ChE 7023 **Homework Set 1** Due: January 16, 2018

All problems from Smith and Van Ness, 4th Ed.

2.4 Liquid water at 100°C and 1 bar has an internal energy (on an arbitrary scale) of 419.0 kJ kg^{-1} and specific volume of 1.044 cm^3 g^{-1}.

(a) What is its enthalpy?

(b) The water is brought to the vapor state at 200°C and 800 kPa, where its enthalpy is 2838.6 kJ kg^{-1} and its specific volume is 260.79 cm^3 g^{-1}. Calculate ΔU and ΔH for the process.

3.5 An ideal gas, $C_p = (5/2)R$ and $C_v = (3/2)R$, is changed from $P_1 = 1$ bar an $V_1 = 10$ m^3 to $P_2 = 10$ bar and $V_2 = 1$ m^3 by the following mechanically reversible processes:

(a) Isothermal compression.

(b) Adiabatic compression followed by cooling at constant pressure.

(c) Adiabatic compression followed by cooling at constant volume.

(d) Heating at constant volume followed by cooling at constant pressure.

(e) Cooling at constant pressure followed by heating a constant volume.

Calculate Q, W, ΔU, and ΔH for each of these processes, and sketch the paths of all processes on a single PV diagram.

3.20 For methyl chloride at 125ºC the virial coefficients are

B = -207.5 cm^3 mol^{-1}

C = 18,200 cm^6 mol^{-2}

Calculate the work of mechanically reversible, isothermal compression of 1 mol of methyl chloride from 1 bar to 60 bar at 125ºC. Base calculations on the following forms of the virial equation:

(a) $$Z = 1 + \frac{B}{V} + \frac{C}{V^2}$$

(b) $$Z = 1 + B'P + C'P^2$$

Why don't both equations give exactly the same result?