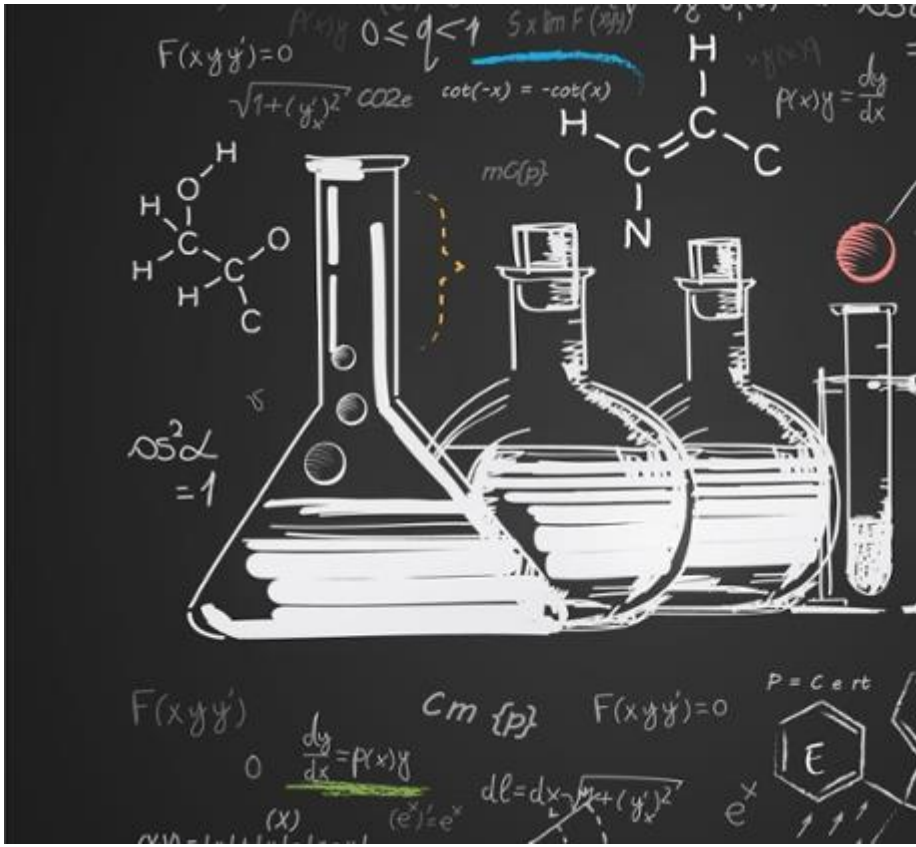
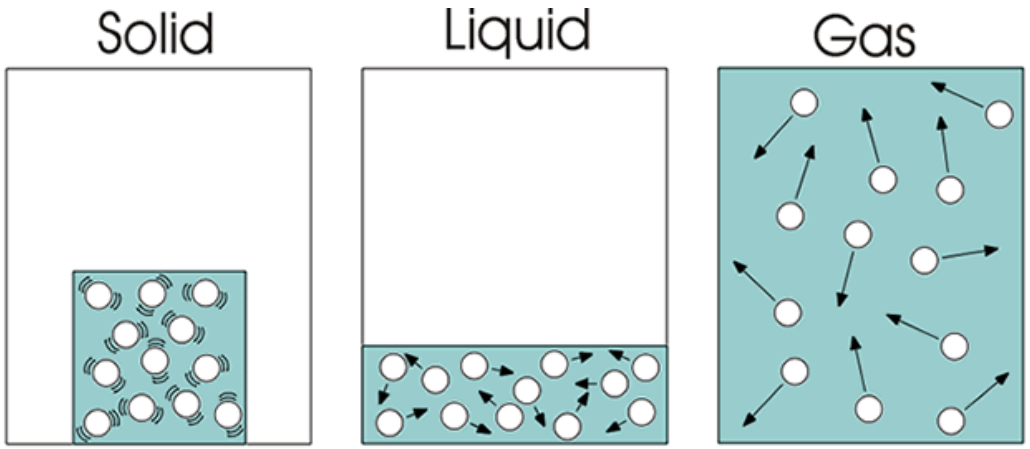

Review of
Basic Chemistry
What you should already know!

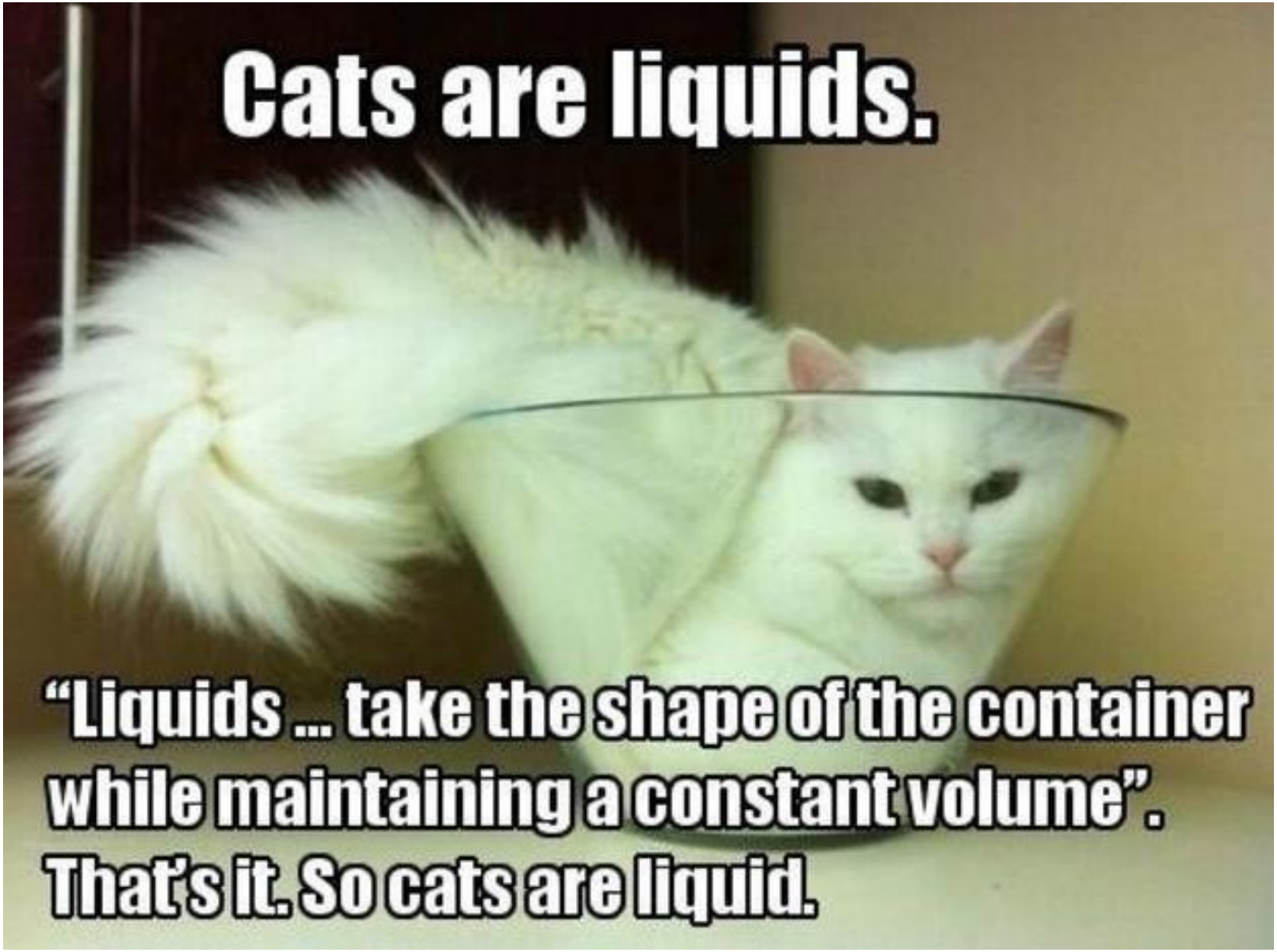
The Short List of the Most Essential Concepts

