Problem 21.2

A 60 W bulb operates at 60 Hz when the AC power supply has an RMS rating of 120 volts.

a.) What is the peak (maximum) voltage applied to the bulb?

b.) What is the resistance of the bulb?

c.) Does a 100 W bulb have a greater or lesser resistance than a 60 V bulb?

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a.) What is the peak (maximum) voltage applied to the bulb?

There are two ways to do this. The math yields:

$$V_{RMS} = .707 V_{max}$$
$$\Rightarrow \quad 120 = .707 V_{peak}$$
$$\Rightarrow \quad V_{peak} = 170 \text{ V}$$

OR, you could have noticed that 120 RMS at 60 Hz is a wall socket, and in class we determine that the maximum voltage for such a source is 170 volts.

b.) What is the resistance of the bulb?

From the previous problem, we determined the relationship between power, voltage and resistance. Using that again, we can write:

$$P = \frac{(V_{RMS})^2}{R}$$
$$\Rightarrow \quad (60 \text{ W}) = \frac{(120 \text{ V})^2}{R}$$
$$\Rightarrow \quad R = 240 \ \Omega$$

c.) Does a 100 W bulb have a greater or lesser resistance than a 60 V bulb?

This is more conceptual than anything else (though you could do the math and see where it takes you). Assuming "using your head" is OK, higher power bulbs need more current through them, and more current is generated (for a given power source) by SMALLER resistance. Therefore, the larger the power rating, the smaller the resistance of the element.