The Proportionality Between Current and Voltage in Ohmic and Non-Ohmic Resistors

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Aim

The aim of this experiment is to test the proportionality between current and voltage in ohmic and non-ohmic resistance.

Preliminary Research

Ohmic resistance is resistance that follows Ohm's law (V = IR) and non-ohmic resistance is resistance that doesn't follow ohm's law. When graphed, the relationship between voltage and current should be linear in Ohmic resistors, where in non-ohmic resistors, the current and voltage are not always linear to each other. Non-ohmic behaviour can include a fluctuation of resistance in certain conditions. Some examples of non-ohmic resistors include the filament lamp, a thermistor and light dependant resistors. A filament lamp's resistance increases the hotter it gets, and this behaviour does not follow Ohm's law. A thermistor's resistance decreases as the temperature increases and a light dependant resistor's decreases as the intensity of light shone on it increases.

Hypothesis

If the voltage across an ohmic resistor increases, the current and voltage will proportionally to each other, while if the voltage across a non-ohmic resistor increases, the current and voltage will not increase proportionally to each other.

Variables

The independent variable is the voltage of the power supply across ohmic and non-ohmic resistors (V).
The dependent variable is the relationship between current and voltage in the resistors.
Controlled variables include:
- The resistance of the wires (Ohms)
- The material of wiring
- How much wiring is used (m)
- The resistance of variable resistor (Ohms)

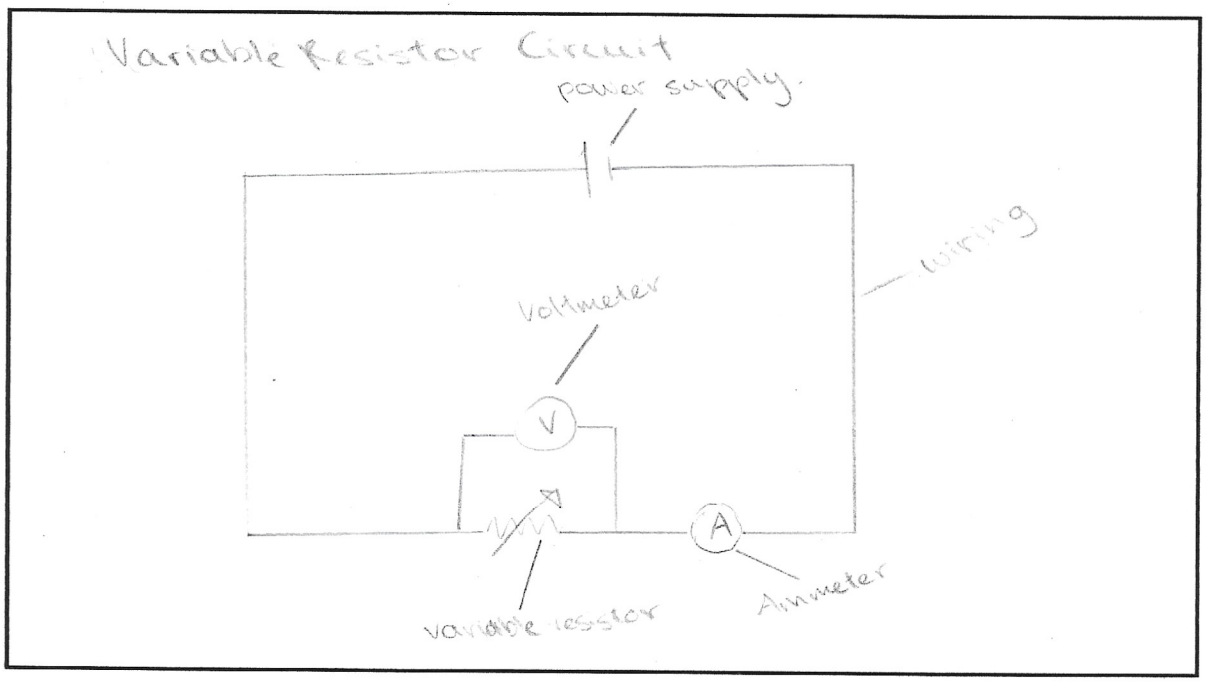
Materials and Equipment

1 filament lightbulb
5 copper wires
1 variable resistor
1 energy pack, which can supply 2V
1 Ammeter
1 Voltmeter

Method

1. Set up the circuit so ammeter, variable resistor and power supply are in series with each other. The variable resistor and voltmeter need to be in parallel with each other.

2. Set the power supply to 2V and the variable resistor's resistance to 10 ohms.
3. Turn on the switch on the energy pack and measure the voltage in V and current in A
4. Repeat steps 2 – 3 for 4 Ohms, 6 Ohms and 8 Ohms.
5. Replace the variable resistor with a filament lightbulb and repeat steps 2 – 4.

