Ohm's Law

General Physics Laboratory (PHY119)

1-Introduction:

Basic Electrical Concepts:

1- **Current (I):** Is the flow of electrons through a conductor or semiconductor. For current to flow, it requires an unbalance of charges between two points. Current is measured in the units of amperes (A).

2- **Voltage (V):** Is the measure of specific potential energy (potential Energy per unit charge) between two points. Voltage as an expression of potential energy is always
relative between two points. Voltage is measured in the units of volts (V).

3- **Power (P):** it determines how much work a circuit can do. The units of power is watts (W) and it can be calculated using the following expression:

$$P = IV \qquad (1)$$

Electric Circuits:

Electric circuits are composed of individual electronic components, connected by conductive wires. From this definition, we understand that each circuit should have some electronic components and these components should be connected. However, not all connected electronic components form a circuit. There are additional rules that .we will present later in this section

Basic electronic elements

1. **Voltage source:** A voltage source is a device that produces a potential difference across its terminals. An example of a voltage source is the battery which converts
chemical energy into electrical energy.

2. **Resistor**: is an element that opposes the flow of current. The ratio of voltage to current is called resistance, and it has the units of ohms (Ω).

Each electric circuit should:

1. Have a voltage source. Without a voltage source there will be no current.

2. Form a closed loop. Any openings in the circuit will act as a high resistance region preventing the motion of charges.

3. Have a resistor. Resistors helps control the current. Otherwise, a large current will pass through the circuit and damage it.

Electrical Meters

Ammeter: An ammeter measures current. It is always connected in series with the circuit being measured. An ammeter should have a small resistance so the effect of Ammeter on the circuit will be kept to a minimum.

The following SAFETY PRECAUTIONS should be observed when using an ammeter ;

1-Always connect an ammeter in series

2-Always start with the highest range

3- Deenergize and discharge the circuit before connecting or disconnecting an ammeter

4-Never use a dc ammeter to measure ac

5- In dc ammeters, observe the proper polarity

Voltmeter: Voltmeters are used to measure voltage. They are always connected in parallel with the circuit being measured. A voltmeter should have a high resistance compared to the circuit being measured to minimize the loading effect.

The following SAFETY PRECAUTIONS should be observed when using a voltmeter :

1-Always connect a voltmeter in parallel

2-Always start with the highest range

3-Deenergize and discharge the circuit before connecting or disconnecting a voltmeter

4- Never use a dc voltmeter to measure an ac voltage

5- On a dc voltmeter, observe the proper polarity .

Multimeter: A multimeter could be used as an ammeter or a voltmeter. When it is used as an ammeter, it should be connected in series. While it should be connected in parallel when using it as a voltmeter.

THERE ARE TWO TYPES OF MULTIMETER:

1- Digit Multimeter :

2- analoge multimeter :

2 .Objective:

1-To test Ohm's law by plotting V versus I.

3. Theory:

Ohm's Law:

When a constant potential difference, V, is applied to a conducting material, a current density, J, is established that is directly proportional to the electric field, E, created within the material. The constant of proportionality is known as the electrical conductivity (σ), and the relation is known as Ohm's Law:

$$J = \sigma E \qquad (2)$$

The electric field created by the potential difference, establishesa current, I, in the conductor which is directly proportional to the potential difference. By considering the resistance of a given length of material, a more useful and familiar form of Ohm's Law may be derived :

$$\mathbf{V = IR} \qquad (3)$$

Where:

R, is the constant of proportionality which represents the resistance of the conductor with units of ohms (Ω).

I, is the current through the conductor in units of amperes (A).

V, is the potential difference measured across the conductor in units of volts (V)

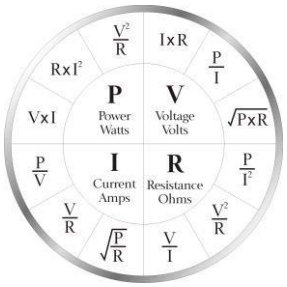


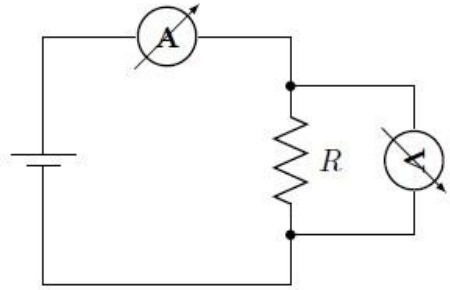
Figure 1: Ohm's law chart

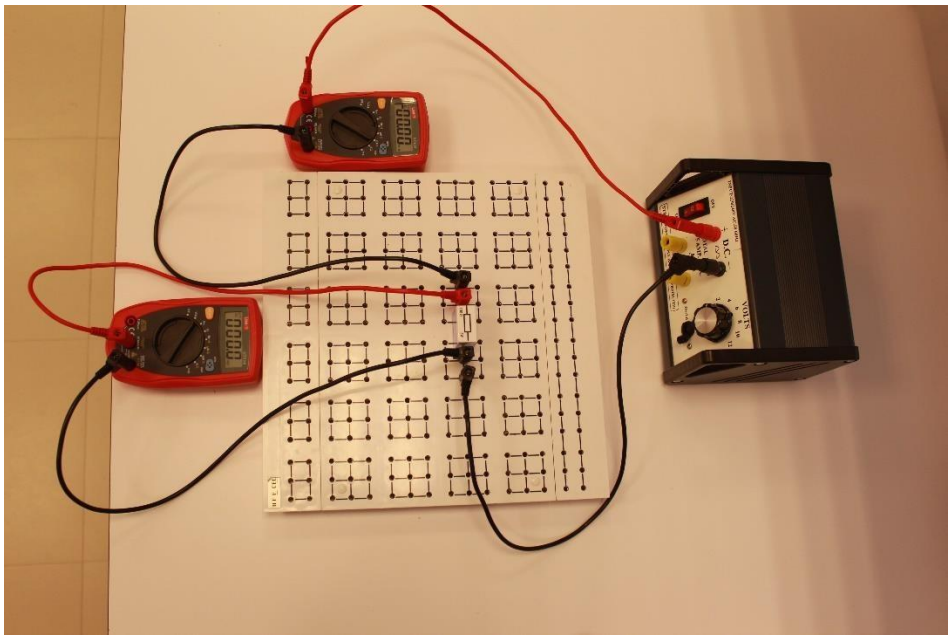
4 .Equipment:

DC power supply – Ammeter – Voltmeter – breadboard - resistors – connecting leads. Instead of using ammeters and voltmeters; digital or analog multimeters could be .used

5. Procedure:

1. Connect the circuit as in the following figure:





2. Calculate the maximum voltage the resistor can withstand from the expression in the chart (see Fig 1), in order not to exceed it,

$Vmax = \sqrt{PR}$

3. Record the real value of the resistance .

4. Turn the power supply on, and then change the voltage V and read the current I from the ammeter. These measurements should be recorded in the following table:

V (……)	I (……..)

5. Use the data table to plot a graph between the current and the voltage .

6. Draw a best fit line to the points on your graph

7. Determine the slope from the best fit line

8. Discuss your result.