# SHREE H. N. SHUKLACOLLEGE OF SCIENCE

(AFFILIATED TO SAURASHTRA UNIVERSITY)

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# F.Y.B.SC.(SEM-1)(CBCS)

## NEW PROPOSED SYLLABUS -JUNE 2019

# BIOCHEMISTRY(101)

## PHYSICAL AND CHEMICAL ASPECTS OF BIOCHEMISTRY

## UNIT -4 OSMOSIS ,VISCOSITY,DIFFUSION AND ADSORPTION


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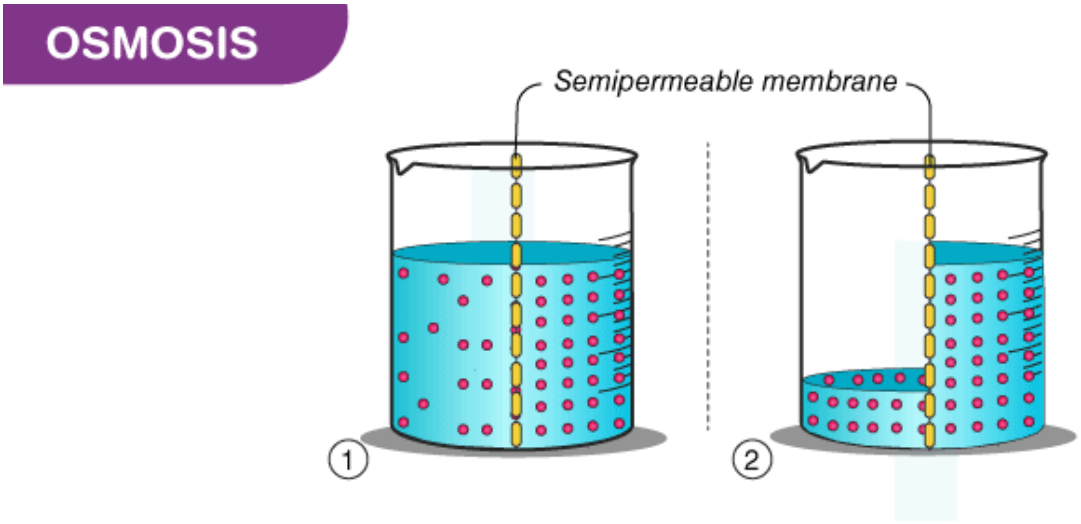
# Osmosis Definition

***" Osmosis is a process by which the molecules of a solvent pass from a solution of low concentration to a solution of high concentration through a semi-permeable membrane."***




## What is Osmosis?

- Osmosis is a passive process and happens without any expenditure of energy.
- It involves the movement of molecules from a region of higher concentration to lower concentration until the concentrations become equal on either side of the membrane.
- Any solvent can undergo the process of osmosis including gases and supercritical liquids.

# Osmotic Solutions

There are three different types of solutions

- **Isotonic Solution**
- **Hypertonic Solution**
- **Hypotonic Solution**

An **isotonic solution** is one that has the same concentration of solutes both inside and outside the cell.

A **hypertonic solution** is one that has a higher solute concentration outside the cell than inside.

A **hypotonic solution** is one that has a higher solute concentration inside the cell than outside.

# Types of Osmosis

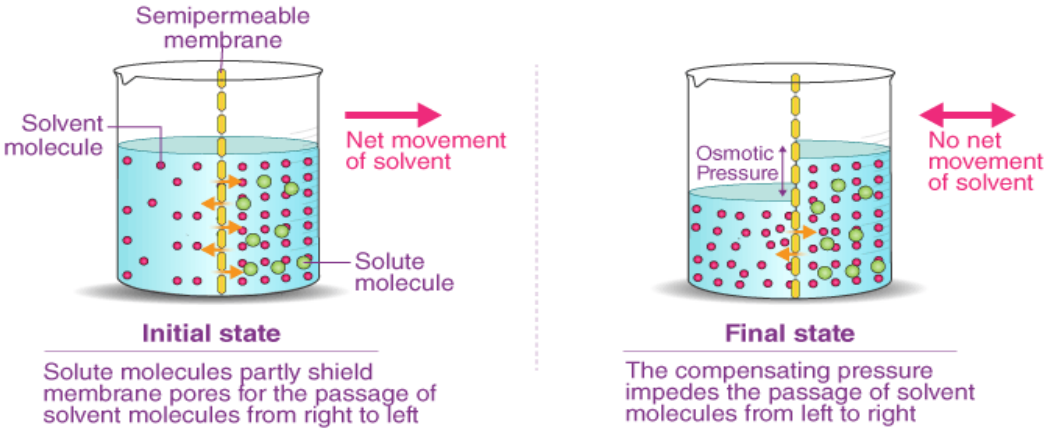
Osmosis have two types:

- **Endosmosis**– When a substance is placed in a hypotonic solution, the solvent molecules move inside the cell and the cell becomes turgid or undergoes deplasmolysis. This is known as endosmosis.
- **Exosmosis**– When a substance is placed in a hypertonic solution, the solvent molecules move outside the cell and the cell becomes flaccid or undergoes plasmolysis. This is known as exosmosis.

## Effect of Osmosis on Cells

- Osmosis affects the cells differently. An animal cell will lyse when placed in a hypotonic solution compared to a plant cell. The plant cell has thick walls and requires more water. The cells will not burst when placed in a hypotonic solution. In fact, a hypotonic solution is ideal for a plant cell.
- An animal cell survives only in an isotonic solution. In an isotonic solution, the plant cells are no longer turgid and the leaves of the plant droop.
- The osmotic flow can be stopped or reversed, also called reverse osmosis, by exerting an external pressure to the sides of the solute. The minimum pressure required to stop the solvent transfer is called the osmotic pressure.

# Osmotic pressure



Osmotic pressure is the pressure required to stop water from diffusing through a membrane by osmosis. It is determined by the concentration of the solute. Water diffuses into the area of higher concentration from the area of lower concentration. When the concentration of the substances in the two areas in contact is different, the substances will diffuse until the concentration is uniform throughout.

Osmotic pressure can be calculated using the equation:

**Π=MRT**

where Π denotes the osmotic pressure,

M is the molar concentration of the solute,

R is the gas constant,

T is the temperature

## Examples of Osmosis

Osmosis has a significant role to play in plants, animals and also in humans. In an **animal cell**, osmosis helps in absorbing water from the intestines to the blood.

Listed below are more examples of Osmosis.

- The absorption of water from the soil is due to osmosis. The plant roots have a higher concentration than the soil. Therefore, the water flows into the roots.
- The guard cells of the plants are also affected by osmosis. When the plant cells are filled with water, the guard cells swell up, and the stomata open.
- If a freshwater or saltwater fish is placed in the water with different salt concentrations, the fish dies due to the entry or exit of water in the cells of the fish.

**Significance of Osmosis**

- Osmosis influences the transport of nutrients and the release of metabolic waste products.
- It is responsible for the absorption of water from the soil and conducting it to the upper parts of the plant through the xylem.
- It stabilizes the internal environment of a living organism by maintaining the balance between water and intercellular fluid levels.
- It maintains the turgidity of cells.
- It is a process by which plants maintain their water content despite the constant water loss due to transpiration.

## Factor affecting osmosis

Osmosis rate is affected by a number of variables, including **temperature, membrane permeability, and the gradient of solute concentration.**

# DIFFUSION

## Diffusion Definition

***"Diffusion is the movement of molecules from a region of higher concentration to a region of lower concentration down the concentration gradient."***

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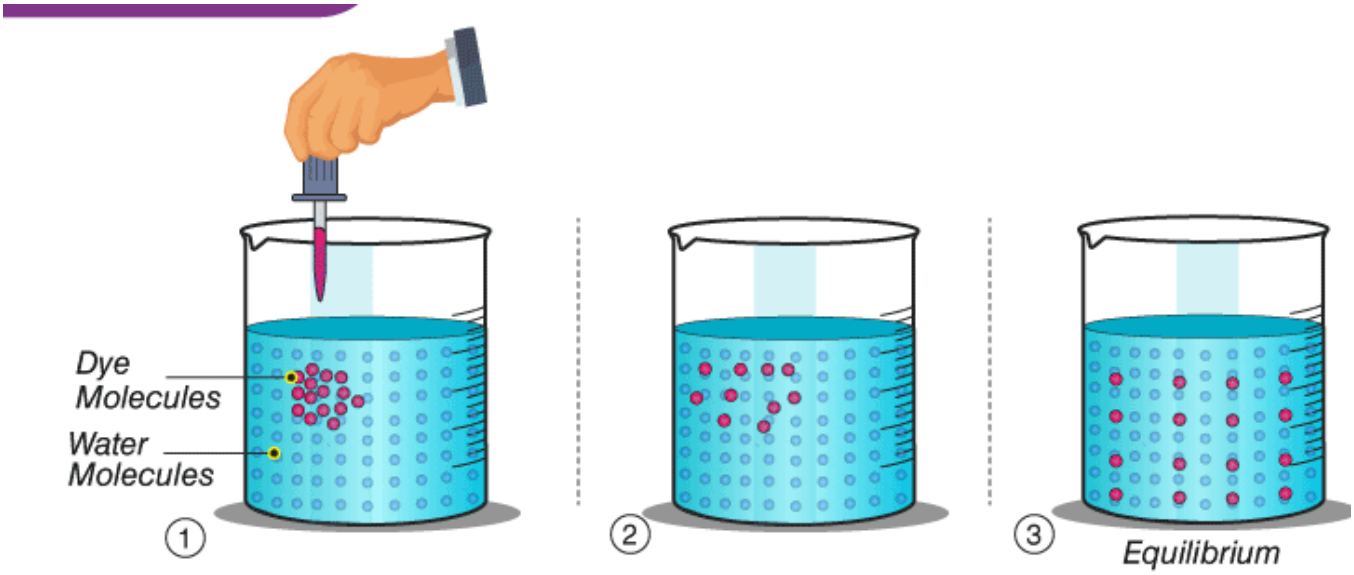
## What is Diffusion?

Diffusion is the process of movement of molecules under a concentration gradient. It is an important process occurring in all living beings. Diffusion helps in the movement of substances in and out of the cells. The molecules move from a region of higher concentration to a region of lower concentration until the concentration becomes equal throughout.




Example:

Take water in a beaker. Add a few copper sulfate crystals in one place and leave it as it is for some time without disturbing it. After some time we can see that the beaker contains a uniformly coloured solution. Here, both water and copper sulfate diffuse independently. With this experiment, we can infer that solutes move from a higher concentration to a lower concentration in a solution.

## Types of Diffusion

Diffusion is widely used in various fields such as biology, physics, chemistry, etc. Diffusion can be classified into two main types: Simple diffusion and facilitated diffusion.

## Simple diffusion

A process in which the substance moves through a semipermeable membrane or in a solution without any help from transport proteins. For example, bacteria deliver small nutrients, water and oxygen into the cytoplasm through simple diffusion.

**Facilitated diffusion**

Facilitated diffusion is a passive movement of molecules across the cell membrane from the region of higher concentration to the region of lower concentration by means of a carrier molecule.

**Dialysis: It is the diffusion of solutes across a selectively permeable membrane. A selectively permeable membrane is one that allows only specific ions and molecules to pass through, while it obstructs the movement of others**

## Factors affecting Diffusion

There are a few factors that affect the process of diffusion, which individually and collectively alters the rate and extent of diffusion. These factors include:

- Temperature.
- Area of Interaction.
- Size of the Particle.

# Significance of Diffusion

Diffusion is important for the following reasons:

- During the process of respiration, this process helps in diffusing the carbon dioxide gas out through the cell membrane into the blood.
- Diffusion also occurs in plant cells. In all green plants, water present in the soil diffuses into plants through their root hair cells.

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# VISCOSITY

## Viscosity Definition

**The definition of viscosity is as follows:**

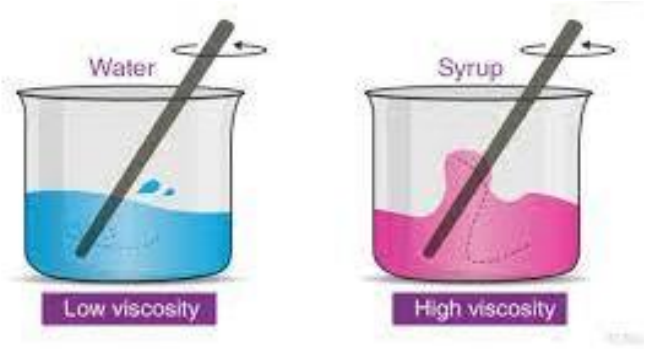
Viscosity is a measure of a fluid's resistance to flow.

***The SI unit of viscosity is poiseiulle (PI). Its other units are newton-second per square metre (N s $m^{-2}$) or pascal-second (Pa s.) The dimensional formula of viscosity is [$ML^{-1}T^{-1}$].***

## What is Viscosity?

Most fluids offer some resistance to motion, and we call this resistance "viscosity." Viscosity arises when there is relative motion between layers of the fluid. More precisely, it measures resistance to flow arising due to the internal friction between the fluid layers as they slip past one another when fluid flows. Viscosity can also be thought of as a measure of a fluid's thickness or its resistance to objects passing through it.

A fluid with large viscosity resists motion because its strong intermolecular forces give it a lot of internal friction, resisting the movement of layers past one another. On the contrary, a fluid with low viscosity flows easily because its molecular makeup results in very little friction when it is in motion. Gases also exhibit viscosity, but it is harder to notice in ordinary circumstances.



## Factor affecting viscosity

- Temperature: as a liquid heats up, it will become less viscous and as it cool it will become more viscous.
- Molecules structure the viscosity of the substance it self for example honey has a higher viscosity than water does.
- Pressure and force .

# ADSORPTION

- Adsorption is defined as the deposition of molecular species onto the surface. The molecular species that gets adsorbed on the surface is known as adsorbate and the surface on which adsorption occurs is known as adsorbent.
- Common examples of adsorbents are clay, silica gel, colloids, metals etc.
- Adsorption is a surface phenomenon. The process of removal of adsorbent from the surface of adsorbate is known as adsorption.
- There are two types of Adsorption – Physical Adsorption and Chemical Adsorption .

For the adsorption process, two components are required:

- **Adsorbate:** Substance that is deposited on the surface of another substance. For example, $H_2$, $N_2$ and $O_2$ gases.
- **Adsorbent:** Surface of a substance on which adsorbate adsorbs. For example, Charcoal, Silica gel, and Alumina.

# Types of Adsorption

On the basis of interaction forces between adsorbate and adsorbent, adsorption is of two types.

1. **Physical adsorption**

This type of adsorption is also known as physisorption. It is due to weak Van der Waals forces between adsorbate and adsorbent.

For example, $H_2$ and $N_2$ gases adsorb on coconut charcoal.

2. **Chemical adsorption**

This type of adsorption is also known as chemisorption. It is due to strong chemical forces of bonding type between adsorbate and adsorbent. We can take the example involving the formation of iron nitride on the surface when the iron is heated in $N_2$ gas at 623 K.

## Applications of Adsorption

1) **Air pollution masks**
   These consist of silica gel or activated charcoal powder; when dust or smoke are paused through them, these particles get adsorbed on the surface of these materials.
2) **Separation of noble gases by Dewar's flask process**
   A mixture of noble gases of Ne, Ar, and Kr is passed through Dewar's flask in the presence of heated coconut charcoal. Argon and Krypton gels adsorbed, leaving Neon.
3) **Purification of water**
   By the addition of alum stone to the water, impurities get adsorbed on the alum, and the water gets purified.
4) **Adsorption chromatography**
   It is used to separate pigments and hormones.

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