**Topic570**  
**Chemical Potentials: Solutions: Henry’s Law**

A given aqueous solution at temperature $T$ contains a simple solute $j$, molality $m_j$. Experiment shows that at equilibrium the partial pressure $p_j$ is close to a linear function of molality $m_j$, the constant of proportionality being the Henry’s Law constant for this particular solute in a defined solvent; equation (a).

$$p_j \equiv H_j \cdot \left( \frac{m_j}{m^0} \right) \quad (a)$$

By definition $m^0 = 1.0 \text{ mol kg}^{-1}$. Experiment shows that as a given real solution becomes more dilute so the relationship given in (a) can be written as an equation. The relationship in (a) is rewritten as an equation to describe the properties of a solution having thermodynamic properties which are ideal.

$$p_j(\text{id}) = H_j \cdot \left( \frac{m_j}{m^0} \right) \quad (b)$$

In other words $H_j$ is the partial pressure of volatile solute in a solution having thermodynamic properties which are ideal and where the molality of the solute equals $1.0 \text{ mol kg}^{-1}$.

For a real solution at equilibrium and at temperature $T$, the partial pressure $p_j(\text{real})$ is related to molality $m_j$ using equation (c) where $\gamma_j$ is the activity coefficient describing the properties of solute $j$ in solution

$$p_j(\text{real}) = H_j \cdot \left( \frac{m_j}{m^0} \right) \cdot \gamma_j \quad (c)$$

By definition, at all $T$ and $p$ limit $(m_j \to 0)\gamma_j = 1 \quad (d)$

As $m_j$ decreases so $p_j(\text{real})$ approaches $p_j(\text{id})$.

Henry’s Law forms the basis of equations which are used to relate the chemical potential of solute $j$, $\mu_j$ to the composition of a solution.