Dimensional Analysis

A review of a topic we have already done!

Dimensional…what?

- Dimensional analysis is a problem-solving method that uses the idea that any number or expression can be multiplied by one without changing its value
- It is a fraction whose numerator and denominator are equivalent measures.
  - The reciprocal can also be used
- It is used to go from one unit to another!

$\frac{1\text{ ft}}{12\text{ in.}}$	$\frac{1\text{ yd}}{3\text{ ft}}$	$\frac{1\text{ mi}}{5{,}280\text{ ft}}$	$\frac{1\text{ lb}}{16\text{ oz}}$	$\frac{1\text{ pt}}{2\text{ c}}$	$\frac{1\text{ qt}}{2\text{ pt}}$	$\frac{1\text{ gal}}{4\text{ qt}}$	$\frac{1\text{ hr}}{60\text{ min}}$	$\frac{1\text{ min}}{60\text{ s}}$	$\frac{1\text{ m}}{100\text{ cm}}$	$\frac{1\text{ km}}{1{,}000\text{ m}}$

How does it work?

- A conversion factor, or a fraction that is equal to one, is used, along with what you're given in order to determine what the new unit will be

- Examples:
  - 60 seconds =
  - 60 minutes =
  - 24 hours =

Written as a fraction…

- You can write any conversion as a fraction!
- Be careful of how you write the fraction!
- For example, you can write 60 seconds = 1 min as:

$$\frac{60 \text{ seconds}}{1 \text{ minute}} \quad \text{OR} \quad \frac{1 \text{ minute}}{60 \text{ seconds}}$$

Fractions continued…

- Again, be careful how you write the fraction
- The fraction must be written so that like units cancel.

$$50.0\ \text{mL} \times \frac{1\ \text{L}}{1000\ \text{mL}}$$

Steps to writing conversion factors

1. Start with the given value
2. Write the multiplication symbol (X)
3. Choose the appropriate conversion factor
4. The problem is solved by multiplying the given data & their units by the appropriate unit factor so that the desired units remain
5. Remember, cancel like units!

Let's try some examples

- Suppose there are 12 slices of pizza in one pizza. How many slices are in 7 pizzas?

Given: 7 pizzas
Want: # of slices
Conversion: 12 slices = one pizza

$$\frac{7 \text{ pizzas}}{1} \times \frac{12 \text{ slices}}{1 \text{ pizza}} = 84 \text{ slices}$$

Let's try some examples

- How old are you in days?

Given: 17 years
Want: # of days
Conversion: 365 days = one year

$$\frac{17 \text{ years}}{1} \times \frac{365 \text{ days}}{1 \text{ year}} = 6205 \text{ days}$$

Let's try some examples

- There are 2.54 cm in one inch. How many inches are in 17.3 cm?

Given: 17.3 cm
Want: # of inches
Conversion: 2.54 cm = one inch

$$\frac{17.3\ \text{cm}}{1} \times \frac{1\ \text{inch}}{2.54\ \text{cm}} = 6.81\ \text{inches}$$

Multiple – Step Problems

- Most problems are not simple one-step solutions.
- Sometimes, you will have to perform multiple conversions.
- Example: How old are you in hours?

Given: 17 years
Want: # of hours
Conversion #1: 365 days = one year
Conversion #2: 24 hours = one day

Solution

$$\frac{17 \text{ years}}{1} \times \frac{365 \text{ days}}{1 \text{ year}} \times \frac{24 \text{ hours}}{1 \text{ day}} =$$

148,920 hours

Combination Units

- Dimensional analysis can also be used for combination units.
- Like converting km/h into cm/s
- Write the fraction in a "clean" manner:

km/h becomes $\frac{\text{km}}{\text{h}}$

Combination Unit Example

- Example: convert 0.083 km/h into m/s

Given: 0.083 km/h
Want: # m/s
Conversion #1: 1000 m = 1 km
Conversion #2: 1 hour = 60 minutes
Conversion #3: 1 minute = 60 seconds

Solution

$$\frac{0.083\ \text{km}}{1\ \text{hour}} \times \frac{1000\ \text{m}}{1\ \text{km}} = \frac{83\ \text{m}}{1\ \text{hour}}$$

$$\frac{83\ \text{m}}{1\ \text{hour}} \times \frac{1\ \text{hour}}{60\ \text{min}} \times \frac{1\ \text{min}}{60\ \text{sec}} = \frac{0.023\ \text{m}}{\text{sec}}$$

Now, you try…

- Complete your assignment by yourself.
- If you have any questions, ask me.
- You may not work in groups and you may not listen to music.