

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

## 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. Once school starts in September, 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 class periods of the year going into some of the assigned chapters (1-4) 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<sup>1</sup> from the TCS office during business hours.** The AP Chemistry Summer Assignment will consist of two parts, which can be done simultaneously. **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 **“Interactive 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 test grade. If you have any questions or trouble completing any of the problems, contact Miss McKay. Forming study groups to complete these assignments is encouraged; it is amazing what we can learn collectively.

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

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

## 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.  $\frac{(2.6 \times 10^{-8})}{(0.52 \times 10^{-9})} =$  \_\_\_\_\_

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.  $\log(1.0 \times 10^4) =$  \_\_\_\_\_

15.  $\log(1.0 \times 10^{-4})$  \_\_\_\_\_

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

16.  $\log(2.3 \times 10^{-5}) =$  \_\_\_\_\_
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?



*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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

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

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

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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  | f. micro |
| b. kilo  | g. nano  |
| c. deci  | h. pico  |
| d. centi |          |
| e. milli |          |

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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  $105^{\circ}\text{F}$  for only short periods of time without permanent damage to the brain or other vital organs. What is this temperature in  $^{\circ}\text{C}$ ?
  
  
  
  
  
  
  
  
  
  
  - b. Ethylene glycol is a liquid organic compound that is used as an antifreeze in car radiators. It freezes at  $-11.5^{\circ}\text{C}$ . Calculate the freezing point temperature in degrees Fahrenheit.
  
  
  
  
  
  
  
  
  
  
  - c. The temperature on the surface of the sun is about  $6300^{\circ}\text{C}$ . What is this temperature in degrees Fahrenheit?
  
  
  
  
  
  
  
  
  
  
  - d. The ignition temperature of paper is  $451^{\circ}\text{F}$ . What is the temperature in degrees Celsius?

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

13. Convert the following temperatures to Kelvin:

- a.  $113^{\circ}\text{C}$ , the melting point of sulfur
- b.  $37^{\circ}\text{C}$ , the normal body temperature
- c.  $357^{\circ}\text{C}$ , 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.  $40.2\text{ g/cm}^3$

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.  $5.6792\text{m} + 0.6\text{m} + 4.33\text{m}$
- b.  $3.70\text{ g} - 2.9133\text{ g}$
- c.  $4.51\text{ cm} \times 3.6666\text{ cm}$



*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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.  $10.6 \text{ kg/m}^3$  to  $\text{g/cm}^3$

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

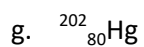
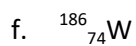
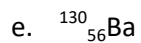
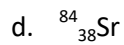
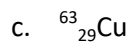
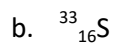
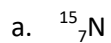
19. Describe the contributions of the following scientists to our knowledge of atomic structure:

- 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.

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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



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.

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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

25. Name the following compounds:

a. KClO

b.  $\text{Ag}_2\text{CO}_3$

c.  $\text{HNO}_2$

d.  $\text{KMnO}_4$

e.  $\text{CsClO}_3$

f.  $\text{KNH}_4\text{SO}_4$

g. FeO

h.  $\text{Fe}_2\text{O}_3$

i.  $\text{TiCl}_4$

j. NaH

k.  $\text{Li}_3\text{N}$

l.  $\text{Na}_2\text{O}$

m.  $\text{Na}_2\text{O}_2$

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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 <sub>2</sub>	
Fe <sup>3+</sup>	NO <sub>2</sub> <sup>-</sup>		
			Manganese (II) chlorate
		SnBr <sub>4</sub>	
Co <sup>2+</sup>	PO <sub>4</sub> <sup>3-</sup>		
Hg <sub>2</sub> <sup>2+</sup>	I <sup>-</sup>		
		Cu <sub>2</sub> CO <sub>3</sub>	
			Lithium nitride
Al <sup>3+</sup>	S <sup>2-</sup>		

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

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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.  $\text{NO}_2$

b.  $\text{SO}$

c.  $\text{C}_6\text{H}_6$

d.  $\text{NaI}$

e.  $\text{K}_2\text{SO}_4$

f.  $\text{Ca}_3(\text{PO}_4)_2$

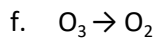
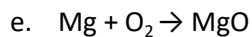
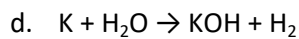
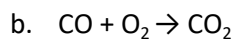
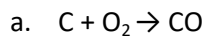
36. How many molecules of ethane ( $\text{C}_2\text{H}_6$ ) are present in 0.334 g of  $\text{C}_2\text{H}_6$ ?

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

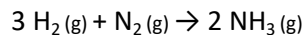
37. What are the empirical formulas of the compounds with the following compositions?
- a. 40.1% C, 6.6% H, 53.3% O
  
  
  
  
  
  
  
  
  
  
  - b. 18.4% C, 21.5% N, 60.1% K
38. The anticaking agent added to Morton salt is calcium silicate,  $\text{CaSiO}_3$ . This compound can absorb up to 2.5 times its mass of water and still remain a free-flowing powder. Calculate the percent composition of  $\text{CaSiO}_3$ .
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?

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

40. Balance the following equations:



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



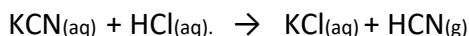
In a particular reaction, 6.0 moles of  $NH_3$  were produced. How many moles of  $H_2$  and how many moles of  $N_2$  were reacted to produce this amount of  $NH_3$ ?



*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

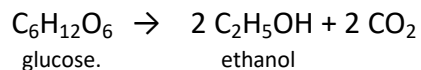
42. When baking soda (sodium bicarbonate or sodium hydrogen carbonate,  $\text{NaHCO}_3$ ) is heated, it releases carbon dioxide gas, which is responsible for the rising of dough in cookies, rolls and donuts.
- Write the balanced equation for the decomposition of the compound (one of the products is  $\text{Na}_2\text{CO}_3$ ).
  
  
  
  
  
  
  
  
  
  
  - Calculate the mass of  $\text{NaHCO}_3$  required to produce 20.5 g of  $\text{CO}_2$ .

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



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

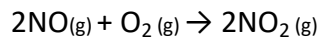
44. Fermentation is a complex chemical process of wine making in which glucose is converted into ethanol and carbon dioxide:



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)

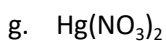
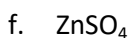
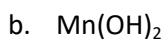
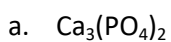
*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

45. Nitric oxide (NO) reacts with oxygen to form nitrogen dioxide (NO<sub>2</sub>), a dark brown gas.

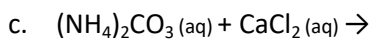
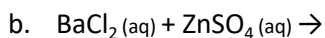
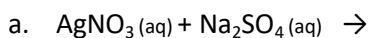


In one experiment, 0.886 mole of NO is mixed with 0.503 mole of O<sub>2</sub>. Calculate which of these two reactants is the limiting reactant. Also calculate the number of moles of NO<sub>2</sub> produced.

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



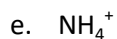
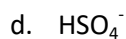
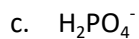
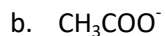
47. Write the net ionic equations for the following reactions:



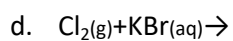
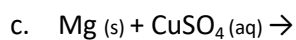
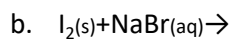
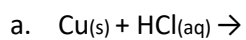
*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

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:



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



*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

51. How many moles of  $\text{MgCl}_2$  are present in 60.0 mL of 0.100 M  $\text{MgCl}_2$  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:

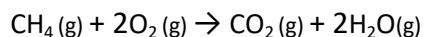
a. 29.0 g of ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) in 545 mL of solution.

b. 15.4 g of sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) in 74.0 mL of solution.

c. 9.00 g of sodium chloride ( $\text{NaCl}$ ) in 86.4 mL of solution.

*AP Chemistry 2023-24 --- Summer Assignment*  
*Timothy Christian School*

54. A sample of nitrogen gas kept in a container of volume 2.3 L and a temperature of 32°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°C?
56. Methane, the principal component of natural gas, is used for heating and cooking. The combustion process is:



If 15.0 moles of CH<sub>4</sub> are reacted, what is the volume of CO<sub>2</sub> in liters produced at 23.0°C and 0.985 atm?