QUESTION 1

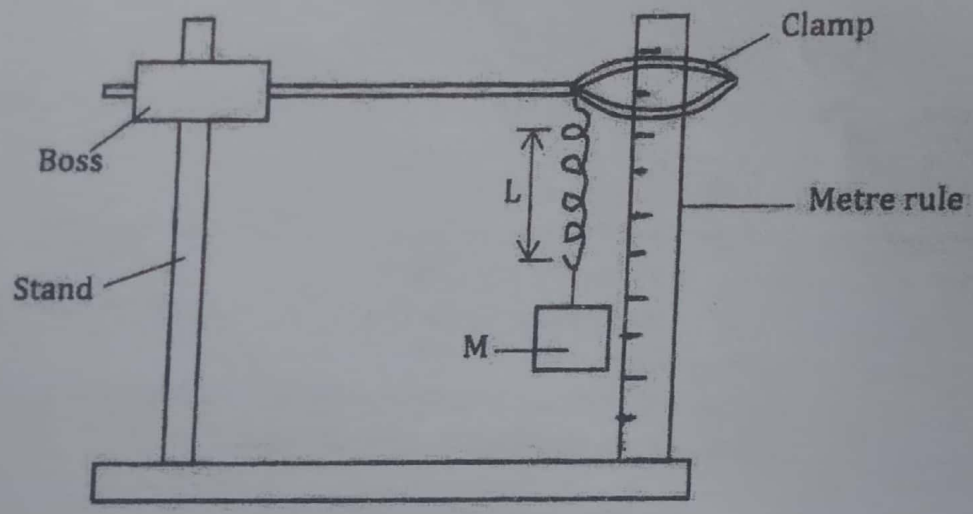
PART A1

(a) You are provided with the following apparatus.

- Helical spring with pointer
- One clamp, one stand and one boss
- A stop watch
- One 50g mass
- Two 100g masses

Proceed as follows:

(i) Suspend the spring vertically alongside a clamped metre rule as shown in the diagram so that the pointer slide along the millimeter scale of the metre rule as shown in the figure below.



(ii) Measure the length L_0 of the unloaded spring. (1/2 mark)

L_0 = 52.5 cm 1dp own value

(iii) Attach a mass of 100g on the spring and measure the new length L of the spring. Record this in the table. (5 marks)

Table

Mass (kg)	Weight .... (N)	L(M) ±0.01	e = (L – L_0)(M) ±0.01	K = $\frac{W}{e}\left(\frac{N}{M}\right)$
~~100~~ 0.10	1.0	0.55	0.015-0.035	28.57-66.67
~~150~~ 0.15	1.5	0.57	0.035-0.055	21.82-34.29
~~200~~ 0.20	2.0	0.59	0.055-0.075	26.67-36.36

1 2 maintain delimns 1 1

(iv) Calculate the change in length $e = (L - L_0)m$ due to the mass of 100g and record in the table.

(v) Repeat the procedure in (i) – (iv) for mass of 150g and 200g.

(vi) Calculate the value of K given:

$K = \frac{w(N)}{e(M)}$ and find the average value of K. (1/2 mark)

K Average = ~~0~~ Cheak average

32.476 N/m ± 4 ✓ ½

PART A2

(a) (i) Using the same set up as in Part A above, attach the 100g on the spring and support it to stop oscillating.

(ii) Pull the mass through a small distance vertically downwards and release it to make vertical oscillations and record the time for 10 oscillations and determine the periodic time (s).

(iii) Hence complete the table to get $T^2(s^2)$ and the value of $K = \frac{39.49 \times M(Kg)}{T^2(S^2)}$ where M = mass used and $T^2(S^2)$ is its periodic time T squared.

