

## Assignment 4

**4.1** Pathria, problem 1.4. Hint: you need to think about the relationship between the excluded volume  $v_0$  and the sphere diameter  $\sigma$ .

**4.2** Pathria 1.8. You may assume the condition  $E/(Nh\nu) \gg 1$  to hold from the outset; convince yourself that this corresponds to the classical limit.

**4.3** Pathria 1.13. Take the initial densities of the two gases to be equal.

**4.4** (a) From the Sackur-Tetrode equation, determine the chemical potential  $\mu$  for a monatomic ideal gas in the classical limit.

(b) It should be clear from (a) that  $\mu$  is negative (in this limit). But from thermodynamics, we know that  $\mu = \partial E / \partial N$ , and it would seem that the energy must always increase when particles are added to a system. Resolve this discrepancy.