7 **(a)** Fig. 7.1 shows the path of a beam of electrons before it passes through a magnetic field.

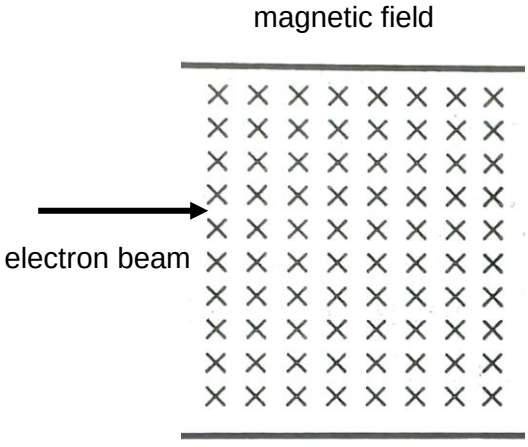

Fig. 7.1

The magnetic flux density in the uniform magnetic field is 0.0050 T. Each electron enters the magnetic field with a speed of $v = 5.0 \times 10^6$ m s^{-1}.

(i) The magnetic force causes the electrons to accelerate in the magnetic field. Explain whether the force does work on the electron.

……

…… [1]

(ii) Determine the magnetic force acting on the electron.

magnetic force = ……N [2]

(iii) Show that the radius of the electrons' path is 5.7 mm.

[2]

(iv) If a proton beam is used instead and the protons travel at the same speed as the electrons, explain qualitatively why this setup may not be practical in a typical school laboratory.

……

…… [2]

(b) Another beam of electrons enters a uniform electric field between two parallel plates at right angles to the field as shown in Fig. 7.2. The region between the plates is a vacuum.

Each electron has mass *m*, charge *e* and speed *v*.

The length of the plates is *x*, the separation of the plates is *d* and the potential difference across the plates is *V*.

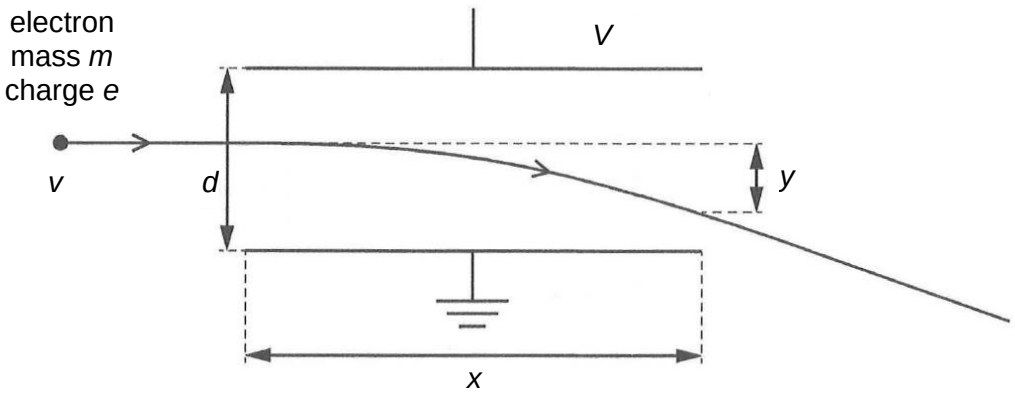

Fig 7.2

The vertical deflection of the electron is *y* at the point where it leaves the region between the plates.

Write down an equation for *y* in terms of *d*, *e*, *m*, *v*, *V,* and *x*. Show your working.

y =…… [3]

[Total:10]