BSJE

PHYSICS PAPER 3 SCHEME.

QUESTION ONE

1. ***You are provided with the following apparatus:***

- Rectangular glass block
- Two plain papers
- Four optical pins
- Four paper pins or thumb pins
- Protractor
- Half metre rule

PART A:

PROCEDURE:

(i)Place the glass block on the plain paper on it's largest area, trace it's outline and mark it's sides A,B,C and D . Mark the point P_0 on the centre of side BC as shown in figure 1 below;

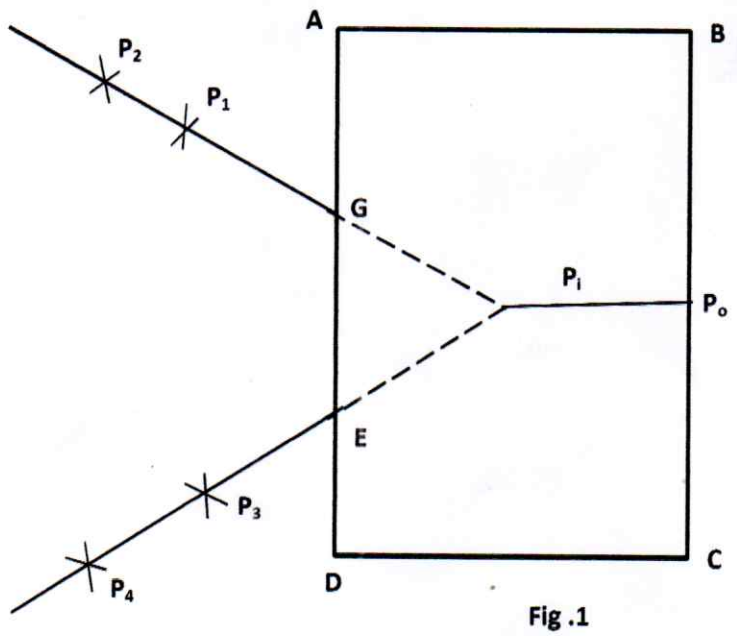


Fig .1

(ii)Measure the breadth of the glass block.

b =....6.2.....cm (1mk)

(iii)Replace the glass block and fix an object pin at P_0 such that the pin lies along the surface of the glass block.

(iv)With your eye on the side AD closer to A ,fix pins P_1 and P_2 such that they are in line with the image P_i of P_o as seen from the side AD through the glass block.

(v)From the same side AD closer to D,fix pins P_3 and P_4 such that they are in line with the image Pi of P_0 seen through the glass block.

(vi)Remove the glass block and join P_1 and P_2 , and P_3 and P_4 to meet at P_i.

(vii)Join P_0 to P_i and measure length P_0P_i

P_0P_i=2.7×10^{-2} ✓1 Reading & Working in metres ≈ 4.7cm .....m (1mk)

(viii)Determine the ratio; $\frac{b}{b-P_0P_i} = n$ $\frac{6.2}{6.2-2.7} = \frac{62}{35}$ ✓1 Correct Substitution (2mks)

$n = 1.7714857$ ✓1 Correct evaluation

(Hand in the outline with the question paper.) **(1mk)**

PART B:

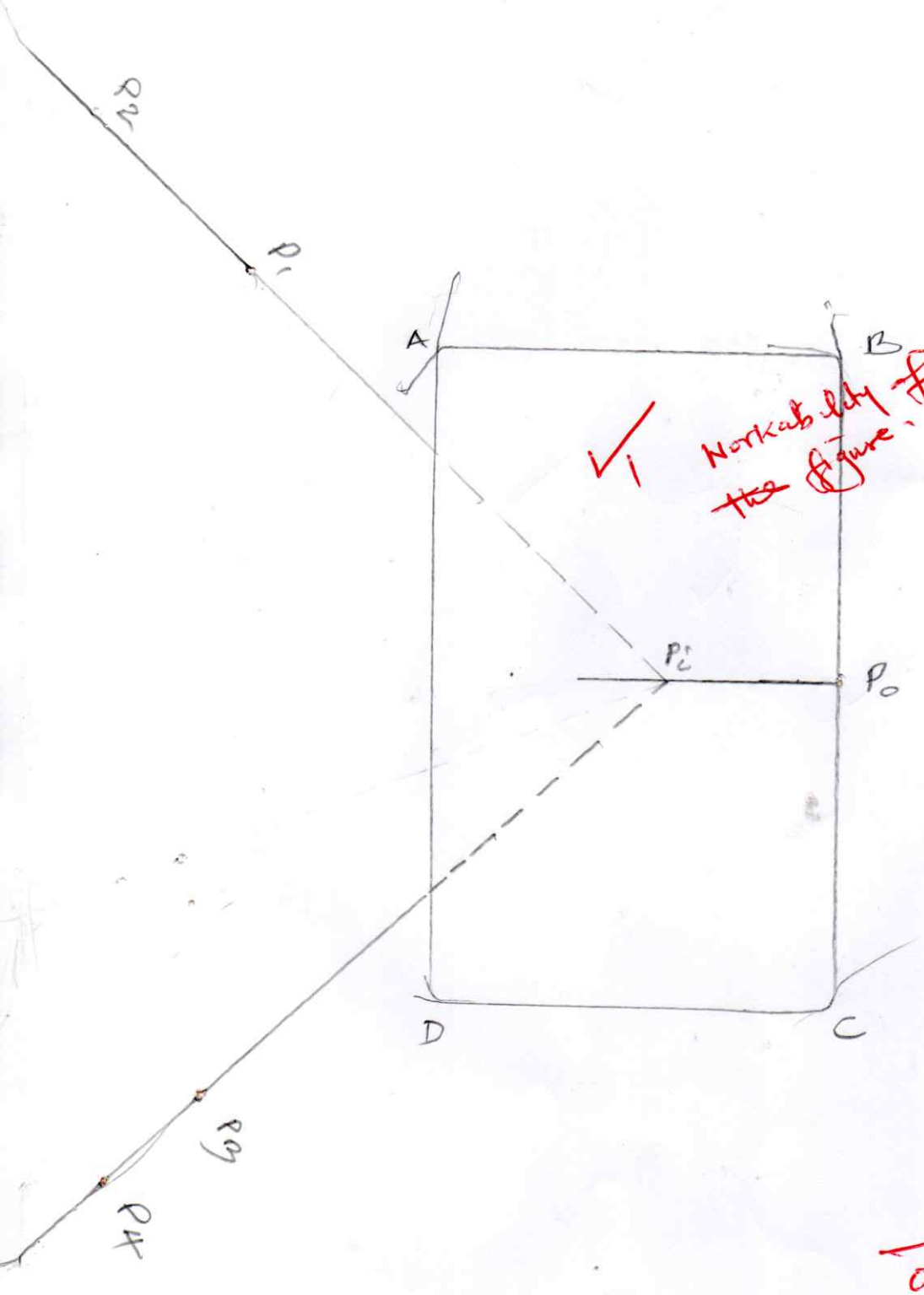
(i)Trace the outline of the glass block again on the second plain paper and label it ABCD as shown in figure 2.

(ii)Construct a normal on the side AB approximately 3cm from A and measure angle of incidence $i=35^0$ (secure the plain paper using paper pins).

(iii)Replace the glass block on the outline and fix pins P_1 and P_2 along the line of ~~30°~~ 35^0.

(iv)Viewing from the sides CD through the block, fix pins P_3 and P_4 such that they appear in line with the images of P_1 and P_2.

03MICS



Workability of the figure.

OTMLC

(v)Join P_3 and P_4 and join x and y.

