NEET Important Questions with Solutions from Magnetic Effects of Current and Magnetism

Q.1. Calculate the magnetic field at the centre of a coil in the form of a square of side $2a$ carrying a current I.

A) $\frac{2\mu_0 I}{\pi a}$

B) $\frac{\sqrt{2}\mu_0 I}{\pi a}$

C) $\frac{5\mu_0 I}{\pi a}$

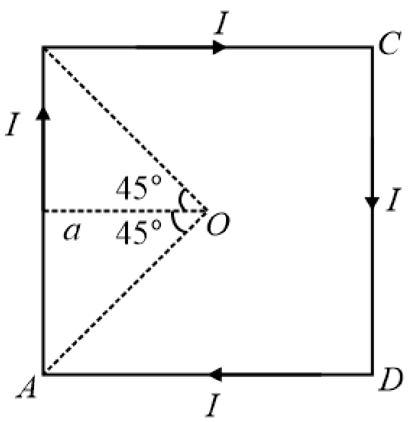
D) $\frac{\sqrt{3}\mu_0 I}{\pi a}$

Answer: $\frac{\sqrt{2}\mu_0 I}{\pi a}$

Solution: The current-carrying coil $ABCD$ may be assumed to be made of four current-carrying conductors AB, BC, CD and DA. Magnetic field at O due to current-carrying conductor AB is

$$B = \frac{\mu_0 I}{4\pi a}[\sin 45^\circ + \sin 45^\circ]$$

$$= \frac{\mu_0 I}{4\pi a} 2 \sin 45^\circ$$



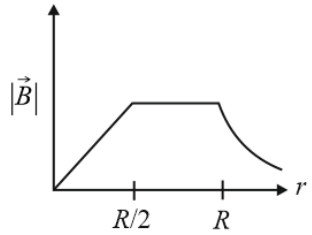
or $B = \frac{\mu_0 I}{4\pi a} \times 2 \times \frac{1}{\sqrt{2}}$

or $B = \frac{\sqrt{2}\mu_0 I}{4\pi a}$.

Total magnetic field at O, $B' = 4B = 4 \times \frac{\sqrt{2}\mu_0 I}{4\pi a}$
$= \frac{\sqrt{2}\mu_0 I}{\pi a}$.

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

A)



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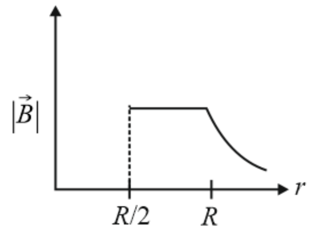
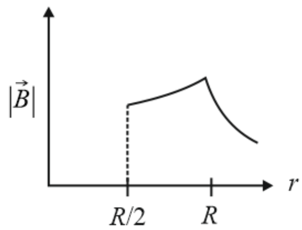
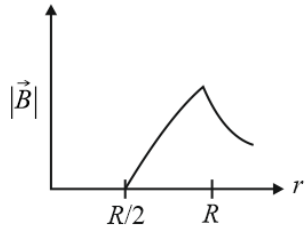


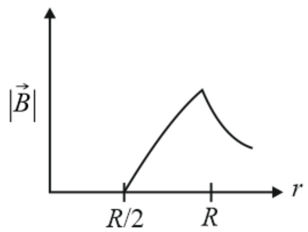
C)



D)



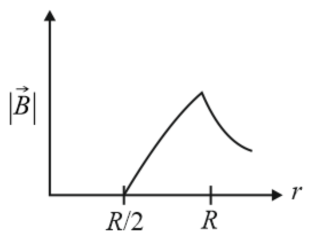
Answer:



Solution: $r < \frac{R}{2}, B = 0$

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

$\frac{\mathrm{R}}{2} < r < R, B = \frac{\mu_0 I}{2\pi r}\left[\frac{r^2 - \left(\frac{R}{2}\right)^2}{R^2 - \left(\frac{R}{2}\right)^2}\right]$



Q.3. To which of the following quantities, the radius of the circular path of a charged particle moving at right angles to a uniform magnetic field is directly proportional?

