9.7/21 Home - Assignment

Cyclotron

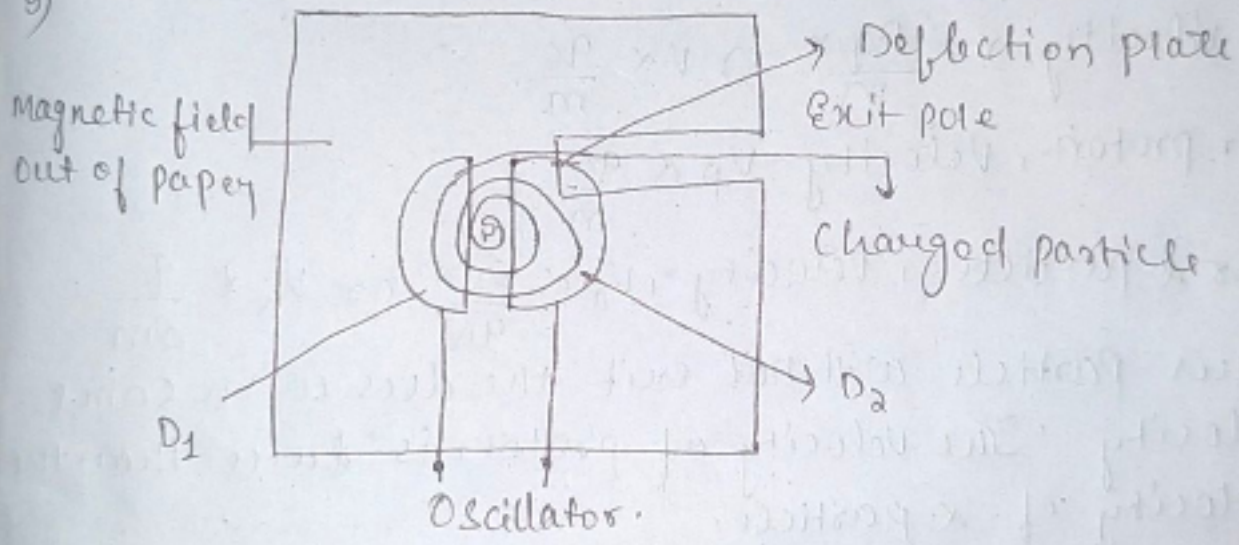
1) A proton is accelarated through a potential difference V, the direction of magnetic field is normal to the velocity of proton is convaited into kinetic energy.

2) Mass of deutron = 2m (1 proton + 1 neutron)
mass of proton = m
$\therefore$ R (Proton) = $\frac{mv}{qV}$

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

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

3)



Working pinciple of cyclotron:-

The cyclotron uses crossed electric and magnetic fields which increase the kinetic energy of a charged particle without changing its frequency of revolution.

4. (i) Let us consider = mass of proton = m, charge of proton = q, mass of α particle = 4m
charged of alpha particle = 2q

Cyclotron frequency

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

For proton: Frequency, $\nu_p \propto \frac{q}{m}$

For alpha particle: Frequency

$$\nu_\alpha \propto \frac{2q}{4m} \quad \text{or} \quad \nu_\alpha \propto \frac{q}{2m}$$

Thus, particle will not accelerate with same cyclotron frequency. The frequency of proton is twice than the frequency of α particle.

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

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

For α particle, velocity, $v_\alpha \propto \frac{2q}{4m}$ or $v_\alpha \propto \frac{q}{2m}$

Thus particle will not exit the dees with same velocity. The velocity of proton is twice than the velocity of α particle.

5. a) particle will trace circular path in clockwise direction as it's deviation will be in the direction $(\vec{v} \times \vec{B})$ ie perpendicular to the velocity of particle, neutron will pass without any deviation as magnetic field does not exert neutral particle.

Electron will trace circular path in anticlockwise direction as its deviation will be in the direction

opp. to $(\vec{v} \times \vec{B})$ with a smaller radius due to large charge / mass ratio, $r = mv/qB$.