MEC

1. One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current is passed in both, the ratio of the magnetic field at the central of the loop (B_L) to that at the centre of the coil (B_C), i.e. R $\frac{B_L}{B_C}$ will be :

(1) $\frac{1}{N}$ (2) N^2

(3) $\frac{1}{N^2}$ (4) N

2. A particle having the same charge as of electron moves in a circular path of radius 0.5 cm under the influence of a magnetic field of 0.5 T. If an electric field of 100 V/m makes it to move in a straight path, then the mass of the particle is (Given charge of electron $=1.6 \times 10^{-19}$C)

(1) 2.0×10^{-24} kg

(2) 1.6×10^{-19} kg

(3) 1.6×10^{-27} kg

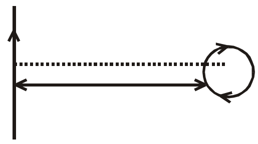
(4) 9.1×10^{-31} kg

3. A bar magnet is demagnetized by inserting it inside a solenoid of length 0.2 m, 100 turas, and carrying a current of 5.2 A. The coercivitv of the bar magnet is :

(1) 1200 A/m (2) 2600 A/m

(3) 520 A/jm (4) 285 A/m

4. An infinitely long current carrying wire and a small current carrying loop are in the plane of the paper as shown. The radius of the loop is a and distance of its centre from the wire is d (d»a). If the loop applies a force F on the wire then :



(1) $F \propto \left(\frac{a^2}{d^3}\right)$ (2) $F \propto \left(\frac{a}{d}\right)$

(3) $F \propto \left(\frac{a}{d}\right)^2$ (4) F = 0

5. At some location on earth the horizontal component of earth's magnetic field is 18×10^{-6}T. At this location, magnetic neeedle of length 0.12 m and pole strength 1.8 Am is suspended from its mid-point using a thread, it makes 45° angle with horizontal in equilibrium. To keep this needle horizontal, the vertical force that should be applied at one of its ends is :

(1) 3.6×10^{-5} N (2) 6.5×10^{-5} N

(3) 1.3×10^{-5} N (4) 1.8×10^{-5} N

6. A hoop and a solid cylinder of same mass and radius are made of a permanent magnetic material with their magnetic moment parallel to their respective axes. But the magnetic moment of hoop is twice of solid cylinder. They are placed in a uniform magnetic field in such a manner that their magnetic moments make a small angle with the field. If the oscillation periods of hoop and cylinder are T_h and T_c respectively, then :

(1) $T_h = 0.5\ T_c$

(2) $T_h = 2\ T_c$

(3) $T_h = 1.5\ T_c$

(4) $T_h = T_c$

7. A magnet of total magnetic moment $10^{-2}\hat{i}$ A-m^2 is placed in a time varying magnetic field, $B\hat{i}(\cos\omega t)$ where B = 1 Tesla and $\omega = 0.125$ rad/s. The work done for reversing the direction of the magnetic moment at t = 1 second, is :

(1) 0.007 J

(2) 0.014 J

(3) 0.01 J

(4) 0.028 J

8. An insulating thin rod of length ℓ has a x linear charge density $p(x) = \rho_0 \frac{x}{\ell}$ on it. The rod is rotated about an axis passing through the origin (x = 0) and perpendicular to the rod. If the rod makes n rotations per second, then the time averaged magnetic moment of the rod is :

(1) $\frac{\pi}{4}n\rho\ell^3$ (2) $n\rho\ell^3$

(3) $\pi n\rho\ell^3$ (4) $\frac{\pi}{3}n\rho\ell^3$

9. A paramagnetic substance in the form of a cube with sides 1 cm has a magnetic dipole moment of 20×10^{-6} J/T when a magnetic intensity of 60×10^3 A/m is applied. Its magnetic susceptibility is :-

(1) 2.3×10^{-2}

(2) 3.3×10^{-2}

(3) 3.3×10^{-4}

(4) 4.3×10^{-2}

10. A galvanometer having a resistance of 20 Ω and 30 divisions on both sides has figure of merit 0.005 ampere/division. The resistance that should be connected in series such that it can be used as a voltmeter upto 15 volt, is :-

