Physics 2 - Homework 8 Solutions

Problem (A):

The molecular weight of glucose ($C_6H_{12}O_6$) is about 180 $g/mole$ so

$$\frac{1\ mole}{0.18\ kg} \times \frac{1000\ kg}{1\ tonne} \times \frac{674\ kcal}{mole} = 3.7 \times 10^6\ kcal$$

Chapter 5:

10. a)

$$14\,km^2 \times (\frac{1000\,m}{1\,km})^2 \times 12\,m \times \frac{1}{6\,hr \times 3600\,s/hr} = 7,778\,m^3/s$$

b)

$$\frac{7,778\,m^3/s}{7\,m/s} = 1,111\,m^2$$

11.

$$\frac{1000\,lb}{person \cdot yr} \times 2.9 \times 10^8\,people \times \frac{4300\,Btu}{lb} = 1.25 \times 10^{15}\,Btu = 1.25\,QBtu$$

Comparing this to the U.S. energy use in 1996, we have $\frac{1.25}{94} = 1.3\%$.

Chapter 6:

1. a) ^{235}U contains 235 grams per mole, so:

$$\frac{1000\,\text{g}}{235\,\text{g/mole}} \times 6.02\times10^{23}\,\text{atom/mole} \times 1.98\times10^{6}\,\text{eV/atm} \times 1.6\times10^{-19}\,\text{J/eV} = 8.1\times10^{13}\,\text{J}$$

b) $0.7\% \times 8.1 \times 10^{13} = 5.7 \times 10^{11}$ J

3. Table 2.7 on pg. 52 says there are 250×10^9 *tonnes* of coal reserves in the United States. In the front cover of the text the energy content of coal is given to be $2.81 \times 10^{10}\ J/ton$, where 1 *ton* = 0.9 *tonne*. Hence,

$$250 \times 10^9\ tonnes \times \frac{1\ ton}{0.9\ tonnes} \times \frac{2.81 \times 10^{10}\ J}{ton} = 7.8 \times 10^{21}\ J$$

From pg. 183, the total of the 2 lowest price classes for uranium is 3×10^6 *tonnes*. In the front cover the energy content is given as $8.28 \times 10^{10}\ J/g$, so

$$3 \times 10^6\ tonnes \times \frac{1000\ kg}{tonne} \times 0.007 \times 8.28 \times 10^{13}\ J/kg = 1.7 \times 10^{21}\ J$$

There is approx. 4.6 times less energy resource in uranium-235 compared to coal.

9. a) From Prob. 1 above, 1 tonne of U-235 has the equivalent of 8.1×10^{16}J, so the number of tonnes required, at 33% efficiency, is:

$$\frac{10^{12}\,\text{W} \times 3.15 \times 10^7\,\text{s}}{(8.1 \times 10^{16})\,\text{J/tonne} \times 0.33} = 1,167\,\text{tonne}$$

b) $\frac{1167}{.007} = 1.67 \times 10^5$ tonne

14. The number of half-lives in 48 days is $\frac{48}{8} = 6$, so the amount remaining is: $20\,\text{Ci} \times (\frac{1}{2})^6 = 3.125 \times 10^{-2}\,\text{Ci}$.