Quiz 16.3 – Weak Acids and Weak Bases

Name: Key

**Question 1**

Find the pH for each of the following solutions:

- 1.5 *F* $NH_3$

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

$K_B = 1.8 \cdot 10^{-5}$

| | $NH_3$ | $NH_4^+$ | $OH^-$ |
|---|---|---|---|
| I | 1.5 | 0 | 0 |
| C | $-x$ | $+x$ | $+x$ |
| E | $1.5-x$ | $x$ | $x$ |

$1.8 \cdot 10^{-5} = \frac{x^2}{1.5-x}$ ← assume $x$ is small

$x = 5.196 \cdot 10^{-3}$

$[H_3O^+] = \frac{10^{-14}}{x} = 1.925 \cdot 10^{-12}$ $pH = 11.71$

- 0.25 *F* HF

$HF + H_2O \rightleftharpoons H_3O^+ + F^-$

$K_A = 6.6 \cdot 10^{-4}$

| | HF | $H_3O^+$ | $F^-$ |
|---|---|---|---|
| I | 0.25 | 0 | 0 |
| C | $-x$ | $+x$ | $+x$ |
| E | $0.25-x$ | $x$ | $x$ |

$6.6 \cdot 10^{-4} = \frac{x^2}{0.25-x}$ ← small

$x = 0.0128$ ← 5.1% !

$x = 0.0125$ ← solve graphically

$[H_3O^+] = x$

$pH = 1.90$

**Question 2**

Find the $pH$, $[H_2C_4H_4O_5]$, $[HC_4H_4O_5^-]$, and $[C_4H_4O_5^{2-}]$ for a 0.300 *F* solution of malic acid

$K_{A_1} = 4.0 \cdot 10^{-4}$ $K_{A_2} = 6.3 \cdot 10^{-6}$

$pH = 1.954$

0.284 M

$H_2A \rightleftharpoons H^+ + HA^-$

0.0110 M

$HA^- \rightleftharpoons H^+ + A^{2-}$

$6.3 \cdot 10^{-6}$ M

| | $H_2A$ | $H^+$ | $HA^-$ | | $HA^-$ | $H^+$ | $A^{2-}$ |
|---|---|---|---|---|---|---|---|
| I | 0.300 | 0 | 0 | | 0.0110 | 0.0110 | 0 |
| C | $-x$ | $+x$ | $+x$ | | $-y$ | $+y$ | $+y$ |
| E | $0.3-x$ | $x$ | $x$ | | $0.0110-y$ | $0.0110+y$ | $y$ |

$4.0 \cdot 10^{-4} = \frac{x^2}{0.3-x}$ ← small

$x = 1.10 \cdot 10^{-2}$ ← 3.7%

$6.3 \cdot 10^{-6} = \frac{y(0.0109+y)}{0.0109-y}$ ← small

$y = 6.3 \cdot 10^{-6}$

**Question 3**

Find the $pH$ for a 1.5 *F* solution of NaClO

For HClO, $K_a = 4.0 \cdot 10^{-8}$, so for $ClO^-$ $K_B = \frac{10^{-14}}{K_A} = 2.5 \cdot 10^{-7}$

$ClO^- + H_2O \rightleftharpoons HClO + OH^-$

| | $ClO^-$ | HClO | $OH^-$ |
|---|---|---|---|
| I | 1.5 | 0 | 0 |
| C | $-x$ | $+x$ | $+x$ |
| E | $1.5-x$ | $x$ | $x$ |

$2.5 \cdot 10^{-7} = \frac{x^2}{1.5-x}$ ← small

$x = 6.12 \cdot 10^{-4}$

$[H_3O^+] = \frac{10^{-14}}{x} = 1.63 \cdot 10^{-11}$

$pH = 10.79$