Parallel Circuits Lab - Guided

PSI Physics

Name:_____

Date:_____ Period:_____

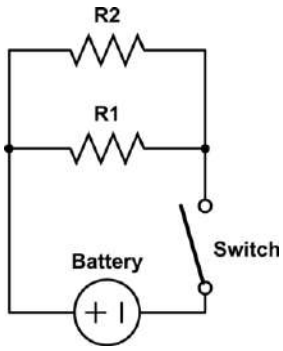
Purpose

Students will investigate the relationships between current, voltage, and resistance in both series and parallel circuits.

When resistors are connected in parallel in a circuit, each resistor provides a different path for the electrons to flow, therefore, reduces the total resistance on the current. The total resistance can be found mathematically by applying the equation: $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$

Materials

- Battery
- Connecting wires
- Two resistors
- Switch
- Ammeter
- Voltmeter



Procedure

1. Arrange two resistors in parallel in the base circuit seen to the right. You will not be changing the locations of the battery or resisters, but you will be adding and moving the ammeter and voltmeter around the circuit.

Figure 1

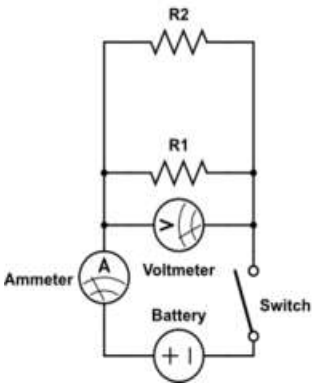


Figure 2

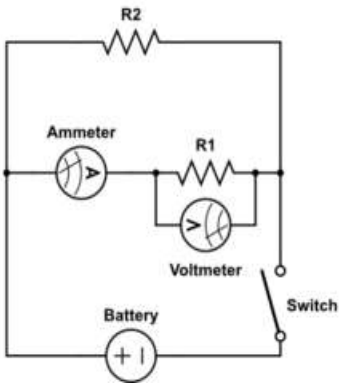
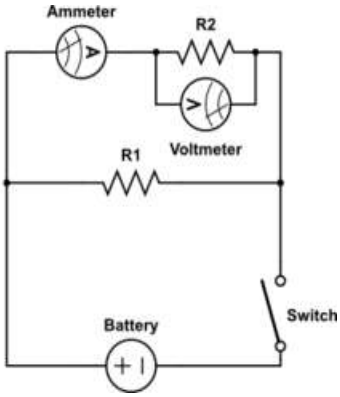


Figure 3



1. Arrange two resistors in parallel with each other with the ammeter in series before the junction point a and the voltmeter across the two junction points as seen in Figure 1.
    - Record the Current as I_T and the Voltage as V_T on the data table. This is the current leaving the battery and the voltage across the resistors.
2. Rearrange the ammeter and voltmeter as shown in Figure 2.
    - Record the Current as I_1 and the Voltage as V_1 on the data table. This is the current flowing through the first resistor (R_1) and the voltage across R_1.
3. Rearrange the ammeter and voltmeter as shown in Figure 3.
    - Record the Current as I_2 and the Voltage as V_2 on the data table. This is the flowing through the second resistor (R_2) and the voltage across R_2.

Parallel Circuit Data Table

Trial 1	
I_T	V_T

Trial 2	
I_1	V_1

Trial 3	
I_2	V_2

Analysis

Use Ohm's Law to calculate the resistance for the entire circuit ($R_{equivalent}$) and for each resister.

Figure 1
$\mathbf{R_{equivalent}} = \frac{V}{I}$

Figure 2
$R_1 = \frac{V_1}{I_1}$

Figure 3
$\mathbf{R_2} = \frac{V_2}{I_2}$

Use the information in the Data Collection and Analysis Tables to answer the following questions:

1. How is the battery voltage, V_T, related to the other two voltage drops, V_1 and V_2? Write an equation that describes the relationship.

2. How is the current through the battery, I_T, related to the other two currents, I_1 and I_2? Write an equation that describes the relationship.

3. Which of the resistances R_1, R_2, and $R_{equivalent}$ is smallest?

4. The equivalent resistance, $R_{equivalent}$, for resistances in parallel is:

$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

   a. Using the values of R_1 and R_2 in your analysis table, calculate $R_{equivalent}$. How does this compare with the value you got from dividing V by I in the Analysis Table?

   b. Is there a way to make $R_{equivalent}$ bigger than R_1 or R_2? If not, why not? Or if so, how?

5. A 9V battery is connected to two resistors in parallel (R_1 = 10 Ω and R_2 = 15 Ω).
   a. What is the equivalent resistance, $R_{equivalent}$, for the circuit?

   b. What is the current, I, through the circuit? (use V = IR)

   c. What is the voltage drop, V_1, across resistor R_1? (use V = IR)

6. If you add a third resistor in parallel with the other two…
   a. Will $R_{equivalent}$, increase, decrease or stay the same? Why?

   b. Does the current, I, increase, decrease or stay the same? Why?

   c. Does the voltage drop, V_1, across R_1 increase, decrease or stay the same? Why?