Science 9

Chemistry V

Name: Notes
Date:
Block:

1. **Naming Ionic Compounds**
2. **Naming Covalent Compounds**
3. **Compounds with Multivalent Metals**
4. **Compounds with Polyatomic Ions**

Naming Ionic Compounds

Review:
Ionic compounds consist of a metal and a non-metal ion.

- They occur when the metal transfers one or more electrons to the non-metal.
- They are bonded together by ionic bonds.

When elements form a compound, we are able to refer to these compounds using either its chemical name or its chemical formula.

Chemical Name:
The name of ionic compounds comes from the name of its elements. It is made up of two parts:

1.) The name of the METAL ion (positive ion) ALWAYS comes first.
   a. We DO NOT change the name of the metal element.
2.) The name of the NON-METAL ion (negative ion) comes second.
   a. We change the ending of the name of the non-metal ion to the suffix *–ide*.

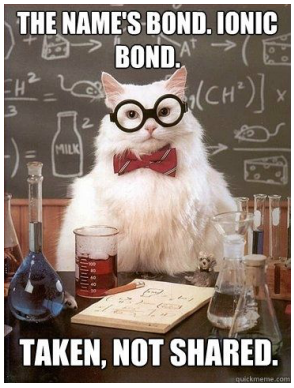
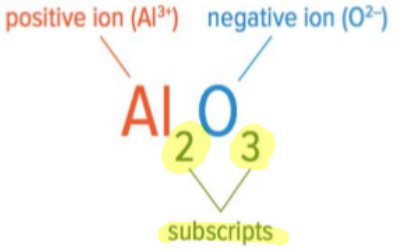


Table 2.5 Ions of Non-Metals

Element	Ion	Symbol	Group
fluorine	fluoride	F^-	17
chlorine	chloride	Cl^-	17
bromine	bromide	Br^-	17
iodine	iodide	I^-	17
oxygen	oxide	O^{2-}	16
sulfur	sulfide	S^{2-}	16
selenium	selenide	Se^{2-}	16
nitrogen	nitride	N^{3-}	15
phosphorus	phosphide	P^{3-}	15

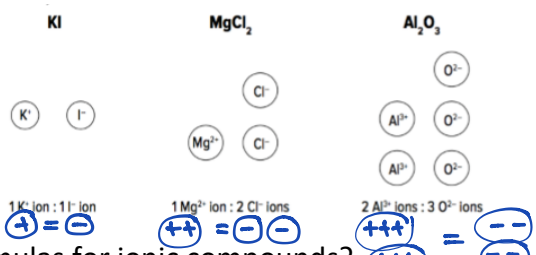
Chemical Symbol	Chemical Name
Li_2O (metal, nonmetal)	Lithium oxide
CaF_2	Calcium fluoride
MgS	Magnesium sulfide

Chemical Formula:



The chemical formula for a compound is composed of its chemical symbols.

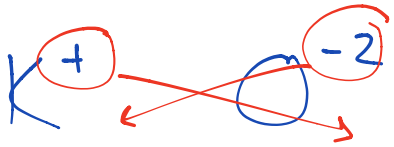
- The symbol for the METAL ion (positive ion) ALWAYS comes first.
- The symbol for the NON-METAL ion (negative ion) comes second.
- Subscripts are used in order to indicate the ratio for each type of ion in the compound.
    - When there is NO SUBSCRIPT, we assume that the number is 1.
- Although an ionic compound is made up of ions, the compound's overall charge has to be zero (positive charges must balance the negative charges).



How do we write the chemical formulas for ionic compounds?

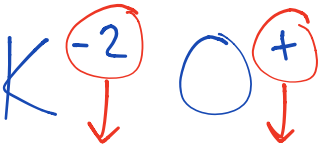
1.) Identify and write the symbol and charge of the elements in the compound (Note: the METAL comes first!)

Ex: Potassium oxide



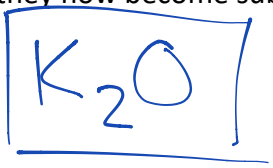
2.) SWAP: Swap the charges of the ions

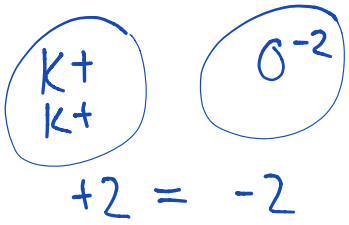
Ex:



3.) DROP: Drop the charges of the ions so they now become subscripts

Ex:



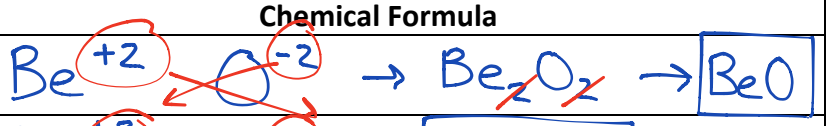


4.) CHOP: Take away the parts of the subscript that contain…

a. The signs (+/-)
b. If possible, reduce the subscripts to the lowest terms (i.e., Mn_2O_4 will become Mn_1O_2)
c. The number '1'

Ex:

ALWAYS CHECK TO SEE IF YOU HAVE AN IONIC COMPOUND!!!!

Chemical Name	Chemical Formula
Beryllium oxide	
Scandium sulfide	
Sodium fluoride	

Naming Covalent Compounds

Review:
Covalent compounds consist of only non-metals.

- They occur when the non-metals share their valence electrons with each other.
  - ***Note: these compounds DO NOT form ions.
- They are bonded together by covalent bonds.

Chemical Name:
The name of covalent compounds comes from the name of its elements. We use prefixes in order to indicate how many atoms are present in the molecule.

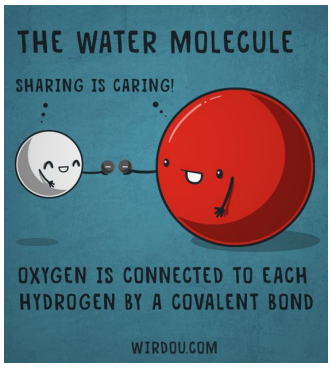


Table 2.8 Prefixes Used to Name Binary Covalent compounds

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

The name of a covalent compound is made up of two parts:

1.) Name the first non-metal element and add the appropriate prefix IN FRONT of the name.
   a. We DO NOT use the prefix 'mono-' for the first element.
2.) Name the second non-metal element and change the ending to the suffix *–ide*. Add the appropriate prefix in front of the element's name.

***Note: When the end of the prefix and the beginning of the element's name contains the same letter (i.e., 'mono-' and 'oxide'), we can drop one of the repeating letters.

Chemical Symbol	Chemical Name
CO_2	Carbon dioxide
H_2O	dihydrogen monoxide
SF_6	sulphur hexafluoride

Chemical Formula:
The chemical formula for a compound is composed of its chemical symbols.

- The prefixes that are attached to the element's name will indicate the subscript for the element.
  - Keep in mind that these compounds do not form ions. You do not need to look at the ion charges!
- For the first element, if it does not have a prefix in its name, we assume that the subscript is 1.

***Note: We DO NOT reduce the subscripts for covalent compounds. When there is no subscript, we assume that the number is 1.
***Note: DO NOT do the drop, swap, and chop method for covalent compounds. We only have to look at the prefixes of the compound's name to find the chemical formula.

Chemical Name	Chemical Formula
Dinitrogen tetroxide	N_2O_4
Nitrogen monoxide	NO
Phosphorus tetrahydride	PH_4

ALWAYS CHECK TO SEE IF YOU HAVE A COVALENT COMPOUND!!!!

Compounds with Multivalent Metals

A multivalent metal is a metal element that is able to form two or more types of ions with different charges. We tend to find the multivalent metals in families 3 – 12.

In order to indicate which charge the metal ion forms, we use roman numerals right after the name.

- Example: Copper can form ions with a +1 or a +2 charge.
  - Cu^{+}: Copper (I)
  - Cu^{+2}: Copper (II)

Table 2.6 Roman Numerals

Metal Ion Charge	Roman Numeral
1+	I
2+	II
3+	III
4+	IV
5+	V
6+	VI
7+	VII

Chemical Name:

Multivalent metals will always form an ionic compound. In order to find the chemical name of the compound, we have to first find out which charge the multivalent metal ion will form.

1.) Find which charge the multivalent metal ion will form.

Ex: Cr_2S_3

Cr^{3+} S^{2-} → Cr_2S_2 → CrS → Cr_2S_3

"guess and check"
"reverse swap & drop"

2.) Write the name of the metal ion (positive ion) first and indicate the charge of the ion with roman numerals. Be sure to place the roman numerals in brackets after the element's name.

Ex: Chromium (III)

3.) Write the name of the non-metal ion (negative ion) after the roman numerals and change the ending to '*-ide*'.

