Practice Problems (Chapter 1):  
Conversions and Dimensional Analysis

Conversion Factors

<table>
<thead>
<tr>
<th>Length</th>
<th>Mass</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m = 1.0936 yds</td>
<td>1 kg = 2.205 lbs</td>
<td>1 L = 1.0567 qt</td>
</tr>
<tr>
<td>1 in = 2.54 cm (exactly)</td>
<td>1 lb = 453.59 g</td>
<td>1 gal = 3.785 L</td>
</tr>
<tr>
<td>1 km = 0.62137 mi</td>
<td>1 ton ≡ 2000 lbs</td>
<td>1 fl oz = 29.6 mL</td>
</tr>
<tr>
<td>1 mi ≡ 5280 ft</td>
<td>1 metric ton (tonne) ≡ 1000 kg</td>
<td>1 cm³ ≡ 1 mL</td>
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</table>

Part I. Use dimensional analysis and one continuous string of conversion factors to solve the following problems. Be sure to use complete units throughout.

1. How many micrograms (µg) are in 9.17 kilograms (kg)?

\[
9.17 \text{ kg} \left( \frac{10^3 \text{ g}}{1 \text{ kg}} \right) \left( \frac{1 \text{ µg}}{10^{-6} \text{ g}} \right) = 9.17 \times 10^9 \text{ µg}
\]

Answer: \(9.17 \times 10^9 \text{ µg}\)

Note: Labeling each number and conversion factor with significant figures is not part of the required work, but was done to illustrate how the significant figures of each answer were obtained.

2. How many cubic centimeters (cm³) are in 2.5 gallons (gal)?

\[
2.5 \text{ gal} \left( \frac{3.785 \text{ L}}{1 \text{ gal}} \right) \left( \frac{1 \text{ mL}}{10^{-3} \text{ L}} \right) \left( \frac{1 \text{ cm}^3}{1 \text{ mL}} \right) = 9462.5 \text{ cm}^3
\]

Answer: \(9.5 \times 10^3 \text{ cm}^3\)

3. The Earth has a mass of \(5.974 \times 10^{21}\) metric tons (tonnes), what is this mass in pounds (lbs)?

\[
5.974 \times 10^{21} \text{ tonnes} \left( \frac{1000 \text{ kg}}{1 \text{ tonne}} \right) \left( \frac{2.205 \text{ lbs}}{1 \text{ kg}} \right) = 1.317267 \times 10^{25} \text{ lbs}
\]

Answer: \(1.317 \times 10^{25} \text{ lbs}\)
4. A leaky faucet drips 1 drop of water every 1.2 seconds. How many gallons of water will this faucet waste as a result during a month with exactly 31 days?

**Note:** 1 mL = 20 drops

\[
\begin{align*}
\text{31 days} & \quad \left( \frac{24 \text{ hrs}}{1 \text{ day}} \right) \quad \left( \frac{60 \text{ min}}{1 \text{ hr}} \right) \quad \left( \frac{60 \text{ sec}}{1 \text{ min}} \right) \quad \left( \frac{1 \text{ drop}}{1.2 \text{ sec}} \right) \quad \left( \frac{1 \text{ mL}}{20. \text{ drops}} \right) \quad \left( \frac{10^{-3} \text{ L}}{1 \text{ mL}} \right) \quad \left( \frac{1 \text{ gal}}{3.785 \text{ L}} \right) = 29.48480845 \text{ gal}
\end{align*}
\]

**Answer:** 29 gal

5. Platinum has a density of 21.090 g/cm\(^3\) and costs $2014 per troy ounce (oz t). At this price, what volume (in cm\(^3\)) of platinum could be purchased for exactly $150,000.00?

**Note:** 1 troy ounce (oz t) = 31.103 g

\[
\begin{align*}
& \quad \left( \frac{1 \text{ oz t}}{2014} \right) \quad \left( \frac{31.103 \text{ g}}{1 \text{ oz t}} \right) \quad \left( \frac{1 \text{ cm}^3}{21.090 \text{ g}} \right) = 109.8392335 \text{ cm}^3
\end{align*}
\]

**Answer:** 109.8 cm\(^3\)

### Part II

The following problems require the use of equations and may also require dimensional analysis. Show any equation used with variables, then again plugged in with numbers in the same order as the variables.

6. What is the volume of the object to the right in cubic inches (in\(^3\))?\[
V = l \times w \times h
\]

\[
\begin{align*}
V &= (3.4 \text{ ft}) (1.2 \text{ ft}) (1.8 \text{ ft}) = 7.344 \text{ ft}^3 \\
7.344 \text{ ft}^3 \left( \frac{12 \text{ in}}{1 \text{ ft}} \right)^3 &= 12690.432 \text{ in}^3
\end{align*}
\]

**Answer:** 1.3 x 10\(^4\) in\(^3\)

7. What is a temperature of 350.0 Kelvin in degrees Fahrenheit?

**Note:** All available digits are used throughout the calculation and only the final answer is rounded to the correct number of significant figures.

\[
\begin{align*}
\text{K} &= \circ C + 273.15 \\
\circ C &= \text{K} - 273.15 \\
\circ C &= (350.0 \text{K}) - 273.15 = 76.85 \circ C \\
\circ F &= 1.8 (\circ C) + 32 \\
1.8 (\circ C) &= 1.8 (76.85 \circ C) + 32 = 138.33 + 32 = 170.33 \circ F
\end{align*}
\]

**Answer:** 170. °F

Note: You can consider the 1.8 and 32 in the °C to °F equation to be exact numbers (∞ sig. fig.s). However, the 273.15 in the °C to K equation is only significant to the \(\frac{1}{100}\) column.