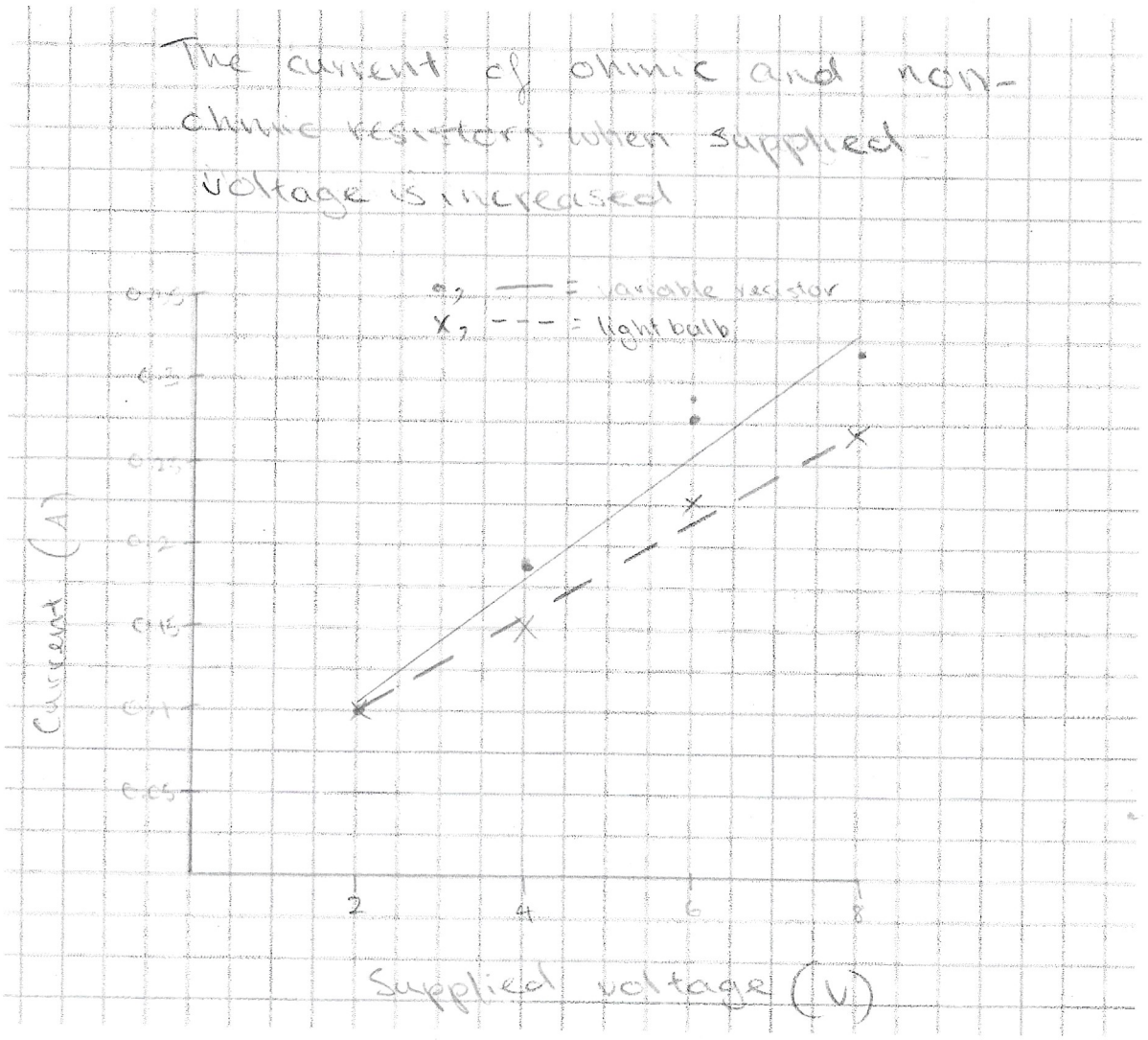


Above: A diagram of the circuit setup

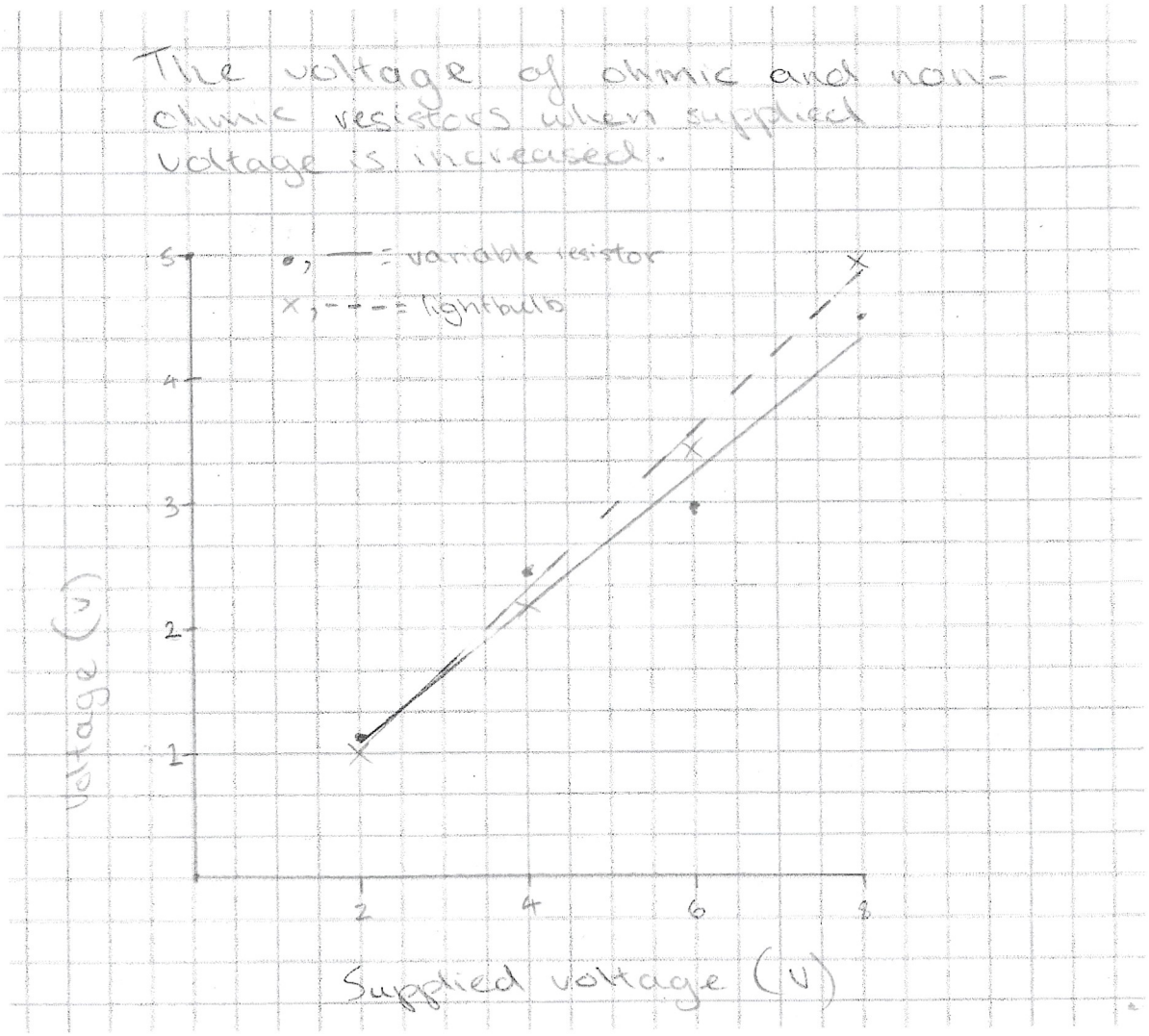
Table of Results

Power Supply (Volts)	Variable resistor (Ohms)	Fixed Resistor Current (Amperes)	Fixed resistor Voltage (V)	Light bulb Current (Amperes)	Light bulb Voltage (V)
2	10	0.10	1.10	0.10	1.00
4	10	0.19	2.04	0.15	2.17
6	10	0.28	2.99	0.20	3.44
8	10	0.32	4.05	0.24	4.95

Graphs



Graph 1



Graph 2

Analysis

The data in graph 1 and graph 2 show that the variable resistor, an ohmic resistor's voltage and current were linear, and that they went in parallel direction. This supports Ohm's law, V = IR as we can see that the current times the resistance is equal to the voltage. However, as displayed in the data, the lightbulb, a non-ohmic resistor's current and voltage were not directly proportional to each other. This does not support Ohm's law. For both resistors, as the volts supplied increased, the current and voltage increased.

Conclusion

In the experiment testing the proportionality between current and voltage in ohmic and non-ohmic resistors, we see that when the volts supplied to the ohmic resistor (variable resistor) was 2V, the current was 0.1A and the voltage was 1.1V. When the volts supplied to the non-ohmic resistor (lightbulb) was 2V, the current was 0.1A and the voltage as 1V. However, when the ohmic resistor's supplied volts increased to 4V and 6V, the current was 0.19A and 0.28A, and the voltage was 2.04A and 2.99A respectively. When the non-ohmic resistor's supplied volts were increased to 4V and 6V, the current was 0.15A and 0.2A, and the voltage was 2.17V and 3.44V. Therefore, the hypothesis

that the current and voltage would be proportional to each other in the variable resistor and the current and voltage would not be proportional in the lightbulb is supported.

Discussion

This data is expected data as the preliminary study sources informed us that ohmic resistors follows Ohm's law while non-ohmic resistors did not. We know that the filament in a filament lightbulb increases its resistance as it heats up, and that the variable resistor's resistance doesn't change unless it is manually increased or decreased. This experiment is not very reliable as results were only recorded once – there was no average to each result. However, this experiment has been repeated by others such as the Florida University, and the results are very similar. This experiment also is only mildly valid, as the scope of experiment is large. The difference between the highest voltage supplied and the lowest supplied voltage is 6, and this isn't a large range. However, this data scope is wide enough that we can still create further hypotheses in regards to the aim and the data. The set of collected data does not include any clear outliers – all the data is uniform on the graph.