

## SUMMER ASSIGNMENT #1 - WRITING FORMULA

You MUST be able to write the chemical formula of a compound, given its IUPAC (International Union of Pure and Applied Chemistry) name.

**You MUST memorize the formula and charge of common polyatomic ions!**

Any ion that ends in “-ite” or “-ate” is a negatively charged ion. An “-ate” ion has 1 more oxygen than an “-ite” ion i.e. nitrate and nitrite. A “per-“ prefix denotes 1 more oxygen than the “-ate” ion, and the prefix “hypo-“ denotes 1 less oxygen than the “-ite” ion i.e. perchlorate and hypochlorite.

**You MUST be able to identify the oxidation state of most monatomic ions**

i.e. sodium ion (+1), magnesium (+2), oxide (-2), and fluoride (-1).

The Reference Table you will use on the AP Exam does not contain the common oxidation states. You must know the state by the ion’s location of the Periodic Table.

A Roman numeral will provide the oxidation state of ions that can have multiple charges i.e. iron (II) or iron (III).

When writing the chemical formula, identify the cation and its charge and the anion and its charge. Reduce the charges, if possible, and then cross over the numbers and write them as subscripts.

### Polyatomic Cation

$\text{NH}_4^+$  ammonium

### Polyatomic Anions

$\text{CN}^-$  cyanide

$\text{OH}^-$  hydroxide

$\text{C}_2\text{H}_3\text{O}_2^-$  acetate (or  $\text{CH}_3\text{COO}^-$ )

$\text{C}_2\text{O}_4^{2-}$  oxalate

$\text{CO}_3^{2-}$  carbonate

$\text{HCO}_3^-$  hydrogen carbonate (**bi**carbonate)

$\text{ClO}^-$  **hypochlorite**

$\text{ClO}_2^-$  chlorite

$\text{ClO}_3^-$  chlorate

$\text{ClO}_4^-$  **perchlorate**

$\text{CrO}_4^{2-}$  chromate

$\text{Cr}_2\text{O}_7^{2-}$  dichromate

$\text{MnO}_4^{1-}$  permanganate

$\text{MnO}_4^{2-}$  manganate

$\text{NO}_2^-$  nitrite

$\text{NO}_3^-$  nitrate

$\text{PO}_3^{3-}$  phosphite

$\text{PO}_4^{3-}$  phosphate

$\text{HPO}_4^{2-}$  hydrogen phosphate (or **bi**phosphate)

$\text{H}_2\text{PO}_4^-$  dihydrogen phosphate

$\text{SO}_3^{2-}$  sulfite

$\text{SO}_4^{2-}$  sulfate

$\text{HSO}_4^-$  hydrogen sulfate (or **bi**sulfate)

**AP CHEMISTRY**  
**2010-2011**

**PROBLEMS – Write the chemical formula using the IUPAC system:**

1. Sodium chloride	2. Magnesium fluoride
3. Copper (II) bromide	4. Iron (III) oxide
5. Silver nitrate	6. Vanadium (V) iodide
7. Calcium sulfate	8. Potassium chlorate
9. Hydrogen cyanide	10. Barium hydroxide
11. Aluminum nitrite	12. Manganese (IV) oxide
13. Ammonium hypochlorite	14. Nickel (III) acetate
15. Calcium bicarbonate	16. Potassium phosphate
17. Zinc nitrate	18. Lead (IV) dichromate
19. Sodium oxalate	20. Ammonium hydroxide

## SUMMER ASSIGNMENT # 2 – NAMING COMPOUNDS

The rules of **chemical nomenclature** or naming compounds are different for inorganic and organic compounds. We will review naming organic compounds later in the course. Inorganic compounds can be further divided into three categories – ionic compounds, acids, and molecular compounds.

To name **ionic compounds**, simply identify the cation (positive ion) followed by the anion (negative ion).

NaCl = Sodium chloride      NH<sub>4</sub>Cl = Ammonium chloride      K<sub>2</sub>CO<sub>3</sub> = potassium carbonate

**Acids** are a special category of chemicals, and therefore, have their own system of nomenclature. Acids containing anions that end in “-ide” are named by changing the “-ide” into “-ic”, and by adding the prefix “hydro” to the anion name, and then followed with the word “acid.”

HF = hydrofluoric acid                      H<sub>2</sub>S = hydrosulfuric acid

Acids containing anions whose names end in “-ate” or “-ite” are named by changing the “-ate” into “-ic” and “-ite” into “-ous”, and then adding the word “acid.” The prefix “hydro” is not utilized.

H<sub>2</sub>CO<sub>3</sub> = carbonic acid                      HNO<sub>2</sub> = nitrous acid

Simple **binary molecular compounds** are named using Greek prefixes. Prefixes mono-, di-, tri-, tetra-, penta-, and hexa- are used to denote 1, 2, 3, 4, 5, and 6 elements, respectively. The prefix are added to each element and the second element is given an “-ide” ending. The prefix mono is never used with the first element.

CO = carbon monoxide      CO<sub>2</sub> = carbon dioxide      P<sub>2</sub>O<sub>5</sub> = diphosphorous pentoxide

**PROBLEMS - Name the following inorganic compounds.**

**IONIC COMPOUNDS**

1. AgBr	2. MgI <sub>2</sub>
3. Ca(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub>	4. Na <sub>3</sub> PO <sub>4</sub>
5. NH <sub>4</sub> ClO <sub>2</sub>	6. K <sub>2</sub> SO <sub>4</sub>

**ACIDS**

7. HBr	8. HClO <sub>4</sub>
9. HI	10. H <sub>2</sub> SO <sub>4</sub>
11. HCl	12. HNO <sub>3</sub>

**BINARY MOLECULAR COMPOUNDS**

13. NO <sub>2</sub>	14. SO <sub>3</sub>
15. N <sub>2</sub> O <sub>4</sub>	16. CCl <sub>4</sub>
17. P <sub>4</sub> S <sub>6</sub>	18. IF <sub>5</sub>

**SUMMER ASSIGNMENT # 3 – FORMULA MASS**

Atoms are the basic building blocks of all matter. Atoms of a single element can exist alone i.e. a pure sample of gold or the atoms of different elements can combine in certain ratios to form compounds i.e. carbon monoxide (CO) or carbon dioxide (CO<sub>2</sub>). Certain elements can exist in multiple forms i.e. oxygen gas (O<sub>2</sub>) or ozone gas (O<sub>3</sub>). Oxygen gas and ozone gas are **allotropes** since they are different forms of the same element in the same state.

You **MUST** be able to identify the mass of an element or a compound. Once you can determine the mass of a compound, you can calculate the percent composition by mass of each element in the compound.

**PROBLEMS – Determine the mass of the compounds or molecules, and calculate the percent composition, by mass, of each element.**

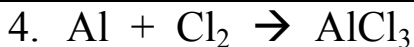
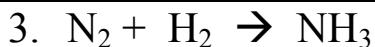
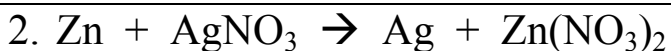
1. C <sub>8</sub> H <sub>18</sub>	2. O <sub>2</sub>
3. KClO <sub>4</sub>	4. (NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>
5. Silver oxide	6. Copper (II) phosphate

### SUMMER ASSIGNMENT # 4 – BALANCING EQUATIONS

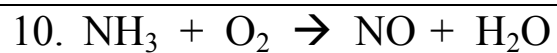
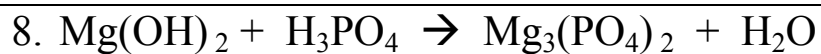
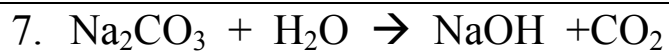
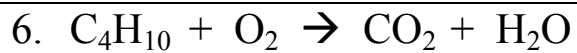
Chemistry is a science of change. Chemists use a chemical equation to show the change in the structure of the substances involved. **Reactants** chemically react to yield **products**. Since matter cannot be created or destroyed in chemical reactions, chemists use coefficients in front of the reactants and the products to balance chemical equations.

The **subscripts** of a compound show the ratio of atoms within a compound. The **coefficients** in front of the reactants or products show the lowest whole number ratio that the reactants will react to produce the ratio of the products. Therefore, when one balances a chemical reaction, ONLY the coefficients can be altered not the subscripts.

**PROBLEMS – Balance the following equation using lowest whole numbers:**



AP CHEMISTRY  
2010-2011



### SUMMER ASSIGNMENT # 5 – THE MOLE

The **MOLE** is a significant concept in chemistry. It allows chemists to convert easily among **number** of particles i.e. atoms, compounds, or ions, **mass** of the particles, and the **volume** of gases at STP.

A mole of anything (atom, compound, or ion) contains  $6.02 \times 10^{23}$  anythings (atoms, compounds, or ions). Conveniently, a mole of atoms or compounds with a certain mass in amu (atomic mass units) retains the same mass except in grams. For example, 1 carbon atoms has a mass of 12 amu but 1 mole of carbon atoms has a mass of 12 grams. For gases, a mole of gaseous atoms i.e. He or molecules i.e.  $\text{CO}_2$  occupies a volume of 22.4 Liters at STP.

- 1 mole of Ar gas has  $6.02 \times 10^{23}$  atoms, a mass of 40 g, and a volume of 22.4 L at STP.
- 1 mole of He gas has  $6.02 \times 10^{23}$  atoms, a mass of 4 g, and a volume of 22.4 L at STP.
- 1 mole of  $\text{CO}_2$  gas has  $6.02 \times 10^{23}$  molecules, a mass of 44 g, and a volume of 22.4 L at STP.

