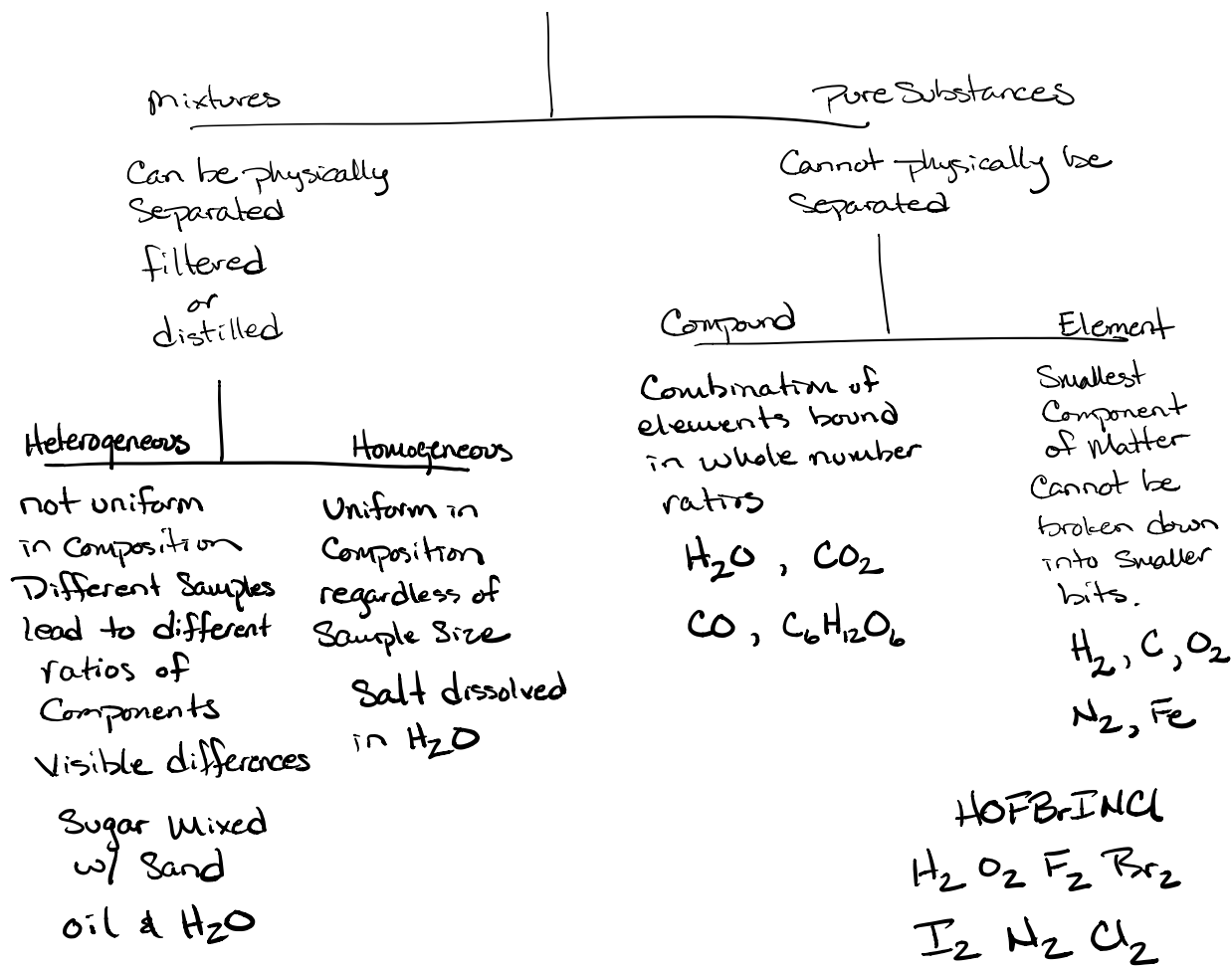


Classification of Matter



Atoms are extremely small

$\frac{1}{2}$ kt  made of Carbon



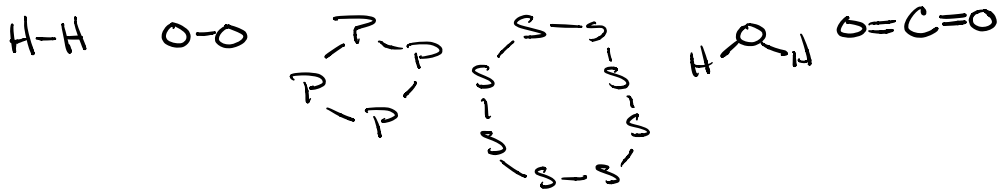
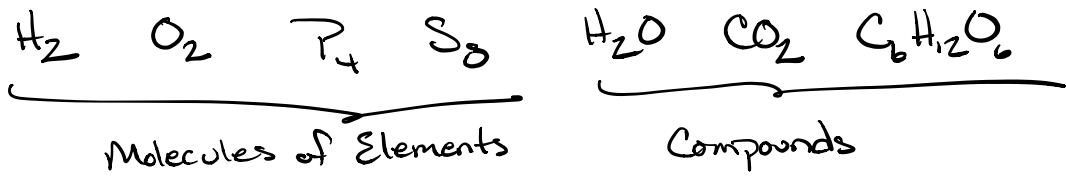
Very small & very light

1,000,000,000 Pb atoms weigh $\approx 3 \times 10^{-13}$ g

1 gram = weight of paper clip

3×10^{14} Pb atoms = 0.0000001 g

A molecule consists of 2 or more atoms in a chemical bond



1.3 Physical & Chemical Properties

Physical property - not associated with change in chemical composition

Density, hardness, color,
Boiling point, melting point,
Conductivity

Physical Change - A change of state of matter
State = solid, liquid, gas

Solid \rightleftharpoons liquid

liquid \rightleftharpoons gas

Solid \rightleftharpoons gas



dry ice

$\text{CO}_2(\text{s})$

$\text{CO}_2(\text{g})$

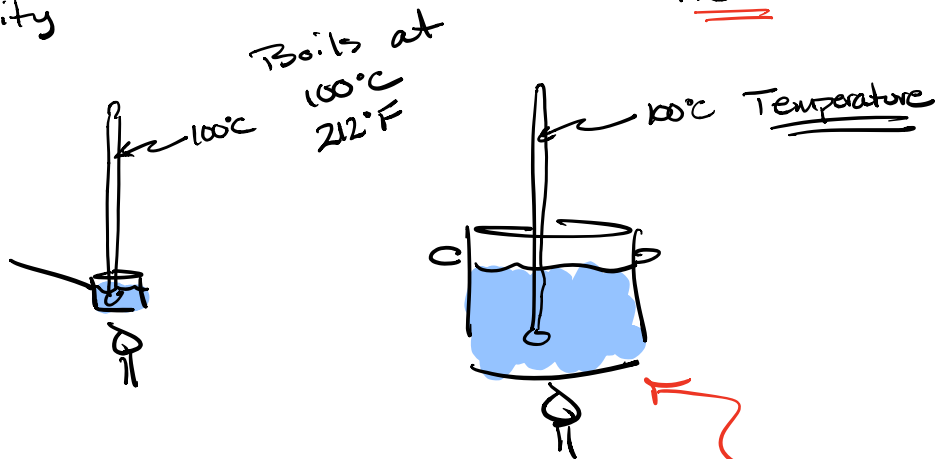
Sublimation

Chemical Change - Result in a change in the composition of matter.

Combustion, Oxidation, decomposition,
Combination, replacement.

Burning or rusting or explosion

Properties of Matter



How long does it take to heat each to 100°C ?

Heat = Sum of Energy

Temperature = Average Energy

Periodic Table

1 IA												13 IIIA		14 IVA	15 VA
1 H Hydrogen 1.008	2 IIA												5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007
3 Li Lithium 6.94	4 Be Beryllium 9.0121831											13 Al Aluminium 26.9815385	14 Si Silicon 28.085	15 P Phosphorus 30.973761998	
11 Na Sodium 22.98976928	12 Mg Magnesium 24.305	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB				
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955908	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938044	26 Fe Iron 55.845	27 Co Cobalt 58.933194	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.630	33 As Arsenic 74.921595	
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90584	40 Zr Zirconium 91.224	41 Nb Niobium 92.90637	42 Mo Molybdenum 95.95	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	
55 Cs Caesium 132.90545196	56 Ba Barium 137.327	57 - 71 Lanthanoids	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.592	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	
87 Fr Francium (223)	88 Ra Radium (226)	89 - 103 Actinoids	104 Rf Rutherfordium (267)	105 Db Dubnium (268)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (269)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (289)	

