CHEMICAL FORMULAS & NOMENCLATURE

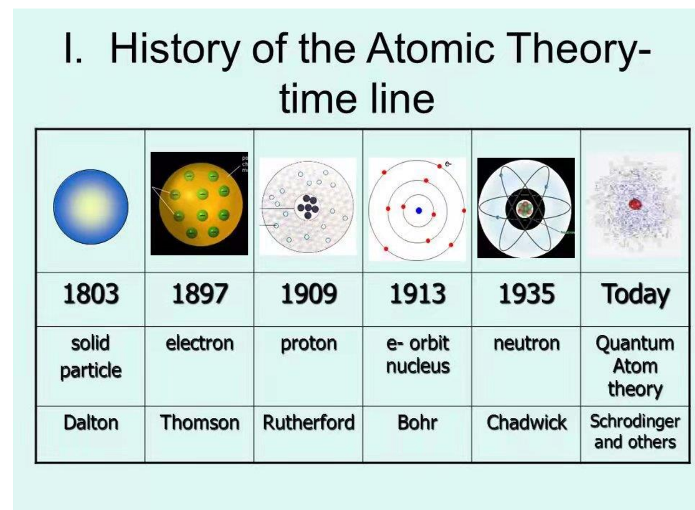
General Chemistry I, Lecture Series 2

Pengxin Liu

Reading:
OGB8 §1.2-3, §1.6, §2, §3.12-13

Brief history

- ~1000 years, Alchemy
- 1650s, Robert Boyle
  - True principle of things (elements)
  - Other chemists: the Phlogiston Theory
- 1770s, Lavoisier
  - Stoichiometry
  - Laws of chemical combination
- 1805, Dalton
  - Elements, atoms, periodic table
  - Thermodynamics, electro-, organic
  - 1897, J.J. Thomson
  - 1899, Bunsen



I. History of the Atomic Theory-time line

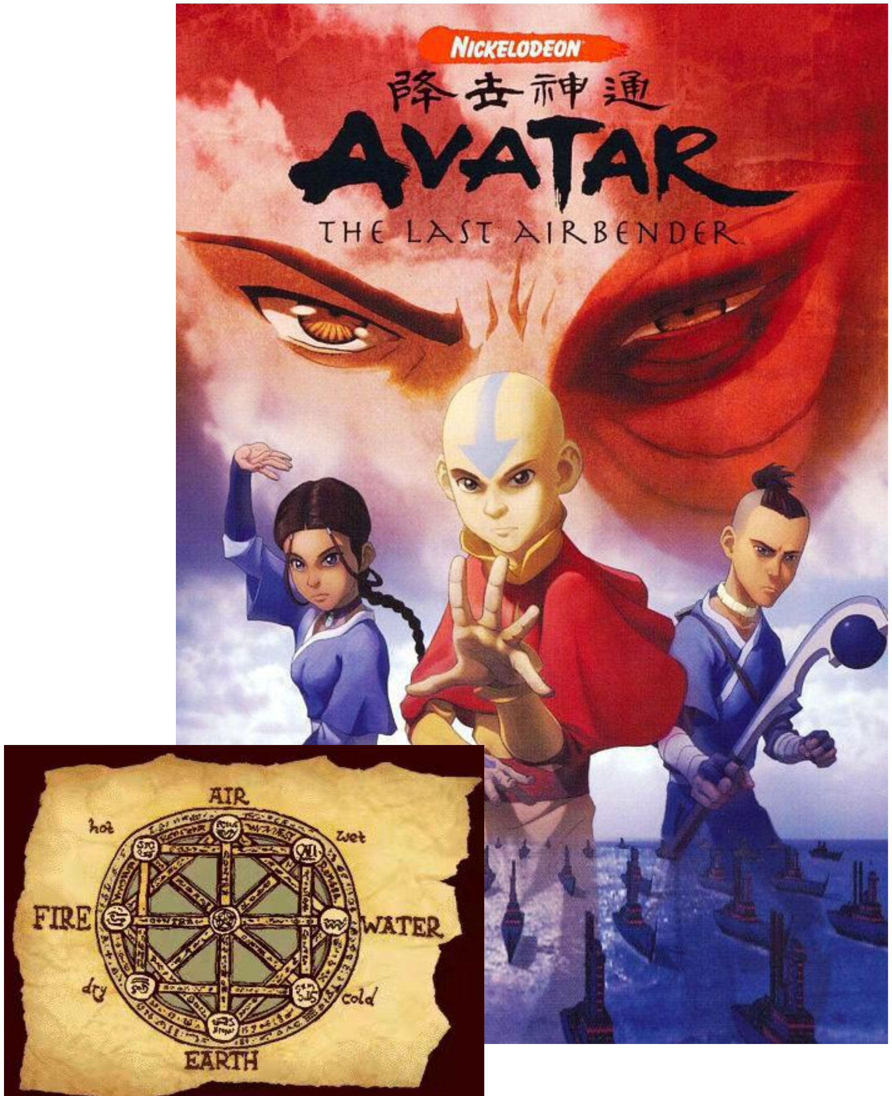
1803	1897	1909	1913	1935	Today
solid particle	electron	proton	e- orbit nucleus	neutron	Quantum Atom theory
Dalton	Thomson	Rutherford	Bohr	Chadwick	Schrodinger and others

Outline

- Chemical formulas
  - Element, compound
  - Atom, molecule
  - The mole
  - Chemical equations

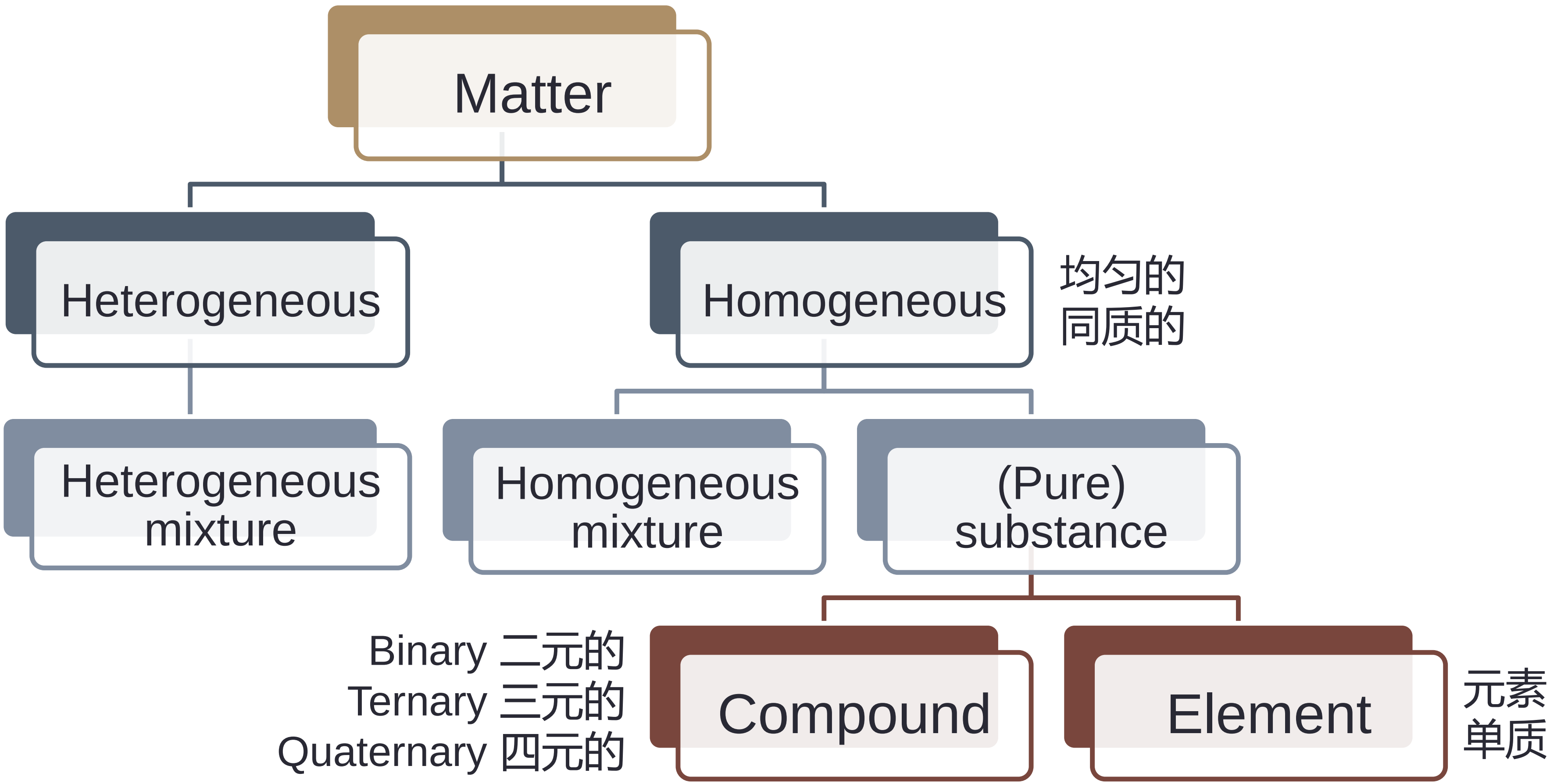
- Chemical nomenclature
  - Conventional
  - Systematic

