

Chapter 1: Energy Fundamentals

Odd-numbered problems

•Problem 1.3 : Cart on a horizontal surface

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

$$F \times d = W$$

$$10lb \times 10ft = 100ft \cdot lbs$$

$$100ft \cdot lbs \times 1.36 \frac{j}{ft \cdot lb} = 136 \text{ joules}$$

•Problem 1.7 : Tons of coal per person

From Table 1.1: $98 \text{ } Q\text{Btu}/\text{yr}$ used in U.S.

U.S. population approximately 300×10^6 people.

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

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

•Problem 1.11 : Windmill heats water

$$40 \text{ gallons} \times 0.1337 \frac{ft^3}{gal} \times 62.4 \frac{lb}{ft^3} = 334 \text{ lb}$$

$$334 \text{ lb} \times 1 \frac{\text{Btu}}{lb \cdot ^\circ F} \times 50^\circ F = 16,700 \text{ Btu needed}$$

$$16,700 \text{ Btu} \times \frac{1,055 \text{ } j}{\text{Btu}} = 17.6 \times 10^6 \text{ } j \text{ needed}$$

$$1400 \text{ W} = 1400 \frac{j}{sec}$$

$$\frac{17.6 \times 10^6 \text{ } j}{1400 \text{ } j/s} = 12,600 \text{ seconds} = 210 \text{ minutes} = 3.5 \text{ hours}$$

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)

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

•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)

$$\text{From Table 1.1: } 18.5 + 27.3 + 36.1 = 81.9$$

•Problem 1.11 : Energy in a pound

Answer: b)

$$1 \text{ lb} = 0.454 \text{ kg}$$

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

•Problem 1.13 : Math

Answer: c)

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