Name: _____ Partner(s): _____

_____

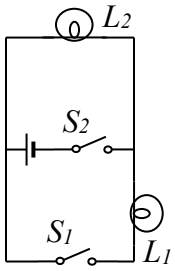
Homework Questions for Investigation #11

Go to the following website and use the circuit construction kit to build each of the circuits below help you answer questions 1-3:

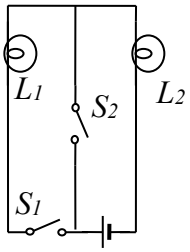
https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html

1. A circuit that contains one battery, two switches (labeled S_1 and S_2) and two lamps (labeled L_1 and L_2) is to be designed so that it does the following:
   1) If only S_1 is closed, nothing will happen.
   2) If only S_2 is closed, only L_2 will light.
   3) If both switches are closed, both lamps will light.

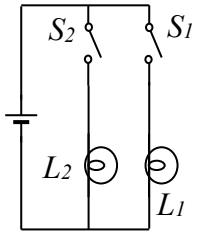
   Below are five design attempts at this circuit. In each of the five designs, determine which of the circuit(s), if any, meet all three of the criteria listed above. For each space in the table below write "Yes" if the criterion is satisfied. If the criterion is not satisfied, specifically state what actually happens instead in that space.



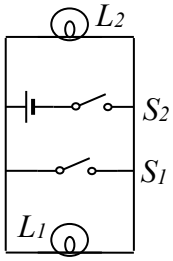
A



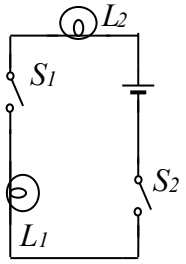
B



C



D



E

Circuit:	A	B	C	D	E
Criterion 1 Satisfied?					
Criterion 2 Satisfied?					
Criterion 3 Satisfied?					

2. Design and sketch a circuit having one battery and three lamps (*A*, *B* and *C*) that all light when a switch is closed. If lamp *A* is unscrewed, both lamps *B* and *C* go out. If lamp *B* is unscrewed, the both lamps *A* and *C* stay lit. If lamp *C* is unscrewed, both lamps *A* and *B* stay lit. Be sure to label the lamps *A*, *B*, and *C* in your sketch. (**Hint:** This is a combination of *Circuit Problems 1* & *2* that you did in the lab. You can also build this circuit using the circuit builder at the website cited on the previous page.)

3. Is your home wired in series or parallel? How do you know? What about an automobile headlight? How do you know? What about "bargain" holiday light strings? Again, how do you know?

4. Plot three separate graphs of voltage vs. current data that you acquired in **Part IV** for the two resistors and the lamp. (For these graphs, even though voltage is the independent variable and current is the dependent variable, you will plot voltage on the vertical axis and current on the horizontal axis.) Attach the graphs to this packet when due. Use your graphs to answer Questions 5-8. If (0,0) is a valid data point, be sure to include it in the graph.

5. Are the shapes of the graphs for the two resistors straight lines or curved lines? If the curves are straight lines, calculate the slopes and compare the values of the slopes to the values of the resistors. If the curves are not straight lines, are the slopes increasing or decreasing as the voltage increases?

6. Is the shape of the graph for the lamp a straight line or a curved line? If the curve is a straight line, calculate the slope. If the curve is not a straight line, is its slope increasing or decreasing as the voltage increases?

7. The *resistance* in a circuit is the slope of the voltage vs. current graph at any point. Is the resistance of the resistors constant? Is the resistance of the lamp constant? (Hint: Revisit Questions 6 and 7.)

8. If the resistance for either device (lamp or resistor) is not constant, is the resistance of the device greater when the voltage is lower or when the voltage is higher? How do you know? (Hint: Refer back to Question 7.)

9. Find the nominal resistance and the minimum and maximum values of the resistors whose color bands are:

   a. GREEN-BLUE-GREEN-SILVER:

      R = _____ Ω ± _____ %

      R_{min} = _____ Ω R_{max} = _____ Ω

   b. BROWN-GRAY-ORANGE-(None)

      R = _____ Ω ± _____ %

      R_{min} = _____ Ω R_{max} = _____ Ω