Ionic Compound Nomenclature

Formulas & Theorems Covered Today:

Homework:
Complete Associated Naming and Formulas Document

Notes:

Chemical Compounds

- There are two main types of chemical compounds, molecular and ionic.
- Molecular compounds are made of atoms which are tightly bound together.
- Generally, molecular compounds are made from two or more nonmetallic atoms.
- Ionic compounds are made of positive and negatively charged ions, which are held together with electrostatic attractions.
- Cations, or positive ions, are formed when metal atoms lose electrons.
- Anions, or negative ions, are formed when nonmetal atoms gain electrons.
- Ionic compounds are generally made from metallic plus nonmetallic ions.

Monatomic Ions

- The ionic charges of monatomic ions often can be determined by using the periodic table.
- The formulas of monatomic ions are written as the element symbol followed by the charge written as a superscript.
- Charges are written as the numerical value followed by the + or – sign.
- If the numerical value of the charge is one, only the + or – is written.
- Metals in Groups 1A, 2A, and 3A lose electrons when they form cations.
- Their ionic charge is positive and numerically equal to the group number.
- Their names are the same as the metal name (as in the sodium ion, Na+).
- Group A nonmetals form anions, and their charge can be obtained by subtracting 8 from the group number; the sign is negative.
- Their names end in –ide (as in oxide ion, O_2^-). Nonmetals in Group 4A and Group O normally do not form ions.

Naming Rules for Binary Monovalent Compounds

1. Name the metal (cation) in the chemical as its name appears on the periodic table
2. Identify the non-metal (anion) from the periodic table
3. Change the non-metal's ending to "ide"

$NaBr$ — Sodium Bromide
$MgCl_2$ — Magnesium Chloride
Sr_3P_2 — Strontium Phosphide
Rb_2S — Rubidium Sulphide
AlF_3 — Aluminum Fluoride

Creating Binary Monovalent Formulas

1. Write down the symbols for the elements involved leaving a space between the elements
2. In the inner upper corners of the elements, place the valence numbers for the elements
3. Criss cross the numbers
4. Reduce if possible

Lithium Fluoride

$Li^{1}\ F^{1}$

LiF

Barium Iodide

$Ba^{2}\ I^{1}$

BaI_2

Calcium Oxide

$Ca^{2}\ O^{2}$

CaO

Beryllium Phosphide

$Be^{2}\ P^{3}$

Be_3P_2

Polyatomic Ions

- Polyatomic ions are tightly bound groups of atoms that behave as a unit and carry a charge.
- The ammonium ion is a polyatomic cation.
- The names of most polyatomic anions end in either –ite or –ate.
- There are a few exceptions, including cyanide (CN^-) and hydroxide (OH^-).
- If polyatomic anions containing oxygen exist as an –ite/-ate pair, the charge on the pair is the same, and the –ite ending indicates one less oxygen atom than the –ate ending.
- Nitrite is NO_2^- and nitrate is NO_3^-.
- For a series of polyatomic anions containing oxygen (oxyanions) containing more than two members, the ion with the largest number of oxygen atoms has the prefix per- and the suffix –ate; the ion with the smallest number of oxygen atoms has the prefix hypo and the suffix -ite.
- The oxyanions containing chlorine are the most common examples:

ClO_4^- is the perchlorate ion
ClO_3^- is the chlorate ion
ClO_2^- is the chlorite ion
ClO^- is the hypochlorite ion

Naming Rules for Ionic Compounds containing Polyatomic Ions

1. Name the cation (metal or ammonium) as the name appears on the periodic table or the table of polyatomic ions
2. Name the anion (non-metal or polyatomic ion) as the name appears on the periodic table or the table of polyatomic ions (make sure to account for any name changes for the oxyanions)

$NaClO_3$ – Sodium Chlorate

$MgBrO_2$ – Magnesium bromite

$(NH_4)_2SO_2$ – Ammonium hyposulphite

Creating formulas for Ionic Compounds containing Polyatomic Ions

1. Write down the symbols for the elements or polyatomic ions involved leaving a space between the elements
2. In the inner upper corners of the elements or polyatomic ions, place the valence numbers for the elements (note: that the polyatomic ions valence number can be found next to the ions on the polyatomic ion sheet)
3. Criss cross the numbers (note: if the number being placed in the subscript of the polyatomic ion is large than 1, you must place the polyatomic ion in brackets)
4. Reduce if possible

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4. Reduce if possible

Lithium Cyanide – $Li^{1}{}_{1}CN$ = $LiCN$

ammonium dichromate – $NH_4{}^{1}{}_{1}Cr_2O_7{}^{2}{}_{2}$ = $(NH_4)_2Cr_2O_7$

Multivalent Metals

- Many of the transition metals (Group B) form cations with more than one charge.
- This is also a characteristic of the cations of tin and lead, the two metals of Group 4A. (Exceptions: Ag forms only 1^+ cations; Zn and Cd form only 2^+ cations).
- There are two methods of naming transition metal ions having a variable charge.
- In the Stock system of naming, a Roman numeral in parentheses is used in the ion's name to indicate the numerical value of the charge.
- The Fe^{2+} ion is named the iron(II) ion. (There is no space between the element name and the parenthesis.)
- In the classical system of naming, the classical name of the element (such as ferr-, from ferrium, Latin for iron) is used as a root word, and a suffix is used to indicate the charge.
- The root word is followed by the suffix –ous to name the cation with the lower of the two ionic charges, and the suffix –ic is used with the higher of the two ionic charges.
- The Fe^{2+} ion is named the ferrous ion and the Fe^{3+} ion is named the ferric ion.

Naming Rules for Ionic Compounds Containing Multivalent Metals

1. Name the metal as the name appears on the periodic table or the table of polyatomic ions
2. Name the anion (non-metal or polyatomic ion) as the name appears on the periodic table or the table of polyatomic ions (make sure to account for any name changes for the oxyanions)
3. To determine the roman numeral for the metal
    a. uncross the subscripts
    b. Compare the value given to the anion to that on the periodic table or the polyatomic ion sheet.
        i. If they match use the number given to the metal as the roman numeral and place it between the name for the metal and non-metal
        ii. If they do not match, use a multiplier to equate the value to what it is on the periodic table or polyatomic ion sheet, do the same for the subscript given to the metal and then use that as the roman numeral for the metal placing it between the metal and non-metal.

Cu_2O – copper (I) oxide

CuO – copper (II) oxide

PbO_2 – lead (IV) oxide

$Mn_2(SO_3)_5$ – manganese (II) sulphite

Creating formulas for Ionic Compounds containing Multivalent Metals

1. Write down the symbol for the multivalent metal and the anion (element or polyatomic ion) leaving

a space between them.

2. In the inner upper corners of the metal and anions, place the valence numbers for the elements (note: that the multivalent metal's valence number can be found in the roman numeral of the name)
3. Criss cross the numbers (note: if the number being placed in the subscript of the polyatomic ion is large than 1, you must place the polyatomic ion in brackets)
4. Reduce if possible

gold(III) chloride – $Au^{3}Cl_{1}$ $AuCl_3$

Chromium(VI) phosphite – $Cr(PO_3)_2$