Lecture 6

Problem 2.33. Use the Sackur-Tetrode equation to calculate the entropy of a mole of argon gas at room temperature and atmospheric pressure. Why is the entropy greater than that of a mole of helium under the same conditions?

Problem 2.37. Using the same method as in the text, calculate the entropy of mixing for a system of two monatomic ideal gases, A and B, whose relative proportion is arbitrary. Let N be the *total* number of molecules and let x be the fraction of these that are of species B. You should find

$$\Delta S_{\text{mixing}} = -Nk\big[x \ln x + (1-x)\ln(1-x)\big].$$

Check that this expression reduces to the one given in the text when $x = 1/2$.

Lecture 7

Problem 3.1. Use Table 3.1 to compute the temperatures of solid A and solid B when $q_A = 1$. Then compute both temperatures when $q_A = 60$. Express your answers in terms of ϵ/k, and then in kelvins assuming that $\epsilon = 0.1$ eV.

Problem 3.3. Figure 3.3 shows graphs of entropy vs. energy for two objects, A and B. Both graphs are on the same scale. The energies of these two objects initially have the values indicated; the objects are then brought into thermal contact with each other. Explain what happens subsequently and why, *without* using the word "temperature."

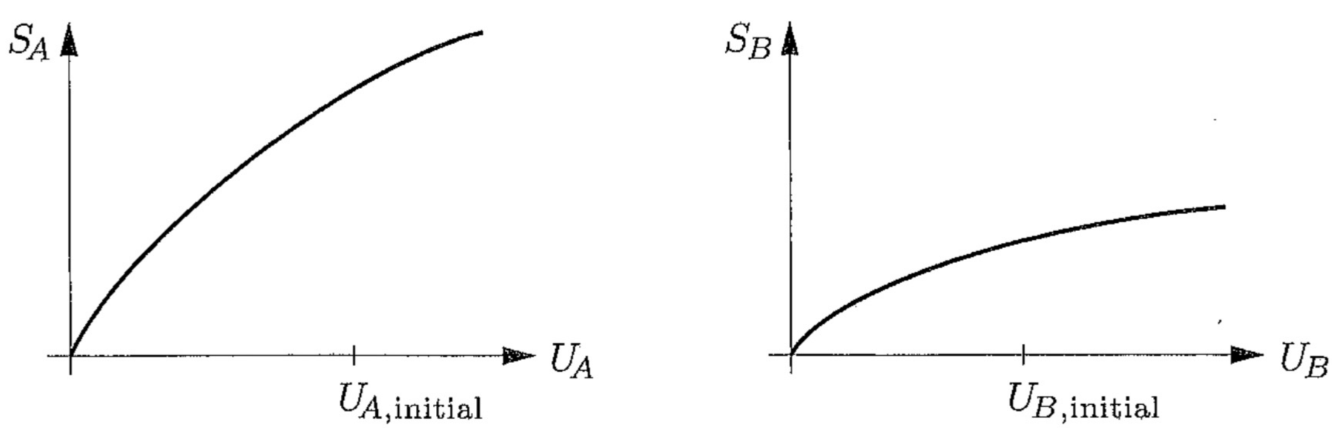

Figure 3.3. Graphs of entropy vs. energy for two objects.

Problem 2.17. Use the methods of this section to derive a formula, similar to equation 2.21, for the multiplicity of an Einstein solid in the "low-temperature" limit, $q \ll N$.

Problem 3.5. Starting with the result of Problem 2.17, find a formula for the temperature of an Einstein solid in the limit $q \ll N$. Solve for the energy as a function of temperature to obtain $U = N\epsilon\, e^{-\epsilon/kT}$ (where ϵ is the size of an energy unit).