

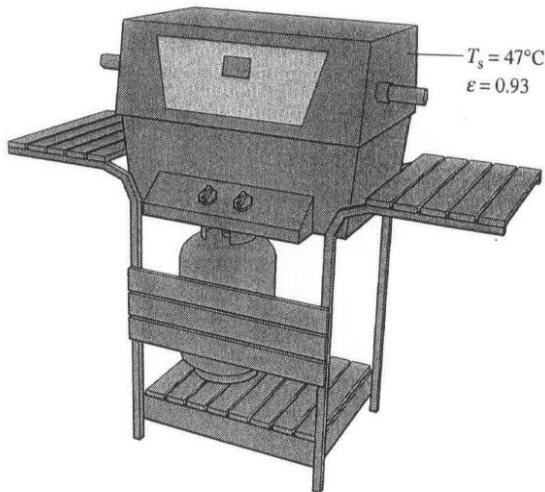
PROBLEM 2.55

KNOWN: Data are provided for a grill hood.

FIND: Determine the net rate of heat transfer between the hood and the surroundings by convection and radiation, per unit area of hood surface.

SCHEMATIC & GIVEN DATA:

$$T_0 = 27^\circ\text{C}$$
$$h = 10 \text{ W/m}^2 \cdot \text{K}$$



ENGR. MODEL:

1. Radiative heat transfer between the hood and surroundings is modeled as an exchange between a surface at T_s and a much larger surrounding surface at T_0 .

ANALYSIS:

Using Eq. 2.34, convection heat transfer is

$$\frac{\dot{Q}_c}{A} = h[T_s - T_0] = 10 \frac{\text{W}}{\text{m}^2 \cdot \text{K}} [20 \text{ K}] \left| \frac{1 \text{ kW}}{10^3 \text{ W}} \right|$$
$$= 0.2 \text{ kW/m}^2$$

Using Eq. 2.33, radiative heat transfer is

$$\frac{\dot{Q}_e}{A} = \varepsilon \sigma [T_s^4 - T_0^4]$$
$$= 0.93 [5.67 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \cdot \text{K}^4}] [(320 \text{ K})^4 - (300 \text{ K})^4]$$
$$= 125.8 \frac{\text{W}}{\text{m}^2} \left| \frac{1 \text{ kW}}{10^3 \text{ W}} \right| = 0.13 \text{ kW/m}^2$$

$$\text{Total} = (\dot{Q}_c/A) + (\dot{Q}_e/A) = 0.33 \text{ kW/m}^2$$