

# AP Chemistry

## Summer Assignment

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*I am available all summer. You are welcome to email questions!*

### **Required Materials:**

1. Class textbook: Please as soon as you can check out the textbook for the year. Go to Lisa Walsh in the Upper School. Do not buy the book, we have a class set.
2. Either two notebooks, one lined and one graphing (engineering), or one thick graphing notebook.
3. Pens of a few different colors and a highlighter
4. Any graphing calculator
5. Class Google Drive folder (please bookmark): <https://goo.gl/oRmcCj>

### **Recommended Supplementary Materials:**

1. *Any AP Chemistry Review Book* – These books are excellent when preparing for the actual AP Chem exam. They give many sample questions and practice questions.
2. If you do not have a user ID for College Board, create one and explore website for the course. The website is: <http://student.collegeboard.org/>
3. Create an account at Kahn Academy and preview their AP Chemistry website: <https://www.khanacademy.org/science/ap-chemistry>

### **Due on the first day of class:**

1. **Memorize** the following (beginning on the following page).
  - a. names and symbols of common chemical elements
  - b. phases of elements at normal temperature and pressure
  - c. formulas of elements that require subscripts in reference form
  - d. oxidation numbers of polyatomic ions including name, symbol, and charge of common ions
  - e. variable valences of common metals including common names
2. Complete the **forty practice problems** beginning on page five. Be prepared to hand in your answers with solutions on the first day of class. Take the opportunity this summer to get your questions answered, do not wait until our first class day!
3. Choose one of the following channels and watch a few of their Chemistry videos. Be ready to discuss on our first day of class. **Find something you enjoy:**
  - Crash Course:* <https://tinyurl.com/p9c5dyx>
  - Periodic Videos:* <https://www.youtube.com/user/periodicvideos>
  - Cody's Lab:* <https://www.youtube.com/user/theCodyReeder>

**Note:** Our first test will cover this summer work and will occur two weeks into school. You need to invest your time into review and problem solving across many days and weeks this summer, not all at the end of August.

## Memorize

### Element Names and Symbols of Common Elements & Phases

Al	aluminum	Mn	manganese
Sb	antimony	Hg	mercury
Ar	argon	Ne	neon
As	arsenic	Ni	nickel
Ba	barium	N	nitrogen
Be	beryllium	O	oxygen
B	boron	Pd	palladium
Br	bromine	P	phosphorous
Cd	cadmium	Pt	platinum
Ca	calcium	Pu	plutonium
C	carbon	K	potassium
Cs	cesium	Ra	radium
Cl	chlorine	Rn	radon
Cr	chromium	Rb	rubidium
Co	cobalt	Se	selenium
Cu	copper	Si	silicon
F	fluorine	Ag	silver
Fr	francium	Na	sodium
Ge	germanium	Sr	strontium
Au	gold	S	sulfur
He	helium	Te	tellurium
H	hydrogen	Th	thorium
I	iodine	Sn	tin
Fe	iron	W	tungsten
Kr	krypton	U	uranium
Pb	lead	Xe	xenon
Li	lithium	Zn	zinc
Mg	magnesium		

- All metals are solid except for mercury which is a liquid.

- All metalloids are solids.

- Nonmetals: carbon, phosphorus, sulfur, & selenium are solids; bromine is a liquid; and the rest are gases.

- Elements with Subscripts: Br<sub>2</sub>, I<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub>, H<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, P<sub>4</sub>, S<sub>8</sub>

### Common Monatomic Ions

1A	2A											3A	4A	5A	6A	7A	8A	
Li <sup>+</sup>														N <sup>3-</sup>	O <sup>2-</sup>	F <sup>-</sup>		
Na <sup>+</sup>	Mg <sup>2+</sup>	3B		4B	5B	6B	7B	8B			1B	2B	Al <sup>3+</sup>		P <sup>3-</sup>	S <sup>2-</sup>	Cl <sup>-</sup>	
K <sup>+</sup>	Ca <sup>2+</sup>	Sc <sup>3+</sup>	Ti <sup>2+</sup> Ti <sup>4+</sup>	V <sup>2+</sup> V <sup>3+</sup>	Cr <sup>2+</sup> Cr <sup>3+</sup>	Mn <sup>2+</sup> Mn <sup>4+</sup>	Fe <sup>2+</sup> Fe <sup>3+</sup>	Co <sup>2+</sup> Co <sup>3+</sup>	Ni <sup>2+</sup>	Cu <sup>+</sup> Cu <sup>2+</sup>	Zn <sup>2+</sup>					Se <sup>2-</sup>	Br <sup>-</sup>	
Rb <sup>+</sup>	Sr <sup>2+</sup>									Ag <sup>+</sup>	Cd <sup>2+</sup>		Sn <sup>2+</sup>				I <sup>-</sup>	
Cs <sup>+</sup>	Ba <sup>2+</sup>									Au <sup>+</sup> Au <sup>3+</sup>			Pb <sup>2+</sup>					

