Welcome to AP Chemistry!

First, please join the Google classroom for the AP Chemistry summer assignment using the code hvkrpcn. The syllabus and all important documents will be posted there. Once schedules are settled in late summer, I will invite you to join the Google classroom for your specific class block.

AP Chemistry is a challenging but rewarding course. The summer assignment is designed to help us make the best use of our class time. You need to refresh what you learned in Chemistry Honors so that you're ready to move forward from there. There will be a quiz on Chapters 1 and 2 and a test on Chapters 3 and 4 during the first few days of school. In addition to the required summer assignment, there is an optional pre-assignment for Chapter 5 (Gas laws). If you have a demanding schedule this fall or struggled with this unit, I recommend that you work your way through the pre-assignment for Chapter 5 this summer.

The questions on the following pages are designed to be completed as you read the textbook. You have two things to turn in for each chapter: the filled-in notes outline, and the end of chapter questions **with work shown**. The end of chapter questions are a bit more challenging, but I have chosen questions for which answers are provided in the back of the book so you can check your work. Answers to the AP Multiple Choice Review Questions are given on page 2. Two supplementary worksheets for section 4.9 are included: one for assigning oxidation numbers, and one for balancing redox reactions.

The summer assignment for the first four chapters is due on the first day of school. **Show all your work, both so you can get full credit and so I can see how well you understand the material.** For those problems that have multiple parts (ex, a-f), complete at least two parts, and do more if the first few were difficult for you.

Section	**Description**	**Done?**
Chapter 1 - Chemical Foundations	Read Chapter 1 in Zumdahl	
	Chapter 1 notes	
	Pages 34-41: 33, 35, 47, 59 (Kelvin only), 71, 77, 79, 89. AP MC Review 1-10	
Chapter 2 - Atoms, Molecules, and Ions	Read Chapter 2 in Zumdahl	
	Chapter 2 notes	
	Pages 74-80: 39, 61, 69, 77, 79, 83, 87, 97. AP MC Review 1-16	
Chapter 3 - Stoichiometry	Read Chapter 3 in Zumdahl	
	Chapter 3 notes	
	Pages 128-133: 37, 47, 65, 75, 77, 89, 99, 103, 117. AP MC Review 1-17	
Chapter 4 – Types of Chemical Reactions and Solution Stoichiometry	Read Chapter 4 in Zumdahl	
	Chapter 4 notes	
	Supplement I: Oxidation numbers	
	Supplement II: Balancing reactions	
	Pages 181-185: 29, 31, 35, 37, 67, 71, 73, 79, 85. AP MC Review 1-15	
Chapter 5 – Gases	Read Chapter 5 in Zumdahl	
	Chapter 5 notes	
	Pages 234-241: 23, 31, 37a&b, 41 (Torr only), 43, 47, 55, 59, 65, 75, 83, 85. AP MC Review 1-16	

Answers to AP Multiple Choice Review Questions

Question	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5
1	C	A	C	C	C
2	C	B	B	C	D
3	A	A	D	B	C
4	B	D	C	C	B
5	A	A	C	D	D
6	B	D	A	A	A
7	C	C	A	B	B
8	D	B	B	B	B
9	D	C	B	D	C
10	B	C	C	A	D
11		A	D	D	B
12		C	D	A	C
13		C	B	B	A
14		B	A	C	C
15		D	D	A	A
16		B	D		D
17			A		

Name ____________________________

Fill in the answers to the questions/prompts that follow as you read your textbook. The notes on Ch 1 – 4 plus the end of chapter questions are your summer assignment.

Chapter 1: Chemical Foundations

Chemistry- An Overview (1.1):

_____________ Is a molecule made up of 2 atoms. Some examples are oxygen, nitrogen, and halogens.

The Scientific Method (1.2):

Making Observations- Explain the difference between qualitative and quantitative observations.

Units of Measurement (1.3):

What are the standard units used for each of the following physical quantities?

Physical Quantity	Name of Unit	Abbreviation
Mass		
Length		
Time		
Temperature		

Uncertainty in Measurement (1.4):

What is the difference between precision and accuracy?

Significant Figures (1.5):

How many significant figures are in each of the following numbers?

