AP CHEMISTRY

SUMMER ASSIGNMENT 2023

Welcome to AP Chemistry! I'm looking forward to a great year together, and cannot wait for you to experience the excitement of understanding the world on a more fundamental level. Below is a list of major topics that we covered in Honors Chemistry. The attached exercises will allow you to review these topics. It will be especially helpful for those who are advancing from CP Chemistry who may not have covered all these topics. **Your work on these assignments will be collected on the first day of the school year, and it will be graded for a combination of completion and accuracy. If you do not know how to solve a problem, please make an effort to learn.** However, the purpose of this assignment is to allow you (and I) to identify areas of strengths and weaknesses as you enter the course. Therefore, don't be overly alarmed if you struggle with some of these problems – we'll be reviewing more challenging content.

REVIEW TOPICS

Metric System and conversions

Significant figures

Basic information on the Periodic Table of Elements

Nomenclature of binary and ternary compounds

The mole & Avogadro's Number

Stoichiometry of elements and compounds

Stoichiometry of reactions

- Involving all three states of matter
- Limiting reagents
- % yield

Gas Laws

The Ideal Gas Law (and derived Gas Laws)

- Properties of a gas
- Kinetic Theory of Matter

Thermodynamics

- Enthalpy and energy diagrams
- Endothermic reactions
- Exothermic reactions
- Hess's Law
- Calorimetry
- Entropy
- Gibbs free energy

Basic Atomic Theory –

- Subatomic particles
- Structure of the atom
- Electron configuration
- Valance electrons

Understanding bonding

- Describing and determining types of chemical bonds (ionic, covalent and metallic)
- Generating and using Lewis Dot Structures
- Determining molecular geometry and polarity

AP Chemistry Summer Review Problems:

***Directions*:** As will be the case during the year, TO RECEIVE FULL CREDIT, YOU MUST:

- Show ALL work
- Clearly identify your final answer by putting a box around it.
- Report numerical answers with the appropriate number of significant figures AND measurement units.

You can use the Periodic Table of Elements, and the other reference documents included with this assignment, as well as your old class notes and materials from your first chemistry course. Also you'll need a calculator; just remember calculators do not know significant figures. Please email me at mhammond@eustace.org if you have any questions along the way.

NOTE: I recommend not doing these problems until closer to the start of the school year (i.e., after July 15th) A recommended schedule is included with the problems. However, it's up to you, as long as you finish by the start of the year. **Please pay particular attention to the stoichiometry problems, as there will be a test on stoichiometry relatively early in the year.** If you study beyond this packet, I would focus on stoichiometry.

Week of July 18th – Stoichiometry of Elements and Compounds

1. How many grams are in 3.56 mg?

2. Copper has a density of 8.96 g/ml. A cube shaped piece of copper has a mass of 27.42 g. Determine the length of a side of the copper sample. (note: 1mL = 1cm^3)

3. How many molecules are in 3.5 mg of carbon dioxide?

4. Determine the molar mass of chromium(VI) phosphate.

5. What is the percent by mass of oxygen in calcium sulfite?

6. Element X is known to have an average atomic mass of 175.689 g and two stable isotopes having isotopic masses of 178.92319 g and 173.8759 g, respectively. What is the percentage of each of the stable isotopes in a sample of Element X?

7. Calculate the molarity of a solution composed of 35.8 g of iron (III) phosphate dissolved into 135 mL of water.

8. A compound is known to have the following percent composition by mass: 71.65% Cl, 24.27% C and 4.07% H. a) Calculate the compound's empirical formula. b) It is further determined that the compound has a molar mass of 98.96 g/mol. Determine the compound's molecular formula.

Week of July 25th- Stoichiometry of Chemical Reactions

9. Write the balanced equation represents the reaction between phosphoric acid and calcium hydroxide.

10. Consider the reaction below. Assume that excess potassium chloride (KCl) is added to a 345 mL solution of 0.2 M silver nitrate ($AgNO_3$), and that a white precipitate forms. (a) Identify the formula of the white precipitate (b) How many grams of this white precipitate can be isolated? (c) State the formula of anything that is still dissolved in the water after the reaction.

$$AgNO_3\ (aq) + KCl\ (aq) \rightarrow$$

11. The compound $Cu(NH_3)_4SO_4$ is made the following reaction of copper (II)sulfate and ammonia:

$$CuSO_4\ (aq) + 4\ NH_3\ (aq) \rightarrow Cu(NH_3)_4SO_4$$

a) If 10.0 g of $CuSO_4$ are reacted, determine the theoretical yield of $Cu(NH_3)_4SO_4$. b) The reaction is run to completion and you obtain 12.6 g of $Cu(NH_3)_4SO_4$. What is the % yield of the reaction?

