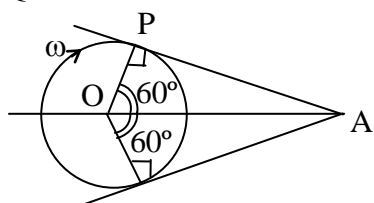


PHYSICS

Q.1 An α particle is moving along a circle of radius R with a constant angular velocity ω . Point A lies in the same plane at a distance $2R$ from the centre. Point A records magnetic field produced by α particle, if the minimum time interval between two successive times at which A records zero magnetic field is 't' the angular speed ω , in terms of t is :

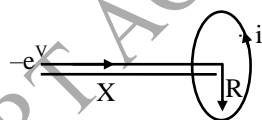
- (A) $\frac{2\pi}{t}$ (B) $\frac{2\pi}{3t}$
 (C) $\frac{\pi}{3t}$ (D) $\frac{\pi}{t}$ [B]

Sol. Point A shall record zero magnetic field (due to α -particle) is at position P and Q as shown in figure. The time taken by α -particle to go from P to Q is –



$$t = \frac{1}{3} \frac{2\pi}{\omega} \text{ or } \omega = \frac{2\pi}{3t}$$

Q.2 An electron moving with velocity v along the axis approaches a circular current carrying loop as shown in the figure. The magnitude of magnetic force on electron at this instant is-



- (A) $\frac{\mu_0}{Z} \frac{eviR^2X}{(X^2 + R^2)^{3/2}}$ (B) $\mu_0 \frac{eviR^2X}{(X^2 + R^2)^{3/2}}$
 (C) $\frac{\mu_0}{4\pi} \frac{eviR^2X}{(X^2 + R^2)^{3/2}}$ (D) 0 [D]

Sol. Direction of electron velocity is along magnetic lines of flux. Hence $F = 0$

Q.3 Cyclotron is used to accelerate –
 (A) electrons (B) neutrons
 (C) positive ions (D) negative ions

[C]

Q.4 An electron of charge e moves in a circular orbit of radius r around the nucleus at a frequency ν . The magnetic moment associated the orbital motion of the electron is –

- (A) $\pi \nu e r^2$ (B) $\frac{\pi \nu r^2}{e}$
 (C) $\frac{\pi \nu e}{r}$ (D) $\frac{\pi e r^2}{\nu}$ [A]

Sol. $M = iA$
 $= (e\nu) \pi r^2$

Q.5 A proton, a deuteron and an α particle with the same KE enter in a region of uniform magnetic field, moving at right angles to B . what is the ratio of the radii of their circular paths ?

- (A) $1 : \sqrt{2} : 1$ (B) $1 : \sqrt{2} : \sqrt{2}$
 (C) $\sqrt{2} : 1 : 1$ (D) $\sqrt{2} : \sqrt{2} : 1$ [A]

Sol. $r_p = \frac{\sqrt{2m_p K}}{eB}$
 $r_d = \frac{\sqrt{2(2m_p)K}}{eB}$
 $r_\alpha = \frac{\sqrt{2(4m_p)K}}{(2e)B}$

Q.6 A long straight wire carrying a current of 30 A is placed in an external uniform magnetic field of induction 4×10^{-4} T. The magnetic field is acting parallel to the direction of current. The magnitude of the resultant magnetic induction in tesla at a point 2.0 cm away from the wire is -

- (A) 10^{-4} (B) 3×10^{-4}
 (C) 5×10^{-4} (D) 6×10^{-4} [C]

Sol. Magnetic field due to wire

$$B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{30}{2 \times 10^{-2}}$$

$$= 3 \times 10^{-4} \text{ T}$$

This magnetic field will be perpendicular to external magnetic field.

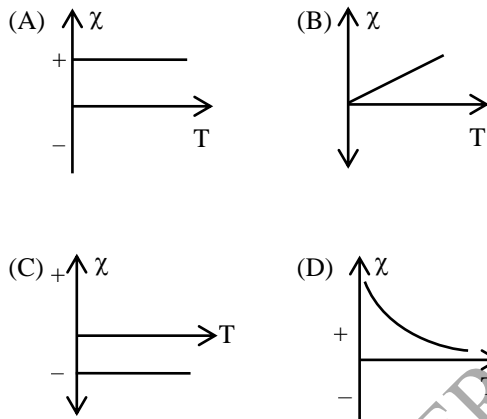
∴ Net magnetic field

$$B = \sqrt{B^2 + B_0^2}$$

$$= \sqrt{(3 \times 10^{-4})^2 + (4 \times 10^{-4})^2}$$

$$= 5 \times 10^{-4} \text{ T}$$

Q.7 Which one of the following graphs represents the behaviour of magnetic susceptibility (χ) of the paramagnetic substance with the temperature T ?

