4 α-particles, each of speed v and mass m, are travelling in a narrow beam in a vacuum, as shown in Fig. 4.1.

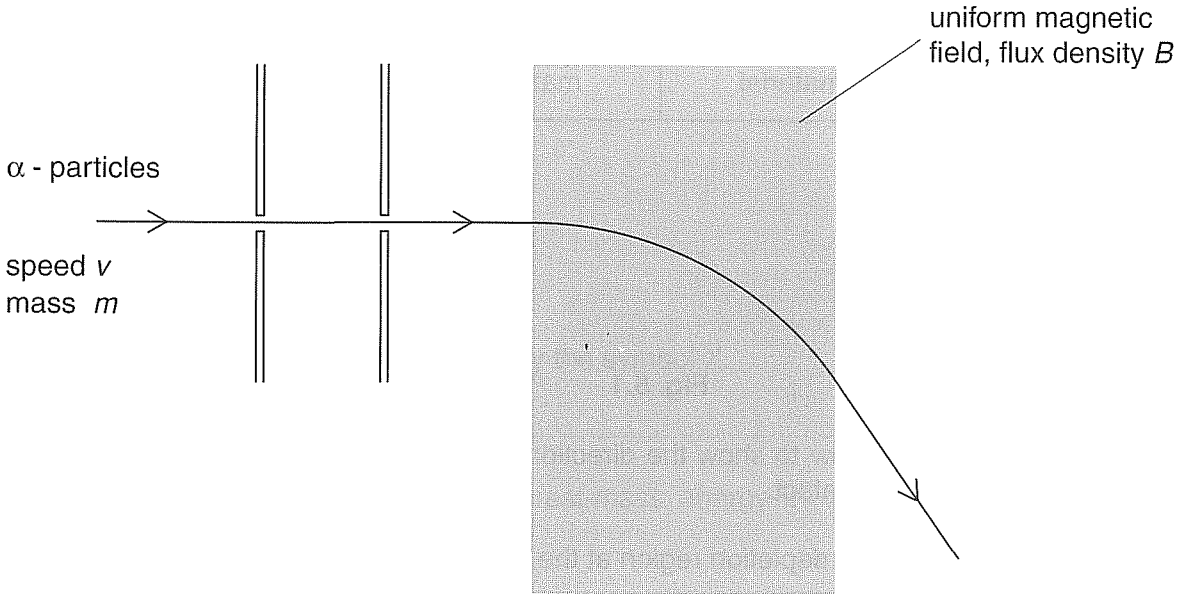

Fig. 4.1

The α-particles enter a region where there is a uniform magnetic field of flux density B. The α-particles in the magnetic field move along the arc of a circle of radius r.

(a) State the direction of the magnetic field.

.....[1]

(b) Show that, for an α-particle in this beam,

(i) the magnitude p of its momentum is given by the expression

$$p = 2Ber,$$

where e is the elementary charge,

[2]

(ii) the kinetic energy E_K is given by the expression

$$E_K = \frac{2(Ber)^2}{m}.$$

[1]

(c) On Fig. 4.1, sketch the path of an α-particle that has a speed greater than v. [2]

[Turn over