

72. **2063 Q.No. 29(a)** Describe Victor Meyer's method for the distinction between primary secondary and tertiary alcohols.[5]

Write Short Notes: [5 marks]

73. **2072 Set D Q.No. 33d** **2070 Set D Q.No. 33 c** Distinction of 1°, 2° and 3° alcohol by Victor Meyer's method. [5]

74. **2063 Q.31 (iv); 2059 Q.31(a); 2055 Q.31(c); 2054 Q.No. 30(d)**
a. Use of Grignard's reagent in the synthesis of 1°, 2°, 3° alcohols.
b. Victor Meyer's method for distinction between primary, secondary and tertiary alcohols.
c. Distinction between 1°, 2° and 3° alcohols by Victor Meyer's Method.
d. Fermentation. [5]

75. **2062 Q.No. 29**
a. Consider the following reaction

$$A \xrightarrow{PI_3} B \xrightarrow{KCN} C \xrightarrow{H_2O/H^+} D \xrightarrow{P_2O_5} E$$

The compound, A is a primary alcohol which gives iodoform test. Identify the organic compounds A, B, C, D and E; giving complete reaction.
b. Describe Victor Meyer's method for the distinction between 1°, 2° and 3° alcohols. [5]

76. **2058 Q.No. 29a** Consider the following reaction

$$A \xrightarrow[\Delta]{PCl_5} B \xrightarrow[\text{dry ether}]{Mg} C \xrightarrow{CO_2} D \xrightarrow[H_2O/H^+]{\Delta} E$$

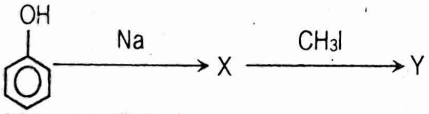
The compound, A is a primary alcohol, which on oxidation gives ethanal. Identify A, B, C, D and E.
Convert the above compound A into methanol and ethyne.[5]

10.2. PHENOLS

Very Short Answer Questions [2 marks]

1. **2076 GIE Set A Q.No. 10** What products would you obtain when phenol is treated with [1+1]
i. phthalic anhydride ii. ferric chloride solution

2. 2076 Set B Q.No. 10 Starting from phenol how would you obtain [1+1]
   i. Phenolphthalein ii. p-hydroxyazobenzene
3. 2076 Set C Q.No. 10 What product would you obtain when phenol is treated with [1+1]
   i. Benzene diazonium chloride?
   ii. Phthalic anhydride?
4. 2074 Set A Q.No. 10 Starting from phenol, how would you obtain p-hydroxyazobenzene? [2]
5. 2074 Set B Q.No. 10 Starting from phenol, how would you obtain benzaldehyde? [2]
6. 2073 Supp Q.No. 10 What is the laboratory test of phenol? What happens when phenol is heated with Zn–dust? [1+1]
7. 2073 Set C Q.No. 10 How does phenol react with [1+1]
   i. aqueous bromine
   ii. Benzene diazonium chloride.
8. 2073 Set D Q.No. 8 Starting from phenol how would you obtain cyclohexane? [2]
9. 2073 Set D Q.No. 10 How is phenol obtained from [1+1]
   i. benzene diazonium chloride
   ii. chlorobenzene
10. 2071 Set D Q.No. 10 What happens when phenol is treated with: [1+1]
    a. Benzene diazonium chloride
    b. Methanal in acidic medium
11. 2070 Set C Q.No. 14 How is picric acid prepared? Write its one use. [2]
12. 2069 Set A Q.No. 8i How would you obtain benzene from phenol? [1]
13. 2069 Set B Q.No. 10 Starting from phenol, how would you prepare methoxybenzene? [2]
14. 2068 Q.No. 3 Why is phenol more acidic than aliphatic alcohol? [2]
15. 2067 Q.No. 7 Name the compound (X) and (Y) in the following reaction. [1+1]



16. 2067 Q.No. 8 Why is phenol more acidic than aliphatic alcohol? [2]
17. 2066 Q. No. 8 How would you prepare methoxybenzene from phenol? [2]
18. 2063 Q.No. 3(ii) Write the action of Monohydroxy benzene with aqueous bromine. [1]
19. 2061 Q.No. 7 Show your acquaintance with Reimer-Tiemann's reaction. [2]
20. 2057 Q.No. 3 Write the reaction between phenol and aq. Br_2. [2]

Short Answer Questions [5 marks]

21. 2063 Q.No. 22(iv) What action takes place when: Phenol reacts with ethanoyl chloride? [1]
22. 2062 Q.No. 22(i) Convert the following Organic compounds: Phenol to m-nitrobenzoic acid [1]
23. 2061 Q.No. 23 How is phenol prepared from (a) aniline (b) benzene? How do you explain that the –OH group phenol is ortho/para directing? [3]
24. 2059 Q.No. 22(a) How could you synthesise? toluene from phenol.
25. 2058 Q.No. 22(a) Convert the following organic compounds Benzene to m-bromophenol.
26. 2057 Q.No. 23(c) Write the chemical equation with conditions for the following reaction.Phenol is coupled with benzene diazonium chloride.
27. 2052 Q.No. 27 An aromatic compound A on reduction yields parent hydrocarbon B.B on nitration gives C.C on reduction in acidic solution gives D. On coupling with diazonium salt D gives diazoaminobenzene. Give name for A, B, C and D. Write the chemical reaction involved.

Long Answer Questions [10 marks]

28. 2071 Supp. Q.No. 30b Identify the major products A, B, C and D in the following reaction sequences.

$$A \xrightarrow[\Delta]{Zn} B \xrightarrow[\Delta]{CH_3Cl/AlCl_3} C \xrightarrow[\Delta]{CeO_2/H^+} D$$

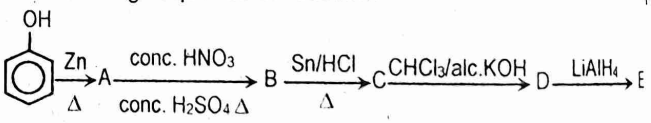
Compound D gives methylbenzene when heated with alc. KOH and hydrazine.

29. 2070 Set C Q.No. 30 b Identify A, B, C, D and E in the following reaction sequences.

$$(A) \xrightarrow[Conc.H_2SO_4\Delta]{Conc.HNO_3} (B) \xrightarrow[\Delta]{Sn/HCl} (C) \xrightarrow[\Delta]{CHCl_3/KOH(alc.)} (D) \xrightarrow[\Delta]{LiAlH_4} (E)$$

Compound A can be obtained by heating phenol in presence of Zn-dust. [5×1=5]

30. 2069 Supp. Set B Q.No. 31 b Identify A, B, C, D and E in the following sequence of reaction. [5]



UNIT 11: ETHERS

11.1 ALIPHATIC ETHERS

Very Short Answer Questions [2 marks]

1. 2076 GIE Set A Q.No. 11 Identify the major products Ⓐ and Ⓑ giving their IUPAC names, in the given reaction sequence. [1+1]

$$\text{Ethoxyethane} \xrightarrow[\Delta]{PCl_5} Ⓐ \xrightarrow{\text{sodiummethoxide}} Ⓑ$$

2. 2076 GIE Set B Q.No. 11 How would you prepare following ethers by Williamson's synthesis? (i) Methoxyethane (ii) Methoxybenzene
3. 2076 Set C Q.No. 11 2076 Set B Q.No. 11 Identify the major products Ⓐ and Ⓑ giving their IUPAC names in the given reaction sequence. [1+1]

$$\text{Methoxymethane} \xrightarrow[\Delta]{\text{Excess HI}} Ⓐ \xrightarrow[\Delta]{\text{Sodium phenoxide}} Ⓑ$$

4. 2075 GIE Q.No. 11 Prepare methoxyethane by Williamson's synthesis method. What happens when methoxyethane is treated with excess HI? [1+1]
5. 2075 Set A Q.No. 11 How would you obtain [1+1]
   i. Anisole from phenol
   ii. Methoxyethane from ethoxyethane.
6. 2075 Set B Q.No. 11 Give an example of unsymmetrical ether and write Williamson's synthesis process for its preparation. [1+1]
7. 2074 Supp. Q.No. 11 2074 Set A Q.No. 11 2074 Set B Q.No. 11 Write an example of Williamson's etherification reaction. What is its importance? [1+1]
8. 2073 Supp Q.No. 11 Convert ethoxyethane to methoxyethane. [2]
9. 2073 Set C Q.No. 11 Write down isomeric ether of isopropyl alcohol and use Williamson's synthesis process for the preparation of such ether. [1+1]
10. 2073 Set D Q.No. 11 Write down an isomeric ether of isopropyl alcohol. What happens when the isomeric ether is heated with excess HI? [1+1]
11. 2072 Supp. Q.No. 11 Write down the possible unsymmetrical ethers of $C_4H_{10}O$ and their IUPAC names. [2]
12. 2072 Set C Q.No. 11(ii) How would you obtain: methoxyethane from ethanol. [1]
13. 2072 Set D Q.No. 11 Write IUPAC name of $CH_3OCH(CH_3)_2$ and use Williamson's synthesis method for its preparation. [1+1]
14. 2072 Set E Q.No. 11 How is unsymmetrical ether prepared by Williamson's ether synthesis? [2]
15. 2071 Supp. Q.No. 11 What are unsymmetrical ethers? Give Williamson's synthesis to prepare unsymmetrical ethers. [1+1]
16. 2071 Set C Q.No. 11 Write an unsymmetrical ether of C_3H_8O. How would you prepare the ether by using Willam's synthesis? [1+1]
17. 2071 Set D Q.No. 11 b Give correct chemical reaction for the preparation of 2-methoxypropane. [1]
18. 2070 Set C Q.No. 11 What is unsymmetrical ether? Write an example and IUPAC name. [1+1]
19. 2070 Set D Q.No. 11 Prepare $CH_3–O–CH_2CH_3$ by using Williamson's ether synthesis. [1]
20. 2069 Set A Q.No. 10 Give an example of Williamson's etherification. [2]
21. 2069 Set B Q.No. 11 2069 Supp. Set B Q.No. 11 Name the isomer of C_2H_6O which reacts with excess HI, gives Iodomethane as major product and write reaction for it. [1+1]
22. 2068 Q.No. 5 Write chemical equation for the reactions taking place when: [1+1]
    i. Sodium phenoxide reacts with iodomethane.
    ii. Ethoxyethane is exposed to light and air.
23. 2066 Q. No. 6 What is Williamson's etherification reaction? [2]
24. 2065 Q.No. 6 Give reason: [2]
    i. It is dangerous to boil sample of ether stored for a long time.
    ii. Ether is stored in a bottle containing iron wire.
25. 2064 Q.No. 8 There are three possible isomeric ethers of $C_4H_{10}O$. One of them is ethoxyethane. Write other two isomers and give their IUPAC name. [2]
26. 2062 Q.No. 4 Write the sequence of chemical reactions for the conversion of ethoxyethane to methoxy ethane. [2]
27. 2061 Q.No. 2 Write IUPAC names of ethers represented by the molecular formula $C_5H_{12}O$. [2]
28. 2060 Q.No. 4 What is the action of ethoxyethane on: [2]
    i. PCl_5 and ii. aq. HI (cold)
29. 2057 Q.No. 4 Write the structure of [2]
    i. anisole and ii. 2 – methoxypropane.
30. 2058 Q.No. 4 What action takes place when excess of ethanol is heated with conc. Sulphuric acid at about 140°C? [2]
31. 2053 Q.No. 15 What is the functional group of ether and amide? [2]

Short Answer Questions [5 marks]

32. 2076 GIE Set A Q.No. 28 How is ethoxyethane prepared in laboratory? Why is ether not evaporated to dryness in air? [5]
33. 2076 GIE Set B Q.No. 26 Describe the laboratory preparation of ethoxyethane with a neat and labelled diagram. [5]
34. 2074 Set A Q.No. 27 Describe the laboratory method of preparation of ethoxyethane. How is ethoxyethane converted into methoxyethane? [4+1]
35. 2074 Set B Q.No. 27 Describe the laboratory method of preparation of ethoxyethane. Why is it dangerous to boil old sample of ether? [4+1]
36. 2073 Set D Q.No. 27 Describe the laboratory method of preparation of ethoxyethane. What happens when ethoxyethane is exposed to air? [4+1]
37. 2072 Supp. Q.No. 28 Write down laboratory method of preparation of ethoxyethane. [5]
38. 2071 Supp. Q.No. 28 2071 Set C Q.No. 26 2071 Set D Q.No. 28 Write down suitable chemical reaction for the preparation of ethoxyethane from ethanol. How is ethoxyethane converted into methoxyethane? What happens when ethoxyethane is heated with: [1+2+1+1]
    i. air ii. conc. H_2SO_4
39. 2070 Set D Q.No. 23 How is ethoxyethane prepared in the laboratory in pure and dry state? [5]
40. 2069 Set A Q.No. 28 Describe laboratory preparation of ethoxyethane with a neat and labelled diagram. [5]
41. 2069 Set B Q.No. 24 How is ethoxyethane prepared in the laboratory? Write Williamsons' synthesis for the preparation of an unsymmetrical ether. [1+4]
42. 2065 Q.No. 23 ii Ethoxyethane into methoxyethane [2.5]
43. 2063 Q.No. 23 Describe the preparation of ethoxyethane in the laboratory. [5]
44. 2058 Q.No. 22(b) Convert the following organic compounds. Ethoxyethane to ethanoylchloride. [2.5]

Write short notes on [5 marks]

45. 2076 Set C Q.No. 33iv 2072 Set E Q.No. 33(iii) 2070 Supp. Q.No. 33 b 2070 Set C Q.No. 33 d 2068 Q.No. 31iii 2066 Q. No. 31i Laboratory preparation of ethoxyethane [5]
46. 2060 Q.No. 31(iv) Laboratory preparation of diethyl ether [5]

47. 2059 Q.No. 29(iv) Predict the major products of the following reactions:

$C_2H_5OC_2H_5 \xrightarrow[0°C]{\text{Conc. HCl}}$ ..... [1]

11.2 AROMATIC ETHER

Very Short Answer Questions [2 marks]

1. 2072 Set C Q.No. 11.2 (i) How would you obtain: anisole from phenol. [1]
2. 2071 Set D Q.No. 11 a Give correct chemical reaction for the preparation of anisole. [1]
3. 2070 Supp. Q.No. 11 Starting from CH_3ONa, how would you prepare methoxybenzene? What happens when methoxybenzene is treated with excess HI? [1+1]
4. 2070 Set D Q.No. 11 Prepare  by using Williamson's ether synthesis. [2]
5. 2069 Set A Q.No. 12 How is Methoxybenzene prepared from phenol? [2]
6. 2064 Q.No. 22(v) What happens when Sodium phenolate reacts with iodomethane? [1]
7. 2063 Q.No. 3(i) Write the action of Sodium phenolate with iodomethane. [2]

UNIT 12: ALDEHYDES AND KETONES

12.1 ALIPHATIC ALDEHYDES AND KETONES

Very Short Answer Questions [2 marks]

1. 2077 Set P Q.No. 6 Write an example of
   i. Cannizzaro's reaction
   ii. DNP-test. [1+1]
2. 2077 Set V Q.No. 6 Write an example of
   i. Rosennmund's reaction
   ii. Coupling reaction. [1+1]
3. 2076 GIE Set A Q.No. 12 An organic compound C_3H_6O does not give silver mirror with Tollen's reagent but given yellow precipitate with NaOH and I_2. Identify the compound and write the reactions involved. [1+1]
4. 2076 Set B Q.No. 12 An organic compound C_3H_6O gives orange precipitate with 2,4-dinitrophenyl hydrazine but does not produce silver mirror with tollen's reagent. Identify the compound and write the reaction involved. [2]
5. 2076 Set C Q.No. 12 An organic Compound C_3H_6O does not give silver mirror with Tollen's reagent but gives yellow precipitation with NaOH and I_2. Identify the compound and write the reactions involved. [2]
6. 2076 Set C Q.No. 8 How is sodiumbenzoate converted into acetophenone? [2]
7. 2075 GIE Q.No. 12 An alkene Ⓐ undergoes ozonolysis to give ethanal and methanal as the major products. Identify Ⓐ and give its IUPAC name. [1+1]
8. 2075 GIE Q.No. 13 Write an example of
   i. Carboxylation reaction ii. Rosemunnd's reduction [1+1]
9. 2075 Set A Q.No. 12 An alkene Ⓐ undergoes ozonlysis to give ethanal and propanone as the major products. Identify Ⓐ and write its IUPAC name. [1+1]
10. 2075 Set A Q.No. 13 Write an example of each of the followings. [1+1]
    i. Rosemund's reduction ii. Decarboxylation reaction
11. 2075 Set B Q.No. 12 What major product would you obtain when methanal reacts with ammonia? Write an important use of the product. [1+1]
12. 2074 Supp. Q.No. 12 Write an example of each of the following. [1+1]
    i. Aldol condensation ii. Rosenmund's reduction
13. 2074 Set A Q.No. 12 Write an example of each of the following [1+1]
    i. Cannizzaro's reaction ii. DNP Test
14. 2074 Set B Q.No. 12 Write an example of each of the following [1+1]
    i. Tollen's test ii. Aldol condensation
15. 2073 Supp Q.No. 12 Starting from ethanal, how would you obtain [1+1]
    i. 3 - hydroxybutanal ii. 2-hydroxypropanoic acid
16. 2073 Set C Q.No. 12 How would you obtain [1+1]
    i. 3-hydroxybutanal and
    ii. 2-hydroxypropanoic acid from ethanal?
17. 2073 Set D Q.No. 12 Write an example of [1+1]
    i. Cannizzaro's reaction
    ii. Aldol Condensation
18. 2072 Set C Q.No. 12 Write an example of: [1+1]
    i. Rosenmund's reduction
    ii. Cannizzaro's reaction
19. 2072 Set E Q.No. 12(i) What happens when Propanone is treated with dilute NaOH solution? [1]
20. 2071 Supp. Q.No. 12 How is ethanal converted into propanone? [2]
21. 2071 Set C Q.No. 12 Give an application of each: [1+1]
    i. DNP test ii. Tollen's test
22. 2071 Set D Q.No. 12 2069 Supp. Set B Q.No. 12 Starting from propanone, how would you prepare 2-hydroxy-2-methylpropanoic acid? [2]
23. 2070 Supp. Q.No. 12 2070 Set D Q.No. 12 How does methanal reacts with [2]
    i. ammonia (NH_3) ii. conc. NaOH
24. 2069 Set A Q.No. 11 How would you obtain 2-hydroxy-2-methylpropanoic acid from propanone? [2]
25. 2069 Set A Q.No. 32a Give the example of Aldol condensation [1]
26. 2069 Set A Q.No. 32c Give the example of DNPH test [1]
27. 2069 Set B Q.No. 12 Give a reaction for each: [1+1]
    i. DNP test ii. Cannizzaro's reaction
28. 2068 Q.No. 4 How is 3-hydroxybutanal obtained from ethanal? [2]

29. 2068 Q.No. 7a Write an examples of each of the followings: Cannizzaro's reaction. [1]
30. 2068 Q.No. 9 Write the functional isomer of CH_3COCH_3 and give a chemical test to distinguish them. [1+1]
31. 2067 Q.No. 4 Identify the product (A) and give its one important use in the following: [1+1]
$HCHO + NH_3 \longrightarrow A + H_2O$
32. 2067 Q.No. 5 What is decarbonylation reaction? Write an example of it. [1+1]
33. 2066 Q. No. 4 ii Write an example of each of the followings: Carbonylation reaction [2]
34. 2066 Q. No. 5 Give balanced chemical equations for the followings: [2]
i. Ethanal is heated with Iodine and aqueous NaOH.
ii. Propanone is heated with hydrazine in presence of glycerol.
35. 2065 Q.No. 4 Write a reaction of each of the following: [2]
i. Tollen's test ii. Cannizzaro's reaction
36. 2064 Q.No. 3 What happens when the product obtained by dehydrogenation of ethanol is allowed to react with Tollen's reagent? [2]
37. 2064 Q.No. 5(i) Write the action of Methanal with Ammonia.[1]
38. 2064 Q.No. 5(ii) Write the action of Propanone with sodium bisulphite. [1]
39. 2064 Q.No. 22(ii) What happens when Propanone reacts with PCl_5? [1]
40. 2064 Q.No. 22(iii) What happens when Ethanal if allowed to react with hydroxyl amine? [1]
41. 2063 Q.No. 5(b) Give an example of each of the following reactions: Wolf Kishner reduction [1]
42. 2063 Q.No. 6(ii) What happens when Ethanal reacts with semicarbazide? [1]
43. 2062 Q.No. 5(ii) Write an example of each of the following reactions giving appropriate conditions: Cannizzaro's reaction [1]
44. 2062 Q.No. 6 Suggest a suitable chemical test to distinguish ethanal from propanone. Give chemical reaction too. [2]
45. 2061 Q.No. 4 Write an example of each of the following reaction: [2]
a. Aldol condensation b. Cannizzaro's Reaction
46. 2060 Q.No. 7 Write the action of
i. ammonia with methanal
ii. acetone with hydrazine. [2]
47. 2059 Q.No. 6 What happens when ethanal is warmed with Tollen's reagent? [2]
48. 2058 Q.No. 6 Identify the products (x) and (y) in the following reaction. [2]
$CH_3CHO \xrightarrow{HCN} (x) \xrightarrow{H_2O/H^+} (y)$
49. 2057 Q.No. 2 Identify X and Y in the following reaction [2]
$CH_3CHO \xrightarrow[\Delta]{I_2/NaOH} X \xrightarrow[\Delta]{Ag} Y$
50. 2057 Q.No. 6 Give an example (with formula) each from aliphatic and aromatic aldehydes, which give aldol condensation reaction. [2]
51. 2056 Q.No. 17 What reagent is used to diagnose diabetes in human urine? [2]
52. 2055 Q.No. 12 What is functional group present in a compound that gives a positive Tollen's test? Write an equation showing the reaction involved in a positive Tollen's test. [2]
53. 2055 Q.No. 13 Complete and balance the following equation: [2]
$CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 + I_2 \xrightarrow{NaOH}$
54. 2054 Q.No. 11a Give the IUPAC name of the following compounds: $CH_3\,CO\,CO\,CH_2\,CH_3$ [1]
55. 2054 Q.No. 14 Identify the product X in the reaction. [2]
$HCHO + CH_3MgI \xrightarrow{\text{dry ether}} \text{intermediate} \xrightarrow{H^+/H_2O} X$
56. 2053 Q.No. 6 What is Tollen's reagent? What happens when acetaldehyde is heated with Tollen's reagent? [2]

Short Answer Questions [5 marks]

57. 2077 Set W Q.No. 10 Write an example of each of the followings: [5]
i. DNP test ii. Rosenmund's reduction
iii. Aldol condensation iv. Tollen's test
v. Cannizzaro's reaction
58. 2076 GIE Set B Q.No. 27 Write any three methods for the preparation of propanone. How is it converted into 2-hydroxy-2 methyl propanoic acid? [3+2]
59. 2075 GIE Q.No. 27 Give any three methods of preparation of ethanal. How would you convert ethanal into propanone? [3+2]
60. 2075 Set A Q.No. 27 Write down any three methods of preparation of propanone. What products would you expect when propanone is treated with
i. I_2 and NaOH ii. 2, 4-DNPH [3+2]
61. 2074 Supp. Q.No. 29 2074 Set A Q.No. 29 An alkene (A) undergoes ozonolysis to give an aldehyde and a ketone as the major products. The aldehyde gives positive iodoform reaction and the ketone undergoes Clemmensen's reduction to yield propane. Identify (A) abd gives its IUPAC name. Also write reactions involved. [5]
62. 2074 Set B Q.No. 29 An alkene (A) undergoes ozonolysis to give an aldehyde and ketone as the major products. The aldehyde and the ketone further go Clemensen's reduction to yield ethane and propane respectively. Identify (A) and give its IUPAC name. What product your expect when (A) is treated with HBr? [4+1]
63. 2073 Supp Q.No. 29 2073 Set C Q.No. 29 An aliphatic compound Ⓐ react with aq. NaOH to give Ⓑ. Ⓑ on oxidation with $K_2Cr_2O_7/H^+$ produce Ⓒ. The compound Ⓒ undergoes Clemmensen's reduction to give propane. If compound Ⓒ responses positive iodoform test, identify Ⓐ, Ⓑ and Ⓒ. What product would you expect when Ⓐ is heated with H_2/Ni ? [5]

64. **2073 Set C Q.No. 28** Give chemical reactions for the preparation of propanone from [1+1+1+2]
i. 2, 2-dibromopropane
ii. calcium acetate
iii. propan-2-ol.
How is propanone converted into 2-methylpropan-2 ol?

65. **2073 Set D Q.No. 28** Give chemical reactions for the preparation of ethanal from
i. 1,1-dibromoethane ii. ethyne
iii. ethanoyl chloride.
How is ethanal converted into propan-2-ol? [3+2]

66. **2073 Set D Q.No. 29** An aliphatic compound Ⓐ reacts with $SOCl_2$ to give Ⓑ. Ⓑ on dehydrohalogenation yields Ⓒ. The compound Ⓒ on ozonolysis gives a mixture of ethanal and methanal. If Ⓐ is an alcohol which responses iodoform test. Identify Ⓐ, Ⓑ and Ⓒ. What product would you expect when compound Ⓑ is heated with H_2/Ni ? [5]

67. **2070 Supp. Q.No. 28** Write any three methods of preparation of ethanal. How would you convert ethanal into
i. 3-hydroxybutanal
ii. 2-hydroxy-2- methylpropanoic acid [3+1+1]

68. **2068 Q.No. 21** An organic compound A reacts with sodium metal to give hydrogen gas. The compound A on treatment with alkaline iodine forms a yellow crystalline substance and on oxidation with acidified dicromate forms an aldehyde with molecular formula C_2H_4O. Identify the compound and write equation for these reactions. [5]

69. **2067 Q.No. 22** How is propanone prepared form:
i. Isopropyl alcohol ii. Ethanoic acid
iii. 2, 2-dichloropropane.
Give the action of propanone on
a. Grignard's reagent b. Chloroform [1+1+1+1+1]

70. **2066 Q. No. 23** An organic compound 'P' which reduces Tollen's reagent. On oxidation with potassium permanganate, formed a compound 'Q' having same number of carbon atoms as 'P'. Q reacts with Na_2CO_3 (aq.) to give carbondioxide. 'Q' on reaction with ethanol in the presence of Sulphuric acid formed an ester having molecular formula $C_4H_8O_2$(R). Identify P, Q, R and write their IUPAC names. [5]

71. **2065 Q.No. 23i** Convert Ethanal into Methanal [2.5]

72. **2064 Q.No. 23** An alcohol (A), reacts with thionyl chloride to produce (B), which on dehydrohalogenation yielded a compound (C). The compound (C), on ozonolysis gave the mixture of ethanal and methanal. If the alcohol, (A) responses positive iodoform test. Identify A, B and C.
How could you convert the above compound, (B) into propanone? [3+2]

73. **2063 Q.No. 22(iii)** What action takes place when:
Propanone is warmed with iodine and aqueous sodium hydroxide [1]

74. **2063 Q.No. 22a** What action takes place when: Methanal is warmed with Tollen's reagent [2.5]

75. **2062 Q.No. 23 b** What happens when: Methanal reacts with ammonia. [2.5]

76. **2062 Q.No. 23(d)** What happens when: Acetone reacts with hydroxyl amine. [2.5]

77. **2058 Q.No. 21** An organic compound ($C_5H_{10}O$) reacts with phenyl hydrazine to form phenyl hydrazone. The compound does not reduce Fehling's solution but gives iodoform test. The compound on Clemmensen's reduction gives pentane. Identify the organic compound giving necessary chemical equations. [5]

78. **2057 Q.No. 21**
a. A carbonyl compound (X) gives addition product (Y) with methyl magnesium bromide. The compound (Y) on hydrolysis gives isopropyl alcohol. Identify X and Y.
b. Convert acetaldehyde to acetone. [5]

79. **2054 Q.No. 21** An alkene A on ozonolysis yields acetone and an aldehyde. The aldehyde is easily oxidised to an acid B. When B is treated with Br_2/P it yields a compound C which on hydrolysis gives a hydroxy acid D. This acid can also be obtained from acetone by the reaction with HCN followed by hydrolysis. Identify the compounds A, B, C and D. [5]

Write short notes on [5 marks]

80. **2052 Q.No. 28(a); 2053 Q.28(b)** Cannizzaro's reaction [5]

Long Answer Questions [10 marks]

81. **2076 GIE Set A Q.No. 31a** How is propanone prepared from
i. ethanoic acid
ii. 2, 2– dichloropropane
iii. 2, 3– dimethylbut –2-ene?
Write the reaction for the conversion of propanone into 2-hydroxy-2-methyl propanoic acid. [3+2+1]

82. **2076 GIE Set B Q.No. 31b** Write an example of each of [3+2]
i. Rosemund's reduction
ii. Cannizzaro's reaction
iii. Wurtz reaction
How is CH_3 MgI used to prepare
i. Propan-2-ol
ii. ethanoic acid

83. **2076 Set B Q.No. 31a** How is ethanal prepared from
(i) Ethyne (ii) But-2-ene (iii) 1,1 - dichloroethane?
Write down suitable method for the conversion of ethanal into 2-hydroxypropanoic acid. [1.5×4]

84. **2076 Set C Q.No. 31a** How is propanone one prepared from
i. 2,2-dichloropropane ii. Isopropyl alcohol
iii. Propyne
Give the suitable chemical reaction for the conversion of ethanoic acid into (i) methane (ii) methyl ethanoate. [3+2]

85. **2073 Supp Q.No. 31b** How is ethanal converted into methanal? Write the action of methanal on [2+1.5+1.5]
i. ammonia ii. conc. NaOH

86. **2072 Supp. Q.No. 31a** How is propanone prepared from:
i. 2, 2-dichloropropane ii. isopropyl alcohol
iii. propyne.
Give suitable chemical reaction for the conversion of ethanoic acid into
i. Methane ii. Methyl ethanoate [3+2]

87. 2071 Supp. Q.No. 31b 2071 Set D Q.No. 31 b An alkene Ⓐ undergoes ozonolysis to give two carbonyl compounds Ⓑ and Ⓒ. The compound Ⓑ on reduction with Zn-Hg/H⁺ gives propane. The compound Ⓒ reacts with HCN and followed by Hydrolysis to produce 2-hydroxypropanic acid as the major product. Write chemical reactions involved and give the IUPAC name of A, B and C. [10]

88. 2070 Set C Q.No. 31 a Write any three methods of preparation of ethanal. How is ethanal converted into [5]
   i. 3 - hydroxylbutanal
   ii. Ethanoic acid

89. 2070 Set D Q.No. 31 a Show your acquaintance with Cannizzaro's reaction and Perkin's Condensation. What happens when propanone is treated with 2, 4 - dinitrophenylhydrazine. [2+2+1]

90. 2069 Supp. Set B Q.No. 32 b Give suitable chemical reaction for the preparation of ethanal from. [5]
   i. ethyne
   ii. ethanoylchloride
   iii. 1, 1-dichloroethane
   How would you convert ethanal to propanone? [5+3+2]

91. 2060 Q.No. 29
   i. Write the possible isomeric aldehydes and ketones that can be formed from C_4H_8O. Give their IUPAC names. Which one of these isomers give iodoform test and why?
   ii. Convert benzaldehyde into aniline and vice versa. [5+5]

92. 2059 Q.No. 29 An organic compound A(C_4H_8O) forms phenyl hydrazone with phenyl hydrazine and reduces Fehling's solution. It has negative Iodoform test. Identify the organic compound A. [5]

93. 2059 Q.No. 29b-(iii) Predict the major products of the following reactions:

$$CH_3COCH_3 \xrightarrow{NH_2OH} \text{.....}$$ [1]

94. 2056 Q.No. 30 b-(iii) Show your acquaintance with the following: Aldol condensation [5]

95. 2055 Q.No. 30 Give three general methods of preparation of aldehydes. [5+5]
   Show your acquaintance with the following reactions
   i. Aldol condensation ii. Cannizzaro's reaction

12.2 AROMATIC ALDELYDES AND KETONES

Very Short Answer Questions [2 marks)

1. 2072 Supp. Q.No. 12 What happens when benzaldehyde is treated with: [1+1]
   i. conc. NaOH solution ii. hydrazine.
2. 2072 Set D Q.No. 12 How does benzaldehyde reacts with:[1+1]
   i. Conc. NaOH ii. Acetic anhydride
3. 2072 Set E Q.No. 12(ii) What happens when Benzaldehyde is heated with conc. NaOH solution. [1]
4. 2070 Set C Q.No. 12 What happens when benzaldehyde is heated with
   i. $LiAlH_4$
   ii. Acetic anhydride in presence of sodium acetate. [1+1]
5. 2069 Set A Q.No. 32e Give the example of Perkin's condensation [1]
6. 2065 Q.No. 7i Mention one example of each of the following: Rosenmund's reduction [1]
7. 2064 Q.No. 22(i) What happens when Benzaldehyde is warmed with aqueous NaOH? [1]
8. 2063 Q.No. 5(a) Give an example of each of the following reactions: Benzoin condensation [1]
9. 2060 Q.No. 5(i) 2059 Q.No. 5 Write an example of each of the following reaction: Perkin's condensation [1]
10. 2058 Q.No. 5 Give an example (with formula) each from aliphatic and aromatic aldehydes which give Cannizzaro's reaction. [2]

Short Answer Questions [5 marks]

11. 2063 Q.No. 22 ii What action takes place when: Benzaldehyde is heated with ethanoic anhydride in presence of sodium ethanoate? [2.5]
12. 2062 Q.No. 23 a What happens when: Benzaldehyde is refluxed with alcoholic KCN. [2.5]

Long Answer Questions [10 marks]

13. 2072 Supp. Q.No. 30b Identify the major products A, B, C, D in the following reaction sequence:

$$A \xrightarrow[\Delta]{Zn} B \xrightarrow[\Delta]{CH_3Cl/AlCl_3} C \xrightarrow[\Delta]{CeO_2/H^+} D$$

   Compound Ⓓ gives methylbenzene when heated with alc. KOH and hydrazine. [4+1]
14. 2055 Q.No. 30 iii Show your acquaintance in the following reactions: Perkin reaction. [5]

Write short notes on [5 marks]

15. 2052 Q.No. 28(a); 2053 Q.28(b) Benzoin condensation [5]

UNIT 13: CARBOXYLIC ACIDS

13.1 ALIPHATIC CARBOXYLIC ACIDS

Very Short Answer Questions [2 marks]

1. 2076 GIE Set B Q.No. 13 What happens when ethanoic acid is heated with: [1+1]
   i. Ethanol in the presence of concentrated H_2SO_4?
   ii. Phosphorus pentoxide?
2. 2075 Set B Q.No. 15i 2069 Set A Q.No. 13 ii 2066 Q. No. 4i Write an example of Decarbonxylation reaction [1]
3. 2074 Supp. Q.No. 13 What is meant by decarboxylation reaction? Give an example of it. [1+1]
4. 2074 Set A Q.No. 13 2074 Set B Q.No. 13 What is meant by carboxylation reaction? Write an example of it. [1+1]
5. 2073 Supp Q.No. 13 2073 Set D Q.No. 13 2059 Q.No. 7 Why is chloroacetic aicd stronger acid than acetic acid? [2]
6. 2072 Supp. Q.No. 13 Identify the product Ⓐ and Ⓑ and give their IUPAC name. [1+1]

$$CH_3COOH \xrightarrow[\Delta]{P_2O_5} A \xrightarrow[\Delta]{LiAlH_4} B$$

7. 2072 Set E Q.No. 13 Why methanoic acid is more acidic than ethanoic acid? [2]

8. 2071 Supp. Q.No. 13 What happens when ethanoic acid is heated
   i. With P_2O_5
   ii. With alcohol in presence of H_2SO_4 [1+1]
9. 2071 Set C Q.No. 13 2065 Q.No. 8 Write a chemical test to distinguish ethanoic acid from methanoic acid. [2]
10. 2071 Set D Q.No. 13 a Write an example of each of Carboxylation reaction. [1]
11. 2070 Supp. Q.No. 13 2070 Set D Q.No. 13 What is the functional isomer of ethanoic acid? Give its IUPAC name. [1+1]
12. 2070 Set C Q.No. 13 Why is ethanoic acid weaker acid than methanoic acid? [2]
13. 2069 Set B Q.No. 13 'Methanoic acid gives Tollen's test but ethanoic acid does not give reason. [2]
14. 2069 Supp. Set B Q.No. 13 How does enthanoic acid reacts with [2]
    i. ethanol ii. PCl_5
15. 2064 Q.No. 7 The boiling point of methanoic acid is higher than ethanol though they have same molecular mass. Explain. [2]
16. 2063 Q.No. 7 You are given two test tubes, one containing methanoic acid and other ethanoic acid. Suggest a suitable chemical test to identify them. Give chemical reaction too. [2]
17. 2060 Q.No. 6 Suggest a suitable chemical test to identify methanoic acid from ethanoic acid. [2]
18. 2060 Q.No. 8 What is decarbonylation? Give one example. [2]
19. 2058 Q.No. 7 Why is methanoic acid stronger than ethanoic acid? [2]
20. 2056 Q.No. 18(b) Write the name of the following components according to the IUPAC rule. [2]
    $CH_3 - C(CH_3)_2 - CH_2 - COOH$
21. 2052 Q.No. 10(b) Name: $CH_3–CH_2–C(CH_3)_2–CH_2–COOH$ according to IUPAC rule [2]

Short Answer Questions [5 marks]

22. 2076 Set B Q.No. 29 2076 Set C Q.No. 29 An aliphatic compound Ⓐ reacts with $SOCl_2$ to give Ⓑ. The compound Ⓑ is heated with ammonia to produce Ⓒ. The compound Ⓒ is further heated with Br_2/KOH to yield Ⓓ. The compound Ⓓ gives Ⓔ when treated with $NaNO_2$/HCl at low temperature. The compound Ⓔ is primary alcohol which gives positive idoform test. Identify ⒶⒷⒸⒹ and Ⓔ. Write reactions involved. [5]
23. 2075 GIE Q.No. 28 2075 Set A Q.No. 28 Describe the laboratory preparation of anhydrous formic acid. [5]
24. 2075 Set B Q.No. 28 How is anhydrous formic acid prepared in the laboratory? Why does methanoic acid give Tollen's test? [3+2]
25. 2075 Set B Q.No. 29 An aliphatic compound Ⓐ reacts with $SOCl_2$ to give Ⓑ. Ⓑ on reduction with H_2 in presence of Pd/$BaSO_4$ to give Ⓒ. When HCN is added to Ⓒ produces Ⓓ. On hydrolysis of Ⓓ in acidic medium forms Ⓔ. Compound Ⓒ can be obtained by heating a mixture of sodium formate and sodium acetate. Identify A, B, C, D, E and write reactions involved. [5]
26. 2074 Supp. Q.No. 28 2074 Set B Q.No. 28 Give chemical reaction for the preparation of ethanoic acid from
    i. 1,1,1-trichloroethane
    ii. Methyl magnesium iodide
    iii. Ethanenitrile
    How is ethanoic acid converted into methanoic acid? [3+2]
27. 2074 Set A Q.No. 28 Give chemical reaction for the preparation of methanoic acid from oxalic acid. How is anhydrous methanoic acid obtained from hydrous methanoic acid? Convert methanoic acid into ethanoic acid. [1+2+2]
28. 2073 Supp Q.No. 27 2073 Set C Q.No. 27 Describe the laboratory method of preparation of anhydrous formic acid. How does it react with Tollen's reagent? [4+1]
29. 2072 Supp. Q.No. 27 Write down a chemical reaction for the preparation of methanoic acid from Oxalic acid. How is methanoic acid converted into ethanoic acid? [2+3]
30. 2072 Set C Q.No. 28 Give the chemical reactions for the preparation of ethanoic acid from (i) sodium ethoxide (ii) ethanenitrile (iii) methyl magnesium iodide
    Why is acetic acid weaker acid than chloroacetic acid? [3+2]
31. 2072 Set C Q.No. 29 2072 Set D Q.No. 29 An aliphatic compound Ⓐ reacts with $SOCl_2$ to give Ⓑ. Ⓑ on reduction with H_2 in presence of Pd/$BaSO_4$ to give Ⓒ. When HCN is added to Ⓒ, produces Ⓓ. On hydrolysis of Ⓓ in acidic medium forms Ⓔ. Compound Ⓒ gives iodoform test and produces silver mirror with Tollen's reagent. Identify Ⓐ, Ⓑ, Ⓒ, Ⓓ, Ⓔ and write reactions involved. [5]
32. 2072 Set D Q.No. 28 Suggest any three suitable chemical reactions for the preparation of ethanoic acid. How is ethanoic acid converted into methanoic acid? [3+2]
33. 2072 Set E Q.No. 31b Write any three methods of preparation of ethanoic acid. How is ethanoic acid distinguished from methanoic acid? [3+2]
34. 2071 Set C Q.No. 31 b Starting from CH_3MgI, how would you prepare ethanol? Convert [5]
    i. ethanol into propanol
    ii. ethanal into propanone
35. 2071 Set D Q.No. 31 a How will you prepare ethanoic acid from
    i. tribromoethane ii. ethanenitrile
    iii. methyl magnesium iodide?
    What happens when ethanoic acid is: [3+2]
    a. Heated with P_2O_5 b. Treated with $SOCl_2$

36. 2070 Supp. Q.No. 27 Identify A, B, C, D and E in the following reaction sequence and write reactions involved.

$$A \xrightarrow{NH_3} B \xrightarrow[\Delta]{Br_2/aq\ KOH} C \xrightarrow{HNO_2} D \xrightarrow[\Delta]{NaOH/I_2} E$$

The compound E produces ethyne when heated with silver powder. [5]

37. 2070 Set C Q.No. 27 Describe the method of preparation of anhydrous formic acid in the laboratory. [5]

38. 2069 Supp. Set B Q.No. 24 How is anhydrous formic acid prepared in the laboratory? Why does formic acid give silver mirror with Tollen's reagent? [5]

39. 2068 Q.No. 23 Write any three important methods of preparation of ethanoic acid. How would you obtain anhydrous formic acid from its aqueous solution? [3+2]

40. 2065 Q.No. 31i Describe Laboratory preparation of anhydrous methanoic acid. [5]

41. 2063 Q.No. 23(e) What happens when Methanoic acid is warmed with ammoniacal silver nitrate? [2.5]

42. 2062 Q.No. 22(ii) Convert the following organic compounds: Ethanoic acid to methanoic acid [2.5]

43. 2061 Q.No. 22 What products are obtained when CH_3COOH is allowed to react with

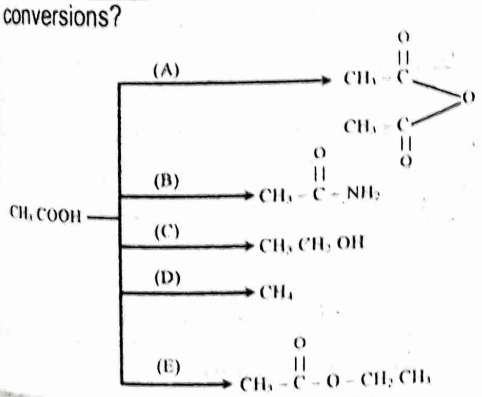
a. NaOH b. NaOH/CaO c. PCl_5
d. P_2O_5 e. $LiAlH_4$

Also mention reaction condition where ever relevant. [5]

44. 2059 Q.No. 23 Why is P_2O_5 not used for the preparation of anhydrous formic acid? Suggest a suitable method for the preparation of anhydrous formic acid. [5]

45. 2056 Q.No. 26 a Convert Ethane to ethanoic acid [2.5]

46. 2055 Q.No. 26 How would you bring about the following conversions? [5]



Long Answer Questions [10 marks]

47. 2071 Supp. Q.No. 31a How will you prepare ethanoic acid from [5+5]

i. Tribromoethane ii. Ethanenitrile
iii. CH_3MgI.

What happens when ethanoic acid is

a. heated with P_2O_5 b. treated with $SOCl_2$

48. 2071 Set C Q.No. 31 a How is anhydrous formic acid prepared from hydrous formic acid? Write suitable chemical reaction to convert ethanoic acid into: [1+2+2]

i. Methane ii. Methylethanoate
iii. Ethanoic anhydride

49. 2070 Supp. Q.No. 31 b How is ethanoic acid prepared from methyl magnesium iodide? What happens when ethanoic acid is, [5×1]

i. Heated with P_2O_5.
ii. Heated with HI in presence of red phosphorous.
iii. Passed over heated MnO.
iv. Warmed with ethanol in presence of conc. H_2SO_4.

50. 2068 Q.No. 28 b Identify each lettered in the following reaction sequence:

$$CH_3COOH \xrightarrow{SOCl_2} (A) \xrightarrow[\Delta]{H_2/Pd/BaSO_4} (B) \xrightarrow{HCN} (C) \xrightarrow{H_2O/H^+} (D)$$

What major product would you obtain when B is treated with alkaline solution of hydrazine and ethylene glycol? [5+4+1]

51. 2067 Q.No. 28 How is formic acid prepared in laboratory? Suggest suitable chemical methods for the conversion of formic acid into ethanoic acid and vice versa. [5+5]

52. 2066 Q. No. 29 a Write any three methods of preparation of ethanoic acid. How would you convert ethanoic acid into

i. Ethanoic anhydride ii. Methylethanoate. [3+2]

53. 2064 Q.No. 29 Describe the preparation of methanoic acid in the laboratory. How is anhydrous acid obtained from it? How does methanoic acid act upon:

i. Fehling's solution ii. Methanol / H^+
iii. Conc. H_2SO_4? [5+2+3]

54. 2057 Q.No. 28 Describe the preparation of anhydrous formic acid in laboratory. How is it converted to acetic acid? [5]

55. 2057 Q.No. 29(a) Consider the following reaction

$$A \xrightarrow[(ii)\ NH_3]{(i)\ PCl_5} B \xrightarrow[\Delta]{Br_2/NaOH} C \xrightarrow[\Delta]{HNO_2} D$$

The compound, A is a carboxylic acid. Calcium salt of A on heating gives acetone. Identify A, B, C and D. [5]

56. 2053 Q.No. 29(b) Consider a reaction:

$$A \xrightarrow{SOCl_2} B \xrightarrow[\Delta]{NH_3} C \xrightarrow[\Delta]{Br_2/KOH} D \xrightarrow[\Delta]{NaNO_2/HCl} E$$

The compound, E is a primary alcohol which has positive iodoform test. Identify A, B, C, D and E. [5]

Write short notes on [5 marks]

57. 2077 Set P Q.No. 12iv Laboratory method of preparation of anhydrous formic acid. [5]

58. 2076 GIE Set A Q.No. 33iv 2076 Set B Q.No. 33iii 2073 Set D Q.No. 33iv 2053 Q.No. 28(a) 2062 Q.31(b) Laboratory preparation on the anhydrous formic acid. [5]

13.2 DERIVATIVES OF CARBOXYLIC ACID

Very Short Answer Questions

1. 2076 GIE Set A Q.No. 15 Write down the functional isomer of methyl methanoate. What product would you expect when the isomer is heated with P_2O_5? [1+1]

2. 2076 Set B Q.No. 15 2076 Set C Q.No. 15 Write down the functional isomer of methyl methanoate. What product would you expect when the isomer is heated with P_2O_5? [1+1]

3. 2075 Set B Q.No. 13 Predict the major products of the following reactions. [1+1]

i. $(CH_3CO)_2O \xrightarrow[\Delta]{LiAlH_4}$ ii. $CH_3COOH \xrightarrow[\Delta]{NaOH/CaO}$

4. 2073 Set C Q.No. 13 Predict the major products of the following reactions [1+1]

i. $CH_3COOH \xrightarrow[\Delta]{P_2O_5}$ ii. $CH_3COCl \xrightarrow[\Delta]{Pd/BaSO_4}$

5. 2072 Set C Q.No. 13 Identify A and B in the following sequence of reaction and give their IUPAC name.

$(CH_3CO)_2O \xrightarrow[\Delta]{LiAlH_4} A \xrightarrow[Conc.\ H_2SO_4]{CH_3COOH} B$

6. 2072 Set D Q.No. 13 Predict the major products of the following reaction: [1+1]

i. $(CH_3CO)_2O \xrightarrow[\Delta]{LiAlH_4}$

ii. $(CH_3COO)_2Ca \xrightarrow{\Delta}$

7. 2072 Set E Q.No. 15(i) Define and give an example of Hoffmann's hypobromite reaction. [1]

8. 2071 Set D Q.No. 13 b 2069 Supp. Set B Q.No. 15i Write an example of each of decarboxylation reaction [1]

9. 2063 Q.No. 4 Convert ethanoyl chloride to methanol. [2]

10. 2062 Q.No. 7 What happens when the product obtained by the action of ethanoyl chloride and ammonia is heated with Br_2 and aqueous KOH? [2]

11. 2059 Q.No. 8 What happens when benzamide is heated with bromine and aq. KOH? [2]

12. 2059 Q.No. 29b (v) Predict the major products of the following reactions:

$CH_3COOCOCH_3 \xrightarrow[\Delta]{LiAlH_4}$ ..... [1]

13. 2057 Q.No. 7 Write chemical reaction when an amide is hydrolyzed. [2]

14. 2052 Q.No. 11 What is functional group of:
a. Ester b. Amide [2]

Long Answer Questions

15. 2070 Set D Q.No. 31 b

$(A) \xrightarrow{NH_3} (B) \xrightarrow{Br_2/aq.KOH} (C) \xrightarrow{HNO_2} (D) \xrightarrow{NaOH/I_2} (E)$

Compound E produces ethyne when heated with silver powder. [5×1=5]

16. 2069 Set B Q.No. 30 b Identify A, B, C, D and E in the following sequence of reactions. [1+1+1]

$(A) \xrightarrow{NH_3} (B) \xrightarrow[\Delta]{Br_2/aq.KOH} (C) \xrightarrow{HNO_2} (D) \xrightarrow{KMnO_4/H^+} (E)$

The compound (E) can be obtained by heating oxalic acid in presence of glycerol.

13.3 AROMATIC CARBOXYLIC ACIDS

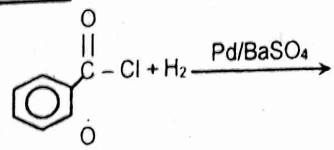
Very Short Answer Questions [2 marks]

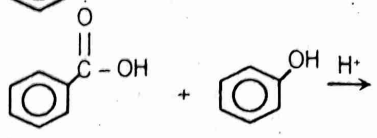
1. 2068 Q.No. 6 Mention suitable method for the conversion of benzoic acid to benzene. [2]

2. 2067 Q.No. 6 2066 Q. No. 7 How is benzoic acid prepared from benzene? [2]

3. 2064 Q.No. 22(iv) What happens when Benzoic acid is nitrated? [2]

4. 2061 Q.No. 5 Complete the following equations: [2]

(a) 

(b) 

Short Answer Questions [5 marks]

5. 2059 Q.No. 22(b) How could you synthesize benzoic acid from aniline? [2]

6. 2057 Q.No. 23(b) Write the chemical equation with conditions for the following reaction benzoic acid is nitrated. [2]

Long Answer Questions [10 marks]

7. 2059 Q.No. 29b-(ii) Predict the major products of the following reactions:

$Ar\ COOH \xrightarrow[(ii)\ NH_3]{(i)\ PCl_5}$ ..... [1]

UNIT 14: NITROCOMPOUNDS

14.1 ALIPHALIC NITROCOMPOUNDS (NITROALKANE)

Very Short Answer Questions [2 marks]

1. 2076 Set B Q.No. 13 2076 Set C Q.No. 13 Why is nitro group called an ambident group? [2]

2. 2075 GIE Q.No. 14 Give a reaction to prepare nitroalkane from haloalkane and name the test used for the detection of nitro compound. [1+1]

3. 2075 Set A Q.No. 14 How is chloropicrin obtained from nitromethane? Give an important use of chloropierin. [1+1]

4. 2072 Supp. Q.No. 14 Mention any two important uses of nitroalkane. [2]

5. 2072 Set C Q.No. 14(i) How are the following conversion carried out: Nitroethane into N-ethylhydroxylamine. [1]

6. 2071 Set C Q.No. 14 How does nitroalkane react with:
i. Zn/NH_4Cl ii. Sn/HCl [2]

14.2 AROMATIC NITROCOMPOUNDS

Very Short Answer Questions [2 marks]

1. 2076 GIE Set A Q.No. 13 What happens when nitrobenzene is reduced with neutral medium? [2]

2. 2076 GIE Set B Q.No. 14 What happens when nitrobenzene is reduced in acidic medium? [1+1]

3. 2075 Set B Q.No. 14 Starting from nitrobenzene how would you obtain picric acid? [2]

4. 2074 Supp. Q.No. 14 How would you predict that nitro group in nitrobenzene is an electron-withdrawing group? [2]

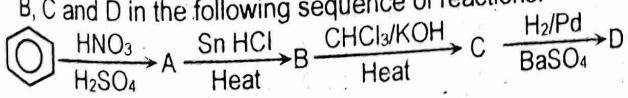
5. 2074 Set A Q.No. 14 Why halogenation in nitrobenzene occurs at meta position? [2]

6. 2074 Set B Q.No. 14 2073 Supp Q.No. 14 2073 Set C Q.No. 14 Why does nitrobenzene undergo electrophillic substitution at meta position? [2]

7. 2073 Set D Q.No. 14 What happens when Nitrobenzene is
   i. subjected to electrolytic reduction
   ii. treated with Zn/NaOH [1+1]
8. 2072 Set C Q.No. 14(ii) How are the following conversion carried out: Nitrobenzene into azobenzene. [1]
9. 2072 Set D Q.No. 14 Convert nitrobenzene into: [1+1]
   i. p-aminophenol ii. Hydrazobenzene
10. 2071 Supp. Q.No. 14 2071 Set D Q.No. 14 Electrophilic substitution reaction in nitrobenzene occurs at meta position. Give reason. [2]
11. 2070 Supp. Q.No. 15 Convert nitrobenzene in p-aminoazobenzene. [2]
12. 2070 Set D Q.No. 14 2062 Q.No. 8 2057 Q.No. 8 2055 Q.No. 17 Why is $-NO_2$ group a meta directing towards electrophilic aromatic substitution? [2]
13. 2069 Supp. Set B Q.No. 14 2069 Set A Q.No. 14 Why does nitrobenzene undergo electrophilic substitution at meta position? [2]
14. 2069 Set B Q.No. 15 What products would you expect when Nitrobenzene is treated with: [1+1]
   i. Zn/NaOH ii. Electrolytic reduction
15. 2058 Q.No. 8 Account for the fact that $-NO_2$ is a meta directing group towards electrophilic aromatic substitution. [2]

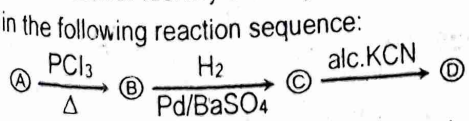
Short Answer Questions [5 marks]

16. 2071 Set C Q.No. 32 How is pure nitrobenzene prepared in the laboratory? Perform the following conversions:
   a. nitrobenzene to p-hydroxyazobenzene
   b. Benzoic acid to p-aminoazobenzene [5+2.5+2.5]
17. 2070 Set D Q.No. 25 What happens when nitrobenzene is reduced in acidic, neutral, alkaline and electrolytic conditions. [5]
18. 2063 Q.No. 21 Write the reasonating structures of nitrobenzene and explain why does it give meta substituted product during electrophilic substitution? How is nitrobenzene converted to p-hydroxyazobenzene? [2]
19. 2057 Q.No. 23(d) Write the chemical equation with conditions for the following reaction:
   Nitrobenzene is reduced in neutral medium. [2.5]
20. 2056 Q.No. 27 How is nitrobenzene prepared in laboratory? [5]
21. 2056 Q.No. 25 Write the structures of organic compound A, B, C and D in the following sequence of reactions. [5]



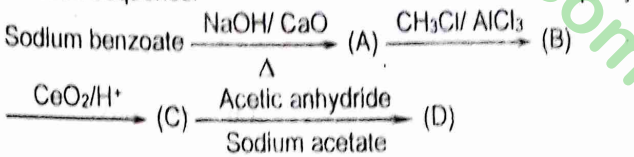
Long Answer Questions [10 marks]

22. 2077 Set W Q.No. 11b How is pure nitro benzene prepared in the laboratory? [5]
23. 2076 Set B Q.No. 30 2076 Set C Q.No. 30 Describe laboratory method of preparation of pure and dry nitrobenzene. Identify the major products Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following reaction sequence:

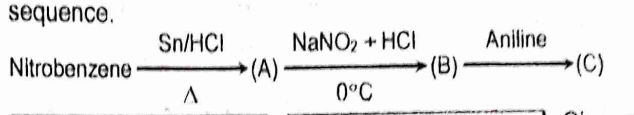


The compound Ⓒ can be obtained by heating toluene in presence of CeO_2/H^+. [6+1+1+1+1]

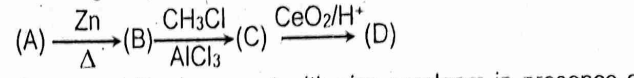
24. 2074 Supp. Q.No. 30 How is pure nitrobenzene prepared in the laboratory? Identify (A), (B), (C) and (D) in the following reaction sequence. [6+4]



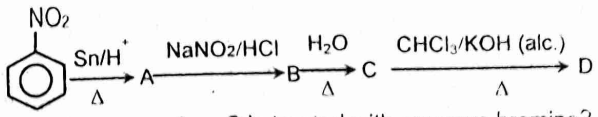
25. 2074 Set A Q.No. 30 How is pure nitrobenzene prepared in the laboratory? Identify (A), (B) and (C) in the reaction sequence.



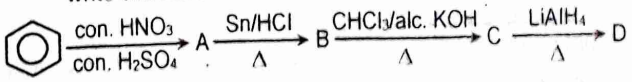
26. 2072 Supp. Q.No. 30a 2071 Supp. Q.No. 30a Give a chemical reaction for the preparation of nitrobenzene from benzene. Starting from nitrobenzene how will you prepare: [1+4]
   i. azobenzene ii. oxyazobenzene
   iii. hydrazobenzene iv. TNT
27. 2072 Set C Q.No. 31 How is dry and pure nitrobenzene prepared in the laboratory? Identify A, B, C and D in the following reaction sequence:



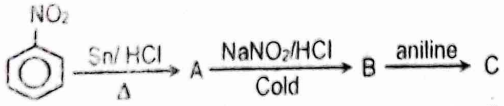
   Compound D when react with zinc amalgam in presence of acid to give toluene. [6+4]
28. 2071 Set D Q.No. 30 How is pure nitrobenzene prepared in the laboratory? Perform the following conversions.
   a. nitrobenzene to *p*-hydroxyazobenzene.
   b. Benzoic acid to *p*-aminoazobenzene [5 + 2.5 + 2.5]
29. 2070 Set D Q.No. 30 a How is nitrobenzene prepared in the laboratory in pure and dry state? [5]
30. 2069 Set B Q.No. 31
   a. How is nitrobenzene prepared in the laboratory?
   b. Convert the following:
      i. Aniline into azodye
      ii. Benzaldehyde into cinnamic acid. [6+2+2]
31. 2069 Supp. Set B Q.No. 31a Sketch a well-labelled diagram for the preparation of nitrobenzene in the laboratory. [5]
32. 2067 Q. No. 30 How is pure nitrobenzene prepared in the laboratory? [6 + 4 = 10]



   What happens when C is treated with aqueous bromine?
33. 2066 Q. No. 28
   (a) How is dry and pure nitrobenzene prepared in laboratory? [6]
   (b) Identify compounds A, B, C and D in the followings and write the reactions involved: [4]



34. 2065 Q.No. 28
a. How is dry and pure nitrobenzene prepared in laboratory? [6]
b. Consider the following reaction: [4]



Identify compounds A, B and C and write the reactions involved.

35. 2059 Q.No. 28 How is nitrobenzene prepared in laboratory in pure and dry state? How is it converted to p-hydroxyazobenzene? [5]

36. 2058 Q.No. 28 Describe the preparation of pure and dry nitrobenzene in laboratory. How is it converted to (i) phenol and (ii) hydrazobenzene? [5]

37. 2053 Q.No. 26 Describe the laboratory method for the preparation of Nitrobenzene. How is it purified?
What happens when Nitrobenzene is subjected to reduction in
a. Acidic medium b. Neutral medium [5]

UNIT 15: AMINO COMPOUNDS (AMINES AND ANILINE)

15.1 ALIPHATIC AMINES

Very Short Answer Questions [2marks]

1. 2077 Set V Q.No. 4 Give a chemical test to distinguish ethanamine from N-methylmethanamine. [2]
2. 2076 GIE Set A Q.No. 14 How does ethanamine reacts with:[1+1]
i. chloroform in presence of alc. KOH?
ii. $NaNO_2$/Hcl at low temperature?
3. 2076 GIE Set B Q.No. 15 Write the isomeric amines of C_2H_7N and give the chemical test to distinguish them. [1+1]
4. 2075 GIE Q.No. 15 Write down two isomeric amines and their names from C_2H_7N. What chemical test is used to distinguish them? [1+1]
5. 2075 Set A Q.No. 15 2073 Supp Q.No. 15 2073 Set C Q.No. 15 2073 Set D Q.No. 15 2072 Set E Q.No. 14 2070 Supp. Q.No. 14 Give a chemical test to distinguish ethanamine from N-methylmethanamine. [2]
6. 2075 Set B Q.No. 15ii Write an example of Carbylamine reaction [1]
7. 2074 Supp. Q.No. 15 2074 Set A Q.No. 15 Write down the structure of a primary amine and a secondary amine from C_3H_9N and give their IUPAC name. [1+1]
8. 2074 Set B Q.No. 15 Write down the structure of a secondary amine and a tertiary amine from C_3H_9N and give their IUPAC name. [1+1]
9. 2072 Supp. Q.No. 15 Write a chemical test to distinguish aliphatic amine from aromatic amine. [2]
10. 2071 Supp. Q.No. 15 Why is methanamine more basic than aniline? [2]
11. 2071 Set C Q.No. 15a 2064 Q.No. 6(ii) Give an example of Hoffmann's bromamide reaction [1]
12. 2071 Set D Q.No. 15 Write the structure of isomeric amines of propanamine and their IUPAC name. [1+1]
13. 2070 Set C Q.No. 15 Convert methanamine into ethanamine. [2]
14. 2069 Set A Q.No. 15 Why is amine more basic than ammonia? [2]
15. 2069 Set B Q.No. 14 Why are aliphatic amines more basic than aniline? [2]
16. 2065 Q.No. 5 There are three possible isomeric amines of C_3H_9N. One of them is propanamine. Write other two isomers and give their IUPAC name. [2]
17. 2063 Q.No. 8 Write the possible isomeric amines of C_3H_9N and give their IUPAC names. [2]
18. 2055 Q.No. 14 Convert $CH_3 - CH_2 - NH_2$ into $CH_3 - CH_2 - CH_2 - NH_2$. [2]
19. 2054 Q.No. 15 Which of the following has most basic character? Explain.
a. NH_3 b. $(CH_3)_2NH$
c. CH_3NH_2 d. $C_6H_5NH_2$ [2]
20. 2052 Q.No. 10(a) Write IUPAC name:
$CH_3 - CH_2 - CH(CH_3)\ CH(NH_2) - CH_3$ [2]

Short Answer Questions [5 marks]

21. 2072 Supp. Q.No. 29 2071 Set C Q.No. 29 Write down a chemical reaction to distinguish ethanamine from N-methylmethanamine. How is ethanamine prepared from:
i. propanamide ii. ethanenitrile
Covert ethanamine into methamine. [1+1+1+2]
22. 2071 Supp. Q.No. 28 How will you prepare ethanamine from
i. propanamide ii. ethanenitrile
What happens when elthanamine is treated with $NaNO_2$ + HCl at low temperature? Convert methanamine into ethanamine. [1+1+1+2]
23. 2071 Set D Q.No. 29 Mention an example of each of Primary, Secondary and Tertiary amine. How are they separated from their mixture by Hoffmann's method? [1+4]
24. 2070 Set D Q.No. 30 b What are amines? How would you separate 1°, 2° and 3° amines from their mixture by Hoffmann's method? [1+4]
25. 2065 Q.No. 29 a Mention any three suitable methods of preparation of Primary amine. How would you convert methenamine into ethanamine? [3+2]
26. 2058 Q.No. 23 What are amines? How are they classified? How do different classes of amines react with diethyl oxalate? [5]
27. 2057 Q.No. 22 How would you separate 1°, 2° and 3° amines from their mixture by Hoffmann's method? [5]
28. 2056 Q.No. 26 b Convert Ethylamine to methylamine [1.5]
29. 2054 Q.No. 20 Discuss any one method that can be used for separation of primary, secondary and tertiary amines. [2]

Long Answer Questions [10 marks]

30. 2077 Set V Q.No. 11i How is primary, secondary and tertiary amines separated from their mixture by Hoffmann's method? [5]
31. 2076 GIE Set A Q.No. 31b Use Hoffmann's method for the separation of 1°, 2° and 3° amines from their mixture. [4]

2. 2076 Set B Q.No. 31b Write down a structural formula of primary, secondary and tertiary amine of each from C_3H_9N. How is Hoffmann's method applied to separate them from their mixture? [4]

3. 2076 Set C Q.No. 31b Write down a structural formula of primary, secondary and tertiary amines of each from C_3H_9N. How would you apply Hoffmann's method to separate them from their mixture? [3+2]

4. 2069 Supp. Set B Q.No. 32 a Explain the method of separation of 1°,2°, 3° amines from their mixture. [5]

5. 2066 Q. No. 29 b Describe the chemical method of separation of 1°, 2° and 3° amines from their mixture. [5]

6. 2064 Q.No. 28(i) What are amines? How are they classified? Describe a suitable method for the separation of amines from their mixtures. [1+1+5]

7. 2064 Q.No. 28(ii) How could you convert methanamine to ethanamine and vice versa? [1.5+1.5]

Write short notes on [5 Marks]

8. 2075 GIE Q.No. 33ii 2075 Set A Q.No. 33ii 2075 Set B Q.No. 33iv 2074 Supp. Q.No. 33(iv) 2074 Set A Q.No. 33c 2074 Set B Q.No. 33b 2073 Supp Q.No. 33iii 2073 Set C Q.No. 33iv 2072 Set C Q.No. 33d 2069 Set A Q.No. 33 d 2069 Set B Q.No. 33a
Separation of 1°, 2° and 3° amines by Hoffman's method. [5]

15.2 AROMATIC AMINE (ANILINE)

Very Short Answer Questions [2 marks]

1. 2076 Set B Q.No. 14 Write an example of each of the following reactions:
   i. Decarboxylation
   ii. Coupling reaction [1+1]

2. 2076 Set C Q.No. 14 What happens when aniline is
   i. Treated with benzene diazonium chloride.
   ii. Heated with chloroform in presence of alc. KOH. [1+1]

3. 2072 Set C Q.No. 15 Give the major products of the following reactions: [1+1]
   i. Benzamide + $Br_2 \xrightarrow[\Delta]{\text{aq. NaOH}}$
   ii. Aniline + Benzenediazonium chloride $\xrightarrow{\text{warm}}$

4. 2072 Set D Q.No. 15 How does aniline react with:
   i. aqueous bromine
   ii. $NaNO_2$+ HCl at low temperature [1+1]

5. 2072 Set E Q.No. 15(ii) 2069 Supp. Set B Q.No. 15 ii Define and give an example of coupling reaction. [1]

6. 2071 Set C Q.No. 15 b Give an example of Carbylamine reaction [1]

7. 2070 Set D Q.No. 15 How are sulphanilic and acetanilide prepared from aniline? [1+1]

8. 2068 Q.No. 7b 2064 Q.No. 6(i) Write an examples of each of the followings: Diazotization reaction. [1]

9. 2065 Q.No. 7ii Mention one example of each of the following: Diazotization reaction [1]

10. 2063 Q.No. 6(i) What happens when: Aniline is shaken well with aq. Br_2. [2]

11. 2061 Q.No. 6 Why is $-NH_2$ group of aniline protected before nitration? [2]

Short Answer Questions [5 marks]

12. 2062 Q.No. 23(c) What happens when: Aniline is coupled with benzene diazonium chloride? [5]

13. 2057 Q.No. 23(a) Write the chemical equation with conditions for the following reaction: Aniline is diazotized. [5]

Long Answer Questions [10 marks]

14. 2076 GIE Set A Q.No. 30 Describe laboratory method of preparation of pure aniline. Identify the major products Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following reaction sequences. [6+1+1+1+1]

$$\text{Ⓐ} \xrightarrow{SOCl_2} \text{Ⓑ} \xrightarrow[Pd/BaSO_4]{H_2} \text{Ⓒ} \xrightarrow[Conc.HCl]{Zn/Hg} \text{Ⓓ}$$

The compound Ⓓ can be obtained by heating benzene and chloromethane in presence of $AlCl_3$.

15. 2076 GIE Set B Q.No. 32

a. How is pure and dry aniline is prepared in the laboratory? Explain with well-labelled diagram.

b. Identify the compound Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following sequence of reaction:

$$\text{Ⓐ} \xrightarrow[\Delta]{Br_2/KOH} \text{Ⓑ} \xrightarrow[0°C]{NaNO_2/HCl} \text{Ⓒ} \xrightarrow[OH^-]{\text{Aniline}} \text{Ⓓ}$$

The compound Ⓒ gives phenol on warming with water. [6+4]

16. 2075 GIE Q.No. 31 How is dry and pure aniline prepared in laboratory? Identify Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following reaction sequence. [6+4]

$$\text{Aniline} \xrightarrow[Cold]{NaNO_2+HCl} \text{Ⓐ} \xrightarrow[\Delta]{H_2O} \text{Ⓑ} \xrightarrow[\Delta]{Zn} \text{Ⓒ} \xrightarrow[\Delta/AlCl_3]{CH_3Cl} \text{Ⓓ}$$

17. 2075 Set A Q.No. 31 How is dry and pure aniline prepared in laboratory? Identify Ⓐ, Ⓑ and Ⓒ in the following reaction sequence.

$$\text{Aniline} \xrightarrow[Cold]{NaNO_2+HCl} \text{Ⓐ} \xrightarrow[\Delta]{H_2O} \text{Ⓑ} \xrightarrow{aq.Br_2} \text{Ⓒ}$$

What product would you expect when Ⓐ is treated with phenol in alkaline condition? [6+3+1]

18. 2075 Set B Q.No. 31 2072 Set D Q.No. 31 How is pure and dry aniline prepared in the laboratory? Identify A, B, C, D in the following reaction sequences

$$A \xrightarrow[\Delta]{Zn} B \xrightarrow[AlCl_3]{CH_3Cl} C \xrightarrow{CeO_2/H^+} D$$

Compound D when react with zinc amalgam in presence of acid to give toluene. [6+4]

19. 2074 Set B Q.No. 30 How is pure aniline prepared in the laboratory? Identify (A), (B), (C), and (D) in the following reaction sequences. [6+4]

$$\text{Sodium benzoate} \xrightarrow[\Delta]{NaOH/CaO} (A) \xrightarrow[AlCl_3]{CH_3Cl/\Delta} (B) \xrightarrow{CeO_2/H^+} (C) \xrightarrow[\text{Sodium acetate}]{\text{Acetic anhydride}} (D)$$

20. 2073 Supp Q.No. 30 How is pure and dry aniline prepared in the laboratory? Identify the major products Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following reaction sequence. [6+4]

$$A \xrightarrow[0°C]{NaNO_2 + HCl} B \xrightarrow[HCl]{CuCl} C \xrightarrow[H^+]{Cl_3CCHO} D$$

The compound Ⓒ undergoes reduction with $LiAlH_4$ to give benzene.

21. 2073 Set C Q.No. 30 How is pure aniline prepared in the laboratory? Identify the major products A, B, C and D in the following reaction sequence. [6+4]

$$A \xrightarrow{Aq.NaOH + Br_2} B \xrightarrow[0°C]{NaNO_2 + HCl} C \xrightarrow[HCl]{CuCl} D$$

The compound D if heated with chloral in presence of acid gives DDT.

22. 2073 Set D Q.No. 30 How is pure and dry aniline prepared in the laboratory? Identify the major products Ⓐ, Ⓑ, Ⓒ and Ⓓ in the following reaction sequences. [6+4]

$$Ⓐ \xrightarrow[HCl]{CuCl} Ⓑ \xrightarrow[\text{dry ether}/\Delta]{CH_3Br/Na} Ⓒ \xrightarrow[\Delta]{CeO_2/H^+} Ⓓ$$

The compound D undergoes Clemmensen's reduction to give Toluene.

23. 2072 Set E Q.No. 30 How is aniline prepared in the laboratory in pure and dry state? How does aniline react with. [7+3]
   i. Chloroform.
   ii. benzene diazonium chloride
   iii. aq. Br_2

24. 2070 Supp. Q.No. 30 a Sketch a well-labelled diagram for the preparation of pure aniline in laboratory. Write the principle and process involved in it. [7]

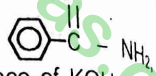
25. 2070 Supp. Q.No. 30 b Explain why,
   i. Amino group of aniline is ortho or para directing.
   ii. Amino group of aniline is protected before nitration.
   iii. Aniline is a weaker base than aliphatic amine. [3]

26. 2070 Set C Q.No. 30 a How is pure aniline prepared in the laboratory? [5]

27. 2069 Set A Q.No. 31
   a. How is pure aniline prepared in the laboratory? [6]
   b. Convert aniline into: [2+2]
      i. azodye ii. N-methylaniline

28. 2068 Q.No. 29 How is pure aniline prepared in the laboratory? Starting from aniline, how would you obtain:
   i. Ortho nitroaniline
   ii. N-methylaniline [6+2+2]

29. 2062 Q.No. 28 Describe the preparation of pure and dry aniline in the laboratory. Give its action upon:
   i. aq. Br_2
   ii. methyl iodide [5]

30. 2061 Q.No. 29 How is aniline prepared in the laboratory? What happens when (a) benzamide,  is allowed to react with bromine in presence of KOH solution (b) aniline is warmed with Chloroform and ethanolic potassium hydroxide? Why is aniline less basic than methylamine? [10]

31. 2060 Q.No. 28 How is aniline prepared in laboratory? Give its action upon (a) $CHCl_3$/alc KOH (b) $NaNO_2$/HCl under ice cold condition and (c) aq. Br_2. [7+3]

32. 2057 Q.No. 29(b) Starting from aniline how would you obtain
   i. o-nitro aniline and
   ii. picric acid? [5]

33. 2054 Q.No. 28 How is aniline prepared in the laboratory? How would you convert aniline into:
   a. Phenol b. Phenyl isocyanide
   c. Sulphanilic acid d. p-benzoquinone
   e. Benzene diazonium chloride [10]

UNIT 16: MOLECULES OF LIFE

Very Short Answer Questions [2marks]

1. 2077 Set P Q.No. 1 Illustrate the formation of peptide bond with an example. [2]

2. 2077 Set W Q.No. 6 Distinguish between essential and non-essential amino acid. [2]

3. 2076 GIE Set A Q.No. 16 Name the constituents present in nucleic acid. [2]

4. 2076 GIE Set A Q.No. 17 What is meant by (i) sugar and (ii) non sugar? [1+1]

5. 2076 GIE Set B Q.No. 16 Distinguish between reducing sugar and non-reducing sugar with an example of each. [1+1]

6. 2076 GIE Set B Q.No. 17 What happens when: [1+1]
   i. fat gets hydrolyzed
   ii. protein gets heated?

7. 2076 Set B Q.No. 16 2075 GIE Q.No. 18 How does DNA differ from RNA in respect of sugar and base units present in it? [1+1]

8. 2076 Set B Q.No. 17 Define sugar and non-sugar giving an example of each. [1+1]

9. 2076 Set C Q.No. 16 What are lipids? Name the products formed when simple lipids undergo hydrolysis. [1+1]

10. 2076 Set C Q.No. 17 What is meant by (i) invert sugar and (ii) non-reducing sugar? [1+1]

11. 2075 GIE Q.No. 19 2071 Set D Q.No. 16 2070 Set D Q.No. 16 Distinguish between sugar and non-sugar with an example of each. [1+1]

12. 2075 Set A Q.No. 18 Name the chemical components which constitute nucleotides. Give a biological function of nucleotides. [1+1]

13. 2075 Set A Q.No. 19 Distinguish between reducing and non-reducing sugar with an example of each. [1+1]

14. 2075 Set B Q.No. 16 Define the terms [1+1]
   i. invert sugar ii. reducing sugar

