For Examiner's Use

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

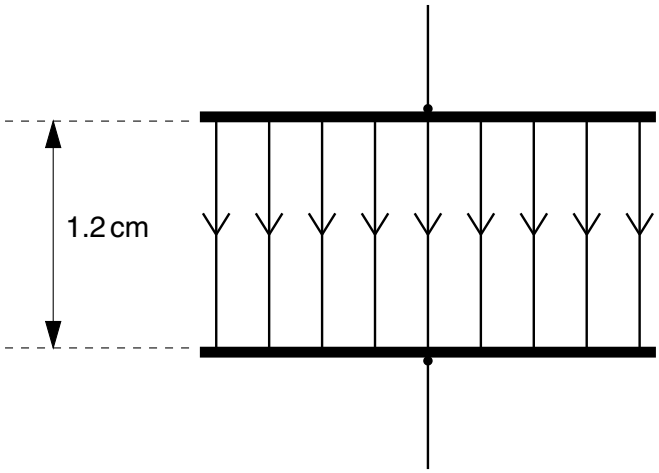


**Fig. 6.1**

The electric field between the plates is found to be $3.0 \times 10^4$ 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 = ..... m s$^{-2}$ [3]

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

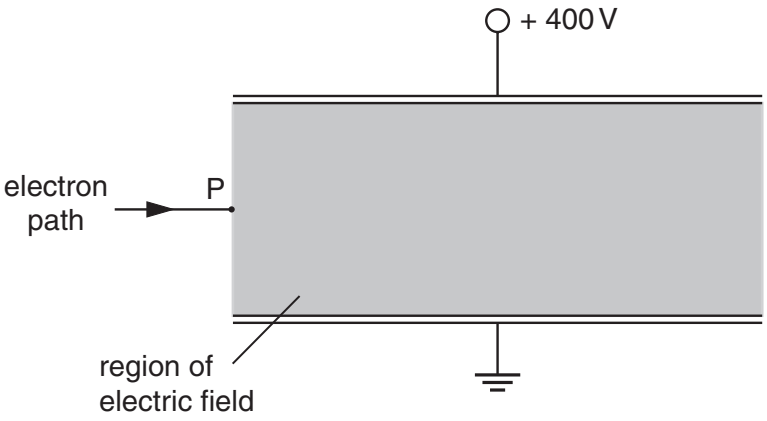


**Fig. 6.1**

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]

**3** 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*

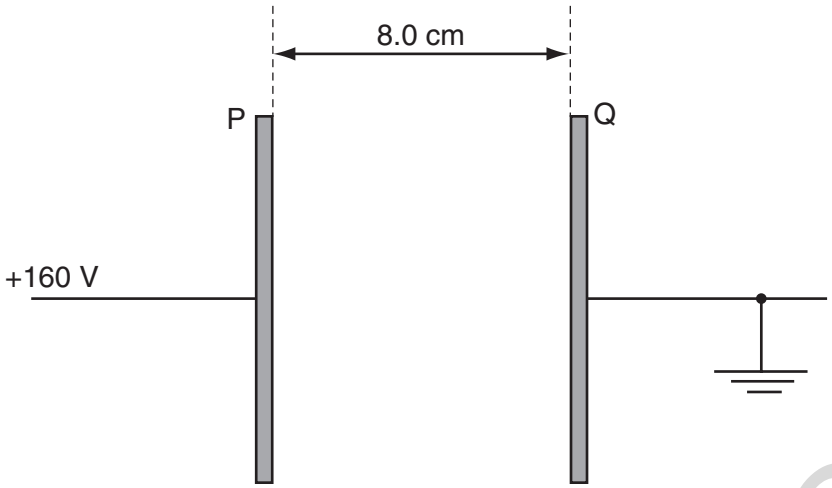


**Fig. 6.1**

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 $2.0 \times 10^3$ V m$^{-1}$.

[1]

**(b)** A dust particle is suspended in the air between the plates. The particle has charges of $+1.2\times10^{-15}$ C and $-1.2\times10^{-15}$ 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.

*For Examiner's Use*

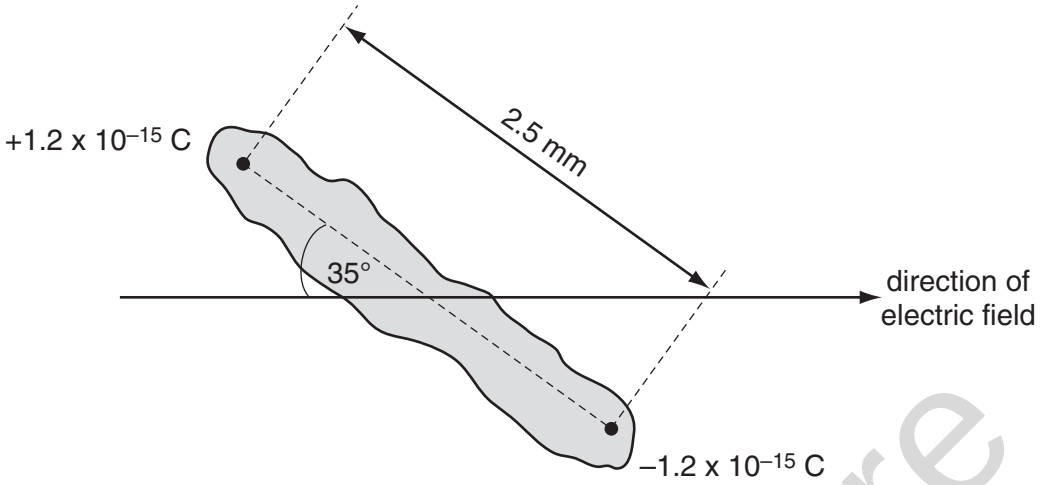


**Fig. 6.2**

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]

