

## CHAPTER 7: LANGUAGE OF CHEMISTRY

Problems: 3-12, 13(a-c), 14(a,c,d), 15(a-c), 16(a,c), 17-19, 20c, 21, 22(a,c), 23-27, 33(a,c,d), 34(a,c,d), 35, 36(a,c), 37(a,b,d), 43-48, 49b, 50b, 51-52, 59-62

### 7.1 CLASSIFICATION OF COMPOUNDS

**binary:** contains 2 elements

**ternary:** contains 3 or more elements

**ionic compound:** *metal + nonmetal(s)* (eg. NaCl, CaBr<sub>2</sub>, KMnO<sub>4</sub>, BaSO<sub>4</sub>)

**molecular compound:** *2 or more nonmetals* (eg. NH<sub>3</sub>, CCl<sub>4</sub>)

Ex. 1: Circle all the examples below that are ionic compounds.

HCl    K<sub>2</sub>O    MgCl<sub>2</sub>    PF<sub>5</sub>    CuBr<sub>2</sub>    CaSO<sub>4</sub>    CH<sub>2</sub>O

Ex. 2: Circle all the examples below that are molecular compounds.

HCl    K<sub>2</sub>O    MgCl<sub>2</sub>    PF<sub>5</sub>    CuBr<sub>2</sub>    CaSO<sub>4</sub>    CH<sub>2</sub>O

### CLASSIFICATION OF IONS:

**monoatomic ion:** charged particle from a *single atom* (eg Na<sup>+</sup>, Cl<sup>-</sup>, O<sup>2-</sup>)

**polyatomic ion:** charged particle of *2 or more atoms* (eg. OH<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>)

### 7.2 MONOATOMIC IONS

An **ion** formed from an **individual atom** is a **monoatomic ion**.

**Know the names and symbols for elements #1-18, titanium (Ti), and all the elements included in Table 7.1 on p. 171 and Figure 7.3 on page 172.**

**CATIONS:** positively charged ions

– *Metal atoms* lose electrons to form **cations**.

I. Some metals only form only one ion:

- Group IA elements form +1 ions:  $H^+$ ,  $Li^+$ ,  $Na^+$ ,  $K^+$
- Group IIA elements form +2 ions:  $Be^{2+}$ ,  $Mg^{2+}$ ,  $Ca^{2+}$ ,  $Sr^{2+}$ ,  $Ba^{2+}$
- Group IIIA elements form +3 ions:  $Al^{3+}$
- silver ion =  $Ag^+$ ; zinc ion =  $Zn^{2+}$ ; cadmium ion =  $Cd^{2+}$

***element name + ion*** →  $Na^+$ =sodium ion or  $Ba^{2+}$ =barium ion

II. The **Stock system** is used to name most **transition metals** and **other metals** that **can form more than one type of ion**:

- e.g. iron (Fe), a transition metal, forms 2 different ions:  $Fe^{2+}$  and  $Fe^{3+}$
- e.g. lead (Pb), in Group IVA, forms 2 different ions:  $Pb^{2+}$  and  $Pb^{4+}$

***element name (charge in Roman numerals) + ion***

$Sn^{2+}$ =tin (II) ion      and       $Sn^{4+}$ =tin (IV) ion

Note: Charges can be written with the sign before or after the number

- e.g.  $Fe^{3+}$  or  $Fe^{+3}$  are both acceptable

Example: Write the name for each of the cations below:

$Ag^+$  = \_\_\_\_\_

$Hg^{2+}$  = \_\_\_\_\_

$Li^+$  = \_\_\_\_\_

$Pb^{4+}$  = \_\_\_\_\_

$K^+$  = \_\_\_\_\_

$Co^{2+}$  = \_\_\_\_\_

$Mn^{2+}$  = \_\_\_\_\_

$Ca^{2+}$  = \_\_\_\_\_

$Al^{3+}$  = \_\_\_\_\_

$Sr^{+2}$  = \_\_\_\_\_

$H^+$  = \_\_\_\_\_

$Cr^{3+}$  = \_\_\_\_\_

Note: Your book includes the Latin system. You are not required to know the Latin system in CHM130 or CHM 130LL lab. Only the Stock system will be used for naming cations that form more than one charge.

**ANIONS:** negatively charged ions

- **Nonmetal atoms** gain electrons to form **anions**
  - Group VIIA elements form  $-1$  ions:  $F^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$
  - Group VIA elements form  $-2$  ions:  $O^{2-}$ ,  $S^{2-}$
  - Group VA elements form  $-3$  ions:  $N^{3-}$ ,  $P^{3-}$

**element stem name + "ide" + ion:** O=oxygen  $\rightarrow$   $O^{2-}$  = oxide ion

$F^-$  = \_\_\_\_\_

$N^{3-}$  = \_\_\_\_\_

$S^{2-}$  = \_\_\_\_\_

$Cl^-$  = \_\_\_\_\_

$Br^-$  = \_\_\_\_\_

$P^{3-}$  = \_\_\_\_\_

### Monatomic Ions: Putting it all together

Example: Give the formulas for each of the following:

calcium ion = \_\_\_\_\_ potassium ion = \_\_\_\_\_ strontium ion = \_\_\_\_\_

sulfide ion = \_\_\_\_\_ cadmium ion = \_\_\_\_\_ aluminum ion = \_\_\_\_\_

silver ion = \_\_\_\_\_ phosphide ion = \_\_\_\_\_ copper (I) ion = \_\_\_\_\_

nitride ion = \_\_\_\_\_ lead (IV) ion = \_\_\_\_\_ fluoride ion = \_\_\_\_\_

### POLYATOMIC IONS

- Be able to use info on polyatomic ions on the Periodic Table provided

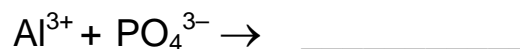
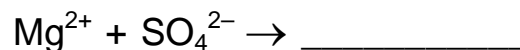
### 7.3 WRITING CHEMICAL FORMULAS (OF IONIC COMPOUNDS)

