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K J Somaiya College of Engineering

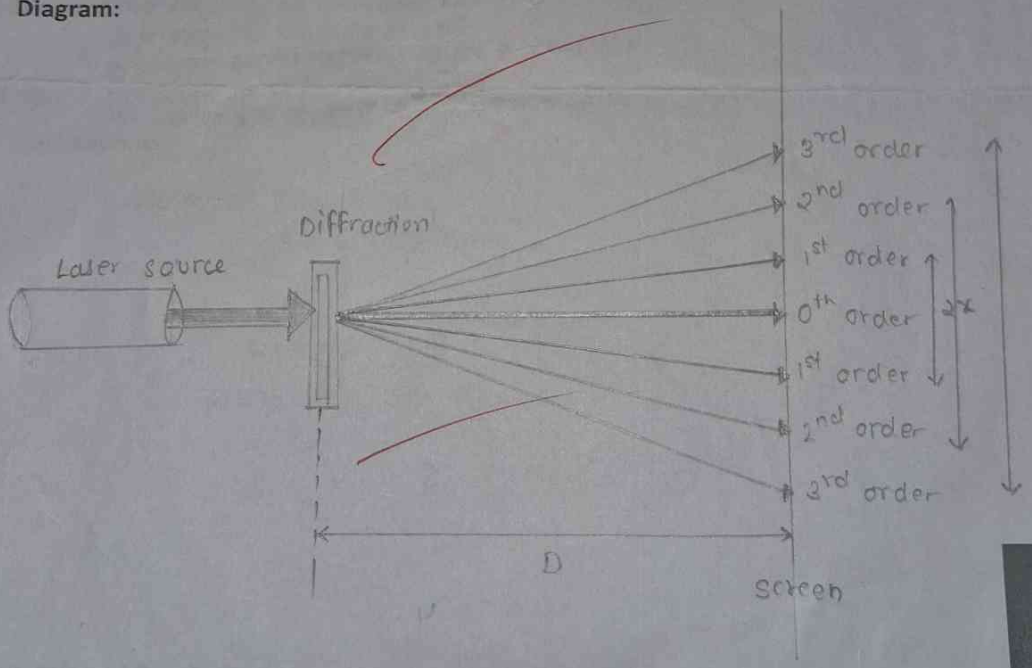
Name:	SIDDHI SAWANT
Roll Number:	78
Batch:	P7-3
Experiment performed on (date):	5/9/24

Title of the Experiment: Grating Constant

Aim: To determine the line density of a plane transmission diffraction grating

Apparatus: Plane transmission diffraction gratings, laser source, screen, and meter scale

Diagram:



29.5 cm
x
2.2
4.2
3.45
8.65

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Observations:

Screen distance D = cm
grating number =

order of maxima m	seperation of diffraction maxima from central maximum		angle of diffraction	sinθ
	2x (cm)	Y (cm)		
1	5.5	2.75	3.84	0.066
2	11	5.5	7.64	0.132
3	16.8	8.4	11.58	0.200
4	22.5	11.25	15.34	0.264
5				

Formula: line density of diffraction grating $N = \frac{\text{slope}}{\lambda}$
slope: slope of line sin θ Vs m
θ = angle of diffraction maxima $\theta = \tan^{-1}(\frac{x}{D})$
m : order of diffraction maxima
λ : wavelength of laser light · λ = 640nm

Calculations:

slope of line = 0.066
$\lambda = 6.4 \times 10^{-7}$ nm

$N = \frac{0.06}{6.4 \times 10^{-7}} = 0.0103 \times 10^{7}$

$N = 1 \times 10^{5}$

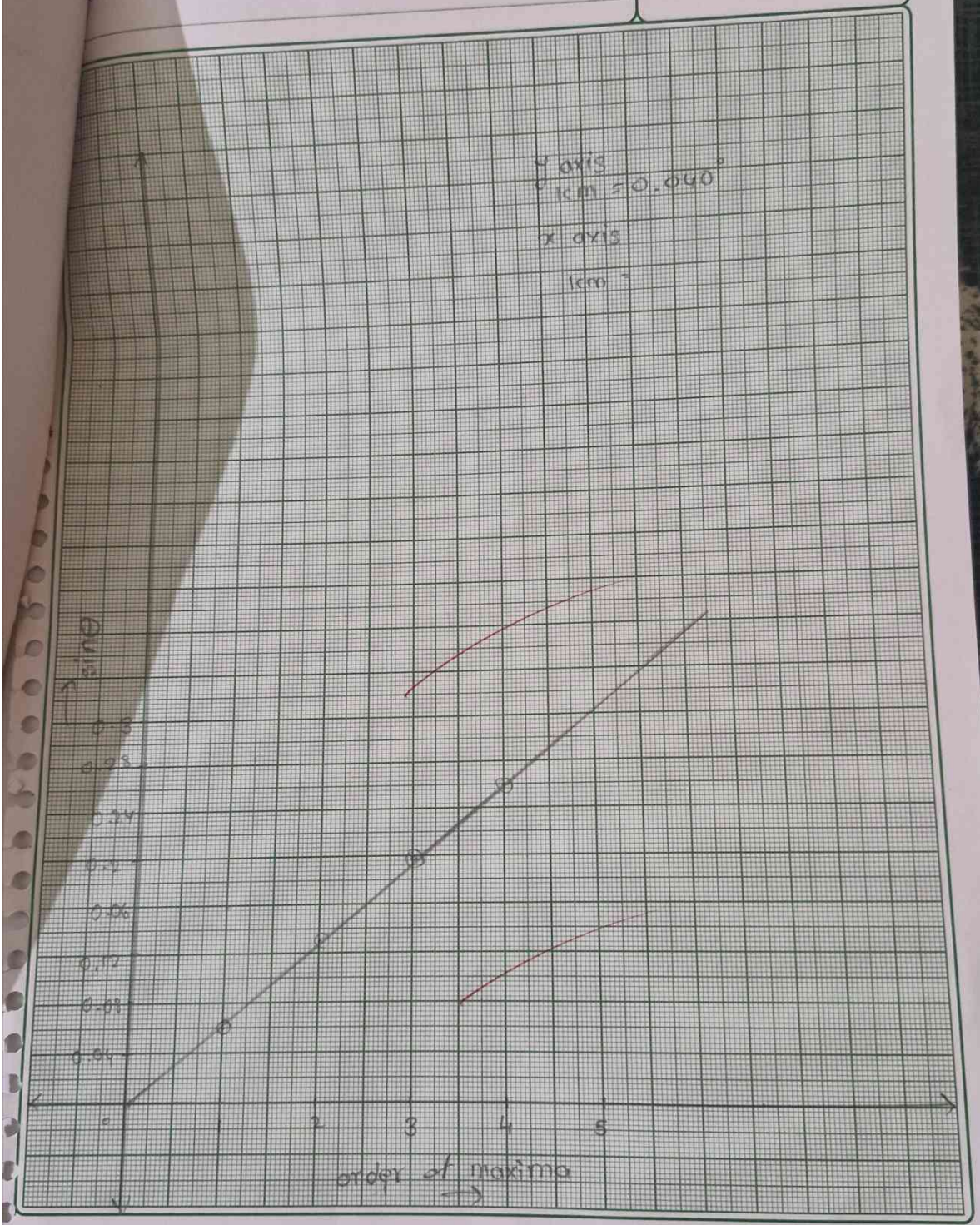
Result/s and Conclusion/s:

Line density of the given diffraction grating
$N = 1.03 \times 10^{5}$

SCALE :-

y axis
1cm = 0.040°

x axis
1cm =



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K J Somaiya College of Engineering

