Quiz 1.3 – Heat, Temperature, and Dimensional Analysis

Name: Key

Question 1

Convert the value 80.0 $\frac{miles}{h}$ to units of m/s

$$\frac{80.0\ \text{miles}}{1\ \text{h}} \left| \frac{1\ \text{h}}{60\ \text{min}} \right| \frac{1\ \text{min}}{60\ \text{s}} \left| \frac{1.609\ \text{km}}{1\ \text{mile}} \right| \frac{1000\ \text{m}}{1\ \text{km}} = 35.75556\ \text{m/s} \rightarrow 35.8\ \text{m/s}$$

Question 2

Light travels at a speed of $2.998 \times 10^8\ m/s$

- How many s does it take for light to travel from the surface of the earth to the moon and back ($478,000\ miles$)?

$$\frac{478,000\ \text{miles}}{1\ \text{mile}} \left| \frac{1.609\ \text{km}}{1\ \text{km}} \right| \frac{1000\ \text{m}}{2.998 \cdot 10^8\ \text{m}} \left| \frac{1\ \text{s}}{1} \right. = 2.56538\ \text{s} \rightarrow 2.57\ \text{s}$$

- How far does light travel in one minute?

$$\frac{1\ \text{min}}{1\ \text{min}} \left| \frac{60\ \text{s}}{1\ \text{s}} \right| \frac{2.998 \cdot 10^8\ \text{m}}{1} = 1.7988 \cdot 10^{10}\ \text{m} \rightarrow 1.799 \cdot 10^{10}\ \text{m}$$

Question 3

A cup of water is about 237 g. How much energy is required to bring one cup of water from 25.0 °C to 100.0 °C?

$q = mC\Delta T$ $\quad q = 237\ g \cdot 4.184\ \frac{J}{g \cdot °C} \cdot 75.0\ °C = 74,371\ J \rightarrow 74,400\ J$ -or- $74.4\ kJ$

Question 4

An adult male should consume about 2500 Cal each day. If 2500 Cal are added to 200.0 lb of water, how much would the water temperature change?

$$\frac{2500\ \text{Cal}}{1\ \text{Cal}} \left| \frac{1000\ \text{cal}}{1\ \text{Cal}} \right| \frac{4.184\ \text{J}}{1\ \text{cal}} = 1.046 \cdot 10^7\ \text{J} \quad \text{(2 sig figs)}$$

$$\frac{200.0\ \text{lb}}{2.205\ \text{lb}} \left| \frac{1\ \text{kg}}{1\ \text{kg}} \right| \frac{1000\ \text{g}}{1} = 90,703\ \text{g} \quad \text{(4 sig figs)}$$

Question 5 $q = mC\Delta T \rightarrow \Delta T = \frac{q}{m \cdot C}$ $\quad \Delta T = \frac{1.046 \cdot 10^7\ J}{90,703\ g \cdot 4.184\ J/g \cdot °C} = 27.56\ °C \rightarrow 28\ °C$

Convert the following temperatures from K to °C or from °C to K

25.0 °C 298.2 K $\quad$ 376.5 K 103.4 °C $\quad$ −12.3 °C 260.9 K $\quad$ 184.7 K −88.5 °C

Question 6

Pure gold has a density of 19.3 $\frac{g}{cm^3}$. A small sample of pure gold measures 3.5 mm by 7.6 mm by 5.5 mm. How much should you expect this sample to weigh?

$V = 0.35\ cm \cdot 0.76\ cm \cdot 0.55\ cm = 0.1466\ cm^3$ (2 sig figs)

$m = d \cdot V$ $\quad m = 19.3\ g/cm^3 \cdot 0.146\ cm^3 = 2.8178\ g \rightarrow 2.8\ g$