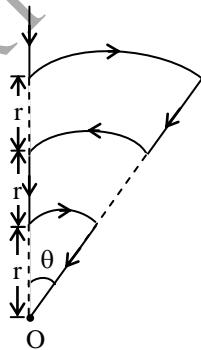


[D]

Sol. From Curie law

$$\chi \propto \frac{1}{T}$$

Q.8 Shown in the figure is a conductor carrying a current I. The magnetic field intensity at the point O (common centre of all the three arcs) is :



(A) $\frac{5\mu_0 I \theta}{24\pi r}$

(B) $\frac{\mu_0 I \theta}{24\pi r}$

(C) $\frac{11\mu_0 I \theta}{24\pi r}$

(D) zero

Sol.

[A]

Hint : Find B due to each arc at O and add them using vector addition.

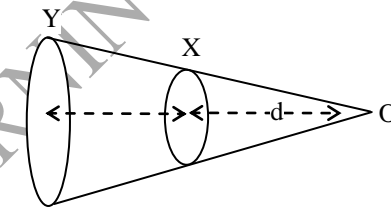
Since magnetic field at the centre of an arc is

equal to $B = \frac{\mu_0 I}{4\pi r} \theta$

hence, net B = $\frac{\mu_0 I}{4\pi} \left[\frac{1}{r} - \frac{1}{2r} + \frac{1}{3r} \right] \theta = \frac{5\mu_0 I \theta}{24\pi r}$

Q.9

Two circular coils X and Y have equal number of turn and carry equal currents in the same sense and subtend same solid angle at point O. If the smaller coil X is midway between O and Y, then if we represent the magnetic induction due to bigger coil Y at O as B_Y and that due to smaller coil X at O as B_X , then :



(A) $\frac{B_Y}{B_X} = 1$

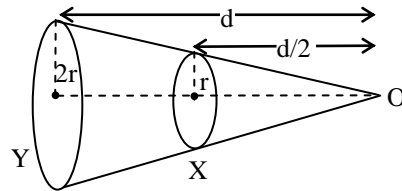
(B) $\frac{B_Y}{B_X} = 2$

(C) $\frac{B_Y}{B_X} = \frac{1}{2}$

(D) $\frac{B_Y}{B_X} = \frac{1}{4}$

Sol.

[C]



As two coils subtend the same solid angle at O, hence area of coil, Y = 4 × area of coil X

$$\left[\text{Solid angle} = \frac{\text{area}}{(\perp \text{ distance})^2} \right]$$

i.e. radius of coil Y = 2 × radius of coil X

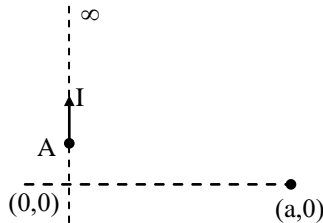
$$\therefore B_Y = \frac{\mu_0}{4\pi} \times \frac{2\pi I (2r)^2}{[(2r)^2 + (d^2)]^{3/2}}$$

$$B_X = \frac{\mu_0}{4\pi} \times \frac{2\pi I (r)^2}{\left[r^2 + \left(\frac{d}{2} \right)^2 \right]^{3/2}}$$

$$\therefore \frac{B_Y}{B_X} = \frac{4}{(4r^2 + d^2)^{3/2}} \times \left[\frac{4r^2 + d^2}{4} \right]^{3/2}$$

$$= \frac{4}{(4)^{3/2}} = \frac{4}{8} = \frac{1}{2}$$

Q.10 An infinitely long wire carrying current I is along y -axis such that its one end is at point $A(0, b)$ while the wire extends upto $+\infty$. The magnitude of magnetic field strength at point $(a, 0)$.



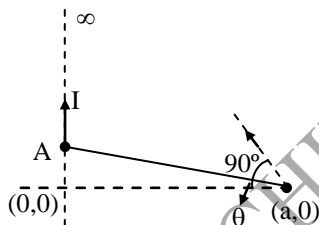
(A) $\frac{\mu_0 I}{4\pi a} \left(1 + \frac{b}{\sqrt{a^2 + b^2}} \right)$

(B) $\frac{\mu_0 I}{4\pi a} \left(1 - \frac{b}{\sqrt{a^2 + b^2}} \right)$

(C) $\frac{\mu_0 I}{4\pi a} \left(\frac{b}{\sqrt{a^2 + b^2}} \right)$

(D) None of these

Sol. [B]



$$B = \frac{\mu_0}{4\pi} \frac{i}{a} (\sin 90^\circ + \sin(-\theta))$$

$$= \frac{\mu_0}{4\pi} \frac{i}{a} \left(1 - \frac{b}{\sqrt{a^2 + b^2}} \right)$$

Q.11 A point charge is moving in clockwise direction in a circle with constant speed. Consider the magnetic field produced by the charge at a point P (not centre of the circle) on the axis of the circle.

