PS 12b Lab 1a
Fun with Circuits

Lab 1a

Learning Goal: familiarize students with the concepts of current, voltage, and their measurement.

Warm Up:
A.) Given a light bulb, a battery, and single copper wire, find as many distinct ways as possible to light the bulb. Draw a schematic below for each correct method. Be sure to clearly show the contact points.

B.) Using the following PHET, make a light bulb light. Show your TF when you're finished.

Circuits Simulation

Questions:

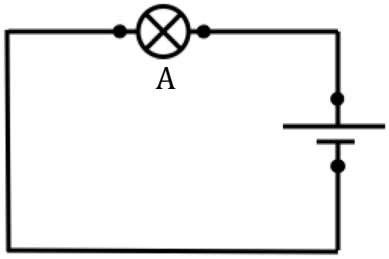
1. What is the role of the battery? It might help to removing it from the circuit. Use the voltmeter to measure the potential difference (i.e. voltage) across the battery. Repeat for the light bulb.

2. In words, what is electrical current?
3. Try measuring the current at various points of the circuit using an ammeter.

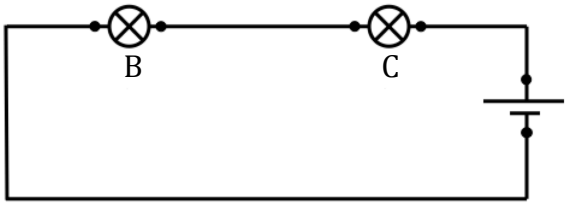
True or False? Current is the largest just when the electrons are leaving the negative terminal of the battery? Explain.

Simple Electrical Circuits

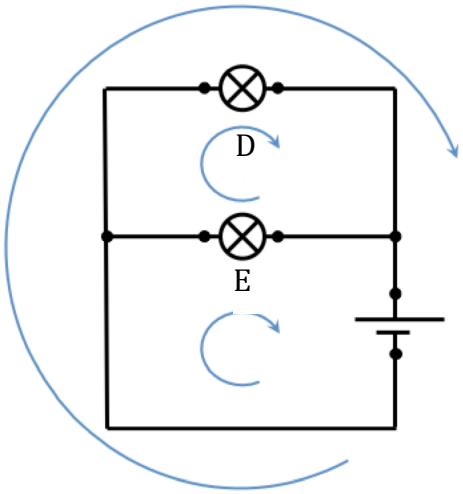
Consider each of the following circuits.



