Polyatomic Ions
+
Covalent Bonds

Names and Formulas
I asked the cat sitting next to me if he had any sodium hypobromite. He said NaBrO.
1. What are Polyatomic Ions?

- **Covalently bonded** atoms of more than one type.

- They all contain a **charge**.

- **Cannot** exist in **isolation**.
Polyatomic Ions

2. What is the most common charge for polyatomic ions?
   - The majority are negative.

3. What charge is the least common for polyatomic ions? Provide an example.
   - There is one positive polyatomic ion
     - $\text{NH}_4^+$ (ammonium)
Step 1

- Write down the symbols for each ion with the metal one first
- Example:

<table>
<thead>
<tr>
<th>Calcium</th>
<th>Phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>PO₄</td>
</tr>
</tbody>
</table>
Step 2

- Determine the ionic charge or combining capacity for each ion and place it to the top right of the symbol

<table>
<thead>
<tr>
<th>Ca</th>
<th>PO₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca²⁺</td>
<td>PO₄³⁻</td>
</tr>
</tbody>
</table>
Step 3

- Drop the signs and crisscross down

<table>
<thead>
<tr>
<th>$\text{Ca}^{2+}$</th>
<th>$\text{PO}_4^{3-}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Ca}^2$</td>
<td>$\text{PO}_4^3$</td>
</tr>
</tbody>
</table>

$\text{Ca}_2(\text{PO}_4)_2$
Step 4

- Reduce if possible

- \( \text{Ca}_3(\text{PO}_4)_2 \)

- Note: brackets are necessary when there is more than one of each polyatomic ion.

- \((\text{NH}_4)_2\text{SO}_4\)

- As there is only one sulphate group there are not brackets in the example above.
<table>
<thead>
<tr>
<th>Number</th>
<th>Roman Numeral</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
</tr>
<tr>
<td>4</td>
<td>IV</td>
</tr>
<tr>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>6</td>
<td>VI</td>
</tr>
<tr>
<td>7</td>
<td>VII</td>
</tr>
</tbody>
</table>
Practice

- Calcium and sulphate
- Cadmium and carbonate
- Chromium (III) and chloride
- Iron (III) and bisulphate
Naming Chemical Compound

- Write down the names of each ion with the metal first
- $\text{Ca}_3(\text{PO}_4)_2$
- calcium phosphate
Practice

- $\text{Ni(OH)}_2$
- $\text{Pb(CO}_3\text{)}_2$
- $\text{NaHCO}_3$
- $\text{Cu(NO}_3\text{)}_2$
Covalent Compounds

Two scientists walk into a restaurant
Scientist one: "I want H₂O"
Scientist two: "I want H₂O, too"
The second scientist dies
1. What is a covalent bond?

- A bond where the *electrons* are *shared*.

- The *subscripts* in these compounds indicate the *actual number* of *atoms* of each element.
Binary Covalent Compounds

2. What is a binary covalent compound?

- Comprised of two non-metals that share their electrons
- Can have one or more covalent bonds
- Can have many atoms (two or more)
Binary Covalent Compounds

3. What is a prefix?

- It is a combination of letters added to the beginning of a word.

- The combination of letters has a specific meaning.

- Example: mono- in monofluoride means there is one fluorine atom.
Binary Covalent compounds

4. If mono- is 1 what are the other prefixes used in covalent compounds?

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>mono-</td>
<td>1</td>
</tr>
<tr>
<td>di-</td>
<td>2</td>
</tr>
<tr>
<td>tri-</td>
<td>3</td>
</tr>
<tr>
<td>tetra-</td>
<td>4</td>
</tr>
<tr>
<td>penta-</td>
<td>5</td>
</tr>
<tr>
<td>hexa-</td>
<td>6</td>
</tr>
<tr>
<td>hepta-</td>
<td>7</td>
</tr>
<tr>
<td>octa-</td>
<td>8</td>
</tr>
<tr>
<td>nona-</td>
<td>9</td>
</tr>
<tr>
<td>deca-</td>
<td>10</td>
</tr>
</tbody>
</table>
Step 1

- Write down the symbols for each element
- Example: Carbon Dioxide

<table>
<thead>
<tr>
<th>Carbon</th>
<th>Oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>O</td>
</tr>
</tbody>
</table>
Step 2

- Write the number of each element you have based on the prefix in the name.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>C</td>
<td>O₂</td>
</tr>
</tbody>
</table>
Step 3

- Write the formula

<table>
<thead>
<tr>
<th>C</th>
<th>O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO₂</td>
</tr>
</tbody>
</table>

NEVER reduce a covalent compound formula
Practice

- carbon disulphide
- tellurium trioxide
- boron monoxide
- nitrogen dioxide

- $P_2O_3$
- $As_2O_5$
- $SCl_4$
- $ICl_3$
Naming Chemical Compound

- Write down the names of each element.
  - Phosphorous Oxygen

- Write the prefix for each element. Do not include mono- for the first element if there is only one atom.
  - diphosphorus trioxygen
- Drop the ending of the second element name and ADD IDE

- diphosphorus trioxygen
- diphosphorus triox
- diphosphorus trioxide