JUNE 2020 SUMMER REVIEW PACKET

-Use your notes, textbook and review sheets to answer all the questions.
-Pay attention to vocabulary and calculations.
-You can also view the reference charts that will be provided the day of the exam.
-A periodic table (+ other reference charts) will also be provided.
-This review is a guide. You will be taken through the various topics that will be covered on the final exam.

Semester 1: Atomic Structure, Bonding, molecular geometry

Chapters 4/5: Atomic structure:

1) What is the electron configuration for Ar?
2) How many pairs of valence electrons does phosphorous have? How many unpaired electrons?
3) How many protons, neutrons and electrons are in a neutral atom of chlorine-37?
4) Describe the relationship between the energy, wavelength and frequency of a photon.

Chapters7/8: Bonding

1) Describe the difference between nonpolar covalent, polar covalent and ionic bonds.
2) What is the shape of CH_4? of CO_2? NH_3?
3) Are the above molecules polar or nonpolar?

Semester 2:

Chapter 10: Chemical Quantities / Mole

Review all types of mole conversions.

1) 2.00 grams of H_2O equals _____moles
2) 75.57 moles of KBr equals _____grams
3) 100. grams of $KClO_4$ equals _____# molecules
4) 5 moles of Cl_2 equals _____liters
5) $3.1x10^{24}$ molecules of C equals _____moles

Chapter 11: CHEMICAL REACTIONS

1. List the 5 types of reactions studied this year.

2. Balance the following reaction: **$Ag_2S(s) + Al(s) \rightarrow Al_2S_3(s) + Ag(s)$**

3. In order for this reaction to occur what must be the relationship of Al to Ag?

4. The equation **$2C_3H_7OH + 9O_2 \rightarrow 6\,CO_2 + 8H_2O$** , Is an example of what type of reaction?

5. A reaction takes place when aqueous K_2SO_4 reacts with aqueous $Pb(NO_3)_2$.
   a. Write the equation showing the products
   b. Balance the equation
   c. Identify the type of reaction.
   d. Identify the spectator ions

6. Balance each of the reactions and identify the type of reaction.

   a) $Ca + H_3PO_4 \rightarrow Ca_3(PO_4)_2 + H_2$

   b) $KBrO_3 \rightarrow KBr + O_2$

   c) $Fe + Cu(NO_3)_2 \rightarrow Fe(NO_3)_3 + Cu$

Chapter 12: Stoichiometry

Solve these Stoichiometry problems. Write your solutions on a separate sheet of paper. Write your answers in the spaces provided.

1. $HCl + NH_3 \rightarrow NH_4CI$ is the equation for the reaction of hydrogen chloride with ammonia. What mass of ammonium chloride is formed from 25.0 g of ammonia? _____
2. $Mg + 2HCI \rightarrow MgCl_2 + H_2$ is the equation for the reaction of magnesium with hydrochloric acid. What mass of magnesium chloride is formed from 0.50 g of HC1?
3. $2KC1O_3 \rightarrow 2KCl + 3O_2$ is the equation for the decomposition of potassium chlorate. What mass of oxygen gas is recovered from the decomposition of 250 g of potassium chlorate?
4. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$ is the equation for the neutralization of sulfuric acid with sodium hydroxide. What mass of sodium sulfate is recovered from the reaction of 25.9 g of sodium hydroxide?____
5. Sulfuric acid forms when SO_3 reacts with water: $SO_3 + H_2O \rightarrow H_2SO_4$. What mass of water is required to react with 0.398 g of SO_3? _____
6. When 0.150 g of nitrogen reacts with excess oxygen, 0.407 g of a nitrogen oxide product forms.
7. Write a balanced chemical equation for the reaction that takes place. _____

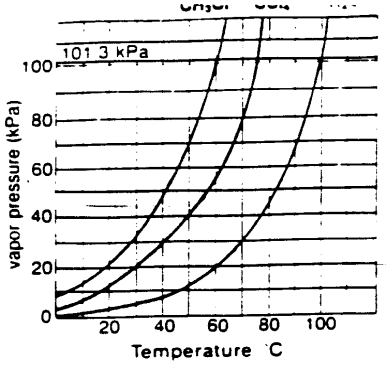
Chapter 13: States of Matter: LIQUIDS/Intermolecular Forces

1. Define: evaporation, boiling point, normal boiling point, sublimation.
2. What type of intermolecular force is primarily responsible for the properties of carbon dioxide, CO_2?
3. At 60°C, the vapor pressure of ethanol is greater than that of water. Which substance, ethanol or water has:

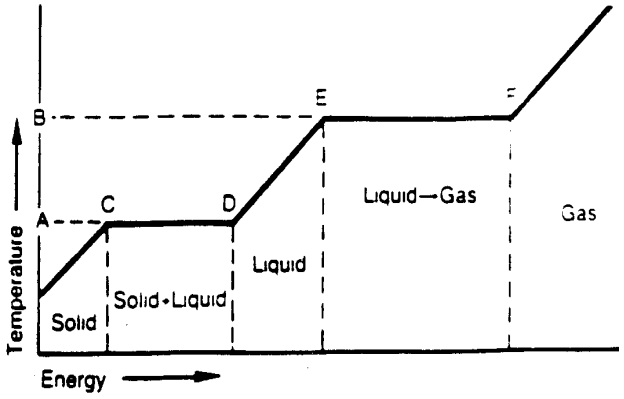
a. the greater vapor pressure at 30°C?_____
b. the highest boiling point? _____
c. the strongest intermolecular forces?_____

Figure #1

CH_3Cl CCl_4 H_2O



Use Figure #2



Use Figure #1 to answer the following questions.

1. When the atmospheric pressure on the surface of CH_3Cl is 101.3 kPa,, what is the boiling point?
2. What is the normal boiling point for CCl_4?
3. What is the pressure when water boils at 70°C?
4. Which liquid on the chart has molecules that exert the strongest forces on each other?
5. Increasing the temperature usually causes the vapor pressure to increase. True or False?
6. Which of the liquids in Figure #1 would be the easiest to evaporate?

Look at Figure #2 to answer the following questions

7. Identify the point on the graph where each of the following occurs.

a. melting begins b. freezing begins c. boiling begin d. condensation begins

8. As the substance goes from D to C, it gives off heat. True or False?

9. Why does the temperature remain constant during a phase change from E to F?

10. As the water temperature goes from 4°C – 0°C and freezes, does the volume increase or decrease?

Chapter 14: Properties of Gases and Gas Laws

Be able to identify which gas law works for what type of problem.

1. A 250.0 cm^3 sample of gas is collected at 44.0 ^oC. What would be the volume of the gas at 93.0 ^oC? (pressure is constant)

2. How many moles are in 25 L sample of gas collected at 15.0 ^oC, and 0.58 atm.

3. What is the volume occupied by 10.0 L of gas at 100.2 kPa after it has been compressed at a constant temperature to 325.5 kPa.

4. A balloon contains a mixture of helium and nitrogen. The partial pressure of the helium is 93.0 kPa. If the total pressure inside the balloon is 101.0 kPa, then what is the partial pressure of the nitrogen gas?

5. If a sample of gas occupies a volume of 100.0 cm^3 at a temperature of 200.0K, what volume would the gas occupy at a temperature of 150.0K? (the pressure and amount of gas do not change).

6. What is the volume of 2.5 moles of oxygen gas measured at 25°C and a pressure of 104.5 kPa?

7. What gas will diffuse faster: oxygen or chlorine?

8. A sample of oxygen gas has a volume of 7.84 mL at a pressure of 71.8 kPa and a temperature of 25°C. What will be the volume of the gas at STP?

Chapter 15/16: SOLUTIONS

1. Determine the Freezing point of the following
   a. 1m NaCl b. 1m $CaC1_2$
2. Determine the boiling point of the following solutions
   a. 2m $C_6H_{12}O_6$ b. 2m K_2SO_4 (use reference chart for Kb)
3. Which compound will raise the boiling point of water the most?
   a. 2m $C_{11}H_{22}O_{11}$ b. 2m NaCl c. 2m $CaC1_2$ d. 2m $AlBr_3$
4. Calculate the molarity of 23 g KCL in 250mL of water.
5. How many grams of NaI is needed to make 0.5L of a 0.1M solution?

Chapter 25: Nuclear Equations

Balanced equations are written for nuclear reactions as well as for chemical reactions. In a nuclear equation, the totals of the atomic numbers on the left and right sides of the equation must be equal. The totals of the mass numbers must also be equal.

Nuclear Symbols

Radiation	Symbol	Charge
Alpha		
Beta		
Positron		
Neutron		
Gamma		

Fill the blank spaces in the following equations for nuclear reactions.

a. $^{238}_{92}U + ^{14}_{7}N \rightarrow$ ____ $+ 5\ ^{1}_{0}n$	d. $^{14}_{7}N + ^{4}_{2}He \rightarrow$ ____ $+ ^{1}_{1}H$
b. $^{238}_{92}U + ^{2}_{1}H \rightarrow$ ____ $+ 2\ ^{1}_{0}n$	e. $^{2}_{1}H + ^{3}_{1}H \rightarrow$ ____ $+ ^{4}_{2}He$
c. _____ $+ ^{14}_{7}N \rightarrow ^{24}_{12}Mg + ^{0}_{-1}e$	f. $^{9}_{4}Be + ^{4}_{2}He \rightarrow$ ____ $+ ^{1}_{0}n$

In the spaces provided, write the symbol for the particle that forms after each radioactive substances decays.

1. ^{238}U emits an alpha particle	
2. ^{133}Xe emits a beta particle	
3. ^{210}Pb emits a beta particle	
4. ^{203}Bi emits a positron	
5. ^{24}Na emits a beta particle	
6. ^{70}As emits a positron	

Half Life Problems

1. The half-life of theoretical element Rg is 20 days. If you start with a sample of element Rg having a mass of 80 grams, calculate the mass of element Rg remaining after a period of 60 days has elapsed.
2. The half-life of carbon-14 is 5730 years. What fraction of a carbon-14 sample would exist after 22 920 years?
3. The half-life of element X is 10 days. If you start with a sample of element X with a mass of 64 grams what mass of element X remains after a period of 50 days?
4. A 50.0g sample of ^{16}N decays to 12.5g in 14.4 seconds. What is the half-life?

5. The half-life of ^{42}K is 12.4 hours. How much of a 750g sample is left after 62.0 hours?

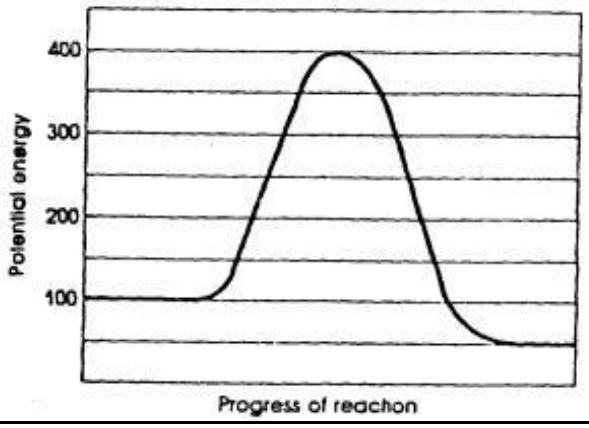
Chapter 18: RATES/REACTION RATES

The rates of chemical reactions depend upon a number of factors. These factors are controlled by scientists in order to cause processes to proceed at desired rates. For each of the following factors, write its probable effect (increase, decrease, no effect) on rate and then explain the effect on the basis of collision theory, if the theory applies.

FACTOR	Effect on Rate	Explanation
1. decreased concentration 2. increased gas pressure 3. decreased temperature 4. decreased surface area 5. addition of catalyst		

Study the energy diagram below and **fill in** the blanks. Then answer the questions that **follow.**

a.Potential energy of reactants: ____ kJ/mol
b.Potential energy of activated complex: __ kJ/mol
c. Activation energy: ___kJ/mol
d. Potential energy of products: ____kJ/mol
e. **ΔH** = _____
f. Is the reaction exothermic or endothermic? _____ . How can you tell?



_____

Chapter 18: <u>EQUILIBRIUM</u>

1. Calculate the value of **Keq** for this reaction at equilibrium. An analysis of the equilibrium mixture in a 1-L flask gives the following results: NOC1, 0.30 mol;
NO, 1.2 mol; Cl_2, 0.60 mol. (First write the expression).

2. Predict the changes in the equilibrium position for this reaction when the following changes are made:

$$\mathbf{2A(g) + B(g) \rightleftharpoons 4C(g) + heat}$$

yellow blue

a. increase the concentration of C
b. add more heat
c. increase A
d. increase the pressure.

3. The five questions which follow refer to a hypothetical reversible chemical reaction in which reactant Y is a bright yellow color, reactant C is colorless, and the product B is a bright blue color. $\mathbf{C(g) + Y(g) \rightleftharpoons 3B(g) + heat}$

The reaction is exothermic, with a **Keq** of 1.5 . The system is initially at equilibrium and has a green color. A stress on the system that would cause the system to favor products would cause the system to turn blue; a stress that favored formation of reactants would give a yellow color.

1. Adding a large quantity of C gives a:
   a. blue color. b. yellow color. c. green color.

2. Cooling the system gives a:
   a. blue color. b. yellow color. c. green color

3. Adding a catalyst gives a:
   a. blue color. b. yellow color. c. green color

4. Increasing the pressure on the system gives a:
   a. blue color. b. yellow color. c. green color

5. Removing B from the system gives a:
   a. blue color. b. yellow color. c. green color

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4. Write the Ksp expression for the insoluble salt Ag_2CO_3.

5. Which of the following salts is the most soluble given the K_{sp}?

a) AgBr , 5 x 10^{-13} b) $BaCO_3$, 5 x 10^{-9} c) $PbCl_2$ 1.6 x 10^{-5} d)AgCl 1.8 x 10^{-10}

Chapter 19: ACIDS /BASES/SALTS

1. In the reaction: **$CO_3^{2-} + H_2O \rightleftharpoons HCO_3^{-1} + OH^{-1}$** the carbonate ion is acting as a(n):
a. Arrhenius base. b. Arrhenius acid. c. Bronsted-Lowry base. d. Bronsted-Lowry acid.

2. Which of the following reactions illustrates **amphoterism**?
   a. $H_2O + H_2O \rightleftharpoons H_3O^{+1} + OH^{-1}$
   b. $NaCI \rightleftharpoons Na^{+1} + OH^{-1}$
   c. $HCI + H_2O \rightleftharpoons H_3O^{+1} + Cl^{-1}$
   d. $NaOH \rightleftharpoons Na^{+1} + OH^{-1}$

3. Identify the **Bronsted-Lowry bases** in this reaction: $H_2S + H_2O \rightleftharpoons H_3O^{+1} + HS^{-1}$
   a. H_2S and H_2O b. H_2S and H_3O^{+1} c. HS^{-1} and H_2O d. HS^{-1} and H_3O^{+1}

4. Which of the following represents a Bronsted-Lowry conjugate acid - base pair?
   a. SO_3^{2-} and SO_2 b. CO_3^{2-} and CO c. H_3O^+ and H_2 d. NH_4^+ and NH_3

5. Calculate the hydrogen-ion concentrate [H^{+1}] for an aqueous solution in which [OH^{-1}] is 1 X 10^{-11} mol/L. Is this solution acidic, basic, or neutral?

6. A 100 mL sample of hydrobromic acid, HBr, is **titrated** to an **end point** with 24.0 mL of 1.5M NaOH. What is the concentration of HBr?
   a. l.4M b. 0.72M c. 3AM d. 0.36M

7. How many milliliters of 0.200M NaOH are required to neutralize 30.0 mL of 0.50M HCl? a. 12mL b. 50mL c. 75mL d. l00mL

8. Calculate the **pH** for the following solutions. State whether each solution is acidic, basic or neutral.
   a. [H^+] = 1.8 x 10^{-10}
   b. [OH^{-1}] = 2.7 x 10^{-10}
   c. [OH^{-1}] = 1 x 10^{-1}
   d. [H^+] = 1 x 10^{-5}

9. Determine the hydronium ion (H_3O^{+1}) concentration of the following solutions
   a. pH = 6.0 b. pH= 2.7 c. pH= 9.0 d. pOH= 8.3

10. Write complete and balanced equations for each of the following acid—base reactions. Then indicate the type of salt produced.
a. $H_2SO_4 + Al(OH)_3$ b. $H_3PO_4 + KOH$ c. $H_3PO_4 + Ca(OH)_2$ d.$HNO_3 + NH_4OH$

11. Identify each as acidic, basic or neutral salts.
a. KNO_3 b. $CaBr_2$ c. Li_3PO_4 d. KCl e. $(NH_4)_2\ SO_4$

12. What does the Ka and Kb values indicate about acid and base strength?

_____

Reference Charts

Abbreviations
atm = atmosphere
mm Hg = millimeters of mercury
K = Kelvin
°C = degrees Celsius

Standard Conditions
1.00 atm = 760.0 mm Hg = 101.3 kPa
0.00 °C = 273 K

1 mole of any gas = 22.4 L at STP

Conversions
K = °C + 273
1 cm^3 (cubic centimeter) = 1 mL (milliliter)
1 dm^3 (cubic decimeter) = 1 L (liter) = 1000 mL

R = .082 $\frac{\text{atm.} \cdot \text{L}}{\text{mol} \cdot \text{K}}$ **R** = 8.32 $\frac{\text{kPa.} \cdot \text{L}}{\text{mol K}}$

A. Formulas and Constants

$pH = -\log[H^+]$	$pOH = -\log[OH^-]$
$[H^+] = \text{antilog}(-pH)$	$[OH^-] = \text{antilog}(-pOH)$
$pH + pOH = 14$	$[H^+][OH^-] = 1 \times 10^{-14}$
$M_a V_a = M_b V_b$	moles = $\frac{\text{mass}}{\text{Molar mass}}$
$M = \frac{\text{mole}}{\text{liter}}$	molality (m) = $\frac{\text{moles solute}}{\text{kg solvent}}$
$\Delta T = K_b \times m \times i$ (K_b = 0.52 °C/m)	$\Delta T_f = K_f \times m \times i$ (K_f = 1.86 °C/m)
$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$	$PV = nRT$

C. Common Polyatomic Ions

ammonium, NH_4^{+1} cyanide, CN^{-1} hydroxide, OH^{-1} acetate, $C_2H_3O_2^{-1}$, or CH_3COO^{-1} bromate, BrO_3^{-1} chlorate, ClO_3^{-1} chlorite, ClO_2^{-1} hydrogen carbonate, HCO_3^{-1} (also called bicarbonate)	carbonite, CO_2^{-2} carbonate, CO_3^{-2} chromate, CrO_4^{-2} dichromate, $Cr_2O_7^{-2}$ oxalate, $C_2O_4^{-2}$ peroxide, O_2^{-2} sulfate, SO_4^{-2} sulfite, SO_3^{-2} monohydrate phosphate, HPO_3^{-2}
hypochlorite, ClO^{-1} iodate, IO_3^{-1} nitrate, NO_3^{-1} nitrite, NO_2^{-1} permanganate, MnO_4^{-1} perchlorate, ClO_4^{-1} thiocyanate, SCN^{-1}	phosphate, PO_4^{-3} phosphite, PO_3^{-3} arsenate, AsO_4^{-3} borate, BO_3^{-3}

B. Solubility Chart # 1

TABLE OF SOLUBILITIES IN WATER

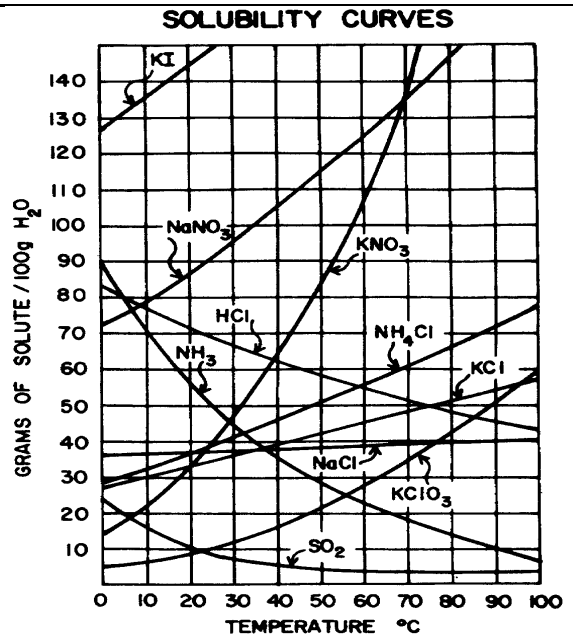
i — nearly insoluble
ss — slightly soluble
s — soluble
d — decomposes
n —not isolated

	acetate	bromide	carbonate	chloride	chromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
Aluminum	ss	s	n	s	n	i	s	s	i	s	d
Ammonium	s	s	s	s	s	s	s	s	s	s	s
Barium	s	s	i	s	i	s	s	s	i	i	d
Calcium	s	s	i	s	s	ss	s	s	i	ss	d
Copper II	s	s	i	s	i	i	n	s	i	s	i
Iron II	s	s	i	s	n	i	s	s	i	s	i
Iron III	s	s	n	s	i	i	n	s	i	ss	d
Lead	s	ss	i	ss	i	i	ss	s	i	i	i
Magnesium	s	s	i	s	s	i	s	s	i	s	d
Mercury I	ss	i	i	i	ss	n	i	s	i	ss	i
Mercury II	s	ss	i	s	ss	i	i	s	i	d	i
Potassium	s	s	s	s	s	s	s	s	s	s	s
Silver	ss	i	i	i	ss	n	i	s	i	ss	i
Sodium	s	s	s	s	s	s	s	s	s	s	s
Zinc	s	s	i	s	s	i	s	s	i	s	i

B. Solubility Chart # 2

Negative Ion	Plus	Positive Ion	Form a Compound Which Is
Any negative ion	+	Alkali metal ions (Li^+, Na^+, K^+, Rb^+, or Cs^+)	Soluble, i.e., >0.1 mol/L
Any negative ion	+	Ammonium ion, NH_4^+	Soluble
Nitrate, NO_3^-	+	Any positive ion	Soluble
Acetate, CH_3COO^-	+	Any positive ion except Ag^+ or Hg^{2+}	Soluble
Chloride, Cl^-, or	+	Ag^+, Pb^{2+}, Hg_2^{2+}, or Cu^+	Not soluble
Bromide, Br^-, or	+	Any other positive ion	Soluble
Iodide, I^-			
Sulfate, SO_4^{2-}	+	Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+}, Ag^+, or Pb^{2+}	Not soluble
	+	Any other positive ion	Soluble
Sulfide, S^{2-}	+	Alkali ions or NH_4^+,	Soluble
	+	Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, or Ra^{2+}	Soluble
	+	Any other positive ion	Not soluble
Hydroxide, OH^-	+	Alkali ions or NH_4^+	Soluble
	+	Any other positive ion	Not soluble
Phosphate, PO_4^{3-}, or	+	Alkali ions or NH_4^+	Soluble
Carbonate, CO_3^{2-}, or	+	Any other positive ion	Not soluble
Sulfite, SO_3^{2-}			

D.



E.

IONIZATION ENERGIES AND ELECTRONEGATIVITIES

First Ionization Energy (kcal/mol of atoms)
Electronegativity*

1	2	13	14	15	16	17	18
H 313 2.2							He 567
Li 125 1.0	Be 215 1.5	B 191 2.0	C 260 2.6	N 336 3.1	O 314 3.5	F 402 4.0	Ne 497
Na 119 0.9	Mg 176 1.2	Al 138 1.5	Si 188 1.9	P 242 2.2	S 239 2.6	Cl 300 3.2	Ar 363
K 100 0.8	Ca 141 1.0	Ga 138 1.6	Ge 182 1.9	As 226 2.0	Se 225 2.5	Br 273 2.9	Kr 323
Rb 96 0.8	Sr 131 1.0	In 133 1.7	Sn 169 1.8	Sb 199 2.1	Te 208 2.3	I 241 2.7	Xe 280
Cs 90 0.7	Ba 120 0.9	Tl 141 1.8	Pb 171 1.8	Bi 168 1.9	Po 194 2.0	At 2.2	Rn 248
Fr 0.7	Ra 122 0.9						

* Arbitrary scale based on fluorine = 4.0