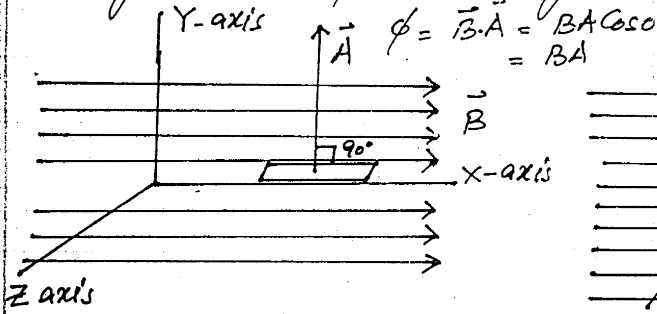
SHORT QUESTIONS CH # 14

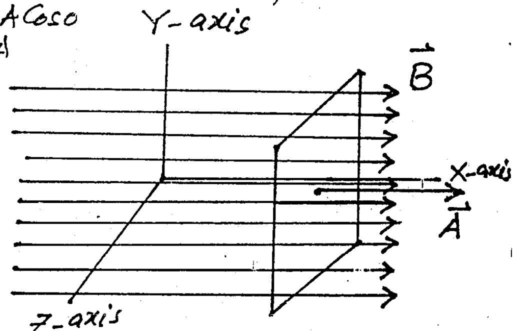
Q 14.1 # A plane conducting loop is located in a uniform magnetic field that is directed along x-axis. For what orientation of the loop is the flux a maximum? For what orientation is the flux a minimum?

 # Ans # MAXIMUM FLUX #

When the plane of the loop is held perpendicular to the x-axis, then its direction is parallel to x-axis. Maximum magnetic line of forces pass through the loop causing maximum flux.



(Min. Flux)



(Max. Flux)

 # MINIMUM FLUX #

The flux passing through the plane conducting loop will be minimum if it is held parallel to the x-axis. The angle between $\vec{B}$ and $\vec{A}$ is equal to 90° Hence flux is

$$\phi = \vec{B}\cdot\vec{A} = BA\cos 90 = 0 \quad (\because \cos 90 = 0)$$

Q 14.2 # A current in a conductor produces a magnetic field which can be calculated by 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's about the moving charges?

#Ans# When the charges are stationary, they can produce only an electric field around them. In case of moving charges, magnetic field is produced in the form of concentric circles around a current carrying conductor due to the flow of these charges. The existance of such field was confirmed by a Danish physicist Hans Oersted in 1820 A.D.

Q # 14.3 Why $\vec{B}$ is non zero outside a solenoid?

#Ans# When current is passed through a solenoid, it behaves like a bar magnet. The field outside the solenoid is negligibally weak (practically zero) because the lines of forces are opposite to each other at its outer surface. Such as the field set up by the upper part of the solenoid tends to cancel the field set up by the lower part in the opposite direction.

Q # 14.4 Describe the change in magnetic field inside a solenoid carrying a steady current I if

(a) the length of the solenoid is doubled but the number of turns remains the same.

(b) The number of turns is doubled, but the length remains Constant.

#Ans# The equation of magnetic field B inside the solenoid is

$$B = \mu_o n I = \mu_o \frac{N}{\ell} I$$

(a) If number of turns N are kept Constant then magnetic field B is inversly proportional to the length l of the solenoid. when length is doubled, no. of turns will be halved. Hence the magnetic field is also halved.

(b) If now the length l is Constant and the number of turns N are doubled then the magnetic field B is also doubled because they are directly proportional to each other.

i.e. $B \propto N$

Q # 14.5 At a given instant the proton moves in the +ve x direction in a region where there is a magnetic field in the negative z direction. What is the direction of magnetic force? Will the proton Continue to move in the positive x direction. Explain

#Ans# Since we know that the magnitude of magnetic force F acting on a charge q moving with velocity $\vec{V}$ inside a magnetic field $\vec{B}$ is

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

The direction of force F is perpendicular to the plane Containing $\vec{V}$ and $\vec{B}$. As proton is moving along x-axis, magnetic field is directed along z-axis there force the magnetic force will be directed along y-axis. Due to this y directed force the proton tends to move in x-y plane and not in the positive x-direction.

Q # 14.6 Two charged particles are projected in to a region where there is a magnetic field perpendicular to their velocities. If the charges are deflected in opposite direction. what can you say about them?

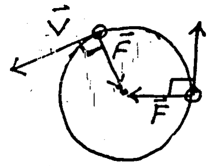
 # Ans # Two possibilities arise concerning to both these charge particles to deflect in opposite direction when they are thrown at right angle to the magnetic field.

(1) when two unlike charges are thrown inside a magnetic field along same direction. They will be deflected along opposite directions.

(2) when two like (same) charges are projected from opposite direction. they will also be deflected along opposite direction.

Q # 14.7 Suppose that a charge q is moving in a uniform magnetic field B with a velocity V. Why is there no work done by the magnetic force that acts on the charge q?

#Ans # The charge particle q under the influence of magnetic force tends to follow a circular path. The direction of force at any instant is at right angle to the direction of motion of charge q. Hence no work will be done by the force F. This force F just changes the direction of motion of charge particle.



