EE 206

Lab 1: *Basic Circuit Laws*

Reference Materials

- Lab Reports (see lab syllabus)
- Lab Safety
- Lab Station Information
- Multimeters
- Ohm's Law (see text)

Objective

The objective of this lab is for the student to learn fundamental electrical laboratory skills (using a breadboard to construct and test circuits, making measurements with a multimeter) and to confirm basic circuit laws.

Equipment Needed

- Breadboard
- CADET
- Multimeter
- Decade Resistance Box

Parts List

Resistors from lab kit

Pre-Lab Preparation

Review the reference material on *Lab Safety* and the *Lab Station*. Review the reference material concerning the use of a multimeter to measure voltage, current, and resistance.

Part I. Basic Measurements

1. Find a 1 kΩ, a 5 kΩ, and a 10 kΩ resistor in your lab kit. Name them R1, R2, and R3, respectively.
    a. Determine the value of each resistor from its color code and record it in the table below in the Nominal Value and Tolerance columns.
    b. Measure each of the resistors with the multimeter and record that in the table.

	Nominal Value	**Tolerance**	**Measured Value**
R1			
R2			
R3			

Build the resistor network shown in Fig. 1, and make the following resistance, voltage, and current measurements.

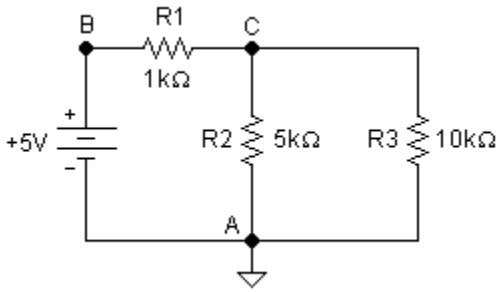

Figure 1. **Resistor Network.**

NOTE: Do not turn the power on the CADET until you are ready to make voltage or current measurements. **Always** turn the CADET power off before making **any** changes to the circuit.

2. Use the +5V fixed voltage source on the CADET for the voltage source for the circuit. Turn the power on the CADET and make the following <u>voltage measurements</u>:
    a. Voltage at node B with respect to ground.
        i. V_B =
    b. Voltage from B to C.
        i. V_{BC} =
    c. Voltage from C to A.
        i. V_{CA} =
        ii. Does the voltage across R2 equal the voltage across R3? If not, why not?
        iii. Compute $V_T = V_{BC} + V_{CA}$ =
    d. Voltage from B to A.
        i. V_{BA} =
        ii. Compare V_{BA} to V_T. Are they equal? Explain.

Caution: **<u>You could seriously damage the multimeter if you try to measure a current by placing the meter in parallel with an element.</u>** Also to protect the multimeter when measuring a current, you should always start the measurement by putting the multimeter in the "A" range rather than the "mA/μA" range. In case the value being measured by the multimeter is too small, you can then switch the meter to the "mA/μA" range.

3. Make the following <u>current measurements</u>:
    a. Current through each of the resistors.
        i. I_{R1} =
        ii. I_{R2} =
        iii. I_{R3} =
        iv. Why is the current through R2 different than the current through R3? If you add these two currents, is the sum the same as the current through R1? What Kirchhoff Law is involved? Explain.
4. Turn off your power supply and disconnect it from the circuit.
    a. Measure the resistance between B and A.
        i. R_{BA} =

b. Compute the equivalent resistance of the circuit using the measured values of the resistors from Step 1b. Verify that R_{BA} is equal to this computed value.

Part II: Ohm's Law

Remember: **Ohm's Law states that V = I × R**

The circuit in Fig. 2 is a basic circuit used to demonstrate the relation between the voltage, current, and resistance of a circuit according to Ohm's law. Vdc is a dc voltage supply. Rx is a variable resistor (use a decade resistance box).

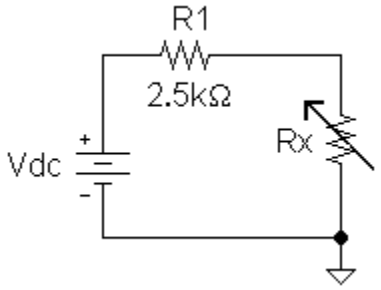

Figure 2. Ohm's Law Test Circuit.

1. Use the multimeter to measure the value of R1.
   a. R1 =

2. Construct the circuit in Fig. 2. Keep Vdc at +5 V and change the value of the resistor Rx to get the resistance (R = R1 + Rx) given in Table 1. Calculate the current values that should result and then carefully measure the values of the current in the circuit using the multimeter.

V_{dc} (V)	Resistance R (ohms)	Current, calculated (μA)	Current, measured (μA)
+5 V	12.5 kΩ		
+5 V	15.0 kΩ		
+5 V	17.5 kΩ		
+5 V	20.0 kΩ		
+5 V	22.5 kΩ		

Table 1. Varying resistance.

3. Now keep the resistance value R constant and vary Vdc using the values given in Table 2. (The different Vdc's in the table can be obtained from the CADET's variable dc voltage source.) Calculate and measure the values of the current in the circuit.

Resistance R (ohms)	V_{dc} (V)	Current, calculated (μA)	Current, measured (μA)
40 kΩ	+1 V		
40 kΩ	+3 V		
40 kΩ	+5 V		
40 kΩ	+7 V		
40 kΩ	+9 V		

Table 2. Varying voltage.

4. Finally vary both the voltage and the resistance, and measure the current in the circuit.

Vdc (V)	Resistance R (ohms)	Current, calculated (μA)	Current, measured (μA)
+2 V	30 kΩ		
+4 V	35 kΩ		
+6 V	40 kΩ		
+8 V	45 kΩ		
+10 V	50 kΩ		

Table 3. Varying both resistance and voltage.

Post-Lab Work

1. Plot a curve that has Voltage on the Y-axis and Current on the X-axis using the data from Table 2. What is the shape of the curve? Why? Explain.
2. For the curve plotted above, select a point from the curve that is not one of the data points from Table 2. Using the voltage and current values from that point, compute the resistance from Ohm's Law.

Lab Report

Use the Report Format specified by your lab instructor. Include in your report the answers to the questions posed in this document. Your report is due at the beginning of next week's lab period.