4.5 Predict ratios forming ionic compounds and use chemical formulas

Review of Terms!

1. **Cation**: positively charged ion
   - Non metal or metal?

2. **Anion**: negatively charged ion
   - Non metal or metal?

Chemical Formula Terms

1. **Symbol**: notes the element being used

2. **Subscript**: shows how many of the individual atoms are present

   ex. O_2

   CO_2

   HBr

3. **Binary Compounds**: composed of 2 elements

Chemical Formula Terms

4. **<u>Oxidation Number</u>**: same as "charge", how many electrons atoms need to gain or lose (to become stable)

   ****get off of periodic table!!**

   ****write them on your P.T. (Al = +3)**

5. **<u>Coefficient Number</u>**: placed *before* the element or compound, distributed to entire compound

ex. 2HBr

$2H_2 + O_2 \rightarrow 2H_2O$

Chemical Formulas

The chemical symbols and numbers indicating the number of atoms contained in the basic unit of a substance

$C_6H_{12}O_6$

Carbon = 6 atoms

Hydrogen = 12 atoms

Oxygen = 6 atoms

How many atoms of each element are present in 3 molecules of glucose?

$3C_6H_{12}O_6$

C=18 H=36 O=18

1. **How many oxygen atoms are there in bleach, also known as sodium hypochlorite (NaClO)?**
2. **Acetone (CH_3COCH_3) or nail polish remover has how many total hydrogen atoms?**
3. **How do you determine oxidation numbers?**
4. **What is the oxidation number of Al, O, and Cl?**

Writing Ionic Formulas

- The elements overall charges have to equal zero
  - Compounds have no net charge!!
- Write the cation first with its charge, then the anion and its charge.
  - Al^{+3} F^{-1}
- Write the chemical formula, using subscripts to indicate how many of each ion are needed to make a neutral compound.
  - use the criss-cross method: Al^{+3} F^{-1} = AlF_3

MORE COMPOUNDS!!

- **Balance the formula so the compound formed has a neutral charge**

Examples:

Ca^{+2} + Br^{-1}

- **Na^{+1} + S^{-2}**

- **Al^{+3} + Cl^{-1}**

Learning Check

Indicate whether a bond between the following would be 1) Ionic 2) covalent

_____ A. sodium and oxygen

_____ B. nitrogen and oxygen

_____ C. phosphorus and chlorine

_____ D. calcium and sulfur

_____ E. chlorine and bromine

Solution

Indicate whether a bond between the following would be 1) Ionic 2) covalent

1 A. sodium and oxygen

2 B. nitrogen and oxygen

2 C. phosphorus and chlorine

1 D. calcium and sulfur

2 E. chlorine and bromine

Ionic Compounds

- Attraction between _____ ions and _____ ions
- Metals _____ electrons and form _____ ions.
- Nonmetals _____ electrons and form _____ ions.

Valence Electrons

What are valence electrons?

What is the importance of valence electrons?

How can you determine the number of valence electrons?

Lewis (Electron-Dot) Structures

What does the octet rule state?

Write the electron-dot structures for:

1. Sr 2. Fe 3. Bi 4. Br

Learning Check

Write the correct formula for the compounds containing the following ions:

A. Na^{+}, S^{2-}

B. Al^{3+}, Cl^{-}

C. Mg^{2+}, N^{3-}

Solution

A. Na^{+}, S^{2-}

2) Na_2S

B. Al^{3+}, Cl^{-}

1) $AlCl_3$

C. Mg^{2+}, N^{3-}

3) Mg_3N_2

Naming Binary Ionic Compounds

- Contain 2 different elements
- Name the metal first, then the nonmetal, modifying the suffix to ***-ide***.
- Use name of a metal with a fixed charge

  Groups 1, 2, 13 and Ag (+1), Zn (+2), and Cd (+2)

Examples:

NaCl	sodium chloride
ZnI_2	zinc iodide
Al_2O_3	aluminum oxide

Learning Check

Complete the names of the following binary compounds:

Na_3N _____

KBr _____

Al_2O_3 _____

MgS _____

Solution

Complete the names of the following binary compounds:

Na_3N	sodium nitride
KBr	potassium bromide
Al_2O_3	aluminum oxide
MgS	magnesium sulfide

Transition Metals

Many form 2 or more positive ions, ALWAYS give oxidation number in parenthesis after symbol

1+	2+	1+ or 2+	2+ or 3+
Ag^{+}	Cd^{2+}	Cu^{+}, Cu^{2+}	Fe^{2+}, Fe^{3+}
silver ion	cadmium ion	copper(I) ion copper (II) ion	iron(II) ion iron(III) ion
	Zn^{2+} zinc ion		

Learning Check

A. The formula for the ionic compound of Na^{+} and O^{2-} is

B. The formula of a compound of aluminum and chlorine is

C. The formula of Fe^{3+} and O^{2-} is

Solution

A. The formula for the ionic compound of Na^+ and O^{2-} is

2) Na_2O

B. The formula of a compound of aluminum and chlorine is

3) $AlCl_3$

C. The formula of Fe^{3+} and O^{2-} is

3) Fe_2O_3

Names of Variable Ions

Use a roman number after the name of a metal that forms two or more ions

Transition metals and the metals in groups 4A and 5A

$FeCl_3$	(Fe^{3+})	iron (III) chloride
$CuCl$	(Cu^{+})	copper (I) chloride
SnF_4	(Sn^{4+})	tin (IV) fluoride
$PbCl_2$	(Pb^{2+})	lead (II) chloride
Fe_2S_3	(Fe^{3+})	iron (III) sulfide

Learning Check

Complete the names of the following binary compounds with variable metal ions:

$FeBr_2$ _____

Cu_2O _____

$SnCl_4$ _____

Fe_2O_3 _____

CuS _____

Solution

Complete the names of the following binary compounds with variable metal ions:

$FeBr_2$	iron (II) bromide
Cu_2O	copper (I) oxide
$SnCl_4$	tin (IV) chloride
Fe_2O_3	iron (III) oxide
CuS	copper (II) sulfide

Learning Check

Name the following compounds:

A. CaO

1) calcium oxide
2) calcium(I) oxide
3) calcium (II) oxide

B. $SnCl_4$

1) tin tetrachloride
2) tin(II) chloride
3) tin(IV) chloride

C. Co_2O_3

1) cobalt oxide
2) cobalt (III) oxide
3) cobalt trioxide

Solution

Name the following compounds:

A. CaO — **1) calcium oxide**

B. $SnCl_4$ — **2) tin(IV) chloride**

C. Co_2O_3 — **3) cobalt (III) oxide**