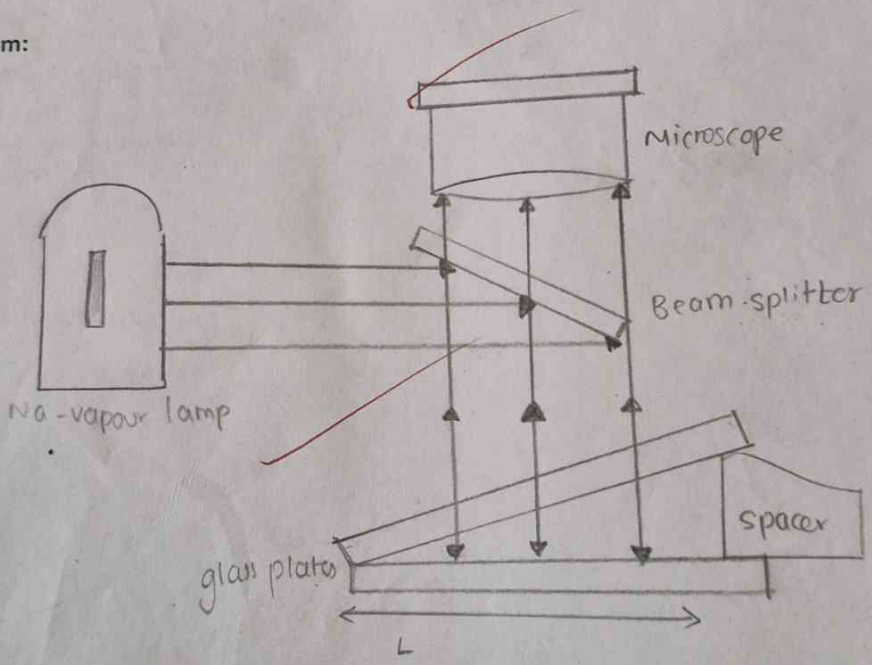
Name:	Siddhi Sawant
Roll Number:	78
Batch:	P7-3
Experiment performed on (date):	12/9/24

Title of the Experiment: Wedge-shaped Film

Aim: To determine spacer thickness in a wedge shaped film interference pattern

Apparatus: Wedge-shaped film set-up (two optically flat glass plates separated by a spacer at one end, beam-splitter with black box), monochromatic source (Na-vapour lamp), and travelling microscope.

Diagram:



Observations:

Sr. No.	Dark fringe no. (n)	Main scale Reading M (cm)	Vernier Reading V = CD × LC (cm)	Total Reading T_n = M + V cm
1	5	6.35	22 × 0.001	6.372
2	10	6.40	15 × 0.001	6.415
3	15	6.45	39 × 0.001	6.489
4	20	6.55	27 × 0.001	6.577
5	25	6.60	20 × 0.001	6.62
6	30	6.7	2 × 0.001	6.702

Formula : spacer thickness $d = \frac{\lambda L}{2\beta}$

λ = wavelength of light from Na-vapour lamp = 589 nm

L = length of glass plate = 4cm

β = Fringwidth (From graph)

Graph : T_n Vs n ($T_n \rightarrow$ y-axis & $n \rightarrow$ x-axis)

Slope → Fringewidth.

Calculations:

$\beta = 0.0132$

$\lambda = 589 \times 10^{-7}$ cm

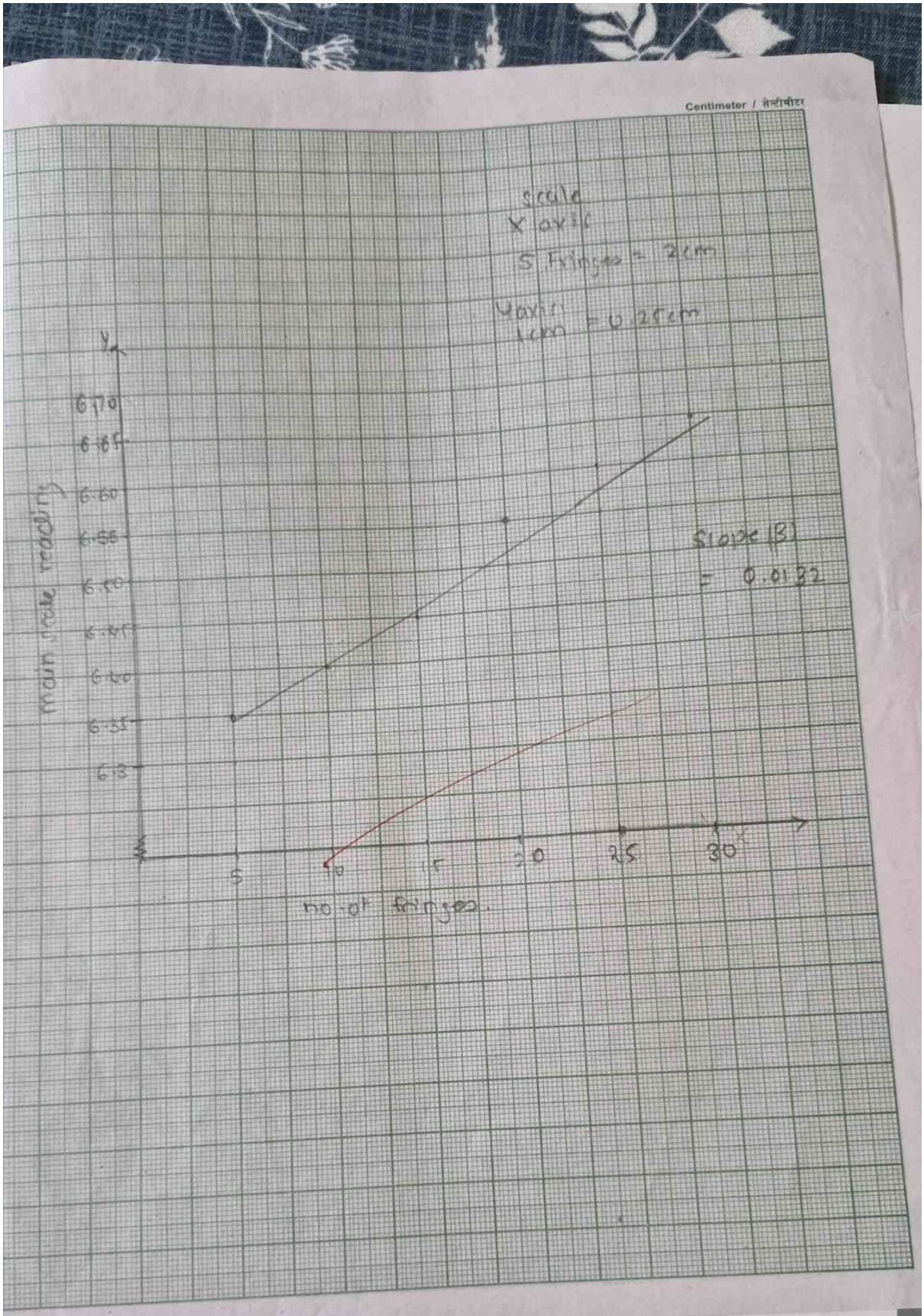
$= 589 \times 10^{-5}$ cm

$\therefore d = \frac{5.89 \times 10^{-5} \times 4}{2 \times 0.0132}$

$d = 8.924 \times 10^{-3}$

Result/s and Conclusion/s:

Thickness of spacer is 8.924×10^{-3} cm


Centimeter / सेन्टीमीटर
scale
X axis
5 Fringes = 2cm
Yaxis
1cm = 0.25cm
Y
6.70
6.65
6.60
6.55
6.50
6.45
6.40
6.35
6.3
main scale reading
Slope (B)
= 0.0132
5
10
15
20
25
30
no. of fringes.

