

Home - Assignment

Cyclotron

1) Given,

A proton is accelerated through a potential difference V the direction of magnetic field is normal to the velocity of proton. is converted into kinetic energy.

$$2) \text{ mass of deuteron} = 2m \quad (1 \text{ proton} + 1 \text{ neutron})$$

$$\text{mass of proton} = m \quad (1 \text{ proton})$$

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

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

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

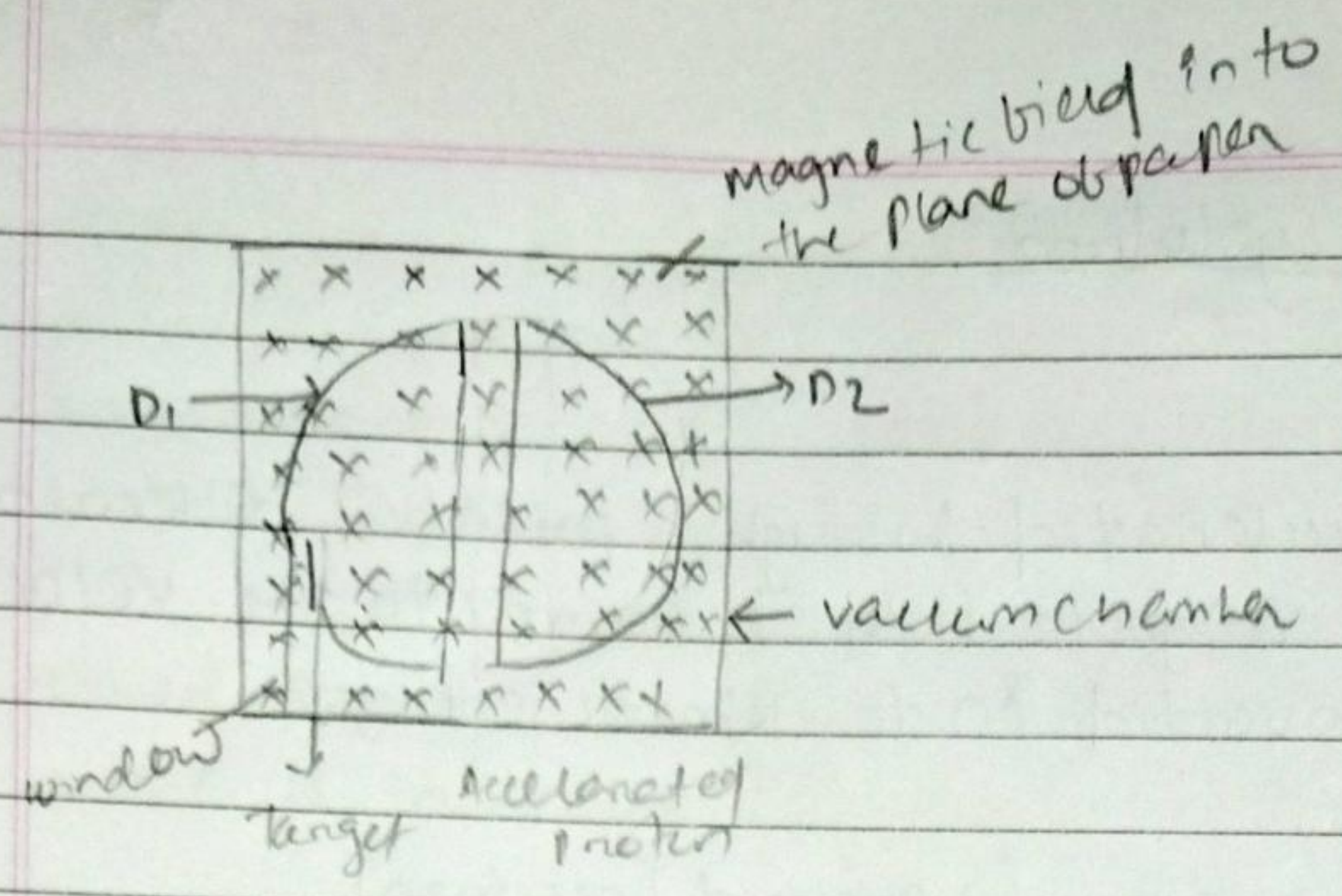
3) Cyclotron: It is a device used to accelerate charged particles like proton, deuteron, α -particles, etc. to very high energies. ~~for~~
Principle: A charged particle can be accelerated to high speeds (energies) by passing it through electric field many no. of times. and at the same time magnetic field ~~is~~ makes the charged particle to move in a circular path.

Magnetic force on charge $q =$ Centripetal force on charge q

$$qvB \sin 90^\circ = \frac{mv^2}{r} \quad \text{or} \quad r = \frac{mv}{qB}$$

Period of revolution of charged particle is given by

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



Hence frequency is independent of both the velocity of particle and the radius of orbit and is called cyclotron frequency or magnetic resonance frequency.

4) Thus the particle will not accelerate with same cyclotron frequency. The frequency of proton is twice than the frequency of alpha particle. Thus particle will not exist the dees with same velocity. The velocity of proton is twice than the velocity of alpha particle.

(5) we know that a charged particle will experience a force when it enters a magnetic field. The magnetic field will move the charged particle in a circular path as the force is perpendicular to velocity of particle. The radius of the circular path will be given by

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

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

As B and v are constant; we can write

$r \propto \frac{m}{q}$ The neutron will move along the straight line as it has no charge.

