Nomenclature

Name: ______________________________

Student ID: __________________________

Date: _______________________________

"What's in a name?" — William Shakespeare

Communicating in chemistry is facilitated by a chemical vocabulary to name compounds. Naming compounds is called nomenclature from the Latin noman *(name)* and calere *(to call)*. There are millions of known chemical substances, so naming them all would require hundreds of pages. In this lab we will focus our discussion to the nomenclature of inorganic compounds- compounds that do not generally contain carbon.

Common Names

Before their compositions were known, many compounds were given informal, ***common names***, many of which are still in use among chemists. The table below lists the common names, formulas, and chemical names (systematic names) of some familiar compounds.

Common Name	Chemical Name	Formula
baking soda	sodium hydrogen carbonate sodium bicarbonate	$NaHCO_3$
bleach (solid)	sodium perborate	$NaBO_3$
Borax	sodium tetraborate decahydrate	$Na_2B_4O_7 \cdot 10\ H_2O$
brimstone	sulfur	S
cream of tartar	potassium hydrogen tartrate	$KHC_4H_4O_6$
Epsom salt	magnesium sulfate heptahydrate	$MgSO_4 \cdot 7\ H_2O$
Freon	dichlorodifluoromethane	CF_2Cl_2
grain alcohol	ethanol	C_2H_5OH
graphite	carbon	C
gypsum	calcium sulfate dihydrate	$CaSO_4 \cdot 2\ H_2O$
laughing gas	dinitrogen oxide	N_2O
lime	calcium oxide	CaO
limestone	calcium carbonate	$CaCO_3$
lye	sodium hydroxide	NaOH
marble	calcium carbonate	$CaCO_3$
MEK	ethyl methyl ketone	$CH_3COC_2H_5$
milk of magnesia	magnesium hydroxide	$Mg(OH)_2$
muriatic acid	hydrochloric acid	HCl
oil of vitriol	sulfuric acid	H_2SO_4
plaster of paris	calcium sulfate ½ hydrate	$CaSO_4 \cdot ½\ H_2O$
potash	potassium carbonate	K_2CO_3
iron pyrite (fool's gold)	iron disulfide	FeS_2
quartz	silicon dioxide	SiO_2
quicksilver	mercury	Hg
rubbing alcohol	isopropyl alcohol	$(CH_3)_2CHOH$
sal ammoniac	ammonium chloride	NH_4Cl
salt	sodium chloride	NaCl
saltpeter	potassium nitrate	KNO_3
slaked lime	calcium hydroxide	$Ca(OH)_2$
sugar	sucrose	$C_{12}H_{22}O_{11}$
TSP trisodium phosphate	sodium phosphate	Na_3PO_4
wood alcohol	methyl alcohol	CH_3OH

Systematic Names

Chemists prefer systematic names that precisely identify the chemical composition of compounds. The systematic name (also called the IUPAC name) is the "official" name of a chemical, as determined by the naming rules published by IUPAC (International Union of Pure and Applied Chemistry). A systematic name reveals which elements are present and, in some cases, the arrangement of atoms in a compound. In the remainder of this lab, we will focus on the systemic naming of compounds using IUPAC rules.

I - Nomenclature of Cations

The name of a monatomic cation is the same as the name of the element forming it, with the addition of the word "ion", as in "sodium ion" for Na^+. For representative elements, the magnitude of the charge is not specified since it is directly related to the group number in which the element is located. When an element can form more than one kind of cation, such as Cu^+ and Cu^{2+} from copper (a transition metal element), we use the charge of the cation, written as a Roman numeral in parenthesis immediately following the name of the element. For example, Cu^+ is a copper(I) ion and Cu^{2+} is a copper (II) ion. Table 2 shows some more examples:

Table 2

Atom	Name	Ion	Name
K	Potassium	K^+	Potassium ion
Ba	Barium	Ba^{2+}	Barium ion
Fe	Iron	Fe^{2+}	Iron(II) ion
Fe	Iron	Fe^{3+}	Iron(III) ion

II – Nomenclature of Anions

Anions are named differently from cations. To name an anion consisting of one element, use the stem of the parent element name and change the ending to "*ide".* As an example, the F^- ion is named by using the stem *fluor*- from fluorine and adding *–ide* to form fluoride ion. The charge of the monoatomic anion is not included in its name but is figured out as: group number – 8. For example, the formula for fluoride ion is F^-, the minus charge was figured out from 7 (group number) – 8 = 1-

Table 3 provides examples of various non-metal elements that form anions along with the stem of the non-metals name.

Table 3

Symbol	Element	Stem	Anion name	Anion Symbol
Br	Bromine	Brom	Bromide	Br^-
Cl	Chlorine	Chlor	Chloride	Cl^-
F	Fluorine	Fluor	Fluoride	F^-
H	Hydrogen	Hydr	Hydride	H^-
I	Iodine	Iod	Iodide	I^-
N	Nitrogen	Nitr	Nitride	N^{3-}
O	Oxygen	Ox	Oxide	O^{2-}
P	Phosphorous	Phosph	Phosphide	P^{3-}
S	Sulfur	Sulf	Sulfide	S^{2-}
C	Carbon	Carb	Carbide	C_2^{2-}
Se	Selenium	Selen	Selenide	Se^{2-}
As	Arsenic	Arsen	Arsenide	As^{3-}
Te	Tellurium	Tellur	Telluride	Te^{2-}

III - Nomenclature of Binary Ionic Compounds

Binary compounds are those formed between two elements. If one of the elements is a metal and the other a nonmetal, the binary compound is usually made up of ions, a cation and an anion and it is called a "binary ionic compound." Nomenclature for binary ionic compounds falls into two categories; 1) binary ionic compounds containing a metal forming only one type of cation, Type I and 2) binary ionic compounds containing a metal that can form two or more types of cations, Type II.

Nomenclature Rules for Metals Forming Only One Type of Cation – Type I

Metals that form only one type of cation tend to be the alkali metals (Group IA, form +1 ions) and the alkaline earths (Group IIA, form +2 ions), along with aluminum (+3 ion), zinc (+2 ion), cadmium (+2 ion) and silver (+1 ion). Follow the steps below when naming binary ionic compounds containing metals with fixed charges:

1. The order for names in a binary compound is first the cation (metal), then the anion (non-metal).
2. For the cation, write the name of the parent atom.
3. Write the name of the anion by first writing the stem for the anion and then adding the suffix "-*ide*."

Example: Name the compound **NaCl**

1. The compound is composed of Na, a metal and Cl, a non-metal. Sodium is in group IA of the periodic table and forms only one type of cation with a +1 charge, Na^+. We name the cation "*sodium*."

2. The name of the non-metal is chlorine. We modify chlorine to its stem "chlor" and add "ide" to form the name of the anion "*chloride*."

3. The name of the compound is *sodium chloride*.

Example: Name the compound **CaS**

1. The compound is composed of Ca, a metal and S, a non-metal. Calcium is in group IIA of the periodic table and forms only one type of cation with a +2 charge, Ca^+. We name the cation "*calcium*."

2. The name of the non-metal is sulfur. We modify sulfur to its stem "sulf" and add "ide" to form the name of the anion "*sulfide*."

3. The name of the compound is "*calcium sulfide*."

Practice Problems – Given the Formula, Write the Name

Write the correct name for the following Type I binary ionic compounds. Remember that all elements involved in this problem set have only one charge. That includes both the cation and the anion in the formula.

1) MgS ____________________

2) KBr ____________________

3) Ba_3N_2 ____________________

4) Al_2O_3 ____________________

5) NaI ____________________

6) SrF_2 ____________________

7) Li_2S ____________________

8) $RaCl_2$ ____________________

9) CaO ____________________

10) AlP ____________________

11) K_2S ____________________

12) LiBr ____________________

13) Sr_3P_2 ____________________

14) $BaCl_2$ ____________________

15) NaBr ____________________

16) MgF_2 ____

17) Na_2O ____

18) SrS ____

19) BN ____

20) AlN ____

Now let's practice writing formulas for Type I binary ionic compounds if given the name. To do this, remember the following rules:

1. The order in a formula is first the cation, then the anion.
2. You must know the charges associated with each cation and anion.
3. The sum of the positive charge and the sum of the negative charges MUST add up to zero.
4. You may not adjust the charges of the cations or anions to get a total charge of zero.
5. You may adjust the subscripts to get a total charge of zero.

Example 1: Write the formula from the following name: **sodium bromide**

Step #1 - Write down the symbol and charge of the first word. Result = Na^+

Step #2 - Write down the symbol and charge of the second word. Result = Br^-

Step #3 - Use the minimum number of cations and anions needed to make the sum of all charges in the formula equal zero. In this case, only one Na^+ and one Br^- are required.

The resulting formula is NaBr.

Example 2: Write the formula from the following name: **aluminum chloride**

Step #1 - Write down the symbol and charge of the first word. Result = Al^{3+}

Step #2 - Write down the symbol and charge of the second word. Result = Cl^-

Step #3 - Use the minimum number of cations and anions needed to make the sum of all charges in the formula equal zero. In this case, only one Al^{3+} is required, but three Cl^- are required.

Why? Answer - Three negative one charges are required because there is one positive three charge. Only in this way can the total charge of the formula be zero.

The resulting formula is $AlCl_3$.

Example 3: Write the formula from the following name (using least common multiple technique): **aluminum sulfide.**

Step #1 - Write Al^{3+} and S^{2-} right next to each other.

Step #2 - Select the least common multiple between the two charges (ignoring the signs). In this case it is 6. This is the amount of positive charge and negative charge you need for a correct formula. Thus you need sufficient aluminum atoms to make a +6 charge and you need sufficient sulfur atoms to make a -6 charge.

The resulting formula requires two Al and three S, so the correct formula is Al_2S_3.

Practice Problems – Given the Name, Write the Formula

Write the correct formula for the following Type I binary ionic compounds. Remember that all elements involved in this problem set have only one charge. That includes both the cation and the anion in the formula.

1) magnesium oxide ____________________
2) lithium bromide ____________________
3) calcium nitride ____________________
4) aluminum sulfide ____________________
5) potassium iodide ____________________
6) strontium chloride ____________________
7) sodium sulfide ____________________
8) radium bromide ____________________
9) magnesium sulfide ____________________
10) aluminum nitride ____________________
11) cesium sulfide ____________________
12) potassium chloride ____________________
13) strontium phosphide ____________________
14) barium iodide ____________________
15) sodium fluoride ____________________
16) calcium bromide ____________________
17) beryllium oxide ____________________
18) strontium sulfide ____________________
19) boron fluoride ____________________
20) aluminum phosphide ____________________

Nomenclature Rules for Metals That Can Form Two or More Types of Cations – Type II

The metals in the center of the periodic table (the transition metals) often form more than one type of cation. For example, lead can form Pb^{+2} and Pb^{+4} ions, and copper can form Cu^{+} and Cu^{2+} ions. This can be confusing when you are naming compounds. For example lead chloride could be $PbCl_2$ or $PbCl_4$. To resolve this problem the IUPAC devised the **Stock System** to name these compounds. In the stock system, when a compound contains a metal that can form more than one type of cation, the charge on the cation of the metal is designated by a Roman numeral placed in parenthesis immediately following the name of the metal. The anion (non-metal) of the compound is named in the usual manner for binary compounds.

As an example the metal iron forms two common ions, Fe^{2+} and Fe^{3+}. The first is called the iron(II) ion, and the second is the iron(III) ion. The Roman numeral immediately following the name of the metal indicates the charge on the ion. Thus, $FeCl_2$ is iron(II) chloride, while $FeCl_3$ is iron(III) chloride.

Example #1: Write the name for: $\mathbf{SnCl_2}$

Step #1 - the first part of the name is the unchanged name of the first element (the metal cation) in the formula. In this example, it would be tin.

Step #2 – since tin forms either a +2 or +4 cation the result from step one will be followed by a Roman numeral, either (II) or (IV). The charge on Cl is -1 and since there are 2 Cl atoms in the formula the total charge equals -2. Since the total charge of the formula unit must be zero (it is neutral) the charge on Sn must be +2. Therefore we use tin(II) for the name of the metal. Notice that there is no space between the name and the parenthesis.

Step #3 - the anion is named in the usual manner of stem plus "ide." In this example the name of the anion is derived in the following manner; take the stem of chlorine and add ide to it: chlor + ide = oxide.

The correct name of the example is tin(II) chloride.

Example #2: Write the name for: $\mathbf{Fe_2O_3}$

Step #1 - the first part of the name is the unchanged name of the first element in the formula. In this example, it would be iron.

Step #2 – since iron forms either a +2 or +3 cation the result from step one will be followed by a Roman numeral, either (II) or (III). The charge on O is -2 and since there are 3 O atoms in the formula the total charge equals -6. Since the total charge of the formula unit must be zero (it is neutral) the charge on each Fe atom must be +3 (2 x +3 = +6). Therefore we use iron(III) for the name of the metal.

Step #3 - the anion is named in the usual manner of stem plus "ide." In this example the name of the anion is derived in the following manner; take the stem of oxygen and add ide to it: ox + ide = oxide.

The correct name of the example is iron(III) oxide.

<u>Practice Problems – Given the Formula, Write the Name</u>

Write the correct name for the following Type II binary ionic compounds. Remember that metals involved in this problem can form two or more cations.

1) CuS ______________________________

2) $PbBr_4$ ______________________________

3) Pb_3N_2 ______________________________

4) Fe_2O_3 ______________________________

5) FeI_2 ______________________________

6) Sn_3P_4 ______________________________

7) Cu_2S ______________________________

8) $SnCl_2$ ______________________________

9) HgO ______________________________

10) Hg_2F_2 ______________________________

11) $CuCl_2$ ______________________________

12) $CuBr$ ______________________________

13) PbO ______________________________

14) Fe_2S_3 ______________________________

15) $PbCl_2$ ______________________________

16) SnO ______________________________

17) Cu_2O ______________________________

18) PbO_2 ______________________________

19) FeO ______________________________

20) SnO_2 ______________________________

Now let's practice writing formulas for Type II binary ionic compounds if given the name. Here are a few examples;

Example #1 - Write the formula for: **copper(II) chloride**

Step #1 - the first word tells you the symbol of the cation and the Roman numeral will tell you the charge on the cation. In this case we write Cu^{2+}.

Step #2 - the anion symbol and charge comes from the second name. In this case, chloride means Cl^{-}.

Step #3 - remembering the rule that a formula must have zero total charge, you write the formula $CuCl_2$.

Example #2 - Write the formula for: **iron(III) sulfide**

Step #1 - the symbol of the cation is Fe and it has a +3 charge (Roman numeral is 3) and so we write Fe^{+3}.

Step #2 - Sulfide (the anion) means S^{2-}.

Step #3 - since a formula must have zero total charge, you write the formula Fe_2S_3.

Example #3 - Write the formula for: **tin(IV) phosphide**

Step #1 -First symbol is Sn from the name tin and the Roman numeral IV gives +4 as tin's charge. We write Sn^{4+}.

Step #2 - Phosphide gives P^{3-}.

This compound's formula is Sn_3P_4.

<u>Practice Problems – Given the Formula, Write the Name</u>

Write the correct formula for the following Type II binary ionic compounds.

1) iron(II) chloride ____

2) copper(I) sulfide ____

3) lead(IV) iodide ____

4) tin(II) fluoride ____

5) chromium(II) nitride____

6) tin(II) oxide ____

7) chromium(III) oxide ____

8) gold(I) iodide ____

9) manganese(II) nitride ____

10) cobalt(III) phosphide ____

11) iron(III) chloride ____

12) copper(II) sulfide ____

13) lead(II) bromide ____

14) tin(IV) iodide ____

15) mercury(II) fluoride ____

16) tin(IV) oxide ____

17) manganese(III) chloride ____

18) chromium(II) nitride ____

19) gold(III) oxide ____

20) cobalt(II) phosphide ____

IV - Nomenclature Rules for Binary Molecular Compounds Containing Two Nonmetals

If the two elements in a binary compound are both nonmetals instead of a metal and a nonmetal, the compound is a molecular compound. Examples of binary molecular compounds include CO, NO, BF_3 and OCl_2. Nomenclature for these compounds follows the rules below:

1. In a compound formed between two nonmetals, the element that occurs first in this series is written and named first:

Si, B, P, H, C, S, I, Br, N, Cl, O, F

2. Write the name of the first element and use a Greek prefix to indicate the number of atoms of each element (except that mono is not used).

Prefix	Number
Mono	1
Di	2
Tri	3
Tetra	4
Penta	5
Hexa	6
Hepta	7
Octa	8
Nona	9
Deca	10

When the prefix ends with an “a” or “o” and the second element begins with a vowel, the a or o is often dropped.

3. Write the stem of the second element and add the suffix “ide.” Use a prefix to indicate the number of atoms for the second element.

Example #1 - write the name for **NO_2.**

Step #1 - The first element in the formula is nitrogen. Since there is only one nitrogen atom present we do not need to add a prefix, i.e., we do not write “mono” nitrogen just nitrogen.

