HOME ASSIGNMENT - 4

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.

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

$$eE = evB$$

$$\Rightarrow V = \frac{E}{B}.$$

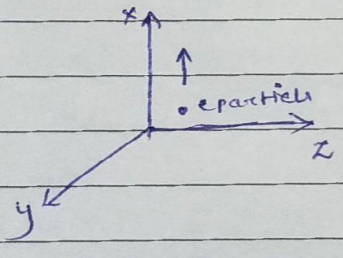
$$\therefore V = \frac{50 \times 10^3}{50 \times 10^{-3}} = 1 \times 10^6 \text{ m/s}.$$

ii) The beam strikes the target with a constant velocity, so force exerted on the target is zero. However, if proton beam comes to rest, it exerts a force on the target equal to rate of change of linear momentum of the beam.

$$F = \frac{\Delta P}{\Delta t} = \frac{mV}{\Delta t} = \frac{mV}{q/i} = \frac{mvi}{q} = \frac{mvi}{ne}.$$

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

2.



From the graph it can be concluded that by Fleming's left hand rule, Magnetic field must be along negative z-axis.

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

1 N

$$B = \frac{E}{qV \sin\theta}$$

If $F = 1N$, $q = 1C$, $V = 1 M/s$, $\theta = 90^\circ$

then SI unit of $B = \frac{1N}{1C \cdot 1m/s \cdot \sin 90^\circ}$

$= 1 NA^{-1}/M = 1$ tesla.

4. Mass of electrons 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. The first proton will be follow circular path. and the second proton entering at an angle of 30° will follow helical path.