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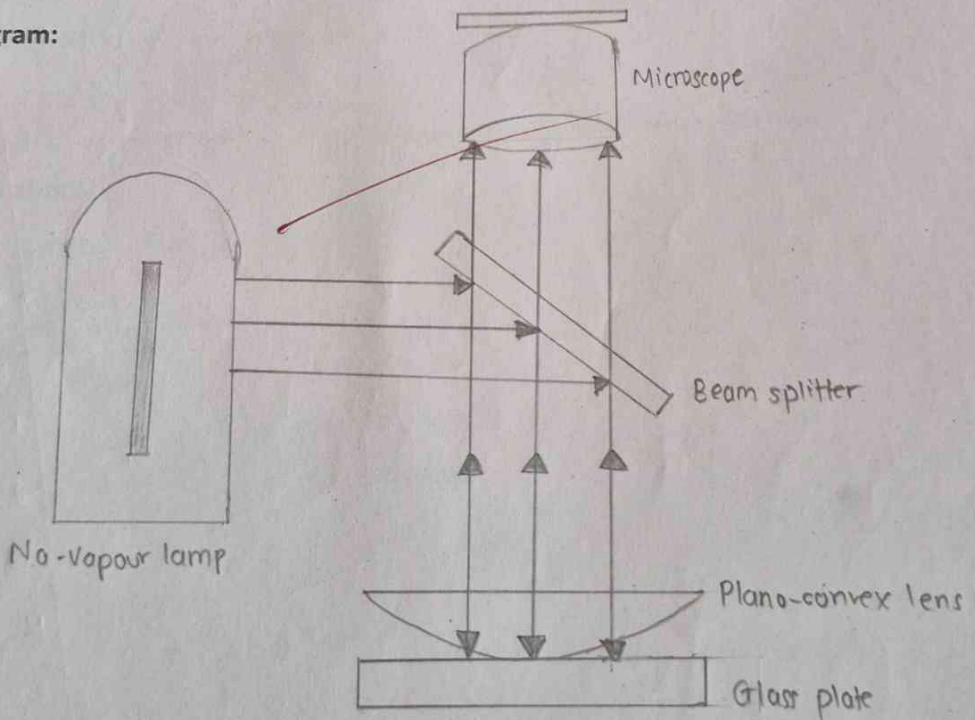
Name: SIDDHI SAWANT	
Roll Number: 63	
Batch: P7-3	
Experiment performed on (date): 19/9/24	

Title of the Experiment: Newton's Rings

Aim: To determine radius of curvature of plano-convex lens by measuring diameters of interference rings

Apparatus: Newton's rings set-up (pair of plane glass plate and plano-convex lens, beam splitter with black box), monochromatic source (Na-vapour lamp), and travelling microscope.

Diagram:



Observations:

Sr no.	Ring no. (n)	Travelling Microscope Reading (cm)						Diameter Dn(cm) = L-R	D_n^2 (cm²) (take 10^{-2} factor common)
		on left L=M+V (cm)			on Right R=M+V (cm)				
		M	V	L	M	V	L		
1	12	6.90	32 x 0.001	6.932	6.50	46 x 0.001	6.546	0.386	14.9
2	10	6.90	2 x 0.001	6.903	6.55	10 x 0.001	6.560	0.343	11.765
3	8	6.85	48 x 0.001	6.898	6.55	34 x 0.001	6.584	0.314	9.860
4	6	6.85	23 x 0.001	6.873	6.60	2 x 0.001	6.602	0.271	7.344
5	4	6.80	40 x 0.001	6.840	6.60	31 x 0.001	6.631	0.209	4.368
6	2	6.80	5x 0.001	6.805	6.65	12 x 0.001	6.662	0.143	2.045

M: Main scale reading, V: vernier scale reading = coinciding division x least count; L: Total reading on left side and R: Total reading on right side of the centre of the ring pattern.

Formula: Radius of curvature of lens $R = \frac{\text{slope}}{4\lambda}$

slope of line D_n^2 v/s n

λ: wavelength of light from Na-vapour lamp = 589nm

Calculations:

Using Formula i.e $\frac{\text{slope}}{4\lambda}$,

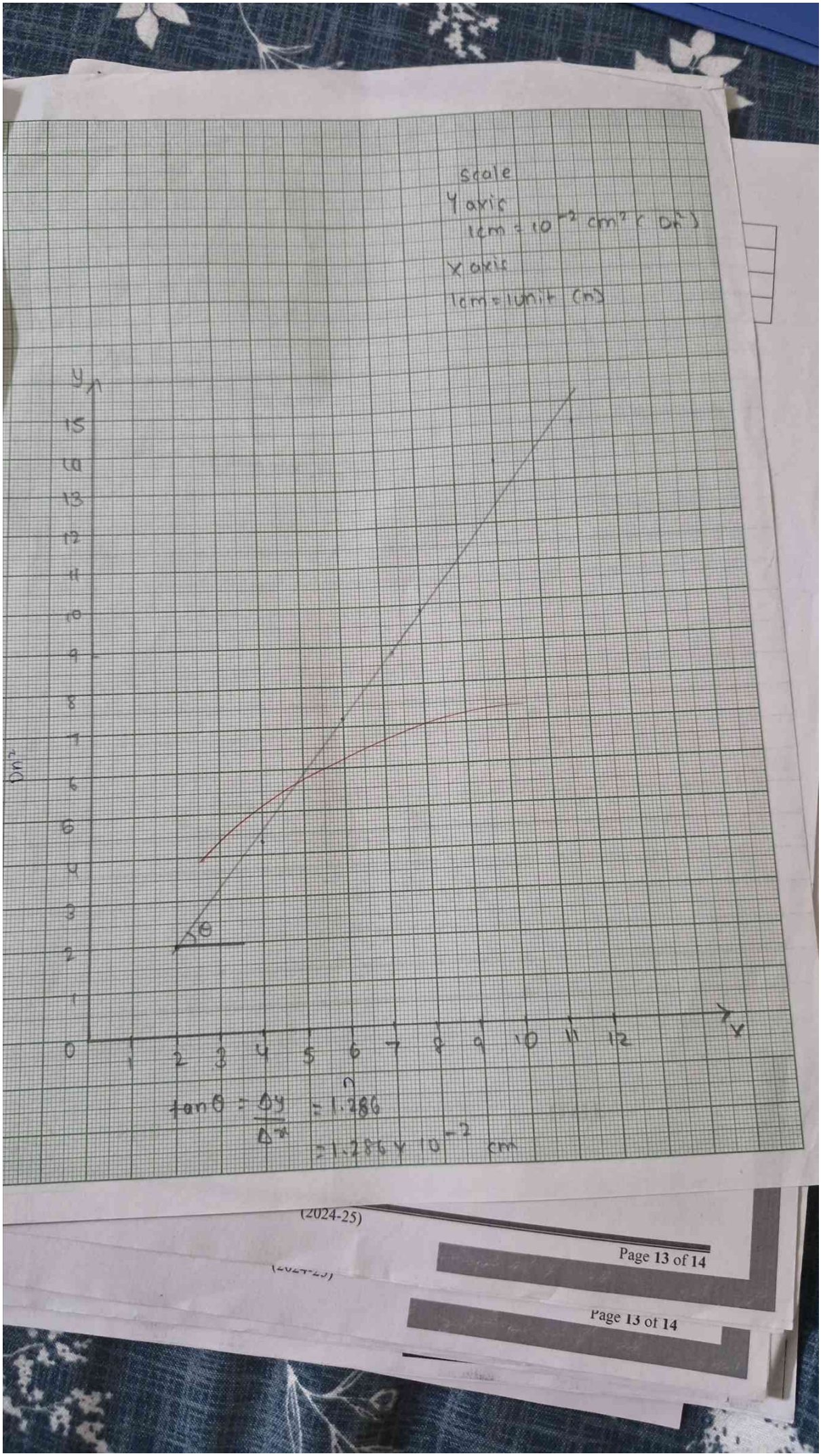
$$R = \frac{1.286 \times 10^{-2}}{4 \times 589 \times 10^{-7}} = \frac{1.286 \times 10^{5}}{4 \times 589}$$

$$= 5.4584 \times 10^{1}$$

$$= 54.584 \text{ cm}$$

Result/s and Conclusion/s:

Radius of curvature of plano-convex lens R = 54.584 cm


Scale
Y axis
1cm = 10⁻² cm² (Dn²)
X axis
1cm = 1unit (n)
y
Dn²
θ
x
n
tanθ = Δy/Δx = 1.286
= 1.286 × 10⁻² cm
(2024-25)
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K J Somaiya College of Engineering

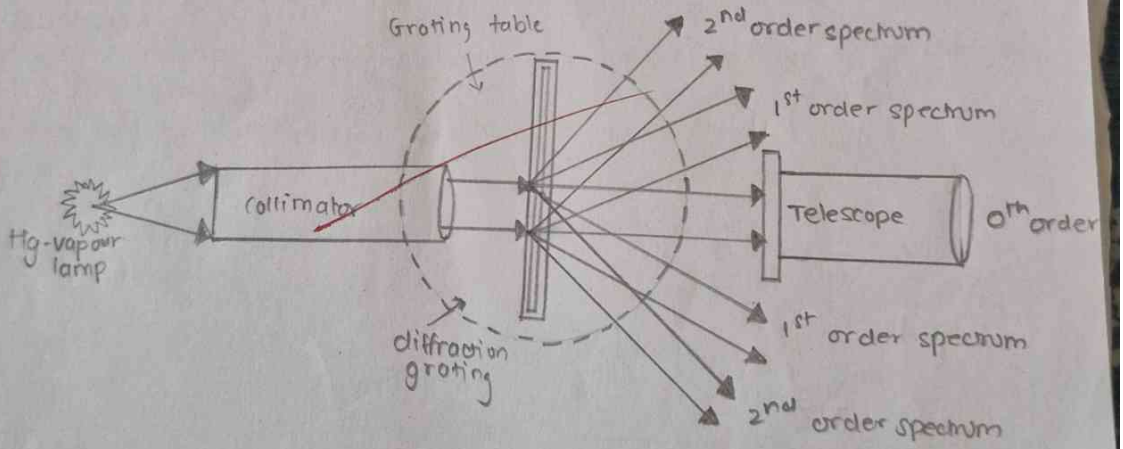
Name: SIDDHI SAWANT
Roll Number: 63
Batch: P7-3
Experiment performed on (date): 26/9/24

Title of the Experiment: Hg - Spectrum

Aim: To determine wavelength of different spectral lines (colours) emitted from a mercury vapour lamp (Hg-source)

Apparatus: Spectometer, Hg vapour lamp, and diffraction grating

Diagram:



Observations:

Sr No.	Spectral line	Spectrometer Reading (degrees and minutes)						Diffraction angle $\theta = \frac{L \sim R}{2}$ (deg min)
		on left $L = M+V$			on Right $R = M+V$			
		M	V	L	M	V	R	
1	Blue/Violet	168°	3'	168°3'	198.5°	8'	198°38'	15°17.5'
2	Green	164°	5'	164°5'	202.5°	12'	202°42'	19°18.5'
3	Yellow	162.5°	28'	162°58'	203.5°	20'	203°50'	20°11'
4	Red	21615°	17'	161°47'	205°	10'	205°10'	21°41.5'
5	white	18350	188°	163°48	183°	15'	183°15'	33'

M: Main scale Reading, V: Vernier reading = coinciding division x least count,
L: Total reading on left of the incident direction, R: total reading on right of the incident direction
The sign ~ means find difference L-R or R-L whichever is positive.

Formula:
Wavelength of spectral line $\lambda = \frac{\sin\theta}{mN}$
θ = angle of diffraction maxima
m = order of diffraction maxima. Take m = 1
N: Line density of diffraction grating, N = 5905 /cm

Calculations:

Wavelength of spectral line $\lambda = \frac{\sin\theta}{mN}$ where θ = angle of diffraction of maxima,
m: order of maxima, (take m=1),
N is line density of diffraction gratting N = 6000 /cm

For blue
* $\lambda = \frac{\sin\left(15 + \frac{17.5}{60}\right)}{600000/m} = 439.55 \times 10^{-9} m$

* For green
$\lambda = \frac{\sin\left(19 + \frac{18.5}{60}\right)}{600000} = 551.086 \times 10^{-9} m$

* For yellow
$\lambda = \frac{\sin\left(20 + \frac{11}{60}\right)}{600000} = 575.042 \times 10^{-9} m$

* For red,
$\lambda = \frac{\sin\left(21 + 41.5/60\right)}{600000}$
$= 616.02 \times 10^{-9} m$

Result/s and Conclusion/s:

Blue	439.55
green	551.086
Yellow	575.04
Red	616.02

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K J Somaiya College of Engineering

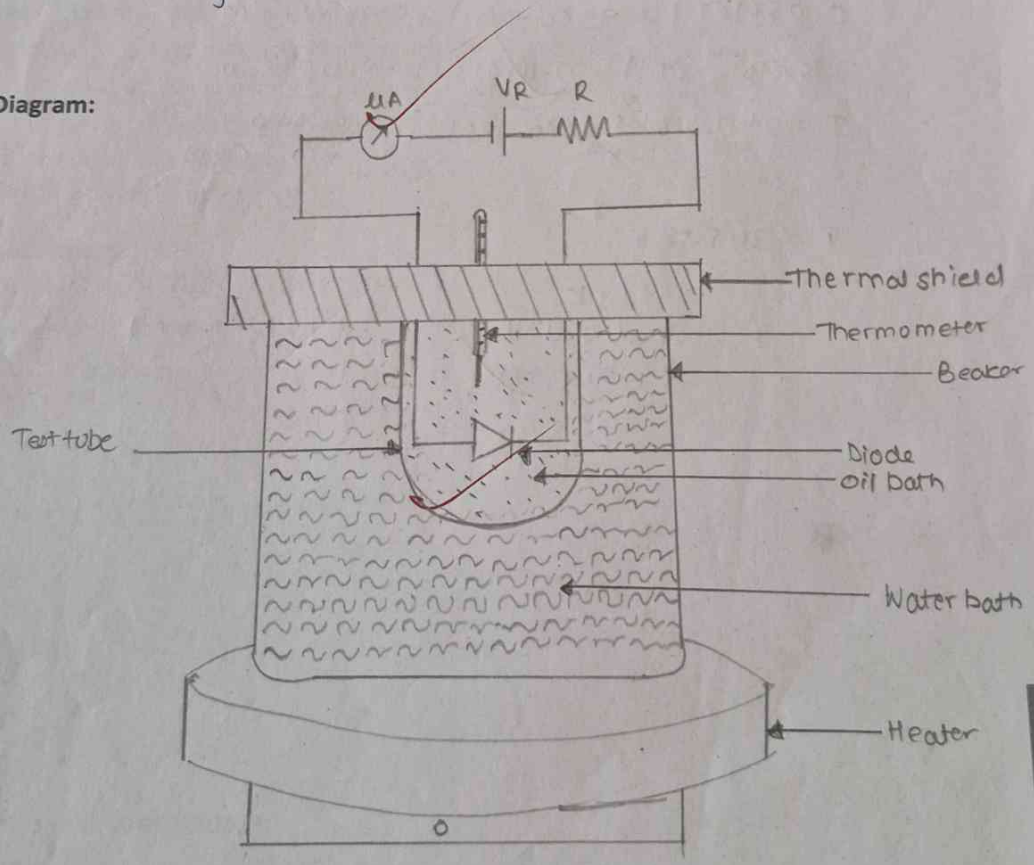
Name: SIDDHI SAWANT
Roll Number: 68
Batch: P7-3
Experiment performed on (date): 17/10/24

Title of the Experiment: Energy Band Gap

Aim: To determine energy band gap of the material of semiconductor p-n junction diode using temperature dependence of reverse saturation current.

