Frequency from graph of T and l^2 = 51.215 Hz.

CONCLUSIONS.

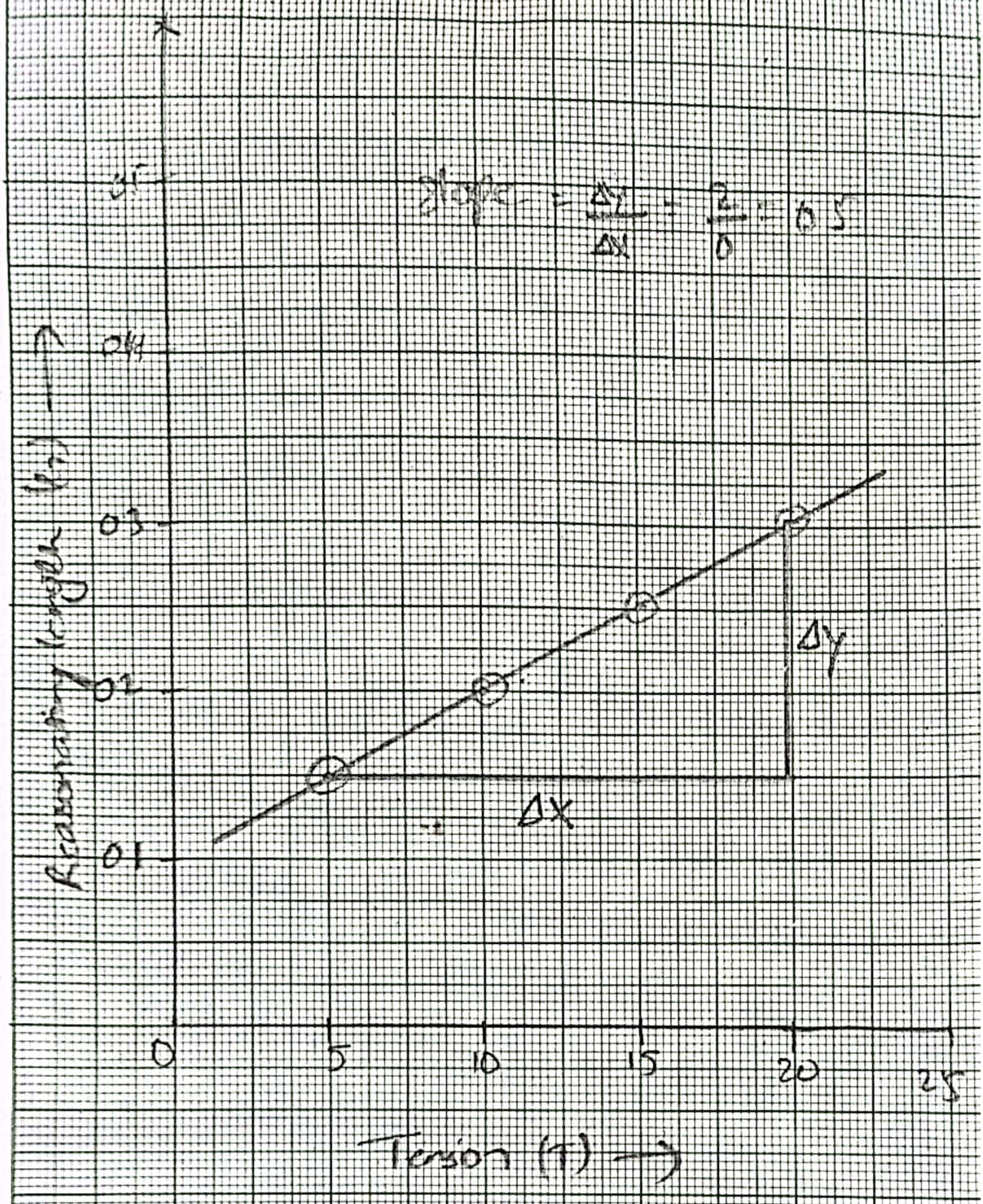
Thus, we can determine the frequency of AC mains and compare the mass per unit length of the wire.

PRECAUTIONS:-

(i) The wire should be connected properly

(ii) After the maximum fluctuation data should be taken.

Along y-axis 10 small square box = 5 division
Along x-axis 20 small square boxes = 0.1 division



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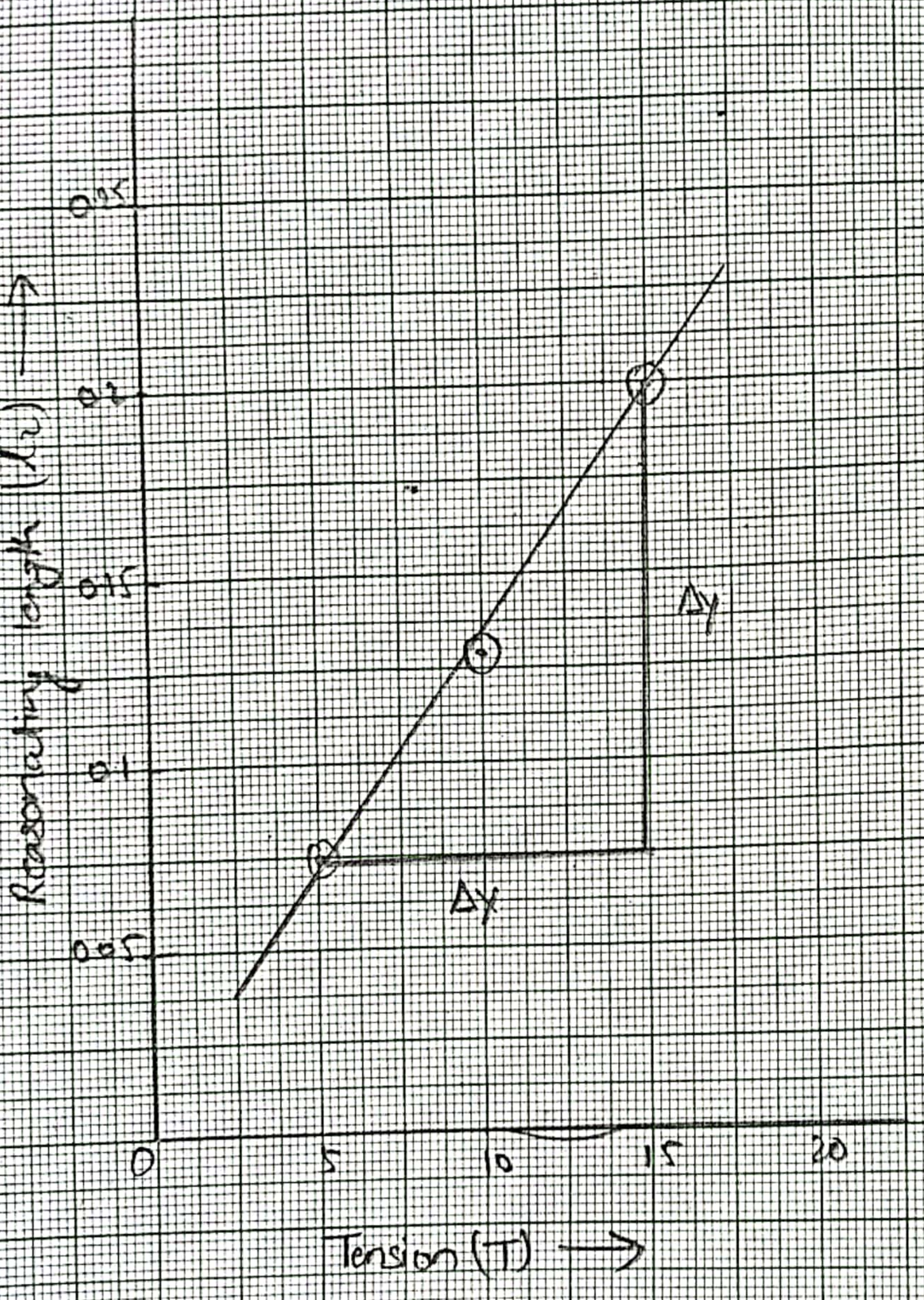

Resonating length (l)
0.25
0.2
0.15
0.1
0.05
0
5
10
15
20
Δy
Δx
Tension (T)

S.N	Total load 'm' (kg)	Resonating length l(m)	Tension(T) = mg	f(Hz)	mean(f1)
1	0.5	0.28	4.9	46.61	
2	1	0.362	9.8	52	50.33
3	1.5	0.485	14.7	51.14	

2. For copper wire

Diameter of wire (d) = 0.8mm = 0.8×10^{-3} m

Density of material of wire (ρ) = 8900 Kg/m^3

Mass per unit length wire (μ) = 4.47×10^{-3} Kg/m

S.No	Total load 'm' (kg)	Resonating length l(m)	Tension(T) = mg	f(Hz)	mean(f2)
1	0.5	0.39	4.9	42.7	
2	1	0.44	9.8	53.62	
3	1.5	0.49	14.7	58.1	51.03
4	2	0.57	19.6	54.41	
5	2.5	0.69	24.5	53.02	

RESULTS

The frequency of A.C mains (f) = $\frac{f_1+f_2}{2}$ = 50.68Hz

Standard value of f = 50 Hz

% error = $\left|\frac{50.68-50}{50}\right| \times 100\%$ = 1.36 %

PROCEDURE

1. The Sonometer is placed on the table and the wire is stretched with a hanger of 0.5 kg.
2. A horse-shoe magnet is placed on the box in exactly mid-way between the bridges so that its poles N and S lie in the wires with one on each side of it.
3. The secondary of the step-down transformer is connected across the wire through the rheostat and a key. The secondary voltage is about 6V.
4. The position of the bridges are adjusted with the magnet exactly mid-way between them until the wire vibrate with maximum amplitude.
5) The distance between the bridges is noted
6) Procedure (4) & (5) are repeated with different tensions by increasing the weights in equal steps of 500 gm
7) Measure the diameter of wire at least in three places and find the mean. Hence, the mass per unit length is determined using above formula.
8) Repeat the same observation for another type of wire.

OBSERVATION

1. For steel wire:

Diameter of wire (d) = 1.04 mm = 1.04×10^{-3} m

Density of material of wire (ρ) = 7850 kg/m^3

Mass per unit length of wire (μ) = 6.7×10^{-3} kg/m directed in the direction opposite to our face, the wire experiences upward force and is deflected upward. After next half cycle of a.c. the current flows from right to left and wire is deflected downward and so on. In this way, the wire moves up and down and its vibrations are maintained.

when the wire resonates, the frequency of a.c. mains is equal to the frequency of vibration of the string

According to laws of transverse vibration of string, the frequency of fundamental mode is

$$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}} \quad \text{—— (1)}$$

where, l is length of the vibrating segment of the wire.

$T = mg$, is the tension is the wire, m is mass placed in the pan and μ is mass per unit length of wire.

If d be the diameter of the wire, then area of cross-section of wire $= \frac{\pi d^2}{4}$

Volume of wire = Area of cross-section x length

$\therefore$ Mass of wire = Volume x Density

$= \frac{\pi d^2}{4} \times l \times \rho$

$\therefore$ Mass per Unit length of wire $(\mu) = \frac{\pi d^2}{4} \times \rho$

Here ρ = density of material of wire

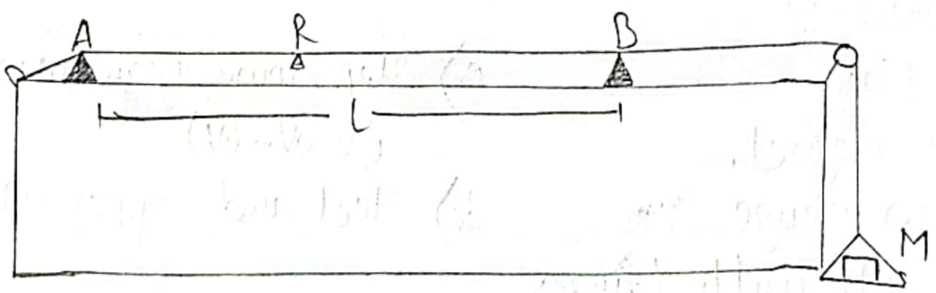

fig:- Sonometer.

