6 (a) Positive ions are travelling through a vacuum in a narrow beam. The ions enter a region of uniform magnetic field and are deflected in a semi-circular arc, as shown in Fig. 6.1.
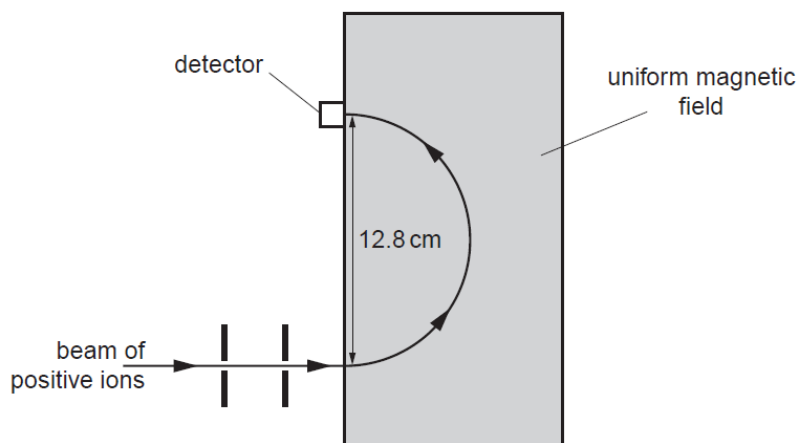

Fig. 6.1

The ions, travelling at a constant speed 1.40×10^5 m s^{-1}, are detected at a detector when the diameter of the arc in the magnetic field is 12.8 cm.

(a) With reference to Fig. 6.1, state the direction of the magnetic field.

.... [1]

(b) The ions have mass $20u$ and charge $+1.60 \times 10^{-19}$ C (where u is the unified atomic mass unit.)

Show that the magnetic flux density is 0.454 T. Explain your working.

[3]

(c) Ions of mass 22*u* with the same charge and speed as those in **(b)** are also present in the beam.

   (i) On Fig. 6.1, sketch the path of these ions in the magnetic field of magnetic flux density 0.454 T. [1]

   (ii) In order to detect these ions at the fixed detector, the magnetic flux density is changed. Calculate this new magnetic flux density.

magnetic flux density = ... T [2]

[Total: 7]