Circuit 1



Circuit 2



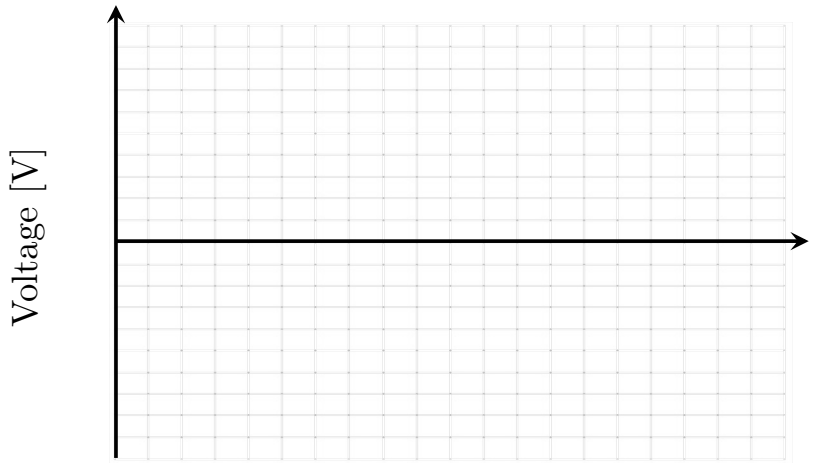
Circuit 3

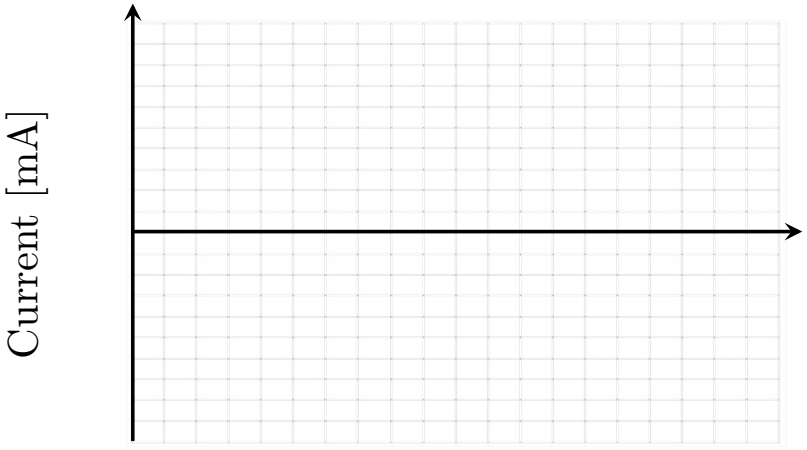
Before constructing them, rank the brightness of each light bulb. Label each bulb A through E, and then use >, =, and > symbols. Show your prediction to the TF.

_____ TF's initials.

Measuring Voltage and Current

Now return to circuit 1. Follow along with the TF as we analyze this circuit.





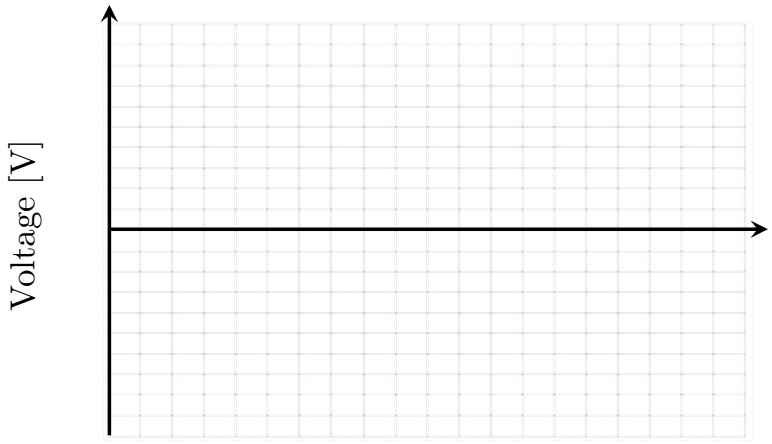
- How does the potential change as you move around the circuit?

- How does the current change as you move around the circuit?

Series Light Bulbs

For the circuit shown in figure 1b, wire up the circuit and use the meters to map out the currents and voltage at various places in the circuit. Specifically,

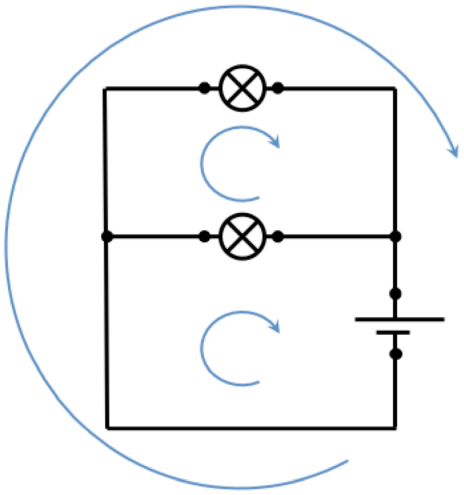
1. Label various points denoted by black dots in each circuit and choose a reference point (for voltage measurements).
2. Measure the voltage with respect to the reference point, and plot this on the voltage versus location grap