PHYSICS PRACTICAL SHEETS

NCIT.. Campus

Date ....

Class : BE Civil 1st year

Roll No.: 4

Shift: Morning

Object of the Experiment (Block Letter)

Experiment No.: 6

Group : C

Sub.: physics practical

Set :

AIM:- DETERMINATION OF THE FREQUENCY OF A.C. MAINS AND AND COMPARE THE MASS PER UNIT LENGTH OF THE TWO GIVEN WIRES.

APPARATUS REQUIRED

a) Sonometer box
b) Horse-shoe magnet.
c) Micro screw gauge
d) Slotted weights with hanger
e) Step down transformer (220V-6V)
f) Steel and copper wires

THEORY

A Sonometer is a hollow sounding box, whose one end of which is fixed at one end and the other end passes through a pulley fixed at the other end of box. The vibrating length of the wire can be adjusted by means of two sharp knife edges, over which the wirepasses. The horse-shoe magnet is placed at the middle of the wire. An alternating current of low voltage is passed through the wire when a current carrying conductor is placed in an uniform magnetic field, it will experience a magnetic force and is deflected. According to Fleming's direction opposite to our face, flows from left to right and is deflected. According to Fleming's left hand rule, if the current flows from left to right and magnetic field is

RESULTS

The value of capacitance = 7.96×10^{-4}

standard value of capacitance = 4.70×10^{-4} F

Percentage error = $\left|\frac{\bar{C}-C_s}{C_s}\right| \times 100\ \% = 69\%$

The value of 'c' from graph (charging) = 8.61×10^{-5} F

The value of 'c' from graph (discharging) = 8.9×10^{-5} F

The value of capacitance from half life (c) = $\frac{T_{1/2}}{0.693R}$

$= 9.01 \times 10^{-4}$ F

CONCLUSIONS:

Hence from above experiment we can determine the capacitance of a capacitor by charging and discharging through resistor.

PRECAUTIONS

- change the priority of ammeter properly.
- Apparatus should be handled with great care.

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S.N	I_0/I	$\ln I_0/I$	C	$\bar{C}$	$C_i-\bar{C}$	$(C_i-\bar{C})^2$	σC
7	11.31	2.42	7.23×10^{-4}		0.34×10^{-4}	0.11×10^{-8}	
8	14.90	2.70	7.57×10^{-4}		0.51×10^{-4}	0.26×10^{-8}	
9	18.23	2.90	7.57×10^{-4}		0.68×10^{-4}	0.46×10^{-8}	
10	23.42	3.15	7.93×10^{-4}		1.04×10^{-4}	1.08×10^{-8}	
11	29.82	3.39	8.11×10^{-4}	6.88×10^{-4}	1.22×10^{-4}	1.48×10^{-8}	2.98×10^{-8}
12	32.80	3.49	8.59×10^{-4}		1.7×10^{-4}	2.89×10^{-8}	
13	41	3.71	8.76×10^{-4}		1.87×10^{-4}	3.49×10^{-8}	
14	46.85	3.84	9.11×10^{-4}		2.2×10^{-4}	4.84×10^{-8}	

For Discharging

S.N	I_0/I	$\ln I_0/I$	C	$\bar{C}$	$C_i-\bar{C}$	$(C_i-\bar{C})^2$	σC
1	1.68	0.51	4.90×10^{-4}		-3.06×10^{-4}	9.36×10^{-8}	
2	2.17	0.77	6.49×10^{-4}		-1.47×10^{-4}	2.16×10^{-8}	
3	2.83	1.04	7.21×10^{-4}		-0.75×10^{-4}	0.56×10^{-8}	
4	3.86	1.35	7.40×10^{-4}		-0.56×10^{-4}	0.31×10^{-8}	
5	5.15	1.63	7.66×10^{-4}		-0.3×10^{-4}	0.09×10^{-8}	
6	6.53	1.87	8.02×10^{-4}		-0.06×10^{-4}	0.0036×10^{-8}	
7	8.5	2.14	8.17×10^{-4}	7.96×10^{-4}	0.21×10^{-4}	0.044×10^{-8}	1.38×10^{-8}
8	11.34	2.42	8.26×10^{-4}		0.3×10^{-4}	0.09×10^{-8}	
9	15.46	2.73	8.24×10^{-4}		0.28×10^{-4}	0.78×10^{-8}	
10	18.89	2.93	8.53×10^{-4}		0.57×10^{-4}	1.30×10^{-8}	
11	21.25	3.05	9.01×10^{-4}		1.05×10^{-4}	1.10×10^{-8}	
12	28.34	3.34	8.98×10^{-4}		1.02×10^{-4}	1.04×10^{-8}	
13	34	3.52	9.23×10^{-4}		1.27×10^{-4}	1.61×10^{-8}	
14	42.5	3.74	9.35×10^{-4}		1.39×10^{-4}	1.93×10^{-8}	

OBSERVATION

S No	Time(t) sec	current I		Resistance (R) ohm
		charging	Dicharging	
1	0	328	170	20,000
2	5	139	101	20,000
3	10	103	78	20,000
4	15	81	60	20,000
5	20	61	44	20,000
6	25	47	33	20,000
7.	30	35	26	20,000
8.	35	29	20	20,000
9.	40	22	15	20,000
10.	45	18	11	20,000
11.	50	14	9	20,000
12.	55	11	8	20,000
13.	60	10	6	20,000
14.	65	8	5	20,000
15.	75	7	4	20,000

CALCULATION

For charging

S.N.	I_0/I	$\ln I_0/I$	C_i	$\bar{C}$	$C_i - \bar{C}$	$(C_i-\bar{C})^2$	σ_C
1	2.35	0.85	2.94×10^{-4}	6.89×10^{-4}	-3.95×10^{-4}	15.6×10^{-8}	2.98×10^{-9}
2	3.18	1.15	4.34×10^{-4}		-2.59×10^{-4}	6.70×10^{-8}	
3	4.04	1.39	5.39×10^{-4}		-1.5×10^{-4}	2.25×10^{-8}	
4	5.37	1.68	5.95×10^{-4}		-0.94×10^{-4}	0.88×10^{-8}	
5	6.91	1.93	6.47×10^{-4}		-0.42×10^{-4}	0.17×10^{-8}	
6	9.37	2.23	6.77×10^{-4}		-0.17×10^{-4}	0.02×10^{-8}	

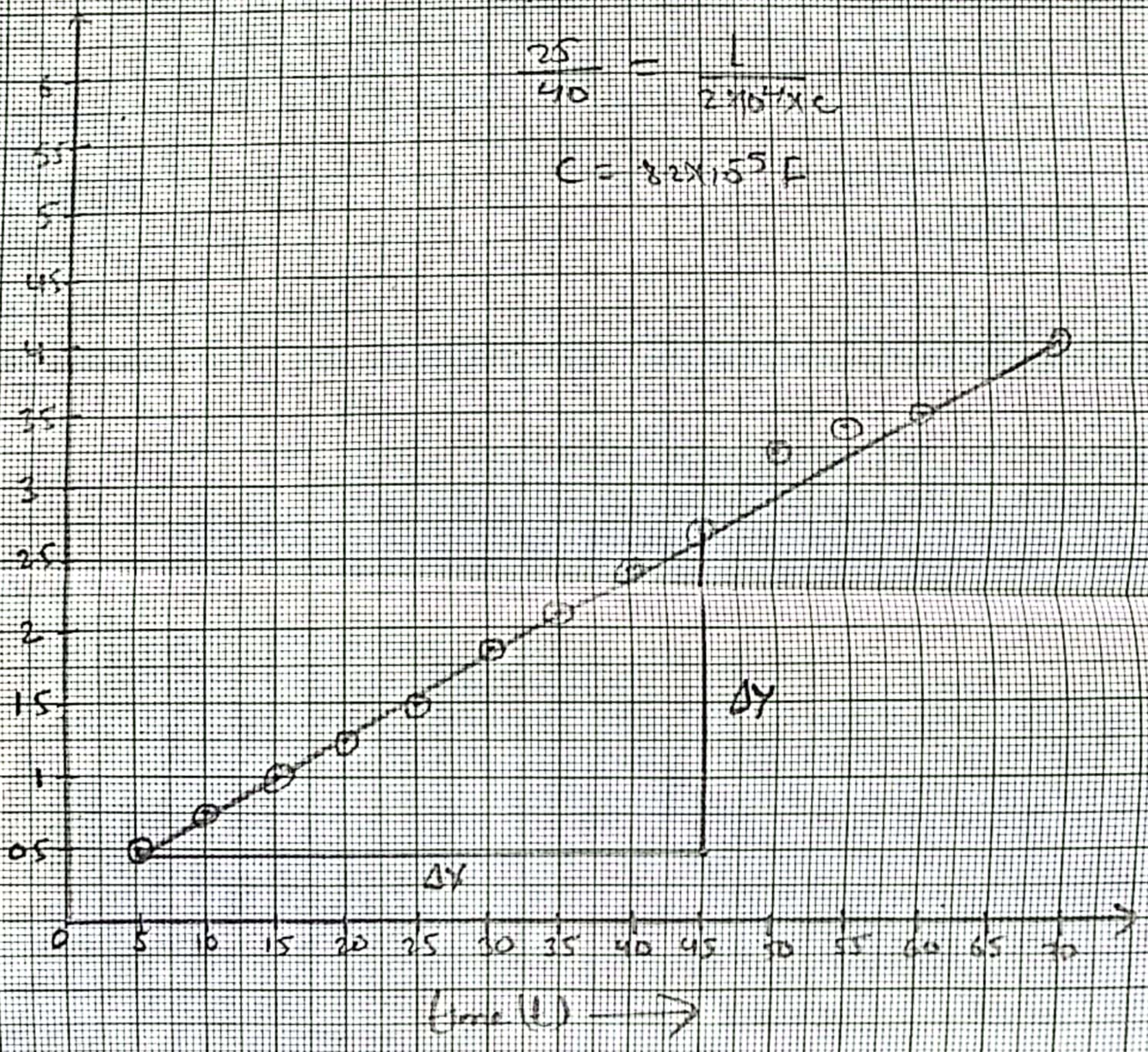
charging.

$$C = \frac{t}{R\ \ln(I_0/I)}$$

$$\frac{\ln(I_0/I)}{t} = \frac{1}{RC}$$

$$\frac{25}{40} = \frac{1}{2\times10^{4}\times C}$$

$$C = 8.2\times10^{5}\ F$$



When $t = RC$, eqn (vii) becomes

$$q = q_0 e^{-1} = \frac{q_0}{e} = 0.37\, q_0$$

$$q = 0.37 q_0 = 37\% \text{ of } q_0$$

Hence, time constant of a discharging circuit is the time at which the charge stored in capacitor fall to 37% of its initial value.

Equation (iv) & (vii) show that magnitude of charging current is equal to magnitude of discharging current.

PROCEDURE

1) Connect the given capacitor (C μF), resistor (R K Ω), two way key (x, y) ammeter (0-200 μA) and battery as shown in figure.
2) Close the switch X, charging starts & ammeter gives the maximum reading. This is I_0 for time $t = 0$. The current then starts decreasing.
3) The maximum current I_0 is noted and then the current I for fixed interval of time (say 5 or 10 sec) is noted.
4) Changing the polarity of ammeter disconnect X and connect Y, note the data as in steps (2) & (3).
5) Find half life $T_{1/2}$ from the plot of I and t.
6) Plot a graph between $\ln\left(\frac{I_0}{I}\right)$ & t for all cases & find the capacitance of capacitor from slope of the plot.

Differentiating with respect to time

$$\frac{dq}{dt} = -\frac{q_0}{RC} e^{-t/RC}$$

$$= -\frac{EC}{RC} e^{-t/RC}$$

$$= -\frac{E}{R} e^{-t/RC} \quad [\because q_0 = EC]$$

$$\therefore I = -I_0 e^{-t/RC} \quad \text{—— (vi)}$$

The negative sign is due to the opposite direction of the flow of charge (or current) during discharging as compared to that during charging.

where $I_0 = \frac{E}{R}$ is the maximum current

$$I = I_0 e^{-t/RC} \quad \text{—— (vii)} \text{ (in magnitude)}$$

Eq^n (v) & (vi) are called the discharging eq^n in terms of charge and current respectively. Here negative sign in the exponential term indicates decreases in charge with time

Time constant :- The factors RC in the discharging equation is called capacitive time constant of discharging circuit. It has dimensions of time.

