NAME ______________________________

EGR 2201 Lab 6
Thevenin's Theorem & Maximum Power Transfer

OBJECTIVES:

- To measure a circuit's Thevenin-equivalent voltage and Thevenin-equivalent resistance.
- To observe variations in current, voltage, and power as a circuit's load resistance changes.
- To verify the maximum-power-transfer theorem.

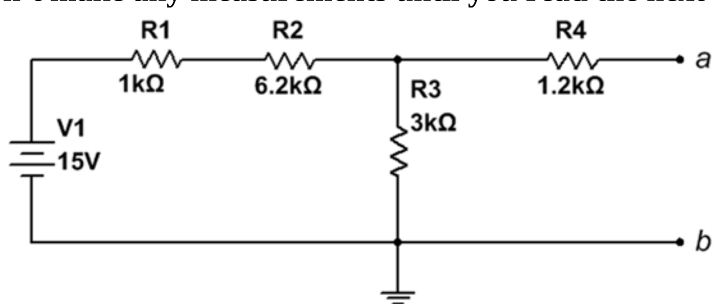
Part 1. Measuring Thevenin-Equivalent Voltage and Resistance.

1. Select the resistors shown in Data Table A. Use the multimeter to measure their resistances, and record the values in the table. **Throughout this lab, round all predicted values, measured values, and percentage errors to three significant digits.**

Data Table A: **Resistor Values**

Resistor I.D.	Nominal Value	Actual Value
R_1	1 kΩ	
R_2	6.2 kΩ	
R_3	3 kΩ	
R_4	1.2 kΩ	

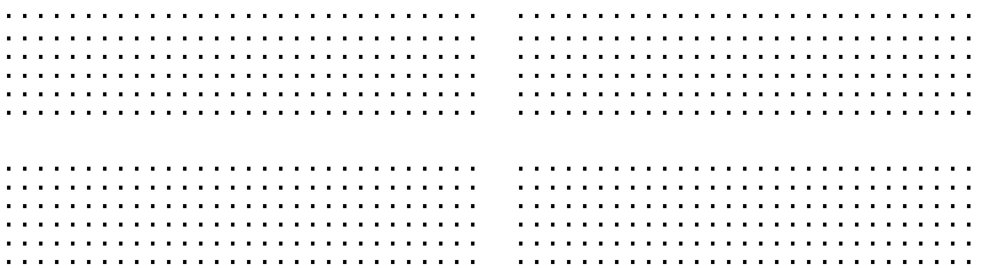
2. **Don't make any measurements until you read through step 4.** Consider the circuit shown below. Using the procedure you learned in class, predict the Thevenin-equivalent voltage V_{Th} and the Thevenin-equivalent resistance R_{Th} at the two open terminals labeled *a* and *b*. Record these values in the "Predicted" column of Data Table B. **Don't make any measurements until you read the next two steps.**



Data Table B: Thevenin-Equivalent Voltage and Resistance

Quantity	Predicted Value	Measured Value	% Error
V_{Th}			
R_{Th}			

3. On the blank breadboard diagram below, draw resistors (**in pencil)** showing how to build the circuit. Label the resistors as R1, R2, R3, and R4. Also show the points where the + and – terminals of the 15-V source attach to the circuit, and clearly identify the points *a* and *b*.



4. Now build the circuit on a breadboard.
   - To measure V_{TH}, simply measure the voltage between points *a* and *b*, with the red meter lead at point *a*.
   - To measure R_{TH}, **first turn off and disconnect the power supply**, and then replace the power supply with a short (in other words, with a wire). Then measure and record the resistance between points *a* and *b*.

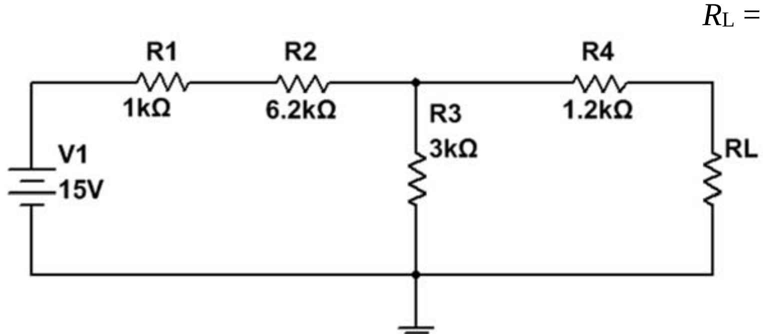
   Record your measured values of V_{TH} and R_{TH} in Data Table B above. Your measured values should be close to your predictions. Compute and record percentage errors.

5. Call me over so that I can check your measurements. __________

Part 2. Maximum Power Transfer.

6. Shown below is the same circuit from Part 1, but with a load resistor R_L connected across the terminals *a* and *b* that were open in the original circuit. Using your results from Part 1 and the maximum-power-transfer theorem, predict the value of R_L that will result in maximum power being transferred to R_L.

R_L = _______________



7. Build the circuit on a breadboard, using your computed value of R_L.

8. Measure and record the values of i_L and v_L in your circuit. From these measured values, use the power law ($p = iv$) to compute the load resistor's power p_L:

Measured i_L = ___________ Measured v_L = ___________ Computed p_L = ___________

9. Copy your values from the previous page into the middle row of Data Table C below.

10. Repeat Step 8 for four smaller values of R_L and four larger values of R_L. **Choose the smallest value to be one-tenth of the value from Step 6, and choose the largest value to be ten times the value from Step 6.** Record your values for each resistor in Data Table C, listing your resistors in order from smallest to largest.

Data Table C: i_L and v_L as R_L is Varied

	R_L	Measured i_L	Measured v_L	Calculated p_L
Smallest R_L = 0.1 × Step 6				
Values from previous page.				
Largest R_L = 10 × Step 6				

GRAPHS Use Microsoft Word or some other software to make the following three graphs. Give each graph a title, and label each axis with the quantity and the unit--for example, "Current (mA)." Include these graphs as part of your typed lab report.

Graph 1: Plot a graph of i_L versus R_L. (This means i_L is plotted on the vertical axis and R_L is plotted on the horizontal axis.)
Graph 2: Plot a separate graph of v_L versus R_L.
Graph 3: Plot a separate graph of p_L versus R_L.

QUESTIONS In your lab report, answer these questions using grammatically correct sentences.

1. Using your Graph 1, describe how i_L changes as R_L increases, and explain why.
2. Using your Graph 2, describe how v_L changes as R_L increases, and explain why.
3. Using your Graph 3, describe how p_L changes as R_L increases, and explain why. Does your graph confirm that power is maximized for the value of R_L that you calculated in Step 6? Explain.

LAB REPORT

For this lab will turn in a typed lab report, with your handwritten lab sheets stapled to the back. The course syllabus has instructions on how to format your lab report, along with a sample lab report.