Certificate

Name : Nandini Sen Class : BSc Part II

Roll No. : Exam No. :

Institution SH. PRAGYA MAHAVIDYALAYA BIJAINAGAR

This is certified to be the bonafide work of the student in the Physics *Laboratory during the academic year 2023/ 2024.*

No of practicals certified 10 *out of* 10 *in the subject of* Physics

Teacher In-charge

Director
Shri Pragya Mahavidyalaya
Bijainagar-305624

Principal

Examiner's signature

Date : 10. Jan. 24

Institution Rubber Stamp

(N. B : The candidate is expected to retain his/her journal till he/she passes in the subject)

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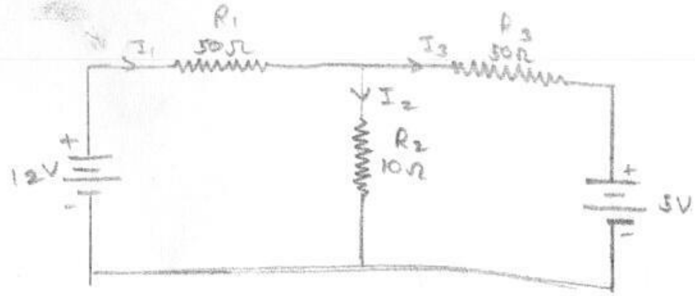

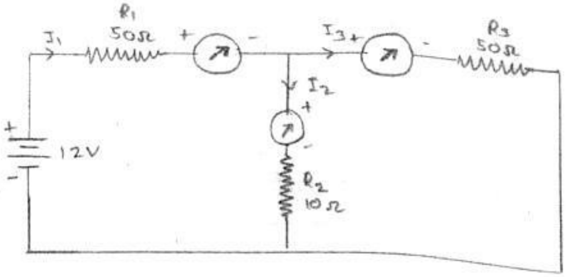

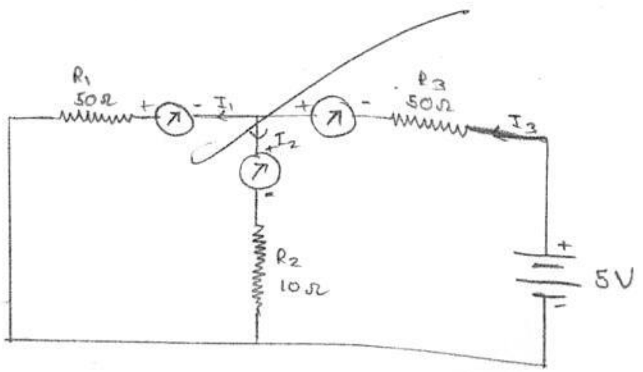

Experiment :- 1 Superposition Theorem

Object :- Verification of Superposition theorem.

Equipments required :- voltmeter, ammeter, wire, circuit box.

Theory :- This theorem states that in a network of linear resistances containing more than one source of emf the current which flow at any point is the sum of all the currents which would flow at that point if each emf source (voltage source) were considered separately and all the other emf source replaced for the time being by resistance equal to their internal resistance.

Observation Table :-

S.No	Source	Theoritical value	Practical value
1.	12V	I_1 = 205.7 mA	200 mA
2.		I_2 = 171.4 mA	160 mA
3.		I_3 = 34.2 mA	40 mA
4.	5V	I_1' = 14.3 mA	20 mA
5.		I_2' = 71.4 mA	60 mA
6.		I_3' = 85.7 mA	80 mA

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Calculation :- (a) Consider only 12 V source :-

$$R_T = \frac{50 \times 10}{60} + 50 = 8.33 + 50 = 58.33\,\Omega$$

[∵ $R_1 \parallel R_2$]

So, Total current $I_T = \frac{V}{R_T} = \frac{12}{58.33} = 205.7\,mA$

$I_1 = 205.7\,mA$

$I_3 = 205.7 \times \frac{10}{60} = 34.2\,mA$

$I_2 = I_1 - I_3 = 171.4\,mA$

(b) Consider only 5 V source :-

$R_T = 58.33\,\Omega$

Here $I_3' = I_T$ so, $I_T = I_3' = \frac{V}{R_T} = \frac{5}{58.33} = 85.7\,mA$

$I_2' = \frac{85.7 \times 50}{50 + 10} = 71.4\,mA$

$I_1' = 85.7 - 71.4 = 14.3\,mA$

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(6) Result :- Theoritical value and ~~calculator~~ calculated value is approx. same hence, superposition theorem varified.

(7) Precaution :- (i) Connection should be neat and clean.
(ii) Connection should be tight.

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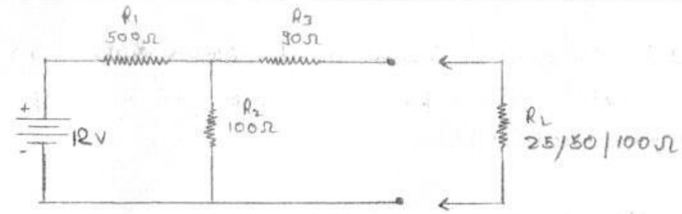

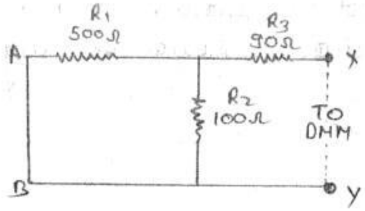

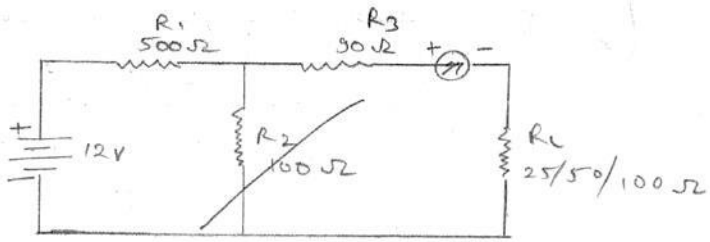

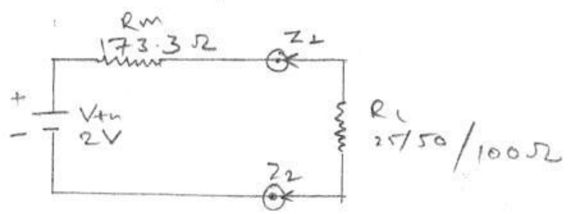

Experiment :- 2 Thevenin's Theorem

(1) Object :- Verification of Thevenin's theorem.

(2) Apparatus :- Box, ammeter, connecting wire, etc.

(3) Theory :- It states that current flowing through a load resistance R_L connected across any two terminals of a linear active bilated network is given by Vac // ($R_{th} + R_L$), where Vac is the open circuit voltage (i.e voltage across the two terminals when R_L is removed) and R_{th} is the internal resistance of the network as viewed back into the open circuited network when all voltage source are replaced by their internal resistance.

(4) Observation :- Least count of ammeter = $\frac{3}{10}$ = 0.3

V_{th} = 2V ; R_{th} = 173.3 Ω

(5) Observation Table :-

S.No	Load Resistance	Practical value	Calculated value
1.	25 Ω	10 mA	9.5
2.	50 Ω	8.9 mA	8.7
3.	100 Ω	7.3 mA	7.2

(6) Calculation :- The value of resistance (R_{th}) :-

$$R_{th} = [R_1 \parallel R_2] + R_3 \ \Omega$$

$$R_{th} = \left[\frac{500 \times 100}{500 + 100}\right] + 90 = 173.3 \ \Omega$$

$V_{th} = 2V$

for :- $R_L = 25 \ \Omega$

$$I_L = \frac{V_{th}}{R_{th}} + R_L = \frac{2}{173.3} + 25 = 10 \ mA$$

for :- $R_L = 50 \ \Omega$

$$I_L = \frac{2}{173.3} + 50 = 8.9 \ mA$$

for :- $R_L = 100 \ \Omega$

$$I_L = \frac{2}{173.3} + 100 = 7.3 \ mA$$

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(7) Result :- The value of theoritical value and calculated value is approx. same hence, Thevenin theorem varified.

