Past Paper 2017

Short Question

(01)

Catalytic Poisoning.

"Deactivation of catalyst by small amount of impurities is called poisoning of catalyst".

Impurities will cause catalytic poisoning if adsorbing ability of impurities is greater than the adsorbing ability of reactant, than impurities will adsorb on catalyst and occupy active site. Reactant do not adsorb and retardation occurs.

(02)

Catalyst effect the energy of Activation.

Catalyst speed up the reaction by reducing the activation energy. (E_a). so that more reactant molecule collide with enough energy to surmount the smaller energy barrier. Thus Activation energy is affected by the use of catalyst.

(03)

(09)

Two Postulates of Langmuir Adsorption Isotherm:

The two postulates of Langmuir Adsorption Isotherm is:

(i) Each adsorbent has specific equivalent site for reactions adsorption.

(ii) Adsorbant molecule attach to their sites.

(iii) One molecule of adsorbate can adsorbe on one site of adsorbent.

(10)

Physical Adsorption	Chemical Adsorption
→ Physical adsorption is fast process	→ Chemical Adsorption is slow process.
→ Relatively weak adsorption	→ This is relatively strong adsorption
→ It has low value of heat of adsorption	→ It has high value of heat of adsorption.
→ It is not specific	→ It is highly specific.
→ It is reversible process	It may be reversible or Irreversible.

a suitable liquid (the dispersion) are called "lyophilic sols".
These are very stable and are not easily coagulated by electrolytes. These are reversible in character. They are usually prepared by simple solution method. They are highly viscous system.
In lyophilic sols the surface tension is lower than that of dispersion medium. Particles may have little or no charge at all. The particales cannot be readily detected under an ultramicroscope.
lyophilic sols particles are solvated due to their interaction with solvent.
Example: Gums, starch, protein.

Lyophobic Sols:

lyophobic mean liquid hating. "Those sols in which dispersed phase and dispersion medium (water) has very less attraction or no interaction between them are called lyophobic sols"

→ The Brownian movement of colloidal particles counteracts the force of gravity acting on them and thus is responsible to a certain extent for the stability of the colloids.

Question NO 1

(a) What is Adsorption? Discuss adsorption phenomenon?

Ans:-

Adsorption:

"The phenomenon of concentration of molecules of a gas or liquid at a solid surface is called adsorption."

→ The substance that deposit on the surface is called Adsorbate

→ The solid on whose surface the deposition occur is called adsorbent.

Adsorbate and adsorbent are basic components which are necessary for adsorption.

Adsorbate is the substance which get attached to other surface and the substance on which adsorption take place is called adsorbent.

(i) Nature of Adsorbate and Adsorbent:

Adsorption depends upon the nature of adsorbate and adsorbent. The various group of adsorbate and adsorbent are responsible for adsorption.

Example:

Polarity of both can use force of attraction between them.

(ii) Surface Area:

Surface area of adsorbent has pronounced effect on the rate of adsorption. Adsorbent with greater surface to volume ratio possess greater extent of adsorption and vise versa.

(iii) Temperature:

Temperature affects the process of adsorption.

Example:

In most cases the chemical adsorption increase of temperature, while physical adsorption decrease with the increase of temperature.

(iv) Pressure / Concentration:

Dynamic equilibrium exist between the adsorbed and desorbed gas molecule during adsorption process. So according to le-Chatlier principle increase

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \overset{k_2}{\rightleftharpoons} E + P$$

According to above equations, rate of reaction as

$$v = k_2 [ES] \quad \text{——— (1)}$$

Net rate of formation of enzyme-substrate complex can be written as

$$\frac{d[ES]}{dt} = k_1 [E][S] - k_{-1} [ES] - k_2 [ES] \quad \text{——— (2)}$$

Applying steady state approximation, because ES complex is formed and used during reaction and it is an unstable intermediate. So $d[ES]/dt = 0$

eq (2) becomes

$$0 = k_1 [E][S] - k_{-1} [ES] - k_2 [ES]$$

$$k_{-1} [ES] + k_2 [ES] = k_1 [E][S]$$

$$[ES](k_{-1} + k_2) = k_1 [E][S]$$

$$[ES] = \frac{k_1 [E][S]}{k_{-1} + k_2} \quad \text{——— (3)}$$

Enzyme is present in a vessel in free form as well as in ES complex form. So

$$[E]_0 = [E] + [ES]$$

Where $[E]_0$ is the initial concentration of enzyme, $[E]$ is the available concentration of free enzyme and

Putting value of [ES] from (6) and (1) we get

$$v = \frac{k_2 [E]_0 [S]}{K_M + [S]} \quad \text{——(7)}$$

Results deduced from eq (7) are

➡ Rate of reaction is a function of concentration of substrate.

