Colligative properties of solutions

1. Colligative properties of solutions.

2. Osmosis. P_{OSM}. Law Van't - Hoff.

3. Hypo - hyper - isotonic solutions. Plasmolysis and hemolysis. $P_{oncotic}$. Haller equation.

4. The relative decrease in pressure saturated steam over solution. I Raoult's Law.

5. Reducing the freezing point and temperature boiling solutions. II Raoult's Law Values.

Colligative - that relate to each other, as they are due common causes. Colligative known properties of solutions that depend on the number of solute particles in solution. By Colligative properties include diffusion, osmosis, lowering saturated vapor pressure above the solution, raising the boiling point, lower freezing point solutions. The higher the concentration, the greater these values accordingly. At however, for electrolyte solution at the same molar concentration as for non-electrolytes, these values will be more, as a result of dissociation the number of particles in the electrolyte solutions than in non-electrolytes.

If between the solution and the solvent or two different solutions concentration put a semipermeable membrane - then there is the phenomenon of osmosis.

In terms of thermodynamics is the driving force behind efforts osmosis system to equalize the concentration, as this system entropy increases insofar as the system goes into a less ordered state, Gibbs energy of the system under reduced chemical potentials aligned. So osmosis process is arbitrary.

Semipermeable membrane - a wall that freely passes in both sides of the solvent molecules and does not pass molecules, ions dissolved substances. Membranes: nature - shells of plant and animal cells selectively pass certain molecules and ions. Colloid - silk, cellophane, clay vessel wall, the value of which far settled educed sediment in them. Sedimentary - $2\ CuSO_4 + K_4[Fe(CN)_6 \rightarrow Cu_2[Fe(CN_{)6}] + 2K_2SO_4$

Osmosis is called one-way diffusion of solvent through semipermeable membrane towards greater concentration. The reason - the difference concentration.

Increased fluid column will put pressure on a semipermeable membrane, which penetration rate of molecules in both directions through osmosis membrane and paused. The pressure should be applied to $1cm^2$ area of the membrane to balance the penetration rate of solvent through the membrane - osmotic pressure or R.

2. P_{OSM} - called value measured minimum hydraulic pressure that must be applied to the solution to stop osmosis. Measure osmometer, cryometry method and plasmolysis.

P_{OSM} depends on:

1. Concentration

$$\frac{P_1}{P_2} = \frac{C_1}{C_2}$$

2. Temperature

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

Van't - Hoff used a combined gas equation of state Mendeleev - Clapeyron and derived a formula P_{OSM}

$P_{OSM} = CRT \cdot PV = nRT;$

$$\frac{n}{V} = C$$

P_{OSM} solution equivalent to pressure to commit solute being in a gaseous state at a solution and taking volume equal volume solution. P_{OSM} depends on the number of particles and independent of their nature. Solutions glucose and urea concentrations are equal to equal P_{OSM} will be isotonic. The cells in isotonic retain their size and function normally.

This is true for non-electrolytes. For electrolytes

P = iCRT,

Where: C - molar concentration;

R- Gas constant;

T - absolute temperature.

"i" - isotonic coefficient or coefficient of Van't - Hoff

i = 1 + (n - 1)

Where: a - the degree of dissociation;

n - The number of particles formed as a result of dissociation.

The phenomenon of osmosis is widespread in living organisms. Raising water on stem, flooding cells and tissues - a phenomenon of osmosis, power cells, ensures tissue elasticity and save forms.

All cells of the body there is a P_{OSM}, Which is supported on constant - isomer. 7.7 am - $7 \cdot 10^{-8}$ Pa · 780kPa - a P_{OSM} blood. Osmotic pressure biological liquids in different organisms vary. So, marine animals have a greater osmotic than in person. This is due to salts that are in the water. P_{OSM} smaller frogs.

Biological liquids - blood, lymph, tissue fluid are aqueous solutions low molecular compounds NaCl, KCl, $CaCl_2$, HMC - proteins, polysaccharides, nucleic acids and formal elements - red blood cells, white blood cells. Their total effect is determined by osmotic pressure biological liquids.

In medical applications, it is more correct to use solution that have the same components and in the same amount, which is part of the blood. Such solutions used as substitutes in surgery.

3. Isotonic: 0,85% NaCl, 5% glucose.

When two solutions with different osmotic pressure, the solution with more osmotic pressure is hypertonic in relation to the second, and the second hypotonic in relation to the first. Hypertensive 10% NaCl. Bandages, hypertonic edemas. Action laxatives $Na_2SO_4 \cdot 10\ H_2O$ in bulk osmosis. When glaucoma to reduce the amount of water. Plasmolysis - cell in hypertonic solution. Above plasmolysis (lysis) depends on the permeability cell membranes. So, if concentrated solutions of salts, glucose causes resistant plasmolysis, the solutions of alcohol, it does not cause chloroform. This is due to the fact that last like water easily penetrates cell membranes.

Hemolysis - if you put a cell in hypotonic solution with less water concentrated solution of the external switch inside the cell, and lead to swelling and to rupture the membrane. This phenomenon is called lysis, in the case of red blood cells a process called hemolysis. Blood from cell contents, which goes outside with hemolysis, by color called "varnish blood."

P_{OSM} solutions of biological polymers (proteins) is proportional to their concentration. In the living cell proteins are dissolved. They even some small amount, causes a P_{OSM}

Part P_{OSM} cells or biological liquids (blood) due to some the concentration of dissolved protein - oncotic pressure. In normal blood 0.04 atm or 0.5% of P_{OSM}.

In the middle of the cell adds a P_{OSM} which makes state turgor.

Donan derived an equation that proves that the concentration of electrolytes in the middle cells is always higher than outside, which causes cell turgor.

$$K = \frac{C^2 зовн}{Свсеред + 2Сзовн}$$

Thus, the collision cell with electrolyte solution a number enters the cell, which causes cell turgor. When lowering the protein content in the blood as a result of starvation, the kidney disease, there is a difference in oncotic pressure in tissues, fluids and blood.

Oncotic pressure fulfills physiological function that affects redistribution in tissues of water, salts. For P_{OSM} pressure Haller determined by the equation.

5. It claimed II Raoult's Law: Reducing or increasing temperature freezing, temperature boils solutions directly proportional to the concentration of solute.
Mathematically, this can be expressed as follows:
Δ temperature freezing = $C_DF \cdot C$
Where: Δ temperature freezing - reducing temperature freezing
C_DF - cryoscopic constant value, which shows the decrease temperature freezing caused by dissolving 1 mole of substance in 1000 g of solvent. Thus, for H_2O = 1,860, 5,120 of benzene for electrolyte solutions introduced factor "and" that shows how much times the number of particles in the dissociation. Temperature freezing = C and C_DF

Similarly, increasing the boiling point described by the equation
Temperature boil Δt_b = Ccab
Where: K_{eb} - constant improvement is caused by the dissolution temperature boil one mole of substance in 1000 g solvent.
K_{eb} H_2O = 0,520
Ebuliometric chiometric constant and depend only on nature solvent and does not depend on the nature of the solute.

Terms freezing:
Temperature freezing - temperature, at which the vapor pressure of the liquid solvent equal atmospheric pressure.
The difference between the solution and the boiling point of the solvent.
Freezing conditions:
Temperature freezing - is the temperature at which the vapor pressure of the liquid is the vapor pressure of the solid phase.

The method is called chiometry and similar ebullioscopy. The methods used for determining molecular weight solutes the decline temperature freezing = K · C;
c = K
In biological studies Δtemperature freezing called depression. Measuring depression blood, lymph, urine allows them to calculate the osmotic concentration that cannot be identify methods of quantitative analysis.
Solutions that submitting Raoult's Law, as increasing concentrations occurs deviation from the ideal state.
The ideal solution is called, the formation of which is not accompanied by chemical interaction, change volume and thermal effect.