15. 2075 Set B Q.No. 17 What are nitrogen bases? Name the nitrogen bases present in DNA. [1+1]
16. 2074 Supp. Q.No. 16 Define non-reducing sugar and give an example of it. [1+1]
17. 2074 Supp. Q.No. 17 What are fats? What happens when fats get hydrolyzed? [1+1]
18. 2074 Set A Q.No. 16 How is sugar differed from non-sugar? Give an example of each. [1+1]
19. 2074 Set A Q.No. 17 What are protein? What happens when protein get heated? [1+1]
20. 2074 Set B Q.No. 16 Write down the structural formula of monosacharides obtained by the hydrolysis of sucrose. [2]
21. 2074 Set B Q.No. 17 Define denaturation of protein. Mention the factors which are responsible for denaturation. [1+1]
22. 2073 Supp Q.No. 18 Name the nitrogen bases present in nucleic acid. [2]
23. 2073 Supp Q.No. 19 What are monosaccharides? Give a structure formula of it. [1+1]
24. 2073 Set C Q.No. 18 2073 Set D Q.No. 18 Illustrate the formation of peptide bond with an example. [2]
25. 2073 Set C Q.No. 19 What are reducing sugars? Write an example of it. [1+1]
26. 2073 Set D Q.No. 19 What are non-reducing sugars? Write an example of it. [1+1]
27. 2072 Supp. Q.No. 16 What are carbohydrates? Write molecular formula of a disaccharides. [1+1]
28. 2072 Supp. Q.No. 17 Define the terms: [1+1]
    i. Co-enzyme ii. Protein
29. 2072 Set C Q.No. 16 2070 Set C Q.No. 17 What are disaccharides? What happens when they get hydrolysed? [1+1]
30. 2072 Set C Q.No. 17 Write an example of simple lipid. What happens when lipid gets hydrolysed? [1+1]
31. 2072 Set D Q.No. 16 Define the terms: [1+1]
    i. Zwitter ions ii. denaturation of protein
32. 2072 Set D Q.No. 17 What is saponification? Give an example of it. [1+1]
33. 2072 Set E Q.No. 16 Define sugar and non-sugar with an example of each. [2]
34. 2072 Set E Q.No. 17 What are essential and non-essential amino acids? Give examples in each case. [1+1]
35. 2071 Supp. Q.No. 16 Distinguish between monosaccharides and diasaccharides with an example of each. [1+1]
36. 2071 Supp. Q.No. 17 Why are amino acids amphoteric? [2]
37. 2071 Set C Q.No. 16 Write an example of each of the following [4×0.5]
    i. reducing sugar ii. simple lipid
    iii. non-sugar iv. disaccharide
38. 2071 Set C Q.No. 17 Name a simple lipid. What happens when simple lipid gets hydrolysed. [1+1]
39. 2071 Set D Q.No. 17 What is meant by peptide bond? Write an example of dipeptide. [1+1]
40. 2070 Supp. Q.No. 16 Write molecular formula of each of the followings. [1+1]
    i. Simple lipid ii. Dipeptide
41. 2070 Supp. Q.No. 18 Name the products obtained by the hydrolysis of cane sugar. What is meant by invert sugar? [1+1]
42. 2070 Set C Q.No. 16 Define essential and non-essential amino-acid with an example of each. [1+1]
43. 2070 Set D Q.No. 17 What is a peptide linkage? Give an example of dipeptide. [1+1]
44. 2069 Set A Q.No. 16 What happens when fat gets hydrolysed. [2]
45. 2069 Set A Q.No. 17 What is denaturation of protein? Give an example: [2]
46. 2069 Set B Q.No. 18 What are lipids? Give one example of it. [1+1]
47. 2069 Set B Q.No. 19 Mention one example of each of sugar and non-sugar. [1+1]
48. 2069 Supp. Set B Q.No. 18 What happens when; [1+1]
    i. fats get hydrolysed ii. Protein is heated
49. 2069 Supp. Set B Q.No. 19 What are disachharides? Write an example of non-sugar. [1+1]
50. 2068 Q.No. 8 What is meant by simple protein? Give an example of it. [1+1]
51. 2068 Q.No. 12 How would you obtain glucose from cane sugar? [2]
52. 2067 Q.No. 10 Define following terms with correct example of each. [1+1]
    i. Sugar ii. Non-sugar
53. 2067 Q.No. 11 What are the constituent of nucleic acid? [2]
54. 2066 Q. No. 11 What is different between essential and non-essential amino acids? [2]
55. 2066 Q. No. 12 How do glucose and fructose differ in their functional group? [2]
56. 2065 Q.No. 11 Name any four nitrogen bases present in nucleic acid. [2]
57. 2065 Q.No. 12 What are the essential conditions of denaturation of Protein? [2]
58. 2064 Q.No. 9(i) Define lipid. [2]
59. 2064 Q.No. 9(ii) Name the pyrimidine bases found in RNA. [2]
60. 2064 Q.No. 10(i) What happens when a disaccharide is hydrolysed. [2]
61. 2064 Q.No. 10(ii) What happens when a protein is denatured. [2]
62. 2063 Q.No. 11 What is meant by peptide bond? Write the structure of dipeptide. [2]
63. 2063 Q.No. 12 2062 Q.No. 12 Point out any two differences between RNA and DNA molecules. [2]
64. 2062 Q.No. 11 Define protein. What is meant by denaturation of protein? [2]
65. 2061 Q.No. 8 Explain how amino acids are combined to form a protein molecule? [2]

66. 2061 Q.No. 9 Distinguish both chemically and physically between a fat and a vegetable oil. [2]
67. 2061 Q.No. 10 What is the role of hydrogen bonding in the structure of DNA? [2]
68. 2060 Q.No. 10 Define Protein and Lipid. [2]
69. 2060 Q.No. 12 Write the open chain structure of glucose and fructose [2]
70. 2059 Q.No. 9 Write the names and structures of monosaccharides produced by the hydrolysis of cane sugar.[2]
71. 2059 Q.No. 10 What happens when a protein is denatured?[2]
72. 2058 Q.No. 9 Write the names of two pyrimidine bases present in RNA and DNA molecules. [2]
73. 2058 Q.No. 10 2057 Q.No. 9 What is a peptide bond? Write an example of a dipeptide. [2]
74. 2057 Q.No. 10 What happens when oil is hydrogenated? [2]
75. 2055 Q.No. 19 What are enzymes and what are their role in the body? [2]
76. 2055 Q.No. 20 What are two differences between DNA and RNA. [2]
77. 2054 Q.No. 18 What are carbohydrates? Give two examples. [2]
78. 2053 Q.No. 8 What is soap? How is soap obtained from fat?[2]
79. 2053 Q.No. 9 Give the main functions of carbohydrates for living beings. [2]
80. 2052 Q.No. 13 Classify carbohydrates and give an example for each. [2]
81. 2052 Q.No. 14 Give a chemical reaction for hydrolysis of dipeptide. [2]
82. 2052 Q.No. 15 Name four types of base residues present in DNA. [2]
83. 2052 Q.No. 16 What is saponification? [2]
84. 2052 Q.No. 17 What happens when protein is (a) Heated (b) Hydrolysed. [2]

UNIT 17: CHEMISTRY IN SERVICE TO MANKIND

Very Short Answer Questions [2 marks]

1. 2077 Set V Q.No. 7 Give structural formula and a major use of an antipyretics drug. [1+1]
2. 2076 GIE Set A Q.No. 18 Mention an important function of each of the following: [2]
   i. NPK fertilizer ii. fungicides
   iii. Analgesics iv. broad spectrum antibiotics
3. 2076 GIE Set A Q.No. 19 Define condensation polymerization. Write an example of such polymer. [1+1]
4. 2076 GIE Set B Q.No. 18 What is an azodye? Write one example with its structure. [1+1]
5. 2076 GIE Set B Q.No. 19 Name any two synthetic polymers specifying the monomer of each. [1+1]
6. 2076 Set B Q.No. 18 Mention an important function of each of the following: [0.5×4=2]
   i. DDT ii. Nitrogen fertilizer
   iii. Broad spectrum antibiotics
   iv. Tranquilizers
7. 2076 Set B Q.No. 19 What is meant by homo... polymerization? Write an example of such polymer. [1+1]
8. 2076 Set C Q.No. 18 Mention an important function of each of the following: [0.5×4=2]
   i. DDT ii. Nitrogen fertilizer
   iii. Tranquilizers iv. Broad spectrum antibiotics
9. 2076 Set C Q.No. 19 Name the monomers of bakelite and state the polymerization process of it. [1+1]
10. 2075 GIE Q.No. 16 Name the monomers which on polymerization yields polyamide. What type of polymerization is this? [1+1]
11. 2075 GIE Q.No. 17 Mention an example of each of: [0.5×4]
    i. Antipyretic ii. Pesticides
    iii. Analgesics iv. Phosphatic fertilizer
12. 2075 Set A Q.No. 16 Name the monomers which on polymerization yields bakelite. What type of polymerization is this? [1+1]
13. 2075 Set A Q.No. 17 Give an important use of each of the followings: [0.5×4]
    i. Weedicides ii. Antibiotics
    iii. Analgesics iv. Nitrogen fertilizer
14. 2075 Set B Q.No. 18 Distinguish between homopolymer and co-polymer with an example of each. [1+1]
15. 2075 Set B Q.No. 19 What are antipyretic drugs? Give the name and structure of an antipyretic drug. [1+1]
16. 2074 Supp. Q.No. 18 Name with the structures the monomers of [1+1]
    i. Bakelite ii. PVC
17. 2074 Supp. Q.No. 19 2074 Set B Q.No. 19 Mention an important use of each of the following. [0.5 × 4 = 2]
    i. Antipyretic drug ii. BHC
    iii. Herbicides iv. NPK fertilizers
18. 2074 Set A Q.No. 18 Write an example of each of condensation polymer and an addition polymer. What are their monomers? [1+1]
19. 2074 Set A Q.No. 19 Mention an important use of each of the following [0.5 × 4]
    i. Analgesic drug ii. Herbicides
    iii. BHC iv. Nitrogen fertilizer
20. 2074 Set B Q.No. 18 Name a condensation polymer and an addition polymer. What are the structures of their monomers? [1+1]
21. 2073 Supp Q.No. 16 Distinguish between addition polymer and condensation polymer with an example of each. [1+1]
22. 2073 Supp Q.No. 17 What is meant by synthetic dye? Write a structure of it. [1+1]
23. 2073 Set C Q.No. 16 Distinguish between synthetic polymer and natural polymer with an example of each. [1+1]
24. 2073 Set C Q.No. 17 What is meant by antipyretic drug? Write a structure of it. [1+1]
25. 2073 Set D Q.No. 16 Distinguish between homopolymer and co-polymer with an example of each. [1+1]

26. 2073 Set D Q.No. 17 Write down the structure of [1+1]
i. aspirin
ii. Paracetamole and mention their one use of each.

27. 2072 Supp. Q.No. 18 Give suitable example of each of the following. [2]
i. Homopolymer ii. Co-polymer
iii. Pesticides iv. Synthetic dye

28. 2072 Supp. Q.No. 19 Give structural formula of each of the following: [2]
i. antibiotic drug ii. antipyretic drug

29. 2072 Set C Q.No. 18 Write down the molecular formula of monomers of [1+1]
i. Bakelite ii. Nylon-6,6

30. 2072 Set C Q.No. 19 Mention an important use of each of the followings: [0.5×4]
i. Antiseptics ii. Antibiotics
iii. Germicides iv. Herbicides

31. 2072 Set D Q.No. 18 Write down the molecular formula of monomers of: [1+1]
i. Bakelite ii. Nylon - 6,6

32. 2072 Set D Q.No. 19 Write down the structural formula of each of the following: [0.5×4]
i. azo-dye ii. analgesic drug
iii. pesticides iii. nitrogen fertilizer

33. 2072 Set E Q.No. 18 What type of polymer is bakelite? Mention its monomers. [1+1]

34. 2072 Set E Q.No. 19 Name any two fertilizers which supply potassium and nitrogen to the plants. [1+1]

35. 2071 Supp. Q.No. 18 2070 Supp. Q.No. 17 Distinguish between addition and condensation polymers with an example of each. [1+1]

36. 2071 Supp. Q.No. 19 What is meant by analgesics? Write an example of it. [1+1]

37. 2071 Set C Q.No. 18 What is meant by Co-polymer? Name a Co-polymer and monomers associated with it. [1+1]

38. 2071 Set C Q.No. 19 Define antiseptics giving a suitable example. [1+1]

39. 2071 Set D Q.No. 18 Write the monomers of: [1+1]
a. Nylon – 6,6 b. Bakelite

40. 2071 Set D Q.No. 19 Mention suitable use of each of: [1+1]
a. antipyretics b. pesticides

41. 2070 Supp. Q.No. 19 Mention a suitable example of each: [4 ×0.5]
i. antibiotics ii. phosphatic fertilizer
iii. herbicides iv. insecticides

42. 2070 Set C Q.No. 18 What are insecticides? Give an example. [1+1]

43. 2070 Set C Q.No. 19 Name any one condensation polymer and addition polymer. What are their monomers? [1+1]

44. 2070 Set D Q.No. 18 What are chemical fertilizers? Give two examples. [1+1]

45. 2070 Set D Q.No. 19 Write a method of preparation of each of the following polymers:
i. Bakelite ii. PVC [1 + 1]

46. 2069 Set A Q.No. 18 Name the monomers of (i) bakelite (ii) Nylon-6,6 [1+1]

47. 2069 Set A Q.No. 19 Give the name of any two insecticides with their chemical formulae. [2]

48. 2069 Set B Q.No. 16 What are the starting materials for preparing the followings:
i. polyvinyl chloride ii. Bakelite [1+1]

49. 2069 Set B Q.No. 17 Distinguish between antipyretics and analgesics with an example of each. [1+1]

50. 2069 Supp. Set B Q.No. 16 Name of the monomers of baketile and what type of polymer is bakalite. [1+1]

51. 2069 Supp. Set B Q.No. 17 Write an example of each of the followings. [0.5×4]
i. Synthetic dye ii. insecticides
iii. phosphatic fertilizer iv. antipyretic drug

52. 2068 Q.No. 10 Give the names of one natural and one synthetic polymer. What are the monomers present in them? [1+1]

53. 2068 Q.No. 11 What are antibiotics? Give an example of broad spectrum antibiotic. [1+1]

54. 2067 Q.No. 9 Name the monomer which on polymerization can give benzene. What type of polymerization is this? [1+1]

55. 2067 Q.No. 12 Distinguish between antibiotic and antiseptics with one example of each. [1+1]

56. 2066 Q. No. 9 Mention one examples of each of the followings: [2]
i. Mixed Fertilizer ii. Analgesic Drug
iii. Antiseptic iv. Azo-dye

57. 2066 Q. No. 10 Classify polymers on the basis of monomer unit. [2]

58. 2065 Q.No. 9 What is meant by condensation polymer? Write an example of it. [2]

59. 2065 Q.No. 10 Give an example of each of the following. [2]
i. Antipyretic drug ii. Phosphorus fertilizer
iii. Disaccharide iv. Insecticide

60. 2064 Q.No. 11 Name any two synthetic polymers specifying the monomers of each. [2]

61. 2064 Q.No. 12 Write any two examples of azo-dyes with their formulae. [2]

62. 2063 Q.No. 9 What are natural and synthetic dyes? Give one example of each. [2]

63. 2063 Q.No. 10 Write an example of each of the following with their formula.
i. A synthetic fertilizer ii. An insecticide [2]

64. 2062 Q.No. 9 2061 Q.No. 11 2060 Q.No. 9 What are insecticides? Write any two example of insecticides. [2]

65. 2062 Q.No. 10 What is an antipyretic drug? Write an example with its structure. [2]

66. 2061 Q.No. 12 What is meant by a synthetic fertilizer? Write the formula of any two synthetic fertilizers. [2]

67. 2060 Q.No. 11 Specify the monomers of Bakelite and Nylon-6,6. [2]
68. 2059 Q.No. 11 Give an example each from analgesic and antipyretic drugs. [2]
69. 2059 Q.No. 12 What is an azo dye? Give one example with structure. [2]
70. 2058 Q.No. 11 Give an example of azodye and write its structure. [2]
71. 2058 Q.No. 12 Define polymerization and write an example. [2]
72. 2057 Q.No. 11 Give the name and structure of an antipyretic drug. [2]
73. 2057 Q.No. 12 Name the monomers of Bakelite and Nylon-6, 6. [2]
74. 2056 Q.No. 10 Give two characteristics of a Dye. [2]
75. 2055 Q.No. 18 Name any two synthetic polymers. [2]
76. 2054 Q.No. 19 What is the difference between an antiseptic and an antipyretic drug? [2]
77. 2053 Q.No. 10 What is an azo dye? [2]

UNIT 18: HEAVY METALS
18.1. COPPER

Very Short Answer Questions

1. 2074 Supp. Q.No. 20 2074 Set A Q.No. 20 Give the balanced chemical reaction for the preparation of black oxide from blue vitriol. How is black oxide converted into red oxide? [1+1]
2. 2074 Set B Q.No. 20 Give the balanced chemical reaction for the preparation of copper sulphate from copper. What happens when blue vitriol is heated at 100°C? [1+1]
3. 2073 Supp Q.No. 20 What happens when copper sulphate solution is treated with ammonia solution? [2]
4. 2073 Set C Q.No. 20 Starting from copper how would you obtain blue vitriol? [2]
5. 2073 Set D Q.No. 20 Write the action of heat on blue vitriol. [2]
6. 2072 Supp. Q.No. 21 Write down the molecular formula of: [2]
   i. Copper pyrite ii. Calamine
   iii. Calomel iv. Cinnabar
7. 2072 Set C Q.No. 21(ii) Give reason: Metalic copper turns black when exposed to moist air? [1]
8. 2071 Supp. Q.No. 21i 2071 Set D Q.No. 21 a Write an important use of red oxide. [0.5]
9. 2071 Supp. Q.No. 21 iii 2071 Set D Q.No. 21 c Write an important use of blue vitriol. [0.5]
10. 2071 Set C Q.No. 21 What is meant by copper matte? [2]
11. 2070 Set C Q.No. 22 Write a reaction for the preparation of each of the following: [1+1]
    i. CuO ii. Cu_2O.
12. 2069 Supp. Set B Q.No. 22 How is red oxide of copper converted into black oxide and vice versa? [1+1]
13. 2062 Q.No. 28a Copper sulphate crystal turns white powder on heating. [1]
14. 2062 Q.No. 28c A brown gas is obtained when copper is treated with conc. nitric acid. [1]
15. 2062 Q.No. 28 (d) Copper becomes green when exposed to air for long time. [1]
16. 2060 Q.No. 18 A light blue colored precipitate 'A' obtained by the addition of caustic soda in the solution of cupric sulphate is converted to a black precipitate 'B' on heating. What are 'A' and 'B'? [2]
17. 2059 Q.No. 16 Write a compound of Cu (II) which is insoluble in water but soluble in dilute acid without effervescence. [2]
18. 2058 Q.No. 14 What happens when NH_3 is passed over red hot CuO. [2]
19. 2057 Q.No. 18 Name two important ores of copper with formulae. [2]
20. 2056 Q.No. 18 Group B Give any one method of conversion of cupric sulphate into cuprous oxide with chemical equations. [2]
21. 2054Q.No. 27(b) Ammonium hydroxide is added to a solution of copper sulphate. [1]
22. 2051 Q.No. 7(c) A copper coin is dropped into concentrated nitric acid in a test tube. [1]
23. 2053 Q.No. 2 Group A When copper wire is put into a solution of silver nitrate beautify crystals are deposited on the surface of the copper. What are these crystals chemically? Write the reaction involved. [2]
24. 2053 Q.No.7(c) Copper turning is treated with conc. HNO_3. [1]
25. 2053 Q.No. 18 Group A 2053 Q.No. 18 Group A What is the effect of heat on copper sulphate penta-hydrate? [2]

Short Answer Questions

26. 2077 Set W Q.No. 8 How is blister copper extracted from its pyrite ore? [5]
27. 2076 Set B Q.No. 26 2076 Set C Q.No. 33ii 2074 Set B Q.No. 26 2072 Supp. Q.No. 26 2072 Set C Q.No. 26 2072 Set D Q.No. 26 2072 Set E Q.No. 29 2070 Supp. Q.No. 29 2069 Supp. Set B Q.No. 29 How is blister copper extracted from copper pyrites? [5]
28. 2070 Set D Q.No. 29 2069 Set A Q.No. 23 2069 Set B Q.No. 29 2068 Q.No. 29 OR 2065 Q. No. 28 Write the preparations, properties and uses of Blue vitriol. [5]
29. 2067 Q.No. 29 How would you convert copper blue vitriol? Name any one alloy of each of: [4+1]
    i. Copper and Zinc. ii. Copper and tin.
30. 2063 Q.No. 31 How is metal copper extracted from its pyrite ore? How is it refined? Rite the action of it upon: (i) moist air and (ii) Conc. H_2SO_4 [5]

Ans: (i) $2Cu + H_2O + CO_2 + O_2 \rightarrow CuCO_3 . Cu(OH)_2$ (green basic carbonate)
(ii) SO_2 is produced. $Cu + H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$

Long Answer Questions

31. 2066 Q.No. 32 Starting from copper pyrite, how would you obtain pure copper? Explain the steps involved in the process with necessary diagram for it. Give the chemical reaction for the followings:
    i. Copper is exposed to moist air.
    ii. Conversion of copper into blue vitriol. [7+1+2]

32. 2064 Q No. 32 How is blister copper extracted from copper pyrite? How does the metal react with:
a. moist air b. conc. H_2SO_4
c. conc HNO_3
Mention the important uses of the metal. [6+3+1]

33. 2060 Q.No. 30 How is pure copper extracted from copper pyrite? Discuss its metallurgical operations with necessary chemical reactions and diagrams. [10]

34. 2059 Q.No. 28 Write a method of preparation of blue vitriol. Describe its action with [1+2+2]
i. ammonia solution till excess
ii. aqueous potassium iodide

35. 2057 Q.No. 32 How is metal copper extracted from its sulphide ore? How is it refined? [7+3]

36. 2056 Q.No. 31 How is blister copper extracted starting from concentrated copper pyrites one? How is it refined electrolytically? [8+2]

37. 2055 Q.No. 31(c)2057 Q.No. 33(b) Write short notes on: Chemistry of Blue Vitriol. [5]

38. 2053 Q.No. 2 Group B Point out the important processes involved in the extraction of copper from its sulphide ore. [5]

Write Short Notes on [5marks]

39. 2077 Set P Q.No. 12iii 2076 GIE Set B Q.No. 33iv 2075 Set A Q.No. 33iii 2070 Set C Q.No. 33 a Chemistry of blue vitriol. [5]

40. 2076 GIE Set A Q.No. 33i 2075 GIE Q.No. 33iv 2075 Set B Q.No. 33i 2074 Supp. Q.No. 33(i) 2074 Set A Q.No. 33b 2073 Supp Q.No. 33i 2073 Set C Q.No. 33i 2073 Set D Q.No. 33i 2071 Supp. Q.No. 33d 2071 Set C Q.No. 33 d Extraction of blister copper from copper pyrites. [5]

41. 2071 Set D Q.No. 33 d Chemistry of black oxide of copper. [5]

18.2 ZINC

Very Short Answer Questions [2 marks]

1. 2077 Set P Q.No. 5 What happens when ZnO is,
i. dissolved in excess caustic alkali
ii. heated with cobalt nitrate? [1+1]

2. 2077 Set P Q.No. 7 What happens when zinc white is
i. dissolved in excess caustic alkali?
ii. heated with cobalt-nitrate? [1+1]

3. 2076 GIE Set A Q.No. 20 How is Rinman's green prepared? Write its an important application. [1+1]

4. 2076 GIE Set B Q.No. 20 How is Rinmann's green prepared? Write its two uses. [1+1]

5. 2076 Set B Q.No. 20 How is lithopone prepared? Write its an important application. [1+1]

6. 2076 Set C Q.No. 20 How is granulated zinc obtained? Write its an important application. [1+1]

7. 2075 Set B Q.No. 22 Give balanced chemical equations for the followings. [1+1]
i. Zinc white is heated with cobaltnitrate.
ii. Zinc is exposed to moist air.

8. 2074 Supp. Q.No. 22 2074 Set A Q.No. 22 2074 Set B Q.No. 22 What product would you expect when zinc white is heated with cobalt nitrate? Write an application of the product. [1+1]

9. 2073 Supp Q.No. 21 2073 Set D Q.No. 21 Give reactions for the extraction of metallic zinc from zinc blende. [2]

10. 2073 Set C Q.No. 21 What happens when Zinc white is [1+1]
i. heated
ii. treated with caustic alkali.

11. 2072 Supp. Q.No. 22 Starting from metalic Zinc, how would you prepare white vitriol? [2]

12. 2072 Set C Q.No. 22 2071 Supp. Q.No. 22 2070 Supp. Q.No. 22 What is Rinman's green? Write its important uses. [1+1]

13. 2072 Set E Q.No. 20 What happens when: [1+1]
i. Zinc is exposed to moist air.
ii. What happens when White vitriol is strongly heated.

14. 2071 Set C Q.No. 22 Give a correct balanced chemical reaction for the preparation of [1+1]
a. White vitriol b. Philosopher's wool

15. 2071 Set D Q.No. 22 What happens when zinc white is: [1+1]
a. heated with cobaltnitrate
b. dissolved with caustic alkali

16. 2070 Set C Q.No. 22 Or Write action of heat on white vitriol. [2]

17. 2070 Set D Q.No. 21 What happens when:
i. Zinc white is heated with cobalt nitrate.
ii. Metallic zinc is dissolved in hot conc. NaOH. [1+1]

18. 2069 Set A Q.No. 20 What happens when zinc white is heated? [2]

19. 2069 Set B Q.No. 20 i, ii, iv Write the molecular formula of:
i. Philosopher's wool ii. Rinman's green
iii. Calamine [0.5×3]

20. 2069 Supp. Set B Q.No. 20 How would you obtain white vitriol from zinc? [2]

21. 2068 Q.No. 18 Give the molecular formula of: [0.5×4]
i. Philosopher's wool ii. Calamine

22. 2068 Q.No. 20 What is the action of heat on white vitriol? [2]

23. 2067 Q.No. 19 Why do zinc become dull in contact of moist air? [2]

24. 2066 Q. No. 18i Name one important ore of each of the followings: Zinc [2]

25. 2065 Q.No. 20i Give the balanced chemical equation:
Zinc is dissolved in hot and conc. NaOH solution. [2]

26. 2064 Q.No. 19 Write an important use of each of following substances:
i. calomel ii. green vitriol
iii. Zinc white [2]

27. 2063 Q.No. 19b What happens when: Zinc oxide is heated with cobalt nitrate. [2]

28. 2063 Q.No. 20 Write the formulae of the following ores of metals:
i. Magnetite ii. Calamine [2]

29. 2062 Q.No. 19 What is meant by galvanisation? [2]

30. 2062 Q.No. 20 iii Write an important use of each of the following substances: White vitriol [2]

31. 2061 Q.No. 18 Write the name of two ores of Zinc with their molecular formulae. [2]

32. 2059 Q.No. 20 What action takes place when aqueous sodium hydroxide is added to zinc sulphate solution drop by drop till excess? [2]
33. 2058 Q.No. 19 Name two ores of zinc with their formulae. [2]
34. 2056 Q.No. 6 Why zinc displace copper from copper sulphate solution? [2]
35. 2056 Q.No. 12 Why is zinc not considered as a transition element? [2]
36. 2052 Q.No. 6 b Write action of cobalt nitrate heat on zinc oxide [2]
37. 2052 Q.No. 7 How will you obtain crystals of white vitriol? Give a chemical reaction. [2]

Short Answer Questions [5 marks]

38. 2071 Supp. Q.No. 26 How is zinc extracted from zinc blende? [5]
39. 2069 Set B Q.No. 29 OR Give the chemistry of Zinc white. [5]
40. 2067 Q.No. 27 Starting from zinc blende, how would you obtain pure zinc? What is galvanization? [5]
41. 2066 Q. No. 27 2064 Q.No. 31(iv) Write the chemistry of white vitriol. [5]
42. 2065 Q.No. 27 Explain the principle and process sketching a well-labelled diagram for the extraction of zinc from its ore. What happens when zinc is exposed to moist air? [4+1]
43. 2062 Q.No. 27 Write two chemical reactions for the preparation of Zinc white, and justify its amphoteric nature by giving suitable chemical reactions. Write its one important use. [5]
44. 2061 Q.No. 24 How is Zinc extracted from its ore? [5]
45. 2058 Q.No. 27 Write the preparation, properties and uses of white vitriol. [5]
46. 2054 Q.No. 26 Describe the different steps involved in extraction of zinc from zinc blende. [5]

Long Answer Questions [10 marks]

47. 2056 Q.No. 29 Name the important ores of zinc. Describe the extraction of pure zinc from its sulphide ore. Give the chemistry of white vitriol. [1+4]

Write Short notes on

48. 2075 GIE Q.No. 33iii 2075 Set B Q.No. 33iii 2072 Set C Q.No. 33b 2070 Supp. Q.No. 33 c 2070 Set D Q.No. 33 a 2069 Supp. Set B Q.No. 33 b 2063 Q.No. 31iii 2057 Q.No. 31c Chemistry of white vitriol. [5]
49. 2075 Set A Q.No. 33iv 2074 Set B Q.No. 33d 2070 Set C Q.No. 33 b 2069 Set A Q.No. 33 v 2068 Q.No. 31i 2060 Q.No. 31(ii) Extraction of zinc from zinc blende. [5]
50. 2072 Set D Q.No. 33c 2071 Set C Q.No. 33 c Chemistry of zinc white [5]

18.3 MERCURY

Very Short Answer Questions [2 marks]

1. 2075 GIE Q.No. 20 2075 Set A Q.No. 20 How is Nessler's reagent prepared from corrosive sublimate? Give a Laboratory use of Nessler's reagent. [1+1]
2. 2075 Set B Q.No. 20 What happen when ammonia gas is passed through the aqueous solution of (i) Corrosive sublimate (ii) Calomel. [1+1]
3. 2072 Set C Q.No. 20 Write down a balanced chemical equation for the preparation of calomel. What happens when calomel is treated with ammonia solution? [1+1]
4. 2072 Set D Q.No. 20 What happens when Corrosive sublimate is: [1+1]
   i. treated with excess KI solution?
   ii. heated with excess $SnCl_2$ solution.
5. 2072 Set E Q.No. 21 How would you convert calomel into corrosive sublimate and vice versa giving suitable chemical equations? [1+1]
6. 2071 Supp. Q.No. 21 ii 2071 Set D Q.No. 21 b Write an important use of corrosive sublimate. [0.5]
7. 2071 Supp. Q.No. 21 iv 2071 Set D Q.No. 21 d Write an important use of calomel. [0.5]
8. 2070 Supp. Q.No. 21 Given a balanced chemical equation for the preparation of corrosive sublimate. What is its action on KI solution? [1+1]
9. 2070 Set C Q.No. 21 2070 Set D Q.No. 20 What is Nessler's reagent? How it is prepared? [2]
10. 2069 Set A Q.No. 21 How is corrosive sublimate converted into calomel and vice-versa? [2]
11. 2069 Set B Q.No. 21 How is Nessler's reagent prepared? Give its one use. [1+1]
12. 2069 Supp. Set B Q.No. 21 What is meant by mercury poisoning? [2]
13. 2068 Q.No. 18iii Give the molecular formula of: Nessler's reagent [0.5]
14. 2065 Q.No. 20 ii Give the balanced chemical equation. Corrosive Sublimate reacts with excess KI solution. [2]
15. 2065 Q.No. 18 iv Write any one use of each of the following Calomel [2]
16. 2064 Q.No. 20 Write the action of Mercury with aqua regia. [2]
17. 2062 Q.No. 20 ii Write an important use of each of the following substances: Corrosive sublimate [2]
18. 2061 Q.No. 20 What happens when $HgCl_2$ is allowed to react with $SnCl_2$. [2]
19. 2060 Q.No. 20 How can you obtain calomel from corrosive sublimate and vice versa? [2]
20. 2058 Q.No. 20 What happens when mercuric chloride reacts with excess KI solution. [2]

Short Answer Questions [5 marks]

21. 2077 Set P Q.No. 10 Write down the chemistry of corrosive sublimate. [5]
22. 2076 GIE Set B Q.No. 29 Describe the extraction of mercury from its cinnabar ore. How is it refined? [4+1]
23. 2076 Set C Q.No. 26 Write the chemistry of corrosive sublimate. [5]
24. 2074 Supp. Q.No. 26 2074 Set A Q.No. 26 Explain the process of extraction of mercury from cinnabar. Why is mercury called quick silver? [4+1]

25. 2073 Supp Q.No. 28 2073 Set C Q.No. 28 Write down the chemistry of corrosive sublimate. [5]
26. 2073 Set D Q.No. 28 Write down the chemistry of calomel. [5]
27. 2070 Supp. Q.No. 29 OR Explain the process of extraction of mercury from its ore. [5]
28. 2070 Set C Q.No. 26 2069 Set A Q.No. 23 OR How is mercury extracted from Cinnabar? [5]
29. 2070 Set D Q.No. 29 Or How is mercury extracted from its ore and refined? [5]
30. 2069 Supp. Set B Q.No. 29 Or How is mercury extracted from its ore? [5]
31. 2068 Q.No. 27 Write one method of preparation of $HgCl_2$ and Hg_2Cl_2 of each. What happens when an aqueous solution of $HgCl_2$ is treated with: [2+2+1]
    i. an aqueous solution of KI
    ii. an aqueous solution of $SnCl_2$
    What peculiar behaviour does mercury have?
32. 2067 Q.No. 31i Write short notes on chemistry of calomel [5]
33. 2065 Q.No. 31 ii Describe Chemistry of calomel [5]
34. 2064 Q.No. 31(iii) Write short notes on Extraction of Hg. [5]
35. 2057 Q.No. 27 Write two methods of preparation of corrosive sublimate. Give its action upon. [5]
    a. excess of KI and b. NH_3.
36. 2055 Q.No. 24 How is mercury extracted from its ore? [5]
37. 2053 Q.No. 20 How is calomel prepared? Give its important properties and uses. [2]
38. 2052 Q.No. 20 Briefly describe the metallurgy of mercury. [2]

