Question 1 . *This question consists of **two** parts A and B; attempt both parts.*

PART A
You are provided with the following:
- a pendulum bob
- a stop-watch
- two metre rules
- two retort stands, two bosses and two clamps.
- some thread.

Proceed as follows:

(a)   Clamp one metre rule horizontally on the two stands so that the graduations are in a vertical plane. Suspend the pendulum bob from the metre rule with two pieces of thread so that the length of each thread from the point of support on the metre rule to the pendulum bob is 50 cm. See **figure 1**. *The length of each thread will remain 50 cm throughout the experiment. The height of the metre rule above the bench should be at least 65 cm.*
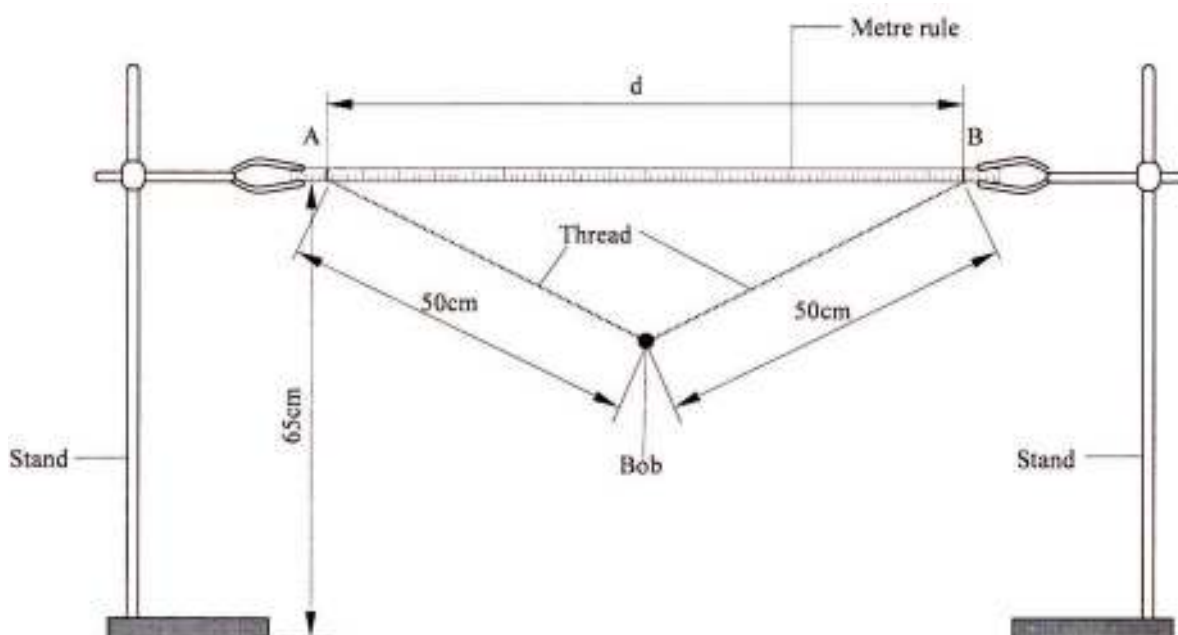

Figure 1

(b)   Set the distance d between **A** and **B** to be 70 cm. Displace the pendulum bob slightly in a plane perpendicular to the length of the metre rule and release it so that it oscillates in that plane. Measure and record in **table 1** the time t for 20 oscillations.

