10.40 Thermodynamics **Fall 2003**
Problem Set 8

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1. Compute U/(RT) of a mole of diatomic ideal gas molecules treating the vibrational mode classically. Assume that the vibrational frequency is 10^{13} s^{-1}, and take the reference state as $\underline{E} = 0$ when the system is in its ground state (degeneracy of 1 and no important excited electronic states). In a few words, explain the significance of the difference between the quantum and classical results.

2. Show that the standard deviation or square root of the variance of the distribution of particle densities, σ_ρ, for a pure fluid varies as $(\langle N \rangle)^{-1/2}$ for a fixed volume system. For typical thermodynamic systems, what happens to the value of $\sigma_\rho / \langle \rho \rangle$ at low densities and at the critical point?

3. Problem 10.11 in the text

4. Problem 10.12 in the text

Be sure to state and justify all assumptions made.
