Ch 19, Problem 36

(a) $Q_w = c_w m_w \Delta T + L_V m_s$

$= (1\ \text{cal}/\text{g}\cdot\text{C}°)(220\ \text{g})(100°\text{C} - 20°\text{C})$

$+ (539\ \text{cal}/\text{g})(5.00\ \text{g}) = 20.3\ \text{kcal}$

(b) $Q_b = c_b m_b \Delta T$

$= (0.0923\ \text{cal}/\text{g}\cdot\text{C}°)(150\ \text{g})(100°\text{C} - 20°\text{C}) = 1.11\ \text{kcal}$

(c) $Q_w + Q_b = c_c m_c (T_i - T_f)$

$$T_i = \frac{Q_w + Q_b}{c_c m_c} + T_f$$

$$= \frac{20.3\ \text{kcal} + 1.11\ \text{kcal}}{(0.0923\ \text{cal}/\text{g}\cdot\text{C}°)(300\ \text{g})} + 100°\text{C} = 873°\text{C}$$

Ch. 20, Problem 45

$$W_{straight} = \left(\frac{P_i + P_f}{2}\right)\Delta V$$

$$E_{int} = n\left(\frac{f}{2}\right)RT = \frac{f}{2}PV$$

Ch 20, Problem 48 (continued)

(a) $E_{int\,c} - E_{int\,a} = \frac{5}{2}(p_c V_c - p_a V_a)$

$= \frac{5}{2}\left((2000\ Pa)(4.0\ m^3) - (5000\ Pa)(2.0\ m^3)\right) = -5000\ J$

(b) $W_{ac} = \frac{p_a + p_c}{2}(V_c - V_a) = (3500\ Pa)(2.0\ m^3) = 7000\ J$

$Q_{ac} = \Delta E_{int\,ac} + W_{ac} = 2000\ J$

(c) $\Delta E_{int\,abc} = \Delta E_{int\,ac} = -5000\ J$

$W_{abc} = (5000\ Pa)(2.0\ m^3) = 10000\ J$

$Q_{abc} = \Delta E_{int\,abc} + W_{abc} = 5000\ J$

Ch 20, Problem 60

(a) $Q = W = \Delta E_{int} = 0 \Rightarrow T_i = T_f$

$p_1 = \frac{p_0 V_0}{V_1} = \frac{p_0 V_0}{3V_0} = \frac{p_0}{3}$

(b) $p_1 V_1^\gamma = p_2 V_2^\gamma \Rightarrow \frac{p_0}{3}(3V_0)^\gamma = (3.00)^{1/3} p_0 V_0^\gamma$

$\Rightarrow 3^{\gamma - 1} = 3^{1/3} \Rightarrow \gamma = \frac{4}{3}$: polyatomic gas

(c) $\frac{\bar{K}_2}{\bar{K}_1} = \frac{T_2}{T_1} = \frac{p_2}{p_1} = (3.00)^{1/3} = 1.44$

Ch 21, Problem 29

(a) $W = (V - V_0)(p - p_0) = (2V_0 - V_0)(2p_0 - p_0) = V_0 p_0$

$= 2.27\ \text{kJ}$

(b) $Q_{abc} = nC_V (T_b - T_a) + nC_p (T_c - T_b)$

$= n\left(\frac{3}{2}R\right)T_a\left(\frac{T_b}{T_a} - 1\right) + n\left(\frac{5}{2}R\right)T_a\left(\frac{T_c}{T_a} - \frac{T_b}{T_a}\right)$

$= nRT_a\left(\frac{3}{2}\left(\frac{T_b}{T_a} - 1\right) + \frac{5}{2}\left(\frac{T_c}{T_a} - \frac{T_b}{T_a}\right)\right)$

$= p_0 V_0\left(\frac{3}{2}(2-1) + \frac{5}{2}(4-2)\right) = \frac{13}{2} p_0 V_0$

$= 14.8\ \text{kJ}$

$\frac{T_c}{T_a} = \frac{(2p_0)(2V_0)}{p_0 V_0} = 4 \qquad \frac{T_b}{T_a} = \frac{(2p_0)(V_0)}{p_0 V_0} = 2$

(c) $\varepsilon = \frac{W}{Q_{abc}} = \frac{2}{13} = 0.154 = 15.4\%$

(d) $\varepsilon = 1 - \frac{T_a}{T_c} = 1 - \frac{1}{4} = 0.750 = 75.0\%$