Le Chatlier's Principle

If we stress a system at equilibrium, it will respond to restore a new equilibrium condition

Examples of Equilibria

Acid/Base – acid/base rxns involve proton (H^+) transfer

$HA \rightleftharpoons H^+ + A^-$ $\quad K_a$ = acid dissociation constant = $\frac{[H^+][A^-]}{[HA]}$

acid — conjugate base

acid = proton donor
base = proton acceptor } (Brønsted-Lowry model) – skip

acid/base rxns tend to be very fast in both directions → equilibrium almost always applies

$pX = -\log_{10} X$

if we apply this operator to the definition of K_a, we get:

$$pK_a = pH - \log_{10}\frac{[A^-]}{[HA]}$$

or $pH - pK_a = \log_{10}\frac{[A^-]}{[HA]}$

when $pH = pK_a$ $\quad [A^-] = [HA]$

$pH < pK_a$ $\quad [A^-] < [HA]$

$pH > pK_a$ $\quad [A^-] > [HA]$

Water as an acid/base

$H_2O \rightleftharpoons H^+ + OH^-$ $\quad K = \frac{[OH^-][H^+]}{[H_2O]}$ but by definition, $[H_2O] \equiv 1$

∴ we define a special constant: $K_w = [H^+][OH^-] \approx 10^{-14}$

$pH + pOH = 14$

Precipitation/Dissolution

A, B are constituent ions

$A_aB_{b(s)} \rightleftharpoons aA + bB$ $\quad K = \frac{[A]^a[B]^b}{[A_aB_{b(s)}]}$ but by def'n, activity of solid $\equiv 1$

∴ we define a special constant: K_{sp} = solubility product = $[A]^a[B]^b$

Oxidation / Reduction

These rxns involve electron (e^-) transfer

oxidation = increase in oxidation state (loss of e^-)

reduction = decrease in oxidation state (gain of e^-)

oxidation and reduction always take place together (e^- by themselves are very unstable, reactive)

oxidizing agent = oxidant = compound that promotes oxidation → it is reduced in the process

reducing agent = reductant = " " " reduction → " " oxidized " " "

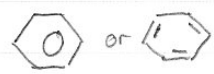
Organic Chemistry – nomenclature

aliphatic compounds:

- alkane : fully saturated (single bonds only) — H-C(H)(H)-C(H)(H)-H or -C-C- ethane
- alkene : one or more double bonds — >C=C< ethene (or ethylene)
- alkyne : one or more triple bonds — -C≡C- ethyne (or acetylene)

aromatic:

- arene : one or more aromatic rings (e^- shared among C in ring)



Alcohol	R-OH	-C-C-OH ethanol
Ether	ROR	-C-O-C- dimethyl ether
Amine	RNH_2 R_2NH R_3N	
Aldehyde	R-C(=O)-H	
Ketone	R-C(=O)-R'	
Carboxylic Acid	R-C(=O)-OH	
Ester	R-C(=O)-O-R'	