Analyzing resistive circuits

In this lab you will be using Ohms law, Kirchoffs laws, and conservation of power to analyze circuits on paper. Then you will be building the circuits and using resistance, voltage, and current measurements to confirm your results.

Pre-lab Exercises

Part 1

Use Ohm's law to calculate the current I_s in the simple circuit below and express the result in mA.

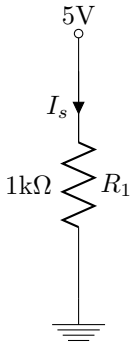

Figure 1:

Now place a 1Ω resistor into the circuit in series with the 1kΩ resistor. Calculate the current I_s once again.

- Question: How large of an effect does the 1Ω resistor have on the total resistance of the circuit? And on I_s?

Part 2

In Figure 2 all the resistors are 1kΩ and V_s is 15VDC.

1. Determine the voltage across and current through each element.
2. Using Kirchoffs 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.
3. Using Kirchoffs 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.
4. 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.

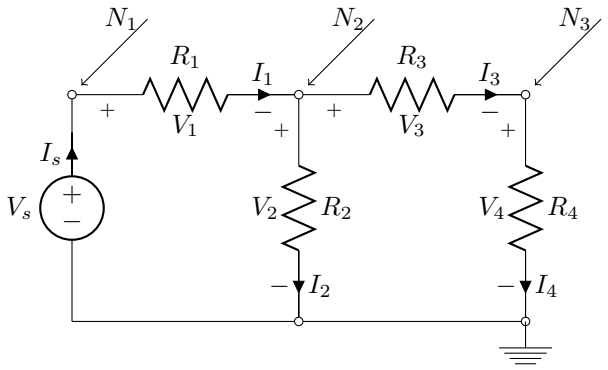

Figure 2:

Lab Exercises

Part 1: Measuring current

(a) Build the circuit from Figure 1.

(b) Now you will use a 1Ω resistor to measure current through your circuit. Place the 1Ω resistor into the circuit so it is in series with the 1kΩ resistor. (Have a TA check your circuit before you proceed)

(c) Turn on your protoboard and measure the voltage across the 1Ω resistor.

(d) Using Ohm's law, calculate the current through the 1Ω resistor.

(e) Now you will use your multimeter to measure the current through your circuit.

CAUTION: Innocent fuse in danger! This is where it is easy to make a mistake and blow the 100mA fuse inside the multimeter. Have a TA assist you with this step.

Make sure your multimeter is set to 100m(A) and the leads are in the proper places. Remove the 1Ω resistor from the protoboard and insert your multimeter where the 1ohm resistor was in the circuit. Measure and note the current.

Note: Once the current measurement is completed, reconfigure the meter to voltage measurement (move the leads and adjust the dial to V). Do this every time you are done measuring current.

Questions:

1. Compare all three values you have for the current I, the theoretical and both measured values. Are the measured values reasonable?
2. Was it reasonable to use a 1ohm resistor to measure current in a circuit? What are the possible drawbacks to using a 1Ω resistor verses a dedicated current measuring device in a random circuit?

Part 2

(a) Begiun building the circuit from Figure 2.

- For V_s you will need 15V and so you will use the protoboard V+ output. Adjust the protoboard V+ knob output to 15V (doesn't have to be exact but close).

- As you build your circuit, measure and record the resistance of each resistor.
- Once the circuit is complete, have a TA check your circuit before you proceed.

(b) Measure and record the voltage across each resistor.

(c) Measure and record the current through each resistor, as well as IS. (Careful with the multimeter settings!)

(d) Calculate the power for each element.

Questions:

1. Does KVL hold true?
2. Does KCL hold true?
3. Is power conserved?
4. Explain the differences between your measured values and the theoretical values from the pre-lab. Where does the error come from? (Hint: There is more than one suspect)