Übungen zur Physikalischen Chemie für Mikrosystemtechnik WS2007/2008

Übungsblatt 10 – Lösungen

A 10.1:

$1\,L\ H_2O \qquad 100\,g\ NaCl \qquad (M = 58\,g\,mol^{-1})$

$\hat{=}\ 1\,kg \qquad = \frac{100}{58}\,mol = 1{,}724\,mol$

$\Rightarrow m_{NaCl} = m_{Na^+} + m_{Cl^-} = 2\,m_{NaCl} = \frac{2 \cdot 1{,}724\ mol}{1\,kg} =$

$= 3{,}45\ \frac{mol}{kg}$

$\Delta T = k_{e,H_2O} \cdot m_{NaCl} \qquad k_{e,H_2O} = \frac{R\,T_{sdp}^2 \cdot M_{H_2O}}{\Delta H_{V,m}} =$

$\Delta T = 0{,}513 \cdot 3{,}45\ \frac{kg \cdot K \cdot mol}{mol\ kg} = \qquad = \frac{8{,}314 \cdot 18 \cdot (373{,}15)^2}{40{,}66 \cdot 10^3 \cdot 10^3}\ \frac{kg \cdot K}{mol}$

$= 1{,}77\,K \Rightarrow \boxed{T_{sdp} = 101{,}77\,^{\circ}C} \qquad = 0{,}513\ \frac{kg\,K}{mol}$

A 10.2: 250 cm^3 H_2O 7.5 g Saccharose ($M = 342.3\ g\ mol^{-1}$)

(9)

$\Delta H_{Sm} = 6.008\ kJ\ mol^{-1}$

Gefrierpunktserniedrigung: $\Delta T = K_{H_2O} \cdot m_{Saccharose}$ m = Molalität

$$K_{H_2O} = \frac{R \cdot T_{Sm}^2 \cdot M_{H_2O}}{\Delta H_{Sm}} = \frac{8.314 \cdot 18 \cdot (273.15)^2}{6.008 \cdot 10^3} \quad \frac{J\ mol^{-1}\ g \cdot K^2}{mol \cdot J\ mol^{-1}}$$

$$= 1858.5\ \frac{g \cdot K}{mol} = 1.858\ \frac{kg \cdot K}{mol}$$

$$m = \frac{mol(Sacch.)}{kg\ H_2O} = \frac{(7.5/342.3) \cdot mol}{0.250\ kg} = 0.0876\ \frac{mol}{kg}$$

$$\Rightarrow \Delta T = 1.8585\ \frac{kg \cdot K}{mol} \cdot 0.0876\ \frac{mol}{kg} = 0.163\ K$$

Gefrierpunkt der Lösung: $-0.163\ °C$

A 10.3: Aceton / Methanol $T = 57.1°C = 330.35\,K$ $p = 1\,atm = 760\,Torr$

$p^*_{Ace} = 786\,Torr$

$p^*_{MeH} = 551\,Torr$

flü $x_{Ace} = 0.4$ Gas: $y_{Ace} = 0.516$

Raoult: $x_A = \frac{p_A}{p_A^*}$ ← ~~flüssig~~ löslich

~~flüssig~~ reine flü

real $a_A = \frac{p_A}{p_A^*} = \frac{392.16}{786} = 0.5 = \gamma_A \cdot x_A = \gamma_A \cdot 0.516$

$\Rightarrow \gamma_A = \frac{0.5}{0.4} = 1.25$

$p_A = y_A \cdot p^{\ominus} = 0.516 \cdot 760\,Torr = 392.16\,Torr$

$x_M = 0.6$ $y_M = 0.484$

$p_M = 0.484 \cdot 760\,Torr = 367.84\,Torr$

$\Rightarrow a_M = \frac{p_M}{p_M^*} = \frac{367.84}{551} = 0.668$

$\gamma_M = \frac{a_M}{x_M} = \frac{0.668}{0.6} = 1.11$