Series 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 a series circuit, the current must flow through each resistor. Therefore, the total resistance of a series circuit is the sum of the resistances of the individual resistors in the circuit: $R_T = R_1 + R_2 + \cdots$

Materials

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

Procedure

1. Arrange two resistors in series 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.

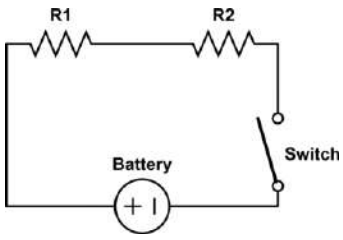


Figure 1

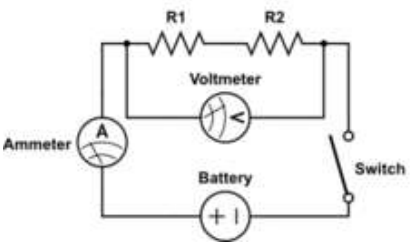


Figure 2

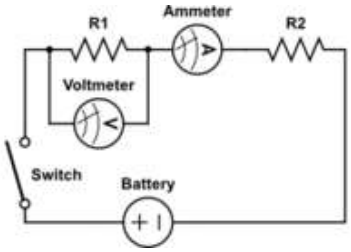
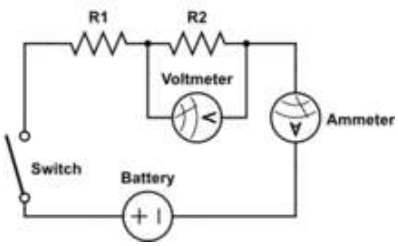


Figure 3



2. Arrange two resistors in series with each other with the ammeter in series before the resistors and the voltmeter across both resistors as seen in Figure 1.
    - Record the current I_T and the voltage V_T on the data table. This is the current leaving the battery and the voltage across the resistors.
3. 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 left after the first resistor (R_1) and the voltage across R_1.
4. 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 current left after the second resistor (R_2) and the voltage across R_2.

Series Circuits Data Table

Figure 1	
I_T	V_T

Figure 2	
I_1	V_1

Figure 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 total current, I_T, related to the other two currents, I_1 and I_2? Write an equation that describes the relationship.

2. 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.

3. How is the equivalent resistance, $R_{equivalent}$, related to the two resistances, R_1 and R_2? Write an equation that describes the relationship.

4. A 9V battery is connected to two resistors in series (R_1 = 12 Ω and R_2 = 33 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)

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

   b. Write the equation for $R_{equivalent}$ for three resistances (R_1, R_2, and R_3) in series.

   c. Does V, the voltage drop across all the resistors, increase, decrease or stay the same? Why?

   d. Does I, the current through the circuit, , increase, decrease or stay the same? Why?

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