

PAST PAPER 2018:

QNo2:

SHORT QUESTIONS & ANSWERS

(i)

Enzyme Inhibition:

The decrease in rate of enzyme catalyzed reaction as a result of complex formation of foreign substance with enzyme is called "enzyme inhibition" and foreign species is called "inhibitor".

Types:

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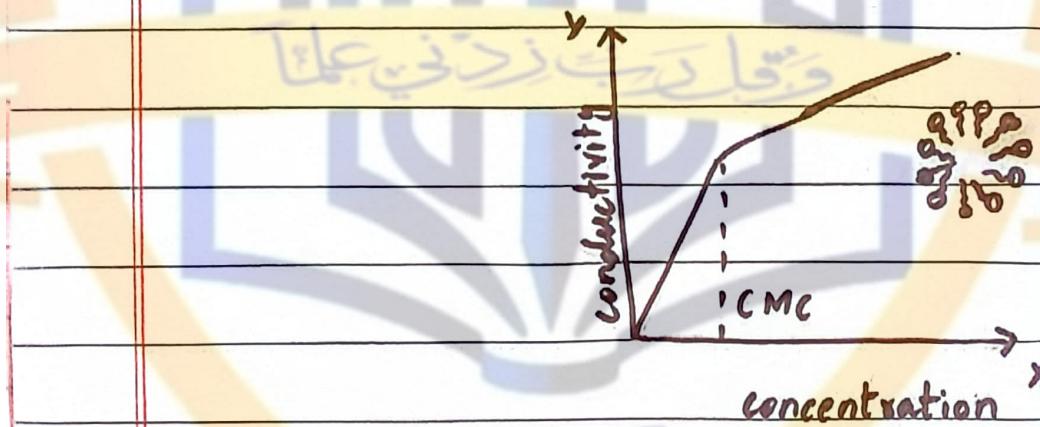
Reversible and irreversible are two types of enzyme inhibition. Reversible are further divided into three types.

- i) Competitive iii) Non-competitive
- ii) Un-competitive

(ii)

Critical Micelle Concentration

Micelles are formed at a certain concentration of surface and this minimum concentration at which process of micellization starts is called "critical micelle concentration". Below CMC, micellisation does not occur.



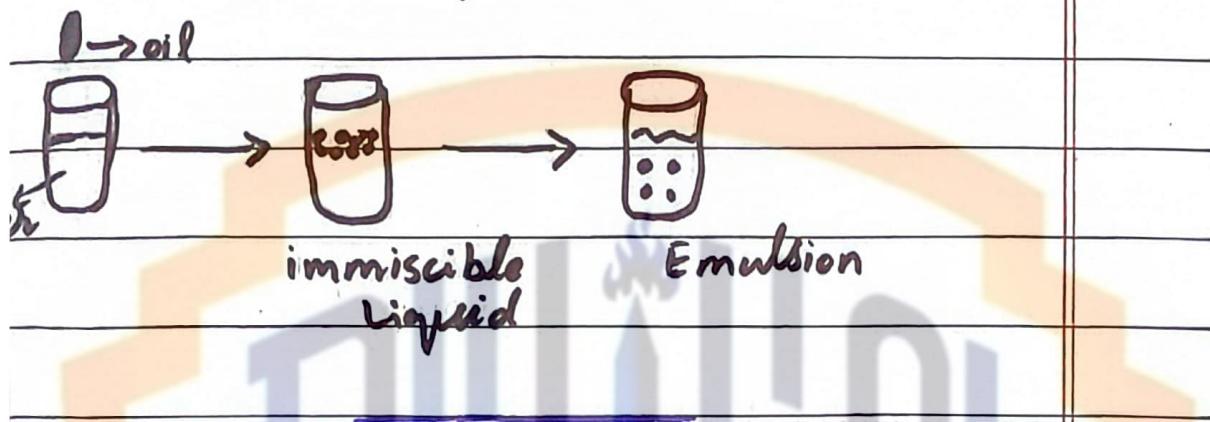
(iii)

Emulsification:

The dispersal of a liquid in the form of an emulsion is called emulsification.

