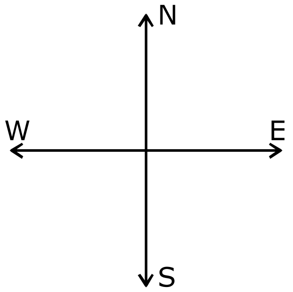
OBJECTIVE - I

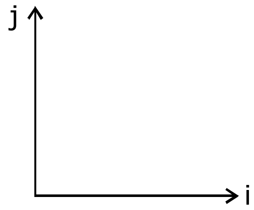
1. A positively charged particle projected towards east os deflected towards north by a magnetic field. The field may be -

(A) towards west (B) towards south (C) upward (D*) downward

Sol. **A**

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





$j = q\left(\hat{i} \times \vec{B}\right) \quad \Rightarrow B \otimes$

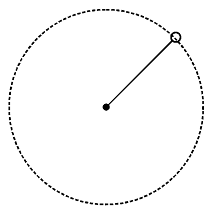
$\Rightarrow$ The magnetic field may be down ward direction.

2. A charged particle is whirled in a horizontal circle on a frictionless table by attaching it to a string fixed at one point. If a magnetic field is switched on in the vertical direction, the tension in the string.

(A) will increase (B) will decrease (C) will remain the same

(D*) may increase or decrease

Sol. **D**



$B=B_0 j$

The tension is the strong may increases or decreases.

3. Which of the following particles will describe the smallest circle when projected with the same velocity perpendicular to a magnetic field ?

(A) electron (B) proton (C) He^+ (D*) Li^+

Sol. **D**

$|F| = |qVB|$

charge of Li^{++} > charge of (He^+, proton, electron)

4. Which of the following particles will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field ?

(A*) electron (B) proton (C) He^+ (D) Li^+

Sol. **A**

$$F = qVB = \frac{mv^2}{r}$$

$$r = \frac{mV}{qB}$$

charge electron = charge of proton = charge of He^+ = charge of Li^+ But mass of electron is

Lowest.

$\therefore$ (the electron so smallest + circle made by)

5. Which of the following particles will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field ?

(A) electron (B) proton (C) He^+ (D*) Li^+

Sol. D

$$T = \frac{2\pi r}{v \perp} \quad ....(i)$$

$$r = \frac{mv_1}{qB}$$

$$\frac{r}{v \perp} = \frac{m}{qB} \quad ....(ii)$$

from eq. (i) & (ii) we get

$$T = \frac{2\pi m}{qB}$$

$$f = \frac{1}{T} = \frac{qB}{2\pi m}$$

Charge of all these particles are same but mass of Li^+ is Highest.

$\therefore$ mass$\uparrow$, f$\downarrow$

6. A circular loop of area 1 cm^2, carrying a current of 10 A, is placed in a magnetic field of 0.1 T perpendicular to the plane of the loop. The torque on the loop due to the magnetic field is

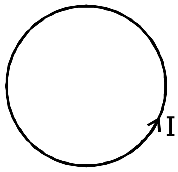
(A*) zero (B) 10^{-4} N-m (C) 10^2 N-m (D) 1 N-m

Sol. A

$B = 0.1\,T$

Area = 1 cm^2

Net torque on the loop due to the uniform magnetic field is always zero.



7. A beam consisting of protons and electrons moving at the same speed goes through a thin region in which there is a magnetic field perpandicular to the beam. The protons and the electrons

(A) will go undeviated

(B) will be deviated by the same angle will not separate

(C*) will be deviated by different angles and hence separate

(D) will be deviated by the same angle but will separate.

Sol. C

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

Charge proton is poritive = e

$F_p = evB$

Charge of electron is negative = -e

$F_e = -evB$

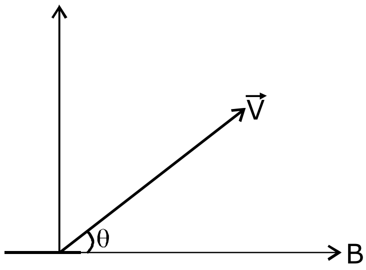
They will be deviated by different angles and Hence separate.

8. A charged particle moves in a uniform magnetic field. The velocity of the particle at some instant makes an acute angle with the magnetic field. The path of the particle will be.

(A) a straight line (B) a circle

(C*) a helix with uniform pitch (D) a helix with nonuniform pitch.

Sol. C



$\vec{F} = q\left(\vec{V} \times \vec{B}\right) = qvB\sin\theta \quad \otimes$

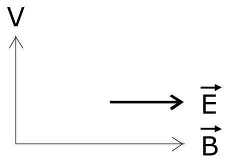
Megnetic force doesn't change the speed of the particle. It change the direction of the velocity of the particle.
Vcosθ provide the displacement of the particle in Horizontal direction & force is provide the centripetal acceleration of the particle.
So the path of the particle will be ahelix with uniform pitch.

9. A particle moves in a region having a uniform magnetic field and a parallel, uniform electric field. At some instant, the velocity of the particle is perpendiculars to the field direction. The path of the particle will be

(A) a straight line
(B) a circle
(C) a helix with uniform pitch
(D*) a helix with nonuniform pitch.

Sol. **D**

$F = q\vec{E} + q\left(\vec{V} + \vec{B}\right)$



$F = q\vec{E}$ provides the acceleration in 'x' direction.

$F_2 = q\left(\vec{V} \times \vec{B}\right) \quad \otimes$ provides the centripetal Force.

The path of the particle will be ahelix with nonuniform pitch.