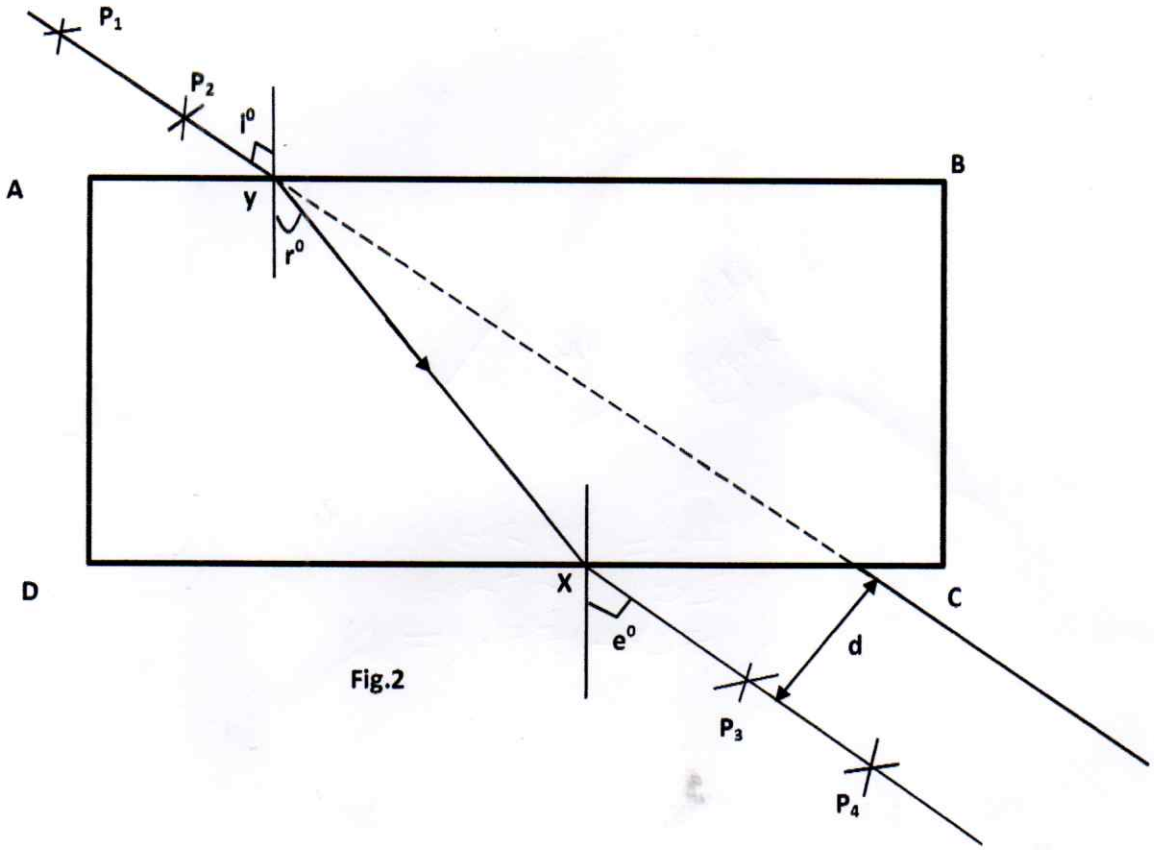


Fig.2

(vi)Extend the line P_1 and P_2 to obtain lateral displacement as shown in the figure and measure the lateral displacement **d** and angle $\mathbf{r^0}$.

(vii)Tabulate your results.

(viii)Repeat the procedure in (i) to (vi) for angles of incidence 45^0, 55^0,65^0 and 75^0.

(Hand in the plain paper on which you have done your experiment together with the exam paper)

~~(2mks)~~ 3mks

i^0	35	45	55	65	75
r^0	24 24	29 29	31 31	33 33	36 36
d(cm)	1.4 1.4	1.9 1.9	3.0 3.0	4.3 4.3	5.0 5.0
e^0	36	41	53	62	72

