Equation Summary, Chapters 7-8 Atkins, Revised Dec. 12, 2006

Partial Molar Volume

$$V_J = \left(\frac{\partial V}{\partial n_J}\right)_{p,T,n'}$$

Gibbs Free Energy

$$G = n_A\mu_A + n_B\mu_B + \ldots$$

$$dG = \mu_A dn_A + \mu_B dn_B + \ldots$$

Gibbs Free Energy (General)

$$dG = Vdp - SdT + \mu_A dn_A + \mu_B dn_B + \ldots$$

Mixing of Ideal Gases

$$\Delta_{mix}G = n_A RT \ln\left(\frac{p_A}{p}\right) + n_B RT \ln\left(\frac{p_B}{p}\right)$$

$$\Delta_{mix}G = nRT\,(x_A \ln x_A + x_B \ln x_B)$$

$$\Delta_{mix}S = -nR\,(x_A \ln x_A + x_B \ln x_B)$$

$$\Delta_{mix}G = -T\Delta S_{mix}$$

$$\Delta_{mix}H = 0$$

Ideal Solutions

$$p_A = x_A p_A^* \qquad \text{Raoult's Law}$$

$$\mu_A = \mu_A^* + RT \ln\left(\frac{p_A}{p_A^*}\right)$$

$$\Delta_{mix}G = nRT\,(x_A \ln x_A + x_B \ln x_B)$$

$$\Delta_{mix}S = -nR\,(x_A \ln x_A + x_B \ln x_B)$$

Ideal Dilute Solutions

$$p_B = x_B K_B \qquad \text{Henry's Law}$$

$$\mu_B = \mu_B^*(l) + RT \ln x_B$$

$$\mu_B^*(s) = \mu_B^*(l) + RT \ln x_B$$

$$\mu_B(l) = \mu_B^*(l) + RT \ln\left(\frac{x_B K_B}{p_B^*}\right)$$

Excess Molar Entropy

$$S^E = \Delta_{mix}S - \Delta_{mix}S^{ideal}$$

Colligative Properties

$$\Delta T = Kx_B = \frac{RT^{*2}}{\Delta_{vap}H}x_B = K_b b$$

$$\Delta T = K'x_B = \frac{RT^{*2}}{\Delta_{fus}H}x_B = K_f b$$

b/(molality, mol kg^{-1}) $= n_A/(n_B M_B)$

$$\ln x_B = -\frac{\Delta_{fus}H}{R}\left(\frac{1}{T} - \frac{1}{T^*}\right) \qquad T^* = T_{fus}$$

$$\Pi = [B]RT \qquad [B] = n_B/V$$

Gibbs Phase Rule

$$F = C - P + 2$$

Lever Rule

$$n_\alpha l_\alpha = n_\beta l_\beta$$

Composition of the Vapour

$$y_A = \frac{p_A}{p} \qquad y_B = \frac{p_B}{p}$$

$$y_A = \frac{x_A p_A^*}{p_B^* + (p_A^* - p_B^*)x_A}$$

$$p = \frac{p_A^* p_B^*}{p_A^* + (p_B^* - p_A^*)y_A}$$