(iv) Table (3 1/2 marks)

Mass m(kg)	Time for 10 oscillations t(s)	T(s) $T = \left(\frac{t}{10}\right)$ ±0.2	$T^2(S^2)$	$\frac{39.49 \times M(Kg)}{T^2(S^2)}$
~~1.00~~ 0.10	4.00 - 8.00	0.600	016 - 0.64	10.97
~~1.50~~ 0.15	7.00 - 11.00	0.910	0.504 - 1.210	7.154
~~2.00~~ 0.20	9.00 - 13.00	1.140	0.81 - 1.69	6.077

3½

(v) Find the average value of K (1/2 mark)

$K = \frac{10.97 + 7.154 + 6.077}{3}$ ✓ ½

$= 7.067\ kg/s^2$ ± 0.4

PART B

(b) You are provided with the following:

- A meter rule
- Complete stand
- One 50g mass and a 100g mass
- Three Pieces of thread 30cm each
- Some water in a beaker
- Liquid L in a beaker
- Tissue paper.

Proceed with the experiment as follows:

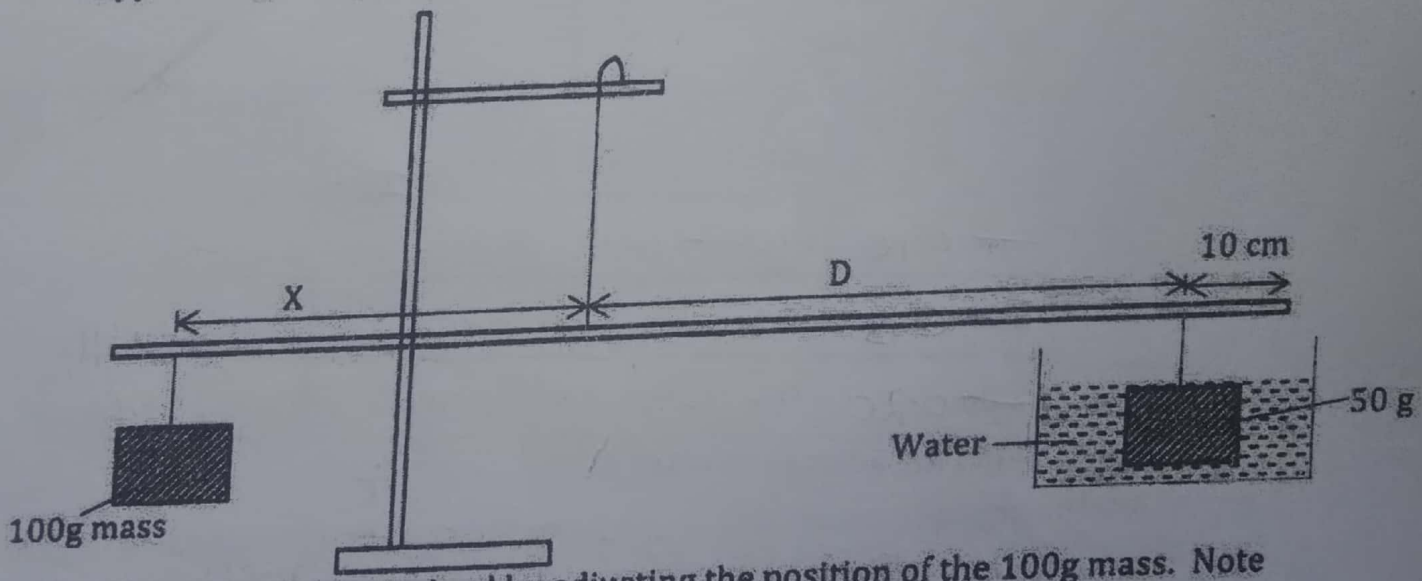
(i) Balance the meter rule on the stand and record the reading at this point.

Balance point = 5.0 cm ± 1 (1 mark)

(For the rest of the experiment, the balancing thread must be placed at this position)

(ii) Set up the apparatus as shown in the figure 4 below;

Use the thread provided to hang the masses such that the positions of the support can be adjusted.



