Dimensional Analysis

and metric system

Why use the metric system?

* is it just to annoy American high school science students?
* It is used by (almost) the entire world except for the United States. (Myanmar and Liberia are the only other hold outs)
* Easier to convert between units because everything uses the same set of prefixes
* It is based off of natural phenomena instead royal decree or objects that won't last

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* Countries in the world that have not adopted the metric system

The "SI" system

SI is a subset of the metric system. SI stands for Systeme Internationale d'Unites or the International System of Units.

length	meter	m
mass	kilogram	Kg
volume	liter	L
temperature	Kelvin/ Celsius	K / C
amount of substance	mole	mol

Metric Prefixes

Name	Symbol	Meaning
Tera	T	1,000,000,000,000
Giga-	G	1,000,000,000
Mega-	M	1,000,000
Kilo-	k	1,000
Hecto-	h	100
Deka-	da	10
(base)		
Deci	d	1/10
Centi-	c	1/100
Milli-	m	1/1,000

Dimensional Analysis

* We will use dimensional analysis to convert units.
* I can not emphasize this enough, I AM NOT TEACHING YOU THE BEST WAY TO CONVERT UNITS!!
* I am instead TEACHING YOU DIMENSIONAL ANALYSIS which is the primary method of math used throughout chemistry.

Using Dimensional Analysis, Factor Label Method (Converting between Units)

* to convert one unit to another you need conversion factors.
* Conversion factor- how much of one unit equals another unit
* Ex. 1 kg = 2.2 lb or 1000 m = 1 km
* Therefore 1 kg/ 2.2 lb = 1 or 2.2 lb / 1 kg =1
* you can always multiply any number by one and not change the number

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1. Write down your given and underline it.
2. draw an H or a field goal post next to it.
3. in any H or field goal post you can put one conversion factor (half on top half on bottom).
4. put the unit you want to cancel out on the opposite side of the field goal.
5. multiply by everything on top, divide by everything on the bottom.

Convert 52 lbs to kg. (2.2 lbs = 1 kg)

52 lbs	1 kg
	2.2 lbs

= 23.6 kg

lbs divided by lbs cancel out

What this represents

* The H's or field goal posts are really just representing multiplying by fractions
* So for convert 52 lbs to kg. (2.2 lbs = 1 kg)

52 lbs	1 kg
	2.2 lbs

= 23.6 kg

* Is really

* 52 lbs x $\frac{1 kg}{2.2 lbs} = 23.6\ kg$

* Writing it out either way is acceptable.
* This is what is meant by "show your work"

Slide 1

1 yd = .9144 m
How many meters are in a football field (100 yds)?

$$\frac{100 \text{ yds} \quad | \quad 1 \text{ yd}}{| \quad .9144 m} \quad \text{(crossed out)}$$

$$\frac{100 \text{ yds} \quad | \quad .9144 m}{| \quad 1 \text{ yd}} = 91.4 \text{ m}$$

no, the units you want to cancel have to be on the opposite side.

yards divided by yards cancel out

You can always do more than one step with this method.
How many meters is 100 ft? (1yd = 3ft)

Slide 2

1 yd = .9144 m
How many meters are in a football field (100 yds)?

$$\frac{100 \text{ yds} \quad | \quad 1 \text{ yd}}{| \quad .9144 m} \quad \text{(crossed out)}$$

$$\frac{100 \text{ yds} \quad | \quad .9144 m}{| \quad 1 \text{ yd}} = 91.4 \text{ m}$$

no, the units you want to cancel have to be on the opposite side.

yards divided by yards cancel out

You can always do more than one step with this method.
How many meters is 100 ft? (1yd = 3ft)

$$\frac{100 \text{ ft} \quad | \quad 1 \text{ yd} \quad | \quad .9144 m}{| \quad 3 \text{ ft} \quad | \quad 1 \text{ yds}} = 30.5 \text{ m}$$
feet and yards cancel

but you have to go to meters so…

Slide 3

1 kg = 2.2 lb, 1000g = 1 kg
1000 mL = 1 L
30 mL = 1 fl oz, 3.8 L = 1 gal

How many kg are in 175 lbs?

how many grams are in 175 lbs?

How many fl oz are in .32 gal? (you will need 3 H's)

1 kg = 2.2 lb, 1000g = 1 kg
1000 mL = 1 L
30 mL = 1 fl oz, 3.8 L = 1 gal

How many kg are in 175 lbs?

175 lbs	1 kg
	2.2 lbs

= 79.5 kg

how many grams are in 175 lbs?

175 lbs	1 kg	1000 g
	2.2 lbs	1 kg

=79,500 g

The key to doing multi-step problems is figuring out a "plan of attack"

in the last problem I can convert

lbs →kg→g, then fill in your H's to match

How many fl oz are in .32 gal? (you will need 3 H's)

0.32 gal	3.8 L	1000 mL	1 fl oz
	1 gal	1 L	30 mL

=40.5 fl oz

If you have a unit expressed as a fraction..

put the number and the numerator of the unit as the given, and write the denominator of the unit below the line. Then, proceed with the rest of the rules

convert 250 g/L to g/mL

Convert 42 km/hr to m/s

If you have a unit expressed as a fraction..

put the number and the numerator of the unit as the given, and write the denominator of the unit below the line. Then, proceed with the rest of the rules

convert 250 g/L to g/mL

250 g	1 L
L	1000 mL

=.25 g/mL
liters cancel

Convert 42 km/hr to m/s

42 km	1000 m	1 hr	1 min
1 hr	1 km	60 min	60 s

=11.7 m/s

1 kg = 2.2 lb, 1 mile = 1.6 km
1 cup = 0.24 L, 1 in = 2.54 cm
30 mL = 1 fl oz, 3.8 L = 1 gal

How many m are in 75 inches?

Convert 220 mL/s to gal/min?

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1 kg = 2.2 lb, 1 mile = 1.6 km
1 cup = 0.24 L, 1 in = 2.54 cm
30 mL = 1 fl oz, 3.8 L = 1 gal

How many m are in 75 inches?

75 in	2.54 cm	1 m
	1 in	100 cm

= 1.9 m

Convert 220 mL/s to gal/min?

220 mL	1 L	1 gal	60 s
1 s	1000 mL	3.8 L	1 min

=3.47 gal/min