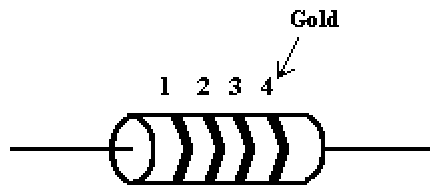
EE101 - Lab 2: Resistive Circuits

ALL PRELABS ARE TO BE COMPLETED ON SEPARATE PAPER AND TURNED IN AT THE BEGINNING OF THE LAB PERIOD (MAKE A COPY TO USE DURING THE LAB). ALL LAB EXERCISES MUST BE COMPLETED IN A COMP BOOK, USING BLUE OR BLACK INK. NO ANSWERS ARE COMPLETE WITHOUT THE UNITS!!

Resistor Color Codes --- Note: *carbon composition resistors will be used*



Color	Value	Multiplier	Tolerance
Black	0	1	
Brown	1	10	
Red	2	100	2%
Orange	3	1,000	
Yellow	4	10,000	
Green	5	100,000	
Blue	6	1,000,000	
Violet	7	10,000,000	
Gray	8	100,000,000	
White	9	1,000,000,000	
Gold			5%
Silver			10%

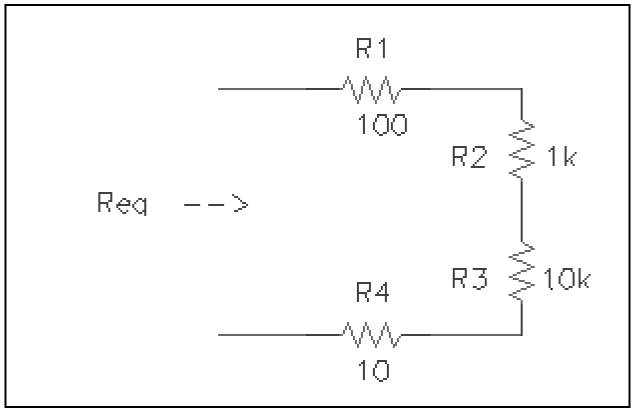
Prelab Exercises

1. Using the resistor color code chart above, list the three colors (in proper order) that would be found on the following resistors:

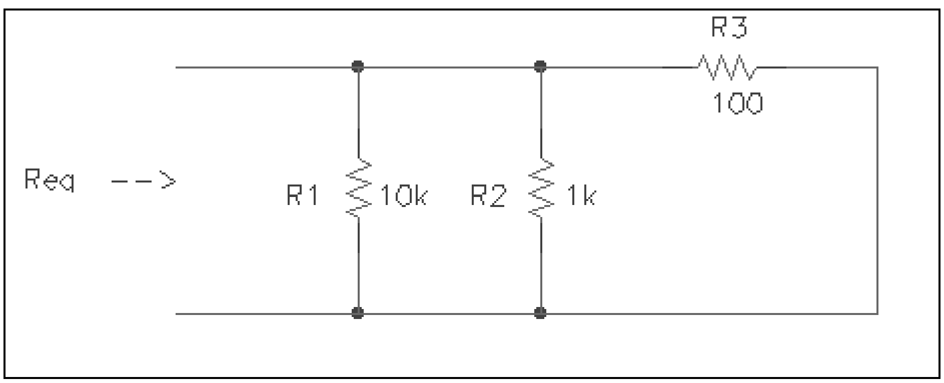
   a. 23,000 ohms
   b. 670 ohms
   c. 1,000 ohms

2. The resistors in the following circuit are said to be in **series**. That is, they are connected one after another to each other, with no other circuit elements connected where each is joined. For series resistors, the equivalent resistance, Req, is obtained by simply adding the resistance values (R1 + R2 +

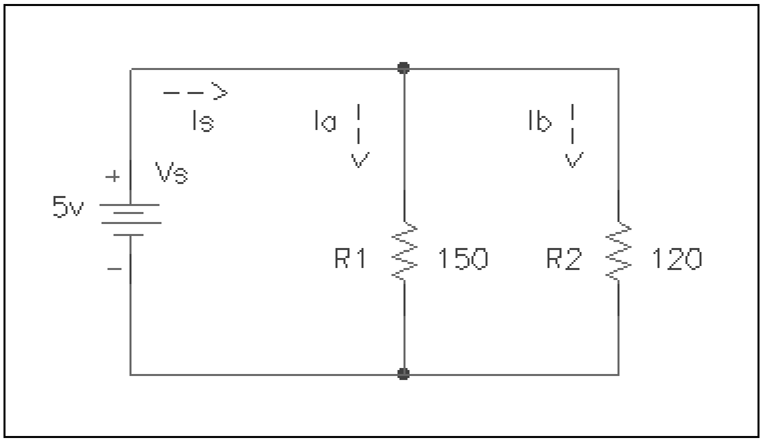
...). An equivalent circuit for the one in the figure would simply be one resistor with the value that you calculated for it. Determine the equivalent resistance, ***Req***, for this network and draw an equivalent circuit.



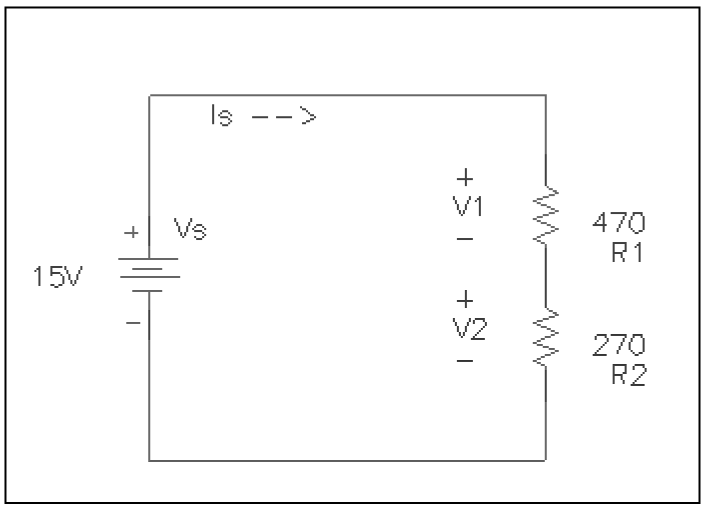
3. The resistors in the circuit below are said to be connected in **parallel** with each other. Parallel circuit elements are elements which are joined to each other at both terminals. The equivalent resistance for parallel resistors is calculated by adding the reciprocals of each resistor, and then taking the reciprocal of that sum. Determine the equivalent resistance, ***Req***, for this network.



4. Using your knowledge of Kirchoff's Voltage Law and Ohm's Law, calculate the values for ***Ia*** and ***Ib***. With this information and Kirchoff's Current Law, determine the value for ***Is***.



5. Draw an equivalent circuit for the network given below by calculating an equivalent resistance for the two resistors. Then, Determine the value of Is by using what you know about KVL, KCL, and Ohm's Law. Once you have determined the value for Is, refer to the original schematic and calculate the values for V1 and V2.



(*end of pre-lab*)

EE 101 Lab Exercise 2: Resistive Circuits

(The exercises outlined below should be included in the Data section of your lab write-up.)

1. Take the resistors out of their bag. Make sure there are 8 of them. Make a chart with headings like the one below. List each resistor by its color bands (see column "Resistor Color Bands" below). Using the color code scheme given on the chart, determine the values for each resistor and write these in the column under "Value". ***If you are color-blind, now is a good time to mention this!*** When you have done this for each resistor, measure the resistor values with a multimeter (set to ohms). Write this value in the "Measured Value" column. When you are measuring resistances, be sure not to grab the leads

with your hands, because you will, in effect, be including your own resistance (in parallel) to that resistor (and this may affect the answer you get). All the resistors in this lab have a tolerance of 5% (as indicated by the gold band on the end). Indicate whether or not the resistors are within tolerance in the last column. When you are finished, put the resistors back in their bag. You will be using these again later in this lab.

Color Bands	Value	Measured Value	Percent Difference	Within Tolerance
br-blk-r-(gold)	1 KΩ	1.04 KΩ	4.0 %	yes

Exercises 2 - 5 require you to build circuits on a protoboard. For all of these circuits, proper breadboarding technique will be expected. This includes using the built-in runners on the breadboards when applicable, using wire cut to proper lengths, and using a proper amount of breadboard space. In short, the circuits you build should be "readable." Any circuit that does not demonstrate proper breadboarding technique will have to be rewired.

2. Using resistors and wire, build the circuit from Exercise 2 in the pre-lab**. Power does not need to be applied to this circuit**. Use the multimeter to measure the equivalent resistance (***Req***) of the circuit. What value do you measure, and how does this compare to the value we calculated in class? (Perform a percent difference between the measured value and the expected value of the equivalent resistance.) The equivalent resistance value you measured here was probably not exactly what you had calculated in the prelab. What reasons can you think of to account for this difference?

$$\% = \frac{Experimental - Theoretical}{Theoretical} \bullet 100$$

3. Follow all the instructions from number 2 above for Exercise 3 in the pre-lab.

4. Build the circuit from Exercise 4 in the pre-lab. **Ask one of the lab assistants to check your circuit before applying power to it.**

    a. **Measuring current using Ohm's Law:** Using a volt meter, determine the value for ***Ia*** by first measuring the voltage drop across the resistor, and then, solve for the current using Ohm's Law. Measure the voltage drop first with the meter probes one way (red/black), then the other (black/red). What affect, if any, does switching the probes have on your measured voltage value? Write down your answer for ***Ia*** (positive answer). In the same way, measure and record the value of ***Ib***. Perform a percent difference between these current values and the ones you calculated in the prelab exercise for this circuit.

    b. Now, measure ***Ia*** and ***Ib*** directly by using the multimeter set to measure current by "breaking" each branch of the circuit - remember, do not attach the leads in parallel with the resistor! Be sure you understand how to do this, if you are not sure, ask before trying something because you can damage the meter by measuring current incorrectly. Record the values. Perform a percent difference between these current values and the ones you calculated in the prelab exercise for this circuit.

    c. Determine the source current ***(Is)*** by "breaking" the circuit and using a current meter. Is this value for ***Is*** equal to the sum of what you measured for ***Ia*** and ***Ib***?

5. With the help of a multimeter, set the protoboard's adjustable source voltage to as close to 15V as you

can make it. This will be ***Vs*** for the circuit in Exercise 5 of the prelab. Record the actual value you set for ***Vs***. Build the circuit from Exercise 5, and as always, **ask one of the lab assistants to look over your circuit before applying power to it.** With the multimeter, measure ***V1*** and ***V2***. Perform a percent difference between your measured voltages for ***V1*** and ***V2*** and those values that you calculated in the prelab. Do these two (measured) values add up to equal the value that you set for your source voltage?

Questions:

(These questions and their answers should be included in the Questions section of your lab write-up).

1. In lab exercises 2 and 3, the equivalent resistance values that you measured were probably not exactly what you had calculated in the prelab. What reasons can you think of to account for these differences?

2. In exercise 4, you were asked to measure the voltage across the resistor with the multimeter probes one way (red first, then black, or "+" then "-"), and then the other way ("-", then "+"). The sign of your measured voltages should have changed when you did this. What *convention* mentioned during lecture was demonstrated here?

3. Also in exercise 4, you measured values for the two branch currents ***(Ia and Ib)*** along with the source current ***(Is)***. What law was demonstrated when you verified that the branch currents summed to equal the source current?

4. In exercise 5, you were asked to note if ***V1***and ***V2*** summed to equal ***Vs***. What law was demonstrated here?

(Be sure to include a brief synopsis of this lab in the Summary section of your lab write-up).

January 2001