Teaching Center

CHM 2046 Exam 2 Review

Chapter 19 – Ionic Equilibria

1) Select the true statement below regarding an A-/HA buffer
   A) The purpose of the buffer is to keep [HA] and [A-] as constant as possible
   B) HA must be a stronger acid that H3O+ and A- must be a stronger base than OH-
   C) Strong base added to an effective buffer solution will be consumed by HA
   D) The optimal buffer will have low [HA] and [A-]
   E) The pKa of HA must be equal to the pH of the buffer

2) To prepare a buffer with a pH = 7.00, about what mass of $NaHSO_{3(s)}$ must be dissolved in 500ml of 0.250 M $Na_2SO_{3(aq)}$? Assume constant volume. The Ka of HSO_3^- is $6.5x10^{-8}$.
   A) 20 g
   B) 23 g
   C) 45 g
   D) 17 g
   E) 5 g

3) A buffer solution that is 0.20 M propanoic acid (Ka = $1.4x10^{-5}$) and 0.30 M sodium propanoate exhibits a pH of 5.02. Predict the pH after the addition of 1.0ml of 0.10 M HCl to 10. mL of the buffer solution.
   A) 5.06
   B) 5.04
   C) 4.99
   D) 4.88
   E) No change in pH

4) Predict the equivalence point of a titration of 20. mL of an aqueous solution of HClO at 25°C (Ka = $3.5x10^{-8}$) with 20. mL of 0.100 M NaOH.
   A) 5.80
   B) 3.92
   C) 11.00
   D) 9.34
   E) 10.08

5) Calculate how many moles of $Na_2S_2O_3$ must be added to dissolve 0.020 mol AgBr in 1.0 L of water at 25°C (assume constant volume). K_{sp} AgBr = $3.3x10^{-13}$ K_f $[Ag(S_2O_3)_2]^{3-}$ = $2.0x10^{13}$
   A) 0.0078 mol
   B) 0.048 mol
   C) 0.040 mol
   D) 0.024 mol
   E) 0.016 mol

6) What is the maximum $[Zn^{2+}]$ in a solution of pH=10.00 at 25°C? Ksp of $Zn(OH)_2 = 4.5x10^{-17}$
   A) $1.0x10^{-7}$
   B) $2.4x10^{-9}$
   C) $4.1x10^{-7}$
   D) $2.4x10^{-4}$
   E) $4.5x10^{-9}$

7) Predict the pH of a saturated solution of lead (II) chloride. (Hint: assume the concentration of Pb^{2+} is the same as the concentration of $Pb(H_20)_6^{2+}$) Ksp $Pb(Cl)_2 = 1.7x10^{-5}$. Ka of $Pb(H_20)_6^{2+} = 3x10^{-8}$
   A) 4.66
   B) 5.64
   C) 3.10
   D) 6.39
   E) 2.84

8) A 1.0 L solutions contains 0.10 M Ni^{2+} and 0.10 M Co^{2+} ions. A carbonate solution is added dropwise to selectively precipitate one of the ions. Which ion would precipitate out first, and what concentration of carbonate is needed to precipitate nearly all of ion X, without starting to precipitate ion Y? K_{sp} of $NiCO_3 = 6.6x10^{-9}$ and K_{sp} of $CoCO_3 = 1.4x10^{-13}$
   A) Cobalt, $1.4x10^{-12}$
   B) Cobalt, $3.3x10^{-8}$
   C) Cobalt, $6.6x10^{-8}$
   D) Nickel, $1.4x10^{-12}$
   E) Nickel, $6.6x10^{-8}$

9) If you mix 50. mL of 0.060 M $Pb(NO_3)_2$ solution with 50. mL of 0.040 M $CaCl_2$ solution, would a precipitate form or not? Ksp = $1.6x10^{-5}$
   A) K<Q, no precipitate forms
   B) K>Q, precipitate forms
   C) K>Q, no precipitate forms
   D) K<Q, precipitate forms
   E) K=Q, no precipitate forms

10) A lab tech adds 2.20 mol KOH to 1.00 L of 0.5 M $Al(NO_3)_3$. What is the concentration of aluminum ions after the aluminum nitrate reacts with the potassium hydroxide?
    Kf of $Al(OH)_4^-$ = $3.0x10^{33}$
    A) $1.0x10^{-31}$
    B) $3.3x10^{-34}$
    C) $9.1x10^{-18}$
    D) $7.1x10^{-36}$
    E) $1.8x10^{-10}$

Chapter 20 – Thermodynamics

11) Select the false statement below
   A) If $\Delta G < 0$, ΔG represents the maximum amount of free energy obtainable from the reaction system
   B) If $\Delta G > 0$, ΔG represents the minimum work that must be done to the system for it to produce products
   C) If $\Delta G° = 0$ then ΔG can be either $=0$, < 0, or > 0
   D) ΔG is based upon the different between Keq and Q of a reaction system at some temperature T
   E) If $\Delta G° > 0$ for a reaction at some temperature, that reaction is product favored and Keq > 1 at that temperature

12) For which of the following reactions do you predict an increase in entropy?
   A) $2NO_2\,(g) \leftrightarrow N_2O_4(g)$
   B) $N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$
   C) $2HI(g) \leftrightarrow H_2(g) + I_2(g)$
   D) $Ni(CO)_4(g) \leftrightarrow Ni(s) + 4CO(g)$
   E) $CO(g) + Cl_2(g) \leftrightarrow COCl_2(g)$

13) Calculate the standard entropy change for the following reaction: $H_2(g) + CO_2(g) \rightarrow H_2O(g) + CO(g)$. S° values (J/molK): $H_2(g) = 131$; $H_2O(g) = 189$; $CO_2(g) = 214$; $CO(g) = 198$
   A) 84 J/K
   B) 42 J/K
   C) -84 J/K
   D) -42 J/K
   E) 0 J/K

14) Which of the following reactions would you expect to be nonspontaneous at all temperatures? Assume all species are gases.
   A) $A \leftrightarrow B + C \;\; \Delta H° > 0$
   B) $A + B \leftrightarrow C \;\; \Delta H° > 0$
   C) $A \leftrightarrow B + C \;\; \Delta H° < 0$
   D) $A + B \leftrightarrow C \;\; \Delta H° < 0$
   E) $A + B + C \leftrightarrow D \;\; \Delta H° < 0$

Chapter 23 – Transition Elements, Coordination Compounds

****Not every professor is covering Ch23 on this exam****

15) Which of the following are true for the coordination compound $[Co(NH_3)_2(en)_2]Cl_3$?

   I: the central ion has a +3 charge
   II: the coordination number is 6
   III: the chloride ions are not ligands

A) Only I
B) Only II
C) I and III
D) II and III
E) I, II, and III

16) Identify what kind of ligand (strong/weak), what kind of wavelength it would absorb (short/long), what kind of spin (high/low), and if it is paramagnetic or diamagnetic for $[Mn(CN)_6]^{4-}$

A) Strong, short, high, diamagnetic
B) Strong, long, low, paramagnetic
C) Weak, short, low, paramagnetic
D) Weak, long, high, diamagnetic
E) Strong, short, low, diamagnetic

17) What is the formula for pentaaminechlorocobalt(III) chloride?

A) $[Co(NH_3)_5Cl]Cl_2$ B) $[Co(NH_3)_5Cl]Cl$ C) $Cl_2[Co(NH_3)_5Cl]$ D) $[Co(NH_4)_5Cl]Cl_2$

E) $[Co(NH_3)_5Cl]$

18) You have two aqueous solutions, one of $[Fe(H_2O)_6]^{2+}$ and the other $[Fe(CN)_6]^{4-}$. One of them is expected to be green and one is expected to be yellow – which would you expect to be which color? Green has a wavelength of 490nm and yellow is 580nm.

A) $[Fe(H_2O)_6]^{2+}$ would be green because H_2O is the weaker field ligand and therefore higher energy photons are absorbed
B) $[Fe(H_2O)_6]^{2+}$ would be yellow because H_2O is the stronger field ligand and therefore higher energy photons are absorbed
C) $[Fe(H_2O)_6]^{2+}$ would be green because H_2O is the weaker field ligand and therefore lower energy photons are absorbed
D) $[Fe(H_2O)_6]^{2+}$ would be yellow because H_2O is the stronger field ligand and therefore lower energy photons are absorbed
E) $[Fe(H_2O)_6]^{2+}$ would be yellow because H_2O is the weaker field ligand and therefore lower energy photons are absorbed