Today Feb 9 - kinetics chapter, second step slow and catalysts,
chapter 15 Sections 1-8

Mechanism

intermediate

step 1: $2NO_{(g)} \underset{k_{rev}}{\overset{k_{fwd}}{\rightleftharpoons}} N_2O_{2(g)}$ fast $K_c = \frac{[N_2O_2]}{[NO]^2}$

step 2: $N_2O_{2(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ slow

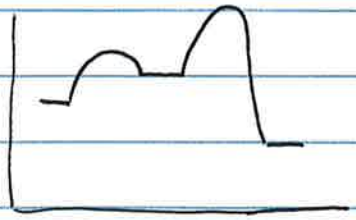
overall: $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

rate = $k_2[N_2O_2][O_2]$

$[N_2O_2] = K_c[NO]^2$

rate = $k_2(K_c[NO]^2)[O_2]$

rate = $k[NO]^2[O_2]$



exothermic and second step slow

· Decomposition of $H_2O_{2(aq)}$

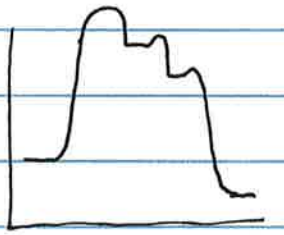
Mechanism:

step 1 $H_2O_2 \longrightarrow 2OH$ (very slow)

step 2 $H_2O_2 + OH \longrightarrow H_2O + HO_2$ (fast)

step 3 $HO_2 + OH \longrightarrow H_2O + O_2$ (fast)

overall $2H_2O_{2(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)}$



mechanism with catalyst:

intermediate

step 1: $H_2O_2 + I^- \rightarrow H_2O + OI^-$

catalyst

step 2: $H_2O_2 + OI^- \rightarrow H_2O + O_2 + I^-$

overall: $2H_2O_2 \longrightarrow 2H_2O + O_2$

6 strong acids (strong electrolyte) · strong acids all dissociate into ions 100%

$HCl_{(aq)}$ $HNO_{3(aq)}$

$HBr_{(aq)}$ $HClO_{4(aq)}$

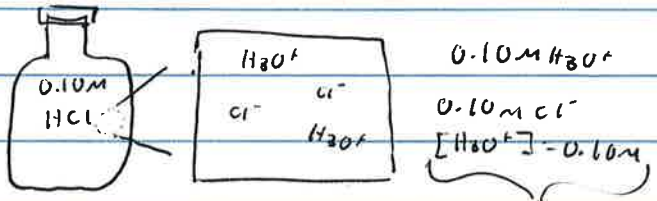
$HI_{(aq)}$ $H_2SO_{4(aq)}$

$HCl_{(aq)} + H_2O \xrightarrow{100\%} H_3O^+_{(aq)} + Cl^-_{(aq)}$

template for all strong acids

$H^+ \equiv H_3O^+$

"proton"



K_c = undefined, non-equilibrium

Weak acids

$HC_2H_3O_2(aq)$

* anything else that begins with H and is not a strong acid

template for all weak acids

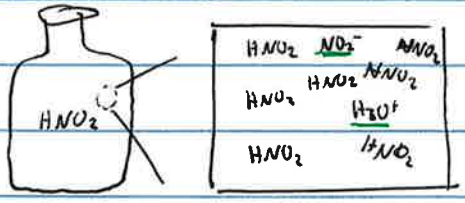
$HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+_{(aq)} + C_2H_3O_2^-(aq)$

associated weak acid — conjugate weak base

$HNO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$

$K_a = \frac{[H_3O^+][NO_2^-]}{[HNO_2]}$

$K_a^{25°C} = \frac{[H_3O^+][C_2H_3O_2^-]}{[HC_2H_3O_2]} = 1.8 \times 10^{-5}$



strong bases

- hydroxides are generally insoluble except group I ($LiOH$, $NaOH$, etc.)
- Group 2 hydroxides are sparingly soluble
- All ionics that dissolve, dissociate 100% into ions in water

$NaOH_{(aq)} \xrightarrow{100\%} OH^-_{(aq)} + Na^+_{(aq)}$

$[OH^-] = 0.30 mol/L$

$Ca(OH)_{2(aq)} \longrightarrow Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$

wa-wb pairs

weak acid	weak base
$HC_2H_3O_2$	$C_2H_3O_2^-$
HNO_2	NO_2^-
HF	F^-
HCN	CN^-

→ Bronsted-Lowry acid-bases

Weak base

template for weak base

$C_2H_3O_2^-(aq) + H_2O(l) \rightleftharpoons OH^-(aq) + HC_2H_3O_2(aq)$

w.b — c.w.a

$$K_b = \frac{[OH^-][HC_2H_3O_2]}{[C_2H_3O_2^-]}$$

pH (unitless)

$[H_3O^+] = 4.5 \times 10^{-3} \frac{mol}{L}$

$pH = -\log(4.5 \times 10^{-3} \frac{mol}{L})$

$pH = 2.35$

10^{-3} exponential (does not count as sig fig) — 2 sig figs

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

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

$2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$ $\quad K_w^{25°C} = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$

$[H_3O^+][OH^-] = 1.0 \times 10^{-14} = K_w$

$[H_3O^+] \longleftrightarrow [OH^-]$

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

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

$pH \longleftrightarrow pOH$

$pH + pOH = 14$