

Exam January 1994 (Part 1)

Translated by Bo Jakobsen (Autumn 2010)

The course was 9 ects points, and the exam an open book exam.

The exam consisted of 3 problems, of which only number 1 is included here.

Problem 1

A system contains N_a atoms of type a. Each atom can be in the ground state, an excited state with energy ϵ or an excited state with energy 2ϵ . The system is in equilibrium at temperature T . In the following model we neglect energy levels which are higher than the mentioned ones.

- 1.1) State the partition function for the system. Which fraction of atoms are in the state with energy ϵ ?
- 1.2) State the specific heat of the system. What is the high temperature limit of the specific heat? Comment on the result.
- 1.3) The above described system is mixed with N_b atoms of type b. Each atom of b-type can be in either the ground state or in an excited state with energy ϵ . State the Helmholtz free energy and the mean energy of the mixture, which is in equilibrium at temperature T . State how the entropy *in principle* can be found (it is not necessary to perform the calculation).