2020-2021 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 3 or higher in May 2021.

When working any problems in AP Chemistry, it is absolutely essential that you SHOW ALL WORK! Many points on the Free Response Questions are awarded for simply showing the equation you used and showing your work. There is usually just one point awarded for a correct answer, and none if there is no work to go with it. Practice writing clearly and neatly. If I can't read your writing, it is doubtful that an AP reader will be able to.

Another thing to practice is mental math. The multiple choice questions on the AP test do not allow a calculator, so you must learn tricks and shortcuts for solving problems without one. Here are some videos to watch on solving problems without a calculator:
https://www.youtube.com/watch?v=TmdWanOo4aA
https://www.youtube.com/watch?v=zET3EmYi3jM

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. You will have an opportunity to ask questions on this assignment during the first three class periods. *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 2019-2020 school year, you are strongly encouraged to begin work on this assignment before school starts. There will be a Canvas Quiz covering this material that will be due the second week of school

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 to begin learning these ions.

Be familiar with general lab safety rules: https://www.carolina.com/knowledge/safety/lab-safety-dos-and-donts-for-students
Be familiar with general lab equipment and their uses:
https://www.slideshare.net/CherylBausman/14-laboratory-equipment

If you have any questions during the summer, you are welcome to contact me via email at jchampagne@conroeisd.net. I wish each of you a restful and enjoyable summer, and I look forward to seeing you next school year!

Mrs. Champagne

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.

The Periodic Table of the Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H 1.01																	2 He 4.00
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.69	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (98)	44 Ru 101.10	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 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.20	77 Ir 192.20	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	103 Lr (262)	104 Rf (267)	105 Db (268)	106 Sg (271)	107 Bh (272)	108 Hs (270)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 Nh (284)	114 Fl (289)	115 Mc (288)	116 Lv (293)	117 Ts (294)	118 Og (294)

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.40	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 173.05
89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	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)

Disposal Alert

This symbol appears when care must be taken to dispose of materials properly.

Biological Hazard

This symbol appears when there is danger involving bacteria, fungi, or protists.

Open Flame Alert

This symbol appears when use of an open flame could cause a fire or an explosion.

Thermal Safety

This symbol appears as a reminder to use caution when handling hot objects.

Sharp Object Safety

This symbol appears when a danger of cuts or punctures caused by the use of sharp objects exists.

Fume Safety

This symbol appears when chemicals or chemical reactions could cause dangerous fumes.

Electrical Safety

This symbol appears when care should be taken when using electrical equipment.

Plant Safety

This symbol appears when poisonous plants or plants with thorns are handled.

Animal Safety

This symbol appears whenever live animals are studied and the safety of the animals and the students must be ensured.

Radioactive Safety

This symbol appears when radioactive materials are used.

Clothing Protection Safety

This symbol appears when substances used could stain or burn clothing.

Fire Safety

This symbol appears when care should be taken around open flames.

Explosion Safety

This symbol appears when the misuse of chemicals could cause an explosion.

Eye Safety

This symbol appears when a danger to the eyes exists. Safety goggles should be worn when this symbol appears.

Poison Safety

This symbol appears when poisonous substances are used.

Chemical Safety

This symbol appears when chemicals used can cause burns or are poisonous if absorbed through the skin.

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 kids have dropped over dead converting metric measurements in problems.

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

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

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 wavelength of a gamma ray in nm if it is equivalent to 1.0×10^{-9} 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 density of a sphere is determined to be 9.52 g/mL. What is the density in g/mm^3?

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 0.618 g/mL, 0.715 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 (if a mixture, homogeneous or heterogeneous):

a. carbonated water	_____	h. rainwater	_____
b. bronze	_____	i. distilled water	_____
c. aspirin (acetylsalicylic acid)	_____	j. cereal in milk	_____
d. air	_____	k. mercury	_____
e. lye (sodium hydroxide)	_____	l. steel	_____
f. radon	_____	m. oil and water	_____
g. blood	_____	n. ethanol	_____

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. _____

20. What is the difference between and intensive and an extensive property? Give 2 examples of each.

21. For each phase change below give the states of matter it is occurring between and specify whether it is exothermic or endothermic:

a. Melting b. Freezing c. Evaporation d. Boiling d. Sublimation e. Deposition

22. Describe each of the following separation techniques:

a. Distillation b. Chromatography c. Filtration d. Evaporation

Topic 6: Atom Structure & History

23. 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

24. Complete the following table:

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

25. 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.