Ex: Chromium (III) sulphide

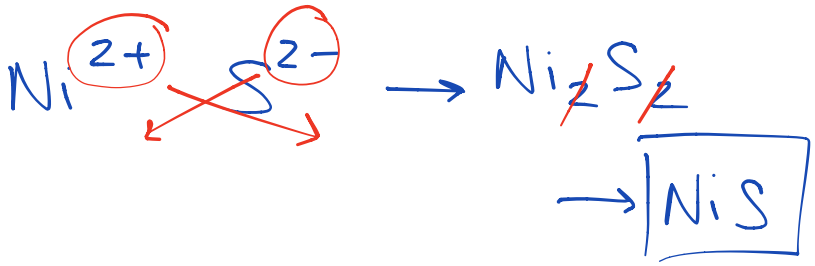
Chemical Symbol	Chemical Name
Fe_2O_3 Fe^{3+} O^{2-}	Iron (III) oxide
CoF_2 Co^{2+} F^-	Cobalt (II) fluoride
$Ti_2O_4 \rightarrow TiO_2$ Ti^{4+} O^{2-}	Titanium (IV) oxide

Chemical Formula:

The chemical formula for compounds that contain multivalent metals can be found by using the SWAP, DROP, and CHOP method as ALL multivalent metals will form an ionic compound.

- The roman numeral in the chemical name will indicate the ion charge of the multivalent metal. This will always be a positive charge.

Ex: Nickel (II) Sulfide



Chemical Name	Chemical Formula
Chromium (III) chloride	Cr^{3+} Cl^- → $CrCl_3$
Cobalt (II) sulfide	Co^{2+} S^{2-} → Co_2S_2 → CoS
Manganese (IV) bromide	Mn^{4+} Br^- → $MnBr_4$

Compounds with Polyatomic Ions

A polyatomic ion is an ion made up of two or more covalently bonded atoms.

- Example: carbonate ion (CO_3^{2-})
  - 1 carbon atom
  - 3 oxygen atoms

Polyatomic ions will form an ion charge. If the ion charge is positive, we will treat the polyatomic ion as a metal. If the ion charge is negative, we will treat the polyatomic ion as a non-metal.

Table 2.7 Names, formulas, and charges of some common polyatomic ions

1+ Charge	1− Charge	2− Charge	3− Charge
ammonium, NH_4^+	acetate, CH_3COO^- chlorate, ClO_3^- chlorite, ClO_2^- hydrogen carbonate, HCO_3^- hydroxide, OH^- nitrate, NO_3^- nitrite, NO_2^- permanganate, MnO_4^-	carbonate, CO_3^{2-} chromate, CrO_4^{2-} dichromate, $Cr_2O_7^{2-}$ peroxide, O_2^{2-} sulfate, SO_4^{2-} sulfite, SO_3^{2-}	phosphate, PO_4^{3-} phosphite, PO_3^{3-}

metal

non-metals

We can treat polyatomic ions as one large element. We CANNOT separate polyatomic ions into its parts.

Chemical Name:

Polyatomic ions will always form an ionic compound. We DO NOT change the name of the polyatomic ion (i.e., we do not change the suffix of the polyatomic ion to '*-ide*').

Ex: $Ca_3(PO_4)_2$

Calcium phosphate

Chemical Symbol	Chemical Name
$Ca(NO_3)_2$	Calcium nitrate
$Be(ClO)_2$	Beryllium hypochlorite
$(NH_4)_2S$	Ammonium sulphide

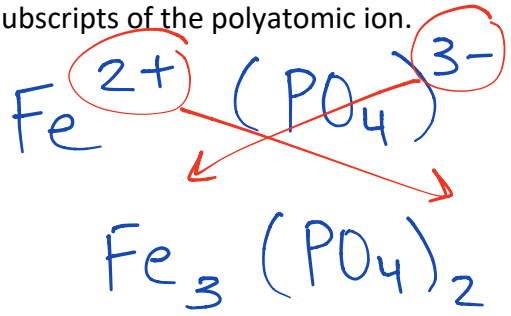
Chemical Formula:

The chemical formula for compounds that contain polyatomic ions can be found by using the SWAP, DROP, and CHOP method as ALL compounds that have a polyatomic ion will form an ionic compound.

- When we have more than one group of polyatomic ions in a compound, we will have to place brackets around the polyatomic ion symbols before writing the subscript.
    - Be sure to place the subscript outside of the brackets.

***Note: The subscripts that are contained within the polyatomic ion are NOT part of the 'chop' step. We DO NOT change the symbols or the subscripts of the polyatomic ion.

Ex: Iron (II) phosphate



Chemical Name	Chemical Formula
Calcium nitrate	$Ca^{2+}(NO_3)^{-} \rightarrow Ca(NO_3)_2$
Sodium hydroxide	$Na^{+}(OH)^{-} \rightarrow Na(OH)$
Cobalt (III) sulfite	$Co^{3+}(SO_3)^{2-} \rightarrow Co_2(SO_3)_3$