Time constant (or relaxation time)

The term RC in equation (iii) & (iv) is called time constant where $t = RC$, from equation (iii)

$$q = q_0(1-e^{-1})$$
$$= q_0(1.-0.37) \Rightarrow 0.63q_0$$
$$q = 0.63q_0 = 63\% \text{ of } q_0$$

Hence, the time constant of charging circuit is defined as the time in which the capacitor charges by about 63% of its maximum charge.

for discharging of capacitor:-

When the capacitor is fully & switch Y is on, discharging occurs in the capacitor through resistor.

Using Kirchhoff's voltage or second law

$$0 = V_C + V_R = \frac{q}{c} + IR \qquad [\text{since e.m.f}(E) = 0]$$

$$0 = \frac{q}{c} + \frac{dq}{dt}.R$$

$$\text{or} = R\frac{dq}{dt} = -\frac{q}{c}$$

$$\text{or} \quad \frac{dq}{dt} = \frac{-q}{RC}$$

$$\text{or} \quad \frac{dq}{q} = \frac{-1}{RC}dt$$

$$\int_{q_0}^{q} \frac{dq}{q} = -\frac{1}{RC}\int_0^t dt$$

$$\text{or} \quad [\ln q]_{q_0}^{q} = \frac{-t}{RC}$$

$$\text{or} \quad \ln q - \ln q_0 = -t/RC$$

$$\text{or} \quad \ln\frac{q}{q_0} = -t/RC$$

$$\text{or} \quad q/q_0 = e^{-t/RC}$$

Again from (iv).

$$\frac{I_0}{I} = e^{t/RC}$$

or $\ln\left(\frac{I_0}{I}\right) = t/RC$

$\therefore \ln\left(\frac{I_0}{I}\right) = t/RC$ —— (v) which is the required equation for determination of c in this experiment.

Equation (iii) & (iv) are called the charging equation in terms of charge & current respectively.

equation (v) shows that 'c' can be determined from the slope of straight line obtained from the plot between $\ln\left(\frac{I_0}{I}\right)$ and 't' as shown in figure.

The half-life of the circuit, $T_{1/2}$ is the time for the current to decreases to half of its initial value.

i.e. when $t = T_{1/2}$, $I = I_0/2$

from equation (v),

$$\ln(2) = T_{1/2}/RC$$

$$c = \frac{T_{1/2}}{R\ln 2}$$

or $c = \frac{T_{1/2}}{0.693R}$ —— (vi)

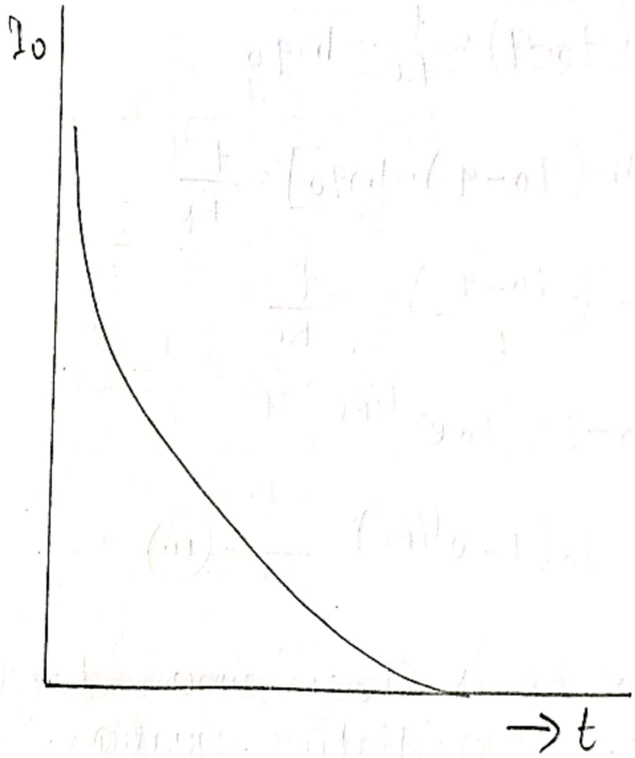


fig:-(C) plot of I~t showing exponential nature

So, equation (i) becomes.

$$-\ln(q_0) = A \quad \text{—— (ii)}$$

Using equation (i) & (ii)

$$\Rightarrow \quad -\ln(q_0 - q) = \frac{t}{RC} - \ln q_0$$

$$\Rightarrow \quad -[\ln(q_0 - q) - \ln q_0] = \frac{t}{RC}$$

$$\Rightarrow \quad \ln\left(\frac{q_0 - q}{q}\right) = -\frac{t}{RC}$$

$$\Rightarrow \quad q_0 - q = q_0 e^{-t/RC}$$

$$\therefore \quad q = q_0(1 - e^{t/RC}) \quad \text{—— (iii)}$$

Where $q_0 = EC$ is the maximum charge stored in the capacitor. Differentiating equation (iii) with respect to time

$$\frac{dq}{dt} = -q_0\left(-\frac{1}{RC}\right) e^{-1/RC}$$

$$\therefore \quad I = \frac{q_0}{RC} e^{-t/RC} = \frac{EC}{RC} e^{-t/RC}$$

$$= \frac{E}{R} e^{-t/RC}$$

$$= I_0 e^{-t/RC}$$

$$\therefore \quad I = I_0 e^{-t/RC} \quad \text{—— (iv)}$$

where $I_0 = \frac{E}{R}$ is the maximum current

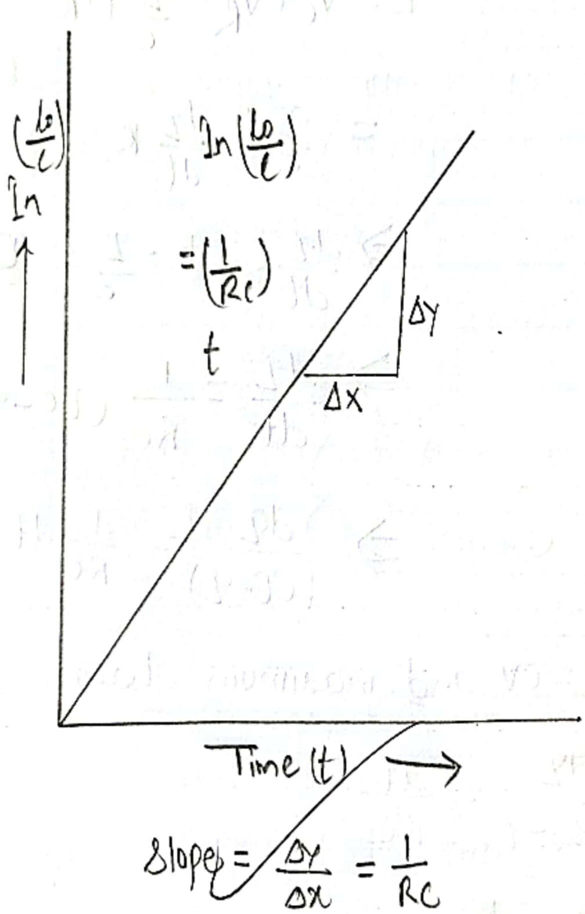


fig:- (b) plot between $\ln(I_0/I)$ and 't' current falls asymtotically to zero

Apply Kirchhoff's loop rule.

$$E = V_c + V_R = \frac{q}{c} + iR$$

$$= \frac{q}{c} + \frac{dq}{dt}R$$

$$\Rightarrow \frac{dq}{dt}R = E - \frac{q}{c} = \frac{Ec - q}{c}$$

$$\Rightarrow \frac{dq}{dt} = \frac{1}{Rc}(Ec - q)$$

$$\Rightarrow \frac{dq}{(CE - q)} = \frac{1}{Rc}dt$$

For a capacitor $q = CV$ and maximum charge, $q_0 = CE$

$$\therefore \frac{dq}{q_0 - q} = \frac{dt}{Rc}$$

Integrating, we get

$$-\ln(q_0 - q) = \frac{t}{Rc} + A \quad \text{—— (1)}$$

Where A is the integrating constant

To find A:-

At $t = 0$, $q = 0$

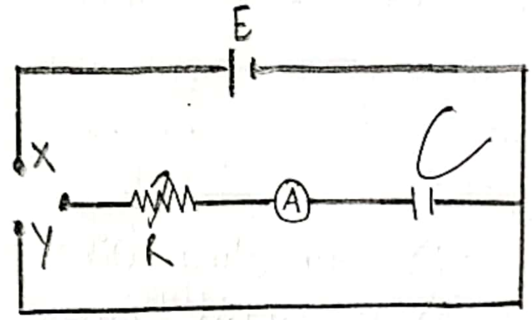


fig:- (a) charging and discharging of capacitor.

PHYSICS PRACTICAL SHEETS

NCIT Campus

Date: 23-11-2079
Class: BE Civil 1st year
Roll No.: 4
Shift: Morning
Object of the Experiment (Block Letter)

Experiment No.: 5
Group: C
Sub.: Physics Pratical
Set:

11/30

AIMS:- DETERMINATION OF THE CAPACITANCE OF A GIVEN CAPACITOR BY CHARGING AND DISCHARGING THROUGH RESISTOR.

APPARATUS REQUIRED

a) Capacitor
b) Microammeter (0-100 μA)
c) Stop watch
d) connecting wires
e) variables high resistance box
f) Battery.

THEORY

charge is the intrinsic property. Modern technology revolves around the use of charge & current.

capacitor is a device used to store charge or electric potential energy. Capacitance is its ability to store charge.

For charging.

Let a capacitor having capacitance 'c' is connected in series with a resistor of resistance 'R' ammeter 'A' a battery with emf E and a two way key as shown in figure, when the key X is on the capacitance, It is in charging mode. The positive and negative charges appear on the plates and oppose the flow of electrons. As the charges accumulate, the potential difference between the plates of capacitor increases and the charging

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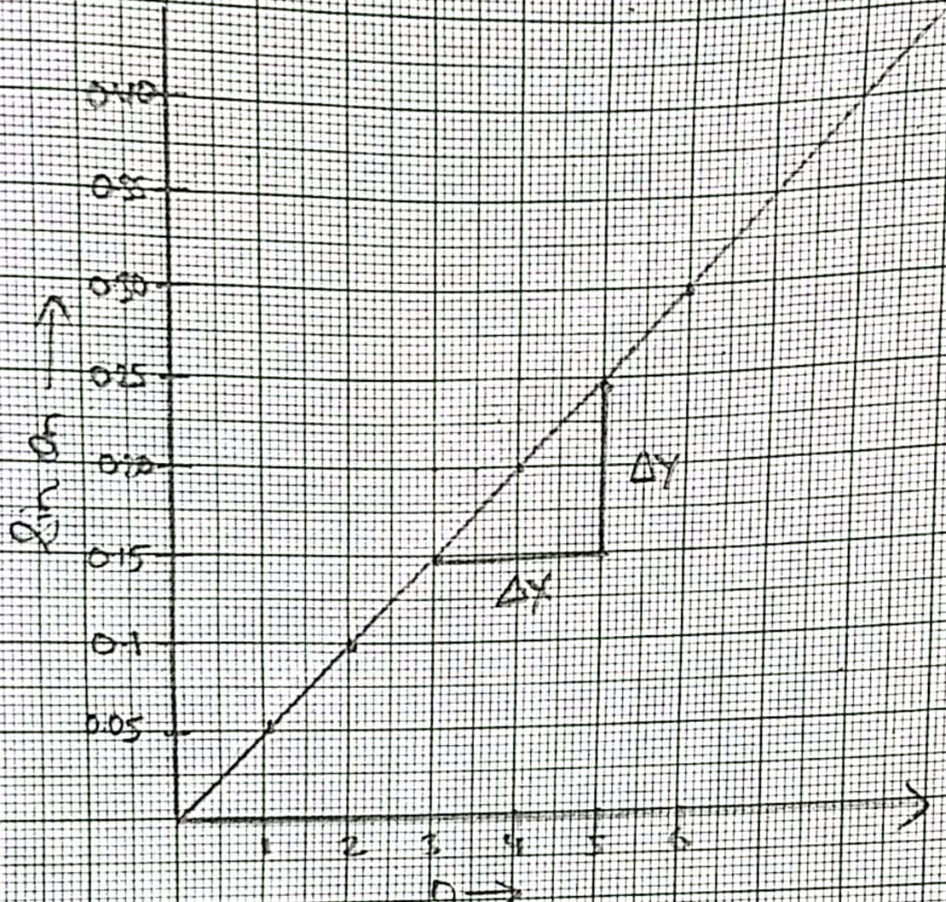
$$\text{Scale} = \frac{0.396 - 0.068}{5} = 0.05$$



$$\text{Slope} = \frac{\Delta Y}{\Delta X} = \frac{0.13}{2} = 0.065$$

fig:- plot of $2r\theta_n \sim n$ for gravity

PROCEDURE

1 A mm graph is fixed on the screen & a straight line is drawn on it
2 Adjust the diffraction gration between laser source & screen
3 Measure the distance betwⁿ grating & screen. Also measure the distance between bright sports about central maximum.
4 Plot a graph of $\sin\theta$ versus n.

