AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST OYJ TEST - 14 Balliwala SOLUTION Date 16-07-2019

[PHYSICS]

1. **(b)** Electric field can deviate the path of the particle in the shown direction only when it is along negative y-direction. In the given options $\vec{E}$ is either zero or along x-direction. Hence it is the magnetic field which is really responsible for its curved path. Options (a) and (c) can't be accepted as the path will be helix in that case (when the velocity vector makes an angle other than 0°, 180° or 90° with the magnetic field, path is a helix) option (d) is wrong because in that case component of net force on the particle also comes in k direction which is not acceptable as the particle is moving in x-y plane. Only in option (b) the particle can move in x-y plane.

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

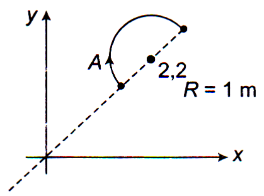
Initial velocity is along x-direction. So let $\vec{v} = v\hat{i}$

$\therefore \vec{F}_{net} = qa\hat{i} + q[(v\hat{i}) \times (c\hat{k} + b\hat{j}] = qa\hat{i} - qvc\hat{j} + qvb\hat{k}$

In option (b)

$$\vec{F}_{net} = q(a\hat{i}) + q[(v\hat{i}) \times (c\hat{k} + a\hat{i}) = qa\hat{i} - qvc\hat{j}$$

2. **(b)** Force on semi-circular wire will be same as the force on straight wire AC



$\vec{\ell} = A\vec{C} = 2R(\cos 45^0 \hat{i} + \sin 45^0 \hat{j}) = \sqrt{2}(\hat{i} + \hat{j})$

$\vec{F} = I\vec{\ell} \times \vec{B} = 1 \times \sqrt{2}(\hat{i} + \hat{j}) \times (3\hat{i} + 4\hat{j} + \hat{k})$

$= \sqrt{2}\left[\hat{i} - \hat{j} + \hat{k}\right]$

3. **(a)** The magnetic moment of current carrying loop

$$M = niA = ni\,(\pi r^2)$$

Hence the work done in rotating it through 180°

$$W = MB\,(1 - \cos\theta) = 2MB = 2(ni\pi\, r^2)B$$

$$= 2\times(50\times2\times3.14\times16\times10^{-4})\times0.1 = 0.1\,\text{J}$$

4. **(c)** P.E. for magnetic dipole is

$u_{\text{I}} = MB$ $\quad[\theta = -180°]$

$u_{\text{II}} = 0$ $\quad[\theta = 90°]$

$u_{\text{III}} = -MB\cos\theta$ $\quad[0 < \cos\theta < 1]$

$u_{\text{IV}} = MB\cos\theta$ $\quad[0 < \cos\theta < 1]$

$\therefore$ Decreasing order of potential energy is,

(I > IV > II > III)

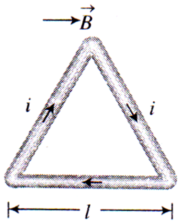
5. **(b)** $B = \dfrac{\mu_0 i}{2R} \Rightarrow i = \dfrac{B\times 2R}{\mu_0}$

Now, $M = i\times A = i\pi R^2 = \dfrac{B\times2R}{\mu_0}\times\pi R^2 = \dfrac{2\pi BR^3}{\mu_0}$

6. **(d)** Since $\theta = 90°$

Hence $\tau = NIAB = 1\times I\times\left(\dfrac{\sqrt{3}}{4}l^2\right)B$

$$= \frac{\sqrt{3}}{4}l^2B$$



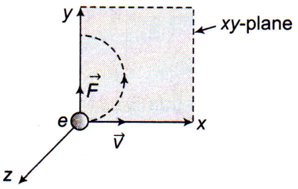
7. D

8. **(d)** Particles entering perpendicularly, hence they will describe circular path. Since their masses are different so they will describe path of different radii.

9. **(c)** In this case $|\vec{F_e}| = |\vec{F_m}|$ and both forces are opposite to each other.

10. **(c)** When particle enters at angle other than 0° or 90° or 180°, path followed is helix.

11. **(b)** To move the electron in xy plane, force on it must be acting in the y-direction initially. The direction of $\vec{F}$ is known, and the direction of v is known, hence by applying Fleming's left hand rule, the direction of magnetic field is also determined.



12. **(c)** $T = \frac{2\pi m}{Bq}$ or $T \propto \frac{m}{q}$

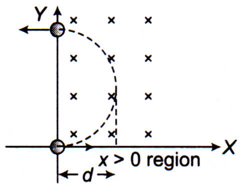
$$\frac{T_\alpha}{T_p} = \frac{4m}{2q} \times \frac{q}{m} = 2$$

or $T_\alpha = 2\left[\frac{25}{5}\right]\mu s = 10\,\mu s$

13. **(b)** It is easy to understand the given problem, along with the following figure.

d = radius of path

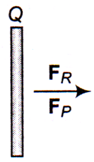
$$= \frac{mv}{qB}$$



14. . Force on wire Q due to wire R

$$F_R = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2 \times 20 \times 10}{0.02} \times 0.1$$

$= 20 \times 10^{-5}$ N (towards right)



Force on wire Q due to wire P

$$F_p = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2 \times 30 \times 10}{0.1} \times 0.1$$

$= 6 \times 10^{-5}$ N (towards right)

Net force on Q

$F = F_R + F_P$

$= 20 \times 10^{-5} + 6 \times 10^{-5}$

$= 26 \times 10^{-5}$ N

$= 2.6 \times 10^{-4}$ N (towards right)

15. Torque acting on the coil

$\tau = NiBA$

$= 100 \times 0.2 \times 2 \times (0.08 \times 0.1)$

$= 0.32$ N-m

Direction of torque τ is given by the vector $\mathbf{M} \times \mathbf{B}$.