12-7-24

Homework - moving charges and magnetism

1 V = potential difference angle between motion B => 90°

$\frac{mv^2}{r} = qvB$

$\frac{1}{2}mv^2 = qV \quad (P.D)$

$R = \frac{mv}{qB}$

$\frac{1}{2}mv^2 = q(2V)$

$R_2 = \left(\frac{m}{qB}\right) v_2$

$\frac{v_1}{v_2} = \frac{1}{\sqrt{2}}$

$R_2 = \left(\frac{m}{qB}\right) v\sqrt{2}$

$v_2 = v_1\sqrt{2}$

$\frac{R_1}{R_2} = \frac{1}{\sqrt{2}}$

2 Mass of deutron = 2m (1 proton + 1 neutron)

Mass of proton = 1 m

$\therefore R\ (\text{proton}) = \frac{mv}{qB}$

$R\ (\text{deutron}) = \frac{2m \times v}{qB}$

$\text{Ratio}\ \left(\frac{\text{Proton}}{\text{deutron}}\right) = \frac{1}{2}$

∴ This particle will not accelerate with same cyclotron frequency. The frequency of proton is twice than the frequency of alpha particle.

∴ Velocity $v = \frac{Bqr}{m} \Rightarrow v \propto \frac{q}{m}$

for proton: velocity, $v_p \propto \frac{q}{m}$

for Alpha : Velocity, $v_\alpha \propto \frac{2q}{4m}$

This particle will not exit the elees with same velocity.

5 We know that a charged particle will experience a force when it enters a magnetic field. The field will move the charged particle in a circular path as the force is perpendicular to the velocity of particle

$$\frac{mv^2}{r} = BqV$$

$$r = \frac{mv}{Bq}$$

As B and v are constant

$$r \propto \frac{m}{q}$$

The neutron will move along the straight line as it has no charge

So the alpha particle will move in the clockwise direction and the electron will move in anticlockwise direction according to right hand rule.