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Date .... Experiment No. .... P. No..................
Name V.I.K.RAM.....SOLANKI Faculty No. ....Class BE 1st year Batch H-4

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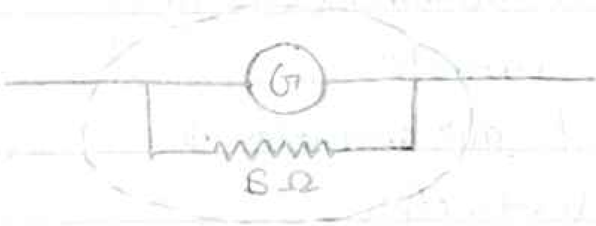

Ammeter of Range
$I = 3$ Amp

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Date 22/09/23 Experiment No. 1 P. No. 1
Name Vikram Solanki Faculty No. .... Class BE 1st year Batch H-9

Object- To convert a galvanometer into an ammeter of given range & to calibrate it.

Apparatus required- Galvanometer, Battery accumulator, ammeter of range as required for conversion, high & Low resistance box, rheostat, plug key, connecting wires & screw gauge.

Theory- A galvanometer can be converted to an ammeter by putting a low resistance shunt in parallel to his ~~cot~~ coil. whose value is given by

$$S = \frac{I_g \times G}{I - I_g}$$

Here, I = Range of ammeter (given 3 amp)
G = Resistance of galvanometer
I_g = Current required for full scale deflection in galvanometer scale (Here $N=30$)

Also $I_g = N \times C_s$

where N = Total no. of divisions on galvanometer (30)
C_s = Current sensitivity / Figure of merit is defined as minimum amount of current required for unit division deflection in galvanometer scale

Here, the value of shunt ($S\,\Omega$) comes out to be very small (less than 1Ω) therefore the length of a copper wire required for the resistance of the amount of shunt $S\,\Omega$ calculated in above formula

$$l = \frac{S \times A}{\rho}$$

Here, $S = 0.031\Omega$
$\rho = 1.7 \times 10^{-6}\,\Omega\,cm$
$A = \pi r^2$ (area of cross-section)
$r = 0.055\,cm$

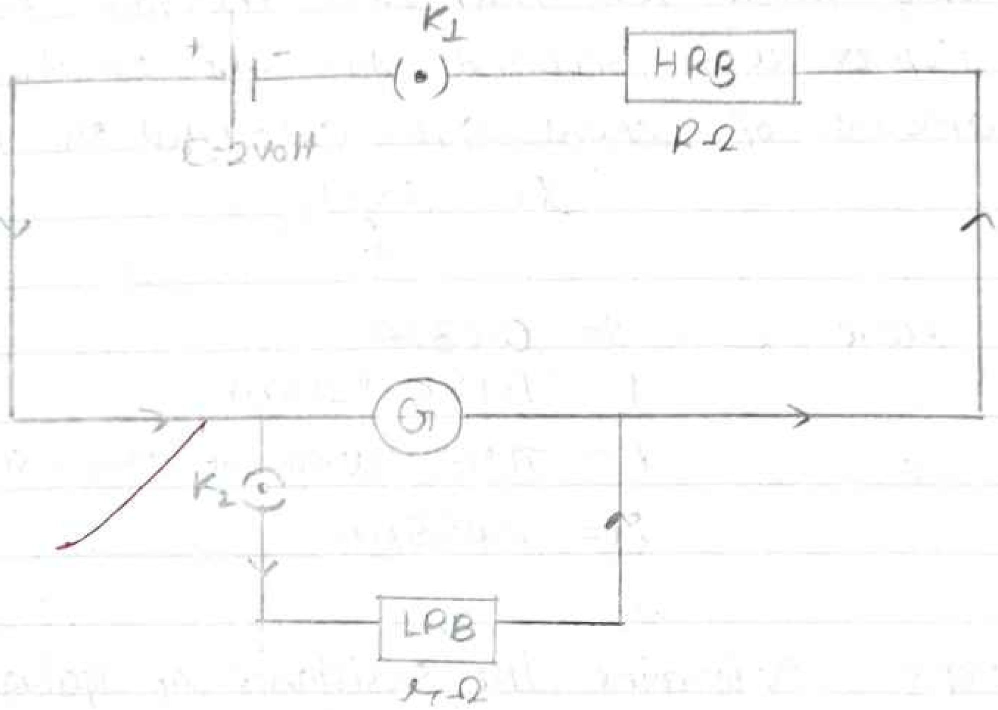
Step 1: Determine the resistance of galvanometer (G) by half deflection method.

Step 2: Determine the current sensitivity (C_s) of given galvanometer.

Resistance of galvanometer, G & current sensitivity (C_s) can be determined by circuit of half deflection method.

The procedure is as follows:-

1. Keep the key K_2 open & close key K_1, apply load resistance $R\,\Omega$ from high resistance box : Due to this



K1
HRB
R Ω
2 volt
G
K2
LRB
r Ω

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load current will flow in the circuit & the deflection is produced in galvanometer.

2. Note down the value of load resistance as R Ω & the deflection in galvanometer as n (0-30)

3. Now without changing the value of load resistance (R Ω) close the key K_2 also. the shunt resistance = r Ω is now connected with galvanometer (LRB). Due to this the deflection in the galvanometer will decrease as some current flow through this LRB.

4. Now keep on changing the LRB value such that the deflection in galvanometer reduces to half i.e $n/2$. Note down the value of low resistance (r Ω) which is required to make half deflection in galvanometer (G = r Ω)

Observation

(a.) For determining the resistance of the galvanometer.

(b.) To determine the current sensitivity

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S.No	Resistance HRB $R\Omega$	Deflection in galvanometer (n)	LRB required for half deflection $r\Omega$	$G = r\Omega$	Mean G	$C_s = \frac{E}{(R+G)n}$ (amp/div)	mean C_s
1	10,100	12	200	200		1.51×10^{-5}	
2.	8610	16	200	200	200	1.41×10^{-5}	1.48×10^{-5}
3	7610	18	200	200		1.42×10^{-5}	

Mean G = 200

Mean $C_s = 1.48\times10^{-5}$

Step 3: To Calculate $I_g = C_s \times N = 44.4\times10^{-5}$

Step 4: For conversion of galvanometer into ammeter of range I = 3amp, calculate the value of required shunt using the formula.

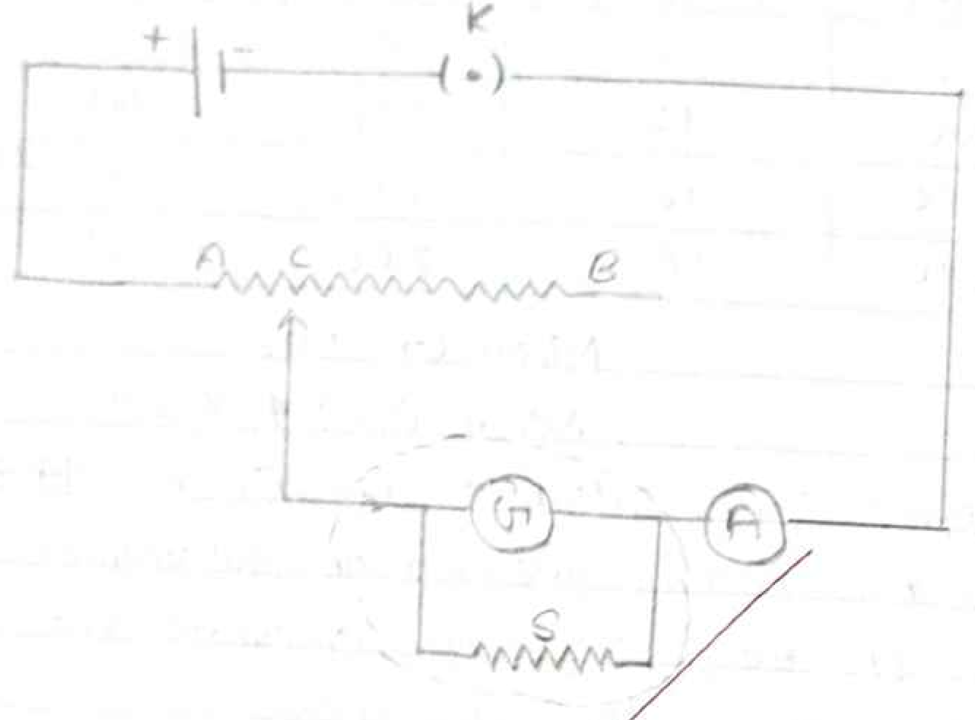
$$S = \frac{I_g\times G}{I-I_g} = \frac{44.4\times10^{-5}\times200}{3-44.4\times10^{-5}} = 0.029$$

