

# Chapter 6: Chemical Names and Formulas

Which of the following are molecules (circle all)?

- a.  $\text{MgCl}_2$
- b.  $\text{H}_2\text{O}$
- c.  $\text{SnF}_2$
- d. Ag
- e.  $\text{Br}_2$

Which of the following are molecular compounds?

- $\text{H}_2\text{SO}_4$     $\text{Pb}(\text{NO}_3)_2$
- NaCl    $\text{NH}_3$

The prefix di- means \_\_\_\_\_  
The prefix tri- means \_\_\_\_\_

What prefixes would you use to describe a compound with four carbons and 10 hydrogen?

## 6.1 Introduction to Chemical Bonding

\_\_\_\_\_:

- the smallest electrically neutral unit of a substance that still has the properties of the substance.
- made up of \_\_\_\_\_ atoms that act as a unit.

EX:

**Molecular Compounds (aka \_\_\_\_\_)**

- are compounds composed of \_\_\_\_\_.
- Have \_\_\_\_\_ melting and boiling points.
- are usually made up of two or more \_\_\_\_\_.

Which of the following are covalent/molecular compounds?

- NaCl
- $\text{H}_2\text{O}$
- $\text{CaCO}_3$
- CO
- $\text{Al}_2\text{O}_3$
- $\text{CF}_4$
- $\text{O}_3$

\_\_\_\_\_ **molecules** are those that contain two atoms.

EX:  $\text{O}_2$     $\text{H}_2$

**Triatomic molecules** are those that contain \_\_\_\_\_ atoms.

EX:  $\text{O}_3$

### Molecular Compounds and Acids

#### Binary Molecular Compounds

- When naming \_\_\_\_\_, prefixes are used to tell how many of each atom is in the formula.
- $\text{CO}_2$  carbon dioxide
- $\text{N}_2\text{O}_4$  \_\_\_\_\_

The prefix mono- is never used with the first element. (The prefix list in on page 159.)

- |          |          |
|----------|----------|
| 1- mono  | 6- hexa  |
| 2- _____ | 7- _____ |
| 3- tri   | 8- _____ |
| 4- _____ | 9- nona  |
| 5- penta | 10- deca |

EX: \_\_\_\_\_ - phosphorous tribromide                      \_\_\_\_\_ -  $\text{SF}_6$   
 $\text{ICl}_3$  - \_\_\_\_\_                      tetraarsenic hexoxide - \_\_\_\_\_  
 $\text{P}_2\text{O}_5$  - diphosphorous

## Acids and Bases

You need to know the names and formulas of these most common acids:

- HCl \_\_\_\_\_
- H<sub>2</sub>SO<sub>4</sub> \_\_\_\_\_
- HNO<sub>3</sub> \_\_\_\_\_
- HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> \_\_\_\_\_
- H<sub>3</sub>PO<sub>4</sub> \_\_\_\_\_

## IONIC BONDING

- are atoms or groups of atoms that have a positive or a negative charge.
- are formed when an atom or group of atoms \_\_\_\_\_ electrons.

### EX:

- Sodium loses an electron Na → \_\_\_\_\_
- Magnesium loses \_\_\_\_\_ electrons Mg → Mg<sup>+2</sup>
- Chlorine \_\_\_\_\_ an electron Cl → Cl<sup>-</sup>
- Phosphorous gains 3 electrons P → \_\_\_\_\_

### Cations

- \_\_\_\_\_ charged ions
- electrons were lost
- \_\_\_\_\_ usually form cations
- the **name of a monatomic ion is the same as the element**

EX: Mg<sup>2+</sup> Ag<sup>+</sup> Al<sup>3+</sup>

### Anions

- \_\_\_\_\_ charged ions
- electrons were \_\_\_\_\_
- \_\_\_\_\_ usually form anions
- monatomic anions **end in -ide**

EX: Cl<sup>-</sup> P<sup>3-</sup> O<sup>2-</sup>

“We think positively about cats (cations) and negatively about ants (anions)!”