A) energy of the particle

B) magnetic field

C) charge of the particle

D) momentum of the particle

Answer: momentum of the particle

Solution: If velocity of particle, v is perpendicular to magnetic field, B i.e. $\theta = 90^\circ$, then particle will experience maximum magnetic force, i.e. $F_{\max} = qvB$. This force acts in a direction perpendicular to the motion of charged particle.

Therefore, the trajectory of the particle is a circle. In this case path of charged particle is circular and magnetic force provides the necessary centripetal force,

i.e. $qvB = \frac{mv^2}{r}$

$\Rightarrow$ Radius of path, $r = \frac{mv}{qB}$

$r = \frac{p}{qB} \left[\because p = mv\right]$

where, $p =$ momentum of the particle

$\therefore r \propto$ momentum

Hence, option (d) is correct.

Q.4. A particle carrying a charge equal to 100 times the charge on an electron is rotating one rotation per second in a circular path of radius $0.8 \mathrm{~m}$. The value of the magnetic field produced at the centre will be ($\mu_0 =$ permeability for vacuum)

A) $\frac{10^{-7}}{\mu_0}$

B) $10^{-17} \mu_0$

C) $10^{-6} \mu_0$

D) $10^{-7} \mu_0$

Answer: $10^{-17} \mu_0$

Solution: Charge on particle$= 100 \times e$

Radius of circular path$= 0.8\ \mathrm{m}$

1 rotation in $1\ \mathrm{s}$

To find magnetic field of centre

$i = \frac{q}{t} = \frac{100 \times e}{1}$

Magnetic field at the centre of circular path $B = \frac{\mu_0}{4\pi} \cdot \frac{2\pi i}{r}$

$\Rightarrow B = \frac{\mu_0 \times 200 \times 1.6 \times 10^{-19}}{4 \times 0.8}$

$\Rightarrow B = 10^{-17} \mu_0$

The value of magnetic field produced at the centre will be $= 10^{-17} \mu_0$

Q.5. An electric charge $+q$ moves with velocity $\vec{v} = 3\hat{i} + 4\hat{j} + \hat{k}$, in an electromagnetic field given by: $\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$. The $y-$component of the force experienced by $+q$ is

A) 2q

B) 11q

C) 5q

D) 3q

Answer: 11q

Solution: Given,

$\vec{v} = 3\hat{i} + 4\hat{j} + \hat{k}$

$\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$

$\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$

We know,

$\vec{F}_{mag} = q\left(\vec{v} \times \vec{B}\right)$

and

$\vec{F}_{E} = q\vec{E}$

$\vec{F}_{net} = \vec{F}_{mag} + \vec{F}_{E}$

Cross product of $\vec{v} \times \vec{B} = \left(3\hat{i} + 4\hat{j} + \hat{k}\right) \times \left(\hat{i} + \hat{j} - 3\hat{k}\right) == -13\hat{i} + 13\hat{j} - \hat{k}$

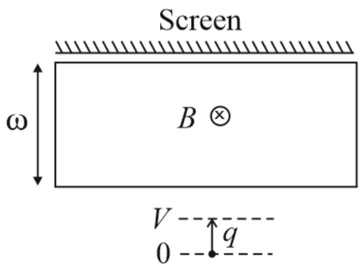
$\vec{F}_{mag} = -13q\hat{i} + 10q\hat{j} - q\hat{k}$

$\vec{F}_{E} = 3q\hat{i} + q\hat{j} - 2q\hat{k}$

$\vec{F}_{net} = -10q\hat{i} + 11q\hat{j} - 3q\hat{k}$

Thus, the y-component is equal to $11q$.

Q.6. A rectangular region of dimensions $w \times I\,(w << I)$ has a constant magnetic field into the plane of the paper as shown. On one side the region is bounded by a screen. On the other side positive ions of mass m and charge q are accelerated from rest and towards the screen by a parallel plate capacitor at constant potential difference $V < 0$, and come out through a small hole in the upper plate. Which one of the following statements is correct regarding the charge on the ions that hit the screen?



A) Ions with $q > \frac{2|V|m}{B^2w^2}$ will hit the screen.

