

Chapter 16 Problem 33 †

Given

$$l = 12 \text{ m}$$

$$w = 8.0 \text{ m}$$

$$\Delta x = 23 \text{ cm} = 0.23 \text{ m}$$

$$T_i = 20 \text{ }^\circ\text{C}$$

$$T_g = 10 \text{ }^\circ\text{C}$$

$$k_{\text{concrete}} = 1 \text{ W/m K}$$

Solution

Find the heat flow into the ground.

The formula for heat loss due to conduction is

$$H = -kA \frac{\Delta T}{\Delta x}$$

The area of the floor is just the length times the width. Therefore, our equation becomes

$$H = -klw \frac{(T_g - T_i)}{\Delta x}$$

Substituting in the known values gives us

$$H = -(1 \text{ W/m} \cdot \text{K})(12 \text{ m})(8.0 \text{ m}) \frac{(10 \text{ }^\circ\text{C} - 20 \text{ }^\circ\text{C})}{(0.23 \text{ m})}$$

$$H = 4170 \text{ W} = 4.17 \text{ kW}$$

†Problem from Essential University Physics, Wolfson