G-1

BARISHAL ENGINEERING COLLEGE

Department of Electrical & Electronic Engineering

LAB REPORT

Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 01

Experiment Name : To determine the refraction index of the material of a Prism.

Submitted By

Name: Md. Mustafizur Rahman

Roll: 192062

Reg. No : 3080

Session : 2019-2020

Semester: 1st Year; 2nd Semester

Submitted to

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Associate Professor (Physics)

Department of Physics

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Durgapur, Barisal.

Date of submission : 15/12/2021

JT

Signature

Experiment Name: To determine the refraction index of the material of a prism.

Theory: We know the law of refraction, $\mu = \frac{\sin i_1}{\sin r_1}$ . . . . . . (1)

where μ is the refractive index
i_1 is the incident angle
r_1 is the refractive angle

But, the angle of deviation,

$$\delta = i_1 + i_2 - A$$

$$r_1 + r_2 = A$$

For angle of minimum deviation,

$i_1 = i_2$, $r_1 = r_2$ & $\delta = \delta_m$

Now, $\delta_m = i_1 + i_1 - A$

or, $i_1 = \frac{A + \delta_m}{2}$

$r_1 + r_1 = A$

or, $r_1 = \frac{A}{2}$

Here equation (1) implies,

$$\mu = \frac{\sin \frac{A+\delta_m}{2}}{\sin \frac{A}{2}} \quad \cdots\cdots (2)$$

where $A = 60^\circ$ = prism angle

δ_m = angle of minimum deviation

Apparatus: Prism, White paper board, board pin, pencil,

Procedure: (1) Attach a white paper on the board and take the boundry at five places.

(2) Draw $MN \perp ON$ in each figure with different angles $35^\circ, 40^\circ, 45^\circ, 50^\circ, 55^\circ$ using chada.

(3) Keeping two pins along the line PQ and see the pins through the places of AC and along RS. Keep another two pins in such way that the pin of PQ is not seen.

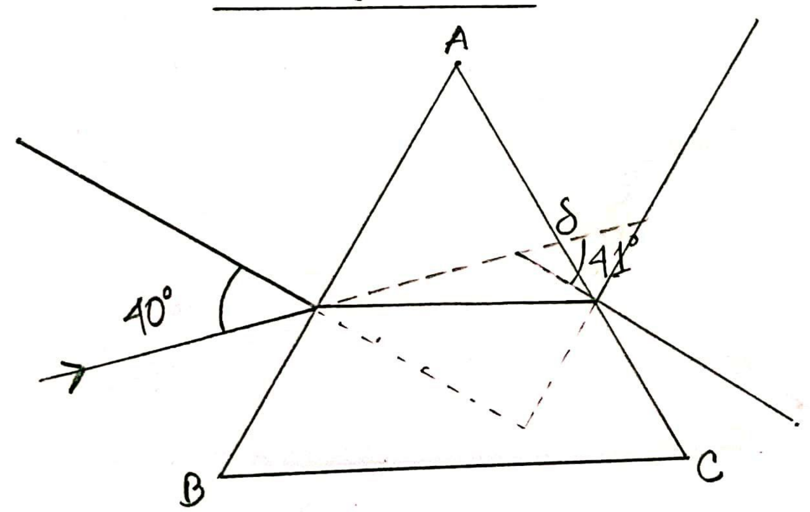
Draw RS removing the pines.

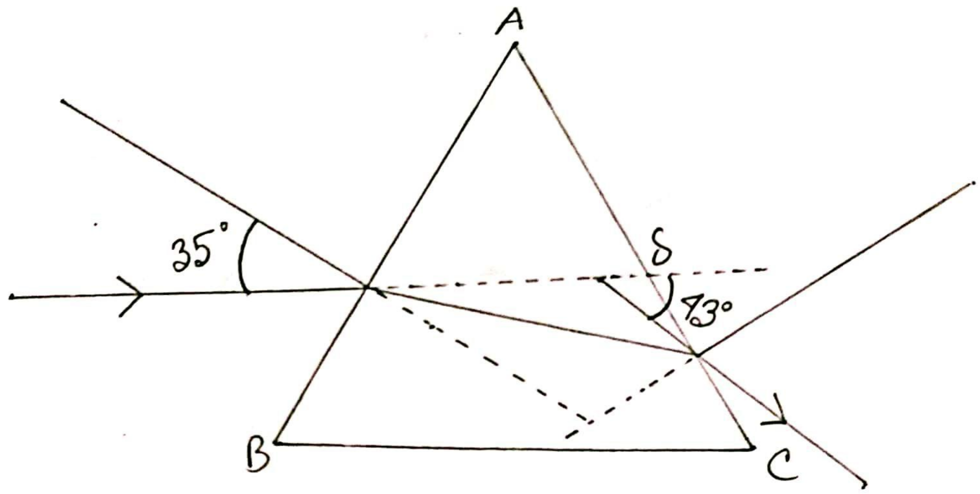
(4) Calculate δ at the extension line of PQ & RS.

