Physics Exploration Homework Supplement P111-10.pdf

Electric Circuit Jeopardy:
Exploring Light bulbs in Parallel and Series

Go to the Physics Exploration Center. Enter through the resource room in 311/312 Thaw Hall.

Go to the setup which consists of a box with several light bulbs. In this assignment, you are required to figure out the wiring of six IDENTICAL light bulbs with each other and with respect to the 120 V power supply (represent the power supply as a battery in the circuit you make). The wiring of the bulbs is hidden. For this experiment, IGNORE the temperature dependence of the resistance of the light bulb filament (assume that each light bulb has the same fixed resistance throughout the experiment)

Important Notes:

- **Depending on which switches you have "on", the current in a particular part of the circuit may be very small. In some cases the brightness of the bulb may become so small that it may appear that the bulb is not lighting up. It is therefore useful to dim the light in the room and also look at the bulbs from the side. If the bulb filament is red, there is current in that part of the circuit.**
- If you are under the impression that a particular bulb filament is burnt out you can gently take it out of the socket and put it in the test socket provided to test it.
- You have been provided with a table that you can use to keep track of what you have tried and observed so far for the various "on" and "off' arrangements of the switches.

(a) Turn on the main switch on the board to connect the whole circuit to the 120 V power supply. There are also individual switches provided with each bulb with which you can either make an individual bulb part of the circuit or disconnect it from the rest of the circuit (Turning "on" the switch provided with a bulb makes that bulb part of the circuit. If the switch associated with a bulb is turned off that particular bulb has an open circuit and no current can flow through it as shown in the figure.). Turn on all of the individual bulbs (note the red marks on the switches).

(b) Turn off switch 1 associated with bulb 1 (open circuit: see the figure above) keeping all the other switches on. Note the changes in the brightness of the other bulbs. Is there any bulb that is brighter than when switch 1 was on? Can you conclude something about the change in current through this bulb due to turning off switch 1? Can you conclude something about the wiring between bulb 1 and the bulb that got brighter? Justify your answer.

(c) What do you predict should happen if you turned on switch 1 and turned off switch 2 (bulb 2 is open circuit) based upon part (b)? Do the experiment. Does the brightness of bulb 1 change the same way you predicted when switch 2 is turned off and switch 1 is on? Justify.

(d) Repeat parts (b) and (c) with bulbs 3, 4, 5 and 6 (i.e., turn off one bulb at a time keeping all the other ones on and observe the change in brightness of the other bulbs). Draw figures showing the connection between the bulbs (resistors) that you are completely certain about. At this point you should be certain about the connections between only some of the bulbs.

(e) Now turn off the switches associated with two bulbs at a time keeping all the other switches on. Notice what happens to the rest of the circuit when you pick certain pairs of bulbs and make both of them open circuit (i.e., "off " position). What does it tell you about the connection between these two bulbs and the 120 V power supply? Draw a circuit showing your prediction and justify your answer. Repeat this process for each pair of bulbs (i.e., turn off two bulbs at a time keeping everything else on and see if you can figure out how those two may be connected with the 120 V power supply.

(f) Using the above steps, draw the whole circuit consisting of the power supply and the individual light bulbs (resistors).