

Hello and welcome to AP Chemistry!

The purpose of this packet is to (1) be informational and (2) ensure your success during the first four units of this course. Use your notes from honors chemistry and the internet/YouTube/AI to help you as you work through this assignment.

The first four units cover 13 chapters, which represent the ENTIRE honors chemistry curriculum, with a few in-depth additions.

The time frame is **3 months**. The pace is VERY FAST. You will have problems to complete in our lecture packets (notes packet), weekly homework assigned through the online textbook, and at least 1 lab per unit with a detailed lab write up due within a week of completing the lab. This course is INTENSE.

The honors chemistry curriculum is the backbone of this course. Historically, students who “struggled” with their honors chemistry and/or honors math course, have a difficult time with this course. Please use this summer assignment as an opportunity to strengthen your understanding of the honors chemistry curriculum. Students with a thorough understanding of this content PRIOR to the start of this course will be in the best position to succeed.

Come fall, you should be experts at metric prefixes and unit conversions, significant figures, and dimensional analysis involving density, molar mass, Avogadro’s number, molar volume, molarity, and balanced chemical equations... to name a few. The periodic table you are provided with ONLY HAS SYMBOLS, no names. You are expected to have polyatomic ions memorized for your first test. Please plan accordingly.

This packet is due the first day of school and will be graded for completion. After that, an answer key will be provided and after school review sessions will be offered.

Our first exam will be at the end of the second week of school. The topics will be matter, measurement and atomic structure. Please see the At-A-Glance calendar for an idea of exam dates and pacing for the 2026-27 school year.

The add/drop period generally closes the 3rd week of school. See the program of studies booklet for more information

Having said all that, I think you will find me to be organized, straight forward, flexible and approachable. Since I have taken over the course I have built in scaffolds, not limited to thorough and targeted study guides and templates to use to aid in lab write ups. I WANT YOU TO BE SUCCESSFUL. Circling back to paragraph 3, this course is intense and will likely be the first time many of you experience an undesirable grade despite your best efforts. All that means to me is that you are appropriately challenged and are LEARNING. One thing this course teaches ALL students is the value of growth mindset and how to embrace challenge.

I wish you all a great summer and I’ll see you in August...

Please take a moment to share this note with your parent/guardian and complete the signatures below.

Parent/Guardian:

Printed name

Signature

Student:

Printed name

Signature

Name _____

AP Chemistry Summer Packet

Directions: *You must show your work to receive credit.* Please use a separate sheet of paper as necessary.

Unit 1: Measurement and Atomic Structure

_____ 1) Which of the following data sets is most precise?

(a) 0.348 L, 0.350 L, 0.348 L.

(d) 0.330 L, 0.332 L, 0.334 L

(b) 0.345 L, 0.345 L, 0.346 L

(e) 0.350 L, 0.351 L, 0.352 L

(c) 0.344 L, 0.346 L, 0.350 L

_____ 2) How many significant figures are in 0.00230 mL?

(a) Perform the following calculations and express your answer to the correct number of significant figures.

(i) $[(285.3 \times 10^5) - (1.200 \times 10^3)] \times 2.895$

(ii) $320.5 - (6104.5/2.3)$

3) A rectangular prism has a length of 6.4 cm, a width of 4.28 cm. and a height of 7.94 cm.

_____ (a) What will be the volume of the prism to the correct number of significant figures?

_____ (b) An identical prism is placed so that its length is added to that of the original prism. Will the volume of these combined prisms have the same number of significant figures as the volume of the original prism? Explain.

_____ 4) A piece of wood is 25.0 cm long is cut from a board that is 2.5 m long. What is the resulting length of the board to the correct number of significant figures?

_____ 5) Express the following numbers in scientific notation – don't forget significant figures!

(a) 6500.

(b) 0.00630

(c) 860

(d) 6501.0

6) Identify the following as chemical (C) or physical (P) properties.

_____ (a) Metallic sodium is soft enough to be cut with a knife

_____ (b) When sodium is cut, the surface is at first shiny; after a few seconds of exposure to air it turns dull gray

_____ (c) The density of sodium is 0.97 g/mL

_____ (d) When sodium comes in contact with water, it melts, and then evolves a flammable gas, and eventually disappears.