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

*For Examiner's Use*

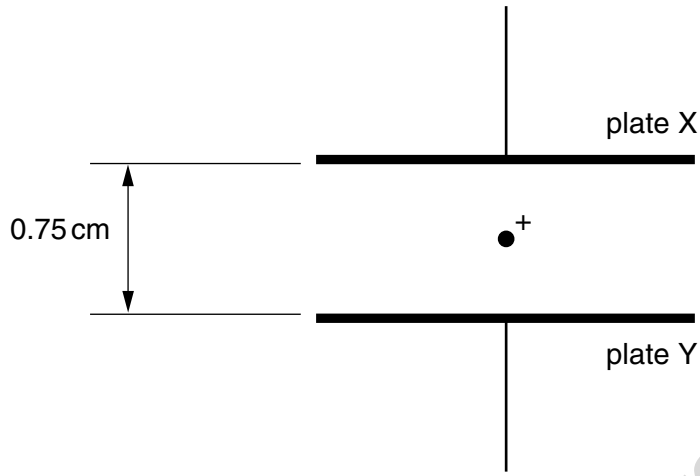


**Fig. 6.1**

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]

For Examiner's Use

**5** **(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.

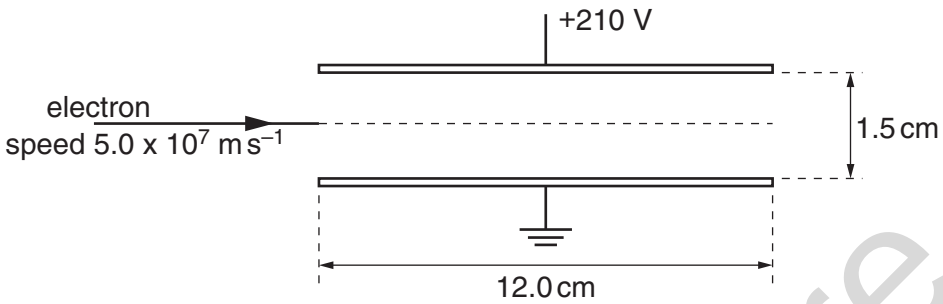


**Fig. 2.1**

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 = .....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 $5.0 \times 10^7$ m s$^{-1}$.

For the electron between the plates,

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

acceleration = ..... 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]

**6** Two parallel plates P and Q are separated by a distance of 7.6 mm in a vacuum. There is a potential difference of 250 V between the plates, as illustrated in Fig. 4.1.

*For Examiner's Use*

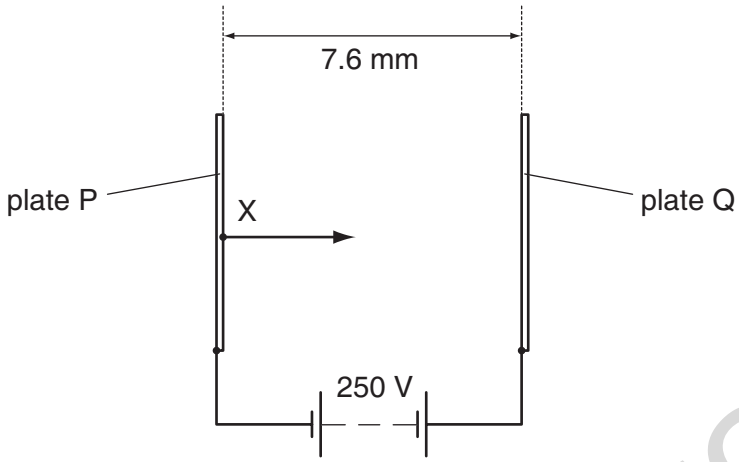


**Fig. 4.1**

Electrons are produced at X on plate P. These electrons accelerate from rest and travel to plate Q.
The electric field between the plates may be assumed to be uniform.

**(a) (i)** Determine the force on an electron due to the electric field.

force = ..... N [3]

**(ii)** Show that the change in kinetic energy of an electron as it moves from plate P to plate Q is $4.0 \times 10^{-17}$ J.

[2]

**(iii)** Determine the speed of an electron as it reaches plate Q.

*For Examiner's Use*

speed = .....m s$^{-1}$ [2]

**(b)** The positions of the plates are adjusted so that the electric field between them is not uniform. The potential difference remains unchanged.
State and explain the effect, if any, of this adjustment on the speed of an electron as it reaches plate Q.

.....

.....

.....

..... [3]