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CLASS:- XII (Sc) DB

SCHOOL NO:- 9882

HOME ASSIGNMENT (Force on moving charge in uniform magnetic and electric field).

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

Given $\vec{v} = v\hat{i}$, $\vec{B} = B\hat{j}$

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

That is force is acting along z axis.

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

$eE = evB$.

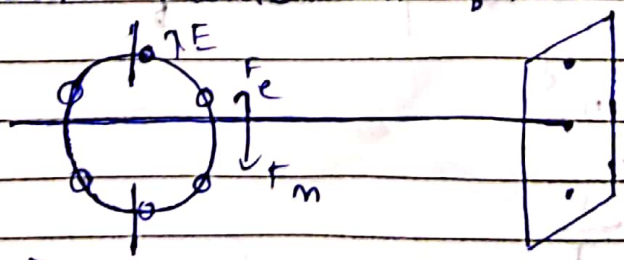
$v = \frac{E}{B}$.

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

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

$v = 5 \times 10^5\ ms^{-1}$.

ii) The beam strikes the target with a constant velocity, so forced 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.



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

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2) Since the force is vector product and it is given by

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

Magnetic field should be in the direction of -z-axis as shown in figure using axis of cartesian coordinate system and also by Right Hand Screw rule for cross product of vectors

3) One Tesla is the magnetic field in which a charge of 1 coulomb moving with a velocity of 1 m/s normal to the magnetic field experience a force of 1 Newton.

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

If $F = 1N$, $q = 1C$, $v = 1 m/s$, $\theta = 90°$

Then SI unit of $B = \frac{1N}{1C \cdot 1 m/s \times \sin 90°}$

$= 1 NA^{-1} m^{-1} = 1$ Tesla

4) When a charge particle enter a region of uniform magnetic field, perpendicular to their paths, they move in circular path

And the time period of their motion is given by

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

But $f = \frac{1}{T}$

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

Since B and q are same for proton and electron

So $f \propto \frac{1}{m}$

Since mass of electron is smaller than that of proton, hence it will have higher frequency.

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