Q. 1 A plane conducting loop is located in a uniform magnetic field that is directed along the x-axis. For what orientation of the loop is the flux a maximum? For what orientation is the flux a minimum?

Ans. The flux is maximum when plane of the loop is perpendicular to x-axis and vector area will be parallel to B i.e. $\theta = 0$.

$\Delta\varphi = \mathbf{B} \cdot \mathbf{A} = BA\cos\theta = BA\cos 0^o = BA$ (maximum)

The flux is minimum when plane of the loop is parallel to x-axis and vector area will be perpendicular to B i.e. $\theta = 90^o$.

$\Delta\varphi = \mathbf{B} \cdot \mathbf{A} = BA\cos\theta = BA\cos 90^o = 0$ (minimum)

Q. 2 A current in a conductor produces a magnetic field, which can be calculated using Ampere's law. Since current is defined as the rate of flow of charge, what can you conclude about the magnetic field due to stationary charges? What about moving charges?

Ans. Since stationary charges do not produce current hence no magnetic field is produced due to stationary charges. They produce only electric field. Moving charges produce current and hence magnetic field will be produced around conductor carrying this current.

Q. 3 Describe the change in the magnetic field inside a solenoid carrying a steady current I, if (a) the length of the solenoid id doubled but the number of turns remains same and (b) the number of turns is doubled, but the length remains same.

Ans. a) When the length of solenoid doubled, the magnetic field B will be halved.

$B = \mu_o nI = \mu_o (N/L) I$ since $n = N / L$

When $L' = 2L$

$B' = \mu_o (N / 2L) I = 1/2 (\mu_o N/L\, I) = 1/2\, B$

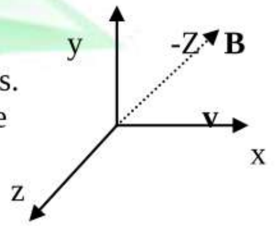
b) When number of turns doubled, the magnetic field B will be doubled.

$B = \mu_o nI = \mu_o N/l\, I$

When $N' = 2N$

$B' = \mu_o 2N / l\, I = 2 (\mu_o N/l\, I) = 2B$

Q. 4 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 the magnetic force? Will the proton continue to move in the positive x direction? Explain.



Ans. As $\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$

According to the right hand rule, magnetic force will act along + y-axis.

No proton will not continue to move along +x-axis rather its will move in a circular path around +y-axis.

Q. 5 Two charged particles are projected into a region where there is a magnetic field perpendicular to their velocities. If the chargers are deflected in opposite directions, what can you say about them?

Ans. The charged particles are deflected in opposite directions due magnetic force given by the relation $\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$. They will experience a force in the magnetic field

$\mathbf{F} = -e(\mathbf{v} \times \mathbf{B})$ on electron & $\mathbf{F} = +e(\mathbf{v} \times \mathbf{B})$ one proton

This shows that particles are oppositely charged, one is positively charged and the other is negatively charged.

Q. 6 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?

Ans. The charge q follows a circular path under the action of magnetic force $F = qvB\sin\theta$

The force F always acts perpendicular to the direction of motion of charge. The angle between F and displacement d is 90^o.

$W = \mathbf{F} \cdot \mathbf{d} = Fd\cos 90^o = 0$ so the work done by the magnetic force is zero. It is only deflecting force and changes the direction of moving charge particle.

Q. 7 **If a charged particle moves in a straight line through some region of space, can you say that the magnetic field in the region is zero?**

Ans. There are two possibilities:

i) Magnetic field is not present i.e. $B = 0$

ii) The magnetic field is parallel or anti-parallel to the direction of motion of charge particle. If charge particle moves parallel to the magnetic field then $\theta = 0$ hence $F = qvB \sin 0^o = 0$. Similarly if charge particle moves anti-parallel to the magnetic field then $\theta = 180^o$ hence $F = qvB \sin 180^o = 0$.

In both the above cases the force F is zero and the particle move in a straight line.

Q. 8 **Why does the picture on a TV screen become distorted when a magnet is brought near the screen?**

Ans. The picture is formed on the TV screen when beam of electrons from picture tube strike on the TV screen. When magnet is brought near the TV screen the electrons being charged particles are deflected by the magnetic field of this magnet and cannot reach the TV screen. Due to this the picture is distorted.

Q. 9 **Is it possible to orient a current loop in a uniform magnetic field such that the loop will not tend to rotate? Explain.**

Ans. Yes it is possible. When plane of the current carrying loop is held perpendicular to the magnetic field, i.e. $\alpha = 90^o$ then torque acting on the loop will be zero.

$$\tau = NIBA \cos\alpha = NIBA \cos 90^o = NIBA \times 0 = 0$$

Hence it will experience no torque and do not rotate.

Q.10 **How can a current loop be used to determine the presence of a magnetic field in a given region of space?**

Ans. A current loop is rotated in that region of space. If at any orientation, torque acts on it then magnetic field is present there. But if current carry loop does not experience any torque then magnetic field is not present. As torque is given by the relation $\tau = NIBA \cos\alpha$.

Q.11 **How can you use a magnetic field to separate isotopes of chemical element?**

Ans. Isotopes of an element in the ions form are projected into the magnetic filed. They will be deflected into circular paths of different radii by the magnetic force. Since $\mathbf{r \propto \sqrt{m}}$ where r is the radius of path of charge particle and m is its mass. The isotopes have different masses hence they will in paths having different radii. Hence isotopes are separated by measuring the radii of their paths.

Q.12 **What should be the orientation of a current carrying coil in a magnetic field so that torque acting upon the coil is (a) maximum (b) minimum?**

Ans. **a)** For maximum torque, the plane of the current carrying coil must be parallel to the magnetic field B. i.e. $\alpha = 0^o$, therefore $\tau_{max} = NIBA \cos\alpha = NIBA\cos 0^o = NIBA$

b) For minimum torque, the plane of the current carrying coil must be perpendicular to the magngtic field B. i.e. $\alpha = 90^o$, therefore $\tau_{min} = NIBA \cos 90^o = NIBA x 0 = 0$

Q.13 **A loop of wire is suspended between the poles of a magnet with its plane parallel to the pole faces. What happened if a direct current is put through the coil? What happens if an alternating current is used instead?**

Ans. As the plane of loop of wire if parallel to the pole faces, its plane is perpendicular to the magnetic field B. i.e. $\alpha = 90^o$, therefore, $\tau = NIBA \cos 90^o = 0$. It means no torque will act on the loop of wire. Hence loop of wire will remain stationary for both alternating current and direct current.

Q.14 **Why the resistance of an ammeter should be very low?**

Ans. Since ammeter is connected in series in a circuit to measure the maximum current. Its resistance is kept very low so that it should not disturb (reduce) the current in the circuit and measure it accurately. If its resistance is high then it will disturb the circuit current and it will not measure the current accurately.

Q.15 **Why the voltmeter should have a very high resistance?**

Ans. We connect voltmeter parallel to the circuit to measure the maximum potential difference because potential difference in parallel remains same. The resistance of voltmeter is kept very high because minimum current should flow through voltmeter and maximum current should flow through the circuit. In this way the potential difference across the resistor is measured accurately.