The value of grating element (a+b) =

(n)	Separation between grating & screen (D)	Distance between bright spot about centre (y)	Distance $x = y/2$	$\tan\theta = x/D$	$\sin\theta$	$\lambda = \frac{(a+b)\sin\theta}{n}$	$\bar{\lambda}$	$(\lambda_1 - \bar{\lambda})^2$	$\sigma\lambda$
1	49	6.8	3.45	0.069	0.068	6.90×10^{-5}	6.77×10^{-5}	1.69×10^{-12}	2.98×10^{-7} cm
2	49	13.4	6.7	0.136	0.134	6.80×10^{-5}		9×10^{-14}	
3	49	20.1	10.05	0.205	0.200	6.77×10^{-5}		0	
4	49	27.1	13.55	0.276	0.265	6.73×10^{-5}		1.6×10^{-13}	
5	49	34.5	17.25	0.352	0.331	6.72×10^{-5}		2.5×10^{-13}	
6	49	42.4	21.2	0.432	0.396	6.70×10^{-5}		4.9×10^{-13}	

Table No 1. Determination of wavelength of given light (λ)

RESUTS:

The wavelength of the given light (λ) = 6.77×10^{-5} cm
Standard value of (λ) = 6.80×10^{-5} cm
Percentage error = $\left|\frac{\bar{\lambda} - \lambda_s}{\lambda_s}\right| \times 100\%$ = 0.44%
Wavelength of given light from graph = $0.065 \times 1.016 \times 10^{-3}$
= 6.604×10^{-5} cm

CONCLUSION :- After performing the experiment the laser wavelength was found to be 6.77×10^{-5} cm

PRECAUTIONS

I Measure the length properly.
II The graph drawn should be free hand.

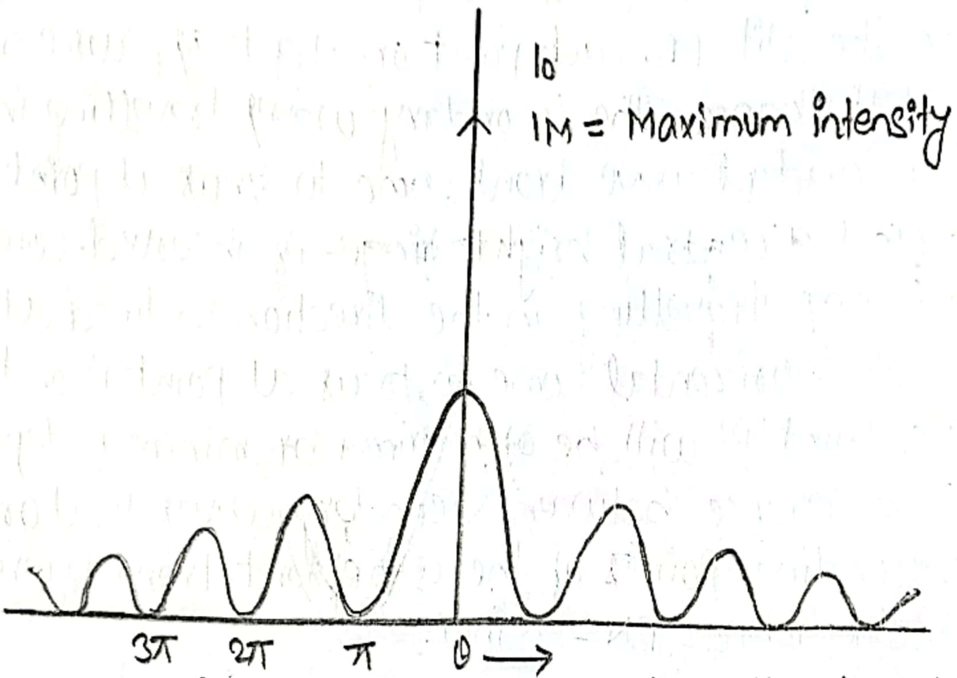


Fig (d) :- Intensity distribution for diffraction through single slit.

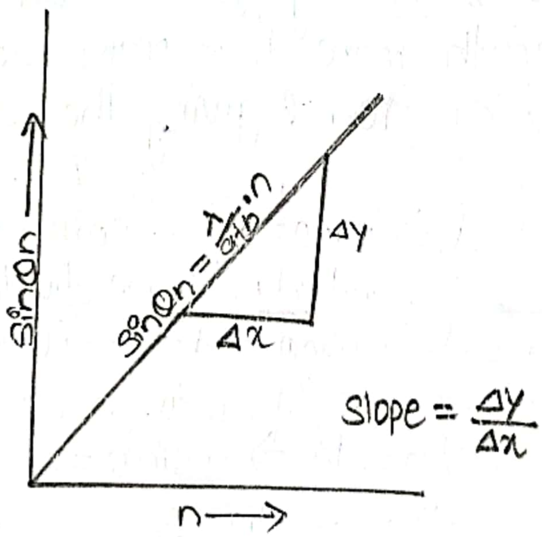


fig (e) plot of $\sin\theta_n \sim n$ for grating.

* Frauch offer diffration through single slit.

Consider a slit of width 'a'. As the plane wave front is incident on the slit AB, each point on it act as source of secondary disturbance. The secondary waves travelling in the direction of incident wave front come to focus at point 'O' on screen and a central bright fringe is observed. consider secondary waves travelling in the direction inclined at angle θ with horizontal come to focus at point 'P' on the screen. The point 'P' will be of maxima or minima depends upon path difference between secondary waves that originate from corresponding points of the wavefront. From figure, this path difference = BN = $a\sin\theta$.

If we divide into two equal parts. The path difference between the waves originating from extreme of each part is $\lambda/2$ as the ray from bottom of each part travels half wavelength more than rom the top part. This has been proved by fresnel giving the concept of fresnel's zones.

$\frac{a}{2}\sin\theta = \frac{\lambda}{2} \Rightarrow a\sin\theta = \lambda$ ...... corresponds to first minimum.

Similarly, if we divide the slit into 4 equal parts

$\frac{a}{4}\sin\theta = \frac{\lambda}{2} \Rightarrow a\sin\theta = 2\lambda$ ..... corresponds to 2nd minimum.

Dividing the slit into 2n equals parts.

$a/2n \sin\theta = \lambda/2 \Rightarrow a\sin\theta = n\lambda$ ---- (ii) minimum

Equation (ii) is the condition of minima for diffraction through single slit. The condition of maxima is

$a\sin\theta = (2n+1)\lambda/2, \; n = 0,1,2,3,4. \ldots$

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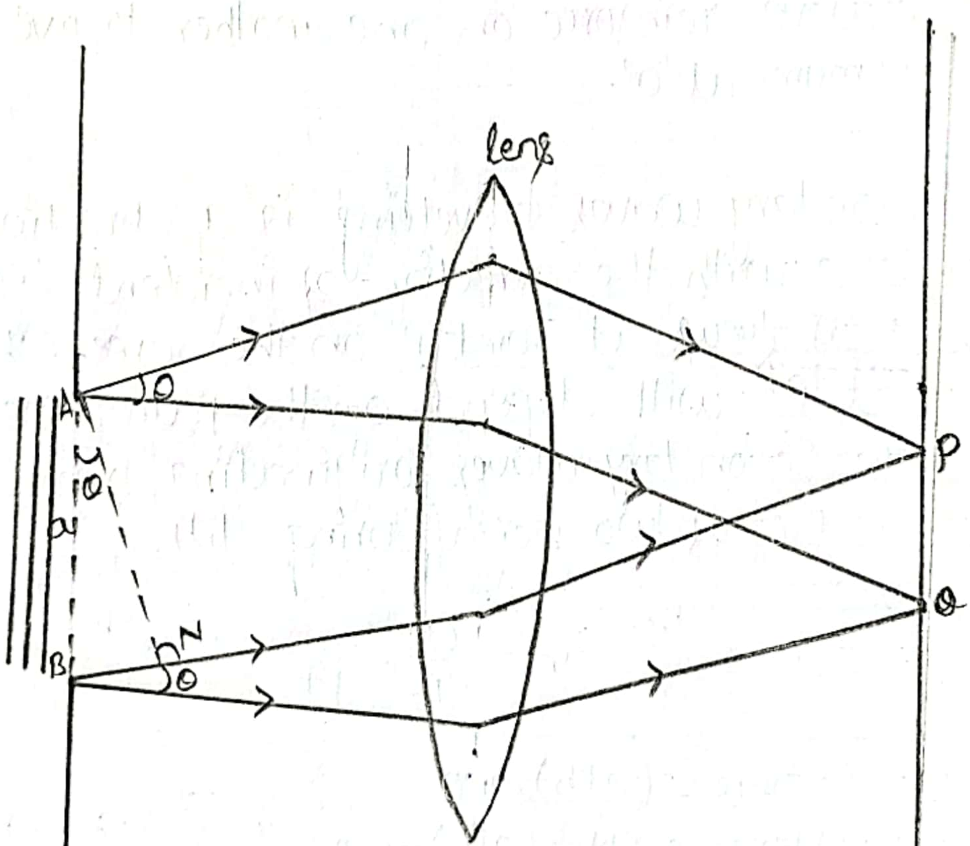

Fig (C) :- Diffration through single slit let a plane wave front of light of wavelength λ be incident normally on the grating surface. Then all the secondary waves travelling in the same direction as that of incident light will come to focus at point 'O' on the screen as shown in figure. Since the path difference betwn corresponding waves arriving at 'O' is zero, so all the secondary wave reinforce on one another to give central bright maximum at 'O'.

Consider, secondary waves travelling is a direction inclined at an angle θ with the direction of incident light, which comes of focus at point 'P' on the screen. The intensity at 'P' will depend on the path difference between the secondary waves originating from corresponding A and C of two neighbouring slits.

from figure

$$\sin = \frac{CN}{AC}$$

or $CN = AC\sin\theta = (a+b)\sin\theta$

$\therefore$ Path difference $CN = (a+b)\sin\theta$

The point 'P' will be maximum intensity if the path difference is equal to integral multiple of 'λ' i.e. when

$$(a+b)\sin\theta = n\lambda \quad \text{——— (1)}$$

Where $n = 1, 2, 3 \ldots\ldots$

Eq^n (1) is the required diffraction grating eq^n and the condition of mimima is,

$$(a+b)\sin\theta = (2n+1)\lambda/2, \quad n = 0, 1, 2, 3 \ldots\ldots$$

Note :- The asterik (*) below is assigned for the extra theoretical feedback for the students & can be omitted.