➡ Rate of reaction is directly proptional to [S] but up to certain limit only. When [S] is low, then $K_M + [S] = K_M$ so eq (7) will be

$$v = \frac{k_2 [E]_0 [S]}{K_M}$$

$$v = \text{constant} \times [S]$$

$$v \propto [S]$$

So rate of reaction is directly proptional to concentration of substrate if concentration of substrate is very low.

➡ When [S] is very high, then $K_M + [S] = [S]$ applying this condition we get.

$$v = \frac{k_2 [E]_0 [S]}{[S]}$$

$$v = k_2 [E]_0 \cdot v_{max}$$

v_{max} is constant value, because k_2 and $[E]_0$ are constant.

v_{max} is independent of [S].

[ES] is available concentration of enzyme substrate complex.

$$[E] = [E]_0 - [ES] \quad \text{——} (4)$$

Putting value of [E] from equation (4) into eq (3)

$$[ES] = \frac{k_1[[E]_0 - [ES]][S]}{k_{-1} + k_2}$$

$$[ES] = \frac{[[E]_0 - [ES]][S]}{k_{-1} + k_2} \quad \text{——} (5)$$

$$k_M = \frac{k_{-1} + k_2}{k_1}$$

Where k_m is the Michaelis-Menten constant.

So eq (5) become

$$[ES] = \frac{[E]_0[S] - [ES][S]}{K_M}$$

$$[ES] = \frac{[E]_0[S]}{K_M} - \frac{[ES][S]}{K_M}$$

$$[ES] + \frac{[ES][S]}{K_M} = \frac{[E]_0[S]}{K_M}$$

$$[ES]\left[\frac{K_M + [S]}{K_M}\right] = \frac{[E]_0[S]}{K_M}$$

$$[ES] = \frac{[E_0][S]}{K_M + [S]} \quad \text{——} (6)$$

to produce lead to higher rate of adsorption.

(b)

Enzyme Catalysis:

The catalysis brought about by enzyme are known as enzyme catalysis.

Enzyme: The reaction being slow remarkably catalyzed by organic compound called enzyme. Enzyme have been formed to be complex protein molecule.

Michaelis-Menten Mechanism:

Michaelis-Menten mechanism of enzymes catalysis key lock and key model of enzyme. ~~Enzyme~~ An enzyme has a specific site for adsorption of a particular substrate.

According to the model, substrate can form a complex with enzyme by a reversible process, then enzyme substrate complex is converted into product with regeneration of enzyme by irreversible process.

The scheme of Michaelis-Menten mechanism of enzyme catalyzed reaction can be given:

Adsorption can be distinguish from absorption because in adsorption adsorbate molecules will attach at the surface while in case of absorption, molecule will penetrate into the body of adsorbent.

Sorption:

When adsorption and absorption take place at same time then the process is known as sorption.

Example:

Dyeing of cotton fibre is an example of sorption.

Types of Adsorption:

Two types of adsorption

- Physical Adsorption
- Chemical Adsorption

Physical Adsorption:

Physical Adsorption occurs through van-der-Waal's forces. So it is also know as physisorption. It is a fast process.

Chemical Adsorption:

Chemical Adsorption occurs through chemical bounding. It is also know as chemisorption. It is a slow process.

Factor Affecting the Adsorption:

Robert Brown (1927), a botanist observed the movement in pollen grain.

He observed that polen grain when suspended in liquid and are observed under a microscope exhibit a ceaseless random motion and travelled a zig-zag path. It has been found that colloidal particles exhibit random zig-zag motion when seen under ultramicroscope. This random zig-zag motion is Brownian movement.

