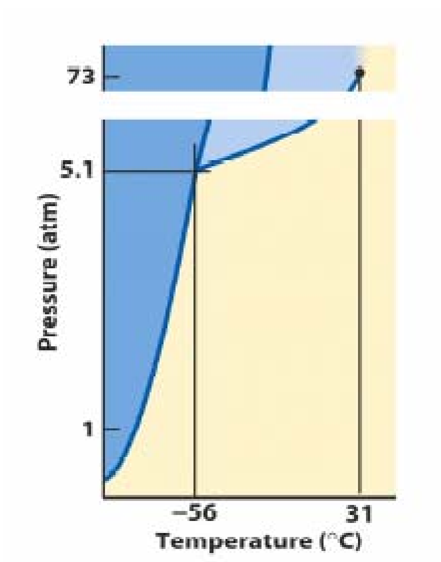
CH 302 Spring 2008 Worksheet 4

Practice Exam 1 (expect the exam to be more difficult)

1. Predict the signs of ΔH and ΔS for the sublimation of CO_2.
   a. $\Delta H > 0, \Delta S > 0$
   b. $\Delta H > 0, \Delta S < 0$
   c. $\Delta H < 0, \Delta S > 0$
   d. $\Delta H < 0, \Delta S < 0$

2. Vapor pressure increases ________ with temperature.
   a. Linearly
   b. Exponentially
   c. Logarithmically
   d. Quadratically

3. Which of the following salts will dissolve most easily in water?
   a. KBr
   b. MgO
   c. BN
   d. LiF



4. For this question, refer to the phase diagram shown above. What is the phase of this substance at -56°C and 5.1 atm?
   a. Solid
   b. Liquid
   c. Gas
   d. Mixture of solid and gas
   e. Mixture of solid, liquid, and gas
   f. Supercritical fluid

5. For this question, refer to the phase diagram shown above question 4. The substance is originally held in a container at -60°C and 20 atm. It is then heated to room temperature, and next allowed to expand to atmospheric pressure. What happens to the substance?
   a. The liquid in the container boils.
   b. The liquid in the container becomes a supercritical fluid.
   c. The gas in the container becomes a supercritical fluid.
   d. The solid in the container sublimes.
   e. The solid in the container melts, then the resulting liquid boils.
   f. The solid in the container sublimes, and then the resulting gas condenses.

6. 1 kg of water starts at 200°C and is allowed to cool to room temperature. For water, the specific heats are c_{ice} = 2.093 J/g°C, c_{water} = 4.186 J/g°C, and c_{steam} = 2.009 J/g°C. The enthalpy changes are ΔH_{fusion} = -335.5 J/g and $\Delta H_{vaporization}$ = 2.26 kJ/g. What is ΔH_{sys} for this process?
   a. -2775 J
   b. -2775 kJ
   c. +2775 kJ
   d. -1745 kJ
   e. +1745 kJ

7. Which of the following gases will be most soluble in water?
   a. CH_4
   b. O_2
   c. CCl_4
   d. He
   e. Cl_2

8. Rank the following in terms of increasing miscibility with water: CH_3OH, CH_4, CH_3CH_2OH, $CH_3CH_2CH_2OH$.
   a. $CH_3CH_2CH_2OH < CH_3CH_2OH < CH_3OH < CH_4$
   b. $CH_4 < CH_3OH < CH_3CH_2OH < CH_3CH_2CH_2OH$
   c. CH4 < $CH_3CH_2CH_2OH < CH_3CH_2OH < CH_3OH$
   d. $CH_3OH < CH_3CH_2OH < CH_3CH_2CH_2OH < CH_4$

9. 25 g of acetic acid (CH_3COOH) and 75 g of ethanol (CH_3CH_2OH) are mixed together. At 25°C, the vapor pressures of these compounds are 16 and 59 torr, respectively. What is the vapor pressure of the mixture?
   a. 37.50 torr
   b. 48.25 torr
   c. 26.75 torr
   d. 50.25 torr
   e. 24.75 torr

10. Butanol boils at 118°C and has a ΔH_{vap} of 50 kJ/mol. What is butanol's vapor pressure at room temperature, 25°C? Recall that 1 atm = 760 torr and R = 8.314 J/mol K.

a. 6.28 torr
b. 91965 torr
c. 756.4 torr
d. 763.7 torr

11. The equilibrium constant *K* for

$$2\ SO_3(g) \rightleftharpoons 2\ SO_2(g) + O_2(g)$$

is 2.5×10^{-25} at 298 K. Predict its value at 500. K The heat of vaporization for this reaction is + 198 kJ/mole.

a. 65.1×10^{-25}
b. 2.5×10^{-11}
c. 2.5×10^{-8}
d. 4×10^{10}

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12. Which of these is **not** an example of using a colligative property to your advantage?
a. Adding salt to water so that your spaghetti cooks faster.
b. Mixing ethylene glycol and water in your radiator so that the liquid remains liquid over a wide range of temperatures.
c. Cooking your spaghetti in a pressure cooker so that it cooks faster.
d. Salting the roads after it snows.

13. 20 g of $BaCl_2$ is added to 1 L of water (d_{water} = 1 g/mL). What is the boiling point of the water, given the boiling point of pure water is 100°C and K_b for water is 0.512 °C/m?
a. 99.852°C
b. 100.148°C
c. 99.951°C
d. 100.0492°C
e. 89.760°C
f. 110.240°C

14. Which is the correct expression of K given the reaction

$$NaCl\ (aq) + AgNO_3\ (aq) \rightarrow NaNO_3\ (aq) + AgCl\ (s)$$

a. $K = \frac{[NaNO_3][AgCl]}{[NaCl][AgNO_3]}$

b. $K = \frac{[NaCl][AgNO_3]}{[NaNO_3][AgCl]}$

c. $K = \frac{[NaNO_3]}{[NaCl][AgNO_3]}$

15. Nothing happens. Which of the following values for K best reflects this statement?

a. 1×10^{-4}
b. 1
c. 1×10^{4}
d. 1×10^{-14}
e. 1×10^{62}

16. For some temperature, assume that K_p for the combustion reaction below is 10^5. You mix 1 atm each of C_2H_5OH, O_2, H_2O, and CO_2. Which of the following is a possible set of equilibrium concentrations?

$$C_2H_5OH\ (g) + 3\ O_2\ (g) \leftrightarrow 2\ CO_2\ (g) + 3\ H_2O\ (g)$$

a. P_{C2H5O2} = 1.31 atm, P_{O2} = 1.92 atm, P_{CO2} = 0.390 atm, P_{H2O} = 0.0845 atm
b. P_{C2H5O2} = 0.0652 atm, P_{O2} = 0.691 atm, P_{CO2} = 1.94 atm, P_{H2O} = 1.62 atm
c. P_{C2H5O2} = 0.691 atm, P_{O2} = 0.0652 atm, P_{CO2} = 1.62 atm, P_{H2O} = 1.94 atm
d. P_{C2H5O2} = 1.92 atm, P_{O2} = 1.31 atm, P_{CO2} = 0.0845 atm, P_{H2O} = 0.390 atm

17. Calculate the equilibrium concentration of CO_2, given that you start with 1 M each of CO, CO_2, and H_2 in water, and K_c = 223.

$$CO\ (aq) + H_2O\ (l) \leftrightarrow CO_2\ (aq) + H_2\ (aq)$$

a. 1.98 M
b. 0.126 M
c. 0.00893 M
d. 1.87 M

18. For the formation of ammonia, imagine you start with 1.5 M N_2, 1 M H_2 and 2.5 M NH_3. Which way will the reaction shift, given K_c = 3.8?

$$N_2(g) + 3\ H_2(g) \leftrightarrow 2\ NH_3\ (g)$$

a. To the products.
b. To the reactants.
c. It won't.
d. Up.
e. Down.

19. An exothermic reaction is placed over a flame. What happens to the reaction?

a. Nothing happens.
b. The reaction shifts toward the reactants.
c. The reaction shifts toward the products.

20. The pressure on the vessel in which the following reaction is taking place is doubled. What happens to the reaction?

$$N_2\ (l) + O_2\ (g) \leftrightarrow 2\ NO\ (g)$$

a. Nothing happens.
b. The reaction shifts toward the reactants.
c. The reaction shifts toward the products.

21. At 298 K, ΔG for a given reaction is -25.7 kJ. What is K for this reaction at 298 K?
a. 1.01
b. 0.990
c. 3.20×10^4
d. 3.13×10^{-5}
e. 22.0

22. At some temperature, $K_w = 5 \times 10^{-14}$. What is the pOH of pure water at this temperature?
a. 6.00
b. 6.65
c. 7.00
d. 7.35
e. 8.00

23. Which of the following is the most likely temperature at which $K_w = 5 \times 10^{-14}$ as above, given $K_w = 1 \times 10^{-14}$ at room temperature?
a. 0 °C
b. 12 °C
c. 25 °C
d. 50 °C

24. What is the OH^- concentration of a solution that is pH 4.6?
a. 9.4
b. 2.5×10^{-5}
c. 4×10^{-10}
d. 1×10^{-10}
e. 7

25. Which of the following is the strongest base?
a. Ammonia, $K_b = 1.8 \times 10^{-5}$

b. Aniline, $K_b = 4.2 \times 10^{-10}$
c. Dimethylamine, $K_b = 5.1 \times 10^{-4}$
d. Pyridine, $K_b = 1.4 \times 10^{-9}$
e. Urea, $K_b = 1.5 \times 10^{-14}$

26. What is the pH of a 0.05 M solution of $Ba(OH)_2$. Hint, you really don't need a calculator to do this problem?
a. 1
b. 13
c. 1.3
d. 12.7

27. The pK_a of hydrofluoric acid (HF) is 3.15. If 132 g of HF is dissolved in 1 L of water, what is the pOH of the resulting solution?
a. 13.5
b. 12.83
c. 14.66
d. 1.17
e. 14.82

28. 1 mole of ethylenediamine is dissolved in 1 L water, and the resulting $[OH^-]$ is 3.16×10^{-11} M. What is K_a for ethylenediamine?
a. 10^{-22}
b. 10^{-7}
c. 5×10^{-6}
d. 1.8×10^{-2}

29. Which of the following is **not** a strong acid?
a. HF
b. HCl
c. HBr
d. HI
e. $HClO_4$
f. $HClO_3$

30. 100 ml of 0.2 M formic acid and 200 ml of .1 M lithium formate are mixed together, What type of solution is formed and what is the pH? $Ka = 1 \times 10^{-4}$ for formic acid. Hint: You should feel silly if you use a calculator.

a. Buffer, 4
b. Weak acid, 2.3
c. Weak base, 10
d. Buffer, 2.3
e. Weak acid, 4
f. Weak base, 11.7