



Figure 13-10: Fugacity of solute in the limit of infinite dilution.

approaches zero. Henry's law constant is the slope of the fugacity at $x_i = 0$. Henry's law in eq. (13.10) represents a linear extrapolation of fugacity from point $x_i = 0$ into the region $x_i > 0$. Within a small range of compositions, the linear extrapolation is essentially indistinguishable from the actual fugacity. In this region, Henry's law provides an accurate estimate of the fugacity of solute. At higher concentrations the linear extrapolation and the actual fugacity diverge and Henry's law breaks down. For gases with very low solubility (for example, most gases in water at near room temperature), eq. (13.10) provides an acceptable approximation.

VLE Using Henry's Law

Calculations of vapor-liquid equilibrium involving a gas dissolved in a liquid are performed using the Lewis-Randall rule for the fugacity of the liquid phase and Henry's law for the vapor phase. Using the subscript s for the solvent, and i for the gas, the equilibrium criterion for the two components is,

$$y_s P = \gamma_s x_s P_s^{\text{sat}}, \quad (13.11)$$

y_i (change subscript to i)

$$y_i P = x_i k_i^H, \quad (13.12)$$

where P is the total pressure, and $y_{s,i}$, $x_{s,i}$ are the mole fractions in each phase ($y_s + y_g = x_s + x_i = 1$). The first equation expresses the equality of fugacities of the solvent in the gas and in the liquid, and the second equation expresses the equality of