(1) 80 Ω (2) 120 Ω

(3) 125 Ω (4) 100 Ω

11. The region between y = 0 and y = d contains a magnetic field $\vec{B} = B\hat{z}$. A particle of mass m and charge q enters the region with a velocity $\vec{v} = v\hat{i}$. If $d = \frac{mv}{2qB}$, the acceleration of the charged particle at the point of its emergence at the other side is :-

(1) $\frac{qvB}{m}\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$

(2) $\frac{qvB}{m}\left(\frac{1}{2}\hat{i}-\frac{\sqrt{3}}{\sqrt{2}}\hat{j}\right)$

(3) $\frac{qvB}{m}\left(\frac{-\hat{j}+\hat{i}}{\sqrt{2}}\right)$

(4) $\frac{qvB}{m}\left(\frac{\sqrt{3}}{2}\hat{i}+\frac{1}{2}\hat{j}\right)$

12. A particle of mass m and charge q is in an electric and magnetic field given by

$\vec{E} = 2\hat{i}+3\hat{j}$; $\vec{B} = 4\hat{j}+6\hat{k}$.

The charged particle is shifted from the origin to the point P(x = 1 ; y = 1) along a straight path. The magnitude of the total work done is :-

(1) (0.35)q (2) (0.15)q

(3) (2.5)q (4) 5q

13. There are two long co-axial solenoids of same length *l*. the inner and outer coils have radii r_1 and r_2 and number of turns per unit length n_1 and n_2 respectively. The rate of mutual inductance to the self-inductance of the inner-coil is :

(1) $\frac{n_2}{n_1}\cdot\frac{r_2^2}{r_1^2}$ (2) $\frac{n_2}{n_1}\cdot\frac{r_1}{r_2}$ (3) $\frac{n_1}{n_2}$ (4) $\frac{n_2}{n_1}$

14. In an experiment electrons are accelerated, from rest, by applying a voltage of 500 V. Calculate the radius of the path if a magnetic field 100 mT is then applied.

[Charge of the electron = 1.6×10^{-19} C

Mass of the electron = 9.1×10^{-31} kg]

(1) 7.5×10^{-4} m

(2) 7.5×10^{-3} m

(3) 7.5 m

(4) 7.5×10^{-2} m

15. A paramagnetic material has 10^{28} atoms/m^3. Its magnetic susceptibility at temperature 350 K is 2.8×10^{-4}. Its susceptibility at 300 K is :

(1) 3.672×10^{-4}

(2) 3.726×10^{-4}

(3) 3.267×10^{-4}

(4) 2.672×10^{-4}

16. A 10 m long horizontal wire extends from North East to South West. It is falling with a speed of 5.0ms^{-1}, at right angles to the horizontal component of the earth's magnetic field, of 0.3×10^{-4} Wb/m^2. The value of the induced emf in wire is :

(1) 2.5×10^{-3} V

(2) 1.1×10^{-3} V

(3) 0.3×10^{-3} V

(4) 1.5×10^{-3} V

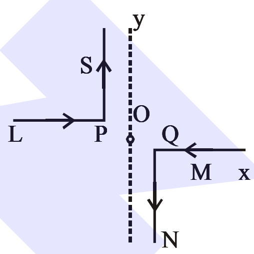
17. A proton and an α-particle (with their masses in the ratio of 1:4 and charges in the ratio of 1:2) are accelerated from rest through a potential difference V. If a uniform magnetic field (B) is set up perpendicular to their velocities, the ratio of the radii $r_p : r_\alpha$ of the circular paths described by them will be :

(1) $1:\sqrt{2}$ (2) 1 : 2

(3) 1 : 3 (4) $1:\sqrt{3}$

18. As shown in the figure, two infinitely long, identical wires are bent by 90° and placed in such a way that the segments LP and QM are along the x-axis, while segments PS and QN are parallel to the y-axis. If OP = OQ = 4cm, and the magnitude of the magnetic field at O is 10^{-4} T, and the two wires carry equal currents (see figure), the magnitude of the current in each wire and the direction of the magnetic field at O will be

($\mu_0 = 4\pi \times 10^{-7}$ NA^{-2}) :



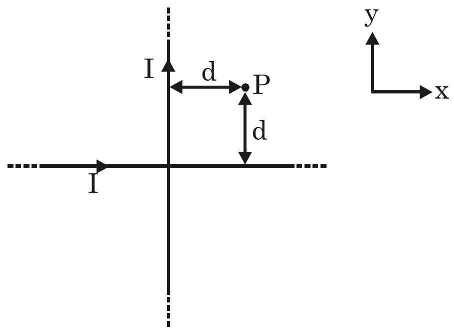
(1) 40 A, perpendicular into the page

(2) 40 A, perpendicular out of the page

(3) 20 A, perpendicular out of the page

(4) 20 A, perpendicular into the page

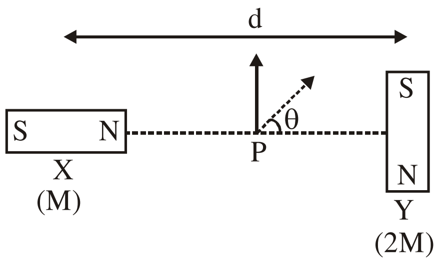
19. Two very long, straight, and insulated wires are kept at 90° angle from each other in xy-plane as shown in the figure. These wires carry currents of equal magnitude I, whose directions are shown in the figure. The net magnetic field at point P will be :



(1) Zero (2) $\frac{+\mu_0 I}{\pi d}(\hat{z})$

(3) $-\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (4) $\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$

20. Two magnetic dipoles X and Y are placed at a separation d, with their axes perpendicular to each other. The dipole moment of Y is twice that of X. A particle of charge q is passing, through their midpoint P, at angle $\theta = 45°$ with the horizontal line, as shown in figure. What would be the magnitude of force on the particle at that instant ? (d is much larger than the dimensions of the dipole)



(1) $\sqrt{2}\left(\frac{\mu_0}{4\pi}\right)\frac{M}{(d/2)^3}\times qv$

(2) $\left(\frac{\mu_0}{4\pi}\right)\frac{2M}{(d/2)^3}\times qv$

(3) $\left(\frac{\mu_0}{4\pi}\right)\frac{M}{(d/2)^3}\times qv$

(4) 0

21. A circular coil having N turns and radius r carries a current I. It is held in the XZ plane in a magnetic field $B\hat{i}$. The torque on the coil due to the magnetic field is :

(1) $B\pi r^2 IN$ (2) $\frac{Br^2 I}{\pi N}$

(3) Zero (4) $\frac{B\pi r^2 I}{N}$

22. Two coils 'P' and 'Q' are separated by some distance. When a current of 3 A flows through coil 'P', a magnetic flux of 10^{-3} Wb passes through 'Q'. No current is passed through 'Q'. When no current passes through 'P' and a current of 2 A passes through 'Q', the flux through 'P' is :-

(1) 6.67×10^{-3} Wb (2) 6.67×10^{-4} Wb

(3) 3.67×10^{-4} Wb (4) 3.67×10^{-3} Wb

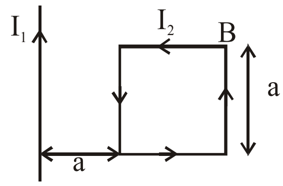
23. A moving coil galvanometer has a coil with 175 turns and area 1 cm^2. It uses a torsion band of torsion constant 10^{-6} N-m/rad. The coil is placed in a maganetic field B parallel to its plane. The coil deflects by 1° for a current of 1 mA. The value of B (in Tesla) is approximately:-

(1) 10^{-3} (2) 10^{-1} (3) 10^{-4} (4) 10^{-2}

24. The stream of a river is flowing with a speed of 2km/h. A swimmer can swim at a speed of 4km/h. What should be the direction of the swimmer with respect to the flow of the river to cross the river straight ?

