Moving Charges and Magnetism

Question1

A tightly wound 100 turns coil of radius 10cm carries a current of 7A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$SI units):

[NEET 2024]

Options:

A.

44 mT

B.

4.4T

C.

4.4 mT

D.

44T

Answer: C

Solution:

The magnitude of magnetic field due to circular coil of N turns is given by

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

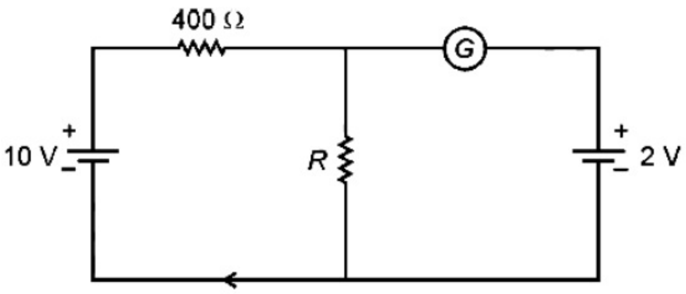
$$= \frac{4\pi \times 10^{-7} \times 7 \times 100}{2 \times 0.1}$$

$$= 4.4 \times 10^{-3} \mathrm{T}$$

$$= 4.4 \, \mathrm{mT}$$

Question2

If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by



[NEET 2023]

Options:

A.

50Ω

B.

100Ω

C.

400Ω

D.

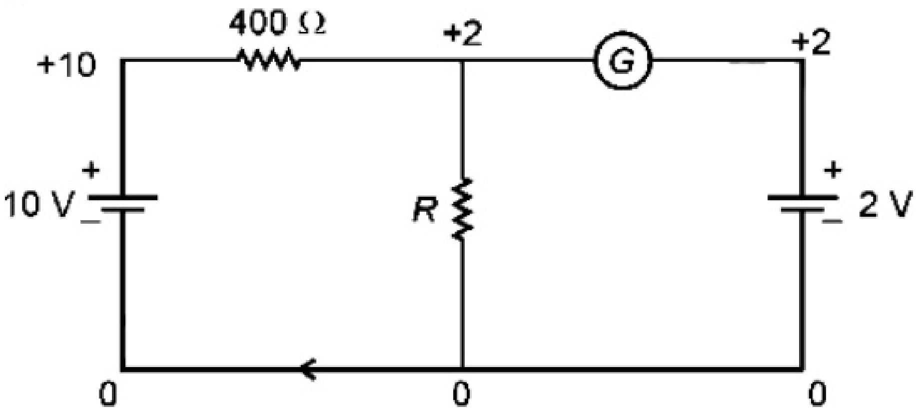
200Ω

Answer: B

Solution:

Since galvanometer does not show any deflection

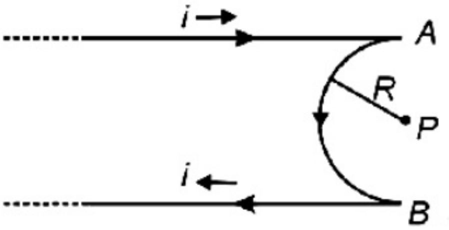
$\Rightarrow i_g = 0$



$$\frac{10-2}{400} = \frac{2}{R} \Rightarrow R = \frac{2 \times 400}{8} = 100\Omega$$

Question3

A very long conducting wire is bent in a semi-circular shape from A to B as shown in figure. The magnetic field at point P for steady current configuration is given by



[NEET 2023]

Options:

A.

$\frac{\mu_0 i}{4R}$ pointed away from the page

B.

$\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed away from page

C.

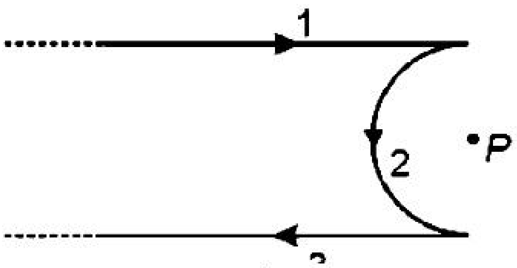
$\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed into the page

D.

$\frac{\mu_0 i}{4R}$ pointed into the page

Answer: B

Solution:



B_P due to wire $1 = \frac{\mu_0 i}{4\pi R}\otimes$

B_P due to wire $3 = \frac{\mu_0 i}{4\pi R}\otimes$

B_P due to wire $2 = \frac{\mu_0 i}{4R}\odot$

$B_{\text{net}} = -\frac{\mu_0 i}{2\pi R}+\frac{\mu_0 i}{4R}=\frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}+1\right]=\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$

Pointed away from page.

Question4

A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})T$. The magnitude of the magnetic force acting on the wire is

[NEET 2023]

Options:

A.

√5/L

B.

5/L

C.

√3/L

D.

3/IL

Answer: B

Solution:

Magnetic force acting on a current carrying wire is

$$\vec{F} = I\vec{\ell} \times \vec{B}$$

$$= IL\hat{i} \times (2\hat{i} + 3\hat{j} - 4\hat{k}) = 3/L\hat{k} + 4/L\hat{j}$$

Magnitude of force

$$|\vec{F}| = \sqrt{(3/L)^2 + (4/L)^2}$$

$$= 5/L$$

Question5

A long straight wire of length 2m and mass 250g is suspended horizontally in a uniform horizontal magnetic field of 0.7T. The amount of current flowing through the wire will be ($g = 9.8ms^{-2}$) :

[NEET 2023 mpr]

Options:

A.

2.45A

B.

2.25A

C.

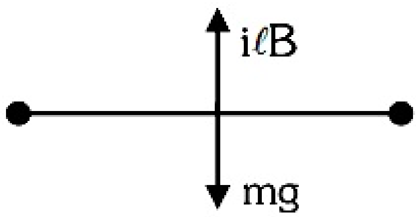
2.75A

D.

1.75A

Answer: D

Solution:



$mg = i/B$

$250 \times 10^{-3} \times 9.8 = i \times 2 \times 0.7$

$i = \dfrac{0.250 \times 9.8}{2 \times 0.7} = 0.250 \times 7$

$i = 1.75A$

Question6

A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron:

[NEET 2023 mpr]

Options:

A.

will turn towards right of direction of motion

B.

will turn towards left of direction of motion

C.

speed will decrease

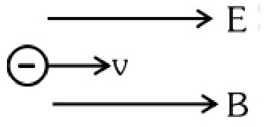
D.

speed will increase

Answer: C

Solution:

Speed of electron will decrease due to electric force magnetic force of electron is zero.



Question7

A closely packed coil having 1000 turns has an average radius of 62.8 cm. If current carried by 62.8 cm the wire of the coil is 1A the value of magnetic field produced at the centre of the coil will be (permeability of free space $= 4\pi \times 10^{-7}$ H / m) nearly .
[NEET Re-2022]

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Options:

A. 10^{-3}T

B. 10^{-1}T

C. 10^{-2}T

D. 10^{2}T

Answer: A

Solution:

$$B = \frac{\mu_0 nI}{2R}$$

$$= \frac{4\pi \times 10^{-7} \times 1000 \times 1}{2 \times 62.8 \times 10^{-2}}$$

$10^{-3}T$

Question8

The shape of the magnetic field lines due to an infinite long, straight current carrying conductor is :
[NEET Re-2022]

Options:

A. a plane

B. a straight line

C. circular

D. elliptical

Answer: C

Solution:

For infinite current carrying conductor MF lines are concentric circles.

Question9

Two very long, straight, parallel conductors A and B carry current of 5 A and 10 A respectively and are at a distance of 10 cm from each other. The direction of current in two conductors is same. The force acting per unit length between two conductors is:($\mu_0 = 4\pi \times 10^{-7}$ SI unit) [NEET Re-2022]

Options:

A. $1 \times 10^{-4} \mathrm{Nm}^{-1}$ and is repulsive

B. $2 \times 10^{-4} \mathrm{Nm}^{-1}$ and is attractive

C. $2 \times 10^{-4} \mathrm{Nm}^{-1}$ and is repulsive

D. $1 \times 10^{-4} \mathrm{Nm}^{-1}$ and is attractive

Answer: D

Solution:

Two parallel wires carrying current in same direction will attract each other.

$$\frac{F}{l} = \frac{\mu_0 i_1 i_2}{2\pi d} = \frac{2 \times 10^{-7} \times 5 \times 10}{10 \times 10^{-2}} = 10^{-4} \mathrm{N/m}$$

Question10

The magnetic field on the axis of a circular loop of radius 100 cm carrying current I $= \sqrt{2}$A, at point 1m away from the centre of the loop is given by: [NEET Re-2022]

Options:

A. 6.28×10^{-4}T

B. 3.14×10^{-7}T

C. 6.28×10^{-7}T

D. 3.14×10^{-4}T

Answer: B

Solution:

On axis of wire $B = \dfrac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2} \times 1^2}{2(1^2 + 1^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2}}{2 \times 2\sqrt{2}} = \pi \times 10^{-7}\text{T}$$

$$= 3.14 \times 10^{-7}\text{T}$$

Question11

From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is [NEET-2022]

Options:

A. Uniform and remains constant for both the regions.

B. A linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.

C. A linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.

D. A linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region.

Answer: C

Solution:

For solid wire Inside point

$$B = \frac{\mu_0 / r^2}{R^2 \times 2\pi r}$$

$$= \frac{\mu_0 I r}{R^2 \times 2\pi}$$

$B \propto r$

Outside point

$B = \dfrac{\mu_0 I}{2\pi r}$ $B \propto \dfrac{1}{r}$

Question12

Given below are two statements
Statement I : Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only.
Statement II : Biot-Savart's law is analogous to Coulomb's inverse square law of charge q, with the former being related to the field produced by a scalar source, Id while the latter being produced by a vector source, q.
In light of above statements choose the most appropriate answer from the options given below
[NEET-2022]

Options:

A. Both Statement I and Statement II are correct

B. Both Statement I and Statement II are incorrect

C. Statement I is correct and Statement II is incorrect

D. Statement I is incorrect and Statement II is correct

Answer: C

Solution:

According to Biot-Savart's law $d\vec{B} = \dfrac{\mu_0}{4\pi}\dfrac{I d\vec{l} \times \vec{r}}{r^3}$ which is applicable for infinitesimal element. It is analogous to Coulomb's law, where $I d\vec{l}$ is vector source and electric field is produced by scalar source q. Here statement I is correct and statement II is incorrect.

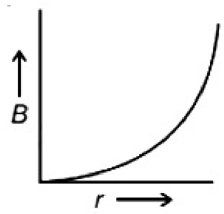
Question13

A thick current carrying cable of radius 'R' carries current 'I' uniformly distributed across its cross-section. The variation of magnetic field B(r)

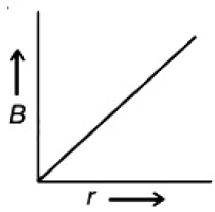
due to the cable with the distance 'r' from the axis of the cable is represented by
[NEET 2021]

Options:

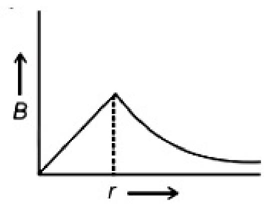
A.



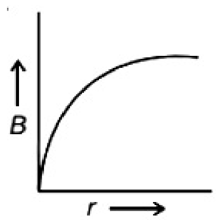
B.



C.



D.



