CHM 151/54 Quiz #5a 25 Pts Fall 05 Name: Key

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1. (8 Pts) Determine the $[H^+]$, $[OH^-]$, pH, and the ~~pH~~ pOH of each of the following.

a. 50.0 mL of 0.015 M $Ba(OH)_2$ solution. Strong Base $Ba(OH)_2 \xrightarrow{H_2O} Ba^{2+} + 2OH^-$

$= 2 \times 0.015 = 0.030\,M$ $\quad pOH = -\log[0.030] = 1.52$

$[H^+] = \frac{10^{-14}}{0.030} = 3.3 \times 10^{-13}$ $\quad pH = 12.48$

b. 75.00 mL of 0.025 M HNO_3 solution. Strong Acid: $HNO_3 \xrightarrow{H_2O} H^+ + NO_3^-$

$[H^+] = 0.025\,M$ $\quad pH = 1.60$

$[OH^-] = \frac{10^{-14}}{0.025} = 4.0 \times 10^{-13}$ $\quad pOH = 12.40$

2. (6 Pts) Determine the pH of a titration solution when 25.00 mL of 0.15 M HCl is titrated with 15.20 mL of 0.14 M KOH. Both Strong: $HCl + KOH \rightarrow H_2O + KCl + XS$

25.00 mL, 0.15 mmol/mL $\quad$ 15.20 mL, 0.14 mmol/mL

mol H^+: $25.00\,mL \left|\frac{0.15\,mmol}{mL}\right| \left|\frac{1\,mol}{1000\,mmol}\right| = 0.00375\,mol\,H^+$

mol OH^-: $15.20\,mL \left|\frac{0.14\,mmol}{mL}\right| \left|\frac{1\,mol\,OH^-}{1\,mmol}\right| = 0.00128\,mol\,OH^-$

$0.00122\,mol\,XS\,H^+$

$pH = -\log\left[\frac{0.00122\,mol}{40.20 \times 10^{-3}\,L}\right] = 1.394$

3. (6 Pts) Lactic acid, $HC_3H_5O_2$, has one acidic hydrogen. A 0.10 M solution of lactic acid has a pH of 2.44. Calculate the Ka for lactic acid.

	$HLac$	$+ H_2O \rightleftharpoons$	H_3O^+	$+ Lac^-$
I	0.10	N/A	0	0
C	$-x$		$+x$	$+x$
E	$0.10-x$		x	x

$x = 10^{-2.44}$

$x = 0.00363$

$0.10 - 0.00361 = 0.09639$

$K_a = \frac{[H_3O^+][Lac^-]}{[HLac]}$

$K_a = \frac{(0.00363)^2}{(0.10-0.00361)}$

$K_a = 1.367 \times 10^{-4}$

4. (5 Pts) The acid-dissociation constant for benzoic acid, $HC_7H_5O_2$, is 6.3×10^{-5}. Calculate the pH of a 0.050 M benzoic acid solution.

	HBz	$+ H_2O \rightleftharpoons$	H_3O^+	$+ Bz^-$
I	0.050	N/A	0	0
C	$-x$		$+x$	$+x$
E	$0.050-x$		x	x

$K_a = \frac{[H_3O^+][Bz^-]}{[HBz]}$

$6.3 \times 10^{-5} = \frac{x^2}{0.050 - x}$ ← try dropping

$x = 0.00177 = [H^+]$

$pH = -\log[H^+] = 2.75$

CHM 151/54 Quiz #5b 25 Pts Fall 05 Name: Key

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1. (8 Pts) Determine the $[H^+]$, $[OH^-]$, pH, and the pOH of each of the following.

a. 85.00 mL of 0.035 M HNO_3 solution. Strong Acid $HNO_3 \xrightarrow{H_2O} H^+ + NO_3^-$

$[H^+] = 0.035$ $pH = -\log[0.035] = 1.46$

$[OH^-] = \frac{10^{-14}}{0.035} = 2.86 \times 10^{-13}$ $pOH = 12.54$

b. 60.0 mL of 0.025 M $Ba(OH)_2$ solution. Strong Base: $Ba(OH)_2 \xrightarrow{H_2O} Ba^{2+} + 2OH^-$

$[OH^-] = 2(0.025) = 0.050M$ $pOH = 1.30$

$[H^+] = \frac{10^{-14}}{0.050} = 2.0 \times 10^{-13}$ $pH = 12.70$

2. (6 Pts) Determine the pH of a titration solution when 25.00 mL of 0.18 M HCl is titrated with 19.20 mL of 0.14 M NaOH. Strong Acid + Strong Base $HCl_{aq} + NaOH_{aq} \rightarrow H_2O(l) + NaCl(s)$

Net ionic Eq. $H^+ + OH^- \rightarrow H_2O(l)$ 1:1 ratio

Find moles H^+: $25.00\,mL \left| \frac{0.18\,mol\,HCl}{1000\,mL} \right| \frac{1\,mol\,H^+}{1\,mol\,HCl} = 0.0045\,mol\,H^+$

Find mol. OH^-: $19.20\,mL \left| \frac{0.14\,mol\,NaOH}{1000\,mL} \right| \frac{1\,mol\,OH}{1\,mol\,NaOH} = 0.00269\,mol\,OH^-$

$0.001812\,mol\ XS\ H^+$

$pH = -\log\left[\frac{0.001812\,mol\,H^+}{44.20 \times 10^{-3}\,L}\right] = 1.387$

3. (5 Pts) The acid-dissociation constant for benzoic acid, $HC_7H_5O_2$, is 6.3×10^{-5}. Calculate the pH of a 0.060 M benzoic acid solution.

$HBz + H_2O \rightleftharpoons H_3O^+ + Bz^-$ $K_a = \frac{[H_3O^+][Bz^-]}{[HBz]}$

	HBz	H_2O	H_3O^+	Bz^-
I	0.060	NA	0	0
C	$-x$		$+x$	$+x$
E	$0.060-x$		x	x

$6.3 \times 10^{-5} = \frac{x^2}{0.060 - x}$ ← try dropping

$x = 0.00194 = [H_3O^+]$ guess (0.0019) 2.718

$pH = 2.71$

4. (6 Pts) Lactic acid, $HC_3H_5O_2$, has one acidic hydrogen. A 0.10 M solution of lactic acid has a pH of 2.44. Calculate the Ka for lactic acid.

$HLac + H_2O \rightleftharpoons H_3O^+ + Lac^-$ $K_a = \frac{(0.003631)^2}{(0.10 - 0.003631)}$

	HLac	H_2O	H_3O^+	Lac^-
I	0.10	NA	0	0
C	$-x$		$+x$	$+x$
E	$0.10-x$		x	x

$K_a = 1.37 \times 10^{-4}$

$x = 10^{-2.44}$

from pH → $x = 0.003631$