ENGR 120 LAB #3 – Electrical Circuits

Objectives

Understand how to use a digital multimeter, power supply and proto board and apply that knowledge to constructing circuits to demonstrate ohm's law.

Material

- Introduction to ECSE textbook
- Course website: www.EngrCS.com
- Instruments: Power Supply and Multimeter
- Supplies:
  - Electrical Tool Box
  - Proto Board
  - Power Extension, Probes & Connecting Cables
  - Available Resistors

Procedure

1) Keep the same lab partner as from the previous lab.

2) Lab experiments
   a) Read through the lab prior to arriving in the lab. The labs provide background information or design that can be done prior to arriving in the lab. Good preparation can minimize the time spent in the lab room and lead to a more enjoyable lab!
   b) Perform each experiment listed in the lab.
   c) Record your results and/or observations for each experiment.

3) Report
   Reports must be created ***individually***. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:
   a) Header:

Your name Lab # Date Team member names Experiment #1: …

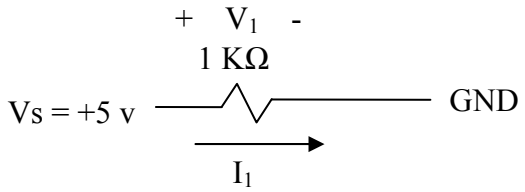
   b) For each experiment:
      i. Clear problem statement; specify items given (if any) and to be found
      ii. Document the resulting circuit design, tables, diagrams, calculations and other results
   c) For the report as a whole:
      i. Lessons learned from the experiments
      ii. Content/format improvement suggestions and reasons for the suggestions
      iii. Estimated time spent on the lab (value is not graded – used to improve labs)

Experiment 1. Ohm's Law

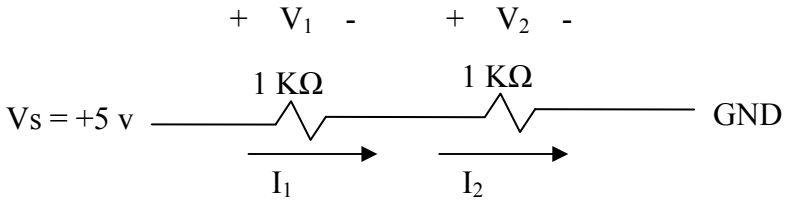
Ohm's Law states that voltage (V, Volt) and Current (I, Amp) through a resistor (R, Ω) are proportional. The following equation is based on Ohm's Law:

$$V = I * R$$

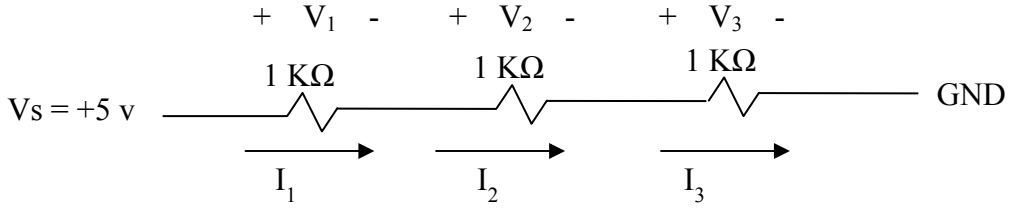
1) Series Resistors
   a) Measure the voltage across the resistor and calculate the current through the resistor



   b) Measure the voltage across each resistor and calculate the current through each resistor



   c) Measure the voltage across each resistor and calculate the current through each resistor

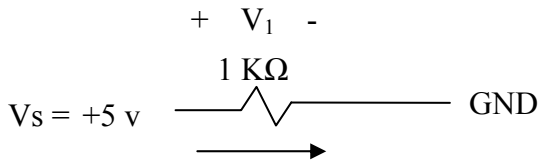


   d) In this case, n 1 KΩ resistors (where n is an integer) are connected in series. Derive the equation for the average voltage across each resistor and current through each resistor in terms of Vs, 1KΩ and n:

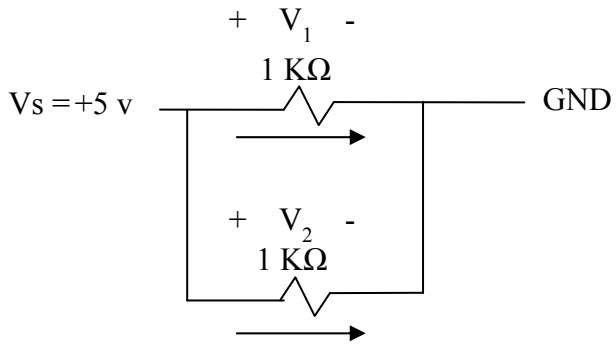
V_n=_____ and

I_n=_____

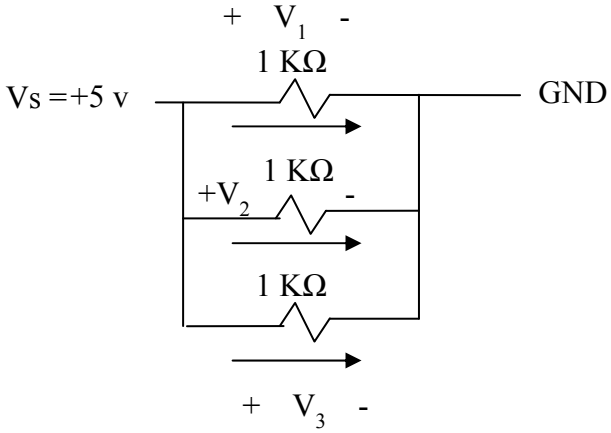
2) Parallel Resistors
   a) Measure the voltage across the resistor and calculate the current through the



