AP CHEMISTRY
2010-2011

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

NH_4^+	ammonium

Polyatomic Anions

CN^-	cyanide
OH^-	hydroxide
$C_2H_3O_2^-$	acetate (or CH_3COO^-)
$C_2O_4^{2-}$	oxalate
CO_3^{2-}	carbonate
HCO_3^-	hydrogen carbonate (**bi**carbonate)
ClO^-	**hypo**chlor**ite**
ClO_2^-	chlor**ite**
ClO_3^-	chlor**ate**
ClO_4^-	**per**chlor**ate**
CrO_4^{2-}	chromate
$Cr_2O_7^{2-}$	dichromate
MnO_4^{1-}	permanganate
MnO_4^{2-}	manganate
NO_2^-	nitr**ite**
NO_3^-	nitr**ate**
PO_3^{3-}	phosph**ite**
PO_4^{3-}	phosph**ate**
HPO_4^{2-}	hydrogen phosph**ate** (or **bi**phosphate)
$H_2PO_4^-$	dihydrogen phosph**ate**
SO_3^{2-}	sulf**ite**
SO_4^{2-}	sulf**ate**
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

AP CHEMISTRY
2010-2011

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_4Cl = Ammonium chloride K_2CO_3 = 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_2S = 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_2CO_3 = carbonic acid HNO_2 = 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_2 = carbon dioxide P_2O_5 = diphosphorous pentoxide

AP CHEMISTRY
2010-2011

PROBLEMS - Name the following inorganic compounds.

IONIC COMPOUNDS

1. AgBr	2. MgI_2
3. $Ca(C_2H_3O_2)_2$	4. Na_3PO_4
5. NH_4ClO_2	6. K_2SO_4

ACIDS

7. HBr	8. $HClO_4$
9. HI	10. H_2SO_4
11. HCl	12. HNO_3

BINARY MOLECULAR COMPOUNDS

13. NO_2	14. SO_3
15. N_2O_4	16. CCl_4
17. P_4S_6	18. IF_5

AP CHEMISTRY
2010-2011

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_2). Certain elements can exist in multiple forms i.e. oxygen gas (O_2) or ozone gas (O_3). 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_8H_{18}	2. O_2
3. $KClO_4$	4. $(NH_4)_2CO_3$
5. Silver oxide	6. Copper (II) phosphate

AP CHEMISTRY
2010-2011

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:

1. $Fe_2O_3 + CO \rightarrow Fe + CO_2$

2. $Zn + AgNO_3 \rightarrow Ag + Zn(NO_3)_2$

3. $N_2 + H_2 \rightarrow NH_3$

4. $Al + Cl_2 \rightarrow AlCl_3$

5. $N_2O_5 + H_2O \rightarrow HNO_3$

6. $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$
7. $Na_2CO_3 + H_2O \rightarrow NaOH + CO_2$
8. $Mg(OH)_2 + H_3PO_4 \rightarrow Mg_3(PO_4)_2 + H_2O$
9. $CH_4 + O_2 \rightarrow H_2C_6H_8O_4 + H_2O$
10. $NH_3 + O_2 \rightarrow NO + H_2O$

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 6.02×10^{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. CO_2 occupies a volume of 22.4 Liters at STP.

- 1 mole of Ar gas has 6.02×10^{23} atoms, a mass of 40 g, and a volume of 22.4 L at STP.
- 1 mole of He gas has 6.02×10^{23} atoms, a mass of 4 g, and a volume of 22.4 L at STP.
- 1 mole of CO_2 gas has 6.02×10^{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 $1.20 \times 10^{\mathbf{24}}$ atoms, a mass of 80 amu, and a volume of 44.8 L at STP.
- 0.5 mole of He gas has 3.01×10^{23} atoms, a mass of 2 g, and a volume of 11.2 L at STP.
- 2.5 mole of CO_2 gas has 1.50×10^{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_4 molecules
3. Number of atoms in 1.5 moles of Zn	4. Number of molecules in 3.0 moles of H_2O
5. Volume 0.75 moles of CH_4 gas	6. Volume of 1.25 moles of Xe gas
7. Moles in 66 g of CO_2 gas	8. Moles in 64 g of O_2 gas
9. Moles in 9.03×10^{23} atoms of Au	10. Moles in 6.01×10^{22} molecules of $C_6H_{12}O_6$
11. Moles in 5.60 L of SO_3 gas	12. Moles in 33.6 L of NO gas
13. Mass of 9.03×10^{23} atoms of C	14. Volume of 3.01×10^{23} molecules of NO_2 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_2 gas	18. Volume of 1.50×10^{24} atoms of Br_2 gas

AP CHEMISTRY
2010-2011

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:

Soluble		**Exceptions (Insoluble)**
Ammonium	NH_4^+	
Potassium *	K^+	
Sodium *	Na^+	
Nitrate	NO_3^-	
Acetate	$C_2H_3O_2^-$	
Chloride^	Cl^-	Ag^+, Hg_2^{+2}, Pb^{+2}
Sulfate	SO_4^{-2}	Ba^{+2}, Pb^{+2}, Hg_2^{+2}, Ag^+
Chlorate	ClO_3^-	
Perchlorate	ClO_4^-	

* all Group I metals
^ same for other halides (Br^- and I^-)

Insoluble		**Exceptions (Soluble)**
Hydroxide	OH^-	ж, Ba^{+2}, Ca^{+2}, Sr^{+2}
Oxide	O^{-2}	ж, Ba^{+2}, Ca^{+2}, Sr^{+2}
Phosphate	PO_4^{-3}	ж
Carbonate	CO_3^{-2}	ж
Sulfide	S^{-2}	ж
Sulfite	SO_3^{-2}	ж
Silicate	SiO_3^{-2}	ж

ж Group IA metals and 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_3PO_4
3. KOH	4. $Pb(NO_3)_2$
5. PbI_2	6. $CaSO_4$
7. $BaSO_4$	8. NH_4Cl
9. $CaCO_3$	10. $Ba_3(PO_4)_2$
11. Na_2CO_3	12. AgI
13. $Ca(OH)_2$	14. $PbSO_4$