King Fahd University of Petroleum & Minerals
Chemical Engineering Department
CHE 303 – Chemical Engineering Thermodynamics II
2009 - 20010 (091)

HW#5
Due: Sat. 5-Dec-2009

Problem 1. (20 points) Problem 6.3

Problem 2. (20 points) Starting from $S = S(T,V)$, prove the following relationship for liquids:

$$\left(\frac{\partial S}{\partial T}\right)_P = \frac{C_V}{T} + \frac{V\beta^2}{\kappa}$$

where C_V, β and κ are the heat capacity at constant volume, the volume expansivity and the isothermal compressibility, respectively. The following triple product rule will be useful during the derivation:

$$\left(\frac{\partial X}{\partial Y}\right)_Z \left(\frac{\partial Z}{\partial X}\right)_Y \left(\frac{\partial Y}{\partial Z}\right)_X = -1.$$

Problem 3. (40 points)

Calculate Z, H^R and S^R for propane gas at 115.14 ^oC and 20 bar using the following methods:

(a) The virial equation of state. (15 points)
(b) Redlich/Kwong equation of state. (15 points)
(c) Lee/Kesler generalized correlations. (10 points)

Problem 4. (10 points)

Using the results from problem 1, estimate the H and S of propane gas at 115.14 ^oC and 20 bar. Use the following reference conditions:

Reference State:
Ideal gas at T = 0 ^oC and P = 1 bar
H and S are equal to zero for the above reference condition.