Spring 2009 CH302 Practice Exam 1

1. In general, increasing the temperature favors which phase changes?
   1. sublimation, vaporization, fusion
   2. sublimation, vaporization, condensation
   3. fusion, vaporization, deposition
   4. vaporization, freezing, deposition
   5. freezing, deposition, condensation

2. Vapor pressure:
   A. Is an equilibrium process
   B. increases as IMF increases
   C. is temperature dependent
   D. is higher in CH_3CH_3 than H_2
   E. decreases with the addition of solutes
   F. depends on the whole volume of the liquid
   G. decreases at temp increases
   1. A, C, E, G
   2. A, B, C, E
   3. A, C, D, E
   4. B, D, F, G
   5. A, C, E
   6. A, C, E, F

3. Rank the following in decreasing order of solubility in water:

$Mg(OH)_2$, NaCl, Al_2O_3, CsI, $BeBr_2$, KOH, BaO.

   1. Al_2O_3 > BaO> $Mg(OH)_2$> $BeBr_2$> KOH> NaCl> CsI
   2. NaCl> CsI> KOH> $BeBr_2$>$Mg(OH)_2$> BaO> Al_2O_3
   3. Al_2O_3 > BaO> $Mg(OH)_2$> $BeBr_2$> KOH> NaCl> CsI
   4. CsI > NaCl> KOH> $BeBr_2$> $Mg(OH)_2$> BaO> Al_2O_3
   5. NaCl> CsI> $BeBr_2$> KOH> $Mg(OH)_2$> BaO> Al_2O_3
   6. CsI > NaCl> $BeBr_2$> KOH> $Mg(OH)_2$> BaO> Al_2O_3

4. According to the given phase diagram for carbon, how many triple points are there? What would you expect to see at 0.01GPa, 4500K?
   1. 5; metastable liquid, graphite and liquid
   2. 4; graphite, metastable liquid and vapor.
   3. 5; vapor, metastable liquid, graphite.
   4. 4; graphite, liquid, diamond.
   5. 3; graphite, metastable liquid and vapor.

5. According to the given pressure-temperature diagram, a sample of carbon at 0.005GPa and 2000K is graphite. This sample is then heated to 7000K at constant pressure. Then, at constant temperature, the sample is compressed to 1.00GPa. Again, at constant pressure, the temperature is decreased to 1000K. At this temperature, the pressure is increased to 500GPa. How many phase transitions has the carbon sample undergone?
   1. 6
   2. 4
   3. 1
   4. 5
   5. 7

6. How much heat is generated when 10g steam at 115 ^{O}C is cooled to -75 ^{O}C?

C_{ice} = *a* J/g ^{O}C; C_{water} = *b* J/g ^{O}C; C_{steam} = *c* J/g ^{O}C; ΔH_{vap} = *d* J/g; ΔH_{fus} = *e* J/g.

1. q = - [150(5*a* + *c*) + 10(100*b* + *d* + *e*)] J
2. q = [150(5*a* + *c*) + 10(100*b* + *d* + *e*)] J
3. q = -[150(*a* + *c*) + 10(100*b* + *d* + *e*)] J
4. q = [150 (*a* + *c*) + 1000*b*] J
5. q = - [150 (5*a* + *c*) + 1000*b*] J

7. Which solvent would you expect BH_3 gas to be most soluble in?

1. C_6H_6
2. H_2O
3. CH_3CH_2OH
4. CH_2Cl_2
5. $N(CH_3)_3$

8. Rank the following in decreasing order of miscibility with water: H_2O_2, C_6H_6, $HOCH_2CH_2NH_2$, $C_2H_6Cl_2$, and $CH_3CH_2CH_2SH$.

1. H_2O_2 > $HOCH_2CH_2NH_2$ > $CH_3CH_2CH_2SH$ > $C_2H_6Cl_2$ > C_6H_6

2. $HOCH_2CH_2NH_2$ > H_2O_2 > $C_2H_6Cl_2$ > $CH_3CH_2CH_2SH$ > C_6H_6

3. H_2O_2 > $HOCH_2CH_2NH_2$ > $C_2H_6Cl_2$ > $CH_3CH_2CH_2SH$ > C_6H_6

4. C_6H_6 > $CH_3CH_2CH_2SH$ > $C_2H_6Cl_2$ > $HOCH_2CH_2NH_2$ > H_2O_2

5. C_6H_6 > $CH_3CH_2CH_2SH$ > $C_2H_6Cl_2$ > H_2O_2 > $HOCH_2CH_2NH_2$

9. At 25 C, the vapor pressure of pure benzene (C6H10) is 0.1252 atm. Suppose 6.4 g of napthalene, C10H8, is dissolved in 78 g of benzene (benzene's molar mass is 78 g/mol). Assuming ideal behavior, what is the vapor pressure of benzene over the solution?

1. 0.9525 atm
2. 0.119 atm
3. 0.1252 atm

10. Water has a vapor pressure of 24 mmHg at 25 °C and a heat of vaporization of 40.7 kJ/mol. What is the vapor pressure of water at 67 °C?

1. 182 mmHg
2 3.15 mmHg
3. 760 mmHg
4. 0 mmHg

11. For the following made-up reaction, where K_{200K} = 0.0035 and K_{300K} = 0.38, solve for the enthalpy change for the reaction.

A + X <-> AX

1. ΔH = 23.3 kJ/mol

2. ΔH = -48 kJ/mol

3. ΔH = 48 kJ/mol

4. ΔH = -23.3 kJ/mol

12. The vapor pressure is always less above the (pure solvent or dilute solution) than it is above the (pure solvent or dilute solution).
    1. dilute solution, pure solvent
    2. pure solvent, dilute solution

13. If you add 45 g of NaCl to 500 g of water, what will the melting and boiling points be of the resulting solution? For liquid water, K_b = 0.52 C/m and K_f = 1.86 C/m. Answer should be in the form of (melting pt, boiling pt)

    1. 101.6 C, 5.73 C
    2. 5.73 C, 101.6 C
    3. -5.73 C, 101.6 C
    4. -5.73 C, 98.4 C

14. Iron thiocyanate ($FeSCN^{2+}$) is a complex ion that appears orange-red in solution

Iron (III) and thiocyanate ions are both colorless in solution. All species are aqueous.

$FeSCN^{2+}$ <-> Fe^{3+} + SCN^-

Set up the equilibrium expression for the reaction:

1. K = $[FeSCN^{2+}]/[Fe^{3+}]$ [SCN-]

2. K = $[Fe^{3+}]$ [SCN-]/ $[FeSCN^{2+}]$

3. K = $[Fe^{3+}]^3$ [SCN-]/ $[FeSCN^{2+}]^2$
4. K = $[FeSCN^{2+}]^2/[Fe^{3+}]^3$ [SCN-]

15. For the decomposition of gaseous water into hydrogen and oxygen gas, K= 8 X 10^{-41}

With this information, is water a good source of oxygen at room temperature?

1. Yes

2. No

16. The gas-phase dissociation of phosphorus pentachloride to the trichloride has Kp = 3.60 at 540°C:

$$PCl_5 \square PCl_3 + Cl_2$$

What will be the partial pressures of all three components if 0.200 mole of PCl_5 and 3.00 moles of PCl_3 are combined and brought to equilibrium at this temperature?

1. $P(PCl_5)$ = 2 atm, $P(PCl_3)$ = 3 atm, $P(Cl_2)$ = 0 atm

2. $P(PCl_5)$ = 3.159, $P(PCl_3)$ = 1.41 atm, $P(Cl_2)$ = 0 .159 atm

3. $P(PCl_5)$ = 0.41 atm, $P(PCl_3)$ = 4.59 atm, $P(Cl_2)$ = 1.59 atm

4. $P(PCl_5)$ = 0.041 atm, $P(PCl_3)$ = 3.159 atm, $P(Cl_2)$ = 0.159 atm

17. For the following reaction, the partial pressures of carbon dioxide, water, methane, and oxygen all are the same at equilibrium. What is their partial pressure?

CH_4 (g) + $2O_2$ (g) <-> CO_2 (g) + H_2O (g)   Keq = 5

1. 1 atm
2. 5 atm
3. 10 atm
4. 0.2 atm
5. 0.1 atm

18. For the following reaction, C_4H_8 (s) + $6O_2$ (g) <-> $4CO_2$ (g) + $4H_2O$ (g), K_{eq} = 10 atm. The initial pressures of oxygen, carbon dioxide, and water are 1 atm, 0.5 atm, and 0.5 atm respectively. Which of the following is true for this system?

1. To approach equilibrium, the reaction must shift left
2. More butene (C_4H_8) needs to be oxidized to reach equilibrium
3. A reagent that removes water vapor would help the system reach equilibrium faster
4. The reaction is now at equilibrium
5. Both 2 and 3 are true

19. For the reaction 3A (g) + B(g) <-> C (s) +D (g), ΔH = -100 J. Which of the following would minimize the formation of C?

I. Decreasing the volume of the container

II. Heating the reaction

III. Removing A from the reaction

IV. Performing the reaction at a very high attitude

1. I
2. II
3. III

4. IV

5. II and III

6. II, III, and IV

7. All of the above

20. Consider the exothermic combustion of hydrogen, $2H_{2\ (g)} + O_{2\ (g)}$ <-> $2H_2O$ (l). Which of the following would shift the reaction to the same direction?

I. Continuously removing water from the reaction

II. Heating the reaction

III. Decreasing the size of the container

1. I and II

2. I and III

3. II and III

4. None

21. Which of the following gives the correct pair of equilibrium constant, K, and change in free energy, ΔG?

1. K = 3, ΔG = 3 kJ/mol

2. K= 1, ΔG = -1 kJ/mol

3. K = 0, ΔG = 0 kJ/mol

4. K = 0.1, ΔG = -5 kJ/mol

5. K = 5, ΔG = -4 kJ/mol

22. The auto-protolysis of water:

I. Produces more hydrogen ions at higher temperatures

II. Produces more hydroxide ions at higher temperatures

III. Explains why water can only have a pH of 7

1. I

2. II

3. III

4. I and II

5. I, II, and III

23. At 100 ^{O}C, the pH of water is 6.145, what is the Kw of water at this temperature?

1. 1.00×10^{-14}
2. 5.13×10^{-13}
3. 0.53×10^{-14}
4. 8.81×10^{-15}
5. 7.01×10^{-16}

24. Determine the molar solubility of copper I thiocyante (CuSCN) whose Ksp = 1.64×10^{-11}.

1. 2×10^{-3} M
2. 4×10^{-6} M
3. 1×10^{-2} M
4. 2×10^{-1} M

25. Rank the following generic compounds from most to least soluble:

CA Ksp = 10^{-8}
C_2A_3 Ksp = 10^{-20}
CA_3 Ksp = 10^{-16}
C_2A Ksp = 10^{-12}

1. $CA_3 > C_2A_3 > CA > C_2A$
2. $C_2A > CA_3 > C_2A_3 > CA$
3. $CA > C_2A > CA_3 > C_2A_3$
4. $C_2A_3 > CA > C_2A > CA_3$

26. Which equation below could be used to convert [H+] into pOH?

1. pOH = -log kW + log [H+]
2. pOH = log(Kw/[H+])
3. pOH = pKw + pH
4. all of these equations could be used
5. none of these equations could be used

27. Rank the following acids in the order of decreasing strength of their conjugate bases (strongest conjugate base to weakest conjugate base):

propionic acid (CH_3CH_2COOH) pKa = 4.89
hypochlorous acid (HClO) pKa = 7.46
formic acid (CHOOH) pKa = 3.74
nitrous acid (HNO_2) pKa = 3.40

1. $CHOOH > HNO_2 > HClO > CH_3CH_2COOH$
2. $CH_3CH_2COOH > CHOOH > HNO_2 > HClO$
3. $HClO > CH_3CH_2COOH > CHOOH > HNO_2$

4. HNO_2 > HClO > CH_3CH_2COOH > CHOOH

28. What would be the pH of a 0.05 M solution of $Ca(OH)_2$ (Calcium Hydroxide) at room temperature?
    1. 12.7
    2. 13
    3. 1.3
    4. 1

29. What would be the pH of a 0.04 M solution of phenylammonium chloride ($C_6H_5NH_3Cl$) at room temperature? (assume the K_b of phenylamine is 4×10^{-10})
    1. 11
    2. 5.4
    3. 8.6
    4. 3
    5. 7

30. If you had a 1 M solution of acetic acid (CH3COOH, Ka = 1.8 x 10-5) and a 1 M solution of formic acid (CHOOH, Ka = 1.8 x 10-4), what would the difference in their pH be?
    1. 3.2
    2. 1.0
    3. 0.5
    4. 2.4
    5. 2.9