SAMPLE PROBLEM E

Electric Power

PROBLEM

An electric space heater is connected across a 120 V outlet. The heater dissipates 1320 W of power in the form of electromagnetic radiation and heat. Calculate the resistance of the heater.

SOLUTION

Given: $\Delta V = 120\ \text{V} \qquad P = 1320\ \text{W}$

Unknown: $R = ?$

Because power and potential difference are given but resistance is unknown, use the form of the power equation that relates power to the other two variables.

$$P = \frac{(\Delta V)^2}{R}$$

Rearrange the equation to solve for resistance.

$$R = \frac{(\Delta V)^2}{P} = \frac{(120\ \text{V})^2}{1320\ \text{W}} = \frac{(120)^2\ \text{J}^2/\text{C}^2}{1320\ \text{J/s}}$$

$$R = \frac{(120)^2\ \text{J/C}}{1320\ \text{C/s}} = 10.9\ \text{V/A}$$

$$\boxed{R = 10.9\ \Omega}$$

PRACTICE E

Electric Power

1. A 1050 W electric toaster operates on a household circuit of 120 V. What is the resistance of the wire that makes up the heating element of the toaster?
2. A small electronic device is rated at 0.25 W when connected to 120 V. What is the resistance of this device?
3. A calculator is rated at 0.10 W and has an internal resistance of 22 Ω. What battery potential difference is required for this device?
4. An electric heater is operated by applying a potential difference of 50.0 V across a wire of total resistance 8.00 Ω. Find the current in the wire and the power rating of the heater.
5. What would the current in the heater in Problem 4 be if the wire developed a short and the resistance was reduced to 0.100 Ω?