Answer: C

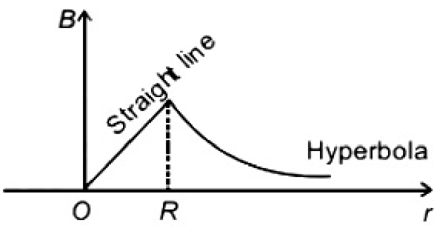
Solution:

From Ampere's circuital law

$B = \frac{\mu_0 I}{2\pi R^2} . r$ if $r < R \Rightarrow B_{inside} \propto r$

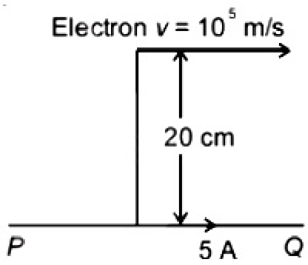
$B = \frac{\mu_0 I}{2z\pi r}$ if $r \geq R \Rightarrow B_{outside} \propto \frac{1}{r}$

Hence the correct plot of magnetic field B with distance r from axis of cable is given as



Question14

An infinitely long straight conductor carries a current of 5A as shown. An electron is moving with a speed of 10^5 m / s parallel to the conductor. The perpendicular distance between the electron and the conductor is 20 cm at an instant. Calculate the magnitude of the force experienced by the electron at that instant.



[NEET 2021]

Options:

A. 4×10^{-20} N

B. $8\pi \times 10^{-20}$ N

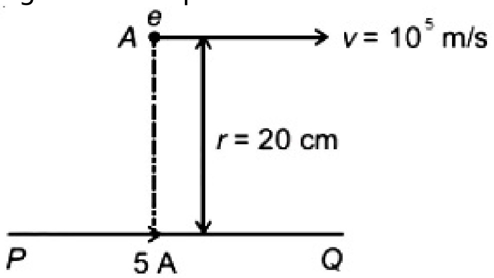
C. $4\pi \times 10^{-20}$ N

D. 8×10^{-20} N

Answer: D

Solution:

Magnetic field produced due to current carrying wire at point 'A'



$B = \frac{\mu_0}{4\pi}\frac{2I}{r}$

$B = \frac{10^{-7} \times 2 \times 5}{20 \times 10^{-2}} = \frac{1}{2} \times 10^{-5}$ (Tesla), upward to the plane of paper

Now, force acting on electron due to this field

$\vec{F} = q(\vec{v} \times \vec{B})$

$|\vec{F}| = 1.6 \times 10^{-19} \times 10^5 \times \frac{1}{2} \times 10^{-5}$

$= 0.8 \times 10^{-19}$ N

$|\vec{F}| = 8 \times 10^{-20}$ N

Question15

In the product

$\vec{F} = q(\vec{v} \times \vec{B})$

$= q\vec{v} \times (B\hat{i} + B\hat{j} + B_0\hat{k})$

For q = 1 and $\vec{v} = 2\hat{i} + 4\hat{j} + 6\hat{k}$ and $\vec{F} = 4\hat{i} - 20\hat{j} + 12\hat{k}$

What will be the complete expression for $\hat{B}$?

[NEET 2021]

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Options:

A. $-8\hat{i} - 8\hat{j} - 6\hat{k}$

B. $-6\hat{i} - 6\hat{j} - 8\hat{k}$

C. $8\hat{i} + 8\hat{j} - 6\hat{k}$

D. $6\hat{i} + 6\hat{j} - 8\hat{k}$

Answer: B

Solution:

$\vec{F} = q(\vec{v} \times \vec{B})$

$= q\vec{v} \times (B\hat{i} + B\hat{j} + B_0\hat{k})$

Given, q = 1 $\vec{v} = 2\hat{i} + 4\hat{j} + 6\hat{k}$ and $\vec{F} = 4\hat{i} - 20\hat{j} + 12\hat{k}$

$\Rightarrow (4\hat{i} - 20\hat{j} + 12\hat{k}) = -1 \times [(2\hat{i} + 4\hat{j} + 6\hat{k})(B\hat{i} + B\hat{j} + B_0\hat{k})]$

Thus, calculating values of RHS,

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 4 & 6 \\ B & B & B_0 \end{vmatrix}$$

$\Rightarrow \hat{i}(4B_0 - 6B) - \hat{j}(2B_0 - 6B) + \hat{k}(2B - 4B)$

Comparing L.H.S and R.H.S

$4B_0 - 6B = 4 \Rightarrow 2B_0 - 3B = 2$ ....(1)

$-(2B_0 - 6B) = -20 \Rightarrow B_0 - 3B = 10$ ......(2)

$2B - 4B = 12 \Rightarrow B = -6$ ......(3)

From (2) and (3)

$B = -6$ and $B_0 = -8$

Hence, $\vec{B} = -6\hat{i} - 6\hat{j} - 8\hat{k}$

Question16

A long solenoid of 50cm length having 100 turns carries a current of 2.5 A. The magnetic field at the centre of the solenoid is :

($\mu_0 = 4\pi \times 10^{-7}$T mA^{-1})

[2020]

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Options:

A. $3.14 \times 10^{-4} T$

B. $6.28 \times 10^{-5} T$

C. $3.14 \times 10^{-5} T$

D. $6.28 \times 10^{-4} T$

Answer: D

Solution:

(d) Magnetic field at the centre of solenoid,
$B_{\text{solenoid}} = \mu_0 nI$

Given : No. of turns / length,

$n = \frac{N}{L} = \frac{100}{50 \times 10^{-2}} = 200 \text{ turns } / n$

Current, $I = 2.5A$

$\therefore B_{\text{solenoid}} = \mu_0 nI = 4\pi \times 10^{-7} \times 200 \times 2.5$

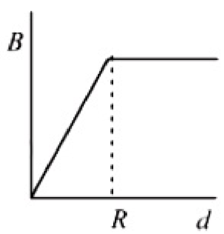
$= 6.28 \times 10^{-4} T$

Question17

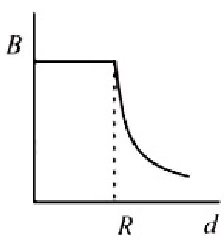
A cylindrical conductor of radius R is carrying a constant current. The plot of the magnitude of the magnetic field, B with the distance, d from the centre of the conductor, is correctly represented by the figure (NEET 2019)

Options:

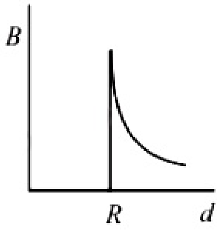
A.



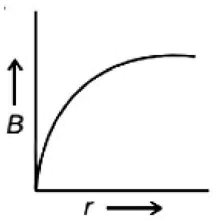
B.



C.



D.



Answer: D

Solution:

Solution:
Magnetic field due to long solid cylindrical conductor of radius R,

(i) For $\$d \int \vec{B}\,.\,d\vec{l} = \mu_0 I' \Rightarrow B(2\pi d) = \frac{\mu_0 I d^2}{R^2} \Rightarrow B = \frac{\mu_0 I d}{2\pi R^2}$

$\therefore B \propto d$

(ii) For $d = R, B = \mu_0 \frac{I}{2}\pi R$ (maximum)

(iii) For $d > R, B = \mu_0 \frac{I}{2}\pi d \Rightarrow B \propto \frac{1}{d}$.

Question18

Ionized hydrogen atoms and α -particles with same momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be
(NEET 2019)

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Options:

A. 1: 4

B. 2: 1

C. 1: 2

D. 4: 1

Answer: B

Solution:

$r = \frac{mv}{qB} = \frac{p}{qB}$

For given p and B, $r \propto \frac{1}{q} \Rightarrow \frac{r_H}{r_\alpha} = \frac{q_\alpha}{q_H} = \frac{2}{1}$

Question19

Two toroids 1 and 2 have total number of turns 200 and 100 respectively with average radii 40cm and 20cm respectively. If they carry same current i, the radio of the magnetic fields along the two loops is (OD NEET 2019)

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Options:

A. 1: 1

B. 4: 1

C. 2: 1

D. 1: 2

Answer: A

Solution:

Solution:
For a toroid magnetic field, $B = \mu_0 ni$

Where, $n =$ number of turns per unit length $= \frac{N}{2\pi r}$

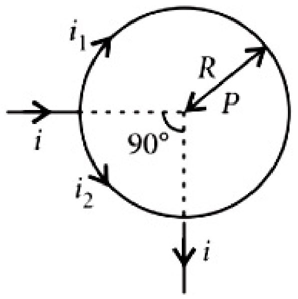
Now, $\frac{B_1}{B_2} = \frac{\mu_0 n_1 i}{\mu_0 n_2 i} = \frac{n_1}{n_2} = \frac{N_1}{2\pi r_1} \times \frac{2\pi r_2}{N_2}$

$\Rightarrow \frac{B_1}{B_2} = \frac{200}{2\pi \times 40 \times 10^{-2}} \times \frac{2\pi \times 20 \times 10^{-2}}{100}$

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

Question20

A straight conductor carrying current i splits into two parts as shown in the figure. The radius of the circular loop is R. The total magnetic field at the centre P at the loop is



(OD NEET 2019)

Options:

A. Zero

B. $3\mu_0 i / 32R$, outward

C. $3\mu_0 i / 32R$, inward

D. $\frac{\mu_0 i}{2R}$, inward

Answer: A

Solution:

Magnetic field due to $i_1 = \frac{\mu_0 i_1}{2R}\frac{\theta_1}{2\pi}$ (Into the plane)

Magnetic field due to $i_2 = \frac{\mu_0 i_2}{2R}\frac{\theta_2}{2\pi}$(Out of the plane)

For parallel combination

Now, $\frac{i_1}{i_2} = \frac{\rho l_2}{A} \times \frac{A}{\rho l_1} = \frac{l_2}{l_1}$

$\Rightarrow \frac{i_1}{i_2} = \frac{\frac{1}{4}(2\pi R)}{\frac{3}{4}(2\pi R)} = \frac{1}{3} \Rightarrow i_1 = \frac{i_2}{3} \Rightarrow i_2 = 3i_1$

$\therefore$ Net magnetic field,

$= \frac{\mu_0 i_1}{2R}\left(\frac{\theta_1}{2\pi}\right) - \frac{\mu_0 i_2}{2R}\left(\frac{\theta_2}{2\pi}\right)$

$= \frac{\mu_0 i_1}{2R}\left(\frac{3\pi}{2 \times 2\pi}\right) - \frac{\mu_0 i_2}{2R}\left(\frac{\pi}{2 \times 2\pi}\right)$

$= \frac{\mu_0}{2R}\left[\frac{3i_1}{4} - \frac{i_2}{4}\right]$

$= \frac{\mu_0}{2R}\left[\frac{3i_1}{4} - \frac{3i_1}{4}\right] = 0$

Question21

A metallic rod of mass per unit length $0.5 kgm^{-1}$ is lying horizontally on a smooth inclined plane which makes an angle of 30° with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction $0.25 T$ is acting on it in the vertical direction. The current flowing in the rod to keep it stationary is
(NEET 2018)

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Options:

A. 7.14A

B. 5.98A

C. 14.76A

D. 11.32 A.

Answer: D

Solution:

Mass per unit length of a metallic rodis $\frac{m}{l} = 0.5 \mathrm{kg\ m^{-1}}$

Let I be the current flowing.
For equilibrium, $mg \sin 30° = I l B \cos 30°$

$I = \frac{mg}{l B} \tan 30°$

$= \frac{0.5 \times 9.8}{0.25 \times \sqrt{3}} = 11.32 \text{ A}$

Question22

Current sensitivity of a moving coil galvanometer is 5 div\/mA and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div\/V. The resistance of the galvanometer is (NEET 2018)

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Options:

A. 40Ω

B. 25Ω

C. 250Ω

D. 500Ω

Answer: C

Solution:

Solution:
Let N = number of turns in galvanometer, A = Area, B = magnetic field k = the restoring torque per unit twist.

