DC Circuits Laboratory **Lab # 3**

Ohm's Law, Parallel Circuits, and KCL

Lab Objectives

When this lab exercise is completed, the student should be able to:

1. Measure voltages across and currents through elements in a parallel circuit built on a protoboard.
2. Calculate and experimentally find an equivalent resistance.
3. Use data to demonstrate Ohm's Law and Kirchhoff's Current Law.
4. Build a parallel circuit on a protoboard in such a way that others can easily recognize the components and take measurements.

Pre-Laboratory Preparation

Prior to your scheduled laboratory meeting time the following items need to be completed. The prelab quiz will be based on this preparation.

1. **Research**
   a. On the internet, find a 1 page article or app note that explains Kirchoff's Current Law. Print it, read it, and bring it to lab - *You may refer to this article when taking the lab quiz.*
2. **Analyze** (calculate the voltage across and current through each circuit element)
   a. On green engineering paper or quadrille paper, analyze the parallel circuits of fig. 1 and fig.2. NOTE: The results of this analysis will be part of the prelab quiz.
3. **Use Excel** to create a data table for recording the measured voltages and currents in fig. 1 and fig. 2. The data table should have spaces for all the voltages and currents called out in each circuit. Design your data table so that you can compare the calculated and measured values using the data tables from Lab 1 and Lab 2 as a model.
4. **Preparation for quiz**: The prelab quiz for this lab may include the following topics:
   a) Calculating voltages and currents using Ohm's Law, KVL and KCL in series and parallel circuits
   b) Understanding Ohm's Law, KVL and KCL
   c) Measuring voltages and currents in parallel circuits
   d) Identifying the nodes in a parallel circuit
   e) Calculating equivalent resistance given a circuit or circuit segment

DC Circuits Lab Procedure - Part 1: Parallel Circuit

1. Build the circuit shown in fig 1.
2. In the data table you created in the prelab, record all the currents and voltages called out in the figure.
3. Repeat steps 1 and 2 for the circuit of fig. 2.
4. Answer the question below. Have your data signed off by your instructor or TA.

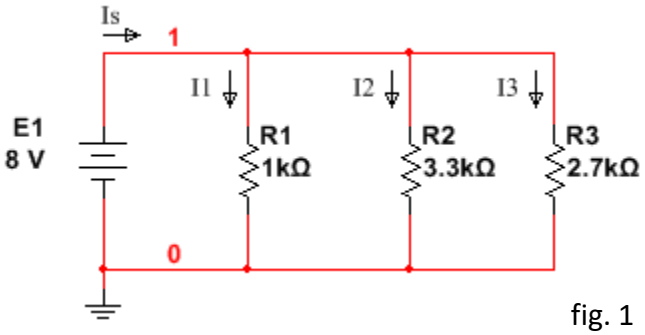

fig. 1

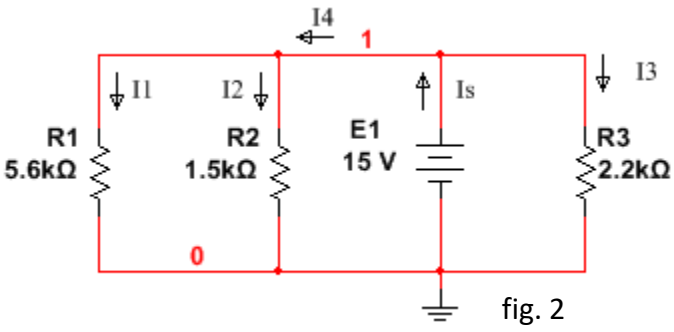

fig. 2

Ohm's Law, Parallel Circuits, and KCL

Questions:

1. In fig.1, the total current splits into I_1, I_2, and I_3. Use your collected data to verify Kirchhoff's Current Law ($I_1 + I_2 + I_3 = I_S$). Was there any error in the result? Where did it come from?

Part 2: Equivalent Circuits

1. Build the circuit shown in fig. 3 below.
2. Measure and record the source current **I_S:**

   I_S = _____

3. Use Ohm's Law, the applied voltage and source current to calculate and record the value of the equivalent resistance Req "seen" by the source (see Lab Note 1).