It is a process of mixing

of two immiscible liquids into a mixture. It is the process of creating phases in a liquid-liquid mixture that results in a creation of emulsions.



(iv)

Colloids

In colloid, the particles are larger typically between 1 and 100 nm.

In sols, particles are smaller in size in between range of nm (1 to 1nm)

Colloids encompass a wider range of dispersions including sols, gels, foams and emulsions

Sols are specific type of colloidal dispersion where solid dispersed in liquids

(v)

Types of Sols:

On the basis of affinity between the disperses and dispersion medium, sols can be divided into two types

i) Lyophilic sols:

They are very stable and are not easily coagulated by electrolytes. They are highly viscous. Example: gum, starch

ii) Lyophobic sols:

They are generally unstable, get easily coagulated on adding electrolyte. Viscosity of colloidal dispersion is same as solvent. Example: Gold, As_2S_3 in water

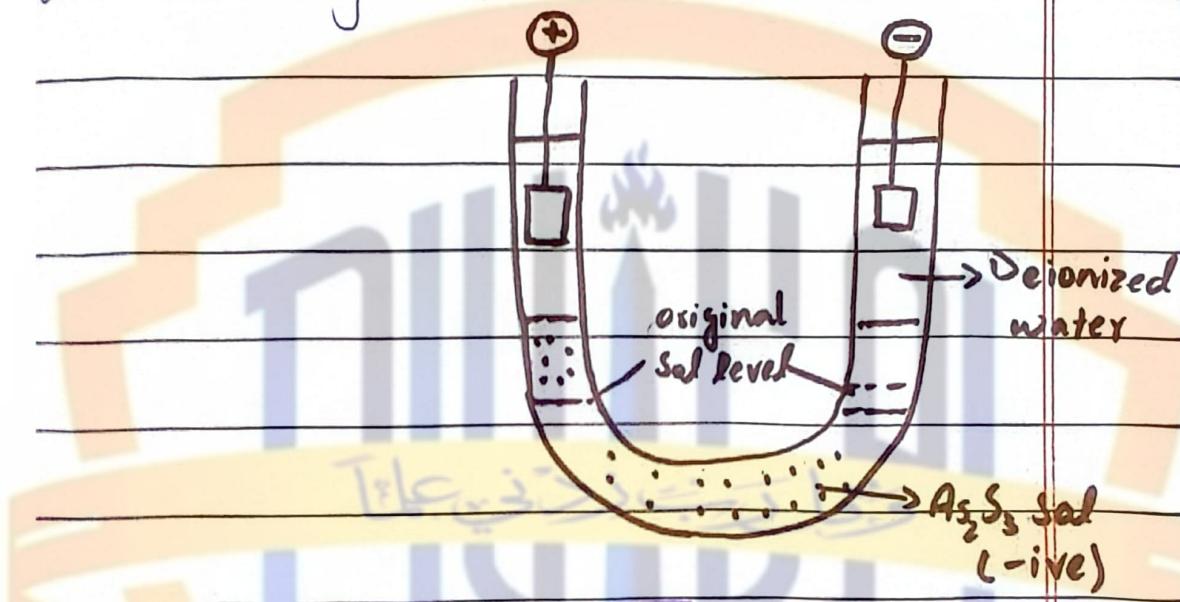
(vi)

Electrophoresis:

The movement of sol particles under an

applied electric field is called

electrophoresis: By noting the direction of motion of sol particles we can determine whether they are tive or -ive.



(vii)

Autocatalysis:

When one of the product of reaction itself act as a catalyst for that reaction is called **Autocatalyst** and phenomenon is **Autocatalysis**:

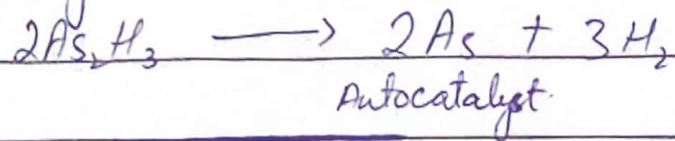
Example:

The free arsenic produced by decomposition of arsine (As_3H_3)

Date: 1 / 20

Day: _____

autocatalyses the reaction.