By setting up a proportion and doing some basic math, one can easily convert among number of particles, mass of particles, and volume of particles at STP, if the particles exist as a gas. Moreover, one can easily determine the number of particles, the mass, or volume of any multiple or fraction of moles.

- 2 moles of Ar gas has  $1.20 \times 10^{24}$  atoms, a mass of 80 amu, and a volume of 44.8 L at STP.
- 0.5 mole of He gas has  $3.01 \times 10^{23}$  atoms, a mass of 2 g, and a volume of 11.2 L at STP.
- 2.5 mole of  $\text{CO}_2$  gas has  $1.50 \times 10^{24}$  molecules, a mass of 110 g, and a volume of 56.0 L at STP.

**AP CHEMISTRY**  
**2010-2011**

**PROBLEMS - Solve the following mole problems (assume all gases are at STP):**

1. Mass of 5 moles of Ag atoms	2. Mass of 0.25 moles of CF <sub>4</sub> molecules
3. Number of atoms in 1.5 moles of Zn	4. Number of molecules in 3.0 moles of H <sub>2</sub> O
5. Volume 0.75 moles of CH <sub>4</sub> gas	6. Volume of 1.25 moles of Xe gas
7. Moles in 66 g of CO <sub>2</sub> gas	8. Moles in 64 g of O <sub>2</sub> gas
9. Moles in $9.03 \times 10^{23}$ atoms of Au	10. Moles in $6.01 \times 10^{22}$ molecules of C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>
11. Moles in 5.60 L of SO <sub>3</sub> gas	12. Moles in 33.6 L of NO gas
13. Mass of $9.03 \times 10^{23}$ atoms of C	14. Volume of $3.01 \times 10^{23}$ molecules of NO <sub>2</sub> gas
15. Number of atoms in 40 g of Ne gas	16. Number of atoms in 4.48 L of methane gas
17. Volume of 6 grams of H <sub>2</sub> gas	18. Volume of $1.50 \times 10^{24}$ atoms of Br <sub>2</sub> gas

**SUMMER ASSIGNMENT # 6 – SOLUBILITY IN WATER**

Certain ionic compounds dissolve well in water and are considered soluble in water. Other ionic compounds do not dissolve very well in water and are considered to be insoluble in water.

You **MUST** commit the solubility rules to memory and be able to determine if an ionic compound is soluble or insoluble in water.

The solubility rules are:

<b>Soluble</b>	<b>Exceptions (Insoluble)</b>
Ammonium $\text{NH}_4^+$	
Potassium * $\text{K}^+$	
Sodium * $\text{Na}^+$	
Nitrate $\text{NO}_3^-$	
Acetate $\text{C}_2\text{H}_3\text{O}_2^-$	
Chloride^ $\text{Cl}^-$	$\text{Ag}^+, \text{Hg}_2^{+2}, \text{Pb}^{+2}$
Sulfate $\text{SO}_4^{-2}$	$\text{Ba}^{+2}, \text{Pb}^{+2}, \text{Hg}_2^{+2}, \text{Ag}^+$
Chlorate $\text{ClO}_3^-$	
Perchlorate $\text{ClO}_4^-$	

\* all Group I metals

^ same for other halides ( $\text{Br}^-$  and  $\text{I}^-$ )

<b>Insoluble</b>	<b>Exceptions (Soluble)</b>
Hydroxide $\text{OH}^-$	ж, $\text{Ba}^{+2}, \text{Ca}^{+2}, \text{Sr}^{+2}$
Oxide $\text{O}^{-2}$	ж, $\text{Ba}^{+2}, \text{Ca}^{+2}, \text{Sr}^{+2}$
Phosphate $\text{PO}_4^{-3}$	ж
Carbonate $\text{CO}_3^{-2}$	ж
Sulfide $\text{S}^{-2}$	ж
Sulfite $\text{SO}_3^{-2}$	ж
Silicate $\text{SiO}_3^{-2}$	ж

ж Group IA metals and  $\text{NH}_4^+$

**AP CHEMISTRY**  
**2010-2011**

**PROBLEMS** Determine if each compound is soluble or insoluble in water. Justify your answer with the appropriate rule.:

1. AgCl	2. K <sub>3</sub> PO <sub>4</sub>
3. KOH	4. Pb(NO <sub>3</sub> ) <sub>2</sub>
5. PbI <sub>2</sub>	6. CaSO <sub>4</sub>
7. BaSO <sub>4</sub>	8. NH <sub>4</sub> Cl
9. CaCO <sub>3</sub>	10. Ba <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>
11. Na <sub>2</sub> CO <sub>3</sub>	12. AgI
13. Ca(OH) <sub>2</sub>	14. PbSO <sub>4</sub>