

NAME _____

EET 1150 Lab 2

Multimeter Review and Power

OBJECTIVES:

- Review the use of the multimeter to measure current, voltage, and resistance.
- Investigate power dissipation in a resistor.

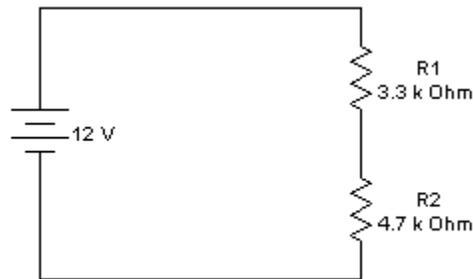
PROCEDURE:

1. Select the resistors shown in Data Table A. Use the digital multimeter (DMM) to measure their resistances, and record the values in the table, **rounded to three significant digits**. Be sure to **use the best range on the DMM**, and record the range you used.

Data Table A: Resistor Values

Resistor I.D.	Nominal Value	Actual Value	DMM Range Used
R ₁	3.3 kΩ		
R ₂	4.7 kΩ		
R ₃	15 kΩ		
R ₄	47 Ω		

2. Consider Circuit 1, shown below:



Circuit 1

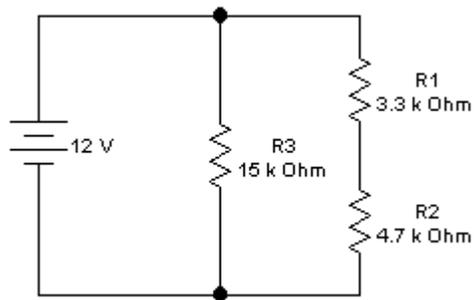
3. Use Multisim to predict values for the following quantities in this circuit: R_T (total resistance), I_T (total current through the power supply), I_1 (current through resistor R1), I_2 (current through resistor R2), V_1 (voltage drop across resistor R1), and V_2 (voltage drop across resistor R2). Record your predicted values in Data Table B.
4. Build the circuit on the breadboard and measure these same quantities, being careful to use the best range on the multimeter. Record your measured values in Table B. Then compute and record the percentage errors between your predicted and measured values. **Throughout this lab, round all predicted values, measured values, and percentage errors to three significant digits.** Your percentage errors should all be less than 5%. Remember, the formula for computing percentage error is:

$$\text{Percentage error} = \frac{|\text{Predicted value} - \text{Measured value}|}{\text{Predicted value}} \times 100$$

Data Table B: Measurements in Circuit 1

Quantity	Predicted Value (Multisim)	Measured Value	DMM Range Used	% Error
R_T				
I_T				
I_1				
I_2				
V_1				
V_2				

5. With the power supply switched off, modify the circuit by adding R3 as shown below. Record predicted and measured values for the quantities listed in Data Table C.



Circuit 2

Data Table C: Measurements in Circuit 2

Quantity	Predicted Value (Multisim)	Measured Value	DMM Range Used	% Error
R_T				
I_T				
I_1				
I_2				
I_3				
V_1				
V_2				
V_3				

CAUTION! In the next part of this lab you're going to "burn up" a resistor. The resistor will get very hot, so do not touch it, or you may get burned. Also, be sure to plug the resistor into the breadboard in such a way that the resistor stands as high off the board as possible. Otherwise you may scorch the breadboard's plastic covering.

- For each of the voltages listed in the first column of Data Table D, use Ohm's Law to predict how much current will flow through a $47\ \Omega$ resistor if that voltage is applied across it. Record your predictions in the table.
- Connect the $47\ \Omega$ resistor across the power supply. Adjust the power supply to each of the voltages listed in Table D, and measure and record the current that flows. **Caution! At some point as you increase the voltage, the current will become so large that the resistor overheats.** If the resistor starts to smoke, turn off the power and let the resistor cool down between measurements. **Be careful not to touch the resistor while it is hot.** Compute and record percentage errors between your measured and predicted values.

Data Table D: Current through $47\ \Omega$ Resistor

Voltage	Predicted Current	Measured Current	DMM Range Used	% Error
5 V				
6 V				
7 V				
8 V				
9 V				
10 V				
11 V				
12 V				
13 V				
14 V				
15 V				

QUESTIONS:

- You have learned three different formulas for calculating the power dissipated in a resistor:

$$P = VI$$

$$P = V^2/R$$

$$P = I^2R$$

Hopefully these three formulas give (approximately) the same answer for any given case. Using your **measured** values from Data Table D, use each of these formulas to compute the power dissipated by the $47\ \Omega$ resistor at each of the different voltages. Record your numbers in Data Table E, which has one column for each of the power formulas. In the last column, compute the percentage difference between the largest and smallest values that you got for that row of the table. Here's the formula to use:

$$\text{Percentage difference} = \frac{\text{Largest value} - \text{Smallest value}}{\text{Smallest value}} \times 100$$

Data Table E: Calculated Power for 47 Ω Resistor

Voltage	Power using $P = VI$	Power Using $P = V^2/R$	Power Using $P = I^2R$	% Difference
5 V				
6 V				
7 V				
8 V				
9 V				
10 V				
11 V				
12 V				
13 V				
14 V				
15 V				

- Based on your data in Table E, do the three power formulas agree? (**Explain your answer.** As part of your explanation, you should consider the size of the percentage differences.)
- Briefly describe the resistor's behavior as the voltage across it increased. Based on what you know about resistor power ratings, and based on the data in Table E, what observations can you make?

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 predicted values.