Mixing gases

Data $P := 1\ \mathrm{atm}$ $T := 300\ \mathrm{K}$

$F_1 := \text{"He"}$ $F_2 := \text{"Xe"}$

$x_1 := 0.5\ \frac{\mathrm{mol}}{\mathrm{mol}}$ $x_2 := 0.5\ \frac{\mathrm{mol}}{\mathrm{mol}}$

"Exact" value (Viacheslav maple's calculus)

$$\rho_o := 2.750733505001462\ \frac{\mathrm{kg}}{\mathrm{m}^3}$$

Method 1: As ideal gases

$M_1 := \mathrm{CoolProp\_Props1}(\text{"M"}, F_1) = 4.0026\ \frac{\mathrm{g}}{\mathrm{mol}}$ $M_2 := \mathrm{CoolProp\_Props1}(\text{"M"}, F_2) = 131.293\ \frac{\mathrm{g}}{\mathrm{mol}}$

$n_1 := x_1\ \mathrm{mol}$ $m_1 := n_1 \cdot M_1 = 2.0013\ \mathrm{g}$ $n_2 := x_2\ \mathrm{mol}$ $m_2 := n_2 \cdot M_2 = 65.6465\ \mathrm{g}$

From $P \cdot V = n \cdot R \cdot T$ $\rho = \frac{m}{V}$ $m = MM \cdot n$

$$\rho_{12} := \frac{m_1 + m_2}{n_1 + n_2} \cdot \frac{P}{R_m \cdot T} = 2.747985\ \frac{\mathrm{kg}}{\mathrm{m}^3}$$

$$err := \left| \frac{\rho_o - \rho_{12}}{\rho_o} \right| = 0.0999\ \%$$

Method 2: Using mixing density formula

Mole to mass fractions

$$y_1 := \frac{m_1}{m_1 + m_2} = 0.02958412 \qquad y_2 := \frac{m_2}{m_1 + m_2} = 0.97041588$$

$$\rho_1 := \mathrm{CoolProp\_Props}(\text{"D"}, \text{"T"}, T, \text{"P"}, P, F_1) = 0.1625\ \frac{\mathrm{kg}}{\mathrm{m}^3}$$

$$\rho_2 := \mathrm{CoolProp\_Props}(\text{"D"}, \text{"T"}, T, \text{"P"}, P, F_2) = 5.3612\ \frac{\mathrm{kg}}{\mathrm{m}^3}$$

$$\rho_{12} := \frac{1}{\left(\frac{y_1}{\rho_1}\right) + \left(\frac{y_2}{\rho_2}\right)} = 2.754476\ \frac{\mathrm{kg}}{\mathrm{m}^3}$$

$$err := \left| \frac{\rho_o - \rho_{12}}{\rho_o} \right| = 0.136\ \%$$

Alvaro

$\mathrm{appVersion}(4) = \text{"1.0.8348.30405"}$