Saathi

Date ___/___/_____

(1) We know centripetal force = magnetic force

$\Rightarrow \frac{mv^2}{r} = q(vB\sin\theta)$

$\Rightarrow \frac{mv^2}{r} = qvB\sin 90 \Rightarrow \frac{mv^2}{r} = qvB$ $(\because v \perp B)$

$\Rightarrow r = \frac{mv}{qB}$ —(i)

Also KE of e^+ = P.E of e^+

$\Rightarrow \frac{1}{2}mv^2 = qV \Rightarrow mv = \sqrt{2qVm}$ —(ii)

From (i) & (ii)

$\Rightarrow r = \frac{\sqrt{2qVm}}{qB} \Rightarrow r = \frac{1}{B}\sqrt{\frac{2mV}{q}}$

$\Rightarrow r \propto \sqrt{V}$

when P.D is 2V ; radius is r'

$\Rightarrow \frac{r'}{r} = \frac{\sqrt{2V}}{\sqrt{V}} \Rightarrow \frac{r'}{r} = \sqrt{2} \Rightarrow r' = \sqrt{2}r$

(2) mass of deutron = 2m ($1e^+ + 1e^-$)

mass of proton = m

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

$r_d = \frac{2mV}{qB}$

$\frac{r_p}{r_d} = \frac{mV}{qB} \times \frac{qB}{2mV} = \frac{1}{2} = 1:2$

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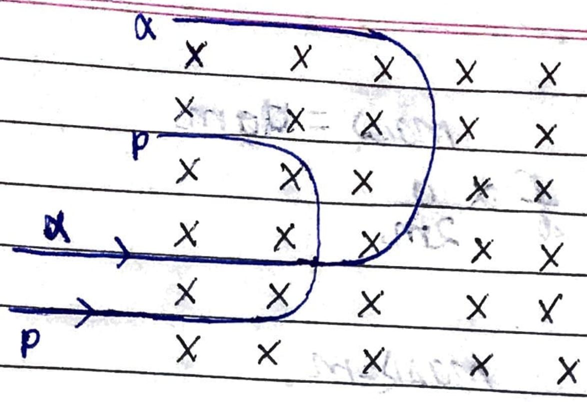


(3) Principle :- Cyclotron works on principle that a +vely charged particle can be accelerated by making it to cross the same electric field repeatedly with the help of magnetic field.

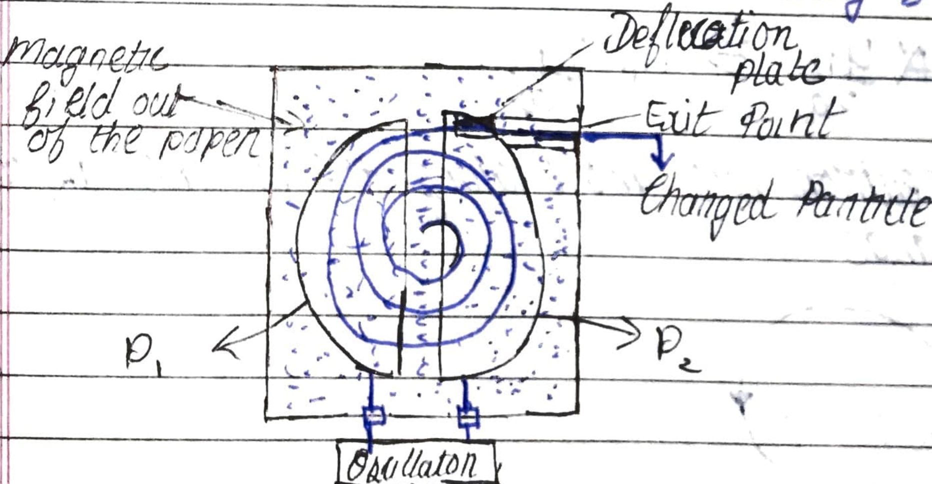
magnetic force = centripetal force

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

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

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

$$\Rightarrow F = \frac{1}{T} = \frac{2\pi m}{qB}$$ (Frequency is independent of velocity)



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(4)(i) α-particle

Charge = 2q mass = 4m

$f = \frac{2qB}{4\pi m} \Rightarrow f \propto \frac{q}{2m}$

proton

Charge = q mass = m

$f' = \frac{Bq}{2\pi m} \Rightarrow f' \propto \frac{q}{m}$

Thus the particle will not accelerate with same cylotron freq. The freq of proton is twice than freq of alpha particle

(ii) $v = \frac{Bqr}{m} \Rightarrow v \propto \frac{q}{m}$

$\frac{v_\alpha}{v_p} = \frac{2q}{4m} \times \frac{m}{q} \Rightarrow \frac{v_\alpha}{v_p} = \frac{1}{2} \Rightarrow v_\alpha = \frac{v_p}{2}$

v_p will have higher velocity.

(5) $\frac{mv^2}{r} = qvB \Rightarrow r = \frac{mv}{qB} \Rightarrow r \propto \frac{m}{q}$

$\therefore r_\alpha \propto \frac{4m}{2q} \Rightarrow r_\alpha \propto \frac{2m}{q}$

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