

STATISTICAL MOLECULAR THERMODYNAMICS

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Video 11.9

Review of Module 11

CRITICAL CONCEPTS FROM MODULE 1 1

- Solids dissolved in solution can be non-electrolytes or electrolytes.
- For non-electrolytes, the same thermochemical equations apply as for liquid-liquid mixtures, but other concentration scales (molal and molar) can be more convenient than mole fraction.
- 1 molal is one mole solute per 1 kg solvent; 1 molar is one mole solute per 1 L final solution.
- Solvent activity can be determined from vapor pressure measurements, and, variations in solvent activity permit determination of solute activity through use of the Gibbs-Duhem equation.

CRITICAL CONCEPTS FROM MODULE 11

- Colligative properties like freezing-point depression, boiling-point elevation, and osmotic pressure, are *independent* of solute identity, depending instead only on the number of dissolved particles.
- The dissociation of electrolytes affects their activity and solution non-ideality. “Strong” electrolytes dissociate completely into their constituent ions.
- Because of their dissociation, electrolyte activities are expressed as mean ionic quantities, depending upon mean ionic molality and mean ionic activity coefficients.
- Colligative properties of electrolytes are “enhanced” by their dissociation into multiple ions in solution.

CRITICAL CONCEPTS FROM MODULE 11

- Debye-Hückel theory is a model to predict mean ionic activity coefficients for electrolytes at high dilution, in particular

$$\ln \gamma_{\pm} = -|q_+ q_-| \frac{\kappa}{8\pi\epsilon_0\epsilon k_B T}$$

- The inverse Debye length, κ , is the distance at which there is the maximum probability of finding a counterion compared to a like ion in an electrolyte solution. It depends on the ionic strength, and can be defined as

$$\kappa^2 = \frac{2N_A e_-^2}{\epsilon_0\epsilon k_B T} \left(\frac{1}{2} \sum_{j=1}^k c_j z_j^2 \right)$$

$$dU = \delta q + \delta w$$



Next: Module 12