57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90766	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93033	68 Er Erbium 167.259	69 Tm Thulium 168.93422	70 Y Yttrium 174.077
89 Ac Actinium (227)	90 Th Thorium 232.0377	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 N Nobelium (259)

Hydrogen H

Boron B

Carbon C

Lithium Li

Sodium Na

Gold Au

"Natrium"
Latin for salt

"Aurum"
Shining Dawn

1 IA										2 IIA										13 IIIA										14 IVA										15 VA										16 VIA										17 VIIA										18 VIIIA																			
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1.4 Measurements

measurement = value + unit

↑
number

↑
Quantifying
the value

Decimal
or
Scientific
notation

SI or English

SI = System International

SI = metric

↑
units of
measure
Definition
of the units

↑
units of

English System

SI System

mass oz, lbs, Tons

grams, kg

Volume fl oz, gts, pts, gal

Liters, mL, uL

Length in, ft, yards, mi

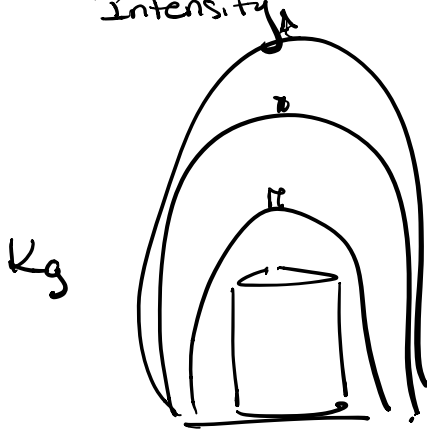
cm, m, km

12 in = 1 ft
3 ft = 1 yard

Based on powers
of 10

Within SI base System 7 base units

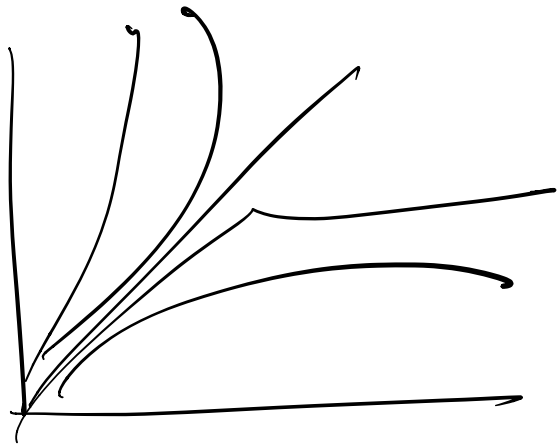
	<u>Base Unit</u>	<u>Symbol</u>
length	meter	m
mass	kilogram	kg
time	second	s
Temperature	Kelvin	K
Current	ampere	A
Amount of Substance	mole	mol
Luminous Intensity	Candela	cd



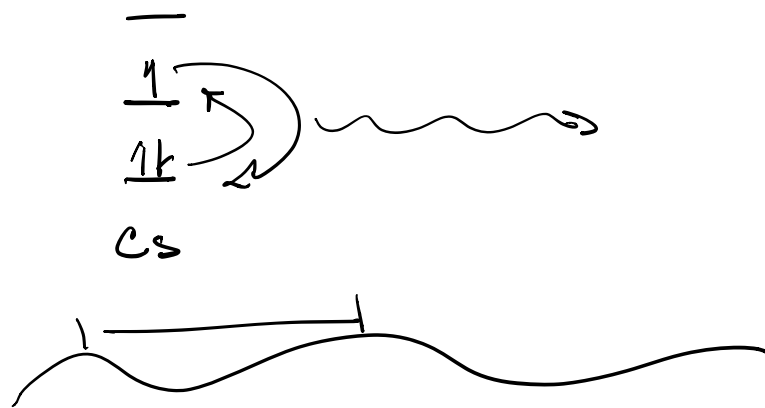
Platinum-Iridium Cylinder

1 kg

Le Grand K



		<u>Definition</u>
length	meter	Distance that light travels in a vacuum in $\frac{1}{299,792,458}$ sec.
Time	Sec	9,192,631,770 periods of radiation emitted by Cesium-133.
mole	mol	Exactly $6.02214076 \times 10^{23}$ anything