- ✓ The Classification of Matter
- ✓ The Names and Symbols of About 45 Elements
- ✓ The Periodic Table
- ✓ The Names and Formulas of Polyatomic Ions
- ✓ The Units and Prefixes of the Metric System for mass, volume and length.
- ✓ Rules for the addition, subtraction, multiplication and division of numbers to produce the correct number of significant figures.
- ✓ The difference between accuracy and precision.
- ✓ Fahrenheit, Celsius, and Kelvin temperature scales.
- ✓ Basic Atomic Theory
- ✓ Ionic vs. Covalent Bonding
- ✓ The Mole Concept
- ✓ Five Basic Types of Chemical Reactions
- ✓ Mass-Mole Calculations
- ✓ Density Calculations
- ✓ Basic Stoichiometric Calculations

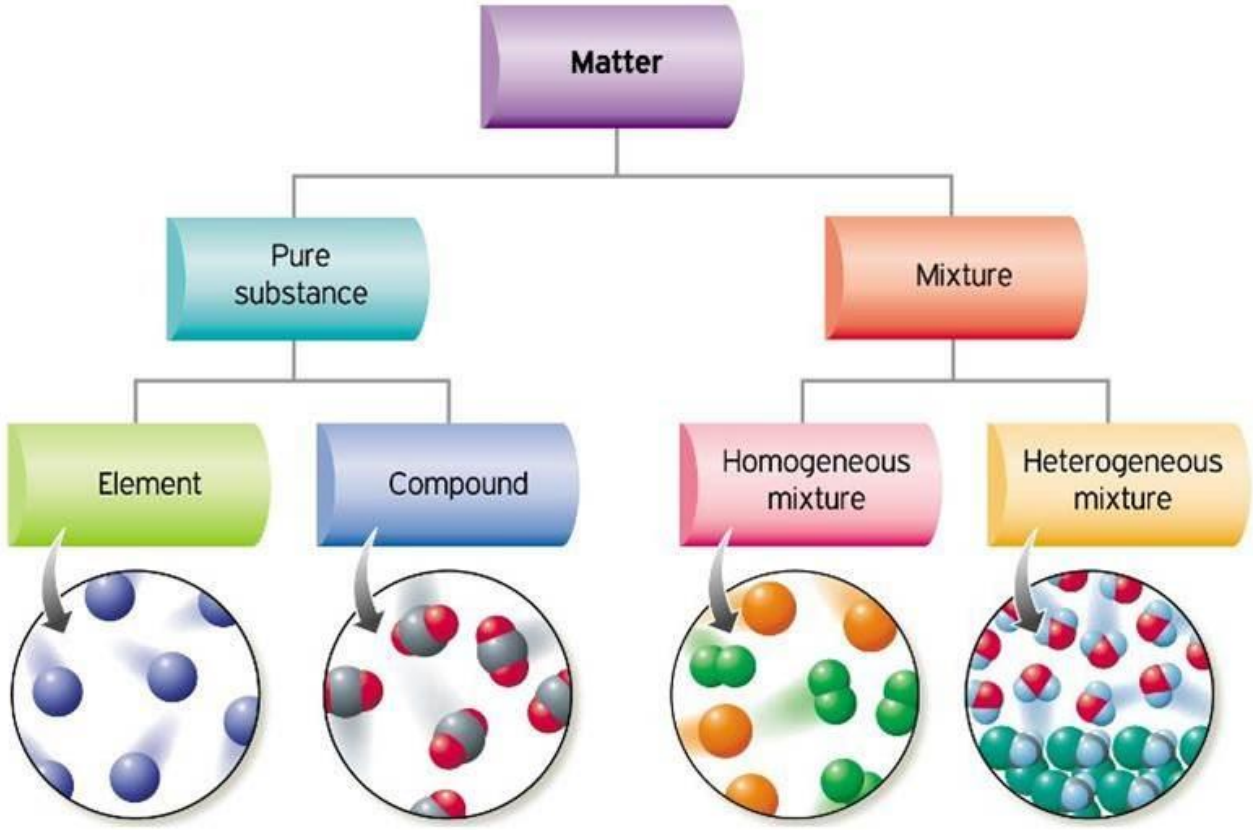


The Classification of Matter




Cats are liquids.
"Liquids ... take the shape of the container while maintaining a constant volume".
That's it. So cats are liquid.

The Classification of Matter



The Names and Symbols of Elements

- Elements 1 – 36 and
- Silver, Ag
- Tin, Sn
- Iodine, I
- Barium, Ba
- Gold, Au
- Mercury, Hg
- Lead, Pb
- Uranium, U

PRODUCED BY THE FOUNDATION FOR EDUCATION, SCIENCE AND TECHNOLOGY FOR NATIONAL SET WEEK 2003

PERIODIC TABLE of the ELEMENTS

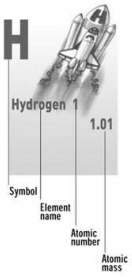
DEPARTMENT OF SCIENCE AND TECHNOLOGY

	IA 1	IIA 2	IIIB 3	IVB 4	VB 5	VIB 6	VIIB 7	VIII 8	VIII 9	VIII 10	IB 11	IIB 12	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
1	H Hydrogen 1 1.01																	He Helium 2 4.00
2	lithium 3 6.94 Li	Be Beryllium 4 9.01											B Boron 5 10.81	C Carbon 6 12.01	N Nitrogen 7 14.01	O Oxygen 8 16.00	F Fluorine 9 19.00	Ne Neon 10 20.18
3	Na Sodium 11 22.99	Mg Magnesium 12 24.31											Al Aluminium 13 26.98	Si Silicon 14 28.09	P Phosphorus 15 30.97	S Sulphur 16 32.06	Cl Chlorine 17 35.45	Ar Argon 18 39.95
4	K Potassium 19 39.10	Ca Calcium 20 40.08	Scandium 21 44.96 Sc	Ti Titanium 22 47.88	V Vanadium 23 50.94	Cr Chromium 24 52.00	Mn Manganese 25 54.94	Fe Iron 26 55.85	Co Cobalt 27 58.93	Ni Nickel 28 58.69	Cu Copper 29 63.55	Zn Zinc 30 65.39	Ga Gallium 31 69.72	Ge Germanium 32 72.61	As Arsenic 33 74.92	Se Selenium 34 78.96	Br Bromine 35 79.90	Kr Krypton 36 83.80
5	Rb Rubidium 37 85.47	Sr Strontium 38 87.62	Y Yttrium 39 88.91	Zr Zirconium 40 91.22	Nb Niobium 41 92.91	Mo Molybdenum 42 95.94	Tc Technetium 43 (98)	Ru Ruthenium 44 101.07	Rh Rhodium 45 102.91	Pd Palladium 46 106.42	Ag Silver 47 107.87	Cd Cadmium 48 112.41	In Indium 49 114.82	Sn Tin 50 118.71	Sb Antimony 51 121.76	Te Tellurium 52 127.60	I Iodine 53 126.90	Xe Xenon 54 131.29
6	Cs Caesium 55 132.91	Ba Barium 56 137.33	Lanthanide Series	Hf Hafnium 72 178.49	Ta Tantalum 73 180.95	W Tungsten 74 183.85	Re Rhenium 75 186.21	Os Osmium 76 190.23	Ir Iridium 77 192.22	Pt Platinum 78 195.08	Au Gold 79 196.97	Hg Mercury 80 200.59	Tl Thallium 81 204.38	Pb Lead 82 207.20	Bi Bismuth 83 208.98	Po Polonium 84 (209)	At Astatine 85 (210)	Rn Radon 86 (222)
7	Fr Francium 87 (223)	Ra Radium 88 (226)	Actinide Series	Rf Rutherfordium 104 (261)	Db Dubnium 105 (262)	Sg Seaborgium 106 (263)	Bh Bohrium 107 (262)	Hs Hassium 108 (265)	Mt Meitnerium 109 (266)									

Lanthanum 57 138.91 La	Cerium 58 140.12 Ce	Praseodymium 59 140.90 Pr	Neodymium 60 144.24 Nd	Promethium 61 (145) Pm	Samarium 62 150.36 Sm	Europium 63 151.96 Eu	Gadolinium 64 157.25 Gd	Terbium 65 158.92 Tb	Dysprosium 66 162.50 Dy	Holmium 67 164.93 Ho	Erbium 68 167.26 Er	Thulium 69 168.93 Tm	Ytterbium 70 173.04 Yb	Lutetium 71 174.96 Lu
Actinium 89 227.02 Ac	Thorium 90 232.03 Th	Protactinium 91 231.03 Pa	Uranium 92 238.02 U	Neptunium 93 (237) Np	Plutonium 94 (244) Pu	Americium 95 (243) Am	Curium 96 (247) Cm	Berkelium 97 (247) Bk	Californium 98 (251) Cf	Einsteinium 99 (254) Es	Fermium 100 (257) Fm	Mendelevium 101 (258) Md	Nobelium 102 (259) No	Lawrencium 103 (260) Lr

ALKALI METALS
ALKALI EARTH METALS
TRANSITION METALS
OTHER METALS
OTHER NONMETALS
HALOGENS
NOBLE GASSES
RARE EARTH METALS

At room temperature the element is:
Gas
Liquid
Natural solid
Man-made solid [synthetic]

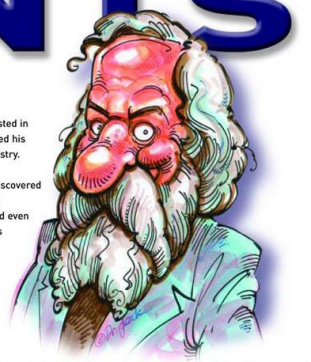


DMITRI MENDELEYEV (1834 – 1907)

The Russian chemist, Dmitri Mendeleyev, was the first to observe that if elements were listed in order of atomic mass, they showed regular (periodical) repeating properties. He formulated his discovery in a periodic table of elements, now regarded as the backbone of modern chemistry.

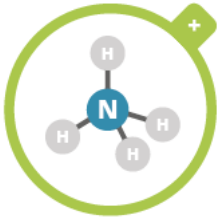
The crowning achievement of Mendeleyev's periodic table lay in his prophecy of then, undiscovered elements. In 1869, the year he published his periodic classification, the elements gallium, germanium and scandium were unknown. Mendeleyev left spaces for them in his table and even predicted their atomic masses and other chemical properties. Six years later, gallium was discovered and his predictions were found to be accurate. Other discoveries followed and their chemical behaviour matched that predicted by Mendeleyev.

