QUESTION ONE

This question has two parts A and B. Answer all the parts

PART A

You are provided with the following:

- A metre rule
- Two identical 100g masses (labelled A and B)
- Liquid L in 250ml beaker, $\frac{3}{4}$ full.
- Three pieces of thread, each 30cm long.
- Stand with clamps
- Tissue paper.
- Vernier calipers

Proceed as follows:

a. Take one 100g mass and measure the diameter d and height h using the Vernier calipers

d= 0.011 3d.p. ....m

h= 0.011 3d.p ....m Accept any because the measurements of the masses were not specified. (1mark)

b. Determine the volume V given that $V = \pi(\frac{d}{2})^2 h$

V....EXACT OR 4 S.F.....m^3 (1mark)

c. Using a stand and one piece of thread, suspend the metre rule in air such that it balances horizontally. Record the position of the centre of gravity. G.

G = 50.0 ±1 1 d.p. **cm** (1mark)

NOTE: The metre rule should remain suspended at this point throughout the experiment.

d. Set up the apparatus as shown in Figure 1 below;

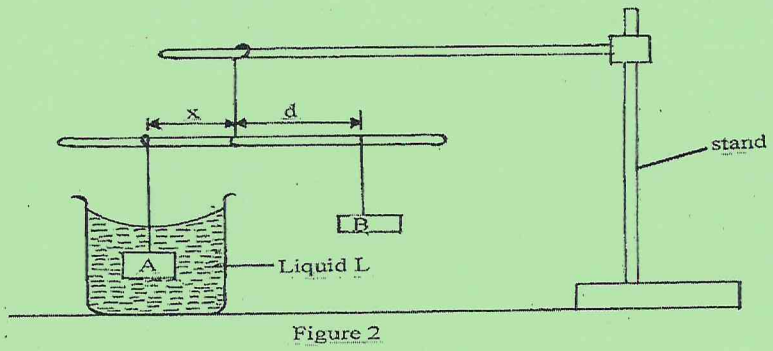


Figure 2

3 mks

- Suspend the mass A at a distance x = 30cm and completely immerse it in liquid L without touching the sides of the beaker.
- Hang mass B and adjust its position such that the rule is balanced and measure the distance d cm. Tabulate your results in table 1 below;

$x\ (cm)$	30	35	40
$d\ (cm)$	26.0	31.0	35.0
$\frac{d}{x}$	EXACT OR 4SF.		

Any 2 Correct @ $\frac{1}{2}$ mk

± 0.5

Any 2 Correct @ $\frac{1}{2}$ mk

(2marks)

e. Determine the weight F of one of the masses A or B in air. Given that

$g = 10N/Kg$ and A =B

Weight F in air = ... 1 N ✓1 ..... (1mark)

Ignore unit but penalise fully if the unit is wrong.

f. Using the principle of moments, determine the apparent weight P of A when completely immersed in liquid L.

$1 \times d = W \times$ Corresponding value of x

$1 \times 26 = W \times 30$ ✓1

Apparent weight P = ... 0.8667 ✓1 ..... (2marks)

Ignore unit but penalise fully if unit is wrong.

g. Find the upthrust U on A when completely immersed. (1marks)

Upthrust; U = ... Answer @ e − Answer @ f ✓1/2

= EXACT ✓1/2

Ignore unit but penalise fully if unit is wrong.

h. Determine the density of liquid L, given that; (1mark)

$$\rho = \frac{Un}{V} \quad where\ n = 0.1Kg/N$$

$$= \frac{\text{Answer @ g} \times 0.1}{\text{Answer @ b}} \quad ✓1/2$$

$$= \text{EXACT OR 4S.F.} \quad ✓1/2$$

Ignore unit but penalise fully if unit is wrong.