7.9152 ______

0.00039 ______

0.0400 ______

5.470×10^3 ______

Do the following calculations. Be sure your answers have the correct number of significant figures:

2.45 x 5.427 = ________

0.00230 x 2.1 = ________

7.355 + 23.1 = ________

435.423 – 237.91 = ________

$(4.356 \times 10^3 + 6.2 \times 10^3) \times (3.4125 - 0.254) =$ _____________

Dimensional Analysis (1.7):
How many moles are in a 54.3 g sample of Neon? (molar mass of Neon: 20.18 g/mol)

What is the mass in grams of 7.20 moles of solid NaCl? (molar mass of NaCl: 58.44 g/mol)

Temperature (1.8):
Write the equations for converting:
Kelvin to Celsius: Celsius to Kelvin:

The boiling point of water is 100 ºC, what is that in Kelvin?

Absolute zero is 0 K, what is this in Celsius?

Density (1.9):
Density equals _________

If the density of a gas is 0.84 g/cm^3 and the gas is in a tube with a volume of 52 mL, what is the mass of the gas?

The Classification of Matter (1.10):
State the difference between atoms, elements, and molecules:

Define and give examples of the three States of Matter:
1)

2)

3)

What is the difference between a compound and a mixture?

Properties of Matter:
Explain the difference between intensive and extensive properties, and give an example of each:
Intensive:

Extensive:

Explain physical and chemical change:
Physical:

Chemical:

Is a change in the state of matter a physical or chemical change?

The Classification of Matter (1.10) continued:

Describe these techniques for separating mixtures, and the physical property on which each technique is based:

1) Distillation

2) Filtration

3) Chromatography

Chapter 2

Vocabulary matching

___Isotopes	a) Atoms of the same element that differ in mass number.
___Atomic number	b) Negatively charged particles, first subatomic particles discovered
___Mass number	c) Smallest particle of an element that retains the element's chemical identity
___Nuclide	d) Neutrally charged particle, found in the nucleus in an atom
___Proton	e) Number of protons in an atom
___Neutron	f) Electrically neutral, containing both cations and anions, usually contain metallic and nonmetallic elements
___Electron	g) Positively charged particles found in the nucleus
___Atom	h) The total of protons plus neutrons in an atom
__Ionic compound	i) A nucleus of a specific isotope of an element

2.3

___________________________ states that equal volumes of different gases at the same temperature and pressure contain the same number of particles .

2.5

_____________ positively charged particle in the nucleus

_____________ negatively charged particle outside the nucleus

_____________ atoms with the same number of protons but different numbers of neutrons

2.7

_____________ Are located on the left side and middle of the periodic table

_____________ Are elements in a column that have similar properties.

_____________ Fall in-between metals and nonmetals and have properties of both.

2.8

______________ are formed between metals and nonmetals

______________ are generally formed between nonmetals only

Naming & Formulas (2.8) – The following are examples. You do not need to memorize all of the names for polyatomic ions, but you do need to **understand** the **logic** of the naming rules.

Formulas of Ions:	**Names of Ions:**
NH_4^+	
H_3O^+	
SO_4^{2-}	
	Perchlorate ion
	Nitrate ion
	Carbonate ion

Ionic compounds: learn predictable (no roman numeral needed) vs unpredictable rules

Formula	**Name**
$Cu(ClO_4)_2$	
$CaCl_2$	
	Iron (II) sulfate
Cu_2SO_4	
	Aluminum Hydroxide

Molecular compounds (Greek prefixes):

Formula:	**Name:**
	Dinitrogen tetroxide
	Tetraphosphorus decasulfide
SO_2	
CO	
H_2O	

Chapter 3: Stoichiometry

Terms and Concepts

- Counting by Weighing
- Atomic Masses
- Mole = Avogadro's number = 6.02×10^{23}
- Determining molar mass
- Calculating percentage composition by mass:

$$\% \text{ element by mass} = \frac{(\text{number of atoms})(\text{atomic weight of element})}{\text{Formula weight of compound}} \times 100\%$$

- Determining empirical formulas
- Understanding quantitative information in balanced equations (how many moles or grams produced)
- Chemical Equations
- Balancing Chemical Equations
- Law of conservation of mass
- Identifying types of reactions: combustion, decomposition, combination
- Limiting reagents
- Calculating theoretical and percent yield.

Atomic Masses (3.2)

______________ are usually mixtures of isotopes; the _________________ represents a weighted average value.

Calculate the formula weight in grams to the nearest tenth decimal. Show your work! **(3.3)**

1) KH ____________

2) Glucose ($C_6H_{12}O_6$) ____________

3) Baking Soda ($NaHCO_3$) ____________

4) NH_3 ____________

5) $NaC_3H_5O_3$ ____________

Calculate the number of moles or mass using significant digit rules. **(3.4)**

1) 5.9 g of H_2 ______ moles

2) 24.8 g of CO_2 ______ moles

3) 0.1245 moles of water ______ grams

Percent Composition of Compounds (3.6 – 3.7)

__Molecular formula

a. Chemical formula that indicates the actual numbers and types of atoms in a molecule

___Empirical formula

b. This formula gives the relative numbers of each type of atom in a molecule

Percent Composition of Compounds (3.6 – 3.7) Continued
Calculate the percentage composition to the appropriate number of significant digits. **(3.6)**

1) $KMnO_4$ K = _____, Mn = ______, O = _____

2) N_2O_5 N = _____, O = _______

Determine the empirical formula. Show your work! **(3.7)**

1) 32.13% aluminum; 67.87% fluorine ______

2) Na 29.1 %, S 40.5% and O 30.4% ______

3) K 42.4%, Fe 15.2%, C 19.5% and N 22.8% ______

Balance the following equations. **(3.9)**

1) __ Na + __ $Cl_2 \rightarrow$ __ NaCl

2) __ $(NH_4)_3PO_4$ + __ $Pb(NO_3)_4 \rightarrow$ __ $Pb_3(PO_4)_4$ + __ NH_4NO_3

3) __ MnO_2 + __ $ClO_3^- \rightarrow$ __ MnO_4^- + __ Cl_2

4) __ HCl + $Na_2CO_3 \rightarrow$ __NaCl + __CO_2 + __H_2O

Determine the numbers of moles or grams of the product produced in the reaction **(3.10)**

$2C_4H_{10} + 9O_2 \rightarrow 4CO_2 + 10H_2O$

1) If 2.5 moles of C_4H_{10} are burned in excess oxygen, how many moles of water are produced?

2) How many moles of carbon dioxide are formed if 4.0 moles of C_4H_{10} are burned in excess oxygen?

3) If 3.0 moles of carbon dioxide were formed, how many grams of butane were burned?

Calculate the number of moles or grams of the product produced in a limiting reactant reaction. **(3.11)**

$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

1) If you have 10.0 g of $Mg(OH)_2$ and 45.0 g of HCl, how many moles of $MgCl_2$ will be produced?

2) How many grams of HCl will remain?

3) How many grams of $Mg(OH)_2$ is needed to react completely with 20.0 g of HCl?

Determine the percent yield. **(3.11)**

1) A student adds 200.0 g of $C_7H_6O_3$ (molar mass 138.12 g) to an excess of $C_4H_6O_3$. The products are $C_9H_8O_4$ (molar mass 180.15 g) and $C_2H_4O_2$. Calculate the percent yield if 231 g of aspirin ($C_9H_8O_4$) is produced.

2) Calculate the percent yield if 550.0 g of C_7H_8 (molar mass 92.13 g) is added to an excess of nitric acid and 305 g of $C_7H_7NO_2$ (molar mass 137.14 g) is formed.

3) Calculate the percent yield if 384 grams of $S_6(s)$ (molar mass 192.42 g) is reacted with excess oxygen and 680 grams of sulfur dioxide (molar mass 64.07 g) is produced.

Chapter 4: Types of Chemical Reactions and Solution Stoichiometry

Vocabulary – Do a mental check of your understanding of the following words, look them up in your book's glossary, and write the definitions for any words you did not correctly define.

Aqueous solution-

Solvent-

Solute-

Chemical Equilibrium-

Spectator Ions-

Acids-

Bases-

Neutralization-

Oxidation-reduction-

Equivalence Point-

Indicators-

4.2 – General Properties of Aqueous Solutions

___________ (Strong/weak/non) electrolytes are solutes that exist in solution completely (or nearly) as ions.
Examples:

___________ (Strong/weak/non) electrolytes are solutes that exist in solution as molecules.
Examples:

___________ (Strong/weak/non) electrolytes are solutes that exist in solution mostly as molecules.
Examples:

_____________________ (Ionic/covalent) compounds are strong electrolytes.

List the Seven Strong Acids – all strong electrolytes

List at least four Weak Acids – weak electrolytes

List at least four Strong Bases – strong electrolytes

List at least four Weak Bases – weak electrolytes

4.3 The Composition of Solutions

What is molarity?

Why do we dilute solutions?

If you have 300mL of 1.00M acetic acid, how much water would you need to add to make it a 0.300M solution?

If 4.60 g of sodium sulfate is dissolved in enough water to make 0.250L of solution, what is the concentration (molarity) in terms of sodium sulfate? What is the concentration of sodium ions?

Label each reaction as a combination reaction, decomposition reaction, or combustion reaction. Note that some reactions fall into more than one category. **(4.4)**

1) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ ______________________

2) $H_2SO_3 \rightarrow H_2O + SO_2$ ______________________

3) $NH_4OH \rightarrow NH_3 + H_2O$ ______________________

4) $2CO + O_2 \rightarrow 2CO_2$ ______________________

5) $CaO + H_2O \rightarrow Ca(OH)_2$ ______________________

6) $C_{10}H_8 + 12O_2 \rightarrow 10CO_2 + 4H_2O$ ______________________

7) $8Fe + S_8 \rightarrow 8FeS$ ______________________

8) $2H_2O \rightarrow 2H_2 + O_2$ ______________________

4.5 Precipitation Reactions

The following four ions are always soluble. Write out what the ions are, and become familiar with this list.

Sodium Potassium Ammonium Nitrate

4.6 Describing Reactions in Solution

Write the molecular (formula) equation, complete ionic equation and the net ionic equation for the reaction between aqueous solutions of magnesium nitrate and sodium hydroxide. $Mg(OH)_2$ forms a precipitate.

Molecular:

Complete ionic:

Net ionic:

What are the spectator ions?

4.7 Stoichiometry of Solutions

How many grams of sodium sulfate are needed to precipitate out the barium ion from 35mL of a 0.030M Barium hydroxide solution? Start by writing the reaction.

How much barium sulfate will be produced?

4.8 Acid-Base Reactions

What is the purpose of a titration? A titration can tell you…

What is the difference between an endpoint and an equivalence point?

How many milliliters of 0.113 M HCl are needed to neutralize 75 mL of 0.210 M $Ba(OH)_2$ solution?

If 56.7 mL of 0.107 M HCl is needed to neutralize a solution of $Ca(OH)_2$, how many grams of $Ca(OH)_2$ are in this solution?

4.9 Oxidation-Reduction Reactions

What is the oxidation number of sulfur in sodium thiosulfate, $Na_2S_2O_3$?

What are the oxidation numbers, and what is the process (oxidation or reduction) when $Cl_2 \rightarrow 2Cl^-$

Supplement I for Section 4.9: ASSIGNING OXIDATION NUMBERS

Oxidation numbers are the means by which we keep track of electrons as they are exchanged in redox (reduction/oxidation) reactions. Not that covalent compounds are made of ions, but by pretending that they are we are able to figure out which species are being oxidized (losing electrons) and which are being reduced (gaining electrons) in a redox reaction. Oxidation numbers are assigned according to the following rules:

Oxidation Number Rules:

1. The oxidation number of any pure element is 0.
2. The oxidation number of a monatomic ion equals that charge on the ion.
3. The oxidation number of fluorine in a compound is always –1.
4. Oxygen has an oxidation number of –2 unless it is combined with F, in which it is +1 or +2, or it is in peroxide (such as H_2O_2 or Na_2O_2), in which it is –1.
5. Hydrogen is +1, unless combined with a metal, and then it is –1.
6. In compounds, Group 1 is +1, Group 2 is +2, and Aluminum is +3.
7. The sum of the oxidation numbers of all atoms in a neutral compound is 0.
8. The sum of the oxidation numbers in a polyatomic ion equals the charge of the ion.

Notice that these rules should make sense to you in terms of the periodic table, the number of valence electrons, and electronegativities!

Give the oxidation number of the indicated atoms/ion:

1) N in N_2O_3 ________

16) C in CH_4 ________

17) Mn in MnO_2 ________

2) S in H_2SO_4 ________

3) C ________

4) C in CO ________

5) Na in NaCl ________

6) H in H_2O ________

7) Ba in $BaCl_2$ ________

8) N in NO_2^- ________

9) S in Al_2S_3 ________

10) S in HSO_4^- ________

11) Cl in $Fe(ClO_2)_3$ ________

12) Fe in $Fe(ClO_2)_3$ ________

13) N in NO_3^- ________

14) C in $C_2O_4^{2-}$ ________

18) S in SO_3^{2-} ________

19) Mg^{2+} ________

20) Cl^- ________

21) O_2 ________

22) P_4 ________

23) Na in Na_2S ________

24) S in H_2S ________

25) Ca^{2+} ________

26) C in CN^- ________

27) H in OH^- ________

28) Mn in $KMnO_4$ ________

29) I in $Mg(IO_3)_2$ ________

Supplement II for Section 4.9: Balancing Redox Reactions (Half-equation method)

Simple redox reactions can be balanced using the oxidation state method outlined in Section 4.9, but I think it's easier to master the half-equation method outlined in Section 18.1. It ALWAYS works. The half-equation method separates the oxidation and reduction of a redox reaction in half reactions.

Step 1: Split reaction into half-reactions (reduction and oxidation)

Step 2: Balance the elements in each half-reaction

Step 3: Balance each half-reaction for charge by adding electrons

Step 4: Multiply the half reactions by some integer to make electrons (lost) = electrons (gained)

Step 5: Add half equations and cancel substances on both sides

Step 6: <u>Check</u> atom balance and charge balance on both sides of the equation!!!!

Complete and balance the following redox reactions using the half-equation method. Label each half-reaction as either reduction or oxidation. The first is done for you as an example.

1) **$Zn(s) + H^+(aq) \rightarrow Zn^{2+} + H_2(g)$**

$Zn \rightarrow Zn^{2+} + 2e-$	oxidation
$2H^+ + 2e- \rightarrow H_2$	reduction
$Zn + 2H^+ \rightarrow H_2 + Zn^{2+}$	overall

2) **$P_4(s) + O_2(g) \rightarrow P_4O_{10}(s)$**

____________________	____________________
____________________	____________________
____________________	overall

3) **$Cu(s) + Ag^+(aq) \rightarrow Cu^{2+}(aq) + Ag(s)$**

____________________	____________________
____________________	____________________
____________________	overall

4) **$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$**

____________________	____________________
____________________	____________________
____________________	overall

<u>Chapter 5 Gases Pre-assignment</u> **Name____________________**

I. Definitions:

Term	Definition/Equation
Pressure	
Barometer	
Manometer	
Atmosphere	
Torr	
mm Hg	
STP	
Boyle's Law	
Charles's Law	
Avogadro's Law	
Ideal Gas Law	
Dalton's Law of Partial Pressures	
Mole fraction	
Kinetic Molecular Theory	
Joule	
van der Waals equation	

II. <u>Calculations and Questions: Use your rules for significant digits!!</u>

1) 5.1: 760 Torr = ________ atm = ________ mm Hg

2) 5.2: As pressure increases, volume (increases/decreases)

3) 5.2: As temperature decreases, volume (increases/decreases)

4) 5.2: As the number of moles of a gas increase, volume (increases/decreases)

5) 5.4: Given the following sets of values, calculate the unknown quantity:

a) P = 1.01 atm, n = 0.00831 mol, T = 25°C, V = ?

b) V= 0.602 L, n = 0.00801 mol, T = 311 K, P = ?

c) At what temperature would 2.10 moles of N_2 gas have a pressure of 1.25 atm in a 25.0 L tank?

6) Propane is burned in excess oxygen.

a) Write the balanced equation for this reaction.

b) If a container has a volume of 57 L and is filled with propane at a pressure of 2.03 atm at a temperature of 32°C, how many moles of CO_2 are generated when the propane is burned?

7) What is the total pressure of a mixture of 6.00 g oxygen and 2.00 g nitrogen at 273K in an 8.0L vessel?

8) 5.5: What is the mole fraction of each component in a solution in which 3.57 g of oxygen is dissolved in 25.0 g of carbon dioxide?

III. <u>Collecting Gases over water (p. 213)</u>

- $P_{total} = P_{gas} + P_{H2O}$
- Fill a eudiometer tube or graduate with water and invert it under the water so that the entire tube stays filled with water when it is held upright. The gas you are collecting is bubbled into the test tube and the gas displaces the water.
- For video example, see http://www.kentchemistry.com/moviesfiles/Units/GasLaws/gasoverwater.htm

a) Write the equation for magnesium reacting with HCl in a single replacement reaction.

b) If 35.0 mL of H_2 gas are collected over water when the temperature is 293K, the external pressure is 758 Torr and the vapor pressure of water at that temperature is 20 Torr, how many moles of H_2 were generated?

c) How many grams of Mg were used in the reaction?