$S = 0.029$

Here, the S is very small (less than 1Ω), So the length of wire used as shunt is given by

$$l = \frac{S\times A}{\rho} = \frac{0.029\times\pi\times(0.055)^2\times10^{-4}}{1.7\times10^{-8}}$$

$= 162.03$ cm



CALIBRATION OF CONVERTED GALVANOMETER

Step 5: Caliberation

The galvanometer is converted into ammeter by connecting the shunt wire of length as calculated

least count of shunted $= \frac{Range}{N} = \frac{3}{30} = 0.1$ amp

galvanometer (converted ammeter)

Least count of actual ammeter-

S.No	Reading of shunted galvanometer In division	In amp (I) (div×LC) amp	Actual ammeter reading I' amp	Error $\Delta I = I - I'$
1.	5	0.5	0.5	0
2.	7	0.7	0.75	0.05
3.	12	1.2	1.25	0.05

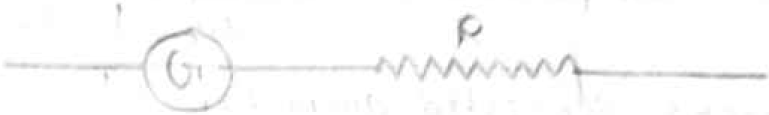
Result To convert given galvanometer of $G = 200$ into ammeter of range 3A, shunt required $S = 0.029$ & length of shunt wire connected is $l = 162.03$ cm

13/10

Precautions (1) All connections should be tight.

(2) The accumulator should be charged & there should be no error in galvanometer reading (point to zero)

(3.) The emf of battery should be greater then range of converted galvanometer.



Voltmeter of Range 3V

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Date 22/09/23 Experiment No. 2 P. No. 6
Name Vikram Solanki Faculty No. Class BE 1st year Batch 11.4

Object - To convert galvanometer into a voltmeter of range 3 volt & calibrate it.

Apparatus required - Galvanometer, accumulator, ammeter, high resistance box, rheostat, plug key, screw gauge, connecting wires.

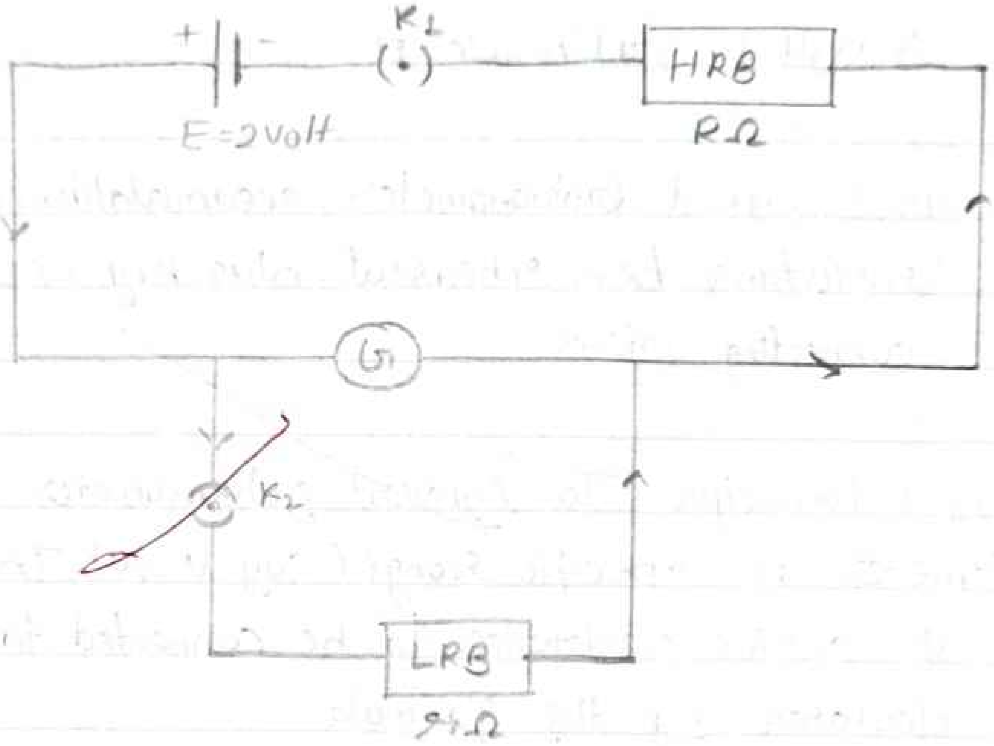
Theory & Principle - To convert galvanometer into a voltmeter of specific range (say V=3V) The required value of series resistance to be connected to galvanometer is calculated by the formula.

$$R = \frac{V}{I_g} - G$$

Where V = Range of voltmeter (given 3V)
G = Resistance of galvanometer
I_g = current required for full scale deflection in galvanometer scale

Also $I_g = N \times C_s$

N = Total no. of divisions on galvanometer scale N=30
C_s = current sensitivity is defined as minimum amount of current required for unit division deflection in galvanometer scale.



CIRCUIT OF HALF DEFLECTION METHOD

Step(I): Determine the resistance of galvanometer (G) by half deflection method

Step (II): Determine the current sensitivity (Cs) of given galvanometer

Resistance of galvanometer (G) & Current sensitivity (Cs) can be determined by one common circuit used in half deflection method.

The procedure is as follows:-

4. Keep the key K_2 open & close key K_1. apply load resistance $R\Omega$ by high resistance box (HRB). Due to this load resistance current will flow in circuit & a deflection is produced in galvanometer.

5. Note down the value of load resistance as $R\Omega$ & the deflection in galvanometer as n (n lies 0-30)

6. Now without changing the value of load resistance ($R\Omega$) close key K_2 also. The shunt resistance ($r\Omega$) from LRB is now connected with galvanometer. Due to this the deflection in galvanometer will decrease as some current will also flow through LRB.

7. Now keep on changing the LRB value such the deflection

in galvanometer reduces to half i.e. $n/2$. Note down the value of $r\Omega$ which is required to make half deflection in galvanometer

$$G = r\Omega$$

Repeat the procedure for 3 observations.

a. for determining the resistance of galvanometer.

b. for calculation of current sensitivity.

Observation table

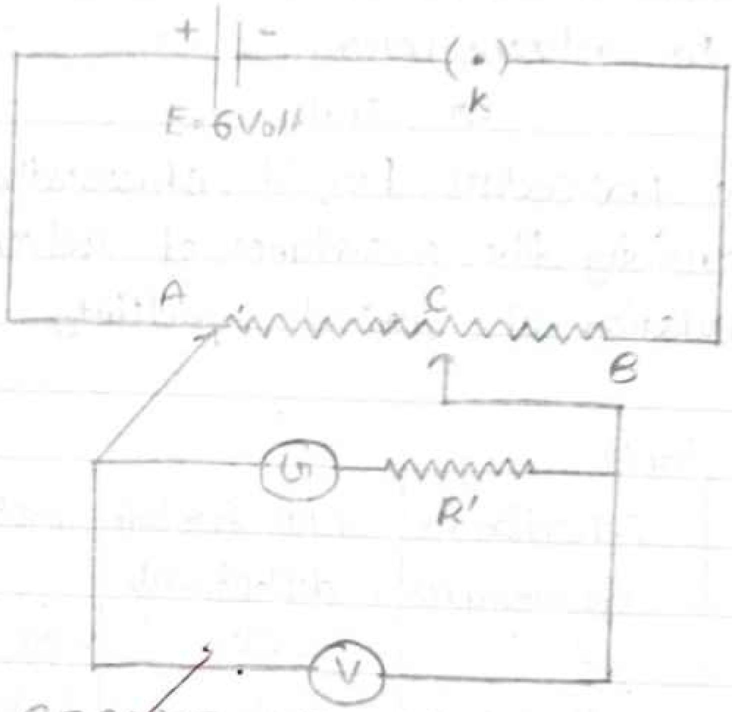
S.No	Resistance from HRB (RΩ)	Deflection in Galvanometer	LRB for half deflection n/2	$G = r\Omega$	Mean GΩ	$C_s = \frac{E}{(R+G)n}$ Amp/div	Mean C_s
1	10,100	12	200	200		1.61×10^{-5}	
2.	8610	16	200	200	200	1.41×10^{-5}	1.48×10^{-5}
3.	7610	18	200	200		1.42×10^{-5}	

Mean $G = 200$

Mean $C_s = 1.48\times10^{-5}$

Step 3 : Calculate $I_g = C_s \times N = 44.4\times10^{-5}$

Step 4 : for the conversion of galvanometer into voltmeter of range $V = 3$ Volt. Calculate the value of series resistance required to connect with the galvanometer using the formula



CIRCUIT OF CALIBRATION OF CONVERTED GALVANOMETER

$$R' = \frac{V}{I_g} - G = \frac{3}{49.4\times10^{-5}} - 200$$

$$R' = 6556.75$$

Least Count of converted voltmeter = $\frac{Range}{N} = \frac{3}{30} = 0.1V$

Step (5) : Caliberation of converted galvanometer.

