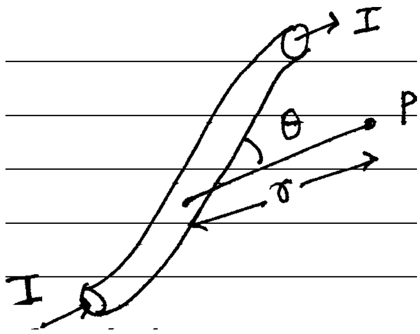
Unit - 13
Magnetic Effects of Electric Current and Magnetism

SUMMARY

Important tips of each topic

1. Biot-Savart;s law :

$$d\vec{B} = \frac{{}_0}{4\pi}\ \frac{1\ d\vec{l}\ \times\ \hat{r}}{r^2}$$
$$dB = \frac{{}_0}{4\pi}\ \frac{1\ dl\ \sin\theta}{r^2}$$
} In Vaccum or AIR



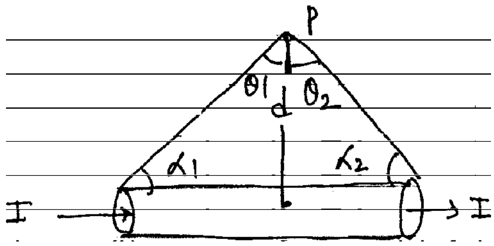
$$d\vec{B} = \frac{{}_r\ {}_0}{4\pi}\ \frac{1\ d\vec{l}\ \times\ \hat{r}}{r^2}$$
$$dB = \frac{{}_r\ {}_0}{4\pi}\ \frac{1\ dl\ \sin\theta}{r^2}$$
} In any Medium

2. For a WIRE

(A) Finite length of a wire

$$B = \frac{\mu_0}{4\ \pi}\ \frac{I}{d}\ [\sin\theta_1\ +\ \sin\ \theta_2]$$

$$= \frac{\mu_0}{4\pi}\ \frac{I}{d}\ [\cos\alpha_1\ +\ \cos\ \alpha_2]$$



(B) Infinite length of a wire

$\theta_1 = \theta_2 = 90^o$ OR $\alpha_1 = \alpha_2 = 0^o$

$$B = \frac{\mu_0}{4\pi}\ \frac{I}{d}\ [\ 1\ +\ 1\ ]$$

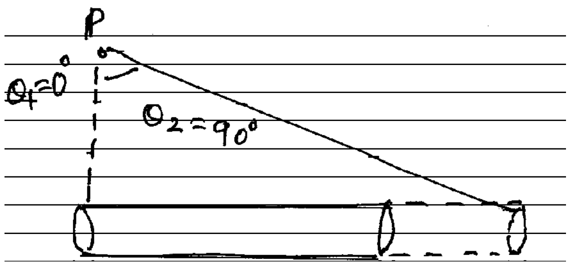
$$\frac{\mu_0}{4\pi}\ \frac{I}{d}\ [\ 2\ ] = \frac{\mu_0}{2\pi}\ \frac{I}{d}$$

(C) Semi - infinite length of a wire

$\theta_1 = 0^o$; $\theta_2 = 90^o$

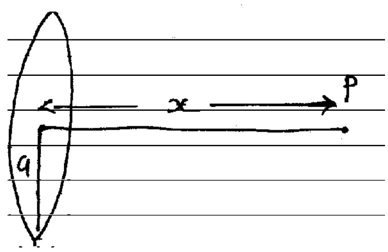
$$B = \frac{\mu_0}{4\pi}\ \frac{1}{d}\ [\ 0\ +\ 1\ ]$$

$$= \frac{\mu_0}{4\pi}\ \frac{1}{d}$$



3. For a RING :

(A) For N = 1 turn



$$B = \frac{{}_0 \; I \; a^2}{2\left(a^2 + x^2\right)^{\frac{3}{2}}}$$

(B) For N = N turns

$$B = N\left[\frac{{}_0 \; I \; a^2}{2\left(a^2 + x^2\right)^{\frac{3}{2}}}\right]$$

(C) At the centre (x = 0)

$$B = N\left[\frac{\mu_0 I}{2a}\right]$$

(D) At $x >> a$

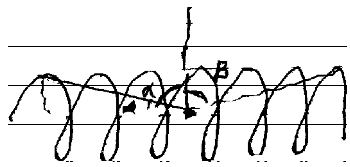
$$B = \frac{{}_0}{4\pi}\frac{2M}{x^3}$$

[Just as, mag. field on the axis of a Bar-magnet]

Where m = magnetic moment

4. For Solenoid

(A) Finite length solenoid



$$B = \frac{{}_0 nI}{2}\left[\sin\alpha + \sin\beta\right] \qquad \text{Where } n = \frac{N}{\ell}$$

Where α and β are angles mode at the either end of the solenoids.

n = no. of turns per unit length ; N = total no. of turns.

(B) Infinite length solenoid

$$\alpha = \beta = 90^o$$

$$B = \frac{{}_0 nI}{2}\left[1 + 1\right]$$

$$B = {}_0 nI \qquad \text{Where } n = \frac{N}{\ell}$$

(C) Mag. field at either end

$$\alpha = 0 \text{ and } \beta = 90^o$$

$$\text{Bend Point} = \frac{{}_0 nI}{2}\left[0 + 1\right]$$

$= \frac{1}{2} \mu_0 nI$

Bend $= \frac{1}{2}$ Binside

(D) Toroid

$B = N\left(\frac{{}_0}{2\pi} \frac{I}{r}\right)$

5. Force on a charged particle in magnetic field.

(A) $\vec{F} = q\left(\vec{V} \times \vec{B}\right)$

$F = qVB\sin\theta$

Direction of force can be determine by using

(B) Fleming's Left and rule

First finger indicates $\Rightarrow$ direction of magnetic field.

Middle finger indicates $\Rightarrow$ direction of motion of POSITIVE charge particle

Thumb indicates $\Rightarrow$ direction of force

(C) If $\theta = 0^o$ or 180^o

charged particle moves on straight line.

(D) If $\theta = 90^o$ ie $\vec{V} \perp \vec{B} \Rightarrow F = qVB$

charged particle moves on circular path of radius r

$$r = \frac{mv}{qB} = \frac{p}{qB} = \sqrt{\frac{2mK}{qB}} = \frac{1}{B}\sqrt{\frac{2mV}{q}}$$

(E) If θ is neither zero nor perpendicular it performs Helical path.

- radius of helical path $r = \frac{m\left(V\sin\theta\right)}{qB}$
- periodic time $T = \frac{2\pi m}{qB}$
- pitch of the helix $= T\left(\nu\cos\theta\right) = \frac{2\pi m\nu\cos\theta}{qB} = \frac{2\pi r}{\tan\theta}$
- No. of pitches $= \frac{\ell}{\text{Pitch distance}}$

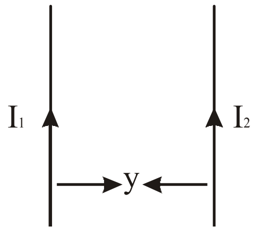
6. Lorentz's force

$$\vec{F} = q\left[\vec{E} + \left(\vec{V} \times \vec{B}\right)\right]$$

7. Cyclotorn

Frequency $f = \frac{1}{T} = \frac{Bq}{2\pi m}$

8. Force between two parallel current carrying wires.



$$F = \frac{_0}{2\pi}\frac{I_1 I_2}{Y}\ell$$

$$\frac{F}{\ell} = \frac{_0}{2\pi}\frac{I_1 I_2}{Y}$$

Case (i) If I_1 and I_2 are flowing in same direction Attraction.

Case (ii) If I_1 and I_2 are flowing in opposite direction Repulsion.

9. Torque acting on a rectangle frame

$\tau = BINA \sin\theta$

(i) If frame is parallel to the field $\theta = 0^\circ$ $\tau = 0$

(ii) If frame is perpendicular to the field $\theta = 90^\circ$ $\tau = BINA$

10. Moving coil Galvano meter.

(i) $\tau = BINA$

τrestoning $= K\phi$ Where ϕ = deflection in galvanometer

$BINA = K\phi$

$$I = \left(\frac{K}{BNA}\right)\varphi$$

(ii) Current sensitivity (S_I) :

The deflection produced in the Galvanometer per unit current flowing throught it.

$$S_I = \frac{\phi}{I} = \frac{BNA}{K}$$

(iii) Voltage sensitivity (S_V) :

The deflection produced in the Galvanometer per unit voltage applied to it.

$$S_V = \frac{\phi}{V} = \frac{\phi}{IR} = \frac{SI}{R} = \frac{BNA}{KR}$$

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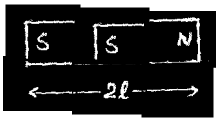
11. Bar magnet and its pole strength (m)



Pole strength :

- The strength of a magnetic pole to atiract magnetic material towards itself.
- Unit is $Amp \times meter = \frac{Newton}{Tesla}$
- Pole strength of the magnet depends on the nature of material of magnet and area of cross- section.
- m does not depend upon length.

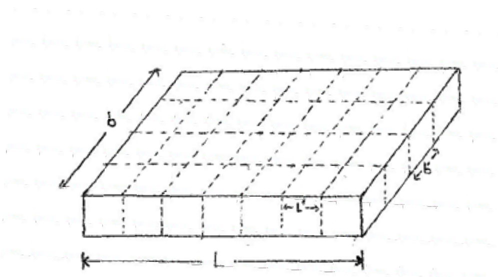
12. Magnetic dipole moment (M) :

$\vec{M} = m \times (2\vec{\ell})$

- dir^{-n} is from south pole to North pole
- unit is $\text{Amp} \times \text{meter}^2 = \frac{\text{Newton} - \text{meter}}{\text{Tesla}}$

13. Cutting of a rectangular bar-magnet.

If a bar-magnet of length L and breadth b is cut into n equal parts then



(i) Length of each part $L' = \frac{L}{\sqrt{n}}$

(ii) Breadth of each part $b' = \frac{b}{\sqrt{n}}$

(iii) Mass of each part $w' = \frac{w}{n}$

(iv) Pole-strength (m) of each part $m' = \frac{m}{\sqrt{n}}$

(v) Magnetic moment (M) of each part $M' = \frac{M}{n}$

(vi) Initial (Original) moment of inertia of a bar $I = \frac{1}{12} W (L^2 + b^2)$

(vii) After cutting new moment of inertia $I' = \frac{I}{n^2}$

14. Cutting of a thin bar-magnet for thin bar magnet b = 0

$$L' = \frac{L}{n} \;;\; w' = \frac{w}{n} \;;\; m' = \frac{m}{n} \;;\; I' = \frac{I}{n^2}$$

15. Magnetic field and Magnetic flux :

(i) Magnetic field is denoted by B and its units are

$$Tesla = \frac{Weber}{m^2} = \frac{Newton}{Amp \times meter} = \frac{Joule}{Amp \times m^2} = \frac{Volt.\ see}{m^2}$$

(G) unit is Gauss 1 Tesla = 10^4 Gauss

16. Magnetic permeability :– (μ)

μo = Absolute permeability of air or vaccum

$$= 4\pi \times 10^{-7} \frac{\text{tesla} \times \text{meter}}{\text{Amp}}$$

μ_r = relative permeability

$$_r = \frac{\ }{_0} = \frac{B}{B_0} = \frac{\text{mag. Flux density in material}}{\text{mag. Flux density in vaccum}}$$

17. Intansity of magnetising field (H^{-1}) :

It is the degree or extent to which a magnetic field can magnetise a substance.

$$H = \frac{B}{\mu}$$

$$\text{unit} = \frac{\text{Ampere}}{\text{meter}}$$

$$= \frac{A}{m} = \frac{N}{m^2 \times \text{tesla}} = \frac{N}{wb} = \frac{J}{m^3 \times \text{tesla}} = \frac{J}{m \times wb}$$

CGS unit : Oersted

$$1\ \text{Oersted} = \frac{80\ \text{Amp}}{\text{meter}}$$

18. Intensity of magnetisation (I)

(i) It is the degree to which a substance is magnetised when placed in a magnetic field.

(ii) It is also defined as the pole strength per unit cross-sectional area of the substance.

(iii) It is also defined as Induced dipole moment per unit volume.

$$I = \frac{m}{A} = \frac{M}{\text{Volume}}$$

$$\text{unit is } \frac{\text{Ampere}}{\text{meter}}$$

19. Magnetic susceptibility (χ_m) and permeability

$$B = B_o + B_m$$

$$= {}_0H + {}_0 1$$

$$= {}_0 (H + I)$$

$$B = \mu_0 H (1 + \chi_m)$$

$$\mu_r = 1 + \chi_m$$

20. Coulomb's law in magnetism.

$$F = \frac{K\, m_1 m_2}{r^2} \qquad \text{where } m_1, m_2 = \text{pole strength}$$

where $K = \frac{\mu_0}{4\pi} = 10^{-7}$ in SI unit

= 1 in CGS unit

21. Magnetic field due to bar-magnet

(i) On axis of a bar-magnet

$$B \text{ axis} = \frac{\mu_0}{4\pi} \frac{2M}{r^3}$$

(ii) On equator of a bar-magnet

$$\text{Bequator} = \frac{\mu_0}{4\pi} \frac{M}{r^3}$$

22. Bar-magnet in magnetic field.

(i) Torque $\tau = MB \sin\theta$

(ii) Work $W = MB(\cos\theta_1 - \cos\theta_2)$

(iii) Potential energy $U = -\vec{M} \cdot \vec{B} = -MB\cos\theta$

23. Tangent Galvanometer :

In equilibrium

$$B = B_H \tan\theta$$

Where $B = \frac{\mu_0 nI}{2r}$

n = no. of turns

r = radius of the coil

I = Current to be measured

θ = angle made by needle from the direction of B_H in equilibrium.

24. Deflection magnetometer :

It works on principle of tangent law

(i) A-Position :

The magnetometer is set perpendicular to magnetic meridian so that magnetic field due to magnet is in AXIAL position.

$$B = B_H \tan\theta = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$$

(ii) B-position :

The arms of magneto meter are set in magnetic meridian so that the magnetic field due to magnet is at its equatorial position.

$$B = B_H \tan\theta = \frac{\mu}{4\pi}\frac{M}{r^3}$$

(iii) Comparison :

$$\frac{M_1}{M_2} = \frac{\tan\theta_1}{\tan\theta_2}$$

$$= \left(\frac{r_1}{r_2}\right)^3$$

25. Vibration Magnetometer :

Periodic time $T = 2\pi\sqrt{\frac{I}{MB_H}}$

$$\therefore M = \frac{4\pi^2 I}{B_H \cdot T^2}$$

(i) Comparison of horizontal components of earth's magnetic field at two places.

$$T = 2\pi\sqrt{\frac{I}{MB_H}}$$

but I and M are constant

$$\therefore T^2 \;\alpha\; \frac{1}{B_H} \Rightarrow \frac{(B_H)_1}{(B_H)_2} = \frac{T_2^2}{T_1^2}$$

(ii) Comparison of magnetic moment of two magnets of same size and mass

$$T = 2\pi\sqrt{\frac{1}{MB_H}}$$

but I and B_H are constant.

$$\therefore T^2 \alpha \frac{1}{M} \Rightarrow \frac{M_1}{M_2} = \frac{T_2^{\,2}}{T_1^{\,2}}$$

26. Diamagnetic material :
- magnetic dipole moment M = 0
- experience fore towards weak mag. field.
- magnetic susceptibility $\chi_m = -$ Ve.

27. Paramagnetic material :
magnetic dipole moment = M = 0
experience force towrards strong mag. field.
magnetic susceptibility $\chi_m = +$Ve.

28. Curie Law :

$$\chi \; \alpha \; \frac{1}{T}$$

$$\chi = \frac{C}{T}$$

29. Curie - weiss law :
At temperature above curie temperature the magnetic susceptibility of force magnetic material is inversely proportional to $(T - T_C)$

$$\chi \; \alpha \; \frac{1}{T - T_C}$$

$$\chi = \frac{C}{T - T_C}$$

MCQ

For the answer of the following questions choose the correct alternative from among the given ones.

1. An element $\vec{d\ell} = dx \uparrow$ (where dx = 1 cm) is placed at the origin and carries a large current I = 10 Amp. What is the mag. field on the Y-axis at a distance of 0.5 meter ?

