Spring Final Exam Review Name: _____

Directions: Complete all of the following questions. Turn this in on the day of your final and you can earn 10 bonus points on your final. You must number and answer every questions on a separate sheet of paper in order to receive the bonus points. All answer must be hand written and you MUST show ALL work. Answers must be correct. This assignment will not be accepted late for any reason.

Section 1: Stoichiometry and Chemical Math

Balance the following:

1) ___Al + ___Cl_2 → ___$AlCl_3$
2) ___$Mg(ClO)_2$ → ___$MgCl_2$ + ___O_2
3) __$FeCl_3$+ __LiOH→__$Fe(OH)_3$ + _LiCl
4) ___Na + ___O_2 → ___Na_2O
5) ___KBr + ___F_2 → ___KF + ___Br_2
6) __Al + __H_2SO_4 →__$Al_2(SO_4)_3$ + __H_2
7) ___$Cr(OH)_3$ → ___Cr_2O_3 + ___H_2O
8) ___Li + ___H_2O →___LiOH + ___H_2
9) ___$Pb(NO_3)_2$ + ___NaBr → ___$PbBr_2$ + ___$NaNO_3$
10) ___$Fe_2(CO_3)_3$ → ___Fe_2O_3 + ___CO_2
11) ___P + ___Fe_2O_3 →___P_4O_{10} +___Fe
12) ___C_4H_8 + ___O_2 →___CO_2 +__H_2O
13) In equation 1, what is the mole ratio of:
    a. Al to Cl_2
    b. Cl_2 to Al
    c. Cl_2 to $AlCl_3$
    d. Al to $AlCl_3$

Problems: (refer to your list of equations above to answer the following questions) Show all your work.

14) In reaction 1, if 2 moles of Al react with 5 moles of Cl_2, what is the limiting reactant?
15) In reaction 3, if 20g of $FeCl_3$ is reacted with 20g of LiOH, what is the excess reactant?
16) In reaction 8, if 9 mols of Li are reacted with 8 mols of H_2O, what's the limiting reactant?
17) How many moles of $AlCl_3$ can be made from 4.5 mole of Al? (reaction 1)
    a. How many moles of Cl_2 are needed to produce 3 moles of $AlCl_3$?
    b. How many moles of Al are needed to react with 7.5 moles of Cl_2?
18) In reaction 4, how many moles of O_2 are needed to react with 5 moles of Na?
19) In reaction 10, how many moles of CO_2 can be produced if 7.5 moles of Fe_2O_3 are made?
20) In reaction 5, how many moles of Br_2 are produced from 8 moles of KBr?
21) In reaction 12, how many moles of O_2 are needed to produce 3.0 moles of CO_2?
22) In equation 11, if 5.0 moles of P begin the reaction:
    a. How many moles of Fe can be produced?
    b. How many moles of Fe_2O_3 will react?
23) In equation 12, if 112.0 grams of C_4H_8 begin the reaction:
    a. How many moles of O_2 will be needed to completely react?
    b. How many moles of CO_2 will be formed?
24) In equation 8, if 3 moles of Li are used:
    a. How many grams of H_2 will be formed?
    b. How many grams of H_2O will also react?
25) In equation 5, if 50.0 grams of KBr are used:
    a. How many grams of KF can be made?
    b. How many grams of F_2 will be needed to completely react with KBr?
26) What is the first step to ALL stoichiometry problems?
27) Define the following terms:
    a. limiting reactant
    b. excess reactant
    c. percent yield
    d. actual yield
    e. theoretical yield

28) What is Avogadro's number?

Convert the following to atoms: Show all your work!

29) 235.0 g $NaNO_3$
30) 13 moles $Al_2(SO_4)_3$
31) 50.0 moles $Fe(OH)_3$
32) 75.0 g $Fe_2(CO_3)_3$
33) 196.0 g H_2SO_4

Convert the following compounds given mass to moles: Show all your work!

34) 235.0 g $NaNO_3$
35) 130.0 g $Al_2(SO_4)_3$
36) 50.0 g $Fe(OH)_3$
37) 75.0 g $Fe_2(CO_3)_3$
38) 196.0 g H_2SO_4

Convert the following compounds given moles to grams: Show all your work!

39) 2.0 moles of C_4H_8
40) 1.5 moles of $Pb(NO_3)_2$
41) 0.25 moles of Fe_2O_3
42) 5.0 moles of LiCl
43) 6.1 moles of KBr

Solve the following problems: Show all your work!

44) A compound's empirical formula is C_2H_5. If the molecular formula has a molar mass of 58 g/mol, what is the molecular formula?
45) What's the empirical formula of a compound that contains 4.04 g of N and 11.46 g of O?
    a. If the MFM is 108.0 g/mol, what is the molecular formula?
46) Analysis shows a compound to contain 26.56 % potassium, 35.41 % chromium, and 38.03 % oxygen. Find the empirical formula of this compound.
47) A compound with a formula mass of 42.08 g/mol is found to be 85.64 % C and 14.36 % H by mass. Find its molecular formula.
48) One student in an art class was interested in the many different effects that ceramic glazes create. One glaze contained 48.8 % cadmium, 20.8 % carbon, 2.62% hydrogen, and 27.8 % oxygen. What is the empirical formula for this compound?
49) A compound was found to contain 49.98 g carbon and 10.47 g hydrogen. Determine the empirical formula of this compound.
50) One problem reported by the nickel-plating industry is that some workers develop "nickel itch," a form of dermatitis that occurs when a certain compound comes in contact with the skin. The empirical formula for this compound is Ni(NO3)2. The molar mass of the molecular formula is 913.55g/mol. What is the molecular formula for this compound?
51) Analysis of a compound containing chlorine and lead reveals that the compound is 40.63% chlorine and 59.37 % lead. The molar mass of the compound is 349.0 g/mol. What are the empirical and molecular formulas for this compound?
52) What is the percent composition of H in $Ca(OH)_2$?
53) What is the percent composition each element of CF_4?
54) What is the percentage of chlorine in NaCl?
55) What is the percent composition of iron in Iron (III) sulfate?

<u>Section 2: Solutions</u>

56) What is a solution?
57) What are the properties of solutions?
58) The thing that is dissolved into a solution is called the _____.
59) The medium in which a substance is dissolved in called the _____.
60) Can solutions have multiple states of matter?

61) Can we combine different states of matter to make solutions?
62) Mixed metals making up a solution such as stainless steel and bronze are called ____?
63) Give an example of a solution created from mixing a solid in a liquid.
64) Is air a solution? Explain, using properties.
65) Is carbon dioxide a solution? Explain using properties of solutions.
66) How do we express concentration of solutions in a quantitative way?
67) What are the units of molarity?
68) What is the abbreviation for molarity?
69) What is the dilution equation?
70) What is the name of a property of a solution which changes as the amount of solute changes?
71) Name two colligative properties.
72) What is the relationship between amount of solute and the freezing point of a solution?
73) What is the relationship between the amount of solute and the boiling point of a solution?
74) How do you dilute a solution?
75) What property of water makes it a "universal solvent"?
76) What do we call a solution whose solvent is water?
77) What sorts of substances do not dissolve in water?
78) What is the general rule for solubility of a substance in its solvent?
79) When the solution has dissolved the maximum amount of solute possible it is _____?
80) When the solute is fully dissolved and there is still room for more, the solution is _____?
81) When a solution has dissolved more than the saturation point the solution is _____?
82) Is gas solubility increased or decreased with increased temperature?
83) What three factors affect the rate of dissolving?

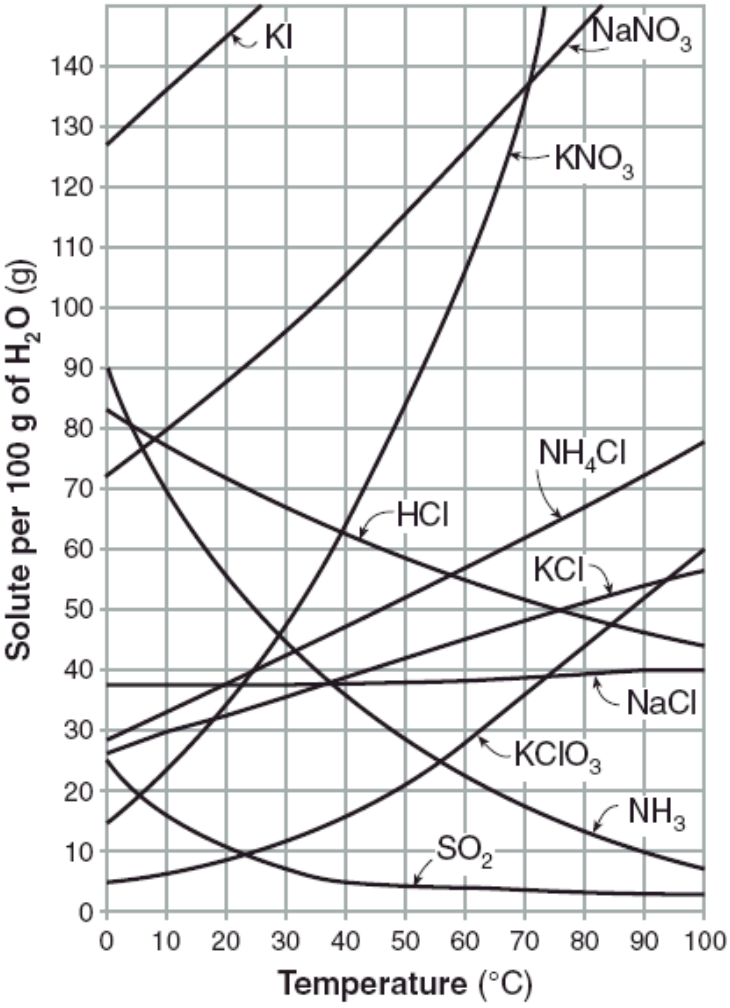
MOLARITY- Show all your work!

84) What is the molarity of a solution that contains 0.202 mol of KCl in a 7.98 L solution?
85) How many moles of HCl are present in .70 L of a .33 M HCl solution?
86) A NaOH solution has 1.9mol of NaOH, and concentration of .555M. What is its volume?
87) How many mL of water are needed to make a 0.171 M solution with 1 g of NaCl?
88) What is the molarity of a solution that contains 125 g NaCl in 4.0 L solution?
89) What is the molarity of a solution that has 85.0 g of $NaNO_3$ with a volume of 750 mL?
90) What is the molarity of a solution of sucrose, $C_{12}H_{22}O_{11}$ that contains 125 g of sucrose in a 3.5 L solution?

DILUTIONS- Show all your work!

91) If I have 340 mL of a 0.5 M NaBr solution, what will the concentration be if I add 560 mL more water to it?
92) If I dilute 250 mL of 0.10 M lithium acetate solution to a volume of 750 mL, what will the concentration of this solution be?
93) If I leave 750 mL of 0.50 M sodium chloride solution uncovered on a windowsill and 150 mL of the solvent evaporates, what will the new concentration of the sodium chloride solution be?

Table G Solubility Curves



94) If a solution of potassium chlorate has 50g of solute dissolved at 60°C, what type of solution is it?

95) How much ammonium chloride would be need to be dissolved in 200g of water at 80°C, to be saturated?

96) If a saturated solution of potassium chloride is cooled from 60°C to 30°C, how much solute would precipitate?

97) Which solutions are most likely gases and why?

98) How much sodium chloride can be dissolved in 100g of water at 40 °C?

99) How much KI can be dissolved in 100g of water at 10 °C?

100) If a solution of hydrochloric acid has 60g of HCl dissolved in 100g of water at 45 °C, what type of solution is it?

<u>Section 3: Acids and Bases</u>

101) List all of the strong acids.
102) List all of the strong bases.
103) What is Arrhenius's definition of acids and bases?
104) What is Bronsted-Lowry's definition of acids and bases?
105) What are the properties of strong acids and bases?
106) What are the properties of weak acids and bases?
107) What does amphoteric mean?
108) What is a hydronium ion?
109) Label the acid, base, conjugate acid, and conjugate base.

a. $H_2SO_4 + H_2O \leftrightarrow HSO_4^- + H_3O^+$

b. $NH_3 + H_2O \leftrightarrow OH^- + NH_4^+$

110) Complete the following neutralization reactions and indicate what kind of salt (acidic, basic, or neutral) will be produced. Be sure to balance the equation.

a. _____$Al(OH)_3$ + _____HNO_3 ←→ Type of salt produced: _____

b. _____H_2O + _____$BaCl_2$ ←→ Type of salt produced: _____

111) Calculate the values of both pH and pOH of the following solutions:

	pH	pOH
a) 0.020M solution of HCl		
b) 0.0050M solution of LiOH		
c) A blood sample 7.2 x 10^{-8}M of H^+		
d) 0.00035M NaOH		

112) A soda has a hydrogen ion concentration of 1.4 x 10^{-5} M. What is the pH? Show your work.

113) Calculate the $[OH^-]$ in a solution that has a $[H^+]$ of 3.2 x 10^{-9} M. Show your work.

114) Calculate the $[H^+]$ in a solution that has a pOH of 12.4. Show your work.

115) Complete the following table:

$[OH^-]$	pOH	$[H^+]$	pH	Acid, Base, or Neutral?
			9.5	Base
				Neutral
	11.3			
		2.2 x 10^{-5} M		
2.3 x 10^{-7} M				

Section 4: Rates and Equilibrium

HEAT

116) What is the formula for determining the amount of energy lost or gained by a substance?

117) What does each variable stand for in the equation from #116?

118) Define specific heat.

119) What is the formula for density?

120) What are the units of density?

121) A 18.75 g piece of iron absorbs 1250.05 J of heat energy, and its temperature changes from 10°C to 148°C. Calculates the specific heat capacity of iron. Show all your work.

122) To what temperature will a 42.0 g piece of glass raise to if it absorbs 4875 J of heat and its specific heat capacity is 0.50 J/g°C? The initial temperature of the glass is 20.0 °C. Show all your work.

123) How many joules of heat are needed to raise the temperature of 8.0 g of aluminium from 18°C to 45°C, if the specific heat of aluminium is 0.90 J/g°C. Show all your work.

Rates/Equilibrium

124) What is Le Chatelier's principle?
125) What is the main idea of the collision model?
126) How does a catalyst speed up a chemical reaction?
127) Use the collision theory to explain why reactions should occur more slowly at lower temperatures?
128) Provide an example of a heterogeneous reaction and an example of a homogeneous reaction. Support your answer.
129) What is equal at equilibrium?
130) What is constant at equilibrium?
131) At the macroscopic level a system at equilibrium appears to be unchanging. Is it also unchanging at the molecular level? Explain.
132) Draw a reaction diagram and label the parts of the diagram.
133) Draw a how a reaction diagram changes when a catalyst is used.
134) What does it mean that a reaction is reversible?
135) **Le Chatelier's Principle Chart:** $2CO_2\ (g) + 22.0\ kcal \leftrightarrow 2CO\ (g) + O_2(g)$

Stress	**Equilibrium Shift**	**$[O_2]$**	**[CO]**	**$[CO_2]$**
A. Add O_2	Left	____	decreases	Increases
B. Add CO			___	
C. Add CO_2				____
D. Remove O_2		____		
E. Remove CO			____	
F. Remove CO_2				____
G. Increase Temperature				
H. Decrease Temperature				
I. Increase Pressure				
J. Decrease Pressure				

136) Write the equilibrium expression for the following reactions:
   a. $N_2\ (g) + 3H_2\ (g) \leftrightarrow 2NH_3\ (g)$
   b. $2KClO_3\ (s) \leftrightarrow 2KCl\ (s) + 3O_2\ (g)$
   c. $H_2O\ (l) \leftrightarrow H^+\ (aq) + OH^-\ (aq)$
   d. $2CO\ (g) + O_2\ (g) \leftrightarrow 2CO_2\ (g)$
   e. $Li_2CO_3\ (s) \leftrightarrow 2Li^+\ (aq) + CO_3^{-2}\ (aq)$
137) $PCl_5\ (g) \leftrightarrow PCl_3\ (g) + Cl_2\ (g)$. What is the equilibrium constant if the equilibrium concentrations are: $[PCl_5]$ =0.0096 M, $[PCl_3]$ =0.0247 M, and $[Cl_2]$ =0.0247 M. Show all your work.
138) The equilibrium concentrations for the reaction below are: $[N_2]$= 1.03 M, $[H_2]$ = 1.62 M, and $[NH_3]$= 0.102 M. What is the equilibrium constant? $N_2\ (g) + 3H_2\ (g) \leftrightarrow 2NH_3\ (g)$. Show all your work.

Section 5: Gas Laws

139) What is the relationship between pressure and volume?
140) What is the relationship between volume and temperature?
141) What is the relationship between volume and number of moles?
142) What is the relationship between pressure and temperature?
143) What is the kinetic molecular theory?
144) If I have an unknown quantity of gas at a pressure of 0.5 atm, a volume of 25 liters, and a temperature of 300 K, how many moles of gas do I have? Show your work.
145) A gas thermometer measures temperature by measuring the pressure of a gas inside the fixed volume container. A thermometer reads a pressure of 248 Torr at 0 ˚C. What is the temperature when the thermometer reads a pressure of 345 Torr? Show your work.
146) A 25.5 liter balloon holding 3.5 moles of carbon dioxide leaks. If we are able to determine that 1.9 moles of carbon dioxide remains in the balloon, what is the new volume of the container? Show your work.
147) If Sample #1 contains 2.98 moles of hydrogen in a 32.8 L container. How many moles of hydrogen are in a 45.3 liter container under the same conditions? Show your work.
148) 1.00 L of a gas at standard temperature and pressure is compressed to 0.573 L. What is the new pressure of the gas? Show your work.
149) In a thermonuclear device, the pressure of 0.050 liters of gas within the bomb casing reaches 4.0 x 10^6 atm. When the bomb casing is destroyed by the explosion, the gas is released into the atmosphere where it reaches a pressure of 1.00 atm. What is the volume of the gas after the explosion? Show your work.
150) On a hot day, you may have noticed that potato chip bag seemed to "inflate", even though they have not been opened. If I have a 250 mL bag at a temperature of 19°C, and I leave it in my car which has a temperature of 60°C, what will the new volume of the bag be? Show your work.
151) A sample of gas occupies a volume of 23 L at 740 torr and 16 ˚C. Determine the volume of the sample at 760 torr and 37 ˚C. Show your work.
152) A bubble of helium gas has a volume of 0.650 mL near the bottom of an aquarium where the pressure is 1.54 atm and the temperature is 12 ˚C. Determine the bubble's volume upon rising near the top where the pressure is 1.01 atm and 16 ˚C? Show your work.
153) Synthetic diamonds can be manufactured at pressures of 6.00 x 10^4 atm. If we took 2.00 liters of a gas at 1.00 atm, and compressed it to a pressure of 6.00 x 10^4 atm, what would the volume of the gas be? Show your work.
154) Sally adds gas to a 5.29 liter balloon that already contained 2.51 moles of argon until it contains 6 mol. What is the volume of the balloon after the addition of the extra gas? Show your work.
155) A sample of gas has a volume of 215 cm^3 at 23.5 ˚C and 0.936atm. What volume will the gas occupy at STP? Show your work.
156) If I contain 3 moles of gas in a container with a volume of 60 liters and at a temperature of 400 K, what is the pressure inside the container? Show your work.
157) If I have 7.7 moles of gas at a temperature of 67 ˚C, and a volume of 88.89 liters, what is the pressure of the gas? Show your work.

158) A container of gas is initially at 0.500 atm and 25 ˚C. What will the pressure be at 125 ˚C? Show your work.

159) A gas container is initially at 47 mm Hg and 77 K (liquid nitrogen temperature.) What will the pressure be when the container warms up to room temperature of 25 ˚C? Show your work.

160) The temperature inside my refrigerator is about 4°C. If I place a balloon in my fridge that initially has a temperature of 22°C and a volume of 0.50 liters, what will be the volume of the balloon when it is fully cooled by my refrigerator? Show your work.

161) A man heats a balloon in the oven. If the balloon initially has a volume of 0.40 liters and a temperature of 20°C, what will the volume of the balloon be after he heats it to a temperature of 250°C? Show your work.

Formula Sheet

K = °C + 273 PV = nRT $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ R= (0.0821 $\frac{L\ atm}{mol\ K}$)

Units of pressure @ STP:

= 1 atmosphere

= 760 mm Hg

= 760 torr

= 29.92 inches Hg

= 14.7 pounds/in^2 (psi)

= 101.3 kPa

= about 34 feet of water!