### Ionic Compounds

- composed of cations and anions
  - usually a \_\_\_\_\_
  - electrically neutral
  - solids at room temperature
  - \_\_\_\_\_ melting points
  - EX: NaCl NaF CaCl<sub>2</sub>
- The more positive element (metal) always comes first.

Atom “X” loses one electron. What is its new charge?

What if atom “X” loses three electrons?

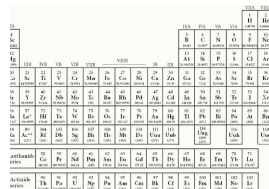
Classify the following as cations or anions.

H<sup>+</sup> \_\_\_\_\_  
K<sup>+</sup> \_\_\_\_\_  
F<sup>-</sup> \_\_\_\_\_  
C<sup>+4</sup> \_\_\_\_\_  
N<sup>3-</sup> \_\_\_\_\_

What are the properties of ionic compounds?

## Ionic Charges

Use this table to fill in the ion charges.



The charge for many ions can be predicted from their position on the periodic table

Group 1-A: \_\_\_\_\_ Group 5-A: \_\_\_\_\_

Group 2-A: \_\_\_\_\_ Group 6-A: \_\_\_\_\_

Group 3-A: \_\_\_\_\_ Group 7-A: \_\_\_\_\_

Group 8-A or Group 0 do not form ions

- Group 4-A elements rarely form ions. They usually share electrons and form molecular compounds, not ionic compounds.

*What causes the charges for each group on the periodic table?*

The charges indicate how many \_\_\_\_\_ an atom will gain or lose.

### Octet Rule and Stability

The goal of an atom is to become \_\_\_\_\_. An atom will \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_ electrons in order for that stability to be attained.

Stability is determined by the \_\_\_\_\_:

- Most atoms want \_\_\_\_\_ valence (outer shell) electrons in order to become stable.

EX: O \_\_\_\_\_ P \_\_\_\_\_ F \_\_\_\_\_ Na \_\_\_\_\_ Mg \_\_\_\_\_ Al \_\_\_\_\_ Sr \_\_\_\_\_

Transition metals often form \_\_\_\_\_. They can be stable losing a varying number of electrons.

- There are three exceptions:  $Zn^{2+}$ ,  $Cd^{2+}$ , and  $Ag^+$

Stock names have Roman numerals to represent the charge of the particular ion.

What is the formula for the following transition metals as ions?

- Copper (I) \_\_\_\_\_
- Iron (III) \_\_\_\_\_
- Lead (II) \_\_\_\_\_
- Manganese (III) \_\_\_\_\_

The mercury ion is unique. It only exists in pairs of mercury (I) ions (like Siamese twins). Its symbol is  $Hg_2^{2+}$ .

### Polyatomic Ions

What are polyatomic ions?

- Tightly bound groups of atoms that behave \_\_\_\_\_ and carry a charge
- These atoms are held together by \_\_\_\_\_ electrons
- ✓ Ions ending in *-ite* or *-ate* contain oxygen. *-ite* ions have one less oxygen than *-ate*.

EX: (*-ite* ions have one less oxygen than *-ate*)

$SO_3^{2-}$ , sulfite       $SO_4^{2-}$ , sulfate

$NO_2^-$ , nitrite       $NO_3^-$ , nitrate

What does the prefix bi- mean here? \_\_\_\_\_

## Ionic Compounds

- Binary compounds – have \_\_\_\_\_
- Binary ionic compounds – 1 metal + 1 nonmetal
- Binary \_\_\_\_\_ compounds – 2 nonmetals

### *Naming Ionic Compounds*

- When naming ionic compounds, simply name the ions as they appear in the formula.
- When naming ionic compounds containing a \_\_\_\_\_, include the Roman numeral representing the charge.

