

Nomenclature

The words of Chemistry

- Several different kinds of ionic compounds in terms of nomenclature
- All are named with the cation(s) first and the anion(s) last.

Ionic Nomenclature

- Two kinds of metal ions
 - Type I ions can have only one possible charge (equal to the group number). These include Groups IA, IIA, IIIB, Al, Ga, In, Zn, Cd, and Ag.
 - Type II ions have more than one possible charge. These include most of the rest of the metals.

Cations – Metal Ions

- Naming type I metal ions is easy because the name of the ion is the same as the metal.
 - Al^{3+} Aluminum ion
 - K^+ Potassium ion

Type I Metals

- | | |
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| <ul style="list-style-type: none"> • Older method <ul style="list-style-type: none"> ◦ Name based on latin form of name ◦ Lower charge has ending "-ous" ◦ Higher charge has ending "-ic" ◦ Need to memorize charges and latin names | <ul style="list-style-type: none"> • IUPAC method <ul style="list-style-type: none"> ◦ Use current name of metal followed by charge in Roman numerals in parenthesis ◦ No memorization required. |
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Type II Metals – 2 ways to name

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| <ul style="list-style-type: none"> • Older method <ul style="list-style-type: none"> ◦ Fe^{2+} Ferrous ion ◦ Fe^{3+} Ferric ion ◦ Au^+ Aurous ion ◦ Au^{3+} Auric ion ◦ Pb^{2+} Plumbous ion ◦ Pb^{4+} Plumbic ion | <ul style="list-style-type: none"> • IUPAC Method <ul style="list-style-type: none"> ◦ Iron(II) ◦ Iron(III) ◦ Gold(I) ◦ Gold(III) ◦ Lead(II) ◦ Lead(IV) |
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Type II Metals – Examples

- Anions are named based on the name of the non-metal.
- We use the root of the name with an "-ide" ending
 - N³⁻ Nitride
 - O²⁻ Oxide
 - Br⁻ Bromide

Anions – Non-metal ions

- Naming ionic compounds is just naming the ions with the cations first.
 - BaCl₂ Barium Chloride
 - K₂O Potassium Oxide
 - Fe₂S₃ Iron(III) Sulfide or Ferric Sulfide
 - MnO₂ Manganese(IV) Oxide

Putting it all together

- The name of the compound gives us all the information we need to write the formula.
- We need to remember that the ions in the formula are in the lowest whole number ratios.
- We need to remember the charges on the type I metal ions and the non-metal ions.

Writing Formulas from Names

- Write the ions that appear in the name (with charges for now).
- "Cross over" the charges.
- Reduce to lowest whole number ratio.
- Get rid of the charges.

Writing Formulas from Names

- Write the ions present with their charges
 - Cu²⁺ N³⁻
- "Cross Over" the charges
 - Cu²⁺ N³⁻
- Reduce to lowest whole number ratio
 - Cu²⁺₃N³⁻₂
- Remove the charges
 - Cu₃N₂

Example – Copper(II) Nitride

- Ionic compounds can also contain **polyatomic ions**
- Polyatomic ions are collections of atoms (usually, but not always, non-metals) that are covalently bonded with an overall charge.
- List of ions must be memorized

Ionic Compounds – Part 2

- Patterns in the polyatomic ions:

- Number of oxygens
- Base form ends in -ate
- One less O ends in -ite
- One more less ends in -ite but begins with hypo -
- One O more than -ate begins with per -.

Ionic Compounds – Part 2

- Patterns in the polyatomic ions:

- Sulfur replaces O:
 - Polyatomic ion gets a thio- prefix.
- Periodic Law:
 - Elements in a column tend to form the same kind of polyatomic ions
 - PO_4^{3-} → Phosphate ion AsO_4^{3-} → Arsenate ion
 - ClO_3^- → Chlorate ion BrO_3^- → Bromate ion

Ionic Compounds – Part 2

- Named like any other ionic compound

- (cation name) (anion name)

- Examples:

Li_2SO_4	Lithium Sulfate
$\text{Fe}(\text{C}_2\text{H}_3\text{O}_2)_2$	Iron(II) Acetate
NH_4I	Ammonium Iodide
$\text{Sc}_2(\text{CO}_3)_3$	Scandium Carbonate

Ionic Compounds – Part 2

- Must memorize number prefixes:

- | | |
|------------|--------------------|
| ● 1 Mono- | ● 6 Hexa- |
| ● 2 Di- | ● 7 Hepta- |
| ● 3 Tri- | ● 8 Octa- |
| ● 4 Tetra- | ● 9 Nona- (Ennea-) |
| ● 5 Penta- | ● 10 Deca- |

Covalent Compounds

- Name the elements in the order they are listed in the compound

- The first element is given the name of the element with the appropriate prefix
- The name of the second element is the root of the element name with the -ide suffix.

Naming Covalent Compounds

- Rules for using prefixes:

- Mono- is only used to distinguish two compounds of the same elements.
 - HCl Hydrogen Chloride
- Never use the "mono-" prefix with the first element.
 - NO_2 Nitrogen Dioxide
- If the prefix ends with the same sound that the element name begins, drop the ending of the prefix.
 - CO Carbon Monoxide

Naming Covalent Compounds

- The elements in the compound should be in the following order:
 - B Si C Sb As P N H Se S I Br Cl O F
- The prefixes give the subscripts of each element
 - **Remember:** no prefix is understood to be 1.

Writing formulas of Covalent Compounds

- H₂O Water
- NH₃ Ammonia
- PH₃ Phosphine
- AsH₃ Arsine
- N₂H₄ Hydrazine
- Any organic compound (compounds) containing mainly C and H.
 - CH₃
 - C₄H₁₀
 - C₆H₆

Exceptions to the IUPAC Rules

- Binary Acids (H_nX)
 - Hydro- prefix
 - Root of "X" name
 - -ic ending
 - The word "acid"
 - HCl Hydrochloric acid
 - H₂S Hydrosulfuric acid
- Oxygen containing acids
 - If the anion ends in -ate, change it to -ic
 - If the anion ends in -ite, change it to -ous.
 - Add the word "acid"
 - HNO₂ Nitrous acid
 - H₂SO₄ Sulfuric acid

Naming Acids – 2 kinds

- Writing formulas:
 - Write the ionic formula
 - Add a "."
 - Add the formula for water with the correct number in front
 - Copper(II) Sulfate Pentahydrate
 - CuSO₄ · 5H₂O

Hydrates – Ionic compounds with water

- Writing names:
 - Name the ionic formula
 - Add the word "hydrate" with the correct prefix
 - Ni(C₂H₃O₂)₂ · 7H₂O
 - Nickel(II) Acetate Heptahydrate

Hydrates – Ionic compounds with water