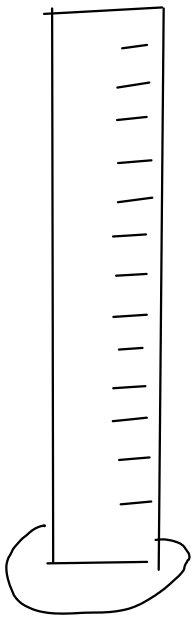
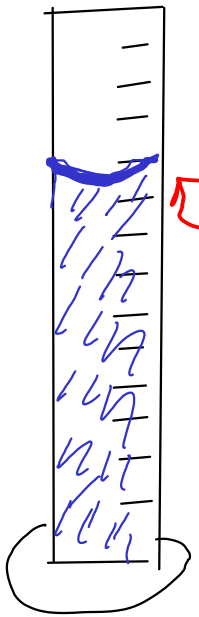
Measuring density

... of a liquid



1) Measure mass of empty cylinder

mass = 88.9753 g



2) Fill cylinder and measure volume of liquid

Volume = 25.9 mL

3) Measure mass of filled cylinder

mass = 119.8943 g

4) Subtract to find mass of liquid

$$\begin{array}{r} 119.8943\ \text{g} \\ -\ 88.9753\ \text{g} \\ \hline 30.9190\ \text{g} \end{array}$$

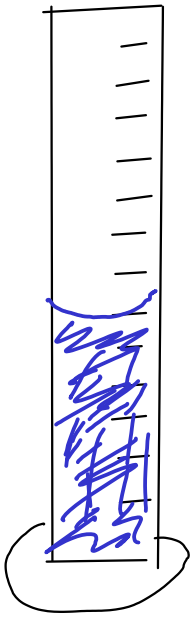
5) Density = mass liquid / volume liquid

$$\text{Density} = \frac{30.9190\ \text{g}}{25.9\ \text{mL}} = 1.19\ \text{g/mL}$$

...of an object

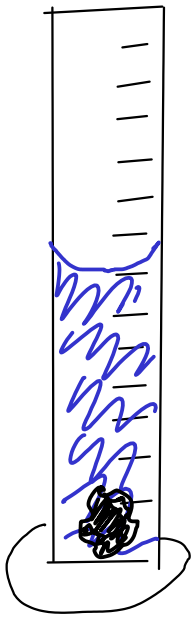
1) Measure mass of object

mass = 20.1073 g



2) Partially fill cylinder with liquid, record volume.

volume = 25.0 mL



3) Put object into cylinder, record new volume

volume = 33.3 mL

4) Subtract to find volume of object

$$\begin{array}{r} 33.3 \text{ mL} \\ -\ 25.0 \text{ mL} \\ \hline 8.3 \text{ mL} \end{array}$$

5) Density = mass object / volume object

$$\text{Density} = \frac{20.1073 \text{ g}}{8.3 \text{ mL}}$$

$$= 2.4 \text{ g/mL}$$

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

$12\ \text{in} = 1\ \text{ft}$

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

$$kg = 10^3 g$$

$$km = 10^3 m$$

$$ks = 10^3 s$$

$$kL = 10^3 L$$

Just apply the prefix to the base unit!

How do we actually USE a conversion factor?

$1\,cm = 10^{-2}\,m$

Convert 15.75 m to cm

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

DRAG AND DROP!

Put what you want to cancel on the bottom, then ...

... put what it equals on the top!

Convert 0.01893 kg to g

$1\,kg = 10^{3}\,g$

$$0.01893\,kg \times \frac{10^{3}\,g}{1\,kg} = 18.93\,g$$

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

Convert 14500 mg to kg

$$14500\ mg \times \frac{10^{-3} g}{mg} \times \frac{kg}{10^{3} g} = \boxed{0.0145\ kg}$$

Convert 0.147 mm to μm

μ ← micro-

(Sometimes μ- is written "mc-")

$mm = 10^{-3} m$ $\quad \mu m = 10^{-6} m$

$$0.147\ mm \times \frac{10^{-3} m}{mm} \times \frac{\mu m}{10^{-6} m} = \boxed{147\ \mu m}$$