The balance point is attained by adjusting the position of the 100g mass. Note that the distance X and D are measured from the supporting string and the 50g mass is fully submerged in water.

Record the values of X and D.

X = 16.5 – 18.5 cm (1 mark)

D = 39.2 – 41.2 cm (1 mark)

Apply the principle of moments to determine the weight W_1 of the 50g mass in water and hence determine the upthrust U_w in water. (2 marks)

$F_1 d_1 = F_2 d_2$

$1 \times 17.5 = 40 \times W_1$; $W_1 = 0.4375N$

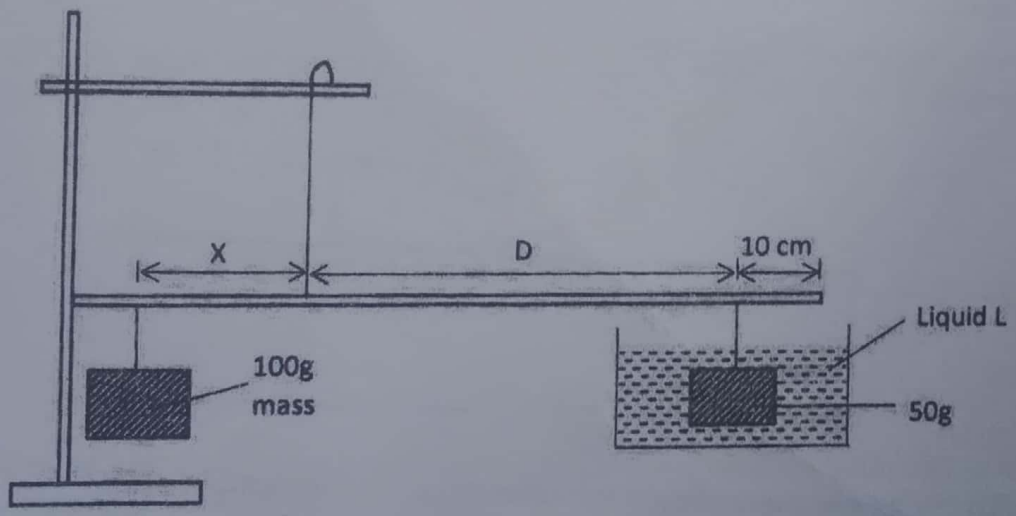
W_1 = 0.4375N ± 0.01

U_w = 0.5 − 0.4375 = 0.0625N ± 0.01

Remove the 50g mass from the water and dry it using the tissue paper

(iii) Now balance the metre rule when the 50g mass is fully immersed in the liquid L.

Record the value of the distance X.



X = 17.2 − 19.2 cm (1 mark)

Apply the principle of moments to determine W_2 of the 50g mass in the liquid L and hence determine the upthrust U_L in the liquid. (2 marks)

W_2 = 0.455N ± 0.01

U_L = 0.5 − 0.455 = 0.045N ± 0.01

$F_1 d_1 = F_2 d_2$

$1 \times 18.2 = 40 W_2$

$W_2 = 0.455$

(iv) Determine the relative density R.D of the liquid L given that:

$R.D = \frac{U_L}{U_W}$ (1 mark)

$\frac{0.045}{0.0625} = 0.72 \pm 0.2$

(v) Find the density of liquid L in Kg/m³ (1 mark)

$\rho_L = R.D \times \rho_W$ ½

$= 0.72 \times 1 g/cm^3$ ½

$= 0.72 g/cm^3$ or $720 kg/m^3$

5

$(700 - 740) kg/m^3$

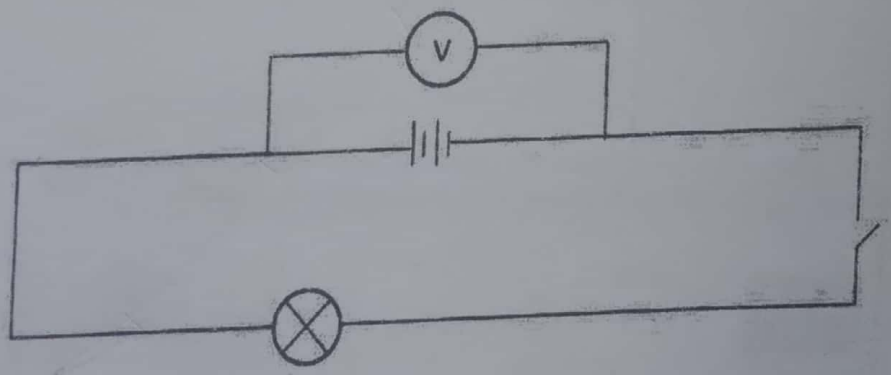
QUESTION 2

You are provided with the following apparatus

- Two dry cells and a cell holder
- A voltmeter
- An ammeter (0 – 1A)
- Potentiometer P
- A bulb and bulb holder
- 7connecting wires
- 4 crocodile clips
- A switch S

PART A

Set up the circuit as shown below.
Ensure the switch is off.



(i) Record the reading of the voltmeter when the switch is open (1 mark)

V_1 ..... 3.0 V ± 0.2 ..... 1dp .....

(ii) Close the switch and record the voltmeter reading. (1 mark)

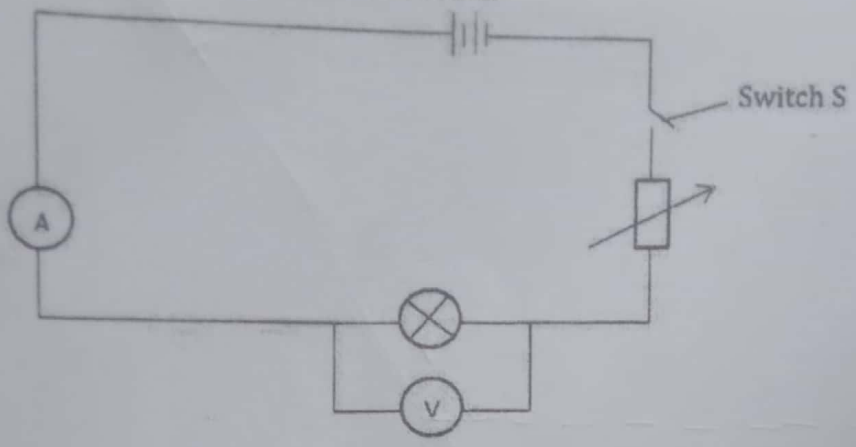
V_2 ..... 2.7 V ± 0.2 ..... 1dp .....

(iii) Explain the differences in the value of V_2 and V_1 (1 mark)

Some voltage is lost / dropped due to internal resistance (r) of the cells.

PART B

(a) Set up the circuit as shown below.



Close the switch S and adjust the potentiometer P till the bulb lights brightest. Record the ammeter and voltmeter reading.

I ..... 0.23A ± 0.02 2dp ..... (1 mark)

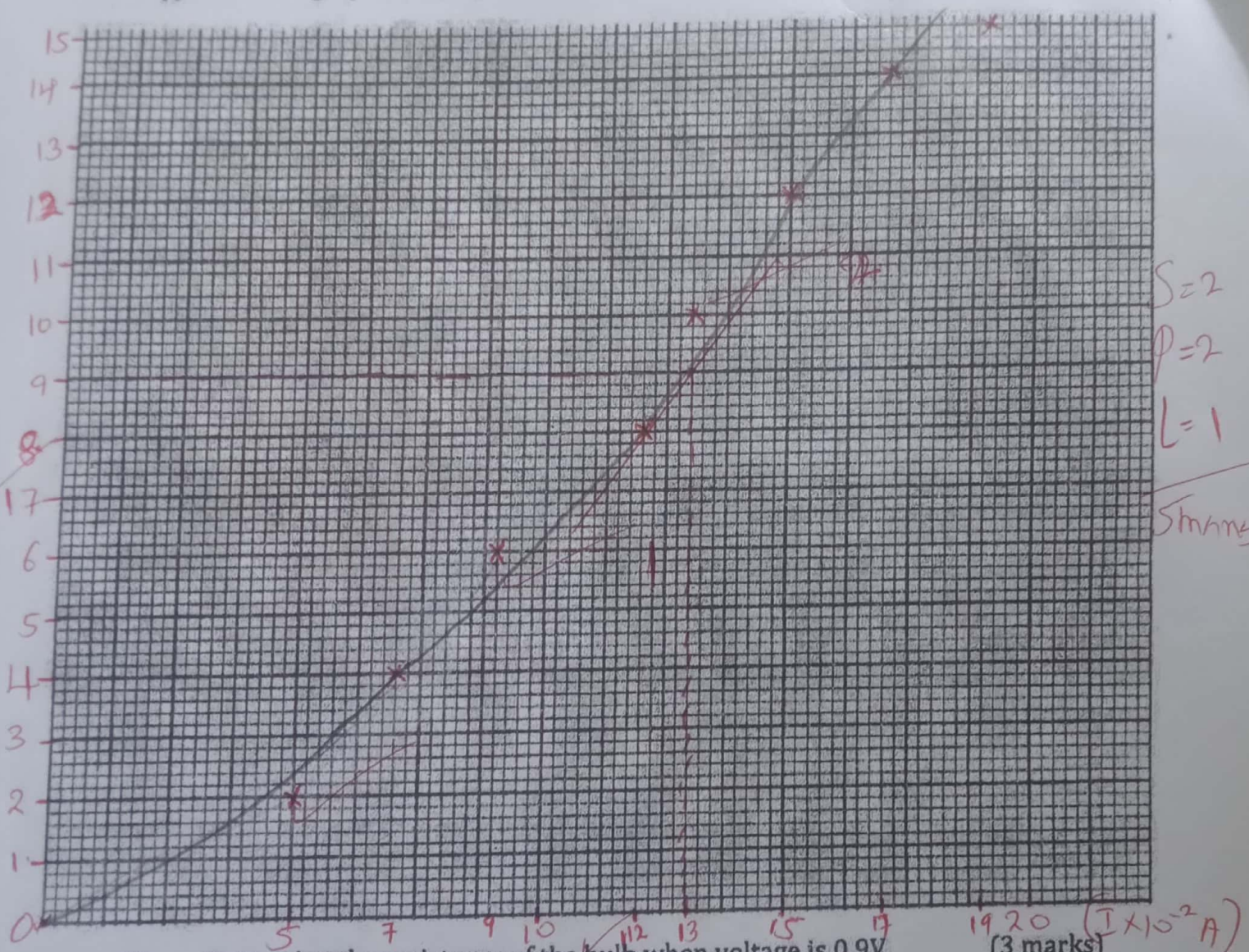
V ..... 2.1V ± ~~0.02~~ 0.2 1dp ..... (1 mark)

(b) By adjusting the potentiometer P obtain the corresponding readings of the values of voltmeter readings given in the table. (6 marks)

Volts (V)	1.5	1.4	1.2	1.0	0.8	0.6	0.4	0.2
Current I (A)	0.19	0.17	0.15	0.13	0.12	0.09	0.07	0.05

±0.02 2dp

(i) Plot a graph of voltage against current. (5 marks)



(ii) Determine the resistance of the bulb when voltage is 0.9V. (3 marks)

$V = IR$

$0.9 = (13.0 \times 10^{-2})R$ ✓1

$R = \frac{0.9}{13.0 \times 10^{-2}}$ ✓1

$R = 6.92\,\Omega \pm 0.3$ ✓1

Also Check instantaneous gradient at V = 0.9V

(iii) Explain the nature of the curve in the graph. (1 mark)

The resistance of the ~~bulb~~ filament bulb increases Variably/non-linearly