

Nomenclature

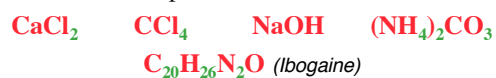
(Compounds: Formulas & Names)

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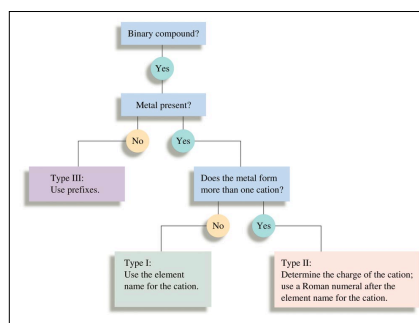
Chemical Formulas and Naming

- Molecular Formula:
 - **Elements' Symbols** = atoms
 - **Subscripts** = relative numbers of atoms
- How are compounds named?



Nomenclature

- Nomenclature: the naming of compounds
- Governed by the IUPAC: *International Union of Pure and Applied Chemistry*
- International rules are updated periodically
- General schemes and examples follow:



Naming Compounds

Binary Ionic Compounds:

For example; CaCl_2

- Name cation first, then anion
- Monatomic cation = name of the element
 - Ca^{2+} = calcium ion
- Anion = root + -ide
 - Cl^- = chlor~~id~~e



Common Monatomic Cations and Anions

TABLE 2.3 Common Monatomic 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	N^{3-}	Nitride
Ba^{2+}	Barium	P^{3-}	Phosphide
Al^{3+}	Aluminum		
Ag^+	Silver		

Common Cations and Anions

1A	2A						3A	4A	5A	6A	7A	8A
Li^+									N^{3-}	O^{2-}	F^-	
Na^+	Mg^{2+}						Al^{3+}			S^{2-}	Cl^-	
K^+	Ca^{2+}		Cr^{2+}	Mn^{2+}	Fe^{2+}	Co^{2+}	Cu^+	Zn^{2+}			Br^-	
			Cr^{3+}	Mn^{3+}	Fe^{3+}	Co^{3+}	Cu^{2+}					
Rb^+	Sr^{2+}						Ag^+	Cd^{2+}		Sn^{2+}		I^-
										Sn^{4+}		
Cs^+	Ba^{2+}						Hg_2^{2+}	Hg^{2+}		Pb^{2+}	Pb^{4+}	

Common Type I cations
 Common Type II cations
 Common monatomic anions

Naming Compounds

(continued)

Binary Ionic Compounds (Type II):

- metal forms more than one cation: Pb^{2+} or possibly Pb^{4+}
? Ambiguous?
- option 1) use Roman numeral in name
 - If Pb^{2+} is the cation; eg. PbCl_2 :
 - PbCl_2 = lead (II) chloride
- or 2) use name (latinized) + suffix: -ous (lower) or -ic (higher)

Plumbum

Plumbous

Common Type II Cations

TABLE 2.4 Common Type II Cations

Ion	Systematic Name
Fe ³⁺	Iron(III)
Fe ²⁺	Iron(II)
Cu ²⁺	Copper(II)
Cu ⁺	Copper(I)
Co ³⁺	Cobalt(III)
Co ²⁺	Cobalt(II)
Sn ⁴⁺	Tin(IV)
Sn ²⁺	Tin(II)
Pb ⁴⁺	Lead(IV)
Pb ²⁺	Lead(II)
Hg ²⁺	Mercury(II)
Hg ₂ ²⁺	Mercury(I)
Ag ⁺	Silver ⁺
Zn ²⁺	Zinc ²⁺
Cd ²⁺	Cadmium ²⁺

*Note that mercury(I) ions always occur bound together to form Hg₂²⁺ ions.
 †Although these are transition metals, they form only one type of ion, and a Roman numeral is not used.

