For Examiner's Use

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

....

.... [1]

(b) Two flat parallel metal plates, each of length 12.0 cm, are separated by a distance of 1.5 cm, as shown in Fig. 2.1.

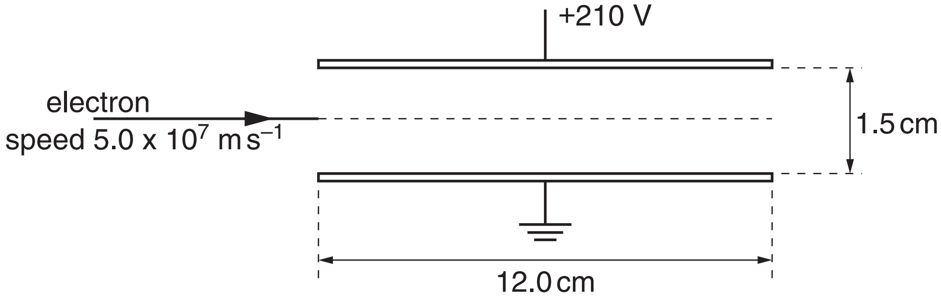

Fig. 2.1

The space between the plates is a vacuum.
The potential difference between the plates is 210 V. The electric field may be assumed to be uniform in the region between the plates and zero outside this region.
Calculate the magnitude of the electric field strength between the plates.

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

(c) An electron initially travels parallel to the plates along a line mid-way between the plates, as shown in Fig. 2.1. The speed of the electron is $5.0 \times 10^7\ \mathrm{m\,s^{-1}}$.

For the electron between the plates,

(i) determine the magnitude and direction of its acceleration,

acceleration = ... $\mathrm{m\,s^{-2}}$

direction ....[4]

(ii) calculate the time for the electron to travel a horizontal distance equal to the length of the plates.

time = ... s [1]

(d) Use your answers in **(c)** to determine whether the electron will hit one of the plates or emerge from between the plates.

[3]

For Examiner's Use

6 Two horizontal metal plates X and Y are at a distance 0.75 cm apart. A positively charged particle of mass 9.6×10^{-15} kg is situated in a vacuum between the plates, as illustrated in Fig. 6.1.

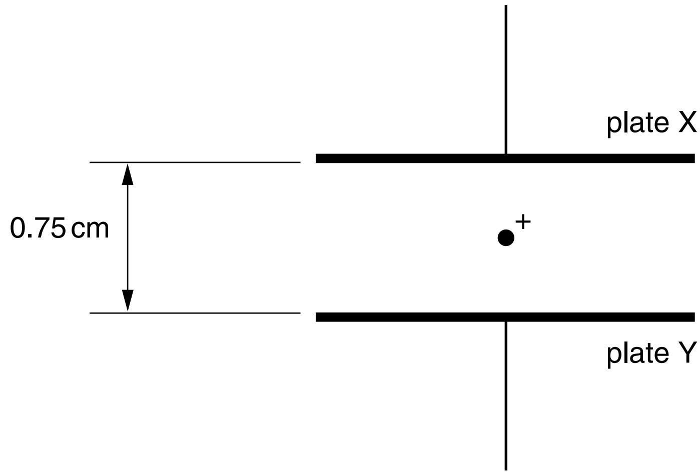

Fig. 6.1

The potential difference between the plates is adjusted until the particle remains stationary.

(a) State, with a reason, which plate, X or Y, is positively charged.

....

....

.... [2]

(b) The potential difference required for the particle to be stationary between the plates is found to be 630 V. Calculate

(i) the electric field strength between the plates,

field strength = ... N C^{-1} [2]

(ii) the charge on the particle.