Step #2 – The second element in the formula is oxygen. Since two oxygen atoms are present in the formula we add the prefix “di.”

The correct name for the compound is nitrogen dioxide.

Example #2 - write the name for **N_2O.**

Step #1 - The first element in the formula is nitrogen. Since there are two nitrogen atoms present we add the prefix “di” giving dinitrogen.

Step #2 – The second element in the formula is oxygen. Since one oxygen atom is present in the formula we add the prefix “mono.”

Step #3 – We drop one “o” and write monoxide rather than monooxide.

The correct name for the compound is dinitrogen monoxide.

Example #3 - write the name for **N_2O_5.**

Step #1 - the first element is nitrogen and there are two. This part of the name will be "dinitrogen."

Step #2 - the second element is oxygen, so "oxide" is used. Since there are five, the prefix "penta" is used.

Step #3 – We drop the “a” from penta and write pentoxide.

The correct name for the compound is dinitrogen pentoxide.

Practice Problems – Given the Formula, Write the Name

Write the correct name for the following binary molecular compounds.

Write the correct name for:

1) As_4O_{10} ________________

2) BrO_3 ________________

3) BN ________________

4) N_2O_3 ________________

5) NI_3 ________________

6) SF_6 ________________

7) XeF_4 ________________

8) PCl_3 ________________

9) CO ________________

10) PCl_5 ________________

11) P_2O_5 ________________

12) S_2Cl_2 ________________

13) ICl_2 ________________

14) SO_2 ________________

15) P_4O_{10} ________________

16) UF_6 ________________

17) OF_2 ________________

18) ClO_2 ________________

19) SiO_2 ________________

20) BF_3 ________________

Now let's practice writing formulas for binary molecular compounds if given the name. Here are a few examples;

Example #1 - write the formula for **dinitrogen trioxide**.

Example #2 - write the name for **carbon monoxide**.

Step #1 - the first name will tell you the first element in the formula. In the first example above, it would be N and in the second, C.

If there is a prefix on the name, this gives the subscript on the element. In the first example above, the "di-" tells you there are two nitrogen's. Absence of a prefix, as in the second example, says there is only one of that element involved.

Step #2 - the anion name tells you the element; oxide means oxygen. Once again, the prefix will tell you how many of the element are involved. "Tri-" means three and "mono-" means one.

The correct formulas of the two examples are N_2O_3 and CO.

Note that "monoxide' is written rather than "oxide" when there is one atom of the second element involved. Note also that when one element of the first atom is involved, no "mono-" is used. Monocarbon monoxide is just as wrong as carbon oxide.

Example #3 - write the formula for **bromine pentafluoride**.

Step #1 - the first symbol is Br and its subscript will be a one, which is understood to be present.

Step #2 - the second element is fluorine, so F is used. The prefix "penta-" indicates a subscript of 5.

The formula of this compound is BrF_5.

Example #4 - write the formula for **diphosphorous pentoxide**.

Step #1 - the first symbol is P and the subscript is 2.

Step #2 - pentoxide says five oxygen's are involved.

The formula of this compound is P_2O_5.

<u>Practice Problems – Given the Name, Write the Formula</u>

Write the correct formula for the following binary molecular compounds.

1) chlorine monoxide ______________________________

2) oxygen difluoride ______________________________

3) boron phosphide ______________________________

4) dinitrogen monoxide ______________________________

5) nitrogen trifluoride ______________________________

6) sulfur tetrachloride ______________________________

7) xenon trioxide ______________________________

8) carbon dioxide ______________________________

9) diphosphorous pentoxide ______________________________

10) phosphorous trichloride ______________________________

11) sulfur dioxide ______________________________

12) bromine pentafluoride ______________________________

13) disulfur dichloride ______________________________

14) boron trifluoride ____

15) tetraarsenic decoxide ____

16) silicon tetrachloride ____

17) krypton difluoride ____

18) chlorine monoxide ____

19) silicon dioxide ____

20) boron trichloride ____

V – Nomenclature for Naming Compounds Containing Polyatomic Ions

A polyatomic ion is an ion that contains two or more elements joined together by covalent bonds. Table 4 provides the names, formulas and charges of some common polyatomic ions;