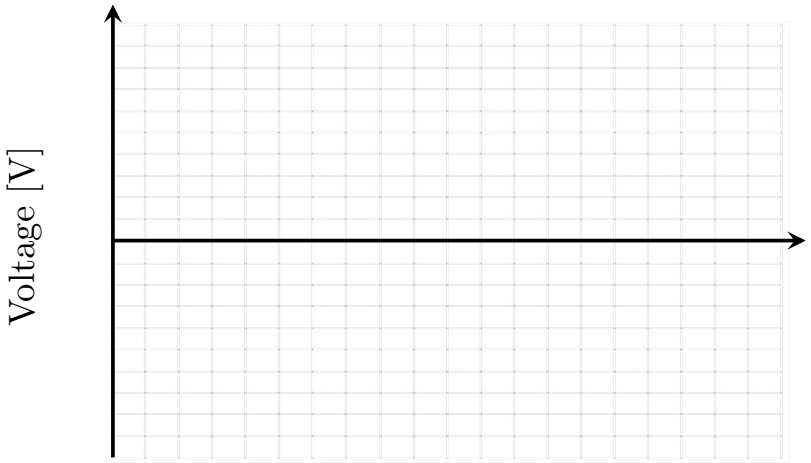
Question: I once heard a student say, "But I thought half of the current was used up by the first light bulb." Comment on this student's statement. We know batteries don't last forever, so what is actually being used up?

Parallel Light Bulbs

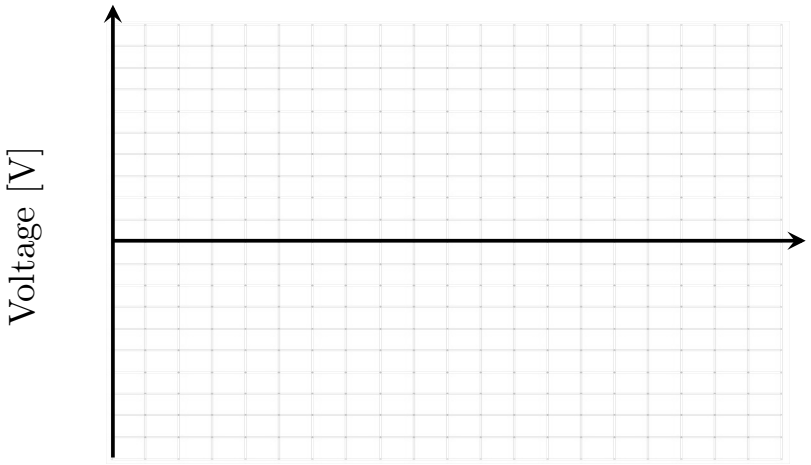
Build the circuit in figure 1c, and map out the voltage at various places in the circuit.



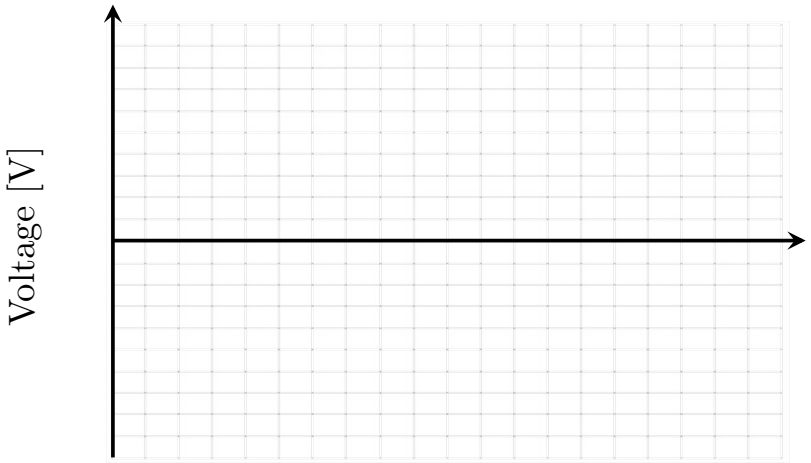
Label each black dot. Measure the voltage at each point with respect to a chosen reference point. Do this for **each loop** given by the blue arrows, and record your results on the graphs shown below. Be sure to label the loops and graphs according.