   resistor
   b) Measure the voltage across each resistor and calculate the current through each

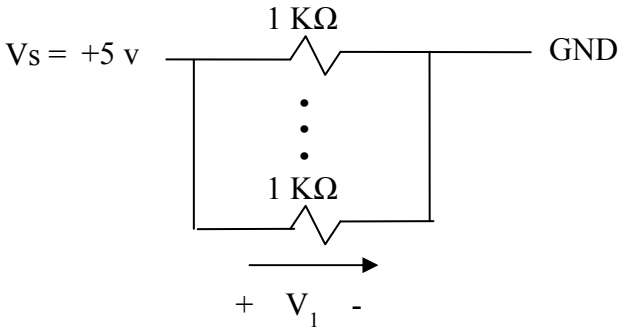


   resistor
   c) Measure the voltage across each resistor and calculate the current through each resistor



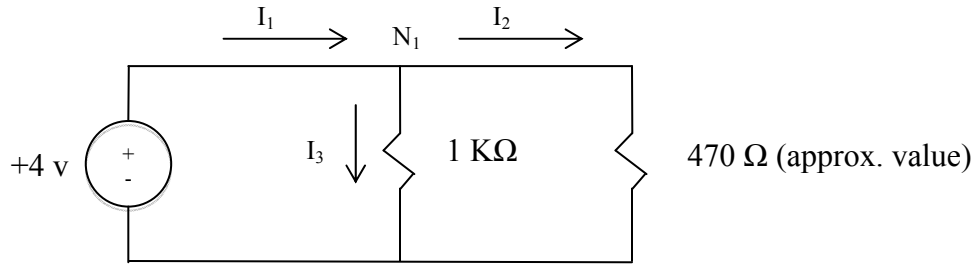
   d) In this case, n 1 KΩ resistors (where n is an integer) are connected in parallel. Derive the equation for the average voltage across each resistor and current through each resistor in terms of Vs, 1KΩ and n: V_n=_____ and

I_n= _____



Experiment 2. Kirchhoff's Current Law

Construct the circuit shown below. If you don't have exact values for the resistors, get close and show which values you used:

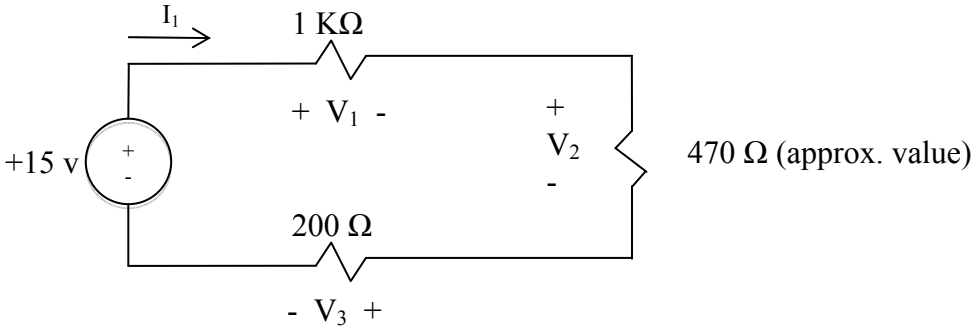


1) Using a DMM, measure the current for I_1, I_2, I_3 and the voltage at N_1. Remember that current measurements must have the DMM in series with the circuit being measured. (Measuring current is not difficult. You could lift one leg (end) of the resistor out of the protoboard and connect the DMM from the resistor leg back to the circuit. Make sure you have a good connection.)

2) What is the relationship between I_1, I_2, and I_3?

Experiment 3. Kirchhoff's Voltage Law

Construct the circuit shown below. If you don't have exact values for the resistors, get close and show which values you used:



1) Using a DMM, measure the voltage drops across the three resistors, V_1, V_2 and V_3.

2) From the voltage measurements taken above, calculate the current through each resistor. And what is the relationship between these values?

3) What is the relationship between the three measured voltages and the power supply voltage?

4) Calculate the power consumed by each of the resistors where P = V * I. The power for a resistor will be the voltage drop across that resistor multiplied by the current flowing through the resistor.

5) Calculate the power delivered by the power supply.

6) Determine if this is a valid ideal circuit where the sum of power delivered by the supply and the power consumed by the resistors is equal to zero? Show your work.