ECE 109 - THE VERY BASICS - INVESTIGATION 5
ONE RESISTOR CIRCUITS

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To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs and tables.

From the last two Investigations we know how to write equations for the voltages and currents of ideal sources and linear resistors. In particular we know that if the reference directions of a linear resistor are *associated* as follows

then $V = RI$. But when the reference directions are *not associated* as follows

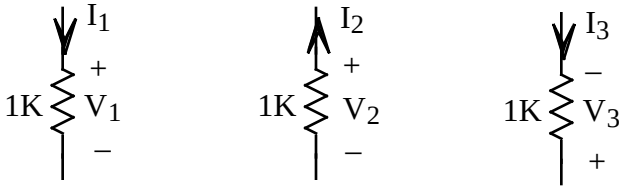
then $V = -RI$

The objective of this Investigation is to make use of these relations to analyze circuits with one resistor and one source. Now the circuits we're going to be working with are very simple but it's still very easy for beginners to make mistakes. So be sure to

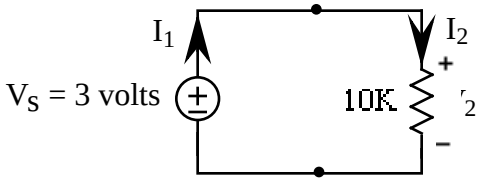
(1) Double check that all voltages and currents in your equations are labeled in your circuit diagram and that you've included all reference directions
(2) Double check that all voltages and currents have their proper subscripts
(3) Double check whether the resistor reference directions are associated or not associated

Be sure to take a look at the **Computer Demos** on Simple Resistor Circuits.

1. We begin with a review problem. Find V as a function of I for each of the following



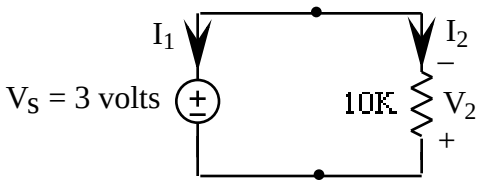
2. We now find the voltages and currents in the following simple circuit



Showing your work to

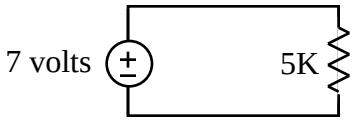
a. First find V_2 from V_S.
b. Then use Ohm's Law to find I_2 from V_2.
c. And then find I_1 from I_2.
d. Is the equivalent positive charge in this circuit flowing clockwise or counterclockwise. How do you know
e. Which way are the electrons going in this circuit

3. Given the same circuit as above but with different reference directions as follows



a. Find V_2.
b. Find I_2.
c. Find I_1.
d. How did changing the reference direction from Problem (1) affect your equations and your results
e. Verify that your results give the same direction for the flow of equivalent positive charge as you got for this circuit in Problem (1)

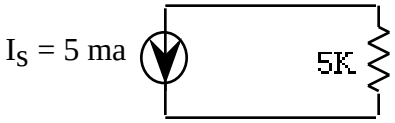
4. Given the following circuit



a. Arbitrarily choose reference directions for the voltages and currents and then solve for them.
b. In what direction is equivalent positive charge flowing through this circuit
c. How did your choice of reference directions in part (a) affect your answer in part (b)

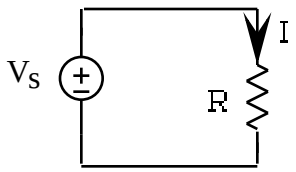
5. Which of the following three steps of circuit analysis involve arbitrary choices and which don't. Explain
   a. Choosing reference directions
   b. Writing the equations for a given set of reference directions
   c. Making use of the results to determine the direction of flow of the equivalent positive charge and the nodes that are at the higher potentials

6. Choose reference directions for the voltages and currents in the following circuit



and then solve for them. Hint - begin by finding the current through the resistor.

7. Given the following circuit



a. How does the size of R affect the magnitude of the current I. Why.
b. Illustrate your result in part (a) with a graph of I as a function of R for $V_S = 5$ volts

8. Math Review - Sketch $V = \dfrac{1000}{1000 + R}$ for $R > 0$