

NOMENCLATURE IONIC-COVALENT COMPOUNDS

Created by: Julio Cesar Torres Orozco

Background: Before there was an established naming (nomenclature) system for chemical compounds, chemists assigned compounds a specific name for reference. Table salt (NaCl), water (H₂O) and ammonia (NH₃) are some of the most common examples of this.

There are two types of chemical compounds that are important in general chemistry: *Ionic and Covalent compounds*. This handout will aim to explain the nomenclature system there exists for these types of compounds.

Ionic compounds: METAL + NON-METAL

RULES:

- Name of ionic compounds is composed of the name of the *positive ion* (from the metal) and the name of the negative ion.

Examples:

NaBr	Sodium bromide
MgCl ₂	Magnesium chloride
(NH ₄) ₂ SO ₄	Ammonium sulfate

- It is important that we learn how to name *monoatomic positive ions*. These are some examples:

Na ⁺	sodium	Zn ²⁺	zinc
Ca ²⁺	calcium	H ⁺	hydrogen
K ⁺	potassium	Sr ²⁺	strontium

- When there are positive ions that have more than one oxidation state (number), as in the case of *transition metals*, we would have to indicate the charge of the ion in Roman numeral in parentheses (**I,II,III,IV,V,VI,VI**) after the name of the specific element.

Examples:

Fe ²⁺	iron(II)	Fe ³⁺	iron (III)
Sn ²⁺	tin(II)	Sn ⁴⁺	tin(IV)
Cu ⁺	copper(I)	Cu ²⁺	copper(II)

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- Positive polyatomic ions have common names ending in suffix **-onium**

Examples:



Now that we have covered positive monoatomic and polyatomic ions, let us look at the naming of negative ions.

RULES:

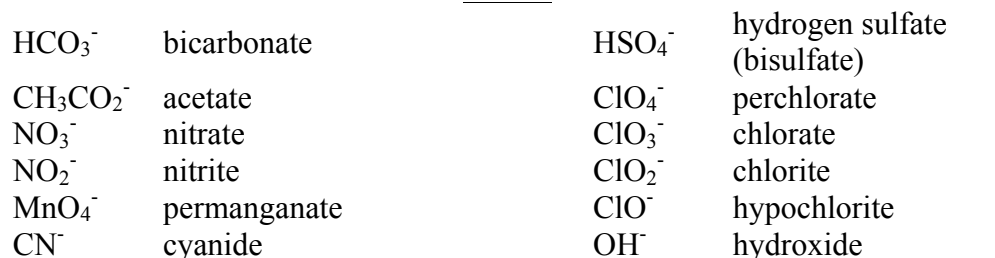
- Monoatomic negative ions are named simply by adding suffix **-ide** to the stem of the element name

Examples:

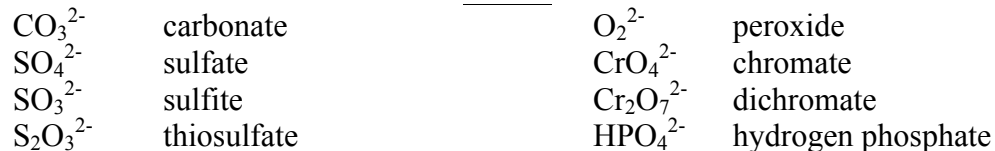


- This is the list of the most common polyatomic negative ions:

-1 ions



-2 ions



-3 ions



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- The name of polyatomic ions ends in either **-ite** or **-ate**. If **-ite** is seen, it means a low oxidation state (also a lower number of oxygen atoms present – example Nitrite as NO_2^- , in this case Nitrogen has an oxidation number of +3)
- If **-ate** is seen, it means a higher oxidation state (higher amount of oxygen atoms present – example Nitrate as NO_3^- In this case Nitrogen has an oxidation number of +5)
- Prefix **hypo-** indicates lowest oxidation state. BrO^- ion is called *hypobromite* ion.
- Prefix **per-** indicates highest oxidation state. IO_4^- ion is called *periodate* ion
- Some ions such as hydroxide (OH^-), cyanide (CN^-) and peroxide (O_2^{2-}) ions are exception to the aforementioned rule.

Covalent compounds: **NON-METAL + NON-METAL**

RULES:

- When naming covalent compounds, oxidation states play a key role. The name of the atom that has the positive oxidation state is named first. Then, the suffix **-ide** is added to the stem of the name of the atom with the negative oxidation state-number.

Examples:

HI	hydrogen iodide
NO	nitrogen oxide
BrF _l	bromine flouride

- In simple covalent compounds, the amount of atoms of an element is indicated by Greek prefixes added to the name of the element:

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

- The prefix **mono-** is usually not necessary because of its redundancy. An exception to this would be carbon monoxide (CO)
- Do not use **mono-** for the first element in the name.

