Matters

State

- Solid
- Liquid
- gas

property

- physical property
- Chemical property : the ability to form new substance.

element.

The fundamental substance, e.g. iron, oxygen - - -

Compounds

= element + element

and Compounds ⟶ Elenent by chemical change.

Atom

What's made element, each element ONLY have one kind of atom.

Molecules

certain pure element have molecules.

e.g. hydrogen → H-H

Mixture

different composition ; two or more pure substance.

pure substance

the same composition

homogeneous mixture.

Also called the solution.

does Not vary in composition from one region to other

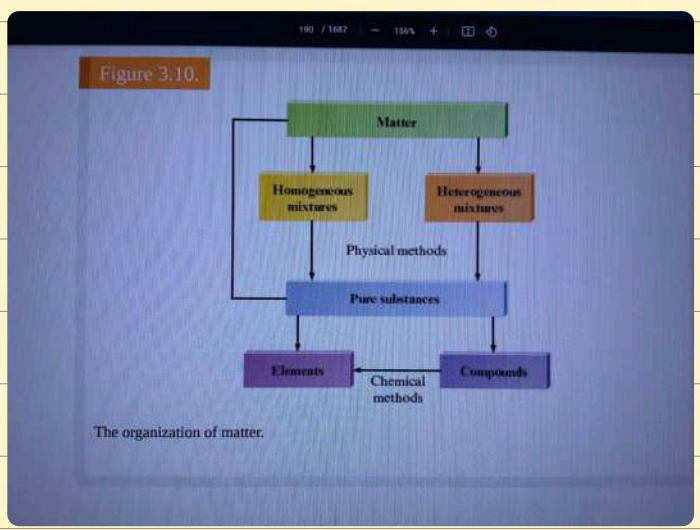
Heterogeneous mixture.

diff from homogeneous

Seperation

① distillation

② filtration



Structure of Atom

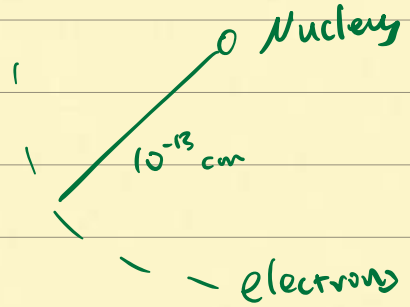
pudding model

↓ 2 on metal foil

Rutherford: Must have nucleus (proton)

Electron: negative
proton: positive
Neutron: no charge
} Nucleus

Modern model



Mass:

Elec: 1 unit −
pro: 1836 +
neu: 1839 none

diff num and arrangement of the electron cause different chem property.

Isotopes

- different Neutrons in the same atom

Atomic number (Z)

Number of proton

Mass Number (A)

of proton + # of neutron

Representation.

$$^{A}_{Z}X$$

where X = the symbol of element

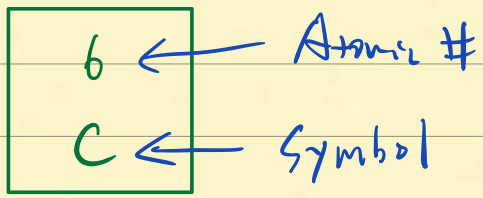
A = the mass number

Z = Atomic #

$$A = Z + \#\text{ of neutron}$$

e.g. $^{23}_{11}Na$ called sodium-23, which have 11 proton, (23-11) neutron and mass number of 23.

Periodic Table



Arranged based on similar chemical properties of various families.

Group / family

family: similarity in chemical property ↓ vertically

group: A family of element, refer by # over column.

Alkali metal

first column of elements.

Alkaline earth mental

Group 2

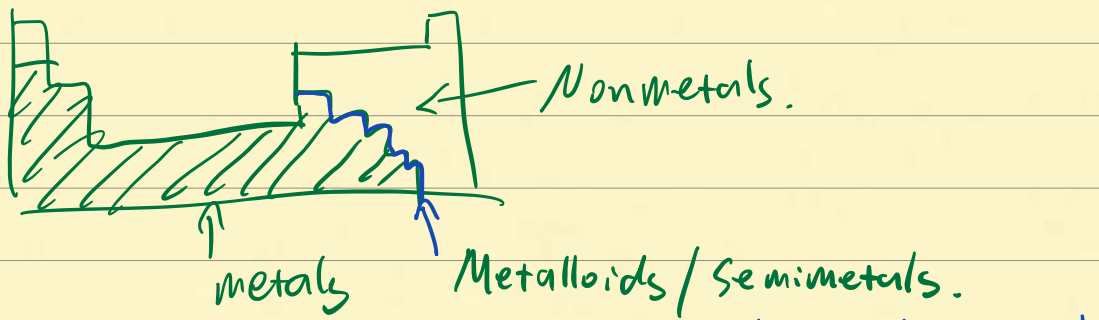
Halogens

Group 7

Noble gas

Group 8

- Most element are metals



diatomic Molecules.

Molecules made up of two atoms.

eg. H_2 N_2 O_2

- All element in group 7 (halogen family) contain diatomic molecules.

eg. F_2. Br_2. I_2.

Ions

adding / removing one or more electrons.

eg. Sodium atom ($Z = 11$) and 10 electrons.

it gives a ion with $(11-10) = 1+$ charge.

or

$$Na \rightarrow Na^{+} + e^{-}$$

Cation

Ion with + charge.

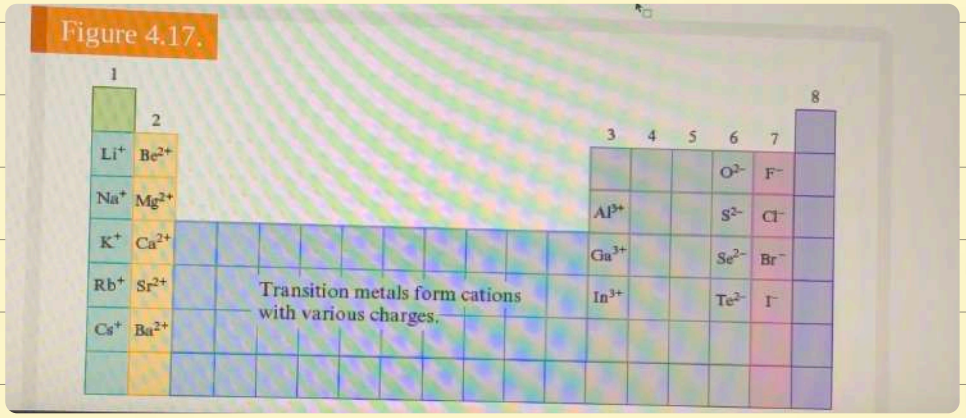
eg. Mg^{2+} Na^{+} Al^{3+}

Anion

Ion with - charge.

eg. $Cl + e^{-} \rightarrow Cl^{-}$

- When metal / Nonmetal react, metal tend to lose electrons, with turn to be gained by nonmetal atoms. → metal cation, nonmetal anions.



Compound contain Ions

eg. NaCl contain Na^+ and Cl^-

$$\#\text{ of cation} + \#\text{ anion} = 0$$

Nomenclature

A system to name each chemical compound

Naming Compounds.

① Binary Compound: only composed by two element.

- Metal + Nonmetal
- Non + Non (Type3)

Metal + Nonmetal: called binary ionic compound

- Type1 compound: only one type of cation.
- Type2 compound: two or more cations.

Table 5.1. Common Simple Cations and Anions

Cation	Name	Anion	Name*
H^+	hydrogen	H^-	hydride
Li^+	lithium	F^-	fluoride
Na^+	sodium	Cl^-	chloride
K^+	potassium	Br^-	bromide
Cs^+	cesium	I^-	iodide
Be^{2+}	beryllium	O^{2-}	oxide
Mg^{2+}	magnesium	S^{2-}	sulfide
Ca^{2+}	calcium		
Ba^{2+}	barium		
Al^{3+}	aluminum		
Ag^+	silver		
Zn^{2+}	zinc		

Type1 compound

① Cation always named first and then anion.

② Simple cation = Name of the element.

③ Simple anion = Name of the element + ide.

eg. Cl^- : chloride

Na^+ : Sodium

NaI : sodium iodide.

CaO: calcium oxide

Type2 Binary Ionic Compounds.

eg. $Fe \rightarrow Fe^{2+}$ or Fe^{3+}

$Cr \rightarrow Cr^{2+}$ or Cr^{3+}

$Au \rightarrow Au^{+}$ or Au^{3+}

Name by indicated the # of + change in cation.

eg. $FeCl_2$: iron(II) chloride.

