2 – Equilibria Problem Set

<u>The Basics</u>

1] Calculate the solubility of $PbCl_2$ (K_{sp} = 1.7 x 10^{-5}) in the presence of 0.122 M NaCl. [1]

2] Calculate the K_{sp} of barium sulfate (MW 233) if its solubility is measured as 0.0023 mg/mL. [2]

3] What is the molar solubility of $PbCl_2$, K_{sp} = 1.7e-5? [3]

4] What is the solubility of barium carbonate? [4] $BaCO_3$ Ksp = 5.0e-9

5] What is the solubility of copper (I) sulfide in 0.1 M Na_2S? [5] Cu_2S Ksp = 3e-49

6] What is the solubility of $PbCl_2$ in 0.10 M NaCl? [6]

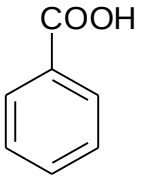
7] Calculate the pH of a solution of 0.025 M acetic acid and 0.025 M sodium acetate. [7]

8] What the pH of $[H^+]$ = 3.35e-6 ? [8]

9] Calculate the pH of a solution of 0.025 M acetic acid, $K_a = 1.8 \times 10^{-5}$ [9]

10] What is the pH of a solution of 0.100 M HCl? [10]

11] What is the pH of 0.10 M benzoic acid? [11] K_a = 6.28e-5



Benzoic acid

12] The concentration of H^+ in a pH 6.772 solution is _____ [12]

13] The pH of a solution of a 0.100 M weak acid (HA) $K_a = 2.7\times10^{-6}$ is ____ [13]

14] What is $[H^+]$ when a solution is pH = 4.653? [14]

15] The solubility of the salt MA_2 ($K_{sp} = 8.9\times10^{-17}$) is ____ [15]

$MA(s) = M^{2+}(aq) + 2A^-(aq)$

16] What is the solubility of a salt, AB ($K_{sp} = 7.2\times10^{-12}$) in the presence of 0.10 M B^-? [16]

17] The K_a of a weak acid (HA) is 7.2×10^{-6}. What is K_b for the following reaction? [17]

$A^- + H_2O = HA + OH^-$

18] The concentration of H^+ in a pH 8.55 solution is [18]

19] What is the pH of a 2.11 M solution of HNO_3? [19]

20] What is the H^+ concentration of a solution that has a pH of 5.32?[20]

21] What is K for this reaction? [21]

$H_2SO_3 = SO_3^{2-} + 2H^+$ K = ?

$H_2SO_3 = HSO_3^- + H^+$ K = 1.23e-2

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

<u>Charge Balance and Mass Balance</u>

22] Write down a valid mass balance for a solution for 0.10 M $NaHCO_3$. [22]

23] What is the charge balance for a solution of 0.1 M $MgCl_2$? [23]

24] What is the charge balance for a solution of 0.10 M $NaHCO_3$? [24]

$K_{a1} = 6.352$ $K_{a2} = 10.329$

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

$HCO_3^- + H_2O \rightleftarrows H_2CO_3 + OH^-$

25] What is the CBE for the follow reaction sequence? [25]

$H_2S = H^+ + HS^-$

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

$H_2O = H^+ + OH^-$

26] Write a charge balance equation for a solution containing $NaNO_3$, KCl, and Na_2SO_4. [26]

27] What is the mass balance equation for the following sequence of reactions? [27]

$CaC_2O_4(s) \rightleftarrows Ca^{2+} + C_2O_4^{2-}$ $K_{sp} = 1.3e-8$

$C_2O_4^{2-} + H_2O \rightleftarrows HC_2O_4^- + OH^-$ K_{b1}

$HC_2O_4^- + H_2O \rightleftarrows H_2C_2O_4 + OH^- \; K_{b2}$

28] What is the charge balance equation for the reaction sequence: [28]

$CaC_2O_4(s) \rightleftarrows Ca^{2+} + C_2O_4^{2-}$ $K_{sp} = 1.3e\text{-}8$

$C_2O_4^{2-} + H_2O \rightleftarrows HC_2O_4^- + OH^- \; K_{b1}$

$HC_2O_4^- + H_2O \rightleftarrows H_2C_2O_4 + OH^- \; K_{b2}$

29] What is the CBE for the follow reaction sequence? [29]

$H_2S = H^+ + HS^-$

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

$H_2O = H^+ + OH^-$

30] What is the MBE for 1.00e-3 M $[Ag(NH_3)_2]Cl$ for the following reaction sequence: [30]

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

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

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

31] What is the MBE for the following sequence of reactions? [31]

$MgF_2 = Mg^{2+} + 2F^-$ K_{sp}

$F^- + H_2O = HF + OH^-$ K_b

$Mg^{2+} + H_2O = Mg(OH)^+ + H^+$ β

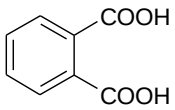
32] What is the charge balance for a solution of 0.10 M $NaHCO_3$? [32]

$pK_{a1}\ H_2CO_3 = 6.352$ $pK_{a2}\ HCO_3^- = 10.329$

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

$HCO_3^- + H_2O \rightleftarrows H_2CO_3 + OH^-$

33] Write a charge balance equation of for a solution of 0.10 M phthalic acid. [33]



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

34] What is the charge balance equation for a solution that is saturated with SrF_2? [34]

K_{sp} (SrF_2) = 2.9×10^{-9} K_a (HF) = 6.8×10^{-4}

35] What is the mass balance equation for a solution that is initially 0.1 M NaF? K_a (HF) = 6.8e-4 [35]

Solubility

36] What is the solubility of SrF_2 (K_{sp} = 2.8e-9) at pH 4.00? HF K_a = 6.76e-4. [36]

37] What best explains the solubility of Ag_2SO_4? [37]

38] What is the molar solubility of BaF_2 (K_{sp} = 1.7e-6) at pH 7.20? K_a (HF) = 6.8e-4 [38]

39] What is the solubility of Hg_2Cl_2 (K_{sp} = 1.2×10^{-18}) in 0.20 M NaCl? [39]

40] The K_{sp} of PbI_2 is 7.9e-9. What is the concentration of I^- required to precipitate 99.99% of 1.6e-4 M Pb^{2+}(aq)? [40]

41] Consider a saturated solution of $R_3NH^+Br^-$, where R is an organic group. Find the solubility of $R_3NH^+Br^-$ in a solution maintained at pH 9.50. [41]

$R_3NH^+Br^-(s) \rightleftarrows R_3NH^+ + Br^-$ $K_{sp} = 4.0\times10^{-8}$

$R_3NH^+ \rightleftarrows R_3N + H^+$ $K_a = 2.3\times10^{-9}$

42] What is the aqueous solubility of AgCl at pH 4.00 (K_{sp} = 1.8e-11)? [42]

43] 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. [43]

44] A 0.2795 g sample of the insecticide containing lindane ($C_6H_6Cl_6$, MW 290.8) and DDT ($C_{14}H_9Cl_5$, MW 354.5) was burned in purified air. The products of this reaction, CO_2, H_2O, and HCl were passed through a solution of $NaHCO_3$ that captured HCl. Chloride was precipitated as AgCl with a solution of excess $AgNO_3$(aq). The AgCl was dried and weighed, 0.7161 g. Calculate the percent lindane and DDT in the sample. [44]

45] Calculate the concentration of Ba^{2+} in solution when 15.00-mL of 0.200 M K_2CrO_4(aq) is added to 25.00-mL of 0.100 M $BaCl_2$(aq). [45]

46] What is the solubility of CaF_2 in 0.100 M HCl. What are the equilibrium concentrations HF and F^- under these conditions? [46]

47] What is the solubility of $MgCO_3$ at pH 5.00? [47]

48] The K_{sp} of AgCl is 1.8e-10. What is the concentration of Cl^- required to remove 99.99% of 1.0e-3 M Ag^+? [48]

49] The K_{sp} of AgCN(s) is 2.2e-16. The K_a of HCN is 6.2e-10. What would you expect with AgCN molar solubility and pH? [49]

Answers

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[1] $x(0.122+2x)^2=1.7e\text{-}5$; $x=1.7e\text{-}5/(0.122+2x)^2$; let 2x=0; $x_1=1.14e\text{-}3$ then $x_2=1.10e\text{-}3$ and $x_3=1.10e\text{-}3$

[2] 9.7×10^{-11}

[3] $K_{sp} = [Pb^{2+}][Cl^-]^2$ $(2x)^2x = 1.7e\text{-}5$ $x = 1.6e\text{-}2$ M

[4]

$BaCO_3$	=	Ba^{2+} +	CO_3^{2-}
--		0	0
--		+x	+x
--		x	x

$x^2 = 5.0e\text{-}9$ $x =$ **7.1e-5 M**

[5]

Cu_2S	=	$2Cu^+$ +	S^{2-}
--		0	0.1 M
--		+2x	+x
--		2x	0.1 + x

$(2x)^2(0.1+x) \cong 4x^2(0.1) = 3e\text{-}49$ $x =$ **9e-25**

[6] $(0.10 + 2x)^2\ x = 1.7e\text{-}5$; $(0.10)^2\ x \approx 1.7e\text{-}5$; $x = 1.7e\text{-}3$ M

[7] 4.74

[8] pH = -log(3.35e-6) = **5.475**

[9] 3.17

[10] 1.000 be careful of s.f.

[11]

HA	=	H+	+	A-
0.10 M		0		0
-x		+x		+x
0.10 – x		x		x

$x^2/(0.10 - x) \cong x^2/0.10 = 6.28e\text{-}5$ $x = [H^+] = 2.5e\text{-}3$ **pH = 2.60**

[12] 1.69×10^{-7} M

[13]

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

$x^2/0.100\text{-}x = 2.7e\text{-}6$ x = 5.2e-4 M

pH = 3.28

[14] pH = 4.653 $[H^+] = 10^{-4.653}$ = **2.22e-5 M**

[15]

MA_2	=	M^{2+}	+	$2A^-$
--		+x		+2x

$(2x)^2x = 8.9e\text{-}17$ x = 2.8e-6 M

[16]

AB	=	A^+	+	B^-
--		x		0.10+x

$x(0.10+x) \approx 0.10x = 7.2e\text{-}12$

x = 7.2e-11 M

[17] $K_aK_b = K_w$ $K_b = 1.00e\text{-}14/7.2e\text{-}6 = 1.4e\text{-}9$

[18] 2.8e-9 M watch S.F.

[19] -0.324 watch S.F.

[20] 4.8×10^6 M watch S.F.

[21] 8.1e-10

[22] 0.10 M = $[H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$

[23] **$2[Mg^{2+}] = [Cl^-]$**

[24] $[Na^+] + [H^+] = [HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$

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

[26] $[Na^+] + [K^+] = [NO_3^-] + [Cl^-] + 2[SO_4^{2-}]$

[27] $[Ca^{2+}] = [C_2O_4^{2-}] + [HC_2O_4^-] + [H_2C_2O_4]$

[28] $2[Ca^{2+}] = 2[C_2O_4^{2-}] + [HC_2O_4^-] + [OH^-]$

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

[30] *1.00e-3 M = $[Ag(NH_3)_2^+] + [Ag(NH_3)^+] + [Ag^+]$*

[31] $2[Mg^{2+}] + 2[Mg(OH)^+] = [F^-] + [HF]$

[32] *$[Na^+] + [H^+] = [HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$*

[33] $[H^+] = 2[A^{2-}] + [HA^-]$

[34] $SrF_2(s) = Sr^{2+} + 2F^-$

$F^- + H_2O = HF + OH^-$

$H_2O = H^+ + OH^-$

CBE: $2[Sr^{2+}] + [H^+] = [F^-] + [OH^-]$

[35] Rxn Seq: $NaF \rightarrow Na^+ + F^-$

$F^- + H_2O \rightarrow HF + OH^-$ **MBE: 0.1 M = $[Na^+] = [F^-] + [HF]$**

[36] $SrF_2(s) = Sr^{2+} + 2F^-$ K_{sp}

$F^- + H_2O = HF + OH^-$ $K_b = K_w/K_a$

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

pH = 4.00 ➔ [OH-] = 1.0e-10 M

$K_b = [HF][OH^-]/[F^-]$ ➔ $[HF] = 0.1479\ [F^-]$

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

[37] $[Ag^+]/2$ or $[SO_4^{2-}]$

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

$K_{sp} = [Ba^{2+}][F^-]^2 = 1.7e\text{-}6$

$K_a\ (HF) = [H^+][F^-]/[HF] = 6.8e\text{-}4$

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

$F^- + H_2O \rightleftarrows HF + OH^-$

$K_b = K_w/K_a = 1.00e\text{-}14/6.8e\text{-}4 = 1.47e\text{-}11$

Using K_b solve for [HF]

$[HF] = K_b[F^-]/[OH^-]$ will sub into MBE

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

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

Sub all knowns into above

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

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

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

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

[39] Hg_2Cl_2 = Hg_2^{2+} $+2Cl^-$

-- 0 0.20

+x +2x

-- x 0.20+2x

$1.2\times10^{-18} = x(0.20+2x)^2$

$1.2\times10^{-18} \approx x(0.20)^2$

x = 3.0e-17

[40] 7.9e-9 = (1-0.9999)[1.6e-4]$[I^-]^2$ $[I^-] = 0.70$ M

[41] MBE: $[Br^-] = [R_3NH^+] + [R_3N]$ #1

$K_a = [H^+][R_3N]/[R_3NH^+]$ #2

$K_{sp} = [R_3NH^+][Br^-]$ #3

3 variables, 3 eqn

$[H+] = 10^{-9.50} = 3.2e\text{-}10$

If solve for $[Br^-]$ we find the solubility of $R_3NH^+Br^-$

Sub into MBE narrow it down to 2 variables

$[R_3N] = [R_3NH^+]$

$K_a/[H^+] = 7.19\ [R_3NH^+]$

$[Br^-] = [R_3NH^+] + [R_3N]$

$[Br^-] = [R_3NH^+] + 7.19\ [R_3NH^+]$

$= 8.19\ [R_3NH^+]$

$[R_3NH^+] = [Br^-] / 8.19$

Sub into Ksp

$K_{sp} = [R_3NH^+][Br^-] = 4.0\times10^{-8}$

$= [Br^-]^2 / 8.19$

$[Br^-]$= 5.7e-4

[42] $AgCl \rightleftarrows Ag^+ + Cl^-$

-- x x

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

[43] *x g AgCl + y g AgBr = 2.000 g*

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

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

0.7527x g Ag + 0.5742y g Ag = 1.300 g

y = 2.000 – x sub into above

0.7527x + 0.5742(2.000 – x) = 1.300 g

mass Ag = 0.849 g

[44] *2 equations:*

Mass lindane + Mass DDT = 0.2795 g #1

Mass AgCl from lindane + Mass AgCl from DDT = 0.7161 g #2

Let x = mass lindane and y = mass DDT

x + y = 0.2795 #3

$$mass\ \ AgCl\ \ from\ \ lindane = x \times \frac{mol\ \ lindane}{290.8g} \times \frac{6mol\ \ AgCl}{mol\ \ lindane} \times \frac{143.35g}{mol\ \ AgCl} = 2.958x$$

$$mass\ \ AgCl\ \ from\ \ DDT = y \times \frac{mol\ \ DDT}{354.5g} \times \frac{5mol\ \ AgCl}{mol\ \ DDT} \times \frac{143.35g}{mol\ \ AgCl} = 2.022y$$

Sub into #3 we have 2.958x + 2.022y = 0.7161 #4

Solve for x in #3 x = 0.2795 – y and sub into #4

2.958(0.2795 – y) + 2.022y = 0.7161

y = 0.1183 g DDT

x = 0.1612 g lidane

*% lindane = 0.1612/0.2795 * 100 = 57.68%*

% DDT = 100 – 57.68 = 42.31 %

[45] Rxn: $K_2CrO_4(aq) + BaCl_2(aq) \rightleftarrows BaCrO_4(s) + 2KCl(aq)$

Must find limiting reagent.

25.00-mL * 0.100 M $BaCl_2$ = 2.50 mmol Ba^{2+}

15.00-mL of 0.200 M K_2CrO_4 = 3.00 mmol CrO_4^{2-}

2.00 mmol Ba^{2+} must limiting reagent. Left over CrO_4^{2-}:

3.00 – 2.50 mmol = 0.50 mmol CrO_4^{2-}

$[CrO_4^{2-}]$ = 0.50 mmol/40.0-mL = 1.25e-2 M

Solubility Reaction:

$BaCrO_4(s)$	$\rightleftarrows Ba^{2+}$ +	CrO_4^{2-}
--	0	1.25e-2
--	+x	+x

K_{sp} = 2.1e-10

2.1e-10 = x (1.25e-2 – x) ≅ x (1.25e-2)

x = 1.7e-8 M

[46] *Rxns:* $CaF_2 \rightleftarrows Ca^{2+} + 2F^-$

$F^- + H_2O \rightleftarrows HF + OH^-$

$H_2O \rightleftarrows H^+ + OH^-$

MBE: $2[Ca^{2+}] = [F^-] + [HF]$ &

$[H^+] = 0.100\ M;\ [OH^-] = 1.00e\text{-}13$

$K_{sp} = [Ca^{2+}][F^-]^2 = 3.9e\text{-}11$ K_a

$(HF) = [H^+][F^-]/[HF] = 6.8e\text{-}4$

$F^- + H_2O \rightleftarrows HF + OH^-$

$K_b = K_w/K_a$

$= 1.00e\text{-}14/6.8e\text{-}4 = 1.4\underline{7}e\text{-}11$

Using K_b solve for [HF]

$[HF] = K_b[F^-]/[OH^-]$ will sub into MBE

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

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

Sub all knowns into above

$2\ [Ca^{2+}] = [F^-] + 1.4\underline{7}e\text{-}11*[F^-]/1.00e\text{-}13$

$2\ [Ca^{2+}] = [F^-] + 147[F^-] = 148\ [F^-]$

$[Ca^{2+}][F^-]^2 = 3.9e\text{-}11$

$74\ [F^-]^3 = 3.9e\text{-}11$

$[F^-] = 8.0\underline{8}\ e\text{-}5$

From K_a

$[HF] = [H^+][F^-]/6.8e\text{-}4$

$= 1.00e\text{-}1*8.08e\text{-}5/6.8e\text{-}4$

[HF]= 1.2e-2

From MBE $[Ca^{2+}] = ½\ [F^-] + ½\ [HF]$

$= ½ * 8.1e\text{-}5 + ½ * 1.2e\text{-}2 = 6.0e\text{-}3$

From K_{sp}

$[\mathbf{Ca^{2+}}] =$ $3.9e\text{-}11/[F^-]^2 = 3.9e\text{-}11/8.08e\text{-}5^2 =$ ***6.0e-3***

[47] MBE: **$[Mg^{2+}] = [CO_3^{2-}] + [HCO_3^-] + [H_2CO_3]$**

$[OH^-] = 1.00e\text{-}9$

$K_{sp} = [Mg^{2+}][CO_3^{2-}] = 3.5e\text{-}8$

$CO_3^{2-} + H_2O = HCO_3^- + OH^-$

$K_{b1} = K_w/K_{a2} = 1.00e\text{-}14/4.69e\text{-}11 =$

$2.13e\text{-}4 = [HCO_3^-][OH^-]/[CO_3^{2-}]$

$HCO_3^- + H_2O = H_2CO_3 + OH^-$

$K_{b2} = K_w/K_{a1} = 1.00e\text{-}14/4.45e\text{-}7 =$

$2.25e\text{-}8 = [H_2CO_3][OH^-]/[HCO_3^-]$

Using K_{b1} solve for $[HCO_3^-]$

$[HCO_3^-] = K_{b1}[CO_3^{2-}]/[OH^-]$

will sub into MBE

Using K_{b2} solve for $[H_2CO_3]$

$[H_2CO_3] = K_{b2}\,[HCO_3^-]/[OH^-]$

$= K_{b1}K_{b2}[CO_3^{2-}]/[OH^-]^2$

Sub both of above into MBE

$[Mg^{2+}] = [CO_3^{2-}] + [HCO_3^-] + [H_2CO_3]$

$[Mg^{2+}] = [CO_3^{2-}] + K_{b1}[CO_3^{2-}]/[OH^-] + K_{b1}K_{b2}[CO_3^{2-}]/[OH^-]^2$

Sub all knowns into above

$[Mg^{2+}] = [CO_3^{2-}] + 2.13e\text{-}4[CO_3^{2-}]/1.00e\text{-}9 + 2.13e\text{-}4*2.25e\text{-}8[CO_3^{2-}]/(1.00e\text{-}9)^2$

$[Mg^{2+}] = 2.13e5[CO_3^{2-}] + 4.79e6[CO_3^{2-}] = 5.01e6[CO_3^{2-}]$

$[CO_3^{2-}] = [Mg^{2+}]/5.01e6$ sub into K_{sp}

$[Mg^{2+}][CO_3^{2-}] = 3.5e\text{-}8$

$[Mg^{2+}]^2/5.01e6 = 3.5e\text{-}8$

$[Mg^{2+}] = 0.42$ M

x g AgCl + y g AgBr = 2.000 g

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

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

0.7527x g Ag + 0.5742y g Ag = 1.300 g

y = 2.000 – x sub into above

0.7527x + 0.5742(2.000 – x) = 1.300 g

mass Ag = 0.849 g

[48] Ksp = 1.8e-10 = $[Ag^+][Cl^-]$ ….99.99% Ag+ removal 1.8e-10 = (1.000-0.9999)(1.0e-3)$[Cl^-]$ **$[Cl^-] = 1.8e\text{-}3$ M**

[49] **AgCN solubility should decrease with increasing pH.**

AgCN = $Ag^+ + CN^-$ K_{sp} AgCN(s) = 2.2e-16 = $[Ag^+][CN^-]$

$CN^- + H_2O = HCN + OH^-$

Since OH- is a product increasing its concentration should drive the reaction to AgCN using Le Chatelier's principles