7) What are the preferred oxidation numbers for elements of Group

_____ (a) IA

_____ (b) IIA

_____ (c) VA

_____ (d) VIA

_____ (e) VIIA

8) Which groups on the periodic table represent the

_____ (a) alkali metals

_____ (b) alkaline earth metals

_____ (c) halogens

9) Name the following ionic compounds:

_____ (a) CaCl_2

_____ (b) CuCl_2

10) Name the following molecules:

_____ (a) N_2O_4

_____ (b) PCl_5

11) Write the formulas for the following:

_____ (a) strontium nitrate

_____ (b) copper (II) sulfate

12) Write the formulas for the following:

_____ (a) dichlorine heptoxide

_____ (b) hydrofluoric acid

13) In the late 1880's JJ Thomson experimented with cathode rays by bending them in an applied electromagnetic field. He discovered that the charge/mass (e/m) ration was the same no matter what the cathode was made of

(a) what did this suggest?

(b) What were these particles called?

14) Draw and label the basic parts of Rutherford's famous gold foil experiment.

14 (a) Describe his results and conclusions he reached.

15) What is the symbol of the atomic number of the element tungsten?

_____ (a) symbol

_____ (b) atomic number

16) How many... are in cobalt-60?

_____ (a) protons

_____ (b) neutrons

_____ (c) electrons

17) What is the... and of the nuclide $\frac{96}{42}\text{Mo}$?

_____ (a) mass number

_____ (b) atomic number

Unit 2: Chemical Reactions

18) Write and balance the following (yes, you are expected to write equations from words and balance).

(a) methane gas burns in oxygen

(b) hydrogen gas combusts

(c) aluminum metal is placed in an aqueous solution of hydrochloric acid

(d) aqueous silver nitrate and sodium chloride are mixed in a beaker

19) Determine the molar mass of the following *show your work*

(a) dinitrogen monoxide
(nitrous oxide)

(b) benzoic acid, $\text{HC}_7\text{H}_5\text{O}_2$

(c) magnesium hydroxide

20) Determine the % composition of the following *show your work*

(a) morphine, $C_{17}H_{19}NO_3$

C:

H:

O:

21) Rank the following in terms of numbers of particles *show your work below*

(a) 0.50 mol H_2O

(b) 23 g Na

(c) 6.0×10^{23} molecules N_2

Rank:

22) Use the space/set up below *to show your work* and determine the empirical formula for

(a) 55.3 % K, 14.6 % P, 30.1 % O

K:

P:

O:

23) Use the space/set up below *to show your work* and determine the molecular formula for

(a) MSG, a flavor enhancer in foods, contains 35.51% C, 4.77% H, 37.85% O, 8.29% N and 13.60% Na, and has a molar mass of 169 g/mol.

C:

H:

O:

N:

Na:

24) The combustion of acetylene gas is represented by this equation: $2\text{C}_2\text{H}_2(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

(a) How many grams of CO_2 are produced when 52.0 g of C_2H_2 burn? *Show your work*

(b) How many moles of H_2O are produced when 64.0 g of C_2H_2 burn? *Show your work*

25) The equation shows the incomplete combustion of ethane: $\text{C}_2\text{H}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{CO}(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

If 2.7 mol C_2H_4 is reacted with 6.30 mol O_2 ,

(a) Identify the limiting reagent *Show your work*

(b) Calculate the mass of water produced *Show your work*

26) Predict products for the following decomposition reactions

(a) $\text{KClO}_3(\text{s}) \rightarrow$

(b) $\text{PbCO}_3(\text{s}) \rightarrow$

(c) $\text{Cu}(\text{OH})_2(\text{s}) \rightarrow$

27) Double Replacement Reactions

(a) Identify the spectator ions in the reaction between $\text{Na}_2\text{CO}_3(\text{aq})$ and $\text{MgSO}_4(\text{aq})$

(a) Write the balanced net ionic equation given the reactants below. *Show your work*

$\text{Cr}_2(\text{SO}_4)_3(\text{aq}) + (\text{NH}_4)_2\text{CO}_3(\text{aq}) \rightarrow$

28) Classify the following as a nonelectrolyte, weak electrolyte, or strong electrolyte in water

(a) H_2SO_3 (b) HClO (c) NH_3 (d) LiClO_4

29) Complete and balance the molecular equations, then write the net-ionic equations for the following:

