Activity: species in a mixture

$a_i(T, P, \{x\})$ = chemical potential

$$\mu_i(T, P, \{x\}) = \mu^{ref}(T, P, \{x\}) + RT \ln a_i$$

$$a_i = \frac{\hat{f}_i(T, P, \{x\})}{f_i^{ref}(T, P^{ref}, \{x\})}$$ = fugacity of "i" in mixture

↑ reference state is important in defining a_i

$$a_i = \frac{p_i}{p^{ref}}$$ ideal mixture of ideal gases

↑ ideal gas reference state

$$\mu_i(T, p, \{x\}) = \mu_i(T, p^{ref}, \{x_i = 1\}) + RT \ln\left(\frac{p_i}{p^{ref}}\right)$$

$$p^{ref} = p^{\circ}$$

$$= \mu_i(T, p^{\circ}_{pure}) + RT \ln\left(\frac{p_i}{p^{\circ}}\right)$$

$$d\mu = \bar{v}\, dp - \bar{S}\, dT$$

$$\nu_A A + \nu_B B \rightleftharpoons \nu_C C + \nu_C D$$

$$K_{equilibrium} = \frac{a_C^{\nu_C} a_D^{\nu_D}}{a_A^{\nu_A} a_B^{\nu_B}} = \frac{(\gamma_C x_C)^{\nu_C} (\gamma_D x_D)^{\nu_D}}{(\gamma_A x_A)^{\nu_A} (\gamma_B x_B)^{\nu_B}}$$

All agree to the following:

$$a_{\text{pure substance}} = 1$$

solids that precipitate out

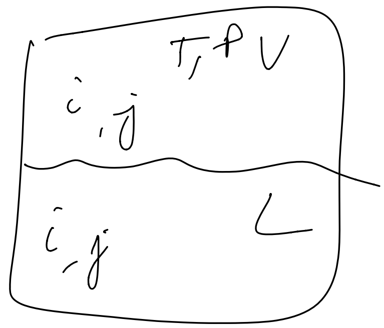
immiscible liquid

(however it will be included in ΔG°

$$K_{eq} = \frac{\left(\gamma_C \, C_C / C_C^0\right)^{\nu_C} \left(\gamma_D \, C_D / C_D^0\right)^{\nu_D}}{\left(\gamma_A \, C_A / C_A^0\right)^{\nu_A} \left(\gamma_B \, C_B / C_B^0\right)^{\nu_B}}$$

C = concentration $\quad [C] = \frac{mol}{L}$

L - V



Ideal Solution in Equil.

Ideal Vapor

Raoult's "Law" $\quad P_i = x_i P_i^*(T)$

$$y_i P^{TOT} = x_i P_i^*(T)$$

At Equilibrium

$$\mu_i^V = \mu_i^L$$

$$\hat{f}_i^V = \hat{f}_i^L$$

$$d\mu = RT\, d(\ln f)$$

$$\hat{\phi}_i^V = \frac{\hat{f}_i^V}{y_i P} \qquad \gamma_i = \frac{\hat{f}_i^L}{x_i f_i^{ref}}$$

fugacity coefficient of "i" in vapor mixture

$$\hat{f}_i^V = \boxed{\hat{\phi}_i^V y_i P = \gamma_i x_i f_i^{ref}} = \hat{f}_i^L$$

vapor-liquid equilibrium of

<u>multi-component systems</u>