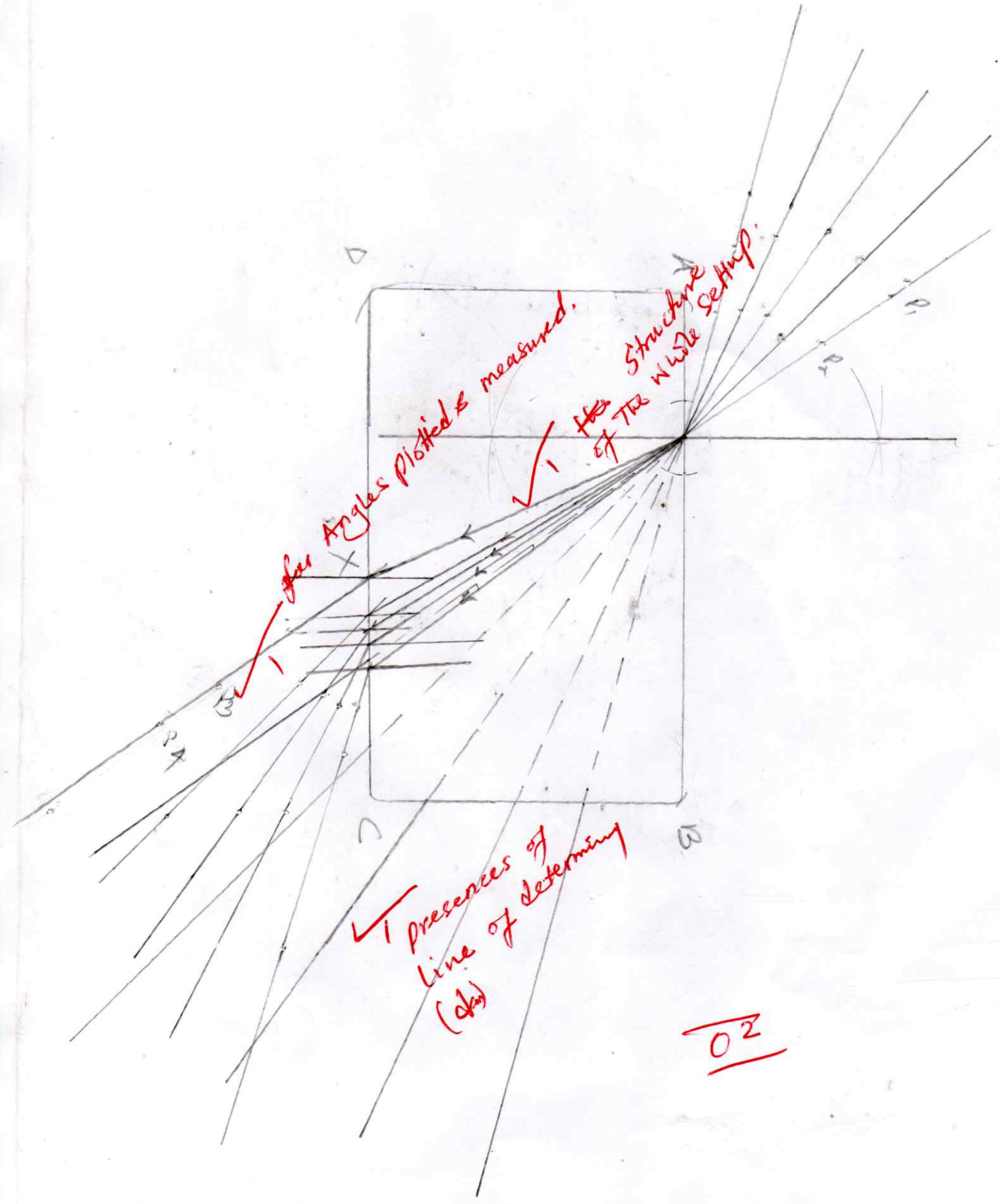
(5mks)

½mk for each correct value ~~in the table~~

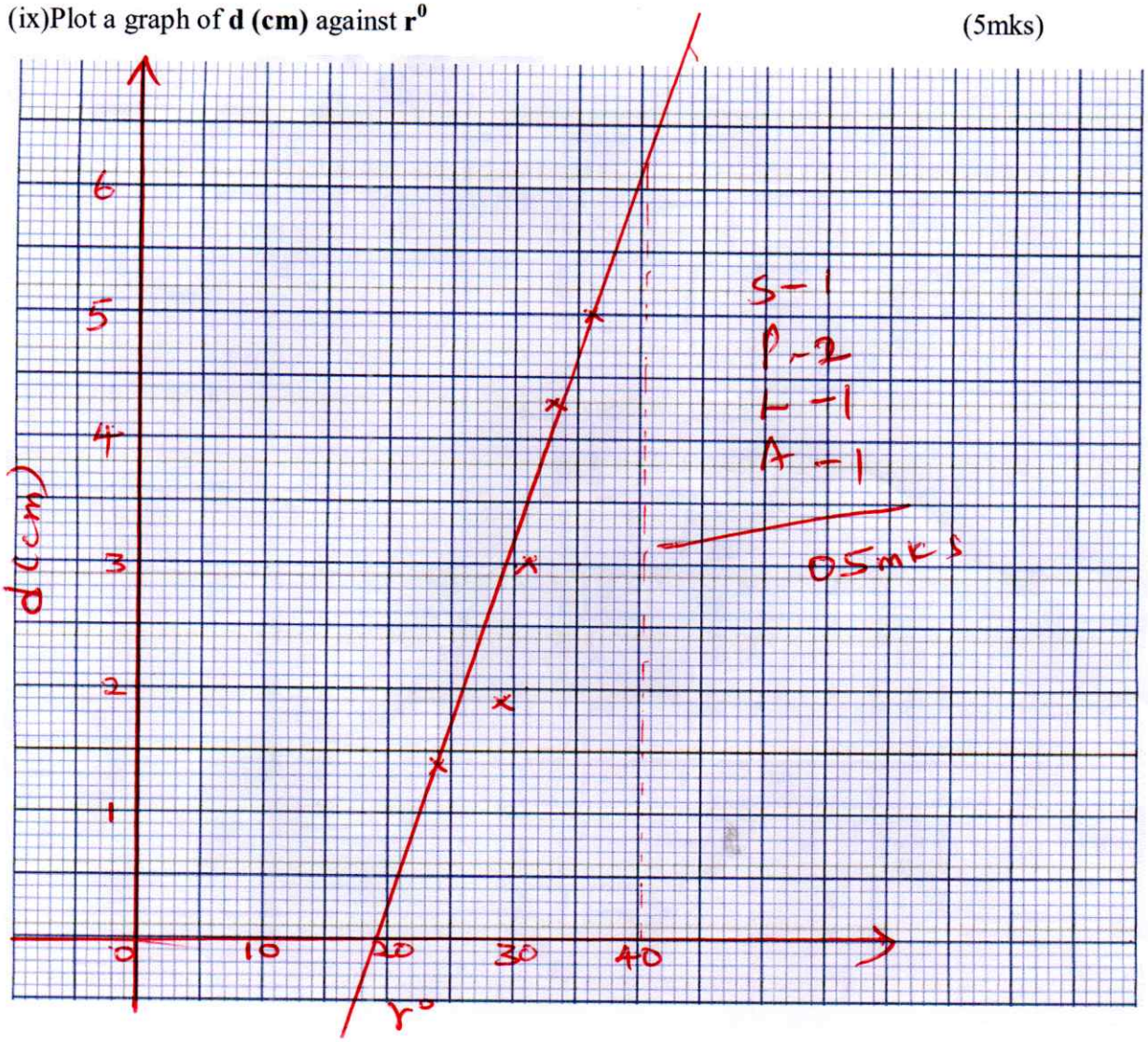
~~4 mks for about 4 correct values~~

½mk for correct values

5mks


for Angles plotted & measured.
of the structure
of the whole setup.
presences of
line of determing
(dip)
02

(ix)Plot a graph of **d (cm)** against $\mathbf{r^0}$ (5mks)



(x)From your graph;

i) Determine the value $\mathbf{r^0}$ where the lateral displacement d equals to the breadth **b** of the block.

$\mathbf{r^0}$ = ... 40^0 ✓1 ..... (1mk)

ii) Given that $k \sin \mathbf{r^0}=1$, determine the value of k (2mks)

$K \sin 40 = 1$

$K = \frac{1}{\sin 40}$ ✓1 Substitut

$= 1.5557$ ✓1 correct evaluation

$= $

✓08

QUESTION2

PART A

- *A glass beaker*
- *A metal solid*
- *Some water*
- *Source of Heat*
- *A piece of cotton thread*
- *A plastic beaker wrapped with tissue paper on the outside.*
- *A thermometer*
- *Liquid L*
- *Measuring balance to be shared*

Proceed as follows:

(a) Fill the glass beaker with the water provided and place it on the heat source.

Use the piece of thread to carefully lower the metal solid to the bottom of the beaker. Heat the water to its boiling point. Use the thermometer to measure its point.

Boiling point of water=.....373.....Kelvin (1 mark)

b) Find the following measurements using appropriate instruments

Mass of the metal solid M_s= .....100 100..... g (½ mark)

Mass of the wrapped empty plastic beaker

M_1.....31.4 31.4.....g (1 mark)

Use the plastic beaker to measure 240ml of liquid L, hence find the joint mass of the plastic beaker and its content liquid L,

M_2=.....276.1 276.1..... g (½ mark)

Initial temperature of liquid L, T_1 = ...297.....Kelvin (1 mark)

c) At boiling point of water, quickly transfer the metal solid into liquid L, stir well and measure the temperature of the mixture immediately.

Temperature of the mixture

T_2 = 304 ✓1 Kelvin 31°C (1 mark)

d) By using the measurements taken in parts (a), (b) and (c) as well as the equation provided below, determine the specific heat capacity of liquid L.

