

Note that K_a will normally always be less than one
 $\hookrightarrow \therefore$ big/small

Strong Acid: $[H^+]_{eq} = [HA]_{initial} \rightarrow$ higher conductivity
faster rate

Weak Acid: $[H^+]_{eq} < [HA]_{init} \rightarrow$ lower conductivity
slower rate

Percent Ionization: $\frac{\text{concentration of ionized HA}}{\text{original concentration of HA}} \times 100$

* % ionization decreases as acid increases

$$\text{Ex: } [H^+] = [A^-] = 5.5 \times 10^{-4} \text{ M}$$

$$[HA]_0 = 0.020 \text{ M}$$

$$\% \text{ ionization} = \frac{[H^+]_{eq}}{[HA]_0} \times 100$$

$$= \frac{5.5 \times 10^{-4} \text{ M}}{0.020 \text{ M}} \times 100$$

$$= 2.75 \%$$

Ex: Calc. $[H_3O^+]$ and pH for a 0.100 M soln of HClO ($K_a = 2.9 \times 10^{-8}$)



$$I \quad 0.100 M \quad \quad \quad 0 \quad \quad 0$$

$$C \quad -x \quad \quad \quad +x \quad \quad +x$$

$$E \quad 0.100 - x \quad \quad \quad x \quad \quad x$$

$$K_a = \frac{[H_3O^+][ClO^-]}{[HClO]}$$

$$= \frac{x^2}{0.1 - x} = 2.9 \times 10^{-8}$$

$$\frac{x^2}{0.1} \approx 2.9 \times 10^{-8}$$

$$\sqrt{x^2} = \sqrt{2.9 \times 10^{-9}}$$

$$x = 5.4 \times 10^{-5}$$

check if it passes

5% rule

$$5.4 \times 10^{-5} < 5\% \text{ of } 0.100$$

$$< 0.005$$

yes it is

is it less than 5% of 0.100M?

$$x = 5.4 \times 10^{-5} = [H_3O^+]$$

$$pH = -\log(5.4 \times 10^{-5}) = 4.27$$

we can use "ignore x approx" if $[HA]_{init} > 100 K_a$

Polyprotic Acid

↳ have more than one acidic proton

↳ more than one proton that dissociates

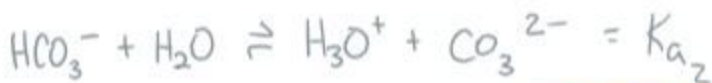
• It's always easier to remove the first proton than any successive proton

$$K_{a_1} \gg K_{a_2} \gg K_{a_3}$$

• pH normally only depends on first dissociation



$$K_{a_1} = \frac{[\text{H}_3\text{O}^+][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} = 4.3 \times 10^{-7}$$



$$K_{a_2} = \frac{[\text{H}_3\text{O}^+][\text{CO}_3^{2-}]}{[\text{H}_2\text{CO}_3]} = 5.6 \times 10^{-11}$$

$$4.3 \times 10^{-7} > 5.6 \times 10^{-11}$$

$$K_{a_1} > K_{a_2}$$

Weak Base Equilibria



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = 1.76 \times 10^{-5}$$

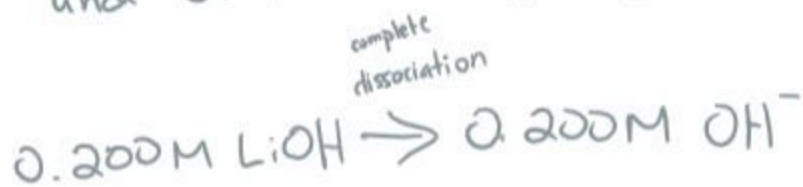
base
dissociation
constant

↳ tells strength of base

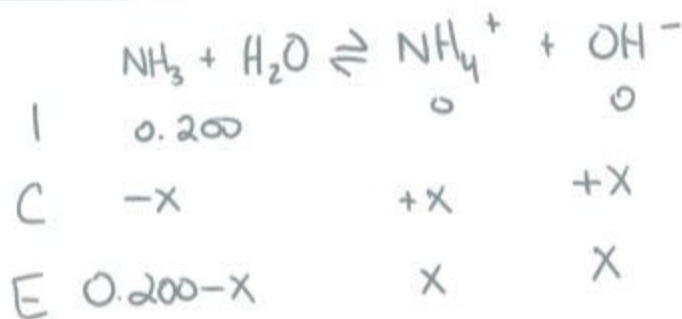
↳ $K_b \uparrow$ = strong base

$K_b \downarrow$ = weak base

Ex: Calc + contrast $[\text{OH}^-]$ in 0.200 M LiOH $\rightarrow$ strong base
and 0.200 M NH_3 ($K_b = 1.76 \times 10^{-5}$)



Weak Base



$$K_b = \frac{x^2}{0.200-x} = 1.76 \times 10^{-5}$$

let's do the
"ignore
x"
method

$$\frac{x^2}{0.200} = 1.76 \times 10^{-5}$$

$$\sqrt{x^2} = \sqrt{1.76 \times 10^{-5} (0.200)}$$

$$x = 0.0019 \text{ M}$$

check $x < 5\%$

$$\frac{0.0019}{0.200} \times 100 = 0.94\%$$

