

Convert 38.47 in to m, assuming $2.54 \text{ cm} = 1 \text{ in}$

$$2.54 \text{ cm} = 1 \text{ in} \quad 1 \text{ cm} = 10^{-2} \text{ m}$$

$$38.47 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = 0.97771 \text{ m}$$

Even though English units are involved, we set this problem up identically to the metric unit examples on the previous pages!

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

88100 kHz to MHz

$$\text{kHz} = 10^3 \text{ Hz}$$

Hz = 1/s (frequency)

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

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

0.004184 kJ to J

$$\text{kJ} = 10^3 \text{ J}$$

J = Joule (energy)

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

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 administered?

$$50 \text{ mg drug} = 1 \text{ mL}$$

$$40 \text{ mg drug} \times \frac{1 \text{ mL}}{50 \text{ mg drug}} = \boxed{0.8 \text{ mL}}$$

This is a CONVERSION FACTOR. It shows us what volume of the liquid is EQUIVALENT to 50 mg of the drug we're injecting!

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?

$$17.5 \text{ mi} = \text{gal gas} \quad 50 \text{ mi} = \text{hr}$$

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

If gas is \$1.99 per gallon, how much will the trip cost?

$$\text{\$1.99} = \text{gal gas}$$

$$2.1 \text{ gal} / \cancel{\text{ gas}} \times \frac{\text{\$1.99}}{\cancel{\text{ gal gas}}} = \boxed{\text{\$4.26}}$$

For a 200 mile trip in a car which averages 15 miles per gallon, if gas costs \$1.99 per gallon, what's the cost of the trip?

$$15 \text{ mi} = \text{gal gas} \quad \$1.99 = \text{gal gas}$$

$$200 \cancel{\text{mi}} \times \frac{\cancel{\text{gal gas}}}{15 \cancel{\text{mi}}} \times \frac{\$1.99}{\cancel{\text{gal gas}}} = \boxed{\$26.53}$$

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

More on precision

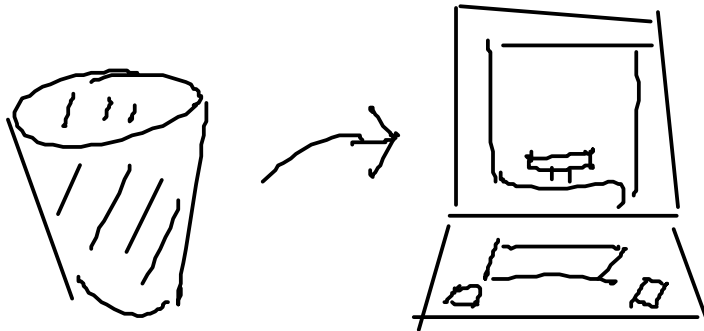
Every measurement contains some amount of ERROR, or some amount of deviation from the true value of what is being measured.

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.