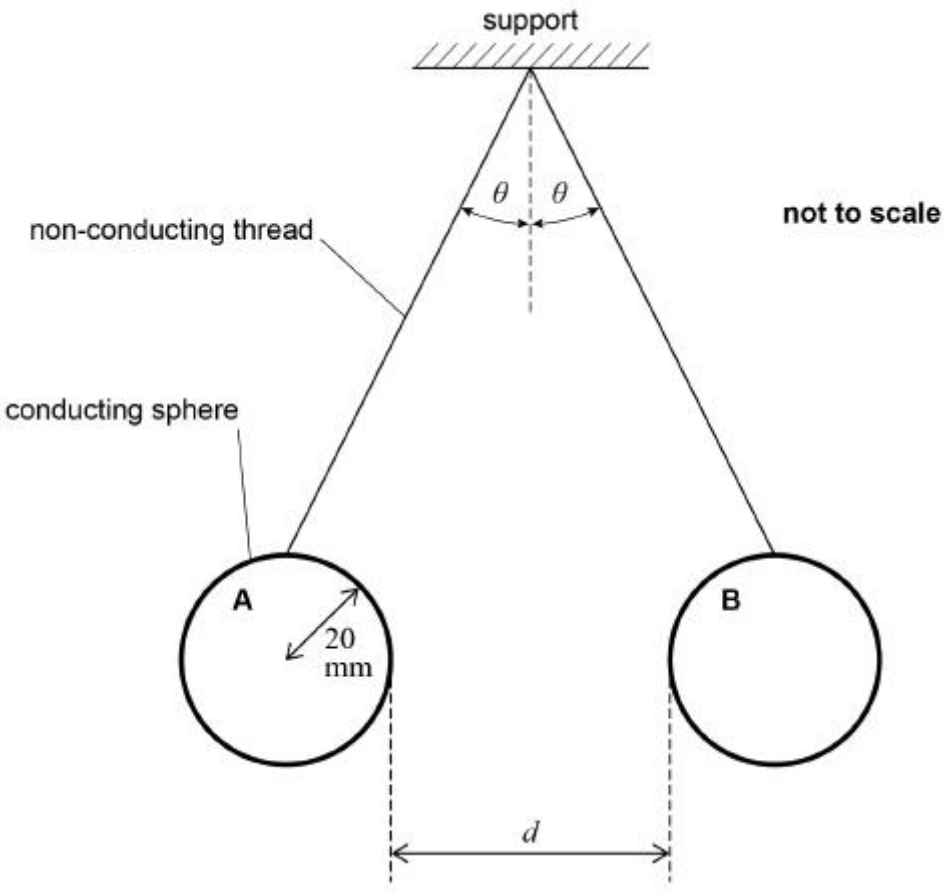
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

The diagram shows an arrangement used to investigate the repulsive forces between two identical charged conducting spheres.
The spheres are suspended by non-conducting thread.



Each sphere has a mass of 3.2×10^{-3} kg and a radius of 20 mm.
The distance d is 40 mm.

The capacitance of a sphere of radius r is $4\pi\varepsilon_0 r$.

Each sphere is charged by connecting it briefly to the positive terminal of a high-voltage supply, the other terminal of which is at 0 V.
After this has been done the charge on each sphere is 52 nC.

(a) Calculate the potential of one of the spheres.

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potential = _____ V

(3)

(b) The charged spheres in the diagram above are at equilibrium.

Draw labelled arrows on the diagram to show the forces on sphere **B**.

(2)

(c) Suggest a solution to **one** problem involved in the measurement of d in the diagram.

_____

_____

_____

_____

_____

_____

(2)

(d) Show that the magnitude of the electrostatic force on each sphere is about 4×10^{-3} N.

(3)

(e) A student measures the angle θ when the apparatus in the diagram above is at equilibrium. The student records θ as 7°.

Discuss whether this measurement is consistent with the other data in this investigation.

_____

_____

_____

_____

(2)

(f) The student says that the gravitational force between the two spheres has no **significant** effect on the angle at which the spheres are in equilibrium.

Deduce with a calculation whether this statement is valid.

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_____

_____

(2)

(Total 14 marks)

Q2.

(a) State what is meant by a capacitance of 370 μF

_____

_____

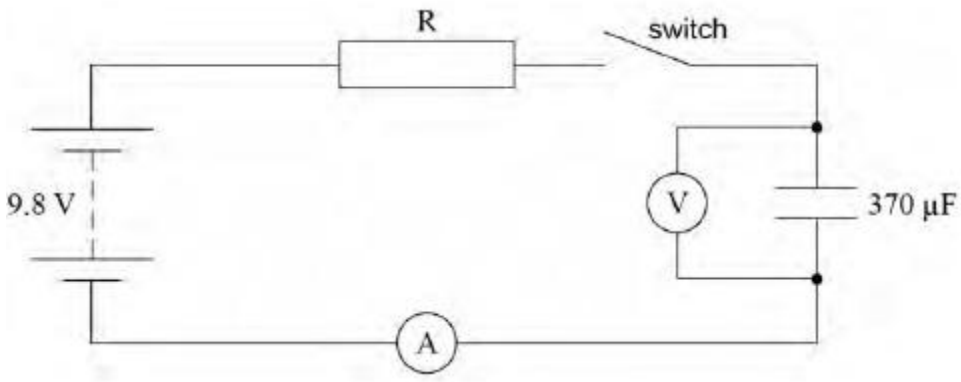
_____

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(2)

(b) The charging of a 370 μF capacitor is investigated using the circuit shown in **Figure 1**.
Both meters in the circuit are ideal.

Figure 1



The power supply of emf 9.8V has a negligible internal resistance. The capacitor is initially uncharged. When the switch is closed at time $t = 0$ charge begins to flow through resistor R.
The time constant of the charging circuit is 1.0 s

Calculate the resistance of R.

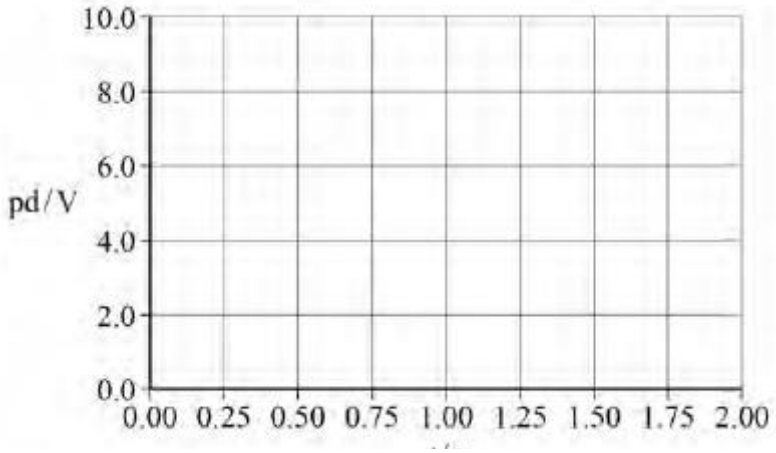
resistance of R = _____ Ω

(1)

(c) Identify, with the symbol X on **Figure 2**, the potential difference (pd) across the capacitor when the switch has been closed for 2.0 s
Sketch the graph that shows how the pd varies from $t = 0$ to $t = 2.0$ s

Figure 2

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(2)

(d) Calculate the time taken for the charging current to fall to half its initial value.

time = _____ s

(1)

(e) Calculate the time taken for the charge on the capacitor to reach 3.0 mC

time = _____ s

(3)

(Total 9 marks)

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