Apparatus: DC power supply, voltmeter, micro-ammeter, semiconductor diode, heating bath, thermometer and connecting wires

Diagram:



* Assignment

Formula: $E_g(0) = E_g(T) + \frac{\alpha T^2}{T+B}$

we have; $\alpha = 3.16 \times 10^{-4}$ eV

$B = 93$K, $E_g(T) = 0.0861$eV

For; $E_g(0) = 0$

T can be found by the equation

$$0 = \frac{0.0861 + 3.16 \times 10^{-4} T^2}{T + 93}$$

For $E_g(0) = 0$

T can be found by the equation

$$0 = \frac{0861 + 3.16 \times 10^{-4} T^2}{T+93}$$

$$0.0861(T) + 93(0.0861) - 3.16 \times 10^{-4}(T^2) = 0$$

$$3.16 \times 10^{-4}(T^2) - 0.0861(T) - 8.0073 = 0$$

$$T = +0.0861 \pm \sqrt{(0.0861)^2 - 4(3.16 \times 10^{-4} \times 10^{-4}(800))}$$

$$2(3016 \times 10^{-4})$$

$T = 345.58$ K

OUT $= -73.41$ K

(not valid ∵ T can't be -ve)

$T = 345.58$K.

Observations:

	Temperature (T)			Reverse	1/T (K^{-1})	$\ln(\frac{I_s}{T^2})$
	°C		Kelvin (K)	I_s (amp)		
1	40	30°	303	20×10^{-6}	0.0033	-22.25
2	45	40°	313	30×10^{-6}	0.0032	-21.90
3	50	45°	318	35×10^{-6}	0.00314	-21.79
4	55	50°	323	40×10^{-6}	0.00309	-21.69
5	60	55°	328	50×10^{-6}	0.003049	-21.49
6	65	60°	333	60×10^{-6}	0.0030	-21.34
7		65°	338	70×10^{-6}	0.00296	-21.212
8		70°	343	80×10^{-6}	0.00292	-21.106

Formula:
Energy Band Gap $E_g = k \times |\text{slope}|$
|slope| : absoulute value of slope of $\ln \frac{I_s}{T^2}$ v/s $\frac{1}{T}$
K: Boltzmann constant $k = 1.38 \times 10^{-23}$ J/k
I_s: Reverse saturation current
T: Absoulute temperature
|slope| = 1430.075

Calculations:

Using value of slope = -1430.075 &
Boltzmann constant = 1.38×10^{-23} J/K
Energy band gap $E_g = 1.38 \times 10^{-23} \times (1430.075)$ J
$= +5.935 \times 10^{-21}$

1 J = 6.242×10^{18} eV
5.935×10^{-21} J = 0.037 eV

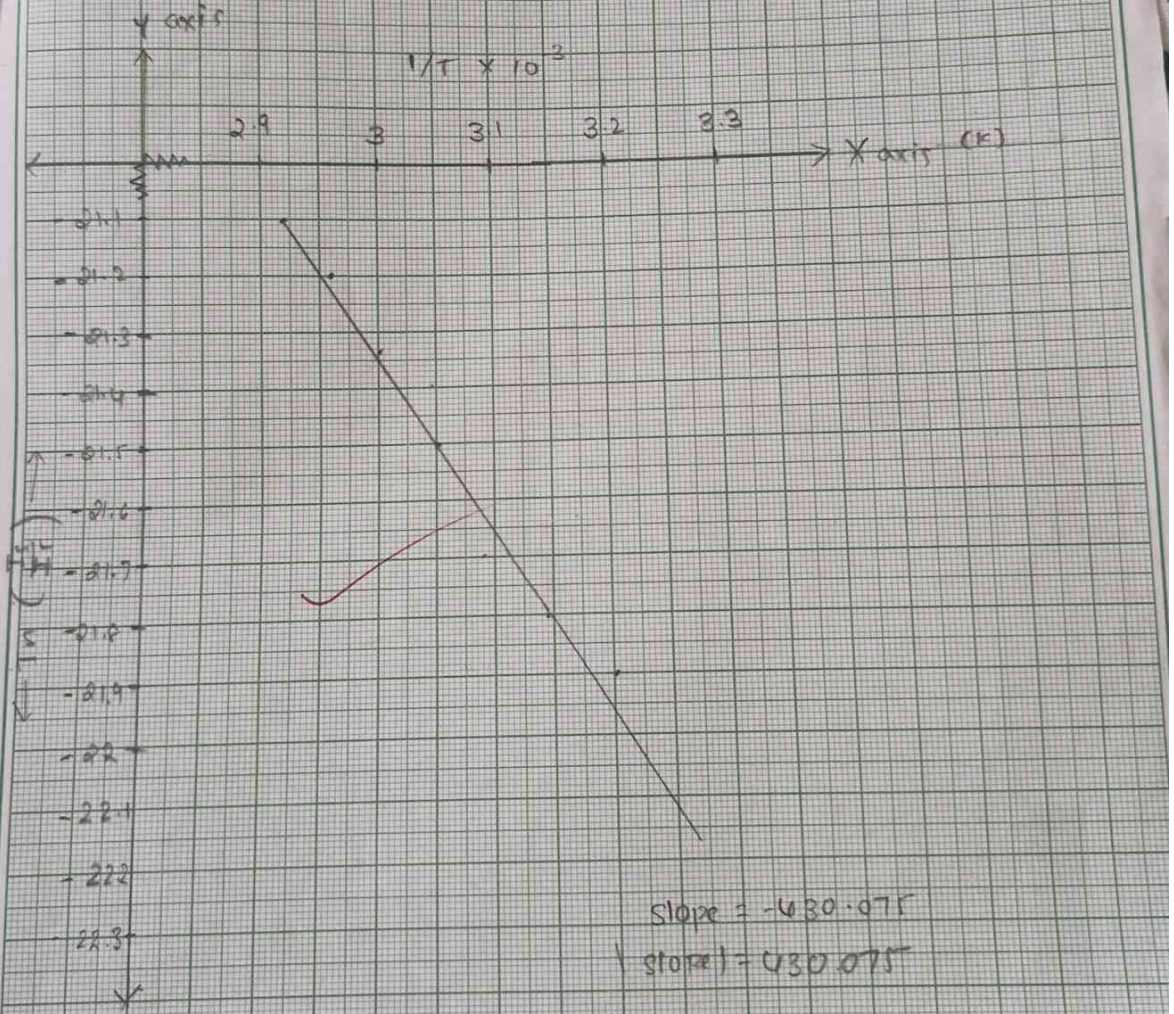
Result/s and Conclusion/s:

Energy band gap of Ge (E_g) = 0.037 eV

SOMAIYA

SCALE :-

Scale
Y-axis
1cm = 0.1 unit
X-axis
2cm = 0.0001 unit



Slope = -430.075

(Slope) = 430.075

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K J Somaiya College of Engineering