Show your work (a) $\text{HBr}(aq) + \text{Ca}(\text{OH})_2(aq) \rightarrow$

Show your work (b) $\text{Cu}(\text{OH})_2(s) + \text{HClO}_4(aq) \rightarrow$

Show your work (c) $\text{HCl}(aq) + \text{Na}_2\text{S}(aq) \rightarrow$

Show your work (d) $\text{HCl}(aq) + \text{Na}_2\text{CO}_3(aq) \rightarrow$

Show your work (e) $\text{HCl}(aq) + \text{Na}_2\text{SO}_3(aq) \rightarrow$

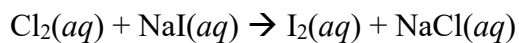
30) Determine the oxidation number of sulfur in each of the following substances:

Show your work

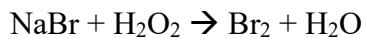
(a) BaSO_4 (b) H_2SO_3 (c) SrS (d) H_2S

31) Redox Reactions

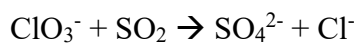
(a) Identify who is oxidized and reduced in the following reaction *Show your work*



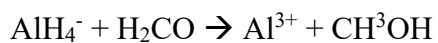
(b) Use the half-react method to write a balanced chemical equation for the following



(c) Balance the following redox reaction in acidic solution



(d) Balance the following redox reaction in basic solution

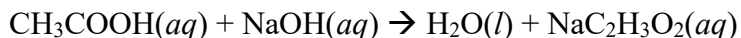


32) Calculate the

(a) molarity of a solution with 12.5 g Na_2CrO_4 in enough water to make 550 mL of solution. *Show your work*

(b) how many moles of KBr are present in 150 mL of a 0.275 M solution? *Show your work*

33) The distinctive odor of vinegar is due to acetic acid, CH_3COOH , which reacts with sodium hydroxide in the following fashion:



(a) if 3.45 mL of vinegar needs 42.5 mL of 0.115 M NaOH to reach the equivalence point in a titration, how many grams of acetic acid are in 1.00-qt sample of this vinegar? *Show your work*

Unit 3: Electrons, Periodicity, Bonding & Geometry

34) Wave calculations

(a) What is the frequency of radiation whose wavelength is 5.0×10^{-5} m? *Show your work*

(b) What is part of the spectrum does this wave fall into? *Show your work*

(c) How far does this wave travel in 10.5 fs? *Show your work*

(d) Calculate and compare the energy of a photon of a wavelength of 3.3 μm (micrometers) with that of a wavelength of 0.154 nm. *Show your work*

35) Use the de Broglie relationship $\lambda = \frac{h}{mv}$ to determine the wavelength of the following object:

(a) an 85-kg person skiing at 50 km/hr. *Show your work*

36) How many possible values for l and m_l are there when $n=3$?

37) For the table that follows, write which orbital goes with the quantum numbers. Don't worry about x , y , or z subscripts. If the quantum numbers are not allowed, write "not allowed"

n	L	m_l	<i>orbital</i>
2	1	-1	2p orbital (example)
1	0	0	
3	-3	2	
3	2	-2	
2	0	-1	
0	0	0	
4	2	1	
5	3	0	

38) Identify the group of elements that corresponds to each of the following generalized electron configurations and indicate the number of unpaired electrons in each

(a) [noble gas] $ns^2 np^5$

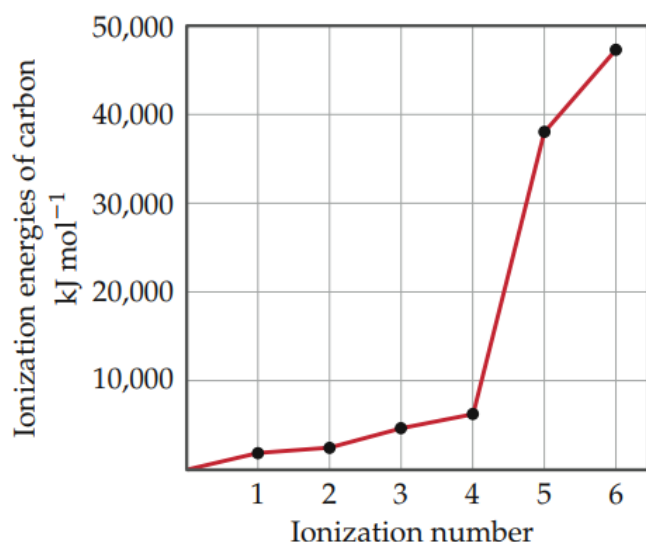
(b) [noble gas] $ns^2 (n-1)d^2$

(c) [noble gas] $ns^2 (n-1)d^{10} np^1$

39) Which will experience a greater effective nuclear charge, the electrons in the $n = 3$ shell in At or the $n = 3$ shell in Kr? Which will be closer to the nucleus? Explain.