Current sensitivity, $I_S = \frac{N BA}{k}$

Voltage sensitivity, $V_S = \frac{N BA}{k R_G}$

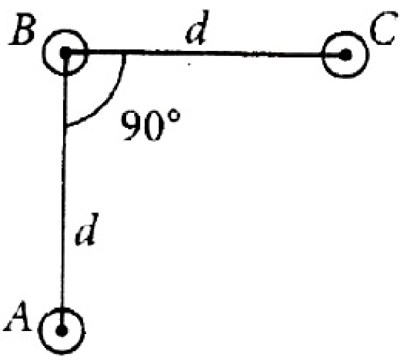
So, resistance of galvanometer

$R_G = \frac{I_S}{V_S} = \frac{5 \times 1}{20 \times 10^{-3}} = \frac{5000}{20} = 250\Omega$

Question23

An arrangement of three parallel straight wires placed perpendicular to

plane of paper carrying same current I along the same direction as shown in figure. Magnitude of force per unit length on the middle wire 'B' is given by



(2017 NEET)

Options:

A. $\frac{2\mu_0 I^2}{\pi d}$

B. $\frac{2\mu_0 I^2}{\pi d}$

C. $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$

D. $\frac{\mu_0 I^2}{2\pi d}$

Answer: C

Solution:

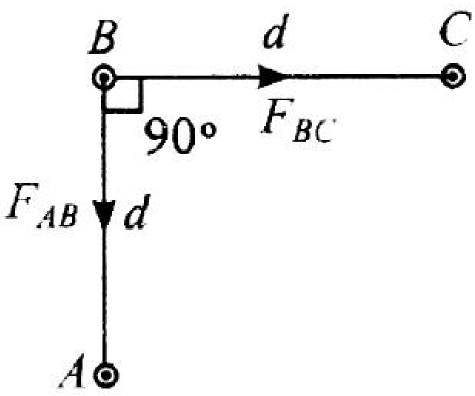
Solution:
Force between wires A and B= force between wires B and CC

$\therefore F_{BC} = F_{AB} = \frac{\mu_0 I^2 l}{2\pi d}$

As $\vec{F}_{AB} \perp \vec{F}_{BC}$, net force on wire B,

$F_{net} = \sqrt{2} F_{BC} = \frac{\sqrt{2}\mu_0 I^2 l}{2\pi d}$

$F_{net} = \frac{\mu_0 I^2 l}{\sqrt{2}\pi d}$ or $\frac{F_{net}}{l} = \frac{2\mu_0 I^2}{\sqrt{2}\pi d}$



Question24

A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B', at radial distances $\frac{a}{2}$ and 2a respectively, from the axis of the wire is
(2016 NEET Phase-1)

Options:

A. 1

B. 4

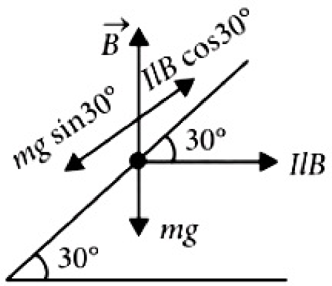
C. $\frac{1}{4}$

D. $\frac{1}{2}$

Answer: A

Solution:

Solution:



Magnetic field at a point inside the wire at distance $r\left(=\frac{a}{2}\right)$ from the axis of wire is

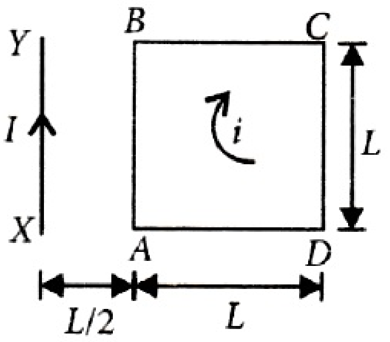
$B = \frac{\mu_0 I}{2\pi a^2} r = \frac{\mu_0 I}{2\pi a^2} \times \frac{a}{2} = \frac{\mu_0 I}{4\pi a}$

Magnetic field at a point outside the wire at distance r(= 2a) from the axis of wire is

$B' = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{2\pi} \times \frac{1}{2a} = \frac{\mu_0 I}{4\pi a} \quad \therefore \frac{B}{B'} = 1$

Question25

A square loop ABCD carrying a current is placed near and coplanar with a long straight conductor XY carrying a current I, the net force on the loop will be



(2016 NEET Phase-1)

Options:

A. $\frac{2\mu_0 I\, iL}{3\pi}$

B. $\frac{\mu_0 I\, iL}{2\pi}$

C. $\frac{2\mu_0 I\, i}{3\pi}$

D. $\frac{\mu_0 I\, i}{2\pi}$

Answer: C

Solution:

Solution:
Here the sides AB and CD will contribute the force but the sides AD and BC will not because they are perpendicular to wire XY.

We know that the magnetic field at distance r from long wire is $B = \frac{\mu_0 I}{2\pi r}$

and also force on a current (i) flow through line section of length L due to B is F=BiL

Using these, the force on AB is $F_1 = \left(\frac{\mu_0 I}{2\pi L / 2}\right) iL = \frac{\mu_0 I\, i}{\pi}$ and

the force on CD is $F_2 = \left(\frac{\mu_0 I}{2\pi (L + L / 2)}\right) iL = \frac{\mu_0 I\, i}{3\pi}$

As the current directions on AB and CD are opposite so the forces will be opposite.

Thus, net forec $F = F_1 - F_2 = \frac{\mu_0 I\, i}{\pi} - \frac{\mu_0 I\, i}{3\pi} = \frac{2\mu_0 I\, i}{3\pi}$

Question26

A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be
(2016 NEET Phase II)

Options:

A. nB

B. n^2B

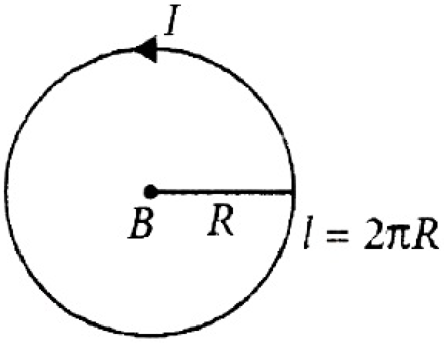
C. 2nB

D. $2n^2B$

Answer: B

Solution:

Solution:
Let I be the length of the wire. Magnetic field at the centre of the loop is



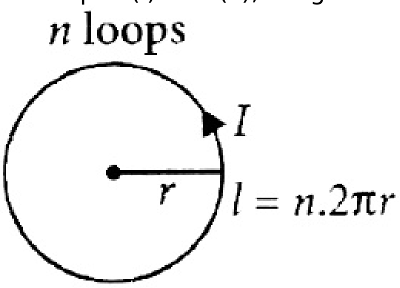
$B = \frac{\mu_0 I}{2R}$

$\therefore B = \frac{\mu_0 \pi I}{l}$ $(\because l = 2\pi R)$.......(i)

$B' = \frac{\mu_0 n I}{2r} = \frac{\mu_0 n I}{2\left(\frac{l}{2n\pi}\right)}$

$B' = \frac{\mu_0 n^2 \pi l}{l}$.....(ii)

From eqns. (i) and (ii), we get $B' = n^2B$



Question27

An electron is moving in a circular path under the influence of a transverse magnetic field of 3.57×10^{-2}T If the value of e/m is 1.76×10^{11}Ckg^{-1}, he frequency of revolution of the electron is (2016 NEET Phase-II)

©

Options:

A. 1 GHz

B. 100 MHz

C. 62.8 MHz

D. 6.28 MHz

Answer: A

Solution:

Here, $B = 3.57 \times 10^{-2} T$, $\frac{e}{m} = 1.76 \times 10^{11} Ckg^{-1}$

Frequency of revolution of the electron,

$\upsilon = \frac{1}{T} = \frac{v}{2\pi r}$..........(i)

Also, $\frac{mv^2}{r} = evB \Rightarrow \frac{v}{r} = \frac{eB}{m}$.........(ii)

From eqns. (i) and (ii)

$\upsilon = \frac{1}{2\pi} \times \frac{eB}{m} = \frac{1}{2 \times 3.14} \times 1.76 \times 10^{11} \times 3.57 \times 10^{-2}$

$= 10^9 Hz = 1 GHz$

Question28

An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude (2015, Cancelled)

©

Options:

A. $\frac{\mu_0 n^2 e}{r}$

B. $\frac{\mu_0 ne}{2r}$

C. $\frac{\mu_0 ne}{2\pi r}$

D. Zero

Answer: B

Solution:

Solution:

Current in the orbit, $I = \frac{e}{T}$

$I = \frac{e}{\left(\left(\frac{2\pi}{\omega}\right)\right)} = \frac{\omega e}{2\pi} = \frac{(2\pi n)e}{2\pi} = ne$

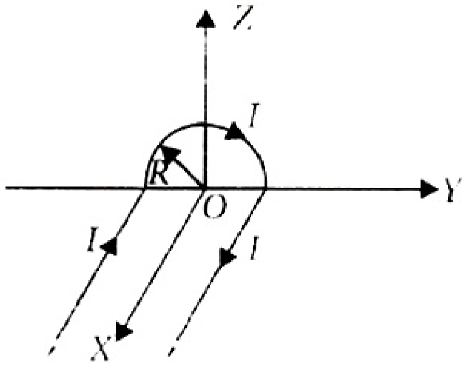
Magnetic field at centre of current carrying circular coil is given by

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

Question29

A wire carrying current I has the shape as shown in adjoining figure.

Linear parts of the wire are very long and parallel to X-axis while semi circular portion of radius R is lying in Y-Z plane. Magnetic field at point O is



(2015)

Options:

A. $\vec{B} = -\frac{\mu_0 I}{4\pi R}\left(\pi\hat{i} + 2\hat{k}\right)$

B. $\vec{B} = \frac{\mu_0 I}{4\pi R}\left(\pi\hat{i} - 2\hat{k}\right)$

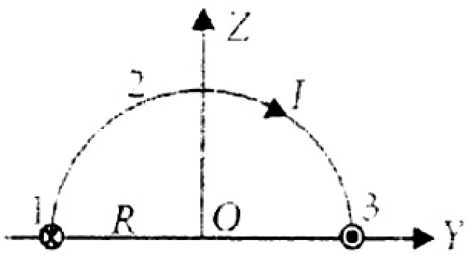
C. $\vec{B} = \frac{\mu_0 I}{4\pi R}\left(\pi\hat{i} + 2\hat{k}\right)$

D. $\vec{B} = -\frac{\mu_0 I}{4\pi R}\left(\pi\hat{i} - 2\hat{k}\right)$

Answer: A

Solution:

Solution:
Given situation is shown in the figure. Parallel wires 1 and 3 are semi-infinite, so magnetic field at O due to them
$\vec{B}_1 = \vec{B}_3 = -\frac{\mu_0 I}{4\pi R}\hat{k}$
M agnetic field at O due to sem i-circu lar arc in
FZ-plane is given by $\vec{B}_2 = -\frac{\mu_0 I}{4R}\hat{i}$
Net magnetic field at point O is given by
$\vec{B} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$
$= -\frac{\mu_0 I}{4\pi R}\hat{k} - \frac{\mu_0 I}{4\pi R}\hat{i} - \frac{\mu_0 I}{4\pi R}\hat{k} = -\frac{\mu_0 I}{4\pi R}\left(\pi\hat{i} + 2\hat{k}\right)$



Question30

A proton and an alpha particle both enter a region of uniform magnetic

field B, moving at right angles to the field B. If the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is 1 MeV, the energy acquired by the alpha particle will be (2015)

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Options:

A. 1.5 MeV

B. 1 MeV

C. 4 MeV

D. 0.5 MeV

Answer: B

Solution:

Solution:

The kinetic energy acquired by a charged particle in a uniform magnetic field B is

$K = \frac{q^2B^2R^2}{2m}$ (as $R = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$)

where q and m are the charge and mass of the particle and R is the radius of circular orbit

∴ The kinetic energy acquired by proton is $K_p = \frac{{q_p}^2B^2{R_p}^2}{2m_p}$ and that by the alpha particle is

$K_\alpha = \frac{{q_\alpha}^2B^2{R_\alpha}^2}{2m_\alpha}$

Thus, $\frac{K_\alpha}{K_p} = \left(\frac{q_\alpha}{q_p}\right)^2\left(\frac{m_p}{m_\alpha}\right)\left(\frac{R_\alpha}{R_p}\right)^2$

or $K_\alpha = K_p\left(\frac{q_\alpha}{q_p}\right)^2\left(\frac{m_p}{m_\alpha}\right)\left(\frac{R_\alpha}{R_p}\right)^2$

Here, $K_p = 1\mathrm{M\,eV}$, $\frac{q_\alpha}{q_p} = 2$, $\frac{m_p}{m_\alpha} = \frac{1}{4}$

and $\frac{R_\alpha}{R_p} = 1$

$\therefore K_\alpha = (1\mathrm{M\,eV})(2)^2\left(\frac{1}{4}\right)(1)^2 = 1\mathrm{M\,eV}$

Question31

In an ammeter 0.2% of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be (2014)

Options:

A. $\frac{1}{499}G$

B. $\frac{499}{500}G$

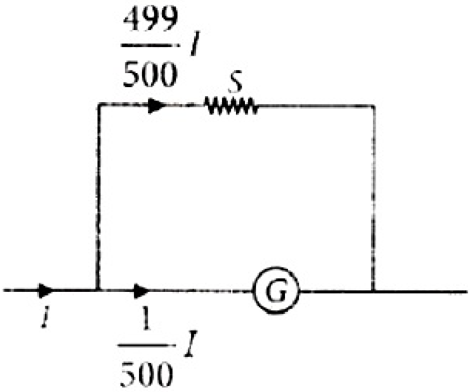
C. $\frac{1}{500}G$

D. $\frac{500}{499}G$

Answer: C

Solution:

Here, resistance of the galvanometer = G
Current through the galvanometer,
$I_G = 0.2\%$ of $I = \frac{0.2}{100}I = \frac{1}{500}I$
∴ Current through the shunt,
$I_S = I - I_G = I - \frac{1}{500}I = \frac{499}{500}I$
As shunt and galvanometer are in parallel
$\therefore I_G G = I_S S \left(\frac{1}{500}I\right) G = \left(\frac{499}{500}\right) S$ or $S = \frac{G}{499}$
Resistance of the ammeter R_A is
$\frac{1}{R_A} = \frac{1}{G} + \frac{1}{S} = \frac{1}{G} + \frac{\frac{1}{G}}{499} = \frac{500}{G}$ or $R_A = \frac{1}{500}G$



Question32

Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that O is their common point for the two. The wires carry I_1 and I_2 currents, currents, respectively. Point P is lying at distance d from O along a direction perpendicular to the plane containing the wires. The magnetic field at the point P will be (2014)

Options:

A. $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$

B. $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

C. $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$

D. $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{\frac{1}{2}}$

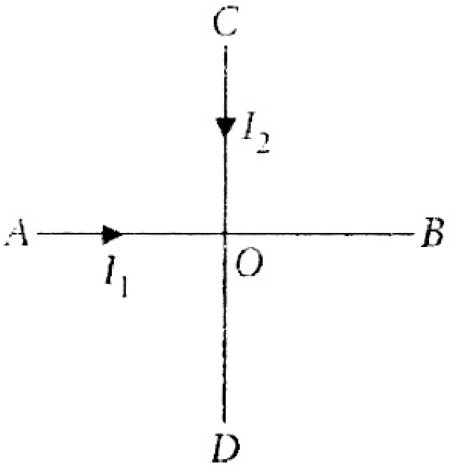
Answer: D

Solution:

The magnetic field at the point P, at a perpendicular distance d from O in a direction perpendicular to the plane ABCD due to currents through A OB and COD are perpendicular to each other. Hence,

$$B = (B_1^{\ 2} + B_2^{\ 2})^{\frac{1}{2}} = \left[\left(\frac{\mu_0}{4\pi} \frac{2I_1}{d} \right)^2 + \left(\frac{\mu_0}{4\pi} \frac{2I_2}{d} \right)^2 \right]^{\frac{1}{2}}$$

$$= \frac{\mu_0}{2\pi d}(I_1^{\ 2} + I_2^{\ 2})^{\frac{1}{2}}$$



Question33

When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ toward west. The electric and magnetic fields in the room are (NEET 2013)

Options:

A. $\frac{ma_0}{e}$east, $\frac{3ma_0}{ev_0}$up

B. $\frac{ma_0}{e}$east, $\frac{3ma_0}{ev_0}$down

C. $\frac{ma_0}{e}$west, $\frac{2ma_0}{ev_0}$up

D. $\frac{ma_0}{e}$west, $\frac{2ma_0}{ev_0}$down

Answer: D

Question34

A long straight wire carries a certain current and produces a magnetic field $2 \times 10^{-4} \mathrm{Wb\,m}^{-2}$ at a perpendicular distance of 5cm from the wire. An electron situated at 5cm from the wire moves with a velocity 10^{7}m / s towards the wire along perpendicular to it. The force experienced by the electron will be (charge on electron left .1 .6 $\times 10^{-19}$C)
(KN NEET 2013)

Options:

A. 3.2N

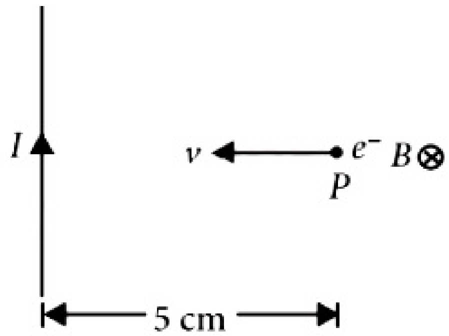
B. 3.2×10^{-16}N

C. 1.6×10^{-16}N

D. zero.

Answer: B

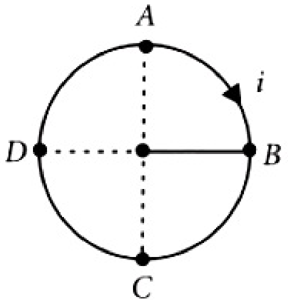
Solution:



The situation is as shown in the figure.
Here, $v = 10^{7} \mathrm{m / s}$,
$B = 2 \times 10^{-4}\ \mathrm{Wb / m^{2}}$
The magnitude of the force experienced by the electron is
$F = evB \sin\theta$
$(\because \vec{v}$ and $\vec{B}$ are perpendicular to each other)
$= evB \sin 90° = 1.6 \times 10^{-19} \times 10^{7} \times 2 \times 10^{-4} \times 1$
$= 3.2 \times 10^{-16}\ \mathrm{N}$

Question35

A circular coil ABCD carrying a current i ' is placed in a uniform magnetic field. If the magnetic force on the segment AB is $\vec{F}$, the force on the remaining segment BCDA is



(KN NEET 2013)

Options:

A. $-\vec{F}$

B. $3\vec{F}$

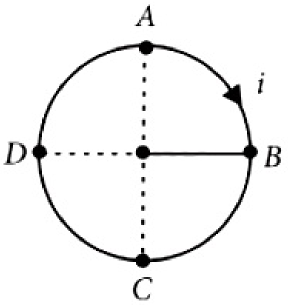
C. $-3\vec{F}$

D. $\vec{F}$.

Answer: A

Solution:

Solution:



The net magnetic force on a current loop in a uniform magnetic field is always zero.

$\therefore \vec{F}_{AB} + \vec{F}_{BCDA} = 0$

$\vec{F}_{BCDA} = -\vec{F}_{AB} = -\vec{F}$

Question36

Two similar coils of radius R are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and 21, respectively. The resultant magnetic field induction at the centre will be (2012)

Options:

A. $\frac{\sqrt{5}\mu_0 I}{2R}$

B. $\frac{3\mu_0 I}{2R}$

C. $\frac{\mu_0 I}{2R}$

D. $\frac{\sqrt{5}\mu_0 I}{R}$

Answer: A

Solution:

Solution:

Magnetic field induction due to vertical loop at the centre O is $B_1 = \frac{\mu_0 I}{2R}$

It acts in horizontal direction.

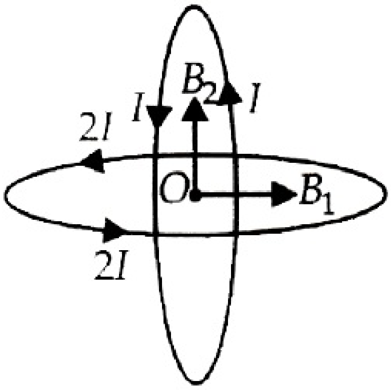
Magnetic field induction due to horizontal loop at the centre O is $B_2 = \frac{\mu_{02} I}{2R}$

It acts in vertically upward direction.

As B_1 and B_2 are perpendicular to each other, therefore the resultant magnetic field induction at the centre O is

$B_{net} = \sqrt{B_1{}^2 + B_2{}^2} = \sqrt{\left(\frac{\mu_0 I}{2R}\right) + \left(\frac{\mu_0 2I}{2R}\right)}$

$= \frac{\mu_0 I}{2R}\sqrt{(1)^2 + (2)^2} = \frac{\sqrt{5}\mu_0 I}{2R}$



Question37

A milli voltmeter of 25 millivolt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be (2012)

©

Options:

A. 0.001

B. 0.01

C. 1

D. 0.05

Answer: A

Solution:

$S = \frac{V_g}{(I - I_g)}$
Neglecting I_g
$\therefore S = \frac{V_g}{I} S = \frac{25 \times 10^{-3} V}{25 A} = 0.001 \Omega$

Question38

An alternating electric field, of frequency u, is applied across the dees (radius = R) of a cyclotron that is being used to accelerate protons (mass = m). The operating magnetic field (B) used in the cyclotron and the kinetic energy (K) of the proton beam, produced by it, are given by (2012)

©

Options:

A. $B = \frac{m\upsilon}{e}$ and $K = 2m\pi^2\upsilon^2R^2$

B. $B = \frac{2\pi m\upsilon}{e}$ and $K = m^2\pi^2\upsilon R^2$

C. $B = \frac{2\pi m\upsilon}{e}$ and $K = 2m\pi^2\upsilon^2R^2$

D. $B = \frac{m\upsilon}{e}$ and $K = m^2\pi\upsilon R^2$

Answer: C

Solution:

Frequency, $\upsilon = \frac{eB}{2\pi m}$
or $B = \frac{2\pi m\upsilon}{e}$......(i)
As $\frac{mv^2}{R} = evB$
or $v = \frac{eBR}{m} = \frac{e2\pi m\upsilon R}{me}$ (Using (i))
$= 2\pi\upsilon R$..........(ii)
Kinetic energy, $K = \frac{1}{2}mv^2 = \frac{1}{2}m(2\pi\upsilon R)^2$ (Using(ii))
$= 2m\pi^2\upsilon^2R^2$

Question39

A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α - particle to describe a circle of same radius in the same field?
(2012 Mains)

©

Options:

A. 2 MeV

B. 1 MeV

C. 0.5 meV

D. 4 MeV

Answer: B

Solution:

Solution:
Kinetic energy of a charged particle,

$K = \frac{1}{2}mv^2$ or $v = \sqrt{\frac{2K}{m}}$

Radius of the circular path of a charged particle in uniform magnetic field is given by

$R = \frac{mv}{Bq} = \frac{m}{Bq}\sqrt{\frac{2K}{m}} = \frac{\sqrt{2mK}}{Bq}$

Mass of a proton, $m_p = m$

Mass of an α-particle, $m_\alpha = 4m$

Charge of a proton, $q_p = e$

Charge of an α-particle, $q_\alpha = 2e$

$\therefore R_p = \frac{\sqrt{2m_pK_p}}{Bq_p} = \frac{\sqrt{2mk_p}}{Be}$

and $R_\alpha = \frac{\sqrt{2m_\alpha K_\alpha}}{Bq_\alpha} = \frac{\sqrt{2(4m)k_\alpha}}{B(2e)} = \frac{\sqrt{2mk_\alpha}}{Be}$

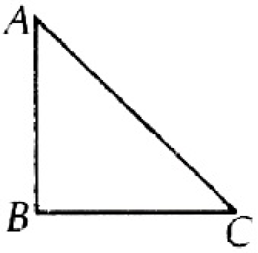
$\therefore \frac{R_p}{R_\alpha} = \sqrt{\frac{K_p}{K_\alpha}}$

As $R_p = R_\alpha$ (Given)

$\therefore K_\alpha = K_p = 1 \text{M eV}$

Question40

A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is



(2011)

Options:

A. $-\sqrt{2}\vec{F}$

B. $-\vec{F}$

C. $\vec{F}$

D. $\sqrt{2}\vec{F}$

Answer: B

Solution:

Solution:
Here. $\vec{F}_{BC} = \vec{F} \because \vec{F}_{AB} = 0$
The net magnetic force on a current carrying closed loop in a uniform magnetic field is zero.
$\therefore \vec{F}_{AB} + \vec{F}_{BC} + \vec{F}_{AC} = 0$
$\Rightarrow \vec{F}_{AC} = -\vec{F}_{BC} \left(\because \vec{F}_{AB} = 0\right)$
$= -\vec{F}$

Question41

A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron (2011)

©

Options:

A. will turn towards right of direction of motion

B. speed will decrease

C. speed will increase

D. will turn towards left of direction of motion

Answer: B

Solution:

Force on electron due to electric field, $\vec{F}_E = -e\vec{E}$
Force on electron due to magnetic field, $\vec{F}_B = -e\left(\vec{v} \times \vec{B}\right) = 0$
Since $\vec{v}$ and $\vec{B}$ are in the same direction.
Total force on the electron, $\vec{F} = \vec{F}_E + \vec{F}_B = -e\vec{E}$
Electric field opposes the motion of the electron, hence speed of the electron will decrease.

Question42

A galvanometer of resistance, G, is shunted by a resistance S ohm. To

keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is
(2011 Mains)

Options:

A. $\frac{G}{(S+G)}$

B. $\frac{S^2}{(S+G)}$

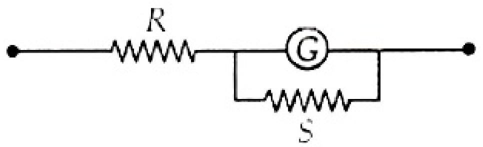
C. $\frac{SG}{(S+G)}$

D. $\frac{G^2}{(S+G)}$

Answer: D

Solution:

Solution:
Let resistance R is to be put in series with galvanometer G to keep the main current in the circuit unchanged.
$\therefore \frac{GS}{(G+s)} + R = G$
$R = G - \frac{GS}{G+S} \Rightarrow R = \frac{G^2 + GS - GS}{G+S} R = \frac{G^2}{G+S}$



Question43

Charge q is uniformly spread on a thin ring of radius R. The ring rotates about its axis with a uniform frequency f Hz. The magnitude of magnetic induction at the centre of the ring is
(2011 Mains)

Options:

A. $\frac{\mu_0 qf}{2\pi R}$

B. $\frac{\mu_0 qf}{2R}$

C. $\frac{\mu_0 q}{2f R}$

D. $\frac{\mu_0 q}{2\pi f R}$

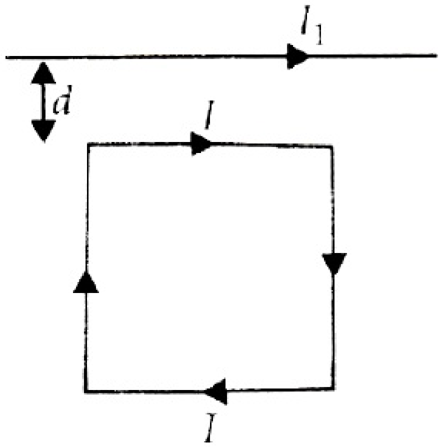
Answer: B

Solution:

The current flowing in the ring is
$I = qf$ ....(i)
The magnetic induction at the centre of the ring is
$B = \frac{\mu_0 2\pi I}{4\pi R} = \frac{\mu_0 qf}{2R}$ (Using (i))

Question44

A square loop, carrying a steady current I, is placed in a horizontal plane near a long straight conductor carrying a steady current I_1, at a distance d from the conductor as shown in figure. The loop will experience



(2011 Mains)

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Options:

A. a net attractive force towards the conductor

B. a net repulsive force away from the conductor

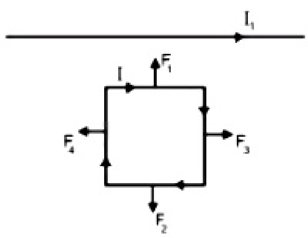
C. a net torque acting upward perpendicular to the horizontal plane

D. a net torque acting downward normal to the horizontal plane

Answer: A

Solution:

Solution:
$F_1 > F_2$. Hence net attraction force will be towards conductor.



Question45

A thin ring of radius R meter has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolutions/s. The value of magnetic induction in Wb/m^2 at the centre of the ring is
(2010)

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Options:

A. $\frac{\mu_0 qf}{2\pi R}$

B. $\frac{\mu_0 q}{2\pi f R}$

C. $\frac{\mu_0 q}{2f R}$

D. $\frac{\mu_0 qf}{2R}$

Answer: D

Solution:

Current produced due to circular motion of charge q is
$I = qf$ ....(i)
Magnetic field induction at the centre of the ring of radius R is
$B = \frac{\mu_{0}2\pi I}{4\pi R} = \frac{\mu_0 I}{2R} = \frac{\mu_0 qf}{2R}$ (Using(i))

Question46

A galvanometer has a coil of resistance 100 ohm and gives a full scale deflection for 30 mA current. If it is to work as a voltmeter of 30 volt range, the resistance required to be added will be
(2010)

Options:

A. 900 Ω

B. 1800 Ω

C. 500 Ω

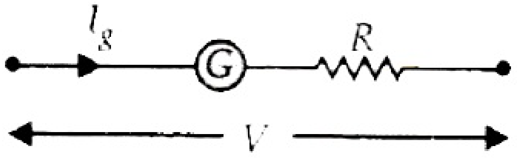
D. 1000

Answer: A

Solution:

Here, Resistance of galvanometer, G = 100 Ω

Current for full scale deflection, $I_g = 30\text{mA} = 30 \times 10^{-3}\text{A}$
Range of voltmeter, V = 30 V
To convert the galvanometer into an voltmeter of a given range, a resistance R is connected in series with it as shown in the figure.
From figure,
$V = I_g(G + R)$
or
$R = \frac{V}{I_g} - G = \frac{30}{30 \times 10^{-3}} - 100\Omega = 1000 - 100 = 900\Omega$



Question47

A square current carrying loop is suspended in a uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$, the net force on the remaining three arms of the loop is
(2010)

Options:

A. $3\vec{F}$

B. $-\vec{F}$

C. $-3\vec{F}$

D. $\vec{F}$

Answer: B

Solution:

Solution:

The force on the two arms parallel to the field is zero(since $\vec{d} \times \vec{B} = 0$

$\therefore$ Force on remaining arms $= -\vec{F}$ since current direction changes for this arm.

Question48

A current loop consists of two identical semicircular parts each of radius R, one lying in the x-y plane and the other in x-z plane. If the current in the loop is i. The resultant magnetic field due to the two semi circular parts at their common centre is
(2010 Mains)

Options:

A. $\frac{\mu_0 i}{2\sqrt{2}R}$

B. $\frac{\mu_0 i}{2R}$

C. $\frac{\mu_0 i}{4R}$

D. $\frac{\mu_0 i}{\sqrt{2}R}$

Answer: A

Solution:

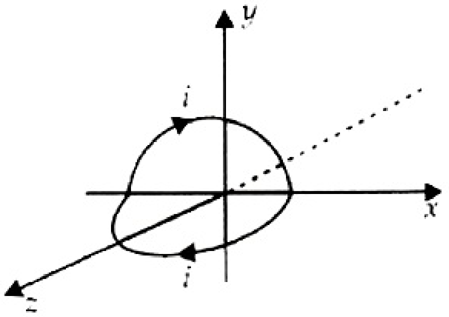
Solution:
The loop mentioned in the question must look like one as shown in the figure

Magnetic field at the centre due to semicircular loop lying in x-y plane ,$B_{xy} = \frac{1}{2}\frac{\mu_0 i}{2R}$ negative z direction.

Similarly, field due to loop in x-z plane,$B_{xz} = \frac{1}{2}\frac{\mu_0 i}{2R}$ in negative y direction

∴ Magnitude of resultant magnetic field,

$B = \sqrt{B_{xy}^2 + B_{xz}^2} = \sqrt{\left(\frac{\mu_0 i}{4R}\right)^2 + \left(\frac{\mu_0 i}{4R}\right)^2} = \frac{\mu_0 i}{4R}\sqrt{2} = \frac{\mu_0 i}{2\sqrt{2}R}$



Question49

A closely wound solenoid of 2000 turns and area of cross section $1.5 \times 10^{-4} m^2$ carries a current of 2.0 A. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be
(2010 Mains)

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Options:

A. 3×10^{-3}N ,

B. 1.5×10^{-3}N m

C. 1.5×10^{-2}N m

D. 3×10^{-2}N m

Answer: C

Solution:

Magnetic moment of the loop,

$M = N I A = 2000 \times 2 \times 1.5 \times 10^{-4} = 0.6 \frac{J}{T}$

Torque, $\tau = M B \sin 30° = 0.6 \times 5 \times 10^{-2} \times \frac{1}{2} = 1.5 \times 10^{-2} N m$

Question50

A particle having a mass of 10^{-2} kg carries a charge of 5×10^{-8}C.The particle is given an initial horizontal velocity of $10^{5} ms^{-1}$ in the presence of electric field $\vec{E}$ and magnitude field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that
(1) $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity.
(2) Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity.
(3) Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity.
(4) $\vec{B}$ should be along the direction of velocity and $\vec{E}$ should be perpendicular to the direction of velocity
Which one of the following pairs of statements is possible?
(2010 Mains)

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Options:

A. (1) and (3)

B. (3) and (4)

C. (2) and (3)

D. (2) and (4)

Answer: C

Question51

A galvanometer having a coil resistance of 60 Ω shows full scale deflection when a current of 1.0 amp passes through it. It can be

converted into an ammeter to read currents upto 5.0 amp by (2009)

Options:

A. putting in series a resistance of 15 Ω

B. putting in series a resistance of 240 Ω

C. putting in parallel a resistance of 15 Ω

D. putting in parallel a resistance of 240 Ω

Answer: C

Solution:

Solution:
$I_gG = (I - I_g)S$ where G is the galvanometer resistance and S is the shunt used with the ammeter.
$1.0 \times 60 = (5 - 1)S$ where S is the shunt used to read a 5 A current when the galvanometer can stand by 1 A.
$S = \frac{1.0 \times 60}{4} = 15\Omega$ in parallel

Question52

The magnetic force acting on a charged particle of charge $-2\mu C$ in magnetic field of 2T acting in y direction, when the particle velocity is $\left(2\hat{i} + 3\hat{j}\right) \times 10^6 ms^{-1}$, is (2009)

Options:

A. 4 N in z direction

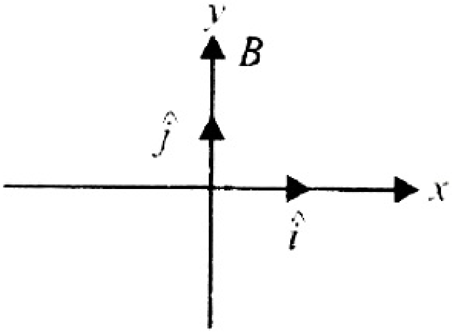
B. 8 N in y direction

C. 8 N in z direction

D. 8 N in -z direction

Answer: D

Solution:



Lorentz force $= q\left(\vec{v} \times \vec{B}\right)$

$= (-2 \times 10^{-6})\left[\left(2\hat{i} + 3\hat{j}\right) \times 10^{6} \times 2\hat{j}\right] = -8\hat{k}N$.

