04-06-2010

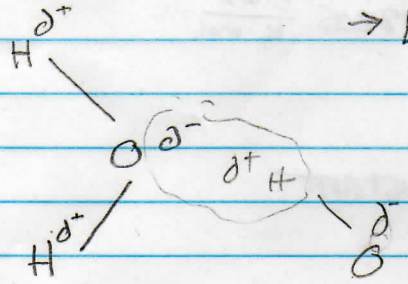
CHEMISTRY REVIEW

HARVEST POINTS!

STATES OF MATTER

1) Gas: molecules/atoms relatively far apart
little or no structure
molecules move relative to one another (fluids)

2) Liquid: molecules more closely spaced
some motion among molecules
weak bonds hold molecules together
→ London, van der Waal's, dipole interactions, H-bonding



17 NH_3
16 CH_4

- Hydrogen bonding in liquid water causes liquid phase of H_2O at room temperature
- also causes water to be a good solvent

3) Solid: molecules more organized
sometimes crystalline
not fluid, can deform (solid mechanics)

ATOMIC STRUCTURE

H^+ Proton: +1 charge
Neutron: neutral charge } essentially same mass (1 amu)
Electron: −1

- Atoms have neutral charge
  - equal numbers of protons/electrons
- Isotopes are atoms w/ same atomic number (# protons) but different atomic mass

[=] "has units of"

Examples of isotopes:
^{35}Cl ^{37}Cl
3 : 1 (in natural setting)
Atomic weight on table: weighted ave. of isotopes

Cl: 17 protons
18 or 20 neutrons

IDEAL GAS LAW

$PV = nRT$ $R = 0.08205 \frac{L \cdot atm}{K \cdot mol}$

if nRT are fixed
PV is a constant
$P_1V_1 = P_2V_2$

$MW_{O_2} \cdot n_{O_2} = \frac{PV}{RT} MW_{O_2}$ $MW_{O_2}[=] \frac{mass}{mole}$

PERIODIC TABLE (p. 101)

Rows = Periods
Columns = Groups
Generalizations:
- elements more from metallic → non-metallic
- heavier elements tend to be more metallic
- atomic radius ↓ from left to right (more positive nucleus)
- ionization potential ↑ from left to right

Group IA: Alkali Metals
IIA: Alkaline Earth (Metals)
VII A: Halogens
VIII A: Noble (Inert, Rare) Gases
↳ don't react, full outer valence

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REACTION STOICHIOMETRY / KINETICS

(Equilibrium)

$aA + bB \underset{K_r}{\overset{K_f}{\rightleftharpoons}} cC + dD$

a, b, c, d
- stoichiometric coefficients
- # moles of reactant/product

- for an elementary reaction:
  - a kinetic expression can be written directly from the stoichiometric expression

$L \rightarrow R \quad r_{forward} = K_f [A]^a [B]^b$

$R \rightarrow L \quad r_{reverse} = K_r [C]^c [D]^d$

at equilibrium, $r_{forward} = r_{reverse}$

$K_F [A]^a [B]^b = K_r [C]^c [D]^d$

$$K_{eq} = K_F / K_r = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

↑ must be positive to exist

LE CHATLIER'S PRINCIPLE

Acid/Base Reactions → H^+ Transfer

(Eq. 4) $HA \rightleftharpoons H^+ + A^-$ [conjugate base]

acid = proton donor
base = proton acceptor

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

$pX = -\log_{10}[X]$

- can apply equilibrium constant equation to describe acid-dissociation constant (Eq. 4)

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

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

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

if $pH = pKa \rightarrow [A^-] = [HA]$

if $pH < pKa \rightarrow [HA] > [A^-]$

if $pH > pKa \rightarrow [HA] < [A^-]$

Water as an acid/base (amphoteric molecule)

$$H_2O \rightleftharpoons H^+ + OH^-$$

$$K_a = \frac{[H^+][OH^-]}{[H_2O]} \qquad K_w = [H^+][OH^-] \approx 10^{-14}$$

(Neutral pH $\approx$ 7)

$$pK_w = pH + pOH \approx 14$$

PRECIPITATION/DISSOLUTION

$$A_a B_b (s) \rightleftharpoons aA + bB$$

$$K_{eq} = \frac{[A]^a [B]^b}{[A_a B_b](s)} \qquad K_{sp} = [A]^a_{eq} [B]^b_{eq}$$

$[A_a B_b](s)$ defined as "1"

$[A]_{eq}$, $[B]_{eq}$ ← equilibrium condition

Ion Activity Product = $[A]^a [B]^b$ = IAP

$[A]$, $[B]$ } actual concentrations

if IAP = K_{sp} → equilibrium
if IAP > K_{sp} → supersaturated
if IAP < K_{sp} → subsaturated