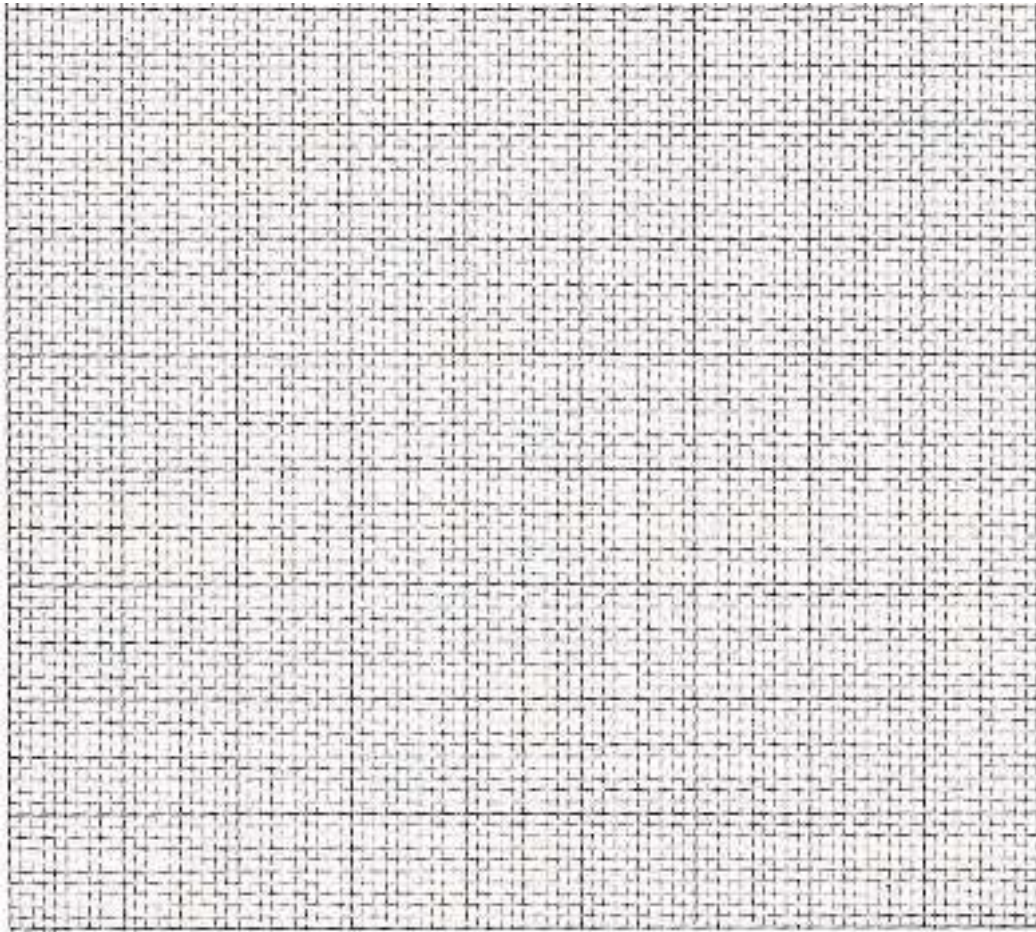(c)   Repeat the procedure in (b) for other values of d shown in **table 1**. Complete the table.

Table 1

Distance d (cm)	70	60	50	40
time t for 20 oscillations (s)				
Period T =				
T^4 (s^4)				
d^2 (cm^2)				

(4 marks)

(d)   (i)   Plot a graph of T^4 (y - axis) against d^2.   (4 marks)

(ii)   Determine the slopes S of the graph.   (2 marks)

(iii)   Given that $S = \dfrac{-4\pi^4}{K^2}$, determine the value of K.   (2 marks)

PART B

You are provided with the following:
- two stands, two clamps and two bosses.
- one meter rule
- one Bar magnet
- a piece of thread
- weighing balance (to be shared)
- stop watch

Proceed as follows.

(e)   Using the meter rule measure the length L and breadth b for the magnet.
        (b is the second largest dimension of the magnet).

        L = ... m

        b = ... m   (1 mark)

(f)   Use the balance to measure the mass M of the magnet.

        M = ... kg.   (1 mark)

(g)   Determine P given that $P = \dfrac{M}{3}(L^2 + b^2)$.   (2 marks)

(h)   Clamp the meter rule between the two resort stands. Using a piece of thread suspend
        the bar magnet from the centre of the metre rule so that its length and breadth are both
        in a horizontal plane as shown in **figure 2**.