Element


NICKELODEON
AVATAR
THE LAST AIRBENDER
AIR
hot
wet
FIRE
WATER
dry
cold
EARTH

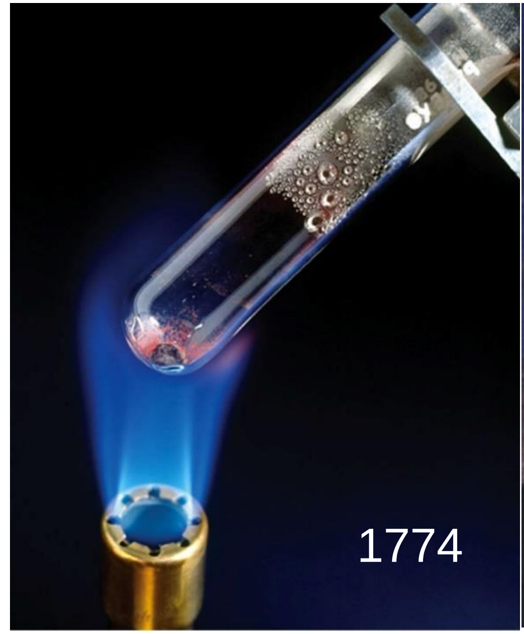

WATER.
EARTH.
FIRE.
AIR.

Classification of Matter



from Latin ***elementem*** "rudiment, first principle, matter in its most basic form"

Discovery of Oxygen



XXXVIII. *An Account of further Diſcoveries in Air. By the Rev.* Joſeph Prieſtley, *LL.D. F. R. S. in Letters to Sir* John Pringle, *Bart. P. R. S. and the Rev. Dr.* Price, *F. R. S.*

L E T T E R I.

TO SIR JOHN PRINGLE, BART. P. R. S.

DEAR SIR, March 15, 1775.

Redde, May 25, 1775.

HAVING been pretty fortunate in the proſecution of my experiments on different kinds of air, ſince the publication of my treatiſe

other of its forms. But the moſt remarkable of all the kinds of air that I have produced by this proceſs is, one that is five or ſix times better than common air, for the purpoſe of reſpiration, inflammation, and, I believe, every other uſe of common atmoſpherical air. As I think I have ſufficiently proved, that the fitneſs of air for reſpiration depends upon its capacity to receive the *phlogiſton* exhaled from the lungs, this ſpecies may not improperly be called, *dephlogiſticated air*. This ſpecies of air I firſt produced from *mercurius calcinatus per ſe*, then from the red precipitate of mercury, and now from red lead. The two former of the ſubſtances yield it pure;

可怜的舍勒 #每日化学史#

1774年9月30日，瑞典波美拉尼亚-德国药剂师卡尔·威廉·舍勒Carl Wilhelm Scheele致信安托万·拉瓦锡Antoine Lavoisier，宣布发现了氧气。但不幸的是，这封信并没有受到学界的广泛关注，因为约瑟夫·普里斯特利Joseph Priestley抢先发表了这一发现。

舍勒的很多其他发现也都被别人抢先发表，例如他早于汉弗莱·戴维Humphry Davy发现钼，钨，钡，氢和氯，还有很多其他的例子。因此，艾萨克·阿西莫夫Isaac Asimov昵称他为“坏运气的舍勒hard-luck Scheele”。

More Elements

Symbol	Names (EN, ZH, JA)	Meaning
H	Hydrogen, 氢, 水素	Water former
O	Oxygen, 氧, 酸素	Acid former
Cl	Chlorine, 氯, 塩素	Pale green
Hg	Mercury, Hydrargyrum, 汞, 水銀	Aqueous silver
Al	Aluminum, Aluminium, 铝, アルミニウム	Alum
W	Tungsten, Wolfram, 钨, タングステン	Heavy stone
Zn	Zinc, 锌, 亜鉛	–
Sn	Tin, 锡, スズ	–

元素周期表(Periodic Table of (Chemical) Elements)

碱金属 alkali metals	碱土金属 alkaline-earth metals	镧系元素 lanthanide	锕系元素 actinicles	过渡金属 transition metal
主族金属 Main group metals	类金属 metalloid	非金属 nonmetal	卤素 halogen	惰性气体 inter gases
气体 gas	液体 liquid	固体 solid	合成元素 composite element	未知元素 unknown element

1 氢 H Hydrogen 1.0079																	2 氦 He Helium 4.0026
3 锂 Li Lithium 6.941	4 铍 Be Beryllium 9.012											5 硼 B Boron 10.811	6 碳 C Carbon 12.011	7 氮 N Nitrogen 14.007	8 氧 O Oxygen 15.999	9 氟 F Fluorine 18.998	10 氖 Ne Neon 20.17
11 钠 Na Sodium 22.989	12 镁 Mg Magnesium 22.989											13 铝 Al Aluminum 26.982	14 硅 Si Silicon 28.805	15 磷 P Phosphorus 30.974	16 硫 S Sulfur 32.06	17 氯 Cl Chlorine 35.453	18 氩 Ar Argon 39.94
19 钾 K Potassium 39.098	20 钙 Ca Calcium 40.08	21 钪 Sc Scandium 44.956	22 钛 Ti Titanium 47.9	23 钒 V Vanadium 50.9415	24 铬 Cr Chromium 51.996	25 锰 Mn Manganese 54.938	26 铁 Fe Iron 55.84	27 钴 Co Cobalt 58.9332	28 镍 Ni Nickel 58.69	29 铜 Cu Copper 63.54	30 锌 Zn Zinc 65.38	31 镓 Ga Gallium 69.72	32 锗 Ge Germanium 72.5	33 砷 As Arsenic 74.922	34 硒 Se Selenium 78.9	35 溴 Br Bromine 79.904	36 氪 Kr Krypton 83.8
37 铷 Rb Rubidium 85.467	38 锶 Sr Strontium 87.62	39 钇 Y Yttrium 88.906	40 锆 Zr Zirconium 91.22	41 铌 Nb Niobium 92.9064	42 钼 Mo Molybdenum 95.94	43 锝 Tc Technetium 99	44 钌 Ru Ruthenium 101.07	45 铑 Rh Rhodium 102.906	46 钯 Pd Palladium 106.42	47 银 Ag Silver 107.868	48 镉 Cd Cadmium 112.41	49 铟 In Indium 114.82	50 锡 Sn Tin 118.6	51 锑 Sb Antimony 121.7	52 碲 Te Tellurium 127.6	53 碘 I Iodine 126.905	54 氙 Xe Xenon 131.3
55 铯 Cs Cesium 132.905	56 钡 Ba Barium 137.33	71 镥 Lu Lutetium 174.96	72 铪 Hf Hafnium 178.4	73 钽 Ta Tantalum 180.947	74 钨 W Tungsten 183.8	75 铼 Re Rhenium 186.207	76 锇 Os Osmium 190.2	77 铱 Ir Iridium 192.2	78 铂 Pt Platinum 195.08	79 金 Au Gold 196.967	80 汞 Hg Mercury 200.5	81 铊 Tl Thallium 204.3	82 铅 Pb Lead 207.2	83 铋 Bi Bismuth 208.98	84 钋 Po Polonium (209)	85 砹 At Astatine (201)	86 氡 Rn Radon (222)
87 钫 Fr Francium (223)	88 镭 Ra Radium 226.03	103 铹 Lr Lawrencium 260	104 鈩 Rf Rutherfordium (261)	105 钍 Db Dubnium (262)	106 𨭎 Sg Seaborgium (263)	107 𨨏 Bh Bohrium (262)	108 𨭆 Hs Hassium (265)	109 鿏 Mt Meitnerium (266)	110 鐽 Ds Darmstadtium (269)	111 轮 Rg Roentgenium (272)	112 Uub (277)	113 Uut 284	114 Uuq 289	115 Uup 288	116 Uuh 292	117 Uus unknow	118 Uuo 294

