4 Two charged, solid metal spheres, A and B, are situated in a vacuum. The charge on each sphere may be considered to be a point charge at its centre.

Their centres are separated by a distance of 0.90 m, as shown in Fig. 4.1.

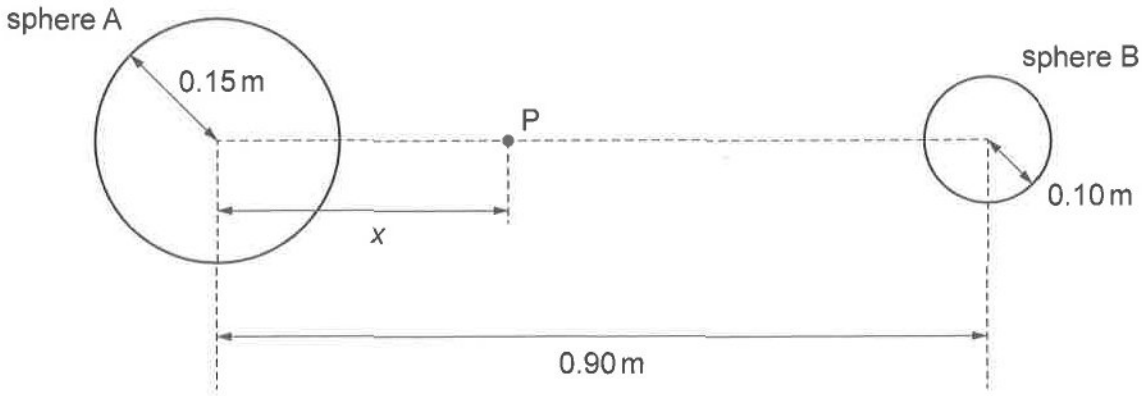

Fig. 4.1 (not to scale)

Sphere A has a radius of 0.15 m and sphere B has a radius of 0.10 m.

Point P is a point on the line joining the centres of the two spheres. Point P is a distance x from the centre of sphere A.

The variation with distance *x* of the electric potential *V* at point P is shown in Fig. 4.2.

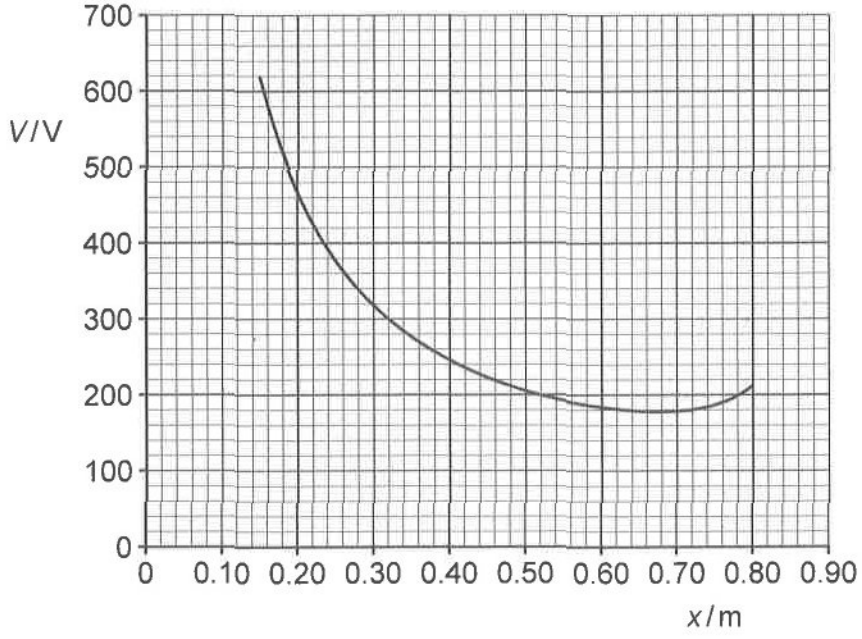

Fig. 4.2

(a) Use Fig. 4.2 to explain whether the spheres have charges of the same, or opposite, sign.

State the sign of the charge on sphere A.

.....

.....

.....

..... [3]

(b) On Fig. 4.3, show the variation with distance x of the electric field strength E for values of x from $x = 0.15\,\text{m}$ to $x = 0.80\,\text{m}$. Use the space above Fig. 4.3 for any working.

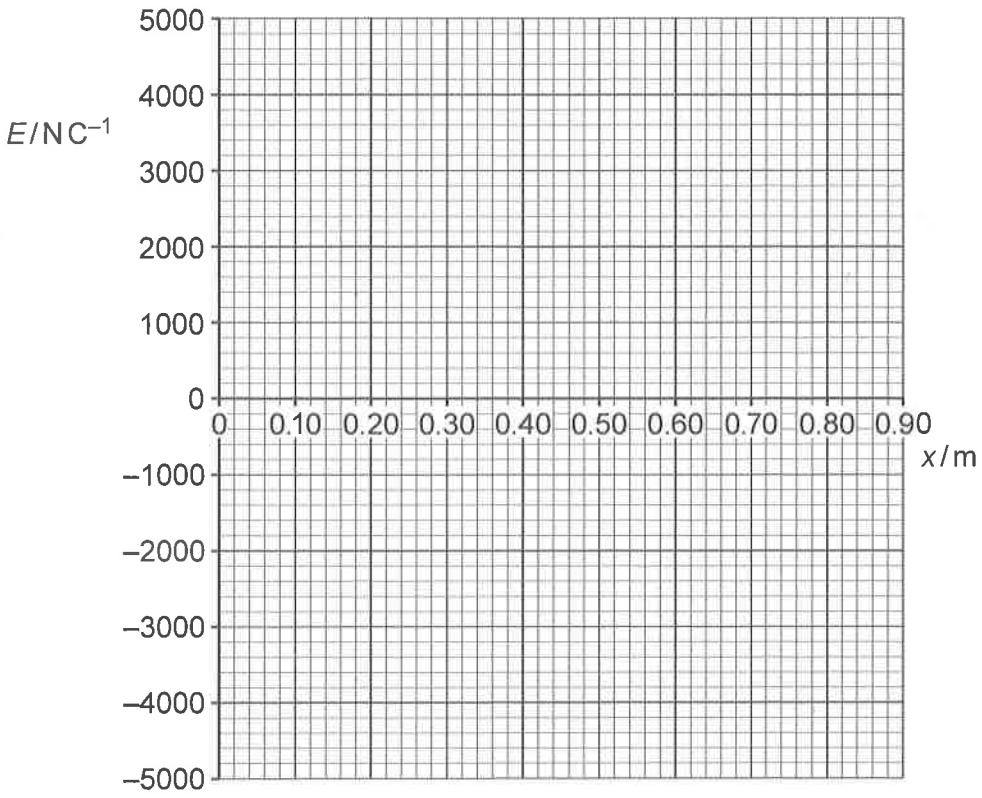

Fig. 4.3

[5]

(c) The magnitude of the charge on sphere A is 1.0×10^{-8} C.

(i) Calculate the magnitude of the electric potential at the surface of sphere A due to its charge.

electric potential = ... V [2]

(ii) Explain why this value is different from the electric potential at the surface of sphere A as shown in Fig. 4.2.

.....

.....

..... [2]

[Total: 12]