PROBLEM 2.52

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:

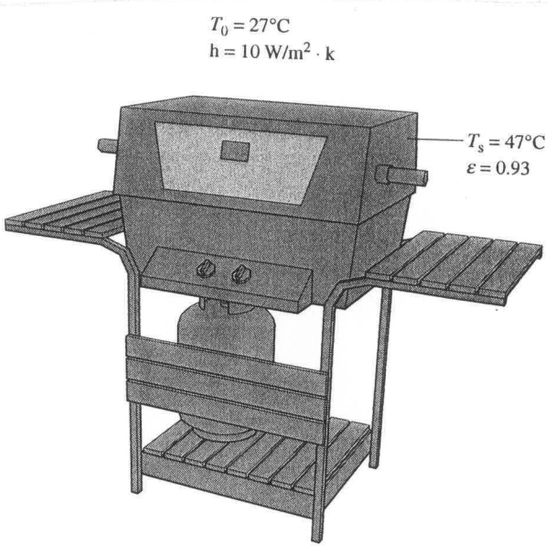

Fig. P2.52

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

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

$$= 0.2\ kW/m^2 \leftarrow$$

Using Eq. 2.33, radiative heat transfer is

$$\frac{\dot{Q}_e}{A} = \epsilon\sigma[T_s^4 - T_0^4]$$

$$= 0.93[5.67\times10^{-8}\frac{W}{m^2\cdot K^4}]\left[(320K)^4 - (300K)^4\right]$$

$$= 125.8\frac{W}{m^2}\left|\frac{1kW}{10^3W}\right| = 0.13\ kW/m^2 \leftarrow$$

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

PROBLEM 2.53

KNOWN: Data is provided for $Q, W, E_1, E_2, \Delta E$ for several processes of a closed system.

FIND: Determine values of missing tabled data.

Process	Q	W	E_1	E_2	ΔE
a	+50	−20	−20	+50	+70
b	+50	+20	+20	+50	+30
c	−40	−60	+40	+60	+20
d	−90	−90	+50	+50	0
e	+50	+150	+20	−80	−100

$\Delta E = Q - W$

Process a:

$\Delta E = Q - W$

$\therefore Q = \Delta E + W = 70 + (-20) = +50$

$\Delta E = E_2 - E_1 = +70 \Rightarrow E_1 = E_2 - 70$

$E_1 = 50 - 70 = -20$

Process b: $\Delta E = E_2 - E_1 = 50 - 20 = 30$

$\Delta E = Q - W$

$\therefore W = Q - \Delta E = +50 - 30 = 20$

Process c:

$\Delta E = E_2 - E_1 \Rightarrow E_1 = E_2 - \Delta E$

$= 60 - 20 = 40$

$\Delta E = Q - W \Rightarrow Q = \Delta E + W$

$\therefore Q = 20 + (-60) = -40$

Process d:

$\Delta E = E_2 - E_1 \Rightarrow E_1 = E_2 - \Delta E$

$\therefore E_1 = 50 - 0 = 50$

$\Delta E = Q - W \Rightarrow Q = \Delta E + W$

$\therefore Q = 0 + (-90) = -90$

Process e:

$\Delta E = Q - W = 50 - 150 = -100$

$\Delta E = E_2 - E_1 \Rightarrow E_2 = \Delta E + E_1$

$E_2 = -100 + 20 = -80$