Note that K_a will normally always be less than one

↳ ∴ big/small

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

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

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

* % ionization decreases as acid increases

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

$[HA]_0 = 0.020$ 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 ($K_a = 2.9\times10^{-8}$)

R	$HClO$	+ H_2O $\rightleftharpoons$	H_3O^+	+ ClO^-
I	0.100 M		0	0
C	$-x$		$+x$	$+x$
E	$0.100 - x$		x	x

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

$$= \frac{x^2}{0.1 - x} = 2.9\times10^{-8}$$

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

$$\frac{x^2}{0.1} \approx 2.9\times10^{-8}$$

$$\sqrt{x^2} = \sqrt{2.9\times10^{-9}}$$

$$\boxed{x = 5.4\times10^{-5}} \leftarrow$$ check if it passes 5% rule

$5.4\times10^{-5} < 5\%$ of 0.100

< 0.005 ← yes it is

↳ is it less than 5% of 0.100M?

$$\boxed{\begin{array}{l} x = 5.4\times10^{-5} = [H_3O^+] \\ pH = -\log(5.4\times10^{-5}) = 4.27 \end{array}}$$

Polyprotetic Acid

↳ have more than one acidic proton

↳ more than one proton that dissociates

- It's always easier to remove the first proton than any sucessive proton

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

- pH normally only depends on first dissociation

Ex: $H_2CO_3 + H_2O \rightleftharpoons H_3O^+ + HCO_3^- = K_{a_1}$

$$K_{a_1} = \frac{[H_3O^+][HCO_3^-]}{[H_2CO_3]} = \boxed{4.3 \times 10^{-7}}$$

$HCO_3^- + H_2O \rightleftharpoons H_3O^+ + CO_3^{2-} = K_{a_2}$

$$K_{a_2} = \frac{[H_3O^+][CO_3^{2-}]}{[H_2CO_3]} = \boxed{5.6 \times 10^{-11}}$$

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

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

Weak Base Equilibria

$$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = 1.76 \times 10^{-5}$$

K_b ← base dissociation constant

↳ tells strength of base

↳ $K_b \uparrow$ = strong base

$K_b \downarrow$ = weak base

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

$$0.200\,M\ LiOH \xrightarrow[\text{dissociation}]{\text{complete}} 0.200\,M\ OH^-$$

Weak Base

	NH_3 + H_2O	$\rightleftharpoons$ NH_4^+	+ OH^-
I	0.200	0	0
C	$-x$	$+x$	$+x$
E	$0.200-x$	x	x

$$K_b = \frac{x^2}{0.200-x} = 1.76\times10^{-5}$$

let's do the "ignore x" method

$$\frac{x^2}{0.200} = 1.76\times10^{-5}$$

$$\sqrt{x^2} = \sqrt{1.76\times10^{-5}(0.200)}$$

$$\boxed{x = 0.0019\,M}$$

check x < 5%

$$\frac{0.0019}{0.200}\times100 = 0.94\%$$ ✓