DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 4

Topic :- MOVING CHARGES AND MAGNETISM

1 **(a)**

$$B = \mu_0 ni \Rightarrow i = \frac{B}{\mu_0 n} = \frac{20 \times 10^{-3}}{4\pi \times 10^{-7} \times 20 \times 100}$$

$= 7.9 amp = 8 amp$

2 **(b)**

$\frac{\mu_0}{4\pi} \cdot \frac{2\pi ni}{r} \Rightarrow B \propto ni$

3 **(d)**

The magnetic field B will be uniform inside the hollow tube, excepts near the ends. Also magnetic field is zero at any point outside the tube.

4 **(c)**

The Lorentz force acting on the current carrying conductor in the magnetic field is

$F = IBl \sin \theta$

Since, wire PQ is parallel to the direction of magnetic field, then $\theta = 0$,

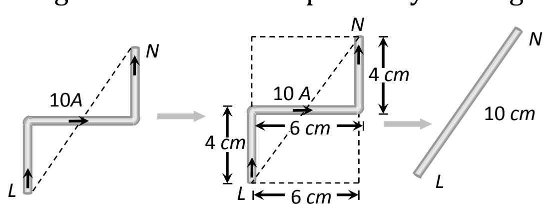
$\therefore F_{PQ} = IBl \sin 0° = 0$

Also, wire QR is perpendicular to the direction of magnetic field, then $\theta = 90°$.

$\therefore F_{QR} = IBl \sin 90° = IBl$

5 **(b)**

The given wire can be replaced by a straight wire as shown below



Hence force experienced by the wire

$F = Bil = 5 \times 10 \times 0.1 = 5N$

6 **(c)**

$$B = 10^{-7} \frac{2\pi ni}{r} = 10^{-7} \times \frac{2 \times \pi \times 25 \times 4}{5 \times 10^{-2}} = 1.257 \times 10^{-3} T$$

7 **(b)**

For a point inside the tube, using Ampere law, $\oint \vec{B}.d\vec{l} = \mu_0 i$. Here, we have $i = 0$ for inside the tube.

$\therefore\ B = 0$

8 **(d)**

Due to decrease in crosses (×), induced current in outer loop is anticlockwise, *i.e.*, from d to c and clockwise in inner loop *i.e.*, from $a \rightarrow b$

9 **(a)**

Magnetic field due to revolution of electron

$$B = \frac{\mu_0}{4\pi} . \frac{2\pi i}{r} = \frac{\mu_0}{4\pi} . \frac{2\pi . \left(\frac{e\omega}{2\pi}\right)}{r} = 10^{-7} \times \frac{e\omega}{r}$$

$$\Rightarrow 16 = 10^{-7} \times \frac{1.6 \times 10^{-19} \omega}{1 \times 10^{-10}} \Rightarrow \omega = 10^{17} rad/sec$$

11 **(b)**

Deflecting couple = torque on the loop = $BiA\cos\theta$.

12 **(c)**

For undeviated motion $\left|\overrightarrow{F_e}\right| = \left|\overrightarrow{F_m}\right|$, which happens when $\vec{v}, \vec{E}$ and $\vec{B}$ are mutually perpendicular to each other

13 **(c)**

$i = 30$ A, $B = 4 \times 10^{-4}$ T

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

Initial magnetic field (parallel to the wire)

$B_1 = 4 \times 10^{-4}$ T

Magnetic field produced by the straight wire

$$B_2 = \frac{\mu_0 i}{2\pi r} = \frac{2 \times 10^{-7} \times 30}{2 \times 10^{-2}}$$

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

B_2 will be in the plane perpendicular to the plane of wire, so

B_1 and B_2 are perpendicular to each other.

$\therefore$ Resultant magnetic field

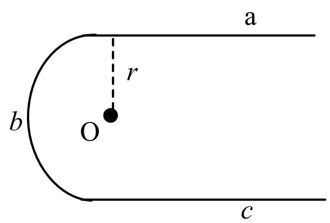
$$B = \sqrt{B_1^2 + B_2^2}$$

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

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

14 **(b)**

Field due to a straight wire of infinite length is $\frac{\mu_0 i}{4\pi r}$ if the point is on a line perpendicular to its length while at the centre of a semicircular coil is $\frac{\mu_0 \pi i}{4\pi r}$.



$\therefore \quad B = B_a + B_b + B_c$

$$= \frac{\mu_0}{4\pi}\frac{i}{r} + \frac{\mu_0}{4\pi}\frac{\pi i}{r} + \frac{\mu_0}{4\pi}\frac{i}{r}$$

$= \frac{\mu_0 i}{4\pi r}(\pi + 2)$ out of the page

15 **(a)**

The effective magnetic field at O

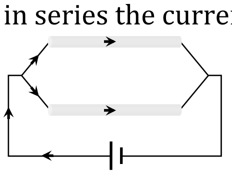
$$B = B_{PE} + B_{RS} = \frac{\mu_0}{4\pi} \cdot \frac{3}{2}\frac{\pi I}{R} + \frac{\mu_0}{4\pi} \cdot \frac{\pi}{2} \cdot \frac{I}{2R}$$

$$\Rightarrow B = \frac{\mu_0 I}{4R}\left[\frac{3}{2} + \frac{1}{4}\right] = \frac{7}{16}\frac{\mu_0 I}{R}$$

