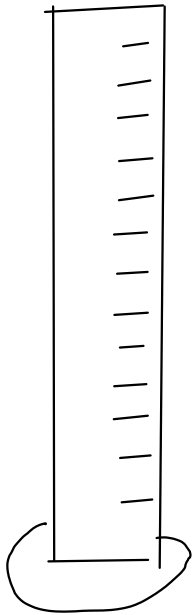


Measuring density

... of a liquid



1) Measure mass of empty cylinder

$$\text{mass} = 97.35 \text{ g}$$



2) Fill cylinder and measure volume of liquid

$$\text{volume} = 25.3 \text{ mL}$$

3) Measure mass of filled cylinder

$$\text{mass} = 130.55 \text{ g}$$

4) Subtract to find mass of liquid

$$\begin{array}{r} 130.55 \text{ g} \\ - 97.35 \text{ g} \\ \hline 33.20 \text{ g} \end{array}$$

5) Density = mass liquid / volume liquid

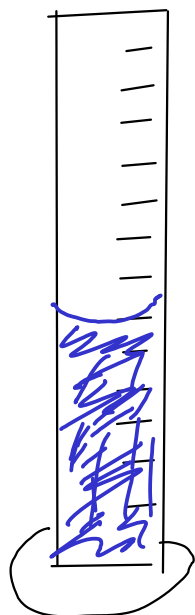
$$\text{Density} = \frac{33.20 \text{ g}}{25.3 \text{ mL}} = 1.31 \text{ g/mL}$$

...of an object



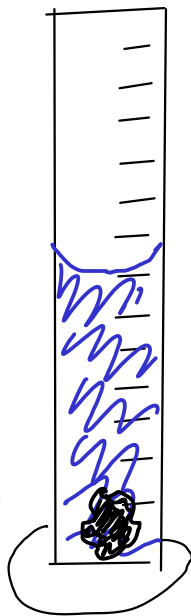
1) Measure mass
of object

$$\text{mass} = 9.78 \text{ g}$$



2) Partially fill cylinder
with liquid, record volume.

$$\text{volume} = 25.0 \text{ mL}$$



3) Put object into cylinder, record new
volume

$$\text{volume} = 26.6 \text{ mL}$$

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

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

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

$$k\ m = 10^3\ m$$

$$k\ g = 10^3\ g$$

$$k\ L = 10^3\ L$$

$$k\ s = 10^3\ s$$

Just apply the prefix to the base unit!

How do we actually USE a conversion factor?

Convert 15.75 m to cm

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

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

* Similar to...

If $X = 2$, then

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

15.75 / $\boxed{\text{EE}}^{-2}$.. on TI-83

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

Convert 0.01893 kg to g

$$0.01893 \cancel{\text{kg}} \times \frac{10^3 \text{ g}}{\cancel{\text{kg}}} = 18.93 \text{ g}$$

$\text{kg} = 10^3 \text{ g}$

DRAG AND DROP

- Drag the part of the factor that contains the unit you want to get rid of (cancel out) to the BOTTOM.

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

Convert 14500 mg to kg

$$mg = 10^{-3}g$$

$$kg = 10^3g$$

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

Convert 0.147 cm² to m²

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

When writing factors, don't use a base (in red) that has its own exponent. If you're dealing with squared or cubed meters, just use meters here!

$$0.147 \cancel{cm}^2 \times \frac{10^{-2} m}{\cancel{cm}} \times \frac{10^{-2} m}{\cancel{cm}} = \boxed{1.47 \times 10^{-5} m^2}$$

$$\boxed{(0.0000147 m^2)}$$

To convert squared or cubed units, apply each factor two (for squared) or three (for cubed) times, because

$$cm^2 = cm \times cm \quad cm^3 = cm \times cm \times cm$$

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

$$8.45 \cancel{\text{kg}} \times \frac{10^3 \cancel{\text{g}}}{\cancel{\text{kg}}} \times \frac{\mu\text{g}}{10^{-6} \cancel{\text{g}}} = \boxed{8.45 \times 10^9 \mu\text{g}}$$

88100 kHz to MHz $\text{kHz} = 10^3 \text{Hz}$

$\text{MHz} = 10^6 \text{Hz}$

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

$\text{Hz} = \text{s}^{-1}$ (Frequency)