

- 4 (a) Define *electric field strength*.

.....
[1]

- (b) Two very small metal spheres X and Y are connected by an insulating rod of length 72 mm. A side view of this arrangement is shown in Fig. 4.1.

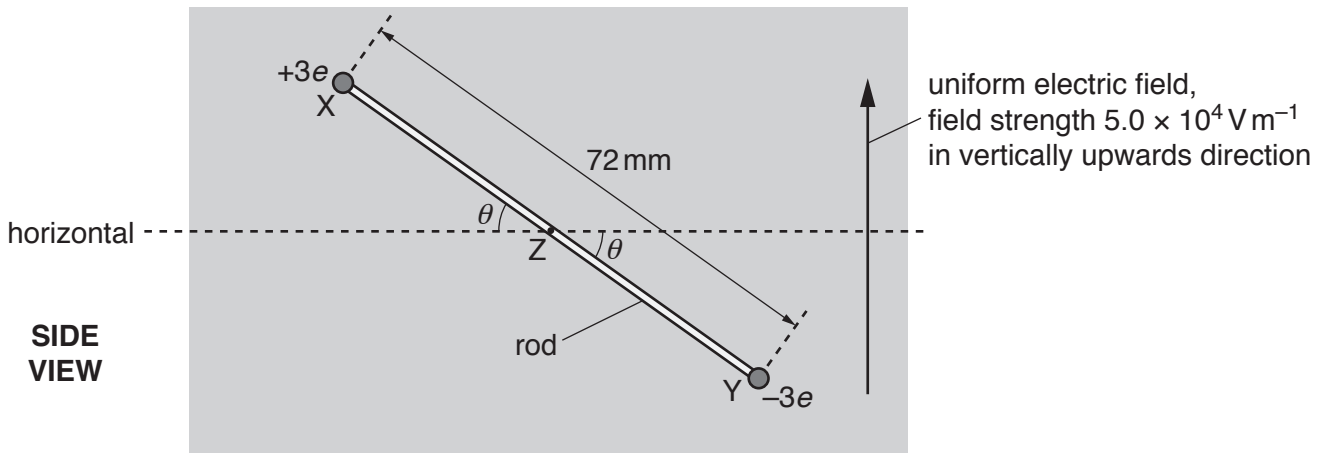


Fig. 4.1 (not to scale)

Sphere X has a charge of $+3e$ and sphere Y has a charge of $-3e$, where e is the elementary charge. The rod is held at its mid point Z at an angle θ to the horizontal. The rod and spheres have negligible mass and are in a uniform electric field. The electric field strength is $5.0 \times 10^4 \text{ V m}^{-1}$. The direction of this field is vertically upwards.

- (i) The electric field is produced by applying a potential difference of 4.0 kV between two charged parallel metal plates.
1. Calculate the separation between the plates.

separation = m [2]

2. Describe the arrangement of the two plates. Include in your answer a statement of the sign of the charge on each plate. You may draw on Fig. 4.1.

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..... [2]

- (ii) Determine the magnitude and direction of the force on sphere Y.

magnitude = N

direction [2]

- (iii) The electric forces acting on the two spheres form a couple. This couple acts on the rod with a torque of $6.2 \times 10^{-16} \text{ Nm}$.

Calculate the angle θ of the rod to the horizontal.

$\theta = \dots\dots\dots^\circ$ [2]

[Total: 9]