(B) Observation table for caliberation of converted galvanometer after conversion-

Least count of convert galv. = $\frac{3}{30} = 0.1V$

Least Count of actual voltmeter = 0.05V

Series Resistance R to be connected = 6556.75 Ω

S.No	Reading of converted galvanometer In division	In volts (division × L.C.) (V Volts)	Actual Voltmeter reading	Error ΔV = V′ − V
1.	2	2×0.1 = 0.2	6×0.05 = 0.3	0.1
2.	2.5	2.5×0.1 = 0.25	12×0.05 = 0.6	0.35
3.	4	4×0.1 = 0.4	18×0.05 = 0.9	0.5

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Result- For conversion of given galvanometer of resistance $G = 200$ into a voltmeter of range 3V, the required value of series resistance is $R' = 6556.75\Omega$

Precautions-

(1) The accumulator should be fully charged.

(2) In the begining of galvanometer needle shold read zero scale division, otherwise there will be some error.

(3) The emf of battery should be greater than the range of converted galvanometer to voltmeter.

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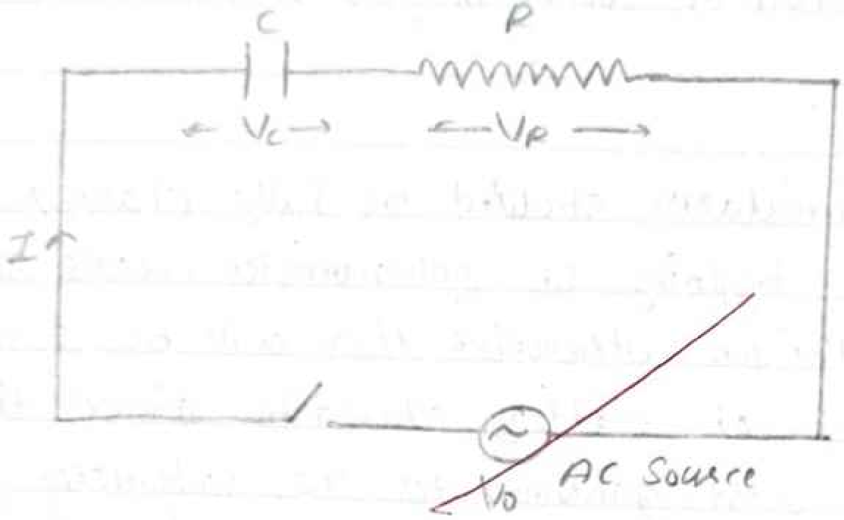
CIRCUIT DIAGRAM :



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Date 6/10/23 Experiment No. 03 P. No. 11
Name Vikram Solanki Faculty No. Class BE 1st year Batch H-4

Object- To study the phase relationship between voltage and current in RC circuit with AC Voltage.

Apparatus required- CR(AC) circuit board, multimeter and connecting wires.

Theory- When an AC voltage is applied across a capacitor resistor combination, the voltage across capacitor & resistor add according to

$$\vec{V_0} = \vec{V_R} + \vec{V_C}$$

where, $\vec{V_0}$, $\vec{V_R}$ and $\vec{V_C}$ are applied voltage, voltage across R & C respectively. As voltage across capacitor lag behind the voltage across the resistor by 90° (Phase difference $\pi/2$).

$$V_0 = \sqrt{V_R^2 + V_C^2}$$

Here

V_R is in phase component as the current is always in phase with V_R

The phase difference 'θ' b/w current I and V_0 (applied voltage) is given by-

$$\tan\theta = \frac{1}{\omega RC} = \frac{1}{2\pi f RC} \qquad f = 50Hz$$

Calculations

(i) $V_c = 21.8\ V$; $V_R = 15.5\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(21.8)^2 + (15.5)^2} = 26.75$$

(ii) $V_c = 23.5\ V$; $V_R = 12.5\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(23.5)^2 + (12.5)^2} = 26.62$$

(iii) $V_c = 25.9\ V$; $V_R = 6.1\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(25.9)^2 + (6.1)^2} = 26.60$$

(iv) $V_c = 26.3\ V$; $V_R = 3.9\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(26.3)^2 + (3.9)^2} = 26.58$$

(v) $V_c = 21.5\ V$; $V_R = 15.6\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(21.5)^2 + (15.6)^2} = 26.56$$

(vi) $V_c = 14.8\ V$; $V_R = 22.4\ V$

$$V_o = \sqrt{V_c^2 + V_R^2}$$
$$= \sqrt{(14.8)^2 + (22.4)^2} = 26.84$$

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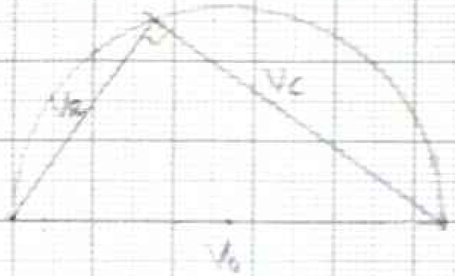
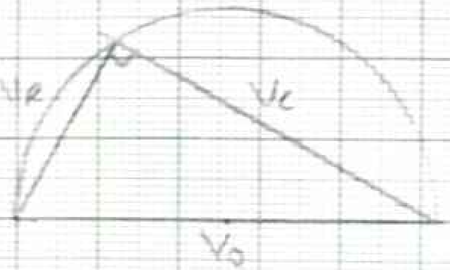
Scale

On x-axis 1 unit = 5 Volt

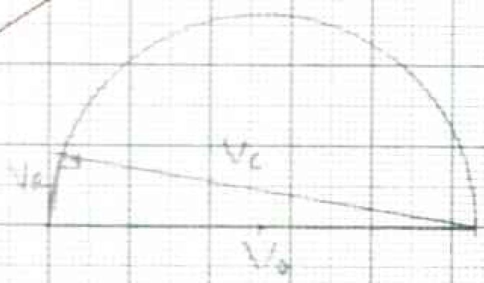


$V_o = 26.75$
$V_R = 15.5$
$V_C = 23$

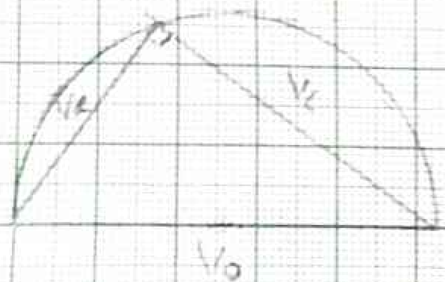


$V_o = 25.62$
$V_R = 12.5$
$V_C = 24$

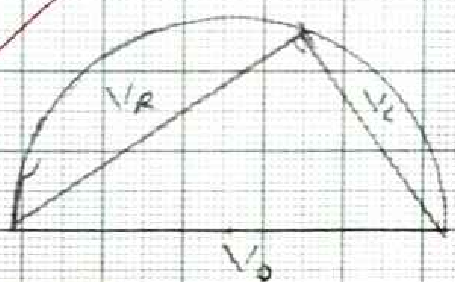
$V_o = 26.50$
$V_R = 5.1$
$V_C = 25.5$



$V_o = 26.58$
$V_R = 3.9$
$V_C = 26$



$V_o = 26.54$
$V_R = 15.6$
$V_C = 21.5$



$V_o = 26.84$
$V_R = 22.4$
$V_C = 15$

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Date .... Experiment No. 03 P. No. 12
Name Vikram Solanki Faculty No. .... Class........ Batch........