B) Ions with $q < \frac{2|V|m}{B^2w^2}$ will hit the screen

C) All ions will hit the screen.

D) Only ions with $q = \frac{2|V|m}{B^2w^2}$ will hit the screen.

Answer: Ions with $q < \frac{2|V|m}{B^2w^2}$ will hit the screen

Solution: Given,

Positive ions of mass m and charge q are accelerated from rest with constant potential difference V across the capacitor.

i.e., $\frac{1}{2}mv^2 = qV$.

The speed of an electron entering the region of the magnetic field is $v = \sqrt{\frac{2qV}{m}}$

The positive ions follow a circular path due to the magnetic field in the rectangular region.

So the ions following the circular path of radius $r > \omega$ will hit the screen and for the ions with radius $r < \omega$ will not the hit the screen.

That is, In order to hit the screen

$\Rightarrow r > \omega$

$\Rightarrow \frac{mv}{qB} > \omega$

$\Rightarrow \frac{m}{qB}\sqrt{\frac{2qV}{m}} > \omega$

$\Rightarrow \frac{1}{B}\sqrt{\frac{2mV}{q}} > \omega$

$q < \frac{2|V|m}{B^2\omega^2}$.

Q.7. An iron rod $0.2\ \mathrm{m}$ long, $10^{-2}\ \mathrm{m}$ in diameter and of permeability 1000 is placed inside a long solenoid, wound with 300 turns per metre. If a current of $0.5\ \mathrm{A}$ is passed through the rod, find the magnetic moment of the rod.

A) $2.6\ \mathrm{J\ T^{-1}}$

B) $0.36\ \mathrm{J\ T^{-1}}$

C) $0.2325\ \mathrm{J\ T^{-1}}$

D) $5.2\ \mathrm{J\ T^{-1}}$

Answer: $0.2325\ \mathrm{J\ T^{-1}}$

Solution: We know that magnetic field, $B=\mu_0(H+I)$

where, μ_0 is permeability of free space, H is magnetising density and I is intensity of magnetization.

$\Rightarrow I=\frac{B}{\mu_0}-H=\frac{\mu H}{\mu_0}-H=(\mu_\mathrm{r}-1)H$

where, μ_r is relative permeability of the medium.

For a solenoid, $B=\mu_0 ni$

where, n is the number of turns per unit length and i is current flowing through the solenoid.

For a solenoid, magnetising density, $H=\frac{B}{\mu_0}=ni$

$\Rightarrow I=(\mu_\mathrm{r}-1)ni$

$\Rightarrow I=\left(1000-1\right)300\times0.5=999\times150\ \mathrm{A\ m^2}$

Magnetic moment of a rod is given by,

$M=I\times V\quad[V\ \text{is volume of rod}]$

$M=I\left(\pi r^2 l\right)=999\times150\times3.14\times\left(0.5\times10^{-2}\right)\times0.2$

$\Rightarrow M=0.2325\ \mathrm{J\ T^{-1}}$

Q.8. A toroidal coil has 3000 turns. The inner and outer radii are $10\ \mathrm{cm}$ and $12\ \mathrm{cm}$, respectively. If current flowing is $5\ \mathrm{A}$, then the magnetic field inside the toroid will be

A) $25\times10^{-3}\ \mathrm{T}$

B) $25\times10^{-2}\ \mathrm{T}$

C) $2.5\ \mathrm{T}$

D) $2.5\times10^{-4}\ \mathrm{T}$

Answer: $2.5\times10^{-4}\ \mathrm{T}$

Solution: Given,

$N=3000$,

inner radius, $R_\mathrm{i}=10\ \mathrm{cm}$,

outer radius, $R_\mathrm{o}=12\ \mathrm{cm}$ and

current $I=5\ \mathrm{A}$.

Magnetic field inside a toroid is stated as $B=\frac{\mu_0 NI}{2\pi R}$,

where μ_0 is permeability constant and

R is mean radius.

So, $R=\frac{R_i+R_o}{2}=\frac{10+12}{2}=11\ \mathrm{cm}=0.11\ \mathrm{m}$.