(A) it is constant in magnitude only

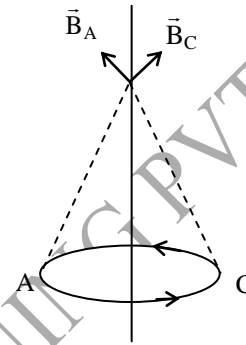
(B) it is constant in direction only

(C) it is constant in direction and magnitude both

(D) it is not constant in magnitude and direction both

Sol. [A]

The point charge moves in circle as shown in figure. The magnetic field vectors at a point P on axis of circle are \vec{B}_A and \vec{B}_C at the instants the point charge is at A and C respectively as shown in the figure.



Hence as the particles rotates in circle, only magnitude of magnetic fields remains constant at the point on axis P but it's direction changes.

\Rightarrow Alternate solution \Rightarrow

The magnetic field at point on the axis due to charged particle moving along a circular path is given by

$$\frac{\mu_0}{4\pi} \frac{q\vec{v} \times \vec{r}}{r^3}$$

It can be seen that the magnitude of the magnetic field at on point on the axis remains constant. But the direction of the field keeps on changing.

Q.12 A particle of charge Q and of negligible initial speed is accelerated through a potential difference of U . The particle reaches a region of uniform magnetic field of induction B , where it undergoes circular motion. If potential difference is doubled and B is also doubled then magnetic moment of the circular current due to circular motion of charge Q will become.

(A) double

(B) half

(C) four times

(D) remain same

Sol. [A]

$$K.E = QU$$

$$\text{magnetic moment} = i \times \text{Area}$$

$$= \frac{Q}{T} \times \pi R^2$$

$$\therefore T = \frac{2\pi m}{qB}$$

$$R = \sqrt{\frac{2mKE}{qB}} = \sqrt{\frac{2mU}{qB}}$$

$$\text{Magnetic moment} = \frac{Q^2 \times B}{2\pi m} \times \frac{\pi \times 2m \times U}{QB}$$

$$\text{Magnetic moment} = QU$$

- Q.13** Consider a toroid of circular cross-section of radius b , major radius R much greater than minor radius b . Find the total energy stored in toroid. (I is current)

- (A) $\frac{\mu_0 N^2 I^2 b^2}{2R}$ (B) $\frac{\mu_0 N^2 I^2 b^2}{3R}$
 (C) $\frac{\mu_0 N^2 I^2 b^2}{6R}$ (D) $\frac{\mu_0 N^2 I^2 b^2}{4R}$

Sol. [D]

$$B = \frac{\mu_0 Ni}{2\pi R}$$

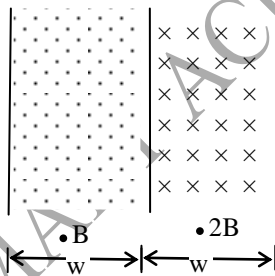
$$\phi = \pi b^2 \times B \times N$$

$$\phi = Li$$

$$L = \frac{\phi}{i} = \frac{\mu_0 N^2 b^2}{2R} \text{ with } b \ll R$$

$$\text{energy} = \frac{1}{2} Li^2 = \frac{\mu_0 N^2 I^2 b^2}{4R}$$

- Q.14** The magnetic field shown in the figure consist of the two magnetic field.

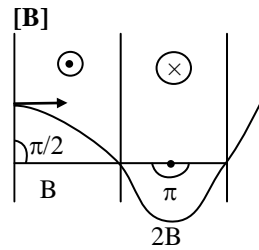


if v is the velocity just required for a charge particle of mass m and charge q to pass through the magnetic field. Particle is projected with velocity " v " then, how much time does such a charge spend in the magnetic field.

- (A) $\frac{\pi m}{2qB}$ (B) $\frac{\pi m}{qB}$

- (C) $\frac{\pi m}{4qB}$ (D) $\frac{3\pi m}{2qB}$

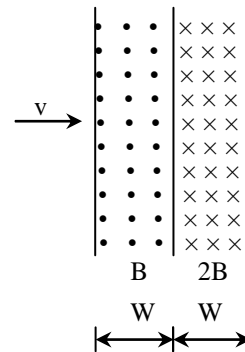
Sol.



$$\text{Time} = \frac{\pi m}{2qB} + \frac{\pi m}{2qB}$$

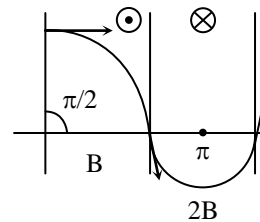
$$= \frac{\pi m}{qB}$$

- Q.15** Region of the magnetic field shown in the figure consist of two uniform magnetic fields. If v is the velocity just required for a charge q of particle of mass m and charge to pass through the region of magnetic field. Particle is projected with velocity " v " then how much time does such a charge spend in the region of magnetic field ?