40) How do the sizes of atoms change as we move (a) from left to right across a row in the periodic table (b) From top to bottom on the periodic table (c) arrange atoms in order of increasing atomic radius, O, Si, I, Ge.

41) Explain the variation in ionization energies of carbon, as displayed in this graph:



42) What are valence electrons?

(a) How many valence electrons does a nitrogen atom have?

(b) An atom has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^2$. How many valence electrons does the atom have?

43) Use Lewis symbols to represent the reaction that occurs between Ca and F ions.

44) Predict the chemical formula of the ionic compound formed between *Show your work*

(a) Al and F

(b) K and S

45) Using Lewis symbols and Lewis structures, draw a molecule of

(a) CCl_4 .

(b) AsO_3^{3-}

(c) XeF_4

46) Using only the periodic table as your guide, select the most electronegative atom in each of the following sets:

(a) Na, Mg

(b) P, S, As, Se

47) Which of the following bonds are polar? (a) B-F (b) Cl-Cl (c) Se-O (d) H-I

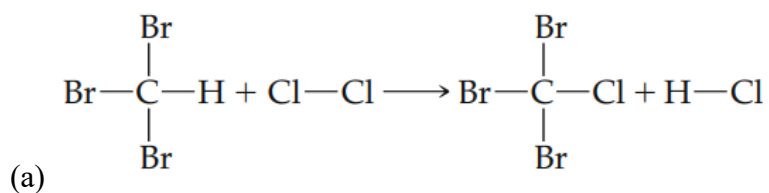
48) Describe the molecule xenon trioxide, XeO_3 , using four possible Lewis structures, each with zero, one, two or three Xe-O double bonds.

(a) Do any of these Lewis structures satisfy the octet rule?

(b) Do any of these Lewis structures have multiple resonance structures? If so, which ones?

(c) Which of the four original Lewis structures yields the most favorable formal charges for the molecule?

49) Using Table 8.4 (ancillary materials), estimate the ΔH for the following gas-phase reactions (formula: Σ bond broken – Σ bonds formed)



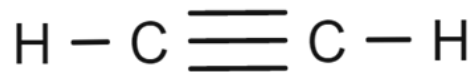
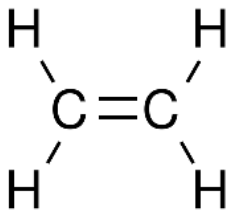
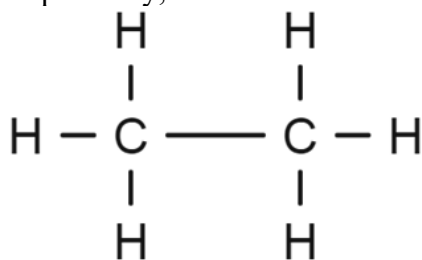
50) Use Table 9.2 & 9.3 (ancillary materials) and give the electron domain geometry and molecular geometry of the following molecules (complete the table)

Molecule	Lewis Structure	electron-domain geometry	molecular geometry
HCN			
SO ₃ ²⁻			
SF ₄			
PF ₆ ¹⁻			

51) Predict whether the following molecules are polar or nonpolar:

Molecule	Lewis Structure	Polarity
CCl ₄		
NH ₃		
SF ₄		
XeF ₄		

52) Consider the Lewis structures for ethane (C_2H_6), ethylene (C_2H_4), and acetylene (C_2H_2) as shown, respectively, below.



(a) How many sigma and pi bonds are there in each molecule?

Unit 4: Solids, Liquids & Gases

Formulas, Constants and Conversion Factors in Ancillary Materials

53) Perform the following conversions: *Show your work*

(a) 0.912 atm to torr

(b) 655 mm Hg to atm

(c) 132.3 kPa to atm

54) A fixed quantity of gas at 21°C exhibits a pressure of 752 torr and occupies a volume of 5.12 L.

