Chemistry 106 Fall 2007 Exam 3 Form B

1. Which one of the following salts will form a neutral solution on dissolving in water?

A. NaCN B. NH_4NO_3 C. NaCl D. KNO_2 E. $FeCl_3$

2. Which one of the following is a buffer solution?

A. 0.10 M KCN
B. 0.40 M HCN and 0.10 KCN
C. 0.20 M CH_3COOH
D. 1.0 M HNO_3 and 1.0 M $NaNO_3$
E. 0.50 M HCl and 0.10 NaCl

3. Suppression of the solubility of one ion by the addition of an excess of the counter-ion in its insoluble salt is called the:

A. common-ion effect
B. ionic suppression effect
C. counter-ion effect
D. excession effect
E. precipitation effect

4. The solubility of lead(II) iodide is 0.064 g/100 mL at 20°C. What is the solubility product for lead(II) iodide?

A. 2.7×10^{-12} B. 1.4×10^{-3} C. 1.1×10^{-11} D. 1.1×10^{-8} E. 3.9×10^{-6}

5. A solution of NaOH (25.00 mL) was titrated to completion with 30.55 mL of 0.1020 M HCl. What was the concentration of the sodium hydroxide?

A. 0.08347 M
B. 11.98 M
C. 0.04174 M
D. 0.1246 M
E. 0.2493 M

6. Calculate the pH of a buffer solution prepared by dissolving 0.20 mole of cyanic acid (HCNO) and 0.80 mole of sodium cyanate (NaCNO) in enough water to make 1.0 liter of solution. [K_a(HCNO) = 2.0×10^{-4}]

A. 3.70 B. 0.97 C. 4.30 D. 4.40 E. 3.10

7. The OH^- concentration in a 7.5×10^{-3} M $Ca(OH)_2$ solution is

A. 1.3×10^{-12} M.
B. 1.0×10^{-7} M.
C. 1.0×10^{-14} M.
D. 1.5×10^{-2} M.
E. 7.5×10^{-3} M.

8. Acetylsalic acid (aspirin) is a weak acid with a $K_a = 3.0 \times 10^{-4}$. What is K_b of the conjugate base of aspirin?

A. 3.0×10^{-18}
B. 3.3×10^{3}
C. 3.3×10^{-11}
D. 3.0×10^{10}
E. 3.3×10^{17}

9. The stronger the acid,

   A. the more concentrated the acid.
   B. the weaker its conjugate base.
   C. the stronger its conjugate base.
   D. the less concentrated the conjugate base.
   E. none of the above

10. Calculate the concentration of oxalate ion ($C_2O_4^{2-}$) in a 0.175 M solution of oxalic acid ($C_2H_2O_4$).
    [For oxalic acid, $K_{a1} = 6.5 \times 10^{-2}$, $K_{a2} = 6.1 \times 10^{-5}$.]

    A. 0.0791 M
    B. 6.1×10^{-5} M
    C. 0.175 M
    D. 4.0×10^{-6} M
    E. 0.11 M

11. A 0.14 M HNO_2 solution is 5.7% ionized. Calculate the H^+ ion concentration.

    A. 0.057 M B. 0.13 M C. 0.14 M
    D. 0.80 M E. 8.0×10^{-3} M

12. Calculate the pH of a 3.5×10^{-3} M HNO_3 solution.

    A. 3.00 B. -2.46 C. 2.46 D. 3.46 E. 0.54

13. A solution with a pOH of 4.3 has a $[H^+]$ of

    A. 4.8×10^{-5} M. B. 6.8×10^{-9} M. C. 3.2×10^{-4} M. D. 2.1×10^{-10} M.
    E. 9.7

14. Arrange the acids HOBr, $HBrO_3$, and $HBrO_2$ in order of increasing acid strength.

    A. $HBrO_3 < HBrO_2 < HOBr$
    B. $HBrO_2 < HOBr < HBrO_3$
    C. $HOBr < HBrO_2 < HBrO_3$
    D. $HBrO_3 < HOBr < HBrO_2$
    E. $HOBr < HBrO_3 < HBrO_2$

15. In the following reaction, which species is the Lewis acid?

$$Cu^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)]^{2+}$$

A. Cu^{2+}
B. NH_3
C. $[Cu(NH_3)]^{2+}$
D. None of these is an acid.

16. In the following reaction, which is the acid reactant and its conjugate base product?

$$CH_3NH_2 + HSO_4^- \rightleftharpoons CH_3NH_3^+ + SO_4^{2-}$$

A. HSO_4^- and SO_4^{2-}
B. CH_3NH_2 and SO_4^{2-}
C. CH_3NH_2 and $CH_3NH_3^+$
D. HSO_4^- and $CH_3NH_3^+$
E. none of these pairs is correct.

17. Pure water establishes an equilibrium of

A. OH^- and H_3O^+ ions in solution.
B. H_2O and OH_2 molecules in solution.
C. O^{2-} and H_4O^{2+} ions in solution.
D. O^{2-}, OH^-, H_2O, H_3O^+, and H_4O^{2+} ions in solution.
E. H_2 and O_2 molecules in solution.

18. Which of the following is a true statement about chemical equilibria in general?

A. Equilibrium is the result of the cessation of all chemical change.
B. There is only one set of equilibrium concentrations that equals the Kc value.
C. At equilibrium, the rate of the forward reaction is equal to as the rate of the reverse reaction.
D. At equilibrium, the rate constant of the forward reaction is equal to the rate constant for the reverse reaction.
E. At equilibrium the total concentration of products equals the total concentration of reactants, that is, [products] = [reactants].

19. On analysis, an equilibrium mixture for the reaction $2H_2S(g) \leftrightarrow 2H_2(g) + S_2(g)$ was found to contain 1.0 mol H_2S, 4.0 mol H_2, and 0.80 mol S_2 in a 4.0 L vessel. Calculate the equilibrium constant, K_c, for this reaction.

A. 0.8 B. 0.64 C. 1.6 D. 12.8 E. 3.2

20. The equilibrium constant for the reaction $Ni(s) + 4CO(g) \leftrightarrow Ni(CO)_4(g)$ is 5.0×10^4 at 25ºC. What is the equilibrium constant for the reaction $Ni(CO)_4(g) \leftrightarrow Ni(s) + 4CO(g)$?

A. 5.0×10^{-4} B. 5.0×10^{4} C. 2.0×10^{-5}
D. 2.5×10^{9} E. 2.0×10^{-3}

21. An equilibrium that strongly favors products has

A. a value of Q<<1.
B. a value of Q>>1.
C. a high rate.
D. a value of K<<1.
E. a value of K>>1.

22. For the reaction $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$, $K_c = 50.2$ at 445ºC. If $[H_2] = [I_2] = [HI] = 1.75 \times 10^{-3}$ M at 445ºC, which one of the following statements is true?

A. The concentrations of H_2 and I_2 will increase as the system approaches equilibrium.
B. The system is at equilibrium, thus no concentration changes will occur.
C. The concentrations of HI and I_2 will increase as the system approaches equilibrium.
D. The concentration of HI will increase as the system approaches equilibrium.
E. The concentrations of H_2 and HI will fall as the system moves toward equilibrium.

23. At 35ºC, the equilibrium constant for the reaction $2NOCl(g) \leftrightarrow 2NO(g) + Cl_2(g)$ is $K_c = 1.6 \times 10^{-5}$. An equilibrium mixture was found to have the following concentrations of Cl_2 and NOCl: $[Cl_2] = 1.2 \times 10^{-2}$ M; $[NOCl] = 2.8 \times 10^{-1}$ M. Calculate the concentration of NO(g) at equilibrium.

A. 1.0×10^{-4} M
B. 2.8×10^{-1} M
C. 1.6×10^{-3} M
D. 2.4×10^{-2} M
E. 1.0×10^{-2} M

24. For the following reaction at equilibrium, which one of the changes below would cause the equilibrium to shift to the left?
$2NOBr(g) \leftrightarrow 2NO(g) + Br_2(g)$, $\Delta H^\circ_{rxn} = 30$ kJ/mol

A. Increase the container volume. B. Remove some Br_2.
C. Decrease the temperature. D. Remove some NO.
E. Add more NOBr.

25. Consider the following gas phase equilibrium system:
$PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ $\Delta H^\circ_{rxn} = +87.8$ kJ/mol.
Which of the following statements is false?

A. Increasing the temperature causes the equilibrium constant to increase.
B. A catalyst speeds up the approach to equilibrium and shifts the position of equilibrium to the right.
C. Decreasing the total pressure of the system shifts the equilibrium to the right.
D. Increasing the temperature shifts the equilibrium to the right.
E. Increasing the system volume shifts the equilibrium to the right.

26. A chemical equilibrium may be established by

A. starting a reaction with products only.
B. starting a reaction with a greater amount of products than reactants.
C. starting a reaction with reactants only.
D. starting a reaction with equal quantities of reactants and products.
E. all the above

27. At 250ºC, the equilibrium constant Kp for the reaction $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ is 1.80. Sufficient PCl_5 is put into a reaction vessel to give an initial pressure of 2.74 atm at 250ºC. Calculate the pressure of PCl_5 after the system has reached equilibrium.

A. 1.50 atm
B. 4.24 atm
C. 1.24 atm
D. 0.94 atm
E. 1.12 atm

28. The reaction $2SO_3(g) \leftrightarrow 2SO_2(g) + O_2(g)$ is endothermic. If the temperature is increased,

A. K_c will increase.
B. no change will occur in K_c .
C. the pressure will decrease.
D. K_c will decrease.
E. more SO_3 will be produced.

29. In which of the following gas-phase equilibria is the yield of products increased by increasing the total pressure on the reaction mixture?

A. $2SO_3(g) \leftrightarrow 2SO_2(g) + O_2(g)$
B. $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$
C. $CO(g) + H_2O(g) \leftrightarrow CO_2(g) + H_2(g)$
D. $2NO(g) + Cl_2(g) \leftrightarrow 2NOCl(g)$

30. Which is the correct equilibrium constant expression for the following reaction?
$Fe_2O_3(s) + 3H_2(g) \leftrightarrow 2Fe(s) + 3H_2O(g)$

A. $K_c = [Fe_2O_3]\,[H_2]^3 / ([Fe]^2[H_2O]^3)$
B. $K_c = [Fe]2[H_2O]^3 / ([Fe_2O_3]\,[H_2]^3)$
C. $K_c = [H_2]/\,[H_2O]$
D. $K_c = [Fe]\,[H_2O] / ([Fe_2O_3]\,[H_2])$
E. $K_c = [H_2O]^3 / [H_2]^3$

31. Determine the equilibrium constant (K_p) at 25°C for the reaction $CO(g) + H_2O(g) \leftrightarrow CO_2(g) + H_2(g)$. $\Delta G° = -28.5$ kJ.

A. 2.9×10^{-60} B. 3.4×10^{59} C. 1.2
D. 1.0×10^{-4} E. 1.0×10^{5}

32. At 1500°C the equilibrium constant for the reaction $CO(g) + 2H_2(g) \leftrightarrow CH_3OH(g)$ has the value $K_p = 1.4 \times 10^{-7}$. Calculate $\Delta G°$ for this reaction at 1500°C.

A. 1.07 kJ/mol B. 105 kJ/mol C. 233 kJ/mol
D. -105 kJ/mol E. -233 kJ/mol

33. Calculate K_p assuming pressure is measured in atmospheres for the reaction $2NOCl(g) \leftrightarrow 2NO(g) + Cl_2(g)$ at 400°C if K_c at 400°C for this reaction is 2.1×10^{-2}.

A. 2.1×10^{-2} B. 1.7×10^{-3} C. 0.70
D. 1.2 E. 3.8×10^{-4}

Answer Key for Test “Exam 3 F07 Form B.mte”, 11/9/07

No. in Q-Bank	No. on Test	Correct Answer
16 122	1	C
16 123	2	B
16 95	3	A
16 126	4	D
16 125	5	A
16 124	6	C
16 118	7	D
16 121	8	C
16 52	9	B
16 120	10	B
16 119	11	E
16 116	12	C
16 48	13	D
16 117	14	C
16 31	15	A
16 33	16	A
16 39	17	A
15 118	18	C
15 119	19	E
15 122	20	C
15 17	21	E
15 121	22	D
15 120	23	E
15 126	24	C
15 127	25	B
15 22	26	B
15 130	27	C
15 129	28	A
15 128	29	D
15 117	30	E
15 125	31	E
15 124	32	C
15 123	33	D