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EXPERIMENT NO. 3

NAME OF EXPERIMENT: TO DETERMINE MAGNETIC MOMENT OF THE GIVEN MAGNET USING DEFLECTION MAGNETOMETER BY TAN-B POSITION

APPARATUS REQUIRED

1. Deflection magnetometer.
2. Bar magnet

THEORY

Tangent B position of gauss:

In this position the centre of the needle is on the equatorial line of the bar magnet.

Hence, the intensity due to magnet is,

$$m = \frac{M}{(d^2+l^2)^{3/2}} \quad \text{—— (i)}$$

But according to tangent law of magnetic forces;

$$f = H \tan\theta \quad \text{—— (ii)}$$

From (i) and (ii)

$$m = \frac{M}{(d^2+l^2)^{3/2}} = H\tan\theta$$

or, $$\frac{M}{H} = (d^2+l^2)^{3/2}\tan\theta \quad \text{—— (iii)}$$

or, $$M = H(d^2+l^2)^{3/2}\tan\theta$$

or, $$m \cdot 2l = H(d^2+l^2)^{3/2}\tan\theta$$

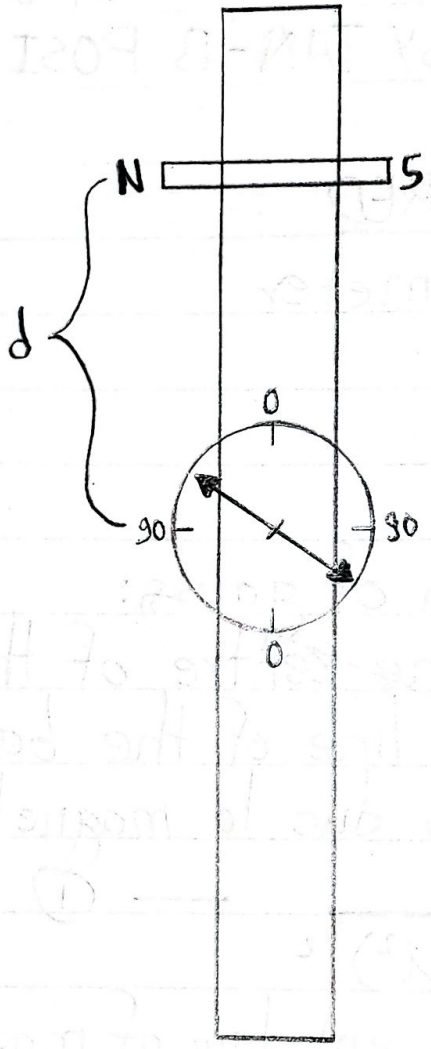

fig. Tangent - B position of gauss

$$\therefore m = \frac{H(d^2+l^2)^{3/2}\tan\theta}{2l} \quad \text{— (iv)}$$

PROCEDURE

1. Magnetometer was adjusted so that its arms were along the magnetic meridian when the pointer reads 90°-90°. ~~in the~~
2. The bar magnet NS was placed on one of the arms with its axis perpendicular to the magnetic meridian with adjusted distance 'd' that makes deflection 'θ' between 30° and 60°.
3. Deflection of the needle was read and subtracted from 90° to get θ and two readings were taken.
4. Again, bar magnet was placed on the same arm, n-pole pointing to west. The deflection was again noted and two readings were taken.
5. Operations (2), (3), (4) were repeated on another arm at the same distance which gave 3 more readings.

OBSERVATIONS

Value of H in lab = 0.34 oersted
Real length (2l) = 15.1 cm

Effective length $(2l) = 15.1 \times 0.85$

$= 12.84$

$\therefore l = \frac{12.84}{2}$

$= 6.42$ cm

OBSERVATION TABLE

No of Obs	Distance of the magnet cms. (d)	Position of the magnet	n-pole pointing	Deflection θ End I	Deflection θ End II	Mean θ	$m = \frac{H(d^2+l^2)^{3/2}}{2l} \times \tan\theta$	Mean m
1.	26+0.6 = 26.6	North	East	37	35			
			West	27	32	33.13	354.09	
		South	East	37	35			
			West	32	30			
2.	24+0.6 = 24.6	North	East	41	38			350.73
			West	39	41	39.88	363.59	
		South	East	46	42			
			West	35	37			
3.	22+0.6 = 22.6	North	East	35	44			
			West	43	44	44.25	334.59	
		South	East	49	47			
			West	43	49			

CALCULATIONS

1. $m_1 = \frac{HC(d^2+l^2)^{3/2}}{2l} \times \tan\theta$

$= \frac{0.34(26.6^2+6.42^2)^{3/2}}{2\times 6.42} \times \tan 33.13$

$= 354.09$

2. $m_2 = \frac{HC(d^2+l^2)^{3/2}}{2l} \times \tan\theta$

$= \frac{0.34(24.6^2+6.42^2)^{3/2}}{2\times 6.42} \times \tan 39.88$

$= 363.59$

3. $m_3 = \frac{HC(d^2+l^2)^{3/2}}{2l} \times \tan\theta$

$= \frac{0.34(22.6^2+6.42^2)^{3/2}}{2\times 6.42} \times \tan 44.25$

$= 334.52$

$\therefore$ Mean$(m) = \frac{m_1+m_2+m_3}{3} = \frac{1052.20}{3}$

$= 350.73$

$\therefore$ Pole strength $(m) = 350.73$ c.g.s unit

Magnetic moment (M) = m × 2l
= 350.73 × 2 × 6.42
= 4503.37 cgs unit

RESULT

Hence, the pole strength and magnetic moment was calculated.

SOURCE OF ERROR

1. There might be magnetic substance near magnetometer.
2. Pointer of the magnetometer might be thick or not straight.
3. There might be friction at the point of the needle.

PRECAUTIONS

1. All magnetic substance should be removed from the table.
2. Magnetometer compass should not be disturbed.
3. The deflection of about 30° to 60° should be produced.