

# Additional Conceptual Short Questions with Answers

**1. A charged particle is moved in a circle under the influence of a uniform magnetic field. If an electric field is turned on that point along the same direction as that of magnetic field, what path will be charged particle take?**

**Ans.** The charged particle will move in a spiral path (helical path) when both electric field and magnetic field are along the same direction. Because magnetic field makes it to move in circular path but electric field makes it to move along its own direction. This helical path is also called a helix.

**2. In a lightning strike, there is a rapid movement of negative charges from a cloud to the earth. In what direction is a lightning strike deflected by earth's magnetic field?**



**Ans.** The downward flow of negative charges in a lightning strike is equivalent to an upward moving current. Thus, we have upward moving current in northward-directed magnetic field. According to right hand rule the lightning strike deflects towards west.

**3. A beam of  $\alpha$  particles and of proton of same velocity  $u$  enters a uniform magnetic field at right angle to field lines. The particles describe a circular path. Calculate the ratio of the radii of the two paths.**

**Ans.** Radius of the path of  $\alpha$  - particle

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

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

$$R_\alpha = \frac{m_\alpha v}{q_\alpha B} \quad (1)$$

Radius of the path of protons

$$R_p = \frac{m_p v}{q_p B} \quad (2)$$

Divide eq (1) by (2)

$$\frac{R_\alpha}{R_p} = \frac{\frac{m_\alpha v}{q_\alpha B}}{\frac{m_p v}{q_p B}} = \frac{m_\alpha v}{q_\alpha B} \times \frac{q_p B}{m_p v}$$

$$q_p = e$$

$$q_\alpha = 2e$$

$$m_\alpha = 4m_p$$

$$\frac{R_\alpha}{R_p} = \frac{m_\alpha q_p}{m_p q_\alpha}$$

$$\frac{R_\alpha}{R_p} = \frac{4m_p e}{m_p \times 2e}$$

$$\frac{R_\alpha}{R_p} = \frac{4}{2} = \frac{2}{1}$$

**4. What happens to the K.E of a charged particle moving in a uniform magnetic field?**

**Ans.** Since magnitude of velocity remain constant, Therefore K.E remain constant and change in K.E is zero.

**5. Suppose that a charge q is moving in a uniform magnetic field with a velocity v. Why is there no work done by the magnetic force that acts on the charge q?**

The magnetic force acting on a charged particle 'q' is given by

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

As magnetic force is always perpendicular to  $\vec{v}$  (i.e.,  $\vec{d}$ )

Therefore, angle between  $\vec{F}$  and  $\vec{d}$  is  $90^\circ$

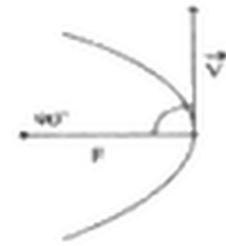
Hence

$$\text{Work} = \vec{F} \cdot \vec{d} = Fd \cos \theta$$

$$= Fd \cos 90^\circ$$

$$\boxed{W = 0}$$

So, no work is done by magnetic force.



**6. Why does the picture of a TV screen become distorted when a magnet is brought near the screen?**

**Ans.** We know that the picture on a TV screen is formed due to the beam of electrons.

When a magnet is brought near screen, the magnetic field of magnet interacts with the magnetic field around the beam of electrons. So a magnetic force acts on the beam, which is given by,

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

Due to path of electron beam is deflected. Hence the picture is distorted.

**7. Is it possible to orient a current loop in a uniform magnetic field such that the loop will not tend to rotate? Explain.**

Yes, it is possible.

**Explanation:**

We know that torque acting on a current loop in a uniform magnetic field is given by

$$\tau = IAB \cos \alpha$$

If  $\alpha = 90^\circ$ , i.e., when the plane of loop is held perpendicular to magnetic field, then

$$\tau = IAB \cos 90^\circ$$

$$\tau = 0$$

So, loop will not tend to rotate in this case.

**8. How can you use a magnetic field to separate isotopes of chemical element?**

**Ans. Explanation (Separation of isotopes)**

For this purpose, the ions of an element are passed through a uniform and perpendicular field. A magnetic force act on them. Under the action of this force, the ions move along circular paths of different radii due to their different masses as explained below.

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

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

Since  $m$ ,  $q$ , and  $B$  are constant

Therefore  $r \propto m$

In this way isotopes of an element can be separated.

**9. A loop of wire is suspended between the poles of a magnet with its plane parallel to the pole faces. What happens if a direct current is put through the coil? What happens if an alternating current is used instead?**

Since in both cases the plane of the loop and magnetic field are perpendicular. So the torque will be zero. i.e.

$$\tau = NIAB \cos \alpha$$

OR  $\tau = NIAB \cos 90^\circ$  (since  $\alpha = 90^\circ$ )

$$\tau = 0 \text{ (minimum)}$$

## Self-Assessment paper 1

**Q.No.2 Write Short Answers any SIX of the following questions.**

1. Can neutron be accelerated in cyclotron? Give reason.
2. An electron beam passes through a region of crossed electric and magnetic fields of intensity E and B respectively. For what value of the electron speed the beam will remain un deflected?
3. Ampere's law is the magnetic analogy of Gauss's law, is this statement true? Discuss.
4. Suppose that a charge q is moving in a uniform magnetic field with a velocity v. Why is there no work done by the magnetic force that acts on the charge q?
5. What is the nature of the force between two parallel current carrying wires (in same direction)?
6. At a given instant, a proton moves in the positive x-direction in a region where there is magnetic field in the negative z-direction. What is the direction of magnetic force? Will the proton continue to move in positive x-direction? Explain.

**Q.No.3 Extensive Question.**

Q(a) Derive the expression for charge to mass ratio of electron.

(b) How a 5 mA, 100 ohms galvanometer is converted into 20V voltmeter?

## Self-Assessment paper 2

**Q.No.2 Write Short Answers any SIX of the following questions.**

1. An electron does not suffer any deflection while passing through a region. Are you sure that there is no magnetic field?

2. Describe the change in the magnetic field inside a solenoid carrying a steady current  $I$ , if the length of the solenoid is doubled but the number of turns remains same.

3. What is cyclotron frequency of a charged particle of mass  $m$ , charge  $q$  moving in a magnetic field  $B$ ?

4. Will like current attract or repel each other? Discuss.

5. A loop of wire suspended between the poles of a magnet with its plane parallel to the pole faces, what happens if the direct current is put through the coil? What happens if an alternating current is used instead?

6. What is stable or dead-beat galvanometer?

7. Two charged particles are projected into a region where there is a magnetic field perpendicular to their velocities. If the charges are deflected in opposite directions, what can you say about them?

**Q.No.3 Extensive Questions.**

Q. (a) What do you understand by the term resistivity, how the resistivity of the

(b) A proton moving at right angles to a magnetic field 0.1T experiences a force of  $2 \times 10^{-12}$  N. What is the speed of protons?

