January 31, 2007

Experiment 0: Parts Checkout, Physics 15b

Check out your kit by Friday, Feb. 9, 2007

1 Buying a Lab Kit

You'll need a check for $80 (to Harvard University). Our lab TF's will preside in room SC305, Tuesday through Thursday evenings, February 6, 7, 8, 6:30 to 7:30 p.m.

If you miss all those chances, then show up on Friday afternoon, February 9, 5-6 p.m.

A Non-lab?

You will **NOT** have to turn in your lab book, after doing this "experiment"—which is not really an "experiment" at all, but only a chance to confirm that your box of tools and parts is complete and functional, and then—to keep you from getting totally bored—a little soldering exercise. In the process you will gain a little familiarity with some of the items. If there are any parts missing, or if the meter, transformer, or soldering iron do not work properly, come to the help lab, Room 305 in the Science Center. Members of the lab staff will be there Friday, February 9, 5-6 p.m.

Note: **The lab kits are not returnable.** We regret this policy, but we can't change it. So please be sure you want to take the course, before buying your kit. Since this "Lab 0" doesn't ask much of you, you should have more than a week to make up your mind before you commit yourself by buying the kit.

Procedure:

1. Parts check

Verify that every item on the tools and parts list attached to this write-up is present in your toolkit. Find some space to lay the larger things out so you can be sure all are in order. If a part is missing, don't panic; just make a note of the part, and next time you come to help lab pick up the missing part.

2. Meter check.

Read the instruction booklet for your meter. Follow the directions on page 9 of the book to install the battery. The small flathead screwdriver should work in the phillips head screw at the back of the meter. Install an AA battery and notice your meter's fuse (small gray cylinder with metal caps); you have a spare one to replace it if it blows. Carefully zero the red (AC) and black (DC) meter scales. This is done by adjusting the clear plastic screw located

in the center bottom of the display window. (What is the mirror on the display window for?)

Before you do this next step take time to think about what the different test probe ports are for and why there are two sets of them. This is *important*.

Plug in the test probes and read the voltage of one of your new AA cells with your meter, using a scale appropriate for 1.5 volts. Touch one meter probe to each end of the battery, the positive probe to the button. Record the voltage in your notebook as precisely as you can. Interpolate within a small division, using the mirror scale to eliminate parallax (move your head until the needle is on top of its mirror image).

Check the zero of the ohms scales on your meter by touching the ends of the test probes to each other. Make sure you make good contact. You should be able to set zero on all scales with the red adjusting wheel.

Note the OFF position on the meter. If the probes touch for a long time while on the ohms scale, the internal battery will run down. To avoid this (annoying) possibility, it is best to get into the habit of always turning off your meter after each use.

3. Transformer check.

Unpack the 12V/2A transformer. Peel the two conductors apart for a length of about 2 inches.

Examine your extension cord, and, if it has sockets that turn to close, open them (using the prongs of the plug at the other end of the cord makes this maneuver). Then plug the cord into an outlet convenient to your work space. Bend the two transformer wires apart so they won't accidentally touch each other, and keep any conductor from connecting between them, such as a metal table top. Why be careful about this? In electrical jargon the two ends of the wires coming from the transformer are called *leads* (sounds like Leeds). Plug the transformer into the extension cord. Set your meter on an AC scale appropriate for measuring roughly 12 volts and make contact between a probe and each output wire in order to measure the output voltage. Make good contact between the lead and test probe by using the probe tip to push the lead down against the top of your (insulating) workbench (a wood desk or pad of paper will work fine). (This procedure of measuring the voltage of an unknown source without touching with your fingers is very important. Never assume that a device is operating properly, safely check the voltage first!) Record your result. The voltage should read around 12 volts. If it reads higher than 20 volts unplug the transformer and notify us. 12 volts is a low enough voltage that you can touch the conducting leads with your fingers. The electrical resistance of your fingers is high enough so that very little current will pass. What happens when your meter is set for d.c. volts? Unplug the transformer when you are finished.

4. Soldering iron check.

(We plan to show the famous *15b soldering video* probably Tuesday, February 6. This may come after you have done some experimenting on your own. That's OK: your experiments may help you appreciate the skilled soldering you'll see. Tom Hayes will try to perform a *don't* demo that same day: showing some really ugly soldering technique.)
Unpack your soldering iron and bend up the central support of the stand. Take your sponge while it's still dry and trim the corners with the scissors so that it fits snugly into the plastic dish. Dampen it with tap water. When soldering, you should work on a manila folder, a piece of cardboard, or a similar table-covering to protect your desk from any molten solder (or the hot iron itself). The iron does not get hot enough to ignite ordinary materials like paper, wood, or carpet, but it will char them. Place your iron on its stand, and before plugging it into the extension cord arrange things to minimize the chance that you, or anything else, will come in contact with the part of the iron that projects from the handle. **It all gets hot**, not just the tip. Also, avoid a situation where a tug on the extension cord will cause the iron to fall to the floor.

The tip of the iron needs to be *tinned* (coated with solder). Otherwise it will oxidize and be useless for soldering. For the initial tinning it is important to melt solder *generously* onto the whole tip as soon as it gets hot enough to melt the solder. When the solder melts you will smell the rosin flux which is a blend of chemicals in a core inside the solder. The flux cleans the material in contact with the molten solder so that the solder can better wet its surface (a neat bit of surface physics). When you are ready to tin the iron, plug it into the extension cord. If the iron is new, it may smoke a bit at the start as some oily residues cook off. It should take between one and two minutes to get hot enough to melt the solder. During this time keep trying to melt the solder against the tip every few seconds, so that it will melt and tin the iron as soon as the iron gets hot enough. Put a generous amount of solder on the iron this first time, and let it cook for ten minutes or so. Leave the solder on the iron (don't clean it off, even though it looks awful) and unplug it. The next time you heat the iron up, you can easily clean off the old solder.

Here is the general rule for soldering iron care - *leave the old solder on the iron when you are done, and only clean it off right before you need to use it again.* That way there is a thicker layer of solder to prevent the copper tip from oxidizing between uses.

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