(a) $2 \times 10^{-8}\ \hat{k}$ T (b) $4 \times 10^{8}\ \hat{k}$ T

(c) $-2 \times 10^{-8}\ \hat{k}$ T (d) $-4 \times 10^{-8}\ \hat{k}$ T

2. Two straight long conductors AOB and COD are perpendicular to each other and carry currents I_1 and I_2. The magnitude of the mag. field at a point "P" at a distance "a" from the point "O" in a direction perpendicular to the plane ABCD is

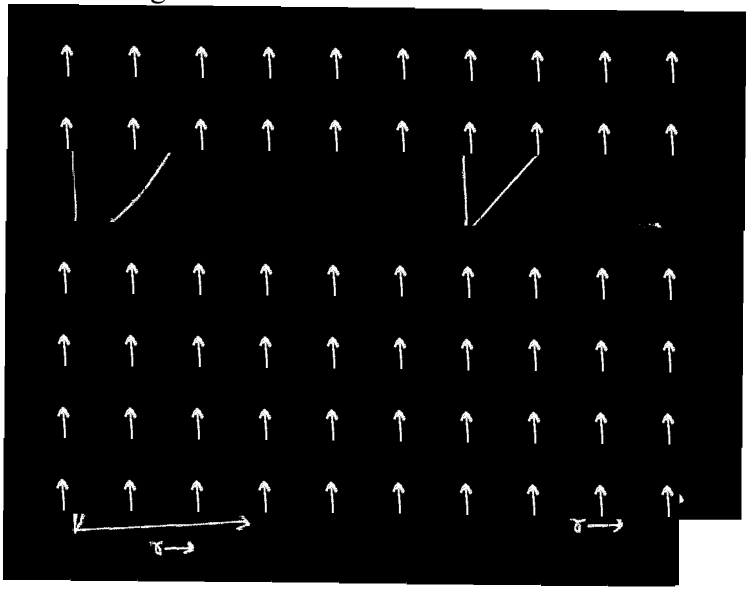
(a) $\frac{\mu_0}{2\pi a}\left(I_1 + I_2\right)$ (b) $\frac{\mu_0}{2\ \pi a}\left(I_1 - I_2\right)$

(c) $\frac{\mu_0}{2\ \pi a}\left(I_1^2 + I_2^2\right)^{\frac{1}{2}}$ (d) $\frac{\mu_0}{2\ \pi a}\ \frac{I_1\ I_2}{\left(I_1 + I_2\right)}$

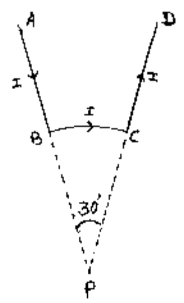
3. B$\rightarrow$R graph. The mag. field B at a distance r from a long straight wire carrying a current varies with r as shown in Fig.

(a)

(c)



4. A current path shaped as shown in figure produces a mag. field at point "P", the centre of the arc BC. If the arc subtends an angle of 30^0 and the radius of the arc is 0.6 meter. What is the magnitude of the field at point P if the current is 3 AMP ?



(a) 2.62×10^{-6} T (b) 2.62×10^{-7} T

(c) 3.62×10^{-7} T (d) 2.62×10^{-8} T

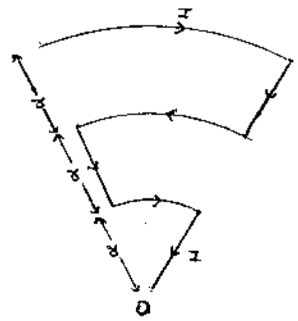
5. As shown in figure a conductor carrying a current I. Find the magnetic field intensity at the point "O".

(a) $\frac{5}{24}\ \frac{\pi_o}{\pi} \times \frac{I}{r}\ \theta\ \hat{k}$

(b) $\frac{-5}{26}\ \frac{\pi_o}{\pi}\ \frac{I}{r}\ \theta\ \hat{k}$

(c) $\frac{-7}{24}\ \frac{\mu o}{\pi}\ \frac{1}{r}\theta\ \hat{k}$

(d) $-\frac{5}{24}\ \frac{o}{\pi}\ \frac{I}{r}\ \theta\ \hat{k}$



6. A length L of wire carries a steady current 1. It is bent first to form a coil of 1 turn. The same length is now bent more sharply to give a double loop of smaller radius. The magnetic field at the centre caused by the same current is.................

(a) A quater of its first value (b) Un changed

(c) Four times of its first value (d) A half of its first value

7. If a long hollow copper pipe carries a direct current, the magnetic field associated with the current will be ....

(a) Only inside the pipe (b) Only outside the pipe

(c) Neither inside nor outside the pipe (d) Both inside and outside the pipe

8. The magnetic induction at a point P which is at a distance 4 cm from a long current carrying wire is 10^{-8} tesla. The field of induction at a distance 12 cm from the same current would be ....tesla.

(a) 3.33×10^{-9} (b) 1.11×10^{-4} (c) 3×10^{-3} (d) 9×10^{-2}

9. The strength of the magnetic field at a point y near a long straight current carrying wire is B. The field at a distance y/2 will be.........................

(a) $\frac{B}{2}$ (b) $\frac{B}{4}$ (c) 2B (d) 4B

10. The mag. field (B) at the centre of a circular coil of radius "a", through which a current I flows is............

(a) $B \alpha a$ (b) $B \alpha \frac{1}{I}$ (c) $B \alpha I$ (d) $B \alpha I^2$

11. A current of a 1 Amp is passed through a straight wire of length 2 meter. The magnetic field at a point in air at a distance of 3 meters from either end of wire and lying on the axis of wire will be............

(a) $\frac{\mu_o}{2\pi}$ (b) $\frac{\mu_o}{4\pi}$ (c) $\frac{\mu_o}{8\pi}$ (d) zero

12. If the strength of the magnetic field produced at 10 cm away from a infinilely long straight conductor is 10^{-5} tesla. The value of the current flowing in the conductor will be.............. Ampere.

(a) 5 (b) 10 (c) 500 (d) 1000

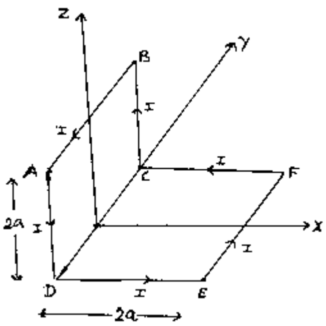
13. A long straight wire of radius "a" carries a steady current I the current is uniformly distributed across its cross-section. The ratio of the magnetic field at a/2 and 2a is ....

(a) $\frac{1}{4}$ (b) 4 (c) 1 (d) $\frac{1}{2}$

14. At a distance of 10 cm from a long straight wire carrying current, the magnetic field is 4×10^{-2}. At the distance of 40 cm, the magnetic field will be ....Tesla.

(a) 1×10^{-2} (b) 2×10^{-2} (c) 8×10^{-2} (d) 16×10^{-2}

15. As shown in figure ABCD and CDEF planes are kept carrying current I. Each side of the plane is having length "2a". The magnetic field due to ABCD and CDEF planes at the point P(a, 0, a) is in the direction.



(a) $\frac{-\hat{i} + \hat{k}}{\sqrt{2}}$ (b) $\frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}}$

(c) $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$ (d) $\frac{\hat{i} + \hat{k}}{\sqrt{2}}$

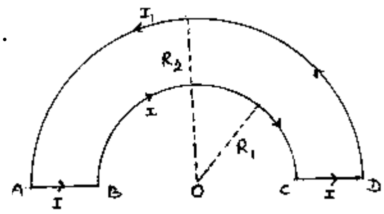
16. A He nucleus makes a full rotation in a circle of radius 0.8 meter in 2 sec. The value of the mag. field B at the centre of the circle will be .... Tesla.

(a) $\frac{10^{-19}}{\mu_o}$ (b) $10^{-19}\ \mu_o$

(c) $2 \times 10^{-10}\ \mu_o$ (d) $\frac{2 \times 10^{-10}}{\mu_o}$

17. The magnetic field at pt. "O" in the figure shown is ....

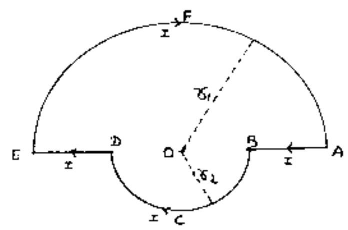
Where AB = CD = 2 cm
$R_1 = 10$ cm
$R_2 = 12$ cm
I = 4 Amp



(a) $\frac{5}{3}\ \mu_o$ going inside (b) $\frac{5}{3}\ \mu_o$ going outside

(c) $\frac{3}{5}\ \mu_o$ going inside (d) $\frac{5}{3}\ \mu_o$ going outside

18. As shown in Fig. there are two semicircles of radii $r_1 = 12$ cm and $r_2 = 10$ cm in which 4 Amp current is flowing The mag. field at the centre "O" is ....



(a) $\frac{55}{3}\ \mu_o$ going inside (b) $\frac{3}{55}\ \mu_o$ going outside

(c) $\frac{6}{55}\ \mu_o$ going inside (d) $\frac{12}{55}\ \mu_o$ going inside

19. The direction of mag. field lines close to a straight conductor carrying current will be ....
    (a) Along the length of the conductor
    (b) Radially outward
    (c) Circular in a plane perpendicular to the conductor
    (d) Helical

20. Due to 10 Amp of current flowing in a circular coil of 10 cm radius, the mag. field produced at its centre is $\pi \times 10^{-3}$ Tesla. The number of turns in the coil will be
    (a) 5000 (b) 100 (c) 50 (d) 25

21. There are 50 turns / cm in a long solenoid. If 4 Amp current is flowing in the solenoid, the approximate value of mag. field along its axis at an internal point and one end will be respectively.
    (a) 12.6×10^{-3} Tesla ; 6.3×10^{-3} tesla
    (b) 12.6×10^{-3} Tesla ; 25.1×10^{-3} tesla
    (c) 25.1×10^{-3} Tesla ; 12.6×10^{-3} tesla
    (d) 25.1×10^{-5} Tesla ; 6.3×10^{-5} tesla

22. The distance at which the magnetic field on axis as compared to the mag. field at the centre of the coil carrying current I and radius R is $\frac{1}{8}$, would be
    (a) R (b) $\sqrt{2}$ R (c) 2R (d) $\sqrt{3}$ R

23. In a H-atom, an electron moves in a circular orbit of radius 5.2×10^{-11} meter and produces a mag. field of 12.56 Tesla at its nucleus. The current produced by the motion of the electron will be .... Amp.
    (a) 6.53×10^{-3} (b) 13.25×10^{-10}
    (c) 9.6×10^{6} (d) 1.04×10^{-3}

24. A conducting rod of 1 meter length and 1 kg mass is suspended by two vertical wires through its ends. An external magnetic field of 2 Tesla is applied normal to the rod. Now the current to be passed through the rod so as to make the tension in the wires zero is [take g = 10 ms^{-2}]
    (a) 0.5 Amp (b) 15 Amp (c) 5 Amp (d) 1.5 Amp

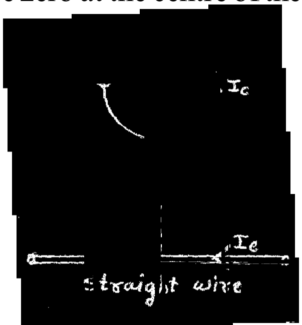
25. A straight wire of mass 200 gm and length 1.5 meter carries a current of 2 Amp. It is suspended in mid-air by a uniform horizontal magnetic field B. [take g = 10 m/s^2]. The B is ....
    (a) $\frac{2}{3}$ tesla (b) $\frac{3}{2}$ tesla (c) $\frac{20}{3}$ tesla (d) $\frac{3}{20}$ tesla

26. A long solenoid has 200 turns per cm and carries a current of 2.5 Amp. The mag. field at its centre is .... tesla.
    (a) $\pi \times 10^{-2}$ (b) $2\pi \times 10^{-2}$ (c) $3\pi \times 10^{-2}$ (d) $4\pi \times 10^{-2}$

27. Two concentric co-planar circular Loops of radii r_1 and r_2 carry currents of respectively I_1 and I_2 in opposite directions. The magnetic induction at the centre of the Loops is half that due to I_1 alone at the centre. If $r_2 = 2r_1$ the value of $\frac{I_2}{I_1}$ is

(a) 2 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) 1

28. Circular loop of a wire and a long straight I_C, I_E respectively as shown in fig. Assuming that these are placed in the same plane. The mag. field will be zero at the centre of the Loop when separation H is ....



(a) $\frac{I_e R}{I_c \pi}$ (b) $\frac{I_c R}{I_e \pi}$

(c) $\frac{\pi I_c}{I_e R}$ (d) $\frac{I_e . \pi}{I_c R}$

29. For the mag. field to be maximum due to a small element of current carrying conductor at a point, the angle between the element and the line joining the element to the given point must be

(a) 0° (b) 90° (c) 180° (d) 45°

30. When a certain length of wire is turned into one circular Loop, the magnetic induction at the centre of coil due to some current flowing is B_0. If the same wire is turned into three Loops to make a circular coil, the magnetic induction at the centre of this coil for the

(a) B_0 (b) $9\ B_0$ (c) $3\ B_0$ (d) $27\ B_0$

31. A long straight wire carrying current of 30 Amp is placed in an external uniform mag. field of induction 4×10^{-4} tesla. The mag. field is acting parallel to the directon of current. The magnitude of the resultant magnetic induction in tesla at a point 2 cm away from the wire is .... tesla.

(a) 10^{-4} (b) 3×10^{-4} (c) 5×10^{-4} (d) 6×10^{-4}

32. Two similar coils are kept mutually perpendicular such that their centres coinside. At the centre, find the ratio of the mag. field due to one coil and the resultant magnetic field by both coils, if the same current is flown.

(a) $1 : \sqrt{2}$ (b) $1 : 2$ (c) $2 : 1$ (d) $\sqrt{3} : 1$

33. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular Loop of n turns. The magnetic field at the centre of the coil for same current will be.

(a) nB (b) n^2B (c) 2nB (d) $2n^2B$

34. The mag. field due to a current carrying circular Loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is $54\,\mu T$ what will be its value at the centre of the LOOP.

(a) $250\,\mu T$ (b) $150\,\mu T$ (c) $125\,\mu T$ (d) $75\,\mu T$

35. When the current flowing in a circular coil is doubled and the number of turns of the coil in it is halved, the magnetic field at its centre will become

(a) Four times (b) Same (c) Half (d) Double

36. Two wires of same length are shaped into a square and a circle. If they carry same current, ratio of the magnetic moment is

(a) $2 : \pi$ (b) $\pi : 2$ (c) $\pi : 4$ (d) $4 : \pi$

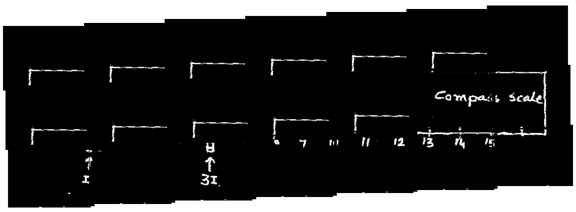
37. Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3 Amp and 4 Amp are the currents flowing in each coil respectively. The magnetic field intensity at the centre of the coils will be .... Tesla.

(a) 5×10^{-5} (b) 7×10^{-5} (c) 12×10^{-5} (d) 10^{-5}

38. Two parallel long wires A and B carry currents I_1 and I_2. ($I_2 < I_1$) when I_1 and I_2 are in the same direction the mag. field at a point mid way between the wires is $10\ \ T$. If I_2 is reversed, the field becomes $30\mu T$. The ratio $\frac{I_1}{I_2}$ is ....

(a) 1 (b) 2 (c) 3 (d) 4

39. Two parallel long straight conductors are placed at right angle to the meter scale at the 2 cm and 6 cm marks as shown in the figure. If they carry currents I and 3I respectively in the upward direction, then will produce zero magnetic field at



(a) Zero mark (b) 9 cm mark (c) 3 cm mark (d) 7 cm mark

40. A long solenoid has 800 turns per meter length of solenoid. A current of 1.6 Amp flows through it. The magnetic induction at the end of the solenoid on its axis is ....tesla.

(a) 16×10^{-4} (b) 8×10^{-4}

(c) 32×10^{-4} (d) 4×10^{-4}

41. A solenoid of 1.5 meter length and 4 cm diameter possesses 10 turn per cm. A current of 5 Amp is flowing through it. The magnetci induction at axis inside the solenoid is

(a) $2\pi \times 10^{-3}$ T (b) $2\pi \times 10^{-5}$ T

(c) $2\pi \times 10^{-2}$ G (d) $2\pi \times 10^{-5}$ G

42. A straight wire of length 30 cm and mass 60 milligrawm lies in a direction 30^0 east of north. The earth's magnetic field at this site is horizontal and has a magnitude of 0.8 G. What current must be passed through the wire so that it may float in air ? $\left(g = 10\ \frac{m}{s^2}\right)$

(a) 10 Amp (b) 20 Amp (c) 40 Amp (d) 50 Amp

43. A long horizontal wire "A" carries a current of 50 Amp. It is rigidly fixed. Another small wire "B" is placed just above and parallel to "A". The weight of wire-B per unit length is $75X10^{-3}$ Newton/meter and carries a current of 25 Amp. Find the position of wire B from A so that wire B remains suspended due to magnetic repulsion. Also indicate the direction of current in B w.r.t. to A.

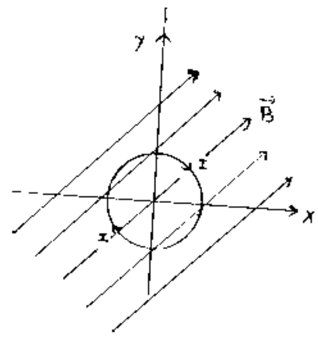
(a) $\frac{1}{2} \times 10^{-2}$ m; in sume direction

(b) $\frac{1}{3} \times 10^{-2}$ m; in mutually opposite direction

(c) $\frac{1}{4} \times 10^{-2}$ m; in same direction

(d) $\frac{1}{5} \times 10^{-2}$ m ; in mutally opposite direction

44. A circular loop of radius R = 20 cm is placed in a uniform magnetic field B = 2 Tesla in xy - Plane as shown in figure. The loop carries a current I = 1 Amp in the direction shown in fig. Find the magnitude of torque acting on the Loop.



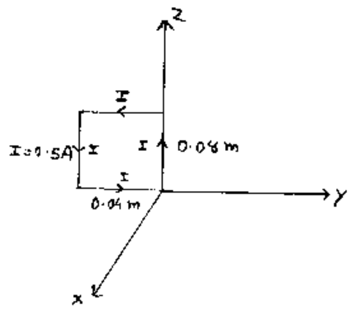
(a) 0.15 N - m

(b) 0.25 N - m

(c) 0.55 N - m

(d) 0.35 N - m

45. The rectangular coil having 100 turns is turned in a uniform mag. field of $\frac{0.05}{\sqrt{2}}\hat{j}$ as shown in the fig. The torque acting on the Loop is ....



(a) 11.32×10^{-4} N.m.$\hat{k}$ (b) 22.64×10^{-4} N.m.$\hat{k}$

(c) 5.66×10^{-5} N.m.$\hat{k}$ (d) zero

46. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform mag. field and desoribe circular path of radius R_1 and R_2 respectively. The ratio of mass of X to that of Y is ....

(a) $\sqrt{\frac{R_1}{R_2}}$ (b) $\frac{R_2}{R_1}$

(c) $\left(\frac{R_1}{R_2}\right)^2$ (d) $\frac{R_1}{R_2}$

47. An electron having mass 9×10^{-31} kg, charge 1.6×10^{-19} C and moving with a velocity of 10^6 m/s enters a region where mag. field exists. If it describes a circle of radius 0.10 m, the intensity of magnetic field must be .... Tesla

(a) 1.8×10^{-4} (b) 5.6×10^{-5}

(c) 14.4×10^{-5} (d) 1.3×10^{-6}

48. A proton and an particle are projected with the same kinetic energy at right angles to the uniform mag. field. Which one of the following statements will be true.

(a) The $\alpha-$ particle will be bent in a circular path with a small radius that for the proton.

(b) The radius of the path of the $\alpha-$ particle will be greater than that of the proton.

(c) The $\alpha-$ particle and the proton will be bent in a circular path with the same radius.

(d) The $\alpha-$ particle and the proton will go through the field in a straight line.

49. A 2 Mev proton is moving perpendicular to a uniform magnetic field of 2.5 tesla. The force on the proton is

(a) 3×10^{-10} N (b) 70.8×10^{-11} N

(c) 3×10^{-11} N (d) 7.68×10^{-12} N

50. A proton is projected with a speed of $2 \times 10^6 \frac{m}{s}$ at an angle of 60^0 to the X-axis. If a uniform mag. field of 0.104 tesla is applied along Y-axis, the path of proton is ....

(a) A circle of $r = 0.2$ m and time period $\pi \times 10^{-7}$ sec

(b) A circle of $r = 0.1$ m and time period $2\pi \times 10^{-7}$ sec

(c) A helix of $r = 0.1$ m and time period $2\pi \times 10^{-7}$ sec

(d) A helix of $r = 0.2$ m and time period $4\pi \times 10^{-7}$ sec

51. A charged particle moves in a uniform mag. field. The velocity of the particle at some instant makes an acute angle with the mag. field. The path of the particle will be

(a) A straight line (b) A circle

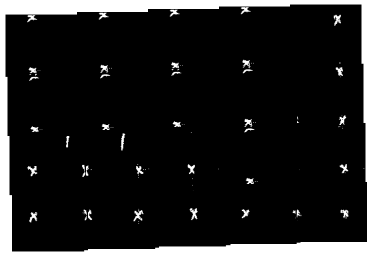
(c) A helix with uniform pitch (d) A helix with non-uniform pitch

52. A, proton, a deuteron and α - an particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and denote respectively the radii of trajectories of these particles, then

(a) $r_\alpha = r_p < r_d$ (b) $r_\alpha > r_d > r_p$

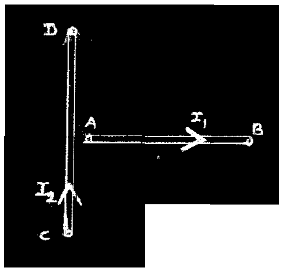
(c) $r_\alpha = r_d > r_p$ (d) $r_p = r_d = r_\alpha$

53. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform mag. field exists perpendicular to this plane. The speeds of the particles are V_A and V_B respectively and the trajectories are as shown in the figure, then.



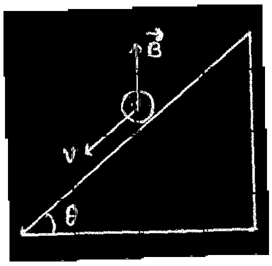
54. An electron and a proton with equal momentum enter perpendicularly into a uniform magnetic then.
   (a) The path of proton shall be more curved than that of electron.
   (b) The path of proton shall be less curved turn that of electron.
   (c) Both are equally curved.
   (d) Path of both will be straight line.

55. A current I, carrying wire AB is placed near an another long wire CD carrying current I_2 As shown in Fig. If free to move, wire AB will have



   (a) rotational motion only
   (b) translational motion only
   (c) rotational as well as translational motion
   (d) neither rotational nor translationed motion

56. A conducting rod of length ? [cross-section is shown] and mass m is moving down on a smooth inclined plane of inclination θ with constant speed v. A vertically upward mag. field $\vec{B}$ exists in upward direction. The magnitude of mag. field $\vec{B}$ is ....



   (a) $\dfrac{mg \sin\theta}{I\ell}$ (b) $\dfrac{mg\cos\theta}{I\ell}$
   (c) $\dfrac{mg\tan\theta}{I\ell}$ (d) $\dfrac{mg}{I\ell\sin\theta}$

57. A deutron of K. E. 50 kev is describing a circular orbit of radius 0.5 m in a plane perpendicular to magnetic field $\vec{B}$. The K.E. of the proton that describe a circular orbit of radius 0.5 m in the same plane with the same $\vec{B}$ is ....
   (a) 200 kev   (b) 100 kev
   (c) 50 kev   (d) 25 kev

58. A magnetic field existing in a region is given by $\vec{B} = Bo\left[1 + \frac{x}{\ell}\right]\hat{k}$. A square Loop of side l and carrying current I is placed with edges (sides) parallel to X-Y axis. The magnitude of the net magnetic force experienced by the Loop is ....
   (a) $2BoI\ell$ (b) $\frac{1}{2}B_OI\ell$
   (c) $BoI\ell$ (d) $BI\ell$

59. The forces existing between two parallel current carrying conductors is F. If the current in each conductor is doubled, then the value of force will be

(a) 2F (b) 4F (c) 5F (d) $\frac{F}{2}$

60. At a given place the horizontal componnent of earth's field is 0.2 G. If a vertical wire carries a current of 30 Amp upward, what is the magnitude and direction of the force on 1 meter of wire ?

(a) 6 E to W (b) 6×10^{-3} E to W

(c) 6×10^{-3} E to W (d) 6×10^{-4} E to W

61. A Galvanometer has a resistance G and 9 current I_G flowing in it produces full scale deflection. S_1 is the value of the shunt which converts it into an ammeter of range 0 to I and S_2 is the value of the shunt for the range 0 to 2I. The ratio $\frac{S_1}{S_2}$ is ....

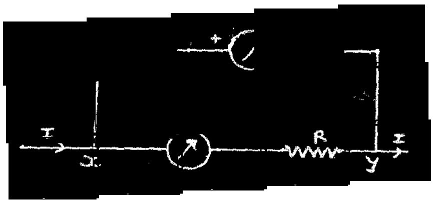
(a) $\frac{2I - I_G}{I - I_G}$ (b) $\frac{1}{2}\left(\frac{I - I_G}{2I - I_G}\right)$

(c) 2 (d) 1

62. A student connect a moving coil voltmeter V and 9 moving coil Ammeter A and resistor R as shown in figure ? If the voltmeter reads 10 volt and the ammeter reads 2 Amp then R is ....

(a) $= 5\,\Omega$ (b) $> 5\,\Omega$

(c) $< 5\Omega$ (d) 10Ω



63. The deflection in a Galvanometer falls from 50 division to 20 when 12Ω shunt is applied. The Galvanometer resistance is ....

(a) 18Ω (b) 36Ω (c) 24Ω (d) 30Ω

64. In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an ele. potential V and then made to describe semicircular paths of radius R using *a* magnetic field B.If V and B are kept constant, the ratio $\frac{\text{Charge on the ion}}{\text{mass of the ion}}$ will be proportional to.

(a) $\frac{1}{R^2}$ (b) R^2 (c) R (d) $\frac{1}{R}$

65. A Galvanometer of resistance 50Ω is connected to a battery of 3 volt along with a resistance of 2950Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be

(a) 6050Ω (b) 4450Ω (c) 5050Ω (d) 5550Ω

66. A Galvanometer coil has a resistance of $15\,\Omega$ and gives full scale deflection for a current of 4 mA. To convert it to an ammeter of range 0 to 6 Amp....................

(a) $10\,m\Omega$ resistance is to be connected in parallel to the galvanometer.

(b) $10\,m\Omega$ resistance is to be connected in series with the galvanometer.

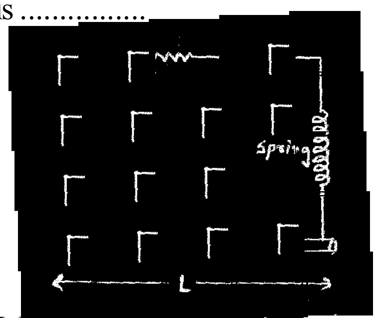
(c) $0.1\,\Omega$ resistance is to be connected in parallel to the galvanometer.

(d) $0.1\,\Omega$ resistance is to be connected in series with the galvanometer.

67. The deflection in moving coil Galvanometer is reduced to half when it is shunted with a $40\,\Omega$ coil. The resistance of the Galvanometer is ....

(a) $60\,\Omega$ (b) $10\,\Omega$ (c) $40\,\Omega$ (d) $20\,\Omega$

68. A straight rod of mass m and length L is suspended from the two idential springs as shown in figure. The spring is streched a distawnce y_0 due to the weight of the wire. The circuit has total resistance R. when the magnetic field perpendicular to the plane of paper is switched on, springs are observed to extend further by the same distance y_0 the magnetic strength is ....



(a) $\frac{2mgR}{LV}$ (b) $\frac{mgR}{LV}$

(c) $\frac{mgR}{2LV}$ (d) $\frac{mgR}{V}$

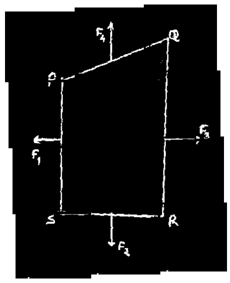
69. A conducting circular loop of radius a carries a constant current I. It is placed in a uniform magnetic field $\vec{B}$, such that $\vec{B}$ is perpendicular to the plane of the Loop. The magnetic force acting on the Loop is ....

(a) $\vec{B}Ir$ (b) $\vec{B}I\pi r^2$ (c) Zero (d) $BI(2\pi r)$

70. Two thin long parallel wires separated by a distance Y are carrying a current I Amp each. The magnitude of the force per unit length exerted by one wire on their is ....

(a) $\frac{\mu o I^2}{Y^2}$ (b) $\frac{\mu o I^2}{2\pi Y}$ (c) $\frac{\mu o}{2\pi}\frac{I}{Y}$ (d) $\frac{\mu o}{2\pi}\frac{I}{Y^2}$

71. A closed Loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segment PS, SR and RQ are F_1, F_2 and F_3 respectivley and are in the plane of the paper and along the directions shown, the force on the segment QP is ....



(a) $\sqrt{(F_3 - F_1)^2 - F_2^{\,2}}$ (b) $F_1 - F_2 + F_3$

(c) $-F_1 + F_2 + F_3$ (d) $\sqrt{(F_3 - F_1)^2 + F_2^{\,2}}$

72. If two streams of protons moive parallel to each other in the same direction, then they
    (a) Do not exert any force on each other
    (b) Repel each other
    (c) Attract each other
    (d) Get rotated to be perpendicular to each other.

73. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current I in the triangle a torque τ acts on it, the side l of the triangle is ....

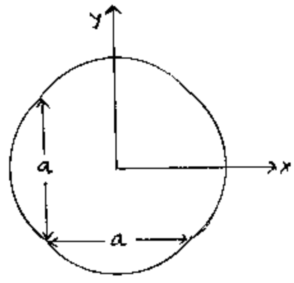
    (a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{BI}\right)^{\frac{1}{2}}$ (b) $\frac{2}{3}\left(\frac{\tau}{BI}\right)$

    (c) $2\left(\frac{\tau}{\sqrt{3}BI}\right)^{\frac{1}{2}}$ (d) $\frac{1}{\sqrt{3}}\ \frac{\tau}{BI}$

74. In a moving coil galvanometer, the deflection of the coil θ is related to ele. current I by the relation.
    (a) $I \alpha \tan\theta$ (b) $I \alpha \theta$
    (c) $I \alpha \theta^2$ (d) $I \alpha \sqrt{\theta}$

75. The unit of ele. current "AMPEAR" is the current which when flowing through each of two parallel wires spaced 1 meter apart in vaccum and of infinite length will give rise to a force between them equal to .... N/m.
    (a) 1   (b) 2×10^{-7}
    (c) 1×10^{-2} (d) $4\pi \times 10^{-7}$

76. A Loop carrying current I lies in XY - plane as shown in the figure. The unit vector $\hat{k}$ is comming out of the plane of the paper. The magnetic moment of the current Loop is..................



    (a) $Ia^2\hat{k}$ (b) $\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$
    (c) $-\left(\frac{\pi}{2}+1\right)a^2 I\hat{k}$ (d) $(2\pi+1)a^2 I\hat{k}$

77. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii "a" and "b" respectively. When a current I passes through the coil, the magnetic field at the centre is ....

    (a) $\frac{\mu_o NI}{b}$ (b) $\frac{2\mu_o NI}{a}$

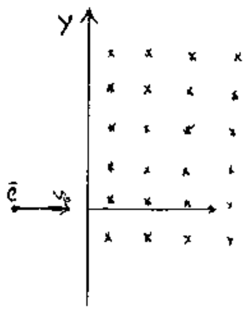
    (c) $\frac{{}_0 NI}{2\ (b\text{-}a)}\ ln\left(\frac{b}{a}\right)$ (d) $\frac{0}{2NI(b\text{-}a)}\ ln\ (ab)$

78. A particle of mass m and charge q moves with a constant velocity ν along the positive x - direction. It enters a region containing a uniform magnetic field B directed along the negative z-direction, extending from x = a to x = b. The minimum value of required so that the particle can just enter the region x > b is

(a) $\frac{qbB}{m}$ (b) $q(b-a)\frac{B}{m}$

(c) $\frac{qaB}{m}$ (d) $q(b+a)\frac{B}{2m}$

79. An electron moving with a speed along the positive x-axis at y = 0 enters a region of uniform magnetic field $\vec{B} = -Bo\hat{k}$ which exists to the right of y - axis. The electron exits from the region after some time with the speed at co-ordinate y then.



