

- 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 K_a , the more it favors dissociation.

• For all weak acids $K_a < 1$. \Rightarrow reactants are favored.

protonated form in higher conc. than deprotonated form.

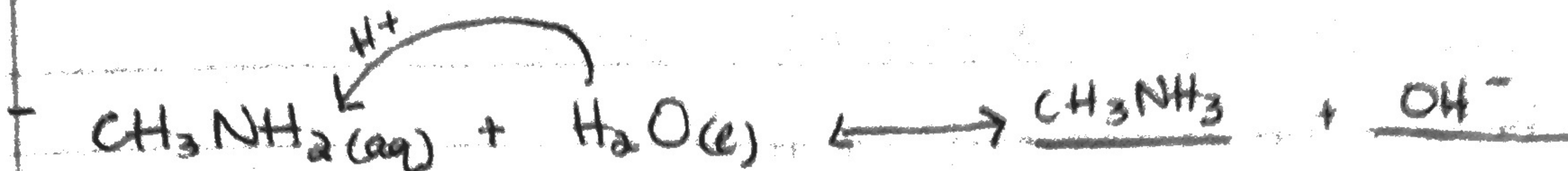
eq. constant =

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

> same for base

Lecture 2/18

- strength is not concentration \rightarrow it's how much it dissociates.



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 $\rightarrow \text{COOH}$

| | |
|-----------------|---|
| hydro | H^+ |
| oxyacids | HNO_3 HNO_2 HClO_4 |
| carboxylic acid | COOH-R |

• common features of base structure

- amine group present; all derivatives of ammonia

~~ammonia~~ - have OH + a metal → KOH
NaOH

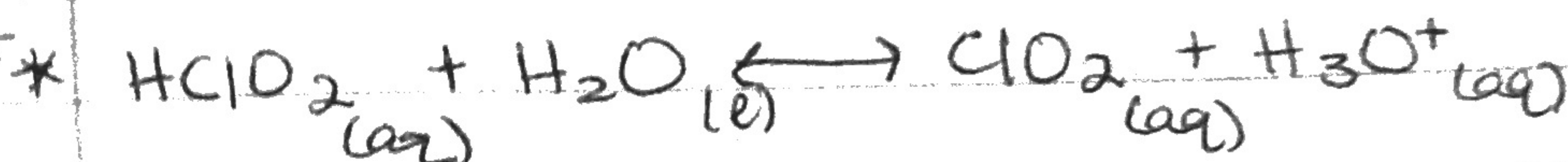
amine → ammonia der.

metal hydroxides → NaOH, KOH

- all molecules have two forms: acid & base

↓ ↓
protonated deprotonated

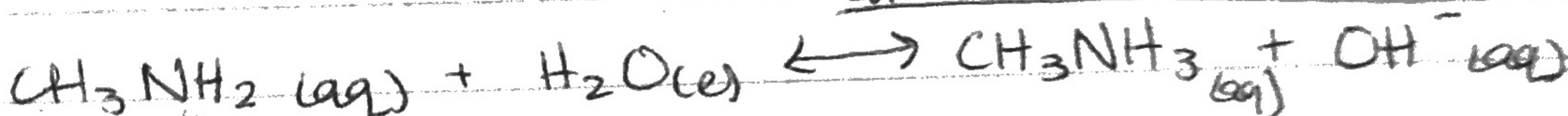
Acid



$$K_a = \frac{[\text{ClO}_2][\text{H}_3\text{O}^+]}{[\text{HClO}_2]}$$

* Acid strength: the ~~size~~ larger the eq. constant, the stronger the acid.
Small K value means less product

Base



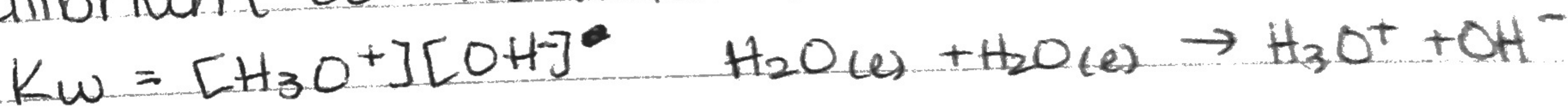
$$K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]}$$

- the stronger the acid, the weaker the conjugate base.