Common Polyatomic Ions			
$C_2H_3O_2^-$	acetate	OH^-	hydroxide
NH_4^+	ammonium	ClO^-	hypochlorite
CO_3^{2-}	carbonate	NO_3^-	nitrate
ClO_3^-	chlorate	NO_2^-	nitrite
ClO_2^-	chlorite	$C_2O_4^{2-}$	oxalate
CrO_4^{2-}	chromate	ClO_4^-	perchlorate
CN^-	cyanide	MnO_4^-	permanganate
$Cr_2O_7^{2-}$	dichromate	PO_4^{3-}	phosphate
HCO_3^-	bicarbonate	SO_4^{2-}	sulfate
HSO_4^-	bisulfate	SO_3^{2-}	sulfite
HSO_3^-	bisulfite		

Ionic compounds containing polyatomic ions generally consist of one or more cations combined with a negative polyatomic ion. These compounds are not binary compounds. They contain three or more elements, as opposed to only two in a binary compound.

When naming these compounds, it is important that you learn to recognize the presence of a polyatomic ion in a formula and know their charges. Also, in these compounds, the cations used will be a mix of fixed charges (Type I) and variable charges (Type II). You must know which are which.

As an example, consider the formula $NaHCO_3$. The formula consists of two parts, a cation, Na^+ and a polyatomic ion, HCO_3^-. When naming compounds containing polyatomic ions we use the following rules;

1. Write the name of the cation

2. Write the name of the polyatomic anion

The correct name for the formula $NaHCO_3$ is therefore sodium bicarbonate.

When more than one unit of the corresponding polyatomic ion is required, parenthesis are used to enclose the ion with the subscript going outside the parenthesis. For example, the very first formula used is $Fe(NO_3)_2$. This means that two NO_3^- are involved in the compound. Here are some examples;

Example #1 - write the name for **$Fe(NO_3)_2$** Step #1 - decide if the cation is one showing variable charge. If so, a Roman numeral will be needed. In this case, iron <u>does</u> show variable charge.

If a variable charge cation is involved, you must determine the Roman numeral involved. You do this by computing the total charge contributed by the polyatomic ion. In this case, NO_3^- has a minus one charge and there are two of them, making a total of minus 2.

Therefore, the iron must be a positive two, in order to keep the total charge of the formula at zero.

Step #2 - determine the name of the polyatomic ion. Nitrate is the name of NO_3^-.

The correct name is iron(II) nitrate.

Example #2 - write the name for **NaOH**

Step #1 - the cation, Na^+, does not show a variable charge, so no Roman numeral is needed. The name is sodium.

Step#2 - OH^- is recognized as the hydroxide ion.

The name of this compound is sodium hydroxide.

Example #3 - write the name for **$KMnO_4$**

Step #1 - the cation, K^+, does not show a variable charge, so no Roman numeral is needed. The name is potassium.

Step#2 - MnO_4^- is recognized as the permanganate ion.

The name of this compound is potassium permanganate.

Example #4 - write the name for **Cu_2SO_4**

Step #1 - decide if the cation is one showing variable charge. If so, a Roman numeral will be needed. In this case, copper <u>does</u> show variable charge.

If a variable charge cation is involved, you must determine the Roman numeral involved. You do this by computing the total charge contributed by the polyatomic ion. In this case, SO_4^{2-} has a minus two charge and there is only one, making a total of minus 2.

Therefore, the copper must be a positive one. Why? Well, there must be a positive two to go with the negative two in order to make zero. Since the formula shows two copper atoms involved, each must be a plus one charge.

Step #2 - determine the name of the polyatomic ion. Sulfate is the name of SO_4^{2-}.

The correct name is copper(I) sulfate.

Example #5 - write the name for $\mathbf{Ca(ClO_3)_2}$

The first part of the name comes from the first element's name: calcium. You also determine that it is not a cation of variable charge.

The second part of the name comes from the name of the polyatomic ion: chlorate.

This compound is named calcium chlorate.

Practice Problems – Given the Formula, Write the Name

The cations in this first set are all of fixed oxidation state, so no Roman numerals are needed.

Write the correct name for:

1) $AlPO_4$ ______________________
2) KNO_2 ______________________
3) $NaHCO_3$ ______________________
4) $CaCO_3$ ______________________
5) $Mg(OH)_2$ ______________________
6) Na_2CrO_4 ______________________
7) $Ba(CN)_2$ ______________________
8) K_2SO_4 ______________________
9) NaH_2PO_4 ______________________
10) NH_4NO_3 ______________________

The cations in this set are all of variable oxidation state, so Roman numerals are needed.

Write the correct name for:

11) $Sn(NO_3)_2$ ______________________
12) $FePO_4$ ______________________
13) Cu_2SO_4 ______________________
14) $Ni(C_2H_3O_2)_2$ ______________________
15) $HgCO_3$ ______________________
16) $Pb(OH)_4$ ______________________
17) $Cu_2Cr_2O_7$ ______________________
18) $Cu(ClO_3)_2$ ______________________
19) $FeSO_4$ ______________________

20) $Hg_2(ClO_4)_2$ ______________________________

These formulas mix the use of the two types of cations.

Write the correct name for:

21) $KClO_3$ ______________________________

22) $SnSO_4$ ______________________________

23) $Al(MnO_4)_3$ ______________________________

24) $Pb(NO_3)_2$ ______________________________

25) $Mg_3(PO_4)_2$ ______________________________

26) CuH_2PO_4 ______________________________

27) $CaHPO_4$ ______________________________

28) $Fe(HCO_3)_3$ ______________________________

29) Na_2CO_3 ______________________________

30) $MnSO_4$ ______________________________

Now let's practice writing names for compounds containing polyatomic ions if given the formula. Here are a few examples;

Example #1 - write the formula for **copper(II) chlorate**

Step #1 - the first word tells you the symbol of the cation. In this case it is Cu.

Step #2 - the Roman numeral **WILL** tell you the charge on the cation. In this case it is a positive two.

Step #3 - the polyatomic formula and charge comes from the second name. In this case, chlorate means ClO_3^-.

Step #4 - remembering the rule that a formula must have zero total charge, you write the formula $Cu(ClO_3)_2$.

Example #2 - write the formula for **silver cyanide**

Step #1 - the first word tells you the symbol of the cation. In this case it is Ag^+.

Step #2 - silver has a constant charge of +1, it is not a cation with variable charge.

Step #3 - the polyatomic formula and charge comes from the second name. In this case, cyanide means CN^-.

Step #4 - remembering the rule that a formula must have zero total charge, you write the formula AgCN.

Example #3 - write the formula for **sodium phosphate**

Step #1 - the cation, sodium, is Na^+, and it does not show a variable charge.

Step#2 - phosphate is PO_4^{3-}.

The formula of this compound is Na_3PO_4. Notice that no parenthesis are required since only one polyatomic is used.

Example #4 - write the name for **barium carbonate**

Step #1 - the cation, barium, does not show a variable charge and its symbol is Ba^{2+}.

Step#2 - carbonate is CO_3^{2-}.

The formula of this compound is $BaCO_3$.

The cations in this first set are all of fixed oxidation state, so no Roman numerals are needed.

<u>Practice Problems – Given the Name, Write the Formula</u>

The cations in this first set are all of fixed oxidation state, so no Roman numerals are needed.

Write the correct formula for:

1) silver carbonate

2) potassium hydrogen phosphate

3) aluminum hydroxide

4) sodium hydrogen carbonate

5) calcium acetate

6) potassium permanganate

7) calcium perchlorate

8) lithium carbonate

9) magnesium hydrogen sulfite

10) sodium hypochlorite

The cations in the following set are all of variable oxidation state, so Roman numerals are needed.

Write the correct formula for:

11) tin(IV) chlorite ____________________

12) mercury(II) phosphate ____________________

13) tin(II) carbonate ____________________

14) mercurous acetate ____________________

15) lead(II) chromate ____________________

16) copper(I) sulfite ____________________

17) stannous dichromate ____________________

18) iron(III) nitrate ____________________

19) ferric sulfate ______________________________

20) ferrous hydroxide ______________________________

These formulas mix the use of the two types of cations.

Write the correct formula for:

21) potassium perchlorate ______________________________

22) lead(IV) hydrogen phosphate______________________________

23) aluminum sulfate ______________________________

24) iron(II) bicarbonate ______________________________

25) barium iodate ______________________________

26) tin(II) hydrogen sulfide ______________________________

27) magnesium dihydrogen phosphate ______________________________

28) silver phosphate ______________________________

29) cobalt(III) nitrite ______________________________

30) ammonium sulfate ______________________________

31) ammonium nitrate ______________________________