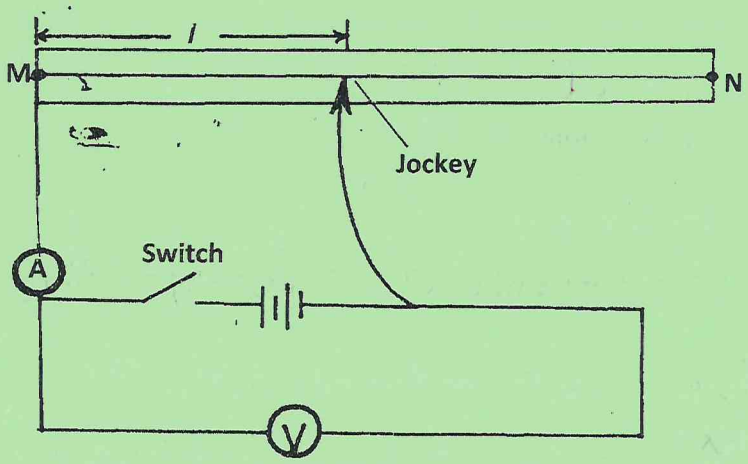
7 mks.

PART B

You are provided with the following apparatus:

- Resistance wire fitted on a millimeter scale labeled MN
- Switch
- Voltmeter
- Ammeter
- Two dry cells in a cell holder
- Six connecting wires
- Micrometer screw gauge

i. Set –up the apparatus as shown in the Figure 2 below;



ii. Remove the crocodile clip from the resistance wire MN and close the switch. Record the voltmeter reading V_0.

V_0 = 3·00 ± 0·20, 1 d.p. ✓ 1 (1mark)

Deny ½mk for missing unit; penalise fully if unit is wrong.

iii. Attach the Jockey to the resistance wire such that l = **50cm**

iv. Record the voltmeter and ammeter readings as V_1 **and** Z respectively

V_1 = 2·70 ± 0·20, 1 d.p. ✓ 1

Z = 0·17 ± 0·05, 2 d.p. ✓ 1

Deny ½mk for missing unit, (1mark)

Penalise fully if unit is wrong. (1mark)

3mks.

v. Determine the value of **X** given that $X = \frac{V1}{z}$ (1mark)

- Correct Substitution. ✓ 1/2
- Evaluation - Ignore unit but Penalise fully for wrong unit. ✓ 1/2

vi. Use the equation below to determine the value of **k , where m = 2.549Ω** (2marks)

$$\frac{V_1}{V_0 - V_1} = \frac{mX}{5} + k$$

- Correct Substitution ✓ 1
- Evaluation ✓ 1

Deny ½mk for missing Unit, Penalise fully for wrong unit.

vii. Measure the diameter **d** of the of the wire on the millimeter scale using the micrometer screw gauge

d = 0.31 ± 0.03 ✓ 1 mm = 5d.p. or 1d.p of std form ($\times 10^{-4}$) m (2marks)

viii. Determine the resistivity ƒ of the wire used in this experiment given that (2marks)

$$X = \frac{\rho l}{A}$$

- Correct Substitution ✓ 1 (Units must be consistent)
- Evaluation - Deny ½mk for Missing unit.

To deny ½ mk for missing unit, penalise fully if unit is wrong.

7mks.

QUESTION TWO

You are provided with the following apparatus

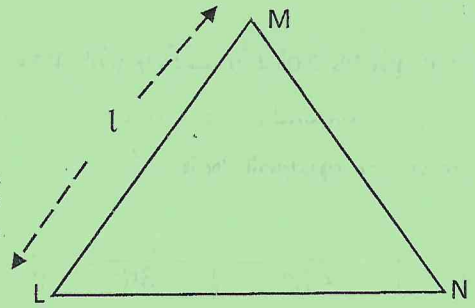
- A glass prism
- A plain sheet of paper
- A soft board
- 4 optical pins
- 4 paper pins

Proceed as follows

a.

i. Firmly fix the plain sheet of paper on the soft board using the thumb pins and place the prism near the centre of the paper. Trace the outline of the prism using a pencil.

ii. Remove the prism from the outline and label the vertices of the outline AB and C as shown in Fig. 3a



Measure Angle LMN and length l

Angle LMN..... $60^{\circ} \pm 1$ whole number ..... (1mark)

