White Station High School
AP Chemistry **Summer Assignment**: 2020/2021
Teacher: George Richardson

Each student is expected to perform the following **Five** tasks during the summer.

1) **Access the ONLINE** copy of the text book. ***Chemistry, 8th ed***. **Zumdahl, S**., Houghton Mifflin Co, 2008. ISBN#: 978-0-547-12532-9 *(Note: This is the Advanced Placement Student edition)* This file is an ONLINE version of the text, and can be found at the following link: https://drive.google.com/file/d/0B73r_GOwSAbkT1Mzb05WN1oxWXM/view?usp=sharing

2) **Create** a "**double entry**" summary or study guide for the following four chapters, (For you special students, that is **Chapter #5, #14, #19 & #22**.)
The Summary should include an outline of the chapter (left hand side of the double entry journal) **and** short sentence or phrase for each significant concept, equation, person, etc… (on the right hand side of the double entry journal) *See an example on the following page* *(Time: 3 – 5 hours)*

3) **Study** (**chapter 5**) **Gas Law**: Know the three fundamental laws: Charles, Boyles, and Avogadro. Know the combined gas law, ideal gas law, gas stoichiometry, Dalton's Partial Pressures, Kinetic Molecular Theory of gases, Effusion, Diffusion, and Deviation from ideal gas law behavior (i.e. Real Gases). **Complete** the attached GAS LAW Problem Work Sheet *(Time: 3 – 4 hours)*

4) **Study** **(chapter 14) Acids and Bases:** Know the three definitions of acids/bases. Know what pH, pOH, pK_a, pK_b, pK_w are, and how they are calculated. Know what H^+ and $[H^+]$ represent. Know what an acid/base reaction is, and what the products are. Know what an end point, neutralization point, equilibrium point. Complete the attached Acid Base *(Time: 3 – 4 hours)*

5) **There are three MAJOR concepts in first year (freshmen) chemistry. They are le Chatelier's principle, Intermolecular forces (IMF's), and Coulumb's force of attraction,** $F = k\frac{q_1 q_2}{r^2}$
I want a 2 to 3 page paper for each of these three concepts. We will use these concepts throughout the year, they will be on the AP Exam, and you cannot be successful in AP Chemistry if you do not have a strong understanding of these three concepts. Each should be 2 to 3 pages, double spaced typed, **plus** cover page & reference page. The papers should be informative, interesting, and entertaining to read. (proper MLA/APA citations are expected.) *(Time: 1 – 2 hours)*

6) **Oh, Know the names/symbols and charges of the polyatomic ions!**

Each task will be graded:
- *a) Obtain a text book: (50 point Home Work grade)*
- *b) Double Entry Journal (50 point EXAM grade)*
- *c) Quiz on Gas laws (50 point Quiz grade)*
- *d) Three short papers, and presentation (50 point LAB grade).*
- *e) Acid Base Practice Problems (50 point Home Work grade)*

Double Entry Journal and Short papers are due the first days of class. Note: I will **NOT** accept **ANY** late work for *full credit*.

My goal is to spend a bare minimum of time reviewing the basics and stuff you should already know and get through "gas law's" which are relatively easy. I want to move through the first part of the book rapidly. Your journal for the chapters will facilitate this process. *ALSO: Refer to my Web Site for additional information: www.wshsAPChemistry.com*

I look forward to an exciting 2020/2021 AP Chemistry class! Thank you.

Here is an example of a double entry journal ***(Note: the content on left - matches up with the comments on the right.)***

Zumdahl, 8th ed.

Chapter 15: Application of Acid/Base Equilibrium

1. Solutions – common ions - - - - - - - - - - - - >
2.
    a. Common ions - - - - - - - - - >
    b. Common ion effect
    c. Equilibrium concentrations
3. Buffer solutions
    a. Definition – A solution that resists a change in the pH.
4. Buffer capacity
5. Titration and titration curves

ETC…….

This is a continuation of acid/base chapter, adding a new demotion of common ions and more complex applications of the ICE box method.

