Zaporizhzhya State Medical University

Analytical Chemistry Department

COLLIGATIVE PROPERTIES OF SOLUTIONS

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Properties of solutions that depend on the number of molecules present and not on the kind of molecules are called **colligative properties.**

These properties include

- vapor pressure depression,
- boiling point elevation,
- freezing point depression,
- diffusion and osmotic pressure.

Raoult's Law:

Fractional lowering of the saturated vapor pressure of a solvent above a solution is equal to the mole fraction of the dissolved substance:

$$\frac{p_0 - p}{p_0} = \frac{\Delta p}{p_0} = N$$

- The freezing point of a nonvolatile substance solution is always lower than the freezing point of a solvent.

- And the boiling point of a nonvolatile substance solution is always higher than the freezing point of a solvent.

Spontaneous process of solute concentration leveling in the whole volume of the solution, due to the thermal motion of the solute and solvent is called **diffusion**.

Diffusion can also occur if a semipermeable membrane that could allow only molecules of the solvent is a boundary between solution and pure solvent (or two solutions of different concentrations).

Many natural films (the intestinal wall, protoplasm, etc.) have properties of semipermeable membranes.

One-side diffusion of solvent molecules through a semipermeable membrane to a more concentrated solution is called osmosis.

Osmotic pressure is the external pressure on a solution, at which osmotic equilibrium (through a semipermeable membrane) between the solution and a pure solvent is established.

Van't Hoff ‘s Law (1887):

Osmotic pressure of a diluted solution is equal to the pressure that a solute would have if it were in a gaseous state at a given temperature and occupied the same volume that the solution occupies

$$\pi = \frac{m \cdot R \cdot T}{M \cdot V}$$

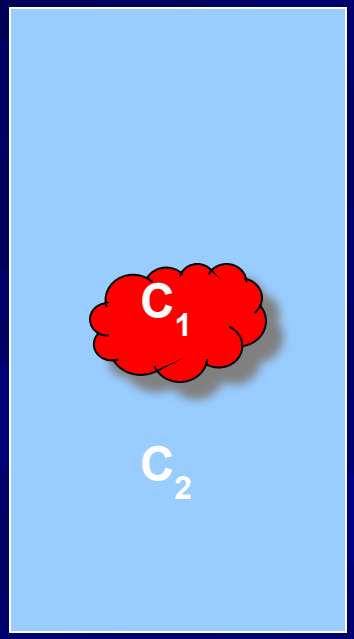
Turgor is a state of tension of the cellular cover caused by osmotic pressure of the cell contents.

Turgor supports tissue elasticity and resiliency, promotes certain form of organs.

Solutions with an identical osmotic pressure are called isotonic.

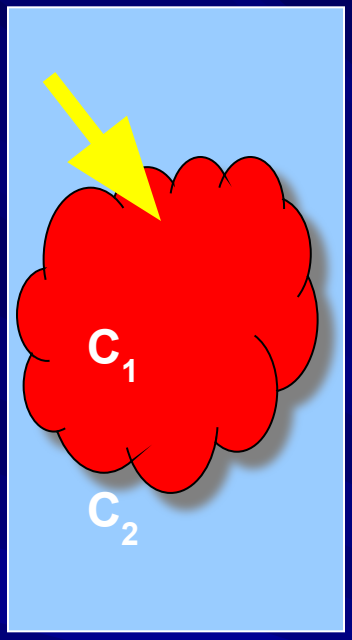
Solutions with a higher osmotic pressure than that of a solution of comparison are called hypertonic.

Solutions with a lower osmotic pressure are hypotonic.



$C_1 = C_2$

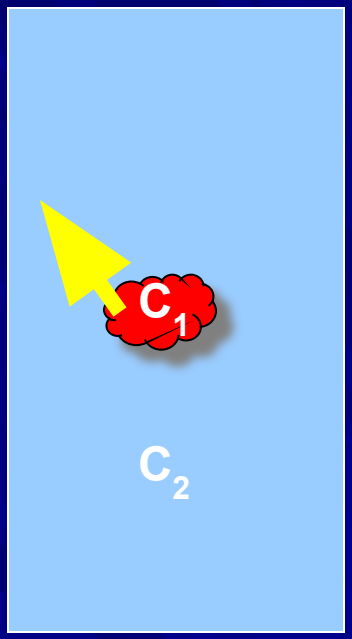
izotonic



$C_1 > C_2$

hypotonic

hemolysis



$C_1 < C_2$

hyper

plasmolysis