Nomenclature 2.1

Naming Ionic Compounds
Writing Ionic Formulas
Naming Hydrates

Naming Binary Ionic Compounds
- The positive ion (cation) is written first.
  - Takes the same name as the element.
- The negative ion (anion) is written last.
  - Takes the first part of its element’s name, and -ide is added to the end.
  Ex) Bromine is changed to Bromide.

Naming Binary Ionic Compounds
- You need to know if an element forms cations with different charges.
- If it does, you need to specify the charge in Roman numerals.
- Ex) CuS is written as Copper(II) Sulfide
- Sulfide has to be $S^{2-}$
- Copper must be $Cu^{2+}$ to make the compound neutral

Naming Binary Ionic Compounds
- CuBr is written as Copper (I) Bromide.
- Bromide has to be $Br^{-}$
- Copper must be $Cu^{2+}$ to make the compound neutral.
- Ex) $Fe_{2}O_{3}$ is written as Iron (III) Oxide.
- Oxide has to be $O^{2-}$
- As there are three of them, they make up a charge of 6-
- The two iron must combine to form a charge of 6+
- Thus, each iron must carry a charge of 3+

Naming Binary Ionic Compounds

1) LiF
2) CaBr$_2$
3) K$_2$S
4) FeS
5) MgO
6) MnO
7) Co$_2$

Naming Compounds with Polyatomic Ions
- For polyatomic ions, always use the name assigned to it.
  - Do not add an additional suffix (such as -ide).
  - E.g., $CO_{3}^{2-}$ is the carbonate ion.
  - CaCO$_3$ is calcium carbonate

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Naming Compounds with Polyatomic Ions

- Ammonium, NH₄⁺, is the only polyatomic cation that you need to know.
  
e.g.) NH₄Cl is ammonium chloride

- NO₃⁻ is the nitrate ion
  
  NH₄NO₃ is ammonium nitrate

Hints for Learning the Names of Polyatomic Ions

- Only three polyatomic ions end in -ide.
  
  - CN⁻ Cyanide
  - OH⁻ Hydroxide
  - O₂²⁻ Peroxide

  Everything else ending in -ide is a monoatomic anion.

Hints for Learning the Names of Polyatomic Ions

- A system for oxoanions.
  
  - Hypo-____-ate (2 less oxygens than ___-ate)
  - _____-ite (1 less oxygen than ___-ate)
  - _____-ate
  - Per-____-ate (1 more oxygen then ___-ate)

  All polyatomic ions in such a series carry the same charge.

Hints for Learning the Names of Polyatomic Ions

- A system for oxoanions.

  - The example of Chlorate, ClO₅⁻
    
    - Hypochlorite ClO⁻ (2 less oxygens than ___-ate)
    - Chlorite ClO₂⁻ (1 less oxygen than ___-ate)
    - Chlorate ClO₃⁻
    - Perchlorate ClO₄⁻ (1 more oxygen then ___-ate)

Naming Compounds with Polyatomic Ions

1) CuCO₃
2) K₂SO₃
3) Cu(ClO)₂
4) KClO₄
5) NaClO₃
6) LiNO₂
7) LiNO₃
8) NaCH₃COO
Recognizing Ionic Compounds

- Ionic compounds contain either a metal and a non-metal, or polyatomic ions.

- If the first word in the compound is a metal or ammonium, it is an ionic compound.

Writing Ionic Formulas

- Ionic compounds are neutral.
  - Thus, all charges must sum up to zero.

- Charges come from the associated group in the periodic table, or a list.

- Parenthesis must be used when there is some multiple of a certain polyatomic ion.

Ex1) Writing Ionic Formulas

Ex1) Calcium Chloride

- Calcium is always 2+ (Group 2A periodic table)

- ide in chloride tells you it is monoatomic

- Chloride is always 1- (Group 7A periodic table)

Criss-Cross Method

\[
\begin{align*}
\text{Ca}^{2+} & \quad \text{Cl}^{-} \\
\text{CaCl}_2
\end{align*}
\]

Ex2) Writing Ionic Formulas

Ex 2) Iron (III) Sulfate

- The Iron ion carries a charge of 3+, as the Roman numeral is (III).

- You know that Sulfate is SO\(_4\)\(^{2-}\) because you memorized the table of polyatomic ions.

Criss-Cross Method

\[
\begin{align*}
\text{Fe}^{3+} & \quad \text{SO}_4^{2-} \\
\text{Fe}_2(\text{SO}_4)_3
\end{align*}
\]
Writing Ionic Formulas

1) Aluminum hydrogen sulfate
2) Iron (II) oxide
3) Iron (III) oxide
4) Strontium chromate
5) Potassium chloride
6) Ammonium Nitrate
7) Lithium Sulfite

Hydrates

- Hydrates are ionic compounds that trap water within their structures.
- Both the name and the chemical formula specify how much water is contained within the structure.

Writing Formulas for Hydrates

- Write the formula for the ionic compound using the rules you learned earlier.
- Add a dot and the correct number of waters taken from the prefix.

E.g.) Sodium sulfate decahydrate
\[ \text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O} \]

Writing Formulas for Hydrates

1) Barium Chloride Dihydrate

2) \( \text{FeCl}_3 \cdot 6 \text{H}_2\text{O} \)
Recognizing Binary Covalent Compounds

- They are made of two non-metals

Naming Binary Covalent Compounds

- Two words with prefixes
  - (1) mono-, (2) di-, (3) tri-, (4) tetra-, (5) penta-, (6) hexa-, (7) hepta-, (8) octa-, (9) nona-, (10) deca-
  - The first word takes the name of the element with the suitable prefix.
  - The prefix mono- is not used when there is only one atom of the first element.
  - The second word takes the name of the element with the -ide suffix and the suitable prefix.

Naming Binary Covalent Compounds

1) SiO₂
2) CO
3) CF₄
4) N₂O₅
5) XeF₆
6) N₂O₃
7) P₄O₇

Writing Molecular Formulas

1) Carbon dioxide
2) Phosphorus trichloride
3) Sulfur tetrafluoride
4) Disulfur dichloride
5) Iodine monochloride
6) Dinitrogen tetraoxide
7) Nitrogen triformide

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Recognizing Acids
- Formulas for acids usually start with \( H \)
  - Hydrogen is always the cation.
- For organic acids, the cation is often placed at the end of the formula.
  - \( \text{CH}_3\text{COOH} \) (acetic acid)
- There are two types of acids that we will look at.
  - Acids that contain Oxygen
  - Acids that do not contain Oxygen

Naming Oxygen Containing Acids
- To name all acids you must look at the anion.
- Oxygen containing acids have polyatomic anions.
- Write the name of the polyatomic anion but change:
  - are to -ic, or
  - -ite to -ous
- and add the word acid.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Polyatomic Ion</th>
<th>Acid's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{HClO}_4 )</td>
<td>Perchlorate</td>
<td>Perchloric acid</td>
</tr>
<tr>
<td>( \text{H}_2\text{SO}_4 )</td>
<td>Sulfate</td>
<td>Sulfuric acid</td>
</tr>
<tr>
<td>( \text{CH}_3\text{COOH} )</td>
<td>Acetic</td>
<td>Acetic acid</td>
</tr>
<tr>
<td>( \text{H}_2\text{SO}_3 )</td>
<td>Sulfite</td>
<td>Sulfurous acid</td>
</tr>
<tr>
<td>( \text{HNO}_2 )</td>
<td>Nitrite</td>
<td>Nitrous acid</td>
</tr>
</tbody>
</table>

Naming Non-Oxygen Containing Acids
- Non-oxygen containing acids have monoatomic or polyatomic anions.
- Write the name of the anion but change -ide to -ic
- Add the prefix hydro- and the word acid.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Ion's Name</th>
<th>Acid's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{HCN} )</td>
<td>Cyanide</td>
<td>Hydrocyanic acid</td>
</tr>
<tr>
<td>( \text{HCl} )</td>
<td>Chloride</td>
<td>Hydrochloric acid</td>
</tr>
<tr>
<td>( \text{HBr} )</td>
<td>Bromide</td>
<td>Hydrobromic acid</td>
</tr>
</tbody>
</table>

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Naming Acids

1) Nitric acid
2) Phosphoric acid
3) Hydrofluoric acid
4) Hydrophosphoric acid
5) Carbonic acid
6) Hypochlorous acid