Chapter 1: Energy Fundamentals

Odd-numbered problems

•Problem 1.3 : Cart on a horizontal surface

Given: $F = 10lb$ and $d = 10ft$

$$F \times d = W$$
$$10lb \times 10ft = 100ft \cdot lbs$$
$$100ft \cdot lbs \times 1.36\frac{j}{ft \cdot lb} = 136\ joules$$

•Problem 1.7 : Tons of coal per person

From Table 1.1: $98\ QBtu/yr$ used in U.S.
U.S. population approximately 300×10^6 people.

$$98 \times 10^{15} Btu \times \frac{1 \text{ ton coal}}{2.7 \times 10^7 Btu} = 3.6 \times 10^9\ tons$$

Then: $\frac{3.6 \times 10^9 tons}{300 \times 10^6 \text{ people}} = 12\frac{tons}{yr \cdot person}$, approximately.

•Problem 1.11 : Windmill heats water

$$40\ gallons \times 0.1337\frac{ft^3}{gal} \times 62.4\frac{lb}{ft^3} = 334\ lb$$
$$334\ lb \times 1\frac{Btu}{lb \cdot °F} \times 50°F = 16,700\ Btu \text{ needed}$$
$$16,700\ Btu \times \frac{1,055\ j}{Btu} = 17.6 \times 10^6\ j \text{ needed}$$
$$1400\ W = 1400\frac{j}{sec}$$
$$\frac{17.6 \times 10^6 j}{1400 j/s} = 12,600 \text{ seconds} = 210 \text{ minutes} = 3.5 \text{ hours}$$

Multiple choice problems

•Problem 1.1 : Product with exponentials

Answer: f)

$(5 \times 6 \times 7) \times 10^{(5+6+7)} = 210 \times 10^{18} = 2.1 \times 10^{20}$

•Problem 1.3: Mass on string

Answer: c)

Initially: $P.E. = mgh$ (see page 113)

$$= 5kg \times 9.8\frac{m}{s^2} \times 2m$$
$$= 98kg\frac{m^2}{s^2}$$
$$= 98Joules$$

•Problem 1.5 : U.S. consumption vs. India

Answer: d)

From Fig. 1.3: $\frac{50}{4} = 12.5$

•Problem 1.7 : Average personal power

Answer: b)

$3000C = 3 \times 10^6 cal$

$3 \times 10^6 \frac{cal}{day} \times 4.184\frac{j}{cal} \times \frac{1\ day}{24\ hours} \times \frac{1\ hour}{3600\ sec} = 145\frac{j}{sec} = 145\ watts$

•Problem 1.9 : Fossil fuel percentage of energy use

Answer: c)

From Table 1.1: $18.5 + 27.3 + 36.1 = 81.9$

•Problem 1.11 : Energy in a pound

Answer: b)

$1\ lb = 0.454\ kg$

$mc^2 = 0.454 \times (3 \times 10^8)^2 = 4.1 \times 10^{16}$

•Problem 1.13 : Math

Answer: c)

$$\frac{4.8 \times 3.6}{2.8} \times 10^{9+5-10} = 6.2 \times 10^4$$