N2 – Dimensional Analysis

Also known as “Unit Conversion”

Target: I can use dimensional analysis to convert not just the numbers in a measurement but also the units

Remember - Canceling Units

One on top cancels with one on the bottom

$$\frac{xy}{x} = y$$

$$\frac{15\ cm^3}{5\ cm} = 3\ cm^2$$

Conversion Factors

A relationship between how many of one thing equals how many of another thing

12in = 1ft **24hrs = 1,440min** **1000m = 1km**

You can rewrite as fractions:

$$\frac{12\text{in}}{1\text{ft}} = 1 \qquad \frac{24\text{hr}}{1{,}440\text{min}} = 1 \qquad \frac{1\text{km}}{1000\text{m}} = 1$$

Conversion Factors

You can flip conversion factors too

12in = 1ft **24hrs = 1,440min**

Just depends on what you are doing

$$\frac{12in}{1ft} = 1 \quad \frac{1ft}{12in} = 1$$

$$\frac{24hr}{1,440min} = 1 \quad \frac{1,440min}{24hr} = 1$$

Using Conversion Factors

If you multiply by a conversion factor, you are just multiplying by 1…your answer LOOKS DIFFERENT because of the unit but is the same SIZE MEASURMENT. (12in/1ft or 1ft/12in)

$$85\ inches\ x\ \frac{1\ ft}{12\ in} = 7.1\ ft$$

Using Conversion Factors

You can use multiple conversion factors –
"a frog hopping across a pond on lily pads"

Convert 3.6mi into cm.

(1cm=0.3937in, 12in=1ft, 1mi=5,280ft)

$$3.6mi\ x\frac{5280\,ft}{1\,mi}x\frac{12in}{1\,ft}\ x\ \frac{1cm}{0.3937in}=5.8x10^5cm$$

You try one…

Convert 15years into minutes

$$15yrs\ x\frac{365days}{1\ year}x\frac{24hrs}{1\ day}\ x\frac{60min}{1hr}=7.9x10^{6}min$$

Line Method

Keeps work neat, tidy, takes less space, easier to grade, a very typical way to show conversions in chemistry. I will always use the line method!

Convert 15years into minutes

$$15yrs\ x\frac{365days}{1\ yr}x\frac{24hrs}{1\ day}\ x\frac{60min}{1hr}=7.9x10^{6}min$$

$$\frac{15\text{ yrs} \mid 365\text{ days} \mid 24\text{ hr} \mid 60\text{ min}}{\quad \mid 1\text{yr} \mid 1\text{ day} \mid 1\text{ hr}} = 7.9 \times 10^{6}\text{ min}$$

Dimensional Analysis with "Derived/Double Units"

Some units are combinations of two or more other units. Like miles per hour (mi/hr). Fix the top unit, then go back and fix the bottom unit

Convert 20mi/hr into in/sec.

$$\frac{20\text{mi}}{1\text{hr}} \cdot \frac{5280\text{ft}}{1\text{mi}} \cdot \frac{12\text{in}}{1\text{ft}} \cdot \frac{1\text{hr}}{60\text{min}} \cdot \frac{1\text{min}}{60\text{sec}} = 352\ \frac{in}{sec}$$

You try one…

Convert 30km/day into ft/min (1m=39.37in)

$$\frac{30km}{1day}\left|\frac{1000m}{1km}\right|\frac{39.37in}{1m}\left|\frac{1day}{24hr}\right|\frac{1hr}{60min} = 820\ \frac{ft}{min}$$

Dimensional Analysis - Squared, Cubed (etc) Units

If you have a unit that is raised to a power, then the conversion factors used will also need to be raised to that power. The number AND the unit.

1 in = 2.54cm but $1in^2 = (2.54cm)^2$

1 ft = 12in but $1ft^3 = (12in)^3$

$$5in^2 \left| \frac{(2.54cm)^2}{(1in)^2} \right. = 32.258\ cm^2$$

YouTube Link to Presentation

- https://youtu.be/fhj5d5zZa-4