

Physics II Lab

Course No. : Phy 4242

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Section : 1B

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Experiment No. 2

Name of the Experiment:

Study of Ohm's Law

Objective:

The purpose of this experiment is to introduce us to Ohm's Law. After finishing this experiment, we will be able to understand the importance of Ohm's Law in the electrical circuit.

Theory:

Ohm's law, a cornerstone of electrical physics, states that, ^{at a constant temperature} the flow of current through a conductor is directly proportional to the voltage applied across it and inversely proportional to its resistance. Symbolized by $V = IR$, where V is voltage, I is current and R is resistance, this principle elegantly captures the relationship between these fundamental electrical quantities, providing

a guiding principal for understanding and manipulating electrical circuits.

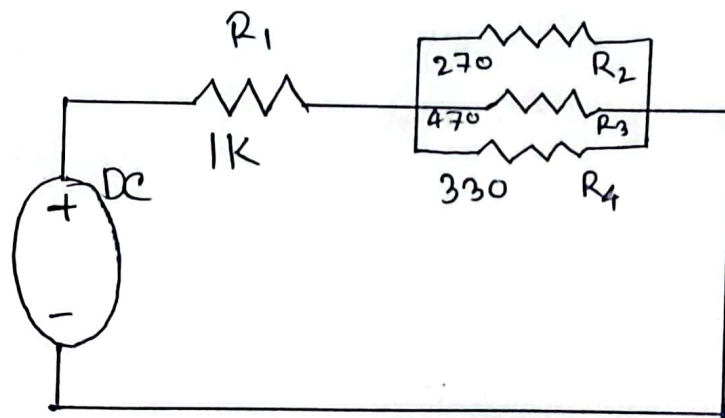
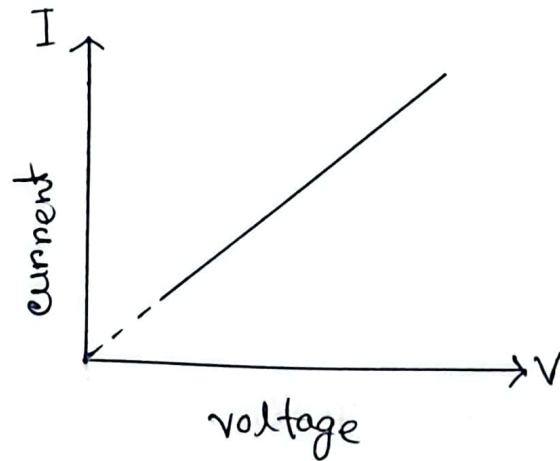


Fig: Circuit Diagram

Used Materials

1. Breadboard
2. Resistor
3. Multimeter
4. Variable Voltage
5. Ammeter
6. Source, wires

Data Table:

No. of Resistors	Measured Resistance (Ω)
R_1	995
R_2	263
R_3	456
R_4	325
R_5	x

Calculation:

Power rating of R_1 , $P = 0.25 \text{ W}$

$$P = I^2 R$$

$$\Rightarrow I = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.25}{995}} = 0.016 \text{ A}$$

