

Welcome to AP Chemistry 2023-2024

According to the College Board, the AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first college year. The college course in general chemistry differs qualitatively from the usual first secondary school course in chemistry with respect to the kind of textbook used: *Modified Mastering Chemistry For Chemistry: The Central Science 14th Edition For Advanced Placement*. The topics covered have an emphasis on chemical calculations and the mathematical formulation of principles, and the kind of laboratory work done by students. Quantitative differences appear in the number of topics treated, the time spent on the course by students, and the nature and the variety of experiments done in the laboratory. Students in an AP Chemistry course should spend at least five hours a week in individual study outside of the classroom.

I am excited that you have accepted the challenge that an AP Chemistry course has to offer. To ensure that all students in the AP Chemistry class are ready to partake in this high-pace, rigorous journey on the first day of school, the following summer assignment must be completed. The purpose of the assignment is to revisit chemical concepts learned in your 1st year chemistry class and expose you to the level of work demanded by the AP curriculum. This will allow us to focus our attention on the advanced chemistry topics that will be tested on the AP exam on May 6, 2024. Your summer assignment consists of the following:

1. Read Chapters 1 – 3 of your text and complete the Practice Questions (Parts I-IV) on the following pages. These problems, worked out in their entirety, are **due the first full day of classes**.
2. Memorize the polyatomic ions and solubility rules listed.

Please take the assignment seriously and start in early August or sooner — there's a lot to do and you won't be able to complete it all on the night before!

If at any time you would like to ask me a question, please email me at boconnell@achs.net

I look forward to a great year,
Mrs. O'Connell

Read Chapters 1 – 2 and answer the following practice questions. These problems, worked out in their entirety, are due the first full day of classes. All work must be shown for calculations in order to receive credit for the problem.

I. Nomenclature

Name each of the following compounds and state whether they are ionic or covalent:

- a. CuI _____
- b. CuI_2 _____
- c. CoI_2 _____
- d. NaHCO_3 _____
- e. S_4N_4 _____
- f. SF_6 _____
- g. NaOCl _____
- h. BaCrO_4 _____

Write formulas for each of the following compounds and state whether they are ionic or covalent:

- a. potassium cyanide _____
- b. copper (II) nitrate _____
- c. selenium tetrabromide _____
- d. iodous acid _____
- e. lead (IV) sulfide _____
- f. copper (I) chloride _____
- g. gallium arsenide _____
- h. cadmium selenide _____

Each of the following compounds is incorrectly named. What is wrong with each name and what is the correct name for each compound?

- a. FeCl_3 , iron chloride _____
- b. NO_2 , nitrogen (IV) oxide _____
- c. CaO , calcium (II) monoxide _____
- d. Al_2S_3 , dialuminum trisulfide _____
- e. $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$, manganese diacetate _____
- f. FePO_4 , iron (II) phosphide _____
- g. P_2S_5 , phosphorous sulfide _____
- h. Na_2O_2 , sodium oxide _____
- i. HNO_3 , nitrate acid _____
- j. H_2S , sulfuric acid _____

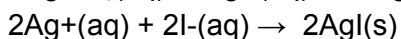
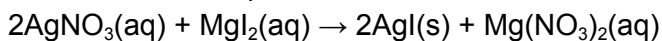
II. Chemical Equations

For each equation below:

- identify the type (synthesis, decomposition, single replacement, metathesis/double replacement, or combustion)
- predict the products, and then
- write the balanced equation and net ionic equation.
- Remember to use the solubility rules for double replacement reactions and the activity series for single replacement reactions. Reminder: when writing these reactions, ignore all of the information about excess, or bubbling, or mixing. These are just excess words used to make complete sentences. Simply pull out the chemical formulas.
- For example:

Solutions of silver nitrate and magnesium iodide are combined.

This is a double replacement reaction.



1. Ammonium sulfate reacts with barium nitrate.
2. Zinc metal is added to a solution of copper (II) chloride.
3. Propane gas (C_3H_8) is burned in excess oxygen.
4. Solid calcium chlorate is heated strongly.
5. Magnesium and nitrogen gas are heated together.
6. Chlorine gas is bubbled through a solution of sodium bromide.
7. Sodium metal is added to distilled water.
8. Sulfuric acid is combined with sodium hydroxide.
9. Solid sodium carbonate is heated in a crucible.

III. Chemical Quantities (show all calculations)

1. How many **significant figures** are in each of the following?

- a. 1.9200 mm
- b. 0.0301001 kJ
- c. 6.022×10^{23} atoms
- d. 460.000 L
- e. 0.000036 cm^3

- f. 10000
- g. 1001
- h. 0.001345
- i. 0.0101
- j. 3.21×10^{-2}

2. Record the following in correct **scientific notation**:

- a. 4050,000,000 cal
- b. 0.000123 mol
- c. 0.00345 Å
- d. 700,000,000 atoms

3. Calculate the following to the **correct number of significant figures**. Look up rules

- a. $1.270 \text{ g} / 5.296 \text{ cm}^3$
- b. $12.235 \text{ g} / 1.010 \text{ L}$
- c. $12 \text{ g} + 0.38 \text{ g}$
- d. $170\text{g} + 2.785 \text{ g}$
- e. 2.1×3.2102
- f. 200.1×120
- g. $17.6 + 2.838 + 2.3 + 200$

4. Assume silicon has three major isotopes in nature as shown in the table below. Calculate and fill in the missing information.

Isotope	Mass (amu)	Abundance
Si-28	27.98	
Si-29		4.70%
Si-32	29.97	3.09%

5. Calcium carbonate decomposes upon heating. How many grams of calcium oxide will be produced after 12.25 g of calcium carbonate is completely decomposed?

6. When ammonia gas, oxygen gas and methane gas (CH_4) are combined, the products are hydrogen cyanide gas and water. Calculate the mass of each product produced when $2.25 \times 10^2 \text{ g}$ of oxygen gas is reacted with an excess of the other two reactants. If the actual yield of the experiment is 105 g of HCN, calculate the percent yield.

7. One type of electromagnetic radiation has a frequency of 107.1 MHz, another type has a wavelength of 2.12×10^{-10} m, and another type has photons with energy equal to 3.97×10^{-19} J/photon. Identify each type of electromagnetic radiation and place them in order of increasing photon energy and increasing frequency.

8. Determine the empirical formula of the compounds with the following compositions by mass:

A. 10.4% C, 27.8% S, 61.7% Cl

B. 21.7% C, 9.6% O, 68.7% F

9. Calculate the percentage by mass of the following compounds:

a. SO_3

b. $\text{CH}_3\text{COOCH}_3$

c. Ammonium Nitrate.

IV. Atomic Structure, Periodicity, and Bonding Review

1. Answer the following questions based on the given electron configuration and identify the elements.

a. Arrange these atoms in order of increasing size: $[\text{Kr}]5s^2 4d^{10} 5p^5$; $[\text{Kr}]5s^2 4d^{10} 5p^1$; $[\text{Kr}]5s^2 4d^{10} 5p^3$

b. Arrange these atoms in order of decreasing first ionization energy: $[\text{Ne}]3s^2 3p^5$; $[\text{Ar}]4s^2 3d^{10} 4p^3$; $[\text{Ar}]4s^2 3d^{10} 4p^5$

2. Write the expected ground-state electron configuration for the following:

a. the element with one unpaired 5p electron that forms a covalent compound with fluorine

b. the first-row transition metal with the most unpaired electrons

b. the metalloid in period 3

c. the halogen in period 5

d. the element with atomic number 47

e. the sodium ion

AP Chemistry Polyatomic List

1. Memorize all of the Polyatomic Ions: Name, Formula, and Charge.
2. Memorize all of the Binary Compounds: Name and Formula.

+1 CHARGE		-1 CHARGE		-2 CHARGE		-3 CHARGE	
ion	name	ion	name	ion	name	ion	name
NH_4^+	ammonium	H_2PO_4^-	dihydrogen phosphate	HPO_4^{2-}	hydrogen phosphate	PO_4^{3-}	phosphate
H_3O^+	hydronium	HCO_3^-	hydrogen carbonate	CO_3^{2-}	carbonate	AsO_4^{3-}	arsenate
Hg_2^{2+}	Mercury I	HSO_3^-	hydrogen sulfite	SO_3^{2-}	sulfite		
		HSO_4^-	hydrogen sulfate	SO_4^{2-}	sulfate		
		NO_2^-	nitrite	$\text{S}_2\text{O}_3^{2-}$	thiosulfate		
		NO_3^-	nitrate	SiO_3^{2-}	silicate		
		OH^-	hydroxide	$\text{C}_2\text{O}_4^{2-}$	oxalate		
		CH_3COO^-	acetate	CrO_4^{2-}	chromate		
		CN^-	cyanide	$\text{Cr}_2\text{O}_7^{2-}$	dichromate		
		CNO^-	cyanate	MoO_4^{2-}	molybdate		
		CNS^-	thiocyanate	O_2^{2-}	peroxide		
		O_2^-	superoxide				
		MnO_4^-	permanganate				
		ClO^-	hypochlorite				
		ClO_2^-	chlorite				
		ClO_3^-	chlorate				
		ClO_4^-	perchlorate				
		BrO_3^-	bromate				
		IO_3^-	iodate				

Formula	Common Name	Formula	Common Name
H_2O	Water	PH_3	Phosphine
H_2O_2	Hydrogen peroxide	AsH_3	Arsine
NH_3	Ammonia	NO	Nitric Oxide
N_2H_4	Hydrazine	N_2O	Nitrous oxide
C_2H_2	Acetylene	CH_4	Methane

Element List

Aluminum	Al	Antimony	Sb	Argon	Ar
Arsenic	As	Barium	Ba	Beryllium	Be
Bismuth	Bi	Boron	B	Bromine	Br
Cadmium	Cd	Calcium	Ca	Carbon	C
Cesium	Cs	Chlorine	Cl	Chromium	Cr
Cobalt	Co	Copper	Cu	Fluorine	F
Gallium	Ga	Gold	Au	Hafnium	Hf
Helium	He	Hydrogen	H	Iodine	I
Iridium	Ir	Iron	Fe	Krypton	Kr
Lanthanum	La	Lead	Pb	Lithium	Li
Magnesium	Mg	Manganese	Mn	Mercury	Hg
Molybdenum	Mo	Neon	Ne	Nickel	Ni
Nitrogen	N	Oxygen	O	Palladium	Pd
Phosphorus	P	Platinum	Pt	Plutonium	Pu
Potassium	K	Radium	Ra	Radon	Rn
Scandium	Sc	Selenium	Se	Silicon	Si
Silver	Ag	Sodium	Na	Strontium	Sr
Sulfur	S	Thallium	Tl	Tin	Sn
Titanium	Ti	Tungsten	W	Uranium	U
Vanadium	V	Xeon	Xe	Zinc	Zn

SOLUBILITY RULES

Always soluble:

alkali metal ions (Li^+ , Na^+ , K^+ , Rb^+ , Cs^+), NH_4^+ ,
 NO_3^- , ClO_3^- , ClO_4^- , $\text{C}_2\text{H}_3\text{O}_2^-$, HCO_3^-

Generally soluble: (mnemonics)

Cl^- , Br^- , I^- Soluble except Ag^+ , Pb^{2+} , Hg_2^{2+} (AP/H)
 F^- Soluble except Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} , Mg^{2+}
 (CBS-PM)
 SO_4^{2-} Soluble except Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} (CBS/PBS)

Generally insoluble:

O^{2-} , OH^- Insoluble except alkali metal ions and NH_4^+
 Ca^{2+} , Sr^{2+} , Ba^{2+} (CBS) somewhat soluble
 CO_3^{2-} , PO_4^{3-} , S^{2-} , SO_3^{2-} , $\text{C}_2\text{O}_4^{2-}$, CrO_4^{2-}
 Insoluble except alkali metals and NH_4^+