



COLLEGE OF ENGINEERING SUNY POLYTECHNIC INSTITUTE

ECE 260

Name: _____

Date: _____

Laboratory 3 – KVL

Purpose: The purpose of this lab is to become familiar with Kirchhoff's Voltage Law (KVL). KVL states that the sum of all the voltages in a closed circuit will sum to zero. It can be used to determine an unknown voltage in a circuit. In this experiment, you will use Multisim and a breadboard to build and test circuits to verify KVL.

Equipment Required

- Breadboard and power supply
- Digital Multimeter (DMM)
- Various resistors
 - 470 Ω resistor
 - 1.5 k Ω resistor
 - 3.3 k Ω resistor

Learning Objectives

1. Become familiar with KVL
2. Build and analyze circuit using a simulation program
3. Build and analyze a circuit you built

Procedure

- 1) Applying KVL to determine an unknown voltage in a circuit.

Here you will demonstrate your knowledge of KVL to determine an unknown voltage and current in a simple series circuit. If you are unfamiliar with KVL, please refer back to your textbook or your notes from class. For the circuit shown below, calculate the current in the circuit and the voltage drop at each element in the circuit. Do this for $V_1 = 6V$ and $12V$. Fill in the table below.



Figure 1

Table 1

V_s	Current I (mA)	V_{R1} (V)	V_{R2} (V)	V_{R3} (V)	V_{R4} (V)	V_{R5} (V)
6						
12						

Now use Multisim to simulate the circuit in Figure 1.

- Access Multisim Live from your laptop.
- Build the circuit in Figure 1 with a power DC variable power supply.
- Insert a multimeter in series with the circuit and set it to measure current (they are along the right side of the window).
 - Also be sure to insert a Ground (GND) into your circuit.
- Place a voltmeter across each of the elements in the circuit
- Click **Run** to simulate the circuit and record the current and voltage values in the table below.
- Click **Stop** to halt simulation before you make changes to the circuit
- Repeat this experiment with the different supply voltages and record your results in the table below.

Table 2

V_s	Current I (mA)	V_{R1} (V)	V_{R2} (V)	V_{R3} (V)	V_{R4} (V)	V_{R5} (V)
6						
12						

- 2) In this section you will build a similar circuit using a breadboard to substantiate the concepts of KVL presented in the previous section. This will involve connecting three resistors in series with a variable voltage source. The $1.5k\Omega$ (R_1) is connected to the power, the 470Ω (R_2) is in the middle and $3.3k\Omega$ (R_3) is connect to GND. See figure below.

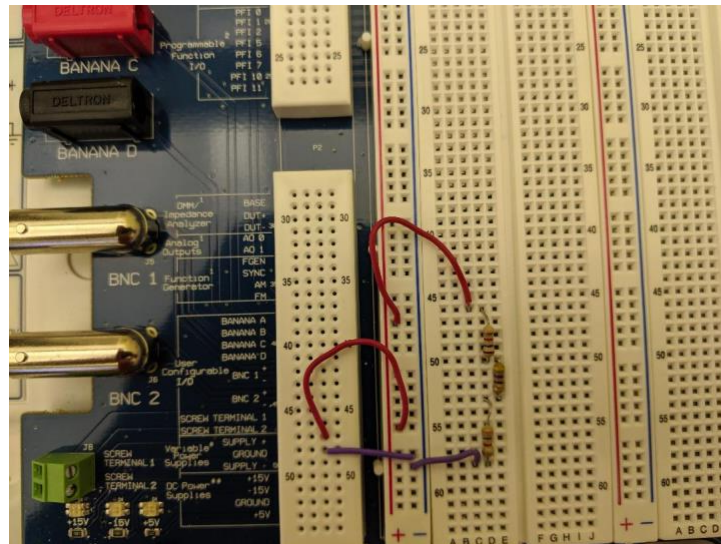


Figure 2

WARNING: Before connecting the circuit, **ALWAYS** verify that you have the proper resistors otherwise you can potentially burn out the components

