AP Chemistry, Summer 2022

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Dear (Future) AP Chemistry Student,

Let me first congratulate you on your excellent decision to take AP Chemistry. As a student of any AP course, you should find the classes and coursework quite challenging – but not daunting. At this time, you may not understand the benefits of taking any AP class; however, when you get to college is when you will reap the dividends of your work now.

The AP Chemistry course will be structured and designed around how the AP Chemistry test is administered in May. The material taught in AP Chemistry is what you would expect if you were to take general chemistry during your first year of college. There will be more in-depth labs than in honors chemistry and the material covered is worth 2-full college semesters.

My goal as your chemistry teacher, is to prepare you well enough to score a "5" on the AP Chemistry Exam. You will not only learn chemistry, but you will also learn many test-taking strategies for doing well on the exam.

Today, you will have received this letter AND the study packet that is DUE on the first day of class. Before you leave for summer, you will need to check out an AP Chemistry textbook from the Library.

I understand that the previous school year presented its own unique challenges for learning chemistry at a faster pace than the 2020-2021 school year required. As to be expected, there may be some gaps in what we covered during the 2021-2022 school year that we will need to identify and fill; the goal of the summer assignment is to help us begin to accomplish that. As a result, each question comes with learning targets and some specific resources to help you (hopefully) review or, in some cases, learn, the material covered. I highly recommend you reach out to any peers you know are taking this class to WORK TOGETHER through any challenging content. Sometimes you learn best from one another (as long as each of you is doing the work in its entirety).

At some point during the summer, please reach out to me via e-mail and reintroduce yourself. In addition to helping with any questions you may have, I would like to know the following information about you:

- Why did you sign up for AP chemistry?
- What are you looking forward to in this course?
- What are you apprehensive about in this course?
- What plans are you considering for your life after high school?

I look forward to getting the chance to work through AP Chemistry WITH you! This is my second year teaching this challenging course, and we will learn and grow together; I'm excited for the journey that lies ahead. Have a great summer, and I will see you in August!

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Advanced Placement Chemistry ~ Summer Review Packet

Learning Target 1 – *I can count the number of significant figures in a measurement.*
Review Reading: **Zumdahl 8th Ed. Pg 11-17** **Wikipedia: Significant Figures**

  1) Count the number of significant figures in the following measurements:

      a) 2.71 g _____   b) 0.00047 kg _____   c) 7.0 x 10^5 m _____   d) 1,030 L _____

      e) 150 pencils _____   f) 37500 g _____   g) 0.1010 cm _____

Learning Target 2 – *I can convert numbers to scientific notation while applying significant figures.*
Review Reading: **Zumdahl 8th Ed. Pg 11-17** **Wikipedia: Significant Figures**

  2) Express each of the following in proper scientific notation (Pay attention to sig figs and units)

      a) 0.000125 m _____   b) 155.0 mL _____

      c) 123,030,000 kg _____   d) 481.9 x 10^{-9} cm _____

Learning Target 3 - *I can add, subtract, multiply, and divide with the correct number of significant figures.*
Review Reading: **Zumdahl 8th Ed. Pg 11-17** **Wikipedia: Significant Figures**

  3) Calculate the correct answer with proper units and sig figs for each of the following:

      a) 12 g + 0.677 g + 86.33 g = _____

      b) (355.78 g) / (0.056 g) = _____

      c) 97.34 mL – 34.1 mL = _____

      d) 14.68 x 5 = _____

  4) Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

      a) 0.14 x (6.02 x 10^{23}) = _____

      b) $\dfrac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4}$ x 100 % = _____ (assume 100 is exact)

      c) $\dfrac{(3.8 \times 10^{-12} + 4.0 \times 10^{-13})}{(4 \times 10^{12} + 6.3 \times 10^{13})}$ = _____

Learning Target 4 – *I can use conversions to solve dimensional analysis problems.*
Review Reading: **Zumdahl 8ᵗʰ Ed. Pg 17-21**   **Khan Academy: Dimensional Analysis**

5) Solve the following problems using conversions and dimensional analysis.

   a) A large railroad car is filled with 1745 gallons of milk. The car springs a leak in the bottom, and milk starts dripping out at a rate of 204.84 mL/sec. If the train is traveling at a speed of 65.4 miles per hour, calculate how many miles it will travel before all the milk has drained out of the car. (1 gal = 3.78 L, 1 mile = 5280 ft, 1 in = 2.54 cm)

   b) The world record for the hundred meter dash is 9.77 seconds. What is the corresponding average speed in units of m/sec, km/hr, ft/sec, and miles/hr?

Learning Target 5 – *I can explain density and use the density equation to find an unknown.*
Review Reading: **Zumdahl 8ᵗʰ Ed. Pg 24-25**   **Wikipedia/Khan Academy: Density**

6) A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?

7) The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

Learning Target 6 – *I can define and explain terms that identify physical/chemical characteristics of matter.*
Review Reading: **Zumdahl 8ᵗʰ Ed. Pg 26-29**   **Wikipedia: Matter   or Wikipedia any of the terms below**

8) Define the following terms:

   a) Solid –

   b) Liquid –

   c) Gas –

   d) Pure substance –

   e) Homogeneous mixture –

   f) Heterogeneous mixture –

   g) Chemical change –

   h) Physical change –

9) Identify the following as a physical property, physical change, chemical property, or chemical change:

    a) Ethanol has a density of 0.697 g/mL.

    b) The solution turns blue upon mixing water and food coloring.

    c) Wood burns in an oven.

    d) Methyl alcohol is highly flammable.

    e) Ice melts in a beaker.

    f) Methyl ethanoate smells like apples.

    g) A car crashes into a wall.

    h) Sugar dissolves in water.

Learning Target 7 – *I can identify the number of protons, neutrons, and electrons in atoms and isotopes.*
Review Reading: **Zumdahl 8ᵗʰ Ed. Pg 50-52**   **Tyler Dewitt (YouTube): Isotope**

10) What number of protons and neutrons are contained in the nucleus of each of the following atoms? Assuming each atom is uncharged, what number of electrons are present?

    a) $^{235}_{92}U$

    b) $^{13}_{6}C$

    c) $^{57}_{26}Fe$

    d) $^{208}_{82}Pb$

11) Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium	70					
						$^{31}_{15}P^{-3}$
Strontium-80						
						$^{55}_{25}Mn^{+2}$

Learning Target 8 – *I can define and use the Law of Definite Proportions and the Law of Multiple Proportions.*
Review Reading: **Zumdahl 8ᵗʰ Ed. Pg 41-44**   **Khan: Law of Definite Proportions, Law of Multiple Proportions**

12) Explain:
    a) Law of Definite Proportions:

    b) Law of Multiple Proportions:

13) Solve the following problem:

Tin – Oxygen compound	Tin % by mass	Oxygen % by mass
Stannous oxide	88.10%	11.90%
Stannic oxide	78.70%	21.30%

Tin – Oxygen compound	Tin mass	Oxygen mass
Stannous oxide	100.0 grams	
Stannic oxide	100.0 grams	

a) Use the Law of Definite Proportions to determine the mass of oxygen needed to combine with the given masses of tin for stannous oxide and stannic oxide.

b) Does the Law of Multiple Proportions hold true in this case? Explain why or why not.

Learning Target 9 – *I can name and write formulas for ionic compounds.*
Review Reading: **Zumdahl 8th Ed. Pg 57-63**   **Wikipedia: IUPAC nomenclature of inorganic compounds**

14) Name or give the formula for the following compounds:

Name   Formula

Sodium fluoride   _____

_____ K_2O

Calcium phosphate   _____

_____ $FeCl_3$

Iron (II) chloride   _____

_____ Hg_2O

Sodium sulfate   _____

_____ $CaCO_3$

Lithium phosphate   _____

_____ SO_2

Calcium hydroxide   _____

_____ H_2SO_4

Cupric chloride   _____

Learning Target 10 – *I can write and balance equations.*
Review Reading: Zumdahl 8th Ed. 97-102   www.chymist.com/Equations.pdf

Write and balance the following equations:
a) Iron metal reacts with oxygen to form rust, iron (III) oxide.

b) Calcium metal reacts with water to produce aqueous calcium hydroxide and hydrogen gas.

c) Aqueous barium hydroxide reacts with aqueous sulfuric acid to produce solid barium sulfate and water.

Learning Target 11 – *I can do conversions associated with moles.*
Review Reading: Zumdahl 8th Ed. 81-88   Tyler DeWitt (youtube) : Mole Calculations

15) Solve the following problems:

a) Calculate the mass of 500. Atoms of iron (Fe).

b) How many formula units are present in 87.2 grams of lead (IV) carbonate?

c) Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

 i.   Calculate the molar mass of aspartame.

 ii.   Calculate the mass, in grams, of 1.56 mol of aspartame.

 iii.   How many molecules are in 5.0 mg of aspartame?

 iv.   How many atoms of nitrogen are in 1.2 g aspartame?

 v.   What is the mass of one molecule of aspartame?

Learning Target 12 – *I can calculate percent by mass for an element in a compound.*
Review Reading: Zumdahl 8th Ed. 88-90   Tyler DeWitt (youtube) : percent mass

16) Calculate the percent by mass for each element in aspartame from the previous problem.

Learning Target 13 – *I can calculate the average atomic mass of an isotope using percent abundance.*
Review Reading: Zumdahl 8th Ed. 78-80   Tyler DeWitt (youtube): average atomic mass

17) An element consists of 1.40% of an isotope with a mass of 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

Learning Target 14 – *I can solve stoichiometry problems, include those that use limiting and excess.*
Review Reading: Zumdahl 8th Ed. 102-115   Tyler DeWitt (Youtube): stoichiometry problems

18) The reusable booster rockets of the U.S. space shuttle employs a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:

_____$Al(s)$ + _____ $NH_4ClO_4(s)$ → _____ $Al_2O_3(s)$ + _____ $AlCl_3(s)$ + ___ $NO(g)$ + _____ $H_2O(g)$
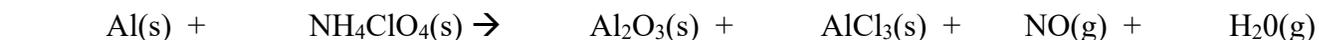
a) Balance the following reaction:

b) If 4.0 g of aluminum reacted with 15.0 g of ammonium perchlorate, what would be the limiting reactant? How much excess of the other reactant would you have?

c) Using the above information, how much aluminum chloride would be produced in grams?

d) If you actually collected 4.18 g of aluminum chloride what would be your percent yield?

19) You add aluminum to a solution of copper (II) chloride and it reacts exothermically. Write and balance the equation below.

   a) If you react 1.25 g of Al, how much copper (II) chloride do you need to add for the Al to fully react?

   b) How much of each product would you collect?

20) When 125.0 g of ethylene (C_2H_4) burns in 60.0 grams of oxygen to give carbon dioxide and water, how many grams of CO_2 are formed? (Hint: balance the equation and determine limiting reactant first)

Learning Target 15 – *I can determine the empirical and molecular formula by calculation.*
Review Reading: **Zumdahl 8ᵗʰ Ed. 90-97**   **Khan Academy: empirical formula**

21) Phenol is a compound that contains 76.57% carbon, 6.43% hydrogen, and 17.0% oxygen.

   a) Calculate the empirical formula.

   b) If its molecular weight is 188 g/mol, what would be its molecular formula?

Learning Target 16 - *I can calculate the empirical formula of an unknown hydrocarbon through a combustion reaction and calculation.*

Review Reading: **Zumdahl 8ᵗʰ Ed. 88-92**   **Google: combustion analysis**

22) One killer of a problem – a GOLD STAR if you can get this one:

Menthol, the substance we can smell in mentholated cough drops, is composed of carbon, hydrogen, and oxygen. A 0.1005 gram sample of menthol is combusted producing 0.2829 g of CO_2 and 0.1159 g of H_2O. What is the empirical formula for menthol? Show work.