$$\text{Now, } V_{\max} = I \times R_{\text{eq}}$$

$$= 0.016 \times \left\{ 995 + (263^{-1} + 456^{-1} + 325^{-1})^{-1} \right\}$$

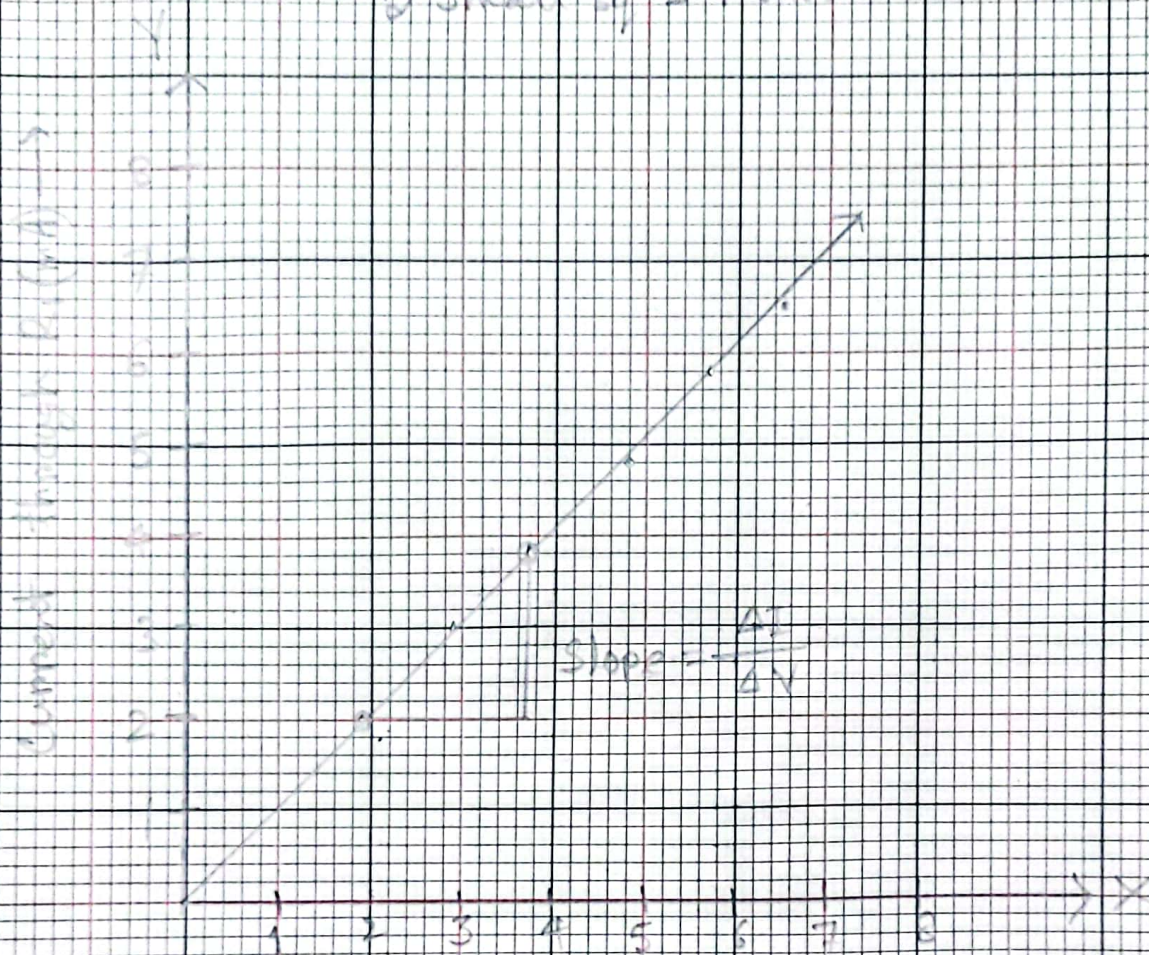
$$= 17.684 \text{ V}$$

Table for Determining Current at Different Voltage

Supply Voltage	Voltage Across R_1 (V)	Current Through R_1 (mA)
0	0	0
2.3	1.97	2
3.46	2.98	3
4.32	3.78	3.8
5.6	4.8	4.8
6.6	5.75	5.8
7.5	6.5	6.5

The points the graph were plotted on a current through R_1 vs voltage across R_1 graph. We took voltage across R_1 along x axis and current across R_1 along y-axis. After plotting the points and joining them, we got a straight line.

Along x and y axis,
5 Small sq = 1 unit



Voltage across R_1 (V) →

Shape of the graph

The shape of the graph is a straight line, that passes through the origin. It is because showing that voltage and current are proportional to each other. So, it supports Ohm's law. ~~The~~

Slope of the graph

The slope of the graph is conductance, G , of the resistor R_1 .

$$G = \frac{\Delta I}{\Delta V}$$

$$\begin{aligned} \text{Using any two points, } G &= \frac{(3.8 - 2) \times 10^{-3}}{(3.78 - 1.97) \times 10^{-2}} \text{ mho} \\ &= 9.945 \times 10^{-4} \text{ mho} \end{aligned}$$

Error Calculation

Using any two points of the graph,

$$\begin{aligned} R &= \frac{\Delta V}{\Delta I} \\ &= \frac{3.78 - 1.97}{(3.8 - 2) \times 10^{-3}} \Omega \\ &= 1005.5 \Omega \end{aligned}$$

Measured resistance = 995Ω

$$\begin{aligned} \therefore \% \text{ of error} &= \frac{|1005.5 - 995|}{995} \times 100\% \\ &= 1.06\% \end{aligned}$$

Discussion

Through this experiment, we got to learn and ^{experience} see Ohm's law first hand. There was a slight error due to factors such as temperature connection loose etc. But the error being little shows that the experiment was accurate. We must be more careful when handling the circuit to get ~~even accurate~~ more correct values.

Question and Answer

Conductance:

Conductance refers to the ease with which electric current flows through a material or component. It is the reciprocal of resistance and measured in siemens (S) or mho. It is denoted by $G = \frac{\Delta I}{\Delta V}$.

Resistance

Resistance is the opposition that a material or component offers to the flow of electric current. It is measured in ohms (Ω) and depends on factors like material type, length, cross-sectional area and temperature. Higher resistance reduces current flow, while lower resistance facilitates it.

Experiment - 2:

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Data sheet for exp-2:

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