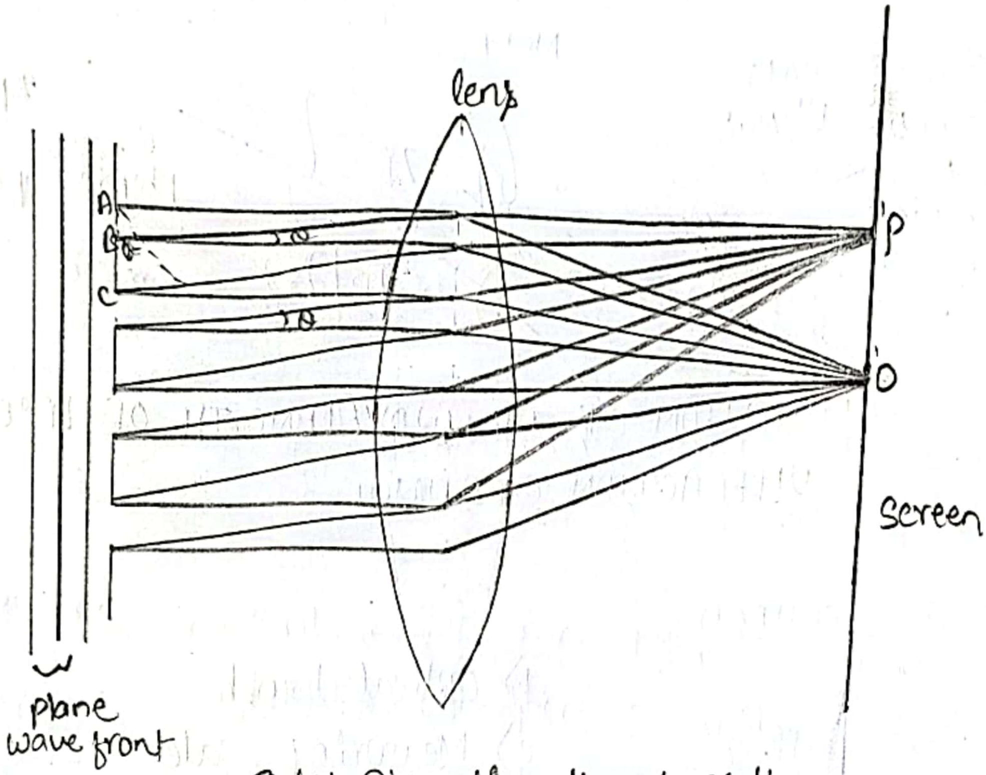

Fig (a). Diffraction through grating.

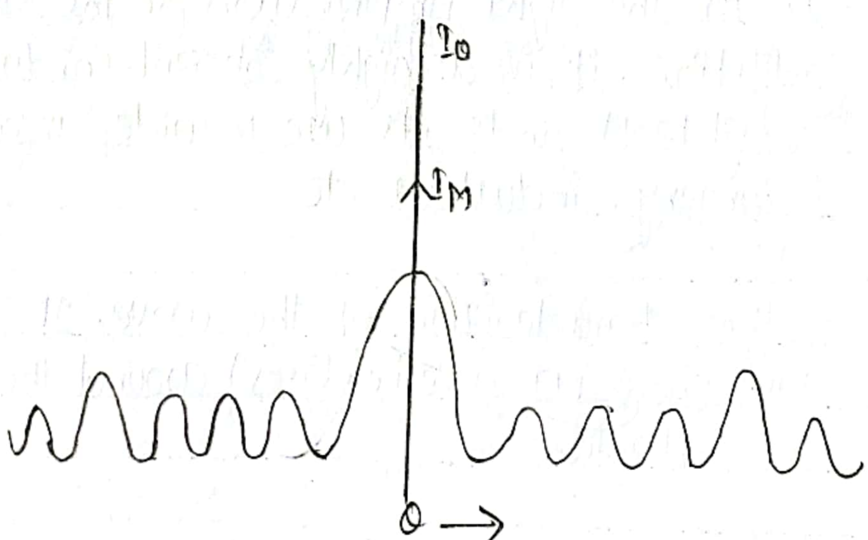

Fig (b) :- Intensity distribution for diffraction through grating.

PHYSICS PRACTICAL SHEETS

NCET. Campus

Date: 27th magh 2079
Class: BE Civil 1st year
Roll No.: 4
Shift: Morning
Object of the Experiment (Block Letter)

Experiment No.: 4
Group: C
Sub.: physics practical
Set:

10/27

AIM :- DETERMINATION OF THE WAVELENGTH OF LASER LIGHT USING DIFFRACTION GRATING

APPARATUS REQUIRED

a) Laser light
b) Diffraction grating
c) Graph as screen (graph paper)
d) Optical bench
e) Measuring scale.

THEORY :

Laser stands for the light Amplification for the Stimulated Emission of Radiation. it is a highly coherent, unidirectional Monochromatic light. It finds its use in wide areas such as in medical surgery, industries etc

Diffraction is the characteristic of the wave. It is the bending of wave (here EM wave i.e. laser) around the corners of an obstacle.

A transparent glass plate consisting of a large number of ruled lines is called diffraction grating. Each line acts as an obstacle while the spacing between the lines allows LASER to pass through the grating. If the width of the transparency and opacity be 'a' and 'b' respectively, the distance (a+b) is called grating element.

and $(a+b) = 1/N$ where, N = no of lines per unit length of grating.

RESULTS

1) The value of wavelength of given light (λ) = 5.42×10^{-4} mm
2) Standard value (λ) = 5893 Å = 5.893×10^{-4} mm
3) percentage error in (λ) = $\left|\frac{5.42 \times 10^{-4} - 5.893 \times 10^{-4}}{5.893 \times 10^{-4}}\right| \times 100\% = 8.030\%$
4) λ from graph = 5.42×10^{-4} mm

CONCLUSIONS:-
Thus, the wavelength of Na-light can be calculated by using Newton's ring method.

PRECAUTIONS:-
1) Instrument should be handled carefully
2) Be careful while measuring the M.S & V.S scale.

27/03/2023 14:25

CamScanner

at 4th, 8th & 16th dark rings gradually

) Find the diameters of corresponding rings

) Plot a graph between D_n^2 & n as figure below.

OBSERVATION

) Radius of curvature of plane - convex lens R=

) Vernier constant of microscope=

Table 1:- Determination of the diameter of rings

order of rings	Microscope reading (left)(x) M.S	V.S	M.S + (V.S × V.C)	Microscope reading (right)(y) M.S	V.S	M.S + (V.S × V.C)	Diameter $D_n = x - y$	D_n^2
4	44	79	44.79	39	86	39.85	4.94	24.404
8	45	64	45.64	38	01	38.10	7.69	58.216
12	46	35	46.35	38	33	38.33	8.00	84
16	46	86	46.86	37	77	37.77	9.09	82.62

Table No 2 Measurement of wavelength (λ)

S.No	n-m	$D_n^2 - D_m^2$	λ	$\bar{\lambda}$	$\lambda_i - \bar{\lambda}$	$(\lambda_i - \bar{\lambda})$	$\sigma\lambda$
1	8-4	31.81	1.39×10^{-4}		-4.03×10^{-4}	16.24×10^{-8}	
2	12-4	5.784	2.37×10^{-4}		-3.05×10^{-4}	9.30×10^{-8}	
3	12-8	39.59	8.1×10^{-4}	5.42×10^{-4}	2.68×10^{-4}	7.18×10^{-8}	0.012
4	16-4	18.62	7.65×10^{-4}		2.23×10^{-4}	4.9×10^{-8}	
5	16-8	24.404	8.017×10^{-4}		0.4×10^{-4}	0.16×10^{-8}	
6	16-12	58.214	8×10^{-4}		2.5×10^{-4}	6.65×10^{-8}	

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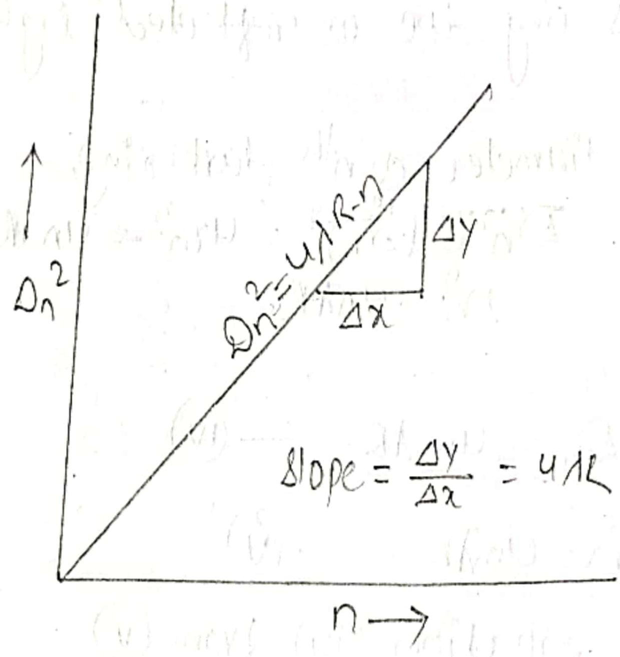


Fig:- 'e' Graph between D_n^2 and n

$$2t = n\lambda$$

$$\therefore \frac{2r_n^2}{2R} = n\lambda$$

or $r_n^2 = n\lambda R$

Hence r_n represents the radius of n^{th} dark ring in case of Newton's ring due to reflected light.

If D_n is diameter of n^{th} dark ring.

$$D_n^2 = (2r_n)^2 = 4r_n^2 = 4n\lambda R$$

$$D_n^2 = 4n\lambda R$$

Similarly if $D_m = 4m\lambda R$ — (iv)

$$D_m^2 = 4m\lambda R \quad \text{— (v)}$$

Substracting equation (iv) from (v)

$$D_n^2 - D_m^2 = 4(n-m)\lambda R$$

$$\therefore \lambda = \frac{D_n^2 - D_m^2}{4(n-m)R} \quad \text{— (vi)}$$

PROCEDURE

i) Clean the glass plates & lenses with a cotton cloth

ii) Place a plano convex lens the base glass plate with its curved surface in contact with plane surface of the glass plate.

iii) look through the travelling microscope & focus the rings sharply. place the cross wire in the centre of the rings.

iv) Slide the microscope towards left & note the corresponding reading (m.s & v.s) by placing the cross wire tangentially

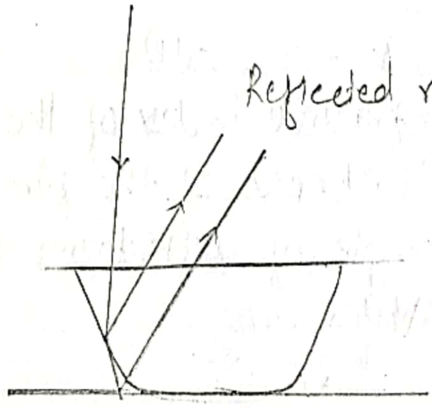


fig:- 'c'

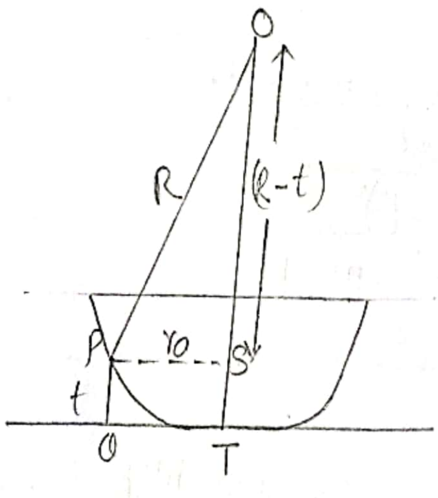


fig:- 'd'

Newton's rings are formed due to both reflected and transmitted rays. In case of interference in thin film due to reflected light, the condition for maximum intensity are:-

$$2\mu t\cos r = (2n-1)\lambda/2 \quad \text{—— (i)}$$

&

$$2\mu t\cos r = n\lambda \quad \text{—— (ii)}$$

where μ = refractive index of the film

t = thickness of the film

r = angle of reflection &

n = order

Consider a plano-convex lens & glass plate arrangement as shown in figure (d). Let PQ the position of nth ring at which thickness of the film PQ = t Therefore, PS = r_n is the radius of nth ring. R be the radius of curvature of plano convex lens.

from figure :-

$$OP^2 = PS^2 + OS^2$$

or $R^2 = r_n^2 + (R-t)^2$

or $R^2 = r_n^2 + R^2 - 2Rt + t^2$

or $r_n^2 = 2Rt - t^2$

Neglecting t^2 being small quantity

$$r_n^2 = 2Rt$$

$$\therefore \quad t = \frac{r_n^2}{2R} \quad \text{—— (iii)}$$

For normal incidence ($r=0$) & for air as medium ($\mu=1$) so, equation (ii) can be written as.