(8) Precaution :- (i) Wires should be connected neatly.
(ii) Connection should be tight.

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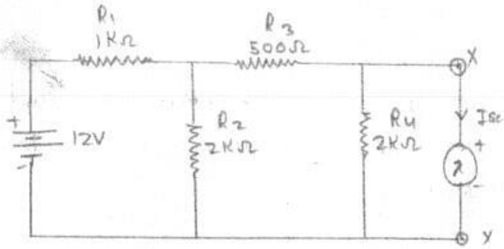

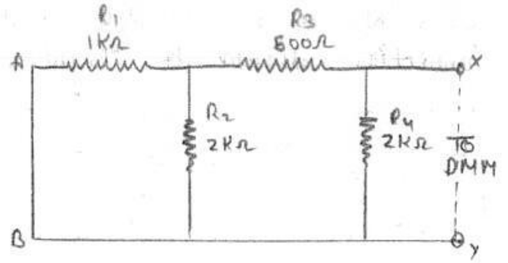

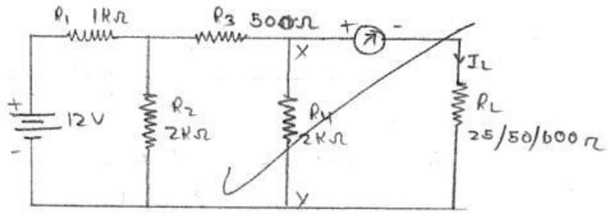

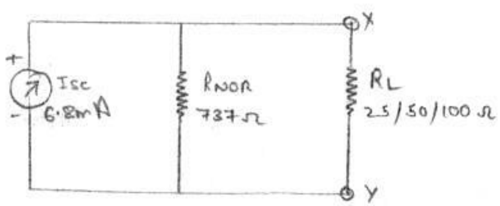

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Expt. No. 3 Page No. 5

Experiment :- 3 Norton Theorem

(1) Object :- Verification of Norton's Theorem.

(2) Apparatus :- Box, connecting wire, etc.

(3) Theory :- Norton theorem states that any two terminals active network containing voltage sources and resistance when viewed from its output terminal is equivalent to a constant current source (Isc) and a parallel resistance (Rnor). The constant current is equal to the current which would flow in a short circuit placed across the terminals and parallel resistance is the resistance of the network when viewed from these open circuited terminals after all voltage source have been removed and replaced by their internal resistance.

(4) Observation Table :-

S.No.	Load resistance	Theoritical value	Calculated value
1.	25Ω	6.55 mA	6.60 mA
2.	50Ω	6.34 mA	6.35 mA
3.	100Ω	5.94 mA	6 mA

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(5) Calculation :- for resistance (R_{NOR}) :-

$$R_{NOR} = [R_1 \parallel R_2 + R_3] \parallel R_4 \ \Omega$$

$$R_{NOR} = 737 \ \Omega$$

For short circuit current (I_{sc}) :-

$I_{sc} = \frac{V_{NOR}}{R_{NOR}}$ → where V_{NOR} is open circuit voltage and is 5V

$$I_{sc} = \frac{5V}{737} = 6.78 \text{ mA}$$

For :- $R_L = 25 \Omega$

$$I_L = \frac{6.78 \times 737}{737 + 25} = 6.55 \text{ mA}$$

For :- $R_L = 50 \Omega$

$$I_L = \frac{6.78 \times 737}{737 + 50} = 6.34 \text{ mA}$$

For :- $R_L = 100 \Omega$

$$I_L = \frac{6.78 \times 737}{737 + 100} = 5.94 \text{ mA}$$

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(6) Result :- Calculated value and observed value is approx. same hence Norton theorem is verified.

(7) Precaution :- (i) Connection should be neat and clean
(ii) Connection should be tight.

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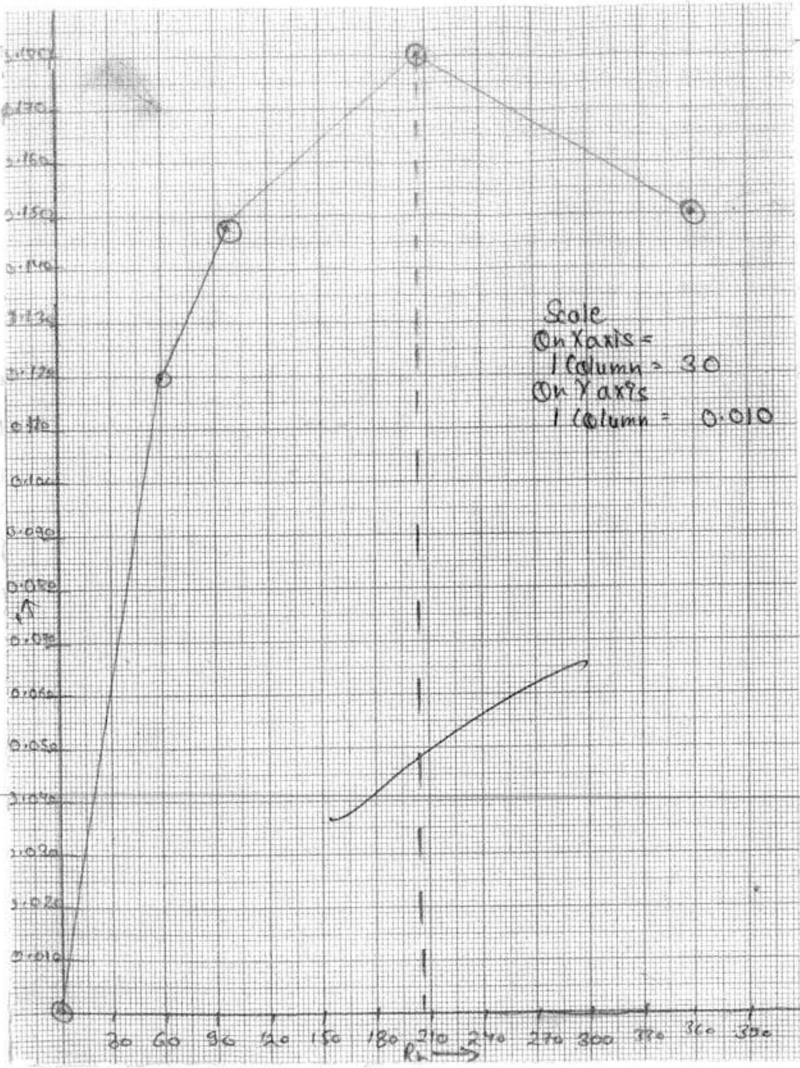

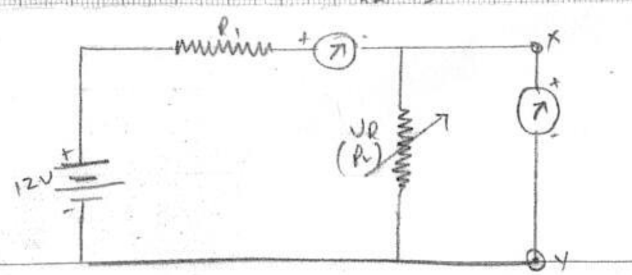

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Experiment - 4 Maximum Power Transfer Theorem

(1) Object :- Verification of Maximum Power Transfer Theorem.

