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

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

where b is the magnetic field
v is the potential difference

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

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

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

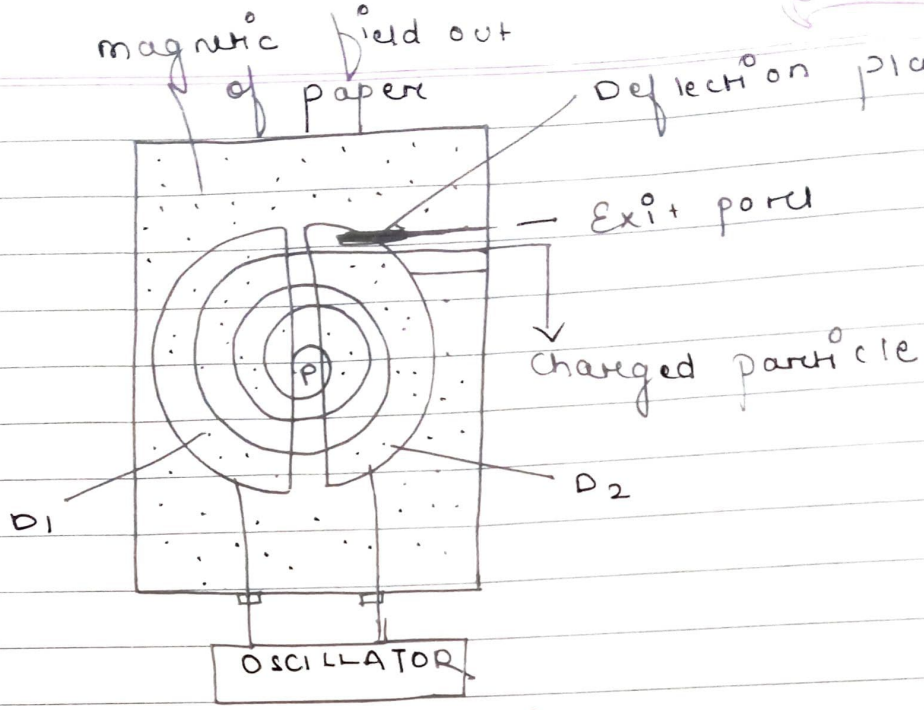
2) Mass of deutron = 2m (1 proton + 1 neutron)
Mass of proton = m (1 proton)

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

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

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

3)



Working principle:- When a charged particle moves with certain velocity in a perpendicular magnetic field, then a Lorentz magnetic force acted on it. The path followed by the charged particle in shape

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

Suppose the positive ion with charge q moves in a direction with a velocity v then

$$qvB = \frac{mv^2}{r} \text{ or } r = \frac{mv}{qB} \quad -(1)$$

The angular velocity w of the ion :

$$w = \frac{v}{r} = \frac{qB}{m} \quad (\text{from } (1))$$

Time taken in describing semi-circle

$$t = \frac{\pi}{w} = \frac{\pi m}{Bq} \quad -(3)$$

$$\frac{T}{2} = t = \frac{\pi m}{qB} \quad -(4)$$

$$\text{OR} \quad T = \frac{2\pi m}{qB} \quad -(5)$$

Clearly the period of revolution is independent of speed / velocity of particle.

4(i) Mass of proton = m
Charge of proton = q.
Mass of alpha particle = 4m
Charge of alpha particle = 2q

Cyclotron frequency,

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

For proton : Frequency, $v_p \propto \frac{q}{m}$.
For alpha particle : Frequency,

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

Thus particles will not accelerate on with same cyclotron 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,

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

Thus particles will not exit the dee with same velocity. The velocity of proton is double.

5) The radius of the circular path can be given by $\frac{mv^2}{r} = Bqv$

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

As B and V are constant, we write

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

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

The electron will inside be a circle smaller than alpha as the small to charge ratio of the alpha particle is more.

So, alpha will move in clockwise and electron in anticlockwise direction.