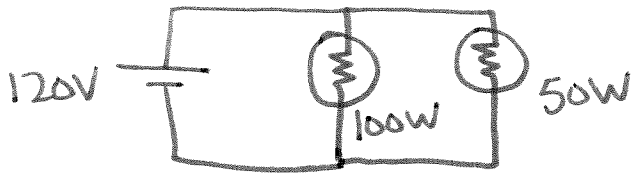
Lightbulbs
Series v. Parallel

$$P = \text{watts} = IV = I^2R = \frac{V^2}{R}$$

- When you look at a 100W lightbulb, here's what it is telling you: "I am 100W if you run 120V of electricity through me". All American lightbulbs have their wattage based on 120V coming from the wall

<u>Lightbulbs in Parallel</u> (The way your house - and mine - are wired)



- You and I know (and so does your grandma for that matter) that a 100W bulb is brighter than a 50 W bulb
- But does grandma know how to determine the resistance of the bulbs based on the above information? (only if she's a physics teacher)

$$R = \frac{V^2}{P}$$

$$R_{100W} = \frac{(120V)^2}{100W} = 144\Omega$$

$$R_{50W} = \frac{(120V)^2}{50W} = 288\Omega$$

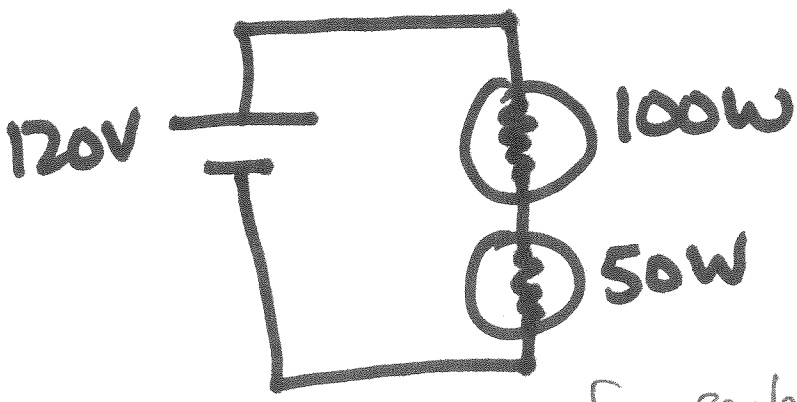
- No big surprise there, the high watt bulb has <u>low</u> resistance to allow more current through it than the 50 W bulb

Bright! $\longrightarrow$ $I_{100W} = \frac{V}{R} = \frac{120V}{144\Omega} = 0.833$ Amps

dim $\longrightarrow$ $I_{50W} = \frac{120V}{288\Omega} = 0.417$ Amps

- The electric company <u>loves</u> 100 W bulbs. Do you see why? Remember, $I = \frac{Q}{time}$. The Bigger The I, the bigger the Q, The bigger the $!

<u>Series lightbulb</u> (Horror's of Horrors! ☹)



- Resistance is same for each <u>individual</u> bulb, but the resistance of the series is $R_{100W} + R_{50W}$

$$144\Omega + 288\Omega = 432\Omega$$

- Recall that in series circuits, only <u>one</u> current may flow (an infinite amount of currents may flow in parallel)

$$V = IR$$
$$120V = I(432\Omega)$$

$$\boxed{I = 0.278 \text{ Amps}}$$

Okay grandma, hang on now!

You only got 0.278 Amps flowing through your two lightbulbs now. Let's figure out the wattage now

$$P_{100W} = I^2 R = (0.278)^2 (144\Omega)$$

$$P_{100W} = 11.13 \text{ Watts}$$

$$P_{50W} = I^2 R = (0.278)^2 (288\Omega)$$

$$P_{50W} = 22.26 \text{ Watts}$$

You'd have to be a dim bulb not to see that the 50W bulb is going to outshine its 100W friend!

Why?

- Putting them in series forces them to share the same current.

$$P = I^2 R$$

and since $R_{50W} > R_{100W}$, the $P_{50W} > P_{100W}$

- left in parallel, they would draw the individual currents they would need to glow as nature intended them.