- (A) $\frac{\pi m}{2qB}$ (B) $\frac{\pi m}{qB}$
 (C) $\frac{\pi m}{4qB}$ (D) $\frac{3\pi m}{2qB}$

Sol. [B]



$$\text{Time} = \frac{\pi m}{2qB} + \frac{\pi m}{2qB}$$

$$= \frac{\pi m}{qB}$$

Q.16 Two long concentric cylindrical conductors of radii a & b ($b < a$) are maintained at a potential difference V & carry equal & opposite currents I . An electron with a particular velocity " U " parallel to the axis will travel undeviated in the evacuated region between the conductors. Then $U =$

- (A) $\frac{4\pi V}{\mu_0 I \ell \ln\left(\frac{b}{a}\right)}$ (B) $\frac{2\pi V}{\mu_0 I \ell \ln\left(\frac{a}{b}\right)}$
 (C) $\frac{2\pi V}{\mu_0 I \ell \ln\left(\frac{b}{a}\right)}$ (D) $\frac{8\pi V}{\mu_0 I \ell \ln\left(\frac{a}{b}\right)}$

Sol. [B]

$$E = \frac{\lambda}{2\pi\epsilon_0 r}$$

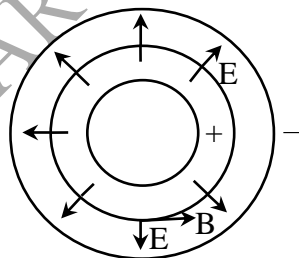
p.d. $V = \frac{\lambda}{2\pi\epsilon_0} \ell \ln\left(\frac{a}{b}\right)$

$$E = \frac{V}{r \ell \ln\left(\frac{a}{b}\right)}$$

B varies with r

$$B = \frac{\mu_0 I}{2\pi r}$$

B & E are perpendicular to each other

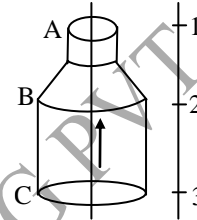


$$\therefore qUB = qE$$

(if particle travel undeviated)

$$U = \frac{E}{B} = \frac{2\pi V}{\mu_0 I \ell \ln\left(\frac{a}{b}\right)}$$

Q.17 A long, straight, hollow conductor (tube) carrying a current has two sections A and C of unequal cross-sections joined by a conical section B. 1, 2 and 3 are points on a line parallel to the axis of the conductor. The magnetic fields at 1, 2 and 3 have magnitudes B_1 , B_2 and B_3 respectively, then :



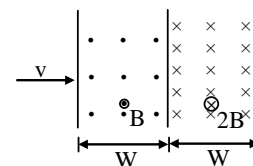
- (A) $B_1 = B_2 = B_3$
 (B) $B_1 = B_2 \neq B_3$
 (C) $B_1 < B_2 < B_3$
 (D) B_2 cannot be found unless the dimensions of the section B are known

Sol.

[A]

To find the magnetic field outside a thick conductor, the current may be assumed to flow along the axis. As points 1, 2, 3 are equidistant from the axis, $B_1 = B_2 = B_3$

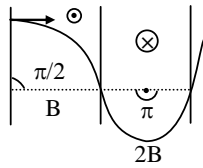
Q.18 The magnetic field shown in the figure consist of the two magnetic fields.



If v is the velocity just required for a charge particle of mass m and charge q to pass through the magnetic field. Particle is projected with velocity ' v ' then how much time does such a charge spend in the magnetic field –

- (A) $\frac{\pi m}{2qB}$ (B) $\frac{\pi m}{qB}$
 (C) $\frac{\pi m}{4qB}$ (D) $\frac{3\pi m}{2qB}$ [B]

Sol.



$$\text{Time} = \frac{\pi m}{2qB} + \frac{\pi m}{2qB} = \frac{\pi m}{qB}$$

- Q.19** Fig. shows a circular wire of radius r carrying a current i . The force of compression on the wire is –

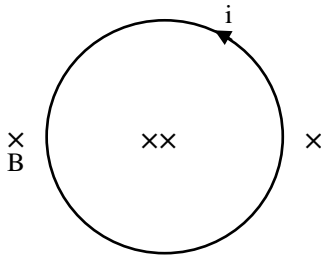


Fig.

- (A) $2iaB$ (B) iaB
 (C) $2\pi iaB$ (D) None of these

[B]

Sol. $dF = idlB$
 $F = \int idlB = iaB$

- Q.20** A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When current I passes through the coil, the magnetic field at the centre is –

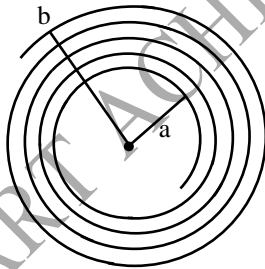


Fig.

- (A) $\frac{N\mu_0 i}{2(b-a)} \log_e \frac{b}{a}$
 (B) $\frac{N\mu_0 i}{2(b-a)} \log_e \frac{b+a}{b-a}$
 (C) $\frac{2N\mu_0 i}{(b+a)} \log_e \frac{b}{a}$
 (D) None of these

[A]

Sol. Magnetic induction due to a circular current-carrying loop at x is $dB = \frac{\mu_0 i}{2x} (dN)$

Total magnetic field at the centre (due to all loops)

$$B = \int \frac{\mu_0 i}{2x} dN$$

$$= \int_a^b \frac{\mu_0 i}{2x} \frac{N}{(b-a)} dx$$

$$= \frac{\mu_0 i N}{2(b-a)} \log_e \frac{b}{a}$$

- Q.21** A particle of charge $q = 4 \mu\text{C}$ and mass $m = 10 \text{ mg}$ starts moving from the origin under the action of an electric field $\vec{E} = 4\hat{i}$ and magnetic field $\vec{B} = (0.2\text{T})\hat{k}$. Its velocity at $(x, 3, 0)$ is $(4\hat{i} + 3\hat{j})$. The value of x is –

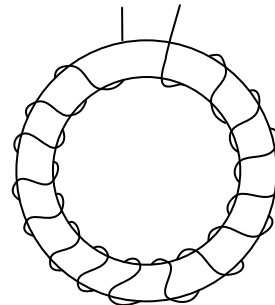
- (A) $\frac{115}{16} \text{ m}$ (B) $\frac{125}{16} \text{ m}$
 (C) $\frac{135}{16} \text{ m}$ (D) $\frac{145}{16} \text{ m}$ [B]

Sol. $W(qE) = \frac{1}{2}mv_x^2 + \frac{1}{2}mv_y^2 - 0$
 $\Rightarrow 4 \times 10^{-6} \times 4x = \frac{1}{2}m(4^2 + 3^2)$

$$4 \times 10^{-6} \times 4 \times x = \frac{1}{2} \times 10 \times 10^{-6} \times 25$$

$$x = \frac{250}{32} \text{ m} = \frac{125}{16} \text{ m}$$

- Q.22** Consider a toroid of circular cross-section of radius b , major radius R much greater than minor radius b , (see diagram) find the total energy stored in magnetic field of toroid –



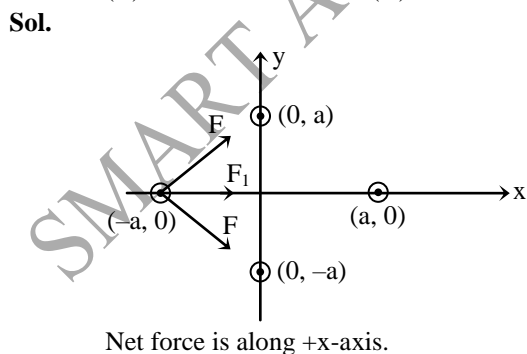
- (A) $\frac{B^2 \pi^2 b^2 R}{2\mu_0}$ (B) $\frac{B^2 \pi^2 b^2 R}{4\mu_0}$
 (C) $\frac{B^2 \pi^2 b^2 R}{8\mu_0}$ (D) $\frac{B^2 \pi^2 b^2 R}{\mu_0}$ [D]

Sol. $B = \frac{\mu_0 Ni}{2R}$
 $\phi = \pi b^2 \times B \times N$
 $\phi = Li$
 $L = \frac{\phi}{i} = \frac{\mu_0 N^2 b^2}{2R}$, with $b \ll R$
 Energy = $\frac{1}{2} Li^2 = \frac{\mu_0 N^2 i^2}{4R} b^2$

- Q.23** Two circular coils made of similar wires but of radius 20 cm and 40 cm are connected in parallel. The ratio of magnetic fields at their centre is -
 (A) 4 : 1 (B) 1 : 4
 (C) 2 : 1 (D) 1 : 2 [A]

Sol. $\frac{B_1}{B_2} = \frac{I_1}{I_2} \times \frac{r_2}{r_1}$
 But $\frac{I_1}{I_2} = \frac{V/R_1}{V/R_2} = \frac{R_2}{R_1} = \frac{\rho \ell_2 / A}{\rho \ell_1 / A} = \frac{\ell_2}{\ell_1}$
 $= \frac{2\pi r_2}{2\pi r_1} = \frac{r_2}{r_1}$
 $\therefore \frac{B_1}{B_2} = \frac{r_2}{r_1} \times \frac{r_2}{r_1} = \left(\frac{40}{20}\right)^2 = 4$

- Q.24** Four very long straight wires carry equal electric currents in the + z-direction. They intersect the x-y plane at $(x, y) = (\pm a, 0), (0, a)$ and $(0, -a)$. The magnetic force exerted on the wire at position $(-a, 0)$ is along -
 (A) + y-axis (B) - y-axis
 (C) + x-axis (D) - x-axis [C]