(1) 60° (2) 150° (3) 90° (4) 120°

25. A rigid square loop of side 'a' and carrying current I_2 is lying on a horizontal surface near a long current I_1 carrying wire in the same plane as shown in figure. The net force on the loop due to wire will be :



(1) Attractive and equal to $\frac{\mu_0 I_1 I_2}{3\pi}$

(2) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{4\pi}$

(3) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{2\pi}$

(4) Zero

26. A rectangular coil (Dimension 5 cm × 2.5 cm) with 100 turns, carrying a current of 3 A in the clock-wise direction is kept centered at the origin and in the X-Z plane. A magnetic field of 1 T is applied along X-axis. If the coil is tilted through 45° about Z-axis, then the torque on the coil is :

(1) 0.55 Nm

(2) 0.27 Nm

(3) 0.38 Nm

(4) 0.42 Nm

27. The magnitude of the magnetic field at the center of an equilateral triangular loop of side 1m which is carrying a current of 10 A is :

[Take $\mu_0 = 4\pi \times 10^{-7}$ NA^{-2}]

(1) 18 μT (2) 3 μT

(3) 1 μT (4) 9 μT

28. A square loop is carrying a steady current I and the magnitude of its magnetic dipole moment is m. If this square loop is changed to a circular loop and it carries the same current, the magnitude of the magnetic dipole moment of circular loop will be :

(1) $\frac{3m}{\pi}$ (2) $\frac{4m}{\pi}$

(3) $\frac{2m}{\pi}$ (4) $\frac{m}{\pi}$

29. In the formula $X = 5YZ^2$, X and Z have dimensions of capacitance and magnetic field, respectively. What are the dimensions of Y in SI units ?

(1) $[M^{-2} L^{-2} T^{6} A^{3}]$

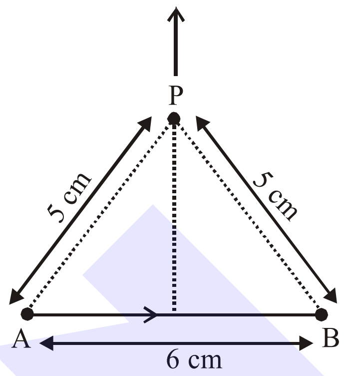
(2) $[M^{-1} L^{-2} T^{4} A^{2}]$

(3) $[M^{-3} L^{-2} T^{8} A^{4}]$

(4) $[M^{-2} L^{0} T^{-4} A^{-2}]$

30. Find the magnetic field at point P due to a straight line segment AB of length 6 cm carrying a current of 5 A. (See figure)

($\mu_0 = 4\pi \times 10^{-7}$ N-A^{-2})

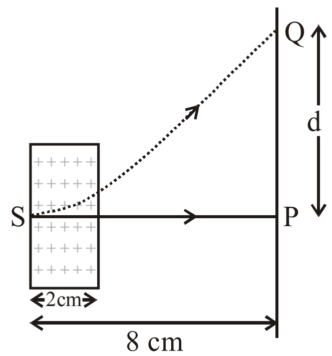


(1) 3.0×10^{-5} T (2) 2.5×10^{-5} T

(3) 2.0×10^{-5} T (4) 1.5×10^{-5} T

31. An electron, moving along the x-axis with an initial energy of 100 eV, enters a region of magnetic field $\vec{B} = (1.5 \times 10^{-3} T)\hat{k}$ at S (See figure). The field extends between x = 0 and x = 2 cm. The electron is detected at the point Q on a screen placed 8 cm away from the point S. The distance d between P and Q (on the screen) is :

(electron's charge = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg)



(1) 12.87 cm (2) 1.22 cm

(3) 11.65 cm (4) 2.25 cm

32. A thin ring of 10 cm radius carries a uniformly distributed charge. The ring rotates at a constant angular speed of 40 π rad s^{-1} about its axis, perpendicular to its plane. If the magnetic field at its centre is 3.8×10^{-9} T, then the charge carried by the ring is close to

($\mu_0 = 4\pi \times 10^{-7}$ N/A^2) :