Naming Compounds (continued)

Binary compounds (Type III):

- Compounds formed between **two nonmetals**
- First element** in the formula is named **first**. It is the more electropositive.
- Second element** is named as if it were an **anion**.
- Use prefixes to count the # of atoms.
- Do not normally use **mono** as a prefix.
 - P₂O₅ = **diphosphorus pentoxide**

Prefixes & The Number of Atoms

TABLE 2.6 Prefixes Used to Indicate Number in Chemical Names

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

Compounds with more than two different elements

- Polyatomic ions: [oxygen as the third atom]

<http://chemconnections.lnl.gov/general/Chem120/polyatomics.html>

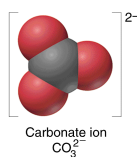


TABLE 2.5 Common Polyatomic Ions

Ion	Name	Ion	Name
Hg ₂ ²⁺	Mercury(I)	NCS ⁻	Thiocyanate
NH ₄ ⁺	Ammonium	CO ₃ ²⁻	Carbonate
NO ₂ ⁻	Nitrite	HCO ₃ ⁻	Hydrogen carbonate (bicarbonate is a widely used common name)
NO ₃ ⁻	Nitrate	ClO ⁻	Hypochlorite
SO ₃ ²⁻	Sulfite	ClO ₂ ⁻	Chlorite
SO ₄ ²⁻	Sulfate	ClO ₃ ⁻	Chlorate
HSO ₄ ⁻	Hydrogen sulfate (bisulfate is a widely used common name)	ClO ₄ ⁻	Perchlorate
OH ⁻	Hydroxide	C ₂ H ₃ O ₂ ⁻	Acetate
CN ⁻	Cyanide	MnO ₄ ⁻	Permanganate
PO ₄ ³⁻	Phosphate	Cr ₂ O ₇ ²⁻	Dichromate
HPO ₄ ²⁻	Hydrogen phosphate	CrO ₄ ²⁻	Chromate
H ₂ PO ₄ ⁻	Dihydrogen phosphate	O ₂ ²⁻	Peroxide
		C ₂ O ₄ ²⁻	Oxalate

QUESTION

The correct name for LiCl is:

- 1) lithium monochloride.
- 2) lithium (I) chloride.
- 3) monolithium chloride.
- 4) lithium chloride.
- 5) monolithium monochloride.

QUESTION

The correct name for FeO is:

- 1) iron oxide.
- 2) iron (II) oxide.
- 3) iron (III) oxide.
- 4) iron monoxide.
- 5) iron (I) oxide.

QUESTION

Of the following, which provides the most acceptable name for $\text{Fe}_2(\text{C}_2\text{O}_4)_3$?

1. Iron (II) oxalate
2. Iron (II) oxalate (III)
3. Iron (III) trioxalate
4. Iron (III) oxalate

QUESTION

Which of the following provides the correct name for $\text{Ca}(\text{H}_2\text{PO}_4)_2$?

1. Calcium dihydrogen phosphate
2. Calcium (II) hydrogen phosphate
3. Calcium di-dihydrogen phosphate
4. Calcium (II) dihydrogen phosphate

Naming Acids

[Compounds with electropositive Hydrogen atom(s)]

TABLE 2.8 Names of Some Oxygen-Containing Acids

Acid	Name
HNO ₃	Nitric acid
HNO ₂	Nitrous acid
H ₂ SO ₄	Sulfuric acid
H ₂ SO ₃	Sulfurous acid
H ₃ PO ₄	Phosphoric acid
HC ₂ H ₃ O ₂	Acetic Acid

hydro-
+ anion root
+ -ic
hydro(anion ro

element root
acid

QUESTION

Hypochlorous acid is related to the anion found in common household bleach. Which of the following is that common anion?

1. ClO₄⁻
2. ClO₃⁻
3. ClO₂⁻
4. ClO⁻

Names from Formulas

Name the following

- | | | |
|----------------------|---|-----------------------------------|
| • SO ₂ | CaBr ₂ | Zn(NO ₃) ₂ |
| • PCl ₅ | (NH ₄) ₂ SO ₄ | FeO |
| • HI _(aq) | HBrO | NaClO ₄ |

Formulas from Names

Provide formulas for the following

- Sulfur trioxide
- Magnesium chloride
- Lead (IV) sulfate
- Diphosphorus pentasulfide
- Ammonium phosphate
- Iron (III) oxide
- Hydrobromic acid
- Chloric acid
- Sodium chlorite