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

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

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

$$kg = 10^3 g$$

$$ks = 10^3 s$$

$$km = 10^3 m$$

$$kL = 10^3 L$$

Just apply the prefix to the base unit!

How do we actually USE a conversion factor?

Convert 15.75 m to cm

$cm = 10^{-2} m$

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

* 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

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

15.75 / EE −2 .. on TI-83

Convert 0.01893 kg to g

$kg = 10^{3} g$

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

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 $\quad m\,g = 10^{-3}\,g \qquad kg = 10^{3}\,g$

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

Convert 0.147 cm^2 to m^2 $\qquad cm = 10^{-2}\,m$

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

$(0.000147\ m^2)$

When converting squared or cubed units, use each conversion factor two (for squared) or three (for cubed) times. If you think of these units as ...

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

... then this should make sense!

8.45 kg to μg

$$kg = 10^{3}\,g \qquad \mu g = 10^{-6}\,g$$

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

$$(8.45 \times 10^{9}\,\mu g)$$

88100 kHz to MHz

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

$$kHz = 10^{3}\,Hz \qquad MHz = 10^{6}\,Hz$$

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

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

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

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

Convert 12.48 km to in $\qquad 2.54\ cm = in \qquad km = 10^{3}\ m \qquad cm = 10^{-2}\ m$

$$12.48\ \cancel{k}m \times \frac{10^{3}\ \cancel{m}}{\cancel{km}} \times \frac{\cancel{cm}}{10^{-2}\ \cancel{m}} \times \frac{in}{2.54\ \cancel{cm}} = \boxed{491300\ in}$$

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