镧系 Lanthanide (Lanthanoid)	57 镧 La Lanthanum 138.905	58 铈 Ce Cerium 140.12	59 镨 Pr Praseodymium 140.91	60 钕 Nd Neodymium 144.2	61 钷 Pm Promethium 147	62 钐 Sm Samarium 150.4	63 铕 Eu Europium 151.96	64 钆 Gd Gadolinium 157.25	65 铽 Tb Terbium 158.93	66 镝 Dy Dysprosium 162.5	67 钬 Ho Holmium 164.93	68 铒 Er Erbium 167.2	69 铥 Tm Thulium 168.943	70 镱 Yb Ytterbium 173.0
锕系 Actinicles	89 锕 Ac Actinium 227.03	90 钍 Th Thorium 232.04	91 镤 Pa Protactinium 231.04	92 铀 U Uranium 238.03	93 镎 Np Neptunium 237.05	94 钚 Pu Plutonium 244	95 镅 Am Americium 243	96 锔 Cm Curium 247	97 锫 Bk Berkelium 247	98 锎 Cf Californium 251	99 锿 Es Einsteinium 254	100 镄 Fm Fermium 257	101 钔 Md Mendelevium 258	102 锘 No Nobelium 259

Chemical Elements

Atomic number

Symbol

Relative atomic mass

Platine
Platin
铂
白金

Name(s)

From element to atom

- Indirect evidence for the existence of atoms: laws of chemical combination

- **Law of Conservation of Mass**
- **Law of Definite Proportions**
- **Law of Multiple Proportions**
- **Gay Lussac’s Law of Gaseous Volumes**
- **Avogadro’s Law**

Law of Conservation of Mass

$$\text{mercury+air} \xrightarrow{350\ ^\circ\text{C}} \text{mercury oxide + remaining gas}$$

$$\text{mercury oxide} \xrightarrow{>500\ ^\circ\text{C}} \text{mercury + gas}$$

$$m(\text{mercury oxide}) = m(\text{mercury}) + m(\text{gas})$$

10.00 g 9.26 g 0.74 g

Antoine Lavoisier
(1743–1794)

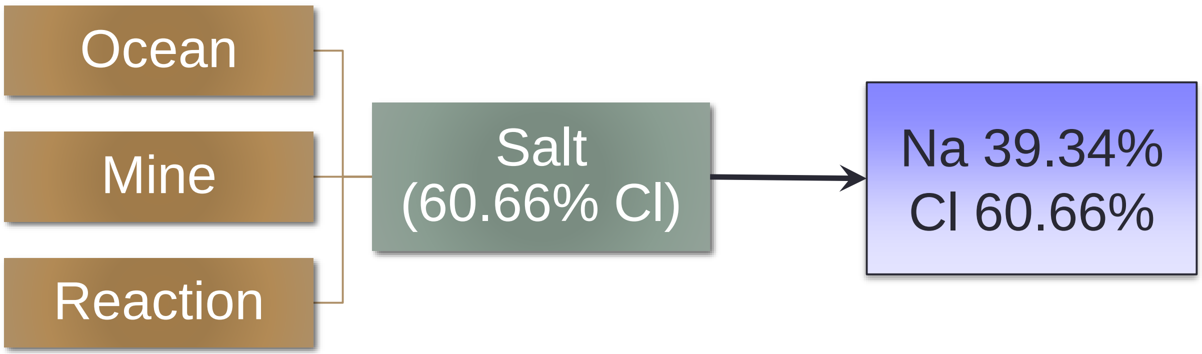
Conclusions from observations and quantitative measurements

- Air is a homogeneous mixture
- Chemical reactions occurred
- Mass was conserved during these chemical reactions

Stoichiometry
化学计量学

Law of Definite Proportions

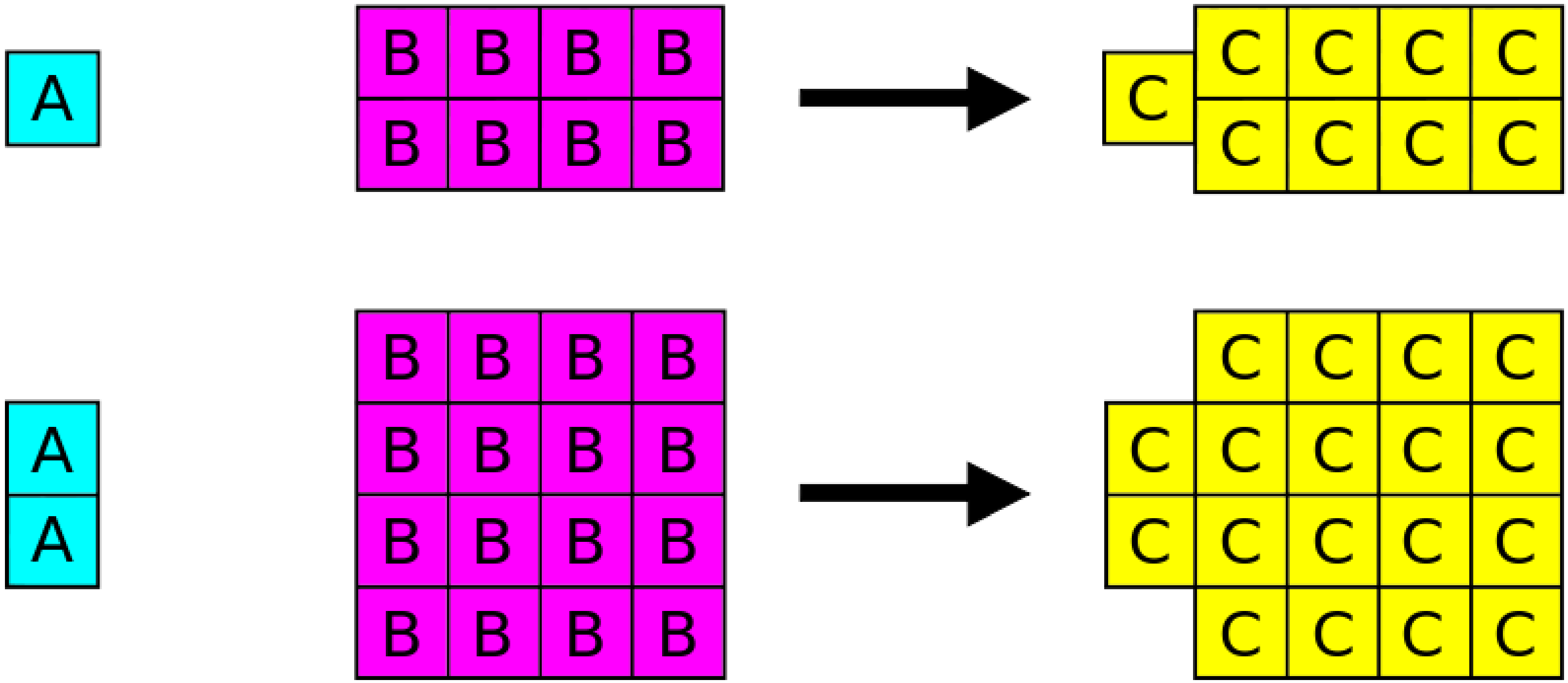
Joseph Proust, a French chemist stated that the proportion of elements by weight in a given compound will always remain exactly the same.