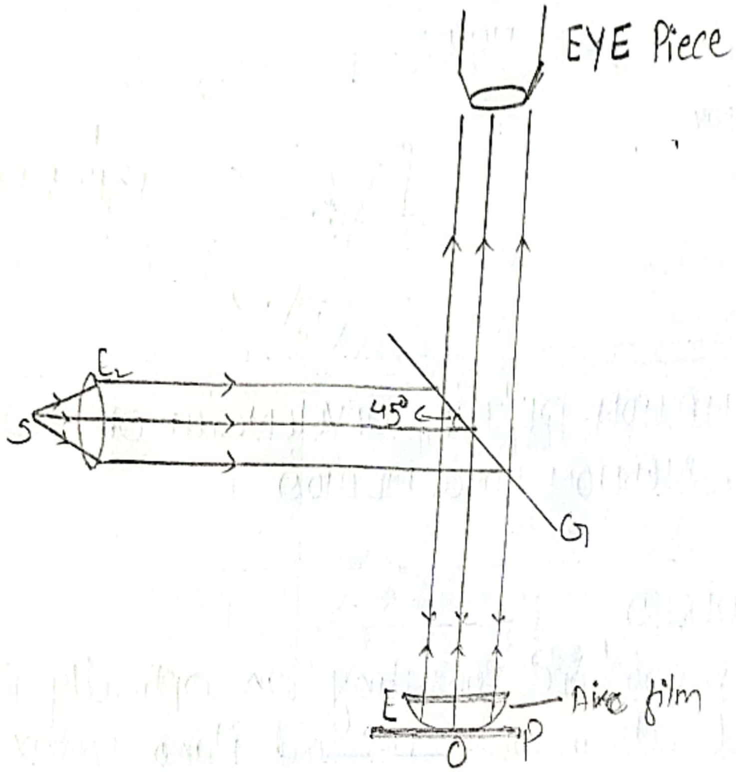


Fig 1:- Experimental arrangement for Newton's ring

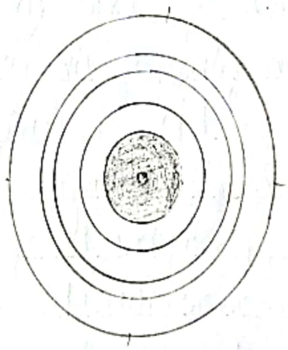


Fig 2:- Netwon's rings due to reflected rays.

PHYSICS PRACTICAL SHEETS

N.E.C. Campus

Date ....
Class : BE civil 1st year
Roll No.: 04
Shift: Morning
Object of the Experiment (Block Letter)

Experiment No.: 3
Group : C
Sub.: Physics Practical
Set :

AIMS:- DETERMINATION OF THE WAVELENGTH OF SODIUM LIGHT BY USING NEWTON RING METHOD

APPARATUS REQUIRED

a.) A travelling microscope consisting on optically plane glass plate inclined at an angle 45° and plano convex lens on another glass plate

b.) Na-light c.) spherometer d.) Torch light

THEORY

When a plano convex lens of large focal length is placed on a plane glass plate, a thin film of air is enclosed between the lower surface of the lens and upper surface of the plate. The thickness of the film is in ascending order to a certain value around the point of contract of lens and glass plate. When a parallel beam of monochromatic light is made to incident on such combination, interference fringes are observed in the form of a series of concentric rings with their centre at the points of contract. such rings due to interference are first observed by Newton and hence called Newton's ring.

27/03/2023 14:25

Table NO 2 :- Measurement of modulus of rigidity of wire (n) and moment of ~~int~~ inertia of disc (I_1)

SN	l	T_1^2	T_2^2	$T_2^2 - T_1^2$	n	$\bar{n}$	I_1	$\bar{I}_1$	~~$(n_1-\bar{n})^2$ or $(I_1-\bar{I}_1)^2$ or~~
1	45	50.41	87.42	37.0	8.87×10^{10}		12903.94		
2	40	36	60.84	24.84	1.17×10^{11}		13730.16		
3	35	34.81	53.290	18.48	1.38×10^{11}	8.16×10^{11}	17843.42	14207.796	
4	30	26.01	44.89	18.887	1.15×10^{11}		13057.58		
5	25	21.16	36	14.84	1.22×10^{11}		13508.43		

RESULTS

1 The value of modulus of rigidity of wire (n) = 8.16×10^{11} dyne/cm^2

2 Standard value of n = 3.4×10^{11} dyne/cm^2

3 Percentage error = $\left|\frac{8.16\times10^{11} - 8.4\times10^{11}}{8.4\times10^{11}}\right| \times 100\%$ = 7.05 %

4 The value of moment of inertia of circular disc (I_1) = 14207.7 g cm^2

5 Standard value of I_1 = $MR^2/2$ = 15736.57 g cm^2

6 Percentage error in I_1 = $\left|\frac{14207 - 15736.57}{15736.57}\right| \times 100\%$ = 9.71 %

7 The value of n from graph = 6.69×10^{10} dyne/cm^2

8 The value of I_1 from graph = 11901.73 g cm^2

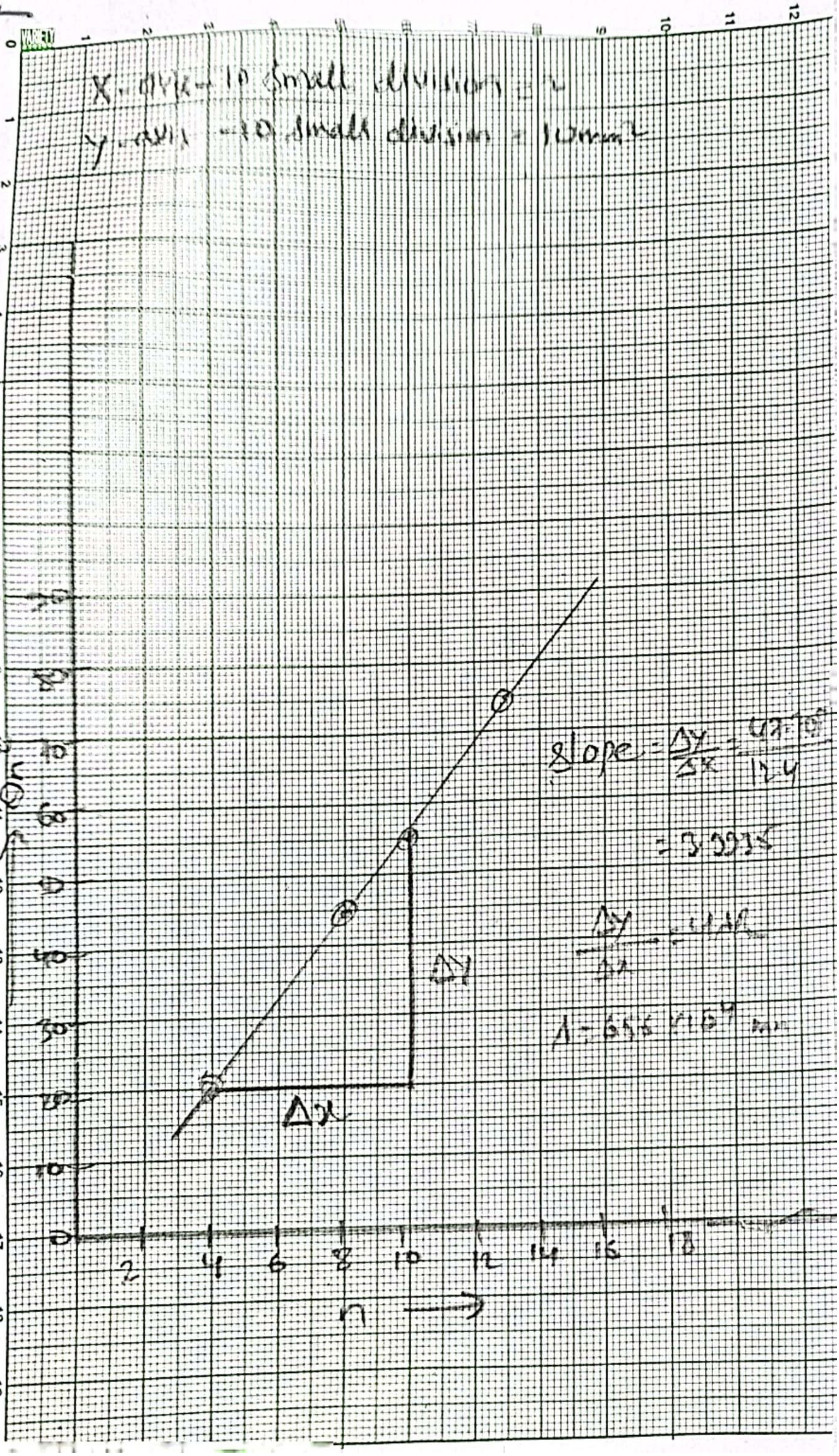
CONCLUSION :-

Thus from the experiment it is observed that we can determine the values of modulus of rigid of given wire and moment of inertia ~~discbe~~ by using torsion pendulum.

PRECAUTIONS :-

I) Measure the length properly

II) The graph drawn should be free hand.


X-axis → 10 small division = 2
y-axis → 10 small division = 10mm²
Slope = Δy/Δx = 47.10/12.4
= 3.9935
Δy/Δx = 4λR
λ = 655 ×10⁻⁹ m
Δy
Δx
2
4
6
8
10
12
14
16
18
n

7) Plot graph between $(T_2^2 - T_1^2) \sim l$ & $(T_2^2 - T_1^2) \sim T_1^2$ & find n and I_1

OBSERVATION

1) Mass of circular ring (M) = 320g
2) Mass of circular disc (M') = 850 g
3) Radius of suspension wire (r) = 00425 cm
4) Radius of circular disc (R) = 6.085 cm
5) Internal radius of circular ring $(R_1) = 9.4 + 0.01 \times 2 = 4.71$ cm
6) External radius of circular ring $(R_2) = 12.1 + 0.01 \times 7 = 6.085$ cm
7) Moment of inertia of circular ring $I_2 = M \frac{(R_1^2 + R_2^2)}{2} = 9473.812\,cm^2$

Table No.1 Determination of time Period

S.No	length cm	Determination of T_1 (Disc) Time for 10 oscillation			Time period (T_1)	Determination of T_2 (Disc) Time for 10 oscillation			Time period
1		1	2	Mean	$T_1 = T_1/10$	1	2	mean	$T_2 = T_2/5$
1	45	71	71	71	7.1	94	93	93.5	9.35
2	40	60	60	60	6.0	78	78	78	7.8
3	35	58	60	59	5.9	73	73	73	7.3
4	30	51	51	51	5.1	67	67	67	6.7
5	25	46	46	46	4.6	60	60	60	6.0

Table No.2 Measurement of modulus of rigidity of wire (η) and moment of Inertia of disc (I_1).

or $T_2^2 = 4\pi^2\left(\frac{I_1+I_2}{C}\right)$ ——— (v)

Subtracting equation (iv) from (v),

$T_2^2 - T_1^2 = \frac{4\pi^2 I_2}{C}$ ——— (vi)

$= \frac{4\pi^2 I_2}{\pi n r^4} \times 2l$

$n = \frac{8\pi I_2 l}{(T_2^2 - T_1^2) r^4}$ ——— (vii)

Again, dividing equation (iv) by (vi)

$\frac{T_1^2}{T_2^2 - T_1^2} = \frac{I_1}{I_2}$

$I_1 = \left(\frac{T_1^2}{T_2^2 - T_1^2}\right) I_2$ ——— (viii)

PROCEDURES.

i) Suspend the circular disc with a ring from a rigid support.

ii) Take the circular ring out of the circular disc and place it over the rigid support.

iii) Twist slightly the disc in horizontal plane. Then note the time taken for 10 oscillation & calculate time period T_1 for circular disc.

iv) Now place the circular ring on the circular disc in such a way that the axis of the wire passing through centre of gravity of the ring.

v) Again, note the time period T_2 for disc and ring for the same length as in case of circular disc.

vi) Repeat the process for different lengths of wire.