= 8 N in -z direction

Question53

Under the influence of a uniform magnetic field, a charged particle moves with constant speed v in a circle of radius R. The time period of rotation of the particle
(2009)

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Options:

A. depends on R and not on v

B. is independent of both v and R

C. depends on both v and R

D. depends on v and not on R

Answer: B

Solution:

Solution:

For the circular motion in a cyclotron,

$qvB = \frac{mv^2}{r} \Rightarrow qB = m\omega = \frac{m \times 2\pi}{T}$

$\therefore T = \frac{2\pi m}{qB}$ is independent of v and r

Question54

A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction $\vec{B}$.After 3 seconds the kinetic energy of the particle will be
(2008)

©

Options:

A. T

B. 4T

C. 3T

D. 2T

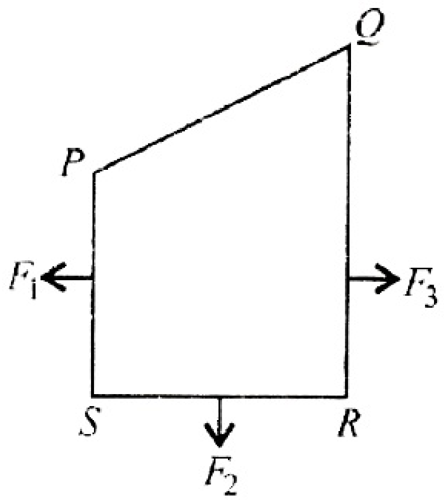
Answer: A

Solution:

Solution:
When a charged particle having a given kinetic energy T is subjected to a transverse uniform magnetic field, it describes a circular path in the magnetic field without any change in its speed. Thus, the kinetic energy of the charged particle remains T at all times.

Question55

A closed loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segments PS, SR and R Q are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is (2008)



Options:

A. $\sqrt{(F_3 - F_1)^2 - F_2^2}$

B. $F_3 - F_1 + F_2$

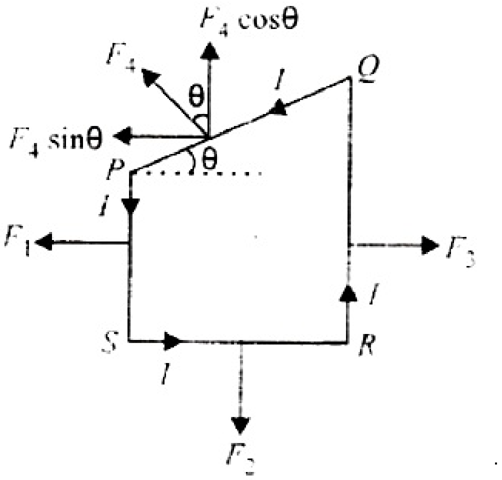
C. $F_3 - F_1 - F_2$

D. $\sqrt{(F_3 - F_1)^2 + F_2^2}$

Answer: D

Solution:

The forces on the various arms are shown in the figure.
Resolving F_4 into two rectangular components, we have $F_4 \cos\theta$ and $F_4 \sin\theta$ acting vertically and horizontally respectively. In equilibrium position $F_4 \cos\theta = F_2$
$F_4 \sin\theta = (F_3 - F_1) \therefore F_4 = \sqrt{(F_3 - F_1)^2 + F_2^2}$



Question56

A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance of 2950 Ω 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 (2008)

Options:

A. 6050

B. 4450 Ω

C. 5050 Ω

D. 5550 Ω

Answer: B

Solution:

Total initial resistance
$= R_G + R_1 = (50 + 2950)\Omega = 3000\Omega$
$\varepsilon = 3V$
$\therefore \text{Current} = \frac{3V}{3000\Omega} = 1 \times 10^{-3} \text{mA}$
If the deflection has to be reduced to 20 divisions, current
$i = 1\text{mA} \times \frac{2}{3}$ as the full deflection scale for 1 mA = 30 divisions.

$3V = 3000\Omega \times 1\text{mA} = x\Omega \times \frac{2}{3}\text{mA}$

$\Rightarrow x = 3000 \times 1 \times \frac{3}{2} = 4500\Omega$
But the galvanometer resistance $= 50\Omega$
Therefore, the resistance to be added

$= (4500 - 50)\Omega = 4450\Omega$

Question57

The resistance of an ammeter is 13Ω and its scale is graduated for a current upto 100 amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 amperes by this meter. The value of shunt-resistance is
(2007)

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Options:

A. 2Ω

B. 0.2Ω

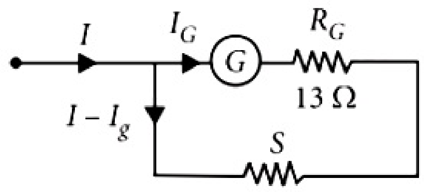
C. 2 kΩ

D. 20Ω.

Answer: A

Solution:

Solution:



Let the shunt resistance be S.
Given: $I = 750$ A
$I_g = 100$ A, $R_G = 13\Omega$
From the figure,
$I_g R_G = (I - I_g)S$
or $100 \times 13 = [750 - 100]S$
or $1300 = 650S$
$\therefore S = \frac{1300}{650} = 2\Omega$

Question58

When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that
(2006)

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Options:

A. angle between is either zero or 180°

B. angle between is necessarily 90°

C. angle between can have any value other than 90°

D. angle between can have any value other than zero and 180°

Answer: D

Solution:

Solution:

Force acting on a charged particle moving with velocity $\vec{v}$ is subjected to magnetic field $\vec{B}$ is given by

$\vec{F} = q(\vec{v} \times \vec{B})$; $F = qvB\sin\theta$

(i) When $\theta = 0°$, $F = qvB\sin 0° = 0$

(ii) When $\theta = 90°$, $F = qvB\sin 90° = qvB$

(iii) When $\theta = 180°$, $F = qvB\sin 180° = 0$

This implies force acting on a charged particle is non-zero, when angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and $180°$.

Question59

Two circular coils 1 and 2 are made from the same wire but the radius of the 1^{st} coil is twice that of the 2^{nd} coil. What potential difference in volts should be applied across them so that the magnetic field at their centres is the same? (2006)

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Options:

A. 2

B. 3

C. 4

D. 6 .

Answer: C

Solution:

Solution:

Question is not correct.

The magnetic field at the centre of the coil,

$$B = \frac{\mu_0 ni}{2r}$$

where r is the radius.

$$\frac{E}{R} = i$$

$\therefore R \propto 2\pi r \Rightarrow R = cr$, where c is a constant.

$\therefore$ In the first coil,

$B_1 = \frac{\mu_0 n i_1}{2r_1} = \frac{\mu_0 n E}{2r_1(cr_1)} = \frac{\mu_0 n E}{2cr_1^2}$

If $r_1 = 2r_2$ $B_1 = \frac{\mu_0 n E_1}{2c(2r_2)^2} = \frac{\mu_0 n E_1}{2c \cdot 4r_2^2}$

$B_2 = \frac{\mu_0 n E_2}{2cr_2^2}$

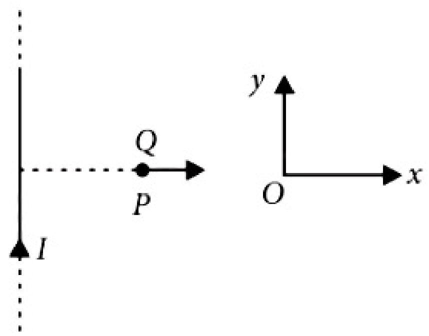
As B_1 will not be equal to B_2 unless E_1 is different from E_2, E_1 and E_2 will not be the same.
It is wrong to ask what potential difference should be applied across them. It should be perhaps the ratio of potential differences.
In that case, $B_1 = B_2$

$\frac{E_1}{4} = E_2 \Rightarrow E_1 = 4E_2$

$\therefore \frac{E_1}{E_2} = 4$

Question60

A very long straight wire carries a current I . At the instant when a charge +Q at point P has velocity $\vec{v}$, as shown, the force on the charge is



(2005)

Options:

A. along Oy

B. opposite to Oy

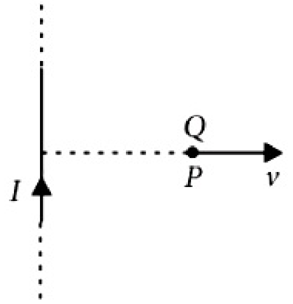
C. along Ox

D. opposite to Ox.

Answer: A

Solution:

According to Fleming's left hand rule direction of force is along Oy axis which is perpendicular to wire.
$\vec{F} = e(\vec{v} \times \vec{B})$.
B due to i is acting inwards i.e., into the paper.
v is along Ox.



$\therefore F = Q^{+}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ v & 0 & 0 \\ 0 & 0 & -B \end{vmatrix}$

$\Rightarrow F = Q^{+}\left[-\hat{j}(-vB) + 0\right]$

$\therefore \vec{F} = +QvB\hat{j}$ i.e.,in Oy direction.