Law of Definite Proportions (1799) infers that (most) compounds

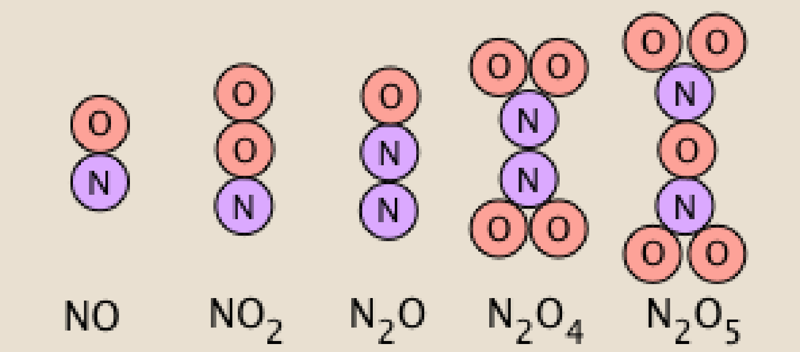
- Can and should be purified;
- Can and should be denoted by formulas.

Law of Definite Proportions



Law of Multiple Proportions

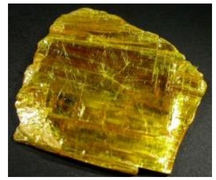
- when two elements combine in more than one proportion to form two or more compounds, the weights of one element that combine with a given weight of the other element are in ratios of small whole numbers.



Ratio of molar masses N:O	14:16	14:32	28:16	28:64	28:80
For 1g of N, how much O needed?	1.14	2.28	0.57	2.28	2.85
Divided through by the smallest mass ratio	2	4	1	4	5

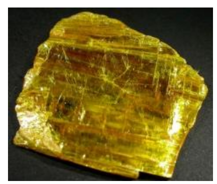
Law of Multiple Proportions

As: 70.03%
S: 29.97%



As: 60.91%
S: 39.09%

As / S
= 2.337



As / S
= 1.558

( As / S = 2.337) ÷ ( As / S = 1.558) $= 1.500 \approx \frac{3}{2}$

Formulas can and should be denoted by portions instead of compositions.

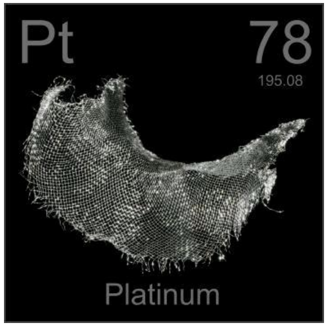
Dalton's Atomic Theory

Postulates atoms as portions of mass (1808).

- Atom
  - Identity — Element symbol
  - Quantity — Relative atomic mass (A_r)

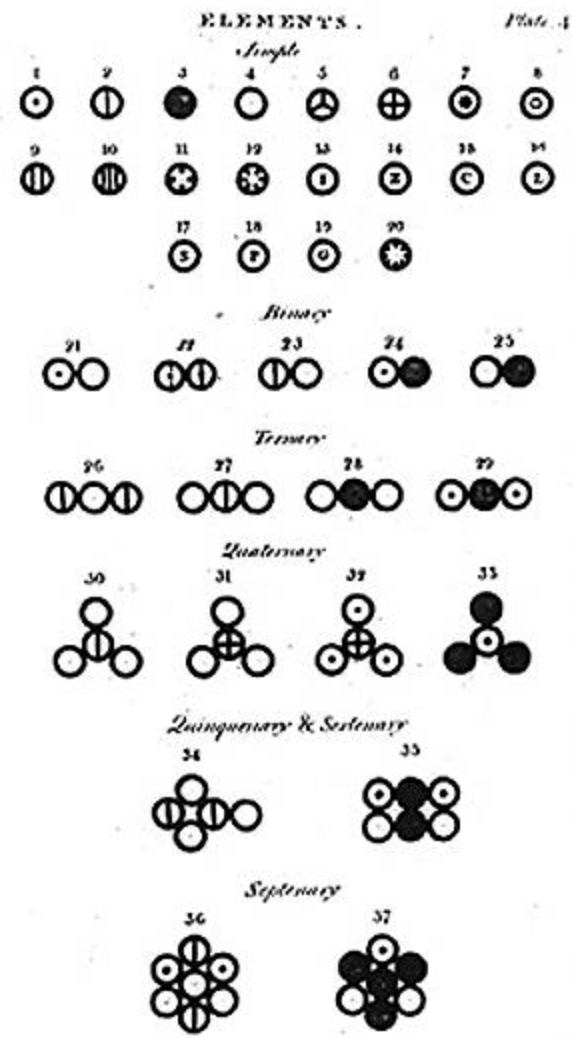
John Dalton (1766–1844)

Compound	Experiment %
Hydrogen sulfide	H 5.92, S 94.08
Realgar	As 70.03, S 29.97
Orpiment	As 60.91, S 39.09



Dalton’s Atomic Theory

1803



Empirical Formulas

For realgar "AsS", why not As_2S_2, As_3S_3, or As_4S_4?

For orpiment "As_2S_3", why not As_4S_6?

AsS and As_2S_3 are empirical formulas

What is the formula of an element?

Hydrogen → H or H_2?

Oxygen → O, O_2, or O_3?

I prefer simplicity!

Dalton's Atomic Theory

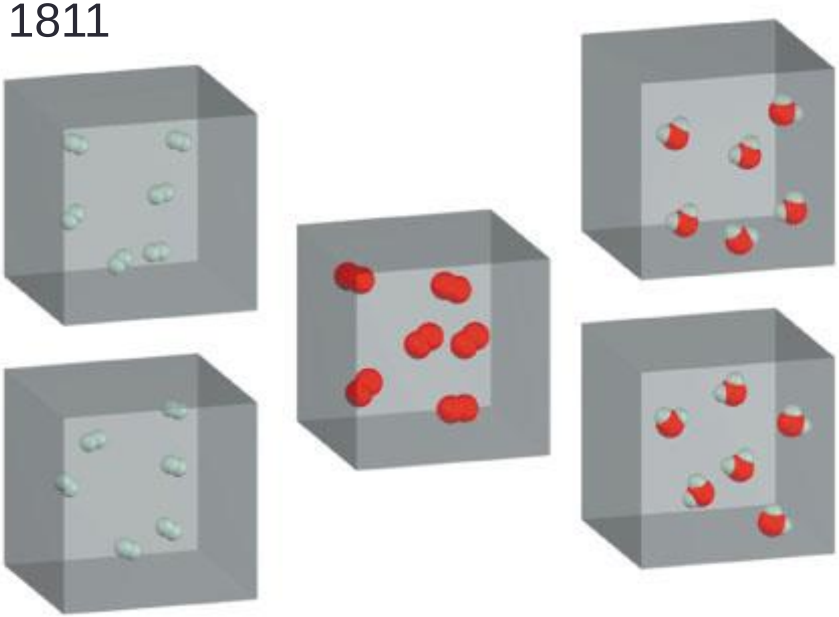
Assume: $A_r(\mathrm{H}) = 1$, $A_r(\mathrm{S}) = 32$, $A_r(\mathrm{As}) = 75$.

Compound	Formula	Calculated %	Experiment %
Hydrogen sulfide	H_2S	H 5.88, S 94.12	H 5.92, S 94.08
Realgar	AsS	As 70.09, S 29.91	As 70.03, S 29.97
Orpiment	As_2S_3	As 60.98, S 39.02	As 60.91, S 39.09

Postulate 假定 → Hypothesis 假说 → Theory 理论

Gaseous Reactions

1811



Joseph Louis Gay-Lussac
(1778–1850)

	Hydrogen	+ Oxygen	$\longrightarrow$ Water vapor
Mass ratio	1	8	9
Volume ratio	2	1	2

Two independent sets of ratios

Avogadro's Hypothesis (1)

Dalton 1808: For all matter,

Number of atoms → Mass

All the atoms of a given chemical element are

Identical in mass.

Amedeo Avogadro
(1776–1856)

Avogadro 1811: For all gases,

Number of molecules → Volume

Relative molecular mass M_r

Equal volumes of different gas at the same temperature and pressure contain equal numbers of particles.

Avogadro's Hypothesis (2)

Hydrogen + Oxygen $\longrightarrow$ Water vapor

	Hydrogen	Oxygen	Water vapor
Mass ratio	1	8	9
Volume ratio	2	1	2
M_r ratio	0.5	8	4.5

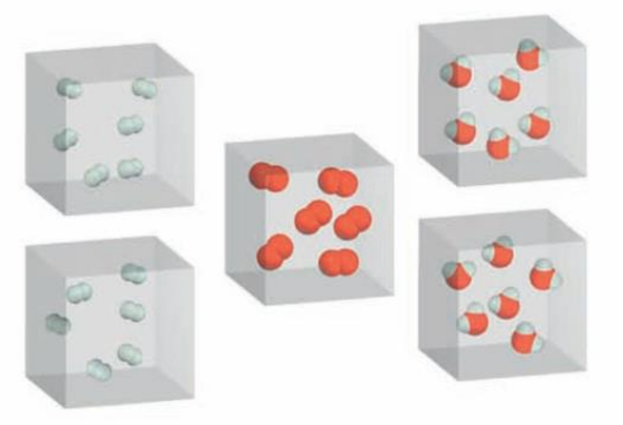
M_r : Relative mass of each particle

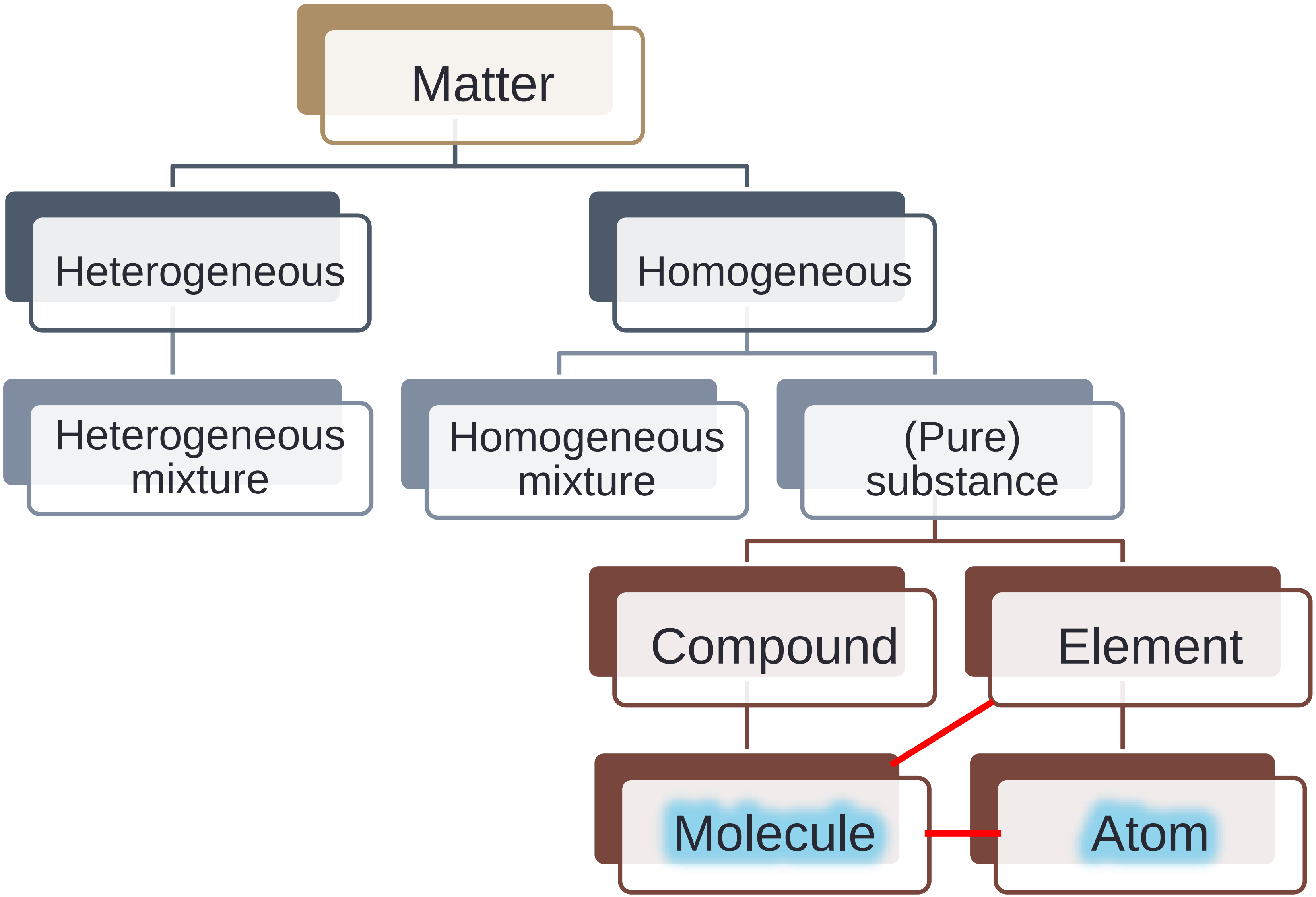
$$2\,H + O \longrightarrow 2\,HO$$

M_r	1	16	9

$$2\,H_2 + O_2 \longrightarrow 2\,H_2O$$

M_r	2	32	18




Matter
Heterogeneous
Homogeneous
Heterogeneous mixture
Homogeneous mixture
(Pure) substance
Compound
Element
Molecule
Atom

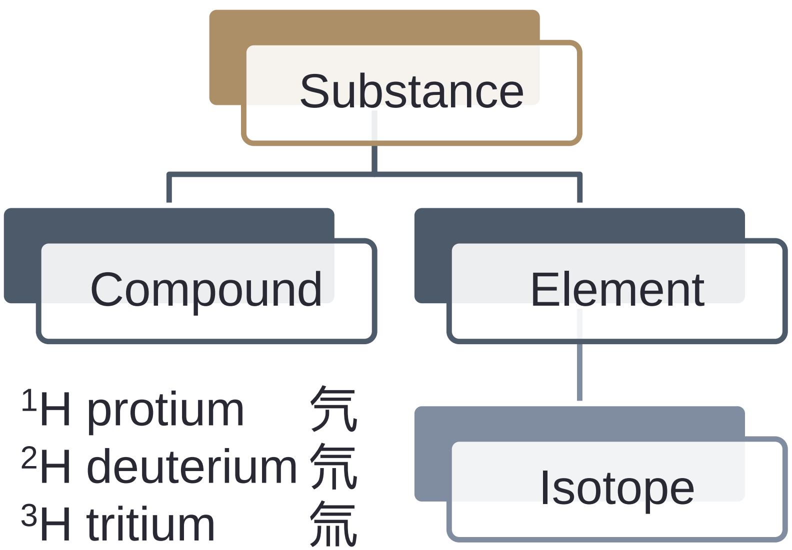
Outline

- Chemical formulas
  - Element, compound
  - Atom, molecule
  - The mole
  - Chemical equations

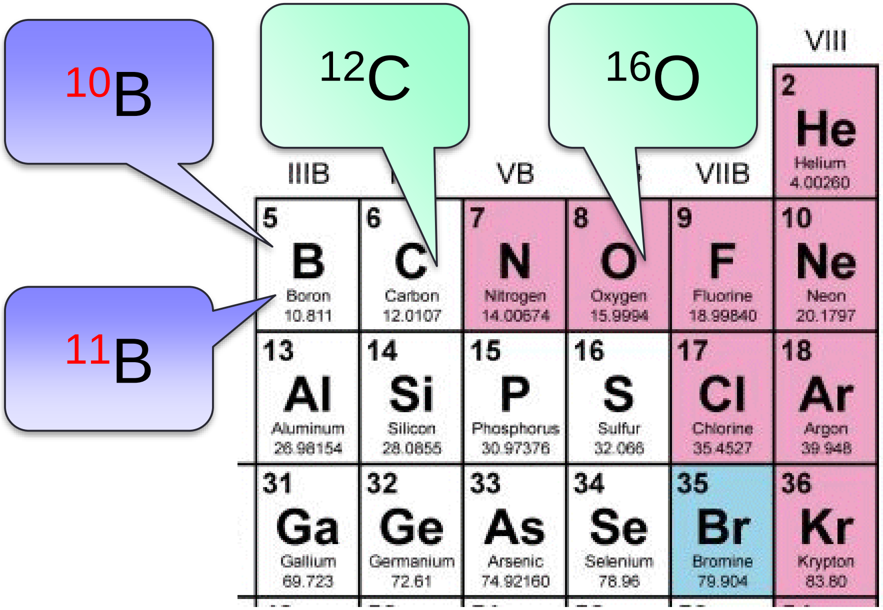
- Chemical nomenclature
  - Conventional
  - Systematic

Relative Atomic Mass and Isotope (1)

	H	B	C	O	Mg
A_r	1.0	10.8	12.0	16.0	24.3



^{1}H protium 氕
^{2}H deuterium 氘
^{3}H tritium 氚



Isotope 1	Abundance	Isotope 2	Abundance	A_r
^{10}B or B-10	~20%	^{11}B or B-11	~80%	B = 10.8
^{35}Cl or Cl-35	~75%	^{37}Cl or Cl-37	~25%	Cl = 35.5

Relative Atomic Mass and Isotope (2)

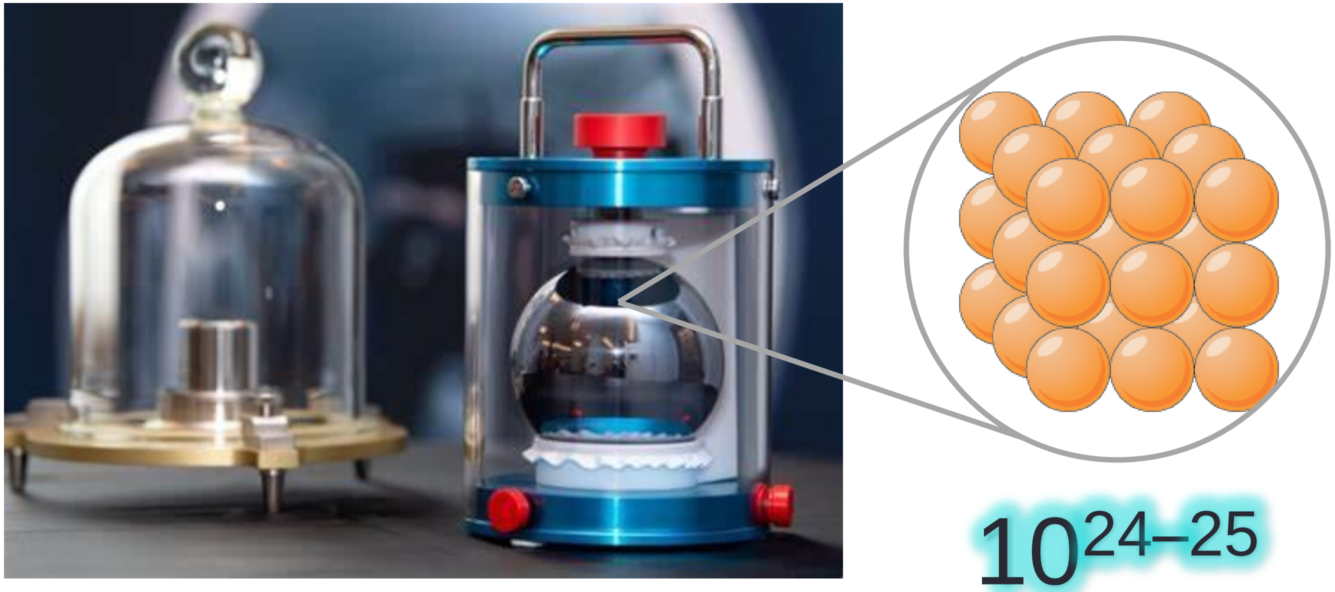
H	B	C	O	F
1.008 99.98%	10.013 80%	12 98.9%	15.995 99.76%	18.998 100%
2.014 0.02%	11.009 20%	13.003 1.1%	16.999 0.04%	
			17.999 0.2%	

1808 Dalton proposed $A_r(H) = 1$

~1900 Physicists took $A_r(O) = 16$

1961 Physicists & chemists agreed $A_r(^{12}C) = 12$

Absolute Atomic Mass (1)



1 kg 1 kg

$10^{24–25}$ atoms

Michael Faraday
(1791–1867)

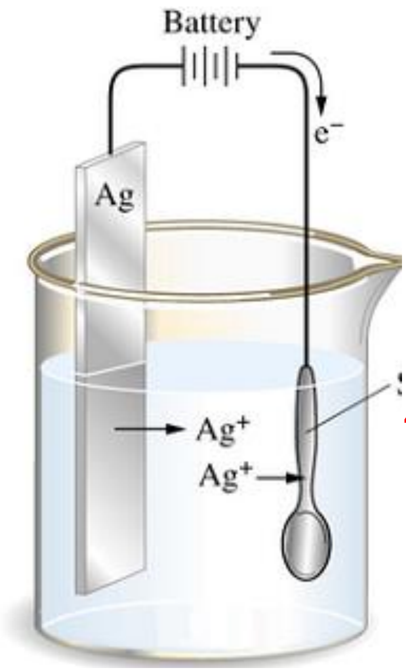
Robert A. Millikan
U. of Chicago / Caltech
(1868–1953)

1834 Faraday constant F = 96485 C/mol

1910 Millikan found $e = 1.60 \times 10^{-19}$ C

Absolute Atomic Mass (2)

1000 mA·h
(3600 C)



Δm =
4.032 g

In 1834, Faraday measured 1.12 mg Ag per C

(Absolute) atomic mass m_a

$$m_a(\text{Ag}) = 1.12\times10^{-3}\ \text{g/C} \cdot 1.60\times10^{-19}\ \text{C}$$
$$= 1.79\times10^{-22}\ \text{g}$$

$$m_a(^{12}\text{C}) = m_a(\text{Ag}) \cdot \frac{A_r(^{12}\text{C})}{A_r(\text{Ag})}$$
$$= 1.99\times10^{-23}\ \text{g}$$

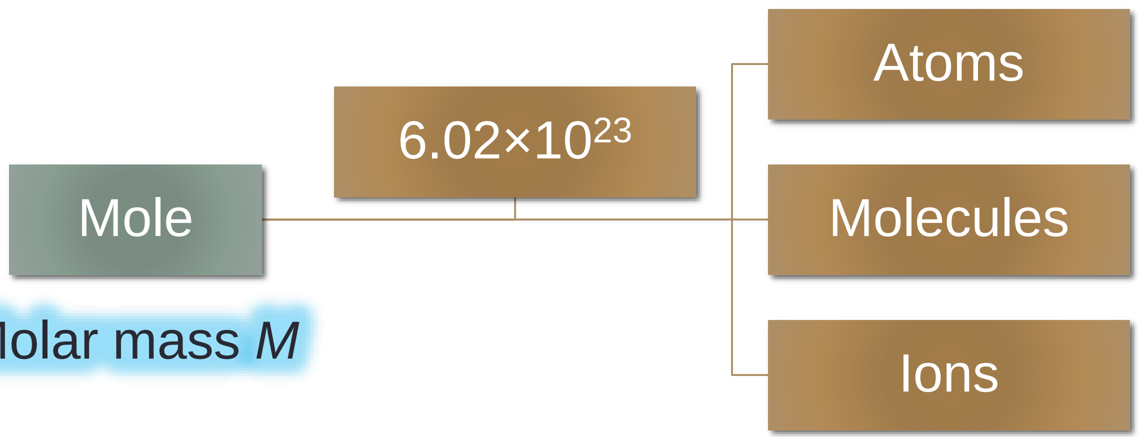
Electrochemistry

电化学

Avogadro's Number & the Mole

$$N_A \equiv \frac{12\ \text{g mol}^{-1}}{m_{a(^{12}\text{C})}} = \frac{12\ \text{g mol}^{-1}}{1.99\times10^{-23}\ \text{g}} = 6.02\times10^{23}\ \text{mol}^{-1}.$$

$$N_A \equiv \frac{F}{e} = \frac{96485\ \text{C mol}^{-1}}{1.60\times10-19\ \text{C}} = 6.02\times10^{23}\ \text{mol}^{-1}.$$



Molar mass M

$$A_r(\text{Ag}) = 107.9 \ \rightarrow M(\text{Ag}) = 107.9\ \text{g mol}^{-1}.$$

$$M_r(\text{H}_2\text{O}) = 18.0 \ \rightarrow M(\text{H}_2\text{O}) = 18.0\ \text{g mol}^{-1}.$$

$$M(\text{NaCl}) = 58.4\ \text{g mol}^{-1}.$$

Chemical Stoichiometry

Review:

OGB8

§2.3 Writing Balanced Chemical Equations

§2.4 Mass Relationships in Chemical Reactions

§2.5 Limiting Reactant and Percentage Yield

Outline

- Chemical formulas
  - Element, compound
  - Atom, molecule
  - The mole
  - Chemical equations

- Chemical nomenclature
  - Conventional
  - Systematic

Conventional nomenclature

- Ionic compound
- Covalent compound
- Greek Numerals

Ionic Compounds

Cl	Chlorine	
Cl^-	Chloride	氯离子
Na	Sodium	
Na^+	Sodium ion	钠离子
NaCl	Sodium Chloride	氯化钠

Anions

Carbon – carbide

Nitrogen – nitride

Oxygen – oxide

Fluorine – fluoride

Phosphorus – phosphide

Sulfur – sulfide

Bromine – bromide

Hydrogen – hydride (cation form: proton)

Anions

TABLE 3.9

Formulas and Names of Some Common Anions

F^-	Fluoride	CO_3^{2-}	Carbonate
Cl^-	Chloride	HCO_3^-	Hydrogen carbonate or bicarbonate
Br^-	Bromide	NO_2^-	Nitrite
I^-	Iodide	NO_3^-	Nitrate
H^-	Hydride	SiO_4^{4-}	Silicate
O^{2-}	Oxide	PO_4^{3-}	Phosphate
S^{2-}	Sulfide	HPO_4^{2-}	Hydrogen phosphate
O_2^{2-}	Peroxide	$H_2PO_4^-$	Dihydrogen phosphate
O_2^-	Superoxide	SO_3^{2-}	Sulfite
OH^-	Hydroxide	SO_4^{2-}	Sulfate
CN^-	Cyanide	HSO_4^-	Hydrogen sulfate or bisulfate
CNO^-	Cyanate	ClO^-	Hypochlorite
SCN^-	Thiocyanate	ClO_2^-	Chlorite
MnO_4^-	Permanganate	ClO_3^-	Chlorate
CrO_4^{2-}	Chromate	ClO_4^-	Perchlorate
$Cr_2O_7^{2-}$	Dichromate		

Polyatomic Anions

O_2^{2-} Peroxide 过氧根[离子]

H_2O_2 Hydrogen peroxide

ClO^-	Hypochlorite	次氯酸根	$HClO$	Hypochlorous acid
ClO_2^-	chlorite	亚氯酸根	$HClO_2$	Chlorous acid
ClO_3^-	chlorate	氯酸根	$HClO_3$	Chloric acid
ClO_4^-	Perchlorate	高氯酸根	$HClO_4$	Perchloric acid

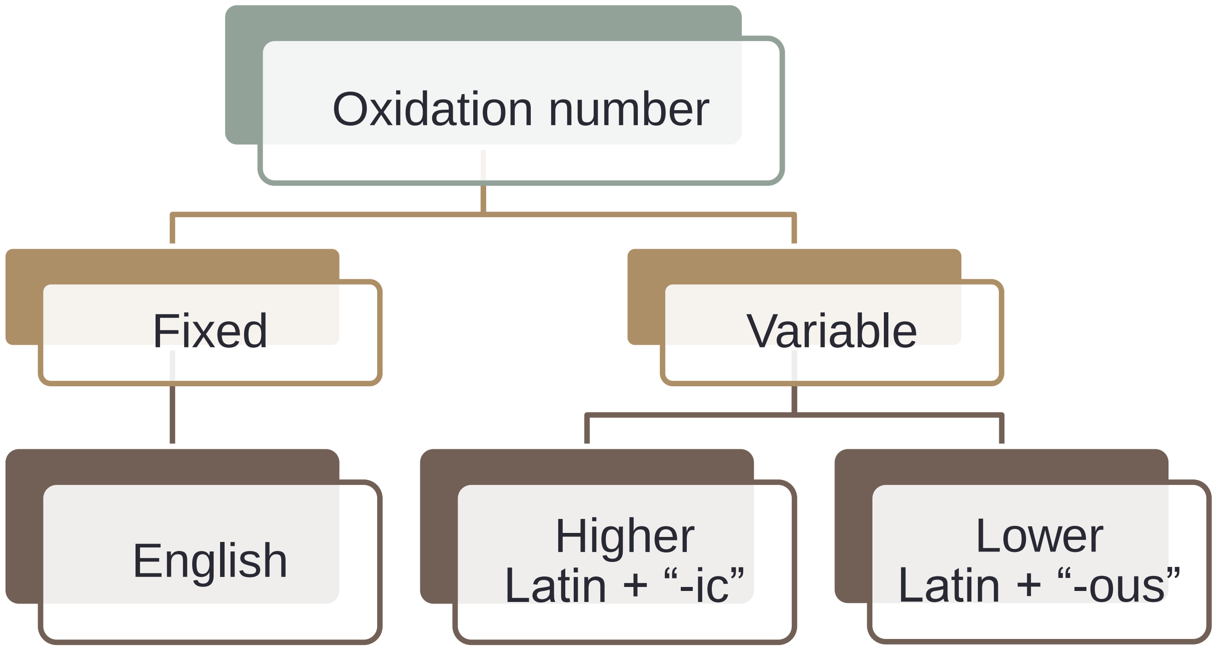
元素周期表(Periodic Table of (Chemical) Elements)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 氢 H Hydrogen 1.0079																	2 氦 He Helium 4.0026
3 锂 Li Lithium 6.941	4 铍 Be Beryllium 9.012											5 硼 B Boron 10.811	6 碳 C Carbon 12.011	7 氮 N Nitrogen 14.007	8 氧 O Oxygen 15.999	9 氟 F Fluorine 18.998	10 氖 Ne Neon 20.17
11 钠 Na Sodium 22.989	12 镁 Mg Magnesium 22.989											13 铝 Al Aluminum 26.982	14 硅 Si Silicon 28.805	15 磷 P Phosphorus 30.974	16 硫 S Sulfur 32.06	17 氯 Cl Chlorine 35.453	18 氩 Ar Argon 39.94
19 钾 K Potassium 39.098	20 钙 Ca Calcium 40.08	21 钪 Sc Scandium 44.956	22 钛 Ti Titanium 47.9	23 钒 V Vanadium 50.9415	24 铬 Cr Chromium 51.996	25 锰 Mn Manganese 54.938	26 铁 Fe Iron 55.84	27 钴 Co Cobalt 58.9332	28 镍 Ni Nickel 58.69	29 铜 Cu Copper 63.54	30 锌 Zn Zinc 65.38	31 镓 Ga Gallium 69.72	32 锗 Ge Germanium 72.5	33 砷 As Arsenic 74.922	34 硒 Se Selenium 78.9	35 溴 Br Bromine 79.904	36 氪 Kr Krypton 83.8
37 铷 Rb Rubidium 85.467	38 锶 Sr Strontium 87.62	39 钇 Y Yttrium 88.906	40 锆 Zr Zirconium 91.22	41 铌 Nb Niobium 92.9064	42 钼 Mo Molybdenum 95.94	43 锝 Tc Technetium 99	44 钌 Ru Ruthenium 101.07	45 铑 Rh Rhodium 102.906	46 钯 Pd Palladium 106.42	47 银 Ag Silver 107.868	48 镉 Cd Cadmium 112.41	49 铟 In Indium 114.82	50 锡 Sn Tin 118.6	51 锑 Sb Antimony 121.7	52 碲 Te Tellurium 127.6	53 碘 I Iodine 126.905	54 氙 Xe Xenon 131.3
55 铯 Cs Cesium 132.905	56 钡 Ba Barium 137.33	71 镥 Lu Lutetium 174.96	72 铪 Hf Hafnium 178.4	73 钽 Ta Tantalum 180.947	74 钨 W Tungsten 183.8	75 铼 Re Rhenium 186.207	76 锇 Os Osmium 190.2	77 铱 Ir Iridium 192.2	78 铂 Pt Platinum 195.08	79 金 Au Gold 196.967	80 汞 Hg Mercury 200.5	81 铊 Tl Thallium 204.3	82 铅 Pb Lead 207.2	83 铋 Bi Bismuth 208.98	84 钋 Po Polonium (209)	85 砹 At Astatine (201)	86 氡 Rn Radon (222)
87 钫 Fr Francium (223)	88 镭 Ra Radium 226.03	103 铹 Lr Lawrencium 260	104 𬬻 Rf Rutherfordium (261)	105 𬭊 Db Dubnium (262)	106 𬭳 Sg Seaborgium (263)	107 𬭛 Bh Bohrium (262)	108 𬭶 Hs Hassium (265)	109 鿏 Mt Meitnerium (266)	110 𫟼 Ds Darmstadtium (269)	111 𬬭 Rg Roentgenium (272)	112 Uub (277)	113 Uut 284	114 Uuq 289	115 Uup 288	116 Uuh 292	117 Uus unknow	118 Uuo 294

镧系 Lanthanide (Lanthanoid)	57 镧 La Lanthanum 138.905	58 铈 Ce Cerium 140.12	59 镨 Pr Praseodymium 140.91	60 钕 Nd Neodymium 144.2	61 钷 Pm Promethium 147	62 钐 Sm Samarium 150.4	63 铕 Eu Europium 151.96	64 钆 Gd Gadolinium 157.25	65 铽 Tb Terbium 158.93	66 镝 Dy Dysprosium 162.5	67 钬 Ho Holmium 164.93	68 铒 Er Erbium 167.2	69 铥 Tm Thulium 168.943	70 镱 Yb Ytterbium 173.0
锕系 Actinicles	89 锕 Ac Actinium 227.03	90 钍 Th Thorium 232.04	91 镤 Pa Protactinium 231.04	92 铀 U Uranium 238.03	93 镎 Np Neptunium 237.05	94 钚 Pu Plutonium 244	95 镅 Am Americium 243	96 锔 Cm Curium 247	97 锫 Bk Berkelium 247	98 锎 Cf Californium 251	99 锿 Es Einsteinium 254	100 镄 Fm Fermium 257	101 钔 Md Mendelevium 258	102 锘 No Nobelium 259

碱金属 alkali metals	碱土金属 alkaline-earth metals	镧系元素 lanthanide	锕系元素 actinicles	过渡金属 transition metal
主族金属 Main group metals	类金属 metalloid	非金属 nonmetal	卤素 halogen	惰性气体 inter gases
气体 gas	液体 liquid	固体 solid	合成元素 composite element	未知元素 unknown element

Metal Cations



$Ca(OH)_2$	Calcium hydroxide	氢氧化钙	$FeCl_3$	Ferric chloride	(三)氯化铁
Al_2O_3	Aluminum oxide	氧化铝	$FeCl_2$	Ferrous chloride	氯化亚铁
AgBr	Silver bromide	溴化银	CuO	Cupric oxide	氧化铜
			Cu_2O	Cuprous oxide	氧化亚铜
NH_3	Ammonia	氨	$SnCl_4$	Stannic chloride	(四)氯化锡
NH_4^+	Ammonium	铵根[离子]	$SnCl_2$	Stannous chloride	氯化亚锡

Some Examples of Ionic Compounds

- NH_4HSO_4
- $MgSiO_4$
- NaH_2PO_4
- $Al(NO_3)_3$
- $CuSO_4$

Covalent Compounds

HBr	hydrogen bromide
$BeCl_2$	beryllium chloride
H_2S	hydrogen sulfide
BN	boron nitride

H_2O	water
NH_3	ammonia
N_2H_4	hydrazine
PH_3	phosphine
AsH_3	arsine
$COCl_2$	phosgene

Greek Numerals in Names

mono- 单	di- 二	tri- 三	tetra- 四	penta- 五
hexa- 六	hepta- 七	octa- 八	nona- 九	deca- 十

CO	Carbon monoxide	一氧化碳	mono- + -oxide = monoxide
CO_2	Carbon dioxide	二氧化碳	
$H_2PO_4^-$	Dihydrogen phosphate	磷酸二氢根	
$Cr_2O_7^{2-}$	Dichromate	重铬酸根	
As_2S_3	(Di)arsenic trisulfide	三硫化二砷	
As_4S_4	Tetraarsenic tetrasulfide	四硫化四砷	
N_2O_4	(Di)nitrogen tetroxide	四氧化二氮	tetra- + -oxide = tetroxide
P_2O_5	(Di)phosphorus pentoxide	五氧化二磷	penta- + -oxide = pentoxide
SF_6	Sulfur hexafluoride	六氟化硫	

Systematic Nomenclature

O_3	Trioxygen
N_2O	Dinitrogen oxide OR Nitrogen(I) oxide
HSO_4^-	Hydrogen sulfate
CuI	Copper(I) iodide

Roman numerals for the oxidation number when it is ambiguous.

$CuSO_4\cdot 5H_2O$	Copper(II) sulfate pentahydrate	五水合硫酸铜(II)
$LiFePO_4$	Lithium iron(II) phosphate	磷酸铁(II)锂
Hg_2Cl_2	Mercury(I) chloride OR Dimercury dichloride	

HBr	Hydrogen bromide	溴化氢	Hydrobromic acid	氢溴酸
HIO_4	Iodic(VII) acid	碘(VII)酸	[Periodic acid	高碘酸]
P_4	Tetraphosphorus	四磷		
D_2O	Deuterium oxide	氧化氘		

Systematic Nomenclature

	Conventional	Systematic Nomenclature
N_2O	dinitrogen oxide	nitrogen(I) oxide
NO	nitrogen oxide	nitrogen(II) oxide
N_2O_3	dinitrogen trioxide	nitrogen(III) oxide
NO_2	nitrogen dioxide	nitrogen(IV) oxide
N_2O_4	dinitrogen tetraoxide	nitrogen(IV) oxide
N_2O_5	dinitrogen pentaoxide	nitrogen(V) oxide

Bottom Line

- These rules are made by chemists and for chemists.
- These rules are subject to revisions.
- The purpose of learning these rules is not only to abide by them, but, more importantly, to create new ones.

Reading:
OGB8 §§1.4, 3.10