Electric Fields 1

Have a go at the following exam questions.

OCR, G485, JUNE 2011

3 **(a)** Define *electric field strength*.

.....

..... **[1]**

(b) Fig. 3.1 shows two horizontal, parallel metal plates **A** and **B**.

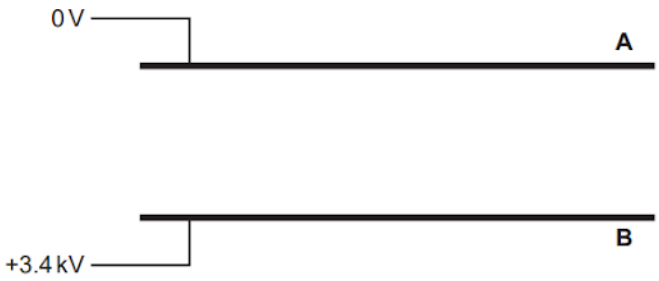


Fig. 3.1

The potential difference across the plates is 3.4 kV and the arrangement provides a uniform electric field between the plates.

On Fig. 3.1 draw at least six lines to represent the electric field between the plates. **[2]**

(c) A beam of electrons enters between the plates at right angles to the electric field. The horizontal velocity of the electrons is $4.0 \times 10^7\,m\,s^{-1}$. The path of the electrons is shown on Fig. 3.2. The horizontal length of each plate is 0.080 m and the separation of the plates is 0.050 cm. **P** is a point 0.040 m from where the beam enters the plates.

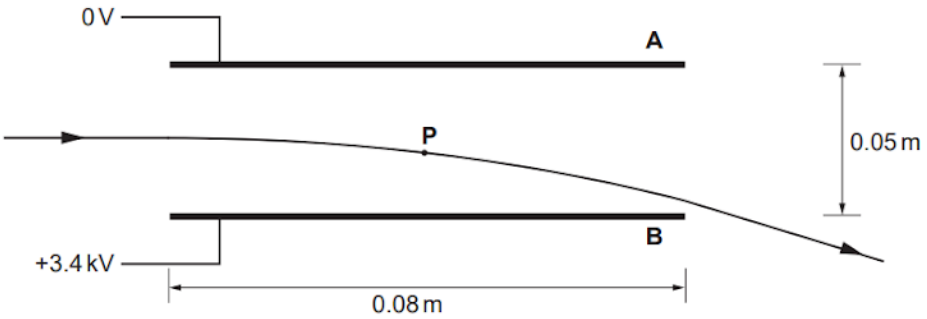


Fig. 3.2

(i) Draw an arrow on Fig. 3.2 to show the direction of the acceleration of an electron at **P**. **[1]**

(ii) Show that the acceleration of an electron between the plates is about $1 \times 10^{16}\,m\,s^{-2}$.

[2]

(iii) Calculate the time taken for an electron on entering the plates to reach **P**.

time = ... s **[1]**

(iv) Show that the vertical velocity of the electron at **P** is $1.2 \times 10^{7}\,m\,s^{-1}$.

[1]

(v) Calculate the magnitude of the resultant velocity of the electron at **P**.

magnitude of the velocity = ... $m\,s^{-1}$ **[2]**

(vi) Calculate the kinetic energy of the electron at **P**.

kinetic energy = ... J **[2]**

(vii) On Fig. 3.3 sketch the variation of kinetic energy E_k of the electron with the horizontal distance x it travels through the electric field and beyond. No calculations are required.