**EX:**  $\text{AlCl}_3$  – aluminum chloride

$\text{KBr}$  – \_\_\_\_\_

$\text{FeCl}_2$  - iron(II) chloride

$\text{FeCl}_3$  - \_\_\_\_\_

### *Writing Ionic Formulas*

- The charges of the ions must cancel out to give the compound a \_\_\_\_\_ charge. (“criss-cross method”)
- Remember that you can find the charges based on the group they are in, the roman numeral behind it, or the charge of the polyatomic ion that you MEMORIZED!

**EX:** Sodium Chloride:  $\text{Na}^+ \text{Cl}^-$        $\text{Na}_1\text{Cl}_1 \rightarrow \text{NaCl}$

Magnesium Iodide:  $\text{Mg}^{+2} \text{I}^-$        $\text{Mg}_1\text{I}_2 \rightarrow \text{MgI}_2$

Magnesium nitride:

Rubidium iodide:

Strontium selenide:

Aluminum oxide:

When writing formulas containing polyatomic ions, use parentheses around multiple polyatomic ions.

**EX:** Ammonium carbonate:  $\text{NH}_4^+ \text{CO}_3^{-2}$        $\rightarrow (\text{NH}_4)_2\text{CO}_3$

Strontium hydroxide:

Calcium nitrate:

Aluminum phosphate:

Why must you have parentheses when writing formulas for polyatomic ions?

Distinguish between the two types of compounds:

**Molecular/Covalent**

- two or more \_\_\_\_\_
- low melting points
- low boiling points

**Ionic**

- metal and a nonmetal
- \_\_\_\_\_ at room temp
- high melting points
- electrically \_\_\_\_\_

*Which of the following is molecular and which is ionic?*

- NaBr
- CO<sub>2</sub>
- O<sub>3</sub>
- NO
- KCl
- AlBr<sub>3</sub>

What is the chemical formula for water?

Which of these is a molecular formula?  
H<sub>2</sub>SO<sub>4</sub>  
HCl  
NaF

Write the law of definite proportions in your own words.

What is the law of multiple proportions?

***Formula***

- shows the kinds and numbers of atoms in the smallest representative unit of the substance.

***Molecular formula***

- chemical formula written for a \_\_\_\_\_
- EX: CO<sub>2</sub> \_\_\_\_\_

***Formula Unit***

- chemical formula written for an ionic compound
- the \_\_\_\_\_ whole number ratio of ions in the compound

***Law of Definite Proportions***

- In all samples of a chemical compound, the elements are always \_\_\_\_\_ by mass.
- Water is always 88.9% O and 11.1% H by mass

***Law of Multiple Proportions***

- Whenever two elements form more than one compound, the different masses of one element that combine with the same mass of the other element are in the ratio of \_\_\_\_\_.

# IONIC

## How is it bonded?

Metal and Nonmetal:

VALENT

METAL

Means:

Metals in group \_\_\_\_\_, & these 4: \_\_\_\_\_

Ex:

**Rule:**  
Name the \_\_\_\_\_ then the \_\_\_\_\_ ending in \_\_\_\_\_.

VALENT

METAL

Means: \_\_\_\_\_

Located in \_\_\_\_\_ & under the \_\_\_\_\_

Ex:

**Rule:**  
Same as mono-BUT use a \_\_\_\_\_ to tell the metal's \_\_\_\_\_.

Contains a polyatomic ion:

Ex:

**Rule:**  
Follow the same mono- or multi-valent metal rules; use the polyatomic ion's name.

# COVALENT

Two Nonmetals:

Ex:

**Rule:**  
Use \_\_\_\_\_ to tell the \_\_\_\_\_ of each element.

**NOTE:** A prefix is NOT needed on the first element if there is only 1.

1 = 6 =  
2 = 7 =  
3 = 8 =  
4 = 9 =  
5 = 10 =

Acids: contain the element \_\_\_\_\_ at the left of the formula.

Need to know:

HCl:

H<sub>2</sub>SO<sub>4</sub>:

HNO<sub>3</sub>:

HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>:

H<sub>3</sub>PO<sub>4</sub>: