Measurements

Measurements are comparisons of properties against accepted standards, called units.

ENGLISH / US SYSTEM OF UNITS:

1 foot = 12 inches   1 yard = 3 feet   1 mile = 1760 yards

1 mile = 5280 feet

So what's the problem?

1) English units don't relate to one another in meaningful, easy-to-remember ways. We have to memorize lots of different, essentially random, numbers.
2) Calculating in English units is cumbersome, since it's difficult to do things like divide by 5280 in your head!

English units are nonstandard and difficult to use. Solution?

THE METRIC SYSTEM

Metric Base Units:

All metric units are made up of COMBINATIONS of BASE UNITS!

Length	meter	m
Mass	*kilogram	kg
Temperature	Kelvin	K
Time	second	s

*we usually treat the gram as if it's the base unit for mass!

- One meter is approximately 3.3 feet.
- One kilogram is approximately 2.2 pounds.

What about SIZE?

Metric units may be made larger or smaller by adding PREFIXES.

A few common metric prefixes:

mega-	10^6	M
kilo-	10^3	k
centi-	10^{-2}	c
milli-	10^{-3}	m
micro-	10^{-6}	μ

Bigger units

_____

smaller units
(or mc-)

MEMORIZE the common metric prefixes listed in the study guide

Applying prefixes

$$1 \underline{\quad} m = \underline{\quad} m$$

$$1 \, km = 10^3 \, m \ (1000 \, m)$$

$$1 \, cm = 10^{-2} \, m \left(\frac{1}{100} \, m \right)$$

The distance between here and Columbia, SC is about 107,000 meters. What metric unit would be best suited for a distance like this?

$$K = 10^3 \ (1000)$$

107 Km

By "best suited", we mean a metric unit that would represent the number without many beginning or end zeros. These kinds of numbers are easier for us to remember!

A piece of chalk is 0.080 meters long. What metric unit would be best suited for this length?

$$C = 10^{-2} \ (1/100)$$

8.0 cm

Derived Units
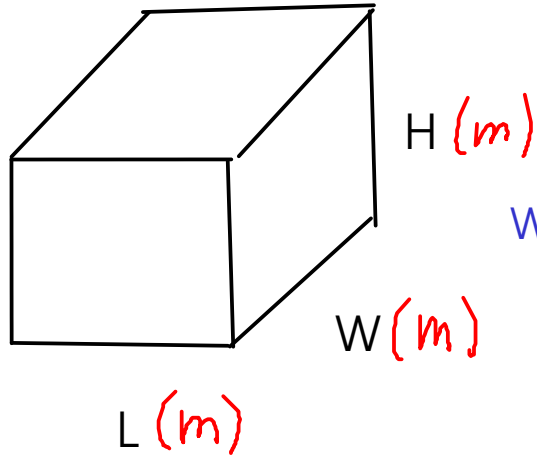
- are units that are made up of combinations of metric <u>base units</u> with each other and/or with <u>prefixes</u>

velocity: $\dfrac{miles}{hr}$ $\qquad$ $\dfrac{km}{hr}$ $\qquad$ $\left(\dfrac{m}{s}\right)$ $\qquad$ $\dfrac{length}{time}$

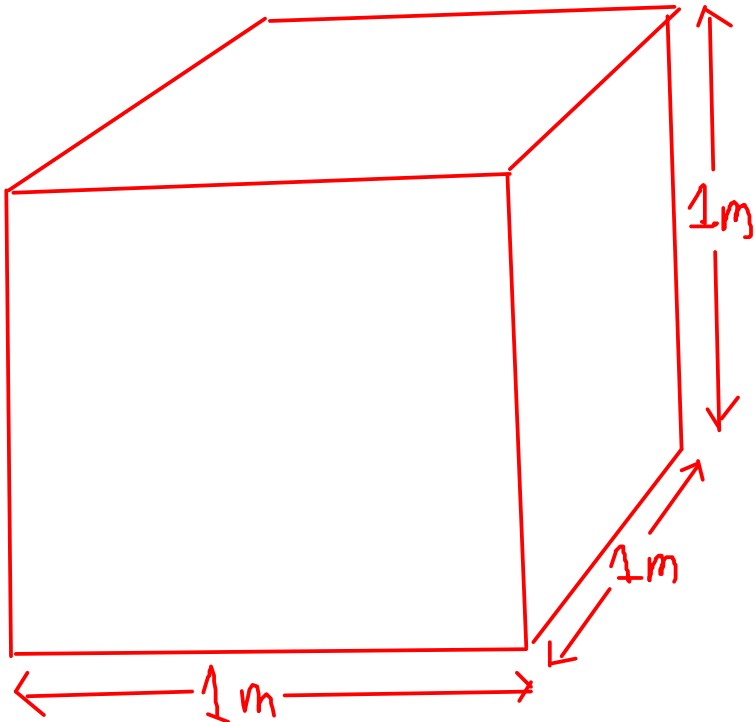Two derived units are particularly important in general chemistry:

    1) VOLUME

    2) DENSITY

VOLUME

H (m)

VOLUME = L × W × H

W (m)

L (m)

What are the units of volume in the metric system?

$$VOLUME = (m) \times (m) \times (m)$$

$$= m^3 \quad \text{"cubic meters"}$$

1m

1m

1m

Problem: The cubic meter is far too large to work with in the laboratory!

Solution? Scale it down!

Practical issues for volume units

- Cubic meters are too large! A meter is very similar in length to a yard, so a cubic meter is a cube that is <u>approximately a yard long on each side!</u>

A smaller unit for volume?

cubic decimeters! dm^3

$\left(decimeter = \frac{1}{10} \, meter\right)$

Cubic <u>decime</u>ters are given the name <u>"liters"</u>, abbreviation <u>"L"</u>

In the lab, we typically need an even smaller unit than the liter, so we use <u>millilite</u>rs (mL)

"CC"
cubic centimeter
=
milliliter

$1 \, mL = 10^{-3} L$

~or~

$1000 \, mL = 1 \, L$