10. An electric current i enters and leaves a uniform circular wire of radius a through diametrically opposite points. A charged particle q moving along the axis of the circular wire passes through its centre at speed υ. The magnetic force acting on the particle when it passes through the centre has a magnitude

(A) $q\nu\frac{\mu_0 i}{2a}$
(B) $q\nu\frac{\mu_0 i}{2\pi a}$
(C) $q\nu\frac{\mu_0 i}{a}$
(D*) zero

Sol. **D**
Zero

OBJECTIVE - II

1. If a charged particle at rest experieces no electromagnetic force,

(A*) the electric field must be zero (B) the magnetic field must be zero

(C) the electric field may or may not be zero (D*) the magnetic field may or may not be zero

Sol. **AD**

⇒ The electric field must be zero.

⇒ The Magnetic field may or may not be zero.

2. If a charged particle kept at list expreiences an electromagnetic force,

(A*) the electric field must not be zero (B) the magnetic field must not be zero

(C) the electric field may or may not be zero (D*) the magnetic field may no may not be zero

Sol. **AD**

⇒ The electric field must not be zero.

⇒ The Magnetic field may or may not be zero.

3. If a charged particle projected in a gravity-free room deflects,

(A) there must be an electric field (B) there must be a magnetic field

(C*) both field cannot be zero (D*) both fields can be nonzero

D

4. A charged particle moves in a gravity-free space without change in veloicty. Which of the following is/are possible ?

(A*) $E = 0, B = 0$ (B*) $E = 0, B \neq 0$ (C) $E \neq 0, B = 0$ (D*) $E \neq 0, B \neq 0$

Sol. **ABD**

⇒ Particle move with constant velocity in ay direction.

So $B = 0$, $E = 0$

⇒ Particle move in a circle with constant speed.

Magnetic force is provide the centripetal force that causes particle is move in a circle.

⇒ If $qE = qvB$ and Magnetic & Electric force in opposite direction in this case particle also move with uniform speed.

5. A charged particle moves alonh a circle under the action of possible constant electric and magnetic fields. Which of the following are possible ?

,

(A) $E = 0, B = 0$ (B*) $E = 0, B \neq 0$ (C) $E \neq 0, B = 0$ (D) $E \neq 0, B \neq 0$

Sol. **B**

A charged particle moves along a circle that mean Magnetic force is provides centripetal force that causes particle is move in a circle.

So, $E = 0, B \neq 0$

6. A charged particle goes undelflected in a region containing electric and magnetic field. It is possible that

(A*) $\vec{E} \,||\, \vec{B}$, $\vec{\upsilon} \,||\, \vec{E}$ (B*) $\vec{E}$ is not parallel to $\vec{B}$

(C) $\vec{\upsilon} \,||\, \vec{B}$ but $\vec{E}$ is not parallel to $\vec{B}$ (D) $\vec{E} \,||\, \vec{B}$ but $\vec{\upsilon}$ is not parallel to $\vec{E}$

Sol. **AB**

⇒ $\vec{V}$ □ $\vec{E}$, $\vec{B}$ □ $\vec{E}$

In this case Magnetic force on the particle is zero & $\vec{V}$ is paralle to $\vec{E}$. So charged particle goes undeflected in a region.

$\vec{E}$ is not parallel to $\vec{B}$, But $\vec{V}$ is parallel to $\vec{E}$.

7. If a charged particle goes unacceleration in a region containing electric and magnetic fields,

(A*) $\vec{E}$ must be perpeandicular to $\vec{B}$ (B*) $\vec{\upsilon}$ must be perpendicular to $\vec{E}$

(C) $\vec{\upsilon}$ must be perpendicular to $\vec{B}$ (D) E must be equla to υB.

Sol. **AB**

$\Rightarrow \quad E \perp \vec{B} \quad \& \quad \vec{V} \perp \vec{E}$

8. Two ions have equla masses but one is singly-ionized and other is douly-ionized. The are project from the same place in a uniform magnetic field with the same veloicty perpendicular to the field.
(A) Both ions will go along circles of equal radii.
(B*) The circle described by the single-ionized charge will have a radius double that of the other circle
(C) The two circles do not touch each other
(D*) The two circles touch each other

Sol. **BD**

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

If charge of singly ionized = e
Then charge of doubly ionized = ze
The circle described by the singly - ionized charge will have a radius double that of the other circle.
The two circle touch each other because brojected from the same place.

9. An electron is moving along the positive X-axis. You want to apply a magnetic field for a short time so that the electron may reverse its direction and move parallel to the negative X-axis. This can be done by applying the magentic field along.
(A*) Y-axis (B*) Z-axis (C) Y-axis only (D) Z-axis only

Sol. **AB**

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

This can be done by applying the Magnetic field along y axis or z axis.

10. Let $\vec{E}$ and $\vec{B}$ denote electric and magnetic fields in a frames S and $\vec{E}$ ' and $\vec{B}$ ' in another frame S' moving with respect to S at a velocity $\vec{\upsilon}$. Two of the following equations are wrong. Identify them.

(A) $B_y^1 + B_y + \frac{\upsilon E_2}{c^2}$ (B*) $E_y^1 + E_y + \frac{\upsilon B_2}{c^2}$ (C*) $B_y^1 + B_y + \upsilon E_2$ (D) $B_y^1 + B_y + \upsilon B_2$

Sol. **BC**

$qE = qvB$

$\Rightarrow \quad e = vB$ By dimensionally b & c are wrong.

$\Rightarrow \quad vE = v^2B$

$\Rightarrow \quad B = \frac{vE}{v^2}$