

# The Language of Chemistry

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# Objectives

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- ❑ Classify a compound as a binary ionic or a ternary ionic compound.
  - ❑ Classify an acid as a binary acid or a ternary oxyacid.
  - ❑ Classify an ion as a monoatomic cation, a monoatomic anion, a polyatomic cation or a polyatomic anion.
  - ❑ Write Stock system names and formulas for common monoatomic ions.
  - ❑ Write Latin system names and formulas for common monoatomic ions
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# Objectives

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- ❑ Predict the ionic charge for ions of representative elements.
  - ❑ Write systematic names and formulas for common polyatomic ions.
  - ❑ Determine the ionic charge on a cation in a binary ionic compound.
  - ❑ Write Stock system names and formulas for binary ionic compounds.
  - ❑ Write Latin system names and formulas for binary ionic compounds.
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# Objectives

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- ❑ Determine the ionic charge on a cation in a ternary ionic compound.
  - ❑ Write Stock system names and formulas for ternary ionic compounds.
  - ❑ Write Latin system names and formulas for ternary ionic compounds.
  - ❑ Write the systematic names and formulas for binary molecular compounds.
  - ❑ Write the systematic names and formulas for binary acids.
  - ❑ Write the systematic names and formulas for ternary oxyacids.
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# Cations

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- Cations: Ions with a positive charge.
    - Monoatomic Cations: Cations that contain only one element.
    - Elements with a single charge – Name of the element followed by the word ion.
      - $\text{Al}^{3+}$  Aluminum Ion
      - $\text{Ba}^{2+}$  Barium Ion
      - $\text{Cd}^{2+}$  Cadmium Ion
      - $\text{Li}^{+}$  Lithium Ion
      - $\text{Mg}^{2+}$  Magnesium Ion
      - $\text{K}^{+}$  Potassium Ion
      - $\text{Ag}^{+}$  Silver Ion
      - $\text{Na}^{+}$  Sodium Ion
      - $\text{Zn}^{2+}$  Zinc Ion
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# Cations

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- Ions with more than one possible ionic charge (Stock System) – Name of the element followed by a Roman numeral in parentheses to indicate the charge, then the word ion.

<input type="checkbox"/> $\text{Co}^{2+}$	Cobalt(II) Ion
<input type="checkbox"/> $\text{Co}^{3+}$	Cobalt(III) Ion
<input type="checkbox"/> $\text{Cu}^{+}$	Copper(I) Ion
<input type="checkbox"/> $\text{Cu}^{2+}$	Copper(II) Ion
<input type="checkbox"/> $\text{Cr}^{2+}$	Chromium(II) Ion
<input type="checkbox"/> $\text{Cr}^{3+}$	Chromium(III) Ion
<input type="checkbox"/> $\text{Fe}^{2+}$	Iron(II) Ion
<input type="checkbox"/> $\text{Fe}^{3+}$	Iron(III) Ion

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# Cations

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- The Stock System.

- $\text{Pb}^{2+}$  Lead(II) Ion
  - $\text{Pb}^{4+}$  Lead(IV) Ion
  - $\text{Mn}^{2+}$  Manganese(II) Ion
  - $\text{Hg}_2^{2+}$  Mercury(I) Ion
  - $\text{Hg}^{2+}$  Mercury(II) Ion
  - $\text{Ni}^{2+}$  Nickel(II) Ion
  - $\text{Sn}^{2+}$  Tin(II) Ion
  - $\text{Sn}^{4+}$  Tin(IV) Ion
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# Cations

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- Ions with more than one possible ionic charge (Latin System):
    - For the ion with the smaller ionic charge – Add the ous suffix to the Latin name of the element, then the word ion.
      - $\text{Co}^{2+}$  Cobaltous Ion
      - $\text{Cu}^{+}$  Cuprous Ion
      - $\text{Fe}^{2+}$  Ferrous Ion
      - $\text{Pb}^{2+}$  Plumbous Ion
      - $\text{Hg}_2^{2+}$  Mercurous Ion
      - $\text{Sn}^{2+}$  Stannous Ion
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# Cations

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## □ Latin System:

- For the ion with the larger ionic charge – Add the ic suffix to the Latin name of the element, then the word ion.

□ $\text{Co}^{3+}$	Cobaltic Ion
□ $\text{Cu}^{2+}$	Cupric Ion
□ $\text{Fe}^{3+}$	Ferric Ion
□ $\text{Pb}^{4+}$	Plumbic Ion
□ $\text{Hg}^{2+}$	Mercuric Ion
□ $\text{Sn}^{4+}$	Stannic Ion

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# Cations

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- Polyatomic Cations – Cations that contain more than one element.
    - $\text{NH}_4^+$  Ammonium Ion
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# Anions

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- Anions – Ions with a negative charge.
    - Monoatomic Anions – Anions that contain only one element.
    - Monoatomic Anions – Name of the element with the suffix ide followed by the word ion.
      - $\text{Br}^-$  Bromide Ion
      - $\text{Cl}^-$  Chloride Ion
      - $\text{F}^-$  Fluoride Ion
      - $\text{I}^-$  Iodide Ion
      - $\text{N}^{3-}$  Nitride Ion
      - $\text{O}^{2-}$  Oxide Ion
      - $\text{P}^{3-}$  Phosphide Ion
      - $\text{S}^{2-}$  Sulfide Ion
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# Anions

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- Polyatomic Anions – Anions that contain more than one element.