(1) 2×10^{-6} C (2) 3×10^{-5} C

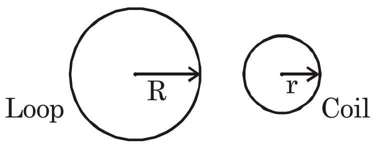
(3) 4×10^{-5} C (4) 7×10^{-6} C

33. A magnetic compass needle oscillates 30 times per minute at a place where the dip is 45º, and 40 times per minute where the dip is 30º. If B_1 and B_2 are respectively the total magnetic field due to the earth at the two places, then the ratio B_1/B_2 is best given by :

(1) 2.2 (2) 1.8 (3) 0.7 (4) 3.6

SOLUTION

1. Ans. (3)



$L = 2\pi R \quad L = N \times 2\pi r$

$R = Nr$

$B_L = \frac{\mu_0 i}{2R} \quad B_C = \frac{\mu_0 N i}{2r}$

$B_C = \frac{\mu_0 N^2 i}{2R}$

$\frac{B_L}{B_C} = \frac{1}{N^2}$

2. Ans. (1)

$\frac{mv^2}{R} = qvB$

$mv = qBR$ ....(i)

Path is straight line

it $qE = qvB$

$E = vB$ ....(ii)

From equation (i) & (ii)

$m = \frac{qB^2R}{E}$

$m = 2.0 \times 10^{-24}$ kg

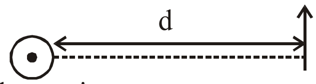
3. Ans. (2)

Coercivity $= H = \frac{B}{\mu_0}$

$= ni \; = \frac{N}{\ell} i \; = \frac{100}{0.2} \times 5.2$

$= 2600$ A/m

4. Ans. (3)



∞ long wire

Eqvilent dipole of given loop

$F = m \cdot \frac{dB}{dr}$

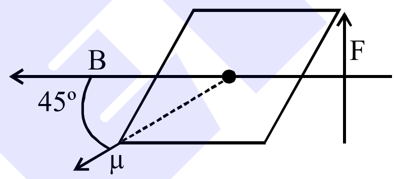
Now $\frac{dB}{dx} = \frac{d}{dx}\left(\frac{\mu_0 I}{2\pi x}\right)$

$\propto \frac{1}{x^2}$

$\Rightarrow$ So $F \propto \frac{M}{x^2} [\because M = NIA]$

$\therefore F \propto \frac{a^2}{d^2}$

5. Ans. (2)



$\mu B \sin 45^\circ = F \frac{\ell}{2} \sin 45^\circ$

$F = 2\mu B$

6. Ans. (4)

$T = 2\pi\sqrt{\frac{I}{\mu B}}$

$T_h = 2\pi\sqrt{\frac{mR^2}{(2\mu)B}}$

$T_C = 2\pi\sqrt{\frac{1/2mR^2}{\mu B}}$

7. Ans. (2)

According to JEE-Mains Ans. key (Bonus)

Work done, $W = (\Delta\vec{\mu}) \cdot \vec{B}$

$= 2 \times 10^{-2} \times 1 \cos(0.125)$

$= 0.02$ J

8. Ans. (1)

$\because M = NIA$

$dq = \lambda dx$ & $A = \pi x^2$

$$\int dm = \int (x)\frac{\rho_0 x}{\ell} dx.\pi x^2$$

$$M = \frac{n\rho_0\pi}{\ell}.\int_0^{\ell} x^3.dx = \frac{n\rho_0\pi}{\ell}.\left[\frac{L^4}{4}\right]$$

$$M = \frac{n\rho_0\pi\ell^3}{4} \text{ or } \frac{\pi}{4}n\rho\ell^3$$

9. Ans. (3)

$$\chi = \frac{I}{H}$$

$$I = \frac{\text{Magnetic moment}}{\text{Volume}}$$

$$I = \frac{20\times10^{-6}}{10^{-6}} = 20\ N/m^2$$

$$\chi = \frac{20}{60\times10^{+3}} = \frac{1}{3}\times10^{-3}$$

$= 0.33 \times 10^{-3} = 3.3 \times 10^{-4}$

10. Ans. (1)

$R_g = 20\Omega$

$N_L = N_R = N = 30$

$$FOM = \frac{I}{\phi} = 0.005\ A/Div.$$

$$\text{Current sentivity} = CS = \left(\frac{1}{0.005}\right) = \frac{\phi}{I}$$