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- The **o** or **a** at the end of the Greek pre-fix is usually dropped when the element name begins with a vowel. Example: N_2O_5 . Dinitrogen Pentaoxide is not correct. The correct name is Dinitrogen pentoxide after dropping the **a** from **penta-**
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1. PRACTICE PROBLEM: Write the formula for the following ionic compounds:

sodium bicarbonate _____

sodium fluoride _____

iron (III) chloride _____

sodium carbonate _____

copper (II) sulfate _____

magnesium hydroxide _____

barium nitrate _____

lithium sulfate _____

magnesium chloride _____

silver nitrate _____

aluminum sulfate _____

calcium hydroxide _____

calcium sulfate _____

mercury (II) nitrate _____

lead (IV) nitrate _____

magnesium iodide _____

sodium nitride _____

lithium sulfate Li_2SO_4

ANSWER KEY:

sodium bicarbonate $NaHCO_3$

sodium fluoride NaF

iron (III) chloride $FeCl_3$

sodium carbonate Na_2CO_3

copper (II) sulfate $CuSO_4$

magnesium hydroxide $Mg(OH)_2$

barium nitrate $Ba(NO_3)_2$

magnesium chloride $MgCl_2$

silver nitrate $AgNO_3$

aluminum sulfate $Al_2(SO_4)_3$

calcium hydroxide $Ca(OH)_2$

calcium sulfate $CaSO_4$

mercury (II) nitrate $Hg(NO_3)_2$

lead (IV) nitrate $Pb(NO_3)_4$

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magnesium iodide MgI_2

sodium nitride Na_3N

2. PRACTICE PROBLEM: Write the names of the following ionic compounds

$NaCl$ _____

$AgCl$ _____

$Fe_2(CO_3)_3$ _____

$Al(OH)_3$ _____

$Cu(OH)_2$ _____

$CaSO_4$ _____

$(NH_4)_2SO_4$ _____

FeS _____

$LiNO_3$ _____

$FeCl_3$ _____

$BaSO_4$ _____

NaI _____

$Mg(NO_3)_2$ _____

$MgCO_3$ _____

ANSWER KEY:

$NaCl$ sodium chloride

$Fe_2(CO_3)_3$ iron(III) carbonate

$Cu(OH)_2$ copper(II) hydroxide

$(NH_4)_2SO_4$ ammonium sulfate

$LiNO_3$ lithium nitrate

$BaSO_4$ barium sulfate

$Mg(NO_3)_2$ magnesium nitrate

$AgCl$ silver chloride • (note: silver is one of the transition metals that only occurs as a (1+) ion) $Al(OH)_3$ aluminum hydroxide

$CaSO_4$ calcium sulfate

FeS Iron(II) sulfide

$FeCl_3$ iron(III) chloride

NaI sodium iodide

$MgCO_3$ magnesium carbonate

3. PRACTICE PROBLEM: Write the formula for the following covalent compounds:

a. disulfur tetrafluoride _____

e. dinitrogen heptachloride _____

b. carbon trioxide _____

f. carbon tetrachloride _____

c. nitrogen pentoxide _____

g. hydrogen monochloride _____

d. nitrogen tribromide _____

h. trihydrogen monophosphide _____

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i. dihydrogen monoxide _____

ANSWER KEY:

a. disulfur tetrafluoride S_2F_4

b. carbon trioxide CO_3

c. nitrogen pentoxide NO_5

d. nitrogen tribromide NBr_3

e. dinitrogen heptachloride N_2Cl_7

f. carbon tetrachloride CCl_4

g. hydrogen monochloride HCl

h. trihydrogen monophosphide H_3P

i. dihydrogen monoxide H_2O

4. PRACTICE PROBLEM: Write the names of the following covalent compounds

a. Br_2I_4 _____

b. P_5F_8 _____

c. NO_5 _____

• Remember: The o or a at the end of the Greek pre-fix is usually dropped when the element name begins with a vowel

d. NBr_3 _____

e. N_2O_5 _____

f. $BrCl_3$ _____

g. H_2S _____

h. N_2O _____

ANSWER KEY:

a. Br_2I_4 dibromine tetriodide

b. P_5F_8 pentaphosphorus octafluoride

c. NO_5 nitrogen pentoxide The o or a at the end of the Greek pre-fix is usually dropped when the element name begins with a vowel § NOTE, we did not write pentaoygen because of this rule!

d. NBr_3 nitrogen tribromide

e. N_2O_5 dinitrogen pentoxide

f. $BrCl_3$ bromine trichloride

g. H_2S dihydrogen monosulfide

h. N_2O dinitrogen monoxide

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Reference:

The following resources were referenced during the creation of this handout: [Purdue's Nomenclature](#) and ["Naming Compounds Tutoring and Worksheet"](#)