Problem Set 11

Problem 6.84

Calculate V^R, H^R, and S^R for each of the following using the generalized virial method:

(e) Ethylbenzene at 620 K and 20 bar.
(f) Methane at 250 K and 90 bar.

Problem 6.101

Use the API mixture rules in slide 11 to estimate the critical temperature and pressure of air at 50% relative humidity, 25 °C, and 1 bar total pressure.

Check your answers with CHEMCAD (CC). Use the air pseudo-component in CC so that your mixture has two components (air and water).

Problem 6.14

Estimate the entropy change of vaporization of benzene at 50 °C. The vapor pressure of benzene is given by the equation:

$$\ln\left(P^{sat} / \text{kPa}\right) = 13.8858 - \frac{2{,}788.51}{(t/°C) + 220.79}$$

(a) Use Eq. 6.86 with an estimated value of ΔV^{lv}.
(b) Use the Clausius-Clapeyron equation of Example 6.6.

Report your answers in J/mol·K.

Problem 6.25

Steam at 2,100 kPa and 260 °C expands at constant enthalpy (as in a throttling process) to 125 kPa.

What is the temperature of the steam in its final state and what is its entropy change?

What would be the final temperature and entropy change for an ideal gas?

Problem 6.28

What is the mole fraction of water vapor in air that is saturated with water at 25 °C and 101.33 kPa? At 50 °C and 101.33 kPa?

Problem 6.83

An equimolar mixture of methane and propane is discharged from a compressor at 5,500 kPa and 90 °C at a rate of 1.4 kg/sec. If the velocity in the discharge line is not to exceed 30 m/sec, what is the minimum diameter of the discharge line?