Homework 7, due Nov. 6, 2006

1. Problem 13.-3 in book.

2. Consider a system of N **distinguishable** particles, at temperature T, with available energy levels ϵ_1 and $\epsilon_2 > \epsilon_1$ (only two available energy levels).

   (a) Determine the equilibrium values of the occupation numbers N_1 and N_2, and the energy U of the system, as a function of temperature.

   (b) Show that the specific heat is given by

$$C_V = Nk \left(\frac{\Delta}{kT} \right)^2 \frac{e^{-\Delta/kT}}{(1 + e^{-\Delta/kT})^2},$$

where $\Delta = \epsilon_2 - \epsilon_1$. Examine the low temperature and high temperature behavior of C_V/Nk, and sketch it as a function of kT/Δ.

3. Problem 13-8 in book.

4. Problem 15-2 in book. You only need to turn in parts (a) and (b), but work out part (c) for your own benefit before the final. For part (a), use $\omega = \omega_{M.B.}$ (keeping the $N!$ in the numerator), and use Stirling's approximation. Note that the result of part (a) can be written as $S = -Nk \sum_j P_j \ln P_j$, where $P_j = N_j/N$ is the probability of occupying level j. In part (c), examine both the $T \to 0$ and $T \to \infty$ behavior.

* . As preparation for the final, also do problem 16-1 in the book. This problem does not need to be turned in.