12th July

Moving charges & Magnetism

1. $\frac{mv^2}{r} = Bq_p v$

$r = \frac{mv}{q_p B}$

$\frac{1}{2} m_p v^2 = q_p V$

$v = \sqrt{\frac{2q_p V}{m_p}}$

Potential difference is doubled

$V' = 2V$

$v = \sqrt{\frac{2q_p \times 2V}{m_p}}$

$v' = \sqrt{2}v$

Radius will be

$q_p vB = \frac{m_p v}{r}$

$r = \frac{m_p v}{q_p vB}$

$r' = \frac{m_p \times \sqrt{2} v}{q v B}$

$r' = \sqrt{2} R$

2.

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2. $r = \frac{mv}{qB}$

Mass of deutron $= 2m$
Mass of proton $= m$

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

R (deutron) $= \frac{2mv}{qB}$

Ratio $= \frac{1}{2}$

3. Cyclotron :- Cyclotron is a device by which the positively charged particles like protons deutrons etc can be accelerated.

Principle :- Cyclotron works on principle that a positively charged particle can be accelerated by making it to cross the same Electric field repeatedly with help of a magnetic field

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

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

$$T = \frac{2\pi r}{v} = \frac{2\pi}{v} \cdot \frac{mv}{qB}$$

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

$$F = \frac{1}{T} = \frac{qB}{2\pi m}$$

From above Equation we can see that frequency F is independent of both V and r is called cyclotron frequency.

4. Mass of proton = m
Charge of proton = q
Mass of alpha particle = 4m
Charge of alpha particle = 2q
Cyclotron frequency

$$\nu = \frac{qB}{2\pi m} \qquad \nu \propto \frac{q}{m}$$

For proton $\nu_p \propto \frac{q}{m}$

For alpha particle $\nu_a \propto \frac{2q}{4m}$

or $\nu_a \propto \frac{q}{2m}$

They will not accelerate with same cyclotron frequency ie frequency of proton is twice than the frequency of alpha particle.

ii) Velocity $v = \frac{Bqr}{m}$ $\quad v \propto \frac{q}{m}$

For proton $v_p \propto \frac{q}{m}$

For alpha particle: $V_\alpha \propto \frac{2q}{4m}$

$V_\alpha \propto \frac{q}{2m}$

Thus particles will not move with same velocity. The velocity of proton is twice than velocity of alpha particle

5. A charged particle experience a force when it enters magnetic field. Due to presence of magnetic field, the charged particle will move in a circular path. This is because force is perpendicular to the velocity of charged particle.

$$\frac{mV^2}{r} = qVB$$

$$r = \frac{mV}{qB}$$

B and V are constant

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

Since the neutron has no charge it will move along a straight line

The Electron will follow a circular path which has a radius smaller than that of alpha particle This is because mass to charge ratio of alpha particle is more than that of Electron

Therefore, the Electron will move in the clockwise direction and the electron will move in anticlockwise, as per Right hand rule