NOMENCLATURE AND WRITING FORMULAS

PART I--FORMULAS AND NOMENCLATURE OF IONIC COMPOUND Composed of Cations and Anions.

Types of Cations (positive ions):

A. Metals lose electrons to form positive ions. These ions are called **monoatomic** because they are made up of only **ONE** ion. They can be of two types: Constant charge or Variable charge.

Constant charge:
Group IA, IIA, IIIA
A few transition metals Ag^{+}, Zn^{2+} and Cd^{2+}

The names of these ions are the same as the name of the atom

Examples: Na^{+} = sodium ion Zn^{2+} = zinc ion

Variable charge:

Most transition metals (except for silver, zinc and cadmium)
A few representative metals: Sn, Bi, and Pb

Fe^{2+}	Iron (II)	Fe^{3+}	Iron (III)
Cu^{+}	Copper (I)	Cu^{2+}	Copper (II)
Sn^{4+}	Tin(IV)	Sn^{2+}	Tin(II)

B. **A polyatomic ion**-- Consists of more than one atom. The most common positive one is ammonium, NH_4^{+}

Types of Anions (negative ions):

A. Non metals gain electrons to form negative ions. These ions are called **monoatomic** because they are made up of only **ONE** ion. The names of these ions end in -ide.

Examples: S^{2-} sulfide Cl^{1-} chloride
N^{3-} nitride O^{2-} oxide

B. **A polyatomic ion**-- Consists of more than one atom. The names of polyatomic anions often end in -ate or -ite

Examples: NO_3^{1-} nitrate NO_2^{1-} nitrite
SO_4^{2-} sulfate SO_3^{2-} sulfite

Two important polyatomic ions end in -ide
OH^{1-} hydroxide CN^{1-} cyanide

A compound is usually IONIC if it:

Contains a cation and an anion--often a metal and a nonmetal

Hint: Formula begins with a **metal** or **NH_4^+**

Ionic - To write the formula

1. Write the symbol of the cation with a SUPERSCRIPT charge.
2. Write the symbol of the anion with a SUPERSCRIPT charge
3. If the charges are NOT balanced, CRISS-CROSS to find the number of each atom necessary to balance the charges.
4. Use a parenthesis if more than ONE polyatomic ion is necessary.

Examples:			
	Aluminum oxide	Al^{3+} O^{2-}	Al_2O_3
	Iron (II) phosphide	Fe^{2+} P^{3-}	Fe_3P_2
	Calcium nitrate	Ca^{2+} NO_3^{1-}	$Ca(NO_3)_2$
	Copper(I) carbonate	Cu^{1+} CO_3^{2-}	Cu_2CO_3
	Barium oxide	Ba^{2+} O^{2-}	BaO
	Notice: the charges are already balanced so the ratio is 1:1		
	Calcium hydroxide	Ca^{2+} OH^{1-}	$Ca(OH)_2$

Ionic - To write the name

1. Write the name of the cation. If the cation has a variable charge, determine the Roman Numeral.

2. Follow with the name of the anion

Examples:		
	Na_2O	**Sodium oxide**
		(Group IA--no Roman Numeral needed)
	Cr_2S_3	**Chromium(III)sulfide**
		(Most transition metals need Roman Numerals)
	$BaSO_4$	**Barium sulfate**
		(Group IIA--no Roman Numeral needed)
	$Pb(OH)_2$	**Lead(II)hydroxide**
		(Pb is a main group metal with variable charge.)
	Cu_2CO_3	**Copper(I)carbonate**
		(Most transition metals need Roman Numerals)
	$FeSO_4$	**Iron(II)sulfate**
		(Most transition metals need Roman Numerals)

Name _____ Section _____ Date_____

PRACTICE PROBLEMS FOR IONIC COMPOUNDS

tin(II)phosphate _____

zinc oxide _____

barium sulfate _____

lithium nitride _____

silver fluoride _____

barium hydroxide _____

lead(II)iodide _____

mercury(II)chloride _____

cobalt(II)nitrate _____

lithium bromide _____

$AlBr_3$ _____

FeS _____

$(NH_4)_3PO_4$ _____

$Hg(NO_3)_2$ _____

Ag_2S _____

$KMnO_4$ _____

$MgCl_2$ _____

Cr_2O_3 _____

K_3P _____

$TiCl_2$ _____

PART II--FORMULAS AND NOMENCLATURE OF COVALENT COMPOUNDS

A compound is usually COVALENT (MOLECULAR) if there is...

1. A nonmetal bonded to a nonmetal
2. A metalloid bonded to a nonmetal

1. To name, use Greek prefixes to indicate the number of atoms present in the compound. Prefixes are listed in your text book. Note: Mono is usually omitted for the first element.

Examples:	CO_2	carbon dioxide
	N_2O_3	dinitrogen trioxide
	CO	carbon monoxide

2. To write the formula, use subscripts to identify the number of atoms present.

Examples:	dinitrogen tetraoxide	N_2O_4
	carbon tetrachloride	CCl_4

Some other traditional or trivial names you need to memorize.

water	H_2O
ammonia	NH_3
methane	CH_4

PRACTICE PROBLEMS FOR COVALENT COMPOUNDS:

Write the names of the following Binary covalent compounds:
(**Remember** to use prefixes here.)

SO_2 _____ PCl_3 _____

NO_2 _____ H_2S _____

SF_6 _____ CBr_4 _____

Write the formulas for the following:

Phorphorus pentachloride _____ Iodine trichloride _____

Dinitrogen tetraoxide _____ diarsenic pentasulfide _____

PART III--FORMULAS AND NOMENCLATURE OF ACIDS

A compound is usually an ACID if it…. begins with the element (H) in its chemical formula (NOTE: This is not true for carboxylic acids, which usually have H at the end.)

1. Binary Many of these acids are formed by bubbling a gas through water. In the gas state they are named as covalent compounds as discussed previously.

However, when these gases are bubbled through water they become ACIDS. To name them, start the name with HYDRO- and end the name with -IC.

$HCl_{(g)}$	hydrogen chloride	$HCl_{(aq)}$	hydrochloric acid
$H_2S_{(g)}$	dihydrogen sulfide or hydrogen sulfide	$H_2S_{(aq)}$	hydrosulfuric acid
$HBr_{(g)}$	hydrogen bromide	$HBr_{(aq)}$	hydrobromic acid

If the (g) or the (aq) are omitted, it would be correct to use either name.

To write the formula from the name, notice the halogens can only form one bond, so they will require only one hydrogen. Sulfur forms two bonds, so it will require two hydrogens.

NOTE: The prefix (HYDRO-) followed by (-IC) indicates the acid contains only two elements, one of which is hydrogen. The acid is called a binary acid.

1. Oxyacids (ALWAYS NAMED AS ACIDS)

Some of these acids are produced by bubbling a substance called an acid anhydride, such as $SO_{3(g)}$, through water.The gas reacts with water to make sulfuric acid, $H_2SO_{4(aq)}$. **NOTE: "hydro" is NOT used in oxyacids.**

To name: Find the polyatomic ion associated with the acid.
If the polyatomic ion ends in -ATE, the acid ends in -IC.
If the polyatomic ion ends in -ITE, the acid ends in -OUS.

Examples: H_2SO_4 derived from sulf<u>ate</u>, the acid is named sulfur<u>ic</u> acid

It is <u>NEVER</u> named hydrogen sulfate.

HNO_2 derived from nitr<u>ite</u>, the acid is named nitr<u>ous</u> acid

It is <u>NEVER</u> named hydrogen nitrite.

To write the formula from the name:

Acetic acid The formula must begin with H because it is an acid. It must be derived from the acetATE ion. Because the acetate ion has a negative one charge, it will require one hydrogen.

Answer: $HC_2H_3O_2$ or CH_3COOH (it's a carboxylic acid)

Sulfurous acid The acid must be derived from the sulfITE ion. Because the sulfite ion has a negative two charge, it will require two hydrogens.

Answer: H_2SO_3

Practice problems for acids

Name the following:

HNO_3	HF(aq)	H_2CO_3
$H_2C_2O_4$	HF(g)	CH_3COOH

Write the formula for each compound:

hydrogen sulfide	hydrosulfuric acid
sulfuric acid	sulfurous acid
hydrogen chloride	hydrochloric acid
perchloric acid	chloric acid
chlorous acid	hypochlorous acid
nitrous acid	phosphoric acid