$Ig_{max} = 0.005 \times 30$

$= 15 \times 10^{-2} = 0.15$

$15 = 0.15\ [20 + R]$

$100 = 20 + R$

$R = 80$

11. Ans. (BONUS)

In question its is not given from which point on y-axis charge particle is given velocity

12. Ans. (4)

$$\vec{F}_{net} = q\vec{E} + q(\vec{v}\times\vec{B})$$

$$= (2q\hat{i} + 3q\hat{j}) + q(\vec{v}\times\vec{B})$$

$$W = \vec{F}_{net}.\vec{S}$$

$= 2q + 3q$

$= 5q$

13. Ans. (4)

$$M = \mu_0 n_1 n_2 \pi r_1^2$$

$$L = \mu_0 n_1^2 \pi r_1^2$$

$$\Rightarrow \frac{M}{L} = \frac{n_2}{n_1}$$

14. Ans. (1)

$$r = \frac{\sqrt{2mk}}{eB} = \frac{\sqrt{2me\Delta v}}{eB}$$

$$r = \frac{\sqrt{\frac{2m}{e}.\Delta v}}{B} = \frac{\sqrt{\frac{2\times9.1\times10^{-31}}{1.6\times10^{-19}}(500)}}{100\times10^{-3}}$$

$$r = \frac{\sqrt{\frac{9.1}{0.16}\times10^{-10}}}{10^{-1}} = \frac{3}{.4}\times10^{-4} = 7.5\times10^{-4}$$

15. Ans. (3)

$$x\ \alpha\ \frac{1}{T_C}$$

curie law for paramagnetic substane

$$\frac{x_1}{x_2} = \frac{T_{C_2}}{T_{C_1}}$$

$$\frac{2.8\times10^{-4}}{x_2} = \frac{300}{350}$$

$$x_2 = \frac{2.8\times350\times10^{-4}}{300}$$

$= 3.266 \times 10^{-4}$

16. Ans. (2)

Induied emf $= Bv\ell$

$= 0.3 \times 10^{-4} \times 5 \times 10$

$= 1.5 \times 10^{-3}$ V

17. Ans. (1)

$KE = q\Delta V$

$$r = \frac{\sqrt{2mq\Delta V}}{qB}$$

$$r \propto \sqrt{\frac{m}{q}}$$

$$\frac{r_p}{r_\alpha} = \frac{1}{\sqrt{2}}$$

18. Ans. (4)

Magnetic field at 'O' will be done to 'PS' and 'QN' only

i.e. $B_0 = B_{PS} + B_{QN} \rightarrow$ Both inwards

Let current in each wire = i

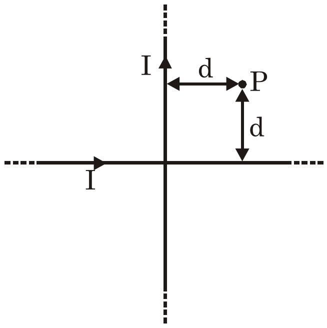
$$\therefore \quad B_0 = \frac{\mu_0 i}{4\pi d} + \frac{\mu_0 i}{4\pi d}$$

$$\text{or} \quad 10^{-4} = \frac{\mu_0 i}{2\pi d} = \frac{2\times10^{-7}\times i}{4\times10^{-2}}$$

$$\therefore \quad i = 20 \text{ A}$$

19. Ans. (1)

Sol.

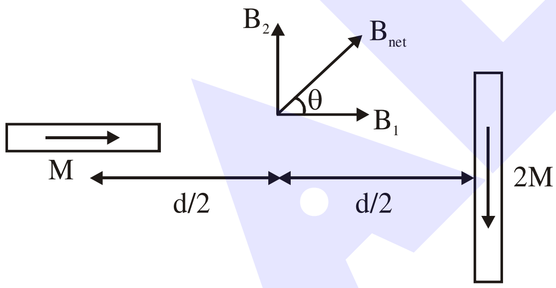


Magnetic field at point P

$$\vec{B}_{net} = \frac{\mu_0 i}{2\pi d}\left(-\hat{k}\right) + \frac{\mu_0 i}{2\pi d}\left(\hat{k}\right) = 0$$