For Examiner's Use

charge = …………………………….. C [3]

6 Two parallel metal plates P and Q are situated 8.0 cm apart in air, as shown in Fig. 6.1.

For Examiner's Use

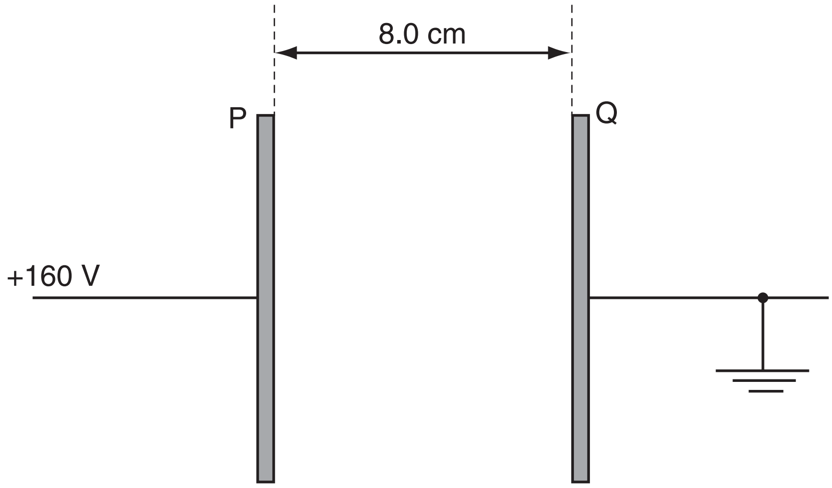

Fig. 6.1

Plate Q is earthed and plate P is maintained at a potential of +160 V.

(a) **(i)** On Fig. 6.1, draw lines to represent the electric field in the region between the plates. [2]

(ii) Show that the magnitude of the electric field between the plates is $2.0 \times 10^{3}\,\mathrm{V\,m^{-1}}$.

[1]

For Examiner's Use

(b) A dust particle is suspended in the air between the plates. The particle has charges of $+1.2 \times 10^{-15}$ C and -1.2×10^{-15} C near its ends. The charges may be considered to be point charges separated by a distance of 2.5 mm, as shown in Fig. 6.2.

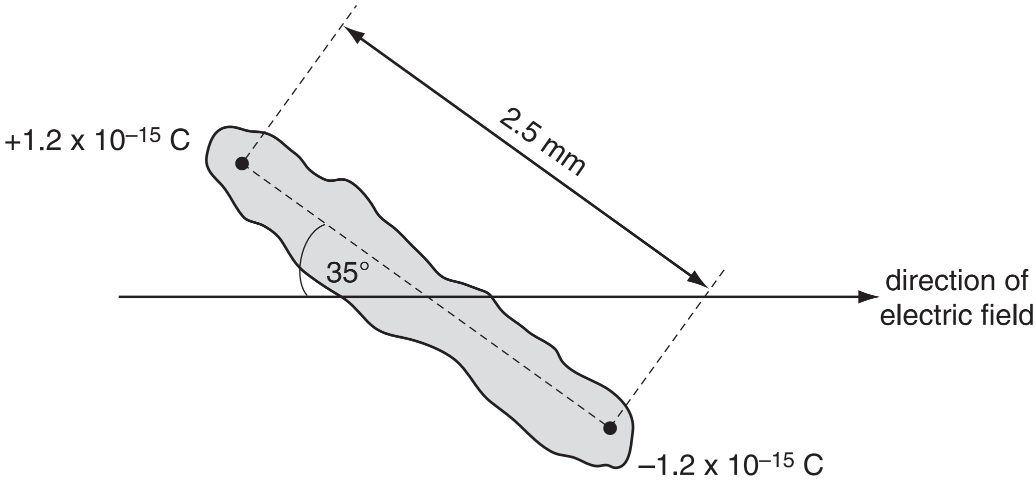

Fig. 6.2

The particle makes an angle of 35° with the direction of the electric field.

(i) On Fig. 6.2, draw arrows to show the direction of the force on each charge due to the electric field. [1]

(ii) Calculate the magnitude of the force on each charge due to the electric field.

force = ... N [2]

(iii) Determine the magnitude of the couple acting on the particle.

couple = ... N m [2]

(iv) Suggest the subsequent motion of the particle in the electric field.

....

....

....[2]

[Turn over

6 An electron travelling horizontally in a vacuum enters the region between two horizontal metal plates, as shown in Fig. 6.1.