(a) Calculate the volume the gas will occupy if the pressure is increased to 1.88 atm while temperature is constant. *Show your work*

(b) Calculate the volume the gas will occupy if the temperature is increased to 175°C while the pressure is held constant. *Show your work*

55) Complete the following table for an ideal gas:

P	V	n	T
2.00 atm	1.00 L	0.500 mol	
0.300 atm	0.250 L		27°C

Show your work

56) Calculate the density of sulfur hexafluoride gas at 707 torr and 21°C. *Show your work*

(b) Calculate the molar mass of a vapor that has a density of 7.135 g/L at 12°C and 743 torr. *Show your work*

57) Calcium hydride, CaH₂, reacts with water to form hydrogen gas:



(a) How many grams of CaH₂ are needed to prepare 145 L of H₂ gas if the pressure of H₂ is 825 torr and 21°C?
Show your work

58) A mixture containing 0.765 mol He(g), 0.330 mol Ne(g), and 0.110 mol of Ar(g) is confined in a 10.00-L vessel at 25°C.

(a) Calculate the partial pressure of each of the gases in the mixture. *Show your work*

(b) Calculate the total pressure of the mixture. *Show your work*

59) Place the following gases in order of increasing average molecular speed at 25°C: Ne, HBr, SO₂, NF₃, CO.

(a) Calculate the root-mean-square speed ($\mu_{\text{rms}} = \sqrt{\frac{3RT}{M}}$; M is molar mass; $R = 8.31 \text{ kg}\cdot\text{m}^2/\text{s}^2\cdot\text{mol}\cdot\text{K}$) of NF₃ molecules at 25°C. *Show your work*

60) List the three states of matter in order of

(a) increasing molecular disorder

(b) increasing intermolecular attraction

(c) Which state of matter is most easily compressed.

61) Which type of intermolecular attractions operates between

(a) all molecules

(b) polar molecules

(c) the hydrogen atom of a polar bond with a nearby, small electronegative atom?

62) Which type of intermolecular forces accounts for each of these differences

(a) CH_3OH boils at 65°C and CH_3SH boils at 6°C

(b) Xe is a liquid at atmospheric pressure and 120 K whereas Ar is a gas under the same conditions

(c) acetone boils at 56°C whereas 2-methylpropane boils at -12°C .

63) Use the vapor-pressure curves in Figure 11.25 (ancillary materials),

(a) estimate the boiling point of ethanol at a pressure of 200 torr

(b) estimate the pressure at which ethanol will boil at 60°C

64) Covalent bonding occurs in both molecular and covalent-network solids. Why do these two kinds of solids differ so greatly in their hardness and melting points?

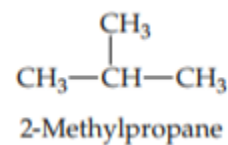
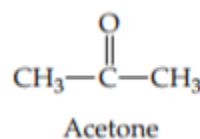
65) What kinds of attractive forces exist between particles in

(a) molecular crystals

(b) covalent-network crystals

(c) ionic crystals

(d) metallic crystals?



66) Explain how the electron-sea model accounts for the high electrical and thermal conductivity of metals.

67) Both covalent-network solids and ionic solids can have melting points well in excess of room temperature, and both can be poor conductors of electricity in their pure form. However, in other ways their properties are quite different.

(a) which type of solid is more likely to dissolve in water

(b) which type of solid can become an electrical conductor via chemical substitution?

68) In general, the attractive intermolecular forces between solvent and solute particles must be comparable or greater than solute-solute interactions for significant solubility to occur. Explain this statement in terms of the overall energetics of solution formation.

69) The solubility of $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ in water is 208 g per 100 g of water at 15°C. A solution of $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ in water at 35°C is formed by dissolving 324g in 100 g of water. When this solution is slowly cooled to 15°C, no precipitate forms

(a) what terms describes this solution?

(b) what action might you take to initiate crystallization?

70) Complete the following molarity calculations:

(a) a sulfuric acid solution contains 571.6 g per liter of solution, determine its molarity. *Show your work*

(b) calculate the number of moles of solute in 600 mL of 0.250 M SrBr_2 . *Show your work*

(c) describe how you would prepare the following aqueous solution, starting with solid KBr:
0.50 L of 1.5×10^{-2} M KBr

(d) calculate the molarity of a solution with a density of 0.876 g/mL contains 5.0 g of toluene (C_7H_8) dissolved in 225 g of benzene (C_6H_6) *Show your work*