Electric Circuits II

Experiment 4: Resistances in Circuits

Equipment needed:

- AC/DC Electronic Lab Board: Resistors
- Multimeter

Purpose The purpose of this lab is to begin experimenting with the variables that contribute to the operation of an electrical circuit. This is the first of a three connected lab.

Procedure

1. Choose three resistors of different value. Enter those set of colors in Table 4.1 below. We will refer to one as #1, another as #2, and the third as #3.
2. Determine the coded value of your resistors. Enter the value in the column labeled "Coded Resistance" in Table 4.1. Enter the tolerance value as indicated by the color of the fourth band under "Tolerance".
3. Use the Multimeter to measure the resistance of each of your three resistors. Enter these values in Table 4.1.
4. Determine the percentage experimental error of each resistance value and enter it in the appropriate column.

Experimental Error = [(|Measure – Coded|)/Coded] x 100%

	Colors 1^{st} 2^{nd} 3^{rd} 4^{th}	Coded Resistance	Measured Resistance
#1			
#2			
#3			

5. Connect the three resistors into the SERIES CIRCUIT.

Series

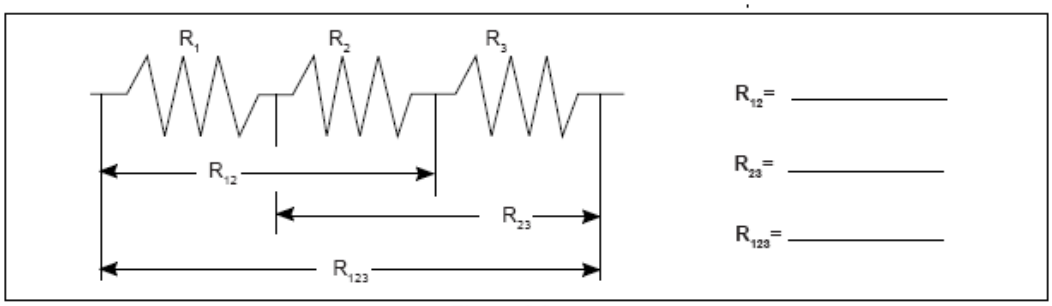


Figure 4.1

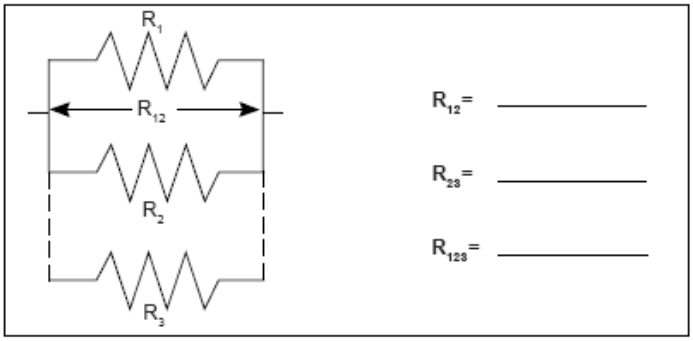
	Measured	Calculated	% Error
R_{12}			
R_{23}			
R_{123}			

6. Construct a PARALLEL CIRCUIT, first using combinations of two of the resistors, and then using all three. Measure and record the values for these resistors.

Parallel

➤ **NOTE:** Include also R_{13} by replacing R_2 with R_3.

⑦ Connect the COMBINATION CIRCUIT below and measure the various combinations of resistance. Do these follow the rules as you discovered them before?



	Measured	Calculated	% Error
R_{12}			
R_{23}			
R_{123}			

Discussion

1. How does the % error compare to the coded tolerance for your resistors?

2. What is the apparent rule for combining unequal resistances in series circuits? In parallel circuits? Cite evidence from your data to support your conclusions.

Experiment 5: Voltages in Circuits

Purpose The purpose of this lab is to continue experimenting with the variables that contribute to the operation of an electrical circuit. You should have completed experiment #4 before working on this lab.

