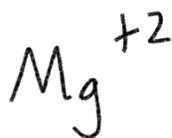
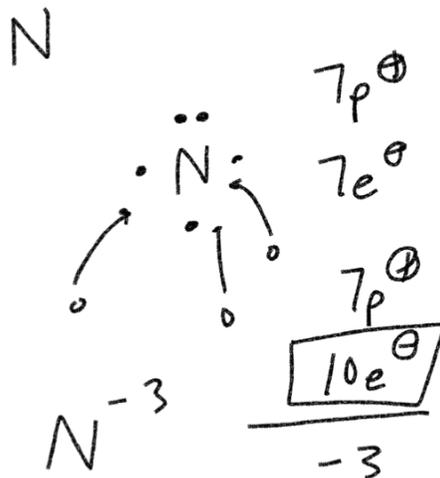
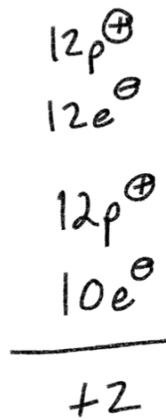


TH-GC General Chemistry week 9 11/10

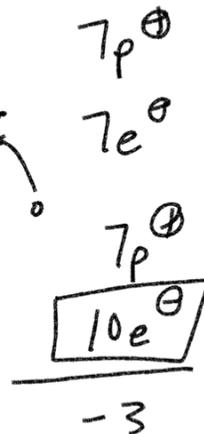
Find the ionic form of each.



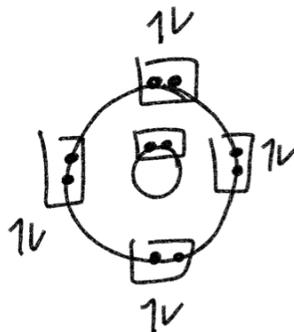
cation



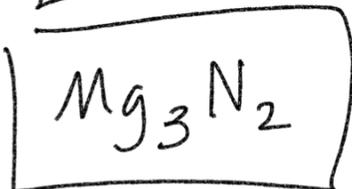
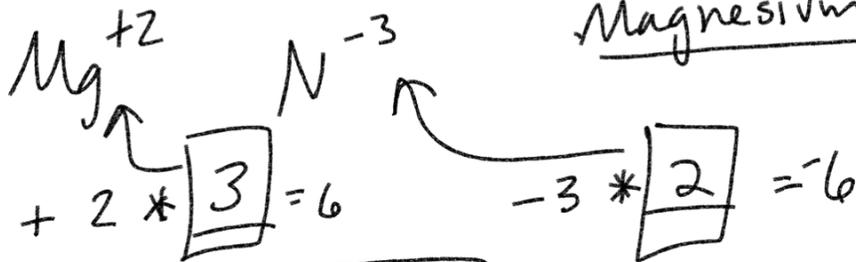
anion

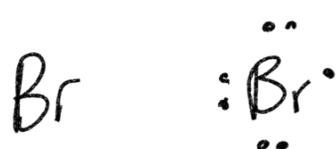


Electrons spin

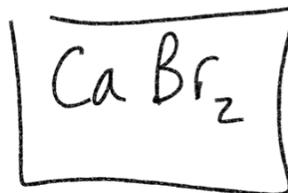
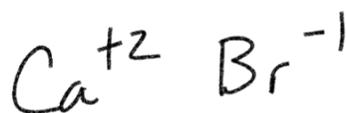
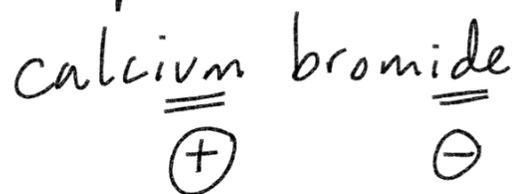


Magnesium nitride



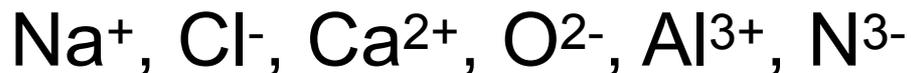


ionic compound



positive ion
(cation)
written first

A **monatomic ion** contains only one atom



A **polyatomic ion** contains more than one atom



hydroxide
OH⁻

cyanide

ammonium
⊕

nitrate

NO₂⁻
nitrite

NO

nitrous oxide

Common Ions Shown on the Periodic Table

+1 ↓ 1A		+2 ↓ 2A		transition metals								+3 ↓ 3A	14 4A	-3 ↓ 15 5A	-2 ↓ 16 6A	-1 ↓ 17 7A	0 ↓ 18 8A
1A	2A	3B	4B	5B	6B	7B	8B		10	11B	12B	3A	4A	5A	6A	7A	8A
Li ⁺												Al ³⁺	C ⁴⁻	N ³⁻	O ²⁻	F ⁻	
Na ⁺	Mg ²⁺				Cr ²⁺ Cr ³⁺	Mn ²⁺ Mn ³⁺	Fe ²⁺ Fe ³⁺	Co ²⁺ Co ³⁺	Ni ²⁺ Ni ³⁺	Cu ⁺ Cu ²⁺	Zn ²⁺			P ³⁻	S ²⁻	Cl ⁻	
K ⁺	Ca ²⁺														Se ²⁻	Br ⁻	
Rb ⁺	Sr ²⁺									Ag ⁺	Cd ²⁺		Sn ²⁺ Sn ⁴⁺		Te ²⁻	I ⁻	
Cs ⁺	Ba ²⁺									Au ⁺ Au ³⁺	Hg ₂ ²⁺ Hg ²⁺		Pb ²⁺ Pb ⁴⁺				

Chromium (II) Cr⁺²

How many protons and electrons are in ${}_{13}^{27}\text{Al}^{3+}$?

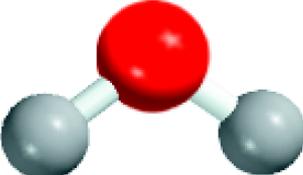
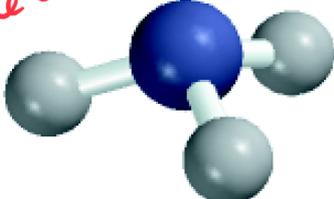
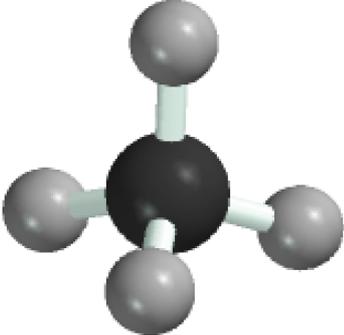
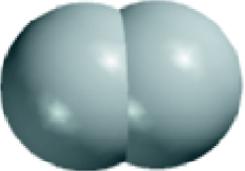
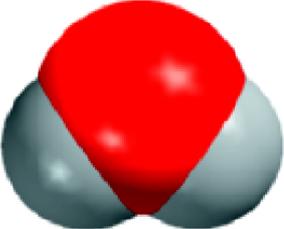
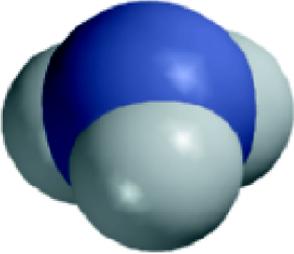
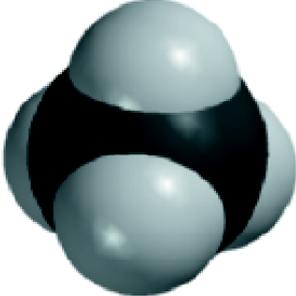
13 protons, 10 (13 - 3) electrons

*missing
3 electrons*

How many protons and electrons are in ${}_{34}^{78}\text{Se}^{2-}$?

34 protons, 36 (34 + 2) electrons

Formulas and Models

	Hydrogen	Water	Ammonia	Methane
Molecular formula	H_2	H_2O	NH_3	CH_4
Structural formula	$H-H$	$H-O-H$	$\begin{array}{c} H-N-H \\ \\ H \end{array}$	$\begin{array}{c} H \\ \\ H-C-H \\ \\ H \end{array}$
Ball-and-stick model				
Space-filling model				

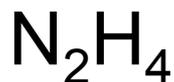
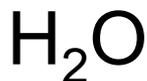
covalent bonds involve sharing valence electrons

A molecular formula shows the exact number of atoms of each element in the smallest unit of a substance

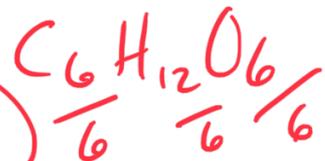
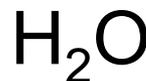


An empirical formula shows the simplest whole-number ratio of the atoms in a substance

molecular



empirical

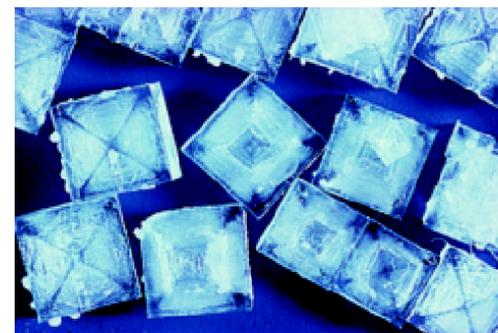
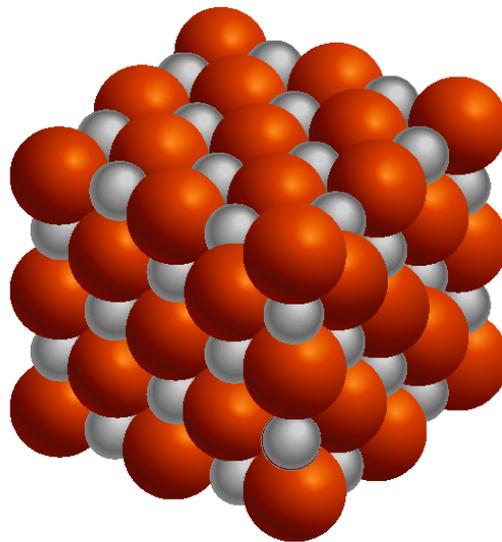
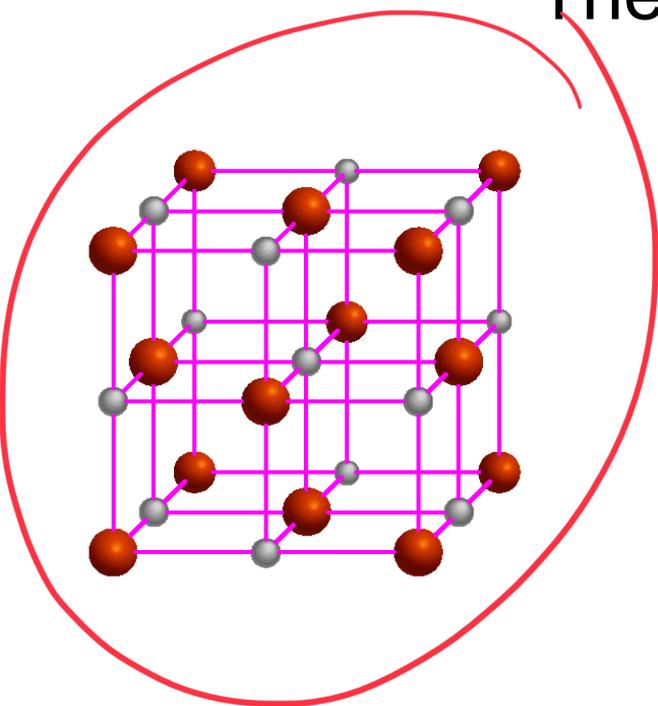


ionic compounds always show the empirical

ionic compounds consist of a combination of cations and an anions

- The formula is usually the same as the empirical formula
- The sum of the charges on the cation(s) and anion(s) in each formula unit must equal zero

The ionic compound NaCl



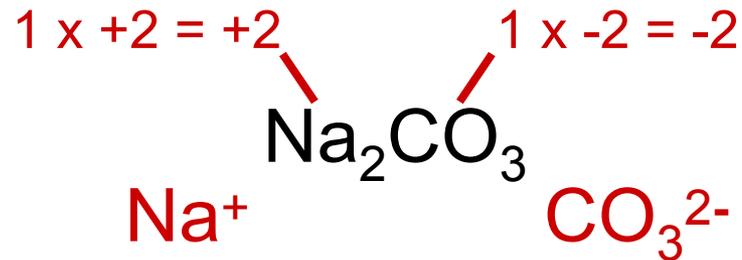
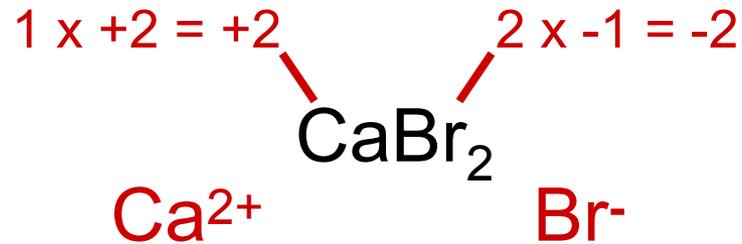
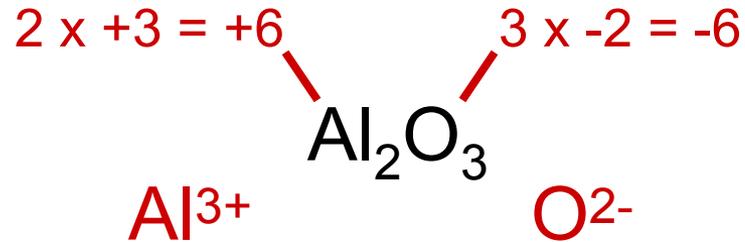
+1		+2							+3 Nonmetals					0
1A	2A						3A	4A	5A	6A	7A	8A		
Li									N	O	F			
Na	Mg						Al			S	Cl			
K	Ca										Br			
Rb	Sr										I			
Cs	Ba													

Metals cations

anions

The most reactive **metals** (green) and the most reactive **nonmetals** (blue) combine to form ionic compounds.

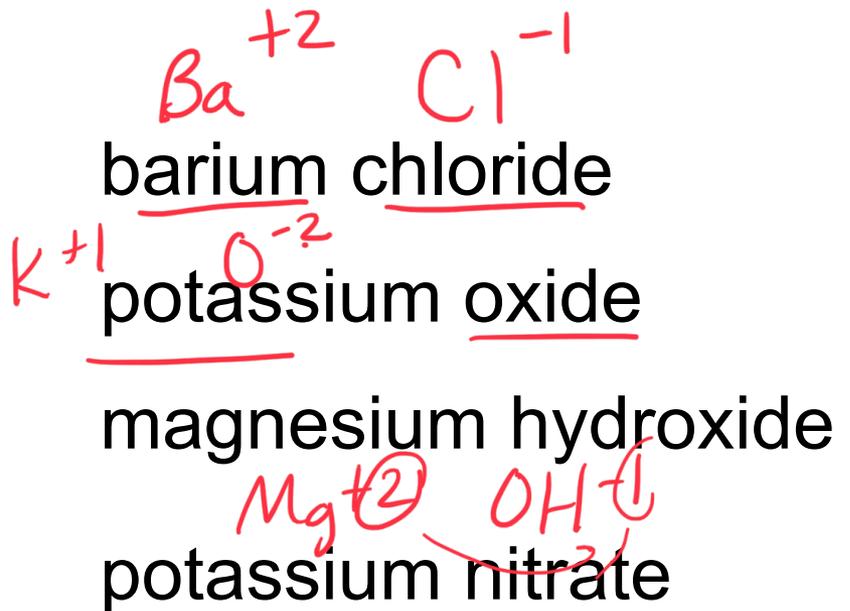
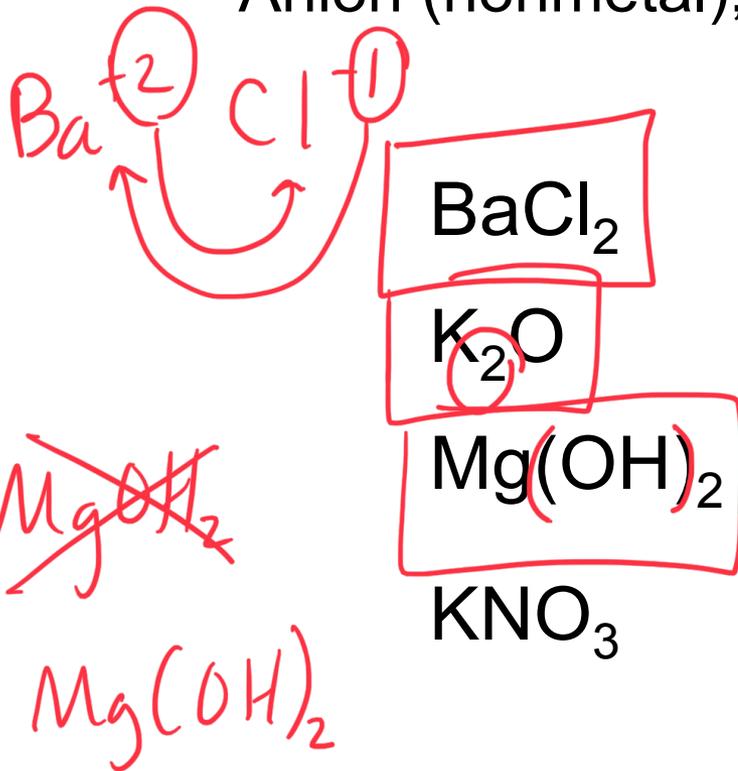
Formula of Ionic Compounds



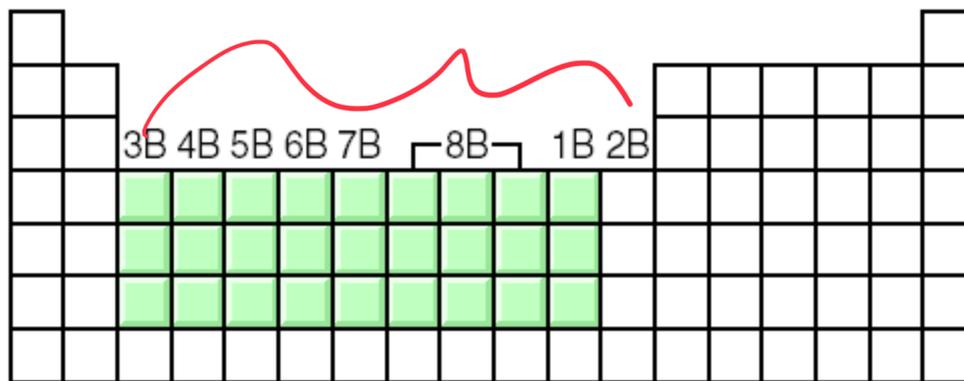
Chemical Nomenclature

- **Ionic Compounds**

- Often a metal + nonmetal
- Anion (nonmetal), add “ide” to element name



- Transition metal ionic compounds
 - indicate charge on metal with Roman numerals



Iron III sulfide
 Fe^{+3} S^{-2}
 $Fe_{(2)}S_{(3)}$
 $+6 - 6 = 0$

$FeCl_2$ 2 Cl^- -2 so Fe is $+2$ iron(II) chloride

$FeCl_3$ 3 Cl^- -3 so Fe is $+3$ iron(III) chloride

Cr_2S_3 3 S^{-2} -6 so Cr is $+3$ ($6/2$) chromium(III) sulfide

Know this (Periodic table)

TABLE 2.2

The “-ide” Nomenclature of Some Common Monatomic Anions According to Their Positions in the Periodic Table

Group 4A

Group 5A

Group 6A

Group 7A

C carbide (C^{4-})*

N nitride (N^{3-})

O oxide (O^{2-})

F fluoride (F^-)

Si silicide (Si^{4-})

P phosphide (P^{3-})

S sulfide (S^{2-})

Cl chloride (Cl^-)

Se selenide (Se^{2-})

Br bromide (Br^-)

Te telluride (Te^{2-})

I iodide (I^-)

*The word “carbide” is also used for the anion C_2^{2-} .

TABLE 2.3

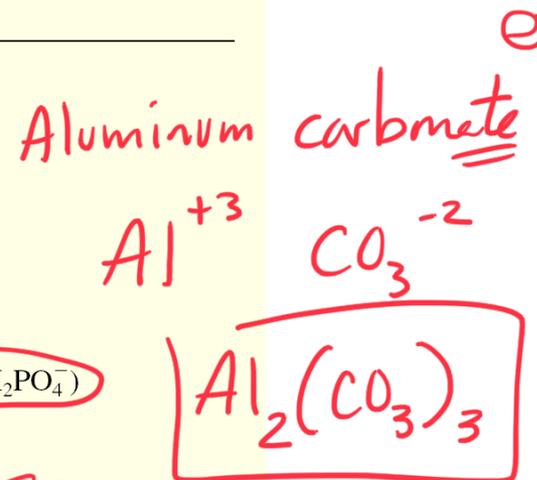
Names and Formulas of Some Common Inorganic Cations and Anions

Cation

aluminum (Al^{3+})
 ammonium (NH_4^+)
 barium (Ba^{2+})
 cadmium (Cd^{2+})
 calcium (Ca^{2+})
 cesium (Cs^+)
 chromium(III) or chromic (Cr^{3+})
 cobalt(II) or cobaltous (Co^{2+})
 copper(I) or cuprous (Cu^+)
 copper(II) or cupric (Cu^{2+})
 hydrogen (H^+)
 iron(II) or ferrous (Fe^{2+})
 iron(III) or ferric (Fe^{3+})
 lead(II) or plumbous (Pb^{2+})
 lithium (Li^+)
 magnesium (Mg^{2+})
 manganese(II) or manganous (Mn^{2+})
 mercury(I) or mercurous (Hg_2^{2+})*
 mercury(II) or mercuric (Hg^{2+})
 potassium (K^+)
 rubidium (Rb^+)
 silver (Ag^+)
 sodium (Na^+)
 strontium (Sr^{2+})
 tin(II) or stannous (Sn^{2+})
 zinc (Zn^{2+})

Anion

bromide (Br^-)
 carbonate (CO_3^{2-})
 chlorate (ClO_3^-)
 chloride (Cl^-)
 chromate (CrO_4^{2-})
 cyanide (CN^-)
 dichromate ($\text{Cr}_2\text{O}_7^{2-}$)
 dihydrogen phosphate (H_2PO_4^-)
 fluoride (F^-)
 hydride (H^-)
 hydrogen carbonate or bicarbonate (HCO_3^-)
 hydrogen phosphate (HPO_4^{2-})
 hydrogen sulfate or bisulfate (HSO_4^-)
 hydroxide (OH^-)
 iodide (I^-)
 nitrate (NO_3^-)
 nitride (N^{3-})
 nitrite (NO_2^-)
 oxide (O^{2-})
 permanganate (MnO_4^-)
 peroxide (O_2^{2-})
 phosphate (PO_4^{3-})
 sulfate (SO_4^{2-})
 sulfide (S^{2-})
 sulfite (SO_3^{2-})
 thiocyanate (SCN^-)



*Mercury(I) exists as a pair as shown.

• Molecular compounds

- Nonmetals or nonmetals + metalloids
- Common names
 - H₂O, NH₃, CH₄,
- Element furthest to the left in a period and closest to the bottom of a group on periodic table is placed first in formula
- If more than one compound can be formed from the same elements, use prefixes to indicate number of each kind of atom
- Last element name ends in *ide*



Trinitrogen pentoxide

TABLE 2.4

Greek Prefixes Used in Naming Molecular Compounds

Prefix	Meaning
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10

Molecular Compounds

HI hydrogen iodide

NF₃ nitrogen trifluoride

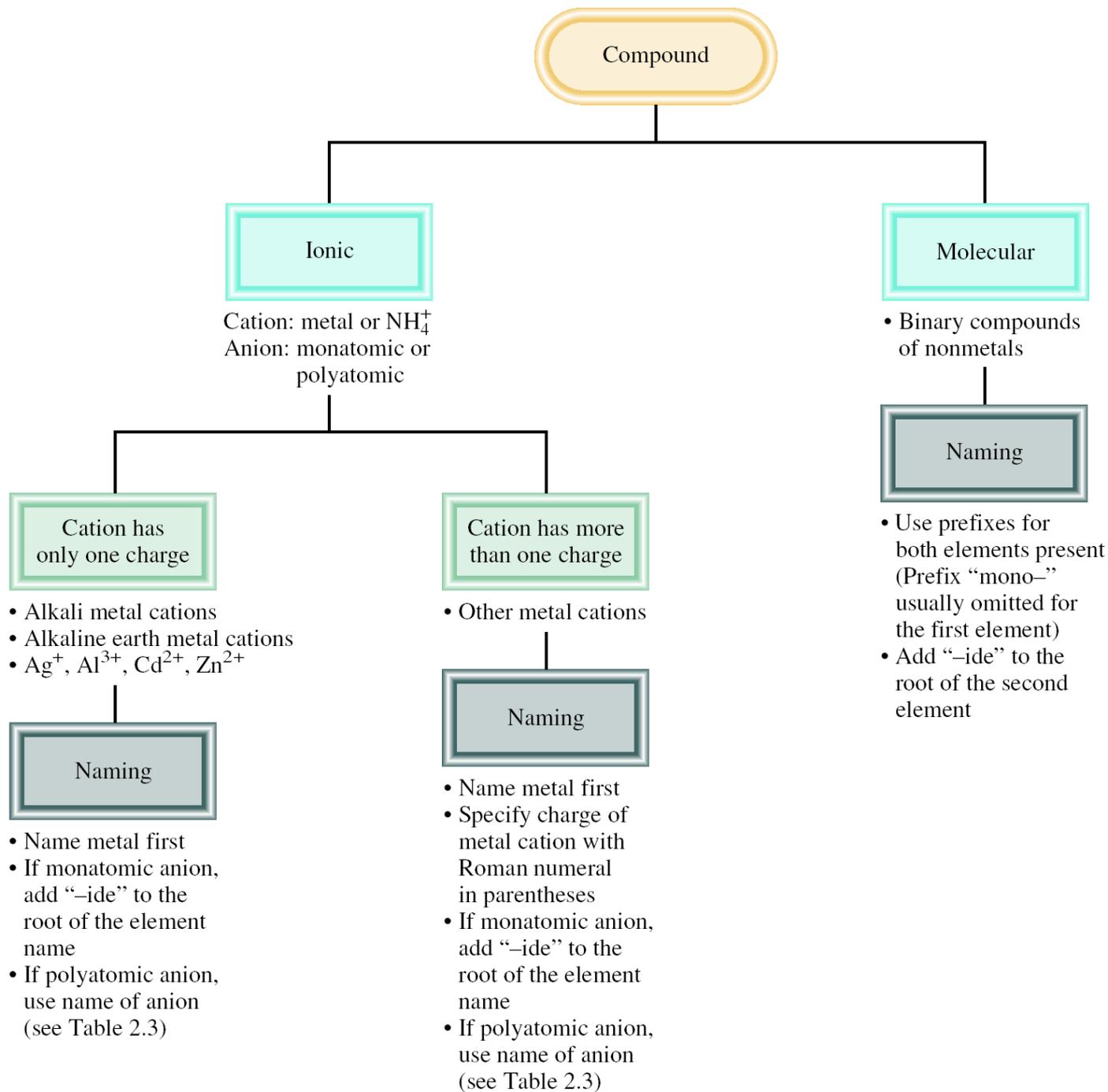
SO₂ sulfur dioxide

N₂Cl₄ dinitrogen tetrachloride

NO₂ nitrogen dioxide

NO₂⁻ nitrite

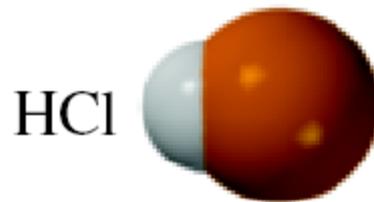
N₂O dinitrogen monoxide



An **acid** can be defined as a substance that yields hydrogen ions (H^+) when dissolved in water.

For example: HCl gas and HCl in water

- Pure substance, hydrogen chloride



- Dissolved in water (H_3O^+ and Cl^-), hydrochloric acid

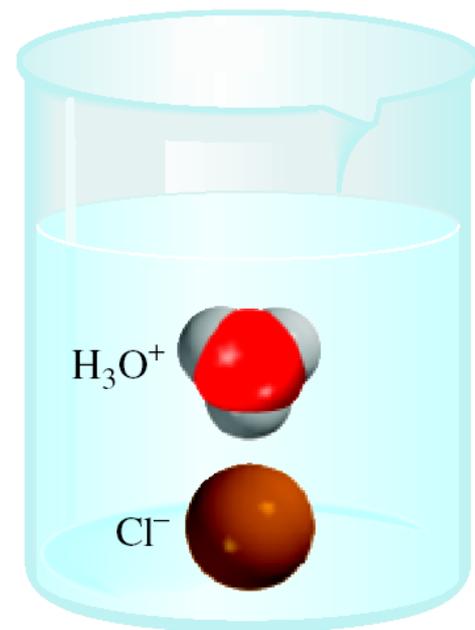


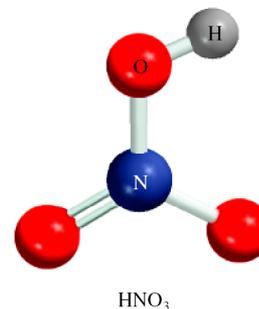
TABLE 2.5 Some Simple Acids

Anion	Corresponding Acid
F^- (fluoride)	HF (hydrofluoric acid)
Cl^- (chloride)	HCl (hydrochloric acid)
Br^- (bromide)	HBr (hydrobromic acid)
I^- (iodide)	HI (hydroiodic acid)
CN^- (cyanide)	HCN (hydrocyanic acid)
S^{2-} (sulfide)	H_2S (hydrosulfuric acid)

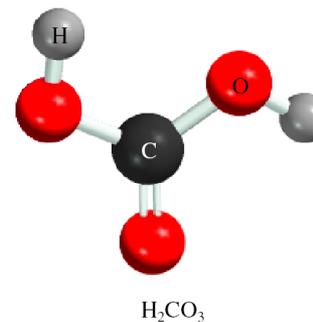
An **oxoacid** is an acid that contains hydrogen, oxygen, and another element.



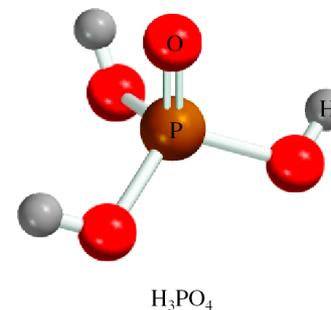
nitric acid



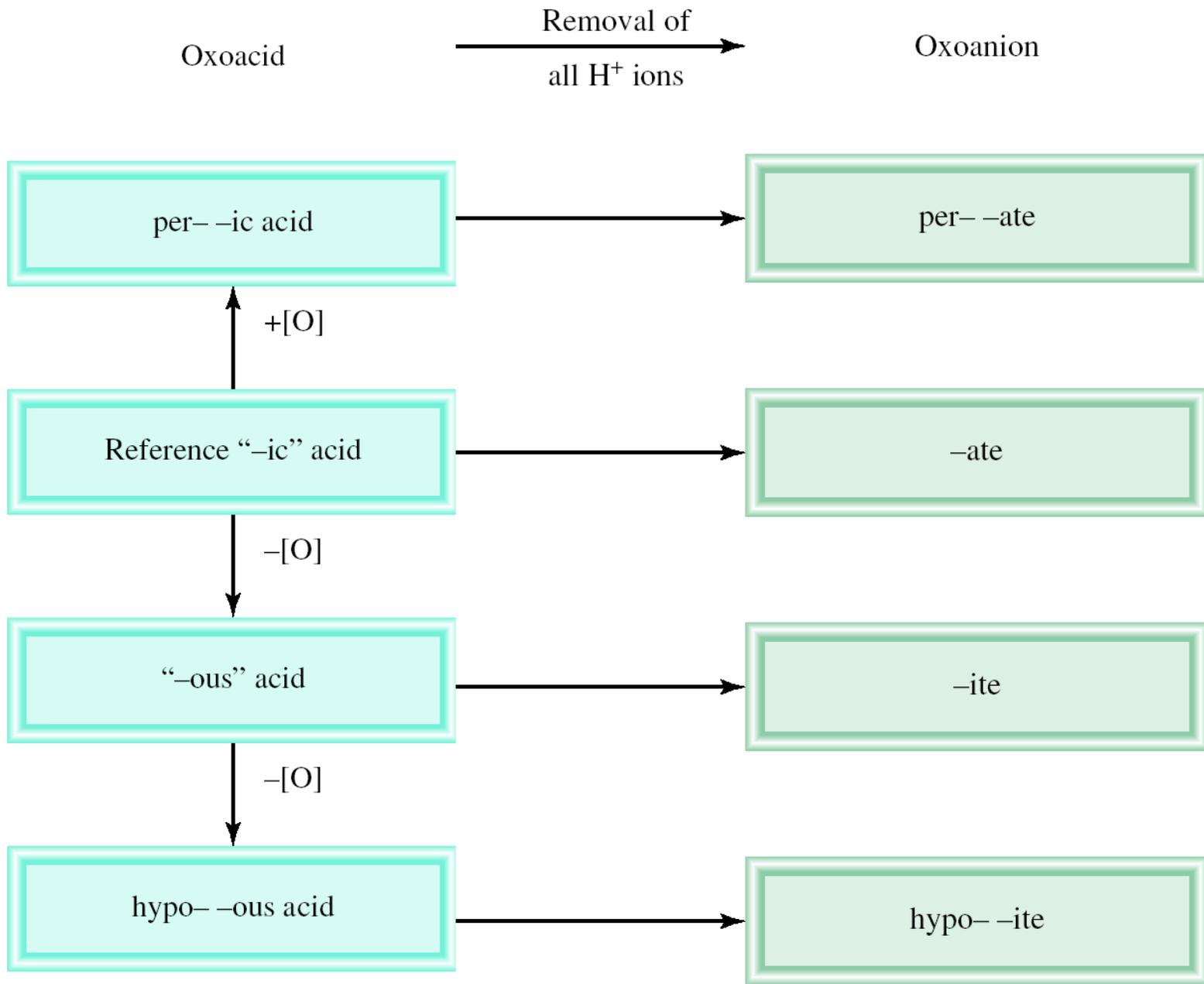
carbonic acid



phosphoric acid



Naming Oxoacids and Oxoanions



The rules for naming **oxoanions**, *anions of oxoacids*, are as follows:

1. When all the H ions are removed from the "ic" acid, the anion's name ends with "-ate." “-
2. When all the H ions are removed from the "ous" acid, the anion's name ends with "-ite." “-
3. The names of anions in which one or more but not all the hydrogen ions have been removed must indicate the number of H ions present.

For example:

- H_2PO_4^- dihydrogen phosphate
- HPO_4^{2-} hydrogen phosphate
- PO_4^{3-} phosphate

TABLE 2.6 Names of Oxoacids and Oxoanions That Contain Chlorine

Acid	Anion
HClO ₄ (perchloric acid)	ClO ₄ ⁻ (perchlorate)
HClO ₃ (chloric acid)	ClO ₃ ⁻ (chlorate)
HClO ₂ (chlorous acid)	ClO ₂ ⁻ (chlorite)
HClO (hypochlorous acid)	ClO ⁻ (hypochlorite)

A **base** can be defined as a substance that yields hydroxide ions (OH^-) when dissolved in water.

NaOH sodium hydroxide

KOH potassium hydroxide

$\text{Ba}(\text{OH})_2$ barium hydroxide

Hydrates are compounds that have a specific number of water molecules attached to them.



barium chloride dihydrate



lithium chloride monohydrate



magnesium sulfate heptahydrate



strontium nitrate tetrahydrate

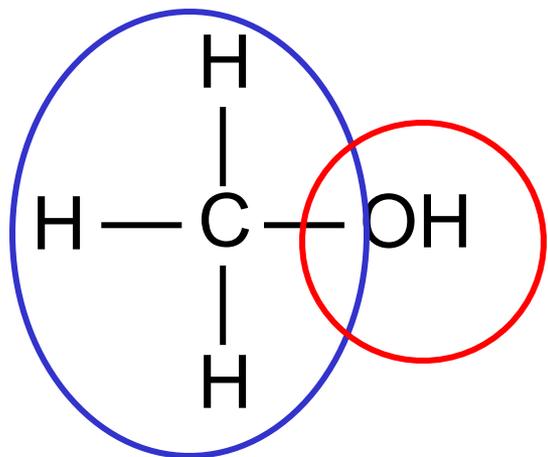


TABLE 2.7**Common and Systematic Names of Some Compounds**

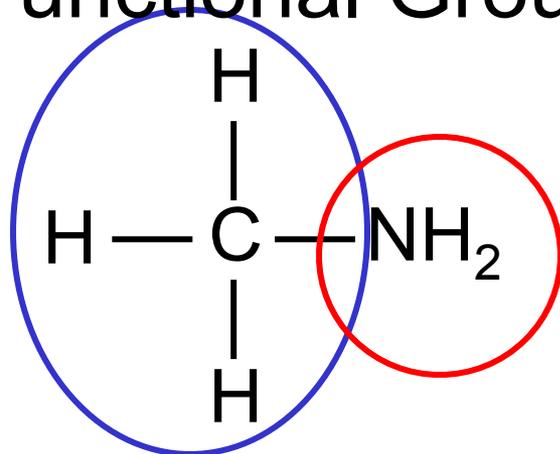
Formula	Common Name	Systematic Name
H_2O	Water	Dihydrogen monoxide
NH_3	Ammonia	Trihydrogen nitride
CO_2	Dry ice	Solid carbon dioxide
NaCl	Table salt	Sodium chloride
N_2O	Laughing gas	Dinitrogen monoxide
CaCO_3	Marble, chalk, limestone	Calcium carbonate
CaO	Quicklime	Calcium oxide
$\text{Ca}(\text{OH})_2$	Slaked lime	Calcium hydroxide
NaHCO_3	Baking soda	Sodium hydrogen carbonate
$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	Washing soda	Sodium carbonate decahydrate
$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	Epsom salt	Magnesium sulfate heptahydrate
$\text{Mg}(\text{OH})_2$	Milk of magnesia	Magnesium hydroxide
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Gypsum	Calcium sulfate dihydrate

Organic chemistry is the branch of chemistry that deals with carbon compounds

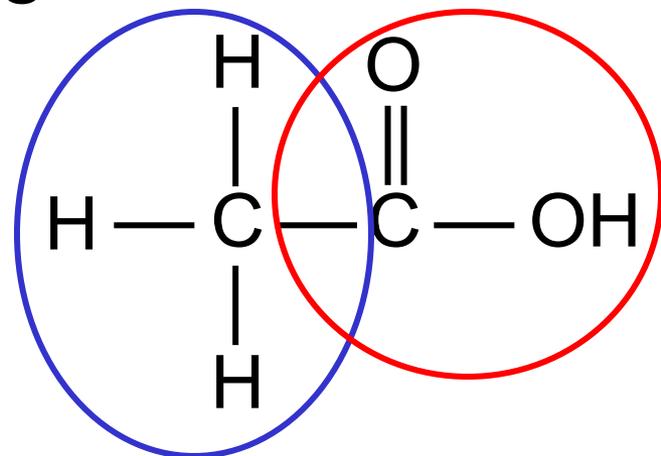
Functional Groups



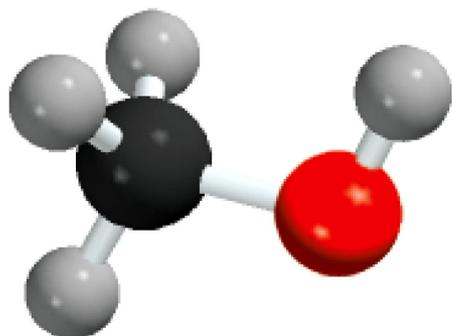
methanol



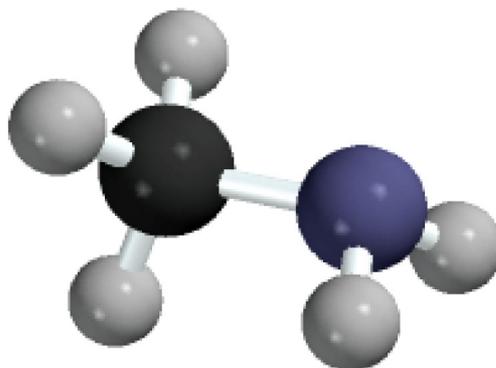
methylamine



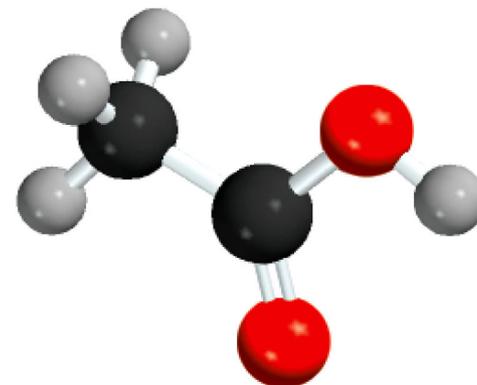
acetic acid



CH_3OH



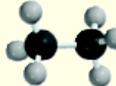
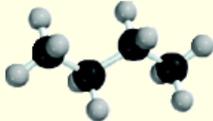
CH_3NH_2



CH_3COOH

TABLE 2.8

The First Ten Straight-Chain Alkanes

Name	Formula	Molecular Model
Methane	CH ₄	
Ethane	C ₂ H ₆	
Propane	C ₃ H ₈	
Butane	C ₄ H ₁₀	
Pentane	C ₅ H ₁₂	
Hexane	C ₆ H ₁₄	
Heptane	C ₇ H ₁₆	
Octane	C ₈ H ₁₈	
Nonane	C ₉ H ₂₀	
Decane	C ₁₀ H ₂₂	