

Exam January 2000

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The course was 9 ects points, and an open book exam.
The exam consisted of 2 problems.

Problem 2 (40%)

A system has $N + 1$ states. The N states all have the same energy $E \neq 0$, while the last has energy 0.

- 1) Find the Helmholtz free energy, F , for the system.
- 2) Show that the