08.07.21

Page No.
Date

Home Assignment :

1 If a particle of charge q is moving with velocity v along the x-axis and the magnetic field B is acting along the x-axis, use the expression $\vec{F} = q(\vec{v} \times \vec{B})$ to find the direction of the force F acting on it. A beam of proton passes undeflected with a horizontal velocity v, through a region of electric and magnetic fields, mutually perpendicular to each other and normal to the direction of the beam. If the magnitudes of the electric and magnetic fields are 100 KV/M and 50MT respectively, calculate

a) velocity v of the beam,
b) the force with which it strikes a target on a screen if the proton beam cutting is equal to 0.80 MA.

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

given, $\vec{v} = v\hat{k}$, $\vec{B} = B\hat{i}$

$\vec{F} = q(v\hat{k}) \times (B\hat{i}) = qvB\hat{j}$

That is, force is acting along y axis

a For a beam of charged particles to pass undeflected crossed electric and magnetic fields, the condition is that electric and magnetic forces on the beam must be equal and opposite, i.e.,

$eE = evB$

$\Rightarrow v = \frac{E}{B}$

Given, $E = 100\ kV/m = 100 \times 10^3\ V/m$, $B = 50\ mT = 100 \times 10^{-3}$

$v = \frac{100 \times 10^3}{50 \times 10^{-3}}$

$= 2 \times 10^6\ m/s$

b $F = \frac{\Delta p}{\Delta t} = \frac{mv}{\Delta t} = \frac{mv}{q/I} = \frac{mvI}{q}$

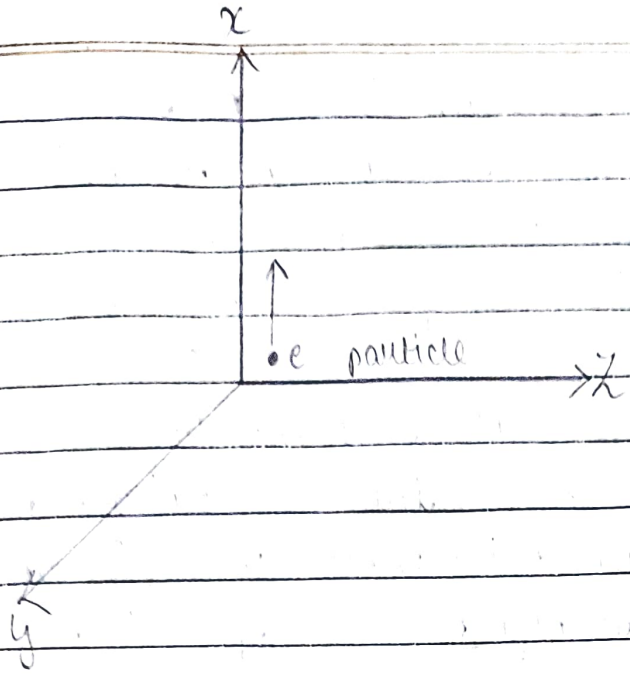
$= \frac{1.67 \times 10^{-27} \times 2 \times 10^6 \times 0.8 \times 10^{-3}}{1.6 \times 10^{-19}}$

$= \frac{2.672 \times 10^{-24}}{1.6 \times 10^{-19}}$

$= 1.67 \times 10^{-5}\ N$

2 A beam of α-particles projected along $+X$ axis, experiences a force due to a magnetic field along the $+Y$ axis. What is the direction of the magnetic field?

A- By Fleming's Left Hand rule, the direction of magnetic field is along $-Z$ axis.



3 Define one tesla using the expression the magnetice force acting on a particle charge q moving with velocity v in a magnetic field B.

A- One tesla is the magnetic field in which a charge of 1C moving with a velocity of 1M/s normal to the magnetic field experiences a force of 1N.

$$B = \frac{F}{qv\sin\theta}$$

If $= 1N$, $q = 1C$, $V = 1M/s$, $\theta = 90°$

then, $B = \frac{1N}{1C.1M/s \cdot \sin 90°} = 1NA^{-1}m^{-1} = 1\ tesla$

4 A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in a circular path with higher frequency?

A- Mass of electron is low as compared to proton. Hence, when both enter into the uniform magnetic region, the electron will move in a circular path with higher frequency on the opposite direction to the current.

5 Two protons of equal kinetic energies enter a region of uniform magnetic field. The first proton enters normal to the field direction while the second enters at 30° to the field direction. Name the trajectories followed by them.

A When a proton enters normal to the field direction, the trajectory is circular.

When a proton enters at 30° to the field direction, the trajectory is helical.