

- 4 Two small charged metal spheres A and B are situated in a vacuum. The distance between the centres of the spheres is 12.0 cm, as shown in Fig. 4.1.

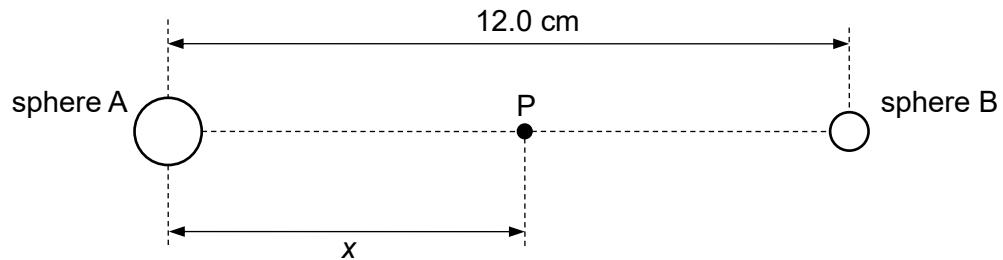


Fig. 4.1

The charge on each sphere may be assumed to be a point charge at the centre of the sphere. Point P lies on the line joining the centres of the two spheres. P is at a distance x from the centre of sphere A.

The variation with distance x of the electric field strength E at point P is shown in Fig. 4.2.

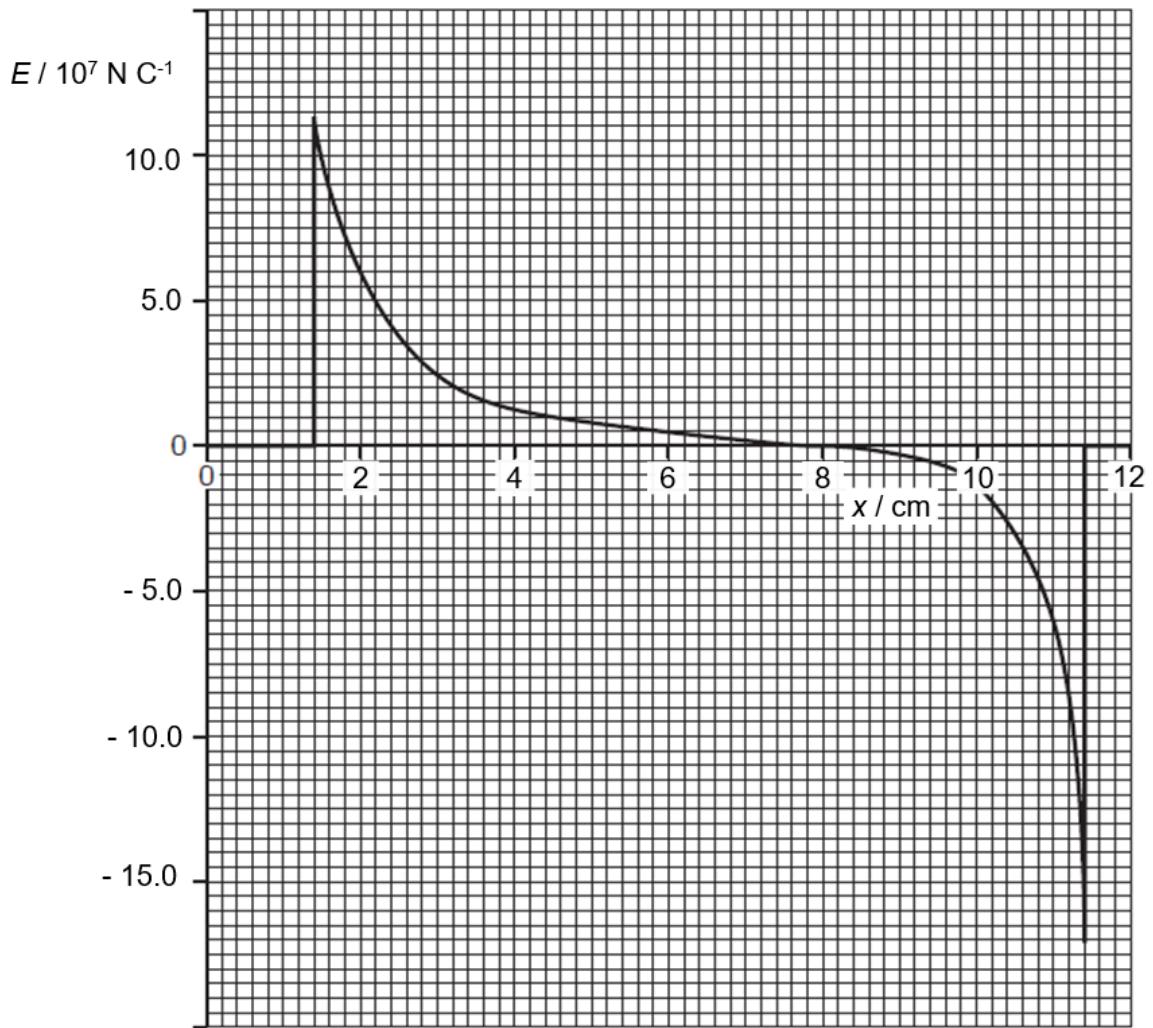


Fig. 4.2

- (a) State the evidence provided by Fig. 4.2 that the spheres are conductors.

..... [1]

- (b) State and explain whether the polarity of the charges on the spheres are of the same sign.

..... [2]

- (c) Use Fig. 4.2 to determine the ratio $\frac{\text{charge on sphere A}}{\text{charge on sphere B}}$.

ratio = [3]

- (d) Hence, on Fig. 4.3, sketch the electric field lines due to these two charges.



Fig. 4.3

[3]

- (e) A proton moves along the line joining the centres of the two spheres.

Estimate the change in energy of the proton as it moves from the point where $x = 3.0\text{ cm}$ to the point where $x = 1.4\text{ cm}$.

energy = J

[3]

[Total: 12]