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### Metals with Multiple Oxidation States

Element	Symbol	Oxidation #	Name
Iron	Fe	+2	Iron (II)
		+3	Iron (III)
Copper	Cu	+1	Copper (I)
		+2	Copper (II)
Mercury	Hg <sub>2</sub>	+2	Mercury (I)
		+2	Mercury (II)
Lead	Pb	+2	Lead (II)
		+4	Lead (IV)
Tin	Sn	+2	Tin (II)
		+4	Tin (IV)

## Polyatomic Ions

$\text{H}_2\text{PO}_4^-$	dihydrogen phosphate	$\text{BrO}_4^-$	perbromate
$\text{C}_2\text{H}_3\text{O}_2^-$	acetate	$\text{IO}^-$	hypoiodite
$\text{HSO}_3^-$	hydrogen sulfite	$\text{IO}_2^-$	iodite
$\text{HSO}_4^-$	hydrogen sulfate	$\text{IO}_3^-$	iodate
$\text{HCO}_3^-$	hydrogen carbonate (bicarbonate)	$\text{IO}_4^-$	periodate
$\text{NO}_2^-$	nitrite	$\text{HPO}_4^{2-}$	hydrogen phosphate
$\text{NO}_3^-$	nitrate	$\text{C}_2\text{O}_4^{2-}$	oxalate
$\text{CN}^-$	cyanide	$\text{SO}_3^{2-}$	sulfite
$\text{SCN}^-$	thiocyanate	$\text{SO}_4^{2-}$	sulfate
$\text{OH}^-$	hydroxide	$\text{CO}_3^{2-}$	carbonate
$\text{MnO}_4^-$	permanganate	$\text{CrO}_4^{2-}$	chromate
$\text{ClO}^-$	hypochlorite	$\text{Cr}_2\text{O}_7^{2-}$	dichromate
$\text{ClO}_2^-$	chlorite	$\text{SiO}_3^{2-}$	silicate
$\text{ClO}_3^-$	chlorate	$\text{O}_2^{2-}$	peroxide
$\text{ClO}_4^-$	perchlorate	$\text{PO}_3^{3-}$	phosphite
$\text{BrO}^-$	hypobromite	$\text{PO}_4^{3-}$	phosphate
$\text{BrO}_2^-$	bromite	$\text{BO}_3^{3-}$	borate
$\text{BrO}_3^-$	bromate	$\text{NH}_4^+$	ammonium

## Problems

Use your textbook (chapters 1-3) and the following internet resources to complete the following problems. The URLs below represent a fraction of the available chemistry addresses available. Please feel free to expand the list and find other web sites that help prepare you for the coming year.

<http://media.collegeboard.com/digitalServices/pdf/ap/ap-chemistry-course-and-exam-description.pdf>

<http://www.collegeboard.com/ap/students/chemistry/index.html>

[www.chemmybear.com](http://www.chemmybear.com)

<https://chemfiesta.org>

<http://science.widener.edu/svb/tutorial/rxnbalancingcsn7.html>

<http://www.chemistry-drills.com/balance.html>

[www.chemteam.info](http://www.chemteam.info)

Show work for all the problems. (Hand written or typed solutions will be accepted). Use dimensional analysis.... That is, show units in work and use those units to evaluate the correct unit in the answer. Answer on a separate sheet. Questions cover topics from general chemistry to basic Mole concepts.

**The goal of these problems is for you to develop solutions, not just answers. In August you should be prepared to logically defend how you solved each of these problems.**

1. Write the **most common guidelines** to determine significant figures (or digits) with an example.
2. Use **factor labeling** (conversion factors) to convert the following:
  - a. 200 meters = \_\_\_ miles.
  - b. 650 in = \_\_\_ meters.
  - c. 4 years = \_\_\_ seconds.
3. Classify each of the following as units of mass, volume, length, density, energy, or pressure.  
a. kg      b. liter      c.  $\text{cm}^3$       d. mm      e.  $\text{kg/m}^3$       f. Joule      g. atm      h. cal
4. Most laboratory experiments are performed at room temperature at  $23^\circ\text{C}$ . Express this temperature in:
  - a.  $^\circ\text{F}$
  - b. Kelvin
5. How many **significant figures** are in each of the following?
  - a. 1.9200 mm
  - b. 0.0301001 kJ
  - c.  $6.022 \cdot 10^{23}$  atoms
  - g. 460.000 L
  - e. 0.000036  $\text{cm}^3$
  - f. 10000
  - g. 1001
  - h. 0.001345
6. Record the following in correct **scientific notation**:
  - a. 4050,000,000 cal
  - b. 0.000123 mol
  - c. 0.00345  $\text{Å}$
  - d. 700,000,000 atoms
7. Calculate the following to the **correct number** of significant figures (or digits).
  - 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.  $2.100 \times 3.2102$
  - f.  $2.35 - 0.4 - 1.23$

8. Give the **chemical symbols** for the following elements (do this from memory):
- |             |             |             |             |              |           |
|-------------|-------------|-------------|-------------|--------------|-----------|
| a. Carbon   | b. sulfur   | c. Titanium | d. Nitrogen | e. Helium    |           |
| f. Krypton  | g. Fluorine | h. Scandium | i. Arsenic  | j. Potassium | k. Sodium |
| l. chloride | m. Iron     | n. Zinc     | o. tin      |              |           |

9. Write the **Latin** names for each of the elements symbols (not from memory, look them up):
- |       |       |       |       |       |       |      |       |
|-------|-------|-------|-------|-------|-------|------|-------|
| a. Na | b. Au | c. Ag | d. Sn | e. Fe | f. Hg | g. K | h. Pb |
|-------|-------|-------|-------|-------|-------|------|-------|

(We can blame Latin for most elements with mismatched symbols. Tungsten (W) comes from the German name for it, "Wolfram".)

10. A solid white substance A is heated strongly in the absence of air. It decomposes to form a new white substance B and a gas C. The gas has exactly the same properties as the product obtained when carbon is burned in an excess of oxygen. Based on these observations, can we determine whether solids A and B and the gas C are elements or compounds? Explain your conclusions for each substance.

11. Label each of the following as either a **physical process** or a **chemical process**.

- Corrosion of aluminum metal.
- Melting of ice.
- Pulverizing an aspirin.
- Digesting a candy bar.
- Explosion of nitroglycerin.

12. You may notice when water boils, you can see bubbles that rise to the surface of the water.

- What is inside these bubbles?
- Is the boiling of water a chemical or physical change? Explain

13. Dalton assumed that all atoms of the same element were identical in all their properties. Explain why this assumption is not valid.

14. Why do we call  $\text{Ba}(\text{NO}_3)_2$  barium nitrate, but we call  $\text{Fe}(\text{NO}_3)_2$  iron(II) nitrate?

15. Calculate the mass of C required to produce 3.450 g of  $\text{CO}_2$  through combustion.

16. Write the formula of the following compounds.

- |                           |                       |                        |
|---------------------------|-----------------------|------------------------|
| a. Calcium sulfate.       | b. Ammonium Phosphate | c. Lithium Nitrite     |
| d. potassium perchlorate. | e. Barium Oxide       | f. Zinc sulfide.       |
| g. Sodium Perbromate      | I. Calcium Iodide     | J. Aluminum Carbonate. |

17. Define the words: **atomic number, atomic mass, mass number, molecular formula, structural formula, empirical formula, isotopes, cation, anion, metalloid, and allotrope**.

18. Determine **number of protons and neutrons** in each of the following.

- |                         |                              |                             |                           |
|-------------------------|------------------------------|-----------------------------|---------------------------|
| a. $\text{K}_{19}^{39}$ | b. ${}_{11}^{23}\text{Na}$ . | c. ${}_{82}^{208}\text{Pb}$ | d. ${}_{15}^{33}\text{P}$ |
|-------------------------|------------------------------|-----------------------------|---------------------------|

19. White gold is an alloy that typically contains 45.0% by mass gold and the remainder is platinum. If **154 g** of gold are available, how many grams of platinum are required to combine with the gold to form this alloy?

20. What is the empirical formula of a compound that contains 53.73% Fe and 46.27% of S?

21. Determine the number of molecules present in 4.50 mol of Nitrogen dioxide.

22. List the following as a diatomic molecule, molecular compound, ionic compound, or atomic element.

a. F<sub>2</sub>    b. Cl<sub>2</sub>    c. C    d. NaCl    e. KF    f. CO<sub>2</sub>    g. H<sub>2</sub>    h. Ag    i. Rust (Fe<sub>2</sub>O<sub>3</sub>)

23. State the contribution of the following chemist in one line.

a. Democritus    b. Mendeleev    c. Dalton    d. Rutherford    e. J.J Thompson

f. Faraday    g. Millikan    h. Proust    i. Cavendish    j. Curie

24. What is the difference between:

- Oxygen and oxide?
- A magnesium atom and a magnesium ion?

25. How many moles of methane (CH<sub>4</sub>) are present in 10.0 grams of methane gas? What volume would this gas fill at STP?

26. Calculate the **mass in grams** of each of the following:

- $2.01 \times 10^{10}$  atoms of Mg.
- $3.01 \times 10^{23}$  Formula units of BaI<sub>2</sub>.

27. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:

- Mass of crucible, cover, and contents before heating: 23.4 g.
- mass of empty crucible and cover: 18.82 g.
- mass of crucible, cover, and contents after heating to constant mass: 20.94 g.

Calculate the experimental percent of water in the compound.

28. How do you distinguish the following? (Use a specific example to show the difference)

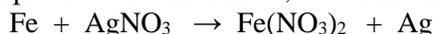
- An element from a compound.
- An element from a mixture.
- A true solution from a heterogeneous mixture.
- Distillation from filtration.

29. An **extensive property** is one that depends on the amount of the sample. Which of the following properties are extensive?

a. volume    b. density    c. temperature    d. energy    e. melting point.    F. pressure

30. There are four types of **general inorganic reactions**. List what these are and give an example of each.

31. What mass of iron is required to replace all the silver from 8.00 g of silver nitrate dissolved in water? (Note: the equation provided is unbalanced, so balance it first.)



32. The chemical formulas for the following compounds:

- Calcium Carbonate
- Ammonium Phosphate
- Sodium Chloride
- Sodium Oxide
- Calcium Sulfate
- Sodium Nitrite
- Magnesium Acetate
- Potassium cyanide
- Zinc(II) Nitrate
- Iron(III) Phosphate
- Nickel (II) Fluoride

33. Mercury has an atomic mass of 200.59 amu. Calculate:  
 a. the mass of  $3.0 \times 10^{10}$  atoms.  
 b. the number of atoms in one nanogram of Mercury.
34. Calculate the molar masses ( g/mol) of  
 a. Ammonia (  $\text{NH}_3$  ) b. Baking soda (  $\text{NaHCO}_3$  )
35. The molecular formula of morphine, a pain-killing narcotic, is  $\text{C}_{17}\text{H}_{19}\text{NO}_3$ .  
 a. What is the molar mass?  
 b. What fraction of atoms in morphine is accounted for by carbon?  
 c. Which element contributes least to the molar mass?
36. Calculate the percentage by mass of the following compounds:  
 a.  $\text{SO}_3$       b.  $\text{CH}_3\text{COOCH}_3$
37. Arsenic reacts with chlorine gas to form a chloride. If 1.587 g of arsenic reacts with 3.755 g of chlorine, what is the simplest formula of the chloride?
38. Write balanced chemical equations for the reactions of **sodium** with the following nonmetals to form ionic solids.  
 a. Nitrogen      b. Oxygen      c. Fluorine
39. Explain why 1 mole of hydrogen gas takes up the same volume at STP as 1 mole of helium gas.
40. What would be the charge on an oxygen atom if it lost **all** of its electrons?

*The following information is for your leisure. It will not be part of any assessed work.*

Chemistry is often called the “central science”, meaning it connects to the basic ideas of motion, forces, and energy from physics as well as the basic ideas of structure, evolution, and homeostasis from biology. This term was questioned in the paper *Is Chemistry “the Central Science?” How are Different Sciences Related? Co-Citations, Reductionism, Emergence, and Posets.*

Instead of being a central science, chemistry (much like biology) is more of a branching-off point. From the core principles you learn in Conceptual Physics and this class you will have a better understanding of a wider variety of topics, and you will be able to explore those topics with some background knowledge already in your pocket.

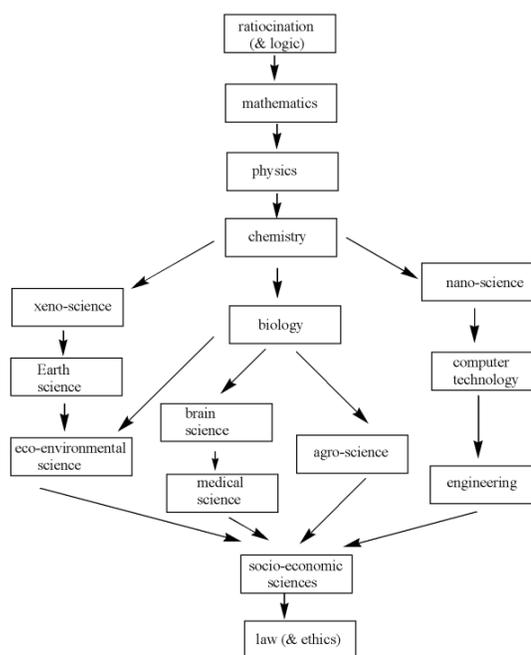


Figure 2. The “framework” partial ordering of the sciences

Citation:

[https://www.researchgate.net/publication/220364433\\_Is\\_Chemistry\\_the\\_Central\\_Science\\_How\\_Are\\_Different\\_Sciences\\_Related\\_Co-Citations\\_Reductionism\\_Emergence\\_and\\_Posets](https://www.researchgate.net/publication/220364433_Is_Chemistry_the_Central_Science_How_Are_Different_Sciences_Related_Co-Citations_Reductionism_Emergence_and_Posets)