        Keep away all unnecessary magnetic materials including voltmeter form this
        experimental set up.
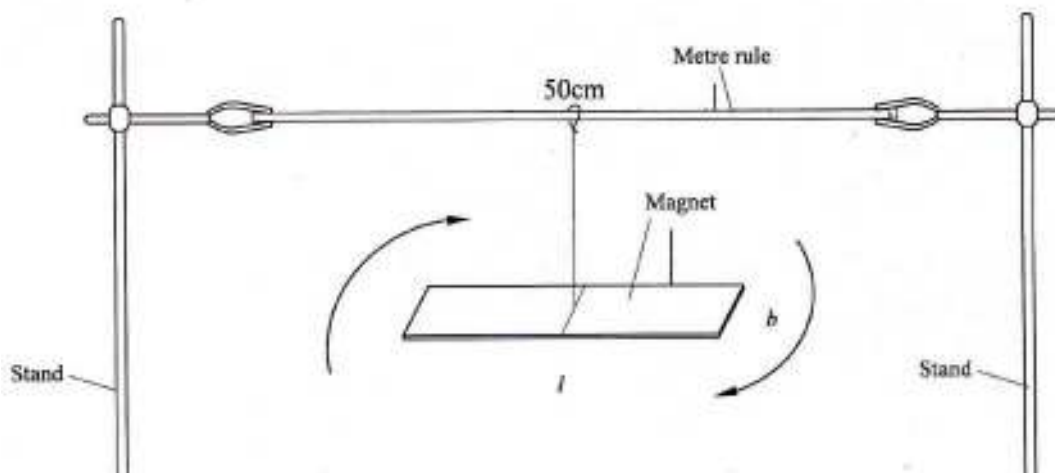
(i)   (I)   Displace one end of the magnet through a small angle and let it oscillate about
                a vertical axis through its centre as shown by the arrows. Measure the time t for
                10 oscillations.   (1 mark)

                (a)   t = ... s

(II)   Determine the period T of the oscillations.   (1 mark)
(III)   Determine the constant G given that $T = 2\pi \sqrt{\dfrac{P}{G}}$.   (2 marks)

Question 2

*This question consists of **two** parts A and B, attempt both parts.*

PART A

You are provided with the following

 - a voltmeter
 - a capacitor
 - a switch
 - a stop watch
 - five connecting wires
 - two cells and a cell holder

Proceed as follows:

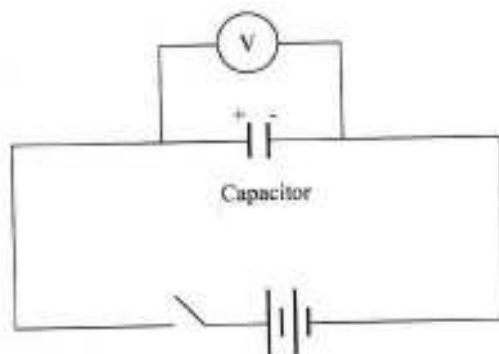(a)   Connect the circuit as shown in **figure 3**.

Figure 3

Make sure that the terminals of the capacitor and those of the battery are correctly connected, *(positive to positive and negative to negative)*.

(b)   Close the switch, read and record the maximum voltage V_o, across the
        capacitor.
        V_o =..............................volts   (1 mark)

(c)   While the voltmeter shows the maximum voltage V_o, open the switch and start
        the stop watch simultaneously. Stop the stopwatch when the voltage has
        dropped from V_o to 2.5 V. Read and record in **table 2** the time taken.

(d)   Reset the stopwatch and close the switch. Repeat the procedure in (c) to
        measure and record the time taken for the voltage to drop from V_o, to each
        of the other values shown in **table 2**.

Table 2

Voltage (V)	2.5	2.25	2.0	1.75	1.50	1.25
Time, t (s)						