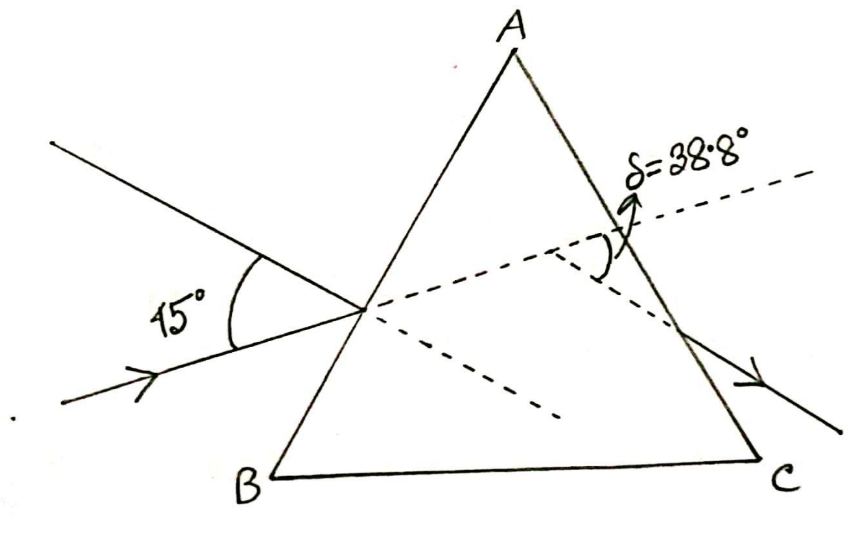
(5) Draw the graph along X-axis incident angle & along Y-axis the value of δ and δm.

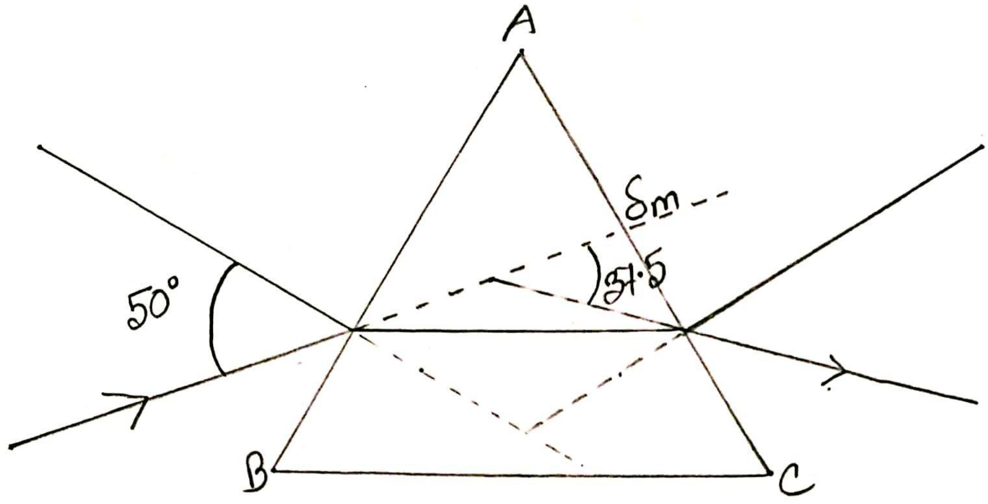
(6) Using the value of δm we find μ.

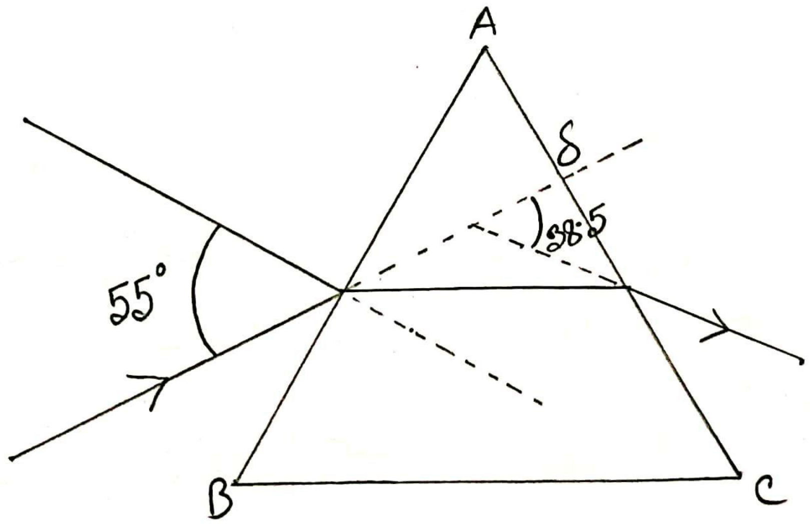
Diagrams:



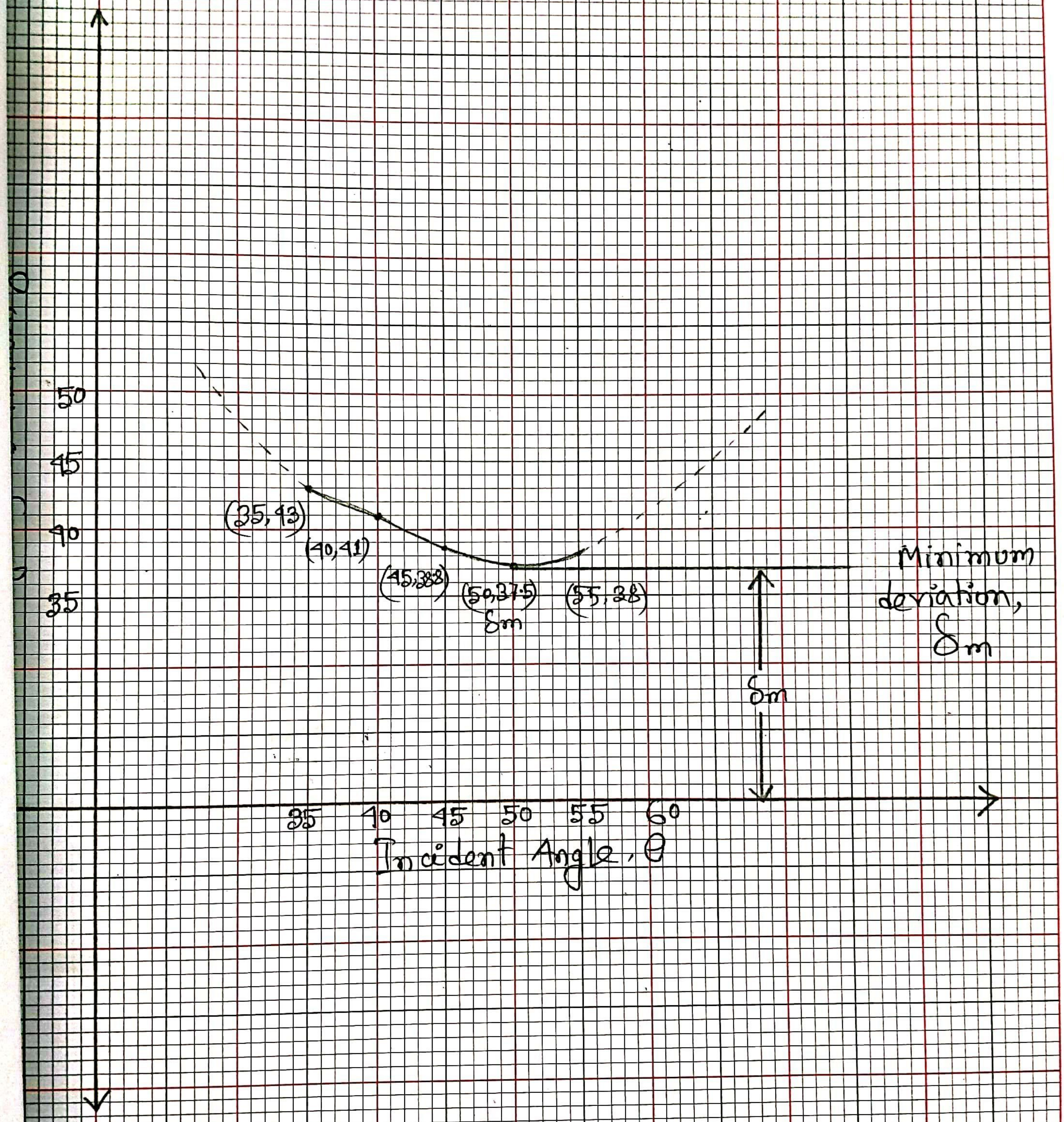

A
35°
δ
43°
B
C


A
δ=38·8°
45°
B
C


A
δm
37.5
50°
B
C


A
δ
38.5
55°
B
C

Roll No. ....


50
45
40
35
(35,43)
(40,41)
(45,38.8)
(50,37.5)
δm
(55,38)
Minimum deviation, δm
δm
35
40
45
50
55
60
Incident Angle, θ

Practical Data Table:

No of Obser.	Prism Angle A	Incident Angle θ	Angle of deviation δ	δ_m	$\mu = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$
1		35°	43°		
2		40°	41°		
3	60	45°	38.8°	37.5	1.504
4		50°	37.5°		
5		55°	38		

Calculation:

$$\mu = \frac{\sin(A+\delta_m/2)}{\sin(A/2)} = \frac{\sin\left(\frac{60+37.5}{2}\right)}{\sin\left(\frac{60}{2}\right)} = 1.504$$

Result: The refractive angle of the prism is 1.504

Precautions: (1) We have to place the pin perpendicularly.

(2) Measure the angle correctly

(3) We have to place the prism along the boundary.

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BARISHAL ENGINEERING COLLEGE

Department of Electrical & Electronic Engineering

LAB REPORT

Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 02

Experiment Name : To determine the length of a rod with slide calipers of an object.

Submitted By

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Session : 2019-2020

Semester: 1st Year; 2nd Semester

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Date of submission : 15|12|2021

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Experiment Name: To determine the length of a rod with slide calipers of an object.

Theory: The distance between two ends of a rod is called length of rod. The length of a rod of an object,

$$L = M + V_R \times V_c - (\pm error)$$

here,

L = Length of the rod

M = Main scale reading

V_R = Vernier Scale

V_c = Vernier constant

e = Instrumental error

Apparatus: (i) Slide calipers (ii) Vernier scale (iii) A rod (iv) Scale

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Procedure : (i) Place the two lows of caliper in contract. If vernier coincide with the main scale zero then. There is no instrumental error. If not coincided then calculate the instrumental error.

(ii) Calculate the vernier constant, V_c

$$V_c = \frac{\text{The value of one small division in the main scale}}{\text{total number of division in the vernier scale}}$$

$$= \frac{1}{20} \text{ mm} = 0.005 \text{ cm}$$

(iii) Draw the moveable low and place the rod between the lows. Make the two touch the each reading of the rod.

(iv) Count the vernier division between the vernier zero line & the line which coincide with the place and main scale division. This is vernier scale reading.

(v) If the error is positive then it will be substracts, if the error is negative it will be added to get the length

Data Table:

Linear scale reading, M	Vernier scale reading, V_R	V_c (cm)	$V_R \times V_c$	Error, e	Length $L = M + V_R \times V_c \pm e$	Mean length (cm)
10·7	1	0·005	0·005	0	10·705	
10·7	7	0·005	0·035	0	10·735	10·722
10·7	5	0·005	0·025	0	10·725	

Result: The actual length of the rod is 10·722 cm.

Discussion: (i) Carefully calculate V_c (ii) Instrumental error must be added to calculation (iii) The laws must not be pressed to hard or too loose.

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Department of Electrical & Electronic Engineering

LAB REPORT

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Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 03

Experiment Name : To determine the spring constant and effective mass of a spring.

Submitted By

Name: Md Mustafizur Rahman

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Session : 2019-2020

Semester: 1st Year; 2nd Semester

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Date of submission : 02|01|2022

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Experiment Name: To determine the spring constant and effective moss of a spring.

Theory: If a spring be clamped vertically at the end P with loaded a mass m_0 at the other end. The period of vibration of the spring along a vertical line is given by,

$$T = 2\pi\sqrt{\frac{m_0+m}{K}} = 2\pi\sqrt{\frac{M}{K}}$$

where, m is a constant called effective mass of the spring and K is the spring constant.

Apparatus: (i) A spiral spring (ii) Convenient Mass (iii) Clamp weighting (iv) Stop watch & clock.

Procedure : (i) Suspend the spring by a book attached to rigid framework of heavy melal rods.

(ii) Measure the length of the spring L

(iii) Add suitable weight of the free end of the spring and note down for different loads.

(iv) A load is added to the hanging weight which is set for vibration

(v) The period T is obtained by timing 10 vibrations repeat this case for different loads.

(vi) A graph of T^2 against load has ploted.

Data table:

No. of obs.	Load(g)	Extension(cm)	No. of vibration	T'	T'/10	T²
1	150	4	10	7	0.7	0.49
2	200	8	10	9.28	0.928	0.861
3	250	12.5	10	10.87	1.087	1.181

