MIND MAP

Chemical Equilibrium

Rate of reaction $= \frac{\text{Change in concentration of product}}{\text{time}}$

$= \left(\frac{dc}{dt}\right)$ products.

$aA(g) + bB(g) \longrightarrow cC(g) + dD(g)$

Law of mass action

The rate of any reaction is directly proportional to the product of active masses of reactants raised to the power equal to their stoichiometric coefficient.

$aA + bB \rightleftharpoons cC + dD$

$r \propto [A]^a [B]^b$

$r_f = K_f [A]^a [B]^b$ K_f = rate constant of forward reaction

$r_b = K_b [C]^c [D]^d$ K_b = rate constant of backward reaction.

At equilibrium

$r_f = r_b$

$K_f [A]^a [B]^b = K_b [C]^c [D]^d$

Equilibrium Constant (K)

$$\frac{K_f}{K_b} = K_{equilibrium} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$K_{equilibrium}$ is a constant and is called the equilibrium constant

$K_{eq} >>> 1 \Rightarrow$ very high conversion of reactants into products

$K_{eq} \approx 1 \Rightarrow$ Concentration of reactant and products is similar

$K_{eq} <<< 1 \Rightarrow$ very low conversion of reactants into products

$$\text{Active mass} = \frac{\text{moles}}{\text{Volume in litres}}$$

$$= \frac{\text{grams(w)}}{\text{mol. wt. } (M_w) \times \text{Volume in litres(V)}}$$

$$= \frac{w \times 1000}{M_w \times V(mL)}$$

$aA(g) + bB(g) \rightleftharpoons cC(g) + dD(g)$

$$K_P = \frac{[P_C]^c[P_D]^d}{[P_A]^a[P_B]^b}$$

where various pressures are the partial pressures of various gasses substances.

$K_x \rightarrow$ Equilibrium constant in terms of mole fraction

$$K_X = \frac{X_C^c X_D^d}{X_A^a X_B^b}$$

Where X_x, X_B, X_C, X_D are the mole fractions of A, B, C and D respectively.

Relation between K_P and K_C

$m_1A + m_2B \rightleftharpoons n_1C + n_2D$

$$K_C = \frac{[C]^{n_1}[D]^{n_2}}{[A]^{m_1}[B]^{m_2}}$$

$$K_P = \frac{(P_C)^{n_1}(P_D)^{n_2}}{(P_A)^{m_1}(P_B)^{m_2}}$$

Relation between K_P and K_x

$K_p = K_x P^{\Delta n_g}$

If $\Delta n_g = 0$, $K_p = K_c = K_x$

K_{eq} from Thermodynamics

$\Delta G^o = -RT \ln K_{eq}$

$$\ln \frac{K_2}{K_1} = \ln K_2 - \ln K_1$$

$$= \frac{-\Delta_r H^\circ}{R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$

Van't Hoff equation

MIND MAP

Chemical Equilibrium

Le Chatelier's Principle

	$\Delta n=0$ $H_2+I_2 \rightleftharpoons 2HI$	$\Delta n>0$ or +ve $PCl_5 \rightleftharpoons PCl_3 + Cl_2$	$\Delta n<0$ or –ve $N_2+3H_2 \rightleftharpoons 2NH_3$
Effect	$x \propto (v)^\circ \propto (P)^\circ$	$x \propto (v)^{1/2} \propto (\frac{1}{P})^{1/2}$	$x \propto \left(\frac{1}{v}\right) \propto (P)$
(i) Pressure (se)	x unchanged	x decreases	x increases
(ii) Volume (se)	x unchanged	x increases	x decreases
(iii) Mixing of inert gas at			
(a) constant pressure	x unchanged	x increases	x decreases
(b) constant volume	x unchanged	x unchanged	x unchanged