Assignment #5 PY 541 Week of Oct. 2–6, 2006

Reading: We begin the second major chapter of PY 541—quantum statistical mechanics. Please read chapter 5, primarily sections 3–5, and continue to chapter 8 in Pathria. I will focus on application rather than formalism. You may find chapters 8, 9, & 11 of Huang a helpful complement to the text reading.

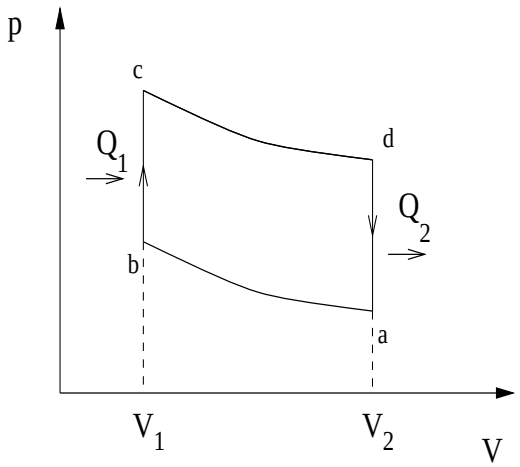
Notes: I would like to give a midterm during the week of October 23 or the week of October 31. Please let me know you time preference.

Problems: Due Tuesday October 10.

1. (From Reif 5.13) A homogeneous substance at temperature T, pressure p, and density n has a constant pressure heat capacity per particle, c_p. The temperature dependence of the coefficient of volume expansion, α, is known. Determine the pressure dependence of c_P at fixed temperature, *i.e.*, compute $\frac{\partial c_p}{\partial p}|_T$, and express the result in terms of T, n, and the properties of α. (*Hint:* Use a Maxwell relation.)

2. (From Reif 5.26) A gasoline engine is represented by the cyclic process $abcd$ in the $p - V$ plane. Here $a \to b$ represents the adiabatic compression of fuel, $b \to c$ represents combustion where the pressure rises suddenly at constant volume, $c \to d$ represents the power stroke of the engine, and $d \to a$ represents the final cooling of the gas at fixed volume.

   Compute the work performed in one cycle of this engine and determine its thermodynamic efficiency η in terms of V_1, V_2, and the specific heat ratio γ.



3. Pathria (2nd edition) 8.3.

4. Pathria (2nd edition) 8.4.