Dimensional Analysis

Dimensional Analysis

- AKA factor-label, unit analysis, etc.
- A problem-solving technique
- Uses units to direct/inform you of how to proceed

Conversion Factors

- A Ratio = 1
- # on the top is the same/equivalent to # on the bottom
- Examples:

$$\frac{1\ m}{100\ cm} \qquad \frac{5280\ ft}{1\ mile}$$

- Units cancel like the numbers do

$$\frac{4*3*6}{6*3} = 4 \qquad \frac{cm*cm*g}{cm*cm} = g$$

Questions to Ask Yourself:

- What is given?
- What is being asked for?
- How to get there from here?

Ex #1: How many cm in 32.4 mm?

$$32.4\ mm\ x\ \frac{1\ cm}{10\ mm} = 3.24\ \text{cm}$$

Put in your calculator: 32.4 / 10 =

Ex #2: How many inches in 8.63 miles?

$$8.63\ miles\ x\ \frac{5280\ ft}{1\ mile}\ x\ \frac{12\ in}{1\ ft} = 547000\ \text{in}$$

Put in your calculator: 8.63 x 5280 x 12 =

Ex #3: How many gallons in 496 mL?

$$496\ mL\ x\ \frac{1\ L}{1000\ mL}\ x\ \frac{1\ gallon}{3.7854\ L} = 0.131 \text{ gallons}$$

Put in your calculator: 496 / 1000 / 3.7854 =

COMPOUND UNITS

g/cm^3 --- read as "per" = division line

Ex #4: How many lb/qt in 2.70 g/cm^3?

$$\frac{2.70\ g}{1\ cm^3}\ x\ \frac{1\ lb}{453.59\ g}\ x\ \frac{1\ cm^3}{1\ mL}\ x\ \frac{1000\ mL}{1\ L}\ x\ \frac{1L}{1.0567\ qt} = 5.63 \text{ lb/qt}$$

Put in your calculator: 2.70 / 453.59 x 1000 / 1.0567 =

Converting Units that are x^2 or x^3

- Remember…units cancel like the numbers do…

$$\frac{4*3*6}{6*3} = 4 \qquad \frac{cm*cm*g}{cm*cm} = g$$

- This means if you have cm^2, you have cm x cm, so…
- To change cm^2, you need to use the conversion factor 2 times

$$32 \text{ cm}^2 \text{ x } \frac{1\ m}{100\ cm} \text{ x } \frac{1\ m}{100\ cm} \text{ x } = 0.0032 \text{ m}^2$$

Example #5:
How many cm^3 are in 16.2 ft^3?

$$16.2\ ft^3\ x\ \frac{12\ in}{1\ ft}\ x\ \frac{12\ in}{1\ ft}\ x\ \frac{12\ in}{1\ ft}\ x\ \frac{2.54\ cm}{1\ in}\ x\ \frac{2.54\ cm}{1\ in}\ x\ \frac{2.54\ cm}{1\ in} =$$

458,732 cm^3 = 459,000cm^3 = 4.59 x 10^5 cm^3

OR

$$16.2\ ft^3\ x\ \frac{(12\ in)^3}{(1\ ft)^3}\ x\ \frac{(2.54\ cm)^3}{(1\ in)^3} = 458{,}732 \text{ cm}^3$$

= 459,000cm^3 = 4.59 x 10^5 cm^3

Example #6:
How many cm^3 are in a block of concrete that measures 2.0 m x 5.6 m x 7.1 m?

$$V = l\ x\ w\ x\ h = 2.0\ m\ x\ 5.6\ m\ x\ 7.1\ m = 79.52\ m^3 = 80.\ m^3$$

$$80.\ m^3\ x\ \frac{100\ cm}{1\ m}\ x\ \frac{100\ cm}{1\ m}\ x\ \frac{100\ cm}{1\ m} = 79520000 \text{ cm}^3 = 8.0 \text{ x } 10^7 \text{ cm}^3$$

OR

$$80.\ m^3\ x\ \frac{(100\ cm)^3}{(1\ m)^3} = 80.\ m^3\ x\ \frac{1000000\ cm^3}{1\ m^3} = 79520000 \text{ cm}^3$$

= 8.0 x 10^7 cm^3