1.

(a) Making use of the fact that Eq. (6.20) is an exact differential expression, show that:

$$(\partial C_P / \partial P)_T = -T(\partial^2 V / \partial T^2)_P$$

What is the result of application of this equation to an ideal gas?

(b) Heat capacities Cv and Cp are defined as temperature derivatives respectively of U and H. Because these properties are related, one expects the heat capacities also to be related. Show that the general expression connecting Cp to Cv is:

$$C_P = C_V + T \left(\frac{\partial P}{\partial T} \right)_V \left(\frac{\partial V}{\partial T} \right)_P$$

Show that Eq. (B) of Ex. 6.2 is another form of this expression.

2.

Determine expressions for G^R, V^R, H^R and S^R im plied by the Dieterici equation:

$$P = \frac{RT}{V - b} \exp\left(- \frac{a}{V R T} \right)$$

Here, parameters a and b are functions of composition only.

3.

A stream of propane gas is partially liquefied by throttling from 200 bar and 370 K to 1 bar. What fraction of the gas is liquefied in this process? The vapor pressure of propane is given by Eq. (6.72) with parameters: A = -6.722 19, **B** = 1.332 36, C = -2.138 68, D = -1.385 51.

4.

Estimate the molar volume, enthalpy, and entropy for 1,3-butadiene as a saturated vapor and as a saturated liquid at 380 K. The enthalpy and entropy are set equal to zero for the ideal-gas state at 101.33 kPa and 273.15 K (0°C). The vapor pressure of 1,3-butadiene at 380 K is 1919.4 kPa.

5.

Estimate the final temperature and the work required when 1 mol of n-butane is compressed isentropically in a steady-flow process from 1 bar and 323.15 K (50°C) to 7.8 bar.

6.

Estimate V^R, H^R and S^R for following by appropriate generalized correlations:
(Carbon dioxide at *400* K and *200* bar).