Question61

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 (2005)

Options:

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

B. $\frac{B}{v}$

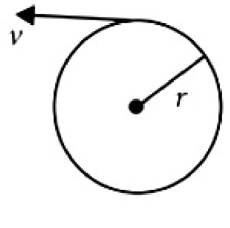
C. $\sqrt{\frac{v}{B}}$

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

Answer: C

Solution:

Solution:



The magnetic field produce by moving electron in circular path $B = \frac{\mu_0 i}{2r}$

where $i = \frac{q}{t} = \frac{q}{2\pi r} \times v$

$\therefore B = \frac{\mu_0 qv}{4\pi r^2} \Rightarrow r \propto \sqrt{\frac{v}{B}}$

Question62

A galvanometer of 50 ohm resistance has 25 divisions. A current of 4×10^{-4} ampere gives a deflection of one division. To convert this galvanometer into a voltmeter having a range of 25 volts, it should be connected with a resistance of (2004)

©

Options:

A. 2500Ω as a shunt

B. 2450Ω as a shunt

C. 2550Ω in series

D. 2450Ω in series.

Answer: D

Solution:

Solution:
The total current shown by the galvanometer $= 25 \times 4 \times 10^{-4}$ A
$\therefore I_g = 10^{-2}$ A
The value of resistance connected in series toconvert galvanometer into voltmeter of 25 V is
$R = \frac{V}{I_g} - G = \frac{25}{10^{-2}} - 50 = 2450\Omega$

Question63

To convert a galvanometer into a voltmeter one should connect a (2004, 2002)

Options:

A. high resistance in series with galvanometer

B. low resistance in series with galvanometer

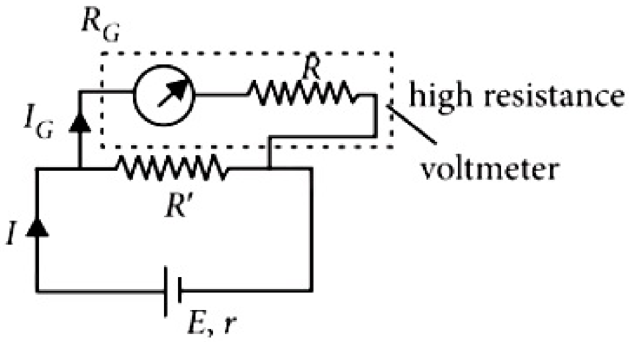
C. high resistance in parallel with galvanometer

D. low resistance in parallel with galvanometer.

Answer: A

Solution:

Voltmeter is used to measure the potential difference across a resistance and it is connected in parallel with the circuit. A high resistance is connected to the galvanometer in series so that only a small fraction (I_g) of the main circuit current (I) passes through it. If a considerable amount of current is allowed to pass through the voltmeter, then the reading obtained by this voltmeter will not be close to the actual potential difference between the same two points.



Question64

A charged particle moves through a magnetic field in a direction perpendicular to it. Then the
(2003)

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Options:

A. speed of the particle remains unchanged

B. direction of the particle remains unchanged

C. acceleration remains unchanged

D. velocity remains unchanged.

Answer: A

Solution:

Solution:
If a moving charged particle is subjected to a perpendicular uniform magnetic field, then according to $F = qvB\sin\theta$, it will experience a maximum force which will provide the centripetal force to particle and it will describe a circular path with uniform speed.

Question65

A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is
(2003)

©

Options:

A. $\frac{B}{2}$

B. B

C. 2 B

D. 4 B

Answer: B

Solution:

Magnetic field induction at point inside the solenoid of length l, having n turns per unit length carrying current i is given by
$B = \mu_0 ni$
If $i \rightarrow$ doubled, $n \rightarrow$ halved then $B \rightarrow$ remainssame.

Question66

A charge q moves in a region where electric field and magnetic field both exist, then force on it is (2002)

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Options:

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

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

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

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

Answer: B

Solution:

Solution:
The force experienced by a charged particle moving in space where electric and magnetic field exists is called Lorentz force. When a charged particle carrying charge q is subjected to an electric field of strength $\vec{E}$, it experiences a forcegiven by $\vec{F}_e = q\vec{E}$ whose direction is same as $\vec{E}$ or opposite of $\vec{E}$ depending on the nature of charge, positive or negative.
If a charged particle is moving in a magnetic field of strength $\vec{B}$ with a velocity $\vec{v}$ it experiences a force given by $\vec{F}_m = q(\vec{v} \times \vec{B})$. The direction of this force is in the direction of $\vec{v} \times \vec{B}$ i.e.perpendicular to the plane containing $\vec{v}$ and $\vec{B}$ is directed as given by right hand screw rule. Due to both the electric and magnetic fields, the total force experienced by the charge q is given by
$\vec{F} = \vec{F}_e + \vec{F}_m = q\vec{E} + q(\vec{v} \times \vec{B})$

Question67

The magnetic field of given length of wire for single turn coil at its centre is B then its value for two turns coil for the same wire is (2002)

Options:

A. $\frac{B}{4}$

B. $\frac{B}{2}$

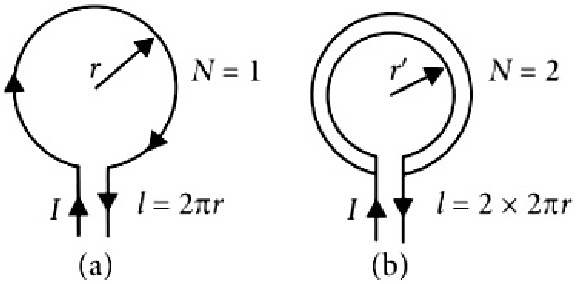
C. 4B

D. 2B.

Answer: C

Solution:

The magnetic field B produced at the centre of a circular coil due to current I flowing through this is given by $B = \frac{\mu_0 N I}{2r}$, N is number of turns and r is radius of the coil. Here $B = \frac{\mu_0 I}{2r} [N = 1]$



$\therefore 2 \times 2\pi r' = 2\pi r$(same length). $\therefore r' = \frac{r}{2}$

$\therefore$ Magnetic field at the centre for two turns (N = 2) is given by

$B' = \frac{\mu_0 \times 2I}{2r'} = \frac{\mu_0 \times 2I}{2r/2} = \frac{4\mu_0 I}{2r} = 4B$

Question68

If number of turns, area and current through a coil is given by n, A and i respectively then its magnetic moment will be (2001)

©

Options:

A. niA

B. $n^2 iA$

C. niA^2

D. $\frac{ni}{\sqrt{A}}$.

Answer: A

Solution:

Magnetic moment $M = niA$

Question69

An electron having mass m and kinetic energy E enter in uniform magnetic field B perpendicularly, then its frequency will be (2001)

©

Options:

A. $\frac{eE}{qvB}$

B. $\frac{2\pi m}{eB}$

C. $\frac{eB}{2\pi m}$

D. $\frac{2m}{eBE}$

Answer: C

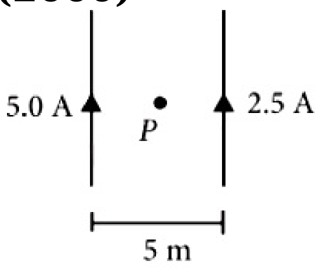
Solution:

The frequency of revolution of a charged particle in a perpendicular magnetic field is

$\upsilon = \frac{1}{T} = \frac{1}{2\pi r / v} = \frac{v}{2\pi r} = \frac{v}{2\pi} \times \frac{eB}{mv} = \frac{eB}{2\pi m}$

Question70

The magnetic field at centre, P will be (2000)



Options:

A. $\frac{\mu_0}{4\pi}$

B. $\frac{\mu_0}{\pi}$

C. $\frac{\mu_0}{2\pi}$

D. $4\mu_0\pi$

Answer: C

Solution:

$$B = \frac{\mu_0}{4\pi}\frac{2i_2}{\left(\frac{r}{2}\right)} - \frac{\mu_0}{4\pi}\frac{2i_1}{\left(\frac{r}{2}\right)} = \frac{\mu_0}{4\pi}\frac{4}{r}(i_2 - i_1)$$

$$= \frac{\mu_0}{4\pi}\frac{4}{5}(2.5 - 5.0) = -\frac{\mu_0}{2\pi}$$

-ve sign show that B is acting inwards i . e., into the plane.

Question71

Magnetic field due to 0.1 A current flowing through a circular coil of radius 0.1 m and 1000 turns at the centre of the coil is (1999)

©

Options:

A. 6.28×10^{-4} T

B. 4.31×10^{-2} T

C. 2×10^{-1} T

D. 9.81×10^{-4} T .

Answer: A

Solution:

$$B = \frac{\mu_0 N i}{2r}$$

$$= \frac{4\pi \times 10^{-7} \times 1000 \times 0.1}{2 \times 0.1} = 6.28 \times 10^{-4} \text{ T}$$

Question72

A straight wire of diameter 0.5 mm carrying a current of 1 A is replaced by the another wire of 1 mm diameter carrying the same current. The strength of the magnetic field far away is (1999, 1997)

©

Options:

A. one-quarter of the earlier value

B. one-half of the earlier value

C. twice the earlier value

D. same as the earlier value.

Answer: D

Solution:

Solution:
Diameter of first wire (d_1) = 0.5 mm Current in first wire (I_1) = 1 A; Diameter of second wire (d_2) = 1 mm and current in second wire (I_2) = 1 A

Strength of magnetic field due to current flowing in a conductor, (B) = $\frac{\mu_0}{4\pi} \times \frac{2I}{a}$ or $B \propto I$.
since the current in both the wires is same, therefore there is no change in the strength of the magnetic field.

Question73

If a long hollow copper pipe carries a current, then produced magnetic field will be (1999)

©

Options:

A. both inside and outside the pipe

B. outside the pipe only

C. inside the pipe only

D. neither inside nor outside the pipe

Answer: B

Solution:

Use Ampère's law
$\oint B \cdot d l = \mu_0 i_{enclosed}$
Outside : $i_{enclosed} \neq 0$ (some value) $\Rightarrow B \neq 0$
Inside $= i_{enclosed} = 0 \Rightarrow B = 0$.

Question74

Magnetic field intensity at the centre of the coil of 50 turns, radius 0.5 m and carrying a current of 2 A, is (1999)

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Options:

A. 3×10^{-5} T

B. 1.25×10^{-4} T

C. 0.5×10^{-5}T

D. 4×10^{6}T .

Answer: B

Solution:

$$B = \frac{\mu_0 (N\, i)}{2r}$$

$$= \frac{4\pi \times 10^{-7} \times 50 \times 2}{2 \times 0.5} = 1.256 \times 10^{-4} T$$

Question75

A charge having $\frac{e}{m}$ equal to 10^{8} C / kg and with velocity 3×10^{5}m / s enters into a uniform magnetic field B = 0.3 tesla at an angle 30° with direction of field. The radius of curvature will be
(1999)

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Options:

A. 0.01 cm

B. 0.5 cm

C. 1 cm

D. 2 cm.

Answer: D

Solution:

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

$$R = \frac{mv}{qB\sin\theta} = \frac{3 \times 10^{5}}{10^{8} \times 0.3 \times \frac{1}{2}} = 2cm$$

Question76

Two long parallel wires are at a distance of 1 metre. Both of them carry one ampere of current. The force of attraction per unit length between the two wires is
(1998)

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Options:

A. $5 \times 10^{-8} \mathrm{N} / \mathrm{m}$

B. $2 \times 10^{-8} \mathrm{N} / \mathrm{m}$

C. $2 \times 10^{-7} \mathrm{N} / \mathrm{m}$

D. $10^{-7} \mathrm{N} / \mathrm{m}$

Answer: C

Solution:

$$F = \frac{\mu_0}{4\pi} \frac{2I_1 I_2}{r}$$
$$= \frac{10^{-7} \times 2(1) \times (1)}{1} = 2 \times 10^{-7} \mathrm{N} / \mathrm{m}$$

Question77

A galvanometer having a resistance of 9 ohm is shunted by a wire of resistance 2 ohm. If the total current is 1 amp, the part of it passing through the shunt will be
(1998)

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Options:

A. 0.2 amp

B. 0.8 amp

C. 0.25 amp

D. 0.5 amp

Answer: B

Solution:

The shunt and galvanometer are in parallel.

