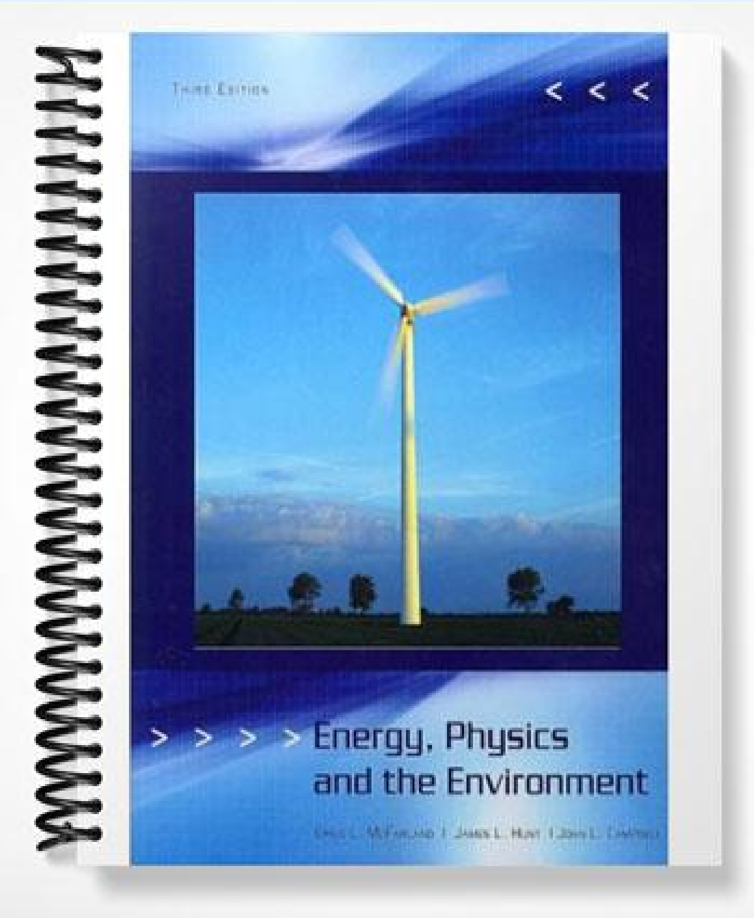
SOLUTIONS MANUAL



CHAPTER 1

1-1. $v = 82\dfrac{\text{km}}{\text{h}} \times \dfrac{1\text{h}}{3600\,\text{s}} \times 1000\dfrac{\text{m}}{\text{km}} = 22.8\dfrac{\text{m}}{\text{s}}$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(4.5\times10^3\ \text{kg})(22.8\ \text{m/s})^2 = 1.2\,\text{MJ}$$

1-2. **(a)** $5.82\,\text{Btu}\times1055\dfrac{\text{J}}{\text{Btu}}\times\dfrac{1}{4184}\dfrac{\text{Cal}}{\text{J}} = 1.47\,\text{Cal}$

(b) $22\ \text{tonnes(oil)}\times4.0\times10^7\,\dfrac{\text{Btu}}{\text{tonne}}\times\dfrac{1}{10^{15}}\dfrac{\text{quad}}{\text{Btu}} = 8.8\times10^{-7}\,\text{quad}$

(c) $52\times10^9\,\text{bl}\times5.5\times10^6\,\dfrac{\text{Btu}}{\text{Bl}}\times\dfrac{1}{10^{15}}\dfrac{\text{quad}}{\text{Btu}} = 2.9\times10^2\,\text{quad}$

1-3. $P = \dfrac{W}{t} = \dfrac{\Delta KE}{t}$

Work = change in KE

$$\frac{1}{2}mv^2 = Pt$$

$$v^2 = \frac{2Pt}{m}$$

$$v = \sqrt{\frac{2Pt}{m}} = \sqrt{\frac{2(5.1\times10^2\ \text{W})(7.2\ \text{s})}{67\ \text{kg}}} = 1.0\times10^1\,\text{m/s}$$

1-4. **(a)** 1 kW·h = 1000 J/s × 3600 s = 3.6×10^6 J

(b) 581 kW·h × 3.6×10^6 J/kW·h = 2.09×10^9 J

1-5. 178000 TW·yr = 1.78×10^5 TW·yr × 10^{12} (W/TW) × (365×24×3600) (s/yr)

= 5.61×10^{24} J

1-6. **(a)** P = (145 + 512 + 500 + 2 + 177) W = 1336 W

Energy = 1.336 kW × 2 h = 2.67 kW·h

(b) Cost = 2.67 kW·h × 0.12 \$/kW h = \$0.32

1-7. Cost = (600 kW·h × 10¢/kW·h) + ((1475 − 600) kW·h × 11¢/kW·h)

= 15625¢ = \$156.25
Average cost per kW·h = 15625¢/1475 kW·h = 10.59¢/kW·h

1-8. 770 kW = 770×10^3 J/s
= $770\times10^3 \times 60$ J/min
= (mgh/t)
= $(300\text{ m}^3 \times 1000\text{ kg/m}^3 \times 9.8\text{ m/s}^2 \times h)/(1\text{ min})$
Therefore h = 16 m

1-9. Volume of water = $(1.2\times10^3\text{ m})^2 \times 3.7\text{ m} = 5.328\times10^6\text{ m}^3$
Mass of water = $5.328\times10^6\text{ m}^3 \times 1000\text{ kg/m}^3 = 5.328\times10^9$ kg
Centre of mass falls (3.7/2) m = 1.85 m

$$P = \frac{mgh}{t} = \frac{(5.328\times10^9\text{ kg})\,(9.8\text{ m/s}^2)(1.85\text{ m})}{3600\text{ s}} = 27\times10^6\text{ W}$$

1-10. **(b)** $$v = 90\frac{\text{km}}{\text{h}}\times1000\frac{\text{m}}{\text{km}}\times\frac{1}{3600}\frac{\text{h}}{\text{s}} = 25\text{ m/s}$$

tan θ = 1/25, therefore θ = 2.29°

In one second, the distance traveled is 25 m, and the vertical height climbed is
h = (25 m) sin 2.29° = 1.0 m

Power $P = \Delta PE$ in 1 sec = $(mgh)/t$ = (1300 kg)(9.8 m/s²)(1.0 m)/(1 s)
= 13×10^3 W

1-11. $$\frac{\text{Energy}}{\text{area}} = 1.35\frac{\text{kW}}{\text{m}^2}\times4 = 5.4\frac{\text{kW}}{\text{m}^2}$$

$$\text{Energy} = 5.4\frac{\text{kW}}{\text{m}^2}\times125\text{m}^2\times24\text{ h}$$
$$= 1.62\times10^4\text{ kW}\cdot\text{h}$$
$$= 1.62\times10^4\text{ kWh}\times10^3\frac{\text{W}}{\text{kW}}\times3600\frac{\text{s}}{\text{h}}$$
$$= 5.83\times10^{10}\text{ J}$$

CHAPTER 2

2-1. **(a)** $N = N_0e^{kt}$

$k = \ell n(1 + R/100) = \ell n(1 + 0.012) = 0.012\text{ yr}^{-1}$