1. Strong acids completely dissociates.

.25M

pH=0.602

$-\log(.25)$

2. $K_a = 1.8 \times 10^{-5}$

$HC_2H_3O_2 \leftrightarrow H^+ + C_2H_3O_2^-$

| | | |
|---|---|---|
| .20 | 0 | 0 |
| .20 − x ≈ 0 | x | x |

$$\frac{x^2}{.20} = 1.8 \times 10^{-5}$$

$$x = .001897\ M$$

$$\frac{.001897}{.20} \times 100 = .948\%$$

$HC_2H_3O_2 \leftrightarrow H^+ + C_2H_3O_2^-$

| | | |
|---|---|---|
| .20 − .0019 | .0019 | .0019 |
| .20 | | |

$= -\log(.0019)$

$1.9 \times 10^{-3}$ 2.72

3.

$HA \longleftrightarrow H^+ + A^-$

| | | |
|---|---|---|
| 0.0885 | 0 | 0 |
| $-.002478$ | $+.002478$ | $+.002478$ |
| $.0860$ | $.00248$ | $.00248$ |

2.8%

$.028 \times (.0885) =$

$.002478$

$$\frac{(.00248)^2}{.086} = 7.15 \times 10^{-5}$$

$K_a$

4. % dissociation

0.11 M HClO $K_a = 2.95 \times 10^{-5}$

$$HClO \rightleftharpoons H^+ + ClO^-$$

| | | | |
|---|---|---|---|
| | .11 | 0 | 0 |
| | $.11 - x \approx 0$ | $x$ | $x$ |

$K_a$

$$\frac{x^2}{.11} = 2.95 \times 10^{-5}$$

$x = 0.0018$ M

$$\frac{.0018}{.11} \times 100 = 1.6\%$$

$$HClO \rightleftharpoons H^+ + ClO^-$$

| | | | |
|---|---|---|---|
| | $.11 - .0018$ | .0018 | .0018 |
| | .11 | | |

5

$BOH \rightleftharpoons B^+ + OH^-$

$.30\,M - x \quad x \quad x$

$1.5\% = .015$

$.015 = \frac{x}{.30}$

$X = 4.5 \times 10^{-3}\,M$

$BOH \rightleftharpoons B^+ + OH^-$

$.30 - 4.5\times10^{-3} \quad 4.5\times10^{-3} \quad 4.5\times10^{-3}$

$.2955$

$\frac{(4.5\times10^{-3})^2}{.2955} = x \quad K_b$

$6.8\times10^{-5}$

$-\log(4.5\times10^{-3}) = 2.35 \quad pOH$

$pH = 11.65$

6. $Na^+$

$NaF + HOH_{(\ell)} \longleftrightarrow \underset{\text{weak acid}}{HF} + \underset{Na^+}{OH^-}$

$K_a = 6.5 \times 10^{-4}$

$K_b = \frac{1 \times 10^{-14}}{6.5 \times 10^{-4}} = \frac{\text{water}}{K_a \text{ or } K_b}$

$HOH \rightleftharpoons H^+ + OH^-$

$K_b = 1.54 \times 10^{-11}$

$1.54 \times 10^{-11} =$

$NaF^- + HOH_{(\ell)} \longleftrightarrow \underset{x}{NaOH} + \underset{x}{HF}$

$\underset{.95}{} - x$

$\frac{x^2}{.95} = 1.54 \times 10^{-11}$

$x = 3.82 \times 10^{-6} M$

$-\log(3.82 \times 10^{-6})$

$pOH = 5.42$

$pH = 8.58$

A salt on the reactant side gives of $OH^-$

$$H_2CO_3 \rightarrow H^+ + HCO_3^-$$

$$HCO^- \rightarrow H^+ + CO_3^{-2}$$

7 $H_2CO_3 \longleftrightarrow H^+ + HCO_3^-$

$K_a = 4.3 \times 10^{-7}$

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

$K_a = 5.61 \times 10^{-11}$

$H_2CO_3 \leftrightarrow H^+ + HCO_3^-$

| | | | |
|---|---|---|---|
| .25 | 0 | 0 | 0 |
| .25 − x | 0 | x | x |

$$4.30 \times 10^{-7} = \frac{x^2}{.25}$$

$$x = 3.278719 \times 10^{-4}$$

$HCO_3^- \leftrightarrow H^+ + CO^{-2}$

$3.278719 \times 10^{-4}$ x x 3

$$5.61 \times 10^{-11} = \frac{x^2}{3.278719 \times 10^{-4}}$$

$$X = 1.356 \times 10^{-7}$$

$HCO_3^- \longleftrightarrow H^+ + CO^{-2}$

$3.278719 \times 10^{-4}$ $\quad x \quad x^3$

$$5.61 \times 10^{-11} = \frac{x^2}{3.278719 \times 10^{-4}}$$

$$X = 1.356 \times 10^{-7}$$

$H^+$ $3.27819 \times 10^{-4}$

$1.356 \times 10^{-7}$ is much smaller then the $H^+$ in the first equation; therefore, we can say that the overall conc. of $H^+$ is $3.27819 \times 10^{-4}$

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

$3.278719 \times 10^{-4}$ $x$

$3.278719 \times 10^{-4}$

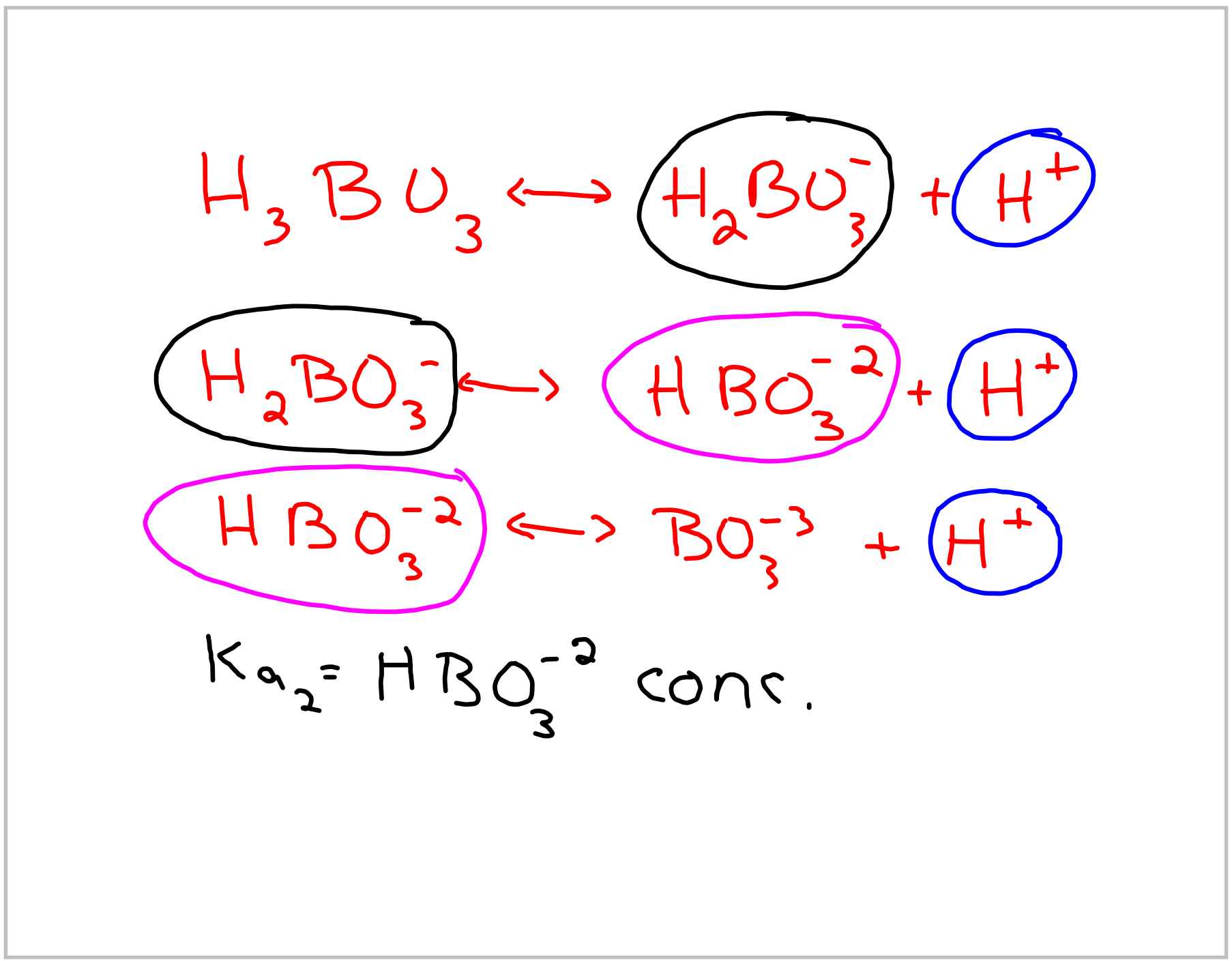
$5.61 \times 10^{-11} = \frac{3.278719 \times 10^{-4}(x)}{3.278719 \times 10^{-4}}$

$x = 5.61 \times 10^{-11}$

$H_2CO_3 = .25M$ $H^+ = 3.3 \times 10^{-4} M$

$HCO_3^- = 3.3 \times 10^{-4} M$

$CO_3^{-2} = 5.6 \times 10^{-11}$


$H_3BO_3 \leftrightarrow H_2BO_3^- + H^+$
$H_2BO_3^- \leftrightarrow HBO_3^{-2} + H^+$
$HBO_3^{-2} \leftrightarrow BO_3^{-3} + H^+$
$K_{a_2} = HBO_3^{-2}$ conc.

$C_6H_5NH_2 + H_2O_{(l)} \longleftrightarrow C_6H_5NH_3^+ + OH^-$

| | | |
|---|---|---|
| .100 | 0 | 0 |
| .100 − x | x | x |

$K_b = 3.94 \times 10^{-10}$

$$\frac{x^2}{.100} = 3.94 \times 10^{-10}$$

$$x = 6.2769 \times 10^{-6} M$$

$$\frac{6.2769 \times 10^{-6}}{.100} \times 100 = .00628\%$$

12. $HCl \longrightarrow H^+ + Cl^-$ rules

$(25)(1.0) = (40)\ x$

$x = .625M \Rightarrow .63M$

$HClO \leftrightarrow H^+ + ClO^-$

① Rules b/c it dissociates completely

$pH = -\log(.625)$

$pH = .204$

$CaCl_2$

6.2 M  6.2 x 2 =

$H_2CO_3$  6.3 M

13. $HCN \leftrightarrow H^+ + CN^-$

$K_a = 4.93 \times 10^{-10}$ $pH = 4.43$

$10^{-4.43}$

13. $HCN \leftrightarrow H^+ + CN^-$

$3.715 \times 10^{-5}$

$3.715 \times 10^{-5}$

$$\frac{(3.715 \times 10^{-5})^2}{x} = 4.93 \times 10^{-10}$$

$x = 2.8\ M$

16.

$$NaClO + H_2O \leftrightarrow NaOH + HClO$$

S.B. W.A.

$5\% = 100 \times g/mL$

$.05\ g/mL$

Na 1x23
Cl 1x35.5
O 1x16
74.5 g/mol

$$\frac{.05\ g \times 1\ mol}{74.5\ g} = 6.71 \times 10^{-4}\ mol$$

$$\frac{6.71 \times 10^{-4}\ mol}{.001\ L} = .671\ M$$

$$NaClO + H_2O_{(\ell)} \longleftrightarrow NaOH + HClO$$

$$.671 \qquad\qquad x \quad x$$

$K_a = 2.95 \times 10^{-5}$ HClO

$$K_w = 1 \times 10^{-14}$$

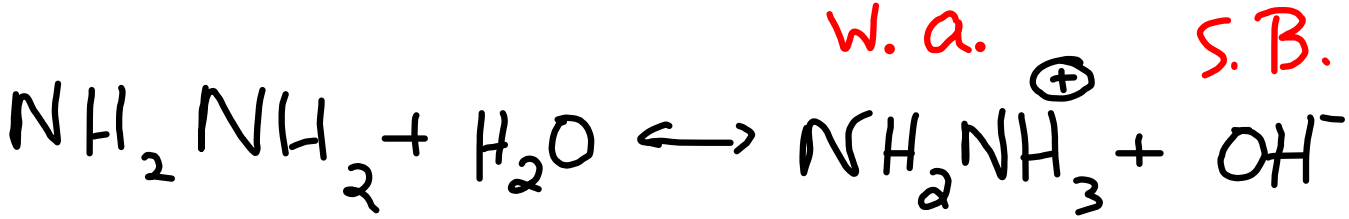
$$\frac{1 \times 10^{-14}}{2.95 \times 10^{-5}} = K_b = 3.39 \times 10^{-10}$$

$$3.39 \times 10^{-10} = \frac{x^2}{.671}$$

$1.51 \times 10^{-5}$ M $\}$ pOH = 4.822

pH = 9.178

17.




$K_b = 1.3 \times 10^{-6}$

$$1.3 \times 10^{-6} = \frac{x^2}{.10}$$

$x = 3.6 \times 10^{-4} M$

$pOH = 3.44$ $pH = 10.56$

$$NH_3 + HOH \longleftrightarrow NH_4^{\oplus} + OH^-$$

$$C_6H_5NH_2 + HOH \rightleftharpoons C_6H_5NH_3^{\oplus} + OH^-$$

$$CH_3NH_2 + HOH \longleftrightarrow CH_3NH_3^{\oplus} + OH^-$$

26.

$HNO_2 \leftrightarrow H^+ + NO_2^-$ acidic

S.B. W.A.

$NaNO_2 + H_2O \rightleftharpoons NaOH + HNO_2$

basic

S.B. S.A.

$NaNO_3 + H_2O \rightleftharpoons NaOH + HNO_3$

neutral

Strong base:

Group 1 ion w/ $OH^-$

11. $H_3BO_3 \leftrightarrow H^+ + H_2BO_3^-$ $\quad K_a = 7.3\times10^{-10}$

.304 $\quad$ x $\quad$ x

$[H_3BO_3] = .304 \quad [H^+] = 1.5\times10^{-5}$

$[H_2BO_3^-] = 1.5\times10^{-5}$

$H_2BO_3^- \leftrightarrow H^+ + HBO_3^{-2}$

$1.5\times10^{-5} \quad 1.5\times10^{-5} \quad x$

$K_a = 1.8\times10^{-13}$

$1.8\times10^{-13} = \dfrac{(1.5\times10^{-5})(x)}{1.5\times10^{-5}}$

$[HBO_3^{-2}] = 1.8\times10^{-13}$

$HBO_3^{-2} \leftrightarrow H^+ + BO_3^{-3}$

$1.8\times10^{-13} \quad 1.5\times10^{-5} \quad x$

$K_a = 1.6\times10^{-14}$

$1.6\times10^{-14} = \dfrac{(1.5\times10^{-5})(x)}{1.8\times10^{-13}}$

$x = 1.92\times10^{-22}$

$x = 1.9\times10^{-22}$

$[BO_3^{-3}] = 1.9\times10^{-22}$