1. Schroeder Problem 2.8.

2. Schroeder Problem 2.10.


4. Schroeder Problem 2.22.

5. Quantum harmonic oscillator.

   (a) Find the entropy $S(q,N)$ of a set of $N$ oscillators of frequency $f$ (Einstein solid) as a function of the total quantum number $q$. Use the multiplicity function (Equation 2.9 in Schroeder), make the Stirling approximation $\ln N! = N \ln N - N$, and replace $N-1$ by $N$. Treat the general case (don’t assume $q << N$ or $q >> N$).

   (b) Let $U$ denote the total energy $qhf$ of the system of oscillators, where $h$ is Planck’s constant. Express the entropy as $S(U,N)$. Show that the total energy at temperature $T$ is

   $$U = \frac{N hf}{\exp(hf/kT) - 1}$$

   This is the Planck blackbody radiation spectrum.