20. Ans. (4)

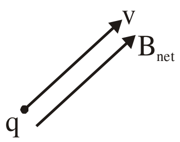
Sol.



$$B_1 = 2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{(d/2)^3}; \quad B_2 = \left(\frac{\mu_0}{4\pi}\right)\frac{2M}{(d/2)^3}$$

$B_1 = B_2$

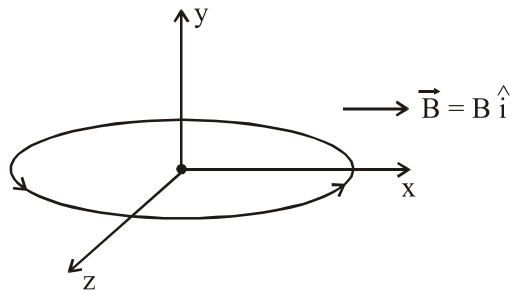
$\Rightarrow B_{net}$ is at 45° (θ = 45°)



velocity of charge and B_{net} are parallel so by $\vec{F} = q\left(\vec{v}\times\vec{B}\right)$ force on charge particle is zero.

21. Ans. (1)

Sol.



Magnetic moment of coil = $NIA\,\hat{j}$

$$= NI\left(\pi r^2\right)\hat{j}$$

Torque on loop (coil) = $\vec{M}\times\vec{B}$

$$= NI\left(\pi r^2\right)B\sin 90^\circ\left(-\hat{k}\right)$$

$$= NI\pi r^2 B\left(-\hat{k}\right)$$

22. Ans. (2)

Sol. $$\phi_q = \frac{\mu_0 i_1 R^2}{2(R^2+x^2)^{\frac{3}{2}}}\times \pi r^2 = 10^{-3}$$

$$\phi_p = \frac{\mu_0 i_2 r^2}{2(r^2+x^2)^{\frac{3}{2}}}\times \pi R^2$$

$$\frac{\phi_P}{\phi_Q} = \frac{i_2}{i_1}\cdot\frac{(R^2+x^2)^{\frac{3}{2}}}{(r^2+x^2)^{\frac{3}{2}}} = \frac{\phi_P}{10^{-3}}$$

$$\frac{2}{3} = \frac{\phi_P}{10^{-3}}$$

$\phi_P = 6.67 \times 10^{-4}$.

23. Ans. (1)

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

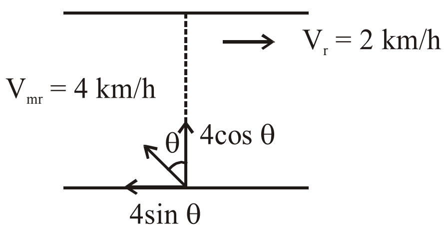
$C\theta = i\,N\,A\,B$

$$10^{-6}\times\frac{\pi}{180} = 10^{-3}\times 10^{-4}\times 175\times B$$

$B = 10^{-3}$ Tesla.

24. Ans. (4)

Sol.



For swimmer to cross the river straight

$\Rightarrow$ 4 sin θ = 2

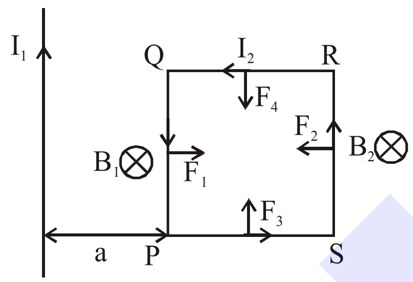
$\Rightarrow \sin\theta = \frac{1}{2} \Rightarrow \theta = 30°$

So, angle with direction of river flow = 90° + θ = 120°

Option (4)

25. Ans. (2)

Sol.



F_3 & F_4 cancel each other

Force on PQ will be $F_1 = I_2 B_1 a$

$$= I_2 \frac{\mu_0 I_1}{2\pi a} a$$

$$= \frac{\mu_0 I_1 I_2}{2\pi}$$

Force on RS will be $F_2 = I_2 B_2 a$

$$= I_2 \frac{\mu_0 I_1}{2\pi 2a} a$$

$$= \frac{\mu_0 I_1 I_2}{4\pi}$$

Net force = $F_1 - F_2 = \frac{\mu_0 I_1 I_2}{4\pi}$ repulsion

Option (2)

26. Ans. (2)

Sol. $|\vec{\tau}| = |\vec{M} \times \vec{B}|$

τ = NI × A × B × sin 45°

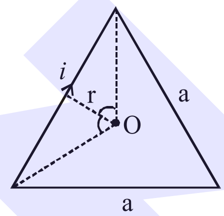
τ = 0.27 Nm

Option (2)

27. Ans. (1)

Sol. $B = 3\left[\frac{\mu_0 i}{4\pi r}(\sin 60° + \sin 60°)\right]$

Here, $r = \frac{a}{2\sqrt{3}} = \frac{1}{2\sqrt{3}}$



$$B = 3\left[\frac{4\pi\times 10^{-7}\times 10\times 2\sqrt{3}}{4\pi\times 1}\left[\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2}\right]\right]$$

B = 18 × 10^{-6} = 18 μT

28. Ans. (2)

Sol. m = NIA = 1 × I × a^2

here a = side of square

Now,

4a = 2πr

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

For circular loop

m' = 1 × I × πr^2

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

$$m' = \frac{4m}{\pi}$$

29. Ans. (3)

Sol. X = 5 YZ^2

$$Y = \frac{X}{5Z^2}$$

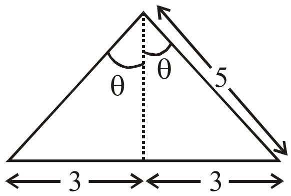
$$[Y] = \frac{[X]}{[Z^2]}$$

$$= \frac{A^2.M^{-1}L^{-2}.T^4}{(MA^{-1}T^{-2})^2}$$

$= M^{-3} . L^{-2} . T^8 . A^4$

30. Ans. (4)

Sol.



$$B = \frac{\mu_0 I}{4\pi d} 2 \sin\theta$$

d = 4 cm

$$\sin\theta = \frac{3}{5}$$

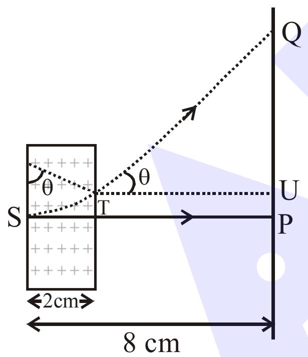
31. Ans. (1)

Sol. $R = \frac{mv}{qB}$

$$= \frac{\sqrt{2m(K.E.)}}{qB}$$

$$R = \frac{\sqrt{2\times 9.1\times 10^{-31}\times(100\times 1.6\times 10^{-19})}}{1.6\times 10^{-19}\times 1.5\times 10^{-3}}$$

R = 2.248 cm



$$\sin\theta = \frac{2}{2.248}$$

$$\tan\theta = \frac{QU}{TU}$$

$$\frac{2}{1.026} = \frac{QU}{6}$$

QU = 11.69

PU = R(1 – cos θ)

= 1.22

d = QU + PU

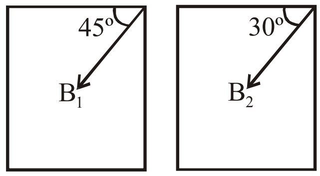
32. Ans. (2)

Sol. $B = \frac{\mu_0 i}{2R} = \frac{\mu_0 q\omega}{2R\, 2\pi}$

$\Rightarrow q = 3 \times 10^{-5}$ C

33. Ans. (3)

Sol.



$$f_1 = \frac{1}{2\pi}\sqrt{\frac{\mu B_1 \cos 45^\circ}{I}} \qquad f_2 = \frac{1}{2\pi}\sqrt{\frac{\mu B_2 \cos 30^\circ}{I}}$$

$$\frac{f_1}{f_2} = \sqrt{\frac{B_1 \cos 45^\circ}{B_2 \cos 30^\circ}} \qquad \therefore \frac{B_1}{B_2} \simeq 0.7$$