Naming Ionic and Molecular Compounds and Writing Formulas

A compound is made of two or more elements.

The name should tell us how many and what type of atoms there are.

We have already examined two types of compounds:

A. Ionic compounds

- **Made of cations and anions.**
- **Metals and nonmetals.**
- **The electrons lost by the cation are gained by the anion.**

I. Naming Monoatomic Ions

Cation

- **Representative metal - if the charge is always the same (Group A) just write the name of the metal. (It does not change)**
- **Transition metals can have more than one type of charge. Indicate the charge with roman numerals in parenthesis.**

Name these:

Na^{+1}	Al^{+3}	Fe^{+3}
Fe^{+2}	Pb^{+2}	Li^{+1}

Write Formulas for these:

Potassium ion	***Magnesium ion***	***Copper (II) ion***
Chromium (VI) ion	***Barium ion***	***Mercury (II) ion***

Anion

- ü **Change the element ending to – ide**
- ü **Ie. Fluorine (F) would become Fluoride (F^{-1})**

Name these:

Cl^{-1}	N^{-3}	Br^{-1}

O^{-2} Ga^{+3}

S^{-2}

Write Formulas for these:

Sulfide ion *Iodide ion* *Phosphide ion*

II. Naming Polyatomic Ions

Polyatomic ions are groups of atoms that stay together and have a charge. You must memorize the following common polyatomic ions:

Nitrate NO_3^{-1} **Sulfate SO_4^{-2}** **Phosphate PO_4^{-3}**

Nitrite NO_2^{-1} **Sulfite SO_3^{-2}** **Phosphite PO_3^{-3}**

Carbonate CO_3^{-2} **Hydroxide OH^{-1}** **Ammonium NH_4^{+1}**

III. Naming Binary Ionic Compounds

Binary Compounds consist of 2 elements. Simply name the two ions.

<u>Representative elements:</u>

Ex. 1. **$NaCl = Na^+ \ Cl^-$ = sodium chloride**

Ex. 2 **$MgBr_2 = Mg^{+2} \ Br^-$ = magnesium bromide**

<u>Transition metals</u>:

- **Need to first figure out their charges, then indicate the charge in brackets following the name of the metal.**
- **The compound must be neutral (same total number of + and – charges).**
- **Use the anion to determine the charge on the positive ion.**

Examples: Naming Binary Ionic Compounds Containing Transition Metals

1. **Write the name of CuO**
   - **Need the charge of Cu**
   - **The charge of O is -2**
   - **Therefore copper must be +2**
   - **Name: Copper (II) chloride**

2. **Name $CoCl_3$**
   - **Cl is -1 and there are three of them = -3**
   - **Co must be +3**
   - **Name: Cobalt (III) chloride**

3. **Name Cu_2S**
   - **Since S is -2, the Cu_2 must have an overall charge of +2, so each ion is +1.**
   - **Name: Copper (I) sulfide**

4. **Fe_2O_3**
   - **Each O is –2; therefore 3 x -2 = -6 charge**
   - **3 Fe must = +6, so each Fe ion is +2.**
   - **Name: Iron (III) oxide**

Write the names of the following binary ionic compounds:

1. KCl
2. Na_3N
3. CrN
4. Sc_3P_2
5. PbO
6. PbO_2
7. Na_2Se

IV. Naming Ternary Ionic Compounds

Ternary Compounds consist of 3 or more elements. Name the two ions. At least one of the ions will be polyatomic – note: the suffix of the polyatomic ion does not change. Example: K_3PO_3 is potassium phosphite

Write the names of the following ternary ionic compounds:

8. $NaNO_3$
9. $CaSO_4$
10. $CuSO_3$
11. $(NH_4)_2O$

12. *LiCN*
13. *$Fe(OH)_3$*
14. *$(NH_4)_2CO_3$*
15. *$NiPO_4$*

V. Writing Chemical Formulas

A chemical formula shows the kind and number of atoms in the smallest piece of a substance.

- **The overall charge of the compound is zero.**
- **Balance the charges by adding subscripts.**
- **Put polyatomic ions in brackets when using a subscript.**

Example: Write the formula for calcium chloride.

Calcium is Ca^{+2}, Chloride is Cl^{-1},
Ca^{+2} Cl^{-1} would have a +1 charge, therefore another Cl^{-1} is needed
Chemical formula: $CaCl_2$

Write the chemical formula of the following compounds:

1. *Lithium sulfide*
2. *tin (II) oxide*
3. *tin (IV) oxide*
4. *Magnesium fluoride*
5. *Copper (II) sulfate*
6. *Iron (III) phosphide*
7. *gallium nitrate*
8. *Iron (III) sulfide*
9. *Ammonium chloride*
10. *ammonium sulfide*
11. *barium nitrate*

Things to look for

- **If cations have brackets in the name, the number is their charge.**
- **If anions end in -ide they are probably off the periodic table (Monoatomic)**
- **If anion ends in -ate or -ite it is polyatomic**

B. Molecular compounds

- **Made of molecules.**
- **Made by joining nonmetal atoms together.**

I. Naming Molecular Compounds

The name of a molecular compound indicates the type and number of atoms. Prefixes are used to tell you the number. You must memorize the following prefixes.

Prefixes

1 mono-	**6 hexa-**
2 di-	**7 hepta-**
3 tri-	**8 octa-**
4 tetra-	**9 nona-**
5 penta-	**10 deca-**

To name a molecular compound, write two words:
Prefix + Name of first nonmetal + Prefix + Name of second nonmetal + ide

Exceptions:

- **don't write mono- if there is only one of the first element.**
- **don't use the following double vowels when writing names (oa oo)**

Name these molecular compounds:

1. N_2O
2. NO_2
3. Cl_2O_7
4. CBr_4
5. CO_2
6. $BaCl_2$

Write formulas for these:

1. *diphosphorus pentoxide*
2. *tetraiodide nonoxide*
3. *sulfur hexaflouride*
4. *nitrogen trioxide*
5. *Carbon tetrahydride*
6. *phosphorus trifluoride*
7. *aluminum chloride*