Common ion is an ions (ions are charged species) that is present in two different disassociation reactions within the same solution. Example: a weak acid only partially dissociates, into "ions", thus there is un-dissolved acid AND H+ and conjugate base ions in solution. A second reaction adds a common ion (likely the conjugate base ion) Thus the equilibrium is shifted.

An application of the "Le Chatelier" principle where the equilibrium concentrations are shifted to release "strain".

Using the ICE box methods used for weak acids/bases (Chapter 14) determine the equilibrium concentrations with the addition of "common" ions. Thus, the starting concentrations of the "products" will not necessarily start as zero.

ETC……

Oh, you should know these!!!

Symbols and Charges for Polyatomic Ions

Formula	Name
1+	
NH_4^+	Ammonium
1-	
$C_2H_3O_2^-$	Acetate * CH_3COO^-
NH_2^-	Amide
BrO_3^-	Bromate
BrO_2^-	Bromite
BrO^-	Hypobromite
ClO_4^-	Perchlorate
ClO_3^-	Chlorate
ClO_2^-	Chlorite
ClO^-	Hypochlorite
CN^-	Cyanide
$H_2PO_4^-$	Dihydrogen phosphate
HCO_3^-	Hydrogen carbonate (bicarbonate)
$HC_2O_4^-$	Hydrogen oxalate (binoxalate)
HSO_4^-	Hydrogen sulfate (bisulfate)
HS^-	Hydrogen sulfide
HSO_3^-	Hydrogen sulfite (bisulfite)
OH^-	Hydroxide
IO_4^-	Periodate
IO_3^-	Iodate
IO_2^-	Iodite
IO^-	Hypoiodite
NO_3^-	Nitrate
NO_2^-	Nitrite
MnO_4^-	Permanganate

Formula	Name
2-	
CrO_4^{2-}	Chromate
CO_3^{2-}	Carbonate
$Cr_2O_7^{2-}$	Dichromate
SiF_6^{2-}	Hexafluorosilicate
HPO_4^{2-}	Hydrogen phosphate
$C_2O_4^{2-}$	Oxalate
O_2^{2-}	Peroxide
SeO_4^{2-}	Selenate
SiO_3^{2-}	Silicate
SO_4^{2-}	Sulfate
SO_3^{2-}	Sulfite
$C_4H_4O_6^{2-}$	Tartrate
$B_4O_7^{2-}$	Tetraborate
$S_2O_3^{2-}$	Thiosulfate
3-	
AsO_4^{3-}	Arsenate
BO_3^{3-}	Borate
PO_4^{3-}	Phosphate
PO_3^{3-}	Phosphite
$C_6H_5O_7^{3-}$	Citrate
4-	
SiO_4^{4-}	Orthosilicate
$P_4O_7^{4-}$	Pyrophosphate

* An alternate way to write acetate is CH_3COO^-

Note: Writing just the plus sign or minus sign for ions with 1^+ or 1^- charges are acceptable.

PREFIXES USED FOR NAMING COVALENT COMPOUNDS:

mono	= 1	tetra	= 4	hepta	= 7	deca	= 10	Anion	Acid
di	= 2	penta	= 5	octa	= 8			ate	ic acid
tri	= 3	hexa	= 6	nona	= 9			ite	ous acid
								ide	hydro- ic acid

Oh, you should know these too!!

Symbols and Charges for Monatomic Ions

Fixed Charge

SYMBOL	NAME
	1+
H^+	Hydrogen
Li^+	Lithium
Na^+	Sodium
K^+	Potassium
Rb^+	Rubidium
Cs^+	Cesium
Ag^+	Silver
2+	
Be^{2+}	Beryllium
Mg^{2+}	Magnesium
Ca^{2+}	Calcium
Cd^{2+}	Cadmium
Sr^{2+}	Strontium
Ba^{2+}	Barium
Zn^{2+}	Zinc
3+	
Al^{3+}	Aluminum
Bi^{3+}	Bismuth
La^{3+}	Lanthanum

SYMBOL	NAME
	1-
H^-	Hydride
F^-	Fluoride
Cl^-	Chloride
Br^-	Bromide
I^-	Iodide
	2-
O^{2-}	Oxide
S^{2-}	Sulfide
Se^{2-}	Selenide
Te^{2-}	Telluride
	3-
N^{3-}	Nitride
P^{3-}	Phosphide
As^{3-}	Arsenide
	4-
C^{4-}	Carbide

Note that the letters in an ion's name before the **-ide** ending is the stem.
For example, the stem for bromide is **brom-**.

Symbols and Charges for Monatomic Ions

Variable Charge

Symbol	Systematic name		Symbol	Systematic name	
	(Stock system)	Common name		(Stock system)	Common name
Cr^{2+}	Chromium (II)	Chromous	Pb^{4+}	Lead (IV)	Plumbic
Cr^{3+}	Chromium (III)	Chromic	Mn^{2+}	Manganese (II)	Manganous
Co^{2+}	Cobalt (II)	Cobaltous	Mn^{3+}	Manganese (III)	Manganic
Co^{3+}	Cobalt (III)	Cobaltic	Hg_2^{2+}	Mercury (I)	Mercurous
Cu^+	Copper (I)	Cuprous	Hg^{2+}	Mercury (II)	Mercuric
Cu^{2+}	Copper (II)	Cupric	Ni^{2+}	Nickel (II)	Nickelous
Fe^{2+}	Iron (II)	Ferrous	Ni^{3+}	Nickel (III)	Nickelic
Fe^{3+}	Iron (III)	Ferric	Sn^{2+}	Tin (II)	Stannous
Au^+	Gold (I)	Aurous	Sn^{4+}	Tin (IV)	Stannic
Au^{3+}	Gold (III)	Auric	V^{2+}	Vanadium (II)	Vanadous
Pb^{2+}	Lead (II)	Plumbous	V^{3+}	Vanadium (III)	Vanadic

AP Chemistry Summer Work – GAS LAW Problems

Name:_____ Date Submitted:_____

Period:____

(Note: You must show ALL WORK and justifications of your answer.)

1. On a hot sunny day in August, the weatherman reports that the barometric pressure is 36 atm (atmospheres). How many Pascals is this? Answer in units of Pascals

2. Suppose that a sample of gas occupies 83 mL of volume at 25ºC and a pressure of 242 torr. What would be the volume if the pressure were changed to 502 torr at 25°C? Answer in units of mL

3. A 1.50 liter tank filled with helium at 125 atm is used to fill balloons. The pressure in each balloon is 950 torr and the volume of each balloon is 1.20 liters. How many balloons can be filled? Answer in units of balloons

4. To what temperature must a sample of helium gas be cooled from 130ºC to reduce its volume from 3.2 L to 0.48 L at constant pressure? Answer in units of K

5. A sample of gas occupies 5 mL at STP. At what pressure would this sample occupy 500 mL if the temperature is changed to 525°C? Answer in units of torr.

6. What is the density of hydrogen sulfide (H_2S) at 1.7 atm and 277 K? Answer in units of g/L

7. A 115 mg sample of eugenol, the compound responsible for the odor of cloves, was placed in an evacuated flask with a volume of 500 mL at 280ºC. After the eugenol completely evaporated, the pressure that it exerted in the flask under those conditions was found to be 48.3 Torr. In a combustion experiment, 18.8 mg of eugenol burned to give 50.4 mg of carbon dioxide and 12.4 mg of water. What is the molecular formula of eugenol?

8. Nitroglycerin is a shock-sensitive liquid that detonates by the reaction:
$4\ C_3H_5(NO_3)_3(\ell) \longrightarrow 6\,N_2(g) + 10\,H_2O(g) + 12\,CO_2(g) + O_2(g)$ Calculate the total volume of product gases at 230 kPa and 273ºC from the detonation of 2.3 lb (1043.3 g) of nitroglycerin. Answer in units of L

9. An oxygen sample has a volume of 3.5 L at 27°C and 900 torr. How many oxygen molecules does it contain?

10. What pressure would a mixture of 3.2 grams of O_2, 6.4 grams CH_4, and 6.4 grams of SO_2 exert if the gases were placed in a 4.2 liter container at 127ºC? Answer in units of atm

11. Jeff and Jill go canoeing. While reaching to feed a duck, the boat flips. Jeff and Jill blow up their inflatable life preservers and then put them on. As they wait for the rescue squad, they calculate how much nitrogen is in each life preserver. They estimate that the volume is 14 L, pressurized to 1.4 atm at 25ºC. The air used for inflation is 80% nitrogen by volume and 20% oxygen by volume. Give the amount of nitrogen gas. Answer in units of gram

12. We mix 119 grams of oxygen gas with 176 grams of argon gas in a volume of 520 mL at 116°C. What will be the final pressure of the gas mixture? Answer in units of atm

13. A 8.4 gram sample of a gaseous substance occupies 16 L at 24°C and 596 torr. What is the density of the gas under these conditions? Answer in units of g/L

14. We observe that 8 grams of a gaseous compound occupies 2099 mL at 52°C and 693 torr. What is the molecular weight of the compound? Answer in units of g/mol

15. Iron pyrite (FeS_2) is the form in which much of the sulfur exists in coal. In the combustion of coal, oxygen reacts with iron pyrite to produce iron (III) oxide and sulfur dioxide, which is a major source of air pollution and a substantial contributor to acid rain. What mass of Fe_2O_3 is produced from 84 L of oxygen at 3.41 atm and 148°C with an excess of iron pyrite? Answer in units of g

16. We drop 36.1 grams of magnesium into 474 mL of a 4 M HCl solution. What is the maximum volume of dry hydrogen that could be produced by this reaction at STP? $Mg(s) + 2HCl(aq) \rightleftharpoons MgCl_2(aq) + H_2(g)$ Answer in units of liters

17. An apparatus consists of a 2 L flask containing nitrogen gas at 27°C and 709 kPa, joined by a valve to a 7 L flask containing argon gas at 27°C and 42.9 kPa. The valve is opened and the gases mix. What is the partial pressure of nitrogen after mixing? Answer in units of kPa

18. What is the partial pressure of argon after mixing? Answer in units of kPa

19. What is the total pressure of the gas mixture? Answer in units of kPa

20. A 322 mL sample of nitrogen (N_2) was collected by displacement of water at 24°C under a total barometric pressure of 573 torr. What mass of dry nitrogen was collected? The vapor pressure of water at 24°C is 22 torr. Answer in units of g

21. The rate of effusion of unknown gas X is found to be about 1.7 times that of SF_6 gas (MW = 146 g/mol) at the same conditions of temperature and pressure. What is the molecular weight of gas X? Answer in units of g/mol

Summer Work - AP Chemistry - Richardson Name _____

Period: _____ Date ___/___/___

Acid-Base Problems

PRACTICE TEST .

NOTE: If you want credit, you MUST SHOW ALL your work. All calculations, all equations used, etc, ete. If you skip steps, don't write down your work, if I can SEE your solutions, you get NO credit. Lets start this year knowing, you must show work to get credit! (it's not the answer, it's the process that is graded)

1. What is the $[H^+]$ when $[OH^-] = 8.1 \times 10^{-5}$?

2. What is the $[H^+]$ when $[OH^-] = 3.3 \times 10^{-9}$?

3. What is the $[H^+]$ in a 0.0025 M HCl solution?
   a) 1.0×10^{-7} M
   b) 4.0×10^{-12} M
   c) 2.5×10^{-3} M
   d) 3.6×10^{-5} M
   e) need more info

4. What is the $[OH^-]$ in a 0.0050 M HCl solution?

5. A solution in which $[H^+] = 10^{-8}$ has a pH of ___ and is _____.
   a) 8, acidic
   b) 6, basic
   c) -6, basic
   d) -8, neutral
   e) 8, basic

6. What is the pH of a 0.00030 M HNO_3 solution?

7. What is the pH of a 0.0060 M KOH solution?

8. A sample of lemon juice is found to have a pH of 2.55. What is the H^+ concentration of the juice?

9. A sample of milk is found to have a pH of 6.60. What is the OH^- concentration of the milk?

10. What is the concentration of OCl^- in a 0.60 M solution of HOCl? $K_a = 3.1 \times 10^{-8}$.

11. What is the pH of a 0.020 M solution of hydrosulfuric acid, a diprotic acid? $K_{a1} = 1.1 \times 10^{-7}$ $K_{a2} = 1.0 \times 10^{-14}$

12. What is the concentration of CO_3^{2-} in a 0.010 M solution of carbonic acid? The relevant equilbria are,
    $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$ $K_{a1} = 4.3 \times 10^{-7}$
    $HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$ $K_{a2} = 5.6 \times 10^{-11}$

13. What is the S^{2-} concentration in a saturated solution (0.10 M) of H_2S, in which the pH has been adjusted to 6.00 by the addition of HCl? For H_2S, $K_{a1} = 1.1 \times 10^{-7}$ and $K_{a2} = 1.0 \times 10^{-14}$.

14. Which of the following salts will result in a basic solution when it is dissolved in water?
    a) KCl
    b) NH_4I
    c) NaCN
    d) $MgBr_2$
    e) none of these

15. What is the pH of a 0.50 M solution of $NaNO_2$? For HNO_2, $K_a = 4.5 \times 10^{-4}$.

16. What is the pH of a 1.0 M solution of NaOCl? For HOCl, $K_a = 3.1 \times 10^{-8}$.

17. Name the three definitions of an acid/base.
    i)
    ii)
    iii)

18. Define the three definitions of acids/bases listed above.
    i)
    ii)
    iii)

19. Is an acid sour or bitter? Explain why.

20. A freshly made sample of distilled water was collected in a cup and the measured pH was 7.00. Several hours later, the sample was again tested but the pH was now 6.40. How can this be possible? Give a reasonable explanations.

21. Your blood has a pH of 7.4. You decide to go on a orange juice beige and drink 3 gallon of juice a day for 3 weeks. (Note: orange juice is acidic, pH ~ 3.0) Your blood does not change pH? How does your body deal with all this added acid without affecting the pH?

22. How does a chameleon change colors? Explain?

23. If I dissolve sodium chloride in water, the pH of the water will still be ~7.00. If I dissolve calcium chloride in water, the pH will be acidic (below 7.00). Explain why?

24. List the 6 strong acids and 3 strong bases. (give their chemical symbols and names).

Hmm, This looks like EXTRA CREDIT work. Perhaps replace a quiz grade??

AP Chemistry - Summer Work: 2020-21 Limiting Reagent Problems

Name:_____ Date Submitted:_____ Period: _____

Note: You must show ALL WORK, and justify (prove) every answer. ie. T-Charts!

1. 15.00 g aluminum sulfide and 10.00 g water react until the limiting reagent is used up. Here is the balanced equation for the reaction: $Al_2S_3 + 6\ H_2O$ ----------> $2Al(OH)_3 + 3\ H_2S$

(A) Which is the limiting reagent?

(B) What is the maximum mass of H_2S which can be formed from these reagents?

(C) How much excess reagent remains after the reaction is complete?

2. Here's a nice limiting reagent problem we will use for discussion. Consider the reaction:

$2\ Al + 3\ I_2$ ------> $2\ AlI_3$

Determine the limiting reagent and the theoretical yield of the product if one starts with:

a) 1.20 g Al and/or 2.40 g Iodine b) How many grams of Al are left over in part a?

3. Given the following equation: $2\ C_4H_{10} + 13\ O_2$ ---> $8\ CO_2 + 10\ H_2O$, show what the following molar ratios should be.

a. C_4H_{10} / O_2

b. O_2 / CO_2

c. O_2 / H_2O

d. C_4H_{10} / CO_2

e. C_4H_{10} / H_2O

4. Given the following equation: $2\ KClO_3$ ---> $2\ KCl + 3\ O_2$

How many moles of O_2 can be produced by letting 12.00 moles of $KClO_3$ react?

5. Given the following equation: $2\ K + Cl_2$ ---> $2\ KCl$

How many grams of KCl is produced from 2.50 g of K and excess Cl_2. From 1.00 g of Cl_2 and excess K?

6. Given the following equation: $Na_2O + H_2O$ ---> $2\ NaOH$

How many grams of NaOH is produced from 1.20 x 10_2 grams of Na_2O? How many grams of Na_2O are required to produce 1.60 x 10_2 grams of NaOH?

7. Given the following equation: $8\ Fe + S_8$ ---> $8\ FeS$

What mass of iron is needed to react with 16.0 grams of sulfur? How many grams of FeS are produced?

8. Given the following equation: $2\ NaClO_3$ ---> $2\ NaCl + 3\ O_2$

12.00 moles of $NaClO_3$ will produce how many grams of O_2? How many grams of NaCl are produced when 80.0 grams of O_2 are produced?

9. Given the following equation: $Cu + 2\ AgNO_3$ ---> $Cu(NO_3)_2 + 2\ Ag$

How many moles of Cu are needed to react with 3.50 moles of $AgNO_3$? If 89.5 grams of Ag were produced, how many grams of Cu reacted?

10. Molten iron and carbon monoxide are produced in a blast furnace by the reaction of iron(III) oxide and coke (pure carbon). If 25.0 kilograms of pure Fe_2O_3 is used, how many kilograms of iron can be produced? The reaction is: $Fe_2O_3 + 3\ C$ ---> $2\ Fe + 3\ CO$

11. The average human requires 120.0 grams of glucose ($C_6H_{12}O_6$) per day. How many grams of CO_2 (in the photosynthesis reaction) are required for this amount of glucose? The photosynthetic reaction is:

$6\ CO_2 + 6\ H_2O \text{ ---> } C_6H_{12}O_6 + 6\ O_2$

12. Given the reaction: $4\ NH_3\ (g) + 5\ O_2\ (g) \text{ ---> } 4\ NO\ (g) + 6\ H_2O\ (l)$
When 1.20 mole of ammonia reacts, the total number of moles of products formed is:

a. 1.20 b. 1.50 c. 1.80 d. 3.00 e. 12.0 AND Explain why?

13. Determine moles of Na_2S that can be prepared by the reaction of 0.2240 moles of sodium with 0.1320 moles of sulfur. Which reactant is the limiting factor?

$16\ Na + S_8 \text{ ---> } 8\ Na_2S$

14. Disulfur dichloride, S_2Cl_2, is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine: $S_8(l) + 4\ Cl_2(g) \rightarrow 4\ S_2Cl_2(l)$
Starting with a mixture of 32.0 g of sulfur and 71.0 g of Cl_2, which is the limiting reactant? What mass of S_2Cl_2 (in grams) can be produced? What mass of the excess reactant remains when the limiting reactant is consumed?

15. Aspirin ($C_9H_8O_4$) is produced by the reaction of salicylic acid ($C_7H_6O_3$) and acetic anhydride ($C_4H_6O_3$). $C_7H_6O_3(s) + C_4H_6O_3(l) \rightarrow C_9H_8O_4(s) + CH_3CO_2H(aq)$
If you mix 100. g of each of the reactants, what is the maximum mass of aspirin that can be obtained?

16. Disulfur dichloride, which has a revolting smell, can be prepared by directly combining S8 and Cl2, but it can also be made by the following reaction:

$3\ SCl_2(l) + 4\ NaF(s) \rightarrow SF_4(g) + S_2Cl_2(l) + 4\ NaCl(s)$

Assume you begin with 5.23 g of SCl_2 and excess NaF. What is the theoretical yield of S_2Cl_2? If only 1.19 g of S_2Cl_2 is obtained, what is the percent yield of the compound?

17. Hydrazine reacts with dinitrogen tetroxide according to the equation:

$2N_2H_4(g) + N_2O_4(g) \rightarrow 3N_2(g) + 4H_2O(g)$

50.0 grams of hydrazine is mixed with 100.0 grams of dinitrogen tetroxide. How much nitrogen gas was produced?