Write Short Notes on

39. 2076 GIE Set A Q.No. 33ii Chemistry of corrosive sublimate. [5]
40. 2076 Set B Q.No. 33ii 2071 Set D Q.No. 33 c 2069 Set B Q.No. 33b Extraction of mercury from cinnabar [5]
41. 2072 Supp. Q.No. iv 2066 Q. No. 31 ii 2063 Q.No. 31(ii) 2059 Q.No. 31(d) 2062 Q.No. 31(b) /2058 Q.No. 31(b) Extraction of mercury. [5]
42. 2072 Set E Q.No. 33(ii) 2061 Q.No. 31(i) 2056 Q.No. 31(b) Chemistry of calomel. [5]
43. 2071 Supp. Q.No. 33c Write short notes on chemistry of corrosive sublimate [5]
44. 2054 Q.No. 30(a) Purification of mercury. [5]

18.4. IRON

Very Short Answer Questions [2 marks]

1. 2076 GIE Set A Q.No. 22 Write the compositions of (i) Stainless steel (ii) Speigeleisen [1+1]
   Ans: Na_2CO_3
2. 2076 GIE Set B Q.No. 22 Write the formula and one use of each: [1+1]
   i. Green vitriol
   ii. Mohr's salt
3. 2076 Set B Q.No. 22 2076 Set C Q.No. 22 What is meant by (i) quenching of steel, (ii) annealing of steel? [1+1]
4. 2075 GIE Q.No. 22 Give the composition and uses of wrought iron. [1+1]
5. 2076 Set A Q.No. 22 Give the compositions and important use of cast iron. [1+1]
6. 2074 Supp. Q.No. 21 Distinguish between quenching and tempering of steel. [1+1]
7. 2074 Set A Q.No. 21 What is the composition of stainless steel? Give an important use of such steel. [1+1]
8. 2074 Set B Q.No. 21 Distinguish between quenching and tempering of steel. [1+1]
9. 2073 Supp Q.No. 22 Name any two important ores of iron. Which parts of Nepal are these ores mainly found? [1+1]
10. 2073 Set C Q.No. 22 Name any two important ores of iron. Which parts of Nepal are these ores mainly found? [1+1]
11. 2073 Set D Q.No. 22 Write down chemical reactions that occur in zone of reduction of blast furnace during extraction of iron. [2]
12. 2072 Supp. Q.No. 20 What is meant by Thomas Slag? Write its one use. [1+1]
13. 2072 Set D Q.No. 22 Write chemical reactions involved in zone of reduction of blast furnace during extraction of iron. [2]
14. 2072 Set E Q.No. 22 2071 Supp. Q.No. 20 What is the composition of stainless steel? Write its uses. [1+1]
15. 2071 Set C Q.No. 20 What is the composition of spiegeleisen? Write its one use. [1+1]
16. 2071 Set D Q.No. 20 What is meant by quenching of steel? [2]
17. 2070 Supp. Q.No. 20 What is the composition of steel? Write its one use. [1+1]
18. 2070 Set C Q.No. 20 Differentiate between cast iron and wrought iron. [2]
19. 2070 Set D Q.No. 22 Why is open-hearth process more advantageous than Bessemer process of manufacture of steel? [2]
20. 2069 Set A Q.No. 22 Write the molecular formula of: i. Mohr's salt ii. Green vitriol [1+1]
21. 2069 Set B Q.No. 20 iii Write the molecular formula of: Mohr's salt [1]
22. 2069 Set B Q.No. 22 Write chemical reaction occurring in zone of reduction in the extraction of iron. [2]
23. 2068 Q.No. 19 What is meant by tempering of steel? Mention one important use of tempered steel. [1+1]
24. 2067 Q.No. 20 What reaction occurs in the combustion zone in the blast furnace during extraction of iron? [2]
25. 2066 Q. No. 20 Mention the function of Spiegeleisen in the manufacture of Steel. [2]
26. 2066 Q. No. 18 ii Name one important ore of each of the followings: Iron [2]
27. 2065 Q.No. 19 Define Rusting of iron. [2]
28. 2063 Q.No. 19a What happens when: Few drops of potassium ferrocyanide is added to aqueous solution of $FeCl_3$. [2]
29. 2062 Q.No. 20 iv Write an important use of each of the following substances: Wrought iron [2]
30. 2061 Q.No. 19 Write two methods by which rusting of iron can be prevented. [2]

31. 2060 Q.No. 19 What is tempering of steel? [2]
32. 2059 Q.No. 19 What is stainless steel? [2]
33. 2057 Q.No. 19 Write two methods of prevention of corrosion. [2]
34. 2056 Q.No. 13 What is the function of limestone in the smelting of iron? [2]
35. 2055 Q.No. 10 Give two ways to prevent corrosion. [2]
36. 2054 Q.No. 9 What is a transition element? Mention two of its important characteristics. [2]
37. 2053 Q.No. 17 Give two methods for preventing rusting of iron. [2]
38. 2053 Q.No. 18 Write the principle involved in manufacture of steel by Open Hearth process. [2]

Short Answer Questions [5 marks]

39. 2077 Set V Q.No. 8 2075 GIE Q.No. 26 2075 Set A Q.No. 26 How is steel manufactured by Open-hearth process? [5]
40. 2076 GIE Set A Q.No. 26 Write down the chemistry of rusting theory of iron. [5]
41. 2075 Set B Q.No. 26 How is steel manufactured by Open-Hearth process? Write the composition of stainless steel. [4+1]
42. 2071 Set C Q.No. 28 2071 Set D Q.No. 26 How is cast iron extracted from Iron pyrites? [5]
43. 2067 Q.No. 31 iii Write short notes on manufacture of steel by Open Hearth process. [5]
44. 2065 Q.No. 31 iii Describe the Manufacture of steel by Open-Hearth Process [5]
45. 2064 Q.No. 27 Draw a neat labelled sketch of blast furnace for the extraction of pig iron and write down the chemical reactions involved at different zones. [3+2]
46. 2063 Q.No. 27 How is steel manufactured by Open Hearth process? What is quenching of steel? [5]
47. 2059 Q.No. 27 What is rusting? Describe electrochemical theory of rusting of iron. List any two methods of prevention of rusting. [0.5+3+1.5]
48. 2056 Q.No. 23 How is steel manufactured by Open Hearth process? Mention its advantage over Bessemer process. [5]
49. 2052 Q.No. 21 Explain any four methods for preventing rusting of iron. [5]

Long Answer Questions [10 marks]

50. 2055 Q.No. 29 Describe the extraction of Iron from its principle ores, giving a neat sketch of the furnace used and the probable reactions occurring their in. [5]
51. 2054 Q.No. 29 How is cast iron produced from iron ore? Discuss the reactions involved. [5]

Write short notes on [5 marks]

52. 2077 Set P Q.No. 12i 2076 GIE Set B Q.No. 33iii Manufacture of steel by open hearth process. [5]
53. 2076 Set B Q.No. 33i 2076 Set C Q.No. 33i 2073 Set D Q.No. 33ii 2072 Set C Q.No. 33a 2072 Set D Q.No. 33b 2070 Set D Q.No.33b 069 Set A Q.No.33a 066 Q. No. 31c 060 Q.No. 31c 058 Q.No.31c Chemistry of rusting theory of iron [5]
54. 2074 Supp. Q.No. 33(iii) 2074 Set A Q.No. 33a 2074 Set [illegible] Q.No. 33a 2070 Set C Q.No. 33 a or Theory of corrosion [illegible] iron [5]
55. 2073 Supp Q.No. 33ii 2069 Set B Q.No. 33c 2061 Q.No. 31i Manufacture of steel by Bassemer's process. [5]
56. 2073 Set C Q.No. 33ii 2072 Set E Q.No. 33i 2070 Supp. Q.No. 33d 2069 Supp. Set B Q.No. 33 a 2072 Supp. Q.No. 33ii Manufacture/ Chemistry of steel by Open-hearth process. [5]
57. 2068 Q.No. 31ii Rusting of iron and its prevention. [5]
58. 2055 Q.No. 31(b) Definition and general properties of Transition elements. [5]

18.5. SILVER

Short Answer Questions

1. 2077 Set V Q.No. 5 2077 Set W Q.No. 7 What is meant by frosting of silver? [2]
2. 2076 GIE Set A Q.No. 21 Why is silver nitrate solution used for staining fingers of voters during election? [2]
3. 2076 GIE Set B Q.No. 21 Why is silver nitrate solution protected from sunlight? [2]
4. 2076 Set B Q.No. 21 2076 Set C Q.No. 21 Why is silver nitrate solution used for staining fingers of voters during election? [2]
5. 2075 GIE Q.No. 21 2075 Set A Q.No. 21 What is meant by 'Spongy Silver'? [2]
6. 2075 Set B Q.No. 21 Silver nitrate solution is widely used for staining fingers of voters during electron. Give reason. [2]
7. 2072 Set C Q.No. 21(i) Give reason: Silver nitrate produces permanent black stain on the skin. [1]
8. 2072 Set D Q.No. 21 Why does silver nitrate produces permanent black stain on the skin? Write an important use of silver nitrate. [1+1]
9. 2064 Q.No. 18 Why does Silver nitrate solution produce black-stain on the skin in presence of sun light? [2]
10. 2062 Q.No. 18 What is the action of heat on silver nitrate? [2]
11. 2061 Q.No. 9 (f) What do you mean by noble metals? Give any two examples. [2]
12. 2058 Q.No. 12 What happens when $AgNO_3$ is heated at 450°C. [2]
13. 2055 Q.No.20 Give two uses of silver nitrate. [2]
14. 2053 Q.No. 19 Group A How is presence of halide ions are tested with silver nitrate solution? [2]
15. 2053 Q.No. 22 Group A Why silver ores are leached with metal cyanides for the extraction of silver? [2]
16. 2053 Q.No. 25 What do you mean by noble metals? Name at least three noble metals you know. [2]

Long Answer Questions

17. 2054 Q.No. 25 Give the various steps involved in the extraction of silver from silver glance. [5]

2077 (Set P)

Time: 1:30 hrs. Full Marks (Condense): 30

Group 'A'

Attempt any five questions. [5×2=10]

1. Illustrate the formation of peptide bond with an example. [2]
2. State Hess's law of constant heat summation. [2]
3. What is the pH of 10^{-9}M HCl? [2]
4. What is the mode of hybridization of B in BF_3. Predict the geometry of such molecule. [1+1]
5. What happens when ZnO is,
   i. dissolved in excess caustic alkali
   ii. heated with cobalt nitrate
6. Write an example of [1+1]
   i. Cannizzaro's reaction
   ii. DNP-test.
7. What happens when zinc white is [1+1]
   i. dissolved in excess caustic alkali?
   ii. heated with cobalt-nitrate?

Group 'B'

Attempt any two questions. [2×5=10]

8. Give the laboratory method of preparation of trichloromethane from ethanol. Why does trichloromethane not give white ppt. with silver nitrate solution? [4+1]
9. Define the terms
   i. Equivalent conductance
   ii. Standard electrode potential.
   The cost of electricity required to deposit 1 g of Mg is Rs. 6. How much would it cost to deposit 10 g of Al? (At. wt of Al = 27) [2+3]
10. Write down the chemistry of corrosive sublimate. [5]

Group 'C'

Attempt any one question. [1×10=10]

11. Define
    i. activation energy
    ii. rate law
    iii. zero-order reaction
    iv. half life of reaction.
    How does surface area and concentration of reactants affect the rate of chemical reaction?
    The experimental data for the reaction $2A + B_2 \longrightarrow 2AB$, are as below:

Expt. no.	(A) molL^{-1}	(B) molL^{-1}	Rate molL^{-1}sec^{-1}
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

    Calculate the rate of formation of AB when the initial concentrations of (A) and (B) are 2.00 molL^{-1} and 4.00 molL^{-1} respectively. [6+4]
12. Write short notes on any two: [2×5]
    i. Manufacture of steel by open hearth process.
    ii. Gibb's free energy change and prediction for spontaneity of reaction.
    iii. Chemistry of blue vitriol.
    iv. Laboratory method of preparation of anhydrous formic acid.

2077 (Set V)

Time: 1:30 hrs. Full Marks (Condense): 30

Group 'A'

Attempt any five questions. [5×2=10]

1. Write an example of a molecule having trigonal pyramidal geometry. What is the mode of hybridization on central atom of the molecule? [1+1]
2. Calculate the enthalpy of formation in the following reactions:
   i. $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$, $\Delta H = -136$ Kcal
   ii. $H_2(g) + I_2(g) \longrightarrow 2HI(g)$, $\Delta H = -24.8$ Kcal. [1+1]
3. What volume of water should be added to 50 mL of semi normal NaOH solution to make it exactly deci-normal. [2]
4. Give a chemical test to distinguish ethanamine from N-methyl methanamine. [2]
5. What is meant by frosting of silver? [2]
6. Write an example of
   i. Rosennmund's reaction
   ii. Coupling reaction. [1+1]
7. Give structural formula and a major use of an antipyretics drug. [1+1]

Group 'B'

Attempt any two questions. [2×5=10]

8. How is steel manufactured by Open-hearth process? [5]
9. Point out the limitation of Ostwald's dilution law. The solubility product of $BaSO_4$ is 1×10^{-11}. Will precipitate occur or not if equal volume of 2×10^{-3} M $BaCl_2$ solution and 2×10^{-4} M Na_2SO_4 solution are mixed? [1+4]
10. Write down the laboratory method preparation of trichloromethane from ethanol. What product would you obtain when trichloromethane is treated with acetone? [4+1]

Group 'C'

Attempt any one question. [1×10=10]

11. i. How is primary, secondary and tertiary amines separated from their mixture by Hoffmann's method?
    ii. An aliphatic haloalkane Ⓐ gives compound Ⓑ when heated with alc.NaOH. The compound Ⓑ reacts with HBr to give major product Ⓒ. On heating the compound Ⓒ with sodium in presence of dry ether yields 2,3-dimethylbutane. What product would you expect when the compound Ⓑ is subjected to ozonolysis? [5+4+1]
12. Define the terms:
    i. half-life period of reaction ii. rate law
    iii. instantaneous rate iv. zero-order reaction
    How do surface area of reactant and catalyst affect the rate of chemical reaction?
    The experimental data for the reaction $2A + B_2 \rightarrow 2AB$, are as below:

Expt. no.	(A) molL^{-1}	(B) molL^{-1}	Rate molL^{-1}sec^{-1}
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

    Find overall order of reaction and rate constant. [4+2+4]

2077 (Set W)

Time: 1:30 hrs. **Full Marks (Condense): 30**

Group 'A'

Attempt any five questions. **[5×2=10]**

1. Why has ammonia got trigonal pyramidal geometry though nitrogen shows sp^3 hybridization? [2]
2. How does chloroform react with (i) acetone (ii) silver powder [1+1]
3. What is meant by molar entropy? Write its unit. [1+1
4. What products would you expect at cathode and anode when aqueous NaCl is electrolysed using platinum electrode? [2]
5. Calculate the pH of 1×10^{-3}M KOH. [2]
6. Distinguish between essential and non-essential amino acid. [2]
7. What is meant by frosting of silver? [2]

Group 'B'

Attempt any two questions. **[2×5=10]**

8. How is blister copper extracted from its pyrite ore? [5]
9. Define molality of solution. Calculate molality of one liter of 93% H_2SO_4 solution (weight by volume). The density of the solution is 1.84 g mL^{-1}. [1+4]
10. Write an example of each of the followings: [5]
    i. DNP test
    ii. Rosenmund's reduction
    iii. Aldol condensation
    iv. Tollen's test
    v. Cannizzaro's reaction

Group 'C'

Attempt any one question. **[1×10=10]**

11. a. What are the oxidation products of primary, secondary and tertiary alcohols?
    b. How is pure nitro benzene prepared in the laboratory? [5+5]
12. Define the terms:
    i. activation energy
    ii. half life of a reaction
    iii. rate law
    iv. molecularity of reaction
    v. effective collision
    vi. order of reaction.

    99% of first order reaction is completed in 32 minutes. What time will it take to complete 99.9% of reaction?

    [1+1+1+1+1+1+4]