Dimensional Analysis
STEM Chemistry

Name KEY

1. How fast is 55 miles per hour (mi/hr), expressing in meters per second (m/s)?

$$\frac{55\ mi}{1\ hr}\left(\frac{1.6093\ km}{1\ mi}\right)\left(\frac{1000\ m}{1\ km}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right)=\frac{88511.5}{3600}=\boxed{25\ \frac{m}{s}}$$

2. The density of water is 1.00 g/cm³. Express this in lb/ft³.

$$\frac{1.00\ g}{cm^3}\left(\frac{1\ kg}{1000\ g}\right)\left(\frac{1\ lb}{0.4536\ kg}\right)\left(\frac{100\ cm^3}{1\ m}\right)\left(\frac{0.3048\ m}{1\ ft}\right)^3=\frac{28316.85\ lb}{453.6\ ft^3}=\boxed{62.43\ \frac{lb}{ft^3}}$$

3. How long does it take light from the sun to reach the Earth (average distance of 93,000,000 miles) if the speed of light is 186,000 miles per second? Determine the time in minutes.

$$9.3\times10^7\ mi\left(\frac{1\ sec}{1.86\times10^5\ mi}\right)\left(\frac{1\ min}{60\ sec}\right)=\boxed{8.3\ min}$$

4. Although the peak rises only 13,796 feet above the sea level, the base of Mauna Kea in Hawaii extends about 18,000 feet below sea level, making the volcano taller than Mt. Everest. Convert the TOTAL HEIGHT of Mauna Kea into meters.

$$(13,796+18,000\ ft)\left(\frac{0.3048\ m}{1\ ft}\right)=\boxed{9691\ m=1.0\times10^4\ m}$$

$31796 \Rightarrow 32,000$

5. Determine the time in minutes it would take a runner to complete a marathon (26.2 miles) if her average speed is 5.2 feet per second.

$$26.2\ mi\left(\frac{1\ ft}{1.893\times10^{-4}\ mi}\right)\left(\frac{1\ sec}{5.2\ ft}\right)\left(\frac{1\ min}{60\ sec}\right)=\frac{26.2}{0.05906}=\boxed{444\ min}$$

6. What is the volume, at room temperature, of a sample of mercury having a mass of 1.0 kg? (Mercury's density at room temperature is 13.5 g/cm³)

$$1.0\ kg\ Hg\left(\frac{1000\ g}{1\ kg}\right)\left(\frac{1\ cm^3\ Hg}{13.5\ g\ Hg}\right)=\frac{1000}{13.5}=\boxed{74\ cm^3}$$