AP Summer Homework Name_____
Chemistry 2018-2019

Buon estate, chimici!

We have to keep the important concepts of second semester this year in your heads over the summer! I suggest waiting until July to start (we all need a break, after all) and doing ***a few problems a week*** until school starts, because if you do it right at the beginning of summer you won't remember anything on the first day of school, **Wednesday, September 5th**! Please bring this packet completed to the **first day of class** and we will briefly review it as well as hopefully correcting our final exams from this year and some other start-of-the-year stuff. ***If you are new to AOSR, I'll be sending you a document ASAP of what we covered in first year chemistry so you can be sure you are ready for AP Chem at AOSR! It moves fast and we do have an after school lab once a week to make sure we can make it through the content in time for the May 9th, 2019 exam!***

Remember: the second year of chemistry is A LOT more fun (because now you have the basic knowledge and can begin to apply it), but **it will be A LOT more work and requires strong math and study skills**. You should expect to be studying 1-2 hours minimum for each class and will be expected to be MUCH more self-drive, resourceful, and resilient in your study time. It is a rewarding college-level, fast-paced course, and I am glad you are taking this opportunity to challenge yourself!

Ci vediamo a settembre!
Ms Klug

Part 1: Review of problems we have done in year one chemistry.

1. A radioactive form of sodium pertechnetate is used as a brain scanning agent in medical diagnosis. An analysis of a 0.9872 gram sample found 0.1220 grams of sodium and 0.5255 grams of technetium. The remainder is oxygen. Calculate the empirical formula of sodium pertechnetate. (Use the value of 98.907 as the atomic mass of Tc).

2. If iodine is not in a person's diet, a thyroid condition called goitre develops. Iodized salt is all that it takes to prevent this disfiguring condition. Calcium iodate, $Ca(IO_3)_2$, is added to table salt to make iodized salt.

a) How many atoms of iodine are in 0.175 moles of $Ca(IO_3)_2$?

b) How many grams of calcium iodate are needed to supply this much iodine (in part a)?

3. Consider the reaction: $I_2O_5\ (g) + 5\ CO(g) \rightarrow 5\ CO_2(g) + I_2(g)$

a) 80.0 grams of iodine(V) oxide, I_2O_5, reacts with 28.0 grams of carbon monoxide, CO. Determine the mass of iodine that could be produced.

b) If, in the above situation, only 0.160 moles, of iodine was produced.

i) what mass of iodine was produced?

ii) what percentage yield of iodine was produced?

4. Silver nitrate, $AgNO_3$, reacts with ferric chloride, $FeCl_3$, to give silver chloride, AgCl, and ferric nitrate, $Fe(NO_3)_3$. In a particular experiment, it was planned to mix a solution containing 25.0 g of $AgNO_3$ with another solution containing 45.0 g of $FeCl_3$.

a) Write the chemical equation for the reaction.

b) Which reactant is the limiting reactant?

c) What is the maximum number of grams of AgCl that could be obtained?

d) How many grams of the reactant in excess will remain after the reaction is over?

Part 2: A new twist on what we have done (called *gravimetric analysis* – we will do this type of problem for one of our first labs in the fall). *It's just reaction stoichiometry – think how you could figure out from the product how much reactant you started with!*

1. An impure sample (there is other "stuff" in there) of Na_2SO_4 has a mass of 1.56 grams. This sample is dissolved and allowed to react with excess $BaCl_2$ solution. The precipitate has a mass of 2.15 grams. Calculate the percentage (by mass) of Na_2SO_4 in the original sample.

2. An impure 0.500 gram sample of NaCl was dissolved in 20.0 mL of water. The chloride ions were precipitated completely by addition of an excess of $AgNO_3$ solution. The dried AgCl precipitate has a mass of 1.15 grams.

a) Give the balanced chemical reaction of the reaction that took place

b) Calculate how many grams of NaCl were in the sample based on the mass of AgCl recovered:

c) What was the percentage of the NaCl in the impure sample?

Part 3: Teach yourself something new (called Molarity) – you will be expected to know this on the first day of class (it's really easy!)

a) First, familiarize yourself with the concepts and terms through this simulation (try many different solutes, and play around with the different variables you can change – turn on the "show values" box, too, so you can get a sense of the math): http://phet.colorado.edu/en/simulation/molarity

Questions from the simulation:

1) What is the solute? Solvent?