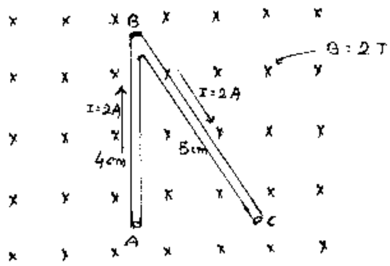
(a) $\nu > v_o, y < 0$

(b) $\nu = v_o, y > 0$

(c) $\nu > v_o, y > 0$

(d) $\nu = v_o, y < 0$

80. A uniform conducting wire ABC has a mass 10 gram. A 2 Amp current is flowing through it. The wire is kept in uniform magnetic field B = 2 tesla the acceleration of the wire will be



(a) zero

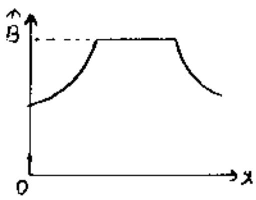
(b) 12 m/s² along y - axis

(c) $1.2 \times 10^{-3}\ \frac{m}{s^2}$ along y - axis

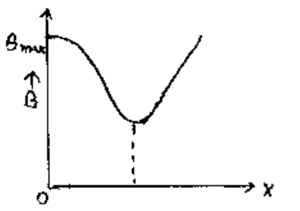
(d) $0.6 \times 10^{-3}\ \frac{m}{s^2}$ along y - axis

81. The correct curve between the magnetic induction (B) along the axis of a long solenoid due to current flow 1 in it and distance x from one end is

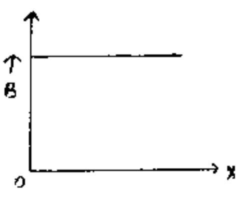
(a)



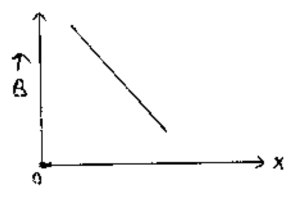
(b)



(c)



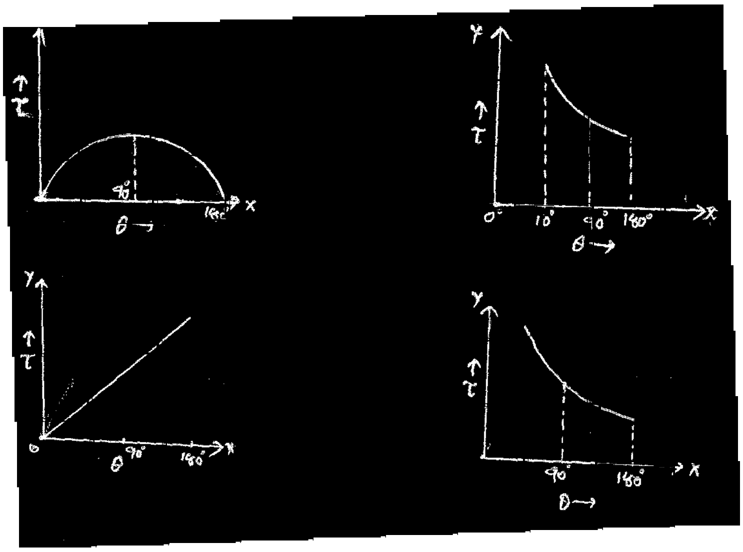
(d)



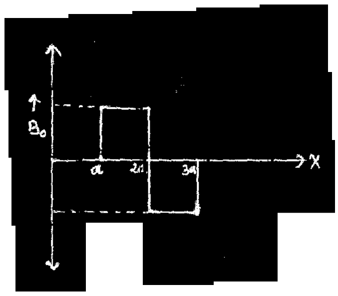
82. When any coil is placed in a uniform mag. field torque is acting on it. The graph of $\tau \to \theta$ is

(a)

(c)

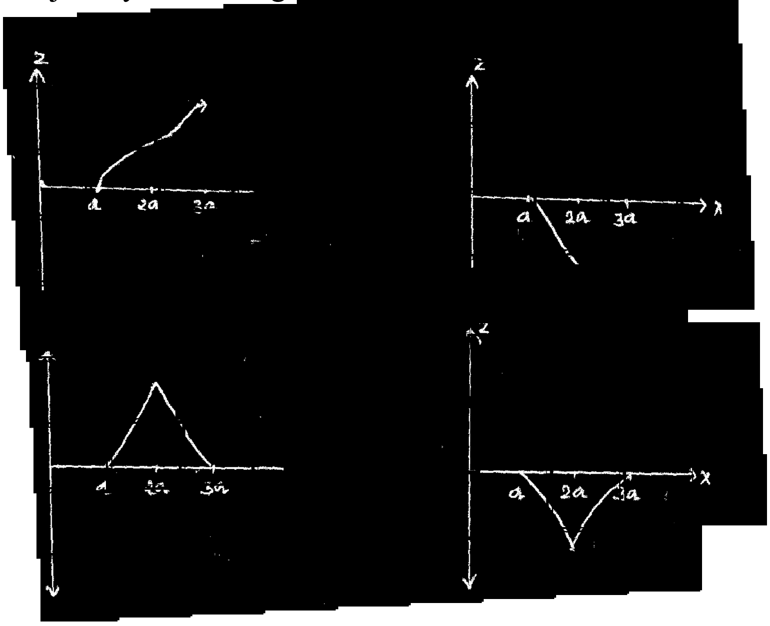


83. A magnetic field $\vec{B} = B_o\hat{j}$ exists in the region $a < x < 2a$ and $\vec{B} = -B_o\hat{j}$ in the region $2a < x < 3a$ where Bo is a positive constant. A positive point charge moving with a velocity $\vec{V} = V_o\uparrow$, where Vo is a positive constant, enters the magnetic field at $x = a$. The trajectory of the charge in this region can be like



(a)

(c)

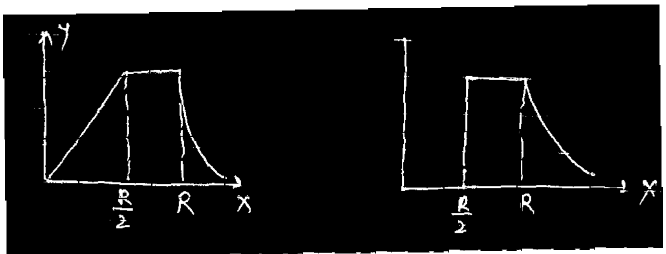


84. Graph of force per unit length between two long parallel current carrying conductors and the distance between them is ....

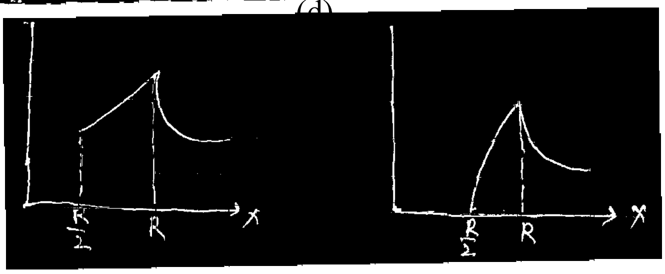
(a) Straight line
(b) Parabola
(c) Ellipse
(d) Rectangular hyperbola

85. An infinitely long hollow conducting cylinder with inner radius $\frac{R}{2}$ and outer radius R carries a uniform current density along its length. The magnitude of the magnetic field $|\vec{B}|$ as a function of the radial distance r from the axis is best represented by

(a)

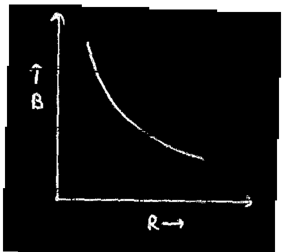


(c)

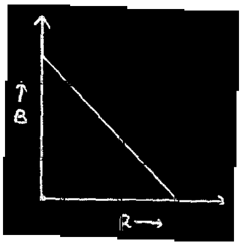


86. A charge Q is uniformly distributed over the surface of non-conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing tarough its centre with an angular velocity co. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure.

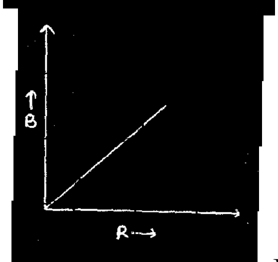
(a)



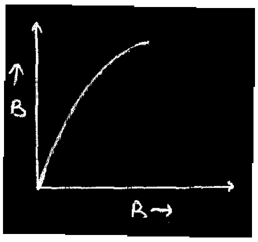
(b)



(c)

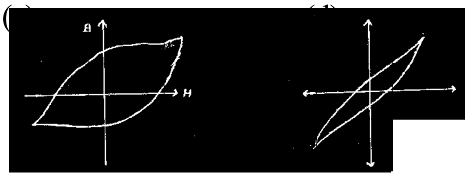


(d)



87. For substances hysteresis B-H curves are given as shown in the figure. For making temporary magnet which of the following group is best.

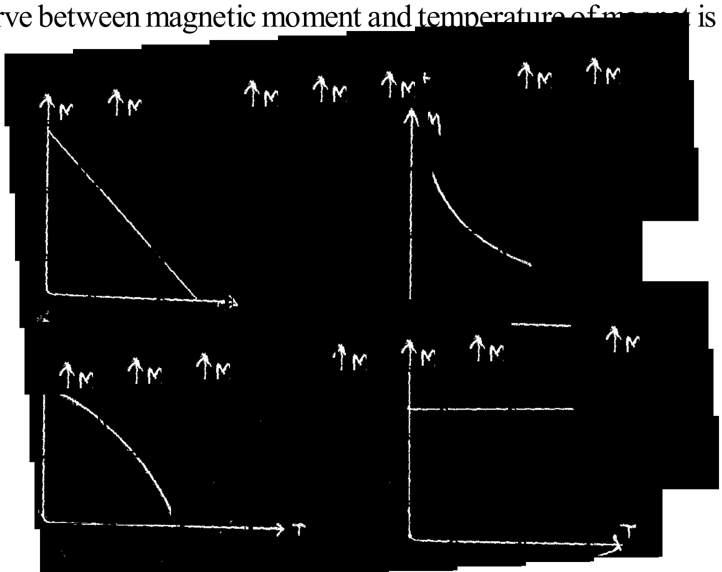
(a)



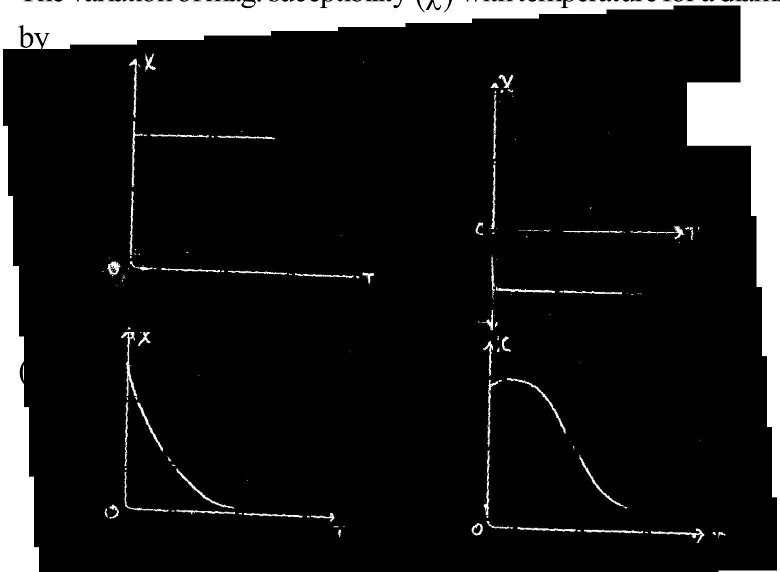
88. A curve between magnetic moment and tempera is

(a)

(c)



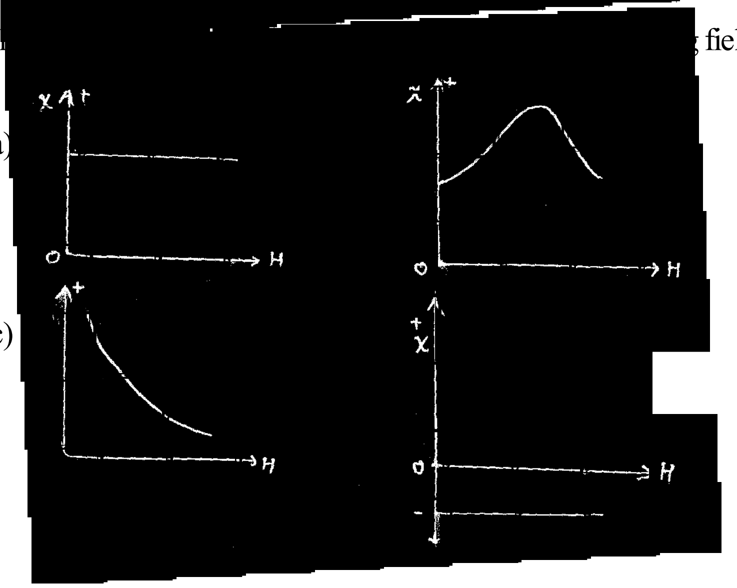
89. The varia mag. suceptibility (χ) with temperature for a diamagnetic substance is best represented by



90. T field for a paramognetic substance is

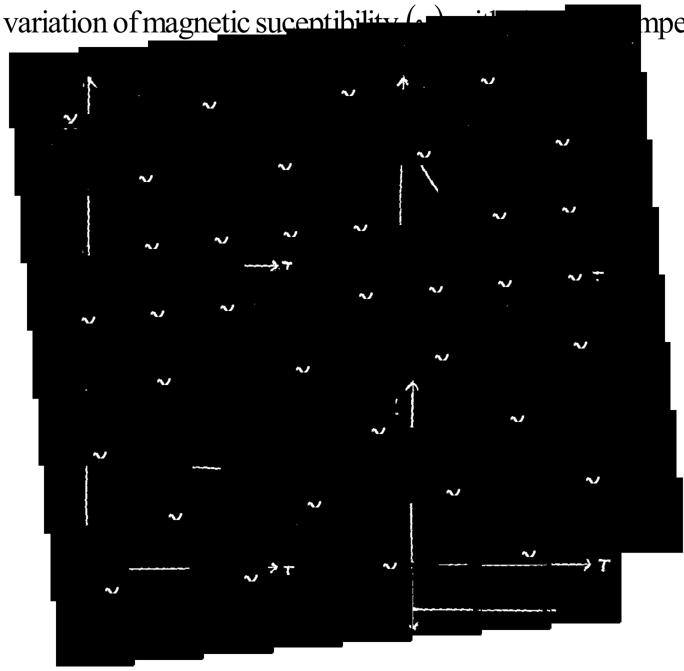
(a)

(c)



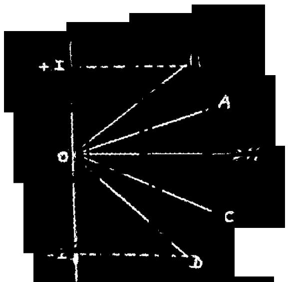
91. The variation of magnetic suceptibility ... mperature T for a termomagnetic material is

(a)



(c)

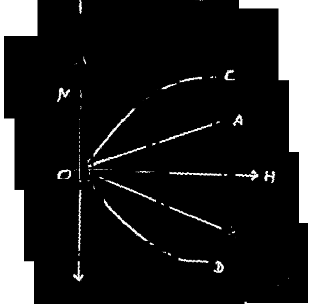
92. The variation of the intensity of magnetisation (I) with respect to the magnetising field (H) in a diamagnetic substance is described by the graph



(a) OD (b) OC

(c) OB (d) OA

93. The most appropriate magnetization M $\rightarrow$ magnetising field H curve for a paramagnetic substance is



(a) A (b) B

(c) C (d) D

94. An iron rod of length L and magnetic moment M is bent in the form o ... ircle. Now its magnetic moment will be

(a) M (b) $\frac{2M}{\pi}$

(c) $\frac{M}{\pi}$ (d) $M\pi$

95. Unit of magnetic Flux density is ....

(a) Tesla (b) $\frac{\text{Weber}}{\text{meter}^2}$

(c) $\frac{\text{Newton}}{\text{Amp} - \text{meter}}$ (d) All of the above

96. Magnetic intensity for an axial point due to a short bar magnet of magnetic moment M is given by

(a) $\frac{{}_{o}}{4\pi}\frac{M}{d^3}$ (b) $\frac{{}_{o}}{4\pi}\frac{M}{d^2}$

(c) $\frac{{}_{o}}{2\pi}\frac{M}{d^3}$ (d) $\frac{{}_{o}}{2\pi}\frac{M}{d^2}$

97. A magnet of magnetic moment M and pole strength m is divided in two equal parts, then magnetic moment of each part will be

(a) M (b) $\frac{M}{2}$

(c) $\frac{M}{4}$ (d) 2 M

98. If a magnet of pole strength m is divided into four parts such that the length and width of each part is half that of initial one, then the pole strength of each part will be

(a) $\frac{m}{4}$ (b) $\frac{m}{2}$

(c) $\frac{m}{8}$ (d) 4m

99. The magnetism of magnet is due to
(a) The spin motion of electron
(b) Earth
(c) Pressure inside the earth core region
(d) Cosmic rays

100. The magnetic field at a point x on the axis of a small bar magnet is equal to the at a point y on the equator of the same magnet. The ratio of the distances of x and y from the centre of the magnet is

(a) 2^{-3} (b) $2^{-\frac{1}{3}}$

(c) 2^{3} (d) $2^{+\frac{1}{3}}$

101. The magnetic field due to a short magnet at a point on its axis at a distance x cm from the middle point of the magnet is 200 gauss. The magnetic field at a point on the neutral axis at a distance x cm from the middle of the magnet is .... gauss.

(a) 100 (b) 400

(c) 50 (d) 200

102. A bar magnet having a magnetic moment of $2 \times 10^4\ \mathrm{J\,T^{-1}}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}$ Tesla exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60^0 from the field is

(a) 0.6 J (b) 12 J

(c) 6 J (d) 2 J

103. A magnet of length 0.1 m and pole strength 10^{-4} A.m. is kept in a magnetic field of 30 tesla at an angle of 30^0. The couple acting on it is .... $\times 10^{-4}$ Joule.

(a) 7.5 (b) 3

(c) 1.5 (d) 6

104. In the case of bar magnet, lines of magnetic induction

(a) Start from the North pole and end at the South pole

(b) Run continuously through the bar and outside

(c) Emerge in circular paths from the middle of the bar

(d) Are produced only at the North pole like rays of light from a bulb.

105. A small bar magnet of moment M is placed in a uniform field of H. If magnet makes an angle of 30^0 with field, the torque acting on the magnet is

(a) MH (b) $\frac{MH}{2}$

(c) $\frac{MH}{3}$ (d) $\frac{MH}{4}$

106. The effective length of a magnet is 31.4 cm and its pole strength is 0.5 A.m. The magnetic moment, if it is bent in the form of a semicircle will be ....Amp.m^2.

(a) 0.1 (b) 0.01

(c) 0.2 (d) 1.2

107. A bar magnet of length 10 cm and having the pole strength equal 00.1×10^{-3} to is kept in a magnetic field having magnetic induction (B) equal to $4\pi \times 10^{-3}$ tesla. It makes an angle of 30^0 with the direction of magnefic induction. The value of the torque acting on the magnet is .... Joule.

(a) $2\pi \times 10^{-7}$ (b) $2\pi \times 10^{-5}$

(c) 0.5 (d) 0.5×10^2

108. A small bar magnet has a magnetic moment 1.2 A.m^2. The magnetic field at a distance 0.1 m on its axis will be .... tesla.

