ME 3007- HW #3

1. Do Problem 3.39, parts a-c, from Abbott and Van Ness.

2. Do Problem 4.32 from Abbott and Van Ness.

3. Do Problem 4.33 from Abbott and Van Ness.

4. Consider a van der Waals fluid.
   a. Evaluate Δu and Δs for the change of state v1 to v2, where v1 > v2.
   b. Evaluate the residual u and s.
   c. Comment on the influence of the real fluid behavior in each case. Is the sign of the change intuitive?

5. The figure is from a paper by Ben-Amotz and Herschbach [Israel J. Chem. 30, 59 (1990)] which discusses the "Zeno line", which they define as the locus of points in the supercritical fluid + liquid range where Z(ρ ,T) =1. They have observed that the Z(ρ ,T) =1 locus is close to a straight line in many experimental and model fluids, as illustrated in the diagram, based on experimental data for methane. Ben-Amotz and Herscbach suggest that the Zeno line can be used to divide the phase diagram into "soft" and "hard" fluid regions, regions where attractive or repulsive forces predominate.
   a. Show that for a fluid obeying the van der Waals equation of state the Zeno line is rigorously linear. Work in reduced variables.
   b. What is the reduced Boyle temperature (the ρ = 0 limit of part (a)) predicted by the van der Waals equation?
   c. Ben-Amotz and Hershbach list the intercept and slope of the Zeno line for methane as 505 K and -18.9 K dm3 mol-1. Compare the predictions of the van der Waals model to these values using the results of part (a) and the critical properties of methane.