<input type="checkbox"/> $\text{C}_2\text{H}_3\text{O}_2^-$	Acetate Ion
<input type="checkbox"/> $\text{CO}_3^{2-}$	Carbonate Ion
<input type="checkbox"/> $\text{ClO}_3^-$	Chlorate Ion
<input type="checkbox"/> $\text{ClO}_2^-$	Chlorite Ion
<input type="checkbox"/> $\text{CrO}_4^{2-}$	Chromate Ion
<input type="checkbox"/> $\text{CN}^-$	Cyanide Ion
<input type="checkbox"/> $\text{Cr}_2\text{O}_7^{2-}$	Dichromate Ion
<input type="checkbox"/> $\text{HCO}_3^-$	Hydrogen Carbonate Ion
<input type="checkbox"/> $\text{HSO}_4^{2-}$	Hydrogen Sulfate Ion
<input type="checkbox"/> $\text{OH}^-$	Hydroxide Ion

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# Anions

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## ■ Polyatomic Anions

- $\text{ClO}^-$  Hypochlorite Ion
  - $\text{NO}_3^-$  Nitrate Ion
  - $\text{NO}_2^-$  Nitrite Ion
  - $\text{ClO}_4^-$  Perchlorate Ion
  - $\text{MnO}_4^-$  Permanganate Ion
  - $\text{PO}_4^{3-}$  Phosphate Ion
  - $\text{SO}_4^{2-}$  Sulfate Ion
  - $\text{SO}_3^{2-}$  Sulfite Ion
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# Binary Ionic Compounds

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- ❑ Binary Ionic compounds are composed of one metal and one nonmetal ion.
  - ❑ The cation is always written first and the anion last.
  - ❑ In naming the compound, the name of the cation is always written first, followed by the name of the anion with the suffix ide.
  - ❑ The ionic charge for the compound must equal zero.
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# Binary Ionic Compounds

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## □ Examples of Binary Ionic Compounds:

- KCl Potassium Chloride
  - NaBr Sodium Bromide
  - CaI<sub>2</sub> Calcium Iodide
  - CaO Calcium Oxide
  - Al<sub>2</sub>O<sub>3</sub> Aluminum Oxide
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# Ternary Ionic Compounds

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- ❑ Ternary Ionic Compounds contain a metal and at least two other elements.
  - ❑ The cation is written first and the polyatomic ion is written last.
  - ❑ In naming the compound, the name of the cation is written first, followed by the name of the polyatomic anion. The names usually end with the ate or the ite suffix.
  - ❑ The ionic charge for the compound must equal zero.
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# Ternary Ionic Compounds

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## □ Examples of ternary ionic compounds:

- $\text{AgNO}_3$  Silver Nitrate
  - $\text{KMnO}_4$  Potassium Permanganate
  - $\text{CaCO}_3$  Calcium Carbonate
  - $\text{Na}_2\text{SO}_4$  Sodium Sulfate
  - $\text{Mg}_3(\text{PO}_4)_2$  Magnesium Phosphate
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# Binary Molecular Compounds

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- ❑ Binary molecular compounds are composed of two nonmetal elements.
  - ❑ The most metallic element is written first. The standard order from most metallic to least metallic is C, P, N, H, S, I, Br, Cl, O, F.
  - ❑ In naming the compound, the name of the most metallic element is written first and the name of the least metallic element is written last followed by the ide suffix.
  - ❑ Greek prefixes are used to indicate the number of atoms of each element when there is more than one atom of that element.
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# Binary Molecular Compounds

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□ Examples of binary molecular compounds:

- CO                      Carbon Monoxide
  - NO                      Nitrogen Monoxide
  - IF<sub>6</sub>                      Iodine Hexafluoride
  - Br<sub>3</sub>O<sub>8</sub>                      Tribromine Octaoxide
  - Cl<sub>2</sub>O<sub>5</sub>                      Dichlorine Pentaoxide
  - P<sub>2</sub>I<sub>4</sub>                      Diphosphorus Tetraiodide
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# Ternary Oxyacids

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- A ternary oxyacid is an aqueous solution of a compound containing hydrogen and a polyatomic ion.
  - Ternary oxyacids are named by adding ic acid or ous acid to the nonmetal stem.
  - Examples:
    - $\text{HClO}_4(\text{aq})$  Perchloric Acid       $\text{ClO}_4^-$  Perchlorate Ion
    - $\text{HClO}_3(\text{aq})$  Chloric Acid       $\text{ClO}_3^-$  Chlorate Ion
    - $\text{HClO}_2(\text{aq})$  Chlorous Acid       $\text{ClO}_2^-$  Chlorite Ion
    - $\text{HClO}(\text{aq})$  Hypochlorous Acid       $\text{ClO}^-$  Hypochlorite Ion
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