- if something has large K_a , has to have small K_b

K_b of Cl^- ~~is~~ has to be 0 because K_a for HCl is

- equilibrium constant for water is:

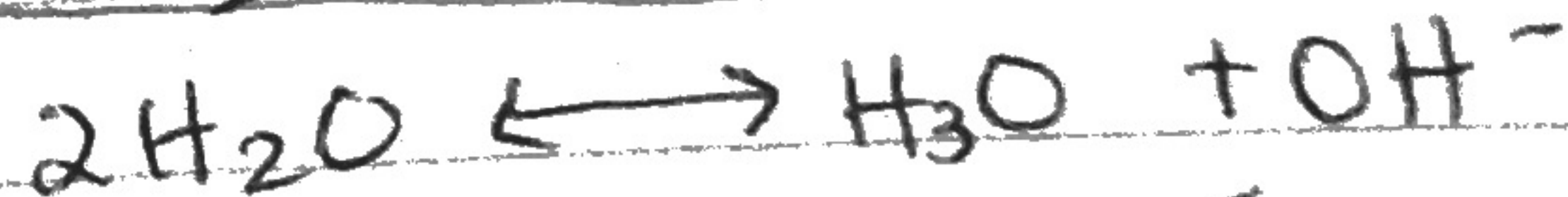
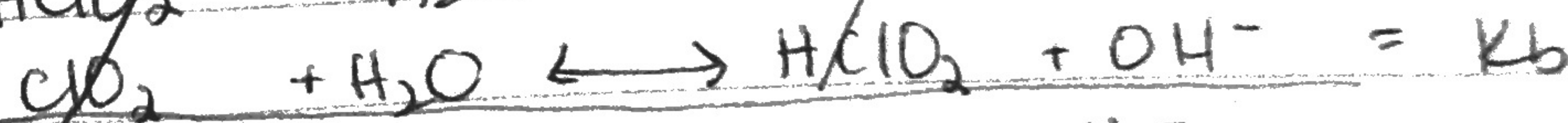
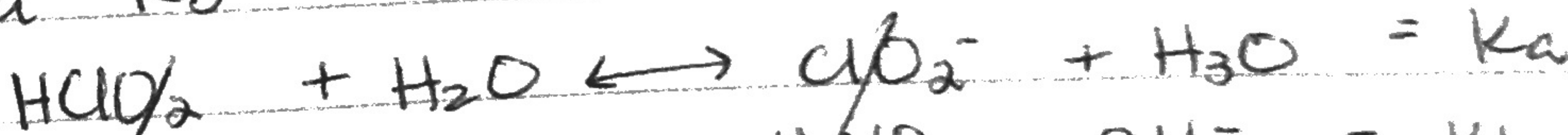


↑
Constant

double one, other has to be 1/2 b/c product is a constant.

K_w

- $K_a \cdot K_b =$



$$\frac{[\text{ClO}_2^-][\text{H}_3\text{O}^+]}{[\text{HClO}_2]} \times \frac{[\text{HClO}_2][\text{OH}^-]}{[\text{ClO}_2^-]} = [\text{H}_3\text{O}^+][\text{OH}^-] = K_w$$

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

$K_w = K_a$

$K_w = K_a \cdot K_b$

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

$[OH^-] = ?$

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

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

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

weak acid

$[OH^-] = ?$

$K_a \dots$ RICE \dots solve $[H_3O^+]$ $\rightarrow K_w \rightarrow [OH^-]$

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

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

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

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

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

} flip the sign.

* different by factor of 10.

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

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

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

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

$\log[OH^-]$

$14 = pH + pOH$