9 (a) (i) State what is meant by a *field of force*.

.....

.....

..... [2]

(ii) State the name of the field, or fields, of force that would give rise to a force on:

1. a moving uncharged particle

.....

2. a stationary charged particle.

.....

[2]

(b) Two parallel metal plates A and B are separated by a distance of 2.4 cm in a vacuum, as shown in Fig. 9.1.

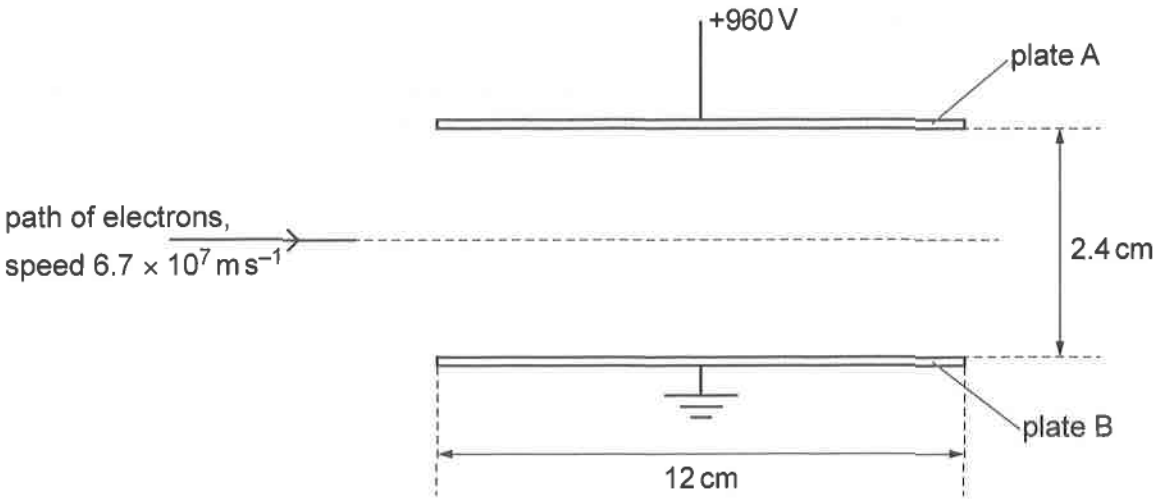

Fig. 9.1

The plates have length 12 cm.

The electric field may be assumed to be uniform between the plates and zero outside the plates.

An electron with speed $6.7 \times 10^7\,\text{m s}^{-1}$ enters the region between the plates. The initial direction of the electron is along the mid-line between the plates.

For the electron between the metal plates, calculate:

(i) the time for the electron to travel a horizontal distance equal to the length of the plates

time = ... s [1]

(ii) the magnitude of its acceleration.

acceleration = ... $m s^{-2}$ [3]

(c) Use your answers in **(b)(i)** and **(b)(ii)** to determine whether the electron will collide with one of the metal plates as it passes through the region between the plates.

[3]

(d) Singly charged particles travelling in a vacuum at a speed of $4.6 \times 10^4\,m\,s^{-1}$ pass into a region of uniform magnetic field of flux density 0.090 T.

The direction of the magnetic field is into the page.

The charged particles enter the region of the magnetic field at right angles to the edge of the region, as shown in Fig. 9.2.

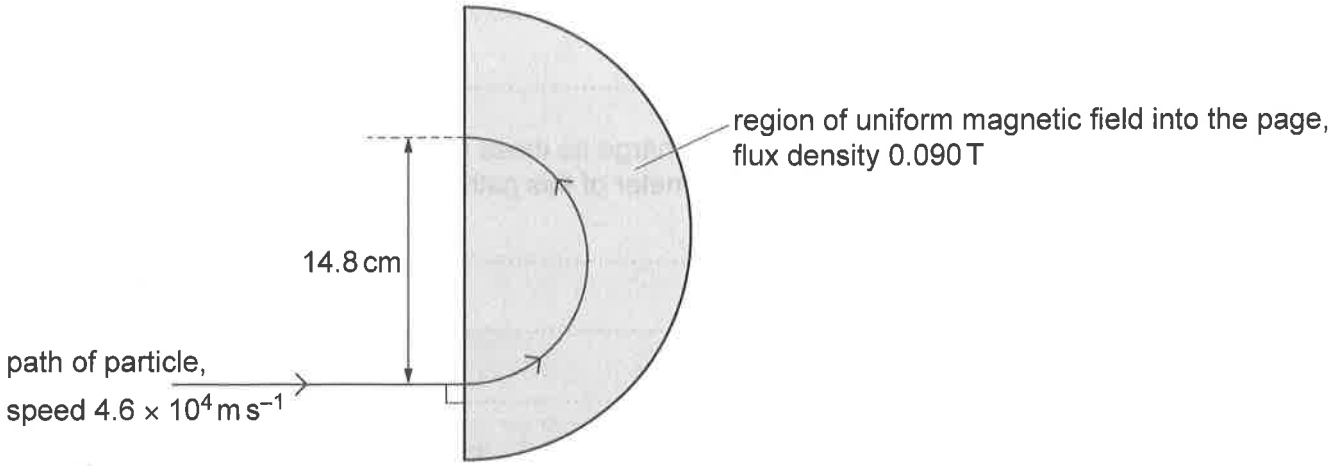

Fig. 9.2

The path of the particles in the magnetic field is a semicircle of diameter 14.8 cm.

(i) Explain why the path of a particle in the magnetic field is circular.

.....

.....

..... [2]

(ii) Determine the mass, in u, of a particle.

mass = ... u [4]

(e) Other particles having the same speed and moving along the same initial path as those in **(d)** now enter the region of the magnetic field in **(d)**. All particles have the same sign of charge.

Suggest, by comparison with the path in **(d)**, the path followed in the magnetic field by particles that have:

(i) a smaller mass but have the same magnitude of charge as those particles in **(d)**

.....

..... [1]

(ii) the same mass but with double the charge as those particles in **(d)**.
Give a quantitative value for the diameter of this path.

.....

.....

..... [2]

[Total: 20]