2) How do you make the solution most concentrated (darkest in color)? Explain.

3) How do you make the solution least concentrated (or most dilute)? Explain.

4) What seems to happen to the M number (called Molarity), when the solution is changing color (becoming more or less dilute)? Explain what you see.

5) What is the molarity number when the water volume is TWICE the moles of salt?

6) What is the molarity number when the moles of salt are TWICE the volume of water?

7) Pick one of the salts towards the bottom (potassium permanganate, potassium chromate, etc) and set the moles of salt to the highest you can and the volume of water to the lowest you can. What happens? What do you suppose "saturated" means? What can you do in the simulation so that the solution isn't saturated any more? Explain.

b) Then, read and work through these examples:
http://www.chemteam.info/Solutions/Molarity.html

c) **Practice problems**:

8) Calculate the molarity of a nickel (II) chloride solution if 75.4 g are dissolved in water to make 750 mL solution total.

9) If a solution of NaCl is 1.2 M, how many grams of NaCl would be in 1.5 L of the solution?

10) Calculate how many liters of water are necessary to make a 0.100 M solution of sodium thiosulfate ($Na_2S_2O_3$) using 300.0 grams of the salt.

11) Remember hydrates from lab final? A common hydrate is cobalt (II) chloride hexahydrate. Calculate the molarity of the solution made between 50.0 grams of salt and 150 mL of water.

12) **Now, for a challenge**: When 125 mL of 0.56 M copper (II) sulfate is mixed with 250. mL of 0.25 M sodium hydroxide, how many grams of copper (II) hydroxide are formed? Which is the limiting reagent? (Just change it to moles and then it's just normal stoich!)

Part 4: AP Sample problems – they may be tough, but you can do it! And you have to! Perseverance will be very important this year.

1) Water is added to 4.267 grams of UF_6. The only products are 3.730 grams of a solid containing only uranium, oxygen and fluorine and 0.970 gram of a gas. The gas is 95.0% fluorine, and the remainder is hydrogen.

(a) From these data, determine the empirical formula of the gas.

(b) What fraction of the fluorine of the original compound is in the solid and what fraction in the gas after the reaction?

(c) What is the formula of the solid product?

(d) Write a balanced equation for the reaction between UF_6 and H_2O. Assume that the empirical formula of the gas is the true formula.

2) Three volatile compounds X, Y, and Z each contain element Q. The percent by weight of element Q in each compound was determined.

Compound	Percent by weight of Element Q	Molecular Weight
X	64.8%	88.1
Y	73.0%	104.
Z	59.3%	64.0

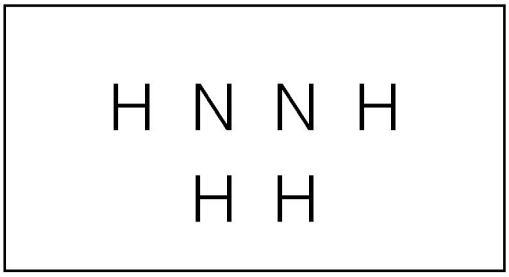
(a) Determine the mass of element Q contained in 1.00 mole of each of the three compounds.

(b) Calculate the most probable value of the atomic weight of element Q. What element fits this identity?

(c) Compound Z contains carbon, hydrogen, and element Q. When 1.00 gram of compound Z is oxidized and all of the carbon and hydrogen are converted to oxides, 1.37 grams of carbon dioxide and 0.281 gram of water are produced. Determine the most probable molecular formula of compound Z.

3) Hydrazine is an inorganic compound with the formula N_2H_4.

(a) In the box below, complete the Lewis electron-dot diagram for the N_2H_4 molecule by drawing in all the electron pairs.



(b) On the basis of the diagram you completed in part (a), do all six atoms in the N_2H_4 molecule lie in the same plane? Explain.

(c) The normal boiling point of N_2H_4 is 114°C, whereas the normal boiling point of C_2H_6 is - 89°C. Explain, in terms of the intermolecular forces present in each liquid, why the boiling point of N_2H_4 is so much higher than that of C_2H_6.