2 (a) Define *electric field strength*.

....

....[1]

(b) A potential difference of 2.5 kV is applied across a pair of horizontal metal plates in a vacuum, as shown in Fig. 2.1.

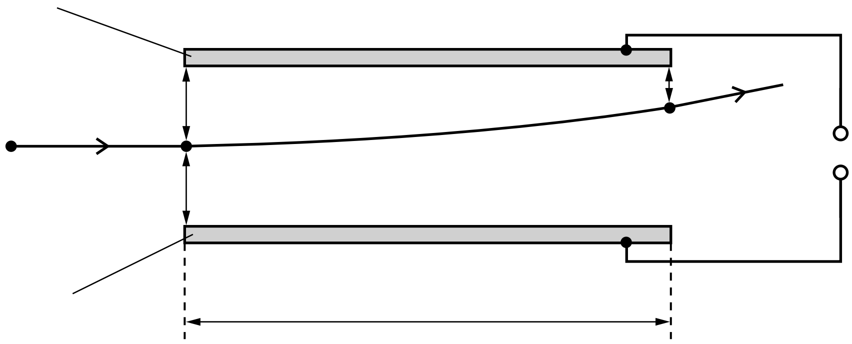

Fig. 2.1 (not to scale)

Each plate has a length of 5.9 cm. The separation of the plates is 4.0 cm. The arrangement produces a uniform electric field between the plates.
Assume the field does not extend beyond the edges of the plates.

An electron enters the field at point A with horizontal velocity $3.7 \times 10^{7}\,\mathrm{m\,s^{-1}}$ along a line mid-way between the plates. The electron leaves the field at point B.

(i) Calculate the time taken for the electron to move from A to B.

time taken = ... s [1]

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

field strength = ... $\mathrm{N\,C^{-1}}$ [2]

(iii) Show that the acceleration of the electron in the field is $1.1 \times 10^{16}\,\mathrm{m\,s^{-2}}$.

[2]

(iv) the acceleration given in **(iii)** and your answer in **(i)** to determine the vertical distance y between point B and the upper plate.

y = ... cm [3]

(v) Explain why the calculation in **(iv)** does not need to include the gravitational effects on the electron.

....

....[1]

(vi) The electron enters the field at time $t = 0$.

On Fig. 2.2, sketch graphs to show the variation with time t of

1. the horizontal component v_X of the velocity of the electron,

2. the vertical component v_Y of the velocity of the electron.

Numerical values are not required.

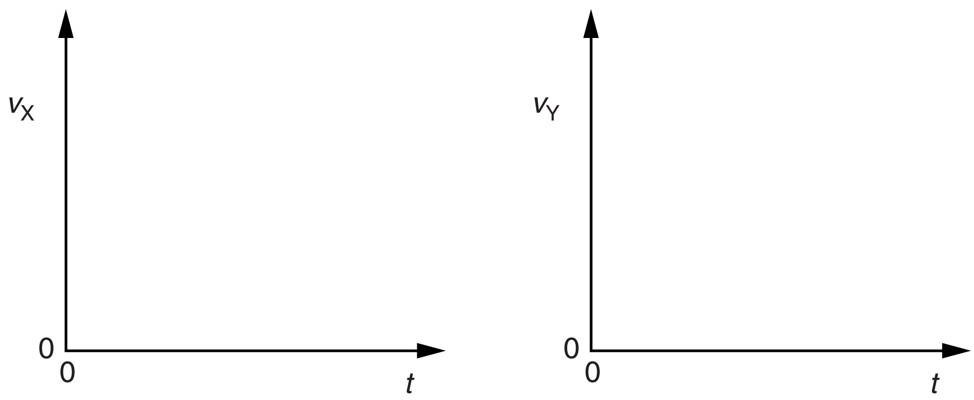

Fig. 2.2

[2]

[Total: 12]