Irreversible reaction: A reaction which can go only in the forw[ard] not the backward direction is called irreversible reaction.

Such type of reaction can be written as—

$$A + B \longrightarrow C + D$$

~~# Relation between~~

Kp: If the substances are gaseous ~~their~~ then each of their act[ive masses] written in terms of partial pressure (P). Then the equilibri[um constant] is represented by Kp.

Relation between Kp and Kc:

Consider a general reaction,

$$jA + kB \rightleftharpoons lC + mD$$

~~For this reaction Kc =~~

where all reactants are ~~gaseous~~ gases. We can write the expression in terms of partial pressure is as

$$K_p = \frac{(P_C)^l (P_D)^m}{(P_A)^j (P_B)^k} \quad \text{——— (1)}$$

Assuming all these gases obey ideal gas equation pressure (P) of a gas is,

$$P = \left(\frac{n}{V}\right) RT$$

where $\frac{n}{V}$ is molar concentration. Thus the partial press[ure of] gases A, B, C & D are :-

$$P_A = [A]RT, \quad P_B = [B]RT, \quad P_C = [C]RT \quad \& \quad P_D = [D]RT$$

Now from (1), $$K_p = \frac{[A]^l (RT)^l [B]^m (RT)^m}{[A]^j (RT)^j [B]^k (RT)^k}$$

$$\Rightarrow K_p = \frac{[A]^l [B]^m}{[A]^j [B]^k} \times \frac{(RT)^{l+m}}{(RT)^{j+k}}$$

$$\Rightarrow K_p = \frac{[C]^l [D]^m}{[A]^j [B]^k} \times (RT)^{(l+m)-(j+k)}$$ [But $\frac{[A]^l [B]^m}{[C]^j [D]^k} = K$

$$\boxed{\therefore K_p = K_c (RT)^{\Delta n}}$$

where $\Delta n = (l+m) - (j+k)$, the difference in the sum
ous products and reactants.

If $\Delta n = 0$ then $\boxed{K_p = K_c}$

~~# Factors influencing equilibrium constant~~:

Relation between K_p and K_x:

let, $nA + mB \rightleftharpoons pC + qD$ (All gases hom

Then $K_p = \frac{P_C^p \times P_D^q}{P_A^n \times P_B^m}$ and $K_x =$

But, In the gas mixture the partial pressure
the mole fraction x of that substance and the

$$\therefore K_p = \frac{(P x_C)^p (P x_D)^q}{(P x_A)^n (P x_B)^m}$$

$$= \frac{x_C^p \cdot x_D^q}{x_A^n x_B^m} \times \frac{P^{p+q}}{P^{m+n}}$$

$$= \cancel{K_x (\Delta T)}^{(p+q)-C}$$

$$= K_x \, P^{\Delta n}$$

where $\Delta n = (p+q) - (m+n)$

$$\boxed{\therefore K_p = K_x \, P^{\Delta n}}$$

(i) Low temperature: By applying le-chatelier's principle, shift the equilibrium to the right. This gives greater yield of a the a temperature of about 450°c is used when the percentage equilibrium mixture is 15.

(ii) High pressure: High pressure on the reaction at equil shift of ~~an~~ the equilibrium to the right. This is so becau on proceeds with a decrease in the number of moles. A pres atm is applied in practice.

(iii) Catalyst: To increase the rate of reaction and thus quicken librium, a catalyst is used. Finely divided iron containing molyb actual practice. Molybdenum acts as a promoter that increase ency of the catalyst.

Determine Kc and Kp from the following given equation

~~(i) $N_2 + 3H_2 \rightleftharpoons 2NH_3$~~

(i) $H_2 + I_2 \rightleftharpoons 2HI$

(ii) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

~~(i) $N_2 + 3H_2 \rightleftharpoons 2NH_3$:~~

~~We have,~~ ~~$N_2 + 3H_2 \rightleftharpoons 2NH_3$~~

~~Initial a 3b 0~~

(i) We have,

	H_2 +	I_2	$\rightleftharpoons 2HI$
Initial	a	b	0
Final	$(a-\alpha)$	$(b-\alpha)$	2α

Kc: let, a mole of H_2 and b mole of I_2 are put in a is V and by heating them ~~in equ~~ 2α mole of HI is produce so in equilibrium the amount of H_2 & I_2 are $(a-\alpha)$ & $(b-\alpha)$;

$\therefore$ Molar concentration of H_2 = $\frac{a-\alpha}{V}$ mol L^{-1}

Molar concentration of I_2 = $\frac{b-\alpha}{V}$ mol L^{-1}

& Molar concentration of HI = $\frac{2\alpha}{V}$ mol L^{-1}

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{\left(\frac{2\alpha}{V}\right)^2}{\left(\frac{1-\alpha}{V}\right)\left(\frac{b-\alpha}{V}\right)} = \frac{4\alpha^2}{(a-\alpha)(b-\alpha)}$$

Kp:

Here, $\Delta n = 2-(1+1) = 0$

We know, $K_p = K_c(RT)^{\Delta n} = K_c(RT)^0$

$\therefore K_p = K_c$

ii) We have

	PCl_5 $\rightleftharpoons$	PCl_3 +	Cl_2
Initial	1	0	0
Final	$(1-\alpha)$	α	α

Kc: ~~let, 1 mole of PCl_5 is dissociated by heating in equi~~ taken. α moles of PCl_5 is dissociated into α moles of PCl_3 Cl_2 in equilibrium. So undissociated $PCl_5 = 1-\alpha$. If reaction occur in a pot whose volume is V then

$[PCl_5] = \frac{1-\alpha}{V}$, $[PCl_3] = \frac{\alpha}{V}$ & $[Cl_2] = \frac{\alpha}{V}$

$$\therefore K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{\frac{\alpha}{V}\cdot\frac{\alpha}{V}}{\frac{1-\alpha}{V}} = \frac{\alpha^2}{(1-\alpha)V}$$

Kp: In equilibrium total number of moles $= 1-\alpha+\alpha+\alpha$ ... al pressure P then partial pressure of PCl_5 is $P_{PCl_5} =$

$=$

Similarly, $P_{PCl_3} = \frac{\alpha}{1+\alpha}P$ & $P_{Cl_2} = \frac{\alpha}{1+\alpha}P$

$$\therefore K_p = \frac{P_{PCl_3} \times P_{Cl_2}}{P_{PCl_5}} = \frac{\frac{\alpha^2}{(1+\alpha)^2}P^2}{\left(\frac{1-\alpha}{1+\alpha}\right)P} = \frac{\alpha^2}{1-\alpha^2}\cdot P$$

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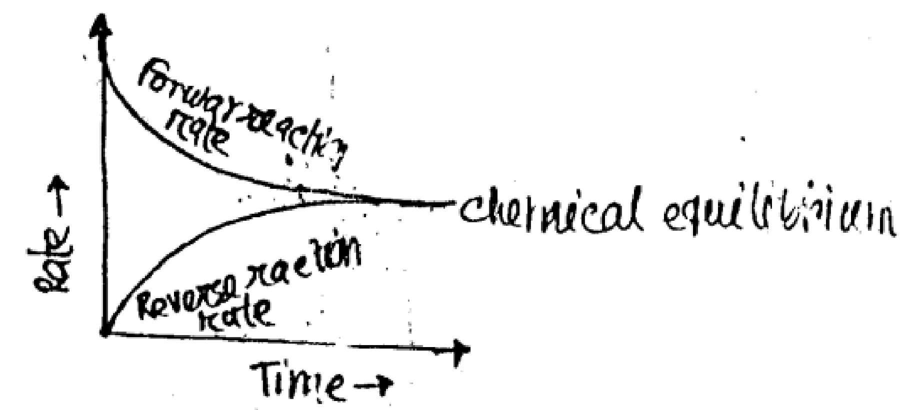
Finios

Chemical equilibrium:

The state of a reversible reaction when [...]tions occur at the same rate and the concentration of reac[...] change with time is called chemical equilibrium.



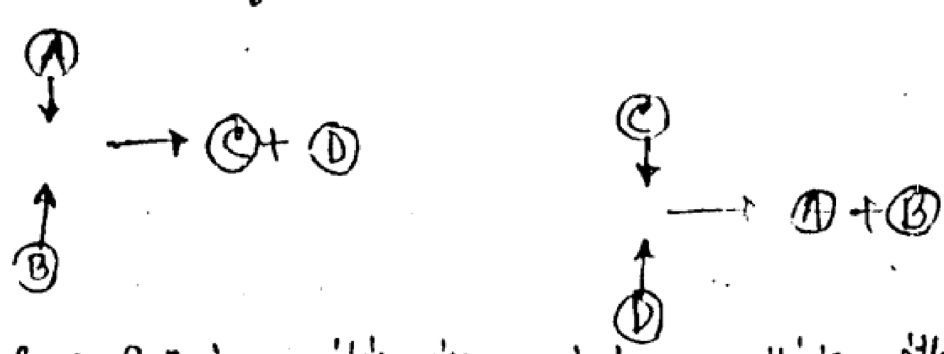
Dynamic chemical equilibrium:

Consider the following reaction,

$$A + B \rightleftharpoons C + D$$

When the reaction attains equilibrium, the concentrations [...] and D remain constant with time. Apparently it appears tha[...] ad But it is not so. The equilibrium is dynamic. Actually th[...] [...]ions are taking place at equilibrium, but the concentrati[...]

The dynamic nature of chemical equilibrium can be [...]ing kinetic molecular model:-



* * # Law of mass action: The law of mass action states that ... cal reaction is propotional to the active masses of reactan...

Here, active mass is meant the molar concentration i.e. nu...

* * # equillibrium constant:

Consider, the following ~~equa~~ reaction,

$$A+B \rightleftharpoons C+D$$

According to the law off mass action, rate of forward re...

where, $[A]$ = concentration of A reactants

$[B]$ = concentration of B reactants

K_1 = Rate constant of forward reaction

Similarly, rate of ~~forward~~ backward reaction $r_b = K_2[C][D]$

where, $[C]$ = concentration of C products

$[D]$ = concentration of D products

K_2 = Rate constant of reverse reaction.

In equilibrium, $r_f = r_b$

$$\Rightarrow K_1[A][B] = K_2[C][D]$$

$$\Rightarrow \frac{K_1}{K_2} = \frac{[C][D]}{[A][B]}$$

$$\therefore K_c = \frac{[C][D]}{[A][B]}$$

Here K_c is called equilibrium constant.

* * # Reversible reaction: A reaction which can go in the forw... tion ~~or~~ simultaneously ~~or~~ is called a reversible reaction.

Such a reaction is represented by writting a pa... reactants and products.

$$A+B \rightleftharpoons C+D$$

The arrow pointing the right indicates the forwar... that pointing the left indicates the reverse direction.