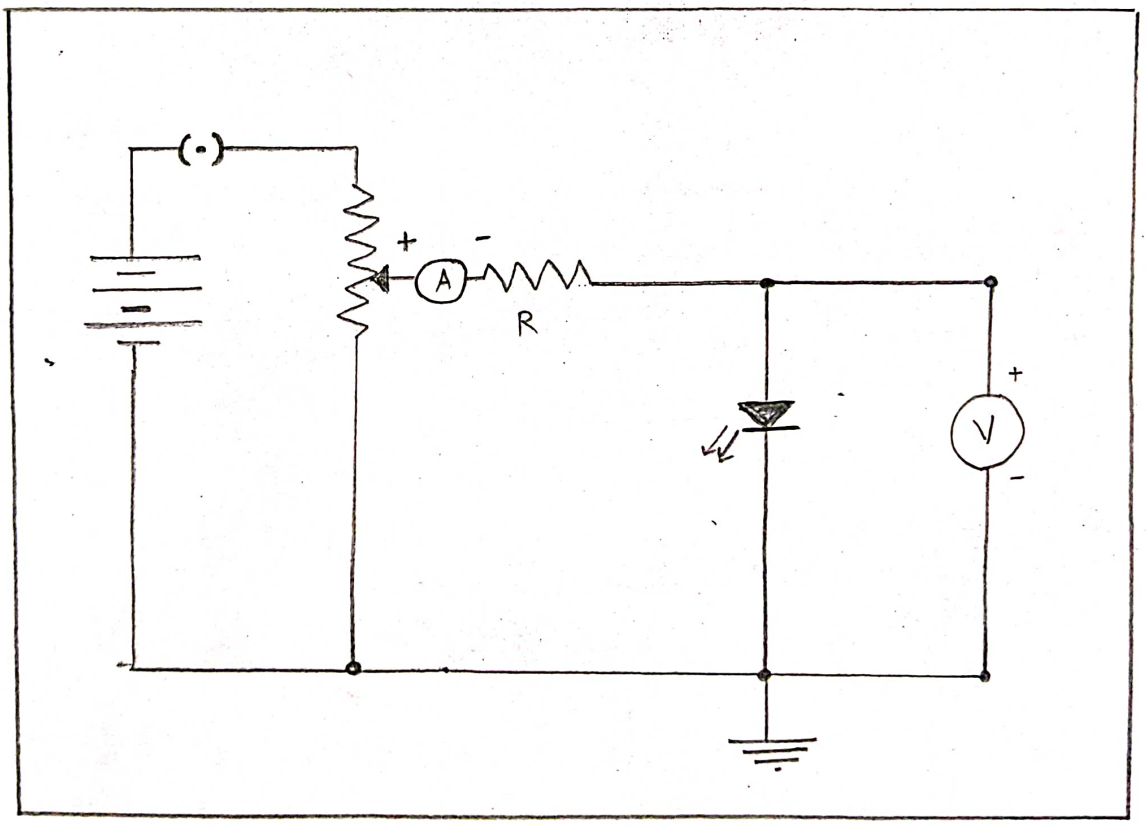
Name:	Ritesh S. Jha
Roll Number:	16010423076
Batch:	P4 - 1
Experiment performed on (date):	23/11/23

Title of the Experiment: Planck's constant

Aim: To determine value of Planck's constant using LEDs of different colours.

Apparatus: Power supply, rheostat, milliammeter, voltmeter, 1K resistor, values LEDs.

Diagram:



Observations:

Sr No.	LED	Wavelength λ (nm)	$1/\lambda$ (nm^{-1})	V_{th} (Volt)
1	Red	650	1.53×10^{-3}	1.908
2	Yellow	570	1.75×10^{-3}	2.178
3	Green	510	1.96×10^{-3}	2.434
4	IR	1094	9.14×10^{-3}	1.121
5	Blue	469	2.13×10^{-3}	2.615

Calculations:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{2.178 - 1.908}{1.75 - 1.53}$$

$$\text{Slope} = 1.227$$

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

$$= \frac{1227 \times 1.6 \times 10^{-19}}{3 \times 10^8}$$

$$= 6.544 \times 10^{-25}$$

$$h = 6.544 \times 10^{-34} \text{ J-S}$$

$$\lambda = \frac{hc}{E} = \frac{hc}{eV_{th}}$$

$$\lambda_{IR} = \frac{hc}{eV_{th}}$$

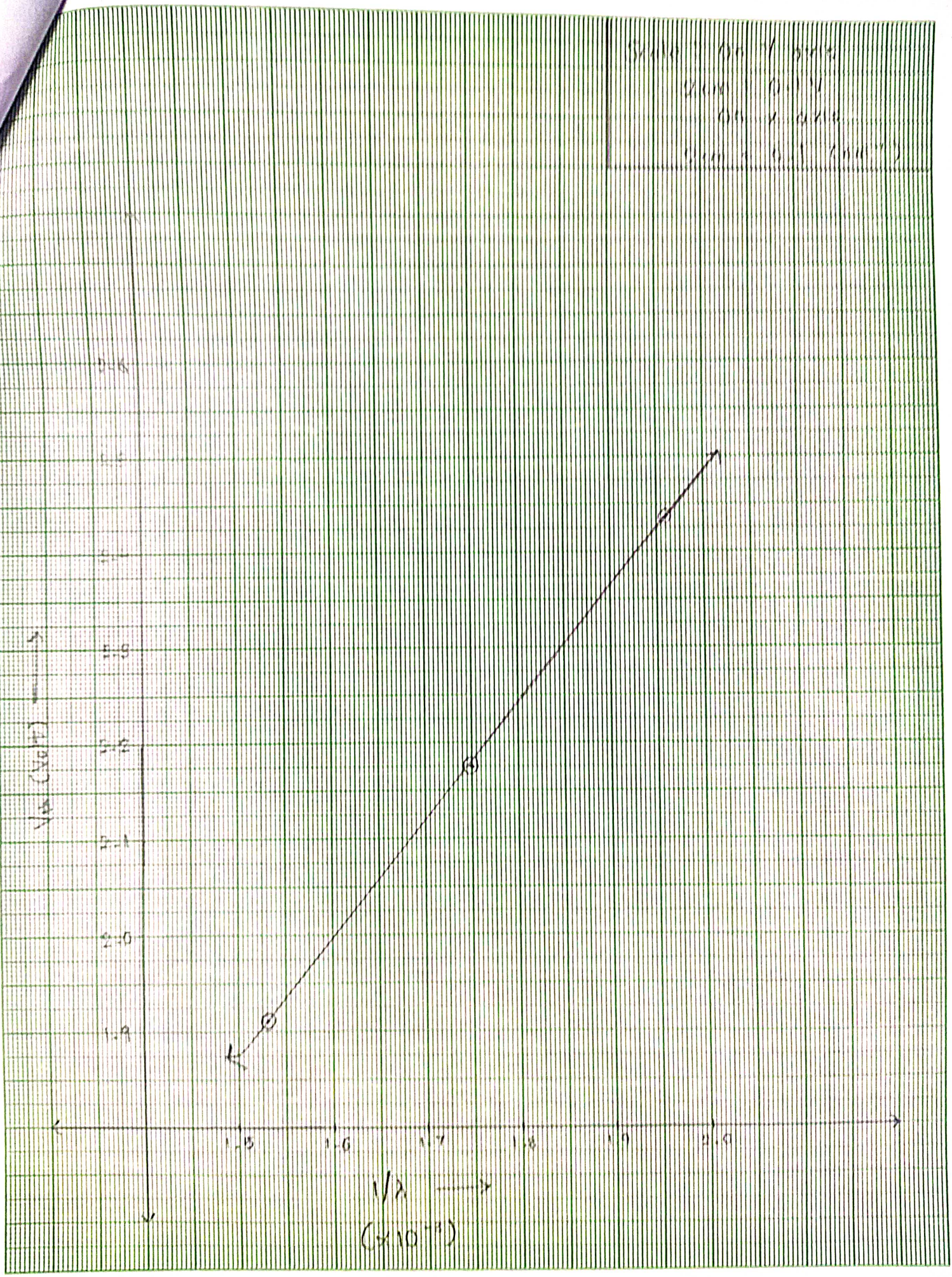
$$= \frac{6.54 \times 10^{-25} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 1.121}$$

$$= 1096 \text{ nm}$$

$$\lambda_{Blue} = \frac{6.54 \times 10^{-25} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 2.615}$$

$$= 469 \text{ nm}$$

Result/s and Conclusion/s: Value of Planck's constant (h) = 6.544×10^{-34} J-S
Wavelength of IR LED = 1096 nm
Wavelength of Blue LED = 469 nm


1/λ (×10⁻⁶)
1.5
1.6
1.7
1.8
1.9
2.0

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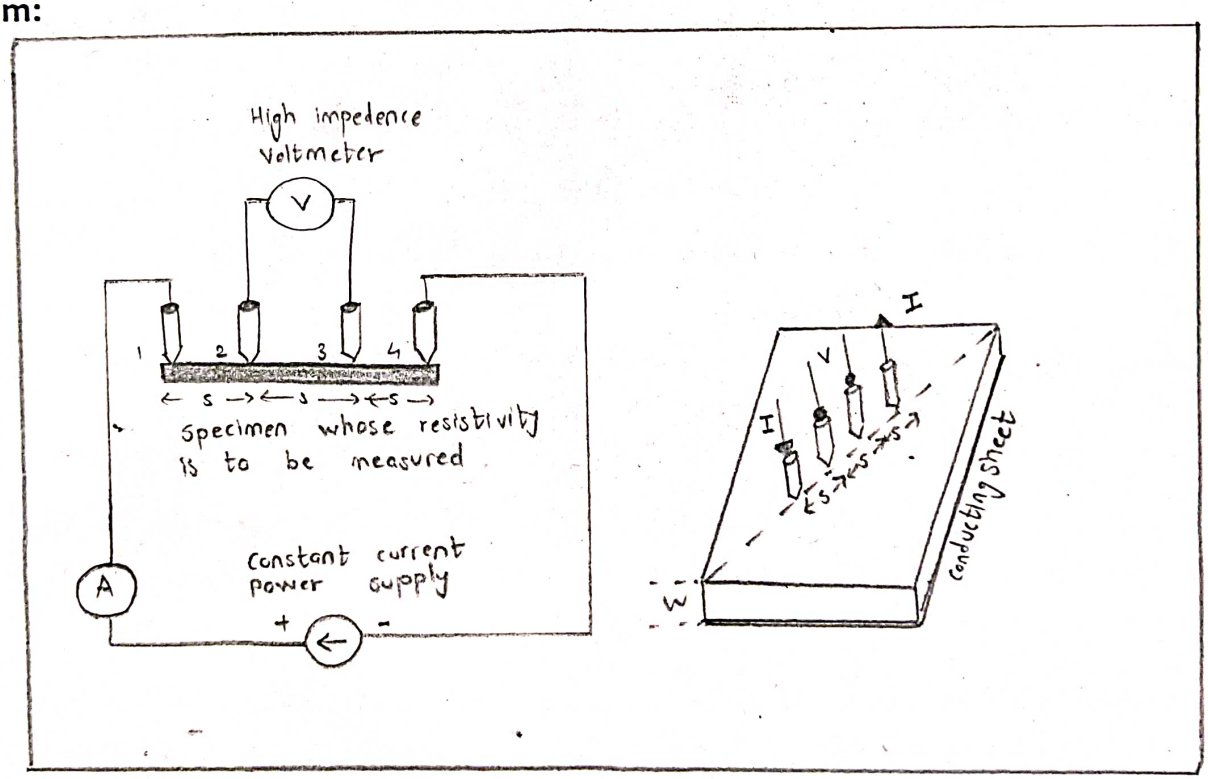
Title of the Experiment: Resistivity by 4-Probe Method

Aim: To determine energy bandgap of semiconductors by four probe method using temperature dependence of resistivity.

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

Diagram:



Observations:

Material : Germanium

Constant current I = 101 mA

Temperature (T) °C	Temperature (T) K	Voltage (V) mV	Resistivity (ρ) (Ω m)	ln (ρ)	$\frac{1}{T}$ (K^{-1})
25	298	2937	0.061	-2.79	3.35×10^{-3}
30	303	2850	0.060	-2.81	3.30×10^{-3}
35	308	2768	0.058	-2.84	3.24×10^{-3}
40	313	2691	0.056	-2.88	3.19×10^{-3}
45	318	2618	0.055	-2.9	3.14×10^{-3}
50	323	2550	0.053	-2.93	3.09×10^{-3}
55	328	2485	0.052	-2.95	3.04×10^{-3}
60	333	2424	0.051	-2.97	3.00×10^{-3}
65	338	2336	0.049	-3.01	2.95×10^{-3}
70	343	2311	0.048	-3.03	2.91×10^{-3}