OBSERVATION TABLE-

S.No	C (μF)	R ($k\Omega$)	V_C (Volt)	V_R (Volt)	$V_0 = \sqrt{V_R^2 + V_C^2}$	V_C (graph)	θ	θ (graph)
1.	0.47	4.7k	21.8	15.5	26.75	22	54.58	55
2	0.33	4.7k	23.5	12.5	26.62	24	61.99	61
3.	0.33	2.2k	25.9	6.1	26.60	25.5	76.74	75
4.	0.22	2.2k	26.3	3.9	26.58	26	81.56	80
5.	0.22	10k	21.5	15.6	26.56	21.5	54.03	54
6	0.47	1.0k	14.8	22.4	26.84	15	33.45	34

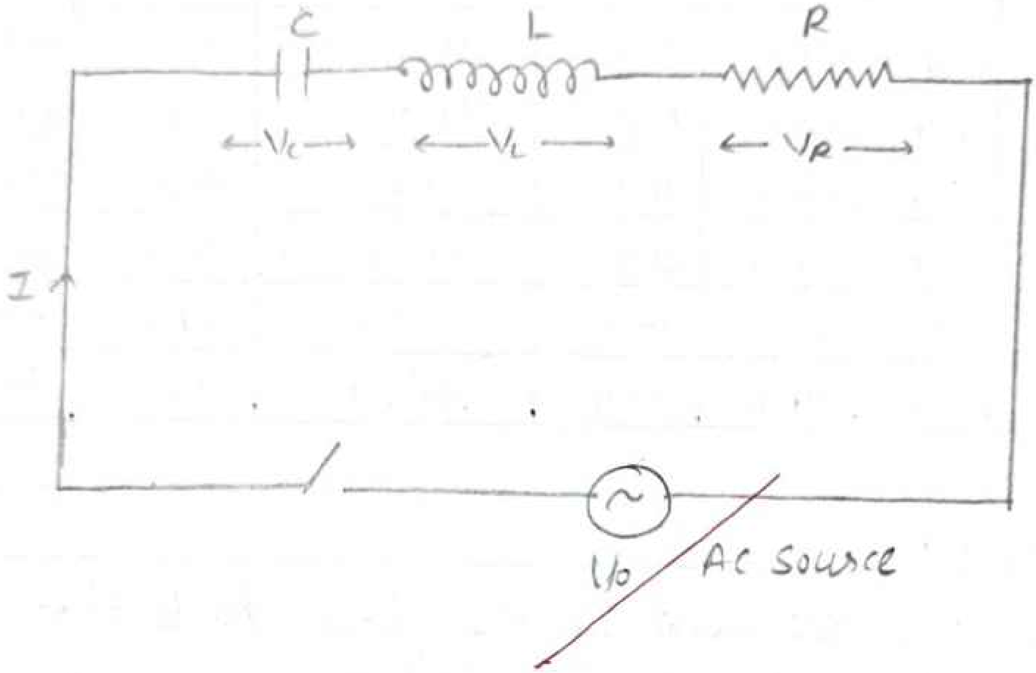
Result.

(1) It is clear and verified from table that addition of $\vec{V_R}$ and $\vec{V_C}$ follows vector addition law.

(2) Measured value of V_0 match with found from figure

(3) The values of phase difference θ from formula match with those found from vector diagram.

CIRCUIT DIAGRAM -



Object: To study voltage and phase relationship between a series LCR (AC) circuit

Apparatus required: LCR circuit board, multimeter and connecting wires.

Theory: If an AC voltage is applied across LCR component connected in series, the addition of voltage is governed by vector addition law as

$$\vec{V_0} = \vec{V_R} + \vec{V_L} + \vec{V_C}$$

Here, $\vec{V_R}$, $\vec{V_L}$, $\vec{V_C}$ are voltage across R, L, C respectively and $\vec{V_0}$ is applied voltage.

The current flowing in the circuit always remains in the phase with V_R whereas voltage across 'L' leads the current phase by '$\pi/2$' and across 'C' lags behind by '$\pi/2$'

Hence

$$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$\text{i.e. } V_0^2 = I^2 \left(R^2 + (\omega L - 1/\omega C)^2\right)$$

Phase difference between current I & applied voltage is given as

$$\tan\theta = \frac{V_L - V_C}{V_R} = \frac{I(\omega L - 1/\omega C)}{IR} = \frac{(\omega L - 1/\omega C)}{R}$$

Calculations :

(i) $V_L = 7.1V$, $V_C = 19.5V$, $V_R = 19.2V$

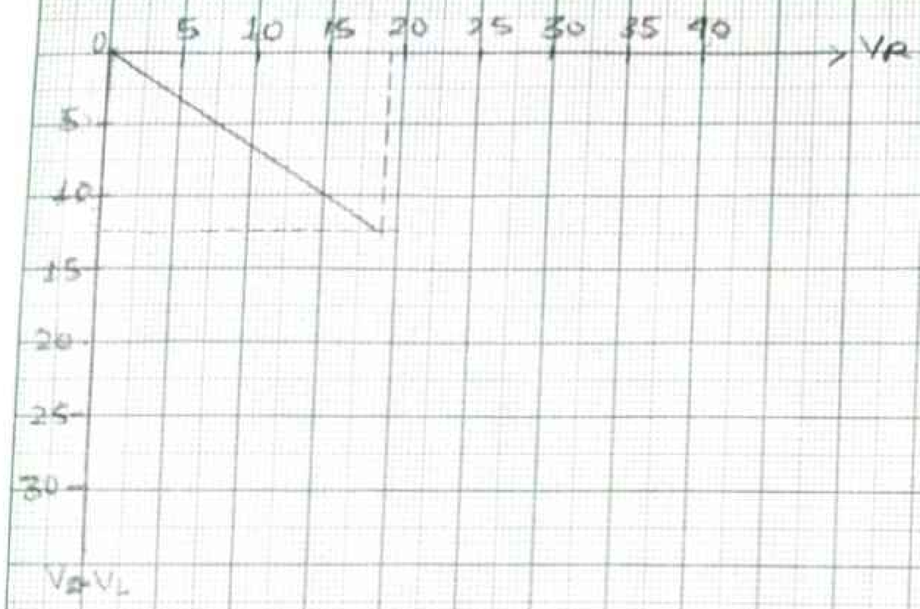
$$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$$
$$= \sqrt{(19.2)^2 + (7.1 - 19.5)^2}$$
$$= \sqrt{(19.2)^2 + (-12.4)^2} = 22.85$$

(ii) $V_L = 8.4V$, $V_C = 14.1V$, $V_R = 21.3$

$$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$$
$$= \sqrt{(21.3)^2 + (8.4 - 14.1)^2} =$$
$$= \sqrt{(21.3)^2 + (-5.7)^2} = 22.04$$

(iii) $V_L = 8.7$, $V_C = 11.3$ $V_R = 21.8$

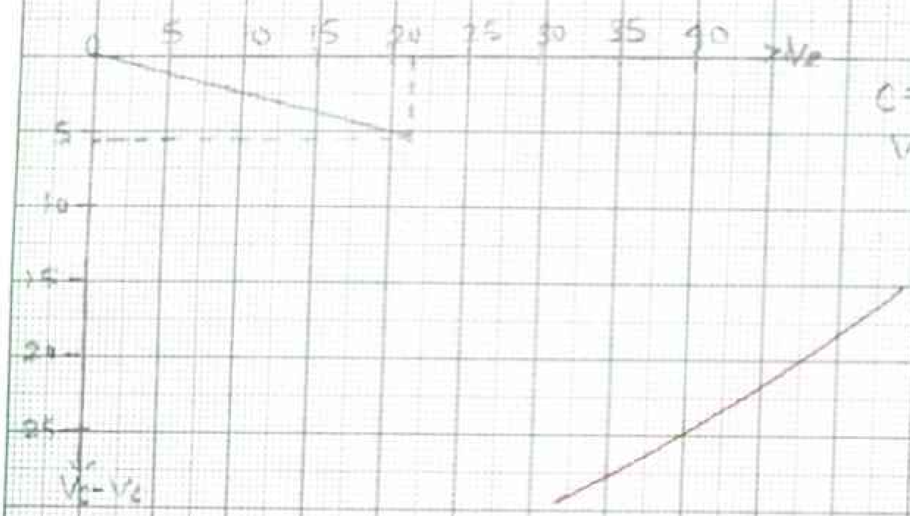
$$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$$
$$= \sqrt{(21.8)^2 + (8.7 - 11.3)^2}$$
$$= \sqrt{(21.8)^2 + (-2.6)^2} = 21.99$$



C = 0.22 µF

$V_C - V_L = 12.4$ V

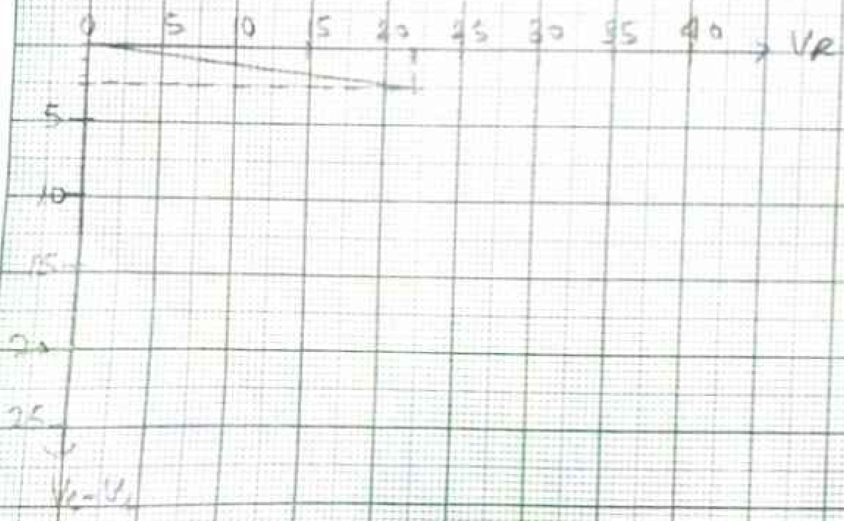
$V_R = 19.2$



C = 0.33 µF

$V_C - V_L = 5.7$ V

$V_R = 21.3$ V



C = 0.47 µF

$V_C - V_L = 2.6$ V

$V_R = 21.8$ V

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Name Vikram Solanki Faculty No. .... Class.............. Batch..........

