9 A particle of charge $+q$ and mass m is travelling with a constant speed of $1.6 \times 10^5\,\text{m s}^{-1}$ in a vacuum. The particle enters a uniform magnetic field of flux density $9.7 \times 10^{-2}\,\text{T}$, as shown in Fig. 9.1.

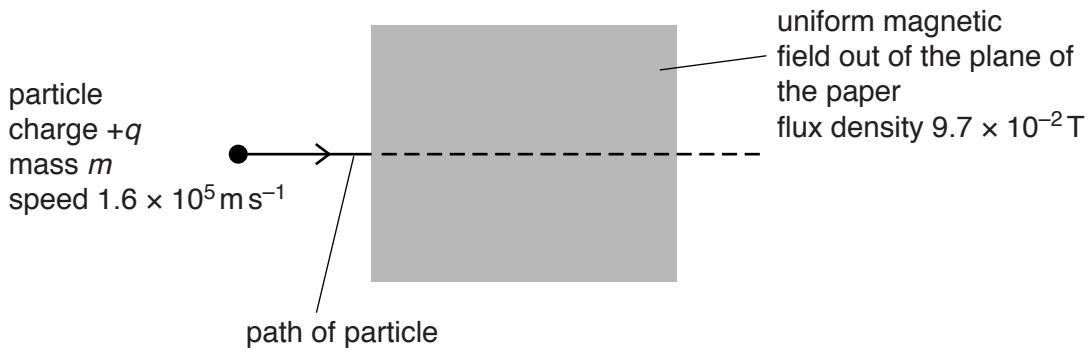

Fig. 9.1

The magnetic field direction is perpendicular to the initial velocity of the particle and perpendicular to, and out of, the plane of the paper.

A uniform electric field is applied in the same region as the magnetic field so that the particle passes undeviated through the fields.

(a) State and explain the direction of the electric field.

.....

.....

.....[2]

(b) Calculate the magnitude of the electric field strength.

Explain your working.

electric field strength = ... V m^{-1} [3]

(c) The electric field is now removed so that the positively-charged particle follows a curved path in the magnetic field. This path is an arc of a circle of radius 4.0 cm.

Calculate, for the particle, the ratio $\frac{q}{m}$.

ratio = ...C kg^{-1} [3]

(d) The particle has a charge of $3e$ where e is the elementary charge.

(i) Use your answer in **(c)** to determine the mass, in u, of the particle.

mass = ...u [2]

(ii) The particle is the nucleus of an atom. State the number of protons and the number of neutrons in this nucleus.

number of protons = ...

number of neutrons = ...
[1]

[Total: 11]