Now, $B=\frac{4\pi\times10^{-7}\times3000\times5}{2\pi\times0.11}=2.7\times10^{-4}\ \mathrm{T}$

Thus, the magnetic field is $2.5\times10^{-4}\ \mathrm{T}$.

Q.9. A solenoid of $1.5\ \mathrm{m}$ length and $4\ \mathrm{cm}$ diameter possesses 10 turns per m. A current of $5\ \mathrm{A}$ is flowing through it. The magnetic induction at axis inside the solenoid is

A) $2\pi \times 10^{-3}$ T

B) $2\pi \times 10^{-5}$ T

C) $2\pi \times 10^{-7}$ T

D) $2\pi \times 10^{-9}$ T

Answer: $2\pi \times 10^{-5}$ T

Solution: Given here,

length of solenoid, $L = 1.5$ m,

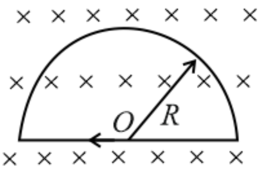
number of turns, $N = 10$ turns m^{-1}, current, $I = 5$ A.

The magnetic induction at the axis inside the solenoid is stated as $B = \mu_0 NI$,

here μ_0 is the permeability constant.

Thus, $B = 4\pi \times 10^{-7} \times 10 \times 5 = 2\pi \times 10^{-5}$ T.

Q.10.



As shown in the figure, a wire is bent to form a D-shaped closed loop, carrying current I, where the curved part is a semi-circle of radius R. The loop is placed in a uniform magnetic field B, which is directed into the plane of the paper. The magnetic force felt by the closed loop is

A) zero

B) IRB

C) $2IRB$

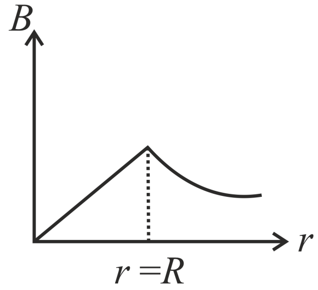
D) $\frac{1}{2}IRB$

Answer: zero

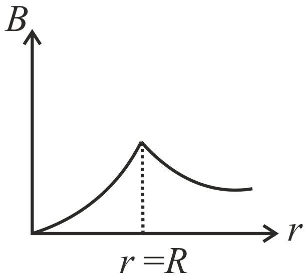
Solution: A wire is bent to form a D-shaped loop carrying current I, where the curved part is semi-circle of radius R. The loop is placed in a uniform magnetic field B which is directed into the plane of the paper. As single current by flowing in the loop, so net magnetic force on a closed current loop in a uniform magnetic field B is zero.

Q.11. A long cylindrical wire of radius R carries a uniform current I flowing through it. The variation of magnetic field with distance 'r' from the axis of the wire is shown by

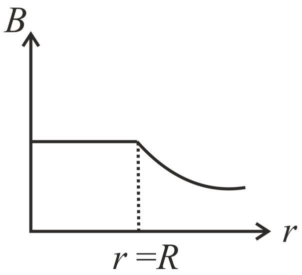
A)



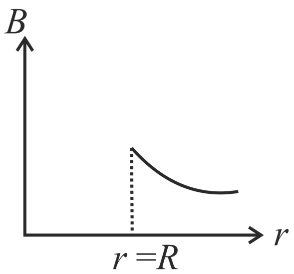
B)



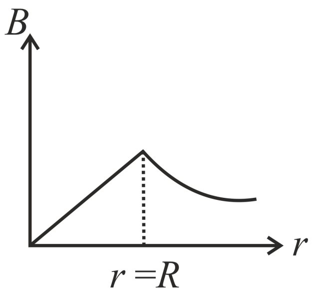
C)



D)

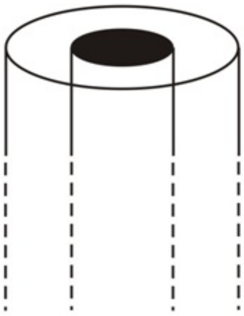


Answer:



Solution: The magnetic field increases as the point moves closer to the boundary of the wire and decreases as it moves away from the boundary of the wire.
Hence the correct option is (a).

Q.12. In a coaxial, straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is non-zero



A) outside the cable.

B) inside the inner conductor.

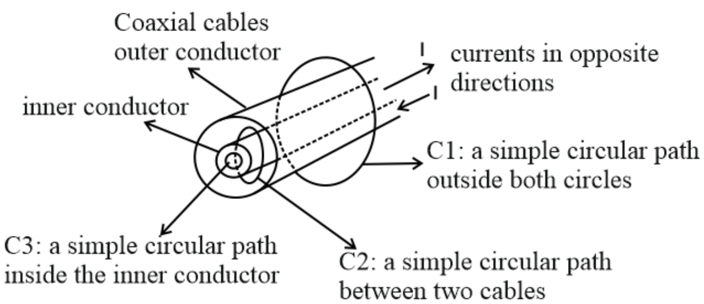
C) inside the outer conductor.

D) in between the two conductors.

Answer: in between the two conductors.

Solution: Let the current in the cables are I. According to Ampere's Circuital law, the magnetic field enclosed by Ampere Loop is given by,

$\int \vec{B} \cdot \mathrm{d} \vec{l} = \mu_0 I_{en.}$, where $I_{en.}$ is the enclosed current by the loop.



At outside the cable for loop C_1 and inside the cable for loop C_3, the enclosed current is given as,

$I_{C_1} = I - I = 0$ and $I_{C_3} = 0$

So, according to Ampere's law, the magnetic field outside the outer conductor and inside the inner conductor will be zero.

For loop C_2 means in between the conductors, the magnetic field is given by,

$B \times 2\pi r = \mu_0 I$, where $r_{\text{in}} \leq r \leq r_{\text{out}}$

$B = \frac{\mu_0 I}{2\pi r}$ means the magnetic field is non-zero.

Q.13. The horizontal component of the earth's magnetic field is 3.6×10^{-5} tesla where the dip angle is 60°. The magnitude of the earth's magnetic field is,

A) 2.8×10^{-4} tesla

B) 2.1×10^{-4} tesla

C) 7.2×10^{-5} tesla

D) 3.6×10^{-5} tesla

Answer: 7.2×10^{-5} tesla

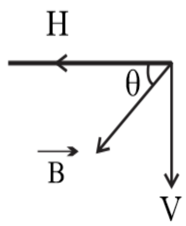
Solution: We know that horizontal component of earth's field,

$H = B\cos\theta$ since, $\theta = 60^{\circ}$

where,

θ is the angle of dip,

B is the earth's magnetic field.



According to the question,

$$H = B\cos(\theta)$$
$$3.6 \times 10^{-5} = B \times \frac{1}{2}$$
$$\Rightarrow B = 7.2 \times 10^{-5}\ \mathrm{T}.$$

Q.14. A current I is flowing along an infinite, straight wire, in the positive $Z-$ direction and the same current is flowing along a similar parallel wire $5\ \mathrm{m}$ apart, in the negative $Z-$ direction. A point P is at a perpendicular distance $3\ \mathrm{m}$ from the first wire and $4\ \mathrm{m}$ from the second. What will be the magnitude of the magnetic field B of P?

A) $\frac{5}{12}\left(\frac{\mu_0 I}{\pi}\right)$

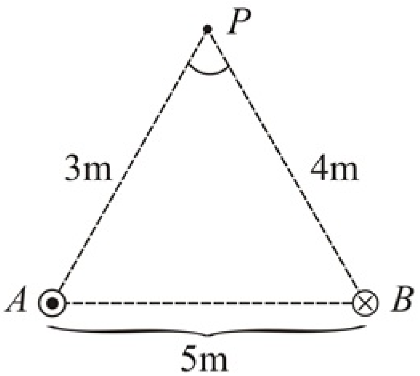
B) $\frac{7}{24}\left(\frac{\mu_0 I}{\pi}\right)$

