Teaching Center
CHM 2046 Exam 2 Review (Summer 2020)
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1. Which compound would have increased solubility when placed in an acidic solution?

(1) $AgCl(s)$ (2) $KF(s)$ (3) $NaNO_3(aq)$ (4) $H_2CO_3(aq)$ (5) $LiBr(s)$

2. A solution is created by combining 0.50 M H_3AsO_4 and 0.25 M HCN. Find the K_{eq} of the chemical reaction shown below as well as determine whether the reactants or products will be favored.

$$H_3AsO_4(aq) + CN^-(aq) \leftrightarrow H_2AsO_4^-(aq) + HCN(aq)$$

pK_a of H_3AsO_4: 2.30 | pK_a of HCN: 9.21

(1) 8.12×10^6; reactants
(2) 8.12×10^6; products
(3) 1.23×10^{-7}; reactants
(4) 1.23×10^{-7}; products
(5) 3.09×10^{-12}; reactants

3. Cr(III) forms an octahedral complex with the ligand CN^-. How many unpaired electrons are in the d orbitals of chromium?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5

4. Calculate the pH of a solution that is 0.10 M CH_3COOH and 0.05 M $Ba(CH_3COO)_2$

(1) 7.60
(2) 4.75
(3) 9.10
(4) 8.21
(5) 11.2

5. Arrange the following compounds in order of decreasing cation molar solubility.

   $Ca_3(PO_4)(s)$ Ksp = 2×10^{-29}
   $CdS(s)$ Ksp = 8×10^{-27}
   $Al(OH)_3(s)$ Ksp = 1.3×10^{-33}
   $Fe(OH)_2(s)$ Ksp = 1.8×10^{-15}

(1) $Ca_3(PO_4)(s)$ > $Al(OH)_3(s)$ > $Fe(OH)_2(s)$ > $Ca_3(PO_4)(s)$
(2) $Al(OH)_3(s)$ > $Ca_3(PO_4)(s)$ > $Fe(OH)_2(s)$ > $CdS(s)$
(3) $Fe(OH)_2(s)$ > $CdS(s)$ > $Ca_3(PO_4)(s)$ > $Al(OH)_3(s)$
(4) $Fe(OH)_2(s)$ > $Ca_3(PO_4)(s)$ > $Al(OH)_3(s)$ > $CdS(s)$
(5) $Ca_3(PO_4)(s)$ > $Fe(OH)_2(s)$ > $Al(OH)_3(s)$ > $CdS(s)$

6. Which of the following is a Lewis Base?
   (1) H_2O
   (2) BF_3
   (3) Ca^{2+}
   (4) $AlCl_3$
   (5) CO_2

7. Which of the following mixtures will result in a buffer solution?
   I: 50mL of 0.10 M NaOH added to 30mL of 0.10 M CH_3COOH
   II: 50mL of 0.10 M HCl added to 100mL of 0.10 M NH_3
   III: 50mL of 0.10 M $HClO_2$ added to 50mL of 0.10 M $NaClO_2$
   (1) Only II (2) Only III (3) I and III (4) II and III (5) I, II and III

8. Two buffers were prepared - the first was made by mixing 50 mL of 0.50 M HF and 50 mL of 0.50 M KF and the second was made by mixing 200 mL of 0.50 M HF and 50 mL of 0.50 M KF. Which mixture has the greater buffer capacity if an acid was added to both buffers?
   (1) The first buffer
   (2) The second buffer
   (3) Both have the same capacity

9. 0.1123 M HBr is used to titrate a 100.0 mL solution of $NaNO_2$ of unknown concentration. It took 44.07mL of HBr to reach the equivalence point. What is the pH of the solution at the following points in the titration:
   Kb of NO_2^- = 1.4×10^{-11}
1) Before acid is added
2) At half-equivalence
3) At equivalence point
4) After 100.0 mL of acid is added

10. Below is a list of formulas for complex compounds and ions; each is matched with its name. One formula – name combination contains an error. Which one?

(1)	$Na_3[AlF_6]$	sodium hexafluoroaluminate
(2)	$[Fe(en)_2(OH)_2]ClO_4$	bis(ethylenediamine)dihydroxoiron(III) perchlorate
(3)	$K_2[Pb(SCN)_2F_2]$	potassium difluorodithiocyanateplumbate(II)
(4)	$[Ni(CO)_6][CuCl_4]_2$	hexacarbonylnickel(II) tetrachlorocuprate(II)
(5)	$[Pt(NH_3)_4BrCl](NO_3)_2$	tetraamminebromochloroplatinum(V) nitrate

11. A solution contains 0.001 M CO_3^{2-} and 0.001 M OH^-. If $Fe(NO_3)_2$ is added slowly to the solution, which salt will precipitate first? What concentration of $Fe(NO_3)$ will cause its precipitation?

$Ksp(FeCO_3) = 1.0 \times 10^{-13}$ $Ksp(Fe(OH)_2) = 1.0 \times 10^{-15}$

(1) $Fe(OH)_2$; 1.0×10^{-9} M
(2) $Fe(OH)_2$; 1.0×10^{-12} M
(3) $FeCO_3$; 1.0×10^{-7} M
(4) $FeCO_3$; 1.0×10^{-10} M

12. Consider the two statements below. Which of the following best explains (I) and (II)?

(I) the Ka of HXO2 is greater than the Ka of HYO2, but (II) the Ka of HX is less than the Ka of HY

(A) (I) X is less electronegative than Y, and (II) the H—X bond is longer than the H—Y bond
(B) (I) X is more electronegative than Y, and (II) the H—X bond is shorter than the H—Y bond
(C) (I) the H—X bond is weaker than the H—Y bond, and (II) X is more electronegative than Y
(D) (I) the H—X bond is stronger than the H—Y bond, and (II) X is less electronegative than Y

13. Consider the complex ion $[Cu(H_2O)]^{2+}$. Which answer includes all of the following true statements?

I: It is paramagnetic II: It is a low spin complex III: It is a high spin complex
IV: The ligands are weak field ligands V: The Cu has 2 unpaired electrons

(1) I, II, V (2) I, III, IV (3) III, IV (4) III, V (5) I, IV, V

14. Consider the following complex ions. Which ones do you expect to be colorless?

I: $[FeCN_6]^{4-}$ II: $[Mn(H_2O)_6]^{2+}$ III: $[Ti(NO_2)_6]^{4-}$ IV: $[V(H_2O)]^{2+}$ V: $[Zn(H_2O)]^{2+}$

(1) I, II (2) I, III, IV (3) II, III, V (4) III, IV (5) I, IV

15. A solution contains 0.40 M $CaCl_2$ and 0.20 $CuCl_2$. A solution of NaOH is added to the mixture to try and separate the metal ions. What is the highest concentration of NaOH that can be added? Ksp of $Ca(OH)_2$ is 6.5×10^{-6} and Ksp of $Cu(OH)_2$ is 2.2×10^{-20}.
    (1) 4.0×10^{-3} M
    (2) 5.7×10^{-3} M
    (3) 2.3×10^{-10} M
    (4) 3.3×10^{-10} M
    (5) 2.5×10^{-4} M

16. The Ksp of CoS is 4.0×10^{-21} and Kf of $[Co(OH)_4]^{2-}$ is 5.0×10^{9}. What is the molar solubility (in M) of CoS in 2.0 M NaOH?
    (1) 1.8×10^{-5}
    (2) 8.9×10^{-6}
    (3) 2.4×10^{-10}
    (4) 3.2×10^{-10}
    (5) 2.0×10^{-1}

17. A 0.10 M solution of which of the following would be most basic?
    $Ka(NH_4^+) = 5.6 \times 10^{-10}$ $Ka(CH_3COOH) = 1.76 \times 10^{-5}$ $Ka(HCN) = 6.17 \times 10^{-10}$
(1) RbI
(2) NH_4NO_3
(3) KCH_3COO
(4) NaCN
(5) $BaCl_2$