(2) Apparatus :- Box, connecting wire, etc.

(3) Theory :- When load is connected across a voltage source power is transfered from the source to the load. The amount of power transfered will depend upon the load resistance. If 'R_L' is made equal to the internal resistance 'R' of source then maximum power is transfered to the load 'R_L'.

(4) Observation Table :-

S.No.	R	R_L (VR)	Voltage (V)	Current (I)	$P_{out} = V \times I$
1.	200	0	0	0.06	0
2	200	48	2.4	0.05	0.12
3	200	97.5	3.9	0.04	0.156
4	200	200	6	0.03	0.18
5	200	390	7.8	0.02	0.15
6	200	900	9	0.01	0.09
7					
8					
9					

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Calculation :-

For R_L = $R_L = \frac{V}{I}$

1. V = 0, I = 0.06 Then, R_L = 0

2. If V = 2.4, I = 0.05 Then, $R_L = \frac{2.4}{0.05} = 48\,\Omega$

3. If V = 3.9, I = 0.04 Then $R_L = \frac{3.9}{0.04} = 97.5\,\Omega$

4. If V = 6, I = 0.03 Then $R_L = \frac{6}{0.03} = 200\,\Omega$

5. If V = 7.8, I = 0.02 Then $R_L = \frac{7.8}{0.02} = 390\,\Omega$

6. If V = 9, I = 0.01 Then $R_L = \frac{9}{0.01} = 900\,\Omega$

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Result :- If R_L = Req 206
Then power transfer in load is maximum.

Precaution :-

1. The load resistance R_L is varied from < R_s to R_s >
2. Internal resistance of the source should be measured before going to the experiment.
3. The battery should be removed and there terminal should while measuring the source resistance

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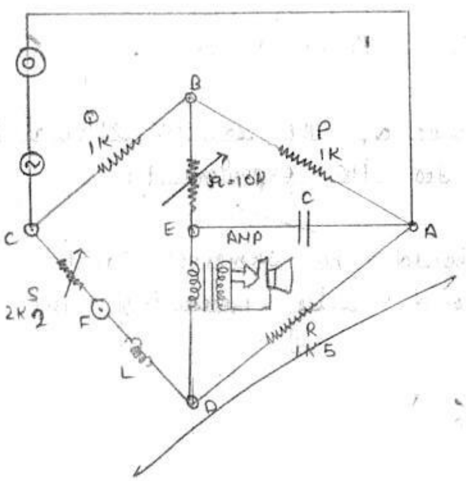

Experiment:- 5 Anderson Bridge Method

(1) Object :- To measure the Inductance of a given coil by Anderson Bridge method.

(2) Apparatus :- Small variable resistance, Galvanometer, audio oscillator, Battery, Plugs, Keys, Inductance Box, Connecting wire

(3) Theory :- In Anderson bridge P, Q and R are the non Inductive resistance arms of the bridge. A non inductive variable resistance 'S' in series with the given coil of unknown Inductance 'L' is put in fourth arm of bridge between F and D. variable resistance 'r' and a variable condenser 'C' are put in parallel to resistance 'P'. An audio amplifier with speaker is put in between the point 'E' and 'D' and an audio frequency (fixed = 1000Hz) oscillator with a volume control is put between terminals of 'A' ~~and~~ 'C'.

For steady current and by equating real parts we have :-

$$L = \frac{CR(Pr + Qr + PQ)}{P}$$

If $P = Q$ then :-

$$L = CR(Q + 2r)$$

where,

L = unknown Inductance ; C = condenser ; r = variable resistance formula :- $L = CR(Q+2R)$

Calculation:-

1. For r = 2500
   → 0.0082 × 1005 (1000 + 2× 2500) × 10⁻⁶
   → 0.0082 × 1005 (6000) × 10⁻⁶
   → 49.4 mH

2. For r = 1900
   → 0.01 × 1005 (1000 + 2×1900) × 10⁻⁶
   → 0.01 × 1005 × 4800 × 10⁻⁶
   → 48.2 mH

3. for r = 800
   → 0.015 × 1005 (1000 + 2× 800) × 10⁻⁶
   → 0.015 × 1005 × 2600 × 10⁻⁶
   → 39.195 mH

4. for r = 700
   → 0.022 × 1005 × (1000 + 2 × 700) × 10⁻⁶
   → 0.022 × 1005 × 2400 × 10⁻⁶
   → 53.06 mH

5. for r = 600
   → 0.033 × 1005 (1000 + 2×600) × 10⁻⁶
   → 0.033 × 1005 × 2200 × 10⁻⁶
   → 72.96 mH

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P, Q, R = arm resistance

(4) Observation Table:-

S.No.	P ohm	Q ohm	R ohm	C	r ohm	L	Mean L
1.	1000	1000	1005	0.082	2.5 × 1000	49.4 mH	
2.	1000	1000	1005	0.01	1.9 × 1000	48.2 mH	
3.	1000	1000	1005	0.015	0.8 × 1000	39.195 mH	52.563 mH
4.	1000	1000	1005	0.022	0.7 × 1000	53.06 mH	
5.	1000	1000	1005	0.33	0.6 × 1000	72.96 mH	

(5) Result:- L = 52.5 mH

So the self-Inductance of given coil is 52.5 mH

(6) Precaution:-
i) Avoid loose Connection
ii) When under balanced Condition occur switch off the power supply - Take reading.

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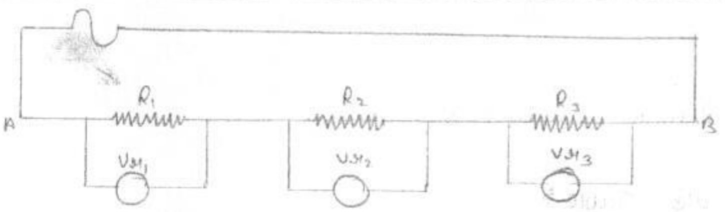
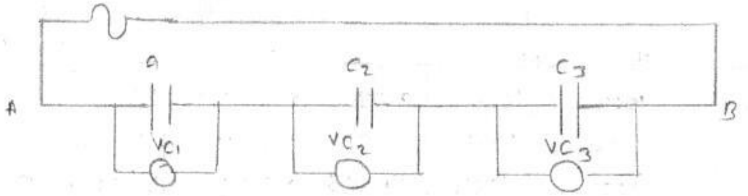
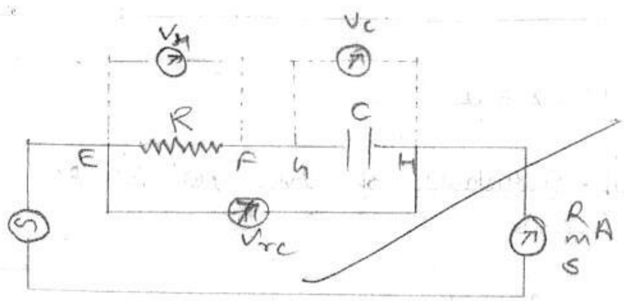
(1)



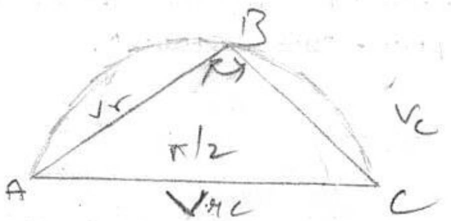
Resistance in Series in AC circuit



Condensers in Series in AC circuit



R - C circuit



Phase difference b/w Vr & Vc

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Experiment - 6

Object - To study R-C circuit using AC mains

Apparatus - R-C box, Connecting wire etc.

Principle - AC circuit will obey ohm's laws only if it has emitted R or C or L in series with it. If a combination of R & C or R & L or R, L & C is there, ohm's law is not obeyd.