(3 marks
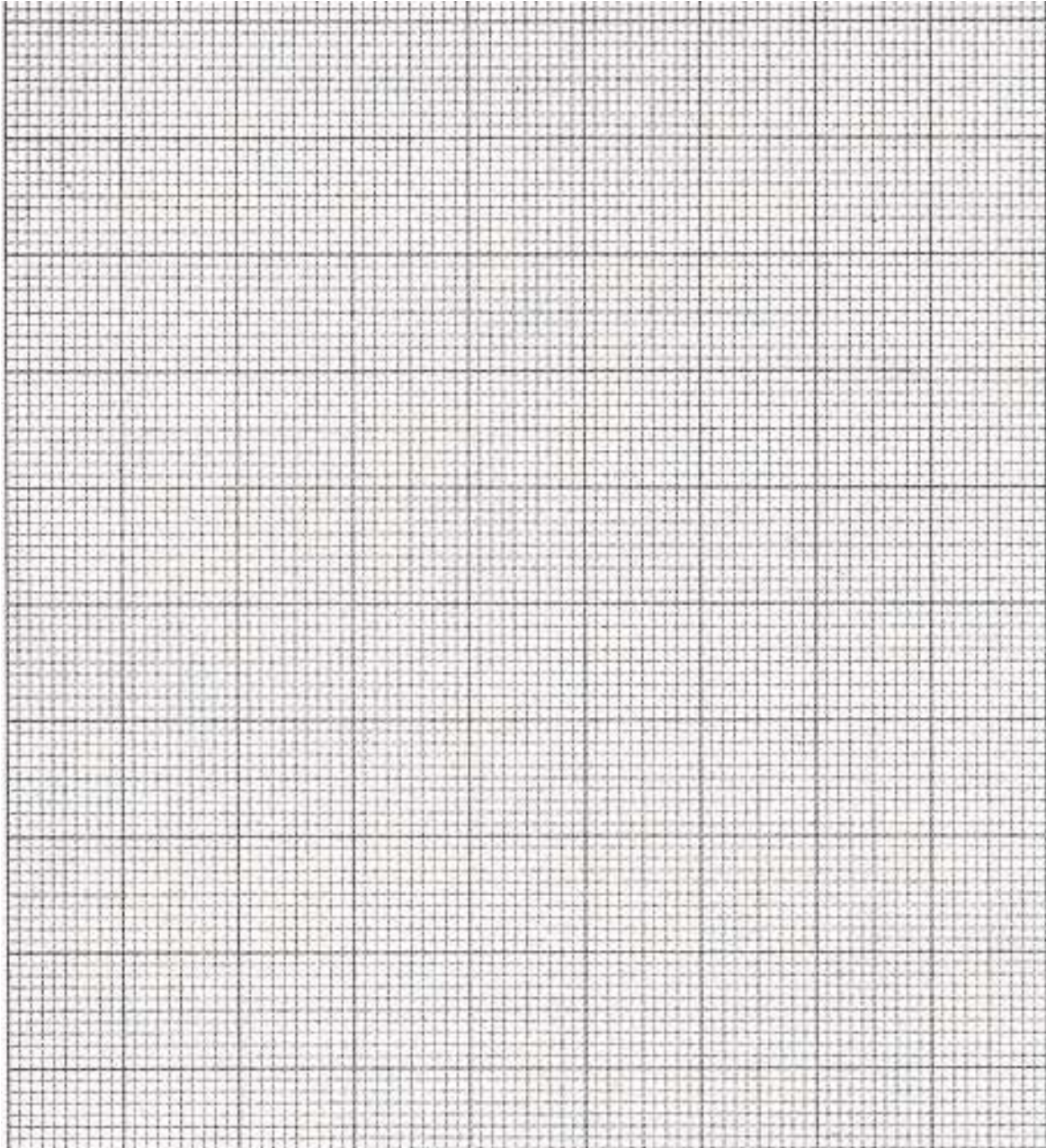
(e)   (i)   On the grid provided, plot a graph of Voltage V (y-axis) against time t,

(4 marks)

    (ii)   Use the graph to determine the time **t** at which $V = \frac{V_0}{2}$

t =...................... seconds   (1 mark)

(f)   Determine the resistance R of the voltmeter given that
        $t = 0.693CR$ where C is the capacitance of the capacitor.
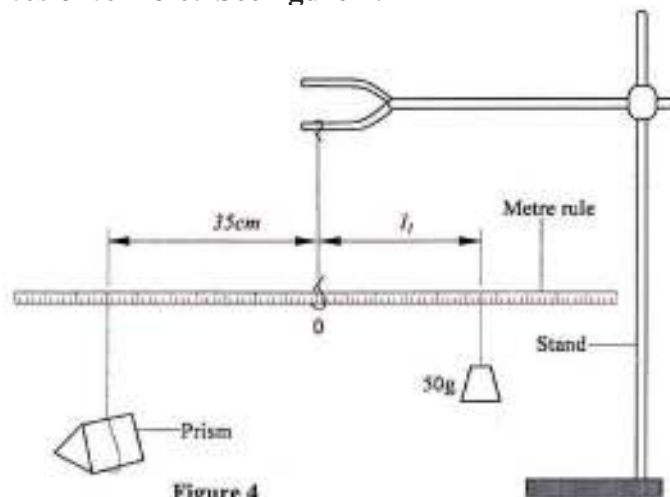
(1 mark)

