

Assignment #8    PY 541    Week of Oct. 30 – Nov. 3, 2006

**Reading:** After completing the discussion of photons and phonons, the rest of this week will be devoted to the basic properties of non-ideal systems, including the cluster expansion for the partition function and the virial expansion. Please read chapter 9 of Pathria, sections 1–5. For a more elementary treatment, you may find sections 10.3 – 10.5 in Reif to be helpful. There is also a brief discussion of cluster expansions in sections 10.1 and 10.3 of Huang.

**Problems:** Due Thursday Nov. 9.

1. Pathria 9.2. Also give a physical justification for the fact that the exponent  $n$  is generally equal to 6.
2. Pathria 9.7.
3. (adapted from Huang 10.1) (a) Calculate  $\bar{b}_2$  and  $\bar{b}_3$  for a classical hard-sphere gas with particles of diameter  $a$ . (b) Express the equation of state for this classical hard-sphere gas in the form of a virial expansion. Include terms up to the third virial coefficient. Consider also the same problem in 2 dimensions (hard circles), and 1 dimension (hard sticks). Comment, if possible, on the qualitative difference as a function of dimension.