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.

ODM PUBLIC SCHOOL

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physics

1.) Given

$v \rightarrow$ along x-axis $\cdot \vec{v} = v\hat{i}$

$B \rightarrow$ along y-axis $\cdot \vec{B} = B\hat{j}$

$\vec{F} = q\vec{v} \times \vec{B}$

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

$\vec{F} = qvB\hat{k}$

$\therefore$ The force is acting along the z-axis.

→ Condition: electric & magnetic forces on the beam must be equal and oppt. So that the charged particle is pass undeflected through crossed electric and magntic field. i.e.

$$eE = evB$$

(a) -) $$v = \frac{E}{B} = \frac{2}{50 \times 10^{-3}} = 2 \times 10^{-6}$$

(b)) $$F = \frac{\Delta p}{\Delta t} = \frac{mv}{\frac{q}{i}} = \frac{mvi}{q}$$

$$= \frac{1.67 \times 10^{-27} \times 2 \times 10^{-6} \times 0.80 \times 10^{-3}}{1.6 \times 10^{-19}}$$

$$= 1.675 \times 10^{-5}\ N$$

(2.) Given that:-

α-particle $\longrightarrow$ (+ve charge) $\longrightarrow$ moving along $+x$-axis.

force experienced due to magnetic field is in the $+y$-axis

$\vec{V} \times \vec{B} = \vec{F}$ (force is vector product)

magnetic field should be in the direction of z-axis as per also right-hand screw rule for cross product vectors.

(3.) "One tesla is that magnetic field in which a charge of 1 C moving with a velocity of 1 ms^{-1} at right angle to the field experience a force of one newton."

(4.) Mass of electron is low as compared to proton.
Hence when bothe enters into the uniform magnetic field region, the electron will move in a circular path with higher frequency on the opposite direction to current.

(5.) (•) when an electron enters normal to the field direction the trajectory is circular.

(•) When the electron enters 30° to the field direction the trajectory is helical.