Determination of Resistance of Resistors in Series and in Parallel in Simple Circuit

1. Introduction

You know that every material offers some resistance to the flow of current. If we have two or more resistances in an electrical circuit, can we find out the equivalent of these resistances? Theoretically, you must have learnt answer to this question in your school physics course. In this experiment, you will verify the law of combination of resistances. Let us discuss the theory used in this experiment briefly.

2. Theory

Consider an electrical conductor. Let V is the voltage and I is the current flowing through the conductor. Then the ratio of V and I is equal to a quantity which is a measure of the resistance offered by the conductor to the flow of charge. There is a relationship between these parameters V, I and R which is known as Ohm's law. Simple circuits can be used to demonstrate Ohm's law. This law states that

$$\frac{V}{I} = R \qquad (1)$$

where R is the resistance. Resistors can be connected in two ways. The resistance R can be net resistance of two or more resistors which are either in series, (that is connected end to end) or in parallel (that is connected to the same two points) as shown in Fig. 6.1(a) and Fig. 6.1(b) respectively.

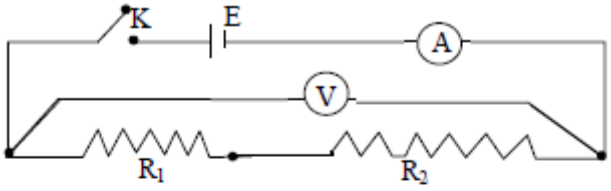

Fig. 1 (a) Resistors in Series

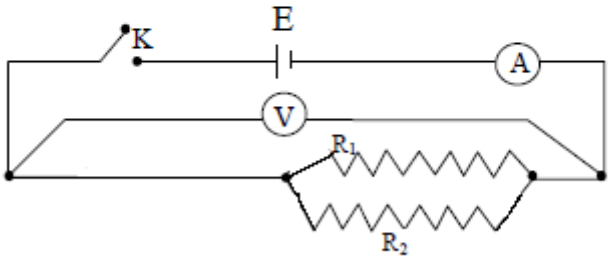

Fig. 1 (b) Resistors in Parallel

If there are two or more than two resistors in any given circuit, it is always possible to replace a combination of resistors with a single resistor and leave unchanged the potential differences between the terminals of combination and current in the rest of the circuit. This single resistance is called the *equivalent resistance*. In this experiment, two resistors R_1 and R_2 will be used. They will be joined in series and in parallel while the potential V and the current I will be varied. If the resistors are connected in series (as shown in Fig. 1.a), then the equivalent resistance of R_1 and R_2 is given by the relation

$$R_S = R_1 + R_2 \qquad (2)$$

The equivalent resistance of R_1 and R_2 connected in parallel (as shown in Fig. 1.b) is given by the relation

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_P} = \frac{R_1 + R_2}{R_1 R_2}$$

$$R_P = \frac{R_1 R_2}{R_1 + R_2} \qquad (3)$$

3. AIMS AND OBJECTIVES

Aims of this experiment are to:

- practically verify the law of combination of resistances in series;
- practically verify the law of combination of resistances in parallel;
- apply Ohm's law by means of drawing appropriate graph to obtain values of net resistances in a simple circuit.

4. Procedure

1. Identify all apparatus.
2. Connect the circuit as shown in Fig. 3. with R_1 and R_2 in series.
3. Make all connections tight.
4. Adjust the Rheostat (R_h) and obtain a series of six readings of current I_1 and voltage V_1 from the Ammeter and Voltmeter respectively.
5. Now connect R_1 and R_2 in parallel.
6. Repeat the steps 3 and 4 to obtain six new sets of values of current I_1 and voltage V_1.
7. Record the readings for both cases in Table 1.

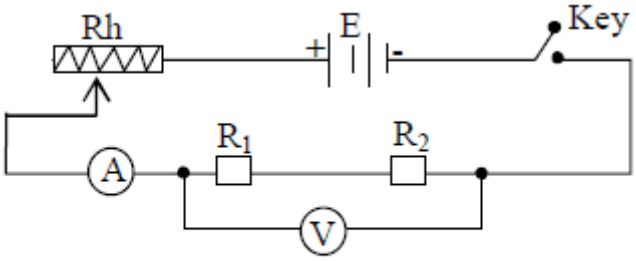

Fig. 3

4.1 Data Analysis

Table 1.: The values of current and voltages

S.No.	When resistance R_1 and R_2 in Series		When resistance R_1 and R_2 in Parallel	
	V_1	I_1	V_2	I_2
1.				
2.				
3.				
4.				
5.				
6.				

- Plot a graph of V_1 versus I_1 using the data set collected in the Table 1, when resistors are in series.
- Similarly a second graph can be plotted between V_2 versus I_2 using the data set collected in Table 1 when the resistors are in parallel.
- From these graphs, obtain the slopes S_1 and S_2.
- These slopes give the values of resistances in series and in parallel according to:

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

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

4.2 RESULT

- The value of resistance in series combination is……..
- The value of resistance in parallel combination is ……

5. CONCLUSION

a) What do the slopes S_1 and S_2 represent?
b) Compare the slopes S_1 and S_2 with the values of R obtained using Eqs. 2 and 3 respectively.
c) What are the accuracies of the values of the resistors for the two circuits obtained?
d) What conclusions can you draw from this experiment?