CHEM 101 Answer to Homework Problems (4th edition)

Chapter 1

1.13

a. K (potassium)  
   b. Sn (tin)  
   c. Cr (chromium)  
   d. B (boron)  
   e. Ba (barium)  
   f. Pu (plutonium)  
   g. S (sulfur)  
   h. Ar (argon)  
   i. Hg (mercury)

1.23

Strategy: Use the density equation:

\[ d = \frac{m}{V} \]

Solution:

\[ d = \frac{m}{V} = \frac{586 \text{ g}}{188 \text{ mL}} = 3.12 \text{ g/mL} \]

1.39

a. **Physical Change.** The material is helium regardless of whether it is located inside or outside the balloon.

b. **Chemical change** in the battery.

c. **Physical Change.** The orange juice concentrate can be regenerated by evaporation of the water.

d. **Chemical Change.** Photosynthesis changes water, carbon dioxide, etc., into complex organic matter.
e. **Physical Change.** The salt can be recovered unchanged by evaporation.

### 1.47

**Strategy:** To convert an exponential number $N \times 10^n$ to a decimal number, move the decimal $n$ places to the left if $n < 0$, or move it $n$ places to the right if $n > 0$. While shifting the decimal, add place-holding zeros as needed.

**Solution:**

a. $1.52 \times 10^{-2} = 0.0152$

b. $7.78 \times 10^{-8} = 0.0000000778$

c. $1 \times 10^{-6} = 0.000001$

d. $1.6001 \times 10^3 = 1600.1$

### 1.57

a. **Strategy:** The solution requires a two-step dimensional analysis because we must first convert pounds to grams and then grams to milligrams.

**Setup:** The necessary conversion factors as derived from the equalities: $1 \text{ g} = 1000 \text{ mg}$ and $1 \text{ lb} = 453.6 \text{ g}$.

$$\frac{453.6 \text{ g}}{1 \text{ lb}} \text{ and } \frac{1 \text{ mg}}{1 \times 10^{-3} \text{ g}}$$

**Solution:**

$$242 \text{ lb} \times \frac{453.6 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ mg}}{1 \times 10^{-3} \text{ g}} = 1.10 \times 10^8 \text{ mg}$$
b. **Strategy:** We need to convert from cubic centimeters to cubic meters.

**Setup:** \(1 \text{ m} = 100 \text{ cm}.\) When a unit is raised to a power, the corresponding conversion factor must also be raised to that power in order for the units to cancel.

**Solution:**

\[
68.3 \text{ cm}^3 \left(\frac{1 \text{ m}}{100 \text{ cm}}\right)^3 = 6.83 \times 10^{-5} \text{ m}^3
\]

c. **Strategy:** In Chapter 1 of the text, a conversion is given between liters and \(\text{cm}^3\) (\(1 \text{ L} = 1000 \text{ cm}^3\)). If we can convert \(\text{m}^3\) to \(\text{cm}^3\), we can then convert to liters. Recall that \(1 \text{ cm} = 1 \times 10^{-2} \text{ m}\). We need to set up two conversion factors to convert from \(\text{m}^3\) to \(\text{L}\). Arrange the appropriate conversion factors so that \(\text{m}^3\) and \(\text{cm}^3\) cancel, and the unit liters is obtained in your answer.

**Setup:** The sequence of conversions is \(\text{m}^3 \rightarrow \text{cm}^3 \rightarrow \text{L}\). Use the following conversion factors:

\[
\left(\frac{1 \text{ cm}}{1 \times 10^{-2} \text{ m}}\right)^3 \text{ and } \frac{1 \text{ L}}{1000 \text{ cm}^3}
\]

**Solution:**

\[
7.2 \text{ m}^3 \times \left(\frac{1 \text{ cm}}{1 \times 10^{-2} \text{ m}}\right)^3 \times \frac{1 \text{ L}}{1000 \text{ cm}^3} = 7.2 \times 10^3 \text{ L}
\]

**Think About It:** From the above conversion factors you can show that \(1 \text{ m}^3 = 1 \times 10^3 \text{ L}\). Therefore, \(7 \text{ m}^3\) would equal \(7 \times 10^3 \text{ L}\), which is close to the answer.

d. **Strategy:** A relationship between pounds and grams is given on the end sheet of your text (\(1 \text{ lb} = 453.6 \text{ g}\)). This relationship will allow conversion from grams to pounds. If we can convert from \(\mu\text{g}\) to grams, we can then convert from grams to pounds. Recall that \(1 \mu\text{g} = 1 \times 10^{-6} \text{ g}\). Arrange the appropriate conversion factors so that \(\mu\text{g}\) and grams cancel, and the unit pounds is obtained in your answer.

**Setup:** The sequence of conversions is \(\mu\text{g} \rightarrow \text{g} \rightarrow \text{lb}\). Use the following conversion
factors:

\[
\frac{1 \times 10^{-6} \text{ g}}{1 \mu \text{ g}} \quad \text{and} \quad \frac{1 \text{ lb}}{453.6 \text{ g}}
\]

Solution:

\[
28.3 \mu \text{ g} \times \frac{1 \times 10^{-6} \text{ g}}{1 \mu \text{ g}} \times \frac{1 \text{ lb}}{453.6 \text{ g}} = 6.24 \times 10^{-8} \text{ lb}
\]

Think Does the answer seem reasonable? What number does the prefix \( \mu \) represent?

About It: Should 28.3 \( \mu \)g be a very small mass?