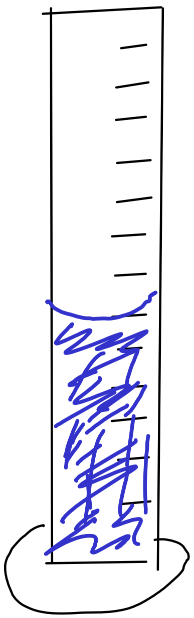
...of an object

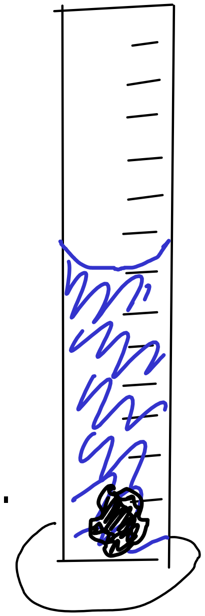
1) Measure mass of object

mass = 9.78 g



2) Partially fill cylinder with liquid, record volume.

volume = 25.0 mL



3) Put object into cylinder, record new volume

volume = 26.6 mL

4) Subtract to find volume of object

$$\begin{array}{r} 26.6\text{ mL} \\ -\ 25.0\text{ mL} \\ \hline 1.6\text{ mL} \end{array}$$

5) Density = mass object / volume object

$$\text{Density} = \frac{9.78\ \text{g}}{1.6\ \text{mL}}$$

$$= 6.1\ \text{g/mL}$$

Converting from one unit to another

We will use the method of dimensional analysis, sometimes called the factor-label method.
... or, the "drag and drop" method!

Dimensional analysis uses conversion factors to change between one unit and another

What's a conversion factor? A simple equality.

Example

12 in = 1 ft

Conversion factors in metric

In the metric system, conversion factors between units may always be made from the metric prefixes!

For example, "kilo-" means 10^3

$$k = 10^3$$

so

$$km = 10^3 m$$

$$kg = 10^3 g$$

$$kL = 10^3 L$$

$$ks = 10^3 s$$

Just apply the prefix to the base unit!

How do we actually USE a conversion factor?

Convert 15.75 m to cm

$cm = 10^{-2}\,m$

$$15.75\,m \times \frac{cm}{10^{-2}\,m} = 1575\,cm$$

* This fraction equals one, so multiplying by it does not change the VALUE of the number, only its UNITS!

* Similar to...

If X = 2, then

$$\frac{X}{2} = 1$$

Convert 0.01893 kg to g

$Kg = 10^{3}\,g$

$$0.01893\,kg \times \frac{10^{3}\,g}{Kg} = 18.93\,g$$

DRAG AND DROP

- Drag the part of the factor that you want to cancel out to the BOTTOM.

- Then, drag the other half of the factor to the TOP

Convert 14500 mg to kg

$mg = 10^{-3} g \qquad kg = 10^{3} g$

$$14500\, mg \times \frac{10^{-3}\, g}{mg} \times \frac{kg}{10^{3}\, g} = \boxed{0{,}0145\, kg}$$

Convert 0.147 cm^2 to m^2

$cm = 10^{-2} m$

$$0{,}147\, cm^2 \times \frac{10^{-2}\, m}{cm} \times \frac{10^{-2}\, m}{cm} = \boxed{1.47 \times 10^{-5}\, m^2}$$

OR $0{,}000147\, m^2$

We have to convert BOTH parts of the squared unit, so we apply the conversion factor twice!

$$cm^2 = cm \times cm$$

... for CUBED units, apply the factor three times!

8.45 kg to μg $\quad$ $kg = 10^3 g$ $\quad$ $\mu g = 10^{-6} g$

$$8.45\ kg \times \frac{10^3\ g}{kg} \times \frac{\mu g}{10^{-6}\ g} = 8450000000\ \mu g$$

$$\boxed{8.45 \times 10^9\ \mu g}$$

88100 kHz to MHz $\quad$ $kHz = 10^3 Hz$ $\quad$ $MHz = 10^6 Hz$

$$88100\ kHz \times \frac{10^3\ Hz}{kHz} \times \frac{MHz}{10^6\ Hz} = \boxed{88.1\ MHz}$$

Convert 38.47 in to m, assuming 2.54 cm = 1 in

$2.54\ cm = in \qquad cm = 10^{-2}\ m$

$$38.47\ in \times \frac{2.54\ cm}{in} \times \frac{10^{-2}\ m}{cm} = \boxed{0.9771\ m}$$

Accuracy and Precision

- two related concepts that you must understand when working with measured numbers!

Accuracy

- how close a measured number is to the CORRECT (or "true") value of what you are measuring

- "Is it right?"

- checked by comparing measurements against a STANDARD (a substance or object with known properties)

Precision

- how close a SET of measured numbers are to EACH OTHER

- "Can I reproduce this?"

- checked by repeated measurements