Procedure

1. Connect the three resistors you use in experiment #4 into the series circuit shown below, using the springs to hold the lead resistors together without bending them. Connect to wires to the D-Cell, carefully noting which wire connected to the negative and which is connected to the positive.
2. Now use the voltage function on the Multimeter to measure the voltage across the individual resistors and then across the combinations of resistors.

Series

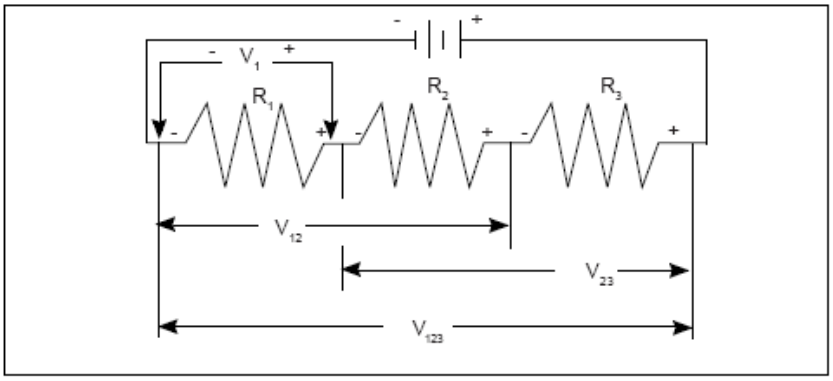


Figure 5.1

R_1 = _____ V_1 = _____

R_2 = _____ V_2 = _____

R_3 = _____ V_3 = _____

R_{12} = _____ V_{12} = _____

R_{23} = _____ V_{23} = _____

R_{123} = _____ V_{123} = _____

	Measured	Calculated	% Error
V_{12}			
V_{23}			
V_{123}			

3. Now connect the parallel circuit below, *using all three resistors*. Measure the voltage across each of the resistors and the combination, taking care with the polarity as before.

> ➤ **NOTE:** Keep all three resistors connected throughout the time you are making your measurements. Write down your values as indicated below.

Parallel

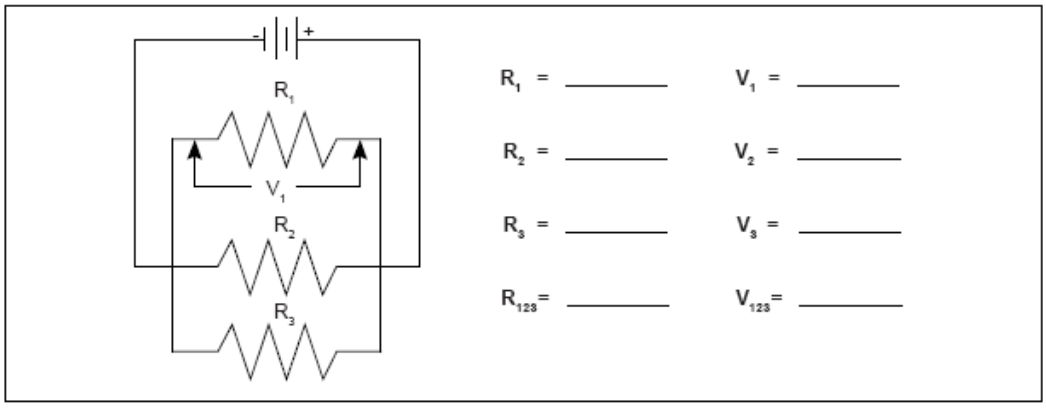


Figure 5.2

	Measured
V_1	
V_2	
V_3	
V_{123}	

Discussion

On the basis of the data you recorded on the table with Figure 5.1, what is the pattern for how voltage gets distributed in a series circuit? Is there any relationship between the size of the resistance and the size of the resulting voltage?

Utilizing the data from Figure 5.2, what is the pattern for how voltage distributes itself in a parallel circuit? Is there any relationship between the size of the resistance and the size of the resulting voltage?

Experiment #6: Currents in Circuits

Purpose The purpose of this lab is to continue experimenting with the variables that contribute to the operation of an electrical circuit.