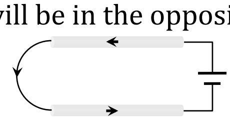
As per Fleming's Right Hand rule, direction of magnetic field is perpendicular and in the plane of paper

16 **(a)**

When connected in parallel the current will be in the same direction and when connected in series the current will be in the opposite direction

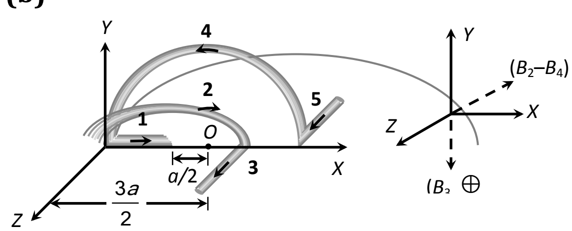


Parallel



Series

17 **(b)**



Magnetic field at 0 due to

Part (1) : $B_1 = 0$

Part (2) : $B_2 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{(a/2)} \otimes$ [along $-Z$-axis]

Part (3) : $B_3 = \frac{\mu_0}{4\pi} \cdot \frac{i}{(a/2)} (\downarrow)$ [along $-Y$-axis]

Part (4) : $B_4 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{(3a/2)} \odot$ [along $+Z$-axis]

Part (5) : $B_5 = \frac{\mu_0}{4\pi} \cdot \frac{i}{(3a/2)} (\downarrow)$ [along $-Y$-axis]

$B_2 - B_4 = \frac{\mu_0}{4\pi} \cdot \frac{\pi i}{a} \left(2 - \frac{2}{3}\right) = \frac{\mu_0 i}{3a} \otimes$ [along $-Z$-axis]

$B_3 + B_5 = \frac{\mu_0}{4\pi} \cdot \frac{1}{a} \left(2 + \frac{2}{3}\right) = \frac{8\mu_0 i}{12\pi a} (\downarrow)$ [along $-Y$-axis]

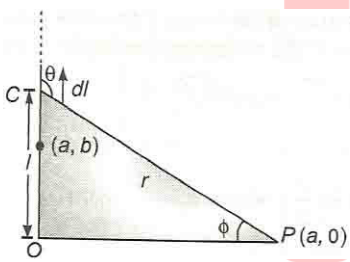
Hence net magnetic field

$$B_{net} = \sqrt{(B_2 - B_4)^2 + (B_3 + B_5)^2}$$

$$\frac{\mu_0 i}{3\pi a} \sqrt{\pi^2 + 4}$$

18 **(b)**

As shown figure take an element dl at C of wire, where $OC = l$. Let $PC = r$ and $\angle OPC = \phi$. According to Biot Savarts law; magnitude of magnetic field induction at P due to current element at C is



$$dB = \frac{\mu_0}{4\pi} \frac{i dl \sin\theta}{r^2} \quad \text{(i)}$$

Here, $\theta = 90° + \phi; r = a \sec\phi$

And $l = a \tan\phi; dl = a \sec^2\phi \, d\phi$

$$\therefore \; dB = \frac{\mu_0}{4\pi} \frac{i(\sec^2\phi \, d\phi) \sin(90° + \phi)}{a^2 \sec^2\phi}$$

$$= \frac{\mu_0}{4\pi} \frac{1}{a} \cos\phi \, d\phi$$

Total magnetic field induction at P is

$$B = \int_{\phi_1} 90° \frac{\mu_0}{4\pi} \frac{1}{a} \cos\phi \, d\phi = \frac{\mu_0}{4\pi} \frac{1}{a} (\sin\phi)_{\phi_1}^{90°}$$

$$= \frac{\mu_0}{4\pi} \frac{1}{a} (1 - \sin\phi_1) = \frac{\mu_0}{4\pi} \frac{1}{a} \left(1 - \frac{b}{\sqrt{a^2 + b^2}}\right)$$

19 **(a)**

The magnetic field in between because of each will be in opposite direction

$$B_{\text{in between}} = \frac{\mu_0 i}{2\pi x} \hat{\mathbf{j}} - \frac{\mu_0 i}{2\pi (2d - x)} (-\hat{\mathbf{j}})$$

$$= \frac{\mu_0 i}{2\pi}\left[\frac{1}{x} - \frac{1}{2d - x}\right](\hat{\mathbf{j}})$$

At $x = d, B_{\text{in between}} = 0$

For $x < d, B_{\text{in between}} = (\hat{\mathbf{j}})$

For $x > d, B_{\text{in between}} = (-\hat{\mathbf{j}})$

Towards x, net magnetic field will add up and direction will be $(-\hat{\mathbf{j}})$.

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20 **(c)**

Magnetic force on the rod $= BIl$

Weight of the rod $= mg$

For no tension in wire, $BIl = m$g

or $I = \frac{mg}{Bl} = \frac{1 \times 10}{2 \times 1} = 5\text{ A}$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	B	D	C	B	C	B	D	A	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	C	C	B	A	A	B	B	A	C