Calculation

Length of the spring = 14.5 cm

When weight is 150g, L = 18.5 cm

∴ Extension = 18.5 − 14.5 = 4 cm

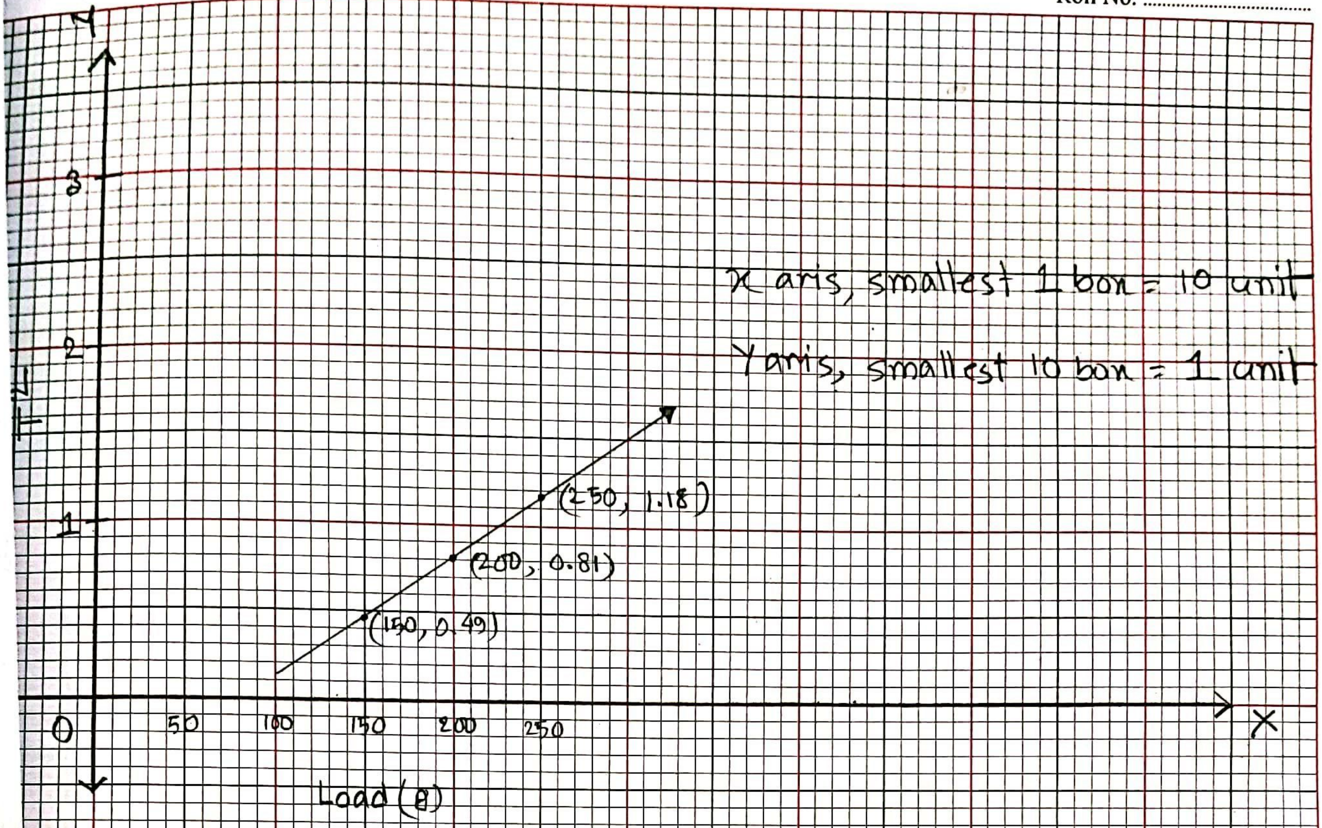
When weight is 200g, L = 22.5 cm

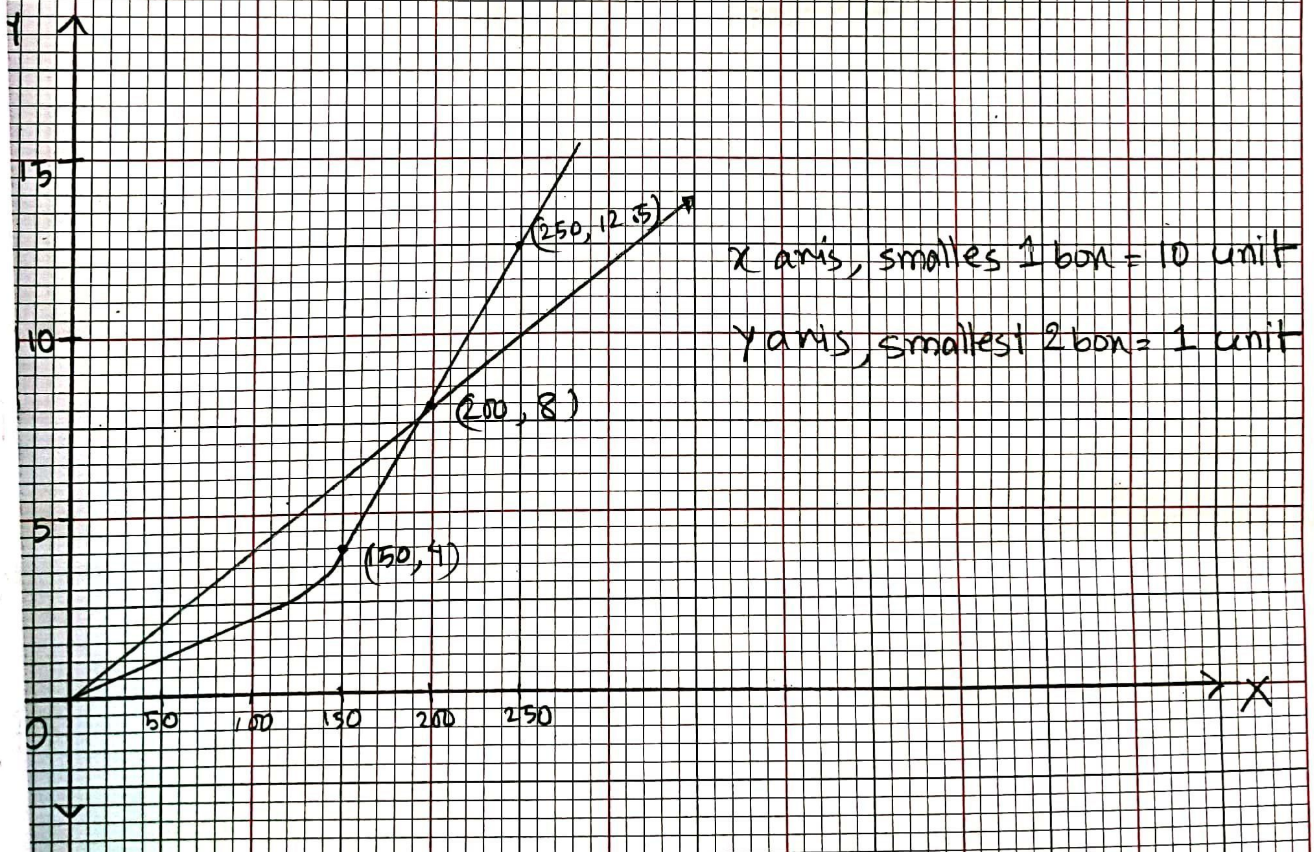
∴ Extension = 22.5 − 14.5 = 8 cm

When weight is 250g, L = 27 cm

∴ Extension = 27 − 14.5
≐ 12.5 cm

Roll No. ....


