

AP CHEMISTRY
2011-2012

13 Linden Avenue
Ossining, NY 10562

June 15, 2011

Dear [Insert Your Name Here],

Greetings! Welcome to AP Chemistry! This will be my second year teaching the course and I am excited by the challenge. The AP Chemistry is considered by many to be the most difficult and challenging AP courses offered by the College Board. I expect to work very hard next year and will devote a lot of time and energy to help you succeed in the course. I expect you to work just as hard.

Your summer assignment is comprised of three parts. **First, you must send me an email** to notify me that you have received the summer assignment and that you intend to take the AP Chemistry course. **My email address is jchoi@tufsd.org.** **Next, you will complete the enclosed summer assignment sheets (#1 – 6) and mail it to my house by August 21st.** The assignment includes problems I expect you to be able to solve from taking Honors or Regents Chemistry. We will build upon and expand on the topics you have studied in chemistry; and so, it is imperative that you have a good working knowledge of the basic skills and concepts you have learned already. **Please type or nearly write the answers on a separate sheet of paper – there is no need to rewrite the problems as long as they are labeled correctly.** Please hold on to the assignment sheets - we will have a test on the topics covered in the assignment sheets at the end of our first week of class.

Lastly, you will research and make a ten slide (minimum) PowerPoint presentation regarding the evolution of the atomic model and email me the presentation and your typed notes by August 28th. For the project, you will trace the evolution of the atomic model from John Dalton to the current model. Be sure to include the following items in your presentation: the discovery of the basic subatomic particles (electron, proton, neutron), the creation of the Periodic Table, the study of radioactivity, the discovery of isotopes, the determination of the mass and charge of subatomic particles, the arrangement of electrons in the atom, the significance of spectral lines, the forces that hold the atom together, and the forces that cause atoms to bond with other atoms.

I do not want a PowerPoint presentation with a lot of text simply cut and pasted from the Internet – I want you to research the topic and provide **typed notes** that will accompany your presentation of each slide. Make your slides visually appealing and simple to understand. Be sure to cite your sources using the APA format (examples can be found on the TUFSD website under Library Media Center tab).

Enjoy your summer vacation. Please email me that you have received the summer assignment. If you have any questions or problems, please do not hesitate to contact me. I look forward to a great year!

Sincerely,
Jason Choi

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.

Learn how to write subscripts i.e. H₂, and superscripts i.e. H⁺¹ on your computer.

Polyatomic Cation

NH₄⁺ ammonium

Polyatomic Anions

CN⁻ cyanide

OH⁻ hydroxide

C₂H₃O₂⁻ acetate (or CH₃COO⁻)

C₂O₄²⁻ oxalate

CO₃²⁻ carbonate

HCO₃⁻ hydrogen carbonate (**bi**carbonate)

ClO⁻ **hypochlorite**

ClO₂⁻ **chlorite**

ClO₃⁻ **chlorate**

ClO₄⁻ **perchlorate**

CrO₄²⁻ chromate

Cr₂O₇²⁻ dichromate

MnO₄¹⁻ permanganate

MnO₄²⁻ manganate

NO₂⁻ **nitrite**

NO₃⁻ **nitrate**

PO₃³⁻ phosphite

PO₄³⁻ phosphate

HPO₄²⁻ hydrogen phosphate (or **bi**phosphate)

H₂PO₄⁻ dihydrogen phosphate

SO₃²⁻ sulfite

SO₄²⁻ sulfate

HSO₄⁻ hydrogen sulfate (or **bi**sulfate)

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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 NH₄Cl = Ammonium chloride K₂CO₃ = 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 H₂S = 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.

H₂CO₃ = carbonic acid HNO₂ = 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 CO₂ = carbon dioxide P₂O₅ = diphosphorous pentoxide

Organic molecules have their own set of rules for naming, and these rules will be studied more in detail at a later date.

Some compounds have common names that are widely accepted. Some examples are:

H₂O – water
NH₃ – ammonia
CH₄ – methane

PROBLEMS - Name the following inorganic compounds.

IONIC COMPOUNDS

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

ACIDS

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

BINARY MOLECULAR COMPOUNDS

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

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 (CO₂). Certain elements can exist in multiple forms i.e. oxygen gas (O₂) or ozone gas (O₃). 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.

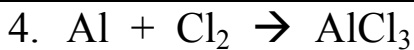
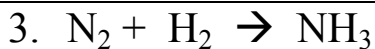
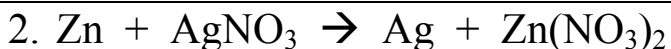
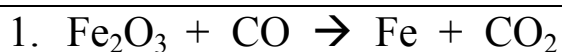
1. C ₈ H ₁₈	2. O ₂
3. KClO ₄	4. (NH ₄) ₂ CO ₃
5. Silver oxide	6. Copper (II) phosphate

SUMMER ASSIGNMENT # 4 – BALANCING EQUATIONS

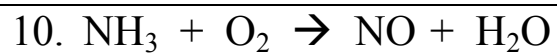
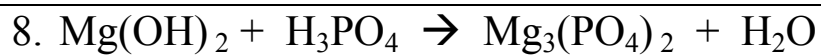
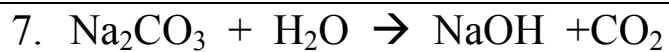
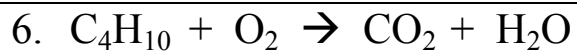
Chemistry is a science of change. Chemists use a chemical equation to show the change in the structure of the substances involved. **Reactants** chemically react to yield **products**. Since matter cannot be created or destroyed in chemical reactions, chemists use coefficients in front of the reactants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



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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 atom 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 e.g. He or Ar, or molecules e.g. CH₄ or CO₂ 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 CO₂ 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 1.20×10^{24} atoms, a mass of 80 amu, and a volume of 44.8 L at STP.
- 0.5 mole of He gas has 3.01×10^{23} atoms, a mass of 2 g, and a volume of 11.2 L at STP.
- 2.5 mole of CO₂ gas has 1.50×10^{24} molecules, a mass of 110 g, and a volume of 56.0 L at STP.

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 ₂ O
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 ₆ H 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

SUMMER ASSIGNMENT # 6 – SOLUBILITY IN WATER

Certain ionic compounds dissolve well in water and are “soluble” in water. Other ionic compounds do not dissolve very well in water and are said 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. Later in the year, we will discuss more in detail what happens when a substance is insoluble.

The solubility rules are:

Soluble	Exceptions (Insoluble)
Ammonium NH_4^+	
Potassium * K^+	
Sodium * Na^+	
Nitrate NO_3^-	
Acetate $\text{C}_2\text{H}_3\text{O}_2^-$	
Chloride^ Cl^-	$\text{Ag}^+, \text{Hg}_2^{+2}, \text{Pb}^{+2}$
Sulfate SO_4^{-2}	$\text{Ba}^{+2}, \text{Pb}^{+2}, \text{Hg}_2^{+2}, \text{Ag}^+$
Chlorate ClO_3^-	
Perchlorate ClO_4^-	

* all Group I metals

^ same for other halides (Br^- and I^-)

Insoluble	Exceptions (Soluble)
Hydroxide OH^-	ж, $\text{Ba}^{+2}, \text{Ca}^{+2}, \text{Sr}^{+2}$
Oxide O^{-2}	ж, $\text{Ba}^{+2}, \text{Ca}^{+2}, \text{Sr}^{+2}$
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^+

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

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