Course Title:Surface Phenomena
Course Code:CHEM-484/673

Properties of Sols

(Kinetic Properties)

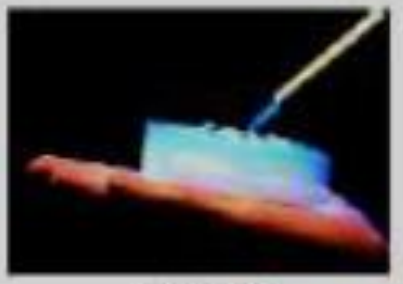
Examples of colloidal systems from daily life

Foams

Milk

Fog, smoke

Detergents



Aerogel

Blood

Paints

Cosmetics

Properties of colloids

A) Kinetic properties.

B) Optical properties.

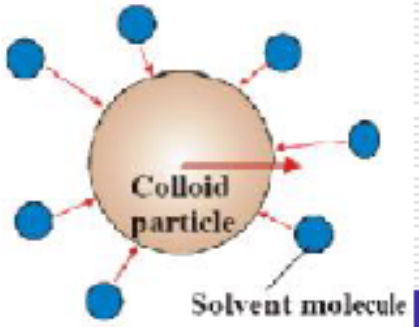
C) Electrical properties.

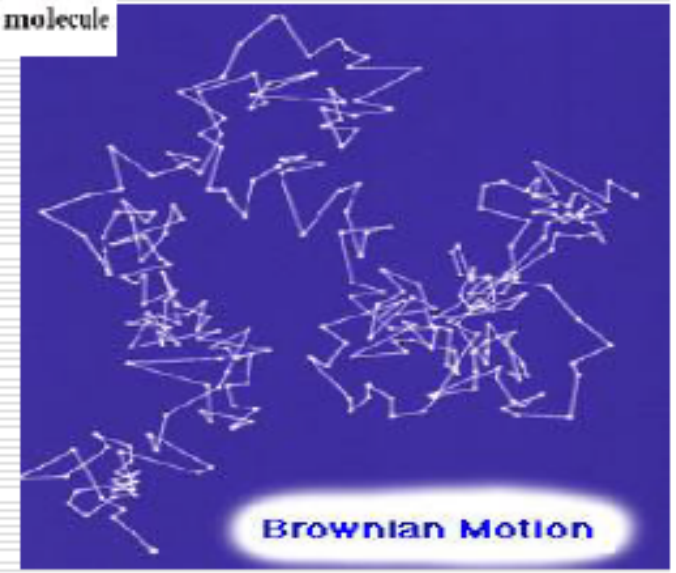
A) Kinetic properties:

Which relate to the motion of the particles within the dispersion medium as following:

- **Brownian motion.**
- **Diffusion.**
- **Sedimentation.**
- **Osmotic pressure.**
- **The Donnan membrane effect.**
- **Viscosity.**

1) Brownian motion:



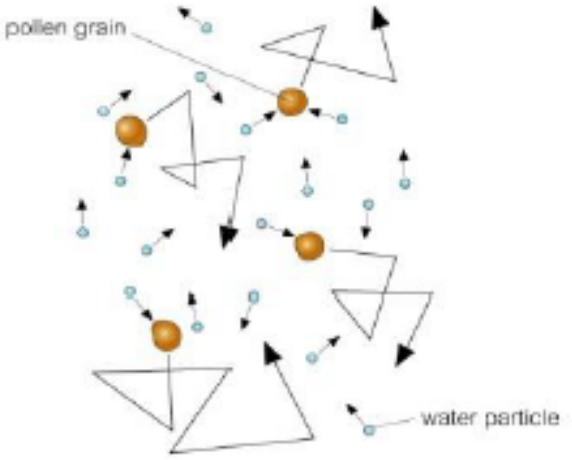


- **Definition:** colloidal particles are subjected to random collision with molecules of the dispersion medium (solvent) so each particle move in irregular and complicated zigzag pathway.

- First observed by Robert Brown (1827) with pollen grains suspended in water.

