9-1F Resistors in Series and Parallel

SkillCheck

- Observing
- Measuring
- Explaining systems
- Evaluating information

Resistors slow down the flow of charge and change electrical energy into other forms of energy. By connecting resistors in different configurations, you can control both current and energy in the circuit. In this investigation, you will build both series and parallel circuits involving resistors. By measuring the current and voltage, you can use Ohm's law to calculate resistance.

Question

How does the total resistance of a circuit change when resistors are connected in series and in parallel?

Safety

- If any components become hot, open the switch immediately.
- If a power supply is being used instead of batteries, be sure to turn off the power supply while constructing the circuit.

Materials

- 6.0 V lantern battery or power supply
- 3 resistors of different sizes (100 Ω–1000 Ω)
- ammeter
- voltmeter
- switch
- connecting wires

Science Skills

Go to Science Skill 11 to learn more about how to use an ammeter and a voltmeter.

Procedure

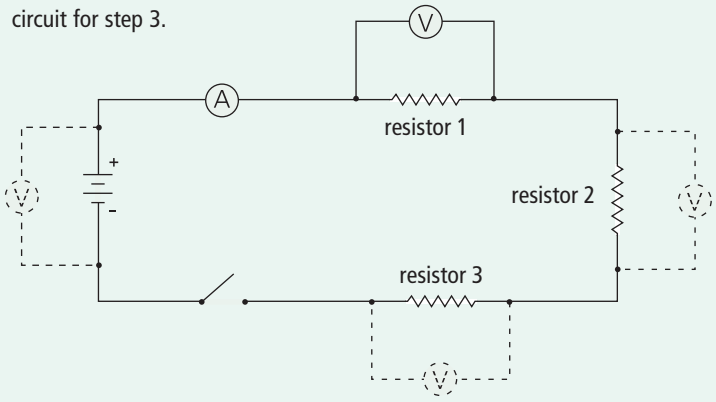
Part 1 Resistors in Series

1. Copy the following data table in your notebook. Give your table a title.

Resistance (Ω)	Voltage (V)	Current (A)
Resistor 1 =	Voltage across resistor 1 =	Total current leaving the battery =
Resistor 2 =	Voltage across resistor 2 =	
Resistor 3 =	Voltage across resistor 3 =	
	Voltage across battery =	

2. Using the resistor colour code, determine the resistance of each resistor. Record these values in your data table.
3. Construct the circuit shown in the diagram.

Construct this circuit for step 3.



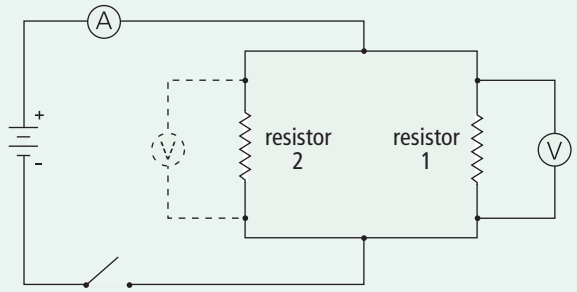
4. Close the switch, and measure the current through the ammeter. Record this current in your data table. If your ammeter is measuring milliamperes (mA), be sure to convert this to amperes (A).
5. Measure the voltage across resistor 1. Record this in your data table.
6. Move your voltmeter, and measure the voltage across the remaining resistors and the battery. Record each measurement in your data table.
7. Open the switch, and disassemble your circuit.

Part 2 Resistors in Parallel

8. Copy the following data table in your notebook. Give your table a title.

Resistance (Ω)	Voltage (V)	Current (A)
Resistor 1 =	Voltage across resistor 1 =	Total current leaving the battery =
Resistor 2 =	Voltage across resistor 2 =	
	Voltage across battery =	

9. Using the resistor colour code, determine the resistance of any two of your three resistors. Record these values in your data table.
10. Construct the circuit shown in the diagram below, using the two resistors you have recorded.



Construct this circuit for step 10.

11. Close the switch, and measure the current through the ammeter. Record this current in your data table.
12. Measure the voltage across resistor 1. Record this in your data table.
13. Move your voltmeter, and measure the voltage across resistor 2 and the battery. Record each measurement in your data table.
14. After you have taken all measurements, open the switch.
15. Clean up and put away the equipment you have used.

Analyze

Part 1

1. Use Ohm's law ($R = \frac{V}{I}$) to calculate the total resistance of your series circuit. (Use the battery voltage and the current leaving the battery.)
2. Compare the total resistance calculated in question 1 to the individual resistors used in the circuit. Is the total resistance greater than or less than the individual resistors?
3. Compare the voltage across each resistor. Does each resistor lose the same amount of voltage?
4. Add the voltages on each of the three resistors. Compare the total voltage lost on the three resistors to the battery voltage.

Part 2

5. Use Ohm's law to calculate the total resistance of your parallel circuit. (Use the battery voltage and the current leaving the battery.)
6. Compare the total resistance calculated in question 5 to the individual resistors used in the circuit. Is the total resistance greater than or less than the individual resistors?
7. Compare the voltage across each resistor. Does each resistor lose the same amount of voltage?

Conclude and Apply

1. Write a short paragraph that states the relationships of the following terms in a series circuit: total resistance, individual resistors, total voltage, voltage across each resistor.
2. Write a short paragraph that states the relationships of the following terms in a parallel circuit: total resistance, individual resistors, total voltage, and voltage across each resistor.