5 An α-particle and a β-particle are both travelling along the same path at a speed of $1.5 \times 10^6\,\mathrm{m\,s^{-1}}$.

They then enter a region of uniform magnetic field as shown in Fig. 5.1.

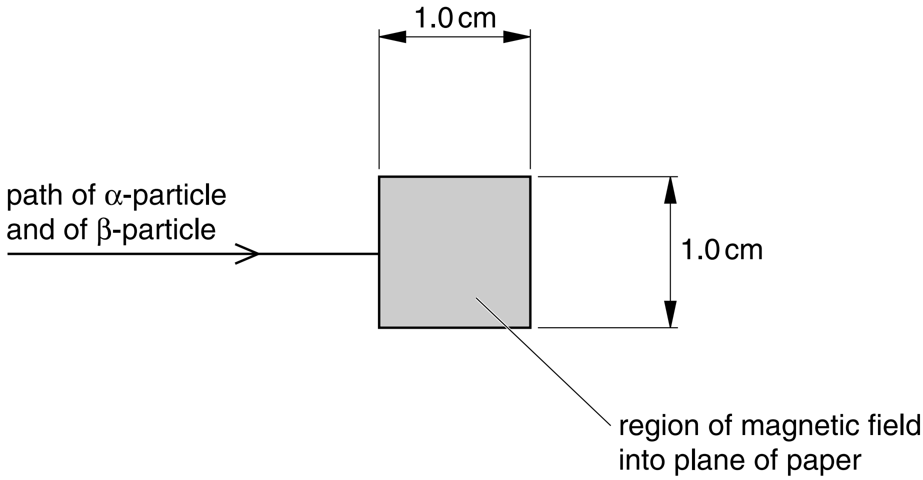

Fig. 5.1

The magnetic field is normal to the path of the particles and is into the plane of the paper.

(a) Show that, for a particle of mass m and charge q travelling at speed v normal to a magnetic field of flux density B, the radius r of its path in the field is given by

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

[3]

(b) Calculate the ratio

$$\frac{\text{radius of path of the } \alpha\text{-particle}}{\text{radius of path of the } \beta\text{-particle}}.$$

ratio = ... [3]

(c) The magnetic field has flux density 1.2 mT. Calculate the radius of the path of

(i) the α-particle,

radius = ... m

(ii) the β-particle.

radius = ... m [3]

(d) The magnetic field extends over a region having a square cross-section of side 1.0 cm (see Fig. 5.1). Both particles emerge from the region of the field.

On Fig. 5.1,

(i) mark with the letter **A** the position where the emergent α-particle may be detected,

(ii) mark with the letter **B** the position where the emergent β-particle may be detected. [3]