Name_____

EET 1150 Lab 3
Basic Laws

OBJECTIVES:

- Use Ohm's law to calculate the current through a resistor at different voltages, and then measure the currents to see if your calculations are correct.
- Measure resistance, currents, and voltages in series-parallel circuits, and verify that the measured values agree with theoretical calculations.
- Verify that Ohm's law, Kirchhoff's laws, the voltage-divider rule, and the current-divider rule are satisfied in series-parallel circuits.

PART 1. Ohm's law.

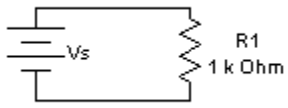
1. In Data Table A, compute and record the minimum and maximum values in the tolerance range of a 1-kΩ resistor with 5% tolerance. **Throughout this lab, use engineering prefixes, and round all computed values and measured values to three significant digits.**

2. Obtain such a resistor and measure its resistance, recording the value in Data Table A and verifying that this value falls within the tolerance range.

DATA TABLE A: 1-kΩ Resistor

Nominal Value	Tolerance Range		Measured Value
	Minimum	Maximum	
1 kΩ			

3. Consider the simple circuit shown below. For each of the source voltages listed in the first column of Data Table B, use Ohm's Law and the resistor's nominal value to calculate how much current will flow through the resistor if that voltage is applied across it. Record your calculations in the table.



DATA TABLE B: Current Through 1-kΩ Resistor

Voltage	Calculated Current	Measured Current	% Error
4 V			
6 V			
8 V			
10 V			

4. Build the circuit on a breadboard. Adjust the power supply to produce each of the voltages listed in Data Table B, and measure and record the current that flows.
5. Compute and record percentage errors between your measured and calculated values, using the equation given below. All of your percentage errors should be less than 5%. If not, figure out what you've done wrong and fix it.

$$\text{Percentage error} = \left| \frac{\text{Calculated value} - \text{Measured value}}{\text{Calculated value}} \right| \times 100$$

PART 2. A series-parallel circuit.

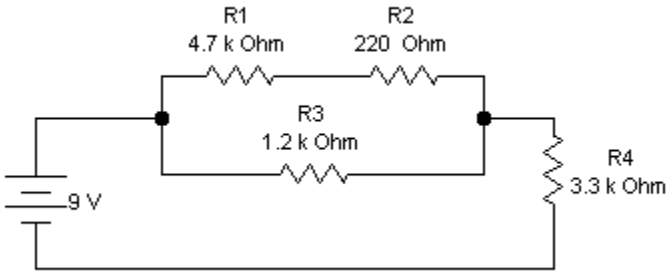
1. In Data Table C, compute and record the minimum and maximum values in the tolerance ranges of the listed resistors. Assume 5% tolerance in every case.

2. Obtain the resistors. Measure and record their actual resistances. Record the measured values in Data Table C and verify that these values fall within tolerance.

DATA TABLE C: Resistor Values

Resistor I.D.	Nominal Value	Tolerance Range		Measured Value
		Minimum	Maximum	
R1	4.7 kΩ			
R2	220 Ω			
R3	1.2 kΩ			
R4	3.3 kΩ			

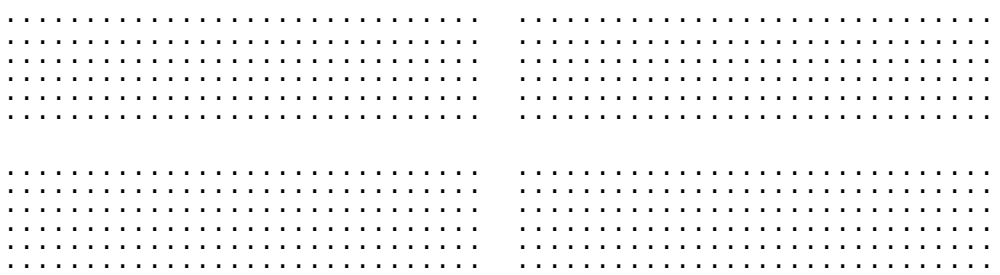
3. Consider the circuit shown below. Data Table D (next page) gives calculated values of several voltages and currents in this circuit, using the following notation: v_1 is the voltage across resistor R1, i_1 is the current through R1, and so on. Also, i_s is the current flowing through the voltage source.



Data Table D: A Series-Parallel Circuit

Quantity	Calculated Value	Measured Value	% Error
v_1	1.95 V		
v_2	91.5 mV		
v_3	2.04 V		
v_4	6.96 V		
i_s	2.11 mA		
i_1	414 µA		
i_2	414 µA		
i_3	1.70 mA		
i_4	2.11 mA		

4. On the blank breadboard diagram below, draw resistors (**in pencil)** showing how to build this circuit. Label the resistors as R1, R2, R3, and R4. Also show the points where the + and – terminals of the voltage source attach to the circuit.



5. Compare the two diagrams—the schematic diagram and your breadboard diagram—until you are confident that they match each other.

6. Build the actual circuit on a breadboard. Then measure the quantities from Data Table D, recording your measured values in the table. As always, round all values to **three significant digits** and include **units** with your values. Compute percentage errors, which should all be less than 5%.

7. **Before taking your circuit apart,** call me over to check your work. I will ask you to show me how to measure a quantity in the circuit, so first be sure that you're confident in your ability to measure the quantities listed in Data Table D.

REVIEW QUESTIONS

1. Based on your data in Data Table D, is **Ohm's law** satisfied in this circuit? Explain, giving **one specific example** of how this rule either is or is not satisfied in the circuit, using actual *measured* values, not calculated values. Show your calculation.
2. Repeat the previous question for **Kirchhoff's voltage law.**
3. Repeat the previous question for **Kirchhoff's current law.**
4. Repeat the previous question for the **voltage-divider rule.**
5. Repeat the previous question for the **current-divider rule.**

TECHNICAL CONCLUSION: Re-read the objectives at the beginning of this lab. For each objective, briefly state what you've learned from the lab. Include some discussion of how far off (percentage errors) your measured values were from your calculated values.