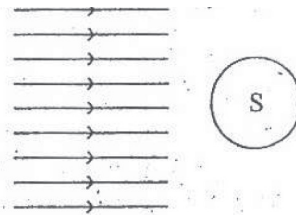


1998 A/L Structured Essay Question No (04)

4. An uncharged conducting sphere (S) is kept in a uniform electric field acting along the horizontal direction as shown in the figure.



(a) Extend the electric field lines given in the above figure to illustrate the electric field in the three regions.

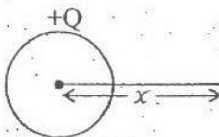
- (1) near and inside the sphere. (2) around the sphere.
(3) far away from the sphere.

(b) Draw lines on the same figure to show the equipotential surfaces in each of the three regions mentioned above. (Use dotted lines for this)

(c) Now the external electric field is removed and the isolated sphere is given a charge Q. The electric potentials, V, measured at

various distances x from the centre of the sphere are given below.

The radius of the sphere is 1 cm



x (cm)	$\frac{1}{x}$ (cm ⁻¹)	V (volts)
2.0	0.500	5.00
2.5	0.400	4.00
4.0	0.250	2.50
5.0	0.200	2.00
8.0	0.125	1.25
10.0	0.100	1.00

Using the grid below, plot a graph of V against $\frac{1}{x}$. (12 cm x 12 cm Graph paper provided)

- (d) (i) Determine the gradient of the graph. (2 lines)
(ii) Hence determine the charge Q on the sphere

$$\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{C}^{-2} \right) \text{ (2 lines)}$$

(e) If you extend the graph that you have drawn in (c) above would you expect the same gradient as in (d) (i) for x values ≤ 1 cm? Explain your answer.

(2 lines)