Q7

(1) The radius of the circular path by the proton in the magnetic field change can described as,

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

where, magnetic field - B
potential difference - V

Therefore $r \propto \sqrt{V}$

Let r be the radius when the potential difference is V and r' be the radius when the potential difference is $2V$

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

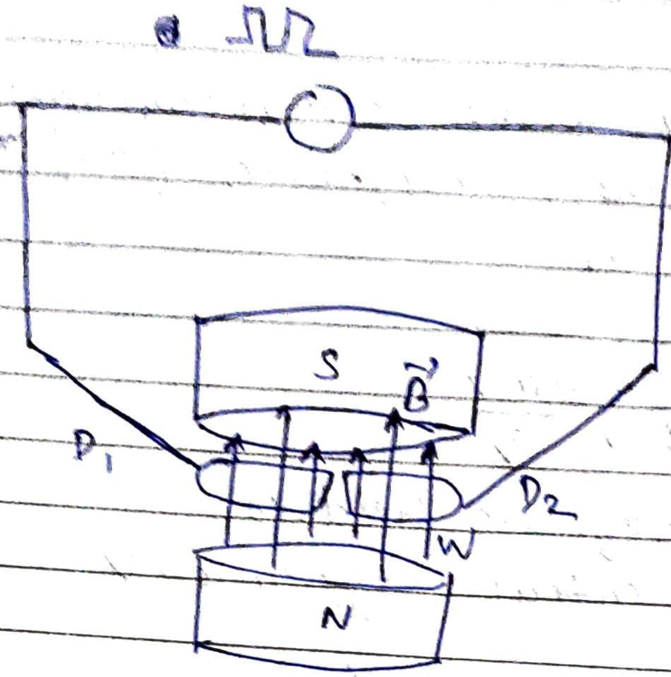
(2) Mass of deutron = 2m (1 proton + 1 neutron)
mass of proton = 1m (1 proton)

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

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

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

(5) (7)



Working: ~~Imaging~~

A cyclotron accelerates a charged particle beam using a high frequency alternating voltage which is applied between two hollow 'D'-shapped ~~material elec~~ sheet metal electrodes inside a vacuume chamber. An alternatinging voltege of several thousend volts are applied between the dees

Cyclotron freqneency is indepent of the velocity of charged particle. Consider a particle of charge q revolving in the path of radius r with a velocity v. Centripetal force = lorentz forece due to magnetic field B. Therefore, freqnency is independent of velocity.

(4) (i) Let us consider : mass of proton m
Charge of proton = q
Mass of alpha particle = 4m
Charge 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

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

$$\Rightarrow \nu_\alpha \propto \frac{q}{2m}$$

Thus, particle will not accelerates with same frequency.

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

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

For alpha particle velocity

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

Thus, particle will not exit the dees with same velocity.