If $V_{r1}, V_{r2}, ---$ & V_{c1}, V_{c2} etc are the voltage resp. across resistance & condenser then -

$$\frac{V_{r1}}{R_1} = \frac{V_{r2}}{R_2} = \frac{V_{r3}}{R_3} = i \text{ (constant)}$$

$$\frac{V_{c1}}{1/\omega C_1} = \frac{V_{c2}}{1/\omega C_2} = \frac{V_{c3}}{1/\omega C_3} = i$$

$$\omega C_1 V_{c1} = \omega C_2 V_{c2} = \omega C_3 V_{c3} = i \text{ (constant)}$$

Here, ω is angular frequency $= 2\pi f$; $f = 50$ Hz. for A.C. mains Here $\frac{1}{\omega C}$ is resistance equivalent to resistance.

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Calculation :-

(1) $i = \frac{4.0}{5 \times 1000} = 0.00081$ Amp $= 0.81$ mA

(2) $i = \frac{8.3}{10 \times 1000} = 0.00083$ Amp $= 0.83$ mA

(3) $i = \frac{8.4}{10 \times 1000} = 0.00084$ Amp $= 0.84$ mA

$$\frac{V_{r_1}}{R_1} = \frac{V_{r_2}}{R_2} = \frac{V_{r_3}}{R_3} = i \text{ (constant)}$$

$0.81\,mA \cong 0.83\,mA \cong 0.84\,mA \cong 0.82\,mA$

① $\omega \times C_1 \times V_{c1}$
$= 100\pi \times 10 \times 10^{-6} \times 2.5$
$= 7.85$ mA

② $\omega \times C_2 \times V_{c2}$
$= 100 \times 0.47 \times 10^{-6} \times 5.5$
$= 0.81$ mA

③ $\omega \times C_3 \times V_{c3}$
$= 100\pi \times 0.22 \times 10^{-6} \times 12$
$= 0.826$ mA

$\omega c_1 V_{c1} = \omega c_2 V_{c2} = \omega c_3 V_{c3} = I$ (constant)
$0.785\,mA = 0.811\,mA = 0.826\,mA = 0.8$ (constant)

$V = V_{r_1} + V_{r_2} + V_{r_3}$
$V = 4.0 + 8.3 + 8.4$
$V = 20.4$

$V = V_{c1} + V_{c2} + V_{c3}$
$V = 2.5 + 5.5 + 12.0$
$V = 20.2$

If 'V' is potential difference across A and B in two circuit then :-

$$V = V_{r_1} + V_{r_2} + V_{r_3} \ldots$$

or, $V = V_{c_1} + V_{c_2} + V_{c_3}$

If R and C are connected in series than :-

$$V_{rc} < V_r + V_c$$

where,

V_{rc} = potential difference across both R and C

As V_r and V_c are vector quantities :-

$$\overline{V_{rc}} = \overline{V_r} + \overline{V_c}$$
$$V_{rc}^2 = V_r^2 + V_c^2$$

Angle b/w V_r and V_c is $\pi/2$ called phase difference

(4) Observation Table :-

Table - I

S.No.	Resistance in series			Condenser in series			
	R	V_r	$i = V_r/R$	C	V_c	$V_c/i/\omega c$	$\omega c V_c = i$
	5K	4.0	0.000812.3	1 MFD	2.5	1.6	0.785 mA
	10K	8.3	0.0.00832.3	0.47 MFD	5.5	1.5	0.811 MA
	15K	8.4	0.000842.2	0.22 MFD	12.0	1.4	0.828 mA

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Calculation for Vrc

$V_{rc} < V_r + V_c$

(1) $20.1 < 19.5 + 5.7$
$20.1 < 25.2$

(2) $20.4 < 16.4 + 12.0$
$20.4 < 28.4$

(3) $20.5 < 20.3 + 2.5$
$20.5 < 22.8$

$V^2_{rc} = V^2_r + V^2_c \cdot (20.4)^2 < (10.4)^2 + (12.0)^2$

(1) $(20.1)^2 < (19.5)^2 + (5.7)^2$
$404.01 < 304.81 + 32.49$
$404.01 \simeq 397.30$

(2) $(20.4)^2 < (16.4)^2 + (12.0)^2$
$416.16 \simeq 412.96$

(3) $(20.5)^2 < (20.3)^2 + (2.5)^2$
$420.25 \simeq 418.34$

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Table - II

S.No	Voltage across R (V_r)	Voltage across C (V_c)	$V_r + V_c$	V_{rc}	$\sqrt{V_r^2 + V_c^2}$	Angle b/w V_r & V_c
	19.5	5.7	25.2	20.1	397.30	
	12.0	16.4	28.4	20.4	412.96	
	2.5	20.3	22.8	20.5	418.34	

Result:-

For resistance :-

$\frac{V_{r1}}{R_1} = \frac{V_{r2}}{R_2} = \frac{V_{r3}}{R_3} = I$ (Constant)

For Condensors :-

$\omega C_1 V_1 = \omega C_2 V_2 = \omega C_3 V_3 = I$ (Constant)

According To ohm law :-

$V_{r1} + V_{r2} + V_{r3} = \text{input}$

$V_{c1} + V_{c2} + V_{c3} = \text{input}$

∴ Resistance R and Condensor C obey ohm's law

For R-C Combination :-

$V_{rc} < V_r + V_c$

$(V_{rc})^2 = (V_r)^2 + (V_c)^2$

Precaution : •) The Connection should be tight
•) Connection should neat & clean

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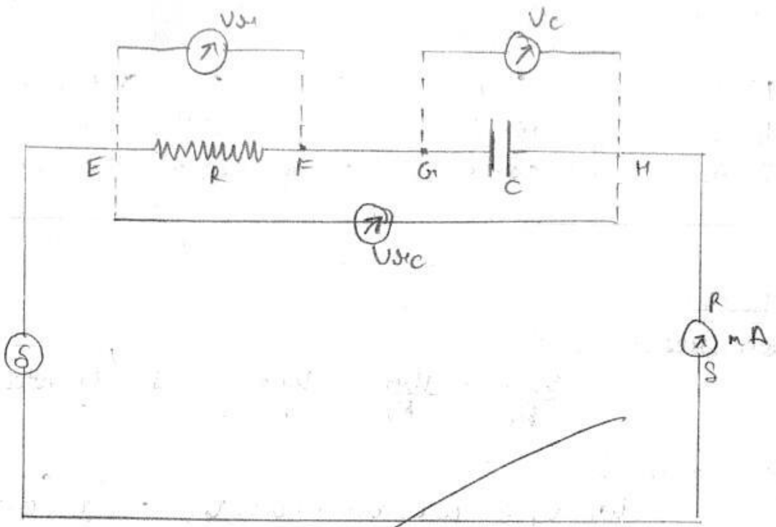

fig:- RC circuit

Experiment :- 7

1) Object :- To measure the Impedance of R-C circuit.

2) Apparatus :- R-C circuit box, connecting wire etc.

