3 **(a)** A beam of electrons travelling at $1.0 \times 10^8\,m\,s^{-1}$ is directed horizontally between two horizontal plates. The electron beam passes between the plates and continues beyond the plates.

Between the plates there is a uniform vertical electric field of strength $8.2 \times 10^5\,N\,C^{-1}$.

There is no electric field outside the plates.

This is shown in Fig. 3.1.

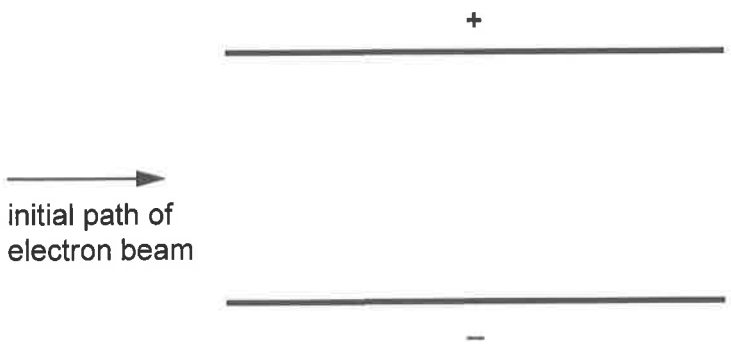

Fig. 3.1 (not to scale)

(i) On Fig. 3.1, draw the path of the electron beam. [3]

(ii) Calculate the length of plates required to produce a vertical deflection of 0.60 mm of the beam from its initial path when it leaves the region of the field.

length = ... m [4]

(b) A uniform magnetic field is applied to the region between the two horizontal plates. The field is directed so that it is into the page in Fig. 3.1.

The force on the electrons due to the magnetic field is in the opposite direction to the force due to the electric field.

Calculate the magnetic flux density required so that the electrons emerge from the horizontal plates undeflected.

magnetic flux density = ... T [3]

[Total: 10]