Analysis of Units and Conversions

Chapter Section 1.4

Dimensional Analysis

- A method to convert from one unit to another using **conversion factors**
- Conversion factors are equal to one so they change the unit without changing the data (25kg is equal to 55lbs).

- Convert 25lbs to Kg

- $25\cancel{kg} \times \frac{2.2lbs}{1\cancel{kg}} = 55lbs$

- Convert 3240 yards to km

$$3240\ \text{yards} \times \frac{1.09\ m}{1\ yard} \times \frac{1km}{1000m} = \quad 3.53\ \text{km}$$

What is 13.5 kg in μg?

A. $1.35 \times 10^{10}\ \mu g$

B. $1.35 \times 10^{7}\ \mu g$

C. $1.35 \times 10^{8}\ \mu g$

D. $1.35 \times 10^{4}\ \mu g$

A. $1.35 \times 10^{10}\ \mu g$

$$13.5\text{kg} \times \frac{1000g}{1kg} \times \frac{1 \times 10^{6}\ \mu g}{1g} = 1.35 \times 10^{10}\ \mu g$$

Derived Unit Conversions

- Composed of more than one unit (m/s) or (g/mL)
- Involves more canceling of units so keep your conversation factors CLEAR
- 3.45 mg/mL to kg/L

- $\frac{3.45\text{mg}}{1\,mL} \times \frac{1g}{1000mg} \times \frac{1kg}{1000g} \times \frac{1000mL}{1\,L} =$
- 3.45 x10^{-3} kg/L

Convert the density of gold from 19200 mg/mL to kg/L

A. 19200kg/L

B. 1.92×10^{-2} kg/L

C. 1.92×10^{4} kg/L

D. 19.2 kg/L

D. 19.2 kg/L

Derived Units as a Conversion Factor

- Allows us to convert from different measures
  - Rate to convert between distance and time
  - Density to convert between mass and volume

How to use derived units as a conversion factor

- Decide what form of the conversion factor to use: g/mL or the reciprocal, mL/g.
- Arrange the conversion with units only making sure the cancellation is correct
- Calculate
- Express with correct sig figs

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Sample Problem — Use of Density as a Conversion Factor

What is the volume in L of a 15.0 kg piece of zinc metal? (Density of Zn = 7.13 g/mL)

What to Think about

1. Decide what form of the conversion factor to use: g/mL or the reciprocal, mL/g.
   Always begin by arranging the factors using *units* only. As the answer will contain one unit, begin with one unit, in this case, kg.

2. Insert the appropriate numerical values for each conversion factor.
   In order to cancel a mass and convert to a volume, use the reciprocal of the density:
   $\frac{1\text{ mL}}{7.13\text{ g}}$

3. Calculate the answer with correct unit and number of significant digits.

How to Do It

$$15.0\ \text{kg} \times \frac{\text{g}}{\text{kg}} \times \frac{\text{mL}}{\text{g}} \times \frac{\text{L}}{\text{mL}} = \text{L}$$

$$15.0\ \cancel{\text{kg}} \times \frac{10^{3}\ \cancel{\text{g}}}{1\ \cancel{\text{kg}}} \times \frac{1\ \cancel{\text{mL}}}{7.13\ \cancel{\text{g}}} \times \frac{10^{-3}\ \text{L}}{1\ \cancel{\text{mL}}} = 2.10\ \text{L}$$

What is the volume of a 13.0kg piece of Aluminum ?(Density of Al 2.70 g/mL)

A. 35.1 L

B. 4.81 L

C. 3.51×10^{-3} L

D. 4.81×10^{-3} L

B. 4.81 L

The density of copper is 8.96 g/mL, what is the mass of 6.0L?

A. 53.76 g

B. 53000 kg

C. 54kg

D. 54g

C. 54kg

The speed of sound is 330m/s. If you count 12 s after seeing a flash of lightning, how many km is it away?

A. 4.0 km

B. 3.96 km

C. 0.036km

D. 4.0×10^{-2} km

A. 4.0 km

How to cancel units with exponents (m^3)

- Write it more than once (p.52)

Conversion factor

$$0.35\ m^3 \times \frac{1\ cm}{10^{-2}\ m} \times \frac{1\ cm}{10^{-2}\ m} \times \frac{1\ cm}{10^{-2}\ m} \times \frac{1\ mL}{1\ cm^3}$$

$$= 3.5 \times 10^5\ mL$$

- Use brackets and exponents

$$0.35\ m^3 \times \left(\frac{1\ cm}{10^{-2}\ m}\right)^3 \times \frac{1\ mL}{1\ cm^3} = 3.5 \times 10^5\ mL$$

Atmospheric pressure on mars is 0.090 lb/in^2. Express in g/cm^2(Given 454 g = 1.00 lb)

A. 6.33 g/cm^2

B. 16.1 g/cm^2

C. 16 g/cm^2

D. 6.3 g/cm^2

D. 6.3 g/cm^2

Temperature

- The measure of heat
- The average kinetic energy of the particles is sample of matter
- Celsius, Kelvin and Fahrenheit
- Absolute zero is -273.15°C or 0K