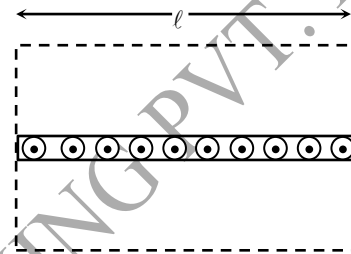


- Q.25** A large metal sheet carries an electric current along its surface. Current per unit length is λ . Magnetic field near the metal sheet is -



- (A) $\frac{1}{2} \mu_0 \lambda$ (B) $\frac{\lambda \mu_0}{2\pi}$
 (C) $\lambda \mu_0$ (D) $\frac{\mu_0}{2\lambda\pi}$ [A]

Sol. Applying Ampere's law



$$\oint \vec{B} \cdot d\vec{\ell} = \mu_0(\lambda \ell)$$

$$2B\ell = \mu_0 \lambda \ell$$

$$B = \frac{1}{2} \mu_0 \lambda$$

- Q.26** O^{++}, C^+, He^{++} and H^+ ions are projected on the photographic plate with same velocity in a mass spectrograph. Which one will strike farthest?
 (A) O^{++} (B) C^+
 (C) He^{++} (D) H^+ [B]

Sol. $D = \text{diameter} = 2r = \frac{2mv}{qB}$

$$D \propto \frac{m}{q}$$

Here $\frac{m}{q}$ is maximum for C^+ .

- Q.27** The magnetic field B due to a current carrying circular loop of radius 12 cm at its centre is 0.5×10^{-4} T. The magnetic field due to this loop at a point on the axis at a distance of 5 cm from the centre -
 (A) 3.9×10^{-5} T
 (B) 5.2×10^{-5} T
 (C) 2.1×10^{-5} T

(D) 9×10^{-5} T [A]

Sol. $B_0 = \frac{\mu_0 I}{2a}$

At axial point

$$B = \frac{\mu_0 I a^2}{2(a^2 + x^2)^{3/2}}$$

$$\frac{B}{B_0} = \frac{a^3}{(a^2 + x^2)^{3/2}}$$

$$\Rightarrow B = B_0 \frac{a^3}{(a^2 + x^2)^{3/2}}$$

$$= 0.5 \times 10^{-4} \times \frac{(12\text{cm})^3}{(144\text{cm}^2 + 25\text{cm}^2)^{3/2}}$$

$$= 3.9 \times 10^{-5} \text{ T.}$$

Q.28 A wire along x-axis carries a current 3.5 A. Find the force on a 1 cm section of the wire exerted by:

$$B = 0.74 \text{ T } \hat{j} - 0.3 \text{ T } \hat{k}$$

(A) $(2.59 \hat{k} + 1.26 \hat{j}) \times 10^{-2}$

(B) $(1.26 \hat{k} - 2.59 \hat{j}) \times 10^{-2}$

(C) $(-2.59 \hat{k} - 1.26 \hat{j}) \times 10^{-2}$

(D) $(-1.26 \hat{k} + 2.59 \hat{j}) \times 10^{-2}$ [A]

Sol. $F = I(\vec{l} \times \vec{B})$
 $= 3.5[10^{-2} \hat{i} \times (.74 \hat{j} - 0.36 \hat{k})]$
 $= (2.59 \hat{k} + 1.26 \hat{j}) \times 10^{-2}$

Q.29 An electric current i enters and leaves a uniform circular wire of radius 'a' through diametrically opposite points. A charged particle 'q' moving along the axis of the circular wire passes through its centre at speed v . The magnetic force acting on the particle when it passes through the centre has a magnitude-

- (A) $qv \frac{\mu_0 i}{2a}$ (B) $qv \frac{\mu_0 i}{2\pi a}$
 (C) $qv \frac{\mu_0 i}{a}$ (D) zero [D]

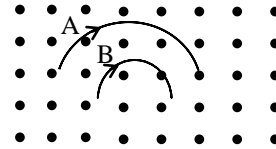
Q.30 Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the masses of X to that of Y is-

- (A) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (B) $\frac{R_2}{R_1}$
 (C) $\left(\frac{R_1}{R_2}\right)^2$ (D) $\frac{R_1}{R_2}$ [C]

Q.31 A negative charged particle falling freely under gravity enters a region having horizontal magnetic field pointing towards north. The particle will be deflected towards-

- (A) East (B) West
 (C) North (D) South [B]

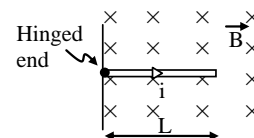
Q.32 Two particle A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure. Then-



- (A) $m_A v_A < m_B v_B$
 (B) $m_A v_A > m_B v_B$
 (C) $m_A < m_B$ and $v_A < v_B$
 (D) $m_A = m_B$ and $v_A = v_B$

