5. & 6. RESISTORS AND VOLTAGE DROPS

Equipment List:
DC power supply
HP-DMM
Simpson VOM
Bread Board & wires
2 resistors
Assorted banana cables
Alligator clips

Purpose: To explore and confirm the predictions of DC circuit theory with combinations of resistors.

Procedure:
Part I - Bread-board, Simpson VOM, no power supply. Choose two different resistors in the range **1,000 to 10,000 ohms**. Call one resistor R_1 and the other R_2.

A. With the HP-DMM or whatever is available, measure the resistance of R_1 and R_2; compare to the color code. Record these values as you will need them later. See the last page to understand how breadboard connections are made.

B. Connect your two resistors in series on the bread board as shown in the diagram. With your HP-DMM or VOM, measure the total resistance across the two resistors and confirm that the total resistance is the sum of the two individual resistors.

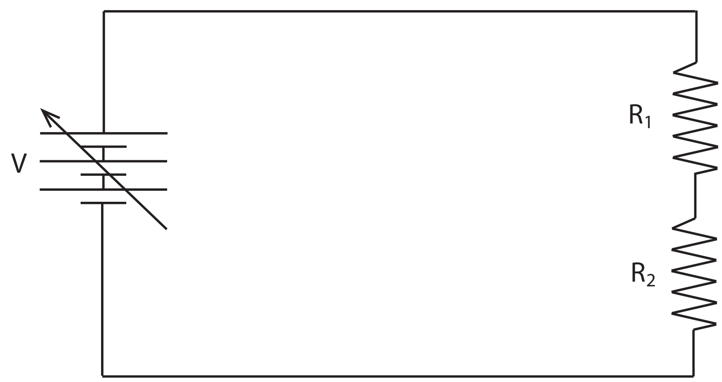
$$R_{\text{total}} = R_1 + R_2$$

C. Connect the two resistors in parallel on the bread board as shown. Measure the total resistance across the two resistors and confirm that they are in parallel.

$$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Part II - Bread-board, Simpson VOM (voltmeter), HP-DMM (ammeter), power supply. In this part of the lab, TAKE NO RESISTANCE MEASUREMENTS DIRECTLY!

A. Construct the circuit as shown below.



B. From circuit theory, find the four algebraic values $I_{R2},\ I_{R1},\ V_{R1}$, and V_{R2} as a function of $R_1,\ R_2$, and V (no numbers).

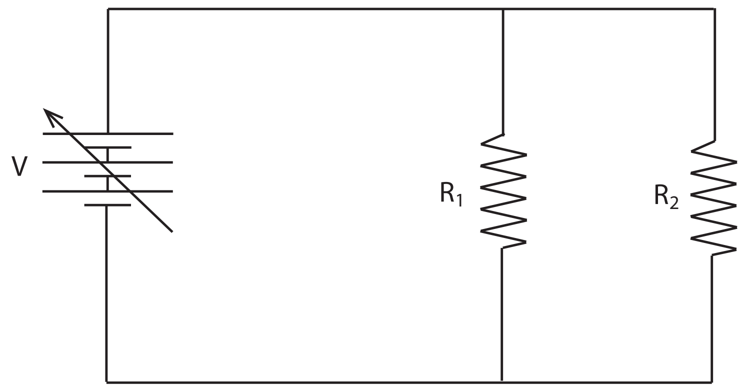
C. Now confirm the predicted values in part B by taking measurements with the VOM and HP-DMM. To make a numerical prediction from these formulas you will need to know the numerical values of R_1, R_2, and V. From part I-A above, you know the values of R_1 and R_2; to find the value of the power source V, you will first construct your circuit and with the power supply connected, turn up the supply to some arbitrary value (above 10 volts) and then measure the supply voltage V. Don't preset the supply voltage to some "nice" value like "exactly" 10 volts; this is bad experimental technique as it prejudices you to a measurement before you've made it.

   You should now calculate all four values from the formulas derived in part B. These calculations represent your precited values. Note that after you have made these numerical predictions you can't change the power supply voltage.

   Now measure all four values ($I_{R2},\ I_{R1},\ V_{R1}$, and V_{R2}) directly. With your circuit still operational and at the same total voltage setting of the power supply as you have already measured in part C, use the VOM as a voltmeter to measure the voltage "drop" across R_1 and R_2. Does your VOM measured values for V_{R1} and V_{R2} agree with your prediction from the part B theory?

D. Now confirm the values of I_{R2} and I_{R1}. This is more difficult because to measure current with an ammeter you must "open" the part of the circuit that you wish to measure the current. Your instructor will demonstrate this for you. Use your HP-DMM as your ammeter. See the diagram below for help as well.

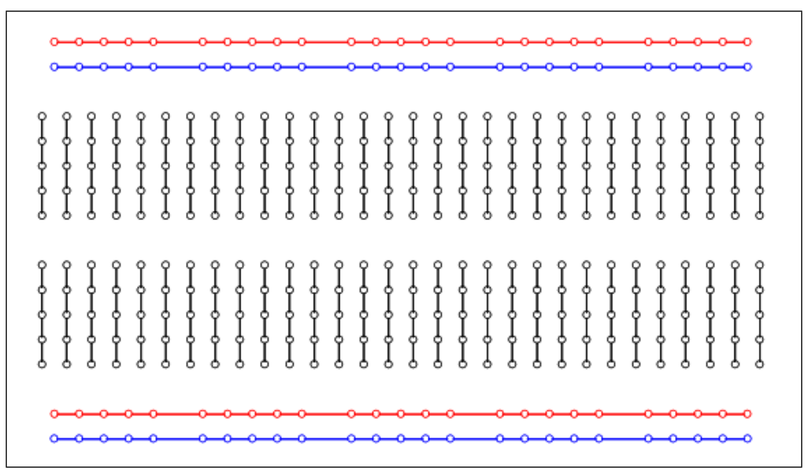
   Again, from the known values of V, R_1, and R_2 you should have a prediction of what I_{R1} and I_{R2} should be. Confirm these predictions with your HP-DMM ammeter.



Repeat all of part II for the new circuit shown.

Conclusion: Comment on the accuracy of your predictions when compared to your measurements. To what extent and in what manner does the usage of a measuring instrument affect the circuit you are trying to measure? Should a voltmeter have a large or small internal resistance? Why? Should an ammeter have a large or small internal resistance? Why? Are there any other sources of error in this experiment? Can you think of any ways to improve or extend this experiment?

The following diagram[1] should help you see how the holes in your breadboard are connected.



[1]Diagram from http://ecee.colorado.edu/ mathys/ecen2250/myDAQ01/