

SUMMER ASSIGNMENT FOR AP CHEMISTRY 2022-2023

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Welcome to AP Chemistry! I am glad and excited that you have opted to sign-up for this class. Choice of this course is a clear statement on your part that you are ready to take the academic challenge AP Chemistry has to offer. I want to take this opportunity to familiarize you with some of the demands and expectations of this course.

The Summer Assignment is a first but necessary step towards the high level of content learning which needs to take place throughout the coming academic year. The objective behind the summer assignment is two-fold: a) review of concepts covered in the Honors chemistry course, and b) free up some time to cover newer or more difficult topics during the academic year.

We'll be doing pretty high level of learning and even higher level of applying that integrated knowledge throughout the school year. It is clear from your success in the honors chemistry course that you have the necessary background and knowledge base. What we have to do in the AP Chemistry is to build on that. As you might have guessed, a lot more time and effort will be needed to succeed in this college level course. Therefore, getting some of the preliminary work out of the way during summer is necessary to hit the ground running in the fall.

Some of the ways the AP Chemistry is different from Honors Chemistry are listed below:

- Students must be able to find charges and write formulas of common simple ions and various polyatomic ions on demand. Unlike honors Chemistry, familiarity with the formulas of many more polyatomic ions will be expected from AP Chemistry students. Students are also expected to know the names and formulas of common acids and bases. Proficiency in recognizing transition metals, and proper use of Roman Numerals is also expected.
- Students must have proficiency in using prefixes in the names of binary covalent compounds. They also need to memorize the formulas of the seven diatomic elements for use in writing chemical equations, and be able to write formulas of some common covalent compounds
- The AP periodic table itself is different from the one supplied for MCAS exams for the honors Chemistry - The AP periodic table has no element names (only symbols and atomic masses), no period number info, no family names (other than identifying lanthanide and actinide series). Students are expected to correlate element names and properties from their prior knowledge, and hence you need to practice recognizing symbols of elements (particularly those of similar sounding elements) and their relative positions to explain periodic trends.

- Students are expected to be able to differentiate between different types of chemical reactions (including the general ideas about the metal activity series), predict expected products, and be able to balance chemical equations. Knowledge about identifying spectator ions is also assumed.
- Students are expected to develop a good sense about solubility of ionic compounds in water, particularly in double displacement reactions, and hence review of and familiarity with solubility rules is necessary.
- AP Chemistry is highly quantitative - Students need to be proficient in using TI-83 and TI-84 types of calculators for multistep calculations involving stoichiometry, gas laws, equilibrium constants, conversion factors, etc. Students are expected to know how to write numbers using significant figures and scientific notation. TI-Nspires are utilized in class and are allowed on the AP Exams and most college courses. They are NOT required for this course however a scientific calculator is a must! If you purchase your own please look to the secondary market and focus on Texas Instruments Calculators.

TI-84 are used in Math classes		TI-36 have "pretty print" and other advanced features without going to a graphing calculator	
TI-30IIX are most familiar from Middle School		TI-Nspire CAS are the ones utilized in class and come in both the original and the II. There is very little difference between the two but a larger cost difference. I would NOT get the CXII as we will not be able to support it.	

I hope the discussion above has convinced you on the need of completing this summer problem set handout. Reviewing your Honors Chemistry class notes is also a good idea along with any other books or online resources you can muster. I cannot emphasize it enough that do not wait till the last week before school start to work on this package – you need to have enough time to do the problems with appropriate focus, and review or learn and relearn any concept you may have difficulty with. Khan Academy, Tyler Dewitt, Perdue Chemistry, ChemLibre, and ChemTeam are some amazing resources for which to assist in your review and learning process. I am planning to give a test on the concepts covered in the package within couple of weeks of the school opening anyway. I have included a lot of notes and info for you to go over which should help you towards doing the problem sets and also prepare for the test.

I can be reached at the school e-mail address throughout the Summer. I'll try to do my best to answer any questions you may have over the vacation period in a reasonable time frame. Again, welcome to AP Chemistry and a fast paced learning of chemistry. I cannot wait to get started in the fall!

DETAILS ON THE SUMMER ASSIGNMENT AP CHEMISTRY 2021-2022

Textbook:

AP Chemistry Course Details:

If you don't have a User ID for College Board, create one and explore the AP Chemistry website: <https://apstudent.collegeboard.org/apcourse/ap-chemistry>. Familiar yourself with the 2 PDF documents on this page:

- AP Chemistry Course Overview
- AP Chemistry Course and Exam Description

You may want to download the [AP Formulas and Equations document](#) which also has the AP Periodic Table. We will utilize the [Chemistry Honor's reference sheet](#) for the start of the year before we transition completely to the AP F&E sheet.

The Summer Assignment

The assignment packet contains notes (to be added in August to allow you time to process and find resources for your own use) as well as practice problems.

AP Summer Notes

Following the link will provide you with some notes and example problems. These example problems are NOT REQUIRED and only provide other types of problems.

You may want to pay attention to the following checklist from the notes:

- Make sure you are especially familiar with the organization of the periodic table (main group vs. transition elements; what each group is called—alkali metals, halogens, etc.), and naming molecules/compounds
- Memorize the following—these chemistry basics, ESPECIALLY the first four listings, are foundational for success in AP chemistry. (Most are on the Chemistry Honors Reference sheet)
 - Names/symbols of common elements and their phases—recommended you make flashcards, a Quizlet, etc. to practice these.
 - Common monoatomic/polyatomic ions—be able to match their names with their symbols, plus charge.
 - Naming molecules and compounds - Ionic & Covalent with Polyatomics
 - Metric prefixes—be able to convert between them also, with basic dimensional analysis.
- The basic solubility rules
- Significant figure rules for addition/subtraction and multiplication/division.

REQUIRED TO BE SUBMITTED ON THE SECOND DAY OF CLASS

Practice problems—required assignment; write your answers on separate notebook or line piece(s) of paper which you can submit on the first day of class. The purpose of these is to refresh your memory of foundational concepts from your past chemistry class so we can hit the ground running with AP Chem. Time Guidelines have been posted to provide you a framework for allocating effort. The entire packet should take no more than 4 hours to complete.

The assignment is mostly focused on the following topics:

- Sig figs & metric conversions
- Structure of the atom & periodic table
- Naming inorganic compounds
- Molecular masses
- Balancing equations
- Stoichiometry w/Limiting reactants
- Solutions, replacement reactions, & solubility
- Basic Understanding of pH and Acid/Base Reactions along with ionic equations

Practice Problems (Part 1 - 80 minutes)

Directions: Complete these in a format which you can submit, showing all work.

Significant Figures and Metric Conversions

1. Round each of the following numbers to **four** significant figures. Write the answer in decimal form AND scientific notation.
 - a. 300.235800
 - b. 456,500
 - c. 0.006543210
 - d. 0.000957830
 - e. - 0.035000

2. Carry out the following operations, and provide answers with the correct number of sig figs:
 - a. $1.24056 + 75.80$
 - b. $23/67 - 75$
 - c. $890,000 \times 112.3$
 - d. $78,132 / 2.50$

3. Perform the following conversions. Solve each problem using dimensional analysis. SHOWING YOUR WORK! Every number must have a unit and be expressed with proper significant figures.
 - a. Convert 50.0 m to mm
 - b. Convert 25 cm to km
 - c. Convert 400 mm to m
 - d. Convert 60 kg to mg
 - e. Convert 500 nm to km
 - f. The average speed of helium at 25°C is 1255 m/s. Convert this speed to miles per hour (mph).

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

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

6. The temperature on the surface of the sun is about 6300°C. What is this temperature in degrees Fahrenheit?

Structure of the Atom & Periodic Table

7. Fill in the following table, assuming each column represents a neutral atom:

Symbol (nuclear notation)	$^{39}_{19}\text{(a) } \text{---}$	(e)	(h)	(k)	(n)
Protons	19	25	(i)	(l)	82
Neutrons	20	30	64	(m)	(o)
Electrons	(c)	(f)	48	56	(p)
Mass #	(d)	(g)	(j)	137	207

8. Describe the contributions of the following scientists to our knowledge of atomic structure:
 - a. J.J. Thomson
 - b. R.A. Millikan
 - c. Ernest Rutherford
9. Describe where the following element groups are located on the periodic table, and give 2 element examples:
 - a. Alkaline earth metals
 - b. Halogens
 - c. Alkali metals
 - d. Noble gases
 - e. Metalloids
 - f. Diatomics
 - g. Transition Metals

Naming Inorganic Compounds

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

- | | | |
|-------|-------|-------|
| a. Li | d. N | g. Mg |
| b. S | e. Al | h. Xe |
| c. I | f. Cs | |

11. Give the name for each of the following ionic compounds

- | | |
|------------------|----------------------|
| a. AlF_3 | e. Li_3PO_4 |
| b. $Fe(OH)_2$ | f. Hg_2S |
| c. $Cu(NO_3)_2$ | g. $Ca(C_2H_3O_2)_2$ |
| d. $Ba(ClO_4)_2$ | h. $(NH_4)_2SO_4$ |

12. Write the chemical formula for each of the following compounds:

- | | |
|-----------------------|-------------------------|
| a. copper (I) oxide | d. zinc nitrate |
| b. potassium peroxide | e. mercury (I) bromide |
| c. aluminum hydroxide | f. iron (III) carbonate |

13. Fill in the blanks in the following table:

Cation	Anion	Formula	Name
(a)	(e)	(i)	Magnesium bicarbonate
(b)	(f)	$SrCl_2$	(m)
Fe^{3+}	NO_2^-	(j)	(n)
(c)	(g)	(k)	Manganese (II) chlorate
(d)	(h)	$SnBr_4$	(o)
Co^{2+}	PO_4^{3-}	(l)	(p)
Hg_2^{2+}	I^-	(u)	(x)
(q)	(s)	$CuCO_3$	(y)
(r)	(t)	(v)	Lithium nitride
Al^{3+}	S^{2-}	(w)	(z)

14. Give the name or chemical formula, as appropriate, for each of the following molecular substances:

- | | |
|-------------------------|---------------------------------|
| a. dinitrogen tetroxide | d. XeO_3 |
| b. SF_6 | e. hydrogen cyanide |
| c. IF_5 | f. tetraphosphorous hexasulfide |

15. Give the name or chemical formula, as appropriate, for the following (types of naming are mixed up here! Make sure you can determine how to name each when the type is not specified):

- | | | |
|----|------------------------------|-----------------------------|
| a. | sodium hypochlorite | d. Iron(III) oxide |
| b. | $\text{Cr}_2(\text{CO}_3)_3$ | e. nitrogen dioxide |
| c. | CO | f. K_2CrO_4 |

Molecular Masses

16. Determine the molar mass of each of the following compounds.

- a. N_2O_5
- b. Iron(II) Carbonate
- c. disilicon hexabromide

17. Calculate the percentage by mass of oxygen in the following compounds.

- a. NO_2
- b. $\text{Cr}(\text{NO}_3)_3$
- c. H_2CO_3

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

19. Find the empirical formulas of the compounds with the following compositions:

- a. 40.1% Carbon, 6.6% Hydrogen, 53.3% Oxygen
- b. 18.4% C, 21.5% N, 60.1% K

Practice Problems (Part 2) -2 hrs Max

Balancing Equations (20 minutes)

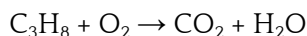
20. Balance the following equations:

- $\text{NaH}_2\text{PO}_4 \rightarrow \text{NaPO}_3 + \text{H}_2\text{O}$
- $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{Ca}(\text{HCO}_3)_2$
- $\text{SrBr}_2 + (\text{NH}_4)_2\text{CO}_3 \rightarrow \text{SrCO}_3 + \text{NH}_4\text{Br}$
- $\text{Mn}_2\text{O}_3 + \text{Al} \rightarrow \text{Al}_2\text{O}_3 + \text{Mn}$
- $\text{S} + \text{N}_2\text{O} \rightarrow \text{SO}_2 + \text{N}_2$
- $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$
- $\text{AgNO}_3 + \text{FeCl}_3 \rightarrow \text{Fe}(\text{NO}_3)_3 + \text{AgCl}$
- $\text{Fe}_2(\text{SO}_4)_3 + \text{KOH} \rightarrow \text{K}_2\text{SO}_4 + \text{Fe}(\text{OH})_3$
- $\text{Al}_2(\text{SO}_4)_3 + \text{KOH} \rightarrow \text{Al}(\text{OH})_3 + \text{K}_2\text{SO}_4$
- $\text{C}_7\text{H}_{16} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

Stoichiometry (70 minutes)

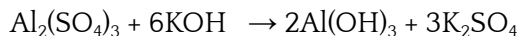
Show your work, and box/circle in your final answer please. Keep in mind that your first step with stoichiometry is always to make sure your equation is balanced (if there is an equation)!!

- How many molecules of ethane (C_2H_6) are present in 0.334 g of ethane?
- How many moles of cobalt (Co) atoms are there in 6.00×10^9 cobalt atoms?
- How many moles of calcium (Ca) atoms are in 77.4 g of calcium?
- How many atoms are present in 3.14 g of copper (Cu)?
- How many moles of oxygen are necessary to react completely with four moles of propane (C_3H_8)?

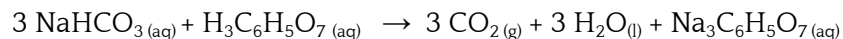


26. The fermentation of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, produces ethyl alcohol, $\text{C}_2\text{H}_5\text{OH}$, and CO_2 as shown here: $\text{C}_6\text{H}_{12}\text{O}_{6(\text{aq})} \rightarrow 2 \text{C}_2\text{H}_5\text{OH}_{(\text{aq})} + 2 \text{CO}_{2(\text{g})}$
- How many moles of CO_2 are produced when 0.300 mol of $\text{C}_6\text{H}_{12}\text{O}_6$ fully reacts?
 - How many grams of $\text{C}_6\text{H}_{12}\text{O}_6$ are needed to form 2.00 g of $\text{C}_2\text{H}_5\text{OH}$?
 - How many molecules of CO_2 form when 2.00 g of $\text{C}_2\text{H}_5\text{OH}$ are produced?

27. How many grams of $\text{Al}(\text{OH})_3$ (molar mass = 78.0 g/mol) can be produced from the reaction of 48.6 mL of .15 M KOH with excess $\text{Al}_2(\text{SO}_4)_3$? Utilize the eqn below.



28. In an experiment, 2.50 g of sodium bicarbonate and 5.00 g of citric acid are allowed to react according to the following reaction between sodium bicarbonate, NaHCO_3 , and citric acid, $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$:



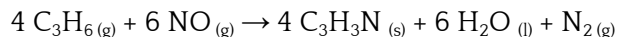
- Which reactant is the limiting reactant? You must show work to support your answer.
- How many grams of carbon dioxide are formed? How many liters is this if we assume STP conditions
- How much of the limiting reactant is left when the reaction is complete?
- How much of the excess reactant remains after the reaction is complete?

29. At high temperatures, sulfur combines with iron to form the brown-black iron (II) sulfide. In an experiment, 7.62 g of Fe are allowed to react with 8.67 g of S.



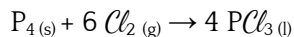
- What is the limiting reagent, and what is the reactant in excess?
- Calculate the mass of FeS formed.

30. Acrylonitrile, $\text{C}_3\text{H}_3\text{N}$, is the starting material for the production of a kind of synthetic fiber (acrylics) and can be made from propylene, C_3H_6 reacting with nitric oxide, NO, as follows:



What mass of $\text{C}_3\text{H}_3\text{N}$ can be made when 21.6 g of C_3H_6 react with 21.6 g of nitric oxide?

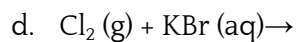
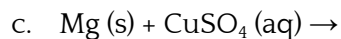
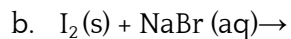
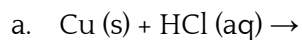
31. Calculate the percent yield for the reaction below, if 75.0 g of phosphorus reacts with excess chlorine gas to produce 111.0 g of phosphorus trichloride



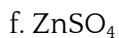
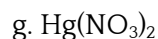
Solutions, Replacement Reactions, & Solubility (40 min)

32. Calculate the molarity of each of the following solutions:
- 29.0 g of ethanol ($\text{C}_2\text{H}_5\text{OH}$) in 545 mL of solution
 - 15.4 g of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) in 74.0 mL of solution
 - 9.00 g of sodium chloride (NaCl) in 86.4 mL of solution

33. Predict the outcomes of the single replacement reactions below by using the activity series (you'll have to look up the activity series online). Then balance the equations.



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



35. Predict, Balance and Write the net ionic equations for the following reactions: (Assume all reactions go to completion, and show if the NIE has all ions canceled write "NIE- No Reaction" but show the prediction and balancing steps.

