Name _____ Date _____ Period _____

Honors Chemistry Spring Final Review

Atomic Structure and the Periodic Table

1. What is a mole? (In chemistry, not the animal, silly!) Which scientist is credited with the famous #?

2. Determine the family name and number of valence electrons in each of the following neutral atoms. Then draw the Lewis dot structure of each.

Atom	Family Name	# of Valence Electrons	Lewis Dot Structure
Na			
Al			
P			
Br			
Ar			

3. Which element has the smallest atomic radius? _____ the largest? _____

4. For each of the following groups of elements, provide the family name, charge, and indicate if the elements included in the group are metals or non-metals.

GROUP #	FAMILY NAME	CHARGE	METAL OR NON-METAL?
1			
2			
3-12			
17			
18			

5. Which of the following elements has properties most like Nitrogen?
   a. Carbon   b. Phosphorus   c. Nickel   d. Neon

   Why?

6. In the space below, draw each of the following atoms according to the Bohr model. Compare the relative atomic radii of each neutral atom with its ion.

Mg: Mg^{+2}:

F: F^-:

7. In each of the following pairs of atoms, circle the atom with the larger atomic radius.
a. K or K^+ c. Li or Cs
b. Ca or Br   d. O or O^{-2}

8. List the following elements in order of decreasing electronegativity: H, N, F, Cl, O, S, Br, I, C

9. In each of the following pairs of elements, circle the element that has the greater ionization energy.
a. Si or Cl
b. Sr or I
c. Ba or Be
d. Fr or He

Bonds and Naming

10. How many electrons are shared in a: Single bond? _____

Double bond? _____

Triple bond? _____

11. Differentiate between ionic and covalent bonds.

12. Draw the Lewis structure for each of the following molecules. Then describe the shape around the central atom.

Molecule	Lewis Structure	Shape
H_2O		
CCl_4		
NH_3		
CO_2		
N_2		

13. Why is Carbon commonly found in organic molecules?

14. Describe the following compounds as ionic or covalent then name them.

Compound	Ionic or Covalent?	Name
ZnO		
XeF$_6$		
CCl$_4$		
HF		

15. Write the formula for the following ionic compounds. (Remember, write the charges then criss-cross applesauce)

Compound	Formula
copper(I) chloride	
copper(II) chloride	
aluminum oxide	
iron(III) sulfide	

16. Name the following compounds with polyatomic ions.

Compound	Name
NH$_4$CH$_3$COO	
KNO$_3$	
Zn(OH)$_2$	
NaHCO$_3$	

17. Write the formula for each ionic compound with polyatomic ions. (Remember, write the formula and charge, then criss-cross applesauce.)

Compound	Formula
aluminum sulfate	
potassium sulfite	
barium carbonate	
tin(IV) phosphate	

Nuclear Chemistry

18.   Write the nuclear symbol charge for each of the following:

Particle	Symbol	Charge
Alpha Particle		
Beta Particle		
Positron		
Electron		
Gamma Ray		

19. Write the nuclear symbol for a copper isotope that has 36 neutrons.

20. Which type of particle(s) has the ability to penetrate skin: alpha, beta, or gamma particles?

21.   a. Explain how nuclear fusion is one of our sources of energy on Earth.

        b. How is nuclear fission a source of energy?

22. What is the daughter nucleus formed when tritium undergoes beta decay?

23. Thorium-232 undergoes 6 alpha decays and 4 beta decays. What is the final product?

24. Actinium-228 has a half-life of approximately 6.0 hours. How much of a 5.0 mg sample would remain after one day?

Chemical Reactions and Stoichiometry

25. To make brass pennies, you use a solution of 5 g of Zn dissolved in 27 g of NaOH. What is the percent by mass of Zn in this solution?

26. In the following reaction, 46.2 g of $MgCl_2$ were produced. Use this information and the balanced equation to answer the questions that follow.

$$2HCl + Mg \rightarrow MgCl_2 + H_2$$

    a. What is the name for $MgCl_2$?

    b. What is the molar mass of $MgCl_2$?

    c. How many moles of $MgCl_2$ are produced?

    d. How many moles of HCl are needed?

    e. What is the molar mass of HCl?

    f. How many grams of HCl are needed?

27. Cholorbenzene, C_6H_5Cl, is used in the production of many important chemicals, such as aspirin, dyes, and disinfectants. One industrial method of preparing chlorobenzene is to react benzene, C_6H_6, with chlorine, as represented by the following equation.

$$C_6H_{6(l)} + Cl_{2(g)} \rightarrow C_6H_5Cl_{(s)} + HCl_{(g)}$$

    a. If 36.8 g of C_6H_6 reacts with an excess of Cl_2, what is the theoretical amount of C_6H_5Cl that should be produced?

    b. When this experiment is carried out by one company, the actual yield is 38.8 g C_6H_5Cl. What is the percent yield?

28. Tin (II) Fluoride, SnF_2 is used in some toothpaste. It is made by the reaction of tin with hydrogen fluoride according to the following equation:

$$Sn_{(s)} + 2\ HF_{(g)} \longrightarrow SnF_{2(s)} + H_{2(g)}$$
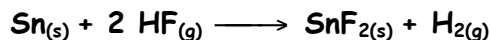
Answer questions a-f assuming that 30.00 g of $HF_{(g)}$ react with 230.0 g $Sn_{(S)}$.

a. What is the molar mass of HF?

b. How many moles of HF are present?

c. How many moles of Sn are present?

d. Which reactant is limiting?

e. How many moles of SnF_2 are theoretically produced?

f. What is the molar mass of SnF_2?

g. How many grams of SnF_2 are theoretically produced?

h. If you carry out this experiment and 103 g of SnF_2 were actually obtained, what is the % yield?

29. Predict the products of the following double replacement reaction and <u>balance</u> the equation. Name each reactant and product.

$$Ca(NO_3)_2\ +\ \ \ \ \ \ Al_2(SO_4)_3 \longrightarrow$$

30. Draw a graph below that represents the relative concentration of reactant and products over time as the following reaction proceeds to completion: $2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2\ (g)}$

What type of reaction is this? _____

31.   a. Write a balanced equation for the combustion of propane (C_3H_8).

b. If excess propane reacts with 165g of oxygen, what mass of water is formed?

Phases of Matter

32. When a gas turns directly to a solid, it undergoes _____.

33. How do solids, liquids, and gases differ? Which of the three phases is most compressible, why?

34. In the space below, plot the graph that represents the uniform heating of solid water from -5 °C to 105 °C. On your graph, label the following phases: solid, liquid, gas. Also label the following phase changes: melting, vaporization.

35. Do particles of a gas ever collide? Do gas particles ever attract or repel each other?

36. Define kinetic energy.

37. What does volatile mean? Provide an example of a volatile liquid.

38. Why does the boiling point of water increase at lower altitudes? For example, water boils at a higher temperature in Death Valley, which is below sea level.

39.   a. Differentiate between evaporation and boiling.

        b. Both of these processes are types of _____.

Kinetics

40. Consider the reaction $F_{2(g)} + 2ClO_{2(g)} \rightarrow 2FClO_{2(g)}$

$[F_2]$ (M)	$[ClO_2]$ (M)	Initial Rate (M/s)
0.10	0.010	1.2×10^{-3}
0.10	0.040	4.8×10^{-3}
0.20	0.010	2.4×10^{-3}

    a. Determine the rate law

    b. Determine the overall order of the reaction

    c. Determine the rate constant, k. (including units)

    d. Determine the rate of the reaction at the time when $[F_2]$ = 0.010 M and $[ClO_2]$ = 0.020 M

41. The reaction of iodide ion with hypochlorite ion, ClO^- (which is found in liquid bleach), follows the equation: $ClO^- + I^- \rightarrow OI^- + Cl^-$. It is a rapid reaction that gives the following rate data.

[ClO⁻] (M)	[I⁻] (M)	Rate of Formation (M s⁻¹)
1.7×10^{-3}	1.7×10^{-3}	1.75×10^4
3.4×10^{-3}	1.7×10^{-3}	3.50×10^4
1.7×10^{-3}	3.4×10^{-3}	3.50×10^4

    a.   Determine the rate law

    b.   Determine the overall order of the reaction

    c. Determine the rate constant, k (including units)

42. What is diffusion? What factors can affect the rate of diffusion?

43. Name 2 ways you can increase the rate at which hot chocolate dissolves in water.

44. Under which conditions will a match burn the fastest: in our atmosphere, or in a closed container filled with pure O_2? Why?

45. Why do reaction rates increase at higher temperatures?

46. How does a catalyst increase reaction rates?

Equilibrium

47. Answer the following questions regarding the following reaction at equilibrium:

$$\underline{\quad} HCl_{(g)} + \underline{\quad} O_{2(g)} \longleftrightarrow \underline{\quad} H_2O_{(l)} + \underline{\quad} Cl_{2(g)} + 113 \text{ kJ}$$

a. Balance the equation.

b. Is the forward reaction endothermic or exothermic? _____

c. Sketch an energy diagram for this reaction.

d. In the table below, predict the changes that would take place in the above reaction in response to each of the stresses.

STRESS	WHICH REACTION IS FAVORED? (FORWARD OR REVERSE)	[HCl] INCREASE OR DECREASE?	[Cl$_2$] INCREASE OR DECREASE?
Temperature Increases			
Pressure Decreases			
O$_2$ is removed			

48. A reaction stops. There are equal amounts of products and reactants. Is equilibrium established? Explain.

49. What is the equation for calculating the equilibrium constant (K) for a chemical reaction?

50. The K_w for water at 25°C is 1×10^{-14}. Does this mean that the reactants or products are favored at equilibrium?

51. The following reaction represents the decomposition of water.   The reaction is at equilibrium.

$$2 \ H_2O_{(l)} + \textbf{heat} \rightarrow 2 \ H_{2(g)} + O_{2(g)}$$
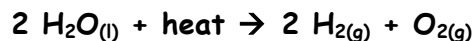
Determine whether each of the following stresses will increase the rate of the **forward or reverse** reaction.

a. the temperature is increased   _____

b. the pressure is decreased   _____

c. the [$H_2O_{(l)}$] is decreased   _____

d. the [O_2] is increased   _____

e. the container volume is decreased   _____

Solutions

52. List all of the intermolecular forces present between the following molecules or atoms.

a. Br_2 –   c. NCl_3 –

b. H_2O –   d. He -

* If you had samples of each of the above substances, rank them in order of INCREASING boiling point.

53. Differentiate between the terms solute and solvent.

54. What is the density of water 25°C?

55. What is the meaning of "like dissolves like"?

56. Describe each of the following as an electrolyte or a non-electrolyte. Justify your answer.

Compound	Electrolyte or Non-electrolyte	Why?
NaCl		
HCl		
$C_6H_{12}O_6$		
KOH		

57. Write the equations for determining molarity (M), molality (*m*) and parts per million (ppm).

58. You dissolve 0.68 moles of NaCl in 1.95L of water. What is the molarity (M) of the solution?

Gas Laws
59. Describe the relationship between each of the following measurable quantities with respect to gas laws as either **directly proportional or indirectly proportional**. Assume the unmentioned quantities are held constant. State which gas law relates the two values.

       a) Pressure and Temperature -

       b) Volume and Pressure -

       c) Volume and Temperature -

60. Write the equation for the combined gas law.

61. Sketch a graph that shows the relationship between temperature and volume of a gas. Label the temperature on the x-axis and pressure on the y-axis.

62. What causes pressure? Write the equation for pressure.

63. A container has 8.0 L of O_2 gas at 50 °C. The gas is compressed to a volume of 3.0 L. What is the new temperature of the gas?

64. A gas in a 35mL container has a pressure of 75atm. If it is transferred to a 45mL container, what is the new pressure in atmospheres? (Hint: Use $P_1V_1=P_2V_2$)

65. On a cold winter morning when the temp is -16°C, the air pressure in the tire of your bicycle is 1.2 atm. After you ride your bike to school, the new temperature of the gas in the tire is 10°C. If the volume of gas in the tire does not change, what will be the new pressure in the tire? (Hint: Use $P_1/T_1=P_2/T_2$).

66. State the equation for the ideal gas law. What does each letter represent? What are the proper units for each measurement?

67. What mass of Fluorine gas (F_2) is in a 96mL container at 27.0°C and 785 torr? (Hint: Use PV=nRT, then use the mole highway to convert to grams)

68. What mass of Hydrogen gas (H_2) has a volume of 33.6L at STP? (Hint: Remember, @STP 22.4L of any gas = 1 mole, then use the mole highway to convert to grams.)

69. What are standard temperature and pressure values?

70.   a. Write the balanced equation for the combustion of methane gas.

        b. If 5.0L of methane react, what volume of carbon dioxide is produced at standard temperature and pressure?

Acids and Bases

71. Determine the color of the acid base indicator in each of the following solutions.

Indicator	Acidic	Neutral	Alkaline
Red Litmus Paper			
Blue Litmus Paper			
Phenolphthalein			

72. Describe the taste of acids and bases. Give examples of each that you may find in your home.

73. Which acid is found in the stomach?

74. Strong acids react with _____ to produce H_2 gas.

75. Strong acids or bases are strong _____, and therefore conduct electricity.

76. What are the products of a neutralization reaction?

77. Write the balanced reaction of sulfuric acid with sodium hydroxide.

78. A solution contains 2×10^{-7} M $[H_3O^+]$.

   a. What is the pH? (Hint: pH = -log $[H_3O^+]$)

   b. Is it acidic, basic, or neutral?

   c. What is the pOH?

   d. What is the $[OH^-]$?

79. What is the purpose of a titration reaction?

80. In a titration, 29.96 mL of $Ba(OH)_2$ requires 16.08 mL of 2.303 M H_2SO_4.

a. Write a balanced equation for this reaction.

b. What is the molarity of the barium hydroxide? (Hint: Use $X_AM_AV_A=X_BM_BV_B$)

81. What does amphoteric mean?

82. Identify the acid and base in the following reaction. Then identify the conjugate acid/base pairs.

$$HF_{(aq)} + H_2O_{(l)} \leftrightarrow F^-_{(aq)} + H_3O^+_{(aq)}$$
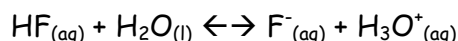
83. Differentiate between a strong and weak acid.

84. Name the 7 strong acids.

85. Which elements on the periodic table tend to form strong bases when combined with hydroxide ions?

86. Provide an example of each of the following:
   o   monoprotic acid:

   o   diprotic acid:

   o   triprotic acid:

Thermochemistry

87. Which process is exothermic: evaporation or condensation?

88. What is the lowest possible temperature in the universe: in Kelvin? _____
                                                                                              in °C? _____

89. Describe the movement of the particles in a sample of matter at absolute zero.

90. What do each of the following values represent and what do their signs indicate about a chemical reaction?

    a. ΔH:

        If positive:

        If negative:

    b. ΔS:

        If positive:

        If negative:

    c. ΔG:

        If positive:

        If negative:

91. Write the equation that represents the relationship between these values.

92. Determine the sign of ΔG and whether a reaction will be spontaneous or not under each of the following conditions:

| ΔH	ΔS	ΔG
+	+	
+	-	
-	+	
-	-	

93. What is the difference between a calorie and a Calorie?

94. How many joules are equivalent to 1 calorie?

95. What is the equation used to calculate specific heat? Indicate the meaning and units of each variable.

96. A 35 g sample of H_2O at 5°C absorbs 630 J of energy. What will be the final temperature of the water?

97. How much heat is released by the following reaction if 0.5 mole of sodium reacts completely with chlorine?

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)} + 822\ kJ$$
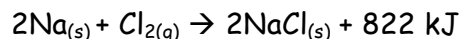
98. Find the ΔH for the reaction below, given the following reactions and subsequent ΔH values:

$$N_2H_{4(l)} + CH_4O_{(l)} \rightarrow CH_2O_{(g)} + N_{2(g)} + 3H_{2(g)}$$

$2NH_{3(g)} \rightarrow N_2H_{4(l)} + H_{2(g)}$	ΔH = 22.5 kJ
$2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$	ΔH = 57.5 kJ
$CH_2O_{(g)} + H_{2(g)} \rightarrow CH_4O_{(l)}$	ΔH = 81.2 kJ

Redox and Electrochemistry

99. Differentiate between a voltaic cell and an electrolytic cell.

100. Assign oxidation numbers to each atom in the following polyatomic ions:

- o nitrate

- o nitrite

- o sulfate

- o sulfite

- o carbonate

- o bicarbonate

101. Calcium reacts with chlorine to synthesize calcium chloride. Write the oxidation and reduction half reactions.

102. For the following reaction: $Na + H_2O \rightarrow NaOH + H_2$
   a. Which species is oxidized?

   b. Which species is reduced?

   c. Balance the reaction in acidic solution