Ohm's Law
Physics Lab #20

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Objective:
The objective of this lab is to determine the relationship between the potential difference across a conductor and the electric current through it. \

Materials:
- Low voltage variable DC power supply\
- Two different resistors
- 2 digital multimeters
- connecting wires

Procedure: Please refer to lab sheet.

Data Collected:

Resistor 2

Voltage (V)	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**
Current (mA ± 0.01mA**)**	0.42	0.72	1.16	1.56	1.91	2.30
Potential Difference (V ± 0.001V**)**	0.526	0.877	1.404	1.893	2.324	2.796

Resistor 7

Voltage (V)	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**
Current (mA ± 0.01mA**)**	0.08	0.18	0.27	0.35	0.45	0.54
Potential Difference (V ± 0.001V**)**	0.466	0.944	1.395	1.843	2.359	2.793

Resistor 2 = 1.202 KΩ
Resistor 7 = 5.07 KΩ

Light Bulb
Before lighting up:

Voltage (V± 0.0001V**)**	0.0069	0.0781	0.5780	0.6560	0.7590
Current (mA± 0.01mA**)**	0.90	10.50	81.30	92.40	109.70

The light bulb lit up at:

Voltage (V± 0.0001V**)**	1.0010
Current (mA± 0.01mA**)**	149.30

After lighting up:

Voltage (V± 0.0001V**)**	1.6090	1.8310	2.116
Current (mA ±	182.30	200.00	223.50

0.01mA)			

Data Analysis:
Calculate the slope of each graph:
Sample Calculation:

Slope of Resistor 2 = $(y_2 - y_1) / (x_2 - x_1)$
$= (2.30\ V - 0.42V\ )/(2.796mA - 0.526mA)$
$= (2.30\ V - 0.42V\ )/(0.002796A - 0.000526A)$
$= 1.88V / 0.00227A$
$= 828\Omega$

Slope of Resistor 7 = 5060Ω

Slope of Cold Resistance of the bulb $= 6.96\Omega$

Resistor	**2**	**7**	**Resistor of bulb**
Slope	0.828 KΩ	5.06 KΩ	6.96Ω

Calculate the percentage error:

Sample calculation: Percentage error of Resistor 2
% error = (Difference in measurements/Average of measurements)* 100%
Difference in measurements = 0.828 KΩ - 1.202 KΩ
= [-0.374 KΩ]
= 0.374 KΩ
Average of measurements = (0.828 KΩ + 1.202 KΩ) / 2
= 1.015 KΩ
Percentage error = (0.374 KΩ / 1.015 KΩ) * 100%
= 37%
Percentage error of Resistor 7 = 0.2%

Discussion:

Ohmic materials are known to maintain a constant resistance regardless of the voltage. This explains why after plotting the graphs of Resistor 2 and Resistor 7 the end results are straight lines. This shows that the potential difference (voltage) and the current are directly proportional therefore maintaining an unchanging slope which represents the resistance. This can also be seen through Ohm's law:

$$\mathbf{V = IR}$$

In order to derive the resistance, the equation must be manipulated to become:

$$\mathbf{R = V/I}$$

This is the same equation used for the slope of the line seeing that it is

$$\mathbf{(y_2 - y_1) / (x_2 - x_1)}$$

the y-axis being the voltage (or potential difference) and the x-axis being the current. Therefore, the current is increased directly proportional to the potential difference as it increases.

The light bulb first appears to obey Ohm's law considering before it lights up, it's resistance is constant. However, after it lights up the slope curves showing its resistivity to be decreasing. This is a characteristic of a nonohmic material. The reason behind this

behavior is that before the light bulb lights up it experiences cold resistivity as there isn't enough atomic movement (which causes heat) to allow the light to shine. After it shines, there is an increasing amount of atomic movement as the current rises allowing the resistivity to increase instead of remaining constant. This is why the slope of the line after the light has been lit is curved.

Sources of Error:

The manual adjustment of the voltage may have caused some error as we may have not adjusted it to the exact values required. If there were a more detailed and precise knob, it could reduce the error. Also, the wire were very rusty therefore acting as very poor conductors. The obvious solution would be to use newer wires.

Conclusion:

The purpose of this lab was to see how the potential difference and the electric current going through a conductor are related. By graphing the results it showed that they were directly proportional. This proved to be correct also for the cold resistivity of the light bulb, however the resistivity of the light bulb after it lit up contradicted Ohm's law as the resistivity did not remain constant.