DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

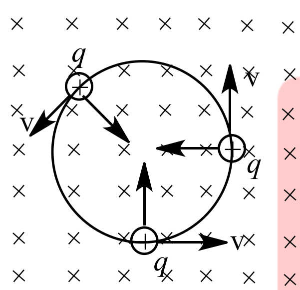
Solutions

Subject : PHYSICS
DPP No. : 7

Topic :- MOVING CHARGES AND MAGNETISM

1 **(d)**

For perpendicular magnetic field magnetic force is provided by the force so,



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

$ie, \quad r = \frac{mv}{qB}$ ...(i)

As in uniform circular motion $v = r\omega$, so the angular frequency of circular motion will be given by

$\omega = \frac{v}{r} = \frac{qB}{m}$ [Using Eq. (i)]

and hence the time period

$T = \frac{2\pi}{\omega} = \frac{2\pi m}{qB}$ ...(ii)

Given, $B = 3.534 \times 10^{-5}$ T,

$q = 1.6 \times 10^{-19}$ C, $m = 9.1 \times 10^{-31}$ kg, $T = ?$

From Eq. (ii), we get

$$\therefore \quad T = \frac{2 \times 3.14 \times 9.1 \times 10^{-31}}{3.534 \times 10^{-5} \times 1.6 \times 10^{-19}} = 1 \times 10^{-6}\,\text{s} = 1\mu\text{s}$$

2 **(c)**

Force acting between two current carrying conductors

$$F = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d}\, l \qquad \text{...(i)}$$

Where, $d =$ distance between the conductors,

$l =$ length of each conductor.

Again, $F' = \frac{\mu_0}{2\pi}\frac{(-2I_1)(I_2)}{(3d)} . l$

$$= -\frac{\mu_0}{2\pi}\frac{2I_1 I_2}{3d} . l \qquad \text{...(ii)}$$

Thus, from Eqs. (i) and (ii)

$$\frac{F'}{F} = -\frac{2}{3}$$

$$\Rightarrow F' = -\frac{2}{3} F$$

3 **(b)**

$F_{\max} = evB$

$= (1.6 \times 10^{-19}) \times (0.9 \times 3 \times 10^8) \times (10^8)$

$= 4.32 \times 10^{-3}$ N

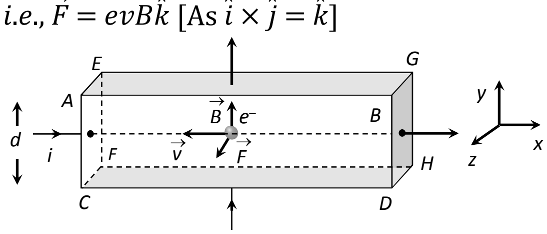
4 **(a)**

The charged particle moving in a magnetic field does not gain energy. However, the direction of its velocity changes continuously. Hence momentum changes

5 **(a)**

As the block is of metal, the charge carriers are electrons, so for current along positive x-axis, the electrons are moving along negative x-axis, *i.e.* $\vec{v} = -v\hat{i}$ and as the magnetic field is along the y-axis, *i.e.* $\vec{B} = B\hat{j}$. So $\vec{F} = q(\vec{v} \times \vec{B})$ for this case yield $\vec{F} = (-e)[-v\hat{i} \times B\hat{j}]$

i.e., $\vec{F} = evB\hat{k}$ [As $\hat{i} \times \hat{j} = \hat{k}$]



As force on electrons is towards the face $ABCD$, the electrons will accumulate on it an hence it will acquire lower potential

6 **(a)**

As magnetic moments are directed along SN, angle between $\vec{M}$ and $\vec{M}$ is $\theta = 120°$

$\therefore$ Resultant magnetic moment

$= \sqrt{M^2 + M^2 + 2M\, M \cos 120°}$

$= \sqrt{M^2 + M^2 + 2M^2(-1/2)} = M$

7 **(d)**

Since, the currents are flowing in the opposite directions, the magnetic field at a point equidistant from the two wires will be zero. Hence, the force acting on the charge at this instant will be zero.