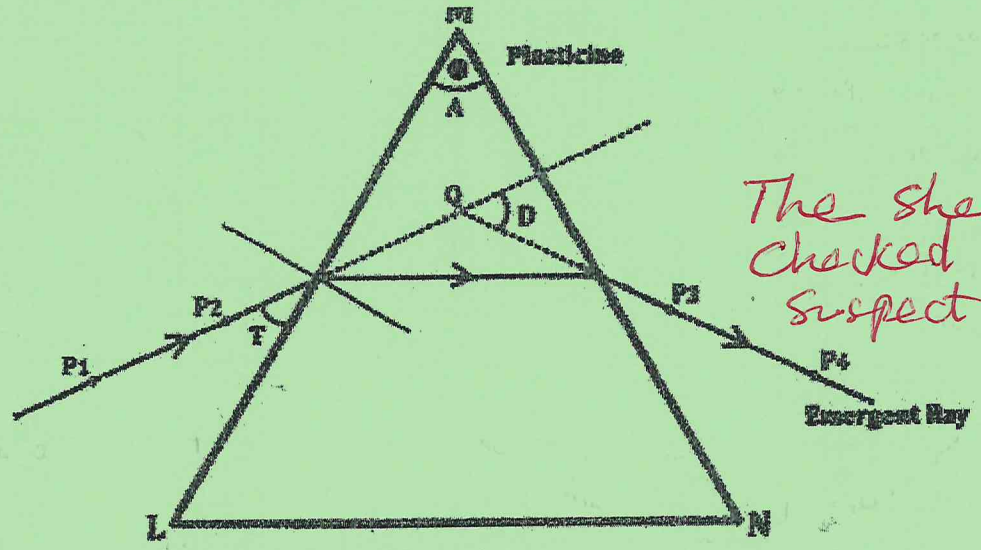
Length l ..... 3.8 ± 0.2, 1 d.p (cm) ..... (1mark)

Deny ½ mk for missing unit, Penalise fully if unit is wrong.

Deny ½ mk for missing unit, Penalise fully if unit is wrong.

2 mks.

iii. On the side ML mark a point and draw a normal. Measure an angle T of 60° from the surface and draw a line along this angle as show in Figure 3b.



The sheet can be checked where we suspect cheating.

Mark the sheet but award no marks.

iv. Replace the prism on the outline and fix pins P_1 and P_2 on the 60° line at a distance of 3cm from each other. View the images of the pins P_1 and P_2 through side MN and fix P_3 and P_4 so that all the pins appear on one line.

v. Remove the prism and draw a line to pass through the holes made by pins P_3 and P_4.extend the line into the outline as shown in figure 3b.Also extend the 60° line so that the two lines cross each other. Determine angle D and record it in the table below

b. Repeat the procedure and complete the table below (6marks)

Angle T (°)	60°	50°	40°	30°	20°
Angle D(°)	47	40	39	41	44
Angle I°(90° − T)	EXACT SUBTRACTION (All Correct @ 1mk.				

5mks.

c. Determine the average value D_m of D (1mark)

All the five values must be seen to have been averaged.

$$= \frac{\text{Value of D at } 60^\circ + \text{Value of D at } 50^\circ + \cdots\cdots \text{Value of D at } 20^\circ}{5} \quad \checkmark 1/2$$

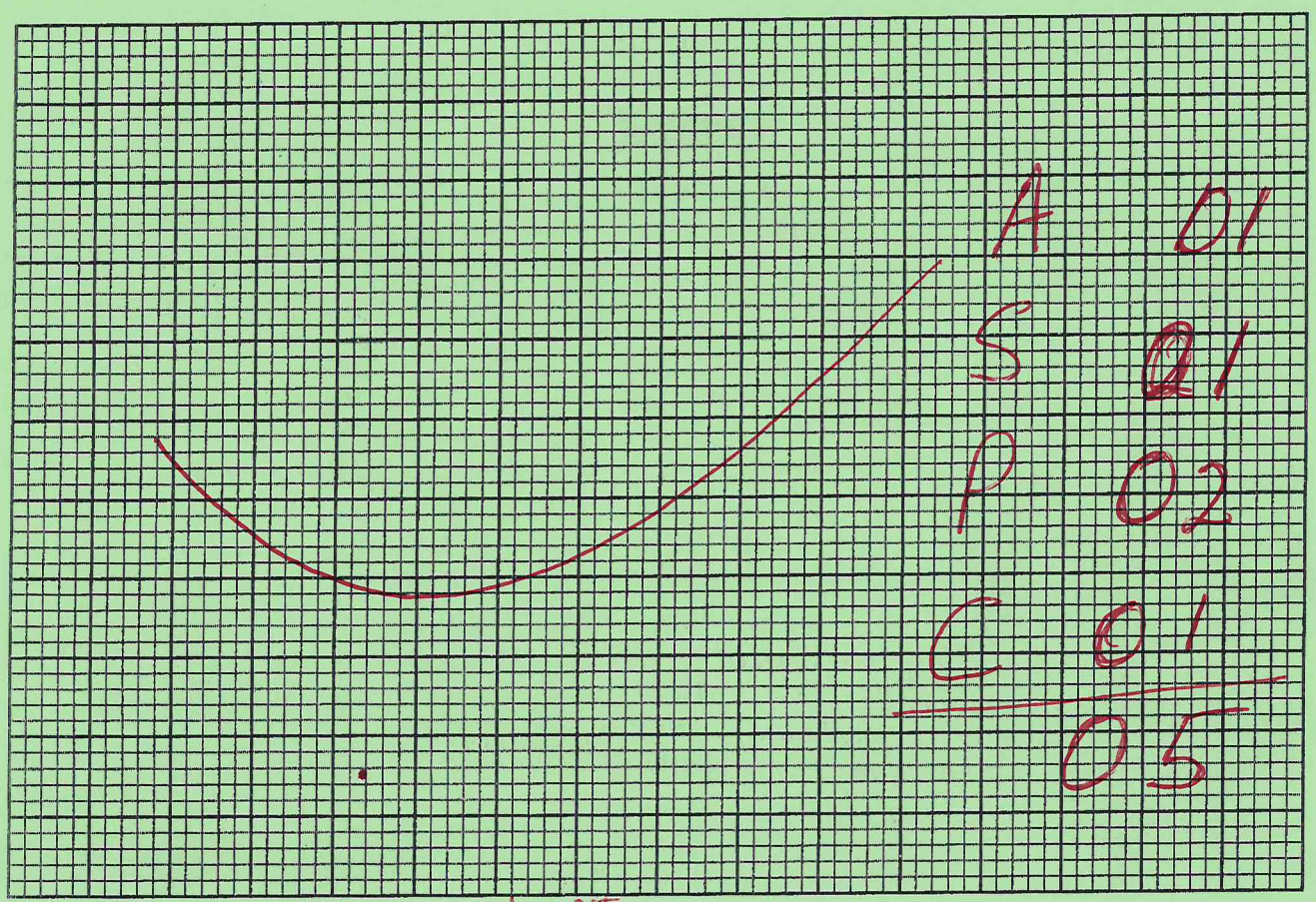
$$= \text{——} \quad 7 \checkmark 1/2$$

Ignore the unit but penalise fully if the unit is wrong.

7mks.

plotting allowance on a graph / allowance of Reading a point on a graph / 1 small square.

d. On the grid provided plot a graph of Angle D (y-axis) against Angle I (5marks)



e. Use your graph to determine the ~~highest~~ lowest value H_{max} of angle D

H_{max} Indicated or shown on graph even if the graph has not scored the marks for line. (1mark)

f. Determine the value of I° when D° is 41° (2mark)

As above for (e.)

g. Determine the constant K for the glass prism from the formula (3marks)

$$k = \frac{\sin(\frac{A + D_m}{2})}{\sin\frac{A}{2}}$$

Ignore units but penalise fully wrong units at accuracy mark.

Correct substitution ✓1

Evaluation ✓1 (Exact or 4 S.f.)

Accuracy (1.5 ± 0.1) ✓1

* Three points will be required to qualify a mark for Curve, with an allowance of 1 small square.

11mks.