3) Principle :- To measure the Impedance of R-C circuit formula required :-

$$Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}} \quad \text{and} \quad Z = \frac{V_{rc}}{i}$$

where, R = Resistance
C = Capacitance
ω = Angular frequency
Z = Impedance

4) Observation Table :-

S.No	R	C	$Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$	V_{rc}	i	$Z = \frac{V_{rc}}{i}$
	10K	1 MFD	10494.8749	19.8	4.1	4.829269×10^6
	2K	0.47 MFD	7064.989	20.8	0.1	208×10^6
	1K	.22 MFD	14510.4687	1.2	2.5	0.48×10^6

Calculation:- $Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$

(i) $R = 10000\,\Omega$ $C = 1\times10^{-6}\,F$ $\omega = 100\pi$

$$R = \sqrt{100000000 + \frac{1\times10^{12}}{10^4\pi^2\times1}} = 10494.8749$$

(ii) $R = 2000\,\Omega$ $C = 0.47\times10^{-6}\,F$ $\omega = 100\pi$

$$R = \sqrt{4000000 + \frac{1\times10^{12}}{10^4\pi^2(0.47)^2}} = 7064.9830$$

(iii) $R = 1000\,\Omega$ $C = 0.22\times10^{-6}\,F$ $\omega = 100\pi$

$$R = \sqrt{1000000 + \frac{1\times10^{12}}{10^4\pi^2(0.22)^2}} = 14510.4687$$

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Result:-

The oritical value:- 1094.8749, 7064.9839, 14510.4687

Experimental value: 4.829269 × 10^6, 208 × 10^6, 0.48 × 10^6

Precautions:-

(i) Range of milliammeter should be suitably adjusted before taking readings.

(ii) K means kilo ohm and M.F. Ω means microfarad.

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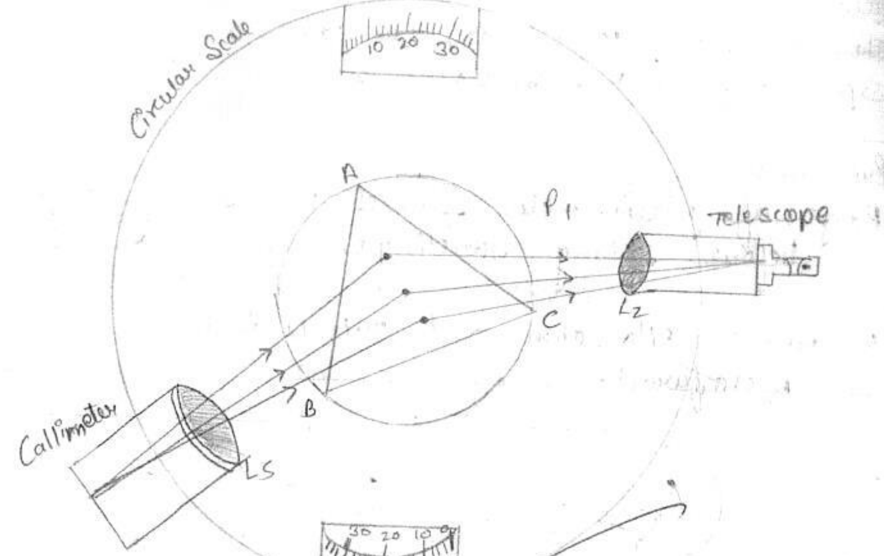

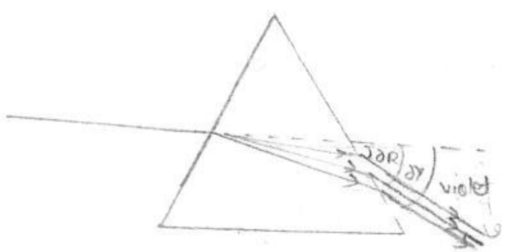

Experiment- 8 Spectrometer

Object :- To determine dispersive power of prism with the help of spectrometer.

Apparatus :- Spectrometer power of prism

Observation :- $W = \frac{\delta V - \delta R}{\delta Y}$

∵ δV = Angle of min. deviation for violet colour
δR = Angle of min. deviation for red colour
δY = Angle of min. deviation for yellow colour

One division of circular main scale of $x = \frac{1}{3}$ degree
No. division on vernier (n) = 40 degree
Least Count of vernier $= \frac{x}{n} = \frac{1}{3 \times 40} = \frac{1}{120}$ degree

S.No	Colour	Minimum deviation Reading				Direct Reading				
			M.S	V.S	Total	M.S	V.S	Total	2θ=a-b	Mean
1.	Red	v_1	348.5	$\frac{10}{60}$ = 0.16	348.66	286.5	$\frac{20}{60}$ = 0.33	286.83	61.83	
		v_2	168.5	$\frac{15}{60}$ = 0.25	168.75	106.5	$\frac{15}{60}$ = 0.25	106.75	62	61.91
2,	Yellow	v_1	348.5	$\frac{1}{60}$ = 0.01	348.51	286.5	$\frac{20}{60}$ = 0.33	286.83	61.85	
		v_2	168.5	$\frac{18}{60}$ = 0.3	168.8	106.5	$\frac{15}{60}$ = 0.25	106.75	62.05	61.86
3.	Violet	v_1	345.5	$\frac{3}{60}$ = 0.05	345.55	286.5	$\frac{20}{60}$ = 0.33	286.83	58.72	
		v_2	165.5	$\frac{9}{60}$ = 0.15	165.65	106.5	$\frac{15}{60}$ = 0.25	106.75	58.75	58.81

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Calculation:-

$$\omega = \frac{|\delta r - \delta v|}{\delta y}$$

$$= \frac{61.91 - 58.81}{61.86}$$

$$\omega = 0.05$$

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Result:- Dispersive power of prism $\omega = 0.05$

Precaution :-

The split width must be very small but knife edges of the split must not touch each other. So, as to get spoted

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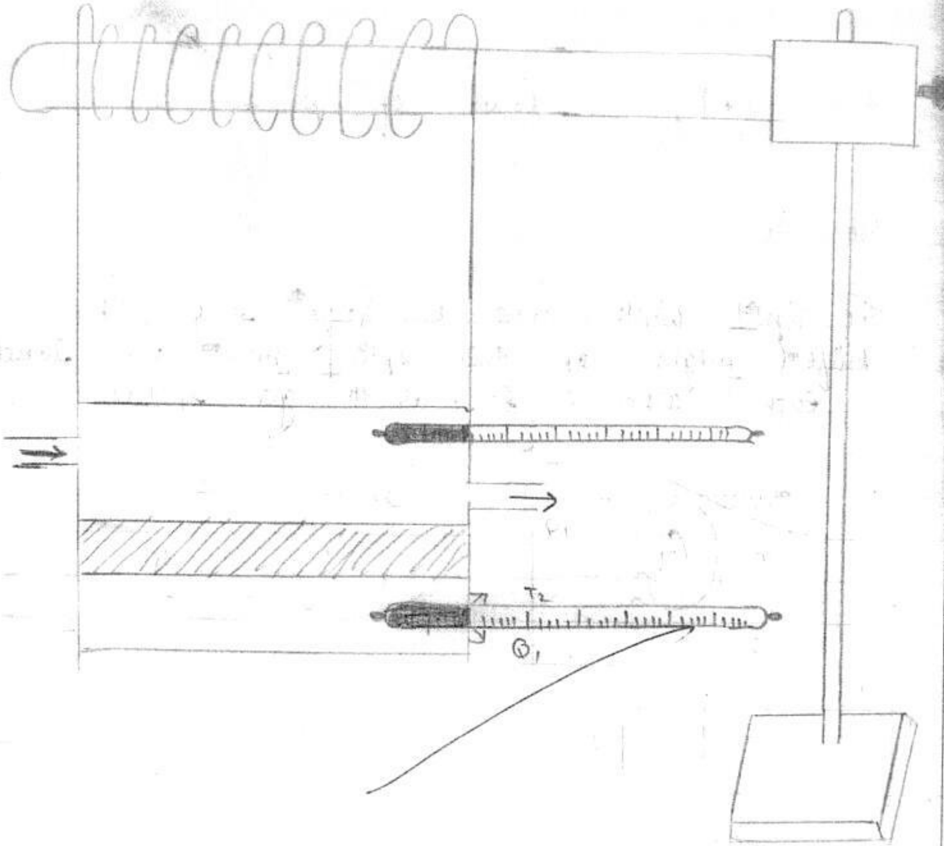

Experiment - 9 Lee - Method

Object :- To determine the terminal conductivity of a solid non-Metallic by Lee's Method.

Apparatus :- Disc, Hollow Cylinder, Insulat or Card board, Heating plate, Thermometer.

Theory :- The Coefficient of Thermal Conductivity K is given by the formula

$$K = \frac{m \cdot s \cdot d}{(\theta_1 - \theta_2) \times \pi r_0} \times \frac{d\theta}{dt} \left[\frac{r + 2t}{2r + 2t} \right]$$

where, m = Mass of Disc plate over the experimental slab.
s = Specific heat of material of Disc.
d → Thickness of experimental Disc.
r → radius of experimental Disc.
θ_1, θ_2 → Steady temperature of the two surface of experimental Disc.
$\left(\frac{d\theta}{dt}\right)$ → Rate of Reduction of two surface of the experimental Disc.

Observation :-

i) Radius of Experimental Disc = 5.45 cm
ii) Thickness 'd' of Experimental Disc = 1.21 cm
iii) Mass of Brass Disc R = 918 gm
iv) Specific heat 's' of Brass = 0.093 cal/gm

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Calculation :-

$$K = \frac{msd}{(\theta_1 - \theta_2)\pi r^2} \times \frac{d\theta}{dt}\left(\frac{r+2t}{2r+2t}\right)$$

$\theta_1 = 97°C$

$\theta_2 = 78°C$

m = 918 gm

S = 0.093 Cal/gm

d = 0.337 cm

r = 5.45 cm

t = 1.21 cm

r_0 = 5.6cm

$$K = \frac{918 \times 0.093 \times 0.337}{(97-78) \times 3.14 \times (5.6)^2} \times \left(\frac{9.5}{6 \times 60}\right) \times \left(\frac{5.45 + 2\times1.21}{2\times5.45 + 2\times1.21}\right)$$

$$= \frac{28.771}{1870.93} \times \frac{9.5}{360} \times \frac{7.87}{13.32}$$

$$= \frac{2151.06}{8971483.53}$$

= 0.00023977 Cal/gm

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v) Radius of Insulator plate = 5.6 cm

vi) Thickness of Insulator plate = 0.337 cm

θ_1 = 97

θ_2 = 78

Observation Table :-

S.No.	Time	Temperature θ_1 (°C)	Temperature θ_2 (°C)
1.	5 minute	97	78
2.	10 minute	97	78
3.	15 minute	97	78
4.	20 minute	97	78
5.	25 minute	97	78

To obtain $\frac{d\theta}{dt}$

S.No.	Time (minutes)	Temperature of Disc (°C)
1.	0 minute	88°C
2.	1 minute	86°C
3.	2 minute	85°C
4.	3 minute	83°C
5.	4 minute	81°C
6.	5 minute	80
7.	6 minute	78.5
8.	7 minute	77
9.	8 minute	75.5
10.	9 minute	74
11.	10 minute	73

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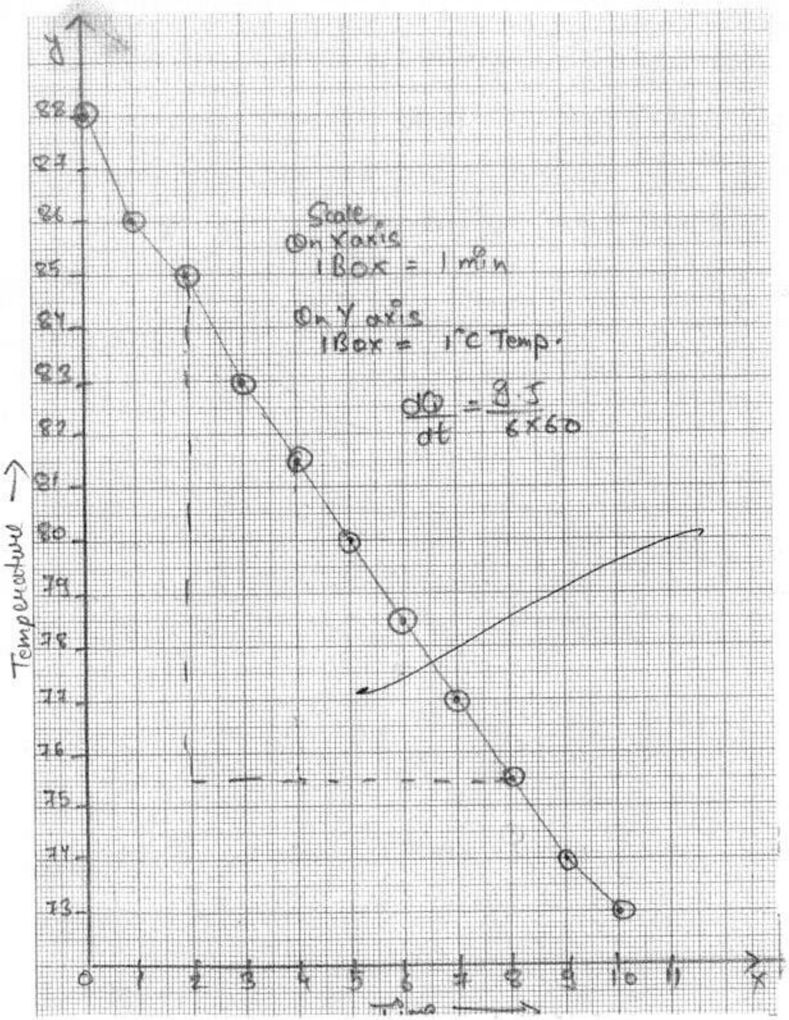

Result :- The Coefficient of thermal Conductivity of given Card board is 0.000 2397 Cal/gm s°C

Precaution :-

i) observation for d and m of the experimental Disc should be taken before starting experimental accurately.

ii) The steady state should be obtained very accurately

iii) Experimental Disc should be thin.

iv) The value of $\left(\frac{d\theta}{dt}\right)$ from the graph should be obtained at θ_2 temperature (θ_2)

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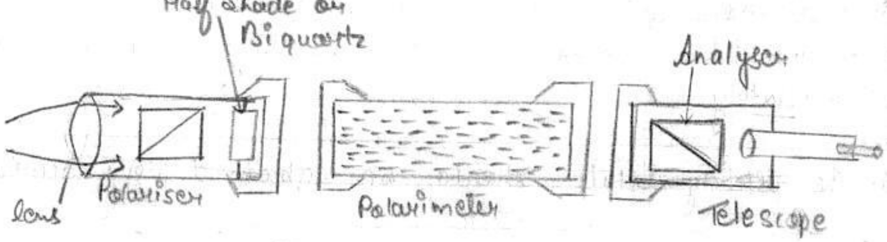

(Polarisation of Light)

Experiment - 10 (Polarisation of light)

object :- To determine the specific rotation of Cane sugar solution with the help of polarisation meter.

Apparatus :- polarimeter, a balance, measuring cylinder, beaker and source of light.

Theory :- The specific rotation of the plane of polarisation of sugar dissolved in water can be determined by the following formula.

$$S = \frac{\theta}{L \times C} = \frac{\theta \times V}{L \times m} = \frac{100\,\theta}{l c}$$

where, θ -> rotation produced in degree.
L -> length of the tube in decimeter.
m -> mass of sugar in gm, dissolve in water.
v -> volume of sugar solution.

observation :-

i) Preparation of sugar solution :-
Mass of the watch glass = 5mm or 11.5 cm
watch glass + sugar = 100 gm

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Mass of sugar taken $m = 10$ gm
Volume of the solution $V = 100\ cm^3$
Concentration of the solution $= \frac{m}{V} = \frac{10}{100} = 0.1\ gm/cm^3$

2) Mass of sugar in second solution $m = \frac{10}{2} = 5$ gm
Volume of second solution $V = 100\ cm^3$
Concentration of the second solution $C = \frac{m}{V} = \frac{5}{100} = 0.05$ gm

3) Mass of sugar in third solution $m = \frac{m}{4} = 2.5$ gm
Volume of third solution ($50\ cm^3$ second solution)
$50\ cm^3$ distilled water

$V = 100\ cm^3$

Concentration of third solution $\frac{m}{V} = \frac{2.5}{100} = 0.0025$ gm

:- To find ~~value~~ of radiation Angle θ

value of one division of main scale
$n = 10$

Least Count of vernier $= \frac{x}{n}$

$\frac{x}{n} = \frac{1}{10} = 0.1$

B. Length of the polarimeter tube = 20 cm
Room temperature = 25°C

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Specific Rotation

$$S = \frac{10\theta}{lC}$$

$$S = \frac{10}{20} \times 138.33$$

$$S = 69.41^{\circ} \text{ decimal/gm/cm}^3$$

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S.No	Liquid in Polarimeter tube	Status of Analysers						Mean Value	Rotating Angle
		Anti Clock wise			Clock wise				
		M.S	V.S	Total	M.S	V.S	Total		
1	Distill. water	97	6×.1 = 6.6	97.6	275	7×.1 = 0.7	275.7	186.65	a =
2	10% of solⁿ	110	7×.1 = 0.7	110.7	291	9×.1 = 0.9	291.9	201.3	b = b-a = 14.65
3	5% of solⁿ	104.5	5×.1 = 0.5	105.0	282	9×.1 = 0.9	282.9	193.95	c = c-a = 7.3
4	2.5% of solⁿ	101	8×.1 = 0.8	101.8	277	7×.1 = 0.7	277.7	189.75	d = d-a = 3.1

S.No.	Concentration	rotation Angle (in degree)	$\frac{\theta}{C}$ (gm/cm³)	Mean θ/C
1.	0.1	14.65	146.5	
2.	0.05	7.3	146	138.83
3.	0.025	3.1	124	

Result:- Specific rotation of sugar for light having temp. 25°C and wavelength 138.33 is 69.4 dec gm/cm³ and percentage error is ~~4.5%~~

Its ~~Authentic~~ Standard value = 66 decimal/gm/cm³

Precaution:- The polarimeter tube should be well cleared.

-> water used should be dust free.

-> whenever a solution is changed rinse the tube with the new solution under examination.

-> There should be no air bubble is left there.

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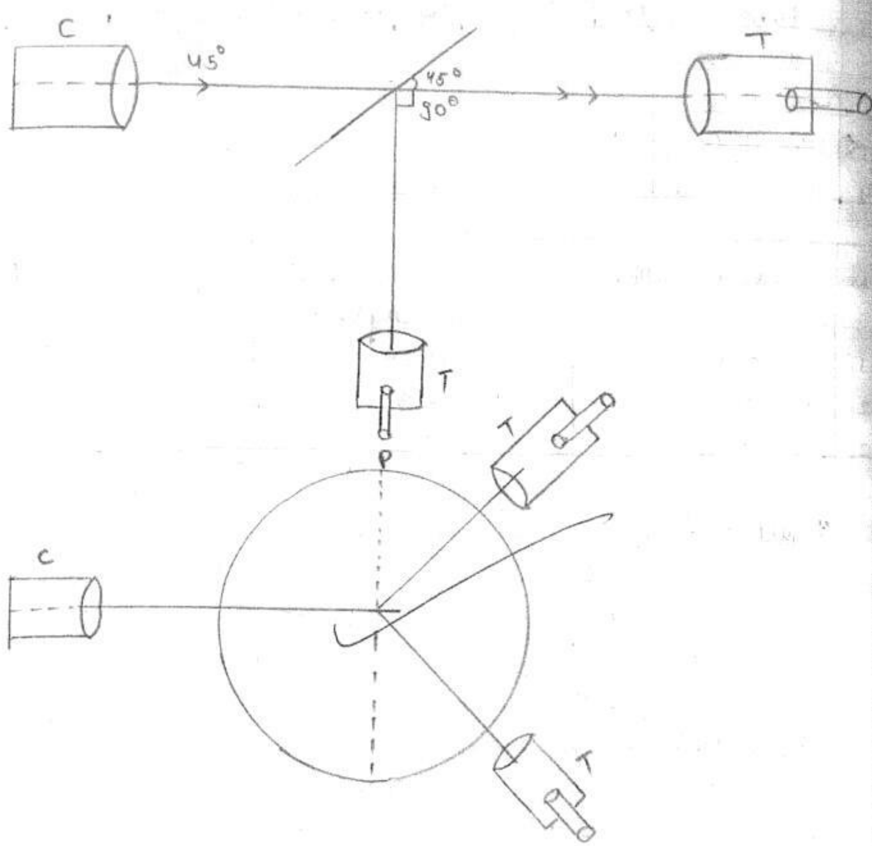

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Experiment Diffraction of light

object :- To determine the wavelength of prominent lines of mercury by plane diffraction grating

Apparatus :- A diffraction grating, spectrometer, mercury lamp, prism, reading lens.

Theory :- The wavelength λ of any spectral lines can be calculated by the formula

$$(a+b)\sin\theta = n\lambda$$

$$\lambda = \frac{(a+b)\sin\theta}{n}$$

where, (a+b) = grating element
(θ) = Angle of diffraction
(n) = order of the spectrum

observation :-

(i) Finding the grating internal

No. of pattern grating lines = 15,000

grating Internal $(a+b) = \frac{2.54}{15000} = 1.69 \times 10^{-4}$ cm

(ii) Finding the Angle of distillation

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Calculation

(A) For Violet Colour

$$\lambda v = \frac{(e+b)\sin\theta}{n}$$

$n = 1$, $(e+b) = \frac{2.54}{15000}$ cm $= 169 \times 10^{-6}$ cm

$\theta v = 12.5$

$\lambda v = 1.6 \times 10^{-6} \times \sin(12.5) = 1.69 \times 10^{-6} \times 0.2164$

$= 0.3657 \times 10^{-6}$

$= 3657 \times 10^{-10}$

(B) For Green Colour

$$\lambda g = \frac{(e+b)\sin\theta}{h}$$

$\theta n = 17$ $\lambda g = \frac{1.69 \times 10^{-6} \times \sin(17)}{1}$

$= 1.09 \times 10^{-6} \times 0.292$

$= 0.49410 \times 10^{-6}$

$= 4941 \times 10^{-10}$

(C) For yellow Colour $\lambda y = \frac{(e+b)\sin\theta}{h}$

$\theta n = 18$ $= \lambda g = \frac{1.6 \times 10^{-6} \times \sin 18}{1}$

$= 1.69 \times 10^{-6} \times 0.3090$

$= 0.3090 \times 1.69 \times 10^{-6}$

$= 0.52223 \times 10^{-6}$

$= 5222 \times 10^{-10}$

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least count of scale $(x) = 1/2°$

Number of parts in vernier $(N) = 30$

Vernier least count $= \frac{x}{n} = \frac{1}{2 \times 30} = \frac{1}{60}$

Appaletical order $= \frac{x}{n} = \frac{1}{60}$

$n = (1)$

Observation Table

S.No.			Spectrometer Reading						$2\theta = (a-b)$		
			Left side Reading of telescope			Right side Reading of teliscope					
			M.S	V.S	Total	M.S	V.S	Total		Mean	
1	Violet	v_1	328	1/60	328.01	303	1/60	303.01	25	12.5	12.5
		v_2	148	1/60	148.01	123	1/60	123.01	25	12.5	
2	green	v_1	332	1/60	332.01	298	1/60	298.01	34	17	17
		v_2	152	1/60	152.01	118	1/60	118.01	34	17	
3	yellow	v_1	333	1/60	333.01	297	1/60	297.01	36	18	18
		v_2	153	1/60	153.01	117	1/60	117.01	36	18	

Result :- For mercury Light Source

$\lambda v = 3657$ Å

$\lambda g = 4941$ Å

$\lambda y = 5222$ Å

Standard value $\lambda v = 4358$ Å

$\lambda g = 5460$ Å

$\lambda y = 5790$ Å

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Precaution :-

1. Before performing the exp. the spectrometer should be adjusted.
2. grating should be set normal to the Incident light
3. grating should not be touched by fingers.
4. while taking observation telescope and prism table should be kept fixed.

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Experiment - 12 Random Decay

Object :- Study random decay using dices and to Calculate logarithmic decrement, half life and mean life.

Apparatus :- Dice, Board, Box

Theory :- (i) It is not possible to predict when any given radioactive nuclie will decay but it is possible to predict the average rate of decay for a large number of nuclie within a given sample.

(ii) The decay of a radioisotope is a random event. It is a statistical process.

(iii) we can use dices to roll a specific number when tossed to study radio active decay.

(iv) we can thus Calculate by graph.

Logarithem Decrement $(\lambda) = 2.303 \left(\frac{AB}{BC}\right)$

Half life $= (T_{1/2}) = \frac{0.693}{\lambda}$

Mean life $= (T_m) = \frac{1}{\lambda}$

Calculation:-

$\lambda = 2.3026 \times \frac{PQ}{QR}$

$PQ = 2.75 - 2.43 = 0.32$

$QR = 7 - 3 = 4$

$\lambda = 2.3026 \times \frac{.32}{4}$

$\lambda = 0.1842$

$T_{1/2} = \frac{.693}{\lambda}$

$= \frac{0.693}{0.184}$

$= 3.76$

Observation :- Total no. of cubes $N_0 = 100$

Order of Throw	No. of cube										No. of decayed Particle	No. of Undecayed Particle	log 10N
	I	II	III	IV	V	VI	VII	VIII	IX	X			
1.	15	14	26	16	21	16	16	21	17	12	174	826	2.91
2.	15	16	14	16	12	13	19	11	15	18	149	677	2.83
3.	9	11	12	10	8	11	7	15	9	13	105	572	2.75
4.	13	10	8	10	7	13	10	10	10	9	100	472	2.67
5.	10	9	5	7	8	9	10	5	7	6	76	396	2.59
6	5	6	8	6	7	6	7	7	5	10	67	329	2.51
7	5	11	3	5	7	3	3	9	5	4	55	274	2.43
8	3	8	5	3	4	5	4	4	3	4	43	231	2.36
9	3	4	1	4	4	2	5	3	4	2	32	199	2.29
10	4	2	3	3	4	2	2	4	3	2	29	170	2.23

Model Calculation:-

If $PQ = .32$ $QR = 4$

$\lambda = 2.3026 \frac{PQ}{RQ} = 2.3026 \times \frac{.32}{4}$

$= 2.3026 \times .08$

$= 0.1842$

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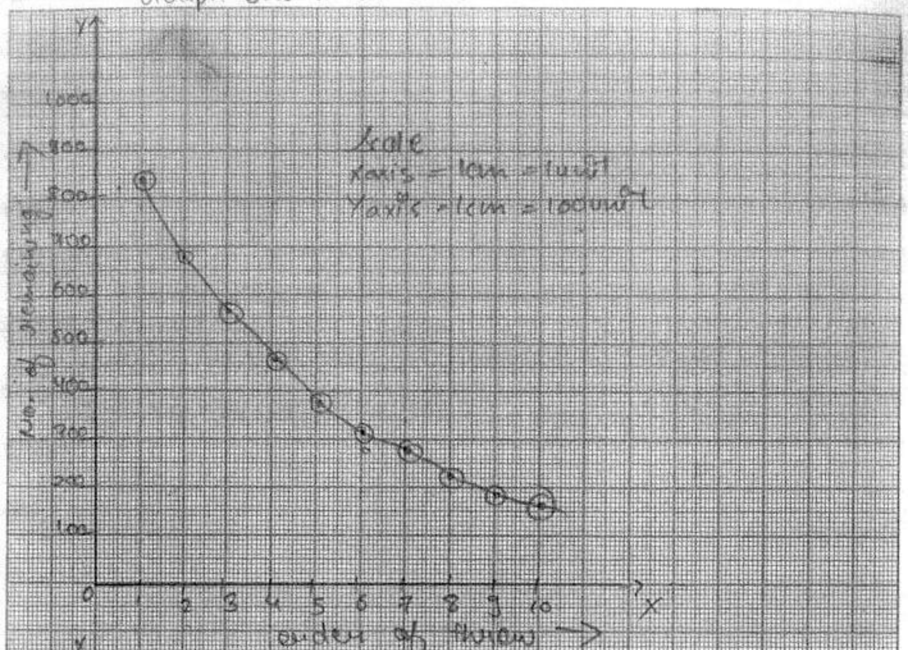
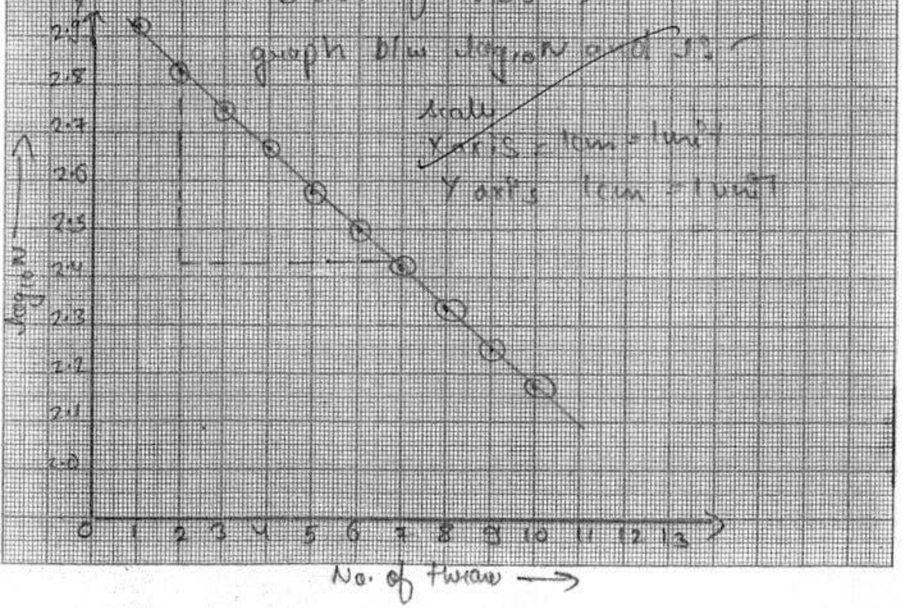
Graph b/w N and t :-





Result :- 1) The graph drawn b/w N and t comes out to be an exponential decay curve.

2) The graph drawn b/w $\log_{10} N$ and t comes out to be a straight line.

3) Decay Constant $\lambda = .1842$, $T_{1/2} = 3.76$

4) Standard value $\Rightarrow \lambda = \frac{1}{6} = .1667$

$$T_{1/2} = 4.2$$

Precaution :-

i) The no. of cubes must be large
ii) All cubes are identical
iii) Higher the repetition, lower the error
iv) The cubes must be stirred well.

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