   R_{eq} = _____

4. Use your calculated value of **R_{eq}** to build the circuit shown in fig. 4, measure and record the resulting current, **I_S**:

   I_S = _____

5. Answer the following question. Have your instructor sign off on this section on your cover sheet.

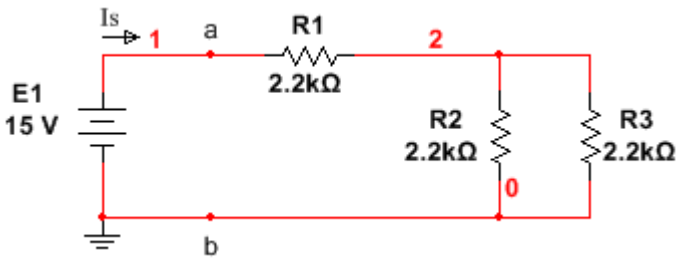

fig. 3

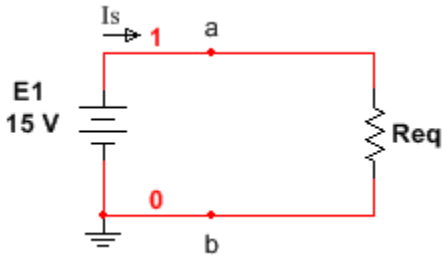

fig. 4

Questions:

2. The equivalent resistance, in this case, turned out to be a standard resistor value. How would you make up an equivalent resistance of 7.9kΩ ±5% using series and parallel combinations of standard value resistors (with no more than 4 resistors)? Draw the circuit below, and show your calculations, including the % error calculation if needed.

Post Lab Requirements and additional Lab notes:

After lab, **during a time specified by your instructor**, take the post lab quiz. You may use the prelab work, the lab data and answers to the lab questions as reference material for this quiz.

Submit your completed documentation at the beginning of next week's lab before you take that week's prelab quiz. Your team's submission package will be graded and returned with comments. Submit the following (stapled together and in the following order):

1) Your team cover sheet, completely with signatures, filled-in by EACH team member, one per team.
2) Your completed data tables for the circuit voltages and currents for both figures 1 and 2 (including calculated and measured values as well as percent-errors with the percent error formula), one per team
3) Pages 2 and 3 of the lab handout (containing completed Q1 for part 1, your data for part 2 and your completed Q2 for part 2), one per team

*** Do NOT submit extraneous information or forget to answer the questions or your grade will be reduced ***
*** Your submission packet is due at the start of lab and will not be accepted after that time (automatic zero) ***

If you have any questions about your submission, please ask your instructor for clarification.

Lab Note 1: Equivalence

When someone says that two circuits are equivalent, it doesn't necessarily mean that they are identical. Think of the equivalence between a 1 dollar bill, and four quarters. One is a piece of paper, the other four metal coins. But because they can be used interchangeably to buy something that costs $1.00, they are **equivalent**. In much the same way, two circuits can be equivalent to one another. Two circuits that cause the same current to flow when attached to the same source (i.e. fig. 3 and fig. 4 in the lab today) are **equivalent**. When you look at terminals a and b on each circuit, with the sources removed, fig, 3 will have the same resistance between terminals a and b that fig. 4 does. That makes fig. 3 and fig.4 **equivalent**, even though they are not the same.

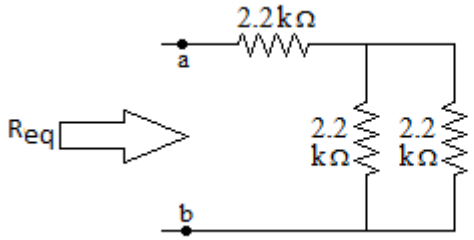

fig. 3

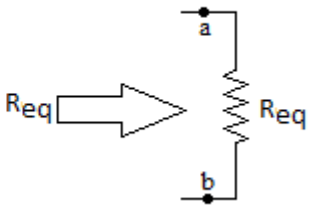

fig. 4

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Team Name and Lab Section:.....

Team Members Present (printed)

First Name, Last Name	Role This Lab	RIT Program

TEAM LABORATORY GRADE

(all work done neatly, legible, complete and organized including data, data tables and questions, completed on time, all signoffs in place, no missing or extraneous information)

Instructor Signature, Part 1 _____	**/10**
Data Tables, calculations, %error, Q1	**/20**
Instructor Signature, Part 2 _____	**/10**
Data, Q2	**/20**
Final Team Grade	**/60**

Instructor comments: