

FORMULA WRITING

I. Binary Ionic Compounds

A. Consist of cation (metal) and anion (nonmetal)

B. Need to know:

1. Symbols of cations and anions

2. Charges of the ions

a. Some ions have the same charges all the time.

Ex. Group 1, 2 metals (+1, +2)

Ag = +1

Zn = +2

Cd = +2

Al = +3

b. Other ions can have different charges in different compounds.

Ex. Most transition metals have at least 2 different charges

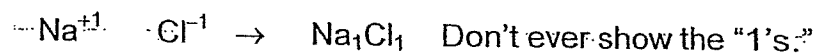
1. You must memorize the different charges of the common ions. You must also memorize the names of the ions with different charges. (*See following pages.*)

2. Charges are also often called oxidation numbers, oxidation states, valence numbers, or valence states.

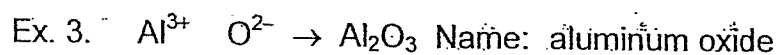
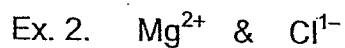
c. To write a formula for a binary ionic compound, keep in mind that although the ions have charge, the compound is neutral. We use subscripts to show how many cations are needed to neutralize the anions.

Ex. 1. Na^+ & Cl^-

To combine these 2 in a compound, "criss cross" the charges to find the number of ions needed.



Formula: NaCl — Name: sodium chloride



- d. Don't forget that in a binary compound, the formula is an empirical formula—it represents the ratio of ions in the crystal.

CHARGES OF IONS YOU NEED TO KNOW

ANIONS: In ionic compounds, charges of the anions can usually be determined by subtracting the Group # from 8.

<u>Nonmetal Symbol</u>	<u>Anion</u>	<u>Name of Anion</u>
Br	Br^{-}	bromide
Cl	Cl^{-}	chloride
F	F^{-}	fluoride
N	N^{3-}	nitride
O	O^{2-}	oxide
S	S^{2-}	sulfide
I	I^{-}	iodide
P	P^{3-}	phosphide
* H	H^{-}	hydride

IONS – MONATOMIC CATIONS

Main Group Elements	Charge	Examples:
1A	1 ⁺	
2A	2 ⁺	
3A	3 ⁺	

d-block elements	Name
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Ag ⁺	Silver
Cd ²⁺	Cadmium
Mn ²⁺	Manganese (II)
Ni ²⁺	Nickel (II)
Zn ²⁺	Zinc

	Stock	Latin
Cr ²⁺	Chromium (II)	Chromous
Cr ³⁺	Chromium (III)	Chromic
Co ²⁺	Cobalt (II)	Cobaltous
Co ³⁺	Cobalt (III)	Cobaltic
Cu ⁺	Copper (I)	Cuprous
Cu ²⁺	Copper (II)	Cupric
Fe ²⁺	Iron (II)	Ferrous
Fe ³⁺	Iron (III)	Ferric
Hg ₂ ²⁺	Mercury (I)	Mercurous
Hg ²⁺	Mercury (II)	Mercuric
Pb ²⁺	Lead (II)	Plumbous
Pb ⁴⁺	Lead (IV)	Plumbic
Sn ²⁺	Tin (II)	Stannous
Sn ⁴⁺	Tin (IV)	Stannic

IONS – POLYATOMIC

<u>Polyatomic Ions</u>	<u>Name</u>
NH_4^+	Ammonium
$\text{C}_2\text{H}_3\text{O}_2^-$	Acetate
BrO^-	Hypobromite
BrO_2^-	Bromite
BrO_3^-	Bromate
BrO_4^-	Perbromate
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
CN^-	Cyanide
HCO_3^-	Bicarbonate (Hydrogen carbonate)
HSO_4^-	Bisulfate (Hydrogen sulfate)
IO_2^-	Iodite
IO_3^-	Iodate
MnO_4^-	Permanganate
NO_2^-	Nitrite
NO_3^-	Nitrate
OH^-	Hydroxide
CO_3^{2-}	Carbonate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
PO_4^{3-}	Phosphate

BINARY MOLECULAR COMPOUNDS

Use numerical prefixes (Greek) to designate the number of atoms in the compound.

Name the least electronegative element first, oxygen & halogens next, and then other nonmetals in order of increasing electronegativity.

Prefixes

½	hemi
1	mono
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa
9	nona
10	deca

The o or a at the end of a prefix is often dropped before another vowel.

The ending of the second element is -ide. Ex. CCl_4 : carbon tetrachloride

ACID NAMES

Common Binary Acids

Solutions, *in water*, of binary molecular compounds containing hydrogen and a halogen: to name them, remove hydrogen, put "hydro" in front of the halogen root, and add "ic" and acid to the end.

<u>Formula</u>	<u>Binary Compound Name</u>	<u>In Solution Acid Name</u>
HCl	hydrogen chloride	hydrochloric acid
HBr		
HF		
HI		

Ternary (and higher) Oxyacids

Need to know the name of the polyatomic ion the acid comes from:

add ic acid to ions ending in -ate

add ous acid to ions ending in -ite

Example: HNO_3 nitrate ion → nitric acid

HNO_2 nitrite ion → nitrous acid

Remember: -ate is "great" — more oxygen

ite is "light" — less oxygen

HYDRATES

Hydrates are ionic compounds that have a specific number of water molecules associated with each formula unit. To name a hydrate, name the ionic compound and use the Greek prefix preceding the word hydrate to indicate the number of water molecules. To write the formula of a hydrate, write the formula of the ionic compound followed by a centered dot and the number of water molecules.

Example: $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$

calcium sulfate pentahydrate

Name These:

$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$

$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

Write Formulas for These:

sodium carbonate hydrate

potassium carbonate dihydrate

ferric chloride hexahydrate

barium chloride dihydrate

