Name:

Physics 589 – Electricity
Instructor R.Sonnenfeld

HARDWARE LAB: Equivalent Resistance: [About 30 minutes]

Parts Needed

- $R_1 = 260\ \Omega$, (Ohm) $R_2 = 400\ \Omega$, $R_3 = 630\Omega$ Resistors (provided)
- Klein Tools Autoranging Multimeter (provided)
- Double-ended alligator clips (provided)
- Soldering iron (provided)
- Solder (provided)

Theory

It can be shown that any circuit made up only of resistors can be replaced by a single resistor called the *Equivalent Resistor or* R_{eq}. The properties of R_{eq} are:

1. The current through the circuit consisting of a battery and R_{eq} is *the same* as the current through the real circuit (with an identical battery).
2. The power dissipated in the real circuit is *the same* as the power dissipated in the circuit with R_{eq}.
3. For these reasons, if you put a multi-meter to measure the resistance of an arbitrary circuit, it will measure the value of R_{eq} of that circuit. We will check this.

1 Writeup

Your writeup should include answers to all the questions that are asked in this guide, and an explanation where it is requested. You DO NOT need to do anything beyond what is requested specifically, nor do you need write a formal lab report.

Procedure – (To do and notice)

1. Measure (and record) each of the three resistors. Their values will be close to 260 Ω, 400 Ω, and 630 Ω, but will not be exactly those values.

2. Assemble the circuits. You are given three $R_1 = 260\ \Omega$, three $R_2 = 400\ \Omega$ and three $R_3 = 630\ \Omega$ resistors.

2a. Circuit 1 This circuit has resistor R_1 in series with a parallel combination of resistors R_2 and R_3. Wrap the wires of the resistors together and THEN add a drop of solder at each junction.

2b. Circuit 2 This circuit has R_2 in series with a parallel combination of R_1 and R_3. Prepare this circuit as before.

2c. Circuit 3 This circuit has R_3 in series with a parallel combination of R_1 and R_2 resistors. Prepare this circuit as before.

3. Predict Use the rules for series and parallel circuits to predict R_{eq}. Record this.

4. Measure Measure each circuit with your multimeter set to Ohms. Your results should agree with theory to within a couple of Ohms.

Analysis – (Write up)

For each of the circuits in steps 2 above, draw a schematic circuit diagram of the three resistors. Label the resistance of each resistor on the diagram.

For each of the circuits, show how you calculated R_{eq} using the appropriate series and parallel circuit rules. Show the numbers plugged into the right formulae, not just your answers. Use the values of the resistors you measured in step 1. (This is just a longer explanation of what you were asked to do in step 3 above. You do not have to do it twice.)

For each of the circuits, record the equivalent resistance measured by your meter. (This is just a repetition of what you were asked to do in step 4 above).

Comment on the agreement of theory and experiment. What reasons can you think of for any differences you saw? What was the percentage error of the largest error you had?

Percentage error is $100 * \frac{(Theory - Measured)}{Theory}$.