Solutions Chap. 11

11.1

$$W_{out} = \Delta K = \frac{1}{2} m v^2$$

$$e = \frac{W_{out}}{Q_H} \Rightarrow Q_H = \frac{W_{out}}{e} = 8.4 \times 10^5 \text{ J}$$

11.5

a) $1000 \text{ Cal} = 1000 \text{ Kcal} \left| \frac{1000 \text{ cal}}{1 \text{ Kcal}} \right| \left| \frac{4.19 \text{ J}}{1 \text{ cal}} \right| \simeq 4.2 \times 10^6 \text{ J}$

b) $\Delta y = \frac{\Delta U_g}{mg} \simeq 42800 \text{ m} \simeq 43 \text{ Km}$

11.10

Table 11.4 $\begin{cases} m = 68 \text{ kg} \\ P = 480 \text{ J/s} \\ V = 15 \text{ km/h} \end{cases}$

$$E_{chem} = 3.2 \text{kg} \left| \frac{1000 \text{g}}{1 \text{Kg}} \right| \left| \frac{44 \text{ KJ}}{1 \text{g}} \right| \left| \frac{1000 \text{J}}{1 \text{KJ}} \right| = 1.4 \times 10^8 \text{ J}$$

$$\Delta t = \frac{\Delta E_{chem}}{P} = 2.93 \times 10^5 \text{ s} \simeq 81 \text{ h}$$

$$\Delta x = v \Delta t \simeq 1200 \text{ Km}$$

11.17

$$K_{avg} = \frac{1}{2} m V_{rms}^2 = \frac{3}{2} K_B T \Rightarrow V_{rms} = \sqrt{\frac{3 K_B T}{m}}$$

$$V_{rms}^{(H_2)} = V_{rms}^{(N_2)} \Rightarrow \sqrt{\frac{3 K_B T_{H_2}}{m_{H_2}}} = \sqrt{\frac{3 K_B T_{N_2}}{m_{N_2}}} \Rightarrow T_{H_2} = \frac{m_{H_2}}{m_{N_2}} T_{N_2} = 30K$$

11.20

$$\Delta E = W + Q = -400J + 600J = 200J$$

11.23

$Q_H = 55kJ$

$Q_C = 40kJ$

$$e = 1 - \frac{Q_C}{Q_H} = 0.27$$

$$W_{out} = Q_H - Q_C = 15kJ$$

11.28

$$e_{max} = 1 - \frac{T_C}{T_H} = 0.6644$$

$$e = 0.30 \quad e_{max} \simeq 0.20 \Rightarrow Q_H = \frac{W_{out}}{e} \simeq 5000J$$

11.36

Slice $\rightarrow$ 300 kcal = 1260 kJ

for 68 kg at $v = 5\ Km/h \Rightarrow P = 380\ W$

$e = 25\%$

$$n E e = P \Delta t$$

$$n = \frac{P \Delta t}{E e} = \frac{380 \frac{J}{s} \cdot 3600 s}{1260 \times 10^3 J \times 0.25} \simeq 4.3 \text{ slices}$$

11.50

a) $e = \frac{W_{out}}{Q_H} = \frac{W_{out}}{Q_c + W_{out}} = 0.40 = 40\%$

b) $e = 1 - \frac{T_c}{T_H} \Rightarrow T_H = \frac{T_c}{1-e} = 480\,K = 210°C$

11.56

$e = \frac{W_{out}}{Q_H} = \frac{W_{out}}{W_{out} + Q_c} \Rightarrow Q_c = W_{out}\left(\frac{1}{e} - 1\right) = 1.9 \times 10^9\,W$

$n = \frac{1.9 \times 10^9\,J}{2.0 \times 10^4\,J} \approx 95\,000$ houses

11.58

$e_{max} = 1 - \frac{T_c}{T_H} = 47.1\%$

$e = \frac{W_{out}}{Q_H} = 35\%$