V_R is a phase component as the current is always in phase with V_R

OBSERVATION TABLE

SNo	C (μF)	V_L (Volt)	V_C (Volt)	V_R (Volt)	$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$ (Volt)	V_0 (graph)	$\theta = \tan^{-1}\left(\frac{V_L - V_C}{V_R}\right)$	θ (graph)
1.	0.22	7.1	19.5	19.2	22.85	24	−32.85	−33°
2.	0.33	8.4	14.1	21.3	22.04	22	−14.98	−14.5°
3.	0.47	8.7	11.3	21.8	21.99	22	− 6.80	−6.5°

Result

(i) It has been verified that V_R, V_L and V_C adds by the law of vector addition.

(ii) Value of V_0 obtained from the graph will be matched with applied voltage.

(iii) Value of phase difference 'θ' obtained from graph matches with calculated value.

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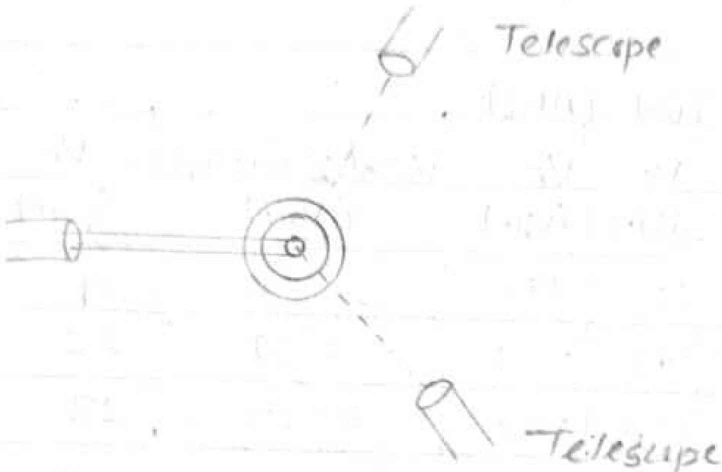
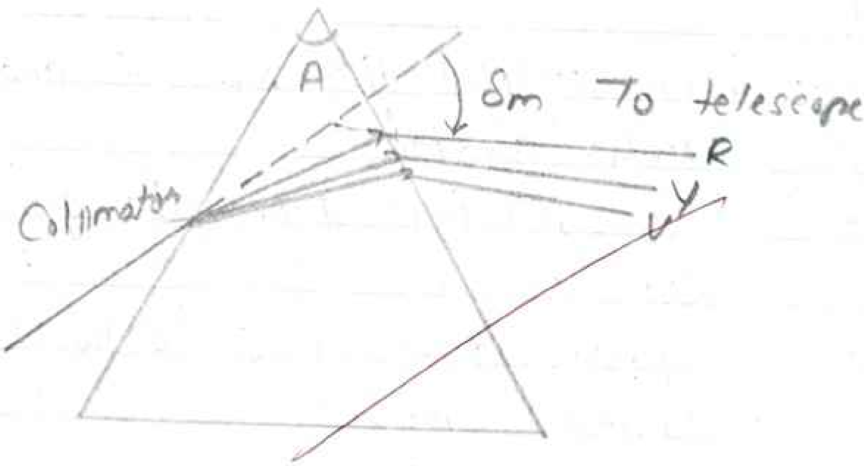


Determination at angle from prism



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Date 13/10/2023 Experiment No. 05 P. No. 15
Name VIKRAM SOLANKI Faculty No. .... Class BE 1st year Batch H-4

Object To determine refrective index & dispersive power of material of prism by using spectrometer.

Apparatus required- Spectrometer, reading lens, lamp, spirit level prism.

Theory- The refractive index of the material of prism is given by

$$\mu = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin(A/2)}$$

Here, A = angle of prism
δm = angle of minimum deviation

$$\text{Dispersive power}(\omega) = \frac{\mu_y - \mu_r}{\mu_y - 1}$$

Observation
The observations noted using the apparatus is-
(i) Angle of prism (given) = 60°
(ii) Value of 1 division on main scale = $(1/2)^\circ$ total divisions on circular scale
L.C of circular scale $\left(\frac{1}{120}\right)^\circ$

Calculations :

given angle of prism = 60°

(i) Angle of min^m deviation for extreme violet colour

$\delta_v = 24° 6' 0''$

Refractive Index of violet colour

$$\mu_v = \frac{\sin\left(\frac{60+24.10}{2}\right)}{\sin\left(\frac{60}{2}\right)}$$

$= 1.36$

(ii) Angle of min^m deviation for extreme red colour

$\delta_r = 24° 7' 12''$

Refractive Index of Red colour

$$\mu_r = \frac{\sin\left(\frac{60+24.12}{2}\right)}{\sin\left(\frac{60}{2}\right)}$$

$= 1.34$

(iii) Angle of min^m deviation for extreme yellow colour

$\delta_y = 23° 58' 12''$

Refractive Index of yellow colour

$$\mu_y = \frac{\sin\left(\frac{60+23.97}{2}\right)}{\sin\left(\frac{60}{2}\right)}$$

$= 1.38$

So $\omega = \dfrac{\mu_v - \mu_r}{\mu_y - 1} = \dfrac{1.36 - 1.34}{1.38 - 1}$

$= 0.052$

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Date .... Experiment No. ....05.................................... P. No...16.........

Name Vikram Solanki........ Faculty No. ....Class................Batch...........

(iii.) For minimum deviation (δ_m)

Least count of spectrometer $= \left(\frac{1}{2}\right)' - 30''$

Spectral line	Circular line	Reading of circular scale for minm deviation			Direct image position			δ_m (a-b)
		MS	VS	Total (a)	MS	VS	Total(b)	
Red	V_1	122.1	40	61°22'48"	74	32	37°15'36"	24° 7' 12"
Yellow	V_1	122.2	16	61°13'48"	74	32	37°15'36"	23°58'12"
Violet	V_2	122.3	25	61°21'36"	74	32	37°15'36"	24°6'0"

Result- The dispersive power of material of a given prism ω = 0.052

Precautions: (i.) Prism should be clean.

(ii) The edge of slit & prism should be perfectly vertical.

(iii.) All the adjustments should be made perfectly to obtain accurate angle.

(iv.) The Ramp illuminated should be saved from all jerks & movements.

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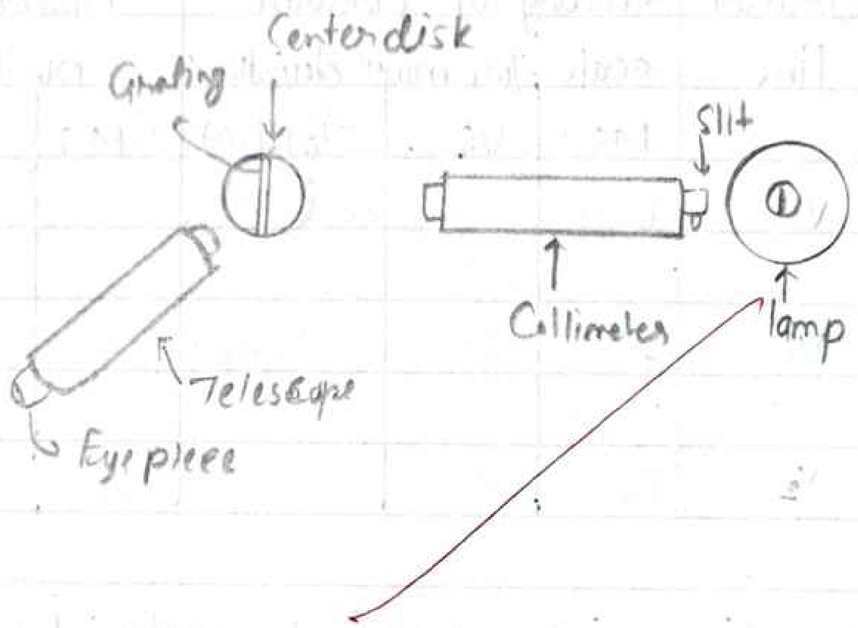

Centerdisk
Grating
Slit
Callimeter
lamp
Telescope
Eye piece

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Date........ Experiment No. 06 P.No. 17

Name Vikram Solanki Faculty No........ Class B.E. 1st year H-4

Object - To determine the wavelengths of prominent lines of mercury by plane diffraction grating.

