

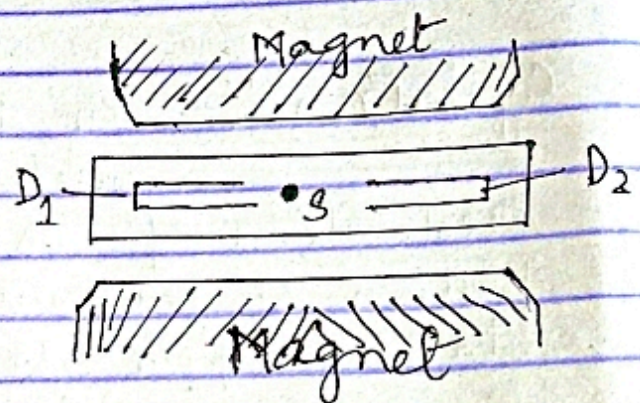
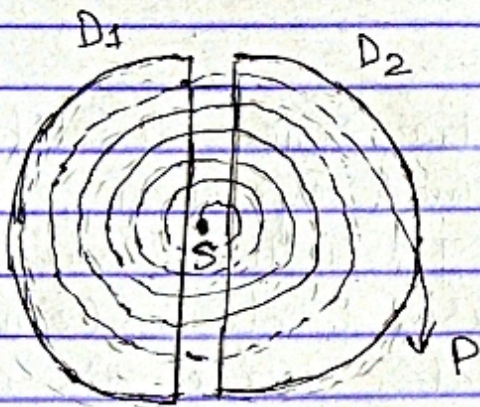
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A-3(H) Paper VI
Cyclotron

Cyclotron: In 1932, Lawrence developed a machine named cyclotron, for the acceleration of charged particles, such as protons or deuterons. These particles (ions), starting from the central source are caused to move in circular orbits by magnetic field and are accelerated by the electric field.

In its simplest form, it consists of two flat semi-circular metal boxes, called dees because of their shape. These hollow chambers have their diametric edges parallel and slightly separated from each other. A radio-frequency alternating potential of the order of megacycles per second is applied between the dees, which act as electrodes. These dees are surrounded by a closed vessel containing gas like hydrogen, helium, ~~de~~ deuterium at very

low pressure. The vessel is placed between the poles of a strong electromagnet which provides a magnetic field perpendicular to the plane of the dees. A filament at the centre of the chamber is heated at the and a small potential difference is



applied between the filament and the metal box to increase the energy of emitted electrons. These electrons ionize some of gas atoms and thus produce positive ions. Another way of producing ions is the use of ion source.

Let us suppose that at any particular instant the alternating potential is in the direction which makes D_1 +ve and D_2 -ve. A positive ion starting from the source S will be attracted by the dee D_2 . Since there is a uniform magnetic field B acting at right angles to the

plane of the dees, the ion of charge q and mass m will move in a circular path of radius r given by the relation

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

$$\text{or } r = \frac{mv}{Bq} \quad \text{--- (1)}$$

In the interior of the dee, the speed of the ion remains constant. After it has traversed half a cycle, the ion comes to the edge of D_2
