- all strong bases are ionic compounds where OH^- is one of the ions.

LM 17: Weak Acids & Bases

- weak acid – proton donor that only partially dissociates in water.
- weak base – proton acceptor ; only partially dissociates
- eq. constants are small
- "strength" of weak acid depends on size of eq. constant. the larger Ka, the more it favors dissociation.
  - For all weak acids $K_a < 1$. → reactants are favored.

protonated form in higher conc. than deprotonated form.

eq. constant =

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \quad \Bigg\rangle \text{ same for base}$$

Lecture 2/18

- strength is not concentration → it's how much it dissociates.
- $$\overset{H^+}{CH_3NH_{2(aq)}} + H_2O_{(l)} \longleftrightarrow \underline{CH_3NH_3} + \underline{OH^-}$$

- ACTIVITY
- common features of acid structure:
  - hanging off H^+ that can be donated.
  - H^+ coming off from an electronegative species so H can come off.
  - most have carboxylic acid → COOH
  -

hydro	H^+
oxyacids	HNO_3 HNO_2 $HClO_4$
carboxylic acid	$COOH-\boxed{R}$

- common features of base structure
  - amine group present; all derivatives of ammonia
  - have OH + a $\boxed{\text{metal}}$ → KOH
    NaOH
  - amine → ammonia der.
  - metal hydroxides → NaOH, KOH
  - all molecules have two forms: acid & base
    acid ↓ protonated, base ↓ deprotonated

__Acid__

$$* \quad HClO_{2(aq)} + H_2O_{(l)} \longleftrightarrow ClO_{2(aq)} + H_3O^+_{(aq)}$$

$$K_a = \frac{[ClO_2][H_3O^+]}{[HClO_2]}$$

* Acid strength: the larger the eq. constant, the stronger the acid.
__small K value means less produ__

__Base__

$$CH_3NH_{2(aq)} + H_2O_{(l)} \longleftrightarrow CH_3NH_{3(aq)} + OH^-_{(aq)}$$

$$K_b = \frac{[CH_3NH_3][OH^-]}{[CH_3NH_2]}$$

- the stronger the acid, the weaker the conjugate base.
  - if something has large Ka, has to have small K
  - Kb = Cl^- has to be 0 because Ka for HCl is
- equilibrium constant for water is:

$$K_w = [H_3O^+][OH^-] \qquad H_2O_{(l)} + H_2O_{(l)} \rightarrow H_3O^+ + OH^-$$

↑ $\boxed{\text{Constant}}$ double one, other has to be ½ b/c product is a constant.

$\boxed{K_w}$ - $K_a \cdot K_b$ =

$$\cancel{HClO_2} + H_2O \longleftrightarrow \cancel{ClO_2^-} + H_3O = K_a$$
$$\cancel{ClO_2} + H_2O \longleftrightarrow \cancel{HClO_2} + OH^- = K_b$$
$$2H_2O \longleftrightarrow H_3O + OH^-$$

$$\underbrace{\frac{[\cancel{ClO_2^-}][H_3O^+]}{[\cancel{HClO_2}]}}_{K_a} \times \underbrace{\frac{[\cancel{HClO_2}][OH^-]}{[\cancel{ClO_2^-}]}}_{K_b} = \boxed{[H_3O^+][OH^-] = K_w}$$

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

$K_w = K_a \cdot K_b$

Ex: Determine $[H_3O^+]$ & $[OH^-]$ in 1×10^{-2} M HF(aq)

$[OH]^-$?

$[H_3O] = 10^{-2}$ M

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{10^{-14}}{10^{-2}} = \boxed{10^{-12} M}$$

Ex: Determine $[H_3O^+]$ & $[OH^-]$ in 6×10^{-2} M NH_4^+(aq)

weak acid

$[OH^-] = ?$

Ka ... RICE .... solve $[H_3O^+] \rightarrow K_w \rightarrow \underline{\underline{[OH^-]}}$

- $pH = -\log_{10}[H_3O^+]$
- $pOH = -\log_{10}[OH^-]$

$\log(10^{-4}) = -4$

$\log(10^{-8}) = -8$

$\log(10^{-10}) = -10$

flip the sign.

*different by factor of 10.

$[H_3O^+] = 10^{-(pH)}$

$[OH^-] = 10^{-(pOH)}$

$K_w = [H_3O^+][OH^-]$

$\log(10^{-14}) = \log[H_3O^+] + \log[OH^-]$

$14 = pH + pOH$