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Physics Lab Report 06

Meter Bridge Experiment 2: Verification of Series Combination of Resistances

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Theory

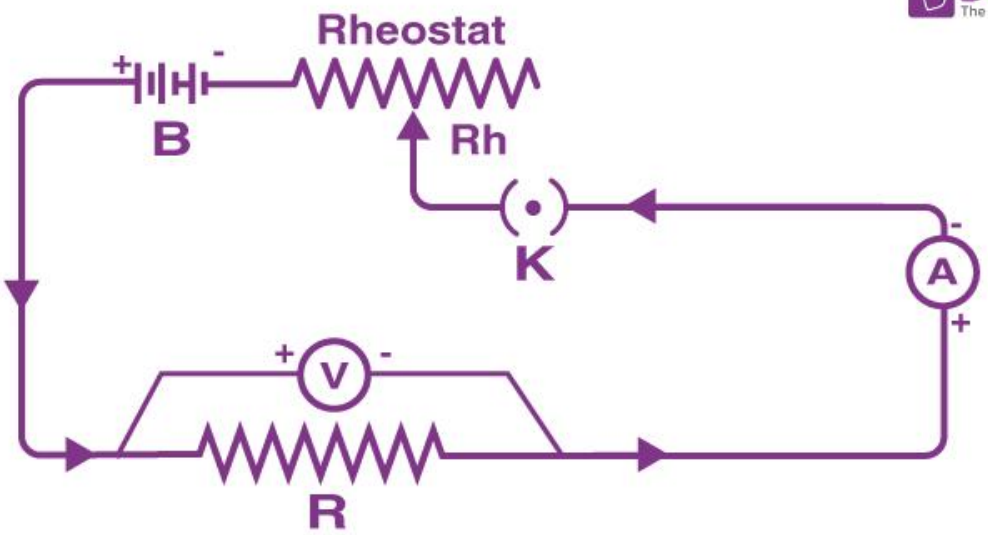
Ohm's law states that, at constant temperature, the current (I) through a conductor is directly proportional to the potential difference (V) across its ends. Mathematically: V = IR, where R is the resistance of the conductor. This means if we plot potential difference (V) along the X-axis and the current current (I) along the Y-axis, the graph will be a straight line. The slope of this line represents the reciprocal of resistance, thereby providing an experimental method to verify the law. Ohm's law forms the basis of electrical circuit analysis and is one of the most fundamental relationships in physics and electrical engineering.

Apparatus

1. DC power supply (battery or eliminator)
2. Rheostat (for varying current)
3. Voltmeter (0–15 V)
4. Ammeter (0–1 A)
5. Key (switch)
6. Connecting wires
7. Resistor (the conductor under test)

Circuit Diagram

A standard Ohm's law circuit was used, consisting of a power supply, key, rheostat, resistor, and ammeter connected in series, with the voltmeter connected across the resistor.

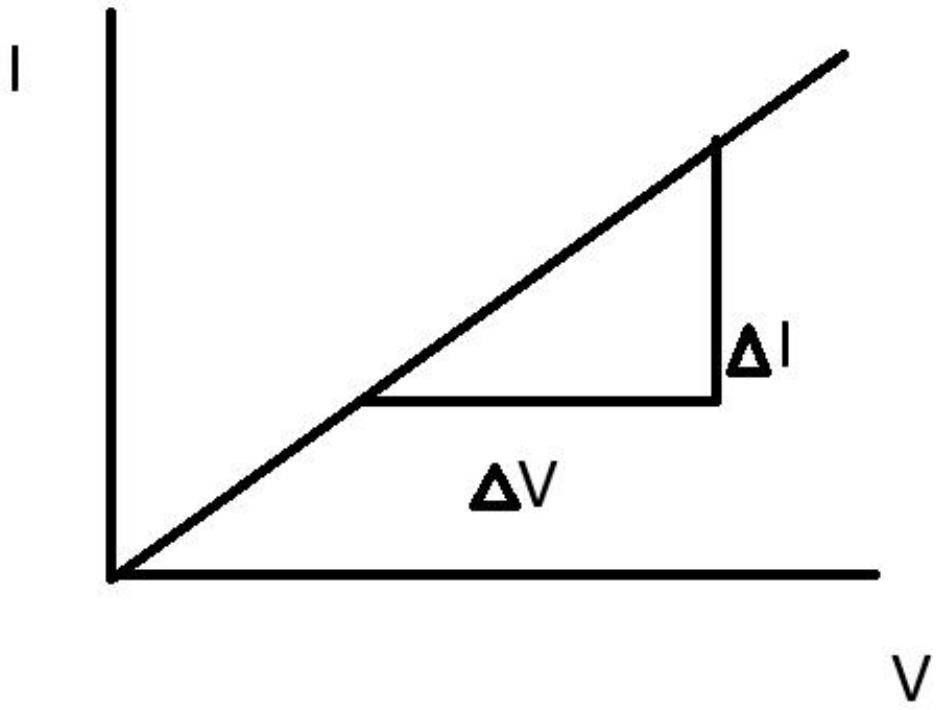


Observation Table

Obs.	Potential difference V (Volts)	Current I (Amperes)	Resistance R = V/I (Ohms)
1	3.2	0.14	22.86
2	5.2	0.2	26.0
3	9.0	0.34	26.47
4	12.2	0.48	25.42
5	13.5	0.52	25.96

Mean resistance = (22.86 + 26.00 + 26.47 + 25.42 + 25.96) / 5
= 25.34 Ω

Gprah: Obtain value of “R” via slope of “I” vs “V”



From the V-I graph, the slope (ΔV/ΔI) gives the resistance, which also approximates to the same value.

Calculation

From the observations, resistance (R) is calculated using the relation R = V/I for each observation. The graph of current (I) versus potential difference (V) is a straight line. The slope of the graph is given by ΔI/ΔV = 0.0378 A/V. Therefore, the resistance from the slope is R = 1/slope = 26.45 Ω.

Error Calculation

The maximum deviation of resistance from the mean is $\Delta R = |26.47 - 25.34| = 1.13\ \Omega$. The percentage error is $(\Delta R / \text{Mean resistance}) \times 100 = (1.13 / 25.34) \times 100 \approx 4.46\%$.

Discussion

The experimental results strongly support Ohm's law as the relationship between potential difference and current was found to be nearly linear, with only minor deviations caused by unavoidable practical limitations. The small variations in resistance values can be attributed to heating effects in the resistor, contact resistance in the wires, and the least count limitations of the ammeter and voltmeter. The resistance value obtained from the slope of the graph (26.45 Ω) is very close to the mean calculated resistance (25.34 Ω), which demonstrates good consistency and accuracy of the experiment. Overall, the experiment provided clear verification of Ohm's law and helped to strengthen the understanding of resistive circuits.