

MONATOMIC IONS

Ionic compounds consist of a _____ metal ion and a negative _____ ion combined in a proportion such that their charges add up to a net charge of _____.

Example: NaCl

Recall:

What is a monatomic ion?

What are cations?

What are anions?

Many transition metals form more than one cation with different ionic charges; therefore, ***the charges of the cations of many transition metal ions must be determined from the number of electrons lost during bonding.***

NAMING IONS

There are two methods that are used to name ions. The preferred method is called the Stock System.

Stock System

An older, less useful method for naming these cations uses a root word with different suffixes at the end of the word.

Symbols and Names of Common Metal Ions With More Than One Ionic Charge		
Symbol	Stock name	Classical name
Cu^+	Copper(I) ion	Cuprous ion
Cu^{2+}	Copper(II) ion	Cupric ion
Fe^{2+}	Iron(II) ion	Ferrous ion
Fe^{3+}	Iron(III) ion	Ferric ion
* Hg_2^{2+}	Mercury(I) ion	Mercurous ion
Hg^{2+}	Mercury(II) ion	Mercuric ion
Pb^{2+}	Lead(II) ion	Plumbous ion
Pb^{4+}	Lead(IV) ion	Plumbic ion
Sn^{2+}	Tin(II) ion	Stannous ion
Sn^{4+}	Tin(IV) ion	Stannic ion
Cr^{2+}	Chromium(II) ion	Chromous ion
Cr^{3+}	Chromium(III) ion	Chromic ion
Mn^{2+}	Manganese(II) ion	Manganous ion
Mn^{3+}	Manganese(III) ion	Manganic ion
Co^{2+}	Cobalt(II) ion	Cobaltous ion
Co^{3+}	Cobalt(III) ion	Cobaltic ion

POLYATOMIC IONS

Unlike a monatomic ion, a polyatomic ion is composed of more than one atom; however, like a monatomic ion, a polyatomic ion behaves as a unit and carries a charge.

Practice:

1. Explain how you determine the charges of metal cations? Of nonmetals? Of transition metal cations?

2. What are the similarities and differences between polyatomic ions and monatomic ions?

3. Write the symbol for the ions of each element. Classify the ion as an anion or a cation, and name the ion.

- a. potassium

- b. oxygen

- c. bromine

- d. tin (2 electrons lost)

- e. beryllium

- f. cobalt (3 electrons lost)

Common Polyatomic Ions		
Charge	Formula	Name
1-	H_2PO_4^-	Dihydrogen phosphate
	$\text{C}_2\text{H}_3\text{O}_2^-$	Ethanoate
	HSO_3^-	Hydrogen sulfite
	HSO_4^-	Hydrogen sulfate
	HCO_3^-	Hydrogen carbonate
	NO_2^-	Nitrite
	NO_3^-	Nitrate
	CN^-	Cyanide
	OH^-	Hydroxide
	MnO_4^-	Permanganate
	ClO^-	Hypochlorite
	ClO_2^-	Chlorite
	ClO_3^-	Chlorate
	ClO_4^-	Perchlorate
2-	HPO_4^{2-}	Hydrogen phosphate
	$\text{C}_2\text{O}_4^{2-}$	Oxalate
	SO_3^{2-}	Sulfite
	SO_4^{2-}	Sulfate
	CO_3^{2-}	Carbonate
	CrO_4^{2-}	Chromate
	$\text{Cr}_2\text{O}_7^{2-}$	Dichromate
3-	SiO_3^{2-}	Silicate
	PO_3^{3-}	Phosphite
	PO_4^{3-}	Phosphate
1+	NH_4^+	Ammonium

BINARY IONIC COMPOUNDS

Binary Compounds =

WRITING FORMULAS WITH BINARY COMPOUNDS

To write the formula of a binary compound, first write the symbol of the cation and then the anion. Then add subscripts as needed to balance the charges.

Another method is the crisscross method.

- In this method, the numerical value of the charge of each ion is crossed over and becomes the subscript for the other ion [answers must be in the lowest whole-number ratio].

NAMING BINARY IONIC COMPOUNDS

To name any binary ionic compound, place the cation name first, followed by the anion name.

** Don't forget that anions end in -ide!

WRITING FORMULAS FOR COMPOUNDS WITH POLYATOMIC IONS

To write the formula for a compound with a polyatomic ion, first write the symbol for the cation followed by the symbol for the anion. Then, add subscripts as needed to balance the charges.

****Whenever more than one polyatomic ion is needed to balance the charges in an ionic compound, use parentheses to set off the polyatomic ion in the formula.**

NAMING COMPOUNDS WITH POLYATOMIC IONS

To name a compound containing a polyatomic ion, state the cation name first and then the anion name. If the cation is a transition metal element that has more than one common ionic charge, include a Roman numeral in the cation name.

Practice

1. Describe the procedures for writing the formulas and names of binary ionic compounds.
2. How do you write the formulas and the names of compounds with polyatomic ions?
3. Write the formula for these binary ionic compounds.
 - a. beryllium chloride

b. cesium sulfide

c. sodium iodide

d. strontium oxide

4. What condition must be met when writing a formula for an ionic compound?

5. Write the formula for these compounds containing polyatomic ions.

a. chromium (III) nitrite

b. sodium perchlorate

c. calcium acetate

d. sodium hydroxide

6. When do you use parentheses in writing a chemical formula?

7. Name the following ionic compounds:

a. LiF

b. SnS₂

b. MnCO₃

c. Sr(H₂PO₄)₂

NAMING MOLECULAR COMPOUNDS

To name a binary molecular compound, use the following guidelines:

Prefixes Used in Naming Binary Molecular Compounds	
Prefix	Number
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10

WRITING FORMULAS FOR MOLECULAR COMPOUNDS

To write the formula of a binary molecular compound, first use the prefixes in the name to tell you the subscript of each element in the formula. Then, write the correct symbols for the two elements with the appropriate subscripts.

Practice

1. Explain how to write the name and formula of a binary molecular compound.
2. Write the names of these molecular compounds.
 - a. NCl_3
 - b. BCl_3
 - c. NI_3
 - d. SO_3
 - e. N_2H_4
 - f. N_2O_3
3. Write the formulas for these binary molecular compounds.
 - a. phosphorus pentachloride
 - b. iodine heptafluoride
 - c. chlorine trifluoride
 - d. iodine dioxide

4. Determine whether each of the following compounds is a molecular compound or an ionic compound. How can you tell?
- iron(III) oxide
 - carbon tetraiodide
 - KBr
 - PBr_3