8 **(a)** Define *magnetic flux density*.

.....

.....

..... [2]

(b) Electrons, each of mass m and charge q, are accelerated from rest in a vacuum through a potential difference V.

Derive an expression, in terms of m, q and V, for the final speed v of the electrons. Explain your working.

[2]

(c) The accelerated electrons in **(b)** are injected at point S into a region of uniform magnetic field of flux density B, as illustrated in Fig. 8.1.

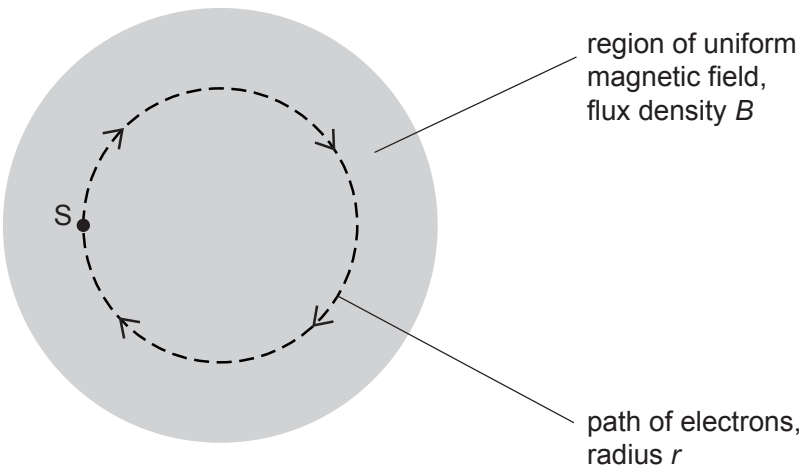

Fig. 8.1

The electrons move at right angles to the direction of the magnetic field. The path of the electrons is a circle of radius r.

(i) Show that the specific charge $\frac{q}{m}$ of the electrons is given by the expression

$$\frac{q}{m} = \frac{2V}{B^2 r^2}.$$

Explain your working.

[2]

(ii) Electrons are accelerated through a potential difference V of 230 V. The electrons are injected normally into the magnetic field of flux density 0.38 mT.
The radius r of the circular orbit of the electrons is 14 cm.

Use this information to calculate a value for the specific charge of an electron.

specific charge = ... $C\,kg^{-1}$ [2]

(iii) Suggest why the arrangement outlined in **(ii)**, using the same values of B and V, is not practical for the determination of the specific charge of α-particles.

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..... [2]

[Total: 10]