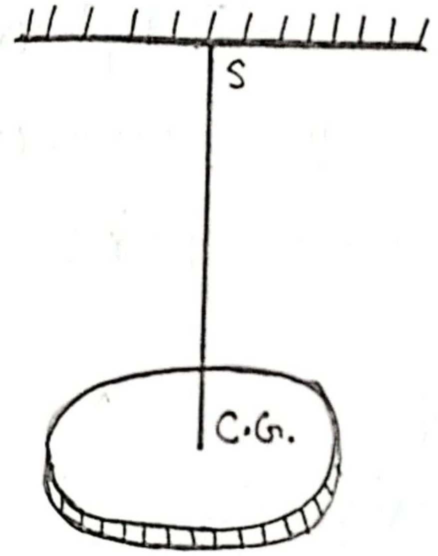


Fig:- Torsion pendulum.

where, n = modulus of rigidity of wire
r = radius of wire
L = length of wire.

The torque is also given by
$\tau = I\alpha$ —— (ii)

Equation (i) & (ii) give $I\alpha = -C\theta$

or $\alpha = -\frac{C\theta}{I}$

or $\frac{d^2\theta}{dt^2} + \frac{C\theta}{I} = 0$

or $\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$

This shows that the motion of torsion pendulum is simple harmonic

Here, $\omega^2 = \frac{C}{I}$

or $\omega = \sqrt{\frac{C}{I}}$

or $\frac{2\pi}{T} = \sqrt{\frac{C}{I}}$

or $T = 2\pi\sqrt{\frac{I}{C}}$ —— (iii)

This is the time period of torsion pendulum.

let I_1 be the moment of inertia of circular disc, then its time period is given by, $T_1 = 2\pi\sqrt{\frac{I_1}{C}}$

or $T_1^2 = 4\pi^2\frac{I_1}{C}$ —— (iv)

Now a circular ring is placed on the circular disc co-axially with the wire, then the period of oscillation for this combination is given by $T_2 = 2\pi\sqrt{\frac{I_1+I_2}{C}}$

where, I_2 is the moment of interia of circular ring

PHYSICS PRACTICAL SHEETS

N.C.I.T. Campus

Date: 11/16/2079
Class: BE Civil 1st year
Roll No.: 221904
Shift: Morning
Object of the Experiment (Block Letter)

Experiment No.: 2
Group: C
Sub.: Physics Pratical
Set:

9

379/11/16

AIM :- DETERMINATION OF THE VALUE OF MODULUS OF REGIDITY OF THE WIRE GIVEN AND MOMENT OF INERTIA OF A CIRCULAR USING TORSION PENDULUM.

APPARATUS REQUIRED

a) Torsion Pendulum set.
b) Thin wire,
c) stop watch,
d) ~~sw~~ screw gauge,
e) Meter scale
f) Spirit level,
g) Balance

THEORY

A disc suspended at its mid-point by a long and thin wire to a rigid support constitutes a torsion pendulum. It is called so because when it is called so when it is twisted and then released, it executes torsional vibrations about the wires an axis.

If the pendulum is torned through an angle 'θ', the wire exerts a restoring torque proportional to angular displacement 'θ' i.e. $\tau \propto \theta$

or $\tau = -c\theta$ —— (i)

where 'c' is called torsion constant of the wire which depends upon its property. It is defined as the restoring torque per unit in the wire and given by

$$c = \frac{\pi \eta r^4}{2l}$$

RESULTS

1 The value of g i) = 10.14   ii) 7.88   iii)   mean = 9.01 m/s^2

2 Standard value of g in kathmandu valley

$$= 9.8\left(1 - \frac{2h}{R}\right) = 9.79\ m/s^2$$

Where, average height of kathmandu from sea level (h) = 1350 m radius of earth (R) = 6400 km.

3 Percentage error in $g = \frac{9.79 - 9.01}{9.79} \times 100\% = 7.96\%$

4. The value of K =

5. Standard value of $K = \frac{\text{Total length of bar}}{\sqrt{12}} =$

6. Percentage error in K =

CONCLUSION

Thus, we find the acceleration due to gravity & radius of gyration of bar pendulum about an axis passing through its centre of gravity

PRECAUTIONS

i) Measure the lengths properly

ii) The graph drawn should be free hand.

Page No.:	
Date:	

Name of Experiment:

CALCULATIONS:

Table 3: Measurement of g from the plot T~l

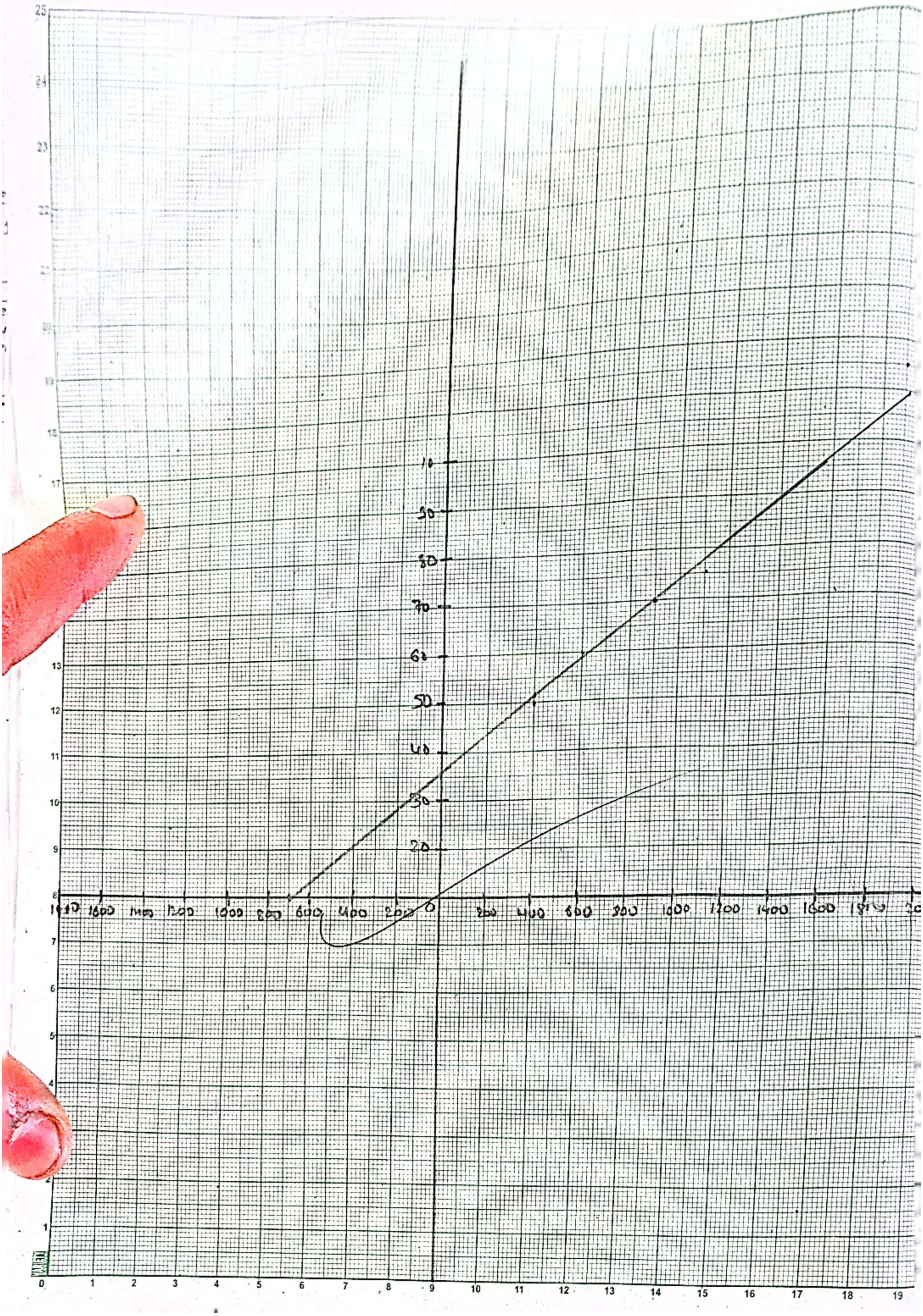
S.N Straight line	length of equivalent simple pendulum (1)	(2)	Mean(l)	Time period (T)	$g = \frac{4\pi^2 l}{T^2}$	$\bar{g}$	$g_1 - \bar{g}$	$(g_1 - \bar{g})^2$	$\sigma_g = \sqrt{\frac{\Sigma (g_1 - \bar{g})^2}{n(n-1)}}$
ABCD	65	65	65	1.60	10.02	9.8	0.22	0.0484	
A'B'C'D'	65	60	62.5	1.55	10.27	10.4	0.47	0.2209	0.3669

Table NO-2 Measurement of K from the plot of T~l

S.NO	l_1	l_2	$K = \sqrt{l_1 l_2}$	$\bar{K}$	$K_i - \bar{K}$	$(K_1 - \bar{K})^2$	$\sigma_K \sqrt{\frac{\Sigma (K_1 - K)^2}{n(n-1)}}$
1	45	20	0.3		-0.02	0.0004	
2	45	20	0.3	0.33	-0.02	0.0004	0.024
3	65	25	0.44		-0.02	0.001	

Table NO3: Determination of g and K from the plot of $lT^2 \sim l^2$

S.NO	Side	OA	OD	slope = $\frac{OA}{OD}$	$g = \frac{4\pi^2}{slope}$	$K = \sqrt{OD}$
1	A	36	700	0.051	7.43	0.26
2	B	36	725	0.049	8.04	0.26


10
90
80
70
60
50
40
30
20
0
1600
1400
1200
1000
800
600
400
200
400
600
800
1000
1200
1400
1600
1800

Name of Experiment:

Page No.:	
Date:	

OBSERVATION

L.C. Of given Stop-watch = 0.01 sec

Table 1. Measurement of length of Pendulum (l) and time period (T) for Side A

S.N	Distance betwn C.G & suspension	Time for 10 oscillation 1	2	Mean(t)	Time Period $T = \frac{t}{10}$	T^2	lT^2	l^2
1	45	16.3	15.97	16.13	1.613	2.601	117.04	2025
2	40	15.78	15.72	15.73	1.573	2.474	98.96	1600
3	35	15.50	15.57	15.53	1.553	2.411	84.38	1225
4	30	15.37	15.40	15.38	1.538	2.365	70.95	900
5	25	15.43	15.68	15.55	1.555	2.418	60.45	625
6	20	15.97	15.94	15.95	1.595	2.544	50.88	400
7	15	17.07	17.03	17.05	1.705	2.907	43.605	225
8	10	19.81	19.60	19.70	1.970	3.880	38.8	100
9	5	27.37	27.50	27.43	2.743	7.524	37.62	25

