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CHAPTER 15

BRONSTED/LOWRY THEORY

ACID = H^+ DONOR → becomes its conjugate base
BASE = H^+ acceptor * MUST HAVE A LONE PAIR *

$\ddot{N}H_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$
base acid acid base
conjugate pair
conjugate pair

in H_2O... $H^+ + H_2O \rightarrow H_3O^+$ hydronium ion
→ may be written as H^+

$HCl_{(g)} \xrightarrow{H_2O} H^+ + Cl^-$ 100%
strong acid

$HF_{(g)} \xrightleftharpoons{H_2O} H^+ + F^-$ (↓10%)
weak acid

AMPHOTERIC → can act as an acid or base
(H_2O)

$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$ autoionization of H_2O

$K_c = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$
@ 25°C $(1 \times 10^{-7}M)(1 \times 10^{-7}M)$

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$\ddot{N}H_3$ + H_2O ⇌ NH_4^+ + OH^-
base, acid, acid, base
conjugate pair, conjugate pair

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(H_2O)

$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$ autoionization of H_2O

$K_c = \dfrac{[H_3O^+][OH^-]}{[H_2O]^2}$ ← $[H_2O]^2$ is constant

$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ @ 25°C
$(1 \times 10^{-7} M)(1 \times 10^{-7} M)$

$pH = -\log[H^+]$ $\quad pOH = -\log[OH^-]$

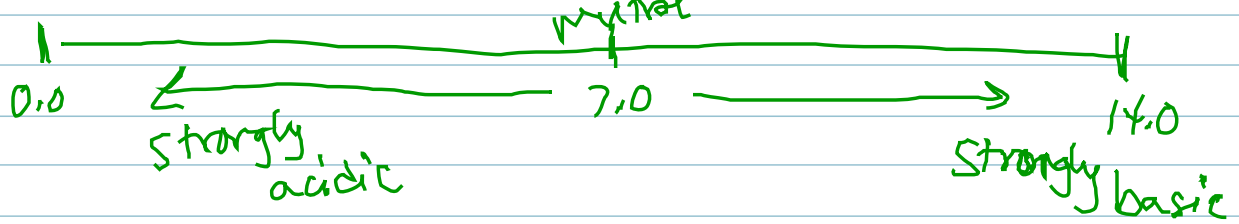
$[H^+] = 10^{-pH}$ $\quad [OH^-] = 10^{-pOH}$

$$pH + pOH = 14$$

acidic solution : $[H^+] > 10^{-7}M$, $[OH^-] < 10^{-7}M$; $pH < 7$, $pOH > 7$

basic soln : $[H^+] < 10^{-7}M$, $[OH^-] > 10^{-7}M$; $pH > 7$, $pOH < 7$

neutral soln : $[H^+] = [OH^-]$, $pH = pOH = 7$



STRONG ACID → ionizes completely (100%)

→ strong electrolytes

aqueous soln's HCl, HBr, HI, H_2SO_4, HNO_3, $HClO_4$

weak acid → weak electrolytes

→ limited ionization (↓ 10%)

STRONG BASES → strong electrolytes

- alkali hydroxides
- $Ba(OH)_2$

Mg, Be ⇒ insoluble
Ca, Sr ⇒ slightly soluble } alkaline earth

* $OH^-_{(aq)}$ is the H^+ acceptor, not M^+

Weak bases NH_3, amines $R-NH_2$

CONJUGATE RELATIONSHIP

- the conjugates of strong acids do NOT act as bases $HX \longrightarrow H^+ + X^-$
- leveling effect of H_2O "

H_3O^+ strongest unionized acid in H_2O

OH^- strongest unionized base in H_2O

stronger base + $H_2O \longrightarrow OH^-$