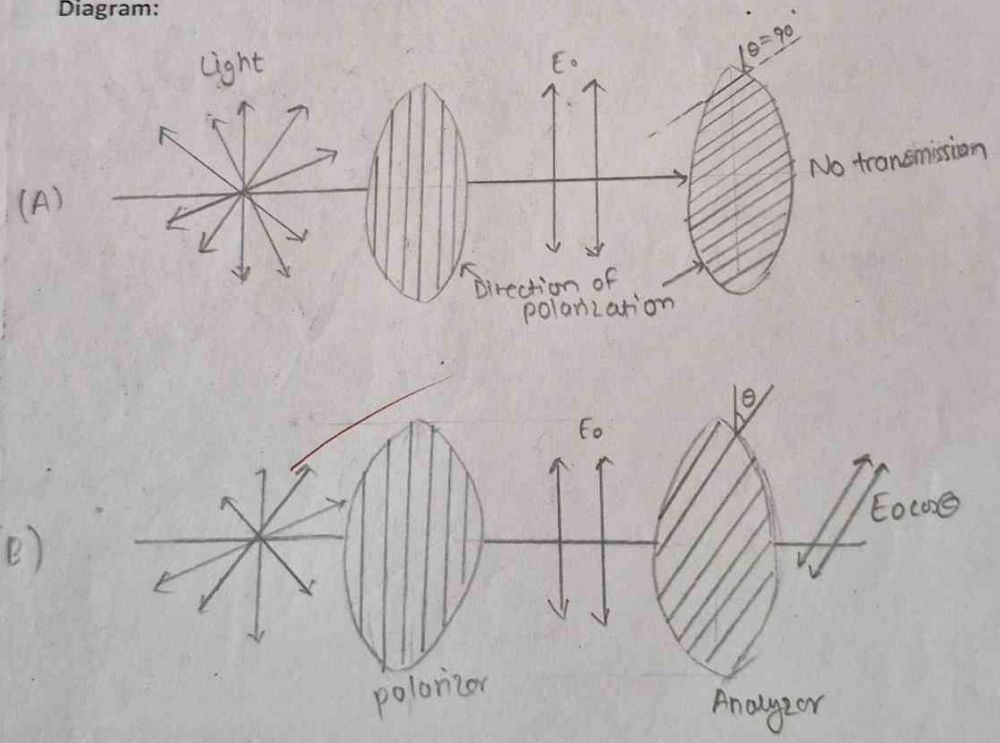
Name: SIDDHI SAWANT	
Roll Number: 63	
Batch: P7 - 3	
Experiment performed on (date): 24/10/24	

Title of the Experiment: Malus law

Aim: To determine the relationship between the intensity of the transmitted light through analyzer and θ, the angle between the axis of polarizer and analyzer and to verify Malus law.

Apparatus: A diode laser, a polarizer-analyzer pair, photo detector, detector output measuring unit (micro ammeter), clips fitted to the polarizer and optical bench.

Diagram:



Observations:

Sr No.	Angle of Analyzer (deg)	Angle between the axis of polarizer and analyzer 'θ' = |Φ - Φ0| (deg)	cos θ	(cos)²θ	current Ir (amp)
1	20	0	1	1	4.05 → Imax
2	30	10	0.9848	0.969	3.86
3	40	20	0.939	0.881	3.60
4	50	30	0.866	0.749	3.13
5	60	40	0.766	0.586	2.38
6	70	50	0.642	0.412	1.93
7	80	60	0.5	0.25	1.24
8	90	70	0.342	0.116	0.58
9	100	80	0.173	0.029	0.07
10	110	90	0	0	0.004

Angle of Analyzer when current is maximum $\Phi_0 = 20°$
Maximum current $I_{max} = 4.05$ A

Calculations:

Formula: $I_t = I_0 \cos^2\theta$

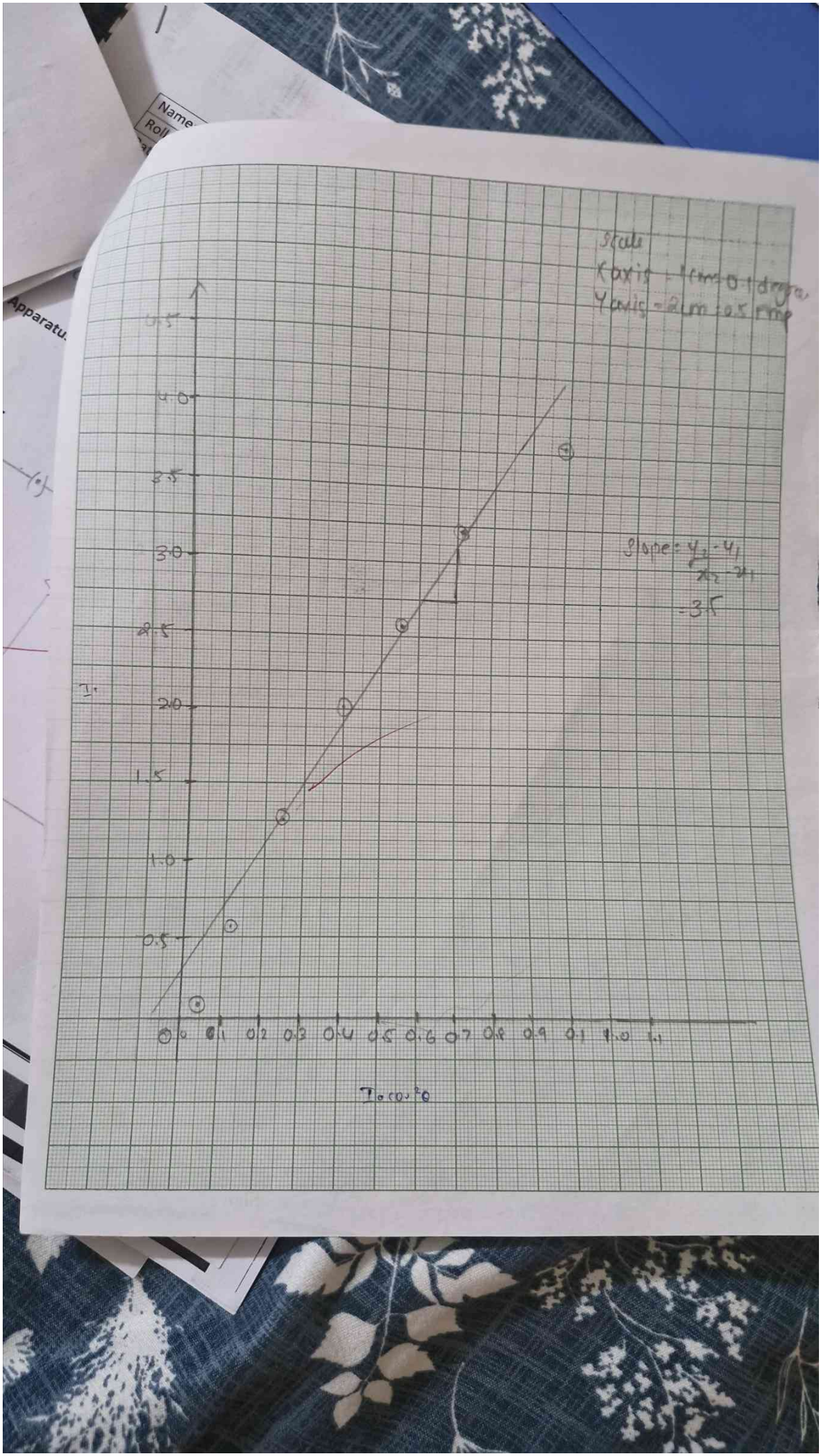
$I_0 = \frac{I_t}{(\cos)^2\theta}$

$I_0 = 3.5$ Amp

I_t from graph
$I_0 = 3.5$ Amp = slope.

Result/s and Conclusion/s:

Hence we determined the relationship between the intensity of the transmitted digit through analyzer and 'θ', the angle between the axis of polarizer and analyzer and verified Malus law.