Y
3
2
1
0
50
100
150
200
250
X
Load (g)
(150, 0.49)
(200, 0.81)
(250, 1.18)
x axis, smallest 1 box = 10 unit
Y axis, smallest 10 box = 1 unit


Y
15
10
5
0
50
100
150
200
250
X
(150, 4)
(200, 8)
(250, 12.5)
x axis, smalles 1 box = 10 unit
Y axis, smallest 2 box = 1 unit

when weight is 150g. 10 vibration = 7 sec

when weight is 200g, 10 " = 9.28 sec

when weight is 250g, 10 " = 10.87 sec

Here, $F = Kx = mg$

or. $Kx = mg$

$$x = \frac{mg}{K} = \frac{g}{K} \cdot m$$

Slope, $m = \frac{Y_2 - Y_1}{x_2 - x_1} = \frac{12.5 - 8}{250 - 200} = \frac{g}{K}$

$$\therefore K = \frac{g}{0.09} = \frac{980}{0.09} = 10888.88 \text{ dyne/cm}$$

Hence,

Spring constant, $K = 10888.88$ dyne/cm

Result: Spring constant,

$K = 10888.88$ dyne/cm

BARISHAL ENGINEERING COLLEGE

Department of Electrical & Electronic Engineering

LAB REPORT

Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 04

Experiment Name : To determine the focal length of a convex lens and power of the lens by displacement method.

Submitted By

Name: Md Mustafizur Rahman

Roll: 192062

Reg. No : 3080

Session : 2019-2020

Semester: 1st Year; 2nd Semester

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Date of submission : 02/01/2022

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Name of Experiment: To determine the focal length of a convex lens and power of the lens by displacement method

Theory: The focal length of a convex lens is $f = \frac{l^2 - d^2}{4l}$ where l is the displacement between object and screen. d is the lens displacement.

$$\text{Power}, P = \frac{100}{f(cm)}$$

The image found by a convex lens is virtual and erect. Since the focal point (F) and center of curveature (2F) are both imaginary points inside the mirror. that cannot be reached.

Apparatus :

(i) Convex lens, Optical bench. Lens stand, Object, Screen.

Procedure:

(i) Set the objects and the screen on the two end of the optical bench.

(ii) Set the convex lens in the middle point of the optical bench

(iii) Place the lens very close to the object and slowly move it to the screen until a clear image. Note the position d_1

(iv) After that move the lens towards the screen until a new clear image forms on the screen. (d_2)

(v) Here, $f = \frac{l^2 - d^2}{4L}$ cm

where L = displacement between object

d = lens displacement.

Data Table :

$d_1 = 26$ cm

$d_2 = 73$ cm

& L = 100 cm.

So lens displacement, $d = d_2 - d_1$

$= (73 - 26)$ cm

$= 47$ cm

Calculation :

The focal length of the convex lens is

$$F = \frac{l^2 - d^2}{4L} = \frac{(100)^2 - (47)^2}{4 \times 100} = 19.47 \text{ cm}$$

Power of the Lens, $P = \frac{100}{F} = \frac{100}{19.47}$

$= 5.13$ D

Result:

The focal length of the convex lens is 19.47 cm

The power of the lens is 5.13 D.

Precautions:

(i) The distance of an object should be more than focal.

(ii) Reading should be taken carefully.

(iii) The lens should be vertical in stand.

BARISHAL ENGINEERING COLLEGE

Department of Electrical & Electronic Engineering

LAB REPORT

Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 05

Experiment Name : To determine the specific heat of a liquid by the method of cooling.

Submitted By	Submitted to
Name: Md Mustafizur Rahman	Dr. Atikur Rahman Baizid
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Session : 2019-2020	Barishal Engineering College
Semester: 1st Year; 2nd Semester	Durgapur, Barisal.

Date of submission : 02|01|2022

Signature

Name of the experiment: To determine the specific heat of a liquid by the method of cooling.

Theory: Newton's law of cooling can be used to determine the specific heat of a liquid by observing the time taken by the liquid in cooling from one temperature to another.

Suppose a liquid of mass M_1 and specific heat S_1 is enclosed within a calorimeter of mass m and specific heat s. The thermal capacity of the system is (M_1S_1+ms). If the temparature of the liquid falls from θ_1 to θ_2 in time t_1, then the average rate of loss of heat is

$$(M_1S_1+ms)\frac{\theta_1-\theta_2}{t_1}$$

If now the liquid be replaced by an equal volume of second liquid of known specific heat (say water) under simillar condition and if the time taken by the second liquid to cool through the same range of temperature from θ_1 to θ_2 be t_2 then the average rate of loss of heat is

$$(M_2S_2+mS)\frac{\theta_1-\theta_2}{t_2}$$

where M_2 and S_2 are the mass and specific heat of the second liquid, respectively. Since the conditions are similar, two rates equal

$$(M_1S_1+mS)\frac{(\theta_1-\theta_2)}{t_1} = \frac{\theta_1-\theta_2}{t_2}(M_2S_2+mS)$$

or, $$S_1=\frac{M_2S_2t_1+mS(t_1-t_2)}{M_1t_2}$$

Apparatus : Double walled enclosure, Calorimeter, Thermometer, Heater, Stopwatch etc.

Brief Procedure: (i) Clean and dry the calorimeter and measure the mass (m) of the calorimeter and stirrer using a digital balance.

(ii) Pour water up to two-third volume of the calorimeter. Measure the total mass (m'') of the calorimeter, water and stirrer. Calculate the mass (M_2) of water.

(iii) Put the calorimeter on the heater and hold the thermometer bulb in the middle of the water and raise the temparature around 65°C. Keep the calorimeter into the double walled enclosure with the help of tongs. Close the lid and fix the thermometer with holders so that it's bulb is in the middle of the water.

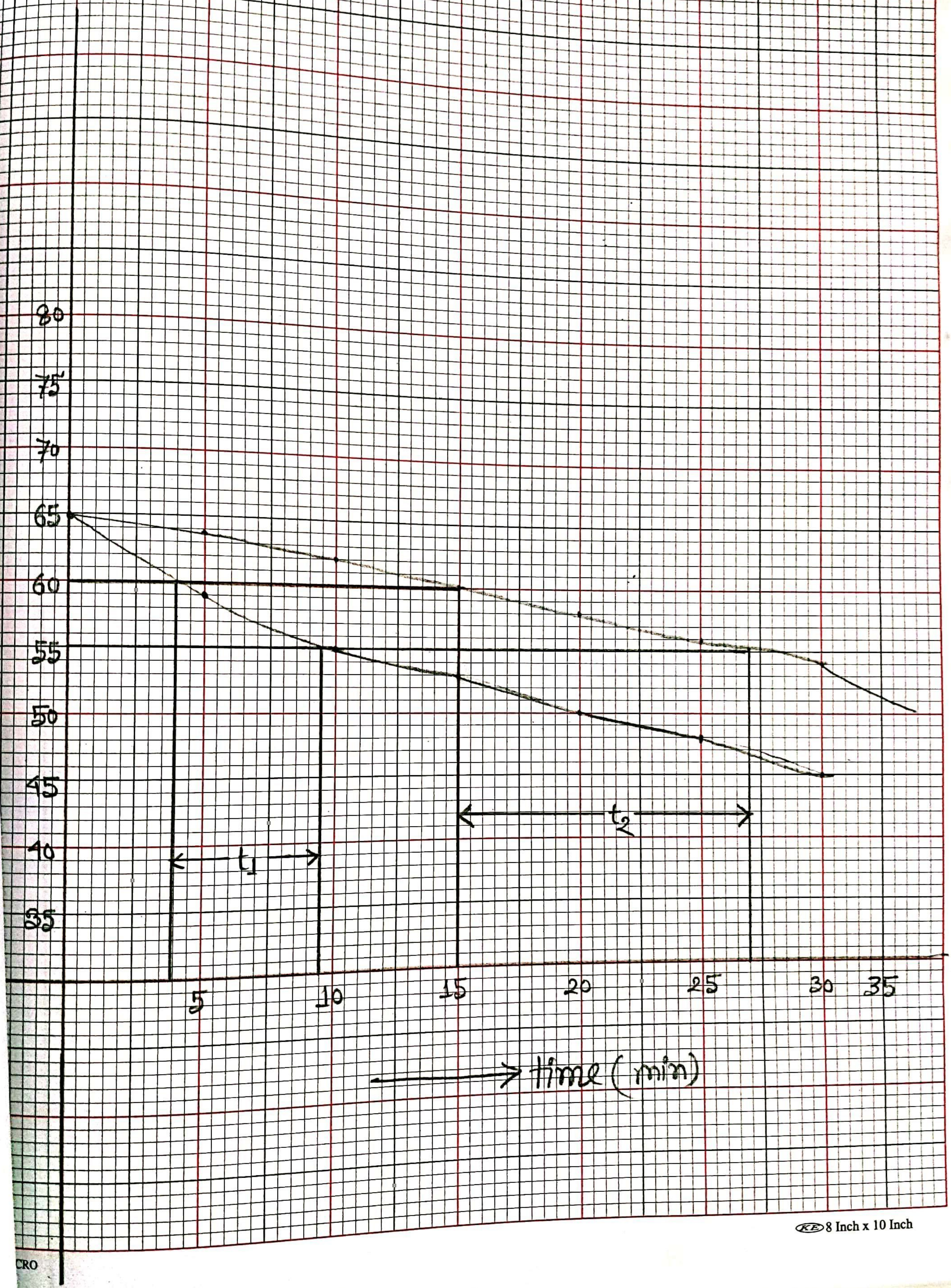
(iv) Start the stopwatch when the

The temparature just at 65°C. Note this temp. in the table. Go on recording the temparature of the water up to 20-25 minutes at an interval of five minutes. Gently stir the water during the whole process.

5. Pour out the water from the calorimeter and wipe it dry. Take experimental liquid in the calorimeter as the same volume of water. Repeat step: 2,3 and 4 for liquid.

6. On a graph paper, plot curves (both for water and liquid) by taking temperature as ordinate and time as abscissa (Graph-1). We calculate t_1 and t_2 from the graph.

7. Using the given formula, determine the specific heat of the given liquid.


80
75
70
65
60
55
50
45
40
35
5
10
15
20
25
30
35
t_1
t_2
time (min)

Experimental data:

Time (min)	0	5	10	15	20	25	30°
Temp (Liquid) °C	65°	59°	55	53	50	48	41
Temp (Water) °C	65°	64°	62	60	58	56	54

Calculations:

From Graph-1 $\theta_1 = 60°C$ & $\theta_2 = 55°C$

time taken by the water to cool from θ_2 to θ_1 is $t_2 = 5.5$ min & time taken by liquid is $t_1 = 12$ min

Mass (liquid), $M_1 = 73$ gm

Mass (Water), $M_2 = 110$ gm

Specific heat of Water, $S_2 = 4.2$ J/gm °C

$t_1 = 12$ min

$t_2 = 5.5$ min

mass of calorimeter, $m = 127$ gm

Specific heat of the material of water,

$s = 0.89$ J/gm °C

$S_1 = ?$

$$\therefore S_1 = \frac{M_2 S_2 t_1 + ms(t_1 - t_2)}{M_1 t_2}$$

$$= \frac{110 \times 4.2 \times 12 + 127 \times 0.89\,(12 - 5.5)}{73 \times 5.5}$$

$$= 1.56 \text{ J/g °C}$$

Result : Specific heat of the liquid is 1.56 J/g°C

Discussions: (i) The temparature of the water in the calorimeter should be raised above 70°C.

