ELECTRIC POWER

OBJECTIVE

To understand electric power distribution in simple series-parallel circuits

EQUIPMENT

battery eliminator, 5 identical miniature light bulbs (with mounts), patch cords, connectors (alligator or fork shaped)

THEORY

- Ohm's Law for resistors is $V = IR$, where I is its current, R is its resistance, and V is its voltage (difference).
- The electric power for any dc circuit component is given by $P=IV$.
- Each series resistor has the same current and a power $P = I(IR) = I^2R$.
- Each parallel resistor has the same voltage and a power $P = \left(\frac{V}{R}\right)V = \frac{V^2}{R}$.
- The brighter the light bulb, the greater its power consumption.

PROCEDURE

Set the battery eliminator at 3 VDC. Connect each mounted light bulb to the battery eliminator, one at a time, and note the brightness. This represents the "baseline" power level for each bulb. In the following expressions, P1 refers to the power of bulb 1, P2 to the power of bulb 2 and so on.

LAB ASSIGNMENT:

Build each circuit described below and draw the corresponding circuit diagrams for each on a piece of paper. Turn in these diagrams and answers to the questions to your TA before leaving the lab.

CIRCUIT 1 – The minimum power circuit (P1 = P2 = P3 = P4 = P5 = min)
There is only one way to wire the bulbs so that they have the same power which is lowest possible for your equipment.

CIRCUIT 2 – The maximum power circuit (P1 = P2 = P3 = P4 = P5 = max)
There is only one way to wire the bulbs so that they have the same power which is highest possible for your equipment.

CIRCUIT 3 – P1 > P2 = P3 = P4 = P5
There are two possible circuits – you are required to find only one.

CIRCUIT 4 – P1 = P2 > P3 = P4 = P5
There are two possible circuits – you are required to find only one.

CIRCUIT 5 – P1, P2 = P3, P4 = P5
There are two possible circuits – you are required to find only one.

CIRCUIT 6 – P1, P2, P3, P4 = P5
There are two possible circuits – you are required to find only one.

QUESTION 1 – We noted that there was only one possible circuit arrangement for CIRCUITS 1 & 2, but multiple possible arrangements for the other circuits. What makes CIRCUITS 1 & 2 unique?

QUESTION 2 – Is it important for these light bulbs to all be identical to produce the above circuits? Explain your reasoning.

Extra Credit Challenge: *(OPTIONAL, 2 pts)*

You must create a circuit in which, initially, four bulbs are ON while the fifth is OFF. Also you must be able to unscrew one of the four burning bulbs in order to turn on the fifth bulb. You are not allowed to change any of the wiring to get this to work. When you have successfully built and tested this circuit, ask the lab TA to verify your result so that you may receive extra credit.