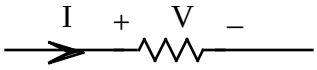
ECE 109L - THE VERY BASICS - LAB 4
OHMS LAW

FALL 2006 **A.P. FELZER**

OBJECTIVE

The objective of this lab is to find out how V is related to I for resistors like the following



LAB

1. **PreLab** - Run and obtain a printout of the following Mathcad programs

   PROGRAM 1 - Range Variables

   a := 1, 1.1 .. 1.3
   2∗a =

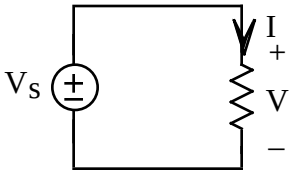
   1. The first line tells Mathcad that
      a. The first value of a = 1
      b. The second value of a = 1.1
      c. The difference between consecutive values of a is 1.1-1 = 0.1
      d. The last value of a = 1.3
   2. When you type 2 *a* = Mathcad will generate a table of numbers - one for each value of *a*

   PROGRAM 2 - Functions

   x := 0, 0.1 . . 0.5
   y(x) := 2∗x
   y(x) =

   1. Mathcad evaluates the function y(x) for every value of x
   2. Note that Mathcad won't accept y := 2∗x when x is a range variable. You must write y(x)

2. To experimentally determine how V is related to I for a given resistor we simply connect up a voltage source as follows



   and measure I for different values of *V*.
   a. **PreLab** - Draw the circuit with a voltmeter inserted to measure *V*. And then draw the circuit with a current meter inserted to measure *I*.
   b. Measure I for the resistor given to you for V = –10, –5, 0, 5 and 10 volts. Put your results in a Table like the following

V (volts)	I (amps)
-10	
-5	
0	
5	
10	

Note that from this point on you should **always** put data like this in Tables.

c. One good way to "see" how V is related to I for a given circuit element is to graph the data points. So plot your data points on a graph with V as a function of I. Then draw a best fit line through your points
d. Find the slope of your line in part (c) equal to the resistance R of your resistor
e. Make use of your results in part (d) to write an equation for V in volts as a function of I in **amps**. **From this point on always** write your equations with **V in volts** and **I in amps**.
f. Explain why only one measurement of V and I is needed to determine R for a given resistor
g. Measure the value of your resistor with an ohmmeter
h. Compare your values for R in parts (e) and (g) in a Table as follows with one column for the value you got from your graph, one column for your ohmmeter reading and one column for the percentage difference.

R From Graph	R From Ohmmeter	% Difference

Then state whether or not the two values are reasonably close.

3. Make a list of the values of the resistor color code. It's a good idea to memorize the color code.

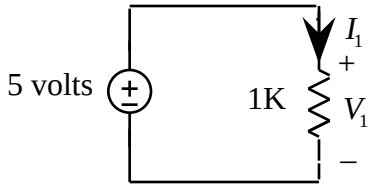
4. Compare the ohmmeter reading of your resistor in Problem (1) with its **nominal** value - the value as given by the resistor's color code. Put your result in a Table like the following

NOMINAL VALUE OF R	MEASURED VALUE OF R	% DIFFERENCE

Then be **sure to state** whether or not the resistor is within tolerance.

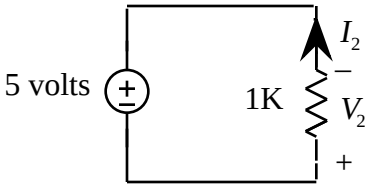
5. The objective of this and the next problem is to see how the choice of reference directions affects the relation between V and I in a resistor. In this problem we address the case of when the resistor reference directions are **associated** as in the following two examples

a. **PreLab** - What does it mean for reference directions to be associated. Draw pictures to illustrate
b. Measure V_1 and I_1 in the following circuit with associated reference directions



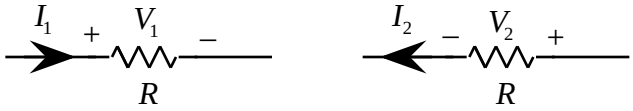
c. Make use of your results in part (b) to write an equation for V_1 as a function of I_1. In particular does $V_1 = 1000 I_1$ or does $V_1 = -1000 I_1$

d. Now measure V_2 and I_2 in the following circuit that also has associated reference directions



e. Make use of your results in part (d) to write an equation for V_2 as a function of I_2. In particular does $V_2 = 1000 I_2$ or does $V_2 = -1000 I_2$

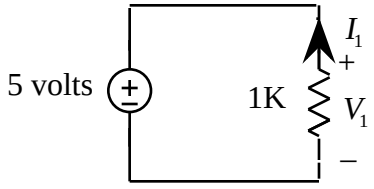
f. What would you conclude is the relationship between V and I for the following resistors with associated reference directions. **Memorize** this result



6. In this problem we address the case of when the resistor reference directions are **not associated** as in the following two examples

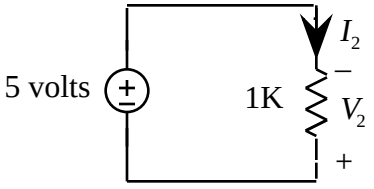
a. **PreLab** - What does it mean for reference directions to not be associated. Draw pictures to illustrate

b. Measure V_1 and I_1 in the following circuit with reference directions that are not associated

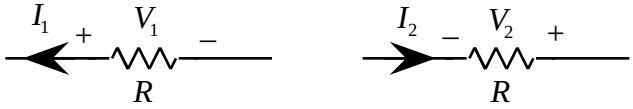


c. Make use of your results in part (b) to write an equation for V_1 as a function of I_1. In particular does $V_1 = 1000 I_1$ or does $V_1 = -1000 I_1$

d. Now measure V_2 and I_2 in the following circuit that also has reference directions that are not associated



e. Make use of your results in part (d) to write an equation for V_2 as a function of I_2. In particular does $V_2 = 1000I_2$ or does $V_2 = -1000I_2$
f. What would you conclude is the relationship between V and I for the following resistors with reference directions that are not associated. **Memorize** this result



7. **PreLab -** Learning the color code
   a. What is the value of a resistor with the color code brown-black-orange
   b. What is the color code of a 4.7K resistor