

Myself, Ms Aparna Juwarkar working as assistant professor in chemistry from PES College of Arts and Science. The paper title is physical chemistry and organic chemistry and the paper code is CHC 103. The unit we are beginning today is solutions and the module which we are going to study under this is thermodynamics of ideal solution. This module includes the various thermodynamic properties of ideal solution. At the end of the module you will be able to explain the various thermodynamic properties or it is also known as thermodynamic of mixing of ideal solution. So let us begin with the module. First of all, what are ideal solutions? Ideal solutions are the ones which obeys the Raoult's law at all temperatures and concentration and how do we obtain an ideal solution? As you all know, a solution is formed when we mix solute and solvent. Similarly ideal solution can be obtained by mixing pure solute and solvent having almost equal or similar molecular structure. I've included 2 examples as you can see that is benzene and toluene. And second example is chlorobenzene and Bromobenzene. Now, with respect to the solutions we study, certain thermodynamic parameters of this ideal solution. These include Gibbs free energy change, volume change, enthalpy change and entropy change. What do we mean by this? There are certain thermodynamic parameters and we're going to study each one in detail. OK, so let us begin with the first one that is Gibbs free energy change on mixing. So when you mix 2 components component one and component two what will be the change in the free energy we are going to study about that which is denoted as ΔG_{mix} , where Δ is a change. G is a symbol for free energy or Gibbs free energy. Gibbs Free Energy is nothing but it is the energy associated with the chemical reaction. So, we are considering a binary solution which is made up of two components. Though free energy change of this mixture can be given as total free energy change of the solution minus total free energy change of the components, it can be written in an equation. ΔG_{mix} is equal to G of solutions minus G of pure components. What is G of solution? G of Solution is G_1 plus and two G_2 . We have two components, that's why we've taken anyone G_1 .

G_1 stands for free energy change per mole of component one in solution and G_2 stands for free energy change per mole of component 2 in solution and we have taken 1 moles of component one and two moles of component two. Where G_1 is free energy change of pure component one and G_2 is a free energy change of pure component two, now what we have to do is in equation. Once we substitute the values we get equation 2 as shown on the screen.

Now we have another equation of free energy per mole of any component in a solution which is given as shown on the screen.

Now, with respect to this equation, we are writing the equation for component one and for component 2. Substituting in equation 2 we get the value of ΔG_{mix} . For an ideal solution a is equal to x which is mole fraction, thus we have a_1 is equal to x_1 and a_2 is equal to x_2 .

Thus we get the value of ΔG_{mix} as $n_1RT \ln x_1$ plus $n_2RT \ln x_2$. we can also write it as summation.

Since value of x is smaller than 1 ΔG is negative. So when we mix 2 components, what we get the value of change in Gibbs free energy is always negative. OK, we're going to go forward with the next property, that is volume change on mixing meaning when you mix 2 component that is component one and component 2 what will be the volume change we are going to study about that and it is denoted as ΔV_{mix} . Δ is a symbol for change, so that means what is the change in volume when we mix 2 solution. We have already discussed earlier that ΔG_{mix} is equal to $n_1RT \ln X_1$ plus $n_2RT \ln X_2$.

Now what we're doing is we're differentiating this equation with respect to pressure at constant temperature. ΔG_{mix} will be 0. Now why this is coming? because as you can see, there is no pressure term involved. So since there is no pressure, the differentiation comes to be 0 now. We also know that ΔG upon pressure is ΔV_{mix} . Therefore it is zero.

The references I've used for this particular module is: Chemistry for degree students by RL Madan, physical chemistry by Peter Atkins and Principles of physical Chemistry by Puri, Sharma at Pathania. thank you.