Honors Chemistry - Semester 2 - Final Exam Review Packet

Name: _____

This Review is to remind you of the material this semester. It should benefit you alongside the reviews for each chapter provided with the tests. It is a good idea to review your tests and know what was missed and why to prepare for the final exam.

Ch 8: Reactions

Predicting Products of Reactions – Write the type of reaction on the line. Write the formula of the reactants and predict the products. Balance the reaction.

1. aluminum metal plus hydrochloric acid _____
2. copper plus sulfuric acid _____
3. combustion of octane, C_8H_{18} _____
4. calcium metal plus magnesium acetate solution_____
5. iron (III) metal plus oxygen_____
6. zinc chloride solution plus strontium sulfide solution_____
7. phosphoric acid plus barium hydroxide solution_____
8. Potassium phosphate solution plus zinc nitrate solution_____
9. Sodium chloride electrolyzed (decompose) _____
10. Calcium metal with water_____
11. Write the molecular, total ionic and net ionic reaction of lead (II) nitrate and potassium iodide.

Ch 12 Gases

1. What is the equation for pressure and describe what pressure is on the molecular level?

2. Fill in the following values of pressure:

   1 atm = _____ mmHg = _____ torr = _____kPa = _____ psi

3. A figure skater exerts a pressure by each blade of about 30.5 lb/in^2: What is this pressure in atm, mmHg, torr, and kPa?

4. Provide equations for the gas laws worked in this chapter.

5. If temperature and number of moles remain constant, explain using "molecules" and collisions what happens to pressure if volume is decreased. Is pressure and volume proportional or inversely proportional?

6. If pressure and number of moles remain constant, explain using "molecules" and collisions what happens to temperature if volume is decreased. Is temperature and volume proportional or inversely proportional?

7. If volume and number of moles remain constant, explain using "molecules" and collisions what happens to pressure if temperature is increased. Is pressure and temperature proportional or inversely proportional?

8. A sample of air has a volume of 2.25 cm^3 when its temperature is 25.5 ℃. If the temperature is increased to 100.0 ℃ without changing the pressure, what is the new volume of the sample in air?

9. The pressure of a 5.71 L sample of neon gas is 23.4 kPa. Calculate the new pressure when the volume becomes 3.40 L.

10. As the temperature of a sample of nitrogen increases from 15.5℃, the pressure of the sample changes from 0.950 atm to 1450 mmHg. What is the final temperature of the gas in celsius

11. What is the ideal gas constant?

12. What volume will be occupied by 17.3 g of oxygen gas at 203 kPa and 11°C ?

13. How many grams of $AlCl_3$ must decompose to produce 3.10 L of Cl_2 at 50.0°C and 0.971 atm?

$$AlCl_3 \rightarrow 2Al\ (s) + 3\ Cl_2\ (g)$$

14. Ammonia and gaseous hydrogen chloride combine to form ammonium chloride according to the equation:

$$NH_3\ (g) + HCl\ (g) \rightarrow NH_4Cl\ (s)$$

If 4.21 L of ammonia at 27°C and 1.02 atm combined with 5.35 L of HCl (g) at 26°C and 0.998 atm, what mass of NH_4Cl is produced?

15. Under what conditions does a real gas behave the LEAST ideal?

16. A slightly porous container contains equal pressures of H_2 gas, CO_2 gas and NH_3 gas. Which gas will effuse fastest? Which will effuse slowest?

17. If neon gas travels at 425 m/s at a given temperature, calculate the velocity of butane, $C_4H_{10,}$ at the same temperature.

18. A carbon dioxide molecule travels at about 505 m/s at room temperature. Find the velocity of a argon atom at the same temperature.

19. An unknown gas diffused 1.62 time slower than does oxygen gas. Calculate the molecular mass of the unknown. Make a reasonable prediction as to what the unknown gas is.

20. A 6.72 g sample of zinc is placed in an excess amount of 3M hydrochloric acid. Hydrogen gas is collected at 25.0ºC. The barometer in the science lab reads the total pressure to be 37.9 inHg. If the partial pressure of water is 30.89 torr, what volume, in L, of hydrogen gas is collected?

21. A gas mixture contains 88.0 g nitrogen, N_2, and 250 g carbon monoxide, CO. The total pressure of the mixture is 1.75 atm.
    a. What are the mole fractions of each gas?
    b. What are the partial pressures of each gas

Ch 11 States of Matter & Intermolecular Forces

22. What is the strongest intermolecular force (IMF) found in a sample of thousands of C_8H_{18} molecules?
    a. London b. dipole dipole c. ion-dipole d. H bridging e. nonpolar bond

23. What is the strongest intermolecular force IMF found between NH_3 molecules?
    a. London b. dipole dipole c. ion-dipole d. H bridging e. nonpolar bond

24. What is the strongest IMF found in a sample of thousands of CH_3Br molecules?
    a. London b. dipole dipole c. ion-dipole d. H bridging e. polar bond

25. What is the strongest IMF found in a sample of thousands of NaCl molecules in H_2O ?
    a. London b. dipole dipole c. ion-dipole d. H bridging e. polar bond

26. What holds PF_3 molecules with other PF_3 molecules?
    a. London b. dipole dipole c. ion-dipole d. H bridging e. polar bond

27. What holds the one chlorine atom to another chlorine atom in Cl_2 gas?
    a. London b. dipole-dipole c. polar bond d. H bridging e. nonpolar bond

28. What holds the potassium ion to the iodine ion in KI?
    a. Dipole-dipole b. polar bond c. H bridging d. London forces e. ionic bond

29. What holds the sulfur atoms to the hydrogen atoms in one molecule of H_2S?
    a. Ionic bond b. polar bond c. H bridging d. dipole-dipole e. nonpolar bond

30. As intermolecular forces increase, which of the following decreases?
    a. Surface tension b. bp c. VP d. mp e. viscosity

31. Circle all of the species below that can form a hydrogen bond. Explain why the others cannot.
    C_2H_6 CH_3NH_2 KCl $CH_3CH_2CH_2$ OH CH_3OCH_3

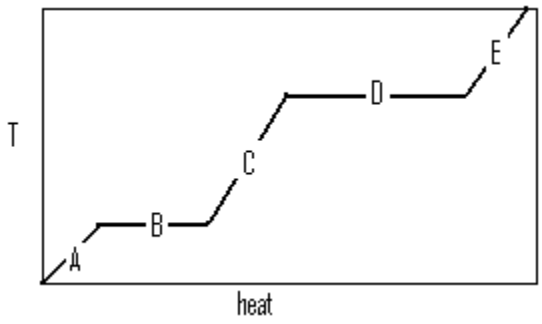
32. Rank the following compounds from weakest force of attraction to strongest. Justify your answers.
    H_2S $MgCl_2$ I_2 N_2 C_2I_6 H_2O NaCl

33. For each set of chemicals, circle the one with:

a. the higher surface tension	$C_5H_{11}OH$	or	C_5H_{12}
b. the higher viscosity	H_2S	or	NH_3
c. the lower vapor pressure	PCl_3	or	C_6H_6

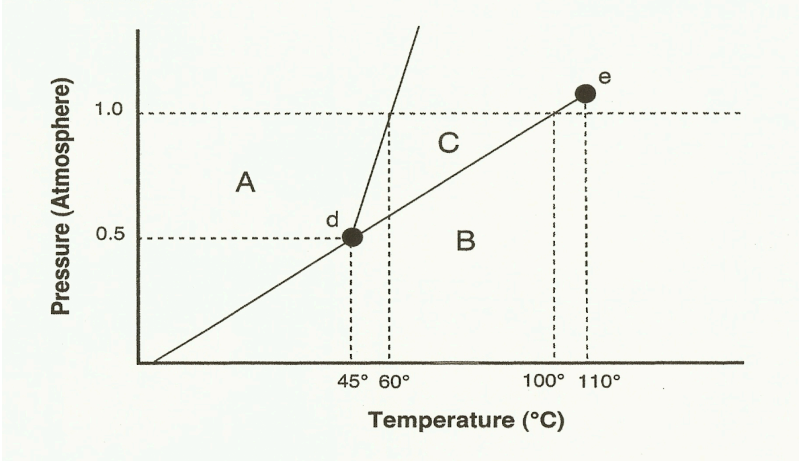
34. Place the letter from the heat curve (A-E) next to each of the following. Match them up.

Solid = _____ Boiling = _____
Liquid = _____ Condensing = _____
Gas = _____ Freezing = _____
Melting = _____ solid↔ liquid _____



Interpreting Phase Diagrams

Use the phase diagram to answer the questions below. .



35. Which section represents the solid phase? _____
36. What section represents the liquid phase? _____
37. What section represents the gas phase? _____
38. What letter represents the triple point? _____ What is the definition of a triple point?
39. What is this substance's melting point at 1 atmosphere of pressure? _____
40. What is this substance's boiling point at 1 atmosphere of pressure? _____
41. At what temperature and pressure do all three phases coexist? _____
42. At a constant temperature, what would you do to cause this substance to change from the liquid phase to the solid phase?
43. At what temperatures and pressures would the substance sublime? What does sublimation mean?

44. At what temperatures and pressures would the substance be a super critical fluid? What is this point called? _____ What is a supercritical fluid?

Ch 10: Thermodynamics

Potential Energy Diagrams

45. What is collision theory?

46. What will increase the rate of reaction?

47. Draw an endothermic and exothermic potential energy diagram. Label E_a, TS, Reactants, Products, ΔH

Enthalpy

48. What is Enthalpy? Is it a state function?

49. What are the 5 ways to calculate enthalpy?

50. What do +/- enthalpy values indicate?

51. Carbon monoxide burns in air to produce carbon dioxide according to the following balanced equation: $2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g) + 566\ kJ$

    How many grams of carbon monoxide are needed to yield 185 kJ of energy?

52. Nitrogen gas combines with oxygen gas according to the following balanced equation:

    $$N_2(g) + 2\ O_2(g) + 67.8\ kJ \rightarrow 2\ NO_2(g)$$

    If you have excess nitrogen, how much heat energy must be added to 540 g of oxygen to use up all that oxygen?

53. If the molar heat capacity of diamond is 6.11 J/mol·K. Determine the change in enthalpy that occurs when 25.0 g of diamond's temperature changes from 572 K to 494 K? Is this process exothermic or endothermic?

54. What is the change in enthalpy when a 500.00 g iron skillet is heated in the oven from 20ºC to 375ºC? Iron has a molar heat capacity of 25.1 J/K·mol.

55. A 28.4 g sample of aluminum is heated to 39.4 ℃, then is placed in a calorimeter containing 50.0 g of water. Temperature of water increases from 21.00 ℃ to 23.00 ℃. What is the specific heat of aluminum?

56. Overall reaction: $H_2O_{(g)} + SO_{3(g)} \rightarrow H_2SO_{4(l)}$ $\Delta H_{rxn} = ?$

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ $\Delta H = -484kJ$
$2S_{(s)} + 3O_{2(g)} \rightarrow 2SO_{3(g)}$ $\Delta H = -890kJ$
$H_{2(g)} + 2O_{2(g)} + S_{(s)} \rightarrow H_2SO_{4(l)}$ $\Delta H = -814kJ$

57. Overall reaction: $C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$ $\Delta H_{rxn} = ?$

$C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(l)}$ $\Delta H = -1401kJ$
$2C_2H_{6(g)} + 7O_{2(g)} \rightarrow 4CO_{2(g)} + 6H_2O_{(l)}$ $\Delta H = -3100kJ$
$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$ $\Delta H = -572kJ$

Use the standard enthalpies of formation, Appendix A on p. 833-834 or your homework

58. Equation to calculate ΔH from heats of formation:

59. *Note: The enthalpy of formation for FeO(s) is not in Appendix A, its ΔH_f = -272 kJ/mol.* Is the reaction endothermic or exothermic?

$$Fe_3O_{4(s)} + CO_{(g)} \rightarrow 3\ FeO_{(s)} + CO_{2(g)}$$

60. $2F_2(g) + 2H_2O(l) \rightarrow 4HF(g) + O_2(g)$

61. $NaOH(s) + HCl(g) \rightarrow NaCl(s) + H_2O(g)$

Entropy

62. What is entropy? Is it a state function?

63. What symbol is used for entropy?

64. Equation to calculate ΔS:

65. What do the +/- values of entropy tell us?

66. Calculate the entropy of the following reaction using standard entropy values in Appendix A of your text. Does the reaction favor order or disorder?

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

67. Predict whether the entropy change will be positive or negative for the following:

a. $H_2O\ (g) \rightarrow H_2O\ (l)$ ΔS_____

b. $C_6H_{12}O_6(s) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$ ΔS_____

c. $2NH_3(g) + CO_2(g) \rightarrow H_2O(l) + NH_2CONH_2(aq)$ ΔS_____

d. $NaCl(s) \rightarrow NaCl(aq)$ ΔS_____

e. $Cu(s)\ (100^oC) \rightarrow Cu(s)\ (25^oC)$ ΔS_____

f. $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ ΔS_____

Gibbs Energy

68. What is Gibbs energy? Is it a state function?

69. What symbol is used for Gibbs energy?

70. Equation to calculate ΔG:

71. What do the +/- values for Gibbs energy tell us?

72. What equation is used when Gibbs energy is not at standard state (298K)? This also brings all thermodynamic values into one equation.

73. What is true when Gibbs energy equals 0?

74. Fill in the chart that helps determine if a reaction is spontaneous.

ΔH	ΔS	ΔG	***Spontaneous?***

75. Calculate the Gibbs energy for the following reaction using Gibbs energy of formation values in Appendix A of your text. Is this reaction spontaneous?

$$CaCl_2(s) + H_2O(g) \rightarrow CaO(s) + 2HCl(g)$$

76. A reaction has a ΔH of -76 kJ and a ΔS of -117 J/K. Calculate ΔG at 298.15 K. Is the reaction spontaneous?

77. The vaporization of bromine requires 31.0 kJ/mol and an increase in disorder (ΔS° = 93.0 J/(mol•K)). At what temperature will this process be spontaneous?

$$Br_{2\,(l)} \rightarrow Br_{2\,(g)}$$

78. (Multiple choice) Given the values of ΔH and ΔS, which of the following changes will be spontaneous at constant T and P?
    a. ΔH = +35 kJ, ΔS = +10 J/K, T = 300. K
    b. ΔH = +45 kJ, ΔS = +153 J/K, T = 312 K
    c. ΔH = – , ΔS = +
    d. ΔH = – , ΔS = -

<u>Ch 13 Solutions</u>

79. Know the following:
    a. Solute
    b. Solvent
    c. Solution
    d. Saturated
    e. Unsaturated
    f. Supersaturated
    g. Colloid
    h. Suspension
    i. Tyndall Effect
    j. Colligative Properties
    k. Surfactant
    l. Emulsion
    m. detergent

80. Are the following substances soluble or insoluble in water? Are they ionic or covalent? What do you use to determine the solubility of the following substances?

a. KBr =
b. $PbCO_3$ =
c. $BaSO_4$ =
d. zinc hydroxide =
e. sodium acetate =
f. silver iodide =
g. cadmium (II) nitrate =
h. zinc carbonate =
i. silver acetate =
j. ammonium fluoride =
k. $Mg_3(PO_4)_2$ =
l. KOH =
m. $NiCl_2$ =
n. NH_4OH =
o. Hg_2SO_4 =
p. $PbBr_2$ =

81. How do you determine the solubility of covalent compounds?

82. Are the following miscible, immiscible, soluble or insoluble?
Octane (C_8H_{18}) (l) and water?
KCl (s) and water?
AgCl (s) and water?
Sugar and water?
HBr (l) and N_2 (l)?
$CH_3(CH_2)_4CH_3$ (l) and CBr_4 (l) ?
CH_3CH_2OH (l) and water?

83. What is the relationship between the solubility of a solid in a liquid and the temperature of the liquid?

84. What is the relationship between the solubility of a gas in a liquid and the temperature of the liquid?

85. What is molarity?

86. Calculate the molarity of a solution made by adding 2.5 grams of sodium hydroxide (NaOH) to 15 liters of water.

87. How many grams of $NaNO_3$ are needed to make 17 liters of 1.8 M solution?

88. How many liters of 12.0M HCl would you need to make 1.2L of 3.5M HCl?

89. What would the molarity of a solution be if you took 2.5L of 1.5M NaOH and added enough water to make the total volume 8.2L?

90. What mass of copper is required to react with 250 ml of a 0.100 M $AgNO_3$ solution?

$$Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow 2Ag_{(s)} + Cu(NO_3)_{2(aq)}$$

91. What volume of 2.00 M HCl is needed to neutralize 1.20 g of NaOH?

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Ch 15: Acids and Bases

92. Explain how the Bronsted-Lowry definition of a base is different from the Arrhenius definition of a base.

93. Why does the Arrhenius definition not work for all acids/bases?

94. Determine the acid, base, conjugate acid, and conjugate base in the following equations:
    a. $HClO_4(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + ClO_4^-(aq)$
    b. $H_2SO_3(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HSO_3^-(aq)$
    c. $HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_3O_2^-(aq)$
    d. $H_2S(g) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HS^-(aq)$
    e. $HSO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_3^{2-}(aq)$

95. What are the properties/characteristics of acids? What are the 7 strong acids?

96. What are the properties/characteristics of bases? What are the 8 strong bases?

97. What is the difference between a strong electrolyte, weak electrolyte, and nonelectrolyte solutions?

98. What is the pH of a 0.0034 M HBr solution?

99. Write the equation for the dissociation of hydrochloric acid, then calculate the pH of a 0.00476 M hydrochloric acid solution.

100. Write the equation for the dissociation of sulfuric acid, then calculate the pH of a solution that contains 3.25 g of sulfuric acid dissolved in 2.75 liters of solution.

101. Write the equation for the dissociation of sodium hydroxide, then calculate the pH of a 0.000841 M solution of sodium hydroxide.

102. Write the equation for the dissociation of aluminum hydroxide, if the pH is 9.85, what are the concentrations of the aluminum and hydroxide ions in solution? Assume concentration is low enough that it dissociates 100%.

103. Write the equation for the dissociation of calcium hydroxide, if the pH is 11.64 and you have 2.55 L of solution, how many grams of calcium hydroxide are in the solution?

104. If it takes 560 mL of 0.50 M NaOH to neutralize 100.0 mL of HCl solution with unknown concentration, what is the [HCl]? And, what was the original pH of the HCl solution? Additionally, identify the titrant and the analyte.

105. If 33.82 mL of an HNO_3 solution of unknown molarity requires 29.95 mL of 0.100M NaOH solution to be neutralized, what is the concentration of the HNO_3 solution? And, what was the original pH of the HNO_3 solution? Additionally, identify the titrant and the analyte.

106. What is the concentration of hydrogen ion, H_3O^+, present in a water sample if 100. ml of the sample requires 7.2 ml of 2.5×10^{-3} M NaOH to be neutralized? And, what was the original pH of the water sample? Additionally, identify the titrant and the analyte.