(viii)

Gels

Emulsion

Phases

In this, dispersed phase is liquid while dispersion medium is solid. In this, dispersed and dispersion medium both phases are liq

Elasticity

Some gels are elastic. Emulsions are not elastic.

Thixotropy

It is a property of gels. They can undergo sol and gel intertransformation. It do not show thixotropy.

Example:

(NIPAM) microgel.

crude oil.

(ix)

Colloidal Dispersion:

Colloidal

dispersion is composed of solid, liquid or gas particles dispersed in a continuous phase. The dispersion medium usually forms the large fraction colloids. Each of two phases making a colloid may be a gas, liquid or solid.

Example:

Dispersion of solid As_2S_3 , gold or oil in water forms colloidal dispersion.

(x)

Effect of Surface area on Adsorption:

The effect of surface area of adsorbent has pronounced effect on rate of dispersion. Adsorbent with greater surface to volume ratio possess greater extent of adsorption. If the 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.

LONG QUESTION:

QNo 5:

(i)

Properties of Suspension:

A suspension is a heterogeneous mixture in which the solid particles do not dissolve, but get suspended throughout the bulk of solvent, left floating around freely in the medium.

There are some properties of suspension.

- 1- Heterogeneous Mixture
- 2- Large size particle
- 3- Tyndall Effect.
- 4- Sedimentation.
- 5- Filtration
- 6- Viscosity.

Heterogeneous Mixture:

Suspension is a heterogeneous mixture which means it is not uniform throughout. This is because the dispersed phase (the particles that are suspended) is not dissolved in continuous phase (the liquid or gas in which particles are suspended).

2. Large Particle Size:

The particles in suspension are much

larger than particles in solution

In fact, they are large enough to be seen by naked eyes.

This is why suspensions are often cloudy or milky.

3- Tyndall Effect:

Suspension

shows tyndall effect because of their large size particles.

Particles of suspension are larger enough to (show) scatter rays of light. This is why beam of light that shines through a suspension appears to be cone of light.

4- Sedimentation:

The particle in suspension will eventually settle out of suspension if it is left undistributed. This is because of particles are not attracted to molecules of continu

phase, so they are free to move around.

5- Filtration:

Suspension can be separated from continuous phase by filtration. This is because the particles in suspension are too large to pass through the pores of filter paper.

6- Viscosity:

Suspension often have high viscosity than the pure continuous phase. This is due to friction between dispersed particles and surrounding particles and surrounding liquid or gas molecules.

(ii)

Enzyme Catalysis:

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

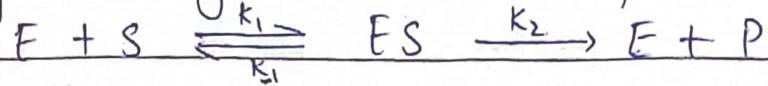
Enzyme: An organic compound used to catalyze the slow reaction to fast are known as enzyme.

Michaelis-Menton Mechanism

Michaelis-Menton mechanism obeys lock and key model of enzyme functioning. An enzyme has specific site for adsorption of a particular substance.

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

enzyme by irreversible process.



According to above eq, rate of R_n is

$$u = k_2 [ES] \quad \text{--- (1)}$$

Net rate formation of enzyme-substrate complex can be

$$\frac{d [ES]}{dt} = k_1 [E][S] - k_1 [ES] - k_2 [ES]$$

Applying steady-state approximation, because ES complex is formed and used during reaction and it is unstable. So, $\frac{d [ES]}{dt} = 0$

$$0 = k_1 [E][S] - k_1 [ES] - k_2 [ES]$$

$$k_1 [ES] + k_2 [ES] = k_1 [E][S]$$

$$[ES] \{k_1 + k_2\} = k_1 [E][S]$$

$$[ES] = \frac{k_1 [E][S]}{k_1 + k_2} \quad \text{--- (2)}$$

$$k_1 + k_2$$

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

$$[E]_o = [E] + [ES]$$

Where $[E]_0$ is initial conc. of enzyme
 $[E]$ is available conc. of free enz
 and $[ES]$ is conc. of enzyme-subst complex.

$$[E] = [E]_0 - [ES]$$

putting above eq. in eq. ①.

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

$$k_1 + k_2$$

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

$$\therefore K_M = \frac{k_1 + k_2}{k_1}$$

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

K_M = Michaelis Menten constant.

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

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

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

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

$$[ES] = [E]_0 [S]$$

$$K_m + [S]$$

putting value of $[ES]$ in

$$u = k_2 [ES]$$

$$u = k_2 [E]_0 [S]$$

$$K_m + [S]$$

Result deduced from eq are:

Rate of reaction is a function

of concentration of substrate

Rate of reaction is directly proportional
to $[S]$ but upto certain limit only.

When $[S]$ is low, then $K_m + [S] \approx K_m$

$$\text{So, } u = k_2 \frac{[E]_0 [S]}{K_m}$$

$$u = \text{constant} \times [S], u \propto [S]$$

so, rate of reaction is directly
proportional to $[S]$.

When $[S]$ is very big then,

$$K_m + [S] \approx [S], \text{ so,}$$

$$u = k_2 \frac{[E]_0 [S]}{[S]}, u = k_2 [E]_0 = V_{max}$$

V_{max} is independent of $[S]$.

QNO 4:

(i)

Determination of Particle size of sols:

There are several techniques exist to finding the or determining the particle size of sols . Here's an overview of some common method;

1- Sieving.

2- Laser diffraction.

3- Dynamic light scattering.

4- Electro Microscopy.

5- X-ray Diffraction.

1- Sieving:

The traditional method uses sieves with varying pore size to physically separate particles based on their size. Its effective for larger particles (> 45 micrometer) but less (for) precise for smaller ones.

Laser Diffraction:

This technique uses lasers to scatter light off particles and resulting diffraction pattern reveals particle size distribution. It's versatile, measuring particles across a wide range (0.1 micrometer to 2 mm) and suitable for suspension or dry powder.

Dynamic Light Scattering:

This method measures intensity fluctuation of scattered light due to Brownian motion of particles in solution.

It excels at determining of size of nanoparticles (1-100nm) and macromolecules.

Electron Microscopy:

EM Technique

like scanning electron microscopy (SEM) and transmission electron microscopy (TEM) provide high resolution image of particles

allowing direct size measurement. EM is ideal for visualizing and characterizing particles down to atomic level and but requires specialized equipment and sample preparation.

X-Ray Diffraction:

This technique analyzes the diffraction of x-rays by a sample to determine crystal structure and particle size. X-ray diffraction is particularly useful for crystalline materials and can measure particle sizes in nanometer range.

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(ii)

ADSORPTION ISOTHERMS:

"Adsorption is the process of attachment of particles of substance on the surface."

another substance".

Adsorption of a substance on the surface of another substance can be investigated under various conditions of temp., and pressure but in most studies relation between extent adsorption and equilibrium pressure can be explored.

When gas starts to adsorb on a surface, initially its rate of desorption is depend upon the number of molecules adsorbed. With increase in no. of molecules adsorb, rate of desorption increase.

Adsorption Isotherms:

"The relation between extent of adsorption and equilibrium pressure at constant temperature is called adsorption isotherm".

Dynamic Equilibrium:

When rate of adsorption become equal to

rate of desorption is called
"dynamic equilibrium"

Equilibrium Pressure:

At dynamic equilibrium pressure is called
"equilibrium pressure".

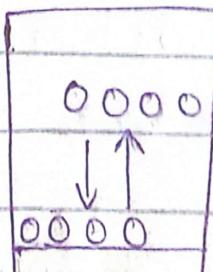
There are two types of Adsorption isotherm:

