AP Chemistry Summer Assignment

To: AP Chemistry Students and Their Parents

From: Dr. Heffner

Re: AP Chemistry Summer Assignment

There are several important reasons for doing AP Chemistry homework over the summer:

- To review basic concepts, you learned when you took first-year chemistry
- To practice math skills which you will need for AP Chemistry
- To hit the ground running when we return in the Fall

AP chemistry covers a lot of concepts at a fast pace. We need to get started right away and not waste time going over things you already know. This assignment is meant to be a **review**. We will spend the first few weeks of the year going into some of the assigned chapters in more depth and so, if you have some questions while you are doing the summer assignment, you will have a chance to ask me.

Please pick up a textbook[1]. from the TCS office during business hours. The AP Chemistry Summer Assignment will consist of two parts. **The first part** will be reading chapters 1-4 in the text book. I am not assigning any formal problems at the end of each chapter, but I highly recommend that you do each **example** as you read through these 4 chapters. My experience is that that each of the examples you encounter as you read through the chapter reflect the problems at the end each chapter.

The second part of the AP Chemistry Summer Assignment will be to complete both the math and chemistry assignments that start on page 2 of this Word Document. The assignment will be collected on the first day of class and will constitute your first homework grade. If you have any questions or trouble completing any of the problems, don't hesitate to email me at rheffner@timothychristian.org. I will be on vacation at various times during the summer but will get back to you as soon as possible. Forming study groups to complete these assignments is encouraged; it is amazing what we can learn collectively.

Have a restful and blessed summer vacation.

Dr. Heffner

1. Zumdahl, Steven and Susan Zumdahl. Chemistry, Ninth Edition. Belmont CA: Cengage Learning, 2014.

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AP Chemistry Summer Math Assignment

Supply the answers in the blanks. **No calculators please! The multiple-choice section of the AP exam does not allow calculators and you need the practice doing mental math without one. You can use paper and pencil (or pen) to work them out.**

1. $1.62 \times 10^{6} + 1.9 \times 10^{5} =$ _____
2. $1.62 \times 10^{6} - 1.9 \times 10^{5} =$ _____
3. $3.72 \times 10^{-8} + 0.211 \times 10^{-7} =$ _____
4. $3.72 \times 10^{-8} - 0.211 \times 10^{-7} =$ _____
5. $(2.3 \times 10^{4})(3.1 \times 10^{4}) =$ _____
6. square root of $9.0 \times 10^{-8} =$ _____
7. cube root of $8.0 \times 10^{-9} =$ _____
8. approximate square root of 3.2 = _____
9. $\dfrac{(2.6 \times 10^{-8})}{(0.52 \times 10^{-9})} =$ _____
10. $10^{x} = 2$ and log 2 = 0.30; x = _____
11. x= _____ if $x^{2}/0.10 = 4.0 \times 10^{-9}$
12. x = _____ if xy = 16 and $y^{2} = 225$
13. $(2.4 \times 10^{-8})(0.25 \times 10^{-2}) = (1.5 \times 10^{-4})$
14. log (1.0×10^{4}) = _____
15. log (1.0×10^{-4}) _____

16. log (2.3×10^{-5}) = _____

17. approximate value of x if $(x + 0.1)(x) = 2.0 \times 10^{-8}$

18. x+y=3 and x–y=9; x=_____

19. (0.001) (0.001) = _____

20. 3.42/342 = _____

21. If a megabuck is one million dollars and a kilobuck is one thousand dollars, how many kilobucks is 342 dollars?

22. A ten cm candle is being burned at both ends. One end burns at the rate of one cm per hour; the other end burns at one-half cm per hour. How far from the center of the candle will the burning ends meet?

23. A wooden cube three cm on edge is placed inside a cube box that is six cm on edge. How much free space is in the box?

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Complete the following list of chemistry problems. They cover concepts you learned in first year chemistry. If you get stuck, feel free to read through the appropriate section of your textbook. Show all work on this copy.

1. Give an example of a homogeneous mixture and a heterogeneous mixture.

2. Do the following statements describe chemical or physical properties?

    a. Oxygen gas supports combustion.

    b. Fertilizers help to increase agricultural production.

    c. Water boils below $100^{O}C$ on top of a mountain.

    d. Lead is denser than aluminum.

    e. Uranium is a radioactive element.

3. Does each of the following describe a physical change or a chemical change?

    a. The helium gas inside a balloon tends to leak out after a few hours.

    b. A flashlight beam slowly gets dimmer and finally goes out.

    c. Frozen orange juice is reconstituted by adding water to it.

    d. The growth of plants depends on the sun's energy in a process called photosynthesis.

    e. A spoonful of table salt dissolves in a bowl of soup.

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4. Give the names of the elements represented by the chemical symbols:

a. Li
b. F
c. P
d. Cu
e. As
f. Zn
g. Cl
h. Pt
i. Mg
j. U
k. Al
l. Si
m. Ne

5. Give the chemical symbols for the following elements:

a. potassium
b. tin
c. chromium
d. boron
e. barium
f. plutonium
g. sulfur
h. argon
i. mercury

6. Classify each of the following substances as an element or compound:

a. Hydrogen
b. water
c. gold
d. sugar

7. Classify each of the following as an element, compound, homogeneous mixture, or heterogeneous mixture:
    a. Seawater
    b. helium gas
    c. sodium chloride (table salt)
    d. a bottle of soft drink
    e. milk shake
    f. air in a bottle
    g. concrete

8. Name the SI base units that are important in chemistry. Give the SI units for expressing the following:
    a. length
    b. volume
    c. mass
    d. time
    e. energy
    f. temperature

9. Write the numbers represented by the following prefixes:
    a. mega
    b. kilo
    c. deci
    d. centi
    e. milli
    f. micro
    g. nano
    h. pico

10. What units do chemists usually use for liquids and solids? For gas density? Explain the differences.

11. Bromine is a reddish-brown liquid. Calculate the density of bromine (in g/mL) if 586 g of the substance occupies 188 mL.

12. Answer the following questions.

    a. Normally the human body can endure a temperature of 105^{O}F for only short periods of time without permanent damage to the brain or other vital organs. What is this temperature in ^{O}C?

    b. Ethylene glycol is a liquid organic compound that is used as an antifreeze in car radiators. It freezes at -11.5^{O}C. Calculate the freezing point temperature in degrees Fahrenheit.

    c. The temperature on the surface of the sun is about 6300^{O}C. What is this temperature in degrees Fahrenheit?

    d. The ignition temperature of paper is 451^{O}F. What is the temperature in degrees Celsius?

13. Convert the following temperatures to Kelvin:

    a. $113^{O}C$, the melting point of sulfur

    b. $37^{O}C$, the normal body temperature

    c. $357^{O}C$, the boiling point of mercury

14. Convert the following temperature to degrees Celsius:

    a. 77 K, the boiling point of liquid nitrogen

    b. 4.2 K, the boiling point of liquid helium

    c. 601 K, the melting point of lead

15. What is the number of significant figures in each of the following measurements?
    a. 4867 mi
    b. 56mL
    c. 60,104 ton
    d. 2900 g
    e. $40.2\ g/cm^3$

16. Carry out the following calculations as if they were calculations of experimental results, and express each answer in the correct units with the correct number of significant figures.

    a. 5.6792m + 0.6m + 4.33m

    b. 3.70 g – 2.9133 g

    c. 4.51 cm x 3.6666 cm

17. Carry out the following conversions (you must use conversion factors):

    a. 22.6 m to dm

    b. 25.4 mg to kg

    c. 556mL to L

    d. 10.6 kg/m^3 to g/cm^3

18. The average speed of helium at $25^{O}C$ is 1255 m/s. Convert this speed to miles per hour (mph) using conversion factors.

19. Describe the contributions of the following scientists to our knowledge of atomic structure:

    a. JJ Thomson

    b. RA Millikan

    c. Ernest Rutherford

    d. James Chadwick

20. Describe the experimental basis for believing that the nucleus occupies a very small fraction of the volume of the atom.

21. Indicate the number of protons, neutrons, and electrons in each of the following species:

    a. $^{15}_{7}N$

    b. $^{33}_{16}S$

    c. $^{63}_{29}Cu$

    d. $^{84}_{38}Sr$

    e. $^{130}_{56}Ba$

    f. $^{186}_{74}W$

    g. $^{202}_{80}Hg$

22. Define, with two examples, the following terms:

    a. alkali metals

    b. alkaline earth metals

    c. halogens

    d. noble gases

23. Elements whose name ends with –ium are usually metals. Sodium is one example. Identify a nonmetal whose name ends with –ium.

24. Explain why the chemical formula HCl can represent two different chemical systems.

25. Name the following compounds:

    a. KClO

    b. Ag_2CO_3

    c. HNO_2

    d. $KMnO_4$

    e. $CsClO_3$

    f. KNH_4SO_4

    g. FeO

    h. Fe_2O_3

    i. $TiCl_4$

    j. NaH

    k. Li_3N

    l. Na_2O

    m. Na_2O_2

26. Write the formulas for the following compounds:

    a. rubidium nitrite

    b. potassium sulfide

    c. sodium hydrogen sulfide

    d. magnesium phosphate

    e. calcium hydrogen phosphate

    f. potassium dihydrogen phosphate

    g. iodine heptafluoride

    h. ammonium sulfate

    i. silver perchlorate

    j. boron trichloride

27. Write the formulas for the following compounds:

    a. copper (I) cyanide

    b. strontium chlorite

    c. perbromic acid

    d. hydroiodic acid

    e. disodium ammonium phosphate

    f. lead (II) carbonate

    g. tin (II) fluoride

    h. tetraphosphorous decasulfide

    i. mercury (II) oxide

    j. mercury (I) iodide

    k. selenium hexafluoride

28. Write the formula of the common ion derived from each of the following:

    a. Li

    b. S

    c. I

    d. N

    e. Al

    f. Cs

    g. Mg

29. Fill in the blanks in the following table:

Cation	**Anion**	**Formula**	**Name**
			Magnesium bicarbonate
		$SrCl_2$	
Fe^{3+}	NO_2^-		
			Manganese (II) chlorate
		$SnBr_4$	
Co^{2+}	PO_4^{3-}		
Hg_2^{2+}	I^-		
		Cu_2CO_3	
			Lithium nitride
Al^{3+}	S^{2-}		

32. How many moles of cobalt (Co) atoms are there in 6.00×10^9 cobalt atoms?

33. How many moles of calcium (Ca) atoms are in 77.4 g of calcium?

34. How many atoms are present in 3.14 g of copper (Cu)?

35. Calculate the molar mass of each of the following substances:

    a. NO_2

    b. SO

    c. C_6H_6

    d. NaI

    e. K_2SO_4

    f. $Ca_3(PO_4)_2$

36. How many molecules of ethane (C_2H_6) are present in 0.334 g of C_2H_6?

37. What are the empirical formulas of the compounds with the following compositions?

    a. 40.1% C, 6.6% H, 53.3% O

    b. 18.4% C, 21.5% N, 60.1% K

38. The anticaking agent added to Morton salt is calcium silicate, $CaSiO_3$. This compound can absorb up to 2.5 times its mass of water and still remain a free-flowing powder. Calculate the percent composition of $CaSiO_3$.

39. The empirical formula of a compound is CH. If the molar mass of this compound is about 78 g, what is the molecular formula?

40. Balance the following equations:

    a. $C + O_2 \rightarrow CO$

    b. $CO + O_2 \rightarrow CO_2$

    c. $H_2 + Br_2 \rightarrow HBr$

    d. $K + H_2O \rightarrow KOH + H_2$

    e. $Mg + O_2 \rightarrow MgO$

    f. $O_3 \rightarrow O_2$

41. Ammonia is a principal nitrogen fertilizer. It is prepared by the reaction between nitrogen and hydrogen.

$$3\ H_{2\,(g)} + N_{2\,(g)} \rightarrow 2\ NH_{3\,(g)}$$

In a particular reaction, 6.0 moles of NH_3 were produced. How many moles of H_2 and how many moles of N_2 were reacted to produce this amount of NH_3?

42. When baking soda (sodium bicarbonate or sodium hydrogen carbonate, $NaHCO_3$) is heated, it releases carbon dioxide gas, which is responsible for the rising of dough in cookies, rolls and donuts.

    a. Write the balanced equation for the decomposition of the compound (one of the products is Na_2CO_3).

    b. Calculate the mass of $NaHCO_3$ required to produce 20.5 g of CO_2.

43. When potassium cyanide (KCN) reacts with acids, a deadly poisonous gas, hydrogen cyanide, HCN, is produced. Here is the equation:

$$KCN_{(aq)} + HCl_{(aq).} \rightarrow KCl_{(aq)} + HCN_{(g)}$$

    If a sample of 0.140 g of KCN is treated with excess HCl, calculate the amount of HCN formed, in grams.

44. Fermentation is a complex chemical process of wine making in which glucose is converted into ethanol and carbon dioxide:

$$\underset{\text{glucose.}}{C_6H_{12}O_6} \rightarrow 2\ \underset{\text{ethanol}}{C_2H_5OH} + 2\ CO_2$$

    Starting with 500.4 g of glucose, what is the maximum amount of ethanol in grams and in liters that can be obtained by the process? (Density of ethanol is 0.789 g/mL)

45. Nitric oxide (NO) reacts with oxygen to form nitrogen dioxide (NO_2), a dark brown gas.

$$2NO_{(g)} + O_{2\,(g)} \rightarrow 2NO_{2\,(g)}$$

In one experiment, 0.886 mole of NO is mixed with 0.503 mole of O_2. Calculate which of these two reactants is the limiting reactant. Also calculate the number of moles of NO_2 produced.

46. Characterize the following compounds as soluble or insoluble in water:

    a. $Ca_3(PO_4)_2$

    b. $Mn(OH)_2$

    c. $AgClO_3$

    d. K_2S

    e. $CaCO_3$

    f. $ZnSO_4$

    g. $Hg(NO_3)_2$

    h. $HgSO_4$

    i. NH_4ClO_4

47. Write the net ionic equations for the following reactions:

    a. $AgNO_{3\,(aq)} + Na_2SO_{4\,(aq)} \rightarrow$

    b. $BaCl_{2\,(aq)} + ZnSO_{4\,(aq)} \rightarrow$

    c. $(NH_4)_2CO_{3\,(aq)} + CaCl_{2\,(aq)} \rightarrow$

48. Give Arrhenius's and Bronsted's definitions of an acid and a base. Why are Bronsted's definitions more useful in describing acid-base properties?

49. Identify each of the following species as a Bronsted acid, base, or both:

    a. HI

    b. CH_3COO^-

    c. $H_2PO_4^-$

    d. HSO_4^-

    e. NH_4^+

    f. ClO_2^-

50. Predict the outcomes of the reactions represented by the following equations by using the activity series, and balance the equations:

    a. $Cu_{(s)} + HCl_{(aq)} \rightarrow$

    b. $I_{2(s)} + NaBr_{(aq)} \rightarrow$

    c. $Mg_{(s)} + CuSO_{4\,(aq)} \rightarrow$

    d. $Cl_{2(g)} + KBr_{(aq)} \rightarrow$

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51. How many moles of $MgCl_2$ are present in 60.0 mL of 0.100 M $MgCl_2$ solution?

52. How many grams of KOH are present in 35.0 mL of a 5.50 M solution?

53. Calculate the molarity of each of the following solutions:

    a. 29.0 g of ethanol (C_2H_5OH) in 545 mL of solution.

    b. 15.4 g of sucrose ($C_{12}H_{22}O_{11}$) in 74.0 mL of solution.

    c. 9.00 g of sodium chloride (NaCl) in 86.4 mL of solution.

54. A sample of nitrogen gas kept in a container of volume 2.3 L and a temperature of $32^{O}C$ exerts a pressure of 4.7 atm. Calculate the number of moles of gas present. (Note: The AP curriculum tends to present pressures in atm rather than kPa. As a result, the value for R will be 0.0821 L·atm/mol·K instead of 8.31 L·kPa/mol·K).

55. Given that 6.9 moles of carbon monoxide gas are present in a container with volume 30.4 L, what is the pressure of the gas (in atm) if the temperature is $62^{O}C$?

56. Methane, the principal component of natural gas, is used for heating and cooking. The combustion process is:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

If 15.0 moles of CH_4 are reacted, what is the volume of CO_2 in liters produced at $23.0^{O}C$ and 0.985 atm?