Homework Solutions
10/24/2007

Problems

22. a.

$$W_{IAF} = -P\Delta V$$

$$W = -\left(1.5atm \bullet \frac{1.013 \bullet 10^5 Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3} L}{1m^3}\right) = -76.0J$$

$$W_{IBF} = -P\Delta V$$

$$W = -\left(2atm \bullet \frac{1.013 \bullet 10^5 Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3} L}{1m^3}\right) = -101J$$

$$W_{IF} = -P\Delta V$$

$$W = -\left[\begin{array}{l} \frac{1}{2}\left(0.5atm \bullet \frac{1.013 \bullet 10^5 Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3} L}{1m^3}\right) + \\ \left(1.5atm \bullet \frac{1.013 \bullet 10^5 Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3} L}{1m^3}\right) \end{array}\right] = -88.7J$$

b.

$$\Delta U = U_f - U_i = 180J - 91.0J = 89.0J$$

$$Q_{IAF} = \Delta U - W = 89.0J - (-76.0J) = 165J$$

$$Q_{IBF} = \Delta U - W = 89.0J - (-101J) = 190J$$

$$Q_{IF} = \Delta U - W = 89.0J - (-88.7J) = 178J$$

27. a.

$$e = \frac{T_h - T_c}{T_h} = 1 - \frac{T_c}{T_h} = 1 - \frac{703K}{2143K} = 0.672 = 67.2\%$$

b.

$$e = \frac{W}{|Q_h|}$$

$$W = |Q_h|e = |1.40 \bullet 10^5 J|(0.420) = 5.88 \bullet 10^4 J$$

$$P = \frac{W}{t} = \frac{5.88 \bullet 10^4 J}{1.00 s} = 5.88 \bullet 10^4 W$$

29. a.

$$e \equiv \frac{W}{|Q_h|} = \frac{Q_h - Q_c}{Q_h} = 1 - \frac{Q_c}{Q_h} = 1 - \frac{1200 J}{1700 J} = 0.294 = 29.4\%$$

b.

$$W = Q_h - Q_c = 1700 J - 1200 J = 500 J$$

c.

$$P = \frac{W}{t} = \frac{500 J}{0.300 s} = 1.67 \bullet 10^3 W = 1670 W$$

51. a.

$$W_{onsystem} = -P\Delta V$$

$$W_{onsystem} = -\left[\begin{array}{l} \frac{1}{2}\left(4.0 atm \bullet \frac{1.013 \bullet 10^5 Pa}{1 atm}\right)\left(40.0 L \frac{10^{-3} m^3}{1 L}\right) + \\ \left(1.0 atm \bullet \frac{1.013 \bullet 10^5 Pa}{1 atm}\right)\left(40.0 L \frac{10^{-3} m^3}{1 L}\right) \end{array}\right] = -1.22 \bullet 10^4 J$$

$$W_{bysystem} = -W_{onsystem} = -(-1.22 \bullet 10^4 J) = 1.22 \bullet 10^4 J$$

b.

$$W_{onsystem} = -P\Delta V$$

$$W_{onsystem} = -\left[\left(1.0atm \bullet \frac{1.013 \bullet 10^5 Pa}{1atm}\right)\left(-40.0L\frac{10^{-3}m^3}{1L}\right)\right] = 4.05 \bullet 10^3 J$$

c.

$$\Delta U = Q + W$$

$$Q = -W$$

$$Q = -\left(-1.22 \bullet 10^4 J + 4.05 \bullet 10^3 J\right) = 8.15 \bullet 10^3 J$$