

Homework 12 (Due Thursday, March 15th)

1. Consider a system of two atoms, each having only three quantum states; the states have energies 0, ϵ and 2ϵ . Find the canonical partition function Q_N assuming:

- (a) Fermi statistics.
- (b) Bose statistics.
- (c) Classical statistics for distinguishable particles.

Hint: The number of possible configurations is small and can be explicitly written out.

2. A cylinder is separated into two compartments by a free sliding piston; the two compartments maintained at equal temperature. Two identical Fermi gases are placed into the two compartments, numbered 1 and 2. The particles in compartment 1 have spin $\frac{1}{2}$, while those in compartment 2 have spin $\frac{3}{2}$. They all have the same mass. Find the equilibrium relative density n_1/n_2 of the two gases at $T = 0$ and $T \rightarrow \infty$.

3. Show that, in two dimensions, the specific heat $C_V(N, T)$ of an ideal Fermi gas is identical to the specific heat of a two-dimensional ideal Bose gas, for *all* N and T . [Hint: See exercise 8.12 in Pathria and Beale]