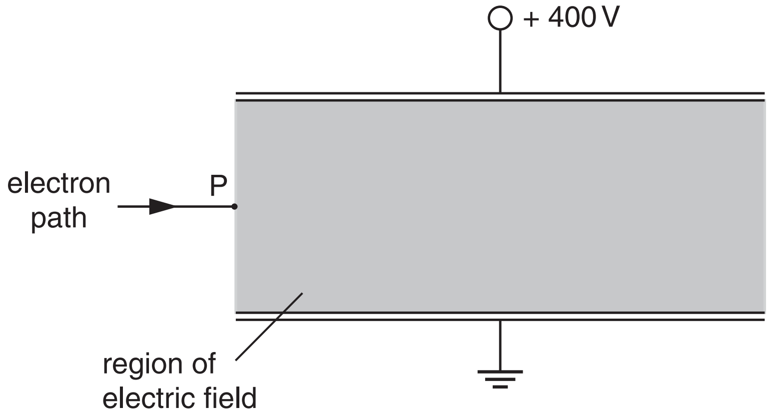

Fig. 6.1

The lower plate is earthed and the upper plate is at a potential of + 400 V. The separation of the plates is 0.80 cm.

The electric field between the plates may be assumed to be uniform and outside the plates to be zero.

(a) On Fig. 6.1,

(i) draw an arrow at P to show the direction of the force on the electron due to the electric field between the plates,

(ii) sketch the path of the electron as it passes between the plates and beyond them. [3]

(b) Determine the electric field strength *E* between the plates.

E = ... V m^{-1} [2]

(c) Calculate, for the electron between the plates, the magnitude of

(i) the force on the electron,

force = …………………………….. N

(ii) its acceleration.

acceleration = ……………………………… m s^{-2}
[4]

(d) State and explain the effect, if any, of this electric field on the horizontal component of the motion of the electron.

....

....

....[2]

6 Two horizontal metal plates are situated 1.2 cm apart, as illustrated in Fig. 6.1.

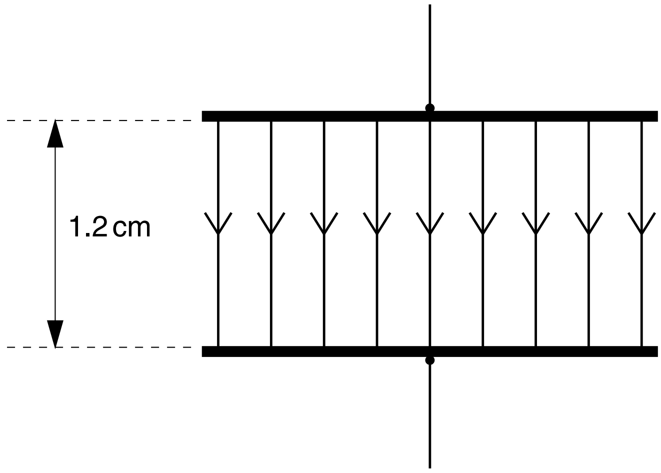

Fig. 6.1

The electric field between the plates is found to be $3.0 \times 10^4\,\mathrm{N\,C^{-1}}$ in the downward direction.

(a) **(i)** On Fig. 6.1, mark with a + the plate which is at the more positive potential.

(ii) Calculate the potential difference between the plates.

potential difference = ... V

[3]

(b) Determine the acceleration of an electron between the plates, assuming there is a vacuum between them.

acceleration = ... $\mathrm{m\,s^{-2}}$ [3]

For Examiner's Use

4 A sphere has volume V and is made of metal of density ρ.

(a) Write down an expression for the mass m of the sphere in terms of V and ρ.

....[1]

(b) The sphere is immersed in a liquid. Explain the apparent loss in the weight of the sphere.

....

....

....

....[3]

(c) The sphere in **(b)** has mass 2.0×10^{-3} kg. When the sphere is released, it eventually falls in the liquid with a constant speed of $6.0\,\text{cm}\,\text{s}^{-1}$.

(i) For this sphere travelling at constant speed, calculate

1. its kinetic energy,

kinetic energy = ... J

2. its rate of loss of gravitational potential energy.

rate = ... $\text{J}\,\text{s}^{-1}$ [5]

(ii) Suggest why it is possible for the sphere to have constant kinetic energy whilst losing potential energy at a steady rate.

....

....

....[2]