8 **(d)**

Since force is perpendicular to direction of motion, energy and magnitude of momentum remains constant

9 **(c)**

$r = \frac{\sqrt{2mK}}{qB}$ and $A = \pi r^2 \Rightarrow A = \frac{\pi(2mK)}{q^2B^2} \Rightarrow A \propto K$

10 **(b)**

Direction of magnetic field at every point on axis of a current carrying coil remains same though magnitude varies. Hence magnetic induction for whole of the x-axis will remain positive

Therefore, (c) and (d) are wrong

Magnitude of magnetic field will vary will x according to the formula, $B = \frac{\mu_0 NIR^2}{2(R^2 + x^2)^{3/2}}$

Hence, at $x = 0$, $B = \frac{\mu_0 NI}{2R}$

and when $x \to \infty$, $B \to 0$

Slope of the graph will be

$$\frac{dB}{dx} = -\frac{3\mu_0 NIR^2.x}{2(R^2 + x^2)^{5/2}}$$

It means, at $x = 0$, slope is equal to zero or tangent to the graph at $x = 0$, must be parallel to x-axis.

Hence (b) is correct and (a) is wrong

11 **(d)**

Since, the currents in the three wires are flowing in same direction so, the wire B will experience a force of attraction due to both wires A and C,

So, $F_{AB} = \frac{\mu_0}{4\pi} . \frac{2i_A i_B}{d} = \frac{\mu_0}{4\pi} . \frac{2 \times 1 \times 2}{d}$

$$= \frac{4\mu_0}{4\pi d} \quad \text{...(i)}$$

and $F_{CB} = \frac{\mu_0}{4\pi} . \frac{2i_B i_C}{d} = \frac{\mu_0}{4\pi} \times \frac{2 \times 2 \times 3}{d}$

$$= \frac{12\mu_0}{4\pi d} \quad \text{...(ii)}$$

As seen from Eqs. (i) and (ii) $F_{CB} > F_{AB}$ hence, the net force of attraction will be directed towards wire C.

12 **(b)**

According to Fleming's left hand rule, in figures (1) and (2) magnetic force on the electron will be directed in –ve z — axis and –ve x — axis respecively. In figure (3) velocity of electron and direction of magnetic field are antiparallel so, no force will act on electron.

13 **(c)**

The magnetic field in the solenoid along its axis

(i) At an internal point $= \mu_o ni$

$= 4\pi \times 10^{-7} \times 5000 \times 4 = 25.1 \times 10^{-3} Wb/m^2$
[Here $n = 50\ turns/cm = 5000\ turns/m$]
(ii) At one end

$$B_{end} = \frac{1}{2}B_{in} = \frac{\mu_0 ni}{2} = \frac{25.1 \times 10^{-3}}{2} = 12.6 \times 10^{-3} Wb/m^2$$

14 **(c)**

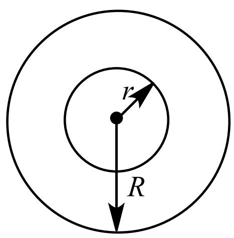
On applying Fleming's left hand rule we find that the force acting on the electron is towards east, so it will deflect towards east.

15 **(b)**

Let R be the radius of a long thin cylindrical shell.

To calculate the magnetic induction at a distance $r (r < R)$ from the axis of cylinder, a circular shell of radius r is shown in figure.

Since, no current is enclosed in the circle so, from Ampere's circuital law, magnetic induction is zero at every point of circle. Hence, the magnetic induction at any point inside the infinitely long straight thin walled tube (cylindrical) is zero.



16 **(a)**

Sensitivity $(S) = \frac{\theta}{i} \Rightarrow \frac{S_A}{S_B} = \frac{i_B}{i_A} = \frac{5}{3} \Rightarrow S_A > S_B$

17 **(d)**

At midpoint, magnetic fields due to both the wires are equal and opposite. So $B_{Net} = 0$

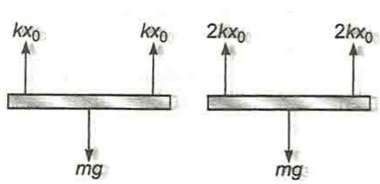
18 **(b)**

In the absence of magnetic field

$$mg = 2kx_0 \qquad .....(i)$$

the current in the rod is $i = \frac{E}{R}$

$\therefore$ Magnetic force on the rod is $F_m = BiL = \frac{ELB}{R}$



In downward direction

$$\therefore \quad 2kx_0 = mg + \frac{BLE}{LE} \qquad .....(ii)$$

From Eqs. (i) and (ii); we get $4kx_0 = 2kx_0 + \frac{BLE}{R}$

$$B = \frac{2kx_0R}{EL} = \frac{mgR}{LE}$$

19 **(c)**

Magnetic field induction at a point due to a long current carrying wire is related with distance r by relation $B \propto 1/r$. Therefore graph (c) is correct.

20 **(b)**

$$B = \frac{\mu_0 Ni}{2r} = \frac{4\pi \times 10^{-7} \times 50 \times 2}{2 \times 0.5} = 1.25 \times 10^{-4} T$$

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