**Experiment 3:**

Ohm’s Law

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**Purpose**: The purpose of this experiment is to experiment with the relationship of voltage, current, and resistance. This experiment will observe electrical circuits through various materials.

**Data**:

|  |  |  |  |
| --- | --- | --- | --- |
| Voltage, V | Current , I | 2D | Resistance, R |
| (V) | (A) | **N** | (Ω) |
| 1 | 0.008 | 14 | 122.591944 |
| -1 | -0.008 | **slope** | error |
| 2 | 0.017 | **A/V** | 2.24663688 |
| -2 | -0.017 | 0.008157 |  |
| -3 | -0.02 | **intercept** |  |
| 3 | 0.02 | **a** |  |
| -4 | -0.03 | 0 |  |
| 4 | 0.03 | **R2** |  |
| -5 | -0.04 | 0.995986 |  |
| 5 | 0.04 | **Sy** |  |
| -6 | -0.05 | **(units)** |  |
| 6 | 0.05 | 0.002501 |  |
| -7 | -0.06 | **Sslope** |  |
| 7 | 0.06 | **A/V** |  |
|  |  | 0.000149 |  |
|  |  | **Sintercept** |  |
|  |  | **(a)** |  |
|  |  | 0.000669 |  |

Table : Voltage and current with 2D stats (through a resistor)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Voltage, V | Current , I | 2D | R | P |
| (V) | (A) | **N** | **Ω** | (W) |
| 0.5 | 0.05 | 20 | 10 | 0.025 |
| -0.5 | -0.05 | **slope** | error v | 0.025 |
| 1 | 0.1 | **A/V** | 2.531E-08 | 0.1 |
| -1 | -0.1 | 0.1 |  | 0.1 |
| 1.5 | 0.15 | **intercept** |  | 0.225 |
| -1.5 | -0.15 | **a** |  | 0.225 |
| 2 | 0.2 | 0 |  | 0.4 |
| -2 | -0.2 | **R2** |  | 0.4 |
| 2.5 | 0.25 | 1 |  | 0.625 |
| -2.5 | -0.25 | **Sy** |  | 0.625 |
| 3 | 0.3 | **(units)** |  | 0.9 |
| -3 | -0.3 | 3.51E-09 |  | 0.9 |
| 3.5 | 0.35 | **Sslope** |  | 1.225 |
| -3.5 | -0.35 | **A/V** |  | 1.225 |
| 4 | 0.4 | 2.53E-10 |  | 1.6 |
| -4 | -0.4 | **Sintercept** |  | 1.6 |
| 4.5 | 0.45 | **(a)** |  | 2.025 |
| -4.5 | -0.45 | 7.85E-10 |  | 2.025 |
| 5 | 0.5 |  |  | 2.5 |
| -5 | -0.5 |  |  | 2.5 |

Table : Voltage and current with 2D stats and calculated power (through a lightbulb)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Voltage, V | | Current , I | | 2D |  |
| (V) | (A) | | **N** | | resistance |
| 0.5 | 0 | | 20 | | #DIV/0! |
| -0.5 | 0 | | **slope** | |  |
| 1 | 0 | | **A/V** | |  |
| -1 | 0 | | 0 | |  |
| 1.5 | 0 | | **intercept** | |  |
| -1.5 | 0 | | **a** | |  |
| 2 | 0 | | 0 | |  |
| -2 | 0 | | **R2** | |  |
| 2.5 | 0 | | #DIV/0! | |  |
| -2.5 | 0 | | **Sy** | |  |
| 3 | 0 | | **(units)** | |  |
| -3 | 0 | | 0 | |  |
| 3.5 | 0 | | **Sslope** | |  |
| -3.5 | 0 | | **A/V** | |  |
| 4 | 0 | | 0 | |  |
| -4 | 0 | | **Sintercept** | |  |
| 4.5 | 0 | | **(a)** | |  |
| -4.5 | 0 | | 0 | |  |
| 5 | 0 | |  | |  |
| -5 | 0 | |  | |  |

Table : Voltage and current with 2D stats (through hand, resistance beyond measurement)

|  |  |  |  |
| --- | --- | --- | --- |
| Voltage, V | Current , I | 2D | Resistance, R |
| (V) | (A) | **N** | Ω |
| 0.5 | 0.02 | 20 | 25 |
| -0.5 | -0.02 | **slope** | error |
| 1 | 0.04 | **A/V** | 1.11875E-07 |
| -1 | -0.04 | 0.04 |  |
| 1.5 | 0.06 | **intercept** |  |
| -1.5 | -0.06 | **a** |  |
| 2 | 0.08 | 0 |  |
| -2 | -0.08 | **R2** |  |
| 2.5 | 0.1 | 1 |  |
| -2.5 | -0.1 | **Sy** |  |
| 3 | 0.12 | **(units)** |  |
| -3 | -0.12 | 2.4835E-09 |  |
| 3.5 | 0.14 | **Sslope** |  |
| -3.5 | -0.14 | **A/V** |  |
| 4 | 0.16 | 1.79E-10 |  |
| -4 | -0.16 | **Sintercept** |  |
| 4.5 | 0.18 | **(a)** |  |
| -4.5 | -0.18 | 5.5533E-10 |  |
| 5 | 0.2 |  |  |
| -5 | -0.2 |  |  |

Table : Voltage and current with 2D stats (through pencil)

**Calculations**:

= 2.2466

**Discussion**:

In the experiment I collected data as voltage which was set from the battery and an ammeter to see the amperage. Using ohm’s law and the 2D stats macro, Resistance was calculated through various objects. These objects were a carbon resistor, a lightbulb, a hand, and a pencil. Focusing on the resistor, the simulation listed the resistance as 120 ohms. However, when calculated based on ohms law and the data collected, the resistance was slightly high, at 122.59 +- 2.25 ohms. This fails the precision vs accuracy test and the accepted value is not within error. If I were to repeat or alter the experiment I believe the most important thing to do was to use more precise tools.

**Conclusion & results**: incomp

Resistance of carbon resistor = 122.59 +- 2.25 ohms   
%diff = 2.16%

The resistance of the carbon resistor was calculated to be 122.59 +- 2.25 ohms with a % difference of 2.16%. This value is too high, but only slightly. I would say that the largest sources of error were the lack of precision in the measurements. When the ammeter reaches .01 it no longer is able to display any greater precision and that likely caused some amount of error. As this experiment is in a simulation I imagine that the code used ohms law and is perfect, so the only sources of error are in this. The error was also much lower for the other materials so it could also be caused by the large value.

**Questions**:

1a.) No, the direction of current does not change the resistance, that property has more to do with the material than the direction of the current.

1b.) Resistance increases with power.

1c.) Temperature increases as the power increases.

2.) Yes, the current is passing though the resistor, the fact that it is measurable shows that some current is making it through the circuit. This is possible because it is still a decent conductor.

3.) The current is not passing through the hand, the resistance is far too high. All of the meters say zero so I must believe there is no current moving through them, or if there is any it is negligible. Skin is a poor conductor.