Location



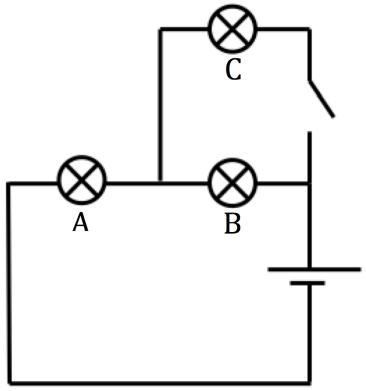
Location



For each independent branch of the circuit, measure the current. How are the three related?

Returing the question we asked earlier, rank the brightness of the light bulbs in the three circuits we analyzed.

Series and Parallel Combinations



Here is a circuit that is a series and parallel combination. Include a switch this time. Before building the circuit make the following predictions.

When the switch is open compare the brightness of bulbs A, B, and C.

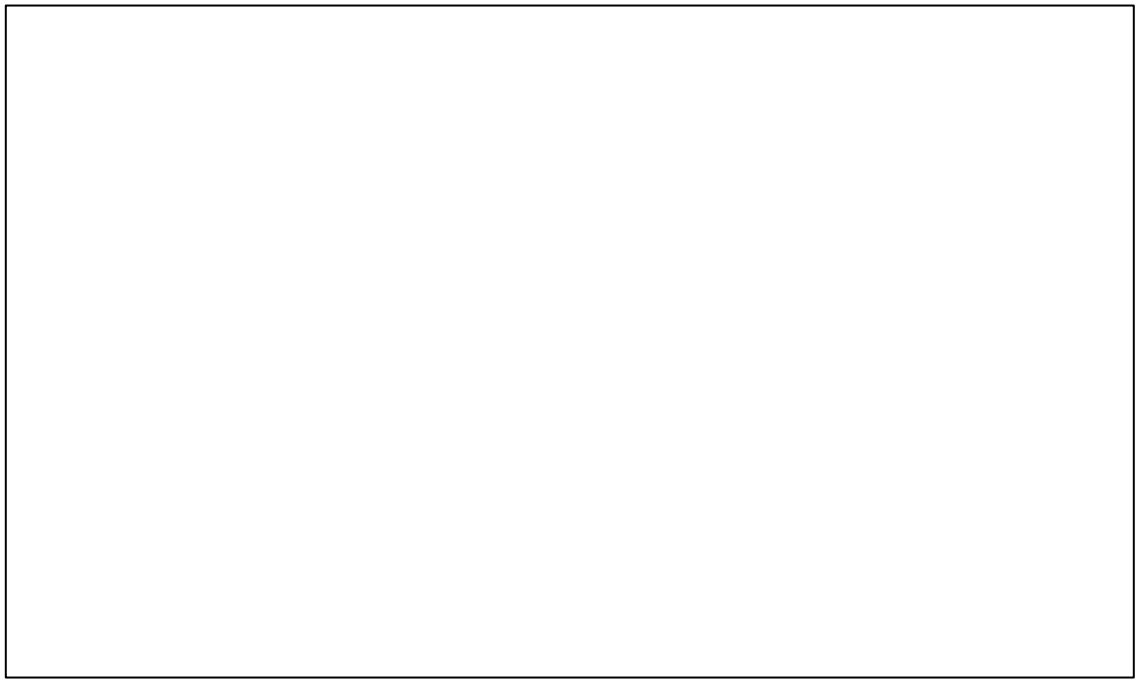
What happens to the brightness of each bulb when you close the switch? Explain your answer.

Before building the circuit, discuss with the TA your predictions, and have the TA initial _____.

Now build the circuit and see if your predictions are correct. If they are not, explain below what the correct answer is and why it happens. Do NOT change your predictions.

Challenge

1. Using the lab materials on the bench design a circuit so that you can turn a hallway light on and off from two different switches. Document your ideas with schematics. Include your final answer with a schematic and then create a working model. Show your result to the TA.



2. Given two batteries and two capacitors, charge the capacitor(s) to light a single light bulb the (a) longest, or (b) the brightest. Draw the corresponding circuit diagrams below.