LAB 1 BATTERIES AND BULBS

EXPERIMENTAL GOAL

Your goal in this laboratory is to develop experimentally a simple model of current flow in a multi-element electrical circuit. (In this case, the "elements" are identical light bulbs.) You will then use your model to *predict* the relative brightness of the bulbs in the four-bulb circuits shown below, and then check your prediction.

Fig. 1

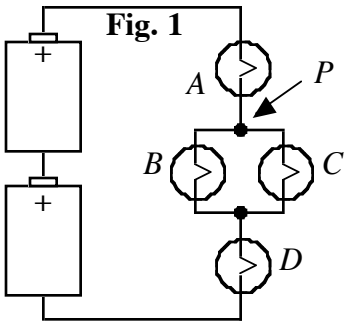


Fig. 2

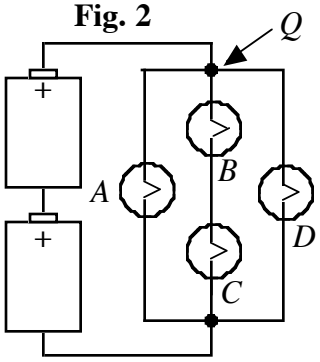
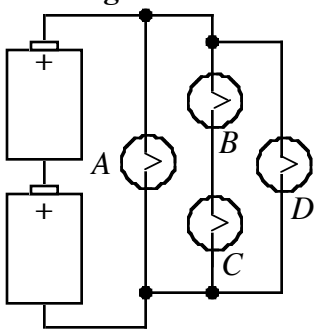


Fig. 3



Your goal should ultimately be to develop a model that is able to predict (qualitatively) the relative brightness of *any* (small) number of identical bulbs in any arrangement and provide answers to the following questions: (1) Does the battery produce a *fixed* amount of electrical current, or does the current depend on the number and/or arrangement of bulbs? (2) What happens to the current when it reaches a junction in the circuit where the possible branches are equivalent, such as the junction marked *P* in Figure 1? What happens when it reaches a junction with unequal branches, such as the one marked *Q* in Figure 2. (3) Why are the circuits in Figures 2 and 3 really the same, even though the one in Figure 3 looks like it has more junctions?

LAB SKILLS you will be developing

1. Connecting circuit elements in various configurations.
2. Using the *ammeter* setting on a digital multimeter. (In this setting, the multimeter displays a quantitative measure of the current flowing through it.)

SOME PROCEDURAL SUGGESTIONS AND NOTES

Trying to understand the behavior of a four-bulb circuit right away might be a daunting task. It may be easier for you to develop a model of current flow by studying simpler circuits and working up to the circuit shown. For example, you might do the following:

1. First connect one light bulb to the two D-cells and observe its brightness. (The D-cells should be connected so the positive end of one is connected to the negative end of the other, as shown in the diagram above.) Also use the digital multimeter to measure the current flowing into the light bulb, out of the light bulb, and between the two batteries.
2. Then connect circuits involving *two* light bulbs. There are *two* distinct ways that you can connect the two bulbs to the battery-pair in this case; what are they? Again, note the brightness of the bulbs in each case, and measure currents flowing into each bulb, out of each bulb, out of the battery pair, and so on. Start making some hypotheses about how current behaves. Then continue your work toward more complicated circuits.
3. Note that the goal is to predict the relative brightness of the identical bulbs in a *given* circuit. We are not asking you in this lab to make detailed predictions about what happens when you *change* a circuit (for example, by adding or subtracting a bulb). This is hard to do with a model of electrical *current* alone: we will address this more general problem in next week's lab.
4. When you prepare for your interview, you should be make sure that *everyone* in your group (1) *explain* the models you have developed, (2) *justify* them model on the basis of experimental evidence that you collected, and (3) use them to predict successfully the relative brightness of bulbs in arbitrary three and four-bulb circuits.

Batteries and Bulbs
Check-out and Write-up

Today's lab, Batteries and Bulbs, aims to develop or reinforce your reasoning about simple electric circuits. We are asking each lab group to set up and observe the circuits on the handout, along with any variations you think to try, and to work up a model of what happens to current in them. Before leaving lab, your group will sit down with one of the instructors, who will give you a diagram of a four-bulb circuit (which may or may not be one you have tried), ask you to predict its behavior, set it up, and discuss what you see.

Check-out: When all members of your group are familiar with your model and feel they can use it to explain what you have observed, you are ready for check-out. Get Rob, Laura, or Jenna. They will:

(1) ask what your model of current is, and what answers you have for the questions on the handout;
(2) show you a circuit diagram and ask you to predict the relative brightnesses of the different bulbs in it;
(3) get you to set the circuit up;
(4) explain how it does or doesn't follow your predictions, and why;
(5) ideally, to do one circuit for each member of the group—if time is short, we may have to shorten this part.

Write-up: Approach your write-up like a short essay on current flow in these simple circuits, for which the audience is an intelligent beginner who has not yet done this lab (perhaps like you or your groupmates a week ago). After an introduction which briefly describes the kind of circuity and summarizes your current model, lay out your current model more fully, together with the evidence you gathered which supports it. You can use both qualitative evidence (relative brightness etc) and quantitative (ammeter measurements). Include data tables where relevant, either in the body of the essay or in an appendix. Length? Two pages should be enough, but the main thing is to get the job done.

Notes for pre-lab etc:

§ cautions on multimeter: how to read; what scale; how to blow the fuse; etc

§ wiggle everything

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