5 **(a)** A dust particle is suspended in air in a uniform electric field of strength 2.0×10^3 V m^{-1}. 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. 5.1.

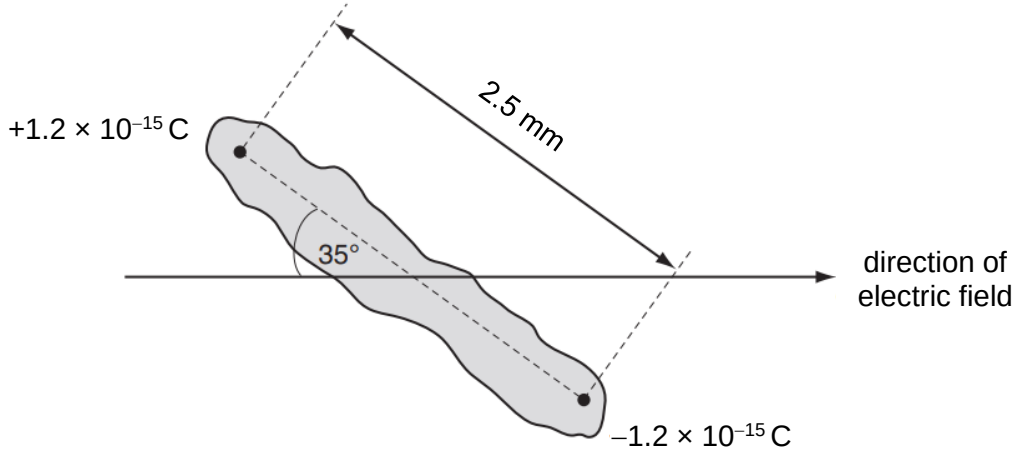

Fig. 5.1

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

(i) On Fig. 5.1, draw arrows to show the direction of 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 [1]

(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.

……

…….. [1]

(b) Two small spherical charged particles G and H may be assumed to be point charges located at their centres. The particles are in a vacuum. Particle G is fixed in position. Particle H is moved along the line joining the two charges, as illustrated in Fig. 5.2.

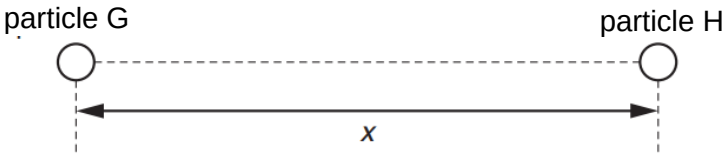

Fig. 5.2

The variation with separation x of the electric potential energy E_P of particle G is shown in Fig. 5.3.

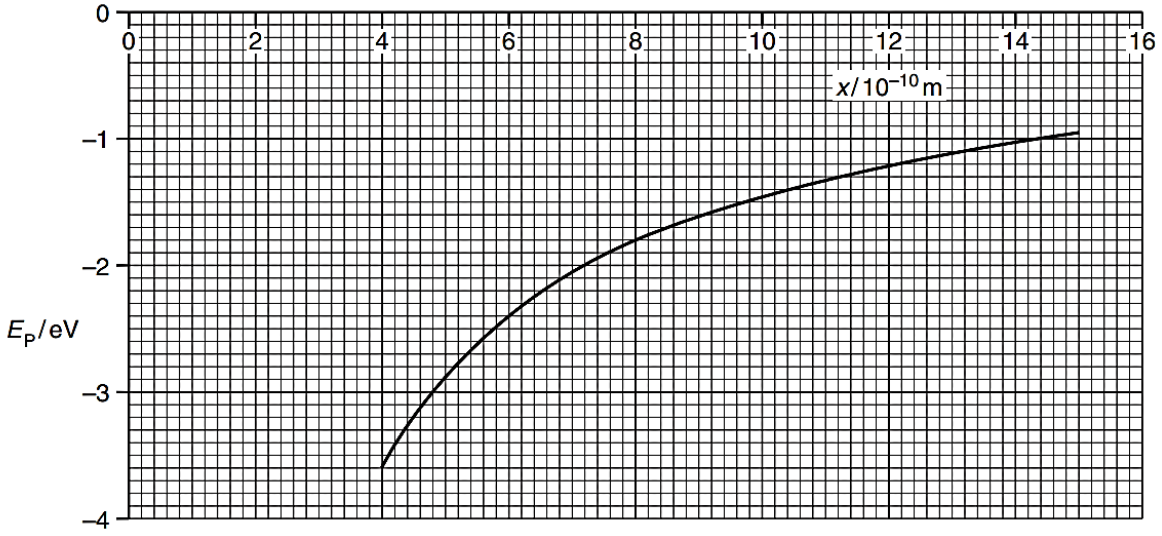

Fig. 5.3

(i) With reference to Fig. 5.3, state the relationship between electric force and electric potential energy.

……

…….. [1]

(ii) With reference to the direction of the electric force between the particles, state whether the two charges have the same, or opposite, polarity.

…….

……... [1]

(iii) Hence, determine the electric force acting on particle H at a distance of 6.0×10^{-10} m.

force = ……. N [3]