Lab Report: Ohm's Law

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1 Background

Ohm's Law states that the current (I) flowing through a conductor between two points is directly proportional to the voltage (V) across the two points and inversely proportional to the resistance (R) between them. This relationship is represented by the equation $V = I \cdot R$.

An ohmic conductor (also known as a linear resistor) and a non-ohmic conductor are two types of electrical conductors that exhibit different behaviors concerning Ohm's Law.

An *ohmic conductor* is a material that obeys Ohm's Law, meaning its resistance remains constant regardless of changes in voltage or current. Most metals, like copper and aluminum, at constant temperature and within a certain range of conditions, behave as ohmic conductors.

A *non-ohmic conductor* is a material that does not obey Ohm's Law; its resistance changes with variations in voltage or current. Examples of non-ohmic conductors include semiconductors, diodes, and certain types of resistors like light-dependent resistors (LDRs) and thermistors.

2 Aim

The experiment aims to compare ohmic and non-ohmic behavior of conductors.

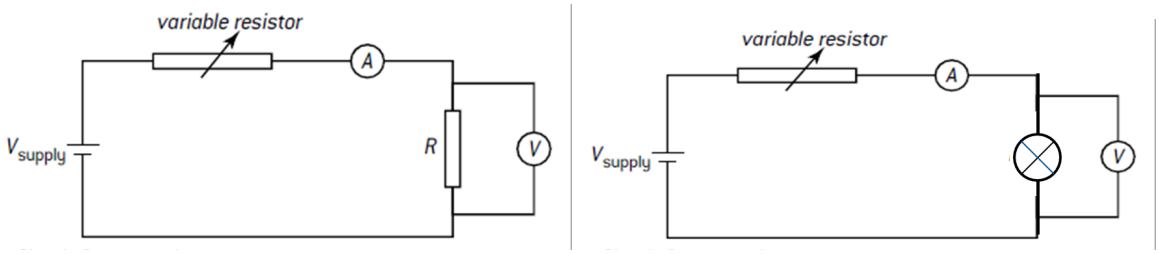
- Compare the I-V graph of fixed resistor with the I-V graph of a small lamp.
- Study how the resistance of filament lamp varies with applied voltage.

3 Materials (Per Pair)

- an ammeter
- a voltmeter

- a switch
- a variable resistor
- a fixed resistor (ohmic conductor)
- a small lamp (non-ohmic conductor)
- connecting wire
- DC power

4 Procedure



(a) Resistor (b) Lamp

1. Connect the current as the figure shows
2. Change the resistance of the variable resistor and observe the change in the potential difference between R (or the lamp) and current

5 Data Collection

Change the resistance of the variable resistor and record 6 different data for V and I for both resistor and lamp.

Tab.1 shows raw data of different V and I of the resistor.

I (A)	V (V)
0.04	0.4
0.08	0.8
0.10	1.0
0.13	1.3
0.15	1.5
0.16	1.7

Table 1: The V and I recorded for resistor.

For the lamp, the relationship between V and I for the lamp is shown in Tab.2.

6 Data Processing

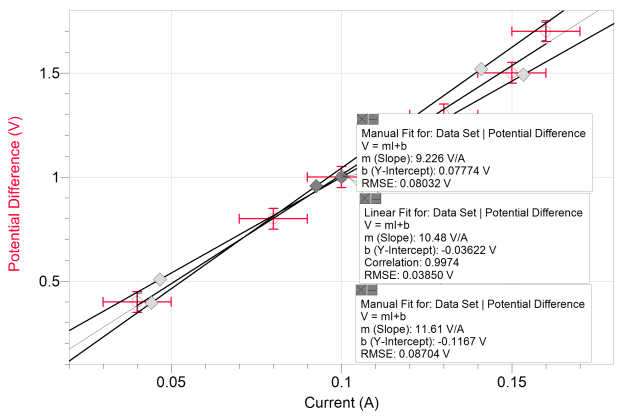
For the ammeter, the minimum scale is 0.02A and the minimum scale of voltmeter is 0.1V. So the measuring error for I is 0.01A and the measuring error for V is 0.05V.

Therefore, the vertical error bar for V should be ± 0.05V and the horizontal error bar for I should be ± 0.01A.

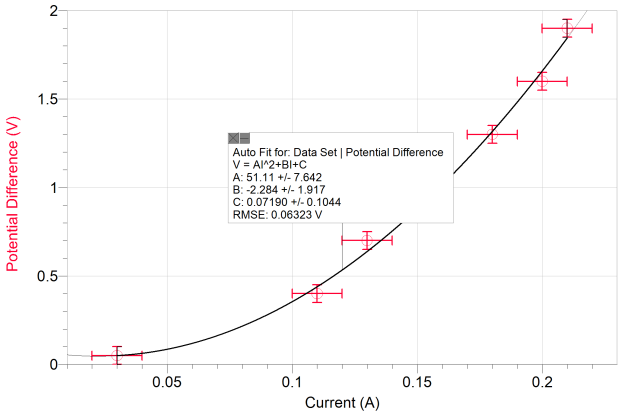
For both the resistor and lamp, the relationship between V and I has been plotted in the figures below.

I (A)	V (V)
0.03	0.05
0.11	0.4
0.13	0.7
0.18	1.3
0.20	1.6
0.21	1.9

Table 2: The I and V recorded for the lamp.



(c) Resistor



(d) Lamp

Figure 1: The plots representing the relationship between V and I, with error bars drawn.

7 Conclusion and Evaluation

According to the plots, it is clear that the resistor is ohmic since the relationship between V and I is approximately linear.

$$R = \frac{U}{I} = \text{the gradient for ohmic conductor}$$

Therefore, $R = (9.22 + 11.61)/2 = 10.42\ \Omega \approx 10\ \Omega$ and the error $= (11.61 - 9.22)/2 \approx 1\ \Omega$. This result $R = (10 \pm 1)\ \Omega$ matches the actual resistance data.

For the non-ohmic conductor, the lamp has changing resistance when V and I changes. This is relevant to the temperature. When current flow and the voltage between the conductor increase, the temperature of the lamp increase and particles inside the conductor isolate more violently, causing the free-moving electrons hard to flow and which caused the increasing in resistance.