AP CHEMISTRY SUMMER PREPARATION PACKET

Joliet Township High School – www.jths.org

West Campus: Mrs. Joy Otry jotry@jths.org

Dear future AP Chemistry student:

I am very happy to welcome you to Advanced Placement Chemistry even before the new school year has begun. I am really excited about the coming year and I hope you are too. Many people consider AP Chemistry one of the hardest AP classes. I believe that if you work hard this class will be a real pleasure and very easy for you. The benefits of passing this class and scoring high in the AP exam make the effort worth it. If you pass the AP exam with a 5, most schools in the country will award you eight (8) credits of chemistry. That includes the first two college semesters of chemistry and the two laboratory classes that come with it. This is a great time and money saver for college. Even if your college does not accept these credits, you will have gained knowledge of the topics covered and you will breeze through freshman chem. The fundamentals in this class are essential to anyone planning on being an engineer, a scientist, a doctor, a nurse, a psychologist, even a chef!

If you love science like I do, there is also the bonus of learning how matter works and how our universe can be explained by understanding the interactions between matter and energy. You will also get to perform some neat laboratory experiments at the college level.

To succeed in this class it is important to have a solid background in basic high school chemistry. If you are in this class, it is because you have had a great experience in Honors Chemistry or College Prep Chemistry and want to learn more. This summer packet will help you refresh some of the fundamentals needed to succeed in AP Chemistry. As soon as we return from summer break, I will be giving you an examination on these fundamentals to assess your strengths and weaknesses. This test will be based on the information in this packet so if you work with it throughout the summer, you will have no problem. Just go over every part of the packet. If you feel that you remember everything and get the problems right then don't kill yourself, enjoy your summer. If you don't remember how to do some of the problems then spend the time figuring it out. If you have any questions while working with this packet, feel free to contact me. My contact information is above.

I hope you have a great summer and I look forward to seeing you in August.

Mrs. Joy Otry

The first part of this packet is a list of the basic chemistry topics I expect you to know coming into AP Chemistry. Review these topics carefully and visit all the links I give you. This will help you refresh your knowledge. Please work hard memorizing those things that need to be memorized. The second part of the packet involves practice problems and questions. As always, if you have any questions let me know, I will gladly help you over the summer.

Here are some links that can help you survive this summer and next school year.

JTHS Chemistry Resource Packet

Bozeman Science

ThatChemGuy

BASIC CHEMISTRY TOPICS:

I. NOMENCLATURE

Learning how to name elements, ions, and compounds is the basic language of chemistry. You need to be REALLY GOOD at this. You need to know the name of elements as well as monatomic and polyatomic ions, their formula, name and charge.

Know the name and symbol of each of the following elements:

H He Li Be B C N O F Ne Na Mg Al Si P
S Cl Ar K Ca Sc Ti V Cr Mn Fe Co Ni Cu
Zn As Se Br Kr Sr Y Mo Ag Cd Sn Sb Te I
Xe Ba La W Pt Au Hg Pb Bi Rn Ra U Pu

There is a great website which explains nomenclature if you are still rusty in this department or wish to review. You are responsible for knowing everything on this site including the name and charges of the ions.
http://www.angelo.edu/faculty/kboudrea/general/formulas_nomenclature/Formulas_&_Nomenclature.pdf

II. DIMENSIONAL ANALYSIS

Chemistry is a quantitative science so we need to work with numbers that represent different quantities. No number is every written alone, there is always a unit showing us what the number is counting. For example: 2 years, 4 shoes, 3.5 grams, etc. Units help us work with these quantities. For a review on dimensional analysis visit this website:
http://www.chem.tamu.edu/class/fyp/mathrev/mr-da.html

At the bottom of that web page there are three problems, use them as practice. More problems will be assigned in the problems section of this packet.

III. CLASSIFICATION OF MATTER

What is matter made out of? I am sure you are familiar with the terms elements, compounds, mixtures, etc. You also need to think about these terms at the particle level. That means at the level of the atoms and particles that make up the matter itself. A great place to review this is below:
http://antoine.frostburg.edu/chem/senese/101/matter/index.shtml

The quizzes in that page are good practice.

Remember that there are some diatomic elements you need to know. Hydrogen, oxygen, nitrogen, fluorine, chlorine, bromine, and iodine all form molecules of two atoms of the same element.

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2

- Remember, I'll Have Neil Over For Clam Brains or H-7

Another classification must be made for compounds. Earlier you learned about the different names between ionic and molecular compounds. It is also very important to know the difference in properties between ionic and molecular compounds. A summary of these properties are found here:
http://www.mrmontero.com/U4/MolecularIonicNotes.pdf

Ionic compounds may or may not be soluble in water. You need to memorize the solubility rules so that you can see a compound and tell if it will dissolve in water or not.

A list of solubility rules is here: http://www.mrmontero.com/U4/SolubilityRules.pdf

IV. CHEMICAL CHANGE

When particles that make up matter rearrange forming substances with different properties, we have a chemical reaction or chemical change. Recall that we use equations to represent the chemical change and that these equations must be balanced in order to maintain the law of conservation of mass. Being able to predict the products of a reaction is one of the main parts of the AP chemistry exam. We will have extensive practice in this area. For the time being, recall the five patterns of chemical reactivity.

Here is a short description of these reactions: http://www.mrmontero.com/U6/patterns.pdf

You also need to know how oxidation-reduction reactions occur. Recall that in REDOX reactions, there is an exchange of electrons. One substance will gain electrons (reduction) while the other loses electrons (oxidation). Many of the single displacement reactions are REDOX reactions. Combustion is also a REDOX reaction. Here you can meet our great friend, trust me, he will be a GREAT friend, CHEMGUY! He has a series of videos on YOUTUBE where he explains many chemistry topics very well. He will be of great help throughout the year. Here is his explanation of REDOX reactions. For now I would just watch the first one. We will cover the rest of the topics in class.
https://www.youtube.com/watch?v=zcVLtoAdyd0

V. QUANTITATIVE CHEMISTRY AND STOICHIOMETRY

It is very easy to measure the mass of matter but it is very difficult to count how many particles there are. By using the concept of the mole we can relate how many particles to how much mass they use. This is extremely important so that we can do stoichiometry and quantify chemical reactions. A mole is a gigantic number of things. Scientists used the concept of a mole even before they knew how many particles there are in a mole. Avogadro's number is 6.02×10^{23}, which is the number of particles in a mole of anything. The concept of the mole came from the amount of hydrogen atoms in 1 gram of hydrogen. Later, Avogadro's number was estimated experimentally. You need to remember how to convert moles to grams and vice-versa also how to find the molar mass (mass of one mole) of different compounds.

Here is a link to basic procedure to solve stoichiometry problems:
http://www.mrmontero.com/U7/StoichReading.pdf

Here is a great stoichiometry and balancing reactions online practice:
http://chimie.adssys.com/nya/tests_stoechio_1/index.htm

You will also need to work with limiting and excess reactants. You will find more practice problems later in the packet.

VI. ATOMIC STRUCTURE

Our last topic revolves about the basic notion of what the atom is like inside. Everyone knows about protons, neutrons, and electrons. The idea is that you understand how we know that there are electrons and how do we know there is a nucleus. The most current model of the atom is the quantum mechanical model which focuses on what the electrons are doing in an atom. We turn to Wikipedia for a short and sweet review of basic atomic theory. Focus on the modern period. http://en.wikipedia.org/wiki/Atomic_theory

PRACTICE PROBLEMS

The following are a series of problems you can do to practice. Some will have the answers included so that you can check your work. As always, if you have any questions, let me know.

