

# EQUILIBRIUM

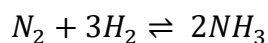
## LAW OF CHEMICAL EQUILIBRIUM

$aA + cB \rightleftharpoons cC + dD$ , GENERAL EQUATION

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$K_c$  = equilibrium constant

- Find the  $K_c$  of following chemical equation?



ANS:-

$$K_c = \frac{[NH_3]^2}{[N_2] [H_2]^3}$$

On reversing a reaction

$$K_c' = \frac{1}{K_c}$$

## RELATION BETWEEN $K_p$ AND $K_c$

$$K_p = K_c (RT)^{\Delta n_g}$$

$\Delta n_g$  = No of gaseous product – no of gaseous reactants

- Write the relation between  $k_p$  and  $k_c$  of reaction  $N_2 + 3H_2 \rightleftharpoons 2NH_3$  ?

Ans:-

$$\Delta n_g = 2 - 4 = -2$$

$$\text{ie, } K_p = \frac{[NH_3]^2}{[N_2][H_2]^3} (RT)^{-2}$$

## Application of $K_c$

## 1. To predict the extent of the reaction

Ithentha vechal oru chemichal reaction nadkuo lye njmlk predict chyn pattm ith njn oru reaction ndaki appo athinte kc kandt aah reaction nadkuo lye kand pidkn pattm athahn 1<sup>st</sup> pareeeneth

P=product

R=reactants

$K_c > 10^3 \Rightarrow$  reaction almost complete,  $P > R$

$K_c$  10 cubenekaalm koodyal almost reaction complte aavm reactantnekaalm product koodtheleykm

$K_c < 10^{-3} \Rightarrow$  reaction procede rarely,  $R > P$

Ith vechaaal njml oru reactionte kc kand value  $10^{-3}$  ithinekaaalm korvaahnel ath rare aaayte reaction nadkn lle chnce llu reactant eykm productnekaaalm koodthl

$10^{-3} < K_c < 10^3 =$  midway, both reactant and product are formed

Ith vechal aaah rand value nte nadkaan njml  $K_c$  kandt value kittnel mid range aahn possibilty ithil reactantm productm ndavm

## 2. For predicting direction of a reaction

Njml oru reaction equilibrium attain chythaaal aaahn  $K_c$  kaaana aaah reaction at equilibrium aaavnm. aaah reactioequilibrium attain chynthinte munne aahn kc kaaannenkl athin vere per aahn parya  $Q_c$  reaction quotient ith manslaaaaakivekknm

note:-  $K_c =$  at equilibrium

$Q_c =$  before attaining equilibrium, reaction quotient

$Q_c < K_c \Rightarrow$  forward reaction

$Q_c > K_c \Rightarrow$  backward reaction

$Q_c = K_c \Rightarrow$  at equilibrium

$K_c$  nekaalm korvaahnel  $Q_c$  avda forward reaction nadkm

$K_c$  nekaaalm koodthlaahnel  $Q_c$  ath backward eykm

If rand value equal ahnenkil ath equilibrium attain chythndavm

### LE CHATLIERS PRINCIPLE

#### **Le Chateliers' Principle**

*When the concentration, pressure or temperature of a system at equilibrium is changed, the system will readjust itself so as to nullify the effect of that change and attain a new state of equilibrium.*

$\Delta H = -ve$  exothermic

$\Delta H = +ve$  endothermic

#### Concentration effect

.When concentration of reactants increases and concentration of product decreases the forward reaction will take place

.when concentration of reactants decreases and concentration of product increases the backward reaction take place

#### Pressure effect

. When pressure increases the reaction will take place in that direction where number of moles decreases

.when pressure decreases the reaction will take place in that direction where number of moles increases

eg:-  $\frac{N_2 + 3H_2}{1+3} \rightleftharpoons \frac{2NH_3}{2}$

$\rightleftharpoons 2$  , ivda reactant 4 m product 2ndm aahn appo pressure kootya koodye nmbrn korneylek povm 4 lle 2 aaavne reaction nadkm ivda forward nadkm

### Temperature effect

- . If temperature increases  $\Delta H = -ve$  backward reaction occurs
- . If temperature increases  $\Delta H = +ve$  forward reaction occurs
- . If temperature decreases  $H = -ve$  forward reaction occurs
- . If temperature decreases  $H = +ve$  backward reaction occurs

Q :-  $N_2 + 3H_2 \rightleftharpoons 2NH_3$ ,  $\Delta H = -92$  KJ/mol; what are the following effect for the following changes ?

1. increasing pressure
2. increaseing temperature
3. removal of ammonia
4. adding  $NH_2$

ANS :- 1. pressure increas chymbo koodthl lle nmbr korvlek povm appo ivda **forward reaction** occur chym

2. ivda temperature increase chymbo  $\Delta H = -ve$  aahn so exothermic reaction aahn appo **backward reaction** occur chym

3. ammonia product aahn appo product remove chya parnl decrease chya decrease chytha **forward reaction** increase chym

4.  $NH_2$  product aahn product increase chythal **forward reaction** increase chym

### ACID BASE CONCEPT

#### 1. ARRHENIUS CONCEPT

Acids are  $H^+$  donors eg:- HCL

Base are  $OH^-$  producers eg:- NaOH

Ithrellu ithil pareeenllu

## 2. LEWIS CONCEPT

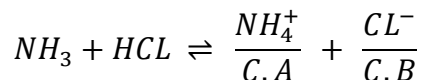
Acids are electron pair acceptors eg:-BF<sub>3</sub>

Base are electron pair donors eg :-NH<sub>3</sub>

## 3. LOWRY-BRONSTED CONCEPT

Acids are H<sup>+</sup> donors

Bases are H<sup>+</sup> acceptors



ITH DIVISION ELLA UNDERLINE CHYTHTHA

Ivda conjugate acid aaahn NH<sub>4</sub><sup>+</sup> athengna kittye vechal NH<sub>3</sub> + H<sup>+</sup> ith chytherm Aahn

Cl<sup>-</sup> veran reason HCl – H<sup>+</sup> ithondan lle hydrogen poypo avde minuse charge vann athrellu

$\begin{aligned} C.A &= S + H^+ \\ C.B &= S - H^+ \end{aligned}$
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SUBSTANCE	C.A	C.B
$H_2O$	$H_3O^+$	$(OH)^-$
$HSO_4^-$	$H_2SO_4$	$SO_4^{2-}$
$NH_3$	$NH_4^+$	$NH_2^-$
$HCO_3^-$	$H_2CO_3$	$CO_3^{2-}$

## PH

$$PH = -\log[H^+]$$

PH is the negative logarithm of concentration of H<sup>+</sup> ion

## BUFFER SOLUTION

SOLUTION WHICH RESIST CHANGE IN PH EVEN THE ADDITION OF SMALL AMOUNT OF BASES OR ACID

EG:- BLOOD

Ith vechndel cherye amount acid or base aah solutionl ndel ath ph value change aavnd nikk bloodl angne aahn njml foodpolthe chele acids okke ndavm blood resist chym blood engnm ph maarya njml dead

aaavm appo aah ph value change aavnethine resist chym athahn buffer solution

### Two buffer solution

Acidic buffer

Eg:- mixture of

Acetic acid

And

Sodium acetate

basic buffer

mixture of

ammonium hydroxide

and

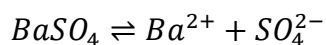
ammonium chloride

### SOLUBILITY PRODUCT (KSP)

Solubility product is the product of molar concentration of ions of a sparingly soluble salt

Solubility product vechal oru sparingly soluble salt ne dissociate chytht athinte ionsnte concentrationte product aahn

Disociate vecha oru compoundnte athinte ions aayt maaati eythnth



$$KSP = [Ba^{2+}] + [SO_4^{2-}]$$

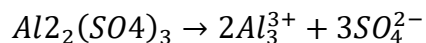


$$KSP = [Na^+] + [Cl^-]$$

lthpole thanne compoud dissociate chythttt athinte concentration edthal athahn solubility product

### RELATION B/W SOLUBILITY PRODUCT AND SOLUBILITY

$KSP = X^x \cdot Y^y (S)^{x+y}$
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$$K_{SP} = 3^3 \cdot 2^2 (S)^{2+3}$$

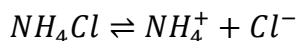
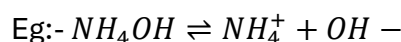
$$= 4 \times 27 \times (S)^5$$

$$= 108(S)^5$$

lthil s aahn solubilty ksp solubilty product aahn ath disociate chytht athinte ionsnte concentration aaahn edkndye x mm y mm athinte ions aahn moles oriklm edkerth

### COMMON ION EFFECT

The disociation of weak electrolyte can be suppressed by the addition of a strong electrolyte having a common ion is called common ion effect



lthil nh4oh oru weak electrolyte aahn and nh4cl strongmm aahn ath randm add chymbo nh4+ eykm athil lle common ion avde nh4+ concentration increase chym ithrellu ith

### SALT HYDROLYSIS

Salt on hydrolysis with water gives acidic, basic or neutral solution is called salt hydrolysis

lthentha vechal oru salt water aayt react chymbo onenkil acid alenkil base alenkil nuetral aayt lle solution ndvm athahn salt hydrolysis ee salt vechal oru acidm oru basem koodi react chythl ndaavnthahn salt

Eg:- Na base aahn Cl acid aahn ath randm koodi react chythtaahn NaCl salt ndaavnth

1. salt of strong acid and base gives nuetral solution eg:- NaCl

2. salt of weak acid and strong base gives basic salt eg:- sodium acetate

3. salt of strong acid and weak base gives acidic salt eg:-  $NH_4Cl$

#### 4. salt of weak acid and weak base

Ithil oru equation vech kaananm

$$pH = 7 + \frac{1}{2} [pK_a - pK_b]$$

Acid ph – base ph chytth aah equationl substitue chytha mathi athinte value > 7 aahnenkl  
basic salt eykm weak acidm weak basem react chymbo if value < 7 aahnel ath acidic eykm

.....kaynj.....