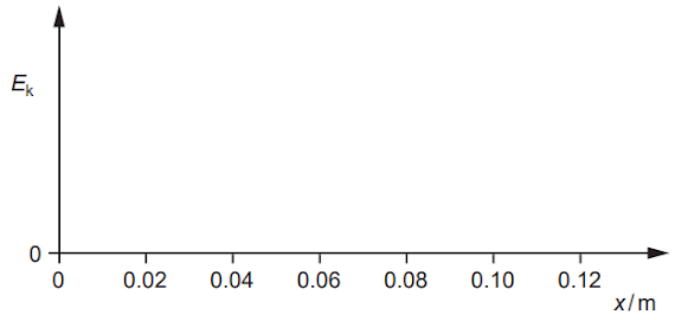


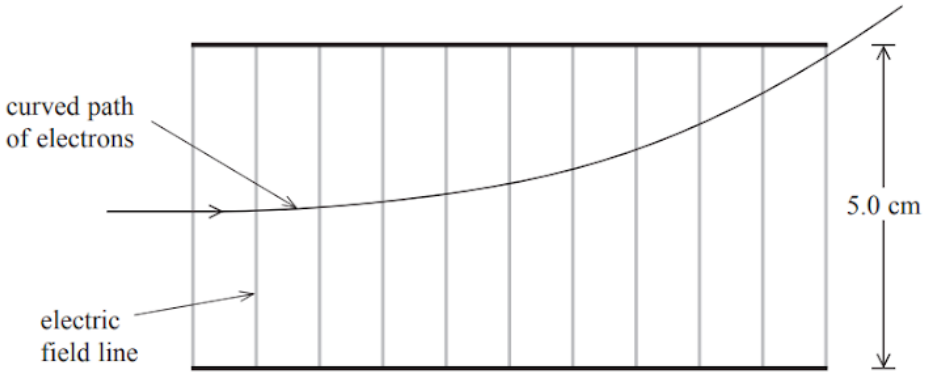
Fig. 3.3

[3]

[Total: 15]

EDEXCEL, 6PH04/01R, JUNE 2013

17 A teacher uses an electron beam tube to demonstrate the behaviour of electrons in an electric field. The diagram shows the path of an electron in a uniform electric field between two parallel conducting plates.



(a) Mark on the diagram the direction of the electric field.

(1)

(b) The conducting plates are 5.0 cm apart and have a potential difference of 160 V across them.
Calculate the force on the electron due to the electric field.

(3)

Force = ...

(c) Explain why the path of the electron is curved between the plates and straight when it has left the plates.

(3)

(d) The electron was initially released from a metal by thermionic emission and then accelerated through a potential difference before entering the region of the electric field.

(i) State what is meant by thermionic emission.

(1)

.....

.....

(ii) In order to be able to just leave the plates as shown, the electron must enter the electric field between the plates with a speed of 1.2×10^7 m s^{-1}.

Calculate the potential difference required to accelerate an electron from rest to this speed.

(3)

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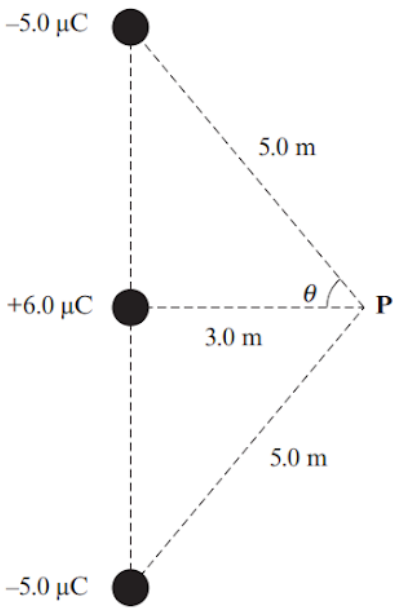
Potential difference = ...

(Total for Question 17 = 11 marks)

4. Three charges are placed in a line as shown.



[use the approximation $\frac{1}{4\pi\varepsilon_0} = 9.0 \times 10^9 \,\mathrm{F^{-1}m}$]

(a) Draw **three arrows** at **P** representing the electric fields due to **each** of the three charges. [2]

(b) Calculate the electric field at **P** due to the +6.0 μC charge only. [2]

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(c) Calculate the resultant electric field at **P** (hint: $\cos\theta = 0.6$). [3]

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