Name
Roll
Apparatu
Scale
X axis = 1 cm = 0.1 degree
Y axis = 2 cm = 0.5 cm
Slope: $\frac{y_2 - y_1}{x_2 - x_1}$
= 35
3.5
4.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
T cos² θ

SOMAIYA VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering

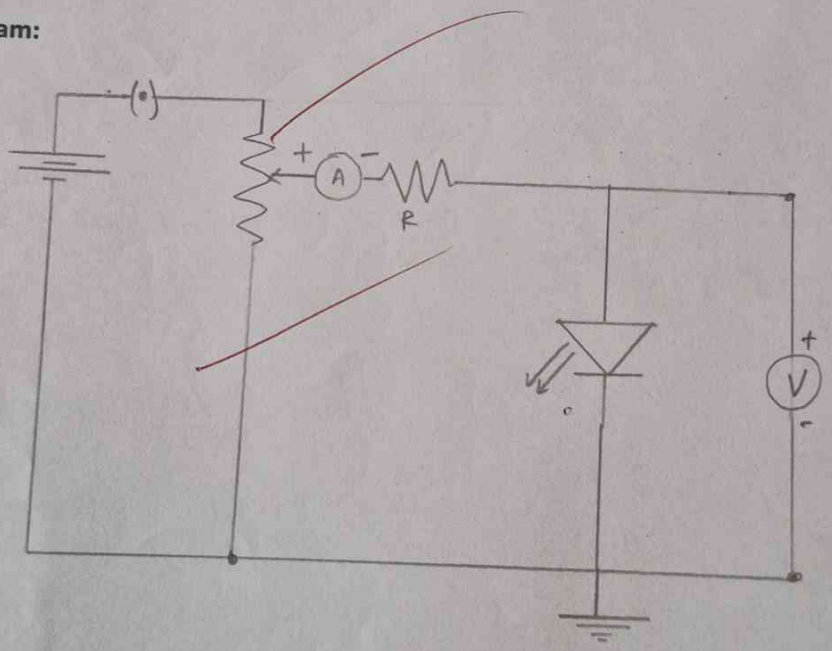
Name: Siddhi Sawant	
Roll Number: 63	
Batch: P7-3	
Experiment performed on (date): 14/11/24	

Title of the Experiment: Plancks constant

Aim: To determine value of Plancks constant wing LEDs of different colours

Apparatus: Power supply, rheostat, milliammeter, voltmeter, 1 k resistor, various LEDs.

Diagram:



Observations:

SrNo	LED	Wavelength (λ)	$\frac{1}{\lambda}$ (nm^{-1})	V_{th} (Volts)
1	Red	650 nm	1.54×10^{-3}	1.908
2	Yellow	570 nm	1.75×10^{-3}	2.178
3	Green	510 nm	1.96×10^{-3}	2.434

Formula:

$h = \text{slope} \times \frac{e}{c}$

slope : slope of line V_{th} vs $\frac{1}{\lambda}$

λ : wavelength of light for a particular LED

$e = 1.6 \times 10^{-19} C$

$c = 3 \times 10^{8}$ m/s

Calculations:

Slope of line V_{th} vs $\frac{1}{\lambda} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 1.498}{1.8 - 1.2} = 1.255$ V.nm

$= 1.255 \times 10^{-6}$ Vm

$h = \text{slope} \times \frac{e}{c}$

$= 1.255 \times \frac{1.6 \times 10^{-19}}{3 \times 10^{8}} \times 10^{-6}$

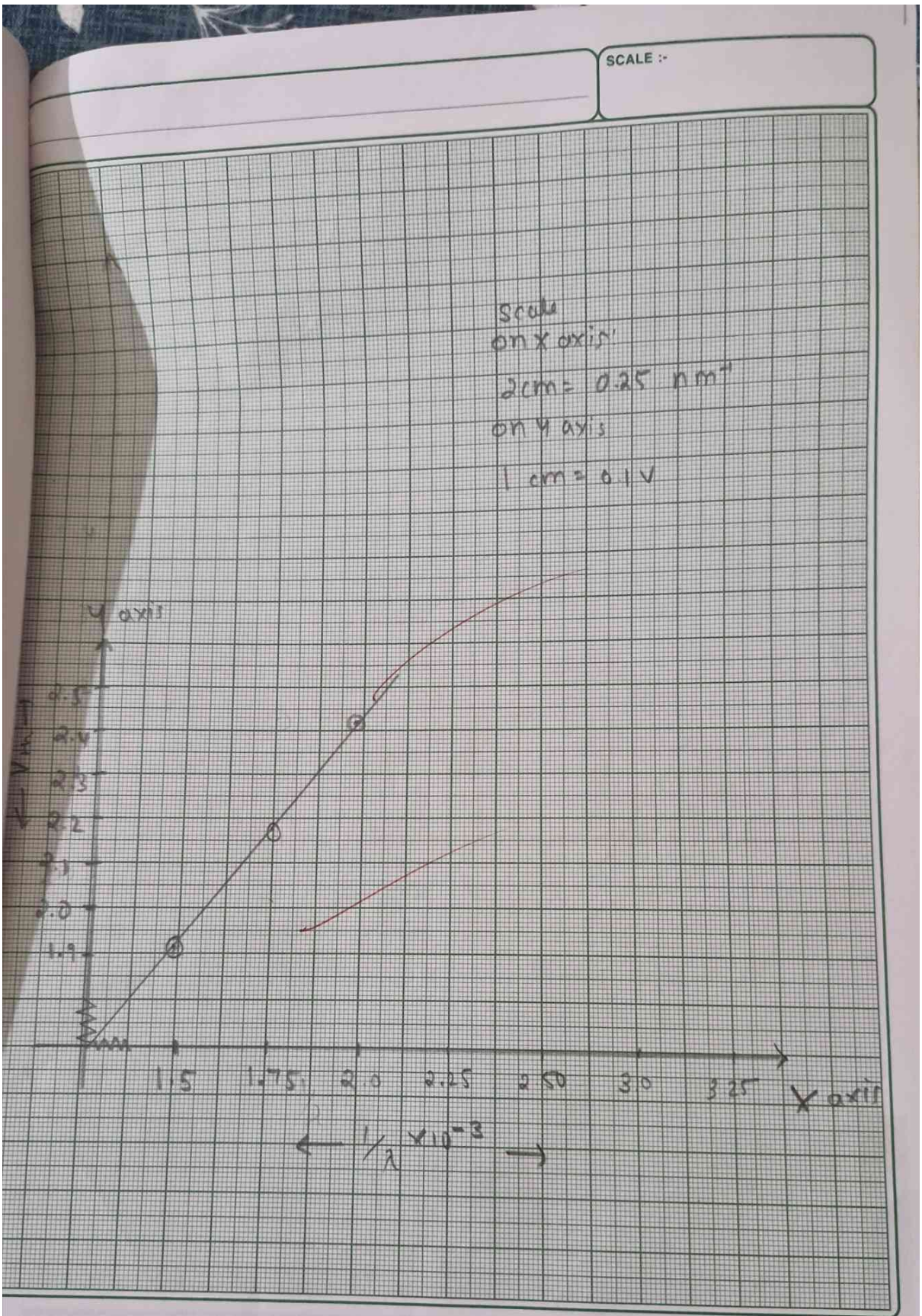
$= 6.693 \times 10^{-34}$ Js

Result/s and Conclusion/s:

Hence, we performed the virtual lab Experiment of planks constant and found it out to be 6.693×10^{-34}

SCALE :-

Scale
on X axis
2cm = 0.25 nm^{-1}
on Y axis
1 cm = 0.1 V



AAKSHAR

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K J Somaiya College of Engineering

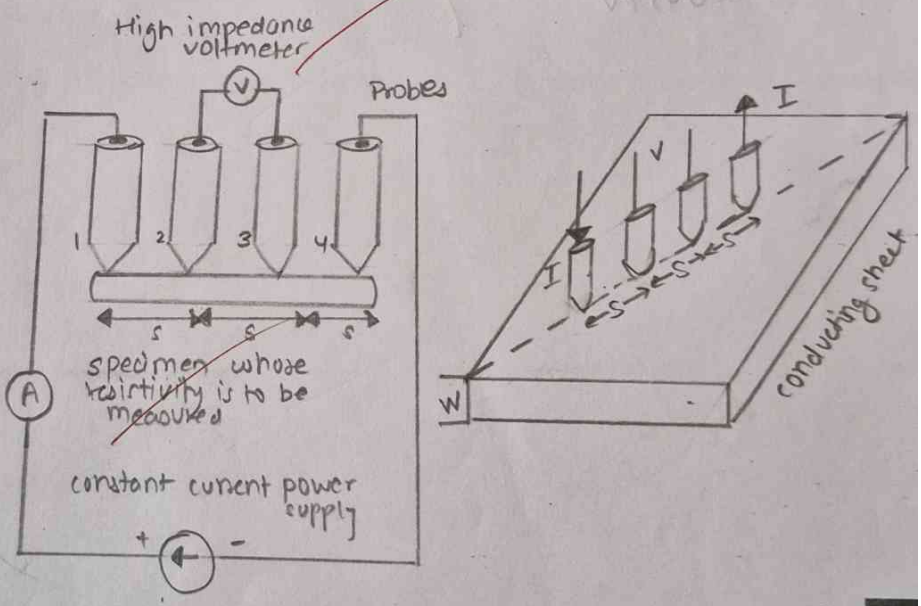
Name:	Siddhi Sawant
Roll Number:	63
Batch:	P7-3
Experiment performed on (date):	14/11/24

Title of the Experiment: Resistivity by 4-Probe Method

Aim: To analyse temperature dependence of resistivity of semiconductor by four probe method.

Apparatus: Probe arrangement, sample, oven 0-200°C, constant current generator, oven power supply and digital panel meter (measuring voltage and current)

Diagram:



Assignment :-

$E_g = K \times |slope|$

|slope| = Absolute value of line lnσ vs $1/T$

$K = 1.38 \times 10^{-23}$ J/K

T = absolute temp.

slope :- $\frac{y_2 - y_1}{x_2 - x_1} = \frac{(-9.787) - (-9.85)}{3.17 - 3.05}$

$= 0.523$

$= 520$

$E_g = 525 \times 1.38 \times 10^{-23}$ J

$= 747.5 \times 10^{-23} \times 6.242 \times 10^{18}$ eV

$= 4522.39 \times 10^{-5}$ eV

$= 0.045$ eV

Observations:

Material: ____

constant current I = ~~mA~~ ___ mA

Temperature (T) °C	temperature (T) K	Voltage (V) mV	Resistivity (ρ) (Ω-m)	ln(ρ)	$\frac{1}{T}$ (K^{-1})
25	298	0.6107	6.794×10^{-5}	-9.689	3.35×10^{-3}
30	303	0.5926	6.00×10^{-5}	-9.719	3.3×10^{-3}
35	308	0.5765	5.837×10^{-5}	-9.748	3.25×10^{-3}
40	313	0.5595	5.675×10^{-5}	-9.776	3.19×10^{-3}
45	318	0.5445	5.522×10^{-5}	-9.804	3.14×10^{-3}
50	323	0.5302	5.378×10^{-5}	-9.830	3.09×10^{-3}
55	328	0.5168	5.241×10^{-5}	-9.856	3.04×10^{-3}
60	333	0.5041	5.113×10^{-5}	-9.881	3×10^{-3}
65	338	0.4921	4.990×10^{-5}	-9.905	2.95×10^{-3}
70	343	0.4807	4.875×10^{-5}	-9.928	2.91×10^{-3}

Formula: $\rho = 2.13 \times 10^{-3} \frac{V}{I}$

ρ = Resistivity, V: voltage across sample, I: current through the sample.

Calculations:

$\rho = 2.13 \times 10^{-3} \times \frac{V}{I}$

At room temp

I = 21 mA hV = 0.6107 mV

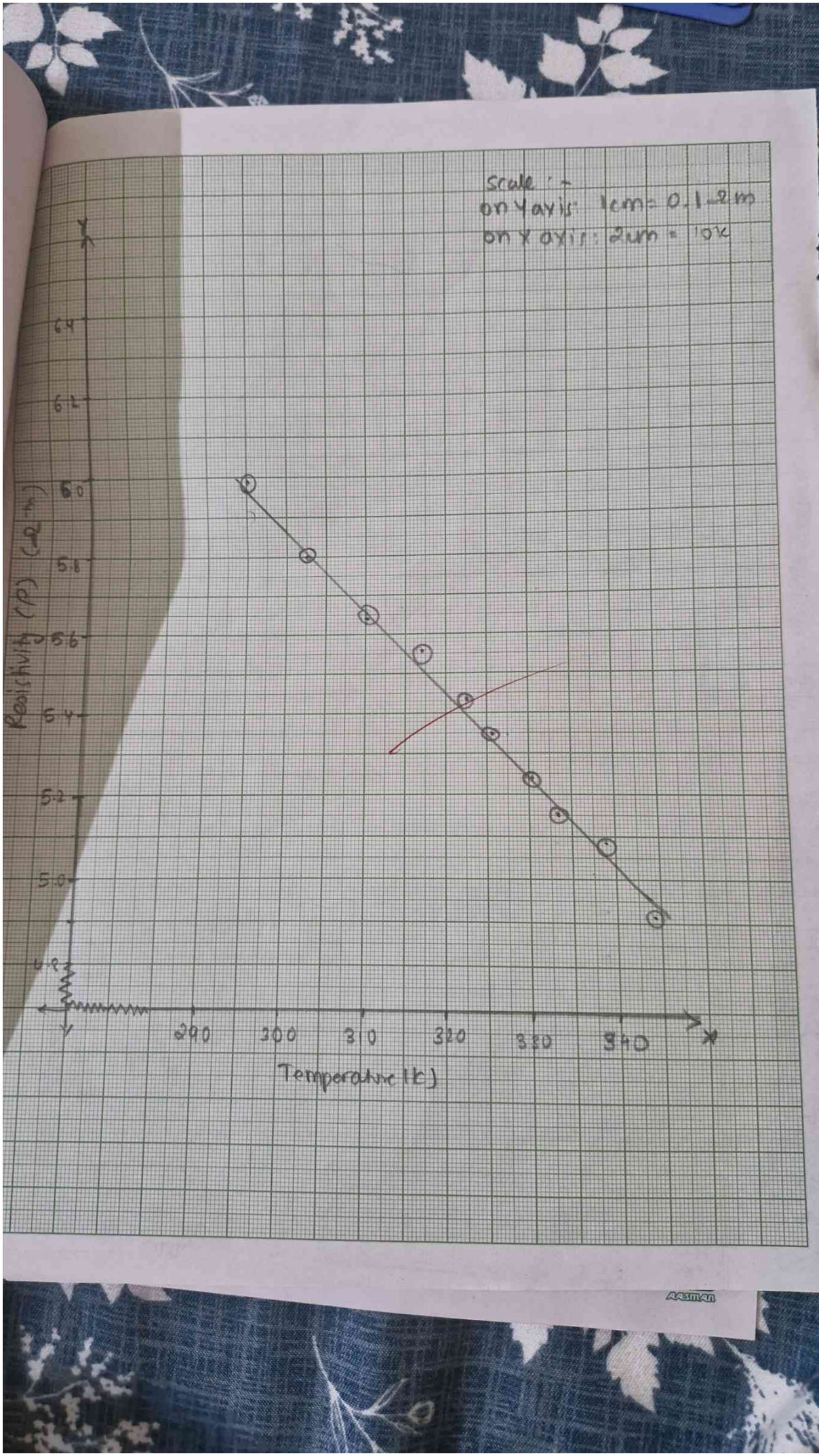
$\rho = 2.13 \times 10^{-3} \times \frac{0.6107}{21}$

$\rho = 6.194 \times 10^{-5}\ \Omega m$

Result/s and Conclusion/s:

Resistivity of a semiconductor at room temperature is $\rho = 6.194 \times 10^{-5}\ \Omega m$

The resistivity changes and is inversely proportional to the temperature


Scale :-
on Y axis: 1cm = 0.1 Ωm
on X axis: 2cm = 10K
Resistivity (ρ) (Ωm)
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
290
300
310
320
330
340
Temperature (K)

SCALE :-
on x axis = 1cm = 0.05 units
on y axis = 1cm = 0.0025 units