This remarkable man, the youngest in a family of 17 children, has left the scientific community with a classification system so powerful that it became the cornerstone in chemistry teaching and the prediction of new elements ever since.
In 1955, element 101 was named after him: Md, Mendelevium.



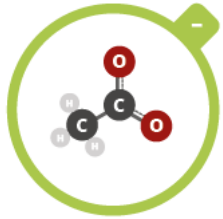
POLYATOMIC IONS: NAMES, FORMULAE & CHARGES

A polyatomic ion is a charged species consisting of two or more atoms covalently bonded together. Here's a guide to some of the most common examples!



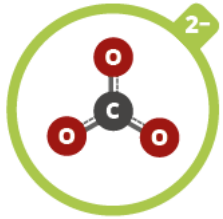
AMMONIUM

Formula: NH_4^+



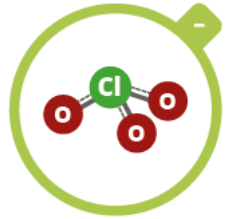
ACETATE

Formula: $C_2H_3O_2^-$



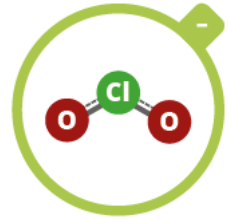
CARBONATE

Formula: CO_3^{2-}



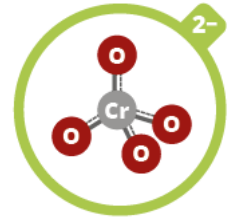
CHLORATE

Formula: ClO_3^-



CHLORITE

Formula: ClO_2^-

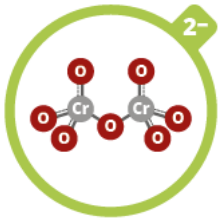


CHROMATE

Formula: CrO_4^{2-}

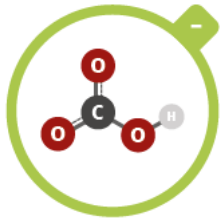
CYANIDE

Formula: CN^-



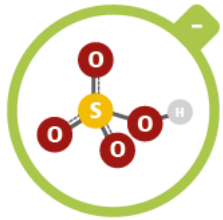
DICHROMATE

Formula: $Cr_2O_7^{2-}$



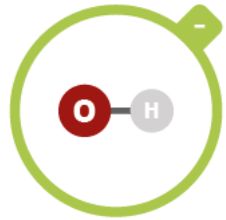
HYDROGEN CARBONATE

Formula: HCO_3^-



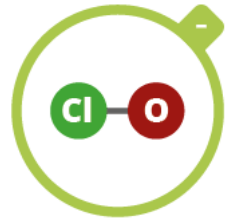
HYDROGEN SULFATE

Formula: HSO_4^-



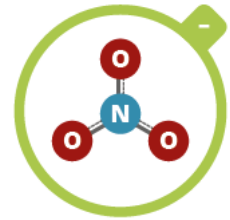
HYDROXIDE

Formula: OH^-



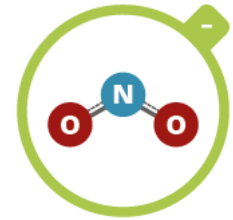
HYPOCHLORITE

Formula: ClO^-



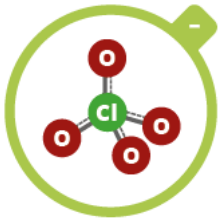
NITRATE

Formula: NO_3^-



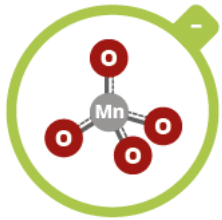
NITRITE

Formula: NO_2^-



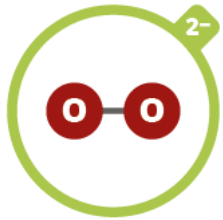
PERCHLORATE

Formula: ClO_4^-



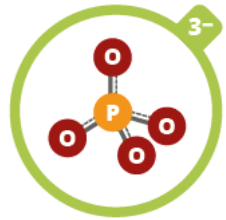
PERMANGANATE

Formula: MnO_4^-



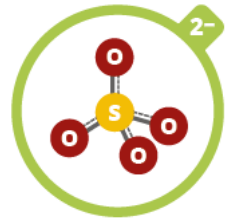
PEROXIDE

Formula: O_2^{2-}



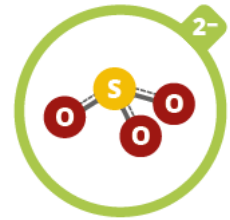
PHOSPHATE

Formula: PO_4^{3-}



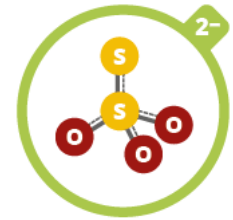
SULFATE

Formula: SO_4^{2-}



SULFITE

Formula: SO_3^{2-}



THIOSULFATE

Formula: $S_2O_3^{2-}$

Table 5. SI prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{24}	yotta	Y	10^{-1}	deci	d
10^{21}	zetta	Z	10^{-2}	centi	c
10^{18}	exa	E	10^{-3}	milli	m
10^{15}	peta	P	10^{-6}	micro	μ
10^{12}	tera	T	10^{-9}	nano	n
10^{9}	giga	G	10^{-12}	pico	p
10^{6}	mega	M	10^{-15}	femto	f
10^{3}	kilo	k	10^{-18}	atto	a
10^{2}	hecto	h	10^{-21}	zepto	z
10^{1}	deka	da	10^{-24}	yocto	y

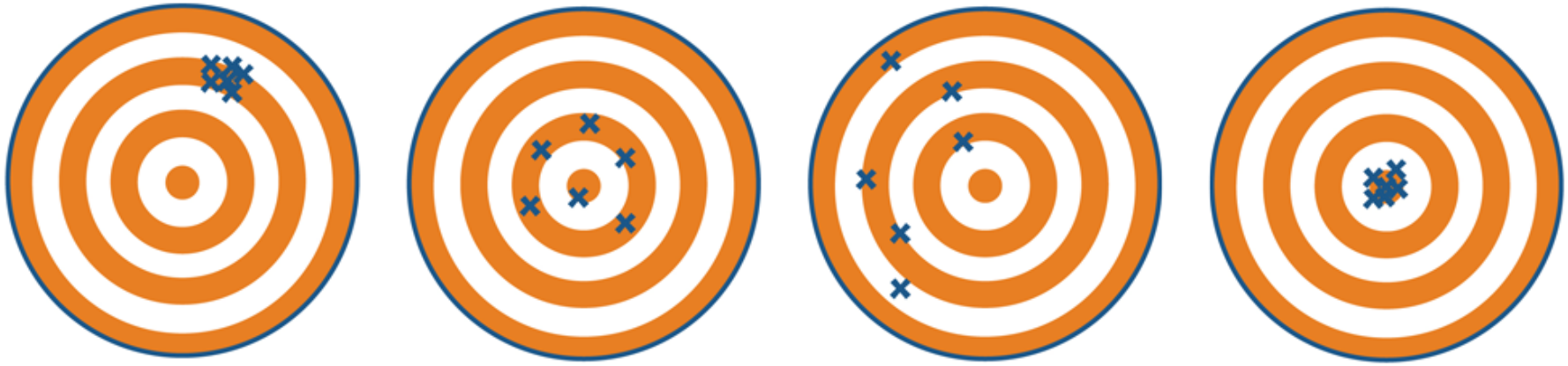
The Metric System

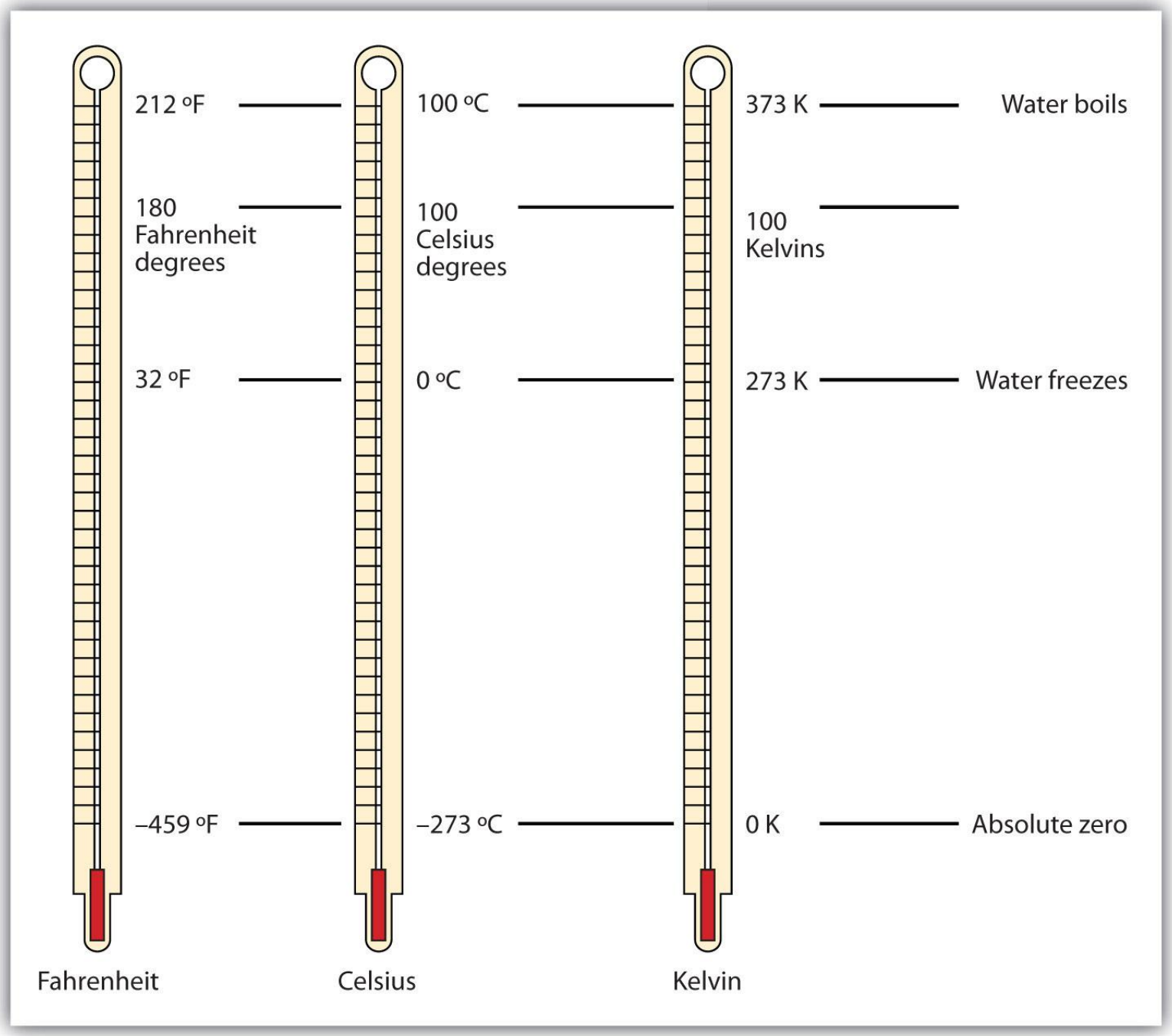
"What about Instagram?"

Rules For Significant Digits

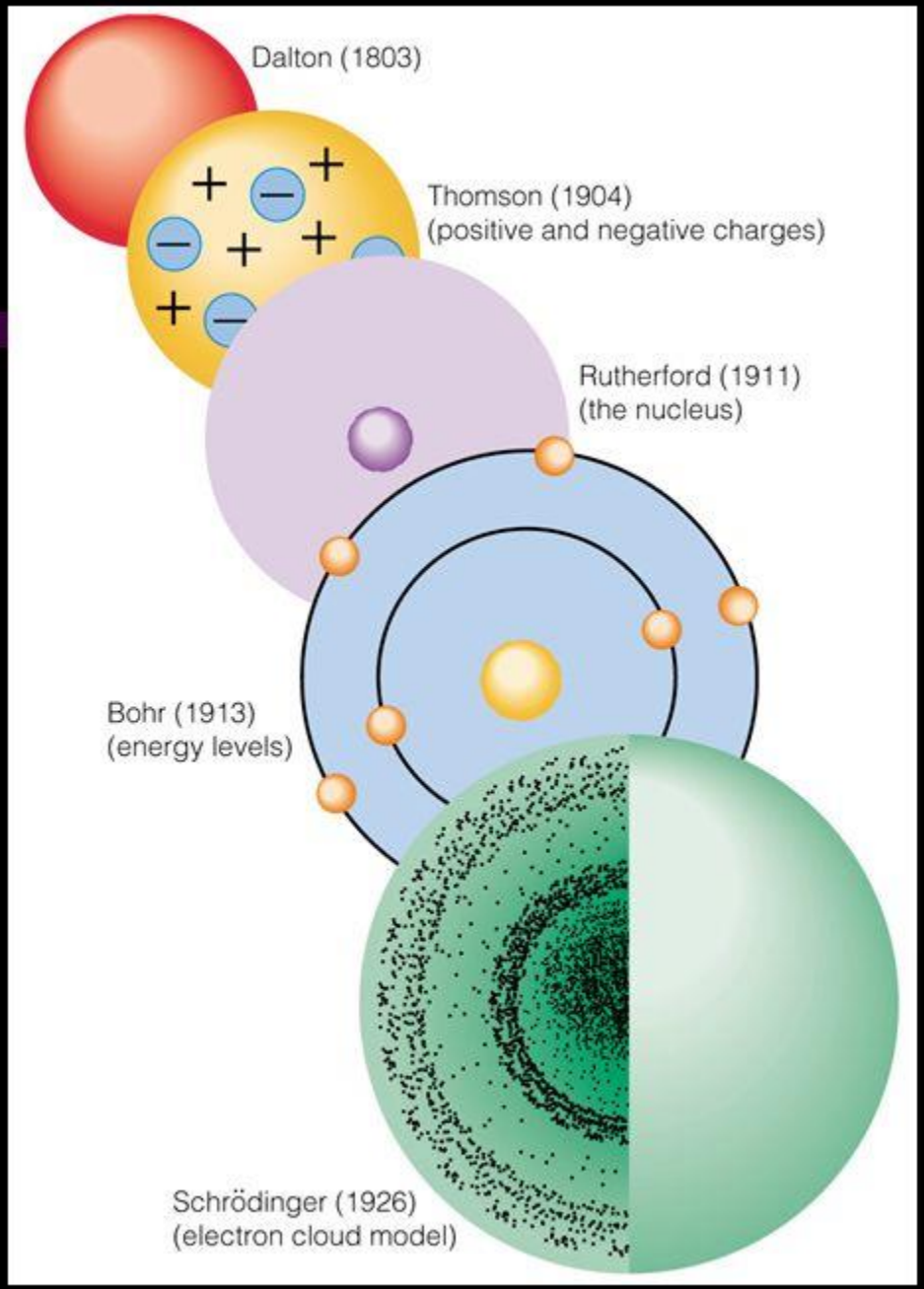
1. Digits from 1-9 are always significant.
2. Zeros between two other significant digits are always significant
3. One or more additional zeros to the right of both the decimal place and another significant digit are significant.
4. Zeros used solely for spacing the decimal point (placeholders) are not significant.