Calculations:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = 548.4$$

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

$$= 2.13 \times 10^{-3} \times \left(\frac{2937}{101}\right)$$

$$\rho = 0.061$$

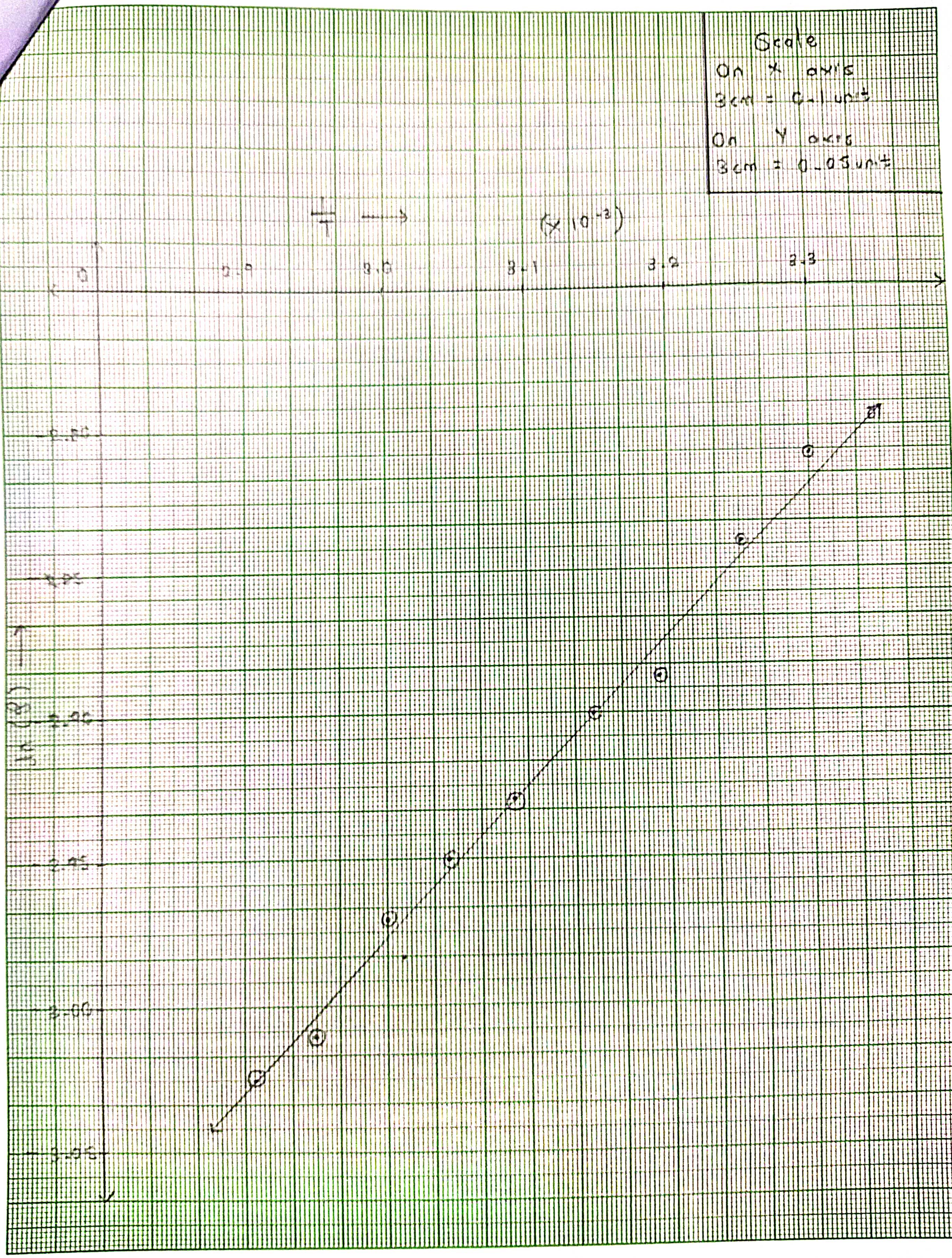
$$\text{Band gap } (E_g) = K \times |\text{slope}|$$

$$= 1.38 \times 10^{-23} \times 548$$

$$= 7.56 \times 10^{-21} \text{ J}$$

$$= 0.047 \text{ eV}$$

Result/s and Conclusion/s: Energy band gap of semiconductor (E_g) = 0.047 eV.


Scale
On X axis
3cm = 0.1 unit
On Y axis
3cm = 0.05 unit
1/T →
(X 10^-3)
0
3.0
3.1
3.2
3.3