- Freundlich Adsorption Isotherm.
- Langmuir's Adsorption Isotherm

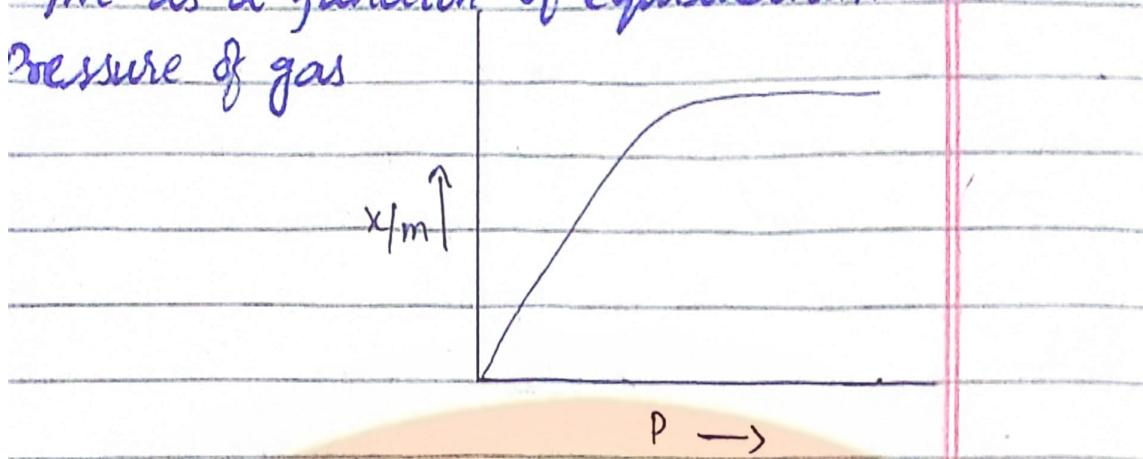
I- Freundlich Adsorption Isotherm

In Freundlich adsorption isotherm, Freundlich gave an empirical relation between extent of adsorption and pressure of gas at constant temperature in form of an empirical equation which is :

$$\frac{x}{m} = kP^{1/n} \quad \text{--- (1)}$$



η_m as a function of equilibrium pressure of gas



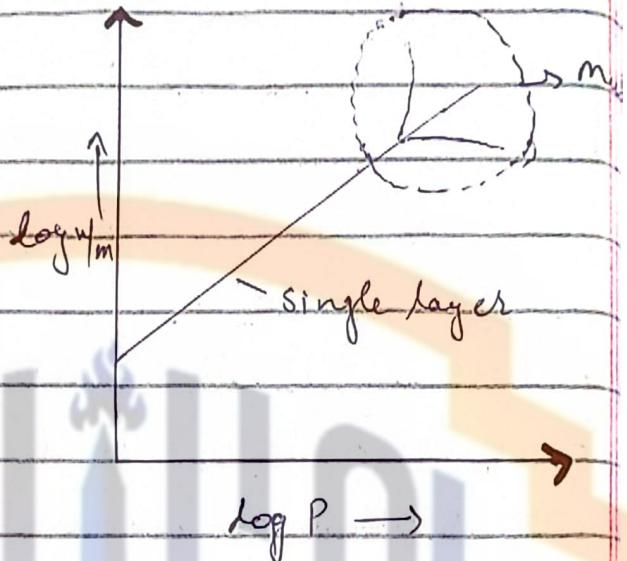
where P is the equilibrium pressure and η_m is the extent of adsorption i.e amount of adsorbate adsorbed per unit mass of adsorbent. k and n are empirical constants which depend on nature of gas, solid and temp., n is dimension less quantity where k has dimension of inverse of pressure.

Eq ① can be written in form of straight line equation;

$$\log \eta_m = \frac{1}{n} \log P + \log k - ②$$

η_m is linear function of $\log P$ whose slope and intercept are $1/n$ and $\log k$. Plot a graph to determine values of empirical

constants n and k.