26. 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.

27. 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 _____

h. known for the uncertainty principle _____

28. Write the electron configuration and orbital notation for the following elements:

a. Sodium _____

b. Phosphorus _____

c. Cobalt _____

29. Describe the periodic trend for atomic structure

_____

30. How does the radius of an anion and a cation change from the radius of a neutral atom?

_____

Topic 7: Periodic Table Structure

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

31. 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 _____

32. 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

33. 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	Ionic/covalent/acid
a.	lithium fluoride	_____	_____
b.	_____	K_2O	_____
c.	calcium phosphate	_____	_____

d.	_____	$MnCl_2 \cdot 2H_2O$	_____
e.	silver sulfide	_____	_____
f.	_____	Cu_2O	_____
g.	magnesium sulfate heptahydrate	_____	_____
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 name)	_____
q.	nickel (II) hypochlorite	_____	_____
r.	_____	$Fe(CN)_3$	_____
s.	rubidium chromate	_____	_____
t.	_____	$Mg_3(PO_4)_2$	_____
u.	mercury(I) nitrate	_____	_____
v.	_____	CCl_4	_____
w.	nitrous acid	_____	_____
x.	_____	H_3PO_4	_____
y.	hydrobromic acid	_____	_____
z.	_____	HCN	_____

Topic 9: Equations

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

35. 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 calcium nitrate react

b. Elemental magnesium and nitrogen gas combine

c. Chlorine gas and aqueous aluminum bromide react

d. Solid copper (II) carbonate decomposes

e. Sulfuric acid is neutralized by potassium hydroxide

f. Liquid benzene, C_6H_6, undergoes combustion

Topic 10: Mole Conversions & Stoichiometry

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

36. 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. How many carbonate ions are in the amount above?

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

37. 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 6.3×10^{25} formula units of aluminum oxide were also produced?

e. If the nitrogen monoxide above was produced at 250°C and a pressure of 1550 mmHg, what

volume would it occupy?

38. 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 3.0×10^{23} nitrogen molecules were made?

39. Write the balanced equation for the reaction of hydrochloric acid and a solution of sodium bicarbonate.

a. Write the net ionic equation

b. If 13.5 mL of 1.5 M HCl reacts with 7.9 mL of 2.4M sodium bicarbonate, what is the theoretical yield of the gas produced?

c. If 0.735g were actually produced, what is the percent yield?

d. If the above amount of the gas was produced at 1.08atm and 29.5°C, what would be the volume of the gas?

e. Draw the Lewis structure for the gas produced, give its shape, polarity of bonds and polarity of the molecule as well as its intermolecular forces.

f. Draw the Lewis structure of water, give its shape, polarity of bonds and polarity of the molecule as well as its intermolecular forces.

40. Phenyl magnesium bromide is used as a Grignard reagent in organic synthesis. Determine its empirical and molecular formula if its molar mass is 181.313g/mol and it contains 39.7458 % carbon, 2.77956% hydrogen, 13.4050% magnesium and the rest bromine.

41. When 5.00 g of an iron (III) chloride hydrate is heated, the new mass is 3.00g. What is the formula of the hydrate?

42. When 50.0g of a metal at 75.0°C is added to 100.g of water at 15.0°C, the temperature of the water rises to 18.3°C. Assume that no heat is lost to the surroundings. What is the specific heat of the metal?

43. Octane and oxygen react to form carbon dioxide and water. How many grams of oxygen are needed to make 704g of carbon dioxide and 324g of water if 228g of octane are combusted? What chemical law is being observed here?

44. If sample A of water has a total mass of 10.000g and a mass of hydrogen of 1.119g and a mass of oxygen of 8.881g, what are the masses of hydrogen and oxygen in sample B with a total mass of 27.000g? What chemical law is being observed here?

45. The following data was collected for 3 compounds:

	Mass of Nitrogen that combines with 1 g of Oxygen
Compound A	1.750 g
Compound B	0.8750 g
Compound C	0.4375 g

Show whether these are the same or different compounds. What chemical law is being observed here?