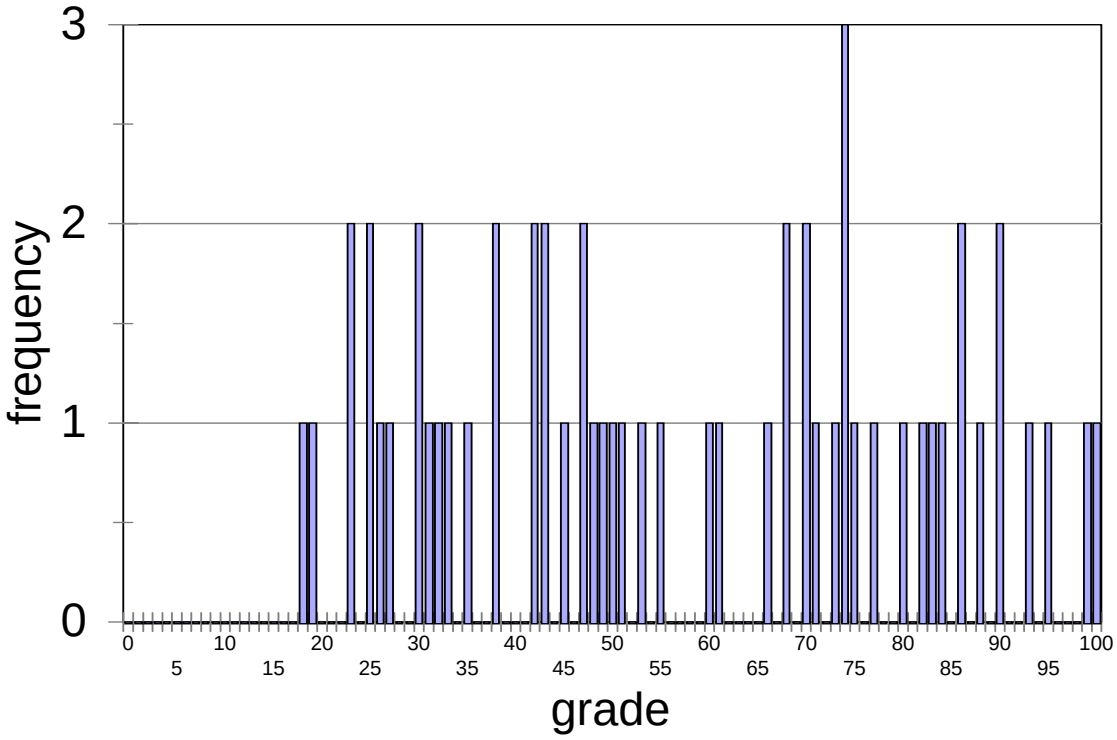
Exam 2 - Oct. 15, 2003

Avg = 57 Med = 54 Hi = 100 Lo = 19



1] What is the pH of a solution of 0.100 M Na_2HA solution given the following:

$H_3A = H_2A^- + H^+$ $K_a = 2.8e\text{-}2$

$H_2A^- = HA^{2-} + H^+$ $K_a = 7.7e\text{-}5$

$HA^{2-} = A^{3-} + H^+$ $K_a = 9.3e\text{-}11$

pH = ½(-log7.7e-5 + -log9.3e-11) = 7.07

2] What is the MBE for 1.00e-3 M $[Ag(NH_3)_2]Cl$ for the following reaction sequence?

$[Ag(NH_3)_2]Cl \rightarrow Ag(NH_3)_2^+ + Cl^-$

$Ag(NH_3)_2^+ = Ag(NH_3)^+ + NH_3$

$Ag(NH_3)^+ = Ag^+ + NH_3$

$1.00e\text{-}3\ M = [Ag(NH_3)_2^+] + [Ag(NH_3)^+] + [Ag^+]$

3] What is the CBE for the follow reaction sequence?

$H_2S = H^+ + HS^-$

$HS^- = H^+ + S^{2-}$

$H_2O = H^+ + OH^-$

$[H^+] = [OH^-] + [HS^-] + 2[S^{2-}]$

4] What is the pH of a solution containing 0.25 M sodium acetate, and 0.25 M CH_3COOH? K_a = 1.75e-5

pH = pKa + log [base]/[acid] = 4.757

5] Which of the following monoprotic acids would be best for creating a buffer system at pH 7.00?

acid A Ka = 5.6e-4
acid B Ka = 7.7e-6
acid C Ka = 1.9e-8
acid D Ka = 7.3e-11

acid C

6] What is pAg when of 50.00 mL of 0.100 M $AgNO_3$ is mixed with 50.00 mL of 0.100 M NaCl?
AgCl K_{sp} = 1.8e-10

4.87

7] The weak acid, HA has K_a = 1.0e-5. What is the fraction, α_{A^-} at pH 7.00?

0.99

8] What is the MBE for the following sequence of reactions?

$MgF_2 = Mg^{2+} + 2F^-$ K_{sp}
$F^- + H_2O = HF + OH^-$ K_b
$Mg^{2+} + H_2O = Mg(OH)^+ + H^+$ β

$2[Mg^{2+}] + 2[Mg(OH)^+] = [F^-] + [HF]$

9] What is K for this reaction?

$H_2SO_3 = SO_3^{2-} + 2H^+$ K = ?
$H_2SO_3 = HSO_3^- + H^+$ K = 1.23e-2
$HSO_3^- = SO_3^{2-} + H^+$ K = 6.6e-8

10] What is the difference between the end point and the equivalence point?

11] What is the solubility of SrF_2 (K_{sp} = 2.8e-9) at pH 4.00? HF K_a = 6.76e-4. For partial credit clearly express what you are doing, e.g. substitutions label equations as #1, #2…. (20 points)

12] A mixture of AgCl (MW 143.35, K_{sp}=1.8e-10) and AgBr (MW 187.9, K_{sp}=5.0e-13) weighs 2.000 g. This mixture is reduced to silver metal (AW 107.9), which weighs 1.300 g. Calculate the mass of AgCl in the original sample. (20 points)

13] What is the concentration Cl^- required to remove 99% of Ag^+ in a solution of 0.100 F $AgNO_3$? (10 points)

Answers

1] pH = ½(-log7.7e-5 + -log9.3e-11) = 7.07

2] *1.00e-3 M = $[Ag(NH_3)_2^+] + [Ag(NH_3)^+] + [Ag^+]$*

3] *$[H^+] = [OH^-] + [HS^-] + 2[S^{2-}]$*

4] pH = pKa + log [base]/[acid] = 4.757

5] *acid C*

6] 4.87

7] *0.99*

8] *$2[Mg^{2+}] + 2[Mg(OH)^{+}] = [F^{-}] + [HF]$*

9] *8.1e-10*

10] Equivalence point is where the titrant added stoichiometrically consumes all of the analyte. The end point is where some physical property indicates that the equivalence point is reached. The two volumes are quite often different from each other.

11] *$SrF_2(s) = Sr^{2+} + 2F^{-}$* *$K_{sp}$* *2 pts*
$F^{-} + H_2O = HF + OH^{-}$ *$K_b = K_w/K_a$* *2 pts*

MBE: $2[Sr^{2+}] = [F^{-}] + [HF]$ *4 pts*

pH = 4.00 ➔ [OH-] = 1.0e-10 M *2 pts*

$K_b = [HF][OH^{-}]/[F^{-}]$ ➔ $[HF] = 0.1479\ [F^{-}]$ *next few steps 8 pts*

$2[Sr^{2+}] = [F^{-}] + [HF] = 1.1479\ [F^{-}]$ *#1*

$K_{sp} = [Sr^{2+}][F^{-}]^2$ ➔ $[F^{-}] = (Ksp/[Sr^{2+}])^{1/2}$ *#2*

Sub 2 into 1

$2[Sr^{2+}] = 1.1479(Ksp/[Sr^{2+}])^{1/2}$ *$[Sr^{2+}]^3 = 9.52e\text{-}10$* *$[Sr^{2+}] = s = 9.8e\text{-}4$ M* *2 pts*

12]

x g AgCl + y g AgBr = 2.000 g *4 pts*

x g AgCl(mol AgCl/143.35 g)*(mol Ag/mol AgCl)*(107.9 g/mol) = 0.7527x g Ag* *4 pts*

y g AgCl(mol AgBr/187.9 g)*(mol Ag/mol AgBr)*(107.9 g/mol) = 0.5742y g Ag* *4 pts*

0.7527x g Ag + 0.5742y g Ag = 1.300 g *4 pts*

y = 2.000 – x sub into above

0.7527x + 0.5742(2.000 – x) = 1.300 g

mass Ag = 0.849 g *4pts*

13]
$[Ag^{+}]$ = (1-0.99) 0.100 F = 1.00e-3 M *$K_{sp} = [Ag^{+}][Cl^{-}] = 1.8e\text{-}10 = 1.00e\text{-}3\ M * [Cl^{-}]$ ➔ $[Cl^{-}] = 1.80e\text{-}7$ M*

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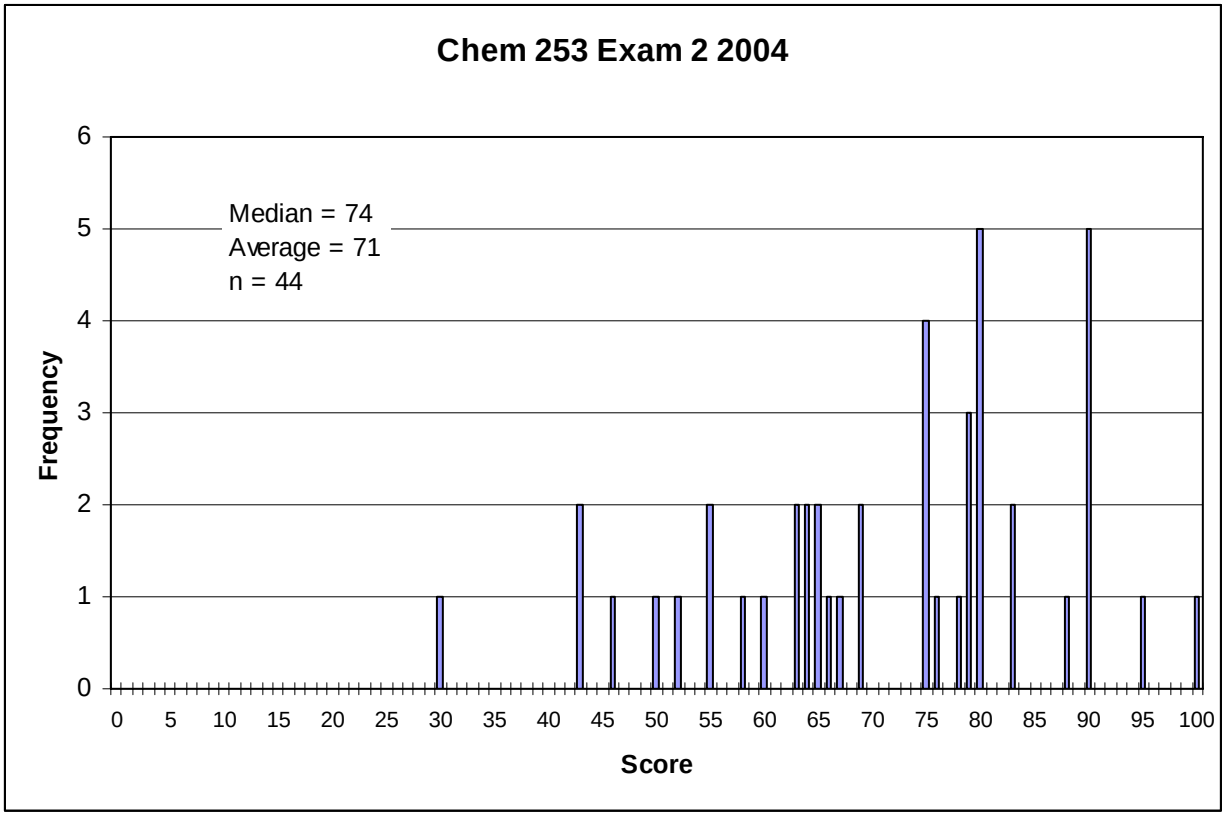
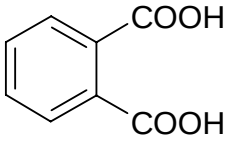
100 total points, Problems 1-18 are worth 5 points each.



1] What is the pH of a solution of a 1.0 M phthalic acid solution? (5 points)



K_{a1} = 1.12e-3 K_{a2} = 3.90e-6

a) 5.92e-4 b) 8.36 c) 7.22 d) 4.18 e) 1.48

2] A 0.5000g sample contained only NaBr (MW 102.89) and NaCl (MW 58.44). It was dissolved into water and precipitated with excess $AgNO_3$. The precipitate (AgBr(s) (MW 187.80) & AgCl(s) (MW 143.35)) was dried. The mass of this precipitate weighed 1.500 g. What are the two equations necessary to solve for the masses of each equation?

Let x = grams of NaBr and y = grams of NaCl

a) x + y = 1.500 & (x/102.89) + (y/58.44) = 0.5000
b) x + y = 1.500 & {x(187.80/102.89)} + {y(143.35/58.44} = 1.500
c) x + y = 0.500 & {x(187.80/102.89)} + {y(143.35/58.44} = 1.500

d) x + y = 1.500 & {x(187.80/102.89)} + {y(143.35/58.44} = 0.500
e) x + y = 0.500 & {x(102.89/187.80)} + {y(58.44/143.35} = 1.500

3] What is the mole fraction of HA^- at pH 3.00 given

$H_2A = H^+ + HA^-$ $K_{a1} = 1.0e\text{-}3$
$HA^- = H^+ + A^{2-}$ $K_{a2} = 1.0e\text{-}9$

a) 0.25 b) 0.50 c) 0.88 d) 0.15 e) 0.010

4] What is the pH of a solution of 0.10 M $NaHCO_3$?

$H_2CO_3 = HCO_3^- + H^+$ $K_{a1} = 4.45e\text{-}7$
$HCO_3^- = CO_3^{2-} + H^+$ $K_{a2} = 4.69e\text{-}11$

a) 8.34 b) 6.22 c) 7.84 d) 9.71 e) 4.66

5] What is or are the simplifying assumption(s) that allow for the use of the Henderson-Hasselbalch equation?

$pH = pK_a + \log([A^-]/[HA])$

a) $pK_a > pH$
c) formal concentrations of A^- & HA are the same as equilibrium concentrations

b) $pK_a = \pm 1$ pH & $[A^-] = [HA]$
c) formal concentrations of A^- & HA are not the same as equilibrium concentrations

6] Write a charge balance equation of for a solution of 0.10 phthalic acid. Neglect the ionization of water. See problem 1 for structure.

CBE:_____

7] Write a mass balance equation for the 0.100 M acetic acid.

$CH_3COOH = H^+ + CH_3COO^-$ $K_a = 1.75e\text{-}5$

MBE:_____

8] What is the pH of a solution consisting of 0.100 M CH_3COONa and 0.100 M CH_3COOH? See also problem 7.

a) 1.75 b) 4.76 c) 4.757 d) 5.717 e) 1.756

9] A common primary standard for the standardization of bases is

a) HCl(aq) | b) Potassium Hydrogen Phthalate | c) Bromine | d) NaOH(aq) | e) DNA

10] Solutions of NaOH(aq) titrant must be restandardized frequently because of

a) solvation of NO_2 from the atmosphere producing HNO_3 | b) solvation of Cl_2 from the atmosphere producing HCl | c) solvation of SO_2 from the atmosphere producing H_2SO_3 | d) solvation of N_2 from the atmosphere producing HNO_3 | e) solvation of CO_2 from the atmosphere producing H_2CO_3

11] What is the definition of "titrant"

a) it is the reagent solution whose concentration is known and is added to the sample in small increments | b) it is the analyte whose concentration in sample is unknown | c) it is the concentration of sample at the end point | d) it is the volume difference between the end and equivalence points

12] Write down the hydrolysis reaction for HCO_3^- demonstrating that it is a weak base.

_____

13] The K_b for dichloroacetate, Cl_2CHCOO^- is

$Cl_2CHCOOH$ $K_a = 5.0e\text{-}2$

a) 1.0e-14 | b) 2.0e-12 | c) 4.0e-8 | d) 2.0e-13 | e) 5.0e-9

14] A 50.00 mL solution of 0.100 M NaI(aq) is titrated with 0.100 M $AgNO_3$(aq). If 75.00 mL of the $AgNO_3$ solution is added, which of the statements below is true?

a) This is the equivalence point. | b) The solution is pink in color. | c) There is a solid precipitate and an excess of Ag^+. | d) There is no solid precipitate but there is excess of Ag^+ | e) There is a solid precipitate and an excess of I^-.

relative to I^-.

Problems 15-18 are based on the following: A 50.0-mL sample of 0.100 M KSCN is titrated with 0.0500 M $CuNO_3$. The K_{sp} of CuSCN is 4.8e-15.

15] Write down the reaction that takes place during this titration.

_____

16] What is pCu when 25.0-mL of the 0.100 M $CuNO_3$ is added to the 50.0-mL sample of 0.100 M KSCN solution? The K_{sp} of CuSCN is 4.8e-15.

a) 1.33 b) 12.84 c) 10.68 d) 5.87 e) 7.00

17] What is pCu when 50.0-mL of the 0.100 M $CuNO_3$ is added to the 50.0-mL sample of 0.100 M KSCN solution?

a) 7.93 b) 6.44 c) 9.13 d) 7.16 e) 8.52

18] What is pCu when 75.0-mL of the 0.100 M $CuNO_3$ is added to the 50.0-mL sample of 0.100 M KSCN solution?

a) 3.22 b) 4.44 c) 7.18 d) 12.70 e) 1.70

19] Homework avg:_____

Answers

1] e) 1.48 only K_{a1} is important. $x^2/(1.0-x) = 1.12e-3$; x = 0.0335
2] c) x + y = 0.500 & {x(187.80/102.89)} + {y(143.35/58.44} = 1.500

3] b) 0.50, D = $[1.0e-3]^2 + [1.0e-3]^2 + [1.0e-3*1.0e-9] = 2.0e-6$, N = $[1.0e-3]^2 = 1.0e-6$, $\alpha = 0.50$

4] a) 8.34 = ½ ($pK_{a1} + pK_{a2}$)
5] c) formal concentrations of A^- & HA are the same as equilibrium concentrations
6] $[H^+] = 2[A^{2-}] + [HA^-]$
7] 0.10 M = $[CH_3COOH] + [CH_3COO^-]$, also $[H^+] = [CH_3COO^-]$
8] c) 4.757 pH = pK_a watch S.F.
9] b) Potassium Hydrogen Phthalate
10] solvation of CO_2 from the atmosphere producing H_2CO_3
11] a) it is the reagent solution whose concentration is known and is added to the sample in small increments

12] $HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$
13] $K_b = K_w/K_a = 2.0e\text{-}13$
14] There is a solid precipitate and an excess of Ag^+. Pink is OK (Fajan's method)
15] $Cu^+ + SCN^- = CuSCN(aq)$

16] Mol SCN^- = 0.0500L*0.100 mol/L = 5.00e-3
Mol Cu^+ = 0.02500-L*0.100 mol/L = 2.50e-3
Excess mol SCN^- = 5.00e-3 - 2.50e-3 = 2.50e-3 $[SCN^-]$ = 2.50e-3 mol/0.0750 L = 3.33e-2 M

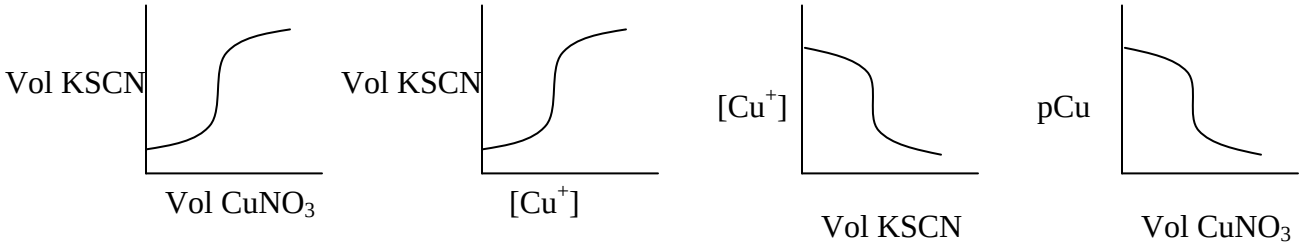
$CuSCN(s) =$	$Cu^+ +$	SCN^-		
--	x	3.33e-2 + x	$(3.33e\text{-}2 + x)x \approx (3.33e\text{-}2)x = 4.8e\text{-}15$	
			x = 1.44e-13 M	pCu = 12.84

17] Mol SCN^- = 0.0500L*0.100 mol/L = 5.00e-3
Mol Cu^+ = 0.0500-L*0.100 mol/L = 5.00e-3

$CuSCN(s) =$	$Cu^+ +$	SCN^-			
--	x	x	$x^2 = 4.8e\text{-}15$	x = 6.9e-8	pCu = 7.16

18] Mol SCN^- = 0.0500L*0.100 mol/L = 5.00e-3
Mol Cu^+ = 0.0750-L*0.100 mol/L = 7.50e-3
Excess mol Cu^+ = 7.50e-3 - 5.00e-3 = 2.5e-3 $[Cu^+]$ = 2.50e-3 mol/0.125 L = 0.0200 M
pCu = 1.70

(Not Used) 19] Which diagram best describes the curve for the titration of 50.0-mL of 0.100 M KSCN with 0.0500 M $CuNO_3$?



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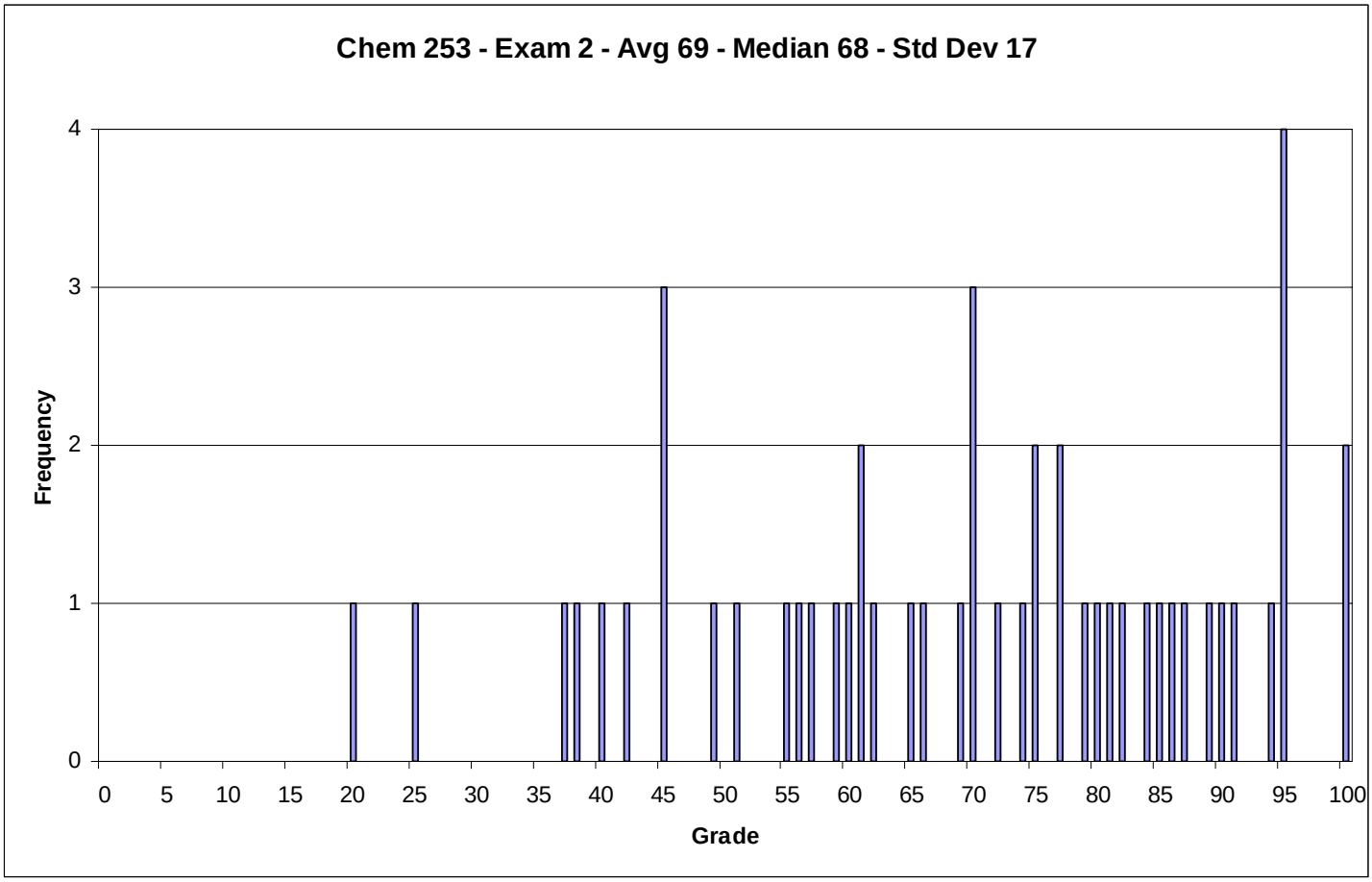

1] The pH of solution of 0.050 M of a weak acid, HA is 5.69. What is K_a for this acid?

a) 6.6e-6
b) 1.7e-4
c) 9.5e-9
d) 8.3e-11
e) 7.4e-7

2] What is the aqueous solubility of AgCl at pH 4.00 (K_{sp} = 1.8e-11)?

a) 4.2e-6
b) 4.0e-4
c) 2.6e-9
d) 3.1e-11
e) 1.8e-11

3] The two K_a's for salicylic acid (H_2A) are 1.07e-3 and 1.82e-14. What is K_b for sodium salicylate (NaHA)?

a) 0.549
b) 7.22e-1
c) 9.35e-12
d) 8.51e-7
e) 6.99e-10

4] What is the charge balance for a solution of 0.10 M $NaHCO_3$?

K_{a1} H_2CO_3 = 6.352 K_{a2} HCO_3^- = 10.329

$HCO_3^- \rightleftarrows H^+ + CO_3^{2-}$
$HCO_3^- + H_2O \rightleftarrows H_2CO_3 + OH^-$

a) $[Na^+] + [H^+] = [HCO_3^-] + [CO_3^{2-}] + [OH^-]$
b) $[Na^+] + [H^+] = [HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$
c) $2[Na^+] + 2[H^+] = 2[HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$
d) $[Na^+] = [HCO_3^-] + 2[CO_3^{2-}]$
e) $[Na^+] + [H^+] = [HCO_3^-] + ½ [CO_3^{2-}] + [OH^-]$

5] Which of the following is a valid mass balance for a solution for 0.10 M $NaHCO_3$?

a) $[H^+]^2 = [H_2CO_3] + [HCO_3^-] + 2[CO_3^{2-}]$
b) $[Na^+]/2 = [H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$
c) $[Na^+] = [H_2CO_3] + [HCO_3^-] + 2[CO_3^{2-}]$
d) $0.10\ M = 2[H_2CO_3] + 2[HCO_3^-] + [CO_3^{2-}]$
e) $0.10\ M = [H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$

6] Which of the following would best explain the solubility of Ag_2SO_4?

a) $[Ag^+]^2$
b) $[Ag^+]^{1/2}$
c) $[Ag^+]$
d) $[Ag^+]/2$
e) $2[Ag^+]$

7] A 0.9961 g silver ore sample was treated with HNO_3 and then with excess NaCl(aq). A precipitate was dried and weighed 0.0711 g. What is percent silver in the ore? AW: Ag 107.9, H 1.008, O 16.00, N 14.01, Cl 35.45

a) 25.11%
b) 8.99%
c) 5.37%
d) 7.89%
e) 0.117%

8] Which of the following is not a primary standard?

a) Potassium Hydrogen Phthalate (KHP)
b) Benzoic Acid
c) Potassium Hydrogen Iodate
d) NaOH
e) $NaHCO_3$

Problems 9-11: A solution of 0.100 M $AgNO_3$ is used to titrate a 100.00 mL solution of 0.100 M KCl. The K_{sp} of AgCl is 1.8e-11

9] What is pAg if 50.00 mL of the titrant is added to the KCl solution?

a) 9.27
b) 4.55
c) 3.21
d) 7.78
e) 6.98

10] What is pAg if 100.00 mL of the titrant is added?

a) 7.00
b) 5.37
c) 11.11
d) 12.34
e) 1.33

11] What is pAg if 150.00 mL of the titrant is added?

a) 11.771
b) 12.885
c) 7.000
d) 1.699
e) 3.556

12] What is pH of solution containing 0.100 M HOCl (K_a = 3.0e-8) and 0.100 M NaOCl.

a) 7.52
b) 7.11
c) 6.33
d) 8.53
e) 6.73

13] The useful pH range of most buffering systems is

a) within 1 pH unit of pK_a
b) within 0.5 pH unit of pK_a
c) within 10 pH units of pK_a
d) within 5 pH units of pK_a
e) within 0.1 pH unit of pK_a

14] What is the pH of solution that is 0.10 M NaH_2PO_3?

$H_3PO_3 \rightleftarrows H_2PO_3^- + H^+$ $\quad\quad$ K_a = 3e-2
$H_2PO_3^- \rightleftarrows HPO_3^{2-} + H^+$ $\quad\quad$ K_a = 1.62e-7

a) 7.9
b) 1.1
c) 10.6
d) 6.8
e) 4.1

15] The fraction (relative concentration) of $H_2PO_3^-$ from a 0.10 F H_3PO_3 at pH 5.00 can be calculated from which formula?

a) $\frac{[H^+]^2}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}}$

b) $\frac{K_{a1}[H^+]}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}}$

c) $\frac{K_{a1}K_{a2}}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}}$

d) $\frac{[H^+]^2}{[H^+]^2 + K_{a1}[H^+]^2 + K_{a1}K_{a2}}$

e) $\frac{K_{a1}[H^+]^2}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}}$

16] Which of the follow is an amphoteric species?

a) H_2CO_3
b) HF
c) F^-
d) HCO_3^-
e) CO_3^{2-}

17] What is the mass balance equation for the following sequence of reactions?

$CaC_2O_4(s) \rightleftarrows Ca^{2+} + C_2O_4^{2-}$ $K_{sp} = 1.3e\text{-}8$
$C_2O_4^{2-} + H_2O \rightleftarrows HC_2O_4^- + OH^-$ K_{b1}
$HC_2O_4^- + H_2O \rightleftarrows H_2C_2O_4 + OH^-$ K_{b2}

a) $2[Ca^{2+}] = [C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$
b) $[Ca^{2+}] = [C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$
c) $2[Ca^{2+}] = 2[C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$
d) $[Ca^{2+}] = [C_2O_4^{2-}] + 2[HC_2O_4^-] + 2[H_2C_2O_4]$
e) $[Ca^{2+}] = [C_2O_4^{2-}] + 2[HC_2O_4^-] + 2[H_2C_2O_4] + [OH^-]$

18] What is the charge balance equation for the reaction sequence of problem 17?

a) $2[Ca^{2+}] = [C_2O_4^{2-}] + [HC_2O_4^-] + [OH^-]$
b) $[Ca^{2+}] = [C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$
c) $[Ca^{2+}] = [C_2O_4^{2-}] + 2[HC_2O_4^-] + 2[H_2C_2O_4] + [OH^-]$
d) $2[Ca^{2+}] = 2[C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$
e) $2[Ca^{2+}] = 2[C_2O_4^{2-}] + [HC_2O_4^-] + [OH^-]$

Name: _____ Section Number: _____

19] What is the molar solubility of BaF_2 (K_{sp} = 1.7e-6) at pH 7.20? K_a (HF) = 6.8e-4

6 points: Clearly underline the variables and the equations necessary to solve this problem.

4 Points: Answer _____

Answers

1] $[H^+]$ = 2.0e-6 M

HA	=	H^+	+	A^-
0.050-x		x		x

$K_a = x^2 / (0.050-x) \cong 2.0e\text{-}6^2 / 0.050 = 8.3e\text{-}11$ Answer d)

2] $AgCl \rightleftarrows Ag^+ + Cl^-$

--	x	x	$K_{sp} = x^2 = 1.8e\text{-}11$	x = 4.2e-6

Answer a)

3] $HA^- + H_2O \rightleftarrows H_2A + OH^-$
$K_aK_b = K_w$ $K_b = K_w/K_a$ = 1.00e-14 / 1.07e-3 = 9.35e-12 Answer c)

4] Answer b: $[Na^+] + [H^+] = [HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$

5] Answer e: 0.10 M = $[H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$

6] Answer d: $[Ag^+]/2$

7]
0.0711 g AgCl (mol AgCl / 143.32 g) (mol Ag / mol AgCl) (107.868 g / mol Ag) (100 / 0.9961g) = 5.37 %

Answer c)

8] Answer d): NaOH

9] Titration Rxn: $Ag^+ + Cl^- \rightleftarrows AgCl(s)$

Moles of excess Cl^- = 0.10000 L * 0.100 M KCl – 0.05000 L * 0.100 M $AgNO_3$ = 5.00e-3 mol Cl^-
$[Cl^-]$ = 5.00e-3 mol Cl^- / 0.1500 L = 3.33e-2

$AgCl(s)$	$\rightleftarrows$	Ag^+	+	Cl^-
--		x		x+3.33e-2

x(3.33e-2) ≅ 1.8e-11
x = 5.4e-10 M
pAg = 9.27 answer a)

10] This is the equivalence point.

$AgCl(s)$	$\rightleftarrows$	Ag^+	+	Cl^-
--		x		x

x^2 = 1.8e-11 x = 4.24e-6 pAg = 5.37 answer b)

11] We are past the equivalence point.

(150.00 – 100.00) mL * 0.100 M Ag^+ (250.00 mL) = 0.0200 M Ag^+ or pAg = 1.699
answer d)

12] $K_a = [H^+][OCl^-] / [HOCl]$ $[H^+] = K_a [HOCl] / [OCl^-]$ $[H^+]$ = 3.0e-8
pH = 7.52
Answer a)

13] Answer a)

14] $pH = ½ (pK_{a1} + pK_{a2}) = ½ (1.5 + 6.790) = 4.1$ answer e)

15] answer: b b) $\frac{K_{a1}[H^+]}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}}$

16] HCO_3^- Answer d

17] Answer b

18] $2[Ca^{2+}] = 2[C_2O_4^{2-}] + [HC_2O_4^-] + [OH^-]$ Answer e

19] MBE: $2[Ba^{2+}] = [F^-] + [HF]$ & $[H^+]$ = 6.31e-8 M; $[OH^-]$ = 1.58e-7

$K_{sp} = [Ba^{2+}][F^-]^2 = 1.7e\text{-}6$ $\quad\quad$ $K_a\,(HF) = [H^+][F^-]/[HF] = 6.8e\text{-}4$

3 variables: $[Ba^{2+}]$, $[F^-]$, $[HF]$

$F^- + H_2O \rightleftarrows HF + OH^-$ $\quad\quad$ $K_b = K_w/K_a = 1.00e\text{-}14/6.8e\text{-}4 = 1.47e\text{-}11$

Using K_b solve for [HF] $\quad\quad$ $[HF] = K_b[F^-]/[OH^-]$ will sub into MBE

$2[Ba^{2+}] = [F^-] + [HF]$

$2[Ba^{2+}] = [F^-] + K_b[F^-]/[OH^-]$

Sub all knowns into above

$2\,[Ba^{2+}] = [F^-] + 1.47e\text{-}11*[F^-]/1.58e\text{-}7$

$2\,[Ba^{2+}] \cong [F^-]$ $\quad\quad$ sub into K_{sp}

$Ksp = [Ba^{2+}][F^-]^2 = [Ba^{2+}](2[Ba^{2+}])^2$

$[Ba^{2+}] = (Ksp/4)^{1/3} = 7.5e\text{-}3M$