(Take S.H.C of metal solid = 480Jkg^{-1}k^{-1} and S.H.C of plastic = 359 Jkg^{-1}k^{-1})

(Heat lost by metal solid) = (heat gained by liquid L) + (heat gained by plastic beaker)

(3 marks)

$M_s c_s \Delta\theta_s = M_L c_L \Delta\theta_L + M_p c_p \Delta\theta_p$ ✓ substitution

$\frac{100}{1000} \times 480 Jkg^{-1}K^{-1} \times (100-31) = \frac{244.7}{1000} kg \times c_L \times (31-24)$

$+ \frac{31.4}{1000} kg \times 359 Jkg^{-1}K^{-1} (31-24)$

$3312 = 1.7129 c_L + 789.082$

$1.729 c_L = 3312 - 789.082$ ✓ correct working

$c_L = \frac{3233.0918}{1.729}$

$= 1869.92 \; Jkg^{-1}k^{-1}$ ✓ Accuracy

08 mks

PART B

You are provided with the following apparatus;

- A nichrome wire
- A 20g mass
- A metre rule
- A test –tube
- A retort stand, boss and clamp

Proceed as follows.

a) Measure the length, L, of the nichrome wire provided

L = ... 50.0 ✓ cm 1dp a must (½ mark)

b) Wind the whole length of the wire tightly on the test-tube making sure that the turns are as close as possible but not overlapping. Measure the length, β, of the coil made.

β = ... 0.5 ✓ ..... cm 1dp a must (½mark)

c) Remove the coil from the test-tube. Straighten the first and the last turns of coil. Bend one end to make a hook.

d) Count and record the number, N, of complete turns remaining on the coil.

N = ... 7 turns ✓ (1 mark)

e) Measure and record the distance h_1 between the end turns of the coil as shown on the figure 1 below.

h_1 = ... 15.0cm ✓ (1/2 mark)

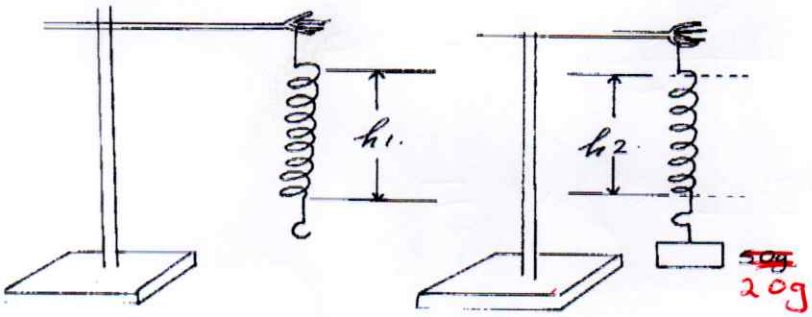


Figure 1 Figure 2

f) Load a 20 g mass on the coil as shown in figure 2 above. Measure and record the distance, h_2, between the end turns of the coil.

h_2 = ... 20.0cm ✓ (1/2 mark)

3 mics

g) Determine the spring constant K in S.I units. (1 mark)

$F = ke$

$k = \frac{F}{e} = \frac{mg}{e} = \frac{20 \times 10^{-3}\,kg \times 10\,N/kg}{(20-15) \times 10^{-2}\,m}$ ✓½ correct substitution.

$= 4\,N/m$ ✓½ correct working with units (1)

No units (0 mic)
Wrong unit (0 mk)

h) Obtain the constant, p, for the wire from the expression: (2marks)

$$P = \frac{4mgR^3}{Kr^4}$$

$= \frac{4 \times 20 \times 10^{-3} \times 10 \times 1.4691842 \times 10^{-6}}{4 \times 1.6702 \times 10^{-16}}$ ✓1 correct substitution

$= 1.75929 \times 10^{7}$ ✓1 correct evaluation to 4sf or to correct sf form.

