Nomenclature Handout: Formulas and Names of Compounds and Ions

A. Ionic Compounds:
- An ionic compound is composed of a positive ion (cation) and a negative ion (anion).
- The cation is always a metal and the anion is always a non-metal or a polyatomic ion.

1. Monoatomic Ions:

You must learn the symbols and names of the monoatomic (one element) ions:

**For Cations** (these are the positively charged metallic elements!)
- The charge is merely their group number (only for the main group elements!)
- The ion name is the element’s name followed by “ion”.

**Example**: Sodium is in Group I so its charge is +1, making its symbol Na\(^+\).
- The name of this ion is sodium ion.

**For Anions** (these are the negatively charged non-metallic elements!)
- The charge is the element's group number minus 8
- For the ion name, take the stem of the element name and add “-ide ion” to the end

**Example**: Sulfur is in Group VI so its charge is 6-8 = -2, making its symbol S\(^2-\).
- The name of this ion is sulfide ion.

2. Polyatomic Ions:

You must learn the symbols and names of the polyatomic (more than one element) ions shown below. There is no easy way to do this outside of memorization!

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Symbol</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO(_3^-)</td>
<td>Nitrate</td>
<td>ClO(_4^-)</td>
<td>Perchlorate</td>
</tr>
<tr>
<td>NO(_2^-)</td>
<td>Nitrite</td>
<td>ClO(_3^-)</td>
<td>Chlorate</td>
</tr>
<tr>
<td>SO(_4^{2-})</td>
<td>Sulfate</td>
<td>OH(^-)</td>
<td>Hydroxide</td>
</tr>
<tr>
<td>SO(_3^{2-})</td>
<td>Sulfite</td>
<td>MnO(_4^-)</td>
<td>Permanganate</td>
</tr>
<tr>
<td>PO(_4^{3-})</td>
<td>Phosphate</td>
<td>Cr(_2O_7^{2-})</td>
<td>Dichromate</td>
</tr>
<tr>
<td>CO(_3^{2-})</td>
<td>Carbonate</td>
<td>CrO(_4^{2-})</td>
<td>Chromate</td>
</tr>
<tr>
<td>HCO(_3^-)</td>
<td>Hydrogen Carbonate</td>
<td>NH(_4^+)</td>
<td>Ammonium</td>
</tr>
<tr>
<td>C(_2H_3O_2^-)</td>
<td>Acetate</td>
<td>H(_3O^+)</td>
<td>Hydronium</td>
</tr>
</tbody>
</table>

*Also look at Table 5.8 in Chapter 5!!*
3. Cations of Transition Metals (The Stock System):

- Some of the transition metals can form more than one cation.
- These cations are named for the parent, followed by the charge in Roman numerals in parentheses followed by the word "ion".
- This is called the **Stock system** of naming cations.
- **Silver ion (Ag⁺), Zinc ion (Zn²⁺), and Cadmium ion (Cd²⁺)** are exceptions because they only form one ion! Memorize these!
- You will always be able to determine the charge of a transition metal from its name or formula!

<table>
<thead>
<tr>
<th>Ion Symbol</th>
<th>Oxidation State</th>
<th>“New” Name</th>
<th>Stock Symbol</th>
<th>“Old” Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu⁺</td>
<td>+1</td>
<td>copper one</td>
<td>Cu(I)</td>
<td>cuprous</td>
</tr>
<tr>
<td>Cu²⁺</td>
<td>+2</td>
<td>copper two</td>
<td>Cu(II)</td>
<td>cupric</td>
</tr>
<tr>
<td>Fe²⁺</td>
<td>+2</td>
<td>iron two</td>
<td>Fe(II)</td>
<td>ferrous</td>
</tr>
<tr>
<td>Fe³⁺</td>
<td>+3</td>
<td>iron three</td>
<td>Fe(III)</td>
<td>ferric</td>
</tr>
<tr>
<td>Co²⁺</td>
<td>+2</td>
<td>cobalt one</td>
<td>Co(II)</td>
<td>cobaltous</td>
</tr>
<tr>
<td>Co³⁺</td>
<td>+3</td>
<td>cobalt three</td>
<td>Co(III)</td>
<td>cobaltic</td>
</tr>
<tr>
<td>Hg₂²⁺</td>
<td>+2</td>
<td>mercury one</td>
<td>Hg(I)</td>
<td>mercurous</td>
</tr>
<tr>
<td>Hg²⁺</td>
<td>+2</td>
<td>mercury two</td>
<td>Hg(II)</td>
<td>mercuric</td>
</tr>
</tbody>
</table>

Also look at Table 6.7 in Chapter 6

B. Covalent Compounds:

Learn all of the following compounds:

1. **Covalently Bonded Compounds**

<table>
<thead>
<tr>
<th>Formula</th>
<th>IUPAC Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>N₂O</td>
<td>Dinitrogen oxide</td>
<td>Nitrous oxide; laughing gas</td>
</tr>
<tr>
<td>CCl₄</td>
<td>Carbon tetrachloride</td>
<td>NA</td>
</tr>
<tr>
<td>CHCl₃</td>
<td>NA</td>
<td>Chloroform (very toxic)</td>
</tr>
<tr>
<td>CS₂</td>
<td>Carbon disulfide (very toxic)</td>
<td>NA</td>
</tr>
<tr>
<td>H₂O₂</td>
<td>Dihydrogen dioxide</td>
<td>Hydrogen Peroxide</td>
</tr>
<tr>
<td>NH₃</td>
<td>Nitrogen trihydride</td>
<td>Ammonia</td>
</tr>
<tr>
<td>CH₄</td>
<td>Carbon tetrahydride</td>
<td>Methane</td>
</tr>
<tr>
<td>PH₃</td>
<td>Phosphorous trihydride</td>
<td>Phosphine (very toxic)</td>
</tr>
<tr>
<td>CO</td>
<td>Carbon Monoxide</td>
<td>NA</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
<td>NA</td>
</tr>
</tbody>
</table>
2. Ionic but Covalently Bonded Compounds

<table>
<thead>
<tr>
<th>Formula</th>
<th>Name</th>
<th>Formula</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂SO₄ (aq)</td>
<td>Sulfuric Acid</td>
<td>HC₂H₃O (aq)</td>
<td>Acetic Acid</td>
</tr>
<tr>
<td>H₂SO₃ (aq)</td>
<td>Sulfurous Acid</td>
<td>H₂CO₃ (aq)</td>
<td>Carbonic Acid</td>
</tr>
<tr>
<td>HCl (aq)</td>
<td>Hydrochloric Acid</td>
<td>H₃PO₄ (aq)</td>
<td>Phosphoric Acid</td>
</tr>
<tr>
<td>HNO₃ (aq)</td>
<td>Nitric Acid</td>
<td>HF (aq)</td>
<td>Hydrofluoric Acid</td>
</tr>
<tr>
<td>HNO₂ (aq)</td>
<td>Nitrous Acid</td>
<td>Na₂CO₃ (aq)</td>
<td>Sodium bicarbonate</td>
</tr>
<tr>
<td>HClO₄ (aq)</td>
<td>Perchloric Acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CuSO₄ • 5 H₂O</td>
<td>copper (II) sulfate 5-hydrate or copper (II) sulfate pentahydrate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>