Therefore, $\frac{1}{R_{eq}} = \frac{1}{9} + \frac{1}{2}$ or $R_{eq} = \frac{18}{11} \Omega$

Using Ohm's law, $V = I R_{eq} = 1 \times \frac{18}{11} = \frac{18}{11}V$

$\therefore$ Current through shunt $= \frac{V}{R_s}$

$= \frac{\frac{18}{11}}{2} = \frac{9}{11} \simeq 0.8\,\text{amp}$

Question78

A coil of one turn is made of a wire of certain length and then from the same length a coil of two turns is made. If the same current is passed in both the cases, then the ratio of the magnetic inductions at their centres will be
(1998)

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Options:

A. 4: 1

B. 1: 4

C. 2: 1

D. 1: 2

Answer: B

Solution:

Magnetic field at the centre of the coil,

$B = \frac{\mu_0}{2\pi}\frac{N\,I}{a}$

Let l be the length of the wire, then

$B_1 = \frac{\mu_0}{2\pi} . \frac{1 \times I}{\frac{l}{2\pi}} = \frac{\mu_0 I}{l}$

and $B_2 = \frac{\mu_0}{2\pi} . \frac{2 \times I}{\frac{l}{4\pi}} = \frac{4\mu_0 I}{l}$

Therefore, $\frac{B_1}{B_2} = \frac{1}{4}$ or ,$B_1 : B_2 = 1 : 4$

Question79

Two parallel wires in free space are 10 cm apart and each carries a current of 10 A in the same direction. The force exerted by one wire on the other, per metre length is
(1997)

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Options:

A. 2×10^{-4} N , repulsive

B. 2×10^{-7} N , repulsive

C. 2×10^{-4} N , attractive

D. 2×10^{-7} N , attractive.

Answer: C

Solution:

Distance between two parallel wires $(x) = 10\mathrm{cm} = 0.1\mathrm{m}$;
Current in each wire $= I_1 = I_2 = 10\mathrm{A}$ and length of wire $(l) = 1\mathrm{m}$.

Force on the wire $(F) = \frac{\mu_0 I_1 . I_2 \times l}{2\pi x}$

$= \frac{(4\pi \times 10^{-7}) \times 10 \times 10 \times 1}{2\pi \times 0.1} = 2 \times 10^{-4}\mathrm{N}$

since the current is flowing in the same direction, therefore the force will be attractive.

Question80

A positively charged particle moving due East enters a region of uniform magnetic field directed vertically upwards. This particle will
(1997)

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Options:

A. move in a circular path with a decreased speed

B. move in a circular path with a uniform speed

C. get deflected in vertically upward direction

D. move in circular path with an increased speed

Answer: B

Solution:

Solution:
When a positively charged particle enters in a region of uniform magnetic field, directed vertically upwards, it experiences a centripetal force which will move it in circular path with a uniform speed.

Question81

Tesla is the unit of
(1997, 1988)

Options:

A. electric field

B. magnetic field

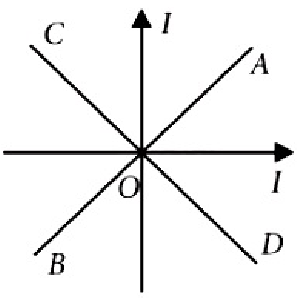
C. electric flux

D. magnetic flux.

Answer: B

Question82

Two equal electric currents are flowing perpendicular to each other as shown in the figure. AB and CD are perpendicular to each other and symmetrically placed with respect to the currents. Where do we expect the resultant magnetic field to be zero?



(1996)

Options:

A. On CD

B. On AB

C. On both OD and BO

D. On both AB and CD.

Answer: B

Solution:

Solution:
The direction of the magnetic field, due to current, is given by the right-hand rule. At axis AB, the components of magnetic field will cancel each other and the resultant magnetic field will be zero.

Question83

The magnetic field $d\vec{B}$ due to a small current element $d\vec{l}$ at a distance $\vec{r}$ and element carrying current i is
(1996)

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Options:

A. $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r} \right)$

B. $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r^3} \right)$

C. $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r} \right)$

D. $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r} 2 \right)$

Answer: B

Solution:

Solution:
According to Biot-Savart's law,
$d\vec{B} \propto i \left(\frac{d\vec{l} \times \vec{r}}{r^3} \right) = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r^3} \right)$.

Question84

A 10 eV electron is circulating in a plane at right angles to a uniform field at magnetic induction $10^{-4}\ Wb/m^2 (= 1.0$ gauss), the orbital radius of electron is
(1996)

©

Options:

A. 11 cm

B. 18 cm

C. 12 cm

D. 16 cm.

Answer: A

Solution:

Kinetic energy of electron $\left(\frac{1}{2} \times mv^2\right) = 10eV$ and

magnetic induction $(B) = 10^{-4} Wb / m^2$

Therefore $\frac{1}{2}(9.1 \times 10^{-31})v^2 = 10 \times (1.6 \times 10^{-19})$

or, $v^2 = \frac{2 \times 10 \times (1.6 \times 10^{-19})}{9.1 \times 10^{-31}} = 3.52 \times 10^{12}$

or, $v = 1.876 \times 10^6 m$

Centripetal force $= \frac{mv^2}{r} = Bev$

Therefore $r = \frac{mv}{Be} = \frac{(9.1 \times 10^{-31}) \times (1.876 \times 10^6)}{10^{-4} \times (1.6 \times 10^{-19})}$

$= 11 \times 10^{-2}\ m = 11\ cm$

Question85

constant velocity in a region having electric and magnetic fields of strength $20\ V\ m^{-1}$ and $0.5\ T$ at right angles to the direction of motion of the electrons. What is the velocity of the electrons? (1996)

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Options:

A. $8\ ms^{-1}$

B. $5.5\ ms^{-1}$

C. $20\ ms^{-1}$

D. $40\ ms^{-1}$.

Answer: D

Solution:

Solution:
Electric field $(E) = 20V / m$ and magnetic field $(B) = 0.5T$
The force on electron in a magnetic field $= evB$
Force on electron on an electric field $= eE$
since the electron is moving with constant velocity, therefore the resultant force on electronis zero.
i.e., $eE = evB \Rightarrow v = \frac{E}{B} = \frac{20}{0.5} = 40\ ms^{-1}$

Question86

A circular loop of area $0.01\ m^2$ carrying a current of 10 A, is held perpendicular to a magnetic field of intensity 0.1 T. The torque acting on the loop is (1994)

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Options:

A. 0.001 N m

B. 0.8 N m

C. zero

D. 0.01 N m.

Answer: C

Solution:

Solution:
Area (A) = $0.01 m^2$;
Current (I) = 10A;
Angle (ϕ) = 90° and magnetic field (B) = 0.1 T.
Therefore actual angle $\theta = (90° - \phi)$
$= (90° - 90°) = 0°$.
And torque acting on the loop $(\tau) = I AB \sin\theta$
$= 10 \times 0.01 \times 0.1 \times \sin 0° = 0$

Question87

A charge moving with velocity v in X -direction is subjected to a field of magnetic induction in negative X -direction. As a result, the charge will (1993)

©

Options:

A. remain unaffected

B. start moving in a circular path Y − Z plane

C. retard along X -axis

D. moving along a helical path around X -axis.

Answer: A

Solution:

The force acting on a charged particle in magnetic field is given by
$\vec{F} = q(\vec{v} \times \vec{B})$; $F = qvB\sin\theta$
$\therefore F = 0$
when angle between v and B is 180°.

Question88

A coil carrying electric current is placed in uniform magnetic field

(1993)

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Options:

A. torque is formed

B. e.m.f is induced

C. both (a) and (b) are correct

D. none of these

Answer: A

Solution:

Solution:
A current carrying coil has magnetic dipole moment. Hence a torque $\vec{m} \times \vec{B}$ acts on it in magnetic field.

Question89

To convert a galvanometer into a ammeter, one needs to connect a (1992)

©

Options:

A. low resistance in parallel

B. high resistance in parallel

C. low resistance in series

D. high resistance in series.

Answer: A

Solution:

Solution:
To convert a galvanometer into ammeter, one needs to connect a low resistance in parallel so that maximum current passes through the shunt wire and ammeter remains protected.

Question90

A straight wire of length 0.5 metre and carrying a current of 1.2 ampere is placed in uniform magnetic field of induction 2 tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is (1992)

©

Options:

A. 2.4 N

B. 1.2 N

C. 3.0 N

D. 2.0 N .

Answer: B

Solution:

Solution:
$F = il \times B = 1.2 \times 0.5 \times 2 = 1.2\ N$

Question91

The magnetic field at a distance r from a long wire carrying current i is 0.4 tesla. The magnetic field at a distance 2r is (1992)

©

Options:

A. 0.2 tesla

B. 0.8 tesla

C. 0.1 tesla

D. 1.6 tesla.

Answer: A

Solution:

Solution:
$B = \frac{\mu_0 i}{2\pi r}$ or $B \propto \frac{1}{r}$
When r is doubled, the magnetic field becomes halved $i.e.$, now the magnetic field will be $0.2\ T$.

Question92

A uniform magnetic field acts right angles to the direction of motion of electrons. As a result, the electron moves in a circular path of radius 2 cm. If the speed of electrons is doubled, then the radius of the circular path will be

(1991)

©

Options:

A. 2.0 cm

B. 0.5 cm

C. 4.0 cm

D. 1.0 cm

Answer: C

Solution:

Solution:

$r = \frac{mv}{qB}$ or $r \propto v$

As v is doubled, the radius also becomes doubled. Hence radius $= 2 \times 2 = 4$ cm

----

Question93

A deuteron of kinetic energy 50 keV is describing a circular orbit of radius 0.5 metre in a plane perpendicular to magnetic field B. The kinetic energy of the proton that describes a circular orbit of radius 0.5 metre in the same plane with the same B is (1991)

©

Options:

A. 25 keV

B. 50 keV

C. 200 keV

D. 100 keV .

Answer: D

Solution:

For a charged particle orbiting in a circular path in a magnetic field

$\frac{mv^2}{r} = Bvq \Rightarrow v = \frac{Bqr}{m}$

$mv^2 = Bqvr$

$E_K = \frac{1}{2}mv^2 = \frac{1}{2}Bqvr = Bq\frac{r}{2} \cdot \frac{Bqr}{m} = \frac{B^2q^2r^2}{2m}$

For deuteron, $E_1 = \frac{B^2q^2 \times r^2}{2 \times 2m}$

For proton, $E_2 = \frac{B^2 q^2 r^2}{2m}$

$\frac{E_1}{E_2} = \frac{1}{2} \Rightarrow \frac{50 \text{ keV}}{E_2} = \frac{1}{2} \Rightarrow E_2 = 100\,\text{keV}$

Question94

The magnetic induction at a point P which is at the distance of 4 cm from a long current carrying wire is 10^{-3} T. The field of induction at a distance 12 cm from the current will be (1990)

©

Options:

A. 3.33×10^{-4} T

B. 1.11×10^{-4} T

C. 33×10^{-3} T

D. 9×10^{-3} T.

Answer: A

Solution:

Solution:

$B \propto \frac{1}{r}$. By Ampère's law.

As the distance is increased to three times, the magnetic induction reduces to one third.

Hence $B = \frac{1}{3} \times 10^{-3}$ tesla $= 3.33 \times 10^{-4}$ tesla

----

Question95

Energy in a current carrying coil is stored in the form of (1989)

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Options:

A. electric field only

B. magnetic field only

C. dielectric strength

D. both (a) and (b).

Answer: D

Solution:

When current flows in a coil, its electric field is perpendicular to the magnetic field always.

Question96

A current carrying coil is subjected to a uniform magnetic field. The coil will orient so that its plane becomes
(1988)

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Options:

A. inclined at 45° to the magnetic field

B. inclined at any arbitrary angle to the magnetic field

C. parallel to the magnetic field

D. perpendicular to magnetic field.

Answer: B

Solution:

The plane of coil will orient itself so that area vector aligns itself along the magnetic field.
