HOME ASSIGNMENT

1. If a particle of charge q is moving with velocity v along the z-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 unelected 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 50 mT 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.

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?

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

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?

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.

10/6/21

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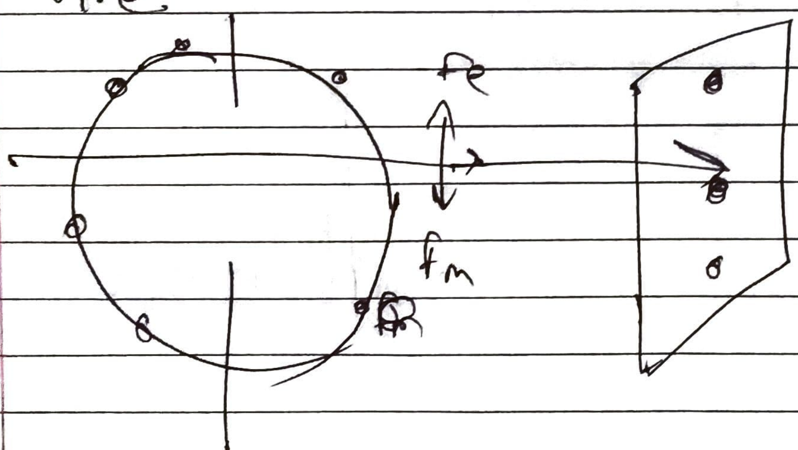
1.) $\vec{F} = q\vec{v} \times \vec{B}$

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 acting along y-axis.

a) for a beam of charged particle to pass underflected cross electric & magnetic field, the condition is that electric & magnetic forces on the beam must be equal & oppo. i.e.



$eE = evB$

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

Given $E = 100$ kv/m $= 100 \times 10^3$

$B = 50 \times 10^{-3}$ T.

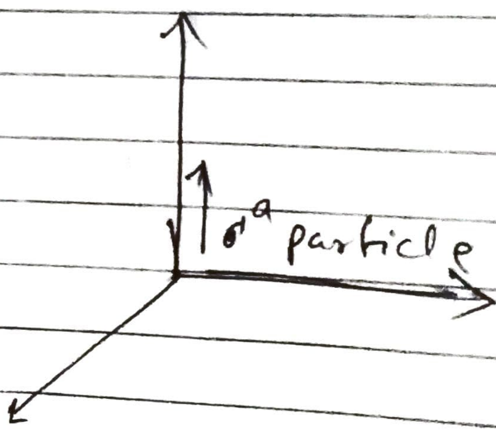
$$v = \frac{100 \times 10^3}{50 \times 10^{-3}} = 2 \times 10^6 \text{ m/s.}$$

5) The beam strikes the target with a constant velocity so force exerted on the target is 0. However if proton beam comes ~~fr~~ forest, it exerts a force on the target equal to rate of charge of linear momentum of the beam i.e.

$$F = \frac{\Delta p}{\Delta t} = \frac{mv}{\Delta t} = \frac{mv}{q/i} = \frac{mvi}{q} = \frac{mvi}{ne}.$$

where n, is the no. of protons striking the target/second.

2) By fleming's left hand rule magnetic field must be along negative z-axis



3) When a charge of 1C, moving with velocity 1m/s, normal to the magnetic field, experiences a force 1N, the magnetic field is said to be one tesla.

4) Electron moveing circular path with a higher frequency

$\frac{mv^2}{r} = qvB$, $r = \frac{mv}{qB}$.

$\omega = \frac{v}{r} = \frac{qB}{m}$.

$\omega = 2\pi f \Rightarrow \frac{qB}{m} = 2\pi f \Rightarrow f \propto \frac{1}{m}$.

Since $m_e < m_p$ $\therefore$ $f_e > f_p$

Thus electron move in circular path with higher frequency.

5) When an electron enters normal to the field direction the trajectory is circular.
When an electron enters 30° to the field direction the tragectory is helical