B10704007
邱允平
四材三甲

Thermodynamics of Materials II Homework#3

$$1\ atm = 760\ mmHg = 1.01 \times 10^5\ N\ m^{-2}, R = 8.314\ J\ mol\ K^{-1}$$

1 The solution contains A and B, which the molar fractions are 0.4 and 0.6, respectively. At this molar fraction, the molar volume of A and that of B are 13 cm^3 mol^{-1} and 11.0 cm^3 mol^{-1}, respectively. The molar volume of pure A and that of pure B are 15.0 cm^3 mol^{-1} and 13.0 cm^3 mol^{-1}, respectively. The total mole of solution is 2.0 moles. According to these statements, fill the following table with the number and the unit.

	Number and unit	
V_A^0	15 cm^3/mol	
V_B^0	13 cm^3/mol	
x_A	0.4	$n_A = 0.8$ mole
x_B	0.6	$n_B = 1.2$ mole
$\bar{V}_A$	13 cm^3/mol	
$\bar{V}_B$	11 cm^3/mol	
$\Delta\bar{V}_A^M$	$13 - 15 = -2$ cm^3/mol	
$\Delta\bar{V}_B^M$	$11 - 13 = -2$ cm^3/mol	
V	$13 \cdot 0.4 + 11 \cdot 0.6 = 11.8$ cm^3/mol	
ΔV^M	$11.8 - (0.4 \cdot 15 + 0.6 \cdot 13) = -2$ cm^3/mol	
V'	23.6 cm^3	
$\Delta V'^M$	-4 cm^3/mol	

2 A solution is consisted of two liquids, A and B, which the total molar volume is followed by:

$$V(cm^3\ \ mol^{-1}) = 100 - 15x_A - 3x_A^2$$

2.1 The functions of partial molar volumes for A and B

2.2 Compared to the ideal solution, the function of the molar volume change of the mixed solution, ΔV^M.

2.1 $\overline{M_A} = M + (1-x_A)\dfrac{dM}{dx_A}$, $\overline{M_B} = M - x_A\dfrac{dM}{dx_A}$, $\dfrac{dV}{dx_A} = -15 - 6x_A$

$\Rightarrow \overline{V_A} = (100 - 15x_A - 3x_A^2) + ((1-x_A)(-15-6x_A) = (100 - 15x_A - 3x_A^2) + 6x_A^2 + 9x_A - 15$

$= \underline{3x_A^2 - 6x_A + 85}$ #

$\Rightarrow \overline{V_B} = (100 - 15x_A - 3x_A^2) - x_A(-15-6x_A) = 100 - 15x_A - 3x_A^2 + 15x_A + 6x_A^2 = \underline{3x_A^2 + 100}$ #

2.2 $V_A^\circ = 82$, $V_B^\circ = 100$

$\Delta V^M = (x_A\overline{V_A} + x_B\overline{V_B}) - (x_AV_A^\circ + x_BV_B^\circ) = (x_A\overline{V_A} + \overline{V_B} - x_A\overline{V_B}) - (x_AV_A^\circ + V_B^\circ - x_AV_B^\circ)$

$= [x_A(\overline{V_A} - \overline{V_B}) + \overline{V_B}] - [x_A(V_A^\circ - V_B^\circ) + V_B^\circ]$

$= [x_A(-6x_A - 15) + 3x_A^2 + 100] - [-18x_A + 100]$

$= -3x_A^2 - 15x_A + 100 + 18x_A - 100 = \underline{-3x_A^2 + 3x_A}$ #