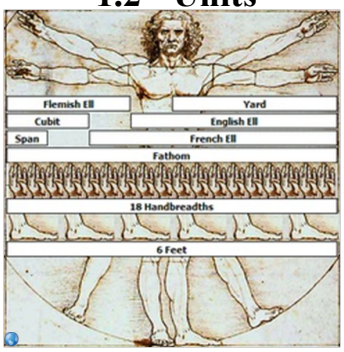
1.2 - Units



Measurement

Standard Unit: One that's accepted globally.

Why use standard units? – We don't use barley corns anymore!

Horse trading story (you don't need to write this down, just listen):

In the old days, when things were measured in barley corns, a farmer in one valley had a herd of horses that he wanted to sell. He traveled on foot to the next valley, and met another farmer. He told that farmer that he had 200 barley corn tall horses to sell for two gold pieces each. The farmer from valley two was incredulous at such a good deal, but agreed to buy three of them.

The first farmer went back to his valley and got his horses, and the next day met the second farmer to finish the transaction.

The second farmer was outraged, and refused to pay for the horses, claiming that they weren't anywhere close to 200 barley corns.

What went wrong?

Measurement

The different valleys had different lengths of barley corn! The farmer from the first valley was used to measuring in shorter ones, so his value of the horses' heights was larger than what the farmer in the second valley knew.

As a result, no horses were traded that day.

Systems of Measurement

Imperial, or British System – Feet, Pounds, etc.

Metric or S.I. (Système International des Unités) – known as MKS system (meters, Kelvins, seconds)

Base Units

Base Units: Fundamental (simplest) units of measurement.

Match the base units to what is measured!

meter (m) second (s) ampere (A)

kilogram (kg) Kelvin (K) mole (mol)

candela (cd)

length
time
mass
electric current
luminous intensity
temperature
amount of matter

Answers:
m = length, kg = mass, s = time, A = electric current, K = temperature, mol = amount of matter, cd = luminous intensity

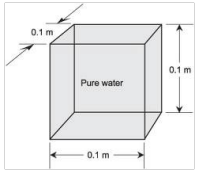
These describe EVERYTHING measureable in the universe!

Derived Units

Expressed in terms of combinations of base units.

Ex: liter – a unit of volume in SI system. How can it be defined in terms of base units?
It equals 1000 cm^3 (1000 mL = little cube made of rulers).

(Transfer water between containers Demo)



Metric Prefixes

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Multiple	Prefix	Symbol
1.0 E 9	giga	G
1.0 E 6	mega	M
1.0 E 3	kilo	k

Multiple	Prefix	Symbol
1.0 E-1	deci	d
1.0 E-2	centi	c
1.0 E-3	milli	m
1.0 E-6	micro	μ
1.0 E-9	nano	n

Temperature

Three systems commonly used, Fahrenheit, Celsius, Kelvin (which doesn't use "degrees").

ºF: Water freezes at 32 ºF, boils at 212 ºF.

ºC: Water freezes at 0 ºC, boils at 100 ºC.

K: Water freezes at 273 K , boils at 373 K.
Kelvin is based on an ABSOLUTE scale: the lowest theoretical temperature is 0 K.

Conversions

ºC → ºF : $^{\circ}F = 1.8(^{\circ}C) + 32$

ºF → ºC : $^{\circ}C = \frac{^{\circ}F - 32}{1.8}$

K → ºC: $^{\circ}C = K - 273$

ºC → K : $K = ^{\circ}C + 273$

Ex 1:

A. It's 70 ºF outside Hutch. What is that in ºC?

70.0 ºF = 21.1 ºC.

B. In London it's 12.0 ºC. What is that in ºF?

12.0 ºC = 53.6 ºF.

C. A lab reports their apparatus operating at 114 Kelvins. What's that in ºC? ºF?

114 Kelvins = -159ºC. -254 ºF.

Density

Property of matter – amount of mass per unit volume.

$$\text{Density } (\rho) = \frac{\text{mass (g)}}{\text{volume (mL)}} = \frac{m}{v}$$

symbol ρ = Greek letter Rho.

Density units are g/mL (or g/cm^3)

Ex 2:

What is the density of a piece of wood with a mass of 50.0 grams, and a volume of 62.5 mL?

$$\rho = \frac{m}{v} = \frac{50.0\,g}{62.5\,mL} = 0.800\,g/ml$$

Ex 3:

The density of gold is 19.3 g/mL. What is the volume of this ring if its mass is 8.26 g? (Assume it's pure gold.)

Ex 3:

Rearrange original density equation to isolate volume.

$$\rho = \frac{m}{v}$$

$$\rho \times v = m$$

$$v = \frac{m}{\rho}$$

Ex 3:

Plug values into your equation, cancel units, and presto! You have your volume.

$$v = \frac{m}{\rho}$$

$$v = \frac{8.26 \cancel{g}}{19.3 \frac{\cancel{g}}{mL}} = 0.428 \text{ mL}$$

Homework

Read Section 2.1 - 2.2 of your book
1.2 Problems in Booklet
Due: next class.