(a) 1.2×10^{-4} (b) 2.4×10^{-4}

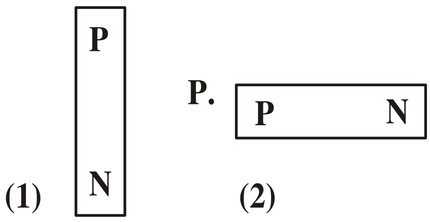
(c) 2.4×10^4 (d) 1.2×10^4

109. Force between two idential bur magnets whose centres are r meter apart is 4.8 N, when their axes are in the same line. If separation is increased to 2r, the force between them is reduced to

(a) 2.4 N (b) 1.2 N

(c) 0.6 N (d) 0.3 N

110. Two equal bar magnets are kept as shown in the figure. The direction of resultant mag. field indicated by arrow head at the point P is approximately



(a) $\longrightarrow$ (b) $\nearrow$

(c) $\searrow$ (d) $\uparrow$

111. A magnet of magnetic moment $50\uparrow$ A.m^2 is placed along the X-axis in a mag. field $\vec{B} = \left(0.5\uparrow + 3.0\hat{j}\right)$ Tesla. The torque acting on the magnet is .... N.m.

(a) $175\hat{k}$ (b) $150\hat{k}$

(c) $75\hat{k}$ (d) $25\sqrt{5}\ \hat{k}$

112. A straight wire currying current I is turned into a circular Loop. If the magnitude of magnetic moment associated with it in MKs unit is M, the length of wire will be

(a) $4\pi M I$ (b) $\sqrt{\dfrac{4\pi M}{I}}$

(c) $\sqrt{\dfrac{4\pi I}{M}}$ (d) $\dfrac{M\pi}{4I}$

113. A bar magnet is 10 cm long and is kept with its North (N) pole pointing North. A neutral point is formed at a distance of 15 cm from each pole. Given the horizontal component of earth's field to be 0.4 Gauss. The pole strength of the magnet is .... A.m.

(a) 9 (b) 6.75

(c) 27 (d) 1.35

114. The true value of angle of dip at a place is 60^0, the apparent dip in a plane inclined at an angle of 30^0 with magnetic meridian is.

(a) $\tan^{-1}\left(\dfrac{1}{2}\right)$ (b) $\tan^{-1}(2)$

(c) $\tan^{-1}\left(\dfrac{2}{3}\right)$ (d) None of these

115. A dip needle lies initially in the magnetic meridian when it shows an angle of dip at a place. The dip circle is roated through an angle x in the horizontal plane and then it shows an angle of dip θ'. Then $\frac{\tan\theta'}{\tan\theta}$ is ....

(a) $\frac{1}{\cos x}$ (b) $\frac{1}{\sin x}$

(c) $\frac{1}{\tan x}$ (d) $\cos x$

116. A dip needle vibrates in the vertical plane perpendicular to the magnetic meridian. The time period of vibration is found to be 2 sec. The same needle is then allowed to vibrate in the horizontal plane and the time period is again found to be 2 sec. Then the angle of dip is

(a) 0^0 (b) 30^0

(c) 45^0 (d) 90^0

117. Two identical short bar magnets, each having magnetic moment M are placed a distance of 2d apart with axes perpendicular to each other in a horizontal plane. The magnetic induction at a point midway between them is.

(a) $\sqrt{2}\,\frac{_o}{4\pi}\frac{M}{d^3}$ (b) $\sqrt{3}\,\frac{\mu_o}{4\pi}\frac{M}{d^3}$

(c) $\sqrt{4}\,\frac{_o}{4\pi}\frac{M}{d^3}$ (d) $\sqrt{5}\,\frac{\mu_o}{4\pi}\frac{M}{d^3}$

118. The magnetic suceptibility of a paramagnetic substance at $-73^\circ C$ is 0.0060, then its value at $-173^\circ C$ will be

(a) 0.0030 (b) 0.0120

(c) 0.0180 (d) 0.0045

119. Needles N_1, N_2 and N_3 are made of a ferrowmagnetic, a paramagnetic and a dia-magnetic substance respectively. A magnet when brought close to them will

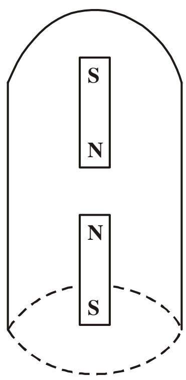
(a) Attract N_1 strongly, N_2 weakly and repd N_3 weakly

(b) Attract N_1 strongly, but repd N_2 and N_3 weakly

(c) Attract all three of them

(d) Attract N_1 and N_2 strongly but repd N_2

120. Two indential bar magnets with a length 10 cm and weight 50 gm weight are arranged freely with their like pole facing in a inverted vertical glass tube. The upper magnet hangs in the between the nearest pole of the magnet is 3 mm. Pole strength of the poles of earth magnet will be .... Amp. meter



(a) 6.64 (b) 2

(c) 10.25 (d) None

121. Susceptibility of one material at 300 k is 1.2×10^{-5}. The temperature at which susceptibility will be 1.8×10^{-5} is .... kelvin.

(a) 450 (b) 200

(c) 375 (d) None

122. Due to a small magnet, intensity at a distance x in the end on position is 9 Gauss. what will be the intensity at a distance $\frac{x}{2}$ on broad side on position.

(a) 9 Gauss (b) 4 Gauss

(c) 36 Gauss (d) 4.5 Gauss

123. A domain in a ferro magnetic substance is in the form of a cube of side length 1 μm. If it contains 8×10^{10} atoms and each atomic dipole has a dipole moment of 9×10^{-24} $A.m^2$ then magnetization of the domain is .... $A.m^{-1}$.

(a) 7.2×10^{5} (b) 7.2×10^{3}

(c) 7.2×10^{-5} (d) 7.2×10^{-3}

124. The magnetic susceptibility is negative for

(a) Paramagnetic materials (b) Diamagnetic materials

(c) Ferromagnetic materials (d) Paramagnetic and ferromagnetic materials

125. When 2 Amp current is passed tarough a tangent galvanometer. It gives a deflection of 30^0. For 60^0 deflaction, the current must be

(a) 1 Amp (b) $2\sqrt{3}$ amp

(c) 4 amp (d) 6 Amp

126. The time period of a freely suspended magnet is a 4 seconds. If it is broken in length into two equal parts and one part is suspended in the same way, then its time period will be

(a) 4 sec (b) 2 sec

(c) 0.5 sec (d) 0.25 sec

127. A thin magnetic needle oscillates in a horizontal plane with a period T. It is broken into n equal parts. The time period of each part will be

(a) T (b) n^2 T

(c) $\frac{T}{n}$ (d) $\frac{T}{n^2}$

128. The plane of a dip circle is set in the geographic meridian and the apparent dip is δ_1. It is then set in a vertical plane per pendicular to the geographic meridian. The appartent dip angle is δ_2. The declination at the place is

(a) $\theta = \tan^{-1}\left(\tan\sqrt{1}\ \ X \tan\sqrt{2}\right)$ (b) $\theta = \tan^{-1}\left(\tan\sqrt{1} + \tan\sqrt{2}\right)$

(c) $\theta = \tan^{-1}\left(\frac{\tan\sqrt{1}}{\tan\sqrt{2}}\right)$ (d) $\theta = \tan^{-1}\left(\frac{\tan\sqrt{2}}{\tan\sqrt{1}}\right)$

129. The coercivity of a bar magnet is 100 A/m. It is to be demagnetised by placing it inside a solenoid of length 100 cm and number of turms 50. The current flowing through the solenoid will be

(a) 4 A (b) 2 A

(c) 1 A (d) Zero

130. The angles of dip at two places are 30^0 and 45^0. The ratio of horizontal components of earth's magnetic field at the two places will be

(a) $\sqrt{3} : \sqrt{2}$ (b) $1 : \sqrt{2}$

(c) $1 : 2$ (d) $1 : \sqrt{3}$

ASSERTION - REASON TYPE
Questions (Neet)

Read the assertion and reason carefully to mark the correct option out of the options given below.

(A) If both assertion and reason are true and the reason is the correct explanation of the asseration.

(B) If both assertion and reason are true but reason is not the correct explaination of the asseration,

(C) If assertion is true but reason is false.

(D) If the assertion and reason both the false.

(E) If assertion is false but reason is true.

131. Assertion : We cannot think of magnetic field configuration with three poles.

Reason : A bar magnet does exert a torque on itself due to its own field.

132. Assertion : If a compass needle be kept at magnetic north pole of the earth, the compass needle may stay in any direction.

Reason : Dip needle will stay vertical at the north pole.

133. Assertion : Dia-magnetic materials can exhibit magnetism.

Reason : Dia-magnetic materials have permanent magnetic dipole moment.

134. Assertion : A paramagnetic sample displays greater magnetisation when it is cooled.

Reason : The magnetisaution does not depend on temperature.

135. Assertion : Two short magnets are placed on a cork which floats on water. The magnets are placed such that the axis of one produced bisects the axis of other at right angles. Then the cork has neither translational nor rotational motion.

Reason : Not force on the cork is zero.

136. Assertion : Cyclotorn does not accelerate electron.

Reason : Mass of the electron is very small.

137. Assertion : Cyclotron is a device which is used to accelerate the positive ion.

Reason : Cyclotron frequency depends upon the veolocity.

138. Assertion : The magnetic field produced by a current carrying solenoid is independent of its length and cross-sectional area

Reason : The magnetic field inside the solenoid is uniform.

139. Asseration : Torque on the coil is the maximum, when coil is suspended in a radial magnetic field.

Reason : The torque tends to rotate the coil on its own axis.

Comprehension Type Questions (For JEE)

Passage - 1

Advanced countries are making use of powerful electro magnets to move trains at very high speed. These trains are called maglev trains. These trains float on a guideway and do not run on steel tail trucks.

Instead of uising an engine based on fossile fuels, they make use of magnetic field forces. The magnetized coil are arranged in the guideway which repel the strong magnets placed in the train's under carriage. This helps train move over the guideway, a technique called electrodynamics suspension. When current passes in the coils guideway, a typical magnetic field is set up between the under carriage of train and guideway which pushes and pulls the train along the guideway depending on the requirement.

The lack of friction and its aerodynamic style allows the train to move at very high speed.

140. The force which makes manglev move is

(a) Gravitational (b) Magnetic

(c) Nuclear forces (d) Air drag

141. The disadvantage of magtev train is

(a) More friction (b) Less pollution

(c) Less wear and tear (d) High initial cost

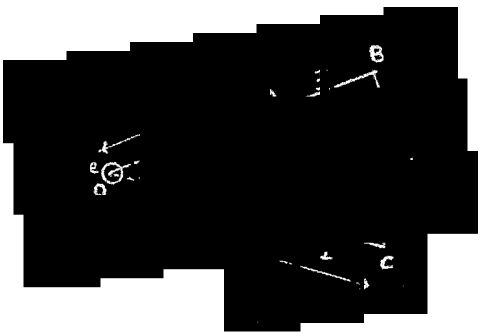
142. The levitation of the train is due to

(a) Mechnical tone

(b) Electros static attraction

(c) Electrostatic repulsion

(d) Magnetic repulsion



Passage - 2

A current Loop ABCD is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the Loop are joined by two straight wires AB and CD. A steady current I is flowing in the Loop. angle made by AB and CD at the origin is 30^0. Another straight thin wire with steady current I_1 flowing out of the plane of the paper is kept at the origin.

143. The magnitude of the magnetic field (B) due to the Loop ABCD at the origin (0) is

(a) zero
(b) $\frac{\mu_o I\ (b - a)}{24\ ab}$
(c) $\frac{\mu_o I\ (b - a)}{4\ \pi\ ab}$
(d) $\frac{{}_oI}{4\ \pi}\left[2\ (b - a) + \frac{\pi}{3}\ (a + b)\right]$

144. Due to the presence of the current I_1 at the origin

(a) The forces on AB and DC are zero.
(b) The forces on AD and BC are zero.
(c) The magnitude of the net force on the looop is given by $\frac{\mu o I\ I_1}{4\pi}\left[2\ (b - a) + \frac{\pi}{3}\ (a + b)\right]$
(d) The magnitude of the net force on the loop is given by $\frac{\mu o I\ I_1}{24\ ab}\ (b - a)$

Matching Type Questions

In each of the following questions, Match column-I and column-II and select the correct match out of the four given choices.

145.

	Coulmn - I		**Coulmn - II**
(A)	Biot-savart's law	(P)	Direction of magnetic field induction
(B)	Right hand thumb rule	(Q)	Magnitude of magnetic field induction
(C)	Fleming's left hand rule	(R)	Direction of induced current
(D)	Fleming's right and rule	(S)	Direction of force due to a mag. field.

(a) $A \rightarrow Q;\ B \rightarrow P;\ C \rightarrow R;\ D \rightarrow S$
(b) $A \rightarrow Q;\ B \rightarrow P;\ C \rightarrow S;\ D \rightarrow R$
(c) $A \rightarrow P;\ B \rightarrow Q;\ C \rightarrow R;\ D \rightarrow S$
(d) $A \rightarrow P;\ B \rightarrow Q;\ C \rightarrow S;\ D \rightarrow R$

146. **Column - I** **Column - II**

(A) Magnetic field induction due to current 1 through straight conductor at a perpendicular distance r. (P) $\frac{\mu_o I}{2r}$

(B) Magnetic field induction at the centre of current (1) carrying Loop of radius (r) (Q) $\frac{\mu_0 I}{4 \pi r}$

(C) Magnetic field induction at the axis of curreint (1) carrying coil of radius (r) at a distance (r) from centre of coil. (R) $\frac{o}{4 \pi} \frac{2I}{r}$

(D) Magnetic field induction at the centre due to circular arc of length r and radius (r) carrying current (I). (S) $\frac{\mu_0}{4\sqrt{2}} \frac{I}{r}$

(a) $A \to R;\ B \to S;\ C \to P;\ D \to Q$

(b) $A \to R;\ B \to P;\ C \to S;\ D \to Q$

(c) $A \to P;\ B \to Q;\ C \to S;\ D \to R$

(d) $A \to Q;\ B \to P;\ C \to R;\ D \to S$

147. **Coulmn - I** **Coulmn - II**

(A) Moving coil Galvanometer (P) Low resistance

(B) Ammeter (Q) Moderate resistance

(C) Voltmeter (R) High, Low or moderate resistance

(D) Avometer (S) High resistance

(a) $A \to P;\ B \to Q;\ C \to R;\ D \to S$

(b) $A \to P;\ B \to Q;\ C \to S;\ D \to R$

(c) $A \to Q;\ B \to P;\ C \to R;\ D \to S$

(d) $A \to Q;\ B \to P;\ C \to S;\ D \to R$

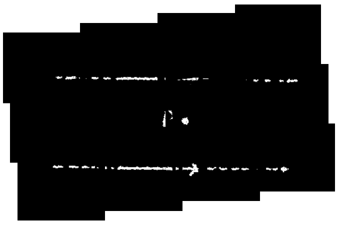
Matrix Match Type Questions

In this section each equation has some statements (A, B, C, D......) given in column-I and some statements (P, Q, R, S, T,.....) in column-II. Any given statement in column-I can have correct matching with ONE OR MORE statements (s) in column-II.

148. Two wires each carrying a steady current - I are shown in four configureations in coulmn-I. Some of the resulting effects are described in coulmn-II. Match the statements in column-I with the statements in column-II.

Coulmn - I

(A)

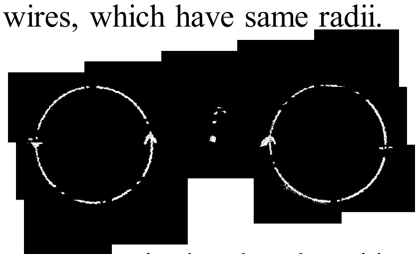


point P is situated midway between the wires

(B)

point P is situated at the midpoint of the line joining the centres of the circular wires, which have same radii.

(C)



point P is situdated at the mid-point of the two Loops.

(D)

point P is situated at the common centre of the wires.

Coulmn - II

(P) The mag. fields at P due to the currents in the wires are in the same direction.

(Q) The magnetic fields at P due to the currents in the wires are in opposite directions.

(R) There is no magnetic field at P.

(S) The wires repel each other.

149. The physical quantities are given in column-I and their various related factors in column-II.

	Coulmn - I		Coulmn - II
(A)	Torque on a coil carrying current when held in a mag. field .	(P)	Restoring torque per unit twist of the suspension strip (K).
(B)	current sensitivity of galvanometer	(Q)	Number of turns in the coil (N)
(C)	voltage sensitivity of galvanometer	(R)	Magnetic field (B)
(D)	figure of merit ofgalvonometer	(S)	Area of the coil (A)

150.