Procedure

1. Connect the three resistors you use in experiment #4 and experiment #5 into the series circuit shown below, using the springs to hold the lead resistors together without bending them. Connect to wires to the D-Cell, carefully noting which wire connected to the negative and which is connected to the positive.
2. Now change the leads in your DDM so that they can be used to measure current. You should be using a scale which goes to a maximum of 200mA. Be careful to observe the polarity of the leads (red is +, black is -). **In order to measure current, the circuit must be interrupted, and the current allowed to flow through the meter**. Disconnect the lead wire from the positive terminal of the battery and connect to the red (+) lead of the meter. Connect the black (-) lead to R_1, where the wire was originally connected. Record your reading in the table as I_0.
3. Now move the DDM to the positions indicated in Figure 6.3 each time interrupting the circuit, and carefully measuring the current in each one. Complete the table.

NOTE: You will be carrying the values from experiment #4 and experiment #5 into the table.

Series

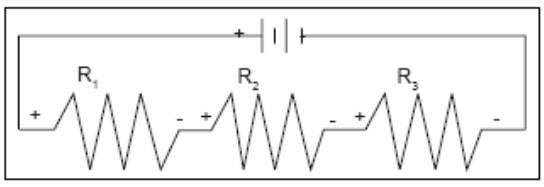


Figure 6.1

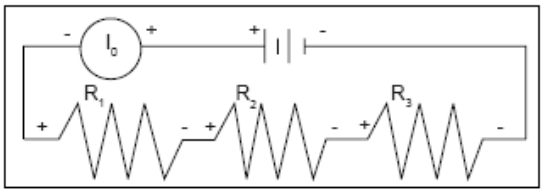


Figure 6.2

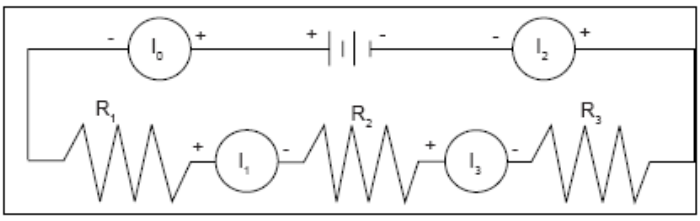


Figure 6.3

R_1 =_____ I_0 =_____ V_1 =_____

R_2 =_____ I_1 =_____ V_2 =_____

R_3 =_____ I_2 =_____ V_3 =_____

R_{12} =_____ I_3 =_____ V_{12} =_____

R_{23} =_____ V_{23} =_____

R_{123} =_____ V_{123} =_____

	Measured
I_0	
I_1	
I_2	
I_3	

④ Connect the parallel circuit below, using all three resistors. Review the instructions for connecting the DMM as an ammeter in step 2. Connect it first between the positive terminal of the battery and the parallel circuit junction to measure $\mathbf{I_0}$. Then interrupt the various branches of the parallel circuit and measure the individual branch currents. Record your measurements in the table below.

Parallel

R_1 = _____ I_0 = _____ V_1 = _____

R_2 = _____ I_1 = _____ V_2 = _____

R_3 = _____ I_2 = _____ V_3 = _____

R_{123} = _____ I_3 = _____ V_{123} = _____

I_4 = _____

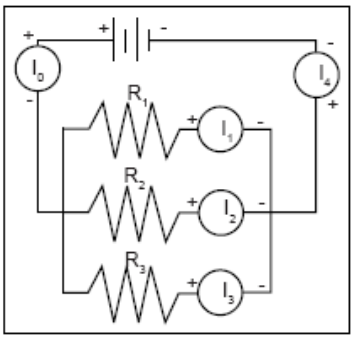


Figure 6.4

	Measured	Calculated	% Error
I_0			
I_4			

Discussion

On the basis of your first set of data, what is the pattern for how current behaves in a series circuit? At this point you should be able to summarize the behavior of all three quantities - resistance, voltage and current - in series circuits.

On the basis of your second set of data, are there any patterns to the way that currents behave in a parallel circuit? At this time you should be able to write the general characteristics of currents, voltages and resistances in parallel circuits.