Experiment #: 09

Experiment Title: Kirchhoff's Laws

Objectives:

1. To verify Kirchhoff's Laws by comparing voltages obtained from a real circuit to those predicted by Kirchhoff's Laws.

Theory:

A simple circuit is one that can be reduced to an equivalent circuit containing a single resistance and a single voltage source. Many circuits are not simple and require the use of Kirchhoff's Laws to determine voltage, current, or resistance values. Kirchhoff's Laws for current and voltage are given by equations 1 and 2.

$$Equation\ 1: \sum_{Junction} I = 0,\ \ Junction\ Law$$

$$Equation\ 2: \sum_{Loop} \Delta V = 0,\ \ \ Loop\ \ Law$$

In this experiment, we will construct two circuits with 4 resistors and a voltage source. These circuits will not be simple, thus Kirchhoff's Laws will be required to determine the current in each resistor. We will then use a digital multi-meter to obtain an experimental value for the voltage across each resistor in the circuits. Kirchhoff's Laws will then be applied to the circuits to obtain theoretical values for the current in each resistor. By applying Ohm's Law, we can then obtain a theoretical value for the voltage across each resistor. The experimental and theoretical voltages can then be compared by means of % error.

List of Equipment:

Apparatus

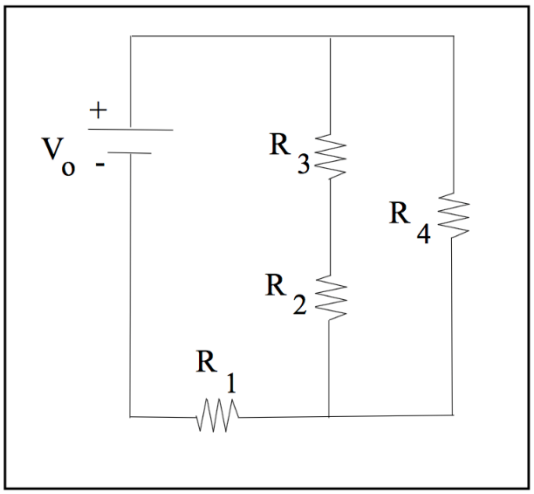
1. Proto-board 4 resistors: (R_1=68$k\Omega$, R_2=47$k\Omega$, R_3=15$k\Omega$, R_4=1000$k\Omega$)
2. Digitalmulti-meter Variable power supply,
3. Wire leads and alligator clips

Circuit Diagram:

Procedure:

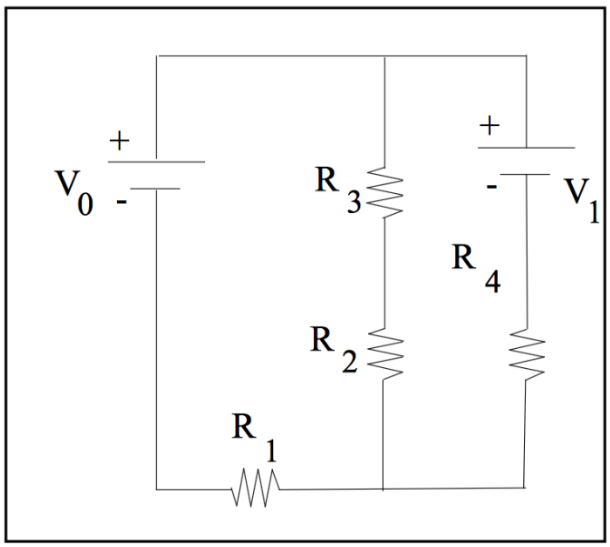
Experimental Procedure Part 1:

1. Using the proto-board, the 4 resistors, the variable power supply, and the wire leads and alligator clips; construct the circuit shown in Figure 2.
2. Turn on the power supply. Connect the multi-meter across the power supply and adjust the voltage to 8.0 volts.
3. Connect the multi-meter across each of the 4 resistors. Record these 4 values of voltage in the data table.
4. Turn the power supply off and disconnect the circuit



Experimental Procedure Part 2:

1. Add a second power supply to the circuit as shown in Figure 3.



2. Turn on the power supplies. Adjust the voltages V_0 and V_1 to 4.0 volts.
3. Connect the multi-meter across each of the 4 resistors. Record these 4 values of voltage

   in the data table.

4. Turn the power supply off and disconnect the circuit.

Data Collection:

Calculation:

Result:

Analysis:

1. For the first circuit, use equations 1 and 2 to write a system of linear equations that may be solved for the current in each branch of the circuit. Then, solve the system to obtain a theoretical value for each current.
2. Using the currents obtained in step 1 of the analysis; apply Ohm's Law to determine the theoretical voltage across each resistor.
3. Compare the theoretical voltages obtained in step 2 of the analysis to those measured in the actual circuit.
4. Repeat steps 1 to 3 for the second circuit.
5. Record the theoretical voltages, the experimental voltages, and the % errors in the results table.

Results:

Part #1	V (theoretical)	V (experimental)	% error
R_1=			
R_2=			
R_3=			
R_4=			

Part #2	V (theoretical)	V (experimental)	% error
R_1=			
R_2=			
R_3=			
R_4=			

Challenge:

Repeat experimental steps 1-4 and the analysis for the circuit in Figure 4 with 5 resistors and apowersupply:
($R1$=68$k\Omega$, $R2$=47$k\Omega$, $R3$=22$k\Omega$, $R4$=15$k\Omega$, $R5$=1000$k\Omega$)

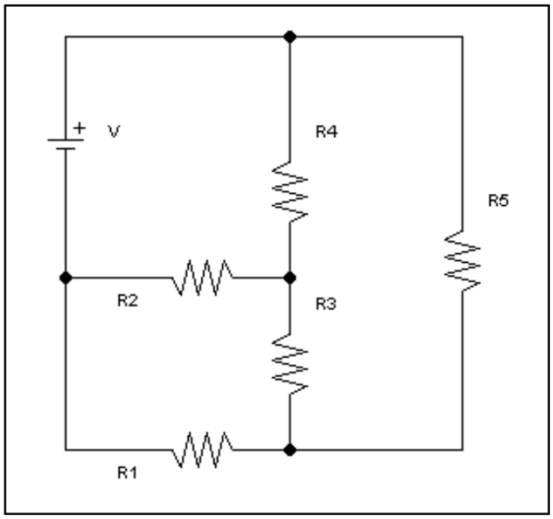


Figure 4

Challenge Results:

Trial #1	V (theoretical)	V (experimental)	% error
R_1=			
R_2=			
R_3=			
R_4=			
R_5=			