

Solution to Practice Problem of the Day #06:

Part (a)

- Bulbs B and C are in *series* and this means that the current through each of these two bulbs is the same.
- Since they are identical bulbs, by Ohm's Law (which says $V_{drop} = IR$) it must therefore be true that each of these two bulbs has the *same voltage drop*.
- Since the total voltage drop from the top of Bulb B to the bottom of Bulb C is V_1 , it must be true that the voltage drop for each bulb is half of this. That is to say: $V_{drop} = \frac{V_1}{2}$

Part (b)

- Let's call V_A the voltage drop across Bulb A. Likewise V_B is the drop across Bulb B, and V_C is the drop across Bulb C.
- The voltage drop across Bulb A V_A is equal to V_1 (since the two terminals of the voltage source are connected directly to the two sides of the resistor). In contrast, V_B and V_C are both equal to $\frac{V_1}{2}$.
- Each bulb has the same resistance.
- The brightness of each bulb scales as the power. The power is given by $P = IV_{drop}$.
- Therefore since voltage drop across Bulb A is greater than the voltage drop across either B or C, the power into A is greater and therefore so is the brightness.
- In other words: $\mathcal{W}_A > \mathcal{W}_B = \mathcal{W}_C$.

Part (c)

- the effect of the voltage source is to *force* the voltage drop across Bulb B to be the voltage of the second source. In other words when the switch closes, $V_B = V_2 = \frac{V_1}{3}$.
- This means that the voltage drop across Bulb B is now somewhat less than it was before you through the switch (V_B was $\frac{V_1}{2}$). So Bulb B is somewhat dimmer than it was before.
- Similarly, after you close the switch the voltage drop across Bulb C is now given by $V_C = V_1 - V_B = V_1 - \frac{V_1}{3} = \frac{2V_1}{3}$. In other words the voltage drop is somewhat increased relative to the original drop of $\frac{V_1}{2}$. So Bulb C has somewhat more power and therefore is somewhat brighter than before.
- In summary: $\mathcal{W}_A > \mathcal{W}_C > \mathcal{W}_B$