prediction of the solubility of sulfamethoxypyridazine (Bustamante et al., 1989) and temazepam (Richardson et al., 1992) in a wide variety of solvents, including water.

If the interactions between solute and solute molecules are comparable in type and magnitude to those between solute and solvent molecules and between solvent and solvent molecules, the enthalpy of mixing is negligible. If the enthalpy of mixing a liquid solute in a solvent is negligible, and can be assumed to be zero, the solution is considered ideal, and the equation:

$$\Delta \bar{H}_{\text{mix},2} = 0 \tag{2.5}$$

holds. If we are concerned with the partial molal changes on mixing with respect to the solute, the familiar Gibbs–Helmholtz relation:

$$\Delta G = \Delta H - T \Delta S \tag{2.6}$$

becomes:

$$\Delta \bar{G}_{\text{mix},2} = \bar{H}_{\text{mix},2} - T \bar{S}_{\text{mix},2} \tag{2.7}$$

Substituting for the partial molal change in molar enthalpy of mixing with respect to the solute (Equation 2.5) gives:

$$\Delta \bar{G}_{\text{mix},2} = - T \bar{S}_{\text{mix},2} \tag{2.8}$$

and then substituting for the partial molal entropy of mixing with respect to the solute (Equation 2.2) gives:

$$\Delta \bar{G}_{\text{mix},2} = R \ln X_2^i \tag{2.9}$$

By thermodynamic definition:

$$\Delta \bar{G}_{\text{mix},2} = RT \ln a_2 \tag{2.10}$$

where a_2 is the activity of the solute in solution. It therefore follows from Equations 2.9 and 2.10 that the mole fraction equals the activity of the solute in solution when the solution is ideal.

Consider the case of an ideal solution involving a solute, a crystalline material at the solution temperature, that is now dissolved in a liquid solvent. Even though the partial molal enthalpy of mixing is still zero because it is an ideal solution, there is an enthalpy requirement to overcome the intermolecular forces of attraction in the crystal structure. The van't Hoff equation (Adamson, 1979) is:

$$\frac{\partial \left(\dfrac{\Delta G}{T} \right)}{\partial T} = - \frac{\Delta H}{T^2} \tag{2.11}$$

Using the superscript sc to refer to the transition from crystalline solid to supercooled liquid at a constant temperature, substituting:

$$\Delta \bar{G}_2^{sc} = - RT \ln a_2 \tag{2.12}$$

for ΔG, and acknowledging that the molar enthalpy of fusion is the change in enthalpy for this transition (Hildebrand and Scott, 1962) gives: