Last Name: KEY Chapter 15: Applications of Acids & Bases

1) Calculate the pH of a buffer that is 0.058 M HF and 0.048 M LiF. The Ka for HF is 3.5×10^{-4}. (5 pts)

2 Sig Figs

$$pH = pK_a + \log\frac{[base]}{[acid]}$$

$$= -\log 3.5\times10^{-4} + \log\frac{0.048\,M}{0.058\,M}$$

$$= 3.46 + \log\frac{0.048}{0.058}$$

$$= 3.46 + (-.082)$$

$$= 3.37$$

2 Sig Fig.

2) Which of the following solutions is a good buffer system? (5 pts)

A) A solution that is 0.10 M NaOH and 0.10 M HCl

B) A solution that is 0.10 M HF and 0.10 M $NaC_2H_3O_2$

C) A solution that is 0.10 M HCl and 0.10 M NH_4^+

D) A solution that is 0.10 M $HC_2H_3O_2$ and 0.10 M $LiC_2H_3O_2$

E) None of the above are buffer systems.

THE ANSWER IS LETTER D

3a) Given the titration of a weak acid with a strong base, e.g. $HC_2H_3O_2 + OH^- \rightarrow C_2H_3O_2^- + H_2O$, would the equivalence point be

CIRCLE ONE: acidic neutral **basic** ? (5 pts)

3b) Given the titration of a weak base with a strong acid, e.g. $C_2H_3O_2^- + HCl \rightarrow HC_2H_3O_2 + Cl^-$, would the equivalence point be

CIRCLE ONE: **acidic** neutral basic ? (5 pts)

4) A 1.00 L buffer solution is 0.150 M in $HC_7H_5O_2$ and 0.250 M in $LiC_7H_5O_2$. Calculate the pH of the solution after the addition of 100.0 mL of 1.00 M HCl. The Ka for $HC_7H_5O_2$ is 6.5×10^{-5}. (10 pts)

Extra Credit: Calculate the initial pH before acid addition. (5 pts)

2 Sig Figs

$HCl + A^- \rightleftharpoons HA + Cl^-$

start	0	0.25mol	0.15mol	0
add	0.1mol	–	–	–
finish	0	0.15	0.25	0.1

$[A^-] = 0.15mol / 1.1L = 0.14M$

$[HA] = 0.25mol / 1.1L = 0.23M$

$pH = pKa + \log \frac{[A^-]}{[HA]}$

$= -\log 6.5\times10^{-5} + \log \frac{0.14}{0.23}$

$= 4.19 - .216$

$= 3.97$

$pH = pKa + \log \frac{[A^-]}{[HA]}$

$= 4.19 + \log \frac{.25}{.15}$

$= 4.19 + .223$

$= 4.41$

Initial pH

5) A 100.0 mL sample of 0.18 M $HClO_4$ is titrated with 0.27 M LiOH. Determine the pH of the solution after the addition of 30.0 mL of LiOH. (10 pts).

2 Sig Figs

$\frac{0.18mol}{L} HClO_4 \times 0.1L = 1.8\times10^{-2} mol\ HClO_4$

$\frac{0.27mol}{L} LiOH \times 0.03L = 8.1\times10^{-3} mol\ LiOH$

$\frac{9.9\times10^{-3} mol\ HClO_4}{\text{excess}}$ = ACID - BASE

$\frac{9.9\times10^{-3}mol}{0.13L} = 7.62\times10^{-2} M\ HClO_4$

$pH = -\log 7.62\times10^{-2} = 1.12$ 2 Sig Figs

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6) If the Ka is 1.82×10^{-5}, what ratio of $C_2H_3O_2^-/HC_2H_3O_2$ must you use to prepare an $HC_2H_3O_2$ buffer with a $[H_3O^+]$ of 5.75×10^{-5}? (10 pts). 3 Sig Figs

$pH = -\log 5.75 \times 10^{-5} = 4.240$

$pKa = -\log 1.82 \times 10^{-5} = 4.740$

$pH = pKa + \log \frac{[BASE]}{[ACID]}$

$4.240 = 4.740 + \log x$

$\log x = -0.500$

$x = 10^{-0.500}$

$= 0.316 = \frac{[BASE]}{[ACID]}$

$K_a = 1.82 \times 10^{-5} = \frac{[H_3O^+][A^-]}{[HA]}$

$1.82 \times 10^{-5} = \frac{5.75 \times 10^{-5}[A^-]}{[HA]}$

$\frac{1.82 \times 10^{-5}}{5.75 \times 10^{-5}} = \frac{[A^-]}{[HA]} = 0.316$

3 Sig Figs

7a) Write the dissociation equation (5 pts) and the K_{sp} expression (5 pts) for $PbCl_2$.

$PbCl_2 \rightleftharpoons Pb^{2+} + 2Cl^-$

$K_{sp} = [Pb^{2+}][Cl^-]^2$

7b) Determine the molar solubility of Pb ions and Cl ions if $K_{sp} = 1.17 \times 10^{-5}$. (5 pts)

3 Sig Figs

$K_{sp} = 1.17 \times 10^{-5} = (S)(2S)^2 = 4S^3$

$S = 1.43 \times 10^{-2} M = [Pb^{2+}]$

$[Cl^-] = 2 \times [Pb^{+}] = 2.86 \times 10^{-2} M$

3 Sig Figs

c) The molar solubility of Zn ion is 1.6×10^{-12} M in pure water. Calculate the K_{sp} for ZnS. (5 pts)

2 Sig Figs

$K_{sp} = [Zn^{2+}][S^{2-}] = s^2 = (1.6\times10^{-12})^2$

$= 2.6\times10^{-24}$

2 Sig Figs

8) Given the reaction $Ag_2SO_{4(s)} \Leftrightarrow 2Ag^+ + SO_4^{2-}$, $K_{sp}= 1.2\text{x}10^{-5}$

a) What would happen if you added $AgNO_3$, (K_{sp} = 51.6), to the system? (5 pts)

CIRCLE ONE: (rxn shifts left) rxn shifts right no change

b) What would happen if you added Na_2SO_4 ($K_{sp}=1.2\text{x}10^{-3}$) to the system? (5 pts)

CIRCLE ONE: (rxn shifts left) rxn shifts right no change

c) What would happen if you added NaCl, (K_{sp} = 36), to the system? (5 pts)

CIRCLE ONE: rxn shifts left (rxn shifts right) no change

ppt of AgCl $K_{sp} = 1.77\times10^{-10}$ (Hint)