Problem Set 12

Problem 10.53

The molar volume $\left(\text{cm}^3\ \text{mol}^{-1}\right)$ of a binary liquid mixture at T and P is given by:

$$V = 120\,x_1 + 70\,x_2 + (15\,x_1 + 8\,x_2)\,x_1\,x_2$$

(a) Find expressions for the partial molar volumes of species 1 and 2 in terms of x_1.

(b) Show that the given equation for V is recovered when these expressions are combined using Eq. 10.11.

(c) Show that these expressions satisfy Eq. 10.14.

(d) Show that $\left(d\,\overline{V}_1 / \text{dx}_1\right)_{x_1=1} = \left(d\,\overline{V}_2 / \text{dx}_1\right)_{x_1=0} = 0$.

(e) Make a plot of V, $\overline{V}_1$, and $\overline{V}_2$ versus x_1.

(f) Label points V_1, V_2, $(\overline{V}_1)_{x_1 \to 0}$, and $(\overline{V}_2)_{x_2 \to 0}$ on the plot and show their values.

Problem 10.18

Estimate the fugacity of isobutylene gas at 280 °C and

(a) 1 bar
(b) 20 bar, and
(c) 100 bar.

Problem 10.21

From the data in the steam tables, determine a good estimate of $f \,/\, f^{\text{sat}}$ for liquid water at 150 °C and 150 bar, where f^{sat} is the fugacity of saturated liquid at 150 °C.