English	SI	
1 in	2.54 cm	} Conversion factors
1 lb	453.6 g	
1 gal	3.785 L	

$$1 \text{ in} = 2.540000 \dots \text{ cm}$$

Very close to exact

\Rightarrow redefined the inch

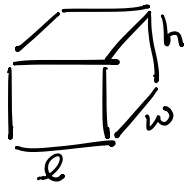
$$1 \text{ in} = 2.54 \text{ cm}$$

SI System based on Metric Prefixes (on units of 10)

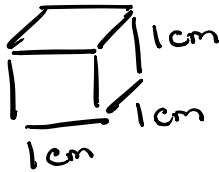
	<u>Prefix</u>	<u>abb</u>	factor of 10	
	Tera	T	10^{12}	
	Giga	G	10^9	1 Gbyte = 1×10^9 byte
larger ↑	Mega	M	10^6	1 MHz = 1×10^6 Hz
	Kilo	k	10^3	1 km = 1×10^3 m
	Base unit			
smaller ↓	deci	d	10^{-1}	1 dL = 1×10^{-1} L
	Centi	c	10^{-2}	1 cg = 1×10^{-2} g
	milli	m	10^{-3}	1 mm = 1×10^{-3} m
	Micro	μ	10^{-6}	1 μ L = 1×10^{-6} L
	nano	n	10^{-9}	
	pico	p	10^{-12}	
	femto	f	10^{-15}	

7 base units in the SI System,
The rest of the units are all derived
from the 7 base.

ex Volume

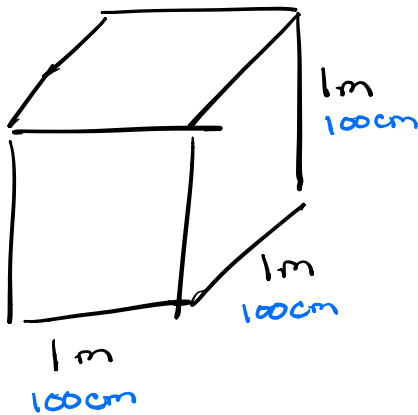


$$V = \underbrace{l \times w \times h}_{\text{Individual length measurements}}$$



$$= 1 \text{ cm} \times 1 \text{ cm} \times 1 \text{ cm}$$

$$= \boxed{1 \text{ cm}^3 = 1 \text{ mL}}$$



$$= \boxed{1 \text{ m}^3 = 1000 \text{ L}}$$

$$= 100^3 \text{ cm}^3 = 1,000,000 \text{ cm}^3$$

$$= 1 \times 10^6 \text{ cm}^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3}$$

$$= 1 \times 10^6 \text{ mL} \times \frac{1 \text{ L}}{1 \times 10^3 \text{ mL}}$$

$$= 1 \times 10^3 \text{ L} = \boxed{1000 \text{ L}}$$

$$1 \text{ cm}^3 = 1 \text{ mL} = 1 \text{ cc}$$

"Cubic Centimeter"

Ex Density

Definition $\frac{\text{mass}}{\text{Volume}}$ ratio

$$\frac{\text{grams}}{\text{milliliters}} = \frac{\text{g}}{\text{mL}} = \text{g/mL}$$

read as "grams per milliliter"

Solids & liquids
density is reported
in g/mL

gas
density reported
in g/L

gold $\frac{d}{19 \text{ g/mL} \text{ or } 19 \text{ g/cm}^3}$

H₂O $1.0 \text{ g/mL} \text{ or } 1.0 \text{ g/cm}^3$

ice
Solid H₂O 0.92 g/mL

air $1.20 \text{ g/L} = 1.20 \times 10^{-3} \text{ g/mL} = 0.00120 \text{ g/mL}$