PART B

You are provided with the following:
- a triangular glass prism
- a metre rule
- a 50 g mass
- some hot water
- some cold water
- some thread
- a thermometer
- one stand, one boss and one clamp
- a beaker

Proceed as follows:

(g)   Using a piece of thread suspend the metre rule from the clamp on the stand and adjust
        the position of the thread until the metre rule balances horizontally. Note this position,
        O of the thread. *(This position of the thread must be maintained throughout the
        experiment).*

(h)   Using another piece of thread suspend the glass prism from the meter rule at a point
        35 cm from O. Suspend the 50 g mass on the opposite side of O using another piece
        of thread. Adjust the position of the thread attached to the 50 g mass until the metre
        rule balances once more. **See figure 4**.

Figure 4

(i)   Determine the distance l_1 between O and the point of support of the 50 g
        mass.

l_1 = ... cm   (1 mark)

(ii)   Use the principle of moments to determine the weight W_1 of the prism in air.
        (Take g = 10 N kg⁻¹)   (1 mark)

(i)   Put cold water into the beaker (approximately three quarter ($\frac{3}{4}$ full). With the glass prism still at 35 cm from O, determine the distance l_2 of the 50 g mass at which the rule balances when the prism is fully submerged in the cold water. **See figure 5.**
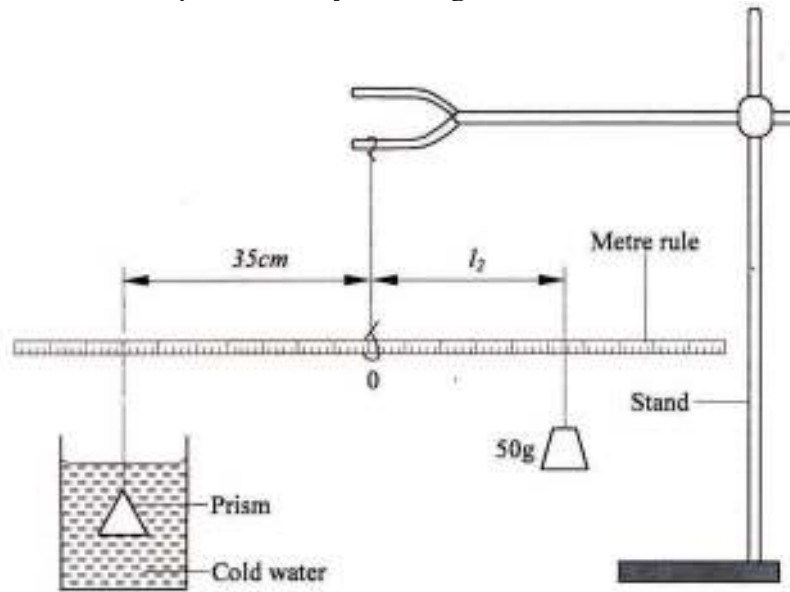

Figure 5

(I) l_2 = ...cm   (1 mark)

(II)   Determine the weight W_2 of the prism in the cold water.   (1 mark)

(j)   Measure and record the temperature T_1 of the cold water when the system is balanced.

T_1 = ...°C   (1 mark)

(k)   Now pour out the cold water and replace it with hot water. Balance the metre rule with the prism fully submerged in hot water. ***Ensure that the prism is still supported at 35 cm from 0.***

(i) Determine the distance l_3 of the point of support of the 50 g mass when the prism is submerged in hot water.

l_3 = ... cm.   (1 mark)

(ii)   Measure and record the temperature T_2 of the hot water.

T_2 =.........................°C   (1 mark)

(iii)   Determine the weight W_3 of the prism in hot water.   (1 mark)

(l)   Determine the constant k for the water given that:

$$k = \frac{(w_1 - w_2) - (w_1 - w_3)}{(w_1 - w_3)(T_2 - T_1)}$$ (2 marks)

81