Apparatus required - A plane diffraction grating, spectrometer, mercury lamp, spirit level, reading lens

Theory - The wavelength λ of a particular spectral line is calculated by the grating equation

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

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

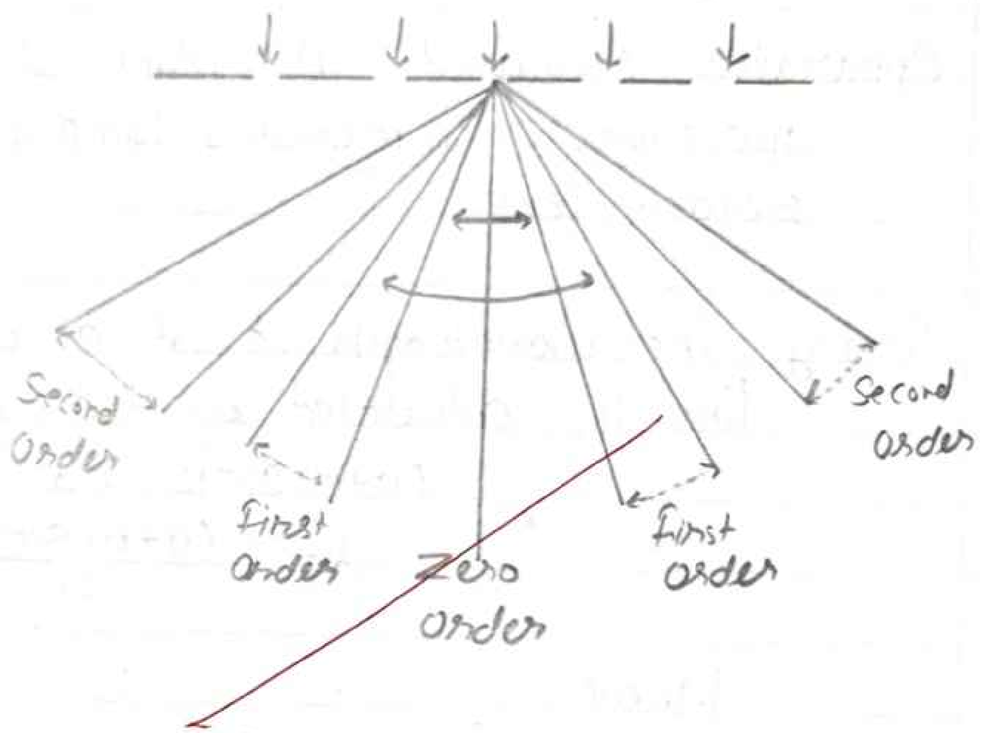
Where,

$(a+b)$ = Grating element

θ = Angle of diffraction and

n = The order of spectrum

Diffraction Grating - A diffraction grating is an arrangement of large number of parallel slites of same width and separated by equal opaque spaces is known as diffraction Grating.



Second
Order
First
order
Zero
order
First
order
Second
order

Procedure :-

1. Note the least count of spectrometer.
2. The telescope from the position of direct image of slit is rotated left till the first order spectrum is seen in the field of view. Then the telescope is clamp near the red end of the spectrum. The telescope is then gradually rotated with the help of its tangential screw and it's vertical cross wire is made to coincide the red, yellow, green and violet spectral lines one by one and each time reading of main scale and verniers are noted.
3. Now the telescope is turned on the right side of the direct image of slit and again the reading of the main scale and vernier are noted.
4. Then for the spectral lines of each color. Find the difference of reading either side of slit for the same vernier. Take the mean find the half of it, which will give the angle of diffraction θ for the spectral lines of that color.

Observation :-

Value of 1 division on main scale = $(1/2)^\circ$ total divisions on circular scale.

Calculations

(1) for violet colour.

$$\lambda = \frac{2.54}{15000} \times \sin(15^\circ 25' 48'')$$

$$= 1.69 \times 10^{-4} \times 0.264$$

$$= 4339.9 \mathring{A}$$

(2) for green colour

$$\lambda = \frac{2.54}{15000} \times \sin(19^\circ 30')$$

$$= 1.64 \times 10^{-4} \times 0.333$$

$$= 5476.5 \mathring{A}$$

(3) for yellow colour

$$\lambda = \frac{2.54}{15000} \times \sin(20^\circ 45' 36'')$$

$$= 1.69 \times 10^{-4} \times 0.354$$

$$= 5805.8 \mathring{A}$$

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Date.................. Experiment No.................. P.No. 19

Name Vikram Solanki Faculty No.......... Class..........

L.C of circular scale = $\left(\frac{1}{120}\right)^\circ$

L.C of spectrometer = $\left(\frac{1}{2}\right)' = 30''$

Colour of light		Spectrum on left, Reading of telescope			Spectrum on Right Reading of telescope			$\theta = \frac{(a-b)}{2}$	Mean θ
		M.S.	V.S	Total (a)	MS	V.S	Total (b)		
Violet	V_1	65	26	65°12'36"	96	8	96°4'1"	15.42	15°25' 48"
	V_2	246	18	246°9'0"	277	7	277°3'	15.45	
Green	V_1	61	26	61°12'57"	100	9	100°4'12"	19.43	19°30'
	V_2	242	6	242°3'	281	25	281°12'	19.57	
Yellow	V_1	60	15	60°7'12"	102	10	102°4'48"	20.98	20°45' 36"
	V_2	241	12	241°0'3"	282	13	282°6'28"	20.55	

Result Wavelength of various lines are given below

Colour	Standard wavelength, Å	observed(λ) Å	error
Violet	3667.3 Å	4339.9 Å	
Green	4739.6 Å	5476.5 Å	
Yellow	5222.1 Å	5805.8 Å	

Precautions - (1) Spectrometer leveling and adjustments should be properly done.

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Date........ Experiment No........ P.No. 20

Name Vikram Solanki Faculty No........ Class........

(II.) Setting up the collimator and telescope for parallel rays is essential.

(III.) The formula used is for normal incidence of light on grating, hence this adjustment should be accurately done.

(IV.) The slit should be sharp and vertical. i.e parallel to the rulings on the grating.

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Date .... Experiment No. 06 P. No. 21
Name Vikram Solanki Faculty No. .... Class BE 1st year Batch H-4

OBJECT To study characteristics of charging and discharging of capacitor through a resistor.

APPARATUS REQUIRED-
CR circuit board (D.C), power supply (DC), digital voltmeter and connecting wires

THEORY When a capacitor and a resistance are connector in series are applied with a DC voltage of V_0 voltage the capacitor begins to store the charge
During the charging of a capacitor, the voltage across the capacitor (V_C) is given as

$$V_C = V_0(1-e^{-t/RC})$$

And the voltage across the resistance (V_R), during charging is given as

$$V_R = V_0 e^{-t/RC}$$

The value of current is given as

$$I_R = \frac{V_0}{R} e^{-t/RC} = I_0 e^{-t/RC}$$

Where V_0 = Voltage applied through power supply
V_C = Voltage across Capacitor
V_R = Voltage across R.

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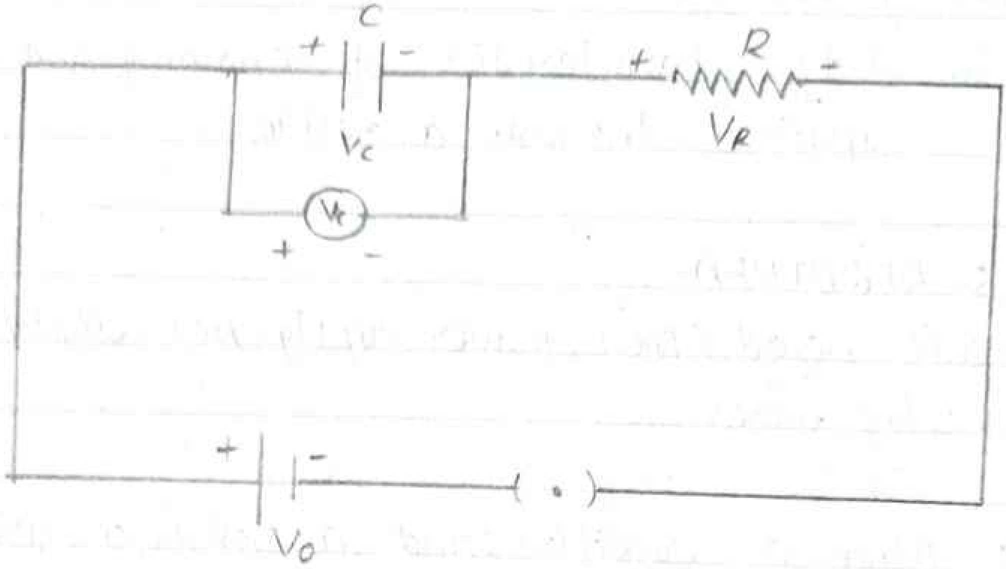
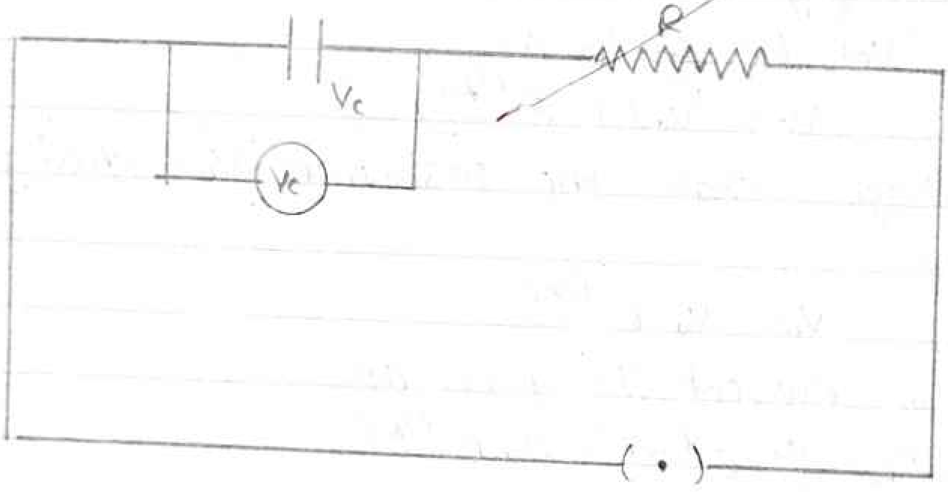