12. 50.0 g of sodium (Na) react with 50.0 g of chlorine gas (Cl_2) to form table salt (NaCl). a) Which reactant is the limiting reactant? b) What mass of NaCl will be formed, assuming 100% yield? c) How much of the non-limiting reactant will remain?

13. If 30.2 mL of 2 M Li_2CO_3 is mixed with 42.5 mL of 1.7 M $CaCl_2$, a) How many grams of $CaCO_3$ will precipitate? b) What is the final concentration of the excess reagent? c) Write the net ionic equation for this reaction.

14. In a lab designed to create $MgCl_2$ from a reaction between HCl (aq) and Mg (s), you start with a 5.259 g sample of Mg. The sample is placed in the acid and allowed to react until all of the magnesium is consumed. The beaker is then heated until only the $MgCl_2$ remains.

a. What are the products of this reaction?

b. How much $MgCl_2$ would you expect to produce?

15. You run the above experiment twice with the same equipment and collect the data below, determine the percent error for each trial AND give a possible explanation for the calculated percent error for each.

	Trial 1	Trial 2
Mass of empty, dry beaker	77.50 g	77.50 g
Mass of dry beaker w/ dry $MgCl_2$	99.23 g	96.87 g

16. A 2.57 L sample of O_2 has a measured pressure of 920 torr and temperature of 30°C. a) How many moles of gas are present in the sample? b) Would you expect a 2.57 L sample of H_2 that has the same pressure and temperature to contain a greater, lesser, or equivalent number of moles. Explain.

17. If a sample of H_2 gas has a pressure of 1.2 atm in a 3.4 L rigid container, what will be the pressure of that same sample of gas if it is moved to a 1.4 L rigid container?

18. A solution of 0.75 M HCl is reacted with excess Na_2CO_3 to generate CO_2 as follows:

$$Na_2CO_3\ (s) + 2\ HCl\ (aq) \rightarrow H_2CO_3\ (aq) + 2\ NaCl\ (aq) \rightarrow 2\ NaCl\ (aq) + H_2O\ (l) + CO_2\ (g)$$

As a result, a volume of 37.1 mL CO_2 is collected over water at 25°C and 755 mmHg. Given that the partial pressure of water vapor at these conditions is 23.8 mmHg, what volume of HCl was reacted?

19. If you raise the temperature of a gas in a rigid container, what happens to the pressure of the gas? Explain what is happening on the particulate level. Be sure to explain what pressure is.

20. Nitrogen monoxide reacts with oxygen to form nitrogen dioxide

$$2NO + O_2 \rightarrow 2\ NO_2 \qquad \Delta H = -114.1\ kJ/mole$$

a) Draw an energy diagram for this reaction, and label the change in enthalpy for the reaction? b) Is this reaction endothermic or exothermic? How do you know? c) What is the enthalpy change when 1.25 g of NO are converted completely to NO_2?

21. PCl_3 can be formed by the combination of its constituent elements as shown:

$$P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$$

Given the following experimental data, calculate the enthalpy change that occurs when a mole of PCl_3 is formed.

$$P_4 + 10\ Cl_2 \rightarrow 4\ PCl_5 \qquad \Delta H_{rxn} = -1774.0\ kJ/mole$$

$$PCl_3 + Cl_2 \rightarrow PCl_5 \qquad \Delta H_{rxn} = -123.8\ kJ/mole$$

22. A 21.8 g sample of zinc is heated to 98.8°C and dropped into an insulated beaker container 46.0 g of water at a temperature of 25.0°C. After reaching thermal equilibrium, the temperature of beaker and contents is 27.1°C. Determine the specific heat capacity of zinc based on this data.

Week of August 15th – Atomic Structure

23. An electron falls from the n = 4 to the n = 2 energy level and emits a photon of wavelength 570 nm. a) What frequency does this correspond to? b) how much energy does the photon possess?

24. Fill in the missing blocks on the following table:

period	**group**	**symbol**	**# of p^+**	**Common charge or oxidation #**	**Atomic mass**	**Valance e^- configuration**
						$3s^2 3p^6$
7				-3		
		P				
6	2					

25. Write the full electron configuration for each of the following:

a. Se:

b. Fe:

26. Write the condensed (Noble gas) electronic configuration for each of the following:

a. Pb:

b. Co:

Week of August 22nd - Bonding

27. Draw the Lewis Dot structure for the following:

a) CH_3Cl b) BI_3 c) NH_4^+ d) SO_3

28. Using their Lewis dot structures, explain why H_2O and $BeCl_2$ have different molecular geometries.

29. For the 6 molecules/ions discussed in the previous two problems, a) identify the molecular shape and state whether the molecule is polar.