

CHEMICAL Equilibrium

FORWARD // REVERSE

Def: type of reaction in which reactant form products // type of reaction in which product form reactant

Type

Endothermic // Exothermic

Direction

left to right // right to left

Equilibrium

tends to form product // tends to form reactant

Example

$2 \rightarrow CO_2$ // $CO_2 \rightarrow C + O_2$

REVERSIBLE // IRREVERSIBLE

Direction

proceeds in both directions // proceeds in one direction

Representation

$\rightleftharpoons$ // $\rightarrow$

Stability

Unstable // Stable

Completion

never complete // complete

Example

$2H_2 + O_2 \rightleftharpoons 2H_2O$ // $2H_2 + O_2 \rightarrow 2H_2O$

Importance of Equilibrium:

- It helps in determining the conc. of equilibrium mixture by knowing initial conc. of reactants.
- predict direction of reaction
- predict extent of reaction
- predict effect of changes in conditions of chemical reaction

Chemical equilibrium:

is the state when forward & reverse reactions occurs at the same rate.

Dynamic equilibrium:

Chemical equilibrium is dynamic equilibrium becu the conc. of reactant & product remain unchanged when they reach equilibrium, but the reaction does not stop.

Catalyst: A substance which increase rate of reaction without participating in the reaction. They have no effect on equilibrium position once it is reached.

Le-chatellier Principle:

If you impose a change in conc, temp, pressure of a reaction, the system respond in a way that opposes the change.

LAW OF MASS-ACTION:

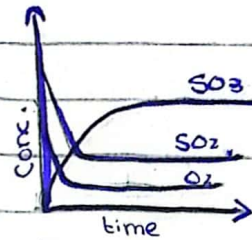
"The rate at which a substance react $\propto$ to active mass. The rate at which a reaction proceed $\propto$ to product of active masses of reactant."



$$\text{rate of FR} \propto [A]^a [B]^b$$

$$\text{rate of reverse} \propto [C]^c [D]^d$$

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



Graph: Conc-Time

ways to Recognize Equilibrium:

*Physical:-

- Spectrometry
- Polarimetry
- Refractrometry

*Chemical:-

- Titration

CONDITIONS FOR EQUILIBRIUM

- catalyst unchanged
- Pressure unchanged
- Temp undisturbed
- Conc of reactant and product should remain same
- If any of reactant or product is in gaseous state, container should be closed.

Equilibrium Constant

ratio of product of conc.

of product to reactants

raised to power equal to coefficients.

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

HAESA SATTAD

"ACIDS, BASES, SALTS"

General Characteristic

Acid | Base

Taste

Sour | Bitter

Red litmus

X | turns blue

Blue litmus

turns red | X

Bronsted -

Lowery Concept:

presented by

G. N. Bronsted &

T. M. Lowery in 1923.

Acid: proton donor

Base: proton acceptor

pH Scale:

• Scale containing number 0-14

describing strengths

← 7 →
acidic | basic
neutral

Strong Acids

0-3

Weak Acid

4-6

Strong Base

12-14

Weak Base

8-11

Arrhenius Concept:

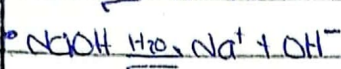
presented by Svante

Arrhenius in 1887.

Acid: gives H^+ ions in aq.

Base: gives OH^- ions in aq.

Example:-



Limitations of

Bronsted - Lowery:

• Does not consider

aprotic Solvents.

• Does not explain

reaction of electron deficient

atoms.

• Does not explain neutralization reaction

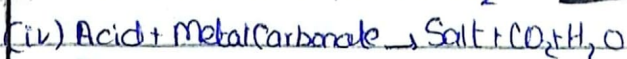
FORMULA: $pH + pOH = 14$

SALT:

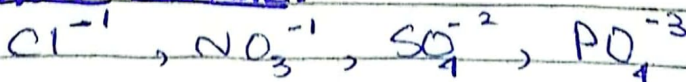
The compound formed by replacement of H atom by metal atom in acids

TYPE OF SALT: • Normal • Acidic • Basic

FORMATION OF SALTS:



SALT CHARGE:



LIMITATIONS of Arrhenius Concept:

(i) applies only to aqueous sol.

(ii) cannot be applied for substances not containing H^+ or OH^- ions.

(iii) It does explain why CO_2 & SO_2 are acidic & NH_3 is base.

(iv) It does not explain neutralization reaction & amphoteric behavior.

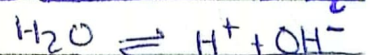
Lewis Concept:

proposed by Lewis in 1923

Acid: e^- pair acceptor.

Base: e^- pair donor.

SELF IONIZATION OF H_2O :



Ionization Constant

$K_w = 1 \times 10^{-14}$ at $25^\circ C$

ACID-BASE

INDICATOR:

• Phenolphthalein:

Acid: X Base: Pink.

• Methyl Red:

Acid: Red Base: Yellow

• Bromothymol Blue:

Acid: Yellow

Base: Blue.