

## Experiment No. 3

### Ohm's Laws

#### Objective:

1. Investigate Ohm's law for two carbon resistors.
2. Use this law to determine the equivalent resistance of 2 or more resistors connected in series and parallel.

#### Equipment:

1. Ammeters.
2. Voltmeters.
3. 2 carbon resistors.
4. Power supply 0-15 V.
5. Connecting wires.

#### Theory:

Resistances in circuits are called resistors and are of two types: composite of carbon and wire-wound resistors (wire coil). Their values are given by coded-color system.

The value of the resistance  $R$  (in ohms  $\Omega$ ) is determined from **Ohm's law**, which states that, the **voltage  $V$**  (in volts  $V$ ) between the two ends of the resistor ("across the resistor") is directly proportional to **the current  $I$**  (in amperes  $A$ ) through the resistor such that:

$$V = I \cdot R \quad \text{Eq.(1)}$$

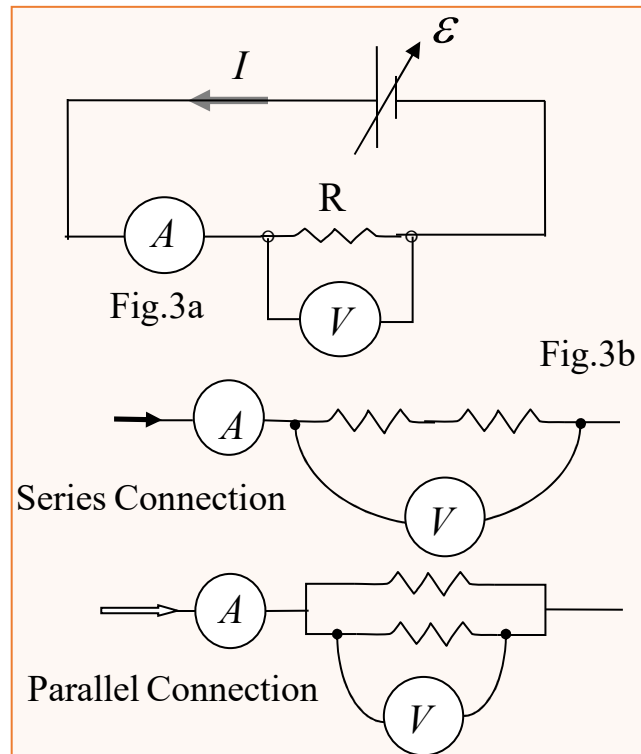
Where  $R$  is the resistance given in  $\Omega = V / A$

Plot of  $V$  vs.  $I$  for resistors gives **straight line relationship whose slope determines the resistance  $R$** . Every ohmic material has a characteristic resistivity  $\rho$  that depends on the properties of the material and on temperature. The resistance  $R$  of a sample depends on geometry (الشكل الهندسي) as

well as on resistivity ( $R = \frac{\rho \cdot l}{A}$ ).

In this lab session. You will be given a carbon resistor of unknown value (its accepted value should be determined from its color band).

Construct the circuit as shown in fig.3a. Using the adjustable power supply, you will vary the voltage between one side of the resistor and the other and thus vary the current. The voltmeter will measure the voltage and an ammeter reads the corresponding value of the current through the resistor.



Resistors could also be connected in a series/parallel circuit like Figure 3b. An equivalent resistor is a single resistor that could replace a more complex circuit and produce the same total current when the same total voltage is applied. For a series circuit, the resistances are additive:

$$R_{eq} = R_1 + R_2 \quad \text{Eq. (2)}$$

where  $R_{eq}$  is the equivalent resistance. For a parallel circuit, the resistances add as reciprocals

$$1/R_{eq} = 1/R_1 + 1/R_2 \quad \text{Eq. (3)}$$

A more complex circuit like Figure 3b can be handled by noting that  $R_1$  and  $R_2$  are in parallel and can be reduced to an equivalent resistance using Equation 3. That equivalent resistance is then in series with  $R_3$  and can be treated using Equation 2 to find the equivalent resistance of the entire series/parallel circuit.

Tabulate your values for  $R_1$ ,  $R_2$ ,  $R_s$ , and  $R_p$ . Where  $R_s$ , and  $R_p$  are the resistances when the two resistors are connected in series and parallel.

Plot V vs. I for each case and determine the slope S.

**Determination of the value of R from its color codes.**

Color Codes		Tolerance	
Black	0	Brown	1%
Brown	1	Gold	5%
Red	2	Silver	10%
Orange	3	<i>To determine the value of the resistance for the color band see the example in the table below</i>	
Yellow	4		
Green	5		
Blue	6		
Violet	7		
Grey	8		
White	9		

$$R = ab \times 10^c$$

$$R = 47 \times 10^3$$

$$= 47000 = 47k\Omega$$

yellow = a

violet = b

Tolerance = Gold = 5%

orange = c

## Experiment No. 3

### Ohm's Laws

Name: ..... Day and Date: .....

Student's No.: .....Sec: .....

Partners Names: .....

#### Data and Calculation:

R <sub>1</sub> (        )Ω		R <sub>2</sub> (        )Ω		R <sub>s</sub> (        )Ω		R <sub>p</sub> (        )Ω	
V(volt)	I (A)	V(volt)	I(A)	V(volt)	I (A)	V(volt)	I(A)
<b>R<sub>1</sub>= S<sub>1</sub>=</b>		<b>R<sub>2</sub>=S<sub>2</sub>=</b>		<b>R<sub>s</sub>=S<sub>s</sub></b>		<b>R<sub>p</sub>=S<sub>p</sub>=</b>	

**Q1.** Plot V (in volts) vs. I (in Amp.) on the same page below for each resistance and find the slope. Find the slope for each case which represents the resistance.

**Q2.** Find the percentage error in each resistance?

**Q3.** Show from your results (from the calculated the slopes) that  $R_s = R_1 + R_2$  and

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad (\text{for example: } S_s = S_1+S_2).$$

