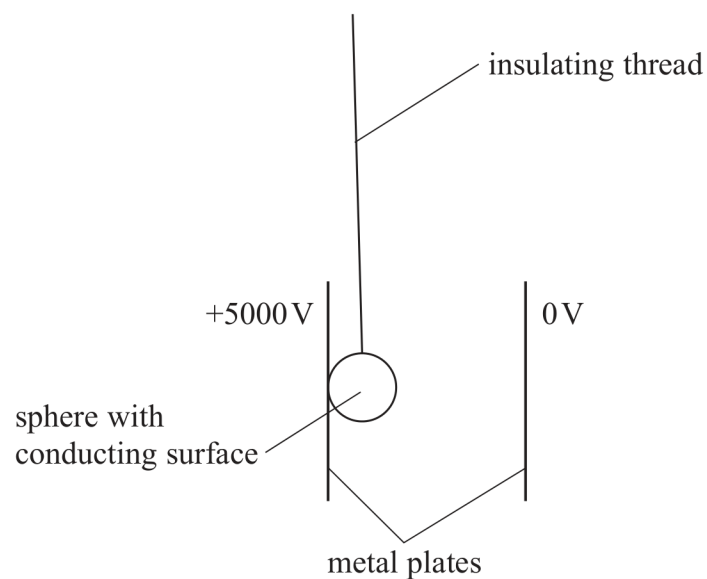17 A potential difference of 5000 V is applied across two vertical metal plates.

A sphere with a conducting surface is suspended by an insulating thread and touches the positively charged plate as shown.

insulating thread

+5000 V   0 V

sphere with
conducting surface

metal plates

The sphere becomes positively charged.

(a) Complete the diagram to show the electric field around a positively charged sphere.

(3)

(b) (i) Show that the charge on the sphere is about 10 nC.

potential at surface of sphere = 5000 V
radius of sphere = 20 mm

(2)

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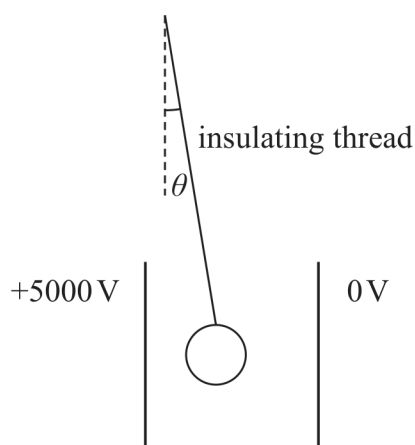..

(ii) The sphere moves away from the positive plate and comes to rest at an angle θ to the vertical.

insulating thread

θ

+5000 V

0 V

Show that the horizontal force on the sphere is about 5×10^{-4} N.

distance between plates = 10.5 cm

(3)

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(iii) Show that θ is about 1°.

mass of sphere = 2.7 g

(3)

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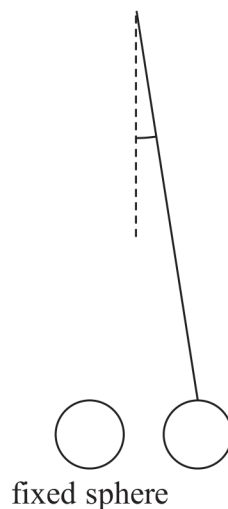
(c) A second identical charged sphere is held in a fixed position.

The first sphere, attached to the insulating thread, is placed near to the fixed sphere.

The spheres exert a repulsive force on each other.

fixed sphere

The force between the spheres is $5.0 \times 10^{-4}\,\text{N}$.

Calculate the distance between the centres of the spheres.

charge on each sphere = 12 nC

(3)

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Distance between centres of spheres = ...

(Total for Question 17 = 14 marks)