Brownian Movement.

→ This movement is due to bombardment of the colloidal particles by the molecules of the dispersion medium. When an unequal number of molecules of the medium strike the colloidal particle from opposite direction, then this colloidal particles begin start his random motion.

These are generally unstable, get easily coagulated on adding electrolytes. These are irreversible in character. They are usually prepared by indirect method. In lyophobic Sols the viscosity of colloidal dispersion is same as that of solvent.

Surface tension in lyophobic sols is similar to that of dispersion medium. The particles carry positive or negative charge. These particles are easily detected under an ultra-microscopes. There is no solvation of the lyophobic sol particles.

Example:

Gold or As_2S_3 in water.

(b) Question No(2)

Kinetic Properties of Sol (Brownian movement).

"The continous zigzag movement of particles in the dispersion medium in a colloidal solution is called Brownian movement"

Long Question:

(a)

Sol:

A sol is defined as:

"type of colloid in which solid particles are suspendend in liquid"

The particles present in a sol are very small in size. The colloidal solution displays the Tyndall effect. Sols can be prepared via condensation or dispersion.

Types of Sol:

Depending upon the nature of interaction between the dispersed phase and dispersion medium sols can be classified into two types.

- Lyophillic Sol
- Lyophobic Sol

Lyophilic Sol:

The term lyophilic mean liquid loving.

"Colloidal sols directly formed by mixing substances like rubber, gum, gelatine, starch etc which

adsorption and vice versa. If substance is divided and subdivided further then we get small particles. This process will increase the surface area to volume ratio to a very large extent.

(08)

Heterogenous Catalyst:

"If the catalyst and reactant have different phases, it is called heterogenous catalyst"

Mostly the catalyst is in solid phase, while reactant are in the gaseous or liquid phase.

Example:

(i) Oxidation of ammonia to NO in the presence of platinum gauze help us to manufacture HNO_3.

$$4NH_{3(g)} + 5O_{2(g)} \xrightarrow{Pt} 4NO_{(g)} + 6H_2O_{(g)}$$

(ii)

$$CO_{(g)} + 2H_{2(g)} \xrightleftharpoons{ZnO\text{-}Cr_2O_3(s)} CH_3OH_{(l)}$$

Electrophoresis:

"The phenomenon of migration of colloidal particle in an electrical field is called Electrophoresis or cataphoresis"

The charge colloidal particle when placed in electrical field, these particle are migrate either positive or negative cathode depend upon their charges.

Mathmatically:

$$v = \frac{}{}$$

SI unit: $m^2 s^{-1} V^{-1}$

Depend upon:

It depend upon

- viscosity of medium
- charge and size of colloidal particle.

(07)

Effect of Surface Area on Adsorption:-

Surface area of Adsorbent has pronounced effect on the rate of adsorption.

Adsorption with greater surface to volume ratio possess greater extent

Physical Appearance	
Appearance of emulsion is similar to liquid.	Gel are versatile in physical appearance. They can be solid liquid or semisolid.
Elasticity:	
Emulsion are not elastic	Some gels are elastic
Classification:	
Emulsion can be classified on the basis of position of inner and outer phase i.e o/w and w/o emulsion.	Gel cannot be classified in this way rather they can be classified on the basis of nature of inner and outer phase i.e organogels etc.

(05)

Method for purifying Colloidal solution:

The method for purifying the colloidal solution.

i) Dialysis
ii) Ultrafiltration
iii) Ultracentrifugation.

(06)

Promoter:

"Such a substance which promotes the activity of a catalyst is called promoter or an activator"

"It is also called catalyst for a catalyst"

Example:

→ Hydrogenation of vegetable oils is accelerated by nickel. The catalytic activity of nickel can be increased by using copper and tellurium.

→ In Haber's process for the manufacture of ammonia, iron is used as catalyst. If small amount of some higher melting oxides like aluminum oxides, chromium oxide or rare earth oxide are added, they increase the efficiency of iron.

(04)

Emulsion	Gel
Phases: Dispersed phase as well as dispersion medium, both are liquid.	Dispersed phase in liquid while dispersion medium is solid.