8/28/2019

Units

Every measurement : #-UNIT

ex: 12 kg.
83 s
4 m

lots of units!

length: cm, in, ft, mm, mi, m, km, yd, parsecs
chains, furlongs, rods, light years, ..

Science uses the International System (SI) units

Quantity	Unit	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K
amount of substance	mole	mol
electrical current	ampere	A
luminous intensity	candela	cd

If these units are too big/small, we use an SI prefix to modify!

Prefix	Symbol	Multiplier
tera	T	$\times 10^{12}$
giga	G	$\times 10^{9}$
mega	M	$\times 10^{6}$
Kilo	k	$\times 10^{3}$
deci	d	$\times 10^{-1}$
centi	c	$\times 10^{-2}$
milli	m	$\times 10^{-3}$
micro	μ	$\times 10^{-6}$
nano	n	$\times 10^{-9}$
pico	p	$\times 10^{-12}$

$G = 10^{9}$

$2.5 \times 10^{9}\ s = 2.5\ Gs$ (av'g human lifespan!)

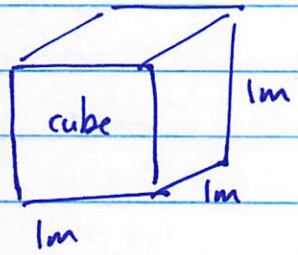
$p = 10^{-12}$

$59.4 \times 10^{-12}\ m = 59.4\ pm$ (radius of H-atom)

Derived units

-no SI unit for volume! Can derive one!

ex:

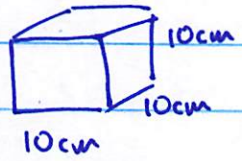


$V = \ell^3 = 1m \times 1m \times 1m$

$= 1m^3$ ← derived unit for volume!

lab: m^3 is BIG!

- could use prefixes!
- common to use:



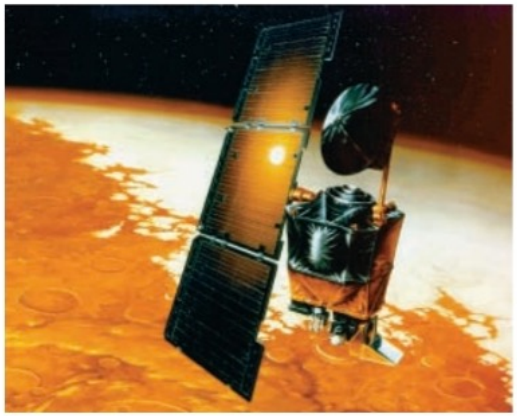
$V = \ell^3 = 1{,}000\,cm^3 = 1\ Liter = 1\ L$

$1\,cm^3 = \frac{1}{1{,}000}\ L = 10^{-3}\ L = 1\ mL$ ← same! 1 cc

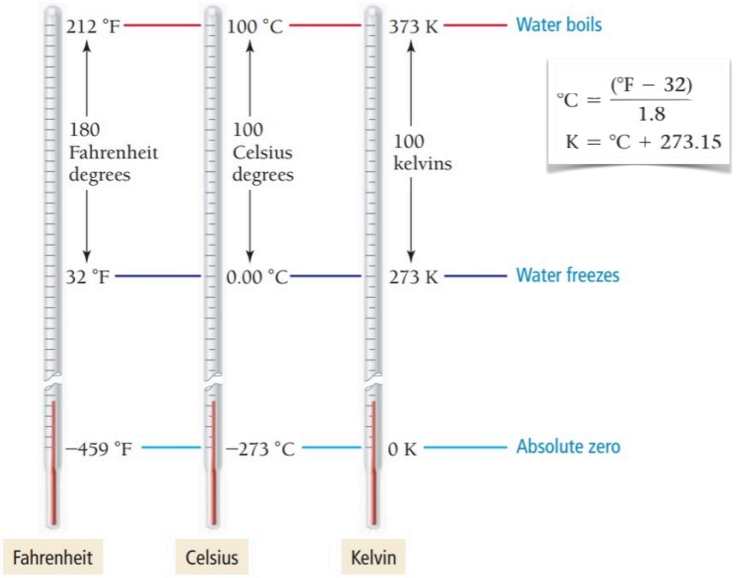
Density

$d = \frac{m}{V}$

- m: mass (depends on amount... EXTENSIVE properties)
- V: volume (depends on amount... EXTENSIVE properties)
- d: density (doesn't depend on amount... INTENSIVE property)



▲ The $125 million *Mars Climate Orbiter* was lost in 1999 because two groups of engineers used different units.



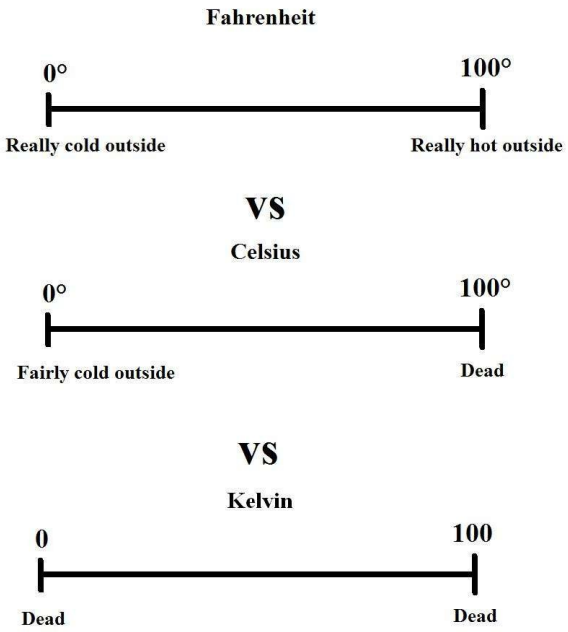
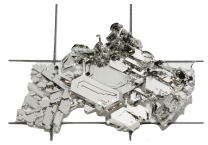


TABLE 1.4 ■ The Density of Some Common Substances at 20 °C

Substance	Density (g/cm^3)
Charcoal (from oak)	0.57
Ethanol	0.789
Ice	0.917 (at 0 °C)
Water	1.00 (at 4 °C)
Sugar (sucrose)	1.58
Table salt (sodium chloride)	2.16
Glass	2.6
Aluminum	2.70
Titanium	4.51
Iron	7.86
Copper	8.96
Lead	11.4
Mercury	13.55
Gold	19.3
Platinum	21.4

4.5 g/cm^3



21 g/cm^3