Lab 3 Parallel Circuits

!!! READ THIS PAGE!!!!

When a wire or light bulb is connected across a battery, we have **evidence** that something is happening in the circuit. The wire gets warm. The bulb glows. *In science, evidence always comes in the form of observations and measurements of the world around us. When questions in this lab ask for evidence, or ask "how do you know", you should consider only those things you can see or otherwise sense directly.* Explanations, calculations, interpretations and logical reasoning help us make sense of these observations and measurements. But, the foundation of science, its core, is the evidence that that we gather from the world around us.

Models and Assumptions

In previous labs, we began working to construct a **model** to account for what we observe in electric circuits. As part of our model, we envision something flowing in a continuous loop from one end of the battery (called a **terminal**), through the rest of the circuit, back to the other terminal of the battery, through the battery and back to the first terminal of the battery again. We call what is flowing in the circuit **current**. Based on modern science, we know that current is a flow of mobile electrons. These electrons do not come from the battery; they are present in the wire and all other conductors.

Often, as scientists work to develop models they must make some *assumptions.* Anything that we take to be true without proof is an **assumption**. In this lab, we will make the same two assumptions that we did in the last:

Assumptions:

A) **There is current flowing through the entire circuit, including the bulb and battery.**
B) **When comparing identical bulbs, the brightness of a bulb is an indication of the amount of current flowing through the bulb. (A brighter bulb has more current flowing through it.)**

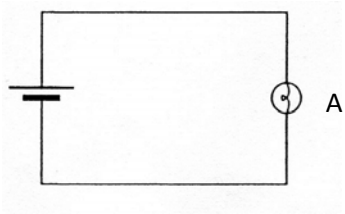
These assumptions seem reasonable to most people. However, it is important to remember that we have no direct evidence for either of these assumptions.

Review

1. Based on our assumptions above, if two identical bulbs are equally bright, what does this indicate about the electric flow through them?
2. Given our assumptions, if one bulb is dimmer than another identical bulb what does this indicate about the flow through the dimmer bulb?

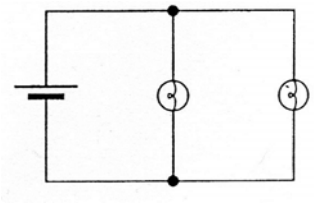
Parallel Circuits

Set up a single bulb attached to a battery as shown in the figure below. The bulb should light. Notice the brightness of the bulb.



single bulb circuit

3. Now add a second identical bulb to the circuit so that the two bulbs have their terminals attached together as shown.



Two bulbs with their terminals attached together in this way are said to be connected in **parallel**.

4. How does the brightness of each of the bulbs compare to the brightness of an identical bulb in a single-bulb circuit?

Concentrate only on any large difference you may observe, not minor differences that may occur if two identical bulbs are , in fact, not quite identical

5. Recall the assumptions we have made in developing our model for electric current (see page 1 of this lab if necessary). Based on these assumptions, would you think there is the same amount of current through a bulb in a single bulb circuit as there is through the same bulb when it is connected in parallel with a second bulb? If not, in which circuit is the current through the bulb greater?

6. What evidence do you have for your answer to #4 above? (Your writting may be graded!)

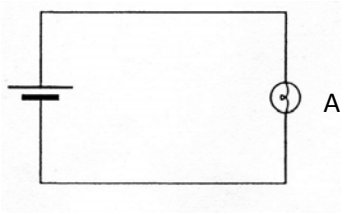
7. Compare the two bulbs in the parallel circuit. Are they the same brightness?

Concentrate only on any large difference you may observe, not minor differences that may occur if two identical bulbs are , in fact, not quite identical

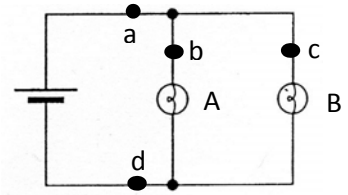
8. Is there the same amount of current through each bulb in the two-bulb parallel circuit? What evidence do you have for your answer?
9. Considering your answers to last few questions above, what can you infer about the relative amounts of current through the battery in a single-bulb circuit and in a circuit in which two identical bulbs are connected in parallel across the battery?
10. Does the amount of current through a battery appear to remain constant or does it seem to depend on the number of bulbs in a circuit and how they are connected?

Apply Your Understanding

Suppose that again there are 3 units of current through Bulb A in Circuit 1.



Circuit 1



Circuit 2

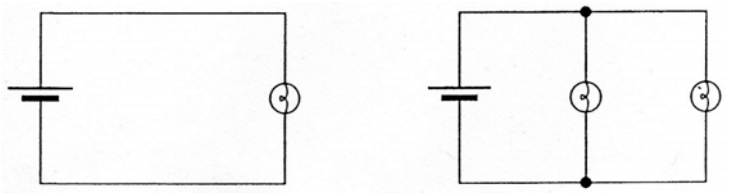
11. How much current is there through the battery in Circuit 1?
12. Are there 3 units of current through Bulb A in Circuit 2? If not, is there more or less than 3 units of current? (You answer must be consistent with your observations of brightness.)
13. How much current is there at point b in Circuit 2?
14. How much current is there at point c in Circuit 2?
15. How much current is there at point a in Circuit 2? THINK CAREFULLY HERE.
16. How much current is there at point d in Circuit 2?
17. How much current is there through the battery in Circuit 2?
18. Describe the flow of current around the entire circuit for the two-bulb parallel circuit. Think about the way the current through the battery might divide and/or recombine at the **junctions** where the circuit splits into the two parallel branches. You can describe the flow of current using words, a picture or a combination of the two.

✓ *Check your answers with your instructor.*

Now connect the second bulb with its terminals directly connected to the terminals of the battery, so that both bulbs are directly connected to the battery.

19. Is there any change to the brightness of the bulbs? Does it seem to matter if each bulb has separate leads to the battery or if the terminals of the bulbs are connected together and then connected to the battery?

Consider the two circuits below and the following dispute between two students.



Circuit 1 Circuit 2

Student 1: *The current through the battery is the same in each circuit. In Circuit 2 the current from the battery is divided between the two bulbs so each bulb has half the current through it that the bulb in Circuit 1 has through it.*

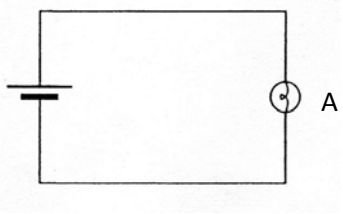
Student 2: *We know the current through each of the bulbs in circuit 2 is the same as through the bulb in circuit 1. We know this because the bulls are all about the same brightness-and bulbs that are equally bright have the same current through them. So the flow through the battery in circuit 2 must be more than that through that the battery in circuit 1"*

20. Do you agree with student 1, student 2 or neither?

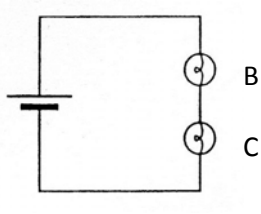
More on next page!!!

Comparing Current Flow in Parallel and Series Circuits.

Consider the following three circuits which contain identical bulbs and batteries. Recall your observations of the brightness of the bulbs which are also shown below the diagrams.

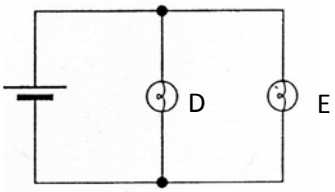


single bulb circuit



two-bulb series circuit

Bulbs B and C are the same brightness as one another but are dimmer than the single bulb A.



two-bulb parallel circuit

Bulbs D and E are the same brightness as one another and are also the same brightness as the single bulb A.

21. Is the amount of current through bulb B the same as through bulb C? If not, which has more? What **evidence** do you have to support your answer? (Your writing may be graded!)

22. Is the amount of current through bulb B the same as through bulb A? If not, which has more? What **evidence** do you have to support your answer?

23. Is the amount of current through bulb D the same as through bulb A? If not, which has more? What **evidence** do you have to support your answer? (Your writing may be graded.)

24. Rank the current through bulbs A, B, C, D and E from least to greatest (least first). If two or more bulbs have the same current through them put an equal sign between them.

25. Rank the current through the battery in the three circuits above from least to greatest (least first). If the current through the battery is the same in any two circuits, state that.

✓ *Check your answers with your instructor.*