- **The velocity of particles increases with decreasing particle size and viscosity.**

- **Increasing the viscosity of dispersion medium (by glycerin) decrease then stop Brownian motion.**



2) Diffusion:

- **Definition:**
- As a result of Brownian motion particles pass (diffuse) from a region of ***higher*** concentration to one with ***lower*** conc.

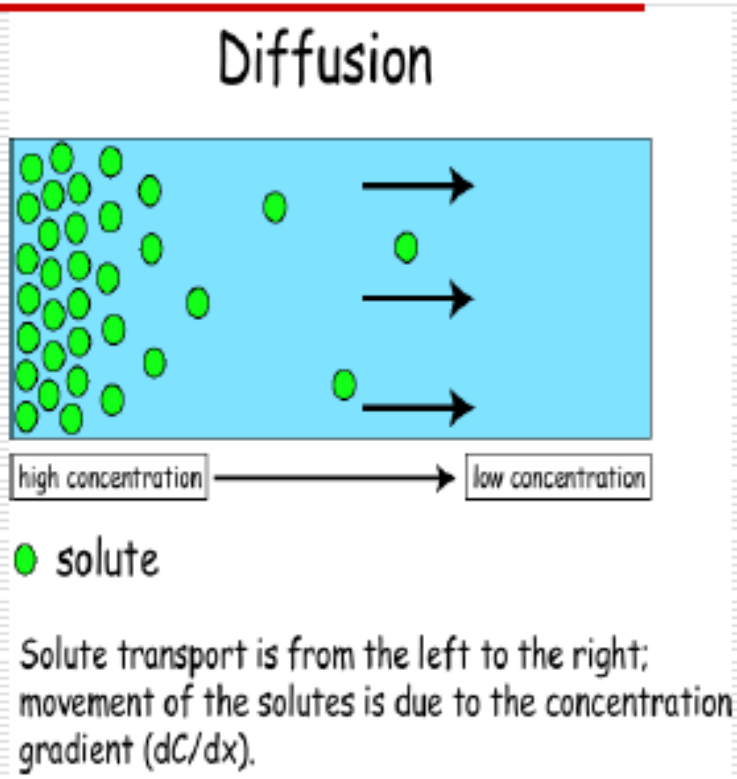
- Rate of diffusion is expressed by; ***Fick's first law:***

$$dm/dt = -DA\, dc/dx$$

Where dm is the mass of substance diffusing in time dt across an area A under the influence of a concentration gradient dC/dx.

The minus sign denotes that diffusion takes place in the direction of decreasing concentration.

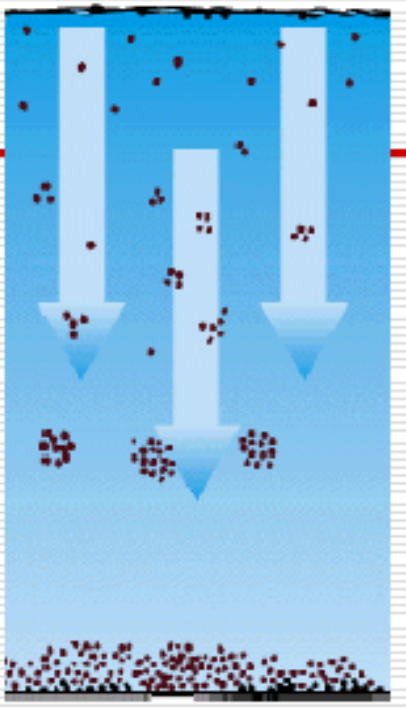
D is the diffusion coefficient.



3) Sedimentation:

☐ Stoke's law;

$$V = 2r^2(p-po)\,g / 9\eta$$



- **V:** velocity of sedimentation of spherical particles.
- **p:** density of the spherical particles.
- **po**: density of the medium.
- **η:** viscosity of the medium.
- **g**: acceleration due to gravity.

At small particle size (less than 0.5 um) Brownian motion is significant & tend to prevent sedimentation due to gravity & promote mixing in stead.

- **so, we use an ultracentrifuge which provide stronger force so promote sedimentation in a measurable manner.**

4) Osmotic pressure:

- The method is based on Van's Hoff's law;

$$P = RTC / M$$

- From the equation;

a) The osmotic pressure (P) depends on molar conc. Of the solute (C) & on absolute temp. (T).

b) The osmotic pressure is inversely proportional to molecular weight (M).

R= molar gas constant

- The equation is valid for very dilute solutions in which the molecules do not interact mutually.

5) The Donnan membrane effect.

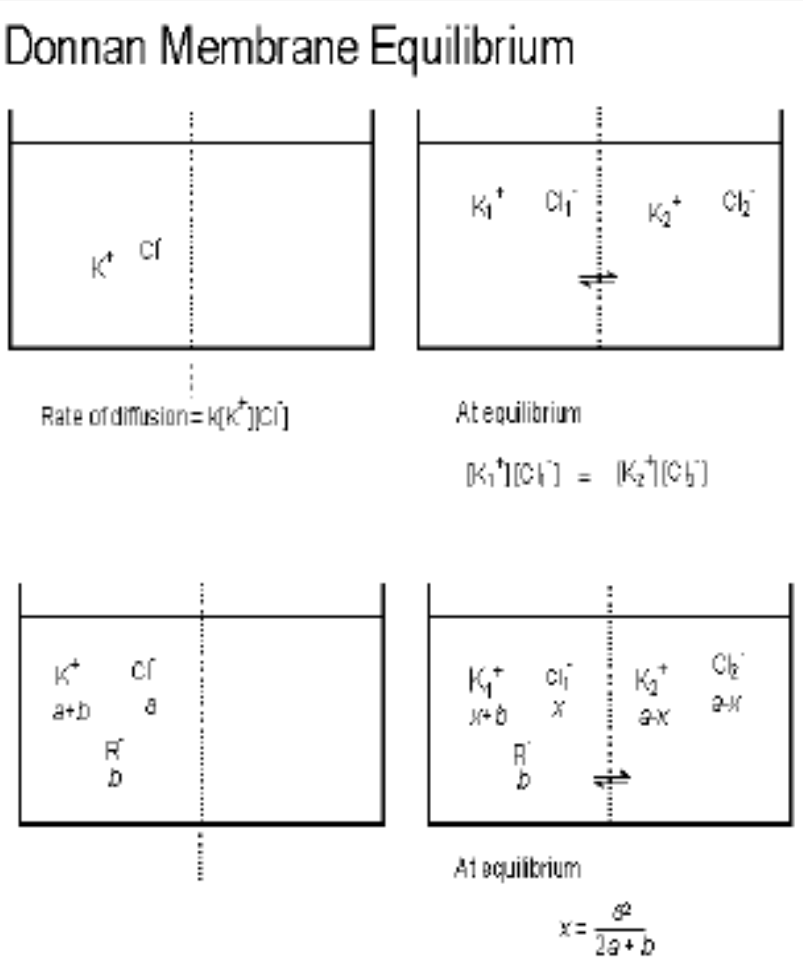
- **Definition:**

Diffusion of small ions through a membrane will be affected by the presence of a charged macromolecule that can't penetrate the membrane due to its size.

Application:

1) **Facilitating the absorption of ionizable drugs from GIT by co-administration of macromolecules of same charge so mutual ionic repulsion occurs e.g**

co-administration of anionic macromolecule e.g. sodium carboxy methyl cellulose, with a diffusible anion e.g. potassium benzyl penicillin to enhance diffusion of the later across body membranes.



6) viscosity

- **Definition:**
- The resistance to flow of a system under an applied pressure
- Viscosity of colloid allows 1- calculation of the molecular weight.

2- Provide useful information about the shape of the colloidal particles.

- ***N.B.***
- Spherocolloidal dispersions are of relatively low viscosity.
- On the other hand Linear colloidal dispersions are of high viscosity.
- If linear colloidal particles coil up into spheres

The viscosity of the system falls due to changing the shape.