

AP Chemistry Summer 2023 Assignment

Hello, and welcome to AP Chemistry! This is your summer assignment, which **should be completed before the first day of school**. The purpose of this summer assignment is to give you a chance to review content from your previous chemistry course that will be necessary for you to know or review in order to be successful in this course. If you have any questions, please make note of them, as there will be some time in the first two days of school to ask questions about topics from the summer assignment. Don't panic if you have trouble with some parts of the assignment, just make note of your question(s) to receive help in the first few days of school.

Your to-do list for the summer:

- Review content from first-year chemistry class (major topics listed below), using the provided list of resources (also below)
- Practice problem-solving skills to complete the enclosed practice questions/puzzles listed below. Note, these questions are not intended to be "quick and easy." They are intended to make you think and apply your chemistry knowledge. Feel free to collaborate with other AP Chem students on these problems, but make sure you understand everything you are doing, or it's just a waste of your time. Don't just try them before reviewing any content, you probably won't get very far, and will likely just get frustrated.
 - Atomic structure tangram (p. 3-5)
 - Nomenclature tangram (p. 6-8)
 - Chemical compounds logic puzzle (p. 9)
 - Stoichiometry marathon problem (p. 10-11)
- Memorize the included memorization list on p. 12
- Acquire a "carbon copy" lab notebook (see information in the "Materials you need to have every day for AP Chemistry" section below)

First-year chemistry content to review this summer:

- Basics of atomic structure and periodic table (proton/neutrons/electrons, mass number, isotopes, average atomic mass, energy levels, groups/families, etc.)
- Nomenclature (naming) of: covalent, ionic, acid, basic organic (alkanes, alkenes, alkynes)
- Reactions (types and balancing)
- Mole conversions and stoichiometry (grams, moles, particles, volume, mole ratios, percent mass, empirical/molecular formulas)

Resources for reviewing first-year chemistry content:

1. Your notes from when you previously took chemistry
2. Khan Academy (focusing primarily on the sections listed below, more info about Khan Academy on p. 2)
<https://www.khanacademy.org/science/chemistry?t=table-of-contents>
 - a. Atoms, compounds, and ions
 - b. Chemical reactions and stoichiometry
3. Science Geek: <http://www.sciencegeek.net/APchemistry/index.shtml>
4. College Board: <https://apstudents.collegeboard.org/courses/ap-chemistry> (has an outline of the content you will learn in this class)
5. To review organic nomenclature:
<http://www.sussexvt.k12.de.us/science/Chemical%20Substances/Alkanes%20alkenes%20and%20alkynes.htm>

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How to use Khan Academy:

- Khan Academy has both information and practice questions for you to apply what you learn
- The tutorials on Khan Academy are a mixture of videos (with the triangle “Play Button” icon next to them) and written tutorials (with the piece-of-paper icon next to them).
- The tutorials are usually listed in order of increasing complexity. The skills from the later tutorials and videos build on the skills from the earlier ones. If you get lost in a tutorial, you may need to go back and review a previous concept first.
- After reviewing over everything in a section, complete the included practice to see if you can apply the skills. See if you can answer the questions without hints. If not, you may need to continue reviewing those concepts still. Remember, nothing says that Khan Academy should be the only resource you use to review those skills. Feel free to mix your resources!

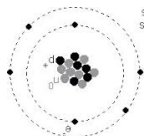
Materials you need to have for AP Chemistry:

- Binder to organize notes + papers received in class (or you may choose instead to use a spiral/composition notebook plus a folder for storing papers you receive)
- Lab notebook (needed on each day that we are working on labs): You are required to have a carbon copy lab notebook like <http://tinyurl.com/labnotebook1> or <http://tinyurl.com/labnotebook2> . You need a “carbon copy” notebook because after each lab, you will be required to turn in the copy pages, and keep the original pages in your notebook. Your lab notebook must be devoted only to AP Chemistry labs and nothing else. Not your AP Chemistry notes, not your other classes, not your favorite chocolate cake recipe, not a list of your celebrity crushes, just your AP Chemistry labs! *Note: if acquiring a carbon-copy lab notebook presents a financial difficulty for your family, please talk to your instructor the first day of class and we will be able to help provide one for you!*
- Notebook paper
- Pencil
- Blue/black ink pen for labs
- Calculator
 - Check out this link for College Board’s calculator policies, the calculators you are allowed to use on the AP exam: <https://apstudents.collegeboard.org/exam-policies-guidelines/calculator-policies>
 - College Board recommends a scientific or graphing calculator for AP Chemistry

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Atomic Structure Tangram

Instructions: Cut out the 16 squares below.

<p>I</p> <p>Charge of -2</p> <p>Transition metal with 5 unpaired electrons</p> <p>Krypton</p>	<p>Halogens</p> <p>Sulfur</p> <p>12 protons</p> <p>Diatomic element with 6 valence electrons</p>	<p>Chlorine</p> <p>Iodide</p> <p>Commonly forms +2 charge</p> <p>$[\text{Ne}]3s^2 3p^4$</p>	<p>Mg</p> <p>Zn</p> <p>8 protons, 10 electrons</p> 
<p>Bromine</p> <p>Average atomic mass: 183.85amu</p> <p>$1s^2 2s^2 2p^6 3s^2 3p^4$</p>	<p>Carbon</p> <p>Carbon</p> <p>Iodine</p>	<p>Alkali Metals</p> <p>Unreactive</p> <p>Calcium</p>	<p>Hg</p> <p>*See Question 1</p> <p>Oxygen</p>
<p>Atomic number 74</p> <p>I_2</p>	<p>Transition metals</p> <p>31P^3-</p>	<p>Element with 2 protons</p> <p>Groups 3-10</p> <p>Noble gas with 4 energy levels</p>	<p>Element that is liquid and not diatomic</p> <p>81 protons, 15 neutrons, 81 electrons</p>
<p>Manganese</p> <p>15 protons, 16 neutrons, 18 electrons</p> <p>Calcium, Rubidium, Oxygen, Nitrogen</p>	<p>Highly reactive group of nonmetals</p> <p>Uranium-238</p> <p>30P^3-</p>	<p>Nitrogen</p> <p>7 Valence Electrons</p> <p>*See Question 2</p>	<p>Highly reactive, shiny, malleable</p> <p>Diatomic: most abundant gas in air</p>

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Atomic Structure Tangram Answer

Instruction: Your job is to create a 4x4 square with the 16 pieces, where all touching sides of the square match. An example of a solved 3x3 square tangram is on the next page, along with some questions you will need to solve some of the pairs.

Please note that for some clues, there are multiple possible matches, but you must get all sides of each square to match their surrounding squares. Fill in your answers on the sheet below, or tape/glue the squares in place.

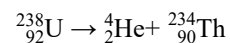
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An example of a solved tangram is below on the left. You should also use this to review some basic math skills and make sure you understand these pairs as well ☺

1+1	4 ε+1	6740 9I	6.74x10 ³ ε÷9
2 εxε	x(x+y) x ² +x	8x2 v/w=p	2 8.5 v/w=p
9	0.00627 ε.27x10 ³	m=d*v x ² +1=5	y = m/d x ± 2

Questions:

1. What element has 2 isotopes: one with a mass number of 79 and a percent abundance of 50.69% and the other with a mass number of 81 and a percent abundance of 49.31%?
2. What is the name of the radioactive isotope that is undergoing alpha decay in the equation below?



3. Did you solve the puzzle without solving all the problems? Check out the pairs you didn't have to solve to see if you agree/understand. Use the table below to identify your favorite pairs (what made you think, was fun to solve, interesting, etc.) and list any questions you still have about pairs that you don't understand. Remember, the point of this is to learn, so if there are any pairs you don't understand, make sure you look them up or list them here.

Favorite Pairs

Questions

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Nomenclature Tangram

Instructions: Cut out the 16 squares below.

<p>NaOH</p> <p>CO</p>	<p>Calcium Chloride</p> <p>Aluminum Oxide</p> <p>Chlorine Trifluoride</p> <p>BaBr₂</p> <p>CO₂</p>	<p>H₂SO₄</p> <p>Silver Nitrate</p> <p>Au₃N₂</p>	<p>Magnesium Bromide</p> <p>CaCl₂</p> <p>NH₃OH</p>
<p>Hydrobromic Acid</p> <p>CF₃</p>	<p>Sodium Sulfite</p> <p>Zn(NO₂)₂</p>	<p>Cesium Phosphate</p> <p>AgNO₃</p>	<p>Carbon Dioxide</p> <p>C₂H₄</p> <p>Gold (II) Nitride</p>
<p>Potassium Nitrate</p> <p>MnS</p> <p>C₂H₆</p>	<p>MgBr₂</p> <p>KNO₃</p>	<p>CH₄</p> <p>Ethene</p>	<p>Hypochlorous Acid</p> <p>Al₂O₃</p> <p>Methane</p>
<p>Barium Bromide</p> <p>Dinitrogen Pentasulfide</p> <p>Sulfuric Acid</p> <p>H₃PO₄</p>	<p>Nitric Acid</p> <p>Na₂SO₃</p> <p>Manganese (II) Sulfide</p> <p>Phosphoric Acid</p>	<p>Ethane</p> <p>S₅S₂N</p> <p>CS₃PO₄</p>	<p>Zinc Nitrite</p> <p>HBr</p> <p>HClO</p>

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Nomenclature Structure Tangram Answer

Instruction: Your job is to create a 4x4 square with the 16 pieces, where all touching sides of the square match. An example of a solved 3x3 square tangram is on the second page. Please note that for some clues, there are multiple possible matches, but you must get all sides of each square to match their surrounding squares. fill in your answers on the sheet below, or tape/glue the squares in place.

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An example of a solved tangram is below on the left. You should also use this to review some basic math skills and make sure you understand these pairs as well ☺

4	$1+3$ 6740	6.74×10^3 $9 \div 9$
$1+1$ 2	$9 \div 1$ 8×2	2 8.5
$x(x+y)$ 3×3	$x^2 + x$ $\sqrt{w} = p$	$17 \div 2$ $\sqrt{w} = p$
9	$m = d \cdot v$ 6.27×10^3	$y = m/d$ $x^2 + 1 = 5$
0.00627	$x^2 + 1 = 5$	$x \pm 2$

Questions:

1. What are the different prefixes used to name organic compounds?
2. What is the correct name for:
 - a. KClO_2 _____
 - b. H_2SO_3 _____
 - c. Cu_2CO_3 _____
3. Did you solve the puzzle without solving all the problems? Check out the pairs you didn't have to solve to see if you agree/understand. Use the table below to identify your favorite pairs (what made you think, was fun to solve, interesting, etc.) and list any questions you still have about pairs that you don't understand. Remember, the point of this is to learn, so if there are any pairs you don't get, make sure you look them up or list them here.

Favorite Pairs

Questions

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Chemical Compounds Logic Puzzle

You have four beakers, labeled A, B, C, and D. Beaker A contains some amount of hydrochloric acid. Beaker B contains some amount of calcium chloride. Beaker C contains some amount of carbon dioxide. Beaker D contains some amount of butane. Each beaker contains a different type of compound (ionic, covalent, organic, or acid). The moles of the compounds in each beaker is different; one beaker contains 0.5mol of its compound, another contains 1.0mol of its compound, another contains 1.5mol of its compound, and another contains 2.0mol of its compound. The mass of the compounds in each beaker is also different; one beaker contains 29g, one beaker contains 54g, one beaker contains 88g, and one beaker contains 111g. The beaker with the fewest moles is not necessarily the beaker with the smallest mass and most moles is not necessarily the highest mass. For each of the four compounds, determine: the name, the formula (e.g. HCl), the type of compound, the moles, and the mass. Put your answers in the table at the bottom of the page. Each answer should be used only once.

Feel free to use the grid below to help you by placing a check or circle for any boxes that are "true" (meaning those two things do go together) and an x for any boxes that are "false" (meaning those two things do not go together). This grid is just for you to do the work if you want to do it in that format; you don't have to use it.

	Ionic	Covalent	Organic	Acid	29g sample	54g sample	88g sample	111g sample	0.5mol	1.0mol	1.5mol	2.0mol
HCl												
CaCl ₂												
CO ₂												
C ₄ H ₁₀												
0.5mol												
1.0mol												
1.5mol												
2.0mol												
29g												
54g												
88g												
111g												

Name	Formula	Type of Compound	How Many Moles	Sample Mass (g)
Hydrochloric acid				
Calcium chloride				
Carbon dioxide				
Butane				

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Stoichiometry Marathon Problem

Lead is a metal that can form two different charges, +2 or +4. When lead makes an ionic compound with nitrate, it can form either lead (II) nitrate or lead (IV) nitrate, depending on the charge of the lead ion.

1. Write the formula for lead (II) nitrate _____
2. Write the formula for lead (IV) nitrate _____

Nitrate compounds dissolve well in water. A chemistry student, Micah, weighs out 3.00g of a lead nitrate sample and dissolves it in water as the first step of a lab to determine the charge of lead in the compound.

3. Determine how many moles of lead (II) nitrate are in 3.00g of lead (II) nitrate.

4. Determine how many moles of lead (IV) nitrate in 3.00g of lead (IV) nitrate.

The next step in Micah's process is to react the lead nitrate solution with a solution of excess sodium hydroxide. This reaction forms a lead hydroxide precipitate (solid).

5. If the lead compounds all have Pb^{2+} , write out the *balanced* double replacement reaction between lead (II) nitrate and sodium hydroxide to form lead (II) hydroxide (a solid) and sodium nitrate (remains dissolved).

6. If the lead compounds all have Pb^{4+} , write out the *balanced* double replacement reaction between lead (IV) nitrate and sodium hydroxide to form lead (IV) hydroxide (a solid) and sodium nitrate (remains dissolved).

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After reacting these two solutions, all of the lead ions have been precipitated (formed a solid) with the hydroxide. Micah uses a filter to purify (separate) lead hydroxide compound and dries it to remove any water, then finds the mass of the pure lead hydroxide compound to be 2.11g.

7. If the original compound was lead (II) nitrate, use stoichiometry and the balanced reaction from question 5 to predict the mass of lead (II) hydroxide that could be formed from 3.00g of lead (II) nitrate.
8. If the original compound was lead (IV) nitrate, use stoichiometry and the balanced reaction from question 6 to predict the mass of lead (IV) hydroxide that could be formed from 3.00g of lead (IV) nitrate.
9. Based on Micah's data, determine whether the original compound was most likely lead (II) nitrate or lead (IV) nitrate. Explain your choice.
10. Based on your answer to question 9, calculate the percent yield in this experiment.

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You must memorize the following information:

1. SI base units and prefixes
2. Solubility rules: all **group I metals** (lithium, sodium, potassium, etc), **ammonium**, and **nitrate** salts are soluble in water.
3. Element Names & Symbols (Elements 1 to 38 and Y, Zr, Pd, Ag, Cd, Sn, Te, I, Xe, Cs, Ba, W, Pt, Au, Hg, Pb, Rn, Fr, Ra, U, and Th). Please note that the periodic table on the AP exam (and on all of the exams we will take in AP Chemistry) has **only symbols, no names**. You need to be know what symbol matches with each name. You do NOT need to memorize the atomic numbers.
4. Monatomic Ions
 - a. Know the charges for groups 1, 2, 13, 15, 16, 17.
 - b. Memorize the charges for the following transition metals Ag^+ , Zn^{2+} , Cd^{2+} , Ni^{2+}
5. For each polyatomic ion in the table below, you should know the name, the formula, and the charge.

-1		-2		-3	
$\text{C}_2\text{H}_3\text{O}_2^-$ (or CH_3CO_2^-)	acetate	SO_4^{2-}	sulfate	PO_4^{3-}	phosphate
NO_3^-	nitrate	SO_3^{2-}	sulfite		
NO_2^-	nitrite	CO_3^{2-}	carbonate		
CN^-	cyanide	$\text{C}_2\text{O}_4^{2-}$	oxalate		
SCN^-	thiocyanate	CrO_4^{2-}	chromate		
MnO_4^-	permanganate	$\text{Cr}_2\text{O}_7^{2-}$	dichromate		
OH^-	hydroxide	O_2^{2-}	peroxide		
HSO_4^-	bisulfate	HPO_4^{2-}	hydrogen phosphate		
HCO_3^-	bicarbonate				
H_2PO_4^-	dihydrogen phosphate				
ClO_4^- *	perchlorate *				
ClO_3^- *	chlorate *				
ClO_2^- *	chlorite *				
ClO^- *	hypochlorite *				

+1	
NH_4^+	ammonium

* Br, I and F may be substituted (examples: bromate is BrO_3^- , and iodite is IO_2^-)

Have a great summer!