**formulas of compounds:** Cation + anion symbols and number of each

Compounds should be neutral  $\rightarrow$  **+ve charges = -ve charge**

## Simple techniques for writing chemical formulas:

1. If both ions have charges that are exactly opposite (+1 & -1, +2 & -2, etc.),  
→ *compound's formula contains one of each*  
– This also applies for polyatomic ions.



2. For monatomic ions with different charges, use the crossover rule:  
→ Make the negative charge the subscript of the cation, and make the positive charge the subscript of anion.  
– Do NOT bring down the + and – signs, just the numbers!



3. For polyatomic ions, where ions have different charges, also use the crossover method:  
— Express more than one polyatomic ion with subscripts and parentheses.





**1. Get the individual ions for each compound**

**2. CATION NAME + ANION NAME, minus "ion" → Name of compound**

– Indicate the charge in Roman numerals in parentheses when necessary!

$\text{CuCl}_2 =$	_____	→	_____
	individual ions		name of compound
$\text{SrS} =$	_____	→	_____
$\text{NiCrO}_4 =$	_____	→	_____
$\text{Mg}(\text{NO}_3)_2 =$	_____	→	_____
$\text{Na}_3\text{P} =$	_____	→	_____
$\text{ZnCO}_3 =$	_____	→	_____
$\text{KOH} =$	_____	→	_____
$\text{Ca}(\text{CN})_2 =$	_____	→	_____
$\text{Li}_3\text{N} =$	_____	→	_____
$\text{PbO}_2 =$	_____	→	_____

**Given the name of a compound, predict the formula:**

— KNOWING charges on ions formed by representative elements!

— KNOWING *how to use* polyatomic ions and their charges when given to you!

sodium carbonate:	_____	→	_____
	individual ions		formula of compound
zinc fluoride:	_____	→	_____
strontium fluoride:	_____	→	_____
lead (IV) chromate:	_____	→	_____
iron (III) nitride:	_____	→	_____
silver sulfite:	_____	→	_____
magnesium sulfate:	_____	→	_____
cadmium phosphate:	_____	→	_____

## 7.7 BINARY MOLECULAR COMPOUNDS

**Molecular Compounds:** compounds consisting of 2 nonmetals

### NAMING:

**# of atoms** of element indicated by **Greek prefix** before element name

1. For first element, Greek prefix + element name
2. For second element, Greek prefix + element name stem + "ide"
  - If only one atom present, "mono-" is generally omitted, except in a few cases (eg. CO=carbon monoxide)

# of atoms	Greek prefix	# of atoms	Greek prefix
1	mono	6	hexa
2	di	7	hepta
3	tri	8	octa
4	tetra	9	nona
5	penta	10	deca

CO<sub>2</sub> = carbon dioxide

SF<sub>6</sub>= \_\_\_\_\_

PCl<sub>3</sub>= \_\_\_\_\_

Cl<sub>2</sub>O<sub>7</sub>= \_\_\_\_\_

N<sub>2</sub>S<sub>5</sub>= \_\_\_\_\_

## 7.8 BINARY ACIDS

## 7.9 TERNARY OXYACIDS

**aqueous solution (aq):** results when a compound is dissolved in water

**acid:** an aqueous solution of a compound with hydrogen

–easy to recognize because H usually in front

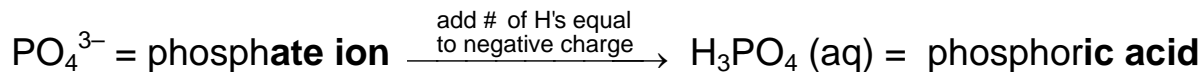
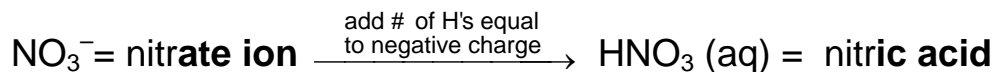
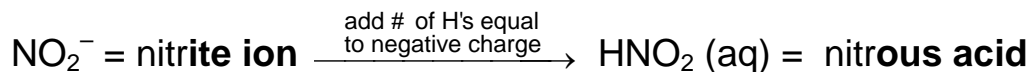
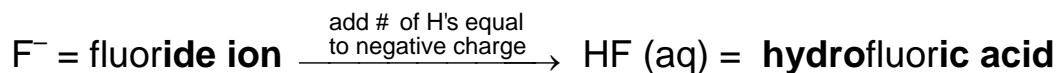
–binary acid: contains hydrogen and 1 other nonmetal

– e.g. HCl (aq), H<sub>2</sub>S (aq)

–ternary oxyacid: contains hydrogen, oxygen, and 1 other element

– e.g. H<sub>2</sub>SO<sub>4</sub> (aq), HNO<sub>3</sub> (aq)

The name of the acid depends on the **anion** from which the acid forms.



Exercises:

