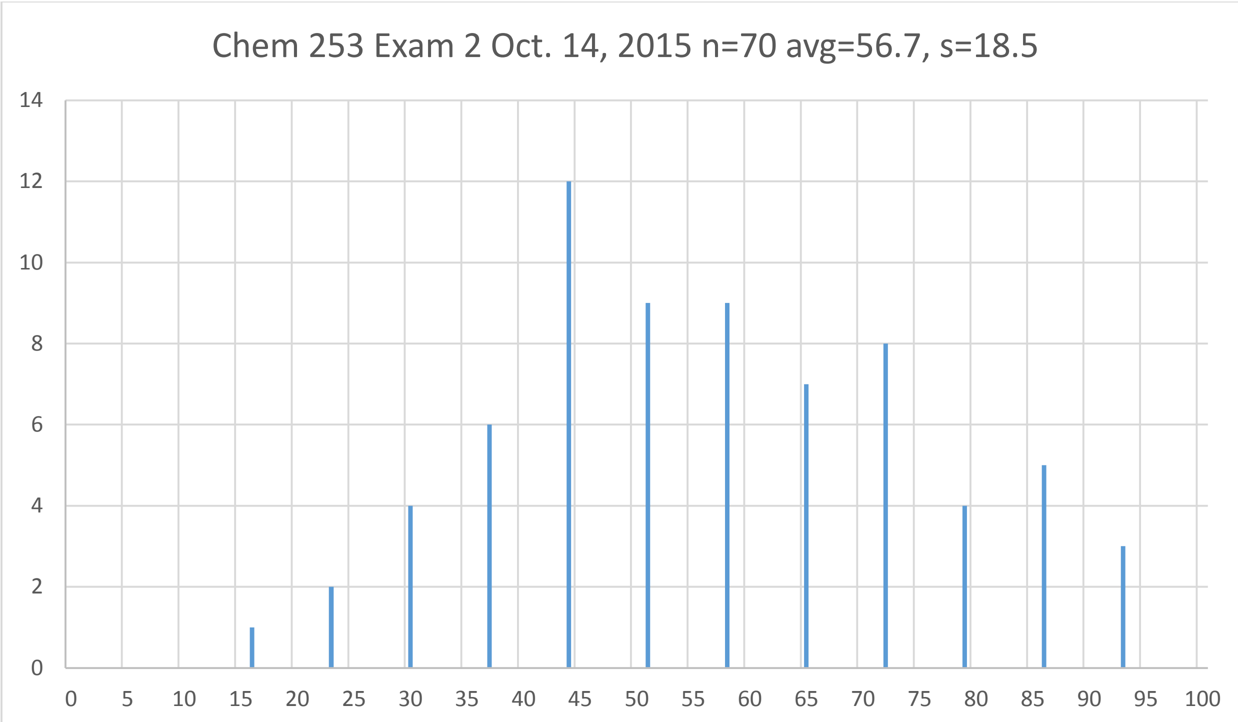

1] A weak acid (HA) has $K_{a1} = 1.0 \times 10^{-4}$. What is the fraction of the conjugate base at pH 4.50?

a) 25%
b) 76%
c) 50%
d) 95%
e) 10%

2] A salt AB_3 has a molar solubility of 0.050M. What is the K_{sp} of that salt?

$AB_3(s) = A^{3+} + 3B^-$

a) 4.6×10^{-10}
b) 3.7×10^{-3}
c) 6.6×10^{-8}
d) 9.1×10^{-15}
e) 1.7×10^{-4}

3] What is the pH of a 0.100M of a diprotic weak acid, H_2A given

$K_{a1} = 1.0 \times 10^{-4}$ $K_{a2} = 1.0 \times 10^{-8}$

a) 7.78
b) 2.50
c) 5.60
d) 3.40
e) 4.50

4] What is the mass balance equation for MnS (K_{sp} = 3 x 10^{-11}).

H_2S, K_{a1} = 9.5 x 10^{-8}, K_{a2} 1.0 x 10^{-14}

a) $[Mn^{2+}] = [S^{2-}] + [HS^-] + [H_2S]$
b) $2[Mn^{2+}] = 2[S^{2-}] + [HS^-] + [H_2S]$
c) $[Mn^{2+}] = [S^{2-}] + [HS^-] + [H_2S] + [OH^-]$
d) $[Mn^{2+}]^{1/2} = [S^{2-}]^{1/2} + [HS^-] + [H_2S]$
e) $[Mn^{2+}] + [H^+] = [S^{2-}] + [HS^-]$

5] What is the charge balance equation for a solution of MnS after it reaches equilibrium? Consider K_w in this analysis.

a) $\frac{1}{2} [Mn^{2+}] + [H^+] = \frac{1}{2} [S^{2-}] + [HS^-] + [OH^-]$
b) $[Mn^{2+}] + [H^+] = 2[S^{2-}] + [HS^-] + [OH^-]$
c) $[Mn^{2+}] + [H^+] = [S^{2-}] + [HS^-] + [OH^-]$
d) $2[Mn^{2+}] + [H^+] = 2[S^{2-}] + [HS^-] + [OH^-]$
e) $[Mn^{2+}] + 2[H^+] = [S^{2-}] + 2[HS^-] + 2[OH^-]$

6] What is pAg when 10.00 mL of 0.0100 M $AgNO_3$ is added to 10.00 mL of 0.0050 M KCl?

AgCl K_{sp} = 1.8 x 10^{-10}

a) 4.50
b) 7.60
c) 2.60
d) 5.20
e) 8.90

7] What is pAg when 10.00 mL of 0.0100 M $AgNO_3$ is added to 20.00 mL of 0.0050 M KCl?

AgCl K_{sp} = 1.8 x 10^{-10}

a) 4.89
b) 7.80
c) 2.94
d) 6.45
e) 5.21

8] What is the pH when 15.00 mL of 0.100 M NaOH is added to 10.00 mL of 0.100 M H_2CO_3?

K_{a1} = 4.46 x 10^{-7}, K_{a2} = 4.69 x 10^{-11}

a) 8.772
b) 7.152
c) 6.991
d) 7.159
e) 10.329

9] What is the pH of 0.100 M NaHA? $pk_{a1} = 4.00$, $pK_{a2} = 9.00$

a) 7.00
b) 6.00
c) 9.00
d) 6.50
e) 4.00

10] The buffer region in the titration curve of a monoprotic weak acid (HA) with 0.100 M strong base (NaOH) relative to the equivalence point volume Ve is

a) Near 2(Ve)
b) Near Ve/2
c) Near Ve
d) At Ve
e) Near Ve/4

11] What happens to standardized 0.100 M NaOH with age?

a) Nothing
b) The pH will start deviating downwards as CO_2 dissolves into the solution.
c) The pH will start deviating upwards as CO_2 dissolves into the solution.
d) The pH will start deviating downwards as O_2 dissolves into the solution.
e) The pH will start deviating downwards as N_2 dissolves into the solution.

12] Which acid would be best for the preparation of a buffer at pH 8.50?

a) $K_a = 5.0 \times 10^{-5}$
b) $K_a = 1.2 \times 10^{-4}$
c) $K_a = 8.7 \times 10^{-10}$
d) $K_a = 9.6 \times 10^{-6}$
e) $K_a = 8.5 \times 10^{-8}$

13] Which expression best describes the solubility of Ag_2S?

$K_{sp} = 8 \times 10^{-51}$ H_2S $K_a = 9.5 \times 10^{-8}$ HS^- $K_a = 1.0 \times 10^{-14}$

a) $[S^{2-}]$
b) ½ $[Ag^+]$
c) 2 $[Ag^+]$
d) $[Ag^+]^2$
e) $[Ag^+]^{1/2}$

14] How many moles of a diprotic acid H_2A must be added to 1.00 L of 1.00 M Na_2A to produce a pH buffer at 6.00? $pK_{a1} = 3.00$ $pK_{a2} = 6.00$

a) 0.500 mol
b) 0.666 mol
c) 1.00 mol
d) 0.250 mol
e) 0.333 mol

15] My Chem 254 Lab Section Meets

a) Mornings at 8:30 am Sec 01
b) Afternoons at 2:30 pm Sec 02
c) Evenings at 6:30 pm Sec 03
d) I am not in a lab this semester

Answers

1] A weak acid (HA) has $K_{a1} = 1.0 \times 10^{-4}$. What is the fraction of the conjugate base at pH 4.50?

$\alpha(HA) = [H^+] / [H^+] + K_{a1}$ $\alpha(A-) = K_{a1} / [H^+] + K_{a1}$
$[H^+] = 3.16e-5$ $\alpha(A-) = 1.e-4 / [3.16e-5] + 1.0e-4 = 0.76$ or 76%

2] A salt AB_3 has a molar solubility of 0.050M. What is the K_{sp} of that salt?
$AB_3(s) = A^{3+} + 3B^-$

$AB_3(s) = A^{3+}$ + $3B^-$
0.50 3(0.050)
$Ksp = 0.050(3*0.050)^3 = 1.7e-4$

3] What is the pH of a 0.100M of a diprotic weak acid, H_2A given
$K_{a1} = 1.0 \times 10^{-4}$ $K_{a2} = 1.0 \times 10^{-8}$

You can ignore K_{a2} as $K_{a1} >> K_{a2}$

H_2A	=	H^+	+	HA^-
0.10 –x		+x		+x

$K_{a1} = 1.0 \times 10^{-4} = [H^+][HA^-] / [H_2A] \cong x^2/0.10$ $[H^+] = 3.16e-3$ pH = 2.50

4] What is the mass balance equation for MnS ($K_{sp} = 3 \times 10^{-11}$).
H_2S, $K_{a1} = 9.5 \times 10^{-8}$, K_{a2} 1.0×10^{-14}

Initial $MnS \rightleftarrows Mn^{2+} + S^{2-}$ $[Mn^{2+}] = [S^{2-}]$

Then S^{2-} hydrolyzes $S^{2-} + H_2O \rightarrow HS^- + OH^-$ $K_{b1} = K_w/K_{a2}$

$HS^- + H_2O \rightarrow H_2S + OH^-$ $K_{b2} = K_w/K_{a1}$

At Equilibrium MBE is $[Mn^{2+}] = [S^{2-}] + [HS^-] + [H_2S]$

5] What is the charge balance equation for a solution of MnS after it reaches equilibrium? Consider K_w in this analysis.

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

6] What is pAg when 10.00 mL of 0.0100 M $AgNO_3$ is added to 10.00 mL of 0.0050 M KCl?
AgCl $K_{sp} = 1.8 \times 10^{-10}$

10.00 mL (0.0100 M) = 0.100 mmol Ag^+
10.00 mL(0.0050 M) = 0.050 mmol Cl^-
Excess Ag^+ = 0.100 – 0.050 mmol = 0.050 mmol
[Ag+] = 0.050 mmol / 20.00 mL = 2.5e-3 M pAg = 2.60

7] What is pAg when 10.00 mL of 0.0100 M $AgNO_3$ is added to 20.00 mL of 0.0050 M KCl?
AgCl $K_{sp} = 1.8 \times 10^{-10}$

10.00 mL (0.0100 M) = 0.100 mmol Ag^+
20.00 mL(0.0050 M) = 0.100 mmol Cl^-
Initially AgCl(s) then AgCl(s) = Ag+ + Cl-
x^2 = 1.8e-10 x = 1.3e-5

8] What is the pH when 15.00 mL of 0.100 M NaOH is added to 10.00 mL of 0.100 M H_2CO_3?
$K_{a1} = 4.46 \times 10^{-7}$, $K_{a2} = 4.69 \times 10^{-11}$

Past 1st eq. pt., i.e. all H_2CO_3 now becomes HCO_3^-
Initial mol HCO_3^- = 10.00 mL (0.100) = 1.00 mmol HCO_3^-
Excess OH- = 15.00 – 10.00 (0.100 M) = 0.500 mmol

HCO_3^-	$+ OH^-$ =	H_2O	$+ CO_3^{2-}$
1.00	0.500 mmol	--	0
-0.500	-0.500		+0.500 mmol
0.500	0		0.500 mmol

K_{a2} = 4.69e-11 = $\frac{[H^+]\,0.500/V}{0.500/V}$ note V is total vol. and V/V = 1

pH = 10.329 note: this is the buffer region

9] What is the pH of 0.100 M NaHA? $pk_{a1} = 4.00$, $pK_{a2} = 9.00$

pH = ½ ($pk_{a1} + pk_{a2}$) = 6.50

10] The buffer region in the titration curve of a monoprotic weak acid (HA) with 0.100 M strong base (NaOH) is at

Near ½ the volume of the equivalence point

11] What happens to standardized 0.100 M NaOH with age?

The pH will start deviating downwards as CO_2 dissolves into the solution.

12] Which acid would be best for the preparation of a buffer at pH 8.50?

$K_a = 8.7 \times 10^{-10}$

13] Which expression best describes the solubility of Ag_2S?

$K_{sp} = 8 \times 10^{-51}$ H_2S $K_a = 9.5 \times 10^{-8}$ HS^- $K_a = 1.0 \times 10^{-14}$

½ $[Ag^+]$

14] How many moles of a diprotic acid H_2A must be added to 1.00 L of 1.00 M Na_2A to produce a pH buffer at 6.00? $pK_{a1} = 3.00$ $pK_{a2} = 6.00$

1.00 L * (1.00 M) = 1.00 mol of H_2A

pH 6.00 = pK_{a2} so use $K_{a2} = 1.00e\text{-}6 = \frac{[H^+][A^{2-}]}{[HA^-]}$

Need $[HA^-] = [A^2]^-$ for pH = pK_a = 6.00

Initial mol A^{2-} = 1.00 L (1.00 M) = 1.00 mol A^{2-}

H_2A	$+ A^{2-}$	=	$2HA^-$
x mol	1.00 mol		0
-x	-x		+2x
0	1.00 - x		2x

1.00-x = 2x x = 0.333 mol H_2A