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

Convert 14500 mg to kg

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

Convert 0.147 mm to μm

micro-

(mc- also means "micro")

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

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

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

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

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

Even though English units are involved, we can solve this problem the same way we solved the previous problem where only metric units were used!

20 Even if you're unfamiliar with the metric units involved in a problem, you can still do conversions easily.

88100 kHz to MHz

Hz = 1/s (Frequency)

$kHz = 10^3 Hz$ $MHz = 10^6 Hz$

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

0.004184 kJ to J

J = Joule (energy)

$kJ = 10^3 J$

$$0.004184\ \cancel{kJ} \times \frac{10^3\ J}{\cancel{kJ}} = \boxed{4.184\ J}$$

A sample application of dimensional analysis: Drug calculations.in the healthcare field.

Example: A patient is ordered 40 mg of codeine phosphate by subcutaneous injection. 50 mg in 1 mL liquid is available. How much of this liquid should be adminstered?

This is a CONVERSION FACTOR. Many statements with "in" or "per" connecting two numbers can be read as conversion factors and used for dimensional analysis!

$$50 \text{ mg} = \text{mL}$$

$$40 \text{ mg} \times \frac{\text{mL}}{50 \text{ mg}} = \boxed{0.8 \text{ mL}}$$

Mileage

A car (averaging 17.5 miles per gallon) is traveling 50 miles per hour. How many gallons of gas will be used on a trip that lasts 0.75 hours?

$17.5 \text{ mi} = \text{gal}$ $\qquad$ $50 \text{ mi} = \text{hr}$

$$0.75 \cancel{\text{hr}} \times \frac{50 \cancel{\text{mi}}}{\cancel{\text{hr}}} \times \frac{\text{gal}}{17.5 \cancel{\text{mi}}} = \boxed{2.1 \text{ gal}}$$

If gas is $3.46 per gallon, how much will the trip cost?

$\$3.46 = \text{gal}$

$$2.1 \text{ gal} \times \frac{\$3.46}{\text{gal}} = \boxed{\$7.41}$$

For a 200 mile trip in a car which averages 15 miles per gallon, if gas costs $3.46 per gallon, what's the cost of the trip?

$15 \text{ mi} = \text{gal}$ $\qquad$ $\$3.46 = \text{gal}$

$$200 \text{ mi} \times \frac{\text{gal}}{15 \text{ mi}} \times \frac{\$3.46}{\text{gal}} = \boxed{\$46}$$

Accuracy and Precision

- two related concepts that you must understand wheh 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

More on precison

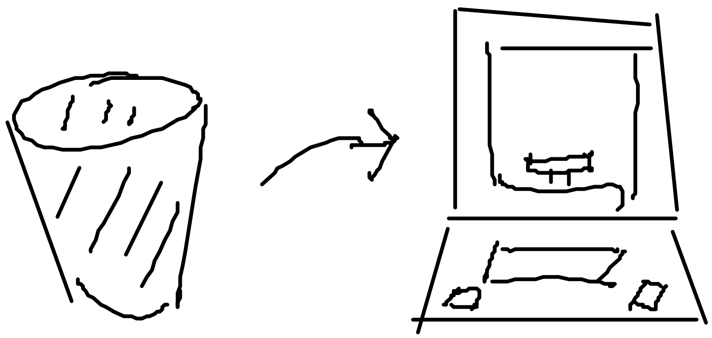
Every measurement contains some amount of ERROR, or some amount of deviation from the true value of what is being measured.

RANDOM ERROR is the variability in a measurement that cannot be traced back to a single cause. Random errors cause measurements to fluctuate around the true value, but can be averaged out given enough measurements.

When reporting measurements, we want to indicate how much random error we think is present. How?

An experiment:

Measure the mass of the RUBBER STOPPER using the BALANCE.



Record the mass on the note card. Include ALL digits given by the balance. Then, give the card to your instructor.