Where: m is the mass used, g is acceleration due to gravity ($g = 10m/s^2$),

$R = \frac{L}{2\pi N}$ and $r = \frac{\beta}{2\pi N}$ ~~2N~~

$R = \frac{50 \times 10^{-2}}{2\pi 7}$

$= 6.0113682$

$R^3 = 1.4691842 \times 10^{6}$

$r = \frac{0.5 \times 10^{-2}}{2\pi 7}$

$= 0.0001136821$

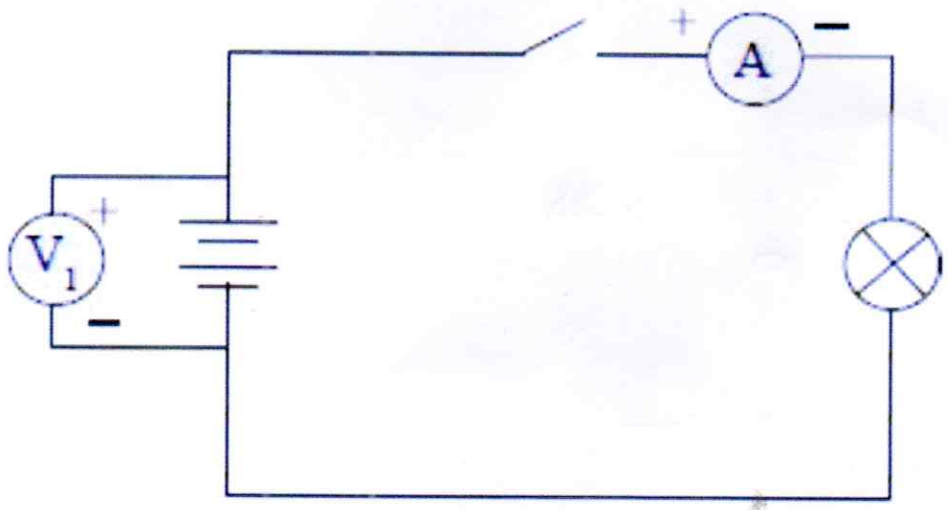
$r^4 = 1.6702 \times 10^{-16}$.

03 mics

PART C

- Two cells
- A 2.5 V torch bulb in a bulb holder
- 10 Connecting wires
- Switch
- Ammeter (0 – 5A),
- Voltmeter (0 – 5 V)
- Two cell holders

Procedure 1



SET UP ONE

• Set up the circuit shown in figure above.

a) Read and record the voltmeter V_1 and ammeter A_1 readings.

V_1 ..... 3.1V 3.1V ½ 1dp amost ..... ½ mark

• Switch on the circuit.

b) Read and record the voltmeter and ammeter readings. Note the brightness of the bulb.

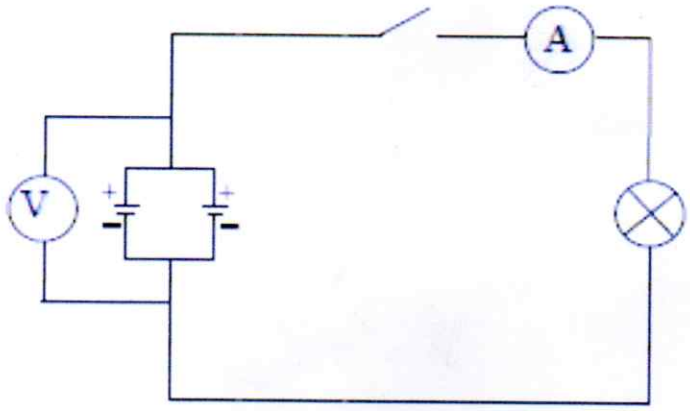
V_2 ..... 2.8V 2.8V ½ 1dp amost ..... ½ mark

A_1 ..... 0.20A 0.20A ½ 2dp amost ..... ½ mark

1½ m/c.

Procedure 2

• Connect the circuit as shown in figure below



SET UP TWO

c) Read and record the voltmeter reading V_3

V_3 ..... 1·5V ..... 1·5V ✓½ 1 dp ✓ must with units. ½ mark

• Put on the switch. Take note of the brightness of the bulb

d) Read and record the voltmeter and ammeter readings.

V_4 ..... 1·4V ..... 1·4V ✓½ 1 dp a must with units ½ mark

A_2 ..... 0·10A ..... 0·10A ✓½ 2 dp a must with units ½ mark

e) Compare the values of V_1 and V_3 1 mark

V_3 is half of V_1 ✓ Correct comparison

.....

f) Make a conclusion on (e) above 1 mark

The e.m.f of the two cells in series ✓½ is 3·0V ✓½ while the emf of two cells in parallel is 1·5V ✓½ total 1 mrc

g) In which set up does the bulb light for a longer time? Explain in terms of A_1 and A_2 (1mark)

In SET UP TWO ✓½. In Set up two only 0·1A is drawn by the bulb ✓½ while in set up one 0·20A is drawn by the bulb.

4½