2022-2023 AP Chemistry

Congratulations on making the decision to take AP Chemistry! This course will move at a fast pace and cover a substantial amount of material, starting with the first day of school. The primary goal of this course is to earn college credit by passing the AP Chemistry exam with a score of 4 or higher in May (most colleges will not give credit for a score of 1, 2, or 3). In order to enroll in chemistry, you must meet minimum English and Mathematics admission requirements.

So that we can spend more time on topics new to you in AP Chemistry, you are expected to be familiar answering questions and solving problems using the content covered in your first year chemistry course. The attached **review assignment** covers first-year chemistry topics that will not be taught in AP chemistry. Videos for each of these topics will be available through YouTube and **Google Classroom**. You will have an opportunity to ask questions on this assignment during the first three class periods. The assignment will be collected prior to your in-class test on these topics during the fourth class period for a grade. *It is up to you whether or not you start work on this assignment before the school year*; if it has been a year since you took your first chemistry course or you took a non-honors chemistry course during the previous school year, you are strongly encouraged to begin work on this assignment the week before school starts.

Copies of the periodic table and the metric prefixes you will be using in AP Chemistry are included in this assignment. Please note that this periodic table does not include element names. Charges of monatomic ions and key polyatomic ions that need to be memorized by the first test are also included. You are encouraged to make flashcards or use the Quizlet ions card deck (linked on Classroom) to begin learning these ions.

Labs will be completed during class for the first semester and during the second semester we will have 2-3 afterschool labs and review sessions.

I wish each of you a restful and enjoyable summer, and I look forward to seeing you next school year!

AP Chemistry Ions

Monatomic Cations	Monatomic Anions	Polyatomic Cations	Polyatomic Anions
Group 1 (including H) H^{+1}, hydrogen Li^{+1}, lithium Na^{+1}, sodium K^{+1}, potassium Cs^{+1}, cesium Group 2 Be^{+2}, beryllium Mg^{+2}, magnesium Ca^{+2}, calcium Sr^{+2}, strontium Ba^{+2}, barium Group 13 Al^{+3}, aluminum Transition and Heavier Metals Cr^{+2}, chromium (II) Cr^{+3}, chromium (III) Mn^{+2}, manganese (II) Mn^{+4}, manganese (IV) Mn^{+7}, manganese (VII) Cu^{+1}, copper (I) Cu^{+2}, copper (II) Fe^{+2}, iron (II) Fe^{+3}, iron (III) Pb^{+2}, lead (II) Pb^{+4}, lead (IV) Hg^{+2}, mercury (II) Ni^{+2}, nickel (II) Ni^{+3}, nickel (III) Sn^{+2}, tin (II) Sn^{+4}, tin (IV) Ag^{+1}, silver Zn^{+2}, zinc	Group 17 and H H^{-1}, hydride F^{-1}, fluoride Cl^{-1}, chloride Br^{-1}, bromide I^{-1}, iodide Group 16 O^{-2}, oxide S^{-2}, sulfide Group 15 N^{-3}, nitride P^{-3}, phosphide	Ammonium, NH_4^{+1} Mercury (I), Hg_2^{+2}	Acetate, $C_2H_3O_2^{-1}$ Bicarbonate (hydrogen carbonate), HCO_3^{-1} Carbonate, CO_3^{-2} Perchlorate, ClO_4^{-1} Chlorate, ClO_3^{-1} Chlorite, ClO_2^{-1} Hypochlorite, ClO^{-1} Permanganate, MnO_4^{-1} Cyanide, CN^{-1} Hydroxide, OH^{-1} Peroxide, O_2^{-2} Nitrate, NO_3^{-1} Nitrite, NO_2^{-1} Chromate, CrO_4^{-2} Dichromate, $Cr_2O_7^{-2}$ Sulfate, SO_4^{-2} Sulfite, SO_3^{-2} Phosphate, PO_4^{-3} Phosphite, PO_3^{-3}

***Note: Transition metals are named with Roman numerals to indicate their oxidation state (charge) if they have multiple oxidation states. Silver and zinc are the only transition metals on this list that have a single oxidation state and therefore are not named with roman numerals. As long as you know which transition metals need Roman numerals, individual charges of these metals do not need to be memorized.

INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.011	7 N 14.007	8 O 16.00	9 F 19.00	10 Ne 20.179
11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.938	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 *La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.02	89 †Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 § (269)	111 § (272)	112 § (277)						

§Not yet named

*Lanthanide Series	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
†Actinide Series	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

GO ON TO THE NEXT PAGE.

Metric Conversions

Unit	Symbol	*Equivalent Expressions*	
mega	M	**1 Mg** = 1,000,000 g = 10^6 g	**1 Mg** = 1,000,000 g = 10^6 g
kilo	k	**1 kg** = 1,000 g = 10^3 g	**1 kg** = 1,000 g = 10^3 g
hecta	h	**1 hg** = 100 g = 10^2 g	**1 hg** = 100 g = 10^2 g
deca	da	**1 dag** = 10 g = 10^1 g	**1 dag** = 10 g = 10^1 g
o		1g = 10^0g	1g = 10^0g
deci	d	**1 g** = 10 dg = 10^1 dg	**1 dg** = 0.1 g = 10^{-1} g
centi	c	**1 g** = 100 cg = 10^2 cg	**1 cg** = 0.01 g = 10^{-2} g
milli	m	**1 g** = 1,000 mg = 10^3 mg	**1 mg** = 0.001 g = 10^{-3} g
micro	µ	**1 g** = 1,000,000 µg = 10^6 µg	**1 µg** = 0.000001 g = 10^{-6} g
nano	n	**1 g** = 1,000,000,000 ng = 10^9 ng	**1 ng** = 0.000000001 g = 10^{-9} g
pico	p	**1 g** = 1,000,000,000,000 pg = 10^{12} pg	**1 pg** = 0.000000000001 g = 10^{-12} g

* Any quantity can be substituted for g; ie. 1 L = 1000 mL just as 1 g = 1000 mg

A helpful pnemonic for memorizing prefixes (you need to know these):

Many **k**ids **h**ave **d**ropped **o**ver **d**ead **c**onverting **m**etric **m**easurements **i**n **p**roblems.

Advanced Placement Chemistry Review Assignment

Topic 1: Significant Figures & Scientific Notation

1. Count the number of significant figures in the following measurements.

   a. 2.71 g _____ b. 0.00047 kg _____ c. 7.0×10^5 m _____ d. 1,030 L _____

   e. 150 pencils _____ f. 37500 µg _____ g. 0.1010 cm _____

2. Express each of the following in proper scientific notation (Pay attention to sig figs and units).

   a. 0.000125 m _____ b. 155.0 mL _____

   c. 123,030,000 ng _____ d. 481.9×10^{-9} cm _____

3. Calculate the correct answer with proper units and significant figures for each of the following:

   a. 12 g + 0.677 g + 86.33 g = _____

   b. (355.78 g) / (0.056 g) = _____

   c. 97.34 mL – 34.1 mL = _____

   d. 14.68 x 5 = _____

4. Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

   a. $0.14 \times (6.02 \times 10^{23})$ = _____

   b. $\dfrac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4} \times 100\ \%$ = _____ (assume 100 is exact)

   c. $\dfrac{(3.8 \times 10^{-12} \times 4.0 \times 10^{-13})}{(4 \times 10^{12} \times 6.3 \times 10^{13})}$ = _____

Topic 2: Dimensional Analysis

Show work using dimensional analysis. No work = no credit even if answer is correct. Follow significant figures and rounding rules unless the number of significant figures is specified. Include units where appropriate.

5. How many hours are in a week? Report your answer to three significant figures.

6. Find the number of centimeters in 1.00×10^2 yards. (1 yd = 3 ft, 1 ft = 12 in, 2.54 cm = 1 in)

7. If Jules Verne expressed the title of his famous book, Twenty Thousand Leagues under the Sea in basic SI units, what would the title be? Round your answer to three significant figures.
   (1 league = 3.45 mi, 1 mi = 1609 m)

8. How many µL are present in 250 mL of H_2O?

9. Wavelengths are often represented in nm. What is the diameter of a helium (He) atom in nm if it is equivalent to 1.0×10^{-13} km?

10. The area of a rectangular room has a length of 10.5 m and a width of 4.50 m. What is this area in m^2? In cm^2?

11. The acceleration of a sphere is determined to be 9.52 m/s^2. What is the acceleration in km/min^2?

Topic 3: Density and Temperature

Show all work. No work = no credit even if answer is correct. Follow significant figures and rounding rules. Include units where appropriate.

12. A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?

13. The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

14. You can figure out whether a substance floats or sinks if you know its density and the density of the liquid. In which of the liquids listed below will high-density polyethylene, HDPE, float? HDPE, a common plastic, has a density of 0.97 g/cm^3. It does not dissolve in any of the following liquids.

Substance	Density (g/cm^3)
ethylene glycol	1.1088
water	0.9997
ethanol	0.7893
methanol	0.7914
acetic acid	1.0492
glycerol	1.2613

15. Mercury is found as a liquid at room temperature. If it has a boiling point of 630. K, what is this boiling point in degrees Celsius?

Topic 4: Precision and Accuracy

16. The density of ethanol was determined experimentally at 25°C in a series of trials to be 0.608 g/mL, 0.705 g/mL, and 0.689 g/mL. The accepted density of ethanol is reported to be 0.789 g/mL.
    a. Are the experimental densities precise? Why/Why not?

    b. Calculate % error for this experiment. Use the average experimental density in your calculation and report your answer to 0.1%. Show your work.

    c. Are the experimental densities accurate? Why/Why not?

Topic 5: Properties and Changes

17. Categorize each of the following as an element, a compound, or a mixture:
    a. carbonated water _____
    b. tungsten _____
    c. aspirin (acetylsalicylic acid) _____
    d. air _____
    e. lye (sodium hydroxide) _____
    f. fluorine _____

18. Iron pyrite, also known as fool's gold, has a shiny golden metallic appearance. Crystals are often in the form of perfect cubes. A cube of iron pyrite measuring 0.40 cm on each side has a mass of 0.064 g.

    a. Which of these observations are qualitative and which are quantitative?

    b. Which of these observations are extensive (dependent on the amount of substance present) and which are intensive (independent of the amount of substance present)?

19. Identify the following as a physical property, physical change, chemical property, or chemical change:

    a. Ethanol has a density of 0.697 g/mL. _____

    b. The solution turns blue upon mixing water and food coloring. _____

    c. Wood burns in an oven. _____

    d. Methyl alcohol is highly flammable. _____

    e. Ice melts in a beaker. _____

    f. Methyl ethanoate smells like apples. _____

    g. Iron rusts on a car. _____

    h. Alkali metals react strongly in hydrochloric acid. _____

Topic 6: Atom Structure & History

20. How many protons and neutrons are contained in the nucleus of each of the following atoms? How many electrons are present in each of these neutral atoms?

    a. $^{13}_{6}C$ ____ protons ____ neutrons ____ electrons

    b. $^{208}_{82}Pb$ ____ protons ____ neutrons ____ electrons

21. Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium-70					31	
						$^{31}_{15}P^{-3}$
Strontium-80					36	
						$^{55}_{25}Mn^{+2}$

22. The natural abundance for boron isotopes is 19.9% boron-10 (exact mass 10.013 amu) and 80.1% boron-11 (exact mass 11.009 amu). Calculate the average atomic mass of boron using the exact masses instead of mass numbers in your calculations. Show your work. Follow significant figures and rounding rules. Include appropriate units.

23. Europium has two stable isotopes, ^{151}Eu and ^{153}Eu, with masses of 150.9197 u and 152.9212 u, respectively. Calculate the percent abundances of these isotopes of europium to 0.1%. Hint: The percent abundances of these two isotopes must add to 100%. Show your work. Follow significant figures and rounding rules. Include appropriate units.

24. Identify the scientist(s) noted for the following events in atomic history.
    a. identified the electron; noted for the plum pudding model _____
    b. noted for the first atomic theory of the atom; solid sphere model _____
    c. developed the planetary model; electrons in fixed orbits _____
    d. developed the quantum mechanical model; electrons are localized to orbitals _____
    e. identified the proton and the nucleus; nuclear model _____
    f. determined the charge of an electron _____
    g. described wave theory _____
    h. known for the uncertainty principle _____
    i. developed quantum numbers _____

25. Identify the model of the atom described in the following statements.
    a. currently accepted model _____
    b. model that first included a subatomic particle _____
    c. model developed using the gold foil experiment _____
    d. original model of the atom; atom was thought to be “indivisible” _____
    e. model that only showed the movement of hydrogen’s electron accurately; involved “quantums” _____

Topic 7: Periodic Table Structure

Identify by name the group or section of the periodic table noted for the following features.

26. a. group containing the most reactive nonmetals; all are diatomics; form -1 ions _____
    b. group containing metals that only form +2 ions _____
    c. set of metals that often form colored ions in solution; the majority have multiple charges as ions _____
    d. group containing the most reactive metals; form +1 ions _____
    e. group containing least reactive elements on periodic table, typically inert _____

27. These elements start with the letter B: B, Ba, Bk, Bi, and Br. Identify which of these elements match the following descriptions. You may use elements once, more than once, or not at all.
    a. Which are metals? _____
    b. Which are liquids? _____
    c. Which are actinides? _____
    d. Which are main block elements? _____

Topic 8: Compound Nomenclature

28. Name or give the formula for the following compounds. All ions included in the summer letter are required to be memorized by name and by formula.

	Name	Formula
a.	lithium fluoride	_____
b.	_____	K_2O
c.	calcium phosphate	_____
d.	_____	$MnCl_2$
e.	silver sulfide	_____
f.	_____	Cu_2O
g.	aluminum sulfate	_____
h.	_____	$ZnCO_3$
i.	chromium (III) phosphide	_____
j.	_____	SO_3
k.	lead (IV) hydroxide	_____
l.	_____	N_2O_5
m.	ammonium sulfite	_____
n.	_____	$BaCr_2O_7$
o.	sodium peroxide	_____
p.	_____	NH_3 (use common names; see ppt/videos if necessary)
q.	nickel (II) hypochlorite	_____
r.	_____	$Fe(CN)_3$
s.	rubidium chromate	_____
t.	_____	$Mg_3(PO_4)_2$

Topic 9: Equations

29. Balance the following equations using the lowest whole-number coefficients.

a. $\_\_Fe + \_\_P_4 \rightarrow \_\_Fe_3P_2$

b. $\_\_Ca + \_\_H_2O \rightarrow \_\_Ca(OH)_2 + \_\_H_2$

c. $\_\_Ba(OH)_2 + \_\_H_3PO_4 \rightarrow \_\_Ba_3(PO_4)_2 + \_\_H_2O$

d. $\_\_(NH_4)_2CO_3 + \_\_Al(ClO_3)_3 \rightarrow \_\_Al_2(CO_3)_3 + \_\_NH_4ClO_3$

30. Write balanced chemical equations for the following word equations. Use the lowest possible whole-number coefficients to balance the equations.

a. Aqueous solutions of ammonium sulfate and barium nitrate form a precipitate of barium sulfate and aqueous ammonium nitrate.

b. Elemental magnesium and oxygen gas combine to form solid magnesium oxide.

c. Chlorine gas and aqueous potassium bromide react to form bromine liquid and aqueous potassium chloride.

d. Solid copper (II) carbonate decomposes to form crystals of copper (II) oxide and carbon dioxide gas.

e. Sulfuric acid is neutralized by lithium hydroxide to form water and aqueous lithium sulfate.

f. Liquid benzene, C_6H_6, undergoes combustion in oxygen gas, making carbon dioxide gas and steam.

Topic 10: Mole Conversions & Stoichiometry

Show your work. No work = no credit. Follow significant figures and rounding rules. Include appropriate units.

31. a. Calculate the number of moles in 500. atoms of iron (Fe).

b. What is the molar mass of lead (IV) carbonate, $Pb(CO_3)_2$?

c. How many formula units are present in 87.2 grams of lead (IV) carbonate?

d. What percentage of oxygen is found in lead (IV) carbonate? Round your answer to 0.1%.

32. The reusable booster rockets of the U.S. space shuttle employed a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:

__Al(s) + __ NH_4ClO_4(s) → __ Al_2O_3(s) + __ $AlCl_3$(s) + _ NO(g) + __H_2O(g)

a. Balance the above reaction using the lowest possible whole-number coefficients.

b. If 4.00 g of aluminum reacted completely, how many grams of aluminum oxide would be made?

c. If 4.18 g of aluminum chloride was produced, how many moles of ammonium perchlorate would be consumed?

d. How many molecules of nitrogen monoxide would form if $6.3x10^{25}$ formula units of aluminum oxide were also produced?

33. The decomposition of ammonia is shown in the following equation: $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$.

a. 42.0 g of nitrogen has what volume in liters at STP?

b. 150 L of NH_3 undergoes decomposition to form how many liters of hydrogen gas at STP?

c. How many liters of ammonia were decomposed at STP if $3.0x10^{23}$ nitrogen molecules were made?