

A Level Physics A

H556/02 Exploring physics

Question Set 27

1 Fig. 20 illustrates a device used to determine the relative abundance of charged rubidium ions.

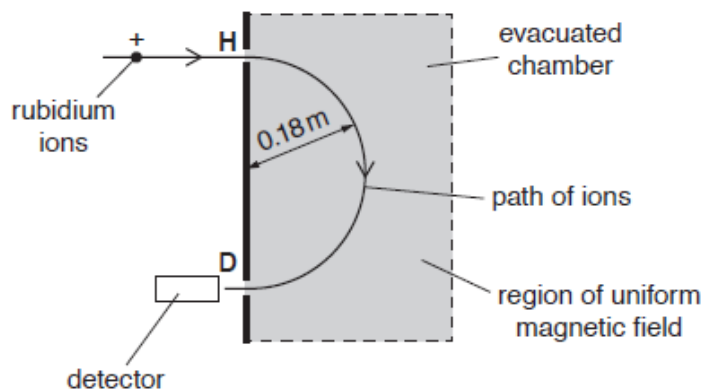


Fig. 20

A uniform magnetic field is applied to an evacuated chamber. The direction of the magnetic field is perpendicular to the plane of the paper.

A beam of positive rubidium ions enters the chamber through a hole at H. The ions travel in a semi-circular path in the magnetic field. The ions are detected at point D.

- (a) Each rubidium ion has charge $+1.6 \times 10^{-19} \text{ C}$ and speed $4.8 \times 10^4 \text{ ms}^{-1}$.
 The radius of the semi-circular path of the ions is 0.18 m.
 The mass of a rubidium ion is $1.4 \times 10^{-25} \text{ kg}$.

Calculate the magnitude of the magnetic flux density B of the magnetic field.

$B = \dots\dots\dots \text{ T [3]}$

(b)

The chemical composition of ancient rocks found on the Earth can be used to estimate the age of the Earth.

Nuclei of rubidium-87 (${}^{87}_{37}\text{Rb}$) decay spontaneously into nuclei of strontium-87 (${}^{87}_{38}\text{Sr}$).

The half-life of rubidium-87 is 49 billion years.

- (i) Name the two leptons emitted in the decay of a rubidium-87 nucleus.

1.

2.

[1]

- (ii) The percentage of rubidium **left** in a sample of an ancient rock is 95%.

Estimate the age of the Earth in billion years.

age = billion years [3]

Total Marks for Question Set 27: 7

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