For most dilute aqueous salt solutions (at ambient temperature and pressure), mean ionic activity coefficients $\gamma_\pm$ are less than unity. Ion-ion interactions within a real solution lower chemical potentials below those of salts in the corresponding ideal solutions. A quantitative treatment of this stabilisation is enormously important. In fact for almost the whole of the 20th Century, scientists have offered theoretical bases for expressing $\ln(\gamma_\pm)$ as a function of the composition of a salt solution, temperature, pressure and electrical permittivity of the solvent.

In effect we offer as much information as demanded by the theory (e.g. molality of salt, nature of salt, permittivity of solvent, ion sizes, temperature, pressure, ....). We set the apparently simple task - please calculate the mean activity coefficient of the salt in this solution.

Many models and treatments have been proposed [1]. Most models start by considering a reference j-ion in an aqueous salt solution. In order to calculate the electric potential at the j-ion arising from all other ions in solution, we need to know the distribution of these ions about the j-ion. Unfortunately this distribution is unknown and so we need a model for this distribution. Further activity coefficients also reflect the impact of ions on water-water interactions in aqueous salt solutions. [2]

Footnotes

[1]  
(b) H. S. Harned and B. B. Owen, The Physical Chemistry of Electrolytic Solutions ,Reinhold, New York,1950, 2nd. edn.,1950, chapter 2. The analysis presented by Harned and Owen anticipates application to irreversible processes; e.g. electrolytic conductance of salt solutions. We confine attention to equilibrium properties.