(ii) The volume of liquids in the calorimeter should be same.

(iii) The calorimeter should be placed in a double walled chamber.

BARISHAL ENGINEERING COLLEGE

Department of Electrical & Electronic Engineering

LAB REPORT

Course Title : Waves and Oscillations, Optics and Thermal Physics Sessional

Course Code : PHY 1202

Experiment No. : 606

Experiment Name : To determine the refractive index of a glass slab.

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Session : 2019-2020

Semester: 1st Year; 2nd Semester

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Date of submission : 02|01|2022

Signature

Name of Experiment : To determine the refractive index of a glass slab.

Theory : The ratio of incident angle and refracted angle is constant for a pair of specific medium and a specific color light ray. This constant is denoted by μ and is the refractive index of the second medium with respect to first.

If i is the incident angle and r is the refractive angle then,

$$\text{Refractive index, } \mu = \frac{\sin i}{\sin r}$$

Apparatus : (i) Glass slab (ii) White paper (iii) Board Pin (iv) Scale

Procedure: (i) Taking a glass slab we make the outer line of the glass slab placed board.

(ii) Taking two board pins, attach one pin at the point O and another pin at the point P_1 and make the line P_1O which is incident ray.

(iii) Now taking another two board pin attach at the point R_1 & S_1 such a way that P_1O, R_1S_1 is situated along the same line.

(iv) Now add the points P_1O, OR_1 & R_1S_1 Simillarly we make another three lines.

(v) Now taking the angles $\angle P_1OA$, $\angle P_2OA$, $\angle P_3OA$ for incident ray and $\angle NOR_1$. $\angle NOR_2$ & $\angle NOR_3$ for refracted angle and place in the data Table.

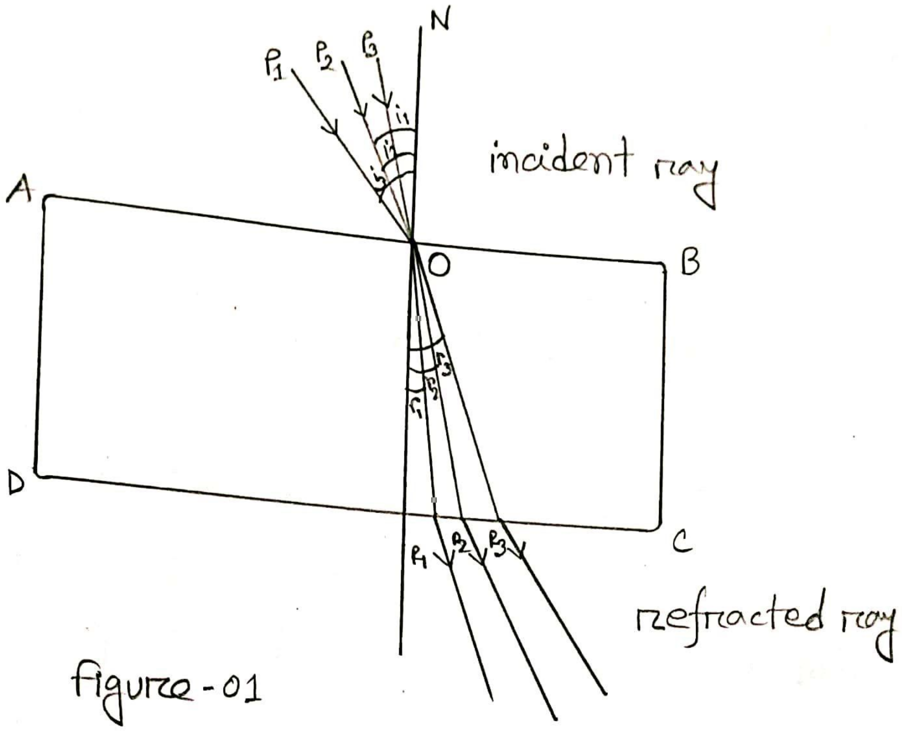

figure-01

Data Table:

No. of Obs.	incident angle, $\angle i$	Refracted angle, $\angle r$	$\sin i$	$\sin r$	$\mu = \frac{\sin i}{\sin r}$	Mean refractive index, μ
1	30°	18°	0.5	0.31	1.61	
2	40°	26°	0.64	0.44	1.45	1.497
3	50°	32°	0.76	0.53	1.43	

Result: The refractive index of the glass slab is $\mu = 1.497$

Precaution:

(i) We should stand the pin vertically.

(ii) We have to measure the angles correctly

(iii) Incident angle should be taken as large as possible.

(iv) The glass slab should not be moved during the whole process.

10.1 20.

Na_2CO_3 Vs HCl

Initial (mL)	Final (mL)	Difference (mL)	Mean V_{acid}
0	8.1	8.1	8.2
8.1	16.3	8.2	
16.3	24.6	8.3	

$$\frac{2 \times 10 \times .1}{8.2} = .243M$$

COOH