$FeCl_3$: iron(III) chloride.

Table 5.2. Common Type II Cations

Ion	Systematic Name	Older Name
Fe^{3+}	iron(III)	ferric
Fe^{2+}	iron(II)	ferrous
Cu^{2+}	copper(II)	cupric
Cu^{+}	copper(I)	cuprous
Co^{3+}	cobalt(III)	cobaltic
Co^{2+}	cobalt(II)	cobaltous
Sn^{4+}	tin(IV)	stannic
Sn^{2+}	tin(II)	stannous

Ion	Systematic Name	Older Name
Pb^{4+}	lead(IV)	plumbic
Pb^{2+}	lead(II)	plumbous
Hg^{2+}	mercury(II)	mercuric
Hg_2^{2+} *	mercury(I)	mercurous

Type1 Vs Type2.

Group 1 and 2 metals are all Type1.

Transitional Metals are almost Type2.

Type3: Nonmetal x2

1. first element named first, and the full element name is used
2. second element is named as though it were an anion.
3. prefixed used to denote the # of atoms present.

prefixes

Prefix	Number Indicated
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8

Mono- is never used in naming the first element!

eg. CO: Carbon Monoxide

eg. BF_3 : boron trifluoride.

NO : nitric oxide

↑ Simplified, for better pronounced.

N_2O_5 : dinitrogen pentoxide.

↑ dropped a, for bette pronounce

Naming Polyatomic Ions

Ion	Name
NH_4^+	ammonium
NO_2^-	nitrite
NO_3^-	nitrate
SO_3^{2-}	sulfite
SO_4^{2-}	sulfate
HSO_4^-	hydrogen sulfate (bisulfate is a widely used common name)
OH^-	hydroxide
CN^-	cyanide
PO_4^{3-}	phosphate
HPO_4^{2-}	hydrogen phosphate
$H_2PO_4^-$	dihydrogen phosphate
CO_3^{2-}	carbonate
HCO_3^-	hydrogen carbonate (bicarbonate is a widely used common name)
ClO^-	hypochlorite
ClO_2^-	chlorite
ClO_3^-	chlorate
ClO_4^-	perchlorate
$C_2H_3O_2^-$	acetate
MnO_4^-	permanganate
$Cr_2O_7^{2-}$	dichromate
CrO_4^{2-}	chromate
O_2^{2-}	peroxide

For the ions above which have oxgen atoms, they are called: oxyanions

For this kind, the one which have a smaller # of oxyen end in -ite, and the larger one end in -ate

eg. SO_3^{2-} : sulfite

SO_4^{2-} : sulfate.

For the case which have more than 2 oxyanions. we used

- hypo : less than
- per : more than.

ClO^-	*hypochlorite*
ClO_2^-	chlor*ite*
ClO_3^-	chlor*ate*
ClO_4^-	*per*chlor*ate*

When metal represent, For those cation with ≥2 cased, named like Type II.

eg. $FeSO_4$ < Fe : ⟷ iron(II)

SO_4: Sulfate, (2-)

Naming Acid

Acid: when dissouled in water, produce H^+ ions.

① With NO oxyen: prefix: hydro & suffix: ic

eg. HCl (hydrogen Chloride)

⇒ hydrochloric Acid

② With oxygen

Aion name + suffix of ic / ous

When the anion name end in -ate, the suffix -ic is used.

eg. H_2SO_4

↑

Aion ⇒ sulfuric acid.

H_3PO_4

↑

Aion ⇒ phosphoric acid

$HC_2H_3O_2$

↑

Aion ⇒ acetic acid.

HNO_2

↳ nitrous acid

Table 5.5. Names of Acids That Do Not Contain Oxygen

Acid	Name
HF	hydrofluoric acid
HCl	hydrochloric acid
HBr	hydrobromic acid
HI	hydroiodic acid
HCN	hydrocyanic acid
H_2S	hydrosulfuric acid

Table 5.6. Names of Some Oxygen-Containing Acids

Acid	Name
HNO_3	nitric acid
HNO_2	nitrous acid
H_2SO_4	sulfuric acid
H_2SO_3	sulfurous acid
H_3PO_4	phosphoric acid
$HC_2H_3O_2$	acetic acid