

AP Physics C – Kirchhoff's Laws lab

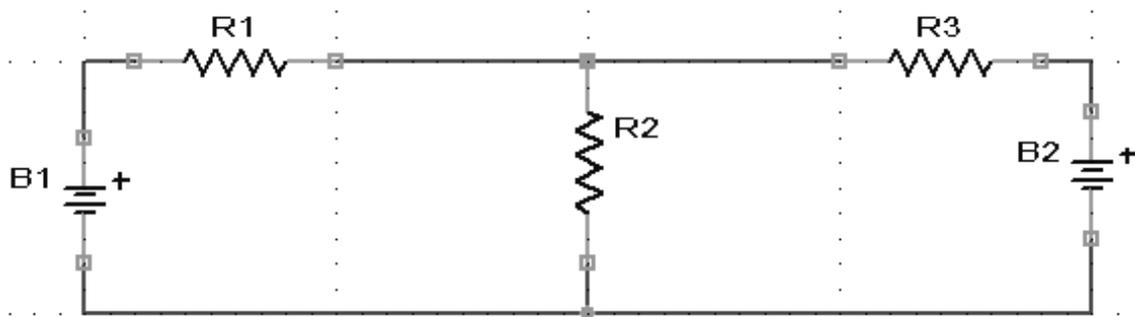
Purpose: To use Kirchhoff's laws to calculate the voltage and current drop across several resistors attached to TWO DC sources, by which the values are then verified experimentally

Materials: circuit board, alligator clip wires, variable DC power supply, 3 resistors, Digital multimeter

Background:

$$KVL \rightarrow V_{source} - V_1 - V_2 \dots V_n = 0$$

$$KCL \rightarrow I_{IN} = I_{OUT}$$



| B1 | B2 | R1 | R2 | R3 |
|-------|------|----------|----------|----------|
| 1.5 V | 9.0V | Ω | Ω | Ω |

Using the circuit board with ONE 1.5 V battery, various alligator clip wires, and the Power Supply set to 9V build the circuit above. Make sure you have WIRES in between each element to that the current can be easily measured.

On the figure above, DRAW and LABEL the CURRENT (Example: I_1, I_2, \dots) as it moves through each resistor

As you can see in the schematic above there are TWO loops. In the spaces below, write the equation for EACH loop using KVL.

| | |
|--|--|
| | |
|--|--|

In the space below, write the equation for the junction above R2 using KCL.

| |
|--|
| |
|--|

Using your derived equations for KVL and KCL, calculate the theoretical current for each resistor in the circuit. Show work below.

| | | |
|----|----|----|
| I1 | I2 | I3 |
|----|----|----|

Calculate the theoretical voltage drop for each resistor using your current calculated above. Show work below

| | | |
|----|----|----|
| V1 | V2 | V3 |
|----|----|----|

Using the digital multi-meter, measure the voltage drop ACROSS each resistor as well as the current THROUGH each resistor

| | | |
|----|----|----|
| I1 | I2 | I3 |
| V1 | V2 | V3 |

Calculate the percent error below between the theoretical current and voltage and the experimental current and voltage drop.

| | | |
|-----|-----|-----|
| I1% | I2% | I3% |
| V1% | V2% | V3% |

Knowing the TRUE direction of the current, calculate the THEORETICAL Equivalent Resistance of this circuit.

Measure and record the TOTAL current of the circuit. The ammeter should be placed between B2 and R2 because that is the wire that leads to the negative of the LARGER battery.

| |
|------------|
| I(total) = |
|------------|

Using the TOTAL voltage drop (or difference since they oppose each other) and the total current measured, calculate the experimental equivalent resistance.

Calculate a percent error between the theoretical and experimental resistance.

Calculate the experimental POWER for each resistance in the circuit. Show work below. Determine the TOTAL power consumption by the resistors by finding the SUM.

| | | | |
|------|------|------|------------|
| P1 = | P2 = | P3 = | P(total) = |
|------|------|------|------------|

Calculate the POWER delivered by each SOURCE as well as the TOTAL power delivered. Keep in mind that the current of the source is the same as whatever is in SERIES with the source. Show work below.

| | | |
|---------|---------|------------|
| P(B1) = | P(B2) = | P(total) = |
|---------|---------|------------|

Calculate the percent difference between the power DELIVERED by the sources and the power CONSUMED by resistors.