CHARGING CIRCUIT



DISCHARGING CIRCUIT

For CR circuit the time constant is given as
$\tau = CR$ (τ = Time Constant)

During discharging, $V_c = V_0 e^{-t/RC}$

Time Constant (τ) can be calculated from graph plotted b/w V_c and time (t)

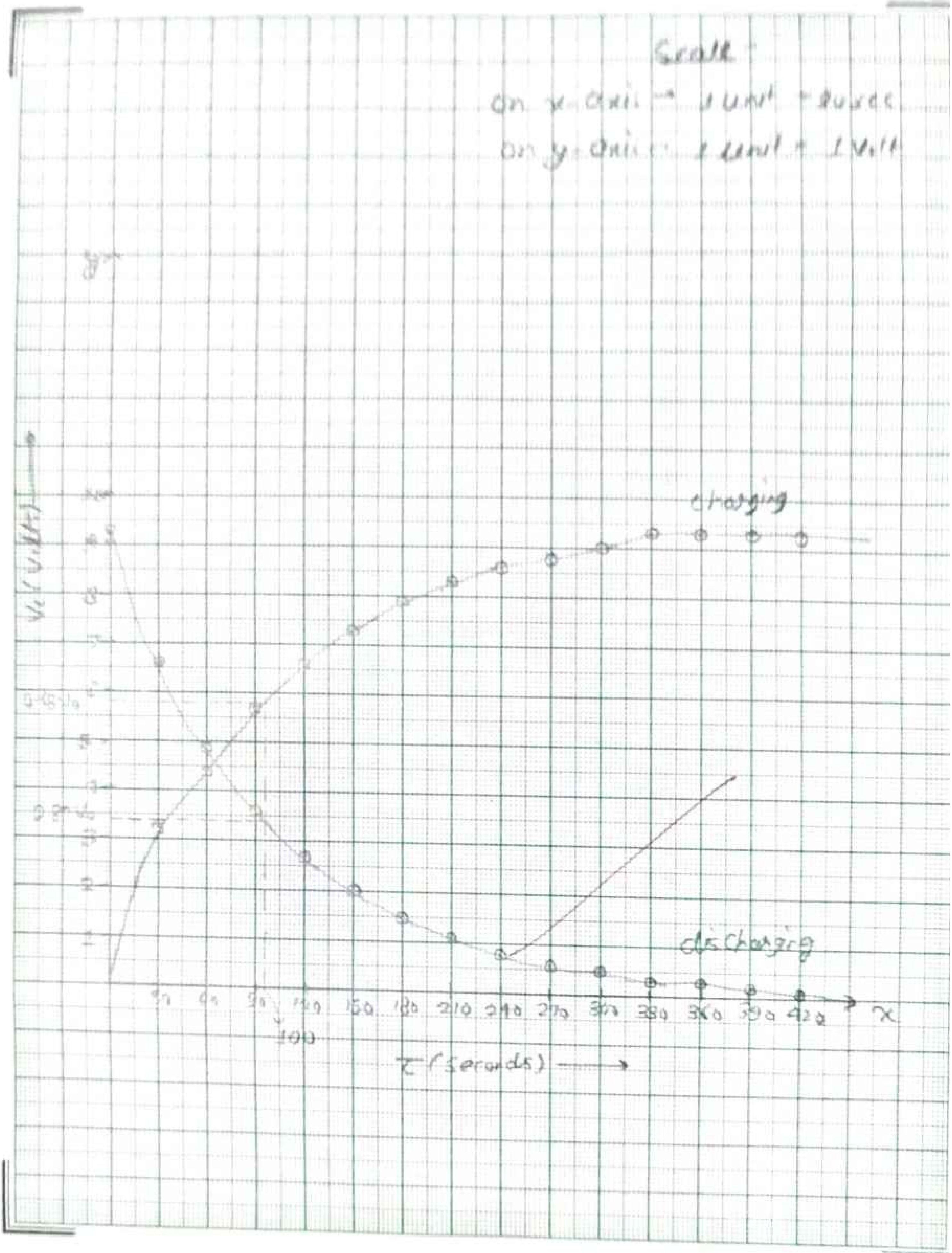
⇒ During charging -
The time constant is that time by which the voltage V_c across the capacitor becomes 63% of the applied voltage.

$$V_c(\tau) = 0.63 V_0$$

⇒ During discharging
The time constant is that time by which the Voltage V_c across the capacitor discharges to 37% of the applied voltage

$$V_c(\tau) = 0.37 V_0$$

where τ = time constant



Scale
charging
discharging
150 180 210 240 270 300 330 360 390 420

OBSERVATION TABLE - C = 1000 μF R = 100 kΩ

During charging						During discharging					
S.No	Time(s)	Vc(Volt)	S.No	Time(s)	Vc(Volt)	S.No	Time(s)	Vc(Volt)	S.No	Time(s)	Vc(Volt)
1	0	0	21	200	8.1	1	0	9.3	22	210	1.1
2.	10	1.0	22	210	8.3	2	10	8.1	23	220	1.0
3	20	1.8	23	220	8.4	3	20	7.4	24	230	0.9
4	30	2.6	24	230	8.5	4	30	6.6	25	240	0.8
5.	40	3.2	25	240	8.6	5	40	6.0	26	250	0.8
6	50	3.9	26	250	87	6.	50	5.4	27	260	0.7
7	60	4.4	27	260	8.7	7	60	4.9	28	270	0.6
8.	70	4.9	28	270	8.8	8	70	4.4	29	280	0.6
9	80	5.3	29	280	8.9	9	80	4.0	30.	290	0.5
10	90	5.7	30	290	8.9	10	90	3.6	31	300	0.5
11	100	6.0	31	300	9.0	11	100	3.3	32	310	0.4
12	110	6.3	32	310	9.0	12	110	3.0	33	320	0.4
13	120	6.6	33	320	9.1	13	120	2.7	34	330	0.3
14	130	6.9	34	330	9.1	14.	130	2.4	35	340	0.3
15	140	7.1	35	340	9.1	15	140	2.2	36	350	0.3
16	150	7.3	36	350	9.2	16	150	2.0	37	360	0.3
17	160	7.5	37	360	9.2	17	160	1.8	38	370	0.2
18	170	7.7	38	370	9.2	18	170	1.6	39.	380	0.2
19.	180	7.9	39	380	9.3	19	180	1.5	40	350	0.2
20	190	8.0	40.	390	9.3	20	190	1.4	41	400	0.2
						21	200	1.2	42	410	0.1

Calculations :-

(1) During charging

Total voltage across capacitor. $V_0 = 9.3V$

$V_1(\tau) = 0.63 V_0$

$= 0.63 \times 9.3$

$= 5.859\ V$

Time corresponding to V_1 is 100 sec

$\tau = 100$ sec

(2) During discharging

Initial voltage across capacitor $= V_0 = 9.3\ V$

$V_2(\tau) = 0.37\ V_0$

$= 0.37 \times 9.3$

$= 3.441\ V$

Time corresponding to $V_2 = 100 sec$

$\tau = 100 sec$

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Date .... Experiment No. .... P. No. 24
Name .... Faculty No. .... Class........ Batch........

43	420	0.1	49	480	0.1
44	430	0.1	50	490	0.1
45	440	0.1	51	500	0.1
46	450	0.1	52	510	0
47	460	0.1	53	520	0
48	470	0.1	54	530	0

⇒ Comparison of the value of Time constant (τ) -

Theoretical value of $\tau = RC$

$= 100 \times 10^3 \times 1000 \times 10^{-6}$

$= 100$ sec

Value of τ from V_c V/s t graph $= 100$ sec

RESULT

The theoretical value of τ is almost same as the value of τ obtained from (V_c vs t) graph

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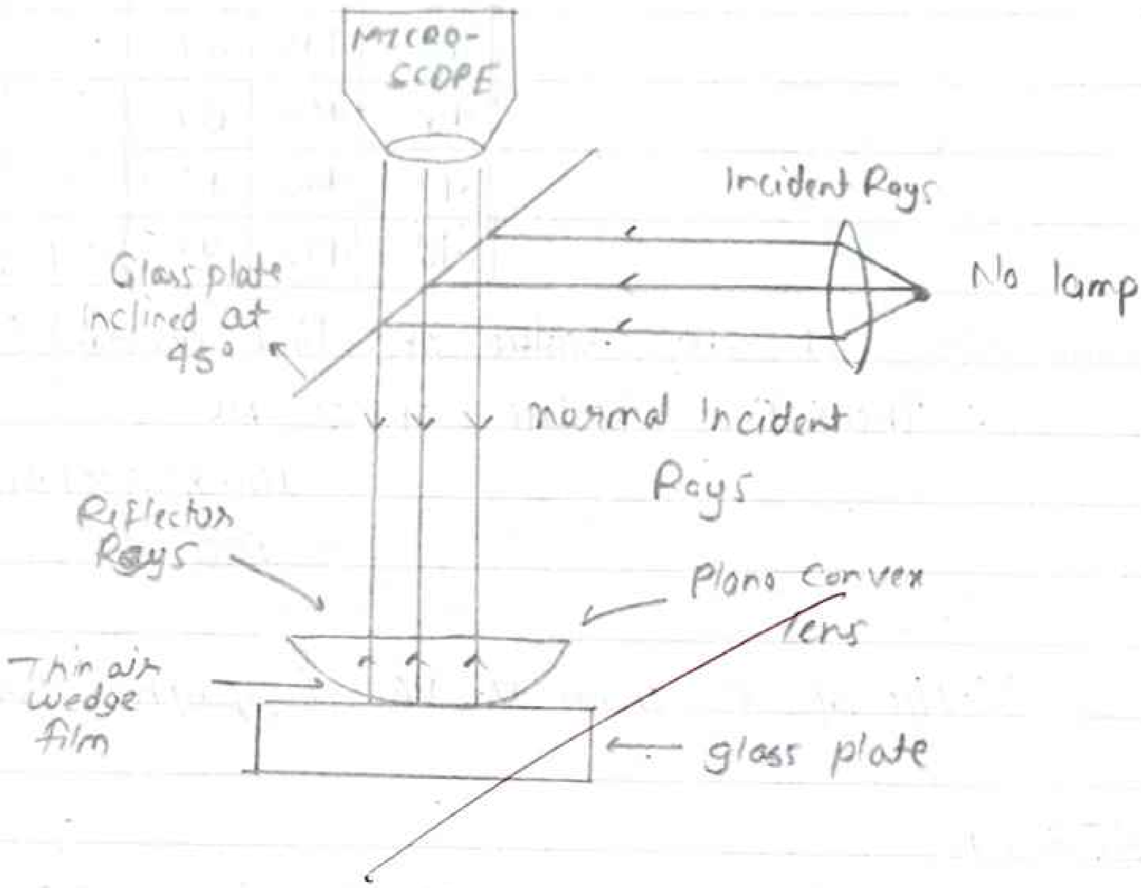
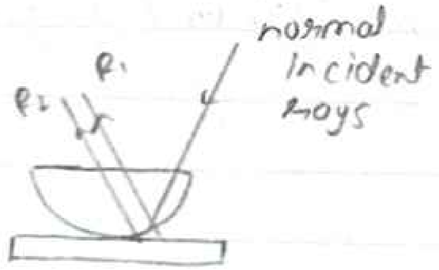
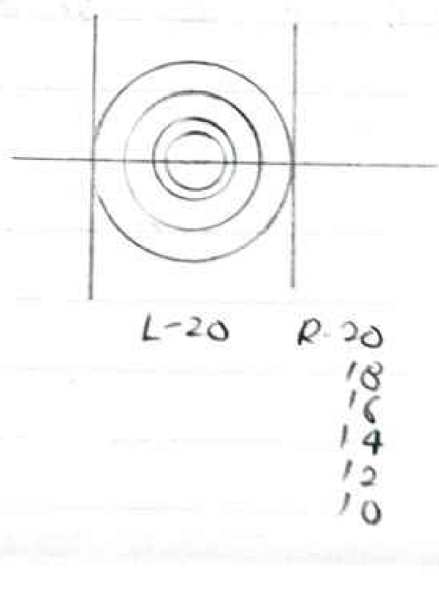

MICRO-
SCOPE
Incident Rays
No lamp
Glass plate
inclined at
45°
normal Incident
Rays
Riflector
Rays
Plano Convex
lens
Thin air
wedge
film
glass plate


normal
Incident
Rays


L-20
R-20
18
16
14
12
10

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Date .... Experiment No. 08 P. No. 25
Name Vikram Solanki Faculty No. .... Class BE 1st yr Batch H-4

Object: To find wave length of light by Newton's Ring method.

Apparatus: A plano-concave lens of large radius of curvature (about 100 cm), travelling microscope, optical arrangement for Newton's ring, sodium lamp & a spectrometer

formula: The mean wave length of D_1 & D_2 lines of sodium light is given by

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR\mu} \quad (n \& p \text{ are Integer})$$

Here, D_{n+p} = Diameter of $(n+p)^{th}$ ring.
D_n = Diameter of n^{th} ring.
R = Radius of curvature, $\mu = 1$ (air)

Theory: When a parallel beam of monochromatic light is incident normally on a combination of plano-convex lens L & a glass plate G a part of each incident ray is reflected from the lower surface of the lens & a part after refraction through the air film between the lens & the plate is reflected back from the plate surface. These two reflected rays are Co-herent. Hence they interfere & produce a system of alternate dark & bright rings with the point of contact between the lens & the plate as the centre. These rings are known as Newton's rings.

Observations

$R = 65\ cm$ (given)

$$\text{least count of microscope} = \frac{\text{one division of main scale } (n)}{\text{Total division on vernier scale } (n)}$$

One division of main scale $(n) = 0.1\ cm$

Total no. of divisions on vernier scale $(n) = 100$

$$\text{Least count of microscope} = \frac{n}{n} = \frac{0.1\ cm}{100}$$

$$= 0.001\ cm$$

Calculations:

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}$$

$$= \frac{0.1130345 \text{ cm}^2}{4 \times 8 \times 65 \text{ cm}}$$

$$= \frac{1130345}{208} \times 10^{-10} \text{ m}$$

$$= 5434.35 \text{ Å}$$

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Date .... Experiment No. .... P. No. 27

Name .... Faculty No. .... Class .... Batch ....

No. of Rings n	MICROSCOPE READING						Diameter			mean
	Left hand side			Right hand side			$D_n = a-b$	$(D_n)^2$	$D_{n+p}^2 - D_n^2$	$D_{n+p}^2 - D_n^2$
	MS	CS×LC	Total (a)	MS	CS×LC	Total (b)				
20	2.5	0.027	2.527	1.9	0.052	1.952	0.575	0.330625		
18	2.5	0.000	2.500	1.9	0.087	1.987	0.513	0.263169		
16	2.4	0.054	2.454	2.0	0.012	2.012	0.442	0.195364		
14	2.4	0.033	2.433	2.0	0.039	2.039	0.305	0.093025		
12	2.4	0.021	2.421	2.0	0.057	2.057	0.364	0.132496	0.198129	0.1130345
10	2.3	0.097	2.397	2.0	0.076	2.076	0.321	0.103041	0.160155	
8	2.3	0.083	2.383	2.0	0.096	2.096	0.287	0.082369	0.112555	
6	2.3	0.067	2.367	2.1	0.016	2.116	0.251	0.063001	0.030024	
4	2.3	0.045	2.345	2.1	0.042	2.142	0.203	0.041209	0.091287	
2	2.3	0.010	2.310	2.1	0.078	2.178	0.132	0.017424	0.085617	

RESULT-

The wavelength (λ) of sodium light (monochromatic light) is $\lambda = 5434.35\,Å$

$$\text{Percentage Error} = \frac{\text{Actual} - \text{Calculated}}{\text{Actual}} = \frac{5893-5434}{5893} \times 100$$

$$= 7.78\%$$

May 2023

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