C) $\frac{5}{24}\left(\frac{\mu_0 I}{\pi}\right)$

D) $\frac{25}{288}\left(\frac{\mu_0 I}{\pi}\right)$

Answer: $\frac{5}{24}\left(\frac{\mu_0 I}{\pi}\right)$

Solution: According to the question,



Magnetic field due to first wire (A) is $B_1=\frac{\mu_0 \times I}{2\pi \times 3}$

Magnetic field due to second wire (B) is $B_2=\frac{\mu_0 \times I}{2\pi \times 4}$

Net magnitude of magnetic field $B=\sqrt{B_1^2+B_2^2}$

$B=\frac{\mu_0 I}{2\pi}\sqrt{\frac{1}{9}+\frac{1}{16}}=\frac{\mu_0 I \times 5}{2\pi \times 3 \times 4}$

Magnetic field $B=\frac{5}{24}\times\frac{\mu_0 I}{\pi}$

Q.15. An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to,

A) $\sqrt{\frac{B}{v}}$

B) $\frac{B}{v}$

C) $\sqrt{\frac{v}{B}}$

D) $\frac{v}{B}$

Answer: $\sqrt{\frac{v}{B}}$

Solution: $B=\frac{\mu_0 i}{2r}$

$\Rightarrow B=\frac{\mu_0 q v}{2r(2\pi r)}$

$\Rightarrow B=\frac{\mu_0 q v}{4\pi r^2}$

$\Rightarrow r \propto \sqrt{\frac{v}{B}}$.

Q.16. The horizontal component of earth's magnetic field at any place is $0.3 \times 10^{-4}\ \mathrm{Wb\ m^{-2}}$. If the angle of dip at that place is 60°, then the value of vertical component of earth's magnetic field (in $\mathrm{Wb\ m^{-2}}$) will be

A) 0.12×10^{-4}

B) 0.017×10^{-4}

C) 0.40×10^{-4}

D) 0.0519×10^{-4}

Answer: 0.0519×10^{-4}

Solution: Given,

$B_H = 0.3 \times 10^{-4} T$

We know, $\tan\ \delta = \frac{B_v}{B_H}$

Where, δ is the angle of dip, B_v is the vertical component of earth's magnetic field and B_H is the horizontal component of earth's magnetic field.

$\Rightarrow B_v = B_H \tan\delta$
$= 0.03 \times 10^{-4} \times \tan 60^\circ$
$= 0.03 \times 10^{-4} \times \sqrt{3}$
$= 0.0519 \times 10^{-4} \mathrm{T}$

Q.17. The true value of angle of dip at a place is 60°. The apparent dip in a plane inclined at an angle of 30° with magnetic meridian is

A) $\tan^{-1} \frac{1}{2}$

B) $\tan^{-1}(2)$

C) $\tan^{-1}\left(\frac{2}{3}\right)$

D) none of these

Answer: $\tan^{-1}(2)$

Solution: The apparent angle of dip is given by,

$\tan\ \delta' = \frac{\tan\ \delta}{\cos\ \beta}$

Where, δ' is the apparent angle of dip, δ is the true angle of dip and β is the angle made with the magnetic meridian.

$\Rightarrow \tan\ \delta' = \frac{\tan\ 60^\circ}{\cos\ 30^\circ} = \frac{\sqrt{3}}{\frac{\sqrt{3}}{2}} = 2$

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

Q.18. An electron (mass$= 9.1 \times 10^{-31}$ kg, charge $= -1.6 \times 10^{-19}$ C) experiences no deflection if subjected to an electric field of $3.2 \times 10^5\ \mathrm{V\ m^{-1}}$ and a magnetic field of $2.0 \times 10^{-3}\ \mathrm{Wb\ m^{-2}}$. Both the fields are normal to the path of electron and to each other. If the electric field is removed, then the electron will revolve in an orbit of radius

A) 45 m

B) 4.5 m

C) 0.45 m

D) 0.045 m

Answer: 0.45 m

Solution: Assuming v as the velocity of electron, E as the Electric field, B as the magnetic field and q as the charge of an electron.