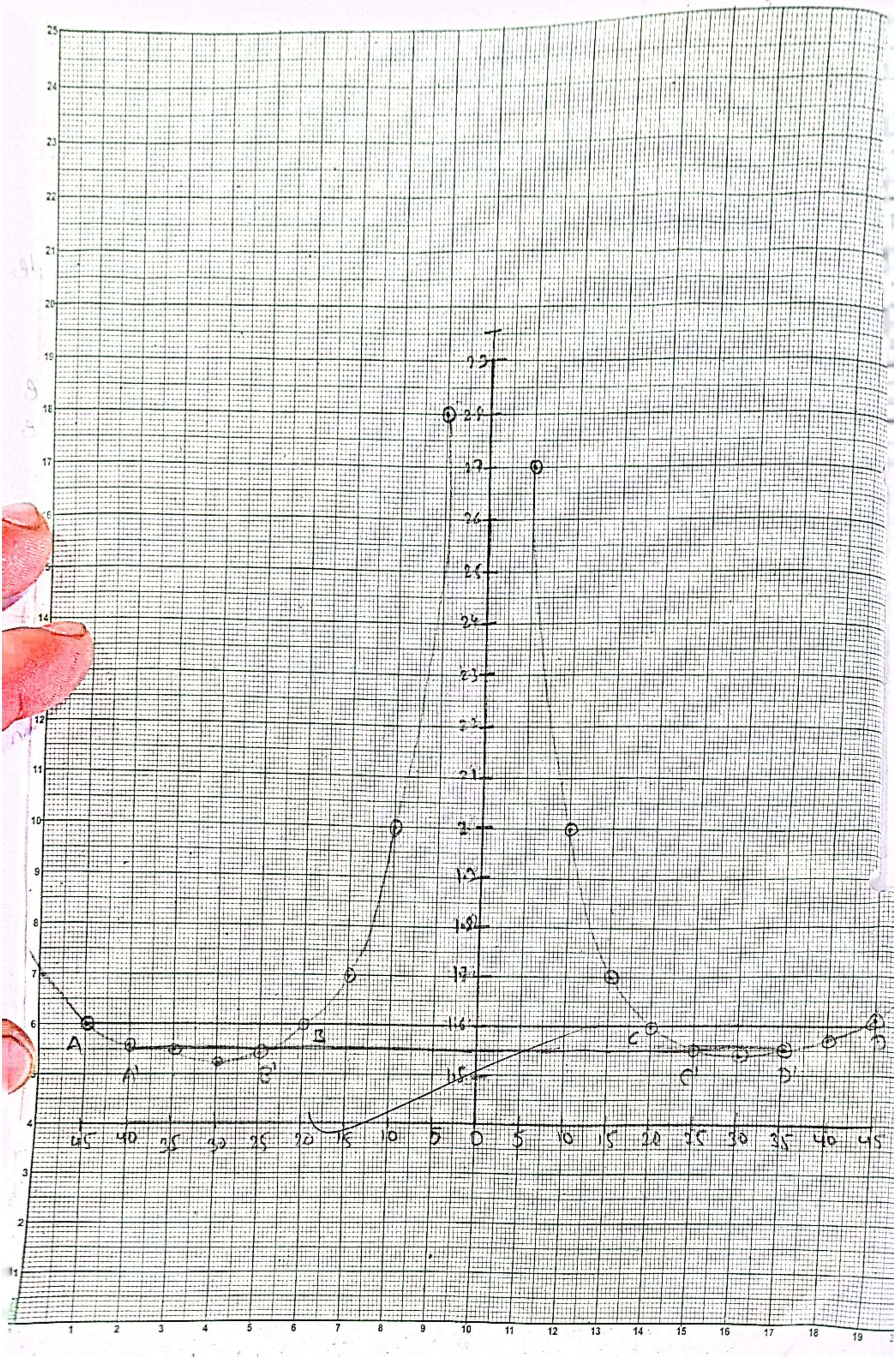
Table 2: Measurement of length of Pendulum (l) and time period (T) for side 'B'

S.N	Distance betwn C.G & suspension	Time for 10 oscillation 1	2	mean(t)	Time period $T = t/10$	T^2	lT^2	l^2
1.	45	16.06	15.93	15.725	1.599	2.556	115.02	2025
2	40	15.65	15.66	15.665	1.565	2.449	97.96	1600
3	35	15.56	15.53	15.543	1.554	2.414	84.49	1225
4	30	15.31	15.34	15.33	1.532	2.347	70.41	900
5	25	15.35	15.37	15.36	1.536	2.359	58.97	625
6	20	15.94	15.94	15.94	1.594	2.540	50.80	400
7	15	17.22	17.16	17.19	1.719	2.954	44.31	225
8	10	20.22	20.16	20.19	2.019	4.076	40.76	100
9	5	28.31	28.	28.155	2.815	7.924	39.62	25

$\frac{1-2}{10}$

D.

Email: ragh.pandit@gmail.com



Name of Experiment:

Page No.:
Date:

PROCEDURE

a) Suspend the bar pendulum is the first hole from side A such that pendulum is hanging parallel to the wall.

b) Set the pendulum into oscillation with small amplitude approximately 5 and note the time taken for 10 complete oscillations.

c) Repeat the procedure (b), again and take the mean let it be (t).

d) Divide it by 10 to get time period (T).

e) Measure the distance (l) of C.G of the bar from the point of suspension. Repeat the process by hanging the bar through different holes.

f) Suspend the bar on side B and repeat the observation as above.

g) plot of graph between l and T is shown in figure below graph

h) Draw horizontal lines ABOCD, A'B'O'C'D'. A"B"O"C"D" as shown

i) Again plot a graph between lT^2 and l^2 for both sides A and B as shown in figure below.

Name of Experiment:

Page No.:
Date:

where, $L = \left(\frac{k^2 + l^2}{l}\right)$

Squaring equation (iv) both sides

$$T^2 = (4\pi^2/g)\left(\frac{k^2+l^2}{l}\right)$$

$$\text{or } lT^2 = \frac{4\pi^2}{g}l^2 + \frac{4\pi^2}{g}k^2 \quad \text{—— (v)}$$

$$\text{or } \frac{4\pi^2}{g}l^2 - lT^2 + \frac{4\pi^2}{g}k^2 = 0$$

which is the quadratic in l, so it possesses two roots, let they be l_1 and l_2

$$\therefore \text{sum of roots } l_1 + l_2 = -\frac{(-T)^2}{\frac{4\pi^2}{g}} = \frac{gT^2}{4\pi^2}$$

$$\text{or. } g = \frac{4\pi^2}{T^2}(l_1 + l_2) = \frac{4\pi^2}{T^2}L \quad \text{—— (vi)}$$

and the product of roots $l_1 . l_2 = \dfrac{\frac{4\pi^2}{g}k^2}{\frac{4\pi^2}{g}} = k^2$

$$k^2 = l_1 . l_2$$

$$\therefore K = \pm\sqrt{l_1 . l_2} \quad \text{—— (vii)}$$

[Since for $ax^2+bx+c=0$ sum of roots $= -b/a$ and product of roots $= c/a$]

Hence, l_1 and l_2 are two values of 'l' for one side of bar pendulum for which the value of time period is same

[If $l_1 = l$ and $l_2 = k^2/l$ such that $l_1 + l_2 = k^2/l + l = L$]

Email: ragh.pandit@gmail.com

Here, $\omega = \sqrt{\frac{mgl}{I}}$, is the angular frequency

or $\frac{2\pi}{T} = \sqrt{\frac{mgl}{I}}$

or $T = 2\pi\sqrt{I/mgl}$

If it is the radius of gyration of the pendulum, Then from the theorem of parallel axis, the total moment of interia of the pendulum about the axis through point of suspension is,

$I = I_{cm} + ml^2 = mk^2 + ml^2$, where $I_{cm} = mk^2$

$= m(k^2+l^2)$

$\therefore T = 2\pi\sqrt{\frac{m(k^2+l^2)}{mgl}}$

$= 2\pi\sqrt{\frac{\frac{k^2}{l}+l}{g}}$ —— (iii)

Thus, time period of compound pendulum is same as that of a simple pendulum of length $L = \frac{k^2}{l} + l$

This length 'L' is therefore called the length of an equivalent simple pendulum or the reduced length of compound pendulum. Since $k^2 > 0$ i.e. $k^2/l > 0$, the length of equivalent simple pendulum (L) is always greater than length of compound pendulum (l).

A bar pendulum is the simplest form of compound pendulum which consists of a uniform metal rod having equally spaced holes drilled along its length on either side of C.G.

The time period of bar pendulum is (shown in fig)

$T = 2\pi\sqrt{\frac{L}{g}}$ —— (iv)

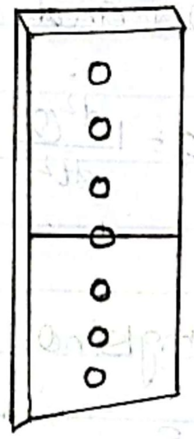


Fig. Bar pendulum.

into its original position.

The restoring torque is,

$$\tau = -mg(G'N) = -mgl\sin\theta \text{ ----- (i)}$$

negative sign indicates that torque is oppositely directed to the displacement 'θ'.

If I is the moment of interia of the pendulum about the axis of suspension and α be its angular acceleration then,

$$\tau = I\alpha = I\frac{d^2\theta}{dt^2} \text{ —— (ii)}$$

from (i) and (ii),

we get, $I\frac{d^2\theta}{dt^2} = -mgl\sin\theta$

and, $\sin = \theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} ----$

for θ to be small, $\sin\theta \sim \theta$

So, $I\frac{d^2\theta}{dt^2} = -mgl\theta$

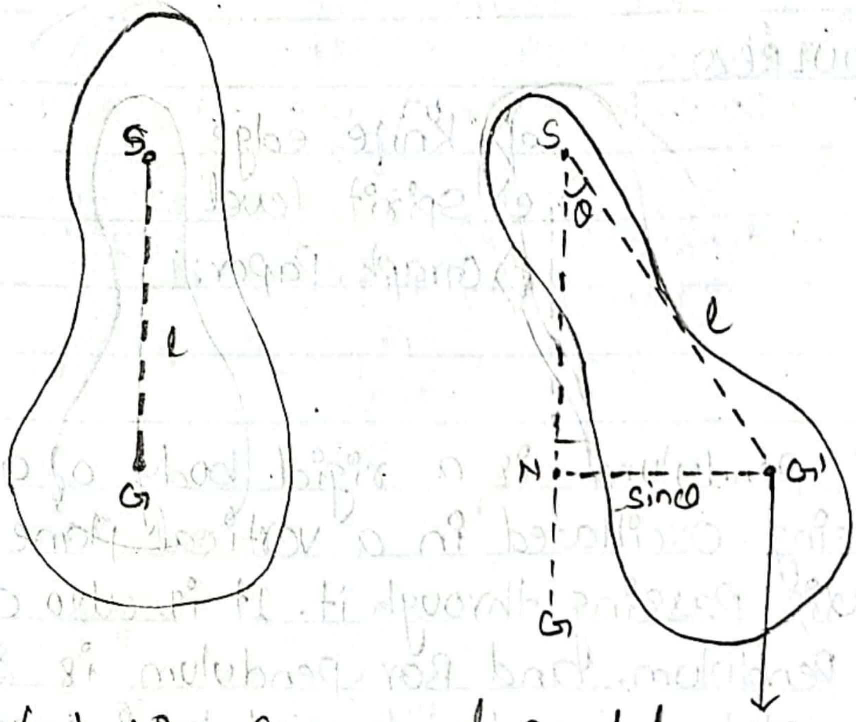
or $\frac{d^2\theta}{dt^2} = -\frac{mgl}{I}\theta$

or $\frac{d^2\theta}{dt^2} + \frac{mgl}{I}\theta = 0$

or $\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$ —— (iii)

equation (iii) is the differential equation of S.H.M. Hence the motion of compound penduleum is simple harmonic

Equation (iii) is also referred as regular harmonic motion



(a) fig:- Compound pendulum (b)

PHYSICS PRACTICAL SHEETS

Date: 6th Magh 2079 .NCIT... CAMPUS
Class: BE civil 1st year. Experiment No.: 1
Roll No.: 4 Group: C
Shift: Morning Sub.: physics pratical
Object of the Experiment (Block Letter) Set:

AIM: DETERMINATION OF THE ACCELERATION DUE TO GRAVITY AND RADIUS OF GYRATION OF THE BAR PENDULUM ABOUT AN AXIS PASSING THROUGH ITS CENTRE OF GRAVITY.

APPARATUS REQUIRED

a) Bar pendulum
b) Stop watch
c) Meter scale
d) knife edge
e) Spirit level
f) Graph Paper.

THEORY

A compound pendulum is a rigid body of arbitrary shape capable of being oscillated in a vertical plane about a horizontal axis passing through it. It is also called real of physical Pendulum. and Bar pendulum is systematic compound pendulum usually a road having equal no. of holes.

Figure (a) shows a compound pendulum free to rotate about a horizontal axis passing through the point of suspension S. In its normal position of rest its c.g 'G' lies vertically below 'S'. The distance between point of suspension (S) and centre of gravity (G) is called length of pendulum(l)

let the pendulum be given the small angular displacement 'θ' so that its c.g takes new Position 'G'' as shown in figure (b). Due to the weight mg acting vertically downward at 'G'', it constitutes a restoring torque whose action is to tend to bring the pendulum back to