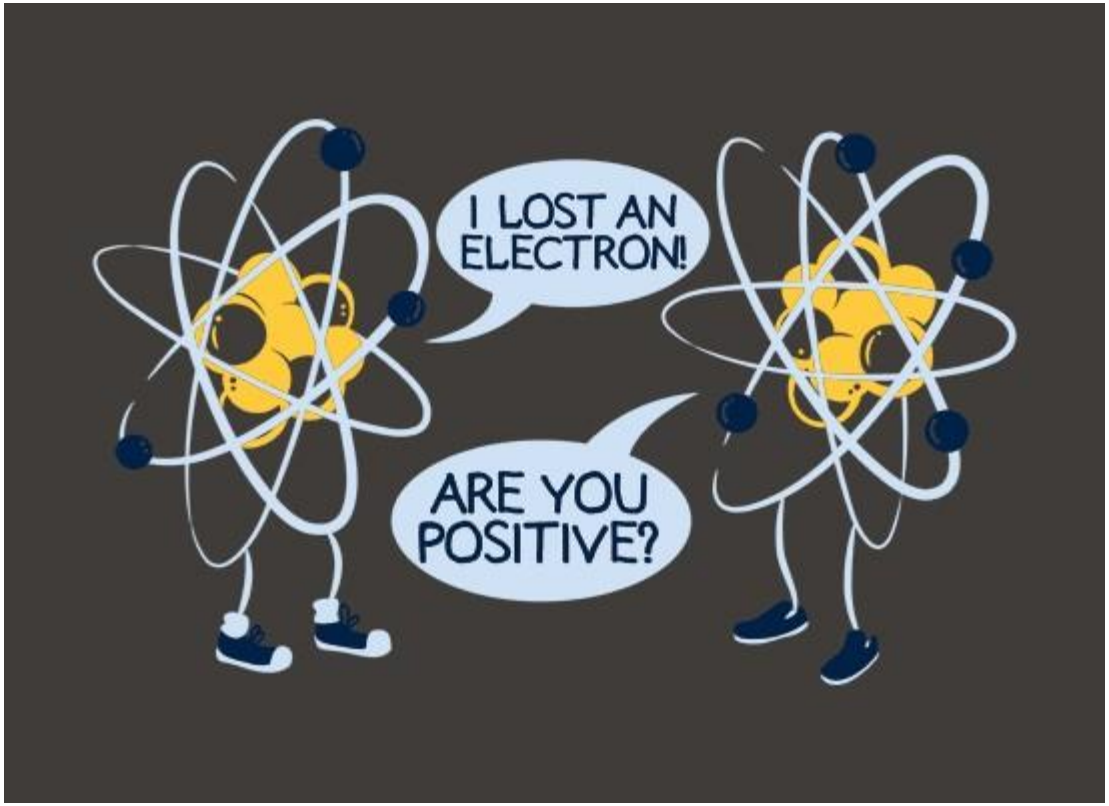
Precision vs Accuracy

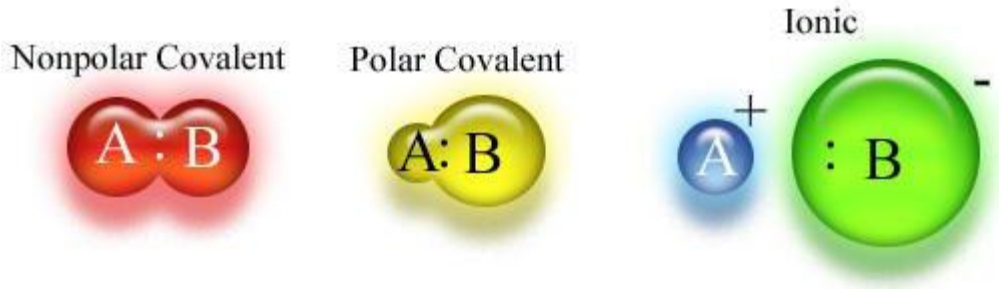


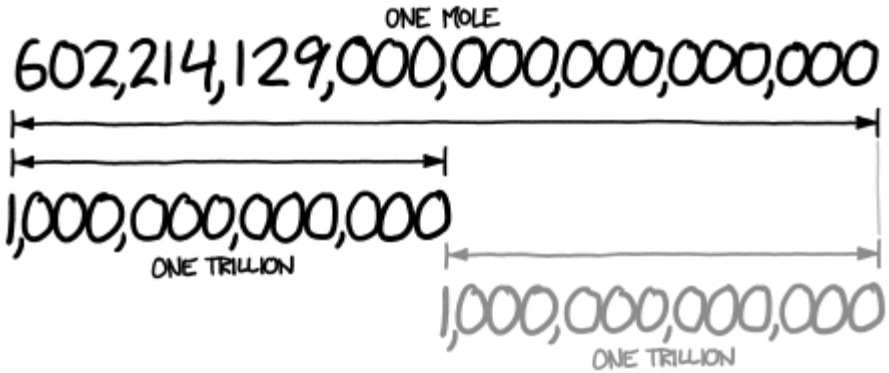

212 °F
180 Fahrenheit degrees
32 °F
–459 °F
Fahrenheit
100 °C
100 Celsius degrees
0 °C
–273 °C
Celsius
373 K
Water boils
100 Kelvins
273 K
Water freezes
0 K
Absolute zero
Kelvin

Evolution of Modern Atomic Theory




I LOST AN ELECTRON!
ARE YOU POSITIVE?


Nonpolar Covalent
A : B
Polar Covalent
A: B
Ionic
+
A
: B
-


ONE MOLE
602,214,129,000,000,000,000,000
1,000,000,000,000
ONE TRILLION
1,000,000,000,000
ONE TRILLION

One mole of red blood cells is more red blood cells than exist in every human on Earth right now.

A mole of basketballs would equal the size of the Earth.

One mole of marbles would cover the entire Earth to a depth of 50 miles!

A mole of sheets of paper would have to be separated into 80,000,000,000 (80 billion) stacks so that each stack reached to the moon. (240,000 miles)

Avogadro's Number and the Mole

- One mole samples of various elements. All have the same number of particles.

Types of Reactions

Combination:

Two or more reactants join together to make products that are fewer in number but larger in atom count.

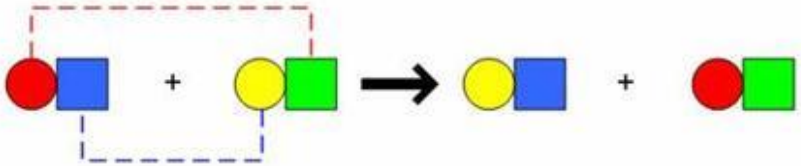
Decomposition:

A reactant breaks apart to form products that are greater in number but smaller in atom count. Combination and Decomposition are the reverse of one another.

Single Displacement:

An element reacts with a compound to form a new element and a different compound. The reactant element "displaces" an element in the compound that is the most chemically similar. For example, a metal will replace a different metal.

Double Displacement:



Two compounds react to form two new compounds. The reactant elements "displace" a chemically similar element twice. For ionic compounds the positive ion reactant combines with the negative ion of the other reactant. The negative ion of the first reactant combines with the positive ion of the second.

What is combustion?

- a very rapid reaction of a substance with oxygen to produce compounds called oxides.

FUEL + OXYGEN → OXIDE + ENERGY

$$H_2 + O_2 \rightarrow H_2O$$

$$C + O_2 \rightarrow CO_2$$

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

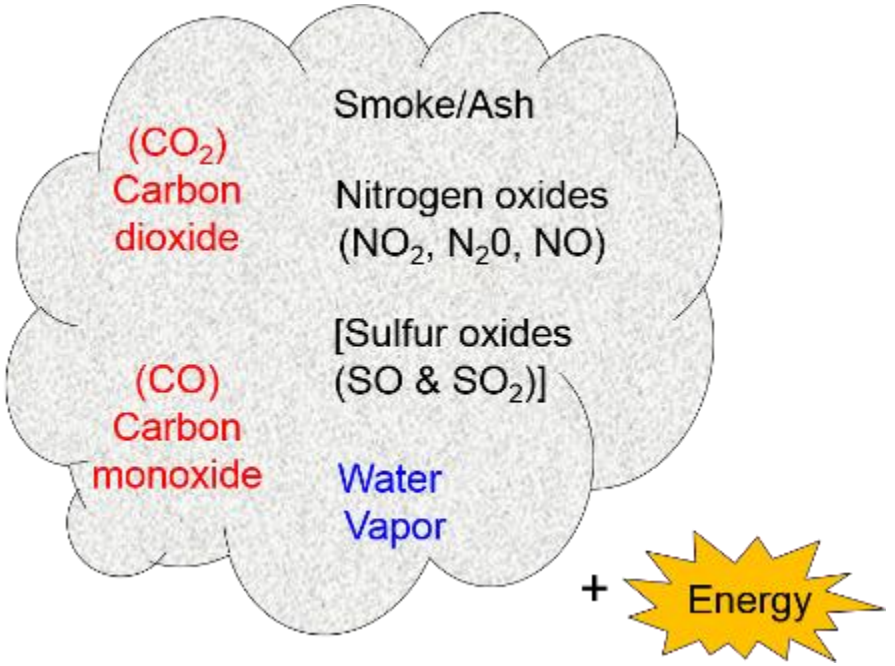
$$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$$

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$

Fuel Combustion

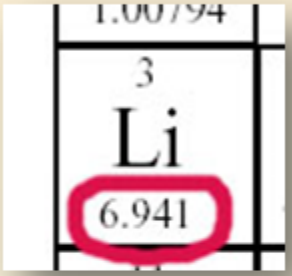
Hydrocarbon fuel
(oil, gasoline, wood, coal, natural gas, etc.)

+ Oxygen



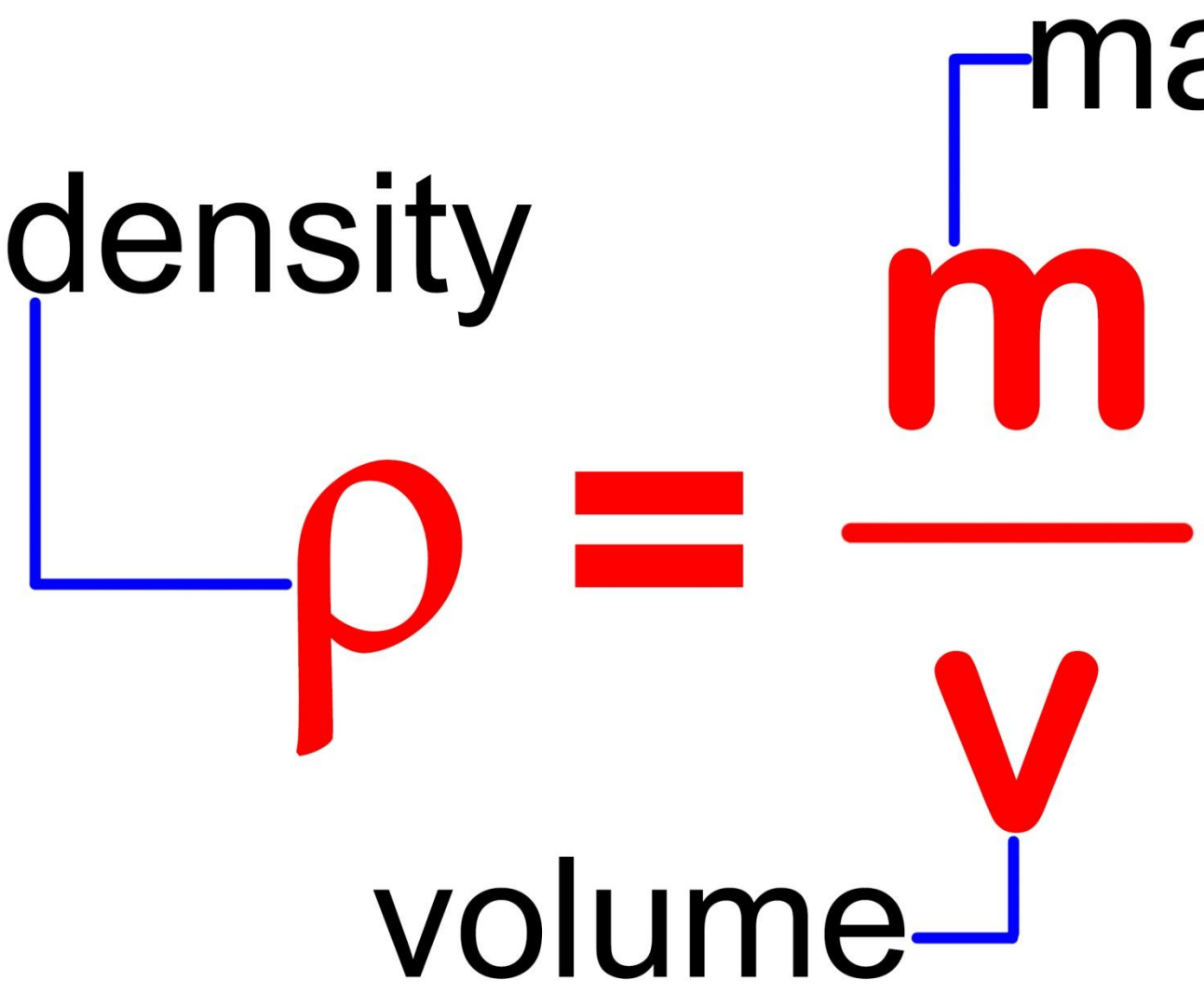
Calculations with Moles:
Converting grams to moles

How many moles of lithium are in 18.2 grams of lithium?



$$\frac{18.2\ \text{g Li}}{6.94\ \text{g Li}} \times \frac{1\ \text{mol Li}}{} = 2.62\ \text{mol Li}$$


PING PONG BALL
LAMP OIL
RUBBING ALCOHOL
SODA CAP
VEGETABLE OIL
BEADS
WATER
CHERRY TOMATO
DISH SOAP
MILK
DIE
100% MAPLE SYRUP
POPCORN KERNEL
CORN SYRUP
HONEY
BOLT


mass
density
m
ρ = —
V
volume

Stoichiometry

Derived from the Greek "*stoicheion*" or element and "*metron*" or measure. This is the term we use to refer to all quanititative aspects of chemical composition and reaction


mass
÷ formula mass
mole
ratio
Finish
Start
mole
mass
X formula mass
X 6.02 X 10 23
/ 6.02 X 10 23
Number
Number

Working a Stoichiometry Problem

6.50 grams of aluminum reacts with an excess of oxygen. How many grams of aluminum oxide are formed?

$$4\ Al + 3\ O_2 \rightarrow 2Al_2O_3$$

$$6.50 \times 2 \times 101.96 \div 26.98 \div 4 = 12.3\ g\ Al_2O_3$$

$$\frac{6.50\ g\ Al \mid 1\ mol\ Al \mid 2\ mol\ Al_2O_3 \mid 101.96\ g\ Al_2O_3}{\quad \mid 26.98\ g\ Al \mid 4\ mol\ Al \mid 1\ mol\ Al_2O_3} = ?\ g\ Al_2O_3$$

What do you get when you combine fluorine, uranium and nitrogen?

FUN