4 **(a)** Two charged particles, A and B, are isolated in space and separated by a distance *x*, as shown in Fig. 4.1.

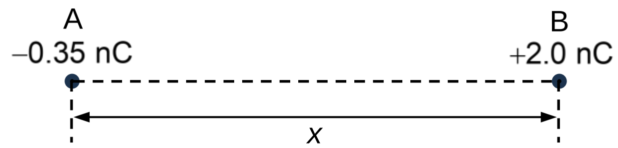

Fig. 4.1

Particle A has a charge of –0.35 nC and particle B has a charge of +2.0 nC .

(i) Explain whether the electric field strength is zero at any point along the straight line between the two charged particles.

....

....

....

....

.... [1]

(ii) Explain whether the electric potential is zero at any point along the straight line between the two charged particles.

....

....

....

....

.... [1]

(b) Two long parallel metal plates, X and Y, are separated by a distance 3.6 cm in a vacuum. Plate X is at potential *V* and plate Y is earthed. The potential difference between the plates gives rise to a uniform electric field in the region between the plates.

A particle of charge -3.2×10^{-19} C and mass 6.6×10^{-27} kg is projected into the uniform electric field midway between plates. It enters the electric field with speed 4.1×10^{5} m s^{-1} at an angle 32° from the vertical and hits plate Y at point P with speed 6.5×10^{5} m s^{-1}. Point P is a vertical distance *d* from the top of the plate.

Fig. 4.2 shows the path of the particle. Ignore gravitational effects.

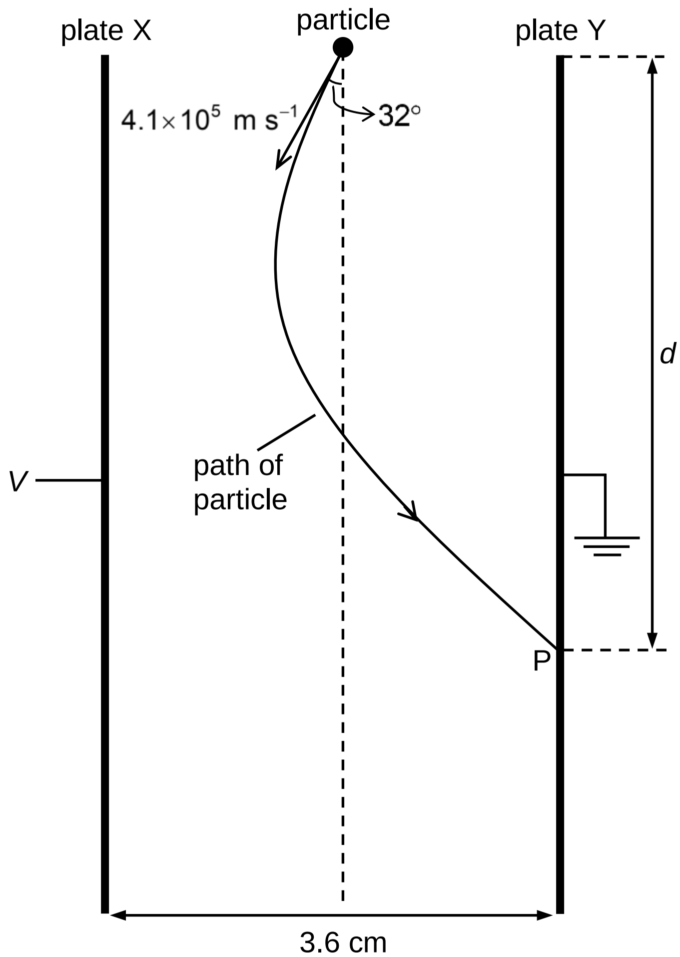

Fig. 4.2

Determine

(i) the potential V,

V = ... V [3]

(ii) the magnitude of the acceleration a of the particle,

a = ... m s^{-2} [2]

(iii) the distance d.

d = ... m [3]

[Total: 10]