Lab 1
Ohm's Law, Kirchoff's Laws, and Conservation of Power

Remember that this experiment should be documented in your lab book as you perform it. Do not make notes on separate paper and transfer the information later. Do it in the book as you go so that when you're done with the experiment you can write your summary and be done. **SHOW ALL UNITS WHERE APPLICABLE!**

1. Before building the circuit, using Ohm's Law, calculate the current through the 10kΩresistor. This is your theoretical value. Give your answer in amps (A), milliamps (mA), and microamps (µA). Show your work to the right of Figure 1. (A= 1,000mA= 1,000,000µA).

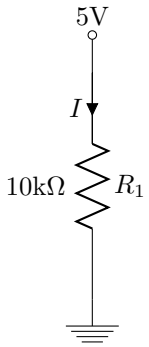

Figure 1:

2. Voltage and current measurements.
   (a) Using a multimeter, measure the actual resistance of the 10kΩ resistor (before building the circuit).
   (b) Build the circuit in Figure 1 on the protoboard. With the multimeter set to measure DC volts, measure the voltage across the resistor.
   (c) One method used to measure the current through a resistor is to use Ohm's Law. Using the data you collected from 2a and 2b, calculate the current, I, through the resistor. Express your answer in milliamps. This is your experimental value.
   (d) Calculate the percent difference between the value for I you obtained in 2c, and the theoretical value for I you calculated in problem 1. Write your answer here.

$$\%error = \frac{Experimental - Theoretical}{Theoretical} \times 100\% \quad (1)$$

(e) Another method used to measure current through a resistor is to "break" your circuit, and insert the multimeter into it to complete the connection. Measure I using the multimeter. Write your answer here.

(f) Calculate the percent difference between the value for I you obtained in 2e and the theoretical value for I you calculated in problem 1.

3. Using 10kΩ resistors, build the circuit in Figure 2 on your protoboard. Take care to lay out your circuit neatly, using wires of proper length where needed. Before connecting power to your circuit, adjust your power supply to 15V (do not assume that cranking the knob all the way up will give you the max labeled value, you must use a meter and adjust this manually). Have a lab TA look over your circuit before you apply power to your circuit.

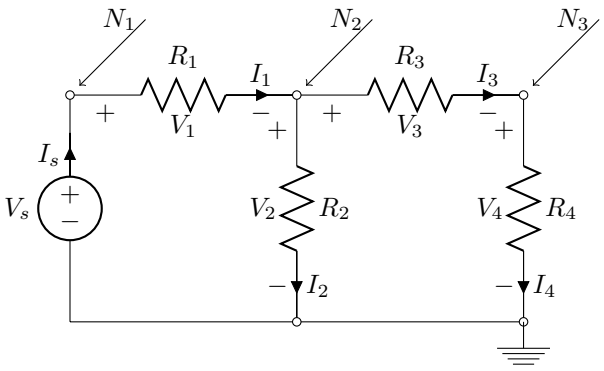

Figure 2:

(a) Using a multimeter, measure and record the DC voltage across each circuit element.

(b) Using Ohm's Law, calculate the values for all the indicated currents in the circuit. You may use either labeled or measured values for your resistors, but you must note which method you use. Using measured values will generate more accurate results. In either case, your decision here will determine how you explain any error in your results.

(c) Using Kirchoff's Current Law, write symbolic node equations for the currents entering and leaving Nodes N_1, N_2, and N_3. Plug in your values for the currents in the equations and see if KCL holds true. If you have some error here (a nonzero sum), evaluate whether it is reasonable or not (compare the remainder with the smallest value in your equation and calculate a percentage.)

(d) Using Kirchoff's Voltage Law, write symbolic loop equations for the three loops in the circuit. Plug in your measured values for the voltages in the equations and see if KVL holds true. Like the previous step, evaluate error in this equation.

(e) Calculate the power delivered or absorbed by all circuit elements (P_s, P_1, P_2, P_3, and P_4). Show that the Law of Conservation of Power is observed by showing that power sums to (almost) zero for the circuit. Evaluate and explain any error if you get a non-zero result.

Question
What reasons can you think of that may explain why your experimental values for I were different than your theoretical values?