- Connect the following circuit in Figure 2 on your breadboard
- Connect a variable power supply to your circuit. Power (+) goes to one end of the circuit (see red wire in Figure 2) and GND (-) connects to the other end (see purple wire in Figure 2). Set the power supply to any voltage value between 1 and 5 V
- Measure the voltage across each resistor in the circuit using the DMM set as a voltmeter

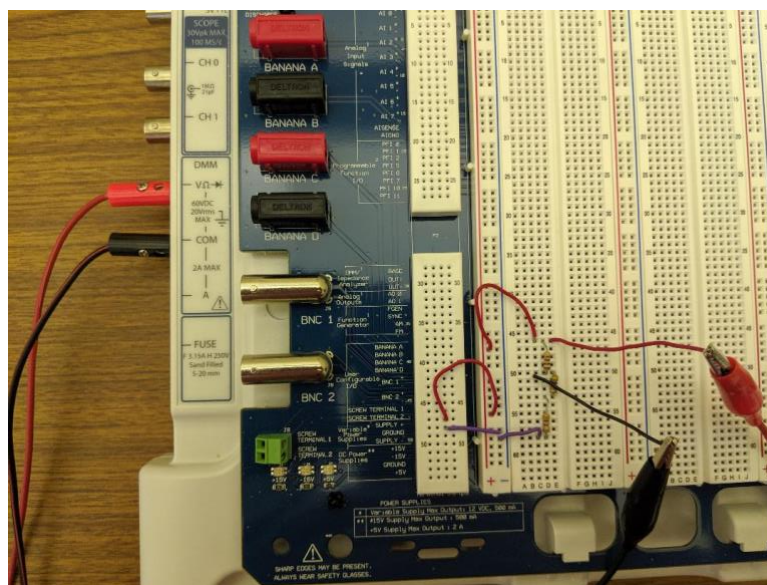


Figure 3

- Sum the voltage drops together. This value should be equivalent to the value of the voltage source. Fill in the table below. Also record the value of the voltage source in the last column. The last two columns should be equivalent.

Table 3

Measured V_{R1}	Measured V_{R2}	Measured V_{R3}	Sum of measured Voltages ($V_{R1}+V_{R2}+V_{R3}$)	Voltage Source Reading

- Measure the total current in the circuit using the DMM. Use Ohm's law to calculate the resistance in the circuit, given the power supply voltage and the current reading from the DMM

What is the measured current? _____

What is the calculated resistance? _____

Does the measured value match the calculated resistance value of the three resistors? Why or why not?

Conclusion

These questions will help you review and interpret the concepts learned in this lab.

In your own words, describe Kirchhoff's Voltage Law. Give two instances from the real world or from your educational career in which it would be used (how it might relate to the principle of conservation of energy)

How many independent equations can be obtained from the following circuit using KVL? Explain how you arrived at this result.

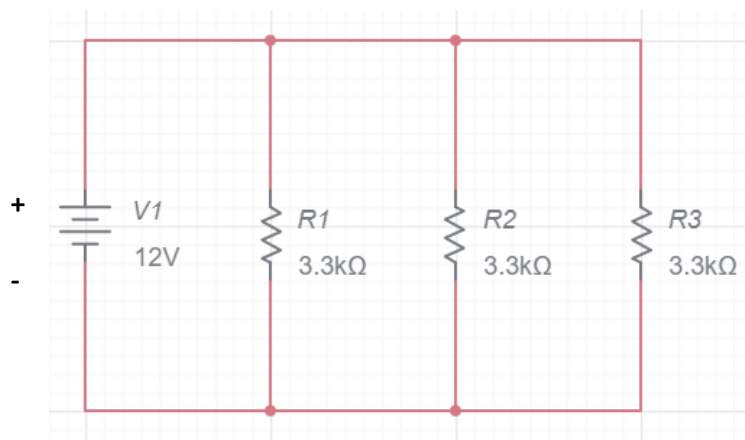


Figure 4

How does your calculated values compare to your values measured in the simulation. What does this tell you about the simulation?

From the circuit you built, were the voltage drops across the three resistors equal? Why or why not?

When would you want to use a simulation to analyze a circuit? When would you use real components?
