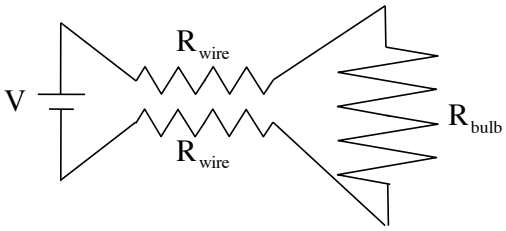
Problem 28.6

A 75 watt light bulb at 120 volts suggests the current can be determined from the power relationship using: $P = iV$



$$\Rightarrow \quad i = \frac{P}{V}$$

$$\Rightarrow \quad i = \left(\frac{75\ \text{W}}{120\ \text{V}}\right)$$

$$= .625\ \text{A}$$

With the current, the resistance of the bulb can be determined from:

$$P = i^2 R_{bulb}$$

$$\Rightarrow \quad R_{bulb} = \frac{P}{i^2}$$

$$= \left(\frac{75\ \text{W}}{(.625\ \text{A})^2}\right)$$

$$= 192\ \Omega$$

The resistance the bulb along with the resistance in the wires generates a net resistance of:

$$R_{total} = R_{bulb} + 2R_{wire}$$

$$= (192\ \Omega) + 2(.8\ \Omega)$$

$$= 193.6\ \Omega$$

According to Ohm's Law, that resistance in a 120 volt circuit will generate a current of:

$$V = iR_{total}$$

$$\Rightarrow \quad i = \left(\frac{120\ \text{V}}{193.6\ \Omega}\right)$$

$$= .62\ \Omega$$

Apparently, if we include the resistance associated with the wires, the current turns out to be .005 amps below the theoretically expected value.