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Nomenclature Chapter 4

Nomenclature: a fundamental system in chemistry for naming compounds and writing their formulas.

Binary Compound: compounds composed of two elements. They are divided into two classes:

1) Compounds containing a metal and a nonmetal
2) Compounds containing two nonmetals

Naming compounds that contain a metal and nonmetal:

Binary Ionic Compound: Contains a positive ion (cation), which is always written first in the formula, and a negative ion (anion), which comes after the cation. They contain a metal and a nonmetal.

There are two types of *binary ionic* compounds:

Type I compounds: metal present forms only one type of cation. (fixed oxidation)

a. The cation is named first and then the anion second.
b. The cation keeps its basic element name, ex: in NaCl, Na is still called sodium
c. The anion's ending is dropped and then "ide" is added, ex: in NaCl, Cl becomes chlor*ide*

The name of the compound is Sodium Chloride

Type II compounds: the metal present can form two or more cations that have multiple oxidation states

-There are many elements that contain multiple potential oxidation states. For example if you observe iron on the periodic table you will see that it has a +2 oxidation state and a +3 oxidation state. Therefore, we need to somehow show which oxidation state the iron is using.

- You can figure out which oxidation state iron is using by looking at how many anions are in the compound, such as $FeCl_2$, which has two anions. We know that Cl (Chlorine) has a -1 oxidation state and we know that there are two chlorines. Therefore, there is a total anion charge of -2. Since the compound needs to have a balanced charge, we know that iron (the cation) is using its +2 oxidation state.

-When writing out the formula, we indicate the iron's +2 oxidation state in the form of a roman numeral in parenthesis after the cation. Like type I compounds, the anion adds an "ide" at the end.

The name of the compound is Iron (II) Chloride

Type III Binary Compounds: compounds containing two nonmetals

a) The cation is named first using its full element name.
b) The second element is named as though it were an anion; still using "ide" at the end.
c) Prefixes are used to show the amount of atoms present

Prefixes	Number Indicated
Mono	1
Di	2
Tri	3
Tetra	4
Penta	5
Hexa	6
Hepta	7
Octa	8

**Mono* is never used in naming the first element

Example:
BF_3
Boron *tri*flouride

N_2O_5
*Di*nitrogen *pent*oxide

Polyatomic Ions:

*very similar to naming binary ionic compounds.

In the reference packet, table E has a list of most of the polyatomic ions. Like the periodic table, you can see the different oxidation states of each polyatomic ion.You can also see the different names for the different polyatomic ions. All you need to do is learn to recognize the different Poyatomic ions, and from there you use the same naming system as for binary ionic compounds!

Example:

NaOH…hmmm that "OH" looks like a polyatomic ion to me, let me go check:

Looking at table E, you can see that OH^- is a polyatomic ion called "hydroxide." Looking at the periodic table of elements, we know that Na is "sodium."……NaOH=Sodium hydroxide!

But what if the compound looks scary? Like this➔

$Fe(NO_3)_3$

Don't worry! It's just like a type II binary compound! If you look in table E, you see that NO_3 is called "nitrate." We can also see that nitrate has a -1 oxidation state. The compound above uses a "3" outside of the parenthesis to show that there are 3 nitrates. That means that there is a total anion charge of -3. Since we need to balance the charge of the compound, we know that the Iron must be using it's +3 oxidation state!....

$Fe(NO_3)_3$ = Iron (III) nitrate!

Chapter 4 Review

Vocabulary Questions

True or False If false, state the right answer

1. Nomenclature is the fundamental system in chemistry for naming compounds and writing their formulas.
2. A binary compound is composed of only two nonmetals.
3. A positive ion is an anion.
4. A negative ion is an anion.
5. Hepta means 5.
6. Polyatomic Ions contain charges.
7. Binary Ionic Compounds contain a metal and a nonmetal.
8. Type III Binary Compounds contain a metal and a nonmetal.
9. A prefix is used to show the amount of atoms present.
10. Mono is always used when naming the first element.

Multiple Choice:

11. The Prefix Octa stands for
    a. 5
    b. 4
    c. 8
    d. 9
12. When writing a Type III Binary Compound, the cation is named

a. First
b. Last
c. Not at all

13. In Type II Compounds
    a. The metal is present and forms cations with multiple oxidation states
    b. The metal is not present and forms anions with one oxidation state
14. Cation has
    a. No charge
    b. Positive charge
    c. Negative charge
    d. Neutral charge
15. An aqueous solution is
    a. A binary compound
    b. A phosphate
    c. An acid
    d. None of the above

Written Questions:

16. Describe a polyatomic ion and give an example of one
17. Give an example of a binary compound
18. What are the two major types of Binary Compounds
19. Describe an anion and when it is used
20. What type of compound only contains nonmetals?

Chapter 4 Problems

1. What is the name for KCl?
2. What is the name for CsO?
3. What is the formula for osmium(IV) oxide?
4. What is the name for $Hg_2Cr_2O_7$?
5. What is the name for $FePO_4$?

6. What is the formula for manganese(II) hydroxide?
7. What is the formula for sodium sulfite?
8. What is the name for BF_3?
9. What is the formula for dinitrogen tetroxide?
10. What is the formula for $Sc_2(S_2O_3)_3$?

Integrated Problems

1. What is the molar mass of potassium sulfide?
2. What is the mass of 4.8 mol of potassium sulfide?
3. Write calcium sulfate as a compound and figure out its empirical formula
4. Write Beryllium Oxide as a compound.
5. How many atoms are in the compound CO_2?