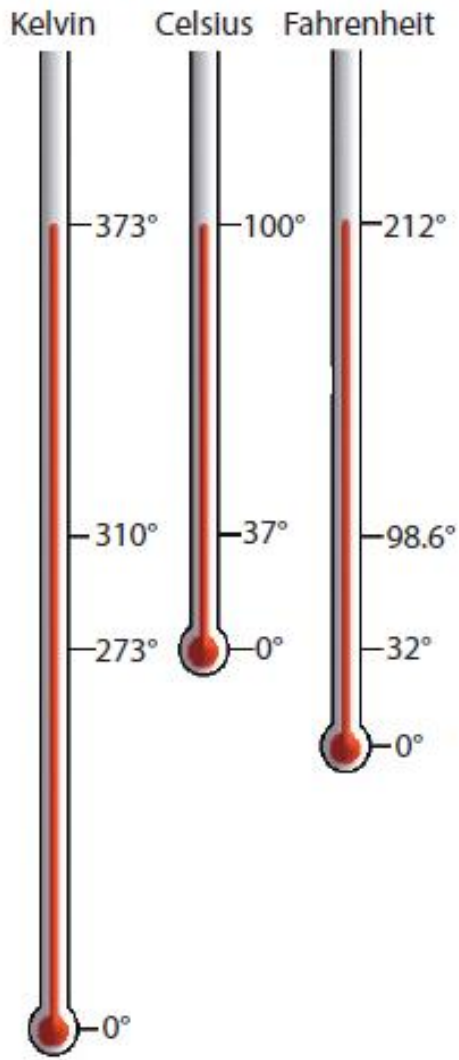

Figure 1.4.3 *The three commonly used temperature scales*

Common Scales

- Notice that 1 ℃ is equal to 1 K
- But 1 ℃ is equal to 1.8 ℉

Temperature

- The number of significant figures in a temperature is determined using the rule of precision.
- Use the precision of the given
- There is no degree symbol (°) placed before K.

Converting between

$$T_F = \frac{1.8°F}{1°C}(T_C) + 32\,°F \quad \text{and} \quad T_C = (T_F - 32°F) \times \frac{1°C}{1.8°F}$$

$$T_K = T_C \frac{(1\,K)}{(1°C)} + 273.15\,K \quad \text{and} \quad T_c = (T_k - 273.15\,K) \times \frac{1°C}{1\,K}$$

What would 19.8°C be in °F?

A. 290 °F

B. -6.22 °F

C. 67.6 °F

D. 54.2 °F

C. 67.6 °F

Convert -88.7 ℃ to K

A. -184.45 K

B. 184.45 K

C. -127.7 K

D. -67.1 K

B. 184.45 K

Convert 125 °F to K

A. -325 K

B. 398 K

C. 325 K

D. -398 K

C. 325 K

Homework

- Problem Set- due Friday
- Finish workbook questions

More Questions

- Question:

Levoxyl is a drug used to treat hypothyroidism. If a patient takes one 75 µg tablet per day, how many milligrams of Levoxyl are in their 1 month (30 day) supply?

2.3 g

$$\frac{75\ \mu g}{day} \times \frac{1\ mg}{1000\ \mu g} \times \frac{30\ days}{1\ month} = 2.3\ g$$

A popular web site states that a 130 pound person will burn 472 Cal/hr bicycling (moderate effort) and 649 Cal/hr rock climbing (ascending).

Alexandra (who happens to weigh 130 pounds) has decided to start a training program bicycling for 45 minutes, 3 times/week as well as rock climbing for 1.5 hours every Saturday. How many extra Calories will Alexandra burn in 8 weeks of training? What percentage of those calories are from bicycling?

- 16000 and 52% from cycling

bicycling:

$$\frac{45\ min}{workout} \times \frac{3\ workouts}{week} \times \frac{8\ weeks}{training\ program} \times \frac{1\ hr}{60\ min} \times \frac{472\ Cal}{hr} = 8496\ \frac{Cal}{training\ program}$$

rockclimbing:

$$\frac{1.5\ hr}{workout} \times \frac{1\ workout}{week} \times \frac{8\ weeks}{training\ program} \times \frac{649\ Cal}{hr} = 7788\ \frac{Cal}{training\ program}$$

total: 8496 Cal + 7788 Cal = 16,284 (round to 2 sig figs) = 16,000 Cal

% from bicycling: 52%

- Brad's computer has 23.5 GB (gigabytes: 1 GB = 1024 MB) of free space. His drive has a capacity of 40.0 GB. A typical writable CD will hold about 700 MB of electronic material.
- How many CD's does Brad need to completely back up his computer?

25 (possibly more)

$$Used\ Space: 40.0\ GB - 23.5\ GB = 16.5\ GB$$

$$16.5\ GB \times \frac{1024\ MB}{1\ GB} \times \frac{1\ CD}{700\ MB} = 24.1\ CDs$$

As the material will fill over 24 CDs, Brad will need at least 25 to back up his computer - and possibl more as he may not be able to fill each CD to capacity.

If he were to use floppies: