Chapter 2
Formulas and Nomenclature

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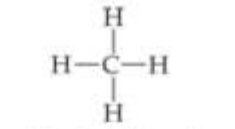
Types of Formulas

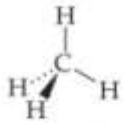
- Empirical formulas give the lowest whole-number ratio of atoms of each element in a compound.

- Molecular formulas give the exact number of atoms of each element in a compound.

Types of Formulas



Structural formula



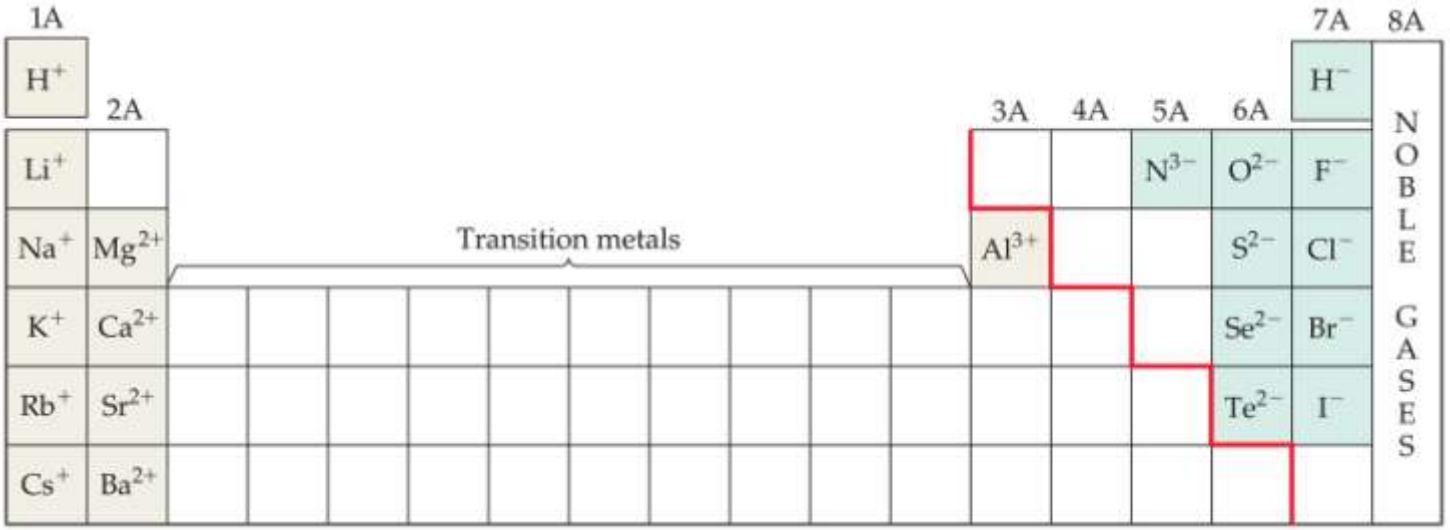
Perspective drawing

Ball-and-stick model

Space-filling model

- Structural formulas show the order in which atoms are bonded.
- Perspective drawings also show the three-dimensional array of atoms in a compound.

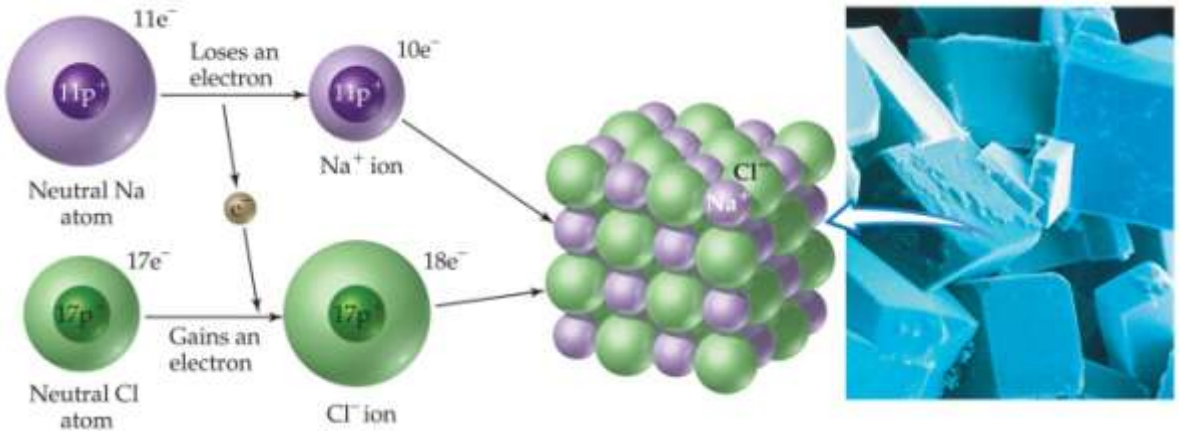
Ions



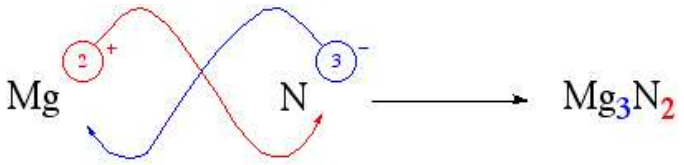
- When atoms lose or gain electrons, they become ions.
  - Cations are positive and are formed by elements on the left side of the periodic chart.
  - Anions are negative and are formed by elements on the right side of the periodic chart.

Ionic Bonds

Ionic compounds (such as NaCl) are generally formed between metals(+) and nonmetals (-).



Writing Formulas



- Compounds produced are electrically Neutral.

- Determine the formula of a compound:
  - Cation charge becomes the subscript on anion.
  - Anion charge becomes the subscript on cation.
  - If these subscripts are not in lowest whole-number ratio, divide by the greatest common factor.

  - The total (+) charge = the total (-) charge.

Common Cations

Charge	Formula	Name	Formula	Name
1+	**H^+**	**Hydrogen ion**	**NH_4^+**	**Ammonium ion**
	Li^+	Lithium ion	Cu^+	Copper(I) or cuprous ion
	Na^+	**Sodium ion**		
	K^+	**Potassium ion**		
	Cs^+	Cesium ion		
	Ag^+	**Silver ion**		
2+	**Mg^{2+}**	**Magnesium ion**	Co^{2+}	Cobalt(II) or cobaltous ion
	Ca^{2+}	**Calcium ion**	**Cu^{2+}**	**Copper(II)** or cupric ion
	Sr^{2+}	Strontium ion	**Fe^{2+}**	**Iron(II)** or ferrous ion
	Ba^{2+}	Barium ion	Mn^{2+}	Manganese(II) or manganous ion
	Zn^{2+}	**Zinc ion**	Hg_2^{2+}	Mercury(I) or mercurous ion
	Cd^{2+}	Cadmium ion	**Hg^{2+}**	**Mercury(II)** or mercuric ion
			Ni^{2+}	Nickel(II) or nickelous ion
			Pb^{2+}	**Lead(II)** or plumbous ion
			Sn^{2+}	Tin(II) or stannous ion
3+	**Al^{3+}**	**Aluminum ion**	Cr^{3+}	Chromium(III) or chromic ion
			Fe^{3+}	**Iron(III)** or ferric ion

*The most common ions are in boldface.

Common Anions

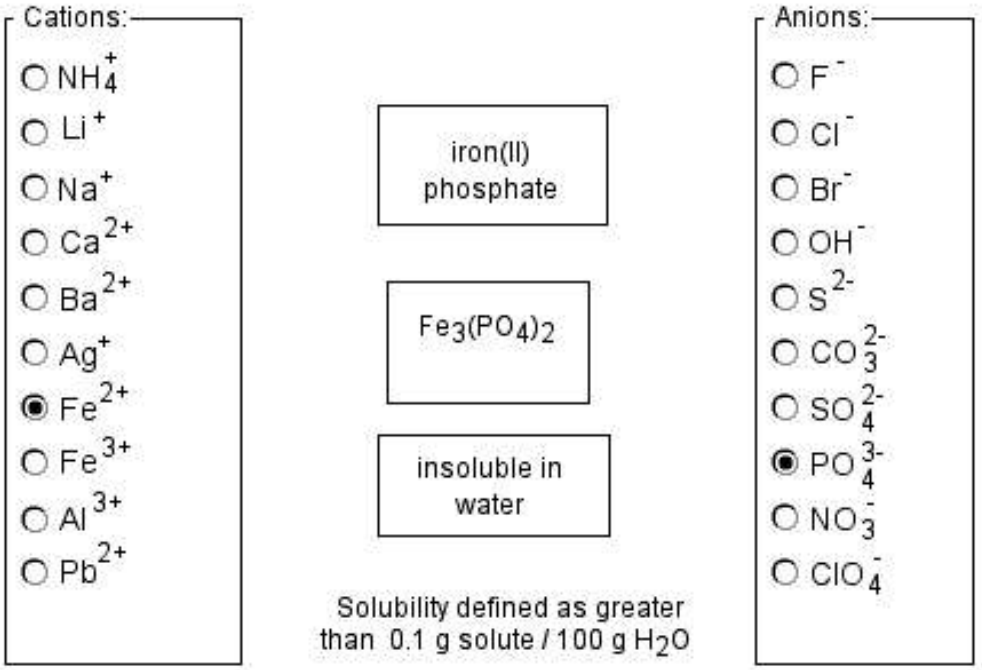
Charge	Formula	Name	Formula	Name
1−	H^-	Hydride ion	**$C_2H_3O_2^-$**	Acetate ion
	F^-	**Fluoride ion**	ClO_3^-	Chlorate ion
	Cl^-	**Chloride ion**	**ClO_4^-**	**Perchlorate ion**
	Br^-	**Bromide ion**	**NO_3^-**	**Nitrate ion**
	I^-	**Iodide ion**	MnO_4^-	Permanganate ion
	CN^-	Cyanide ion		
	OH^-	**Hydroxide ion**		
2−	**O^{2-}**	**Oxide ion**	**CO_3^{2-}**	**Carbonate ion**
	O_2^{2-}	Peroxide ion	CrO_4^{2-}	Chromate ion
	S^{2-}	**Sulfide ion**	$Cr_2O_7^{2-}$	Dichromate ion
			SO_4^{2-}	**Sulfate ion**
3−	N^{3-}	Nitride ion	**PO_4^{3-}**	**Phosphate ion**

*The most common ions are in boldface.

Inorganic Nomenclature

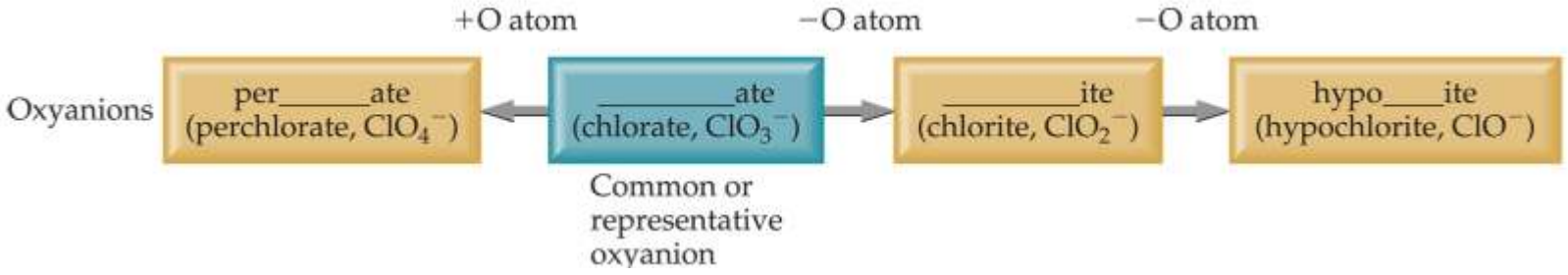
- Write the name of the cation.
- If the anion is an element, change its ending to -*ide*; if the anion is a polyatomic ion, simply write the name of the polyatomic ion.
- If the cation can have more than one possible charge, write the charge as a (Roman numeral).

Inorganic Nomenclature



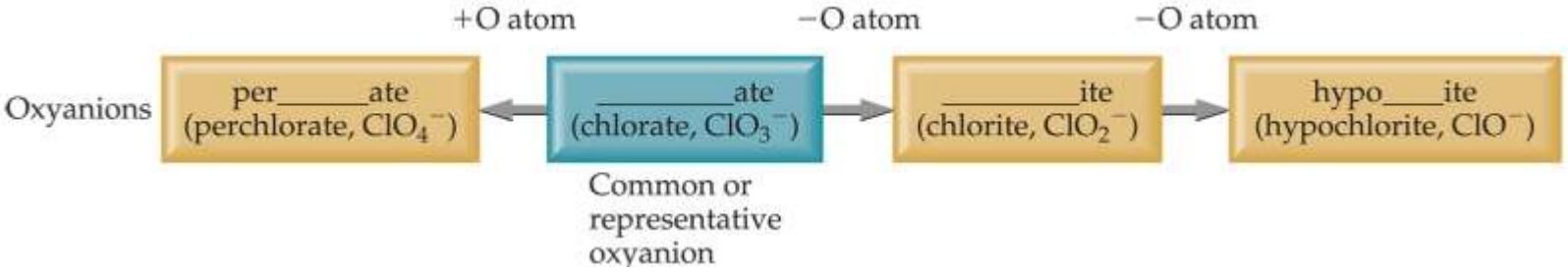
Patterns in Oxyanion Nomenclature

- The one with the second fewest oxygens ends in -*ite*
  - ClO_2^- : chlorite
- The one with the second most oxygens ends in -*ate*
  - ClO_3^- : chlorate

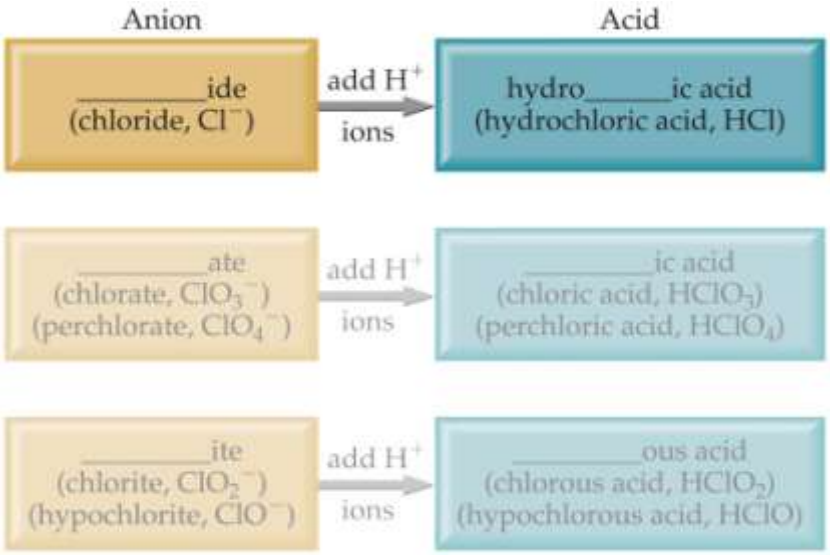


Patterns in Oxyanion Nomenclature

- The one with the fewest oxygens has the prefix *hypo*- and ends in -*ite*
  - ➢ClO^- : hypochlorite
- The one with the most oxygens has the prefix *per*- and ends in -*ate*
  - ➢ClO_4^- : perchlorate

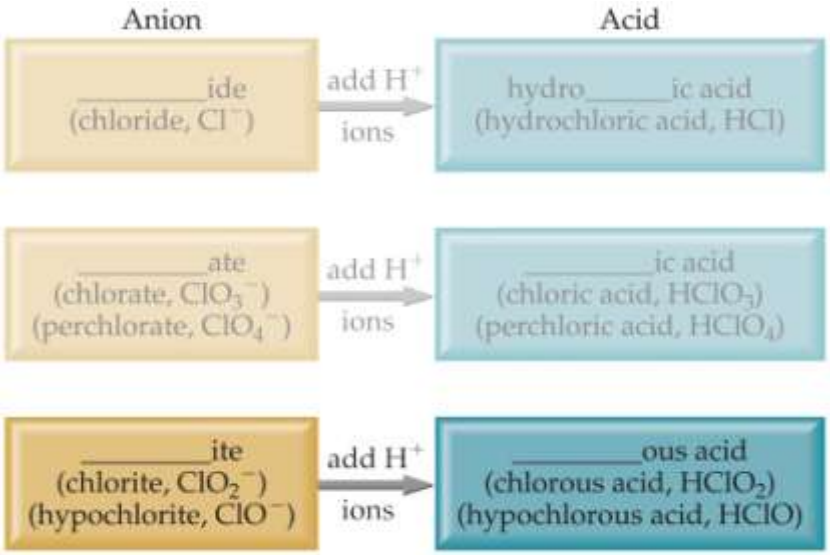


Acid Nomenclature



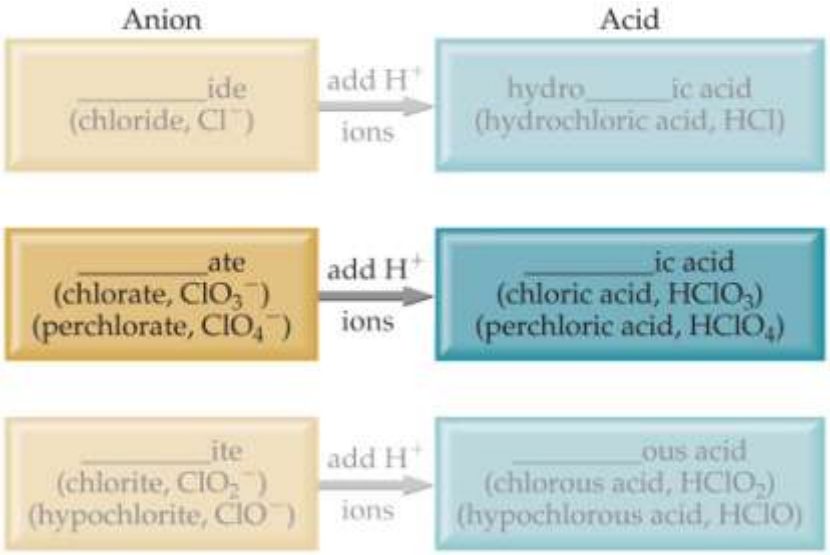
- If the anion in the acid ends in -*ide*, change the ending to -*ic acid* and add the prefix *hydro*- :
  - HCl: hydrochloric acid
  - HBr: hydrobromic acid
  - HI: hydroiodic acid

Acid Nomenclature



- If the anion in the acid ends in -*ite*, change the ending to -*ous acid*:
  - HClO: hypochlorous acid
  - $HClO_2$: chlorous acid

Acid Nomenclature



- If the anion in the acid ends in -*ate*, change the ending to -*ic acid:*
  - $HClO_3$: chloric acid
  - $HClO_4$: perchloric acid

Nomenclature of Binary Compounds

Prefix	*Meaning*
Mono-	*1*
Di-	*2*
Tri-	*3*
Tetra-	*4*
Penta-	*5*
Hexa-	*6*
Hepta-	*7*
Octa-	*8*
Nona-	*9*
Deca-	*10*

- The less electronegative atom is usually listed first.
- A prefix is used to denote the number of atoms of each element in the compound (*mono*- is not used on the first element listed, however.)

Nomenclature of Binary Compounds

Prefix	*Meaning*
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Nona-	*9*
Deca-	*10*

- The ending on the more electronegative element is changed to -*ide*.
  - CO_2: carbon dioxide
  - CCl_4: carbon tetrachloride

Nomenclature of Binary Compounds

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Mono-	*1*
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Nona-	*9*
Deca-	*10*

If the prefix ends with *a* or *o* and the name of the element begins with a vowel, the two successive vowels are often elided into one:

N_2O_5: dinitrogen pentoxide