When it goes undeflected,

$\Rightarrow qE = qvB$

$\Rightarrow v = \frac{E}{B}$

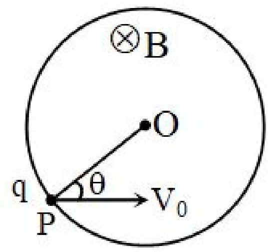
$\Rightarrow v = \frac{3.2 \times 10^5}{2 \times 10^{-3}} = 1.6 \times 10^8 \text{ m s}^{-1}$

Also,

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

$\Rightarrow R = \frac{9.1 \times 10^{-31} \times 1.6 \times 10^8}{1.6 \times 10^{-19} \times 2 \times 10^{-3}} = 0.45 \text{ m}$

Q.19. A particle of charge q and mass m is projected with a velocity V_0 towards a circular region having uniform magnetic field B perpendicular and into the plane of paper from point P as shown in the figure. R is the radius and O is the centre of the circular region. If the line OP makes angle θ with the direction of V_0, then the value of V_0 so that particle passes through O is



A) $\frac{qBR}{m \sin\theta}$

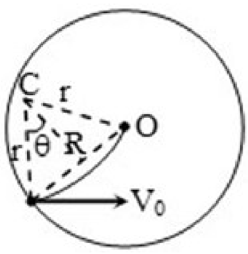
B) $\frac{qBR}{2m \sin\theta}$

C) $\frac{2qBR}{m \sin\theta}$

D) $\frac{3qBR}{2m \sin\theta}$

Answer: $\frac{qBR}{2m \sin\theta}$

Solution:



$r = \frac{mV_0}{qB}$

$R = 2r \sin\theta$

$\Rightarrow R = \frac{2mV_0}{qB} \sin\theta$

$\Rightarrow V_0 = \frac{qBR}{2m \sin\theta}$

Q.20. The length of a bar magnet is 10 cm and it's pole strength is 10^{-3} Wb. It is placed in a magnetic field of induction $4\pi \times 10^{-3}$ T, in a direction making an angle of 30° with the field direction. The value of torque acting on the magnet will be

A) $2\pi \times 10^{-7} \text{ N m}$

B) $2\pi \times 10^{-5}$ N m

C) 0.5×10^{2} N m

D) 0.5 N m

Answer: $2\pi \times 10^{-7}$ N m

Solution: Given,

$L = 10\ \text{cm}$

$m = 10^{-3}\ \text{Wb}$

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

$\theta = 30^{\circ}$

Torque on the magnet is,

$\tau = MB\sin\theta$

$\Rightarrow \tau = mLB\sin\theta \quad [\because M = mL]$

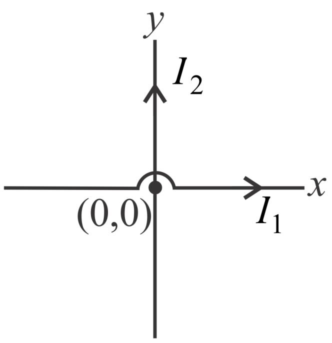
Substituting the given values in the formula, we get,

$\tau = 0.1 \times 10^{-3} \times 4\pi \times 10^{-3} \times \sin 30^{\circ}$

$\tau = 10^{-7} \times 4\pi \times \frac{1}{2}$

$\tau = 2\pi \times 10^{-7}$ N m

Q.21. Two long straight conductors with current I_1 and I_2 are placed along X and Y axes. The equation of locus of point of zero magnetic induction is -



A) $y = x$

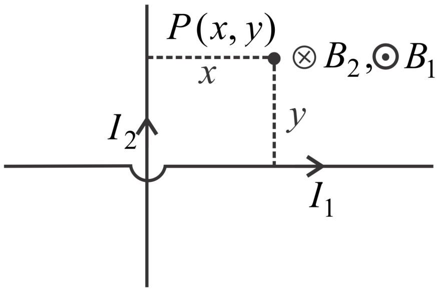
B) $y = \frac{I_2}{I_1}x$

C) $y = \frac{I_1}{I_2}x$

D) $y = \frac{x}{I_1 I_2}$

Answer: $y = \frac{I_1}{I_2}x$

Solution:



$B_P = 0$

$B_1 - B_2 = 0$

$\Rightarrow B_1 = B_2$

$\frac{\mu_0 I_1}{2\pi y} = \frac{\mu_0}{2\pi}\frac{I_2}{x} \therefore \boxed{y = \frac{I_1}{I_2}x}$

Q.22. When an additional resistance of $1980\ \Omega$ is connected in series with a voltmeter, the scale division reads 100 times larger value. Resistance of the voltmeter is

A) $10\ \Omega$

B) $20\ \Omega$

C) $30\ \Omega$

D) $40\ \Omega$

E) $50\ \Omega$

Answer: $20\ \Omega$

Solution: Let's take R_v as the resistance of the voltmeter and

i_g as the current through the meter.

If n is the number of divisions in the meter then

$n = \frac{i_g R_v}{V}\ \ldots(\text{i}),$

where, V is the per scale reading of the given voltmeter.

Given, if an additional resistance is connected in series with the voltmeter then the full-scale reading increases 100 times.

$n = \frac{i_g(1980 + R_v)}{100V}\ \ldots(\text{ii})$

From equations (i) and (ii),

$(i_g R_v)(100) = i_g(R_v + 1980)$

$\therefore\ R_v = 20\ \Omega$

Q.23. A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north tip pointing down at 22° with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.35 G. Determine the magnitude of the earth's magnetic field at the place. $(\cos 22^\circ = 0.9272)$

A) 0.38 G

B) 0.35 G

C) 0.30 G

D) $0.40\ \mathrm{G}$

Answer: $0.38\ \mathrm{G}$

Solution: Given, angle of dip $\delta = 22^{\circ}$

Horizontal component of the earth's magnetic field $H = 0.35\ \mathrm{G}$

Let the magnitude of the earth's magnetic field at the place is R.

Using the formula, $H = R\cos\ \delta$

or $R = \frac{H}{\cos\ \delta} = \frac{0.35}{\cos\ 22^{\circ}} = \frac{0.35}{0.9272} = 0.38\ \mathrm{G}$

Thus, the value of the earth's magnetic field at that place is $0.38\ \mathrm{G}$.

Q.24. A magnet is cut in three equal parts by cutting it perpendicular to its length. The time period of original magnet is T_0 in a uniform magnetic field B. Then, the time period of each part in the same magnetic field is

A) $\frac{T_0}{2}$

B) $\frac{T_0}{3}$

C) $\frac{T_0}{4}$

D) None of these

Answer: $\frac{T_0}{3}$

Solution: In this question we have to calculate the time period after vertical cut

We have to use the formulae of vertical cutting

We know that,

In the case of vertical cutting

$T_1 = \frac{\text{Original time period}}{n}$

Since, it is cutted into three part

$T_1 = \frac{T_0}{3}$

Q.25. In a coaxial, straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is zero

A) outside the cable.

B) inside the inner conductor.

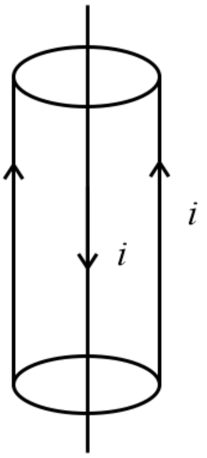
C) inside the outer conductor.

D) in between the two conductors.

E) None of these

Answer: outside the cable.

Solution: Here a coaxial, straight cable, the central conductor carries current i and the outer conductor carries current $-i$.



According to Ampere's law, $\int B \cdot \mathrm{d} l=\mu_0 i$, here $\int B \cdot \mathrm{d} l$ is line integral of magnetic field B around a closed path and μ_0 is permeability of free space.

The magnetic field outside the cable around the loop is $\int B \cdot d l=\mu_0 i=\mu_0(i-i)$ (Since the current directions are opposite)

Thus, $\int B \cdot \mathrm{d} l=0$. Hence, magnetic field is zero outside the cable.

The magnetic field inside the inner conductor, inside the outer conductor and in between the conductors will be constant, since the current of inner cable is considered only.

Practice more on Magnetic Effects of Current and Magnetism