Q # 14.8

If a charge particle moves in a straight line through some region of space, can you say that the magnetic field in the region is zero?

 # Ans # No, we can not say that the magnetic field in a certain region of space is zero because a charge particle can move in a straight line inside a magnetic field without experiencing any magnetic force if

(1) it is thrown parallel to the magnetic field i.e $\vec{V} \parallel \vec{B}$ or $\theta = 0$

$$\because F_m = q(\vec{v} \times \vec{B}) = qVB\sin 0 = 0$$

(2) it is thrown antiparallel to the magnetic field i.e $\theta = 180°$

$$\therefore F = qVB\sin 180 = 0$$

Hence in the absence of magnetic force it will not be deflected and follows a rectilinear path.

Q # 14.9 Why does a picture on a TV screen become distorted when a magnet is brought near the screen?

 # Ans # As we know that when charges are moving in a certain region, a magnetic field is existed around the charges due to the flow of current. The electrons emitting from electron gun produces their own magnetic field when they are moving towards the screen of the television. When a magnet is brought very close to the screen, the electrons emitting from the electron gun experience a magnetic force and hence are deflected. Due to their change of path by the magnet, the picture will be distorted.

Q # 14.10 Is it possible to orient a current loop in a uniform magnetic field such that the loop will not tend to rotate? Explain.

 # Ans # The torque experienced by a current carrying loop is given as.

$$\tau = BINA \cos\alpha$$

where α is the angle b/w plane of the coil and magnetic field $\vec{B}$. If $\alpha = 90°$ i.e. the plane of coil is held at right angle to the magnetic field B then

$$\tau = BINA \cos 90 = 0 \quad (\because \cos 90 = 0)$$

Hence the coil will not rotate if the plane of the coil is right angle to the magnetic field $\vec{B}$

Q # 14.11

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

 # Ans # If the current loop experiences a torque in a given region of space, then it will be a clear indication of existance of magnetic field in that particular region because when a current is passed through the loop it behaves like a magnet. As a result a strong field is produced inside the loop.

Q # 14.12

How can you use a magnetic field to separate isotopes of chemical elements?

 # Ans # Since we know that the radius of a charge particle inside a magnetic field is given as $r = \frac{mv}{qB}$

it shows that the radius of the path is directly proportional to the mass of the charge particle. As isotopes of an elements are of same charge but different masses, Hence they will follow circular paths of different radii when they are projected from the same point at right angle to the magnetic field $\vec{B}$ So they can be distinguished easily due to their different masses.

Q # 14.13 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 # The torque acting on a current carrying coil is given as

$$\tau = BINA \cos\alpha$$

(a) If $\alpha = 0$ the torque is maximum and is equal to $\tau_{max} = BINA$ which is possible only when the plane of the coil is parallel to the magnetic field.

(b) If $\alpha = 90^\circ$ i.e. the plane of the coil is at right angle to $\vec{B}$ then it will experience no torque

$$\tau_{min} = BINA \cos 90^\circ$$
$$= BINA \times 0$$
$$\tau_{min} = 0$$

Q # 14.14

A loop of wire is suspended b/w 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?

 # Ans # When a unidirectional current or DC current is passed through a loop of wire, The two sides of the loop at right angle to the magnetic field $\vec{B}$ experience equal and opposite magnetic forces that produce a couple either in clockwise direction or counter clockwise direction as a result of which the coil is deflected.

When an alternating current or AC current is passed through the coil, it also tends to deflect the coil along a certain direction. As this current reverses its direction after each half cycle, hence the deflection of the coil is also reversed and the coil starts oscillating b/w the pole peices of the magnet.

Q # 14.15 Show that the sensitivity and stability of a suspended moving coil galvanometer is exclusive of one another i.e. a sensitive galvanometer can not be stable nor can a stable galvanometer be sensitive

 # ANS # The sensitivity and stability of a galvanometer are two independent factors different from each other. A sensitive galvanometer is one which produces a very large deflection even for a very small current. But a galvanometer is said to be stable if its pointer quickly comes to rest when current is passed through it or current is stopped through it. Usually, the pointer of a sensitive galvanometer does not come to rest quickly but vibrates about its equilibrium position for some time before coming to rest. Thus a sensitive galvanometer cannot be stable.

Q #14.6 Why the resistance of an ammeter should be very low?

 # Ans # As we already know that an ammeter is a low resistance galvanometer and is always connected in series inside the electrical circuit where the current is to be measured. If the resistance of the galvanometer is large then it will cause an increase in the resistance of the circuit that reduces the value of current inside the circuit. Due to this reason it is not possible to measure the actual current through any component of the circuit. Hence the resistance of the ammeter should be low so that it doesn't disturb the circuit.

Q #14.7 Why the voltmeter should have a high resistance?

 # Ans # Voltmeter is a high resistance galvanometer and is always connected in parallel with the two points across which the potential difference is to be measured. If the resistance of the galvanometer is small then it will also draw some current from the circuit and some voltage drop occurs across its terminals that alters the actual potential difference to be measured. Hence before connecting a voltmeter, it should be assured that its resistance should be high as compared to the circuit resistance.