Electric Circuits Lab

Purpose: To construct series and parallel circuits
To compare the current, voltage, and resistance in series and parallel circuits
To draw schematic (circuit) diagrams of various circuits

Materials: Computer with internet access and Java/Flash for simulated circuit kit

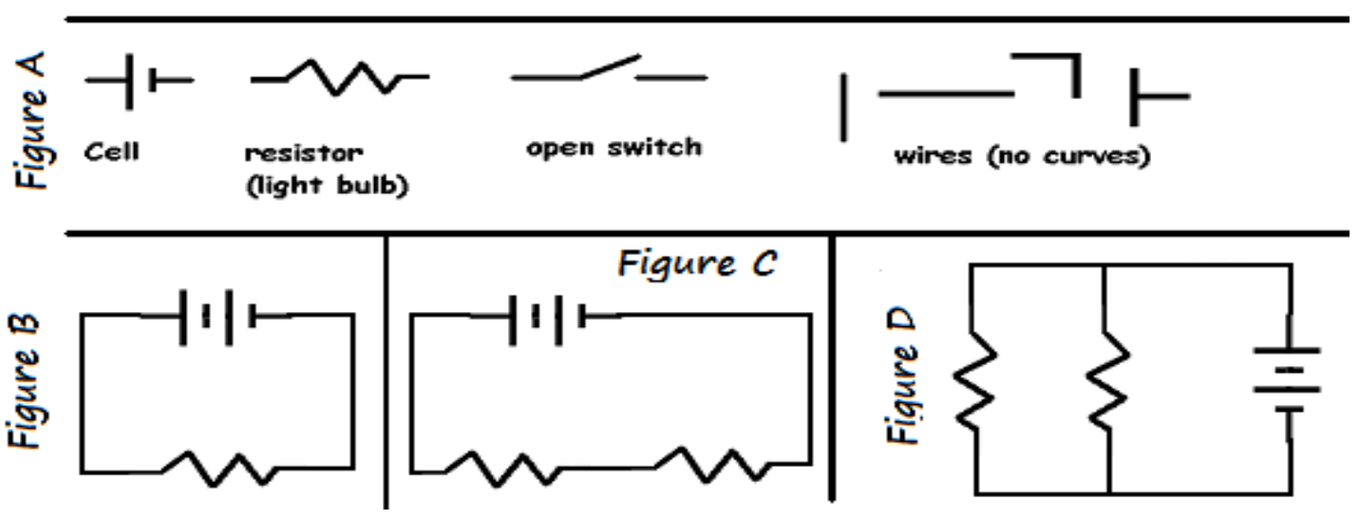
Setup: Go to http://theteterszone.net/wp/circuits-2 to start

Simulation basics:

(1) maximize the window so you have more room to work
(2) click the "show>>" button and check "Hide electrons"
(3) the simulation labels a cell as a battery, this lab properly calls it a cell.
(4) all you need to do to make circuits is to click and drag items from the right side onto the blue workspace, right click on items if you need to delete or disconnect
(5) do not connect bulbs directly to anything, use wires

Play time! Start off by playing around with the simulation to see how it works and what you can do for 5-10 minutes.

Now reset the simulation and start Part 1



Part 1:

You will construct 4 different electric circuits using various combinations of cells and light bulbs. **Be careful when using multiple cells to always connect (+) to (-).** Be sure to complete the following for each circuit:

- **(a)** Describe the brightness of each bulb when your circuit is complete.
- **(b)** Draw a circuit diagram for each setup. Use the symbols provided in **Fig A**.
- **(c)** Identify each circuit as series or parallel. I realize you might be guessing at this, but make an educated guess.

Circuit 1: One cell and one bulb	**Circuit 2: One cell and two bulbs**
Circuit 3: Two cells and one bulb	**Circuit 4: Two cells and two bulbs**

<u>Have your teacher approve your work up to this point.</u>

Electric Circuits Lab

Series Circuits

Do this first…

#1) Click the "load" button in the top right corner, and find the Circuit Kit file you saved previously during the setup. If you do not do this you may have to re-do the lab.
#2) Now add a voltmeter by checking the "Voltmeter" box on the right side, it should show up on the workspace. The white box that is already on the workspace is the ammeter.
NOTE: At no point should you take a light bulb from the workspace. If you delete a bulb you will need to re-load the circuit kit file.

Part 2: Single bulb series circuit

1) Use bulb #1 (filament pointing to the right) and construct the circuit shown in **Figure B** on page 1. Measure the voltage provided by the battery (2 cells) by touching the red lead on the voltmeter to the (+) end of the battery and the black lead to the (-) end of the battery. Notice that the leads are placed "across" the battery, this is how you measure voltage. **Record this value.**
2) Now measure the voltage across the light bulb in the same manner. **Record this value as the voltage "ACROSS".**
3) This is also known as the "**voltage drop**" due to the electrical energy being converted into heat and light by the bulb. **Record this value as the voltage "DROP".** *Note that this is the same value as the voltage "across" from the previous step.*
4) Measure the current in the circuit by connecting the ammeter "in-line" between the (+) end of one cell and the light bulb. Basically you are adding the ammeter to the circuit just like you would a light bulb. **Record this value.**
5) Calculate **(K-U-E-S)** the resistance of the light bulb using the bulb's voltage drop and the current measured.

   Have your work approved up to this point
6) Repeat steps 1-5 using bulb #2 (filament pointing to the left).

   Have your work approved up to this point.

Part 2: Single bulb series

LIGHT BULB #1

Voltage provided by the battery (both cells) _____

Voltage “ACROSS” light bulb #1 _____

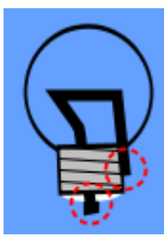
Voltage “DROP” for light bulb #1 _____

Current in the circuit with light bulb #1 _____

Calculate the Resistance of light bulb #1 (Show K-U-E-S)

Work approved _____

LIGHT BULB #2



Voltage provided by the battery (both cells) _____

Voltage “ACROSS” light bulb #2 _____

Voltage “DROP” for light bulb #2 _____

Current in the circuit with light bulb #2 _____

Calculate the Resistance of light bulb #2 (Show K-U-E-S)

Work approved _____

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Part 3: Two bulb series circuit

1) Use both bulb #1 and #2 to construct a circuit like **Figure C** on p. 1. This is a series circuit.
2) Disconnect one of the bulbs. What happens to the other bulb? Reconnect the bulb.
3) Measure the voltage provided by the battery by touching the red lead to the (+) end of the battery and the black lead to the (-) end of the battery. **Record this value.**
4) Measure the voltage drops across each light bulb. **Record this value.**
5) Add the voltage drops of each bulb together. This should equal the voltage provided by the battery, however, some electrical energy is lost in the wires and you may notice a very small difference. **Record this on your lab sheet as the total voltage drop across the bulbs.**
6) Measure the current in the circuit by connecting the meter *in-line* between the (+) end of one battery and one of the light bulbs. **Record this value.** Measure the current again, this time between the bulbs. **Record this value.** Measure the current once more, this time between the (-) end of the battery and the other light bulb. **Record this value.** Are these three currents related? How?
7) Calculate **(K-U-E-S)** the equivalent (total) resistance of both light bulbs by using the total voltage drop across both bulbs and the current measured at any point in the circuit. How does the equivalent resistance relate to the resistance of both bulbs you found in Part 2?

Have your work approved up to this point

Part 3: Two bulb series circuit

Answer to question #1

Voltage provided by battery _____

Voltage drop across light bulb #1 _____

Voltage drop across light bulb #2 _____

Total Voltage drop across both bulbs _____

Current between (+) of battery and light bulb #1_____

Current between bulb #1 and bulb #2 _____

Current between (-) of battery and light bulb #2_____

How are these three currents related? (same, one larger/smaller)

Calculate the TOTAL or EQUIVALENT Resistance of the circuit:

(Show K-U-E-S)

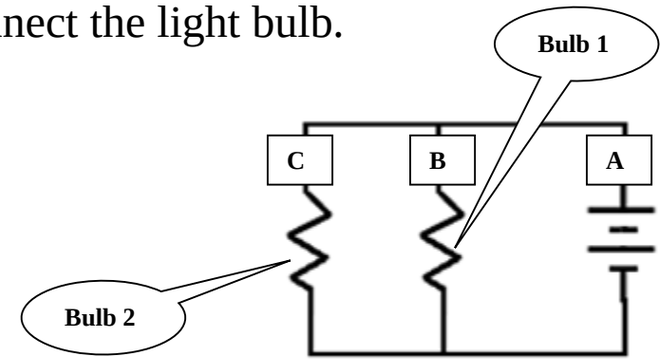
How does the total resistance of the two bulb series compare to total resistance of the two bulbs from Part 2?

Work Approved _____

Electric Circuits Lab

Part 4: Two bulb parallel circuit

1) Construct a circuit like **the figure below**. Use enough wires so that the circuit is structured like the figure. This is a parallel circuit due to the two pathways for the current to flow. Disconnect one of the bulbs. What happens to the other bulb? What might be an advantage of parallel circuits over series circuits based on this observation? Reconnect the light bulb.



2) Measure the voltage provided by the battery by touching the red lead to the (+) end of the battery and the black lead to the (-) end of the battery. **Record this value.**

3) Measure the voltage drop across each light bulb. **Record these values.** How do these voltages compare to the voltage provided by the battery?

4) Measure the current in the circuit by connecting the meter *in-line* at point A. **Record this value.** Measure the current again…this time connect the meter *in-line* at point B. **Record this value.** Measure the current one more time…this time connect the meter *in-line* at point C. **Record this value.** How does the current through both point B and point C relate to the current through point A?

5) Calculate **(K-U-E-S)** the equivalent (total) resistance of the light bulbs using the voltage provided by the battery and the current when measured nearest the battery at point A. How does the equivalent resistance relate to the resistance of both bulbs you found in Part 2?

<u>Have your work approved up to this point</u>

Part 4: Two bulb parallel circuit

Answer to question #1

Voltage provided by the battery _____

Voltage drop across light bulb #1 _____

Voltage drop across light bulb #2 _____

How do these voltages compare to the voltage provided by the battery?

Current at Point A _____

Current at Point B _____

Current at Point C _____

How does the sum of the currents at B and C relate to the current at A? (same, one larger/smaller)

Calculate the Total or Equivalent Resistance (Show K-U-E-S)

How does the total resistance of the two bulb parallel circuit compare to total resistance of the two bulbs from Part 2? (same, one larger/smaller)

Work Approved _____

Electric Circuits Lab

Lab Conclusions:

1. Describe the flow of charge in the series circuit.

2. Describe the flow of charge in the parallel circuit.

3. What happens to the equivalent resistance when light bulbs are connected in series? To answer you need to compare Parts 2 and 3.

4. What happens to the equivalent resistance when light bulbs are connected in parallel? To answer you need to compare Parts 2 and 4.

5. Which circuit draws more current from the cells…series or parallel? Explain why this is so.

6. How is the voltage from the battery distributed in a series circuit? (how does the voltage compare from bulb to bulb)

7. How does the voltage of each part in a parallel circuit compare to the battery voltage?

8. Draw a circuit diagram of a parallel circuit with three light bulbs and a switch. The switch should only turn off one of the light bulbs. You can try it on the simulation first…it might help.