

Nomenclature

(Compounds: Formulas & Names)

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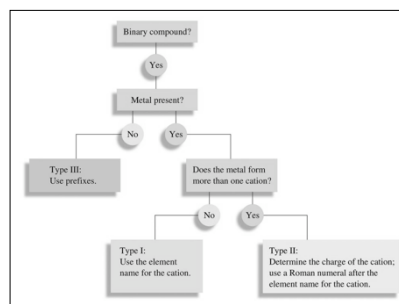
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Chemical Formulas and Naming

- Molecular Formula:
- **Elements' Symbols** = atoms
- **Subscripts** = relative numbers of atoms
- How are compounds named?
 CaCl_2 CCl_4 NaOH $(\text{NH}_4)_2\text{CO}_3$
 $\text{C}_{20}\text{H}_{26}\text{N}_2\text{O}$ (*Ibogaine*)

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**ide**
- CaCl_2 = calcium chloride

Common Monatomic Cations and Anions

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 ⁻	
Rb ⁺	Sr ²⁺			Cr ³⁺	Mn ³⁺	Fe ³⁺	Co ³⁺	Ag ⁺	Cd ²⁺	Sn ²⁺		I ⁻	
Cs ⁺	Ba ²⁺							Hg ₂ ²⁺	Hg ²⁺	Pb ²⁺			

Common Type I cations
 Common Type II cations
 Common monatomic anions

QUESTION

The correct name for LiCl is:

- A) lithium monochloride.
- B) lithium (I) chloride.
- C) monolithium chloride.
- D) lithium chloride.
- E) monolithium monochloride.

Naming Compounds (continued)

Binary Ionic Compounds (Type II):

- metal forms more than one cation: Pb²⁺ or possibly Pb⁴⁺ ? *Ambiguous?*
- option 1) use Roman numeral in name
 - If Pb²⁺ is the cation; eg. PbCl₂ :
 - PbCl₂ = lead (II) chloride
- or 2) use name (latinized) + suffix: -ous (lower) or -ic (higher)

Plumbum Plumbous

Common Type II Cations

Ion	Systematic Name
Fe ²⁺	Iron(II)
Fe ³⁺	Iron(III)
Cu ⁺	Copper(I)
Cu ²⁺	Copper(II)
Co ⁺	Cobalt(I)
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?
Cd ²⁺	Cadmium?

*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

QUESTION

The correct name for FeO is:

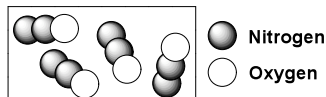
- A) iron oxide.
- B) iron (II) oxide.
- C) iron (III) oxide.
- D) iron monoxide.
- E) iron (I) oxide.

Prefixes & The Number of Atoms

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

QUESTION

Predict the correct name of the compound represented in the box.

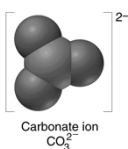


- A) Nitrogen oxide B) Oxygen nitride
 C) Dinitrogen monoxide D) Nitrogen dioxide

Compounds with more than two different elements

- Polyatomic ions: [oxygen as the third atom]

<http://chemconnections.org/general/chem120/polyatomics.html>



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		
SO_3^{2-}	Sulfite	ClO^-	Hypochlorite
SO_4^{2-}	Sulfate	ClO_2^-	Chlorite
HSO_4^-	Hydrogen sulfate (bisulfate is a widely used common name)	ClO_3^-	Chlorate
OH^-	Hydroxide	ClO_4^-	Perchlorate
CN^-	Cyanide	$\text{C}_2\text{H}_3\text{O}_2^-$	Acetate
PO_4^{3-}	Phosphate	MnO_4^-	Permanganate
HPO_4^{2-}	Hydrogen phosphate	$\text{Cr}_2\text{O}_7^{2-}$	Dichromate
H_2PO_4^-	Dihydrogen phosphate	CrO_4^{2-}	Chromate
		O_2^{2-}	Peroxide
		$\text{C}_2\text{O}_4^{2-}$	Oxalate

QUESTION

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

- A. Calcium dihydrogen phosphate
 B. Calcium (II) hydrogen phosphate
 C. Calcium di-dihydrogen phosphate
 D. Calcium (II) dihydrogen phosphate

QUESTION

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

- A. Iron (II) oxalate
 B. Iron (II) oxalate (III)
 C. Iron (III) trioxalate
 D. Iron (III) oxalate

Naming Acids

[Compounds with electropositive Hydrogen atom(s)]

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
$\text{HC}_2\text{H}_3\text{O}_2$	Acetic Acid

Hydro- + anion root + -ic
 hydro(anion root) + -ic

element root
 acid

QUESTION

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

- A. ClO_4^-
- B. ClO_3^-
- C. ClO_2^-
- D. ClO^-

Names from Formulas

Name the following

- | | | |
|-----------------------------|------------------------------|----------------------------|
| • SO_2 | CaBr_2 | $\text{Zn}(\text{NO}_3)_2$ |
| • PCl_5 | $(\text{NH}_4)_2\text{SO}_4$ | FeO |
| • $\text{HI}_{(\text{aq})}$ | 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