Solutions Revisited

There are many different types of mixtures and there are many ways to describe the composition of mixtures. The primary ways that we describe mixtures are mass percent, mole fraction, molarity and molality. Each of these is useful for different types of situations.

$$\text{mass \%} = \frac{\text{mass part}}{\text{mass total}} \qquad \text{M} = \frac{\text{moles solute}}{\text{liters of solution}}$$

$$\chi_a = \frac{\text{moles a}}{\text{moles total}} \qquad \text{m} = \frac{\text{moles solute}}{\text{mass of solvent}}$$

One of the important things that we need to discuss is what factors control how much of one substance will dissolve in another. To do this we need to think about the forces that drive solution formation.

There are two forces that drive chemical reactions, enthalpy and entropy. The energy change of the reaction and the change in randomness, respectively.

Factors Affecting Solubility

There are three main factors that determine how much solute can be dissolved in to a given solvent:

Structure Effects- substances with similar polarity will generally dissolve well.

Pressure Effects- for gasses the partial pressure of the gas above the solvent has a large impact on the solubility of the gas in the solvent. The higher pressure the higher the solubility, mathematically this is expressed as Henry's Law: $P = kC$

Ex:

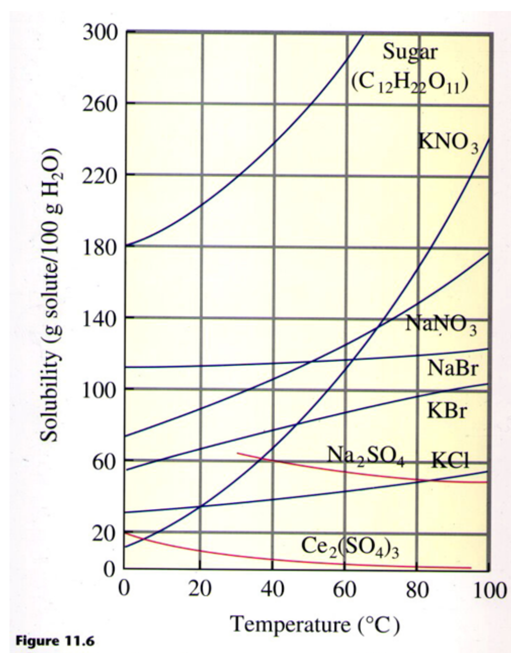

Figure 11.6
The temperature dependence of solubility for various solids
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Vapor Pressure and Solutions

Solutions often have different properties than pure liquids. These changes in properties are often very useful for determining the molar mass of the substance. One property that changes with the addition of a solute to a solvent is the vapor pressure.

When a nonvolatile solute is added to a solvent the vapor pressure is lowered according to Raoult's law.

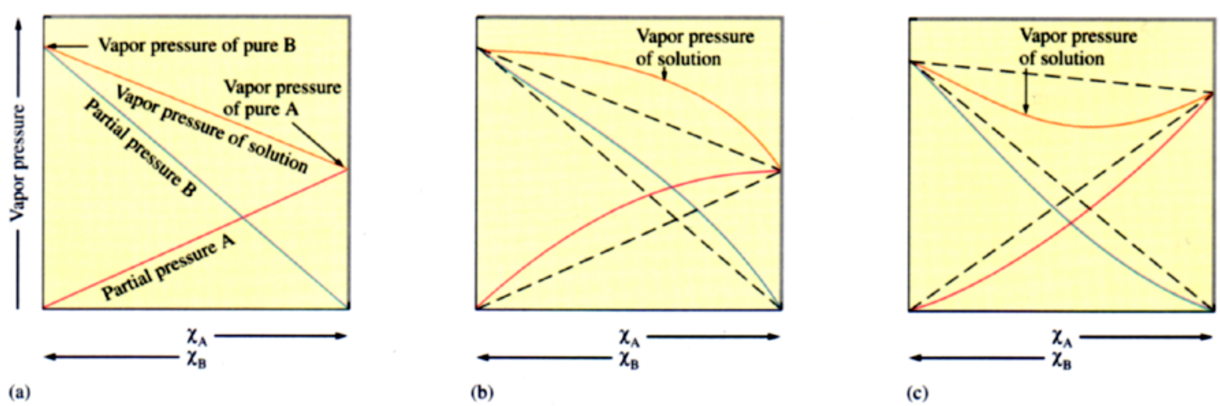
$$P_{soln} = \chi_{solvent} P^{o}_{solvent}$$

If the solute added to the solvent is a volatile compound then it's vapor must be taken in to account and we use a modified form of Raoult's law:

$$P_{Total} = P_A + P_B = \chi_A P^{o}_A + \chi_B P^{o}_B$$

Solutions that obey Raoult's law are called ideal solutions, and occur when the solute-solute interactions and the solvent-solvent interactions are similar.

If the the solute and solvent are not similar then the solution will not obey Raoult's law and we say it has either a positive or negative deviation.



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