I. CHEMICAL FORMULAS

Write the formulas for the following substances:

NAME	FORMULA
a. Barium sulfate	
b. Ammonium chloride	
c. Chlorine monoxide	
d. Silicon tetrachloride	
e. Magnesium fluoride	
f. Sodium oxide	
g. Sodium peroxide	
h. Copper (I) iodide	
i. Zinc sulfide	
j. Potassium carbonate	
k. Hydrobromic acid	
l. Perchloric acid	
m. Lead (II) acetate	
n. Sodium permanganate	
o. Lithium oxalate	
p. Potassium cyanide	
q. Iron (III) hydroxide	
r. Silicon dioxide	
s. Nitrogen trifluoride	
t. Chromium (III) oxide	
u. Calcium chlorate	
v. Sodium thiocyanate	
w. Cobalt (III) nitrate	
x. Nitrous acid	
y. Ammonium phosphate	
z. Potassium chromate	

Write the names for the following substances:

FORMULA	NAME
a. Al_2S_3	
b. $CuSO_4$	
c. PCl_3	
d. Li_3N	
e. $BaSO_3$	
f. N_2F_4	
g. $KClO_4$	
h. NaH	
i. $(NH_4)_2Cr_2O_7$	
j. HNO_2	
k. Sr_3P_2	
l. $Mg(OH)_2$	
m. Al_2S_3	
n. AgBr	
o. P_4O_{10}	
p. $HC_2H_3O_2$	
q. CaI_2	
r. MnO_2	
s. Li_2O	
t. FeI_3	
u. Cu_3PO_4	
v. PCl_3	
w. NaCN	
x. Cs_3N	
y. $Zn(NO_3)_2$	
z. N_2O	

II. DIMENSIONAL ANALYSIS

Solve these problems using dimensional analysis and using conversion factors. I am sure you can solve them some other ways but stick to the format taught either last year or in the webpage above.

1. How many miles could you drive for $7.90 if the gas mileage of your car is 14.0 km/liter of gas and the price is $2.64/gal? (1.61 km/mile, 4 qt/gal, 1.10 qt/L)
   ANSWER: 94.6 miles

2. Mark McGuire hit 70 home runs in the 1998 season. Given that there are four bases with ninety feet between each base, how many miles did he run in that season just from home runs?
   (1 mile = 5280 ft)
   ANSWER: 4.77 miles

3. David Hill operates a crane that can pick up 3.0 tons of excavated earth in an hour. Dave's wages are $35 per hour. What is the cost of picking up 85 kg of excavated earth? (2.2 lb/kg, 2000 lb/ton)
   ANSWER: $1.1

4. If one afternoon Mike Gauthier decides to dig a hole through the earth to China for a game of ping pong, how many centuries would elapse before he got there if he dug at a rate of 0.40 miles depth per day and the diameter of the earth is 1.27×10^7 m? (1.61 km/mile)
   ANSWER: 0.54 centuries

5. One 1.6 oz. package of cinnamon and spice instant oatmeal contains 34 g of carbohydrates. If you had instant oatmeal 6.0 days a week, how many ounces of carbohydrate would you consume in a week? (16 oz = 1 lb = 454 grams = 256 Drams = 7000 Grains) (ans: 7.2 oz of carbohydrate)
   ANSWER: 7.2 oz. of carbohydrate

6. Vanillin (used to flavor vanilla ice cream and other foods) is the substance whose aroma the human nose detects in the smallest amount. The threshold limit is 2.0×10^{-11}g per liter of air. If the current price of 50.0 g of vanillin is $112, determine the cost to supply enough vanillin so that the aroma could be detected in a large aircraft hangar with a volume of 5.0×10^7 ft^3.
   ANSWER: 6.3 cents

III. CHEMICAL EQUATIONS:

For each equation below, identify the type (synthesis, decomposition, single replacement, double replacement, or combustion), predict the products, and then write the balanced reaction. Remember to use the solubility rules for double replacement reactions. You are always given the reactants so write their formulas and try to figure out the products. For example:

Solutions of silver nitrate and magnesium iodide are combined.
ANSWER: This is a double replacement precipitation reaction.

$$\underline{2} \;\; AgNO_{3\,(aq)} + MgI_{2\,(aq)} \rightarrow \underline{2}\, AgI_{(s)} + Mg(NO_3)_{2\,(aq)}$$

1. Ammonium sulfate reacts with barium nitrate.

2. Zinc metal is added to a solution of copper (II) chloride.

3. Propane gas (C_3H_8) is burned in excess oxygen.

4. Solid calcium chlorate is heated strongly decomposing into calcium chloride and oxygen gas.

5. Magnesium and nitrogen gas are heated together.

6. Chlorine gas is bubbled through a solution of sodium bromide.

7. Solutions of lead nitrate and calcium iodide are combined.

8. Sulfuric acid is combined with sodium hydroxide.

9. Isopropyl alcohol (C_3H_7OH) is burned in oxygen.

10. Iron metal shavings are added to hydrochloric acid.

11. Solid sodium carbonate is heated in a crucible.

12. Sodium metal is added to distilled water.

IV. QUANTITATIVE CHEMISTRY AND STOICHIOMETRY:

For every problem you need to balance the equation correctly so that you can use the right mole ratios. If you are given amounts of both reactants, you need to find the limiting reactant. Remember than when gases are involved, there are 22.4 liters in a mole of any gas at standard temperature and pressure (STP). If the reactions occur in solution the concentration is used as molarity (*M*) recall that molarity is the number of moles of solute in a liter of solution.

1. Calcium carbonate decomposes upon heating, producing calcium oxide and carbon dioxide gas.
   a. Write a balanced chemical equation for this reaction.
   b. How many grams of calcium oxide will be produced after 12.25 g of calcium carbonate is completely decomposed? ***ANSWER: 6.86 g CaO***
   c. What volume of carbon dioxide gas is produced from this amount of calcium carbonate, at STP? ***ANSWER: 2.94 L***

2. Hydrogen gas and bromine gas react to form hydrogen bromide gas.
   a. Write a balanced chemical equation for this reaction.
   b. 3.2 g of hydrogen gas and 9.5 g of bromine gas react. Which is the limiting reagent? ***ANSWER:*** $\boldsymbol{Br_2}$
   c. How many grams of hydrogen bromide gas can be produced using the amounts in (b)? ***ANSWER: 9.7 g HBr***
   d. How many grams of the excess reactant are left unreacted? ***ANSWER: 3.1 g*** $\boldsymbol{H_2}$
   e. What volume of HBr, measured at STP, is produced in (b)? ***ANSWER: 2.7 L HBr***

3. When ammonia gas, oxygen gas and methane gas (CH_4) are combined, the products are hydrogen cyanide gas and water.
   a. Write a balanced chemical equation for this reaction.
   b. Calculate the mass of each product produced when 225 g of oxygen gas is reacted with an excess of the other two reactants. ***ANSWER: 253.8 g*** $\boldsymbol{H_2O}$ ***and 127 g HCN***
   c. If the actual yield of the experiment in (b) is 105 g of HCN, calculate the percent yield. ***ANSWER: 82.7%***

4. When solutions of potassium iodide and lead (II) nitrate are combined, the products are potassium nitrate and bright yellow lead (II) iodide.
   a. Write a balanced equation for this reaction, including (aq) and (s).
   b. Calculate the mass of precipitate produced when 50.0mL of 0.45*M* potassium iodide solution and 75mL of 0.55*M* lead (II) nitrate solution are mixed. ***ANSWER: 5.2 g*** $\boldsymbol{PbI_2}$
   c. Calculate the volume of 0.50*M* potassium iodide required to react completely with 50.0mL of 0.50*M* lead (II) nitrate. ***ANSWER: 100 mL KI***