Non Sibi High School

Andover's Chem 300: Accelerated/Honors Chemistry

Chapter 17, Review Quiz 1 Answers

1

A 65 mL sample of HBr gas, measured at 35°C and 722 mmHg, was dissolved in water to yield 275 mL of solution. Calculate the molarity of hydrogen ion, the molarity of hydroxide ion, pH, and pOH in this solution.

$$\mathrm{n} = \frac{\frac{722}{760}\,\mathrm{atm} \times \frac{65}{1000}\,\mathrm{L}}{0.0821\,\frac{\mathrm{L\cdot atm}}{\mathrm{mol\cdot K}} \times (35+273)\,\mathrm{K}} = 0.00244\,\mathrm{mol\,HBr}$$

$$[\mathrm{HBr}]_\mathrm{i} = \frac{0.00244\,\mathrm{mol}}{\frac{275}{1000}\,\mathrm{L}} = 0.0089\,\mathrm{M}$$

HBr = strong acid:

R)	$HBr(aq)$	$\longrightarrow$	$H^+(aq)$	$+$	$Br^-(aq)$
I)	0.0089		0		0
C)	-0.0089		+0.0089		+0.0089
E)	0		0.0089		0.0089

$$[\mathrm{H^+}] = 0.0089\,\mathrm{M}$$

$$[\mathrm{OH^-}] = \frac{1.0\times10^{-14}}{0.0089} = 1.1\times10^{-12}\,\mathrm{M}$$

$$\mathrm{pH} = -\log(0.0089) = 2.05$$

$$\mathrm{pOH} = 14.00 - 2.05 = 11.95$$

2

A 0.086 gram sample of strontium hydroxide was dissolved in water to create 58 mL of solution. Calculate the molarity of hydroxide ion, the molarity of hydrogen ion, pOH, and pH in this solution.

$$0.086\,\mathrm{g}\left(\frac{1\,\mathrm{mol}}{121.6\,\mathrm{g}}\right) = 7.07\times10^{-4}\,\mathrm{mol\,Sr(OH)_2}$$

$$[\mathrm{Sr(OH)_2}]_\mathrm{i} = \frac{7.07 \times 10^{-4}\,\mathrm{mol}}{\frac{58}{1000}\,\mathrm{L}} = 0.012\,\mathrm{M}$$

$Sr(OH)_2$ = strong base:

R)	$Sr(OH)_2(aq)$	$\longrightarrow$	$Sr^{2+}(aq)$	+	$2OH^-(aq)$
I)	0.012		0		0
C)	-0.012		+0.012		+2(0.012)
E)	0		0.012		0.024

$$[\mathrm{OH^-}] = 0.024\,\mathrm{M}$$

$$[\mathrm{H^+}] = \frac{1.0 \times 10^{-14}}{0.024} = 4.2 \times 10^{-13}\,\mathrm{M}$$

$$\mathrm{pOH} = -\log(0.024) = 1.62$$

$$\mathrm{pH} = 14.00 - 1.62 = 12.38$$

3

Write the acid ionization equation and calculate the pH and percent ionization of 0.63 M hypobromous acid, HBrO ($K_a = 2.5 \times 10^{-9}$).

R)	$HBrO(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$BrO^-(aq)$
I)	0.63		0		0
C)	-x		+x		+x
E)	0.63 - x		x		x

$$\mathrm{K_a} = 2.5 \times 10^{-9} = \frac{\mathrm{x}^2}{0.63 - \mathrm{x}}$$

$$(0 < \mathrm{x} < 0.63)$$

$$\mathrm{x} = 4.0 \times 10^{-5}\,\mathrm{M} = [\mathrm{H^+}]$$

$$\mathrm{pH} = -\log(4.0 \times 10^{-5}) = 4.40$$

$$\%\,\mathrm{ionization} = \frac{4.0 \times 10^{-5}}{0.63} \times 100\% = 0.0063\%$$

4

A 0.85 M lactic acid solution has a pH of 1.97. Write the acid ionization equation and calculate K_a for lactic acid, $HC_3H_5O_3$.

R)	$HC_3H_5O_3(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$C_3H_5O_3{}^-(aq)$
I)	0.85		0		0
C)	-x		+x		+x
E)	0.85 - x		x		x

$$[H^+] = 10^{-1.97} = 0.011\,M = x$$

$$K_a = \frac{(0.011)^2}{(0.85 - 0.011)} = 1.4 \times 10^{-4}$$

5

A 0.017 M solution of propanoic acid is 2.7% ionized. Write the acid ionization equation and calculate the pH of the solution and K_a for propanoic acid, $HC_3H_5O_2$.

R)	$HC_3H_5O_2(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$C_3H_5O_2{}^-(aq)$
I)	0.017		0		0
C)	-x		+x		+x
E)	0.017 - x		x		x

$$\frac{x}{0.017} \times 100\% = 2.7\%$$

$$x = 4.6 \times 10^{-4}\,M = [H^+]$$

$$pH = -\log(4.6 \times 10^{-4}) = 3.34$$

$$K_a = \frac{(4.6 \times 10^{-4})^2}{(0.0.017 - 4.6 \times 10^{-4})} = 1.3 \times 10^{-5}$$

6

A cyanic acid, HCNO, solution has a pH of 2.25. Given that $K_a = 3.5 \times 10^{-4}$ for cyanic acid, write the acid ionization equation and calculate the initial molarity of the cyanic acid solution.

R)	$HCNO(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$CNO^-(aq)$
I)	M_i		0		0
C)	-x		+x		+x
E)	M_i - x		x		x

$$[\mathrm{H^+}] = 10^{-2.25} = 0.0056\,\mathrm{M} = \mathrm{x}$$

$$\mathrm{K_a} = 3.5 \times 10^{-4} = \frac{(0.0056)^2}{(\mathrm{M}i - 0.0056)}$$

$$\mathrm{M}_i = 0.095\,\mathrm{M}$$

7

Write the stepwise acid ionization equations and calculate the pH of 0.23 M selenous acid, H_2SeO_3, which has the following acid ionization constants:

$$\mathrm{Ka_1} = 2.3 \times 10^{-3}$$

$$\mathrm{Ka_2} = 5.3 \times 10^{-9}$$

1st ionization:

R)	$H_2SeO_3(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$HSeO_3{}^-(aq)$
I)	0.23		0		0
C)	-x		+x		+x
E)	0.23 - x		x		x

$$\mathrm{Ka_1} = 2.3 \times 10^{-3} = \frac{\mathrm{x}^2}{0.23 - \mathrm{x}}$$

$$(0 < \mathrm{x} < 0.23)$$

$$\mathrm{x} = 0.022\,\mathrm{M} = [\mathrm{H^+}]$$

$$\mathrm{pH} = -\log(0.022) = 1.66$$

2nd ionization:

$$\mathrm{HSeO_3{}^-(aq) \rightleftharpoons H^+(aq) + SeO_3{}^{2-}(aq)}$$

8

Identify the Bronsted acids and bases in the forward and reverse directions for the reaction below:

$$\mathrm{H_2C_6H_5O_7{}^-(aq) + HC_3H_2O_4{}^-(aq) \rightleftharpoons HC_6H_5O_7{}^{2-}(aq) + H_2C_3H_2O_4(aq)}$$

forward reaction:
Bronsted acid = $H_2C_6H_5O_7{}^-$ (donates proton), Bronsted base = $HC_3H_2O_4{}^-$ (accepts proton)

reverse reaction:
Bronsted acid = $H_2C_3H_2O_4$, Bronsted base = $HC_6H_5O_7{}^{2-}$

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Write the formula for:

a. the conjugate acid of $HC_2O_4{}^-$
b. the conjugate base of $HAsO_4{}^{2-}$

a. conjugate acid = add H^+ to formula = $H_2C_2O_4$
b. conjugate base = remove H^+ from formula = $AsO_4{}^{3-}$

10

Write the base ionization equation and calculate the pH and percent ionization of 0.44 M dimethylamine, $(CH_3)_2NH$ ($K_b = 5.4 \times 10^{-4}$).

R)	$(CH_3)_2NH(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$(CH_3)_2NH_2{}^+(aq)$	+	$OH^-(aq)$
I)	0.44				0		0
C)	-x				+x		+x
E)	0.44 - x				x		x

$$K_b = 5.4 \times 10^{-4} = \frac{x^2}{0.44 - x}$$

$$(0 < x < 0.44)$$

$$x = 0.015\,M = [OH^-]$$

$$pOH = -\log(0.015) = 1.82$$

$$pH = 14.00 - 1.82 = 12.18$$

$$\%\,\text{ionization} = \frac{0.015}{0.44} \times 100\% = 3.4\%$$

11

A 0.084 M codeine solution has a pH of 10.46. Write the base ionization equation and calculate K_b for codeine, $C_{18}H_{21}O_3N$.

R)	$C_{18}H_{21}O_3N(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$C_{18}H_{21}O_3NH^+(aq)$	+	$OH^-(aq)$
I)	0.084				0		0
C)	-x				+x		+x
E)	0.084 - x				x		x

$$pOH = 14.00 - 10.46 = 3.54$$

$$[OH^-] = 10^{-3.54} = 2.9 \times 10^{-4}\,M = x$$

$$K_b = \frac{(2.9 \times 10^{-4})^2}{(0.084 - 2.9 \times 10^{-4})} = 1.0 \times 10^{-6}$$

12

A 0.077 M solution of piperidine is 12% ionized. Write the base ionization equation and calculate the pH of the solution and K_b for piperidine, $C_5H_{11}N$.

R)	$C_5H_{11}N(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$C_5H_{11}NH^+(aq)$	+	$OH^-(aq)$
I)	0.077				0		0
C)	-x				+x		+x
E)	0.077 - x				x		x

$$\frac{x}{0.077} \times 100\% = 12\%$$

$$x = 0.0092\,M = [OH^-]$$

$$pOH = -\log(0.0092) = 2.04$$

$$pH = 14.00 - 2.04 = 11.96$$

$$K_b = \frac{(0.0092)^2}{(0.077 - 0.0092)} = 1.2 \times 10^{-3}$$

13

A quinoline, C_9H_7N, solution has a pH of 9.00. Given that $K_b = 6.3 \times 10^{-10}$ for quinoline, write the base ionization equation and calculate the initial molarity of the quinoline solution.

R)	$C_9H_7N(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$C_9H_7NH^+(aq)$	+	$OH^-(aq)$
I)	M_i				0		0
C)	-x				+x		+x
E)	M_i - x				x		x

$$pOH = 14.00 - 9.00 = 5.00$$

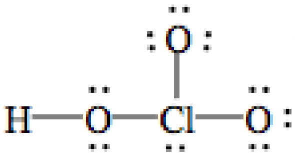
$$[OH^-] = 10^{-5.00} = 1.0 \times 10^{-5}\,M = x$$

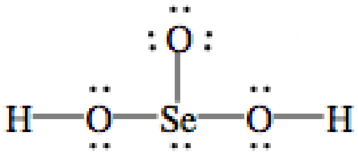
$$K_b = 6.3 \times 10^{-10} = \frac{(1.0 \times 10^{-5})^2}{(Mi - 1.0 \times 10^{-5})}$$

$$M_i = 0.16\,M$$

14

Draw Lewis structures for chloric acid, $HClO_3$, and selenous acid, H_2SeO_3. Which is the stronger acid? Give two reasons to justify your answer.



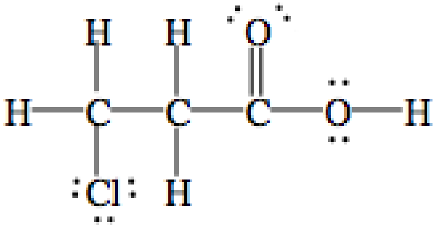


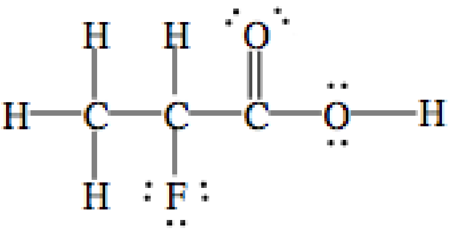
Chloric acid is stronger acid because:

1. $HClO_3$ has more terminal oxygens (3 - 1 = 2) than H_2SeO_3 (3 - 2 = 1).
2. Electronegativity for central atom Cl is higher than for central atom Se.

15

Which of the two acids shown below is the stronger acid? Give two reasons to justify your answer.





The acid on the right is stronger because:

1. Electronegativity of F is higher than Cl.
2. F is closer to ionizable proton than Cl.

16

Predict whether a solution of each compound below will be acidic, basic, or neutral. For solutions that are not neutral, show all relevant hydrolysis reactions that affect the pH and also calculate the equilibrium constant for each reaction you write using information from the following data tables:

Acid	K_a
HCN	4.9×10^{-10}
HIO	2.3×10^{-11}

Base	K_b
$(CH_3)_3N$	6.4×10^{-5}
NH_3	1.8×10^{-5}

a. $(CH_3)_3NHCl$ [composed of $(CH_3)_3NH^+$ and Cl^-]
b. KCN
c. NaI
d. NH_4IO

a. Cl^- = spectator ion

$(CH_3)_3NH^+$ hydrolyzes as weak acid = solution is acidic:

$$(CH_3)_3NH^+(aq) \rightleftharpoons H^+(aq) + (CH_3)_3N(aq)$$
$$K_a = \frac{1.0 \times 10^{-14}}{6.4 \times 10^{-5}} = 1.6 \times 10^{-10}$$

b. K^+ = spectator ion

CN^- hydrolyzes as a weak base = solution is basic:

$$CN^-(aq) + H_2O(l) \rightleftharpoons HCN(aq) + OH^-(aq)$$
$$K_b = \frac{1.0 \times 10^{-14}}{4.9 \times 10^{-10}} = 2.0 \times 10^{-5}$$

c. Na^+ and I^- = spectator ions = solution is neutral

d. Both ions hydrolyze, so we must compare equilibrium constants:

$$NH_4{}^+(aq) \rightleftharpoons H^+(aq) + NH_3(aq)$$
$$K_a = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-10}$$

$$IO^-(aq) + H_2O(l) \rightleftharpoons HIO(aq) + OH^-(aq)$$
$$K_b = \frac{1.0 \times 10^{-14}}{2.3 \times 10^{-11}} = 4.3 \times 10^{-4}$$
$$K_a < K_b = \text{solution is basic}$$

17

For each solution below, show any relevant hydrolysis reactions and calculate the pH.

a. 0.31 M $C_6H_5NH_3Br$ [composed of $C_6H_5NH_3{}^+$ and Br^-]
b. 1.2 M $KC_3H_5O_3$

$K_b = 4.3 \times 10^{-10}$ for $C_6H_5NH_2$
$K_a = 1.4 \times 10^{-4}$ for $HC_3H_5O_3$

a. Br^- = spectator ion

$C_6H_5NH_3{}^+$ hydrolyzes as weak acid:

$$\begin{array}{ccccccc}
\text{R)} & C_6H_5NH_3{}^+(aq) & \rightleftharpoons & H^+ & + & C_6H_5NH_2(aq) \\
\text{I)} & 0.31 & & 0 & & 0 \\
\text{C)} & -x & & +x & & +x \\
\text{E)} & 0.31 - x & & x & & x
\end{array}$$

$$K_a = \frac{1.0 \times 10^{-14}}{4.3 \times 10^{-10}} = 2.3 \times 10^{-5} = \frac{x^2}{0.31 - x}$$
$$(0 < x < 0.31)$$
$$x = 0.0027\,M = [H^+]$$
$$pH = -\log(0.0027) = 2.57$$

b. K^+ = spectator ion

$C_3H_5O_3{}^-$ hydrolyzes as a weak base:

$$\begin{array}{cccccccc}
\text{R)} & C_3H_5O_3{}^-(aq) & + & H_2O(l) & \rightleftharpoons & HC_3H_5O_3(aq) & + & OH^-(aq) \\
\text{I)} & 1.2 & & & & 0 & & 0 \\
\text{C)} & -x & & & & +x & & +x \\
\text{E)} & 1.2 - x & & & & x & & x
\end{array}$$

$$K_b = \frac{1.0 \times 10^{-14}}{1.4 \times 10^{-4}} = 7.1 \times 10^{-11} = \frac{x^2}{1.2 - x}$$
$$(0 < x < 1.2)$$
$$x = 9.2 \times 10^{-6}\,M = [OH^-]$$
$$pOH = -\log(9.2 \times 10^{-6}) = 5.04$$
$$pH = 14.00 - 5.04 = 8.96$$

18

Predict whether a solution of sodium hydrogen malonate, $NaHC_3H_2O_4$, will be acidic or basic. Show all relevant reactions that affect the pH and also give the value of the equilibrium constant for each reaction you write using some or all of the following information:

For malonic acid, $H_2C_3H_2O_4$, $Ka_1 = 1.5 \times 10^{-3}$ and $Ka_2 = 2.0 \times 10^{-6}$
For the hydrogen malonate ion, ${HC_3H_2O_4}^-$, $K_b = 6.7 \times 10^{-12}$

Na^+ = spectator ion

weak acid ionization reaction:

$$\mathrm{HC_3H_2O_4{}^-(aq) \rightleftharpoons H^+(aq) + C_3H_2O_4{}^{2-}\;\; K_a\,for\,HC_3H_2O_4{}^- = Ka_2\,for\,H_2C_3H_2O_4 = 2.0 \times 10^{-6}}$$

weak base hydrolysis reaction:

$$\mathrm{HC_3H_2O_4{}^-(aq) + H_2O(l) \rightleftharpoons H_2C_3H_2O_4(aq) + OH^-(aq)\;\; K_b\,for\,HC_3H_2O_4{}^- = 6.7 \times 10^{-12}}$$

$$\mathrm{K_a > K_b = solution\,is\,acidic}$$

19

Will the reaction of P_4O_{10} and water produce H_3PO_3 or H_3PO_4? Write a balanced equation for the reaction.

The reaction of P_4O_{10} (oxidation number of P = +5) and water will produce H_3PO_4 (oxidation number of P = +5) rather than H_3PO_3 (oxidation number of P = +3). The balanced equation will be $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$.

20

a. An unknown monoprotic weak acid was found to be 30.60% carbon, 45.16% chlorine, and 3.85% hydrogen by mass, with the remainder being oxygen. Determine the empirical formula of the acid.

b. In a separate experiment, 3.75 grams of the acid was dissolved in 45 mL of water and then titrated with 0.164 M barium hydroxide. The volume of base required to reach the equivalence point was 72.8 mL. Calculate the molar mass and determine the molecular formula of the acid.

a.

$$100\% - 30.60\%\,\mathrm{C} - 45.16\%\,\mathrm{Cl} - 3.85\%\,\mathrm{H} = 20.39\%\,\mathrm{O}$$

Assume one hundred grams of unknown compound:

$$30.60\,\mathrm{g\,C}\left(\frac{1\,\mathrm{mol}}{12.01\,\mathrm{g}}\right) = 2.548\,\mathrm{mol\,C}$$

$$45.16\,\mathrm{g\,I}\left(\frac{1\,\mathrm{mol}}{35.45\,\mathrm{g}}\right) = 1.274\,\mathrm{mol\,Cl}$$

$$3.85\,\mathrm{g\,H}\left(\frac{1\,\mathrm{mol}}{1.008\,\mathrm{g}}\right) = 3.82\,\mathrm{mol\,H}$$

$$20.39\,\mathrm{g\,O}\left(\frac{1\,\mathrm{mol}}{16.00\,\mathrm{g}}\right) = 1.274\,\mathrm{mol\,O}$$

$$\frac{2.548}{1.274}\,\mathrm{mol\,C} : \frac{1.274}{1.274}\,\mathrm{mol\,Cl} : \frac{3.82}{1.274}\,\mathrm{mol\,H} : \frac{1.274}{1.274}\,\mathrm{mol\,O}$$

$$\mathrm{empirical\,formula} = \mathrm{C_2ClH_3O}$$

b. $0.164\,\mathrm{M\,Ba(OH)_2} \longrightarrow 0.164\,\mathrm{M\,Ba^{2+}}$ and $2 \times 0.164\,\mathrm{M} = 0.328\,\mathrm{M\,OH^-}$

$$\mathrm{HA(aq) + OH^-(aq) \longrightarrow H_2O(l) + A^-(aq)}$$

$$72.8\,\mathrm{mL}\left(\frac{1\,\mathrm{L}}{1000\,\mathrm{mL}}\right)\left(\frac{0.328\,\mathrm{mol\,OH^-}}{1\,\mathrm{L}}\right)\left(\frac{1\,\mathrm{mol\,HA}}{1\,\mathrm{mol\,OH^-}}\right) = 0.02388\,\mathrm{mol\,HA}$$

$$M = \frac{3.75\,\mathrm{g}}{0.02388\,\mathrm{mol}} = 157\,\mathrm{g/mol}$$

$$\frac{M}{EM} = \frac{157}{78.49} = 2$$

$$\mathrm{molecular\,formula} = \mathrm{C_2ClH_3O} \times 2 = \mathrm{C_4Cl_2H_6O_2}$$

Since the acid is monoprotic, we can rewrite the molecular formula as $\mathrm{HC_4Cl_2H_5O_2}$.

21

Calculate the initial molarity of a sodium fluoride, NaF, solution that has a pH of 8.17 given that $\mathrm{K_a} = 6.8 \times 10^{-4}$ for hydrofluoric acid, HF.

$\mathrm{Na^+}$ =spectator ion, $\mathrm{F^-}$ hydrolyzes as a weak base:

R)	$F^-(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$HF(aq)$	+	$OH^-(aq)$
I)	M_i				0		0
C)	-x				+x		+x
E)	M_i - x				x		x

$$\begin{aligned}
\mathrm{pOH} &= 14.00 - 8.17 = 5.83 \\
[\mathrm{OH^-}] &= 10^{-5.83} = 1.5 \times 10^{-6}\,\mathrm{M} = \mathrm{x} \\
\mathrm{K_b\ for\ F^-} &= \frac{1.0 \times 10^{-14}}{6.8 \times 10^{-4}} = 1.5 \times 10^{-11} = \frac{(1.5 \times 10^{-6})^2}{(\mathrm{M}i - 1.5 \times 10^{-6})} \\
\mathrm{M}_i &= 0.15\,\mathrm{M}
\end{aligned}$$

22

Calculate the initial molarity of a $C_5H_5NHNO_3$ [composed of $C_5H_5NH^+$ and $NO_3{}^-$] solution that has a pH of 2.83 given that $K_b = 1.7 \times 10^{-9}$ for C_5H_5N.

$NO_3{}^-$ =spectator ion, $C_5H_5NH^+$ hydrolyzes as a weak acid:

R)	$C_5H_5NH^+(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$C_5H_5N(aq)$
I)	M_i		0		0
C)	-x		+x		+x
E)	M_i - x		x		x

$$\begin{aligned}
[\mathrm{H^+}] &= 10^{-2.83} = 0.0015\,\mathrm{M} = \mathrm{x} \\
\mathrm{K_a\ for\ C_5H_5NH^+} &= \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-9}} = 5.9 \times 10^{-6} = \frac{(0.0015)^2}{(\mathrm{M}i - 0.0015)} \\
\mathrm{M}_i &= 0.38\,\mathrm{M}
\end{aligned}$$

23

Given that a 0.72 M KIO solution has a pH of 12.24, calculate K_a and pK_a for HIO.

K^+ =spectator ion, IO^- hydrolyzes as a weak base:

R)	$IO^-(aq)$	+	$H_2O(l)$	$\rightleftharpoons$	$HIO(aq)$	+	$OH^-(aq)$
I)	0.72				0		0
C)	-x				+x		+x
E)	0.72 - x				x		x

$$\mathrm{pOH} = 14.00 - 12.24 = 1.76$$

$$[\mathrm{OH^-}] = 10^{-1.76} = 0.017\,\mathrm{M} = \mathrm{x}$$

$$\mathrm{K_b\ for\ IO^-} = \frac{(0.017)^2}{(0.72 - 0.017)} = 4.1 \times 10^{-4}$$

$$\mathrm{K_a\ for\ HIO} = \frac{1.0 \times 10^{-14}}{4.1 \times 10^{-4}} = 2.4 \times 10^{-11}$$

$$\mathrm{pK_a\ for\ HIO} = -\log(2.4 \times 10^{-11}) = 10.62$$

24

Given that a 0.066 M $C_6H_{15}O_3NHCl$ [composed of $C_6H_{15}O_3NH^+$ and Cl^-] solution has a pH of 4.48, calculate K_b and pK_b for $C_6H_{15}O_3N$.

Cl^- =spectator ion, $C_6H_{15}O_3NH^+$ hydrolyzes as a weak acid:

R)	$C_6H_{15}O_3NH^+(aq)$	$\rightleftharpoons$	$H^+(aq)$	+	$C_6H_{15}O_3N(aq)$
I)	0.066		0		0
C)	-x		+x		+x
E)	0.066 - x		x		x

$$[\mathrm{H^+}] = 10^{-4.48} = 3.3 \times 10^{-5}\,\mathrm{M} = \mathrm{x}$$

$$\mathrm{K_a\ for\ C_6H_{15}O_3NH^+} = \frac{(3.3 \times 10^{-5})^2}{(0.066 - 3.3 \times 10^{-5})} = 1.7 \times 10^{-8}$$

$$\mathrm{K_b\ for\ C_6H_{15}O_3N} = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-8}} = 5.9 \times 10^{-7}$$

$$\mathrm{pK_b\ for\ C_6H_{15}O_3N} = -\log(5.9 \times 10^{-7}) = 6.23$$

25

For which titration below will the pH be above 7 at the equivalence point?

$HNO_2(aq) + NaOH(aq)$ or $HNO_3(aq) + Sr(OH)_2(aq)$?

$HNO_2(aq) + NaOH(aq)$ = weak acid + strong base: pH above 7 at equiv. point
$HNO_3(aq) + Sr(OH)_2(aq)$ = strong acid + strong base: pH = 7 at equiv. point

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