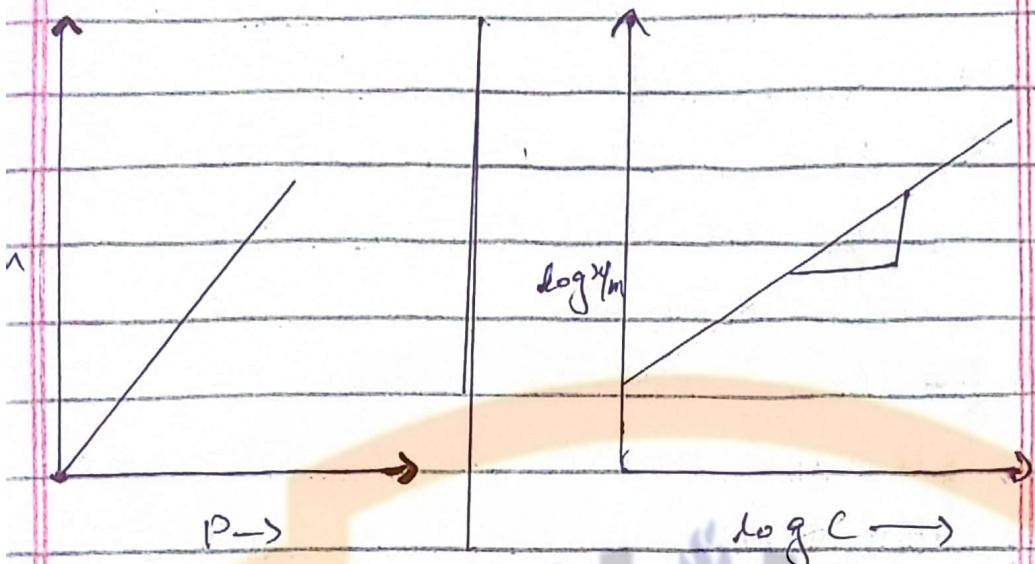
This isotherm for adsorption from solution to solid surface can be written by replacing P with C.

$$w_m = K C^n$$

By taking log:

$$\log w_m = \log K + \frac{1}{n} \log C$$

This equation is used to study adsorption of ionic material on biosorbent in aqueous medium.



lot x_m as function
of P when n = 1

Langmuir Adsorption Isotherm:

Langmuir was an American physical chemist who worked on adsorption of gas on solid.

He also derived adsorption isotherm and got noble prize in chemistry in 1932.

Postulates:

1- Each adsorbent has specific equivalent sites for adsorption.

2- Adsorbate molecule attach

to these sites.

3- One molecule of adsorbate can adsorb on one site of adsorbent.

4- There is no interaction between molecules of adsorbate adsorbed.

5- Rate of adsorption is relatively high as compared to rate of desorption.

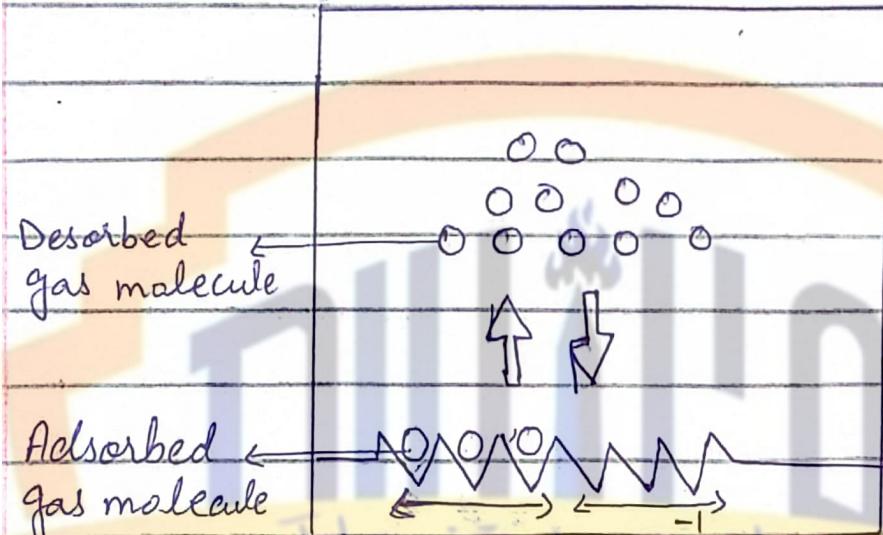
6- Rate of adsorption becomes equal to rate of desorption at equilibrium.

7- "Fractional surface coverage" (Θ), a new dimensionless quantity is equal to ratio of number of sites covered to total number of sites.

$$\Theta = \frac{\text{no. of sites occupied}}{\text{total no. of sites}}$$

8- Rate of adsorption depends upon equilibrium pressure of gas (adsorbate) and fraction of available sites and

rate of desorption depends upon
the fraction of sites covered.



Dynamic Equilibrium
exists between adsorbed &
desorbed molecules.

= PUACP