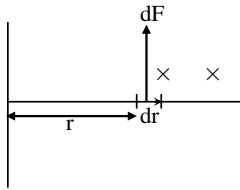
Sol. [B] use $r = \frac{mv}{qB}$

Q.33 A straight conductor of mass m and carrying a current i is hinged at one end and placed in a plane perpendicular to the magnetic field B as shown in figure. At any moment if the conductor is let free, then the angular acceleration of the conductor will be (neglect gravity) -



- (A) $\frac{3iB}{2m}$ (B) $\frac{2iB}{3m}$
 (C) $\frac{iB}{2m}$ (D) $\frac{3i}{2mB}$ [A]

Sol.



Torque

$$d\tau = dF \times r$$

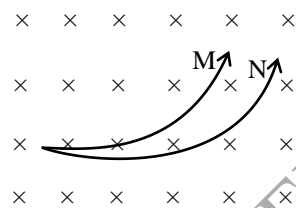
$$= iBdr \times r$$

$$\tau = \int_0^L iBrd r = \frac{iBL^2}{2}$$

$$\alpha = \frac{\tau}{I} = \frac{iBL^2}{2mL^2} = \frac{3iB}{2m}$$

- Q.34** Two charged particle M and N are projected with same velocity in a uniform magnetic field.

Then M and N respectively



- (A) an electron and a proton
 (B) a deuteron and a proton
 (C) a deuteron and an electron
 (D) a proton and α - particle [D]

- Q.35** A charge q is moving with a velocity

$$\vec{v}_1 = 1\hat{i} \text{ m/s at a point in a magnetic field and}$$

experiences a force $\vec{F}_1 = q(-1\hat{j} + 1\hat{k})\text{N}$. If

the charge is moving with a velocity

$$\vec{v}_2 = 1\hat{j} \text{ m/s at the same point, it experiences}$$

and a force $\vec{F}_2 = q[1\hat{i} - 1\hat{k}]\text{N}$. The magnetic

induction \vec{B} at that point is-

(A) $(\hat{i} + \hat{j} + \hat{k}) \text{ Wb/m}^2$

(B) $(\hat{i} - \hat{j} + \hat{k}) \text{ Wb/m}^2$

(C) $(-\hat{i} + \hat{j} - \hat{k}) \text{ Wb/m}^2$

(D) $(\hat{i} + \hat{j} - \hat{k}) \text{ Wb/m}^2$ [A]

- Q.36** A particle moves in a circular path of diameter 1.0 m under the action of magnetic field of 0.40 Tesla . An electric field of 200 V/m makes the path of particle straight. Find the charge/mass ratio of the particle.

(A) $2.5 \times 10^5 \text{ cb/kg}$ (B) $2 \times 10^5 \text{ cb/kg}$

(C) $3.5 \times 10^5 \text{ cb/kg}$ (D) $3 \times 10^5 \text{ cb/kg}$

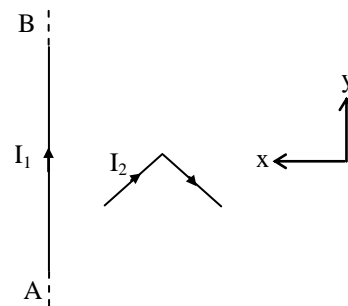
[A]

- Q.37** A charged particle is released from rest in a region of steady and uniform electric and magnetic field which are parallel to each other.

The particle will move in a -

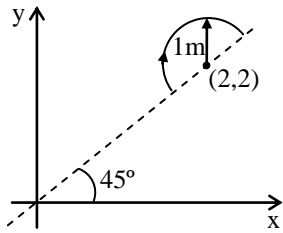
- (A) straight line (B) circle
 (C) helix (D) cycloid [A]

- Q.38** In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying current I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The resultant force on the wire CD is-



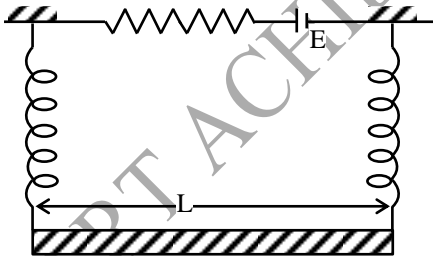
- (A) zero
 - (B) towards negative x-axis
 - (C) towards positive y-axis
 - (D) none of these
- [D]

Q.39 A uniform magnetic field $\vec{B} = (3\hat{i} + 4\hat{j} + \hat{k})$ exists in region of space. A semicircular wire of radius 1 m carrying current 1 A having its centre at (2, 2, 0) is placed in x-y plane as shown in figure. The force on semicircular wire will be-



- (A) $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$
 - (B) $\sqrt{2}(\hat{i} - \hat{j} + \hat{k})$
 - (C) $\sqrt{2}(\hat{i} + \hat{j} - \hat{k})$
 - (D) $\sqrt{2}(-\hat{i} + \hat{j} + \hat{k})$
- [B]

Q.40 A straight rod of mass m and length L is suspended from the identical springs as shown in the figure. The spring stretched a distance x_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. The magnetic field strength is.....



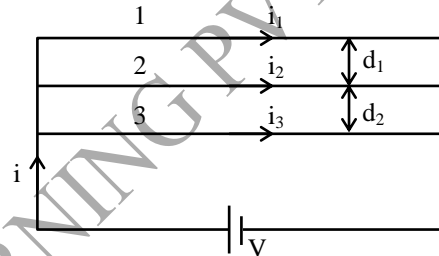
- (A) $\frac{2mgR}{LE}$
 - (B) $\frac{mgR}{EL}$
 - (C) $\frac{mgR}{2LE}$
 - (D) $\frac{mgR}{E}$
- [B]

Q.41 A hypothetical magnetic field existing in a region is given by $\vec{B} = B_0 \hat{r}$. Where \hat{r} denotes the unit vector along the radial direction. A circular loop of radius a carrying a current i , is placed with its plane parallel to the

x-y plane and centre at (0, 0, d). The magnitude of magnetic force acting on the loop is-

- (A) $\frac{2\pi a^2 i B_0}{d}$
 - (B) $\frac{2\pi a^2 i B_0}{\sqrt{a^2 + d^2}}$
 - (C) $\frac{\pi a^2 i B_0}{d}$
 - (D) $\frac{\pi a^2 i B_0}{\sqrt{a^2 + d^2}}$
- [B]

Q.42 Three long wires of resistances in the ratio 3 : 4 : 5 are connected in parallel to each other as shown in figure. If net force on middle wire is zero then $\frac{d_1}{d_2}$ will be -



- (A) 9 : 25
 - (B) 5 : 3
 - (C) $\sqrt{5} : \sqrt{3}$
 - (D) 1 : 1
- [B]

Q.43 A charged particle of mass m and charge q is accelerated through a potential difference of V volts. It enters a region of uniform magnetic field which is directed perpendicular to the direction of motion of the particle. The particle will move on a circular path of radius given by -

- (A) $\sqrt{\frac{Vm}{qB^2}}$
 - (B) $\frac{2Vm}{qB^2}$
 - (C) $\sqrt{\frac{2Vm}{q}} \left(\frac{1}{B}\right)$
 - (D) $\sqrt{\frac{Vm}{q}} \left(\frac{1}{B}\right)$
- [C]

Q.44 A particle of de-Broglie wavelength 2.21×10^{-13} m and charge 1.6×10^{-19} cb is projected with a speed 2×10^6 m/s at an angle 60° to the x-axis. If a uniform magnetic field of 0.3T is applied along the y-axis, the path of the particle is -

- (A) a circle of radius 0.03 m and time period $6.25 \pi \times 10^{-8}$ sec

(B) a circle of radius 0.01 m and time period

$$\frac{6.25\pi}{3} \times 10^{-8} \text{ sec}$$

(C) a helix of radius 0.03 m and time period

$$6.25 \pi \times 10^{-8} \text{ sec}$$

(D) a helix of radius 0.01 m and time period

$$\frac{6.25\pi}{3} \times 10^{-8} \text{ sec} \quad \text{[C]}$$

Q.45 A rigid circular loop of radius r and mass m lies in the x - y plane on a flat table and has a current I flowing in it. At this particular place. The earth's magnetic field is $\vec{B} = B_x \hat{i} + B_y \hat{j}$. The minimum value of I for which one end of the loop will lift from the table is

(A) $\frac{mg}{\pi r B_x}$

(B) $\frac{mg}{\pi r B_y}$

(C) $\frac{mg}{2\pi r \sqrt{B_x^2 + B_y^2}}$

(D) None of these

Q.46 Magnetic induction at the centre of a circular coil is given by -

(A) $\frac{\mu_0 NI}{2r}$

(B) $\frac{\mu_0 NI r^2}{(r^2 + x^2)^{3/2}}$

(C) $\frac{\mu_0 NI}{2r^2}$

(D) $\frac{\mu_0 NI}{r}$ [A]

Sol. $B = \frac{\mu_0 NI}{2r}$

Q.47 A charge q moves in a region where electric field and magnetic field both exist, then force on it is -

(A) $q(\vec{v} \times \vec{B})$

(B) $q\vec{E} + q(\vec{B} \times \vec{v})$

(C) $q\vec{B} + q(\vec{E} \times \vec{v})$

(D) $q\vec{E} + q(\vec{v} \times \vec{B})$

[D]

Sol. $\vec{F} = \vec{F}_E + \vec{F}_B$
 $= q [\vec{E} + (\vec{v} \times \vec{B})]$