	Coulmn - I		Coulmn - II
(A)	A chared particle moving parallel to direction of mag. field	(P)	undeflected
(B)	Acharged particle moving perpendicular to the direction of magnetic field	(Q)	circular path
(C)	A charged particle moving at an angle in a region of strong mag. field	(R)	Helical path
(D)	A charged particle moving in a strong and uniform electric field of large region	(S)	parabolic path

KEY NOTE

1	B	26	B	51	C	76	B	101	A	126	B
2	C	27	D	52	A	77	C	102	C	127	C
3	D	28	A	53	B	78	B	103	C	128	C
4	B	29	B	54	C	79	D	104	B	129	B
5	D	30	B	55	C	80	B	105	B	130	A
6	C	31	C	56	C	81	A	106	A	131	D
7	B	32	A	57	B	82	A	107	A	132	B
8	A	33	B	58	C	83	A	108	B	133	C
9	C	34	A	59	B	84	D	109	D	134	C
10	C	35	B	60	D	85	D	110	B	135	A
11	D	36	C	61	A	86	A	111	B	136	A
12	A	37	A	62	C	87	D	112	B	137	C
13	C	38	B	63	A	88	C	113	D	138	B
14	A	39	C	64	A	89	B	114	B	139	D
15	D	40	B	65	B	90	A	115	A	140	B
16	B	41	A	66	A	91	A	116	C	141	D
17	A	42	D	67	C	92	B	117	D	142	D
18	A	43	B	68	B	93	A	118	B	143	B
19	C	44	B	69	C	94	B	119	A	144	B
20	C	45	C	70	B	95	D	120	A	145	B
21	C	46	C	71	D	96	C	121	B	146	B
22	D	47	B	72	B	97	B	122	C	147	D
23	D	48	C	73	C	98	B	123	A	148	ઉકેલ જુઓ
24	C	49	D	74	B	99	A	124	B	149	ઉકેલ જુઓ
25	A	50	C	75	B	100	D	125	D	150	ઉકેલ જુઓ

HINT

1. $d\ell = dx = 10^{-2}$ m ; I = 10 Amp ; r = 0.5 m.

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I \, \vec{d\ell} \times \vec{r}}{r^3}$$

$= 4 \times 10^{-8} \hat{k}$ Tesla.

2. Point "P" is lying symmetrically w.r.t.the two long wires

$$B_1 = \frac{\mu_O}{2\pi} \frac{I_1}{a} \; ; \; B_2 = \frac{\mu_O}{2\pi} \frac{I_2}{a}$$

$$B = \sqrt{B_1^2 + B_2^2}$$

$$= \frac{\mu_O}{2\pi \; a} \left(I_1^2 + I_2^2\right)^{\frac{1}{2}}$$

3. mag. field inside the wire $B \propto r$

mag. field outside the wire $B \propto \frac{1}{r}$

4. $\frac{\mu_O}{4\pi} \frac{I}{R} (\theta) = \frac{\mu_O}{4\pi} \times \frac{3}{0.6} \times \frac{\pi}{6} = 2.6 \times 10^{-7}$ T

5. $B_3 = B_5 = B_7 = 0$

$$\vec{B_2} = \frac{\mu_O}{4\pi} \frac{I}{3r} \text{ going inside}$$

$$\vec{B_4} = \frac{\mu_O}{4\pi} \frac{I}{2r} \theta \text{ comming outside}$$

$$\vec{B_6} = \frac{\mu_O}{4\pi} \frac{I}{r} \theta \text{ going inside}$$

$\therefore$ total mag. field $\vec{B} = -\vec{B_2} + \vec{B_4} - \vec{B_6}$

6. $B = N \left(\frac{\mu_O \; I}{2 \; \pi}\right) \Rightarrow B \propto \frac{N}{r} \Rightarrow \frac{B_1}{B_2} = \frac{N_1}{r_1} \times \frac{r_2}{N_2}$

$B_2 = 4B_1$

techanique $B_2 = n^2$ Bl

$= (2)^2$ Bl

$= 4$Bl

7. only outside the pipe

Hollow copper pipe $I = 0$

$$\therefore B = \frac{\mu_O}{2\pi} \frac{I}{r} = 0$$

i.e. Inside mag.fieldis ZERO

8. $B = \frac{\mu_O}{2\pi} \frac{I}{y} \Rightarrow \quad \frac{B_1}{B_2} = \frac{y_2}{y_1}$

$\therefore B \propto \frac{1}{y} \qquad \frac{10^{-8}}{B_2} = \frac{12 \times 10^{-2}}{4 \times 10^{-2}}$

$B_2 = 3.33 \times 10^{-9}$ tesla

9. $B = \frac{\mu_O}{2\pi} \frac{I}{y} \Rightarrow B \propto \frac{1}{y} \Rightarrow \frac{B_1}{B_2} = \frac{y_2}{y_1}$

$\Rightarrow B_2 = 2B_1$

10. $B = \frac{\mu_O I}{2 a} \Rightarrow B \propto I$

11. $\theta_1 = \theta_2 = 0$

$$B = \frac{\mu_O}{4\pi} \frac{I}{y} [\sin\theta_1 + \sin\theta_2]$$

12. I = 5 Amp.

13. (c)

$(B_{Wire})_{r<9} = (B_{Wire})_{r>9}$

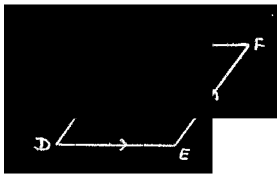
$$\left(\frac{\mu_O I}{2\pi \ 9^2}\right) \frac{9}{2} = \frac{\mu o}{2\pi} \frac{I}{29}$$

$B_1 = B_2$

$\frac{B_1}{B_2} = 1$

14. $B = \frac{\mu o}{2\pi} \frac{I}{y} \Rightarrow B \propto \frac{1}{y} \Rightarrow \frac{B_1}{B_2} = \frac{y_2}{y_1} \qquad \Rightarrow B_2 = 1 \times 10^{-2}$

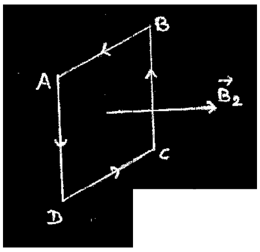
15. CDEF plane is in XY plane



As shown in fig. $\vec{B_1}$ is along +Z axis i.e. $\hat{k}$

ABCD plane is in YZ - plane

$\therefore$ $\vec{B_2}$ is along + x - axis i.e. $\uparrow$



$\therefore$ direction of resultant mag. field is in the direction of P(q, o, a) is along unit vector of $\hat{\imath} + \hat{k}$

$$\frac{\uparrow + \hat{k}}{\left|\uparrow + \hat{k}\right|} = \frac{\uparrow + \hat{k}}{\sqrt{(1)^2 + (1)^2}} = \frac{\uparrow + \hat{k}}{\sqrt{2}}$$

16. $I = \dfrac{Q}{t} = \dfrac{2 \times 1.6 \times 10^{-19}}{2} = 1.6 \times 10^{-19}$ Amp

$$B = \frac{\mu_O}{2a} = \mu_O \times 10^{-19} \text{ Tesla.}$$

17. Mag. field due to ABandCD wire ZERO.

$$B_{BC} = \frac{\mu_O}{4\pi} \frac{I}{R_1} \cdot \theta \quad \text{going inside}$$

$$B_{AD} = \frac{\mu_O}{4\pi} \frac{I}{R_2} \cdot \theta \quad \textit{Outside}$$

$$\therefore \ B = B_{BC} - B_{AD}$$

$$= \frac{\mu_O}{4\pi} I \cdot \theta \left[\frac{1}{R_1} - \frac{1}{R_2} \right]$$

18. Mag.fielddue to ABand DE wire is ZERO.

$$B_{BCD} = \frac{\mu_O}{4\pi} \frac{I}{R_1} \cdot \theta = \frac{\mu_O}{4\pi} \frac{I}{R_1} \times \pi = \frac{\mu_O I}{4 \ R_1}$$

$$B_{EFA} = \frac{\mu_O I}{4 \ R_2}$$

$$\therefore B = B_{BCD} + B_{EFA}$$

$$= \frac{\mu_O I}{4} \left[\frac{1}{R_1} + \frac{1}{R_2} \right]$$

20. $B = N\left(\dfrac{\mu_O I}{2a}\right) \Rightarrow N = 50$

21. $n = 50\,\dfrac{\text{turns}}{\text{cm}} = 5000\,\dfrac{\text{turns}}{\text{meter}}$

$B_{Inside} = \mu_O nI$

$= 25.1 \times 10^{-3}$ tesla

$Bend = \dfrac{\mu_O nI}{2}\left[\sin 0^o + \sin 90^o\right]$

$= \dfrac{\mu_O nI}{2}$

22. $\dfrac{B_1}{B_2} = \left(\dfrac{R^2}{x^2 + R^2}\right)^{\frac{3}{2}}$

$\dfrac{1}{8} = \left(\dfrac{R^2}{x^2 + R^2}\right)^{\frac{3}{2}}$

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

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

$\dfrac{1}{4} = \dfrac{R^2}{x^2 + R^2}$

$x = \sqrt{3}\ R$

23. $B = \dfrac{\mu o I}{2a} \Rightarrow 12.56 = \dfrac{4\pi \times 10^{-7}\,I}{2 \times 5.2 \times 10^{-11}}$

24. $f_{mag} = f_{grav.}$

$BI\ell = mg \quad I = \dfrac{mg}{B\ell} \qquad (\theta = 90^o)$

= 5 Amp.

25. $f_{mag} = f_{gra.}$

$B = \dfrac{mg}{I\ell}$

$= \dfrac{2}{3}$ tesla

26. $B = \mu_O nI = 6.28 \times 10^{-2} = 2\pi \times 10^{-2}$ *tesla*

27. for smaller Loop $B_1 = \frac{\mu_O I_1}{2 r_1}$ ....(1)

for Bigger Loop $B_2 = \frac{\mu_O I_2}{2 r_2}$ ....(2)

but $r_1 < r_2 \Rightarrow B_1 > B_2$

$\therefore B = B_1 - B_2$ ....(3)

$= \frac{\mu_O}{2}\left[\frac{I_1}{r_1} - \frac{I_2}{r_2}\right]$

$B = \frac{\mu_O}{2}\left[\frac{I_1}{r_1} - \frac{I_2}{2r_1}\right]$ $(\because r_2 = 2r_1)$

$B = \frac{1}{2}B_1$ From the data

$\frac{1}{2} B_1 = \frac{\mu_O}{2r_1}\left[I_1 - \frac{I_2}{2}\right]$

$\therefore \frac{I_2}{I_1} = 1$

28. $B_{Loop} = B_{wire}$

$\frac{\mu_O I_C}{2R} = \frac{\mu_O I_e}{2\pi H}$

$\therefore H = \frac{Ie \cdot R}{\pi I_C}$

29. 90^o

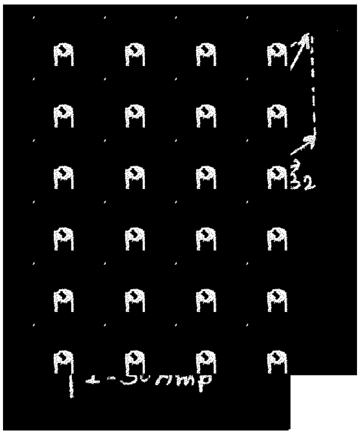
$dB = \frac{\mu_O}{4\pi}\frac{I\, d\ell \sin\theta}{r^2}$

where $\theta = 90^o$; dB becomes maximum

30. $B = n^2 Bo$

$= (3)^2 \; Bo$

$= 9 \; Bo$



31. $B_1 = 4 \times 10^{-4}$ tesla

(parallel to wire)

$$B_2 = \frac{\mu_O}{2\pi} \frac{I}{y}$$

$= 3 \times 10^{-4}$ tesla

$= 5 \times 10^{-4}$ tesla.

32. $$B = B_1 = B_2 = \frac{\mu_O \; I}{2 \; a}$$

$$B_{net} = \sqrt{B_1^{\;2} + B_2^{\;2}}$$

$= \sqrt{2}B$

$$\therefore \frac{B}{B_{net}} = \frac{1}{\sqrt{2}}$$

33. for 1 turn $B = \dfrac{\mu_O \; I}{2 \; r}$ where $\ell = 2\pi r \Rightarrow r = \dfrac{\ell}{2\pi}$

for n turn $B_n = \dfrac{\mu o I}{2 r'}$ where $\ell = n\,(2\pi r')$

$$B_n = n \left(\frac{\mu_O \; I}{2 \; \frac{r}{n}} \right) \qquad r' = \frac{r}{n}$$

$B_n = n^2 B$

34. $$\frac{B\,Centre}{B\,axis} = \left(1 + \frac{x^2}{a^2}\right)^{\frac{3}{2}}$$

$Bcentre = 250\,\mu T$

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35. $B = n\left(\dfrac{\mu_O \ I}{2a}\right)$

$B \ \alpha \ nI$

36. Suppose length of the wire is ℓ

$\text{Asquare} = \left(\dfrac{\ell}{4}\right)\left(\dfrac{\ell}{4}\right) = \dfrac{\ell^2}{16}$

[redacted]

$\therefore$ magnetic moment $M_{\text{Square}} = I\,A_{\text{Square}}$

$= \dfrac{I\ell^2}{16}$

$\ell = 2\pi r \Rightarrow r = \dfrac{\ell}{2\pi}$

$\therefore \ \text{Acircle} = \pi r^2 = \dfrac{\pi\ell^2}{4\pi^2}$

$= \dfrac{\ell^2}{4\pi}$

$\therefore$ magnetic moment $M_{\text{Circle}} = 1\ A_{\text{Circle}}$

$= \dfrac{I\ell^2}{4\pi}$

eq $-(1) \div (2)$

$\dfrac{M_{\text{Square}}}{M_{\text{Circle}}} = \dfrac{\pi}{4}$

37. $B = \sqrt{B_1^{\ 2} + B_2^{\ 2}}$

$= \dfrac{\mu_O}{2\ r}\ \sqrt{I_1^{\ 2} + I_2^{\ 2}}$

$= 5 \times 10^{-5}$ tesla. suppose point "p" is at same r distance from the wires.

38. When I_1 and I_2 are in the same direction

$\dfrac{\mu_O}{2\pi}\ \dfrac{I_1}{r} - \dfrac{\mu_O}{2\pi}\ \dfrac{I_2}{r} = 10 \ \ \mu T$

when $I_1$and I_2 are in the opposite direction

$$\frac{\mu_O}{2\pi}\ \frac{I_1}{r} + \frac{\mu_O}{2\pi}\ \frac{I_2}{r} = 30\ \mu T$$

solve above two equations

$I_1 = 20$ Amp and $I_2 = 10$ Amp

$$\therefore \frac{I_1}{I_2} = 2$$

39. from the fig, the distance between two wires is = (6-2) = 4 cm

$$|B_1| = |B_2|$$

$$\frac{\mu_O}{2\pi}\ \frac{I_1}{x \times 10^{-2}} = \frac{\mu_O}{2\pi}\ \frac{I_2}{(4 - x) \times 10^{-2}}$$

$\therefore$ x = 10 m

$\therefore$ Location of point on sicle = 2 + 1 = 3 cm mark.

40. $$B = \frac{\mu_O n I}{2}\left[\sin 0^o + \sin\frac{\pi}{2}\right] = \frac{\mu o n I}{2} = 8 \times 10^{-4} \text{ tesla.}$$

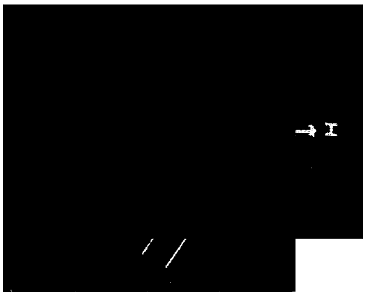
41. $$n = 10\ \frac{\text{turns}}{\text{m}} = 1000\ \frac{\text{turns}}{\text{metre}} \Rightarrow B = \mu_O n I = 2\pi \times 10^{-3} \text{ Tesla}$$

42. $F_{mag} = F_{gravitational}$

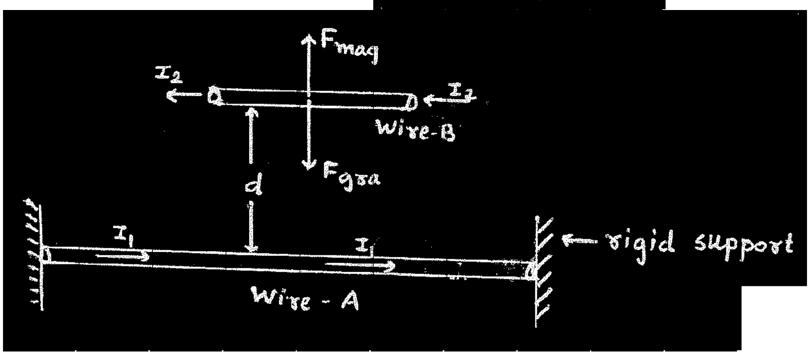
$BI\ell \sin\theta = mg$

$$I = \frac{mg}{B\ell \sin\theta}$$

I = 50 Amp



43.



$$\frac{F_{mag}}{L} = \frac{\mu_O}{2\pi}\ \frac{I_1\ I_2}{d}$$ (acting in upward dir^n)

$$\frac{F_{mag}}{L} = \frac{Mg}{L}$$

$$\frac{\mu_O}{2\pi} \frac{I_1 \; I_2}{d} = \frac{Mg}{L}$$

$$\frac{\mu_O}{2\pi} \frac{I_1 \; I_2}{d} = 75 \times 10^{-3}$$

$$\therefore \; d = \frac{1}{3} \times 10^{-2} \text{ meter}$$

44. magnetic moment $M = IA$

$= (1)\, \pi \, (0.2)^2$

$= 0.04\pi \text{ Amp.m}^2 \; (\perp \text{to the plane Inside})$

$\therefore \; \left|\vec{\tau}\right| = MB\sin\theta$ $\qquad\qquad \theta = \text{Angle bet}^{-n} \text{ M and}$

$= 0.25 \text{ N.m}$

45. mag. moment $\overrightarrow{M} = N\,(IA)\,\hat{n}$

$= 16 \times 10^{-2} \uparrow \text{Amp.m}^2$

$\therefore \; \vec{\tau} = \overrightarrow{M} \times \overrightarrow{B}$

$= 5.66 \times 10^{-5} \, \hat{k}$

46. $r = \sqrt{\dfrac{2mk}{qB}}$

$r \; \alpha \; \sqrt{m} \Rightarrow \dfrac{m_1}{m_2} = \left(\dfrac{R_1}{R_2}\right)^2$

47. $B = \dfrac{m\vartheta}{qr} \Rightarrow 5.6 \times 10^{-5} \text{ tesla}$

48. $r = \sqrt{\dfrac{2mk}{qB}}$

$r \; \alpha \; \dfrac{\sqrt{m}}{q}$ $\qquad\qquad (\because \text{ k. E and B are same})$

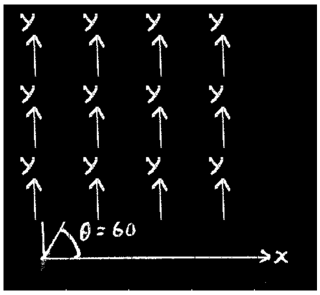
$\dfrac{rp}{r\alpha} = 1 \Rightarrow r_p = r_\alpha$

49. $F = Bqv$

$= Bq\sqrt{\dfrac{2E}{M}}$

$= 7.6 \times 10^{72}$ N

50. path of the proton will be a helix of radius $r = \dfrac{mv\sin\theta}{qB}$



where

θ = Angle bet^{-n} $\vec{B}$ and $\vec{v}$

$\theta = 30^{o}$

r = 0.1 meter

* time period $T = \dfrac{2\pi m}{qB} = 2\pi \times 10^{-7}$ Sec

51. when particle entres at angles other than 0^{o} or 90^{o} or 180^{o}, path followed is helix.

52. $r_p = \dfrac{\sqrt{2mk}}{e.B}$

$r_d = \sqrt{\dfrac{2(2m)k}{eB}} = \sqrt{2}\ r_p$

$r_\alpha = \sqrt{\dfrac{2\ (4m)k}{(2e)\ B}} = r_p$

$r_\alpha = r_p < r_d$

53. $r = \dfrac{mv}{qB} \Rightarrow r\ \alpha\ mv$

$\therefore\ r_A > r_B$

$\therefore\ m_A\ v_A > m_B v_B$

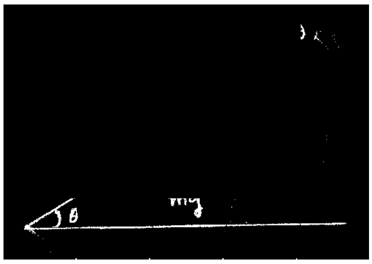
54. $r = \dfrac{mv}{qB}$

since both have same momentum,therefore the circularpath of both will have the same radius.

55. wire ABis placed in non-uniform mag. field generated by CD wire hence ABwire will perform translational and rotational motion.

56. The cross-section of a rod is appears as a circle.

The rod will move with a constant speed v if the net force on the rod is zero.



$$BI\ell \cos\theta = mg \sin\theta$$

$$B = \frac{mg}{I\ell} \frac{\sin\theta}{\cos\theta}$$

$$B = \frac{mg \tan\theta}{I\ell}$$

57. $$r = \frac{\sqrt{2m_1 E k_1}}{Bq_1} = \frac{\sqrt{2m_2 Ek_2}}{Bq_2}$$

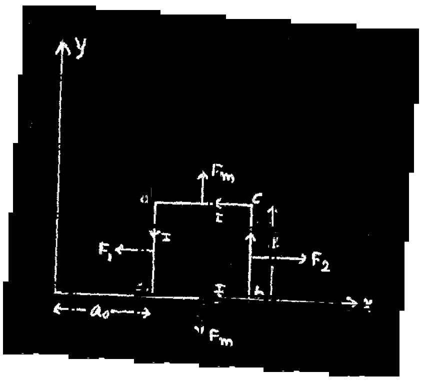
$$Ek_2 = \frac{m_1}{m_2} \frac{q_2}{q_1} Ek_1$$

$$= \frac{2m}{m} \times \frac{q}{q} \times 50 \text{ keV}$$

$$= 2 \times 50$$

$$= 100 \text{ keV}$$

58. The mag. force (Fm) on wire ab and cd is equal and opposite, hencecencelled each other



$$F_1 = F_{ad} = BoI\left[1 + \frac{90}{\ell}\right]\hat{k}$$

$$F_2 = F_{cb} = BoI\left[1 + \frac{90 + \ell}{\ell}\right]\hat{k}$$

$$F = F_1 - F_2$$

$$= Bo.I.\ell$$

59. $$F = \frac{\mu_O}{2\pi} \frac{I_1 \ I_2 \ \ell}{y}$$

$$F \ \alpha \ I_1 \ I_2$$

4 times

60. $F = BI\ell$

$= 6 \times 10^{-4}$ east to west

61. $S_1 = \dfrac{G.\ I_G}{I - I_G}$; $S_2 = \dfrac{G.I_G}{2I - I_G}$

$\therefore \dfrac{S_1}{S_2} = \dfrac{2I - I_G}{I - I_G}$

62. If x is the resistance of ammeter then

$10 = 2\left(x + R\right) \Rightarrow \dfrac{10}{2}\ x + R$

$V = I\left(R\right)\ \ 5 = x + R$

$x = 5 - R$

$\therefore$ x is less than $5\,\Omega$

63. $I = 50$ k ; $I_G = 20$ k
where K = figure of merit

$S = \dfrac{G.\ I_G}{I - I_G}$

$G = 18\,\Omega$

64. ACC to work-energy theorem

$qV = \dfrac{1}{2}\ mv^2$ (for ele. field)

$BqV = \dfrac{mv^2}{R}$ (for mag.field)

$v = \dfrac{BqR}{m}$ ...(2)

sub eq.(2) in (1)

$qV = \dfrac{1}{2}\ m\ \dfrac{B^2 q^2 R^2}{m^2}$

$V = \dfrac{B^2 R^2}{2}\ \dfrac{q}{m}$

$$\frac{q}{m} = \frac{2V}{B^2 R^2}$$

$$\frac{q}{m} \alpha \frac{1}{A^2}$$

65. total initial resistance = G + R

$= 50 + 2950$

$= 3000\,\Omega$

$$\therefore\ I = \frac{V}{G + R} = \frac{3}{3000} = 0.001 \text{ Amp}$$

Let x be the effective resistance of the circuit

$$3 \text{ volt} = 3000 \times 0.001 = x \times \frac{20}{30} \times 0.001$$

$x = 4500\ \Omega$

$\therefore$ resistance to be added = $4500 - 50$

$= 4450\ \Omega$

66. $$S = \frac{G\ I_G}{-I_G} = \frac{4 \times 10^{-3} \times 15}{6 - \left(4 \times 10^{-3}\right)} = 10 \times 10^{-3} = 10\ m\ \Omega$$

above shunt resistance should be connected in parallel

67. $I_G \cdot G = \left(I - I_G\right) \cdot S$

$$G = \frac{\left(I - I_G\right) \cdot S}{I_G} = S = 40\ \Omega$$

68. In absence of mag. field

mg = 2 Kyo ....(1)

From the cct $I = \frac{V}{R}$

$\therefore$ mag. force on the rod $F_m = BI\ell \sin 90^\circ$

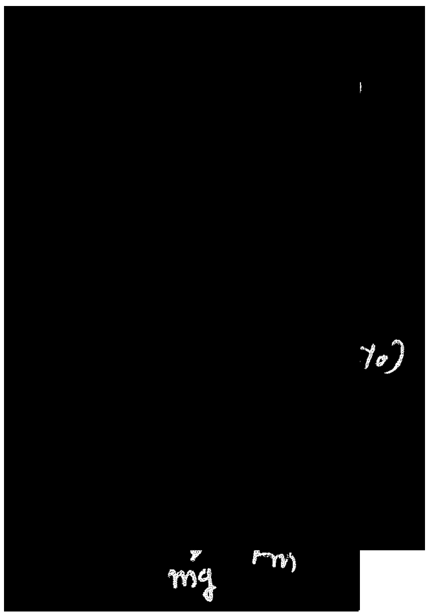
$$= \frac{B\ell V}{R}$$

In presence of mag. field mg + f_m = 4 Kyo ....(2)

Sub Eq. (1) in (2)

$2ky_o + F_m = 4ky_o$

$Fm = 2ky_o$



$$\frac{B\ell V}{R} = 2ky_o$$

$$B = \frac{2ky_o \cdot R}{LV}$$

Sub eq. (1)

$$B = \frac{mgR}{LV}$$

69. Net force on a current carrying closed Loop is alwys zero if it is placed in a uniform mag. field.

70. $F = \frac{\mu o}{2\pi}\frac{I_1 I_2 \ell}{y}$

$$\frac{F}{\ell} = \frac{\mu o}{2\pi}\frac{I.\,I}{y} = \frac{\mu o}{2\pi}\frac{I^2}{y}$$

71. since all the given forces are lying in plane, so the given Loop is in equilibrium.
From the fig.

$$F_4 \cos\theta = F_2$$

$$F_4 \sin\theta = F_3 - F_1$$

$$\therefore\ F_4^2 = (F_4 \cos\theta)^2 + (F_4 \sin\theta)^2$$

$$F_4^2 = (F_2)^2 + (F_3 - F_1)^2$$

$$\therefore\ F_4 = \sqrt{F_2^2 + (F_3 - F_1)^2}$$

72. For charge particles, if they are moving freely in space [illegible] ver mag. force between them. Hence due to ele. force they repel each other.

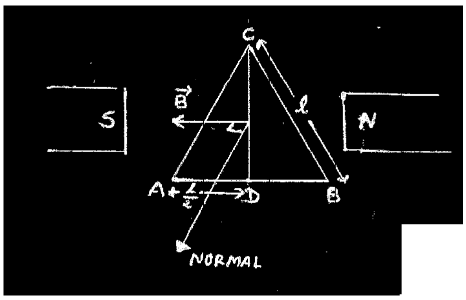
73. In ΔCAD

$$AC^2 = AD^2 + DC^2$$

$$\ell^2 = \frac{\ell^2}{4} + DC^2$$

$$DC = \frac{\sqrt{3}}{2}\ell$$

Area of ΔABC



$$A = \frac{1}{2}(\ell)\left(\frac{\sqrt{3}}{2}\ell\right)$$

$$A = \frac{1}{4}\sqrt{3}\,\ell^2$$

torque acting on ΔABC is

$$\tau = IAB\sin\theta$$

$$= I\left(\frac{1}{4}\sqrt{3}\;\ell^2\right)B\sin\theta$$

$$\theta = 90^o$$

$$\tau = \frac{\sqrt{3}}{4}I\,\ell^2 B$$

$$\therefore\ \ell^2 = \frac{4\tau}{\sqrt{3}IB}$$

$$\therefore \ell = 2\left(\frac{\tau}{\sqrt{3}\,I\,B}\right)^{\frac{1}{2}}$$

74. $\tau = NIAB$ and $\tau = k\theta$

$$\therefore NIAB = k\theta$$

$$I = \left(\frac{k}{NAB}\right)\theta$$

$$\therefore I\ \alpha\ \theta$$

75. $F = \frac{\mu o}{2\pi}\frac{I_1 I_2 \ell}{y}$

$$\frac{F}{\ell} = 2\times10^{-7}\ \frac{N}{m}$$

76. Area of aceq square $=\ a \times 9$

$$= 9^2$$

Now area of 4 semi circles

$$= 4\times\frac{1}{2}\left(\pi\frac{a^2}{4}\right)$$

$= \frac{\pi}{2} a^2$

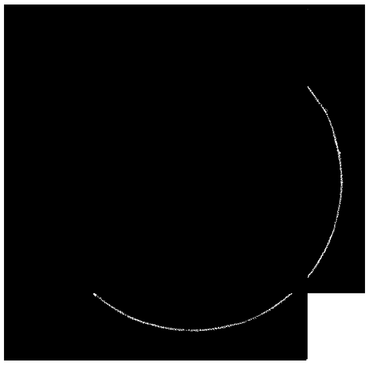
$\therefore$ total Area A = Area of + Area of 4 semi circles square

$= a^2 + \frac{\pi}{2} a^2 \quad = a^2 \left[1 + \frac{\pi}{2} \right]$

$\therefore$ M = IA

$Ia^2 \left[1 + \frac{\pi}{2} \right]^{\hat{k}}$

77. No. of turns per unit width $= \frac{N}{b-a}$



$\therefore$ the no. of turns in thickness dx is $dN = \left(\frac{N}{b-a} \right) dx$

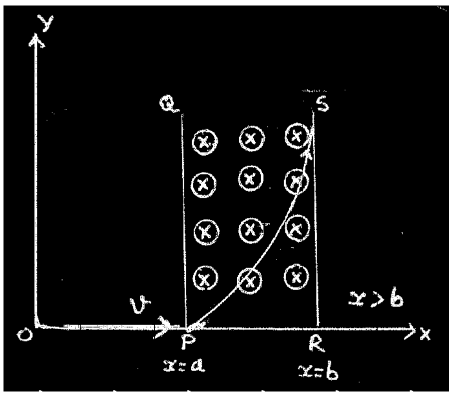
$\therefore$ mag. field at the centre is $dB = dN \left(\frac{\mu_0 I}{2x} \right)$

$dB = \left(\frac{N}{b-a} \right) \frac{\mu_0 I}{2x} . dx$

$\therefore$ total mag. field $B = \int dB$

$= \frac{\mu_0 NI}{2(b-a)} \ n \left(\frac{b}{a} \right)$

78. In the fig. the z-axis points outof the paper and mag. field is direced into the paper represented by



It is present between PQ and RS only

The particle moves in a circular path of radius r in the magnetic field.

It can just enter the region x > 9 for

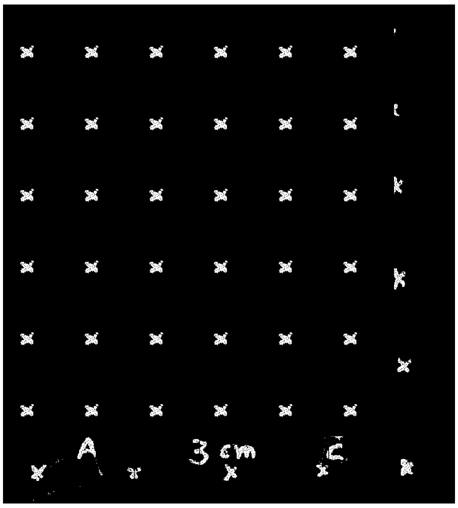
Now $r = \frac{mv}{qB} \geq (b-a)$

$v \geq \frac{(b-a)qB}{m}$

$\therefore v \min = \frac{qB(b-a)}{m}$

79. Electron is performing circular motion so according to work Energy theorem mag. field does not do any work.K.E. remains constant the force on $\bar{e}$ will act along negative y-axis initially in clockwise direction.

$\therefore v = v_0$



80. the AB and BC wire is equivalent to AC wire

$\therefore$ Force acting on AC wire $F = BI\ell \sin\theta$

$= 2\times 2\times 3\times 10^{-2} \sin 90^0$

$F = 12\times 10^{-2}\,N$ along y -axis

$\therefore$ acceleration $a = \dfrac{F}{m}$

$= 12\ m/s^2$

81. mag. field in the middle of the solenoid is maximum.

mag. field is half at the end compare to its value in the middle.

Bend $= \dfrac{1}{2}$ B centre

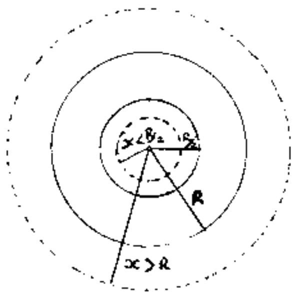
82. $\tau = BINA \sin\theta$

$\tau \rightarrow \sin\theta$

$\therefore \tau \rightarrow \theta$ is a sinusoidal graph

sinusoidal graph

85. Case - 1 $x < \dfrac{R}{2}$



$|\vec{B}| = 0$

Case - 2 $\dfrac{R}{2} \le x < R$

$\int \vec{B}.\vec{d\ell} = \mu_O I \quad \left[\because\ J = \dfrac{I}{A} \quad I = JA\right] oJ$

$|\vec{B}|\,2\pi x = \mu_O JA$

$$\left|\vec{B}\right|2\pi x=\mu_O.J\left[\pi x^2-\pi\left(\frac{R}{2}\right)^2\right]$$

$$\left|\vec{B}\right|=\frac{\mu_O J}{2x}\left[x^2-\frac{R^2}{4}\right]$$

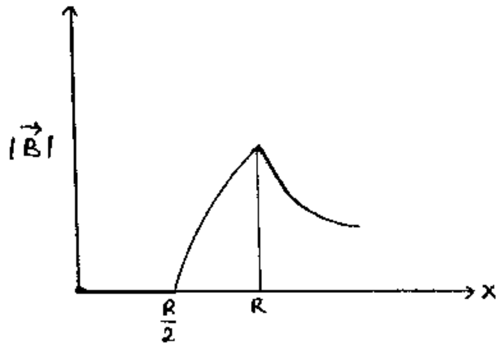
Case - 3 $\quad x \geq R$

$$\int \vec{B}.\vec{dl}=\mu_O JA$$

$$\left|\vec{B}\right|2\pi x=\mu 0J\left[\pi R^2-\pi\left(\frac{R}{2}\right)^2\right]$$

$$=\frac{\mu_O J}{2x}\frac{3}{2}R^2$$

$$=\frac{3\mu_O J}{2x}\frac{3}{2}R^2$$



86. $dB=\frac{\mu_0 I}{2r}$ (mag. field at the centre of the ring)

$$=\frac{\mu_0}{2r}.dq.f$$

$$dB=\frac{\mu_0}{2r}\ dq.\frac{\omega}{2\pi}$$

$$B=\frac{\mu_0\omega}{4\pi}\int\frac{dq}{r}$$

$$=\frac{\mu_0\omega}{4\pi}\int\frac{Q}{\pi R^2}(2\pi r.dr)\frac{1}{r}$$

$$=\frac{\mu_0\omega.Q}{2\pi R^2}\int_{r=0}^{r=R}dr$$

$$=\frac{\mu_0.\omega.Q.}{2\pi R}$$

$$B=\left(\frac{\mu_0\omega.Q.}{2\pi}\right)\frac{1}{R}$$

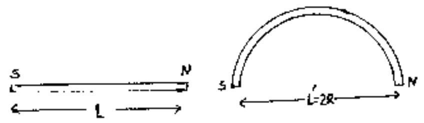
$$B\alpha\frac{1}{R}$$

$\therefore$ Graph - A is true

87. For a temporarymagnet the hysteresis Loop should be long and narrow.
88. Magnetism of a magnet falls with rise of temp and becomes practically zero above curie temperature.
89. For a diamagnetic substance χ is small negative and independent of temperature.
90. For a paramagnetic substance χ is independent is magnetic field.
91. For a ferromagnetic substance sueptibility $\chi = \frac{C}{T - T_C}$

As temp T of substance isincrease its χ is decreasing
92. Intensity of magnetisation of diamagnetic substance is very small and negative
93. For a paramagnetic substance magnetization M is proportional to magnetising field H and M is positive.
94.

On bending a rod its pole strength remains unchanged where as its magnetic moment changes.

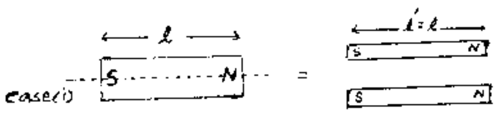


$$M' = m(2R)$$

$$= m\left(2\frac{L}{\pi}\right) \quad = \frac{2}{\pi}mL \quad = \frac{2m}{\pi}$$

95. All of the above

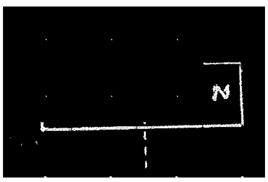
97. Case (i)



If cut along the axis of magnet of length ℓ, then new pole strength $m' = \frac{m}{2}$ and new length $\ell' = \ell$

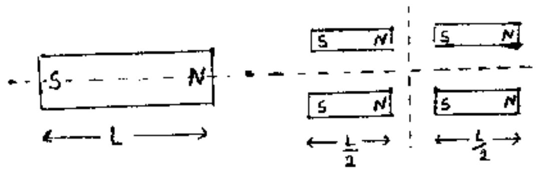
$\therefore$ New magnetic moment $M' = \frac{m}{2} \times \ell = \frac{m\ell}{2} = \frac{M}{2}$

Case (ii)



Ifcut perpendicular to the axis of magnet, then new pole strength $m' = m$ and new length $\ell' = \frac{\ell}{2}$

$\therefore$ New magnetic moment $M' = m \times \frac{\ell}{2} = \frac{m\ell}{2} = \frac{M}{2}$

98. 

For each part $m' = \frac{m}{2}$

99. The spin motion of electron

100. On the axis $B_1 = \frac{2M}{x^3}$

On the equator $B_2 = \frac{M}{y^3}$

As $B_1 = B_2$

$$\frac{2M}{x^3} = \frac{M}{y^3}$$

$$\frac{x^3}{y^3} = 2$$

$$\frac{x}{y} = 2^{\frac{1}{3}}$$

101. On the axis Baxis $= \frac{2M}{x^3}$

$200 \text{ gauss} = \frac{2M}{x^3}$

$100 \text{ gauss} = \frac{M}{x^3}$

$100 \text{ gauss} = \text{Bequator}$

102. $W = MB(1 - \cos\theta)$

$= 2 \times 10^4 \times 6 \times 10^{-4} (1 - \cos 60^\circ)$

$= 6 \text{ Joule}$

103. $\tau = MB \sin\theta$

$= m(2\ell) \times B \sin\theta$

$= 10^{-4} \times 0.1 \times 30 \sin 30^\circ$

$= 1.5 \times 10^{-4}$ Joule

105. $\tau = MH \sin\theta$

$= MH \sin 30^{o}$

$= \dfrac{MH}{2}$

106. 0.1 Amp m^2

107. torque $\tau = MH_H \sin\theta$

$= 2\pi \times 10^{-7}$ Joule

108. $B = \dfrac{\mu 0}{4\pi} \dfrac{2M}{d^3}$

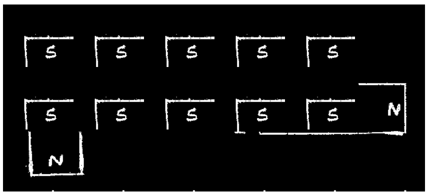
$= 2.4 \times 10^{-4}$ tesla

109. In magnetic dipole, force $\times \dfrac{1}{r^4}$

$\dfrac{F_2}{F_1} = \dfrac{r_1^4}{r_2^4}$

$\dfrac{F_2}{4.8} = \left(\dfrac{r_1}{2r_1}\right)^4$

$= 0.3$ Newton

110. 

111. $\vec{\tau} = \vec{M} \times \vec{B}$

$= 150\,\hat{K}$ N.m

112. Mag. moment of circular Loop carrying current is

$M = IA \quad = I(\pi R^2) \quad = I\pi\left(\dfrac{L}{2\pi}\right)^2$

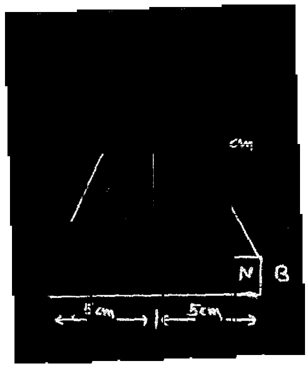
$M = \dfrac{IL^2}{4\pi} \quad \Rightarrow L = \sqrt{\dfrac{4\pi M}{I}}$

113. $L = 10 \times 10^{-2}\,m$

$r = 15 \times 10^{-2}\,m$

$OP = \sqrt{225 - 25}$

$= \sqrt{200}$ cm



since, at theneutral point, magnetic field due to the magnetic equal to B_H

$$B_H = \frac{\mu o}{4\pi} \frac{M}{\left(OP^2 + AO^2\right)^{\frac{3}{2}}}$$

= 1.35 Amp. meter

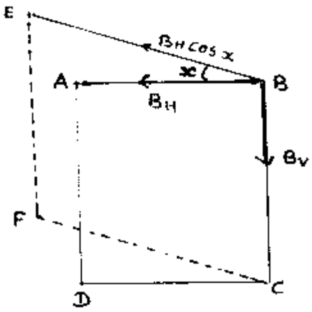
114. $\tan\phi' = \dfrac{\tan\phi}{\cos\beta}$ where ϕ' = Apparent angle of dip

$= \dfrac{\tan 60^o}{\cos 30^o}$ ϕ = true angle of dip

$\tan\phi' = 2$ β = Angle made by vertical plane with magnetic meridian

$\phi' = \tan^{-1}(2)$

115. for ABCD plane



$$\tan\theta = \frac{B_V}{B_H} \quad ......(1)$$

for BCFE plane

$$\tan\theta = \frac{B_V}{B_H \cos x} \quad .....(2)$$

solved the equation 1 and 2.

116. In vertical plane $T = 2\pi\sqrt{\dfrac{I}{MB_V}}$ ...(1)

In horizontal plane $T = 2\pi\sqrt{\dfrac{I}{MB_H}}$ ....(2)

but in both the cause T = 2 sec.

$$\sqrt{\frac{I}{MB_V}} = \sqrt{\frac{I}{MB_H}}$$

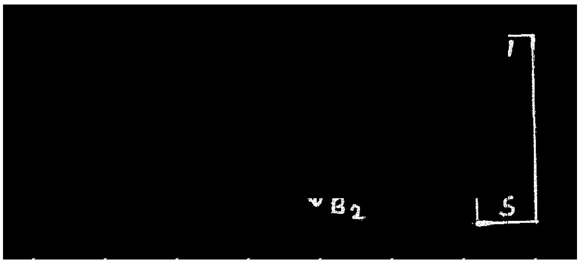
$$\frac{1}{B_V} = \frac{1}{B_H}$$

$$1 = \frac{B_V}{B_H}$$

$$1 = \tan\phi$$

$$\phi = 45^o$$

117. $B_{1\ axis} = \frac{\mu_O}{4\pi} \frac{2M}{d^3}$ ......(1)



$B_{2\ equator} = \frac{\mu_O}{4\pi} \frac{M}{d^3}$ ......(2)

At point P

$B_{resultant} = \sqrt{B_1^2 + B_2^2}$

$= \sqrt{5} \frac{\mu_O}{4\pi} \frac{M}{d^3}$

118. Magnetic suceptibility $\chi_m \alpha \frac{1}{T}$

$\frac{\chi_{m2}}{\chi_{m1}} = \frac{T_1}{T_2}$

$\frac{\chi_{m2}}{0.0060} = \frac{273-73}{273-173}$

$\frac{\chi_{m2}}{0.0060} = \frac{200}{100}$

$\chi_{m2} = 0.0120$

119. ferro magnetic substances, magnetised strongly in the direction of magnetic field.
Para magnetic substances magnetised weakly in the direction of magnetic field.
Diamagnetic substances is magnetised weakly in opposite direction of magnetic field.

120. The repulsive force between tab magnets = weight

$\frac{\mu o}{4\pi} \frac{m_1 m_2}{r^2} = 50$ gm. weight

$10^{-7} \frac{m^2}{9 \times 10^{-6}} = 50 \times 10^{-3} \times 9.8$

$m^2 = \frac{9 \times 10^{-6} \times 50 \times 10^{-3} \times 9.8}{10^{-7}}$

m = 6.64 Amp. meter

121. $\frac{\chi_{m2}}{\chi_{m1}} = \frac{T_1}{T_2}$

$\frac{1.8 \times 10^{-5}}{1.2 \times 10^{-5}} = \frac{300}{T_2}$

$T_2 = 200$ kelvin

122. $B_{axis} = \frac{2M}{x^3} = 9 \ (\text{In CGS})$

$= \frac{M}{x^3} = \frac{9}{2}$

Bequater $= \frac{M}{\left(\frac{x}{2}\right)^3}$

$= 8\frac{M}{x^3}$

$= 8\left(\frac{9}{2}\right)$

$= 36$ Gauss

123. Volume of the domain $= \left(1\times10^{-6}\right)^3 \ m^3$

$= 10^{-18} \ m^3$

$\therefore$ New dipole moment mnet $= Nm$

$= 8\times10^{10}\times9\times10^{-24}$

$= 72\times10^{-14} \ A.m^2$

$\therefore$ Magnetization $M = \frac{m_{net}}{vol}$

$= \frac{72\times10^{-14}}{10^{-18}} \frac{A.m^2}{m^3}$

$= 72\times10^{+4}$

$= 7.2\times10^5$ Amp. meter^{-1}

124. Diamagnetic materials

125. $I \ \alpha \ \tan\phi$

$\frac{I_1}{I_2} = \frac{\tan\phi 1}{\tan\phi 2}$

$\frac{2}{I_2} = \frac{\tan 30^o}{\tan 60^o}$

$I_2 = 6$ Amp.

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126. $T = 2\pi\sqrt{\dfrac{I}{MH_H}} = 4\,\text{sec}$ where $I = \dfrac{1}{12}ML^2$

when magnet is cut into two equal havies, then

new magnet moment $M' = \dfrac{M}{2}$

moment of inertia $I' = \dfrac{1}{12}M'L'^2$

$= \dfrac{1}{12}\left(\dfrac{M}{2}\right)\left(\dfrac{L}{2}\right)^2$

$= \dfrac{1}{8}.\dfrac{1}{12}ML^2$

$I' = \dfrac{I}{8}$

$\therefore$ new time period $T' = 2\pi\sqrt{\dfrac{I'}{M'BH}}$

$= 2\pi\sqrt{\dfrac{\frac{I}{8}}{\left(\frac{M}{2}\right)BH}}$

$= \dfrac{1}{2}2\pi\sqrt{\dfrac{I}{MH}}$

$= \dfrac{T}{2}$

$= \dfrac{4}{2}$ $= 2$ sec.

127. Moment of inertio $I = \dfrac{\text{mass} \times (\text{length})^2}{12}$ $\left(\because I = \dfrac{1}{12}ML^2\right)$

$= \dfrac{1}{n} \times \left(\dfrac{1}{n}\right)^2$

$= \dfrac{1}{n^3}$ time

Magnetic moment M = pole strength × length

$= \dfrac{1}{n}$ time

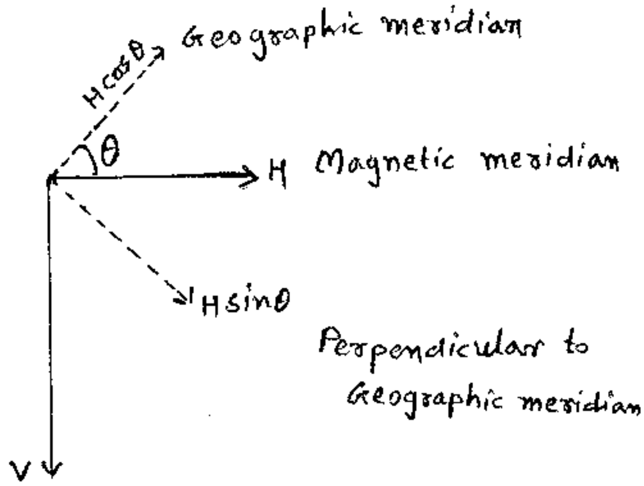
$$T = 2\pi\sqrt{\frac{I}{MH}}$$

$$= \sqrt{\frac{\frac{1}{n^3}}{\frac{1}{n}}} \text{ time}$$

$$= \frac{1}{n} \text{ time}$$

$$\therefore T^1 = \frac{T}{n} \text{ sec.}$$

128. $\tan\delta_1 = \frac{V}{H\cos\theta}$



$$\tan\delta_2 = \frac{V}{H\cos(90^\circ - \theta)} = \frac{V}{H\sin\theta}$$

$$\frac{\tan\delta_1}{\tan\delta_2} = \frac{\sin\theta}{\cos\theta}$$

$$\frac{\tan\delta_1}{\tan\delta_2} = \tan\theta$$

$$\theta = \tan^{-1}\left(\frac{\tan\delta_1}{\tan\delta_2}\right)$$

129. coercivity $H = 100\frac{A}{m}; \ell = 100\,\text{cm} = 1\,\text{m}; n = 50$

As $H = nI \Rightarrow I = \frac{H}{n} = \frac{100}{50} = 2$ Amp.

130. $H_1 = B\cos\delta_1$; $H_2 = B\cos\delta_2$

$$\therefore \frac{H_1}{H_2} = \frac{\cos 30^\circ}{\cos 45^\circ}$$

$$= \frac{\sqrt{3}}{\sqrt{2}}$$

143. There will be nomagnetic field at "0" due to wire AB and CD carrying current "I".

Wire carrying I_1 is also produced zero magnetic field at "0".

Mag. field at "0 due to arc AD" $= \frac{\mu_O I}{24\ ab}(b-a)$

$$= \frac{\mu_O}{4\pi} \frac{(I)\left(\frac{\pi}{6}\right)}{a} \text{ (coming out at pt "0")}$$

Mag. field at "0" due to arc BC $B_2 = \frac{\mu_O}{4\pi} \frac{(I)\left(\frac{\pi}{6}\right)}{b}$ (going inside atpt "0")

$\therefore$ Net mag. field B $B = B_1 - B_2$ (comoing out)

$$= \frac{\mu_O}{4\pi} \frac{\pi}{6} \cdot I\left(\frac{1}{a} - \frac{1}{b}\right)$$

$$= \frac{\mu_O I}{24}\left(\frac{b-a}{ab}\right)$$

$$= \frac{\mu_O I}{24\ ab}(b-a)$$

144. The forces on AD and BC are zero because mag.field d we to a straight wire on AD and BC is parallel to elementary length of the Loop and both the fields are in nuturally opposite direction.

148.

	P	Q	R	S
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

149. $A \rightarrow Q, R, S$

$B \rightarrow P, Q, R, S$

$C \rightarrow P, Q, R, S$

$D \rightarrow P, Q, R, S$

150. $A \rightarrow P$

$B \rightarrow Q$

$C \rightarrow R$

$D \rightarrow P, S$