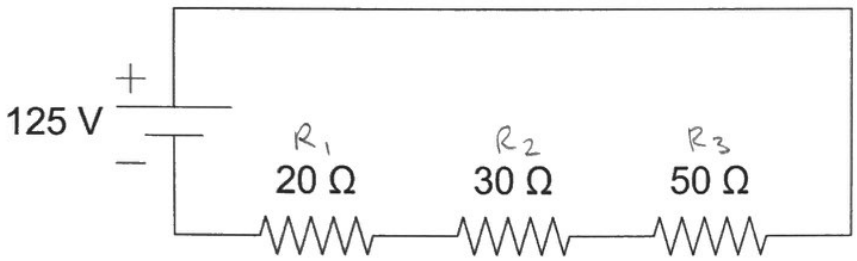
Series Circuit Practice

Fill in the chart below using the infromation from the series circuit:

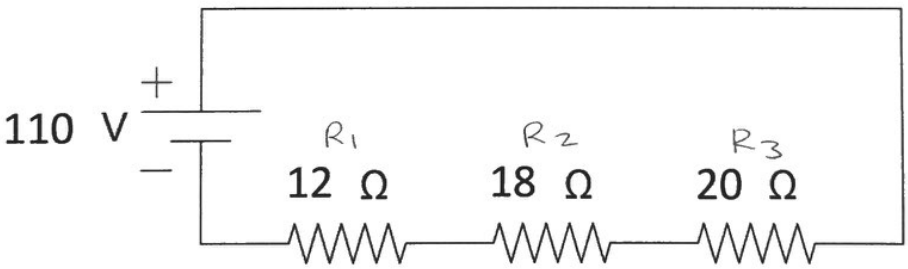
Don't forget the rules of Series circuits:
Resistance: Add up all the resistors. $R_T = R_1 + R_2 + R_3...$
Current: Current stays the same at each resistor $I_T = I_1 = I_2 = I_3...$
Voltage: Add up to get total voltage $\Delta V_T = \Delta V_1 + \Delta V_2 + \Delta V_3...$
Ohm's Law is V=IR

Practice problem 1:



R_T= 20+30+50= 100Ω	I_T= V=IR 125=I(100) I=1.25A	V_T= 125V (Given)
R_1= 20Ω (Given)	I_1= 1.25A	V_1= V=IR V=(1.25)(20) = 25V
R_2= 30Ω (Given)	I_2= 1.25A	V_2= V=(1.25)(30) = 37.5V
R_3= 50Ω (Given)	I_3= 1.25A	V_3= V=(1.25)(50) = 62.5V

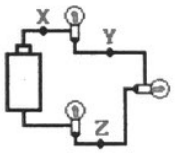
Practice problem 2:



R_T= 12+18+20=50Ω	I_T= V=IR 110V=I(50) I=2.2A	V_T= 110V (given)
R_1= 12Ω (given)	I_1= 2.2A	V_1= (2.2)(12) = 26.4V
R_2= 18Ω (given)	I_2= 2.2A	V_2= (2.2)(18) = 39.6V
R_3= 20Ω (given)	I_3= 2.2A	V_3= (2.2)(20) = 44V

Questions on Series Circuits:

3. Three identical light bulbs are connected to a D-cell as shown at the right. Which one of the following statements is true?

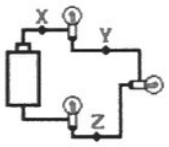


a. All three bulbs will have the same brightness.
b. The bulb between X and Y will be the brightest.
c. The bulb between Y and Z will be the brightest.
d. The bulb between Z and the battery will be the brightest.

Answer: A

The current in a series circuit is the same at each resistor present in the circuit. Since each light bulb has the same resistance ("identical bulbs") and the same current, they will have the same power output ($P = I^2R$ as discussed in the previous Lesson). Thus, they will shine with the same brightness.

4. Three identical light bulbs are connected to a battery as shown at the right. Which adjustments could be made to the circuit that would increase the current being measured at X? List all that apply.

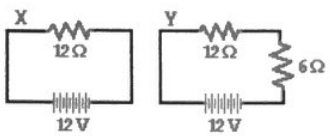


a. Increase the resistance of one of the bulbs.
b. Increase the resistance of two of the bulbs.
c. Decrease the resistance of two of the bulbs.
d. Increase the voltage of the battery.
e. Decrease the voltage of the battery.
f. Remove one of the bulbs.

Answer: C, D, and F

The current at location X is the same as the current at the battery location. To increase the value of the current at the battery, it would be necessary to increase the battery voltage (choice D) or to decrease the equivalent resistance. Since the equivalent resistance is the sum of the resistance of the individual resistors, any decrease of resistance or removal of a resistor will lead to a decrease in the equivalent resistance.

5. Compare circuit X and Y below. Each is powered by a 12-volt battery. The voltage drop across the 12-ohm resistor in circuit Y is ___ the voltage drop across the single resistor in X.

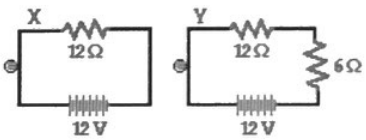


a. smaller than
b. larger than
c. the same as

Answer: A

The voltage gained at the battery is equal to the accumulative voltage drop when passing through the external circuit. In circuit X, the voltage drop across the single resistor must be 12 V. In circuit Y, the voltage drop across the 12 ohm resistor must be less than 12 V since there will be an additional voltage drop in the 6 ohm resistor. In fact, one might reason that the two voltage drops in circuit Y will be 8 volts and 4 volts respectively, to add to a total voltage drop of 12 volts.

6. A 12-V battery, a 12-ohm resistor and a light bulb are connected as shown in circuit X below. A 6-ohm resistor is added to the 12-ohm resistor and bulb to create circuit Y as shown. The bulb will appear ___.



a. dimmer in circuit X
b. dimmer in circuit Y
c. the same brightness in both circuits

Answer: B

The brightness of a light bulb is related to the power output of the bulb, which can be computed as the $I \bullet \Delta V$ (see previous Lesson). Since Circuit Y contains an additional resistor, its equivalent resistance is greater than that of Circuit X. As such, Circuit X has a greater current than that of Circuit Y. The voltage impressed across each circuit is the same - 12 volts (the battery voltage). This 12 volts of electric potential difference is divided among the various circuit elements. There are two resistors and a light bulb in Circuit Y and only one resistor and a light bulb in Circuit X. And so the light bulb of Circuit X will have a greater ΔV than the light bulb of Circuit Y. And so it is reasonable to conclude that the light bulb of Circuit X has the greatest power - that is, the greatest $I \bullet \Delta V$ product. And since the bulb brightness will depend upon this power value, one must conclude that the bulb will appear brighter in Circuit X and dimmer in Circuit Y.