Ohm's law

Introduction

When a battery is connected to a circuit consisting of wires and other circuit elements like resistors and capacitors, voltages can develop across those elements and currents can flow through them. In this lab we will investigate three types of circuits: those with only resistors in them and those with resistors and either capacitors (RC circuits) or inductors (RL circuits). We will confirm that there is a linear relationship between current through and potential difference across resistors (Ohm's law: $V = IR$).

Objective of the experiment:

1- Realization of Ohm's law experimentally (finding the linear relation between voltage and current passing through a liner resistance).
2- Measuring the resistance used in the experiment.

Theory:

Ohm's law states that the voltage difference between two sides of resistive metal conductor (Voltage, **V**) is directly proportional to current intensity passing through it (Current, **I**) with fixed temperature. This law considered among most important laws in electricity, and its mathematical formula is:

$$\boldsymbol{I = \frac{V}{R}} \quad \text{or} \quad \boldsymbol{V = IR} \quad \text{or} \quad \boldsymbol{R = \frac{V}{I}}$$

Thus, the ratio V:I is constant, this constant is called as the resistance R used in the experiment. So if (**I**) is measured by Amper and (**V**) is measured by Volte, then (**R**) is measured by Ohm and its symbol is (**Ω**). Ohm's law applicable only on linear resistors. Don't forget that the electrical resistivity is electric property of the material and represents the resistant to the passing electrical current through the material when a voltage difference is applied on its both side. Generally the conductors considered as linear resistances when the temperate is fixed.

Instruments:

- DC power supply.
- Small resistor.
- Voltmeter.
- Ammeter.
- Connection wires.

Methods:

1. Connect the circuit as shown in Figure 1.
2. Make sure the circuit is connected correctly by observing the Ammeter reading.
3. Record number of readings for current (**I**) by changing the voltage each time, as shown in table below:

V (volt)							
I (amp)							

4. Draw the relation between current (**I**) and voltage (**V**) from the reading you recorded, as shown in Figure 2.
5. Find the slope value from the relation :

$$Slope = \frac{\Delta I}{\Delta V}$$

6. Calculate the current value through the relation:

$$R = \frac{1}{\text{Slope}}$$

Which should be equal to the fixed resistant used in the experiment.

Notes:

1- It is better not to leave the circuit close during all the period of readings recording to avoid heating in the resistor which may affect of the reading accuracy.

2- It is preferably to choose voltmeter with very high resistance to ensure there is no current passing through it and the current passing through the resistor is the same current measured with Ammeter.

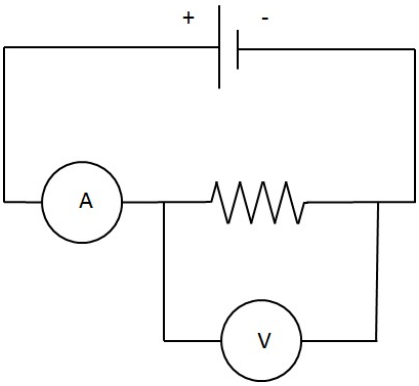

Figure 1. Ohm's law experiment circuit.

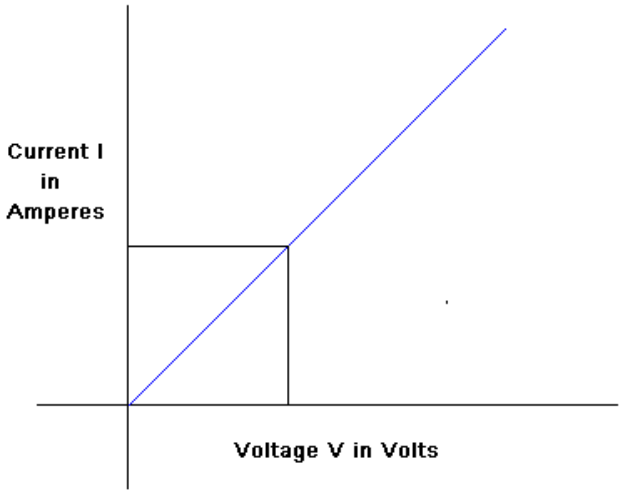

Figure 2. Ohm's law graph, relation between I and V.

Discussion:

Q1) List the most important error sources in the experiment!

Q2) Discuss why the internal resistance of the Ammeter should be very small, where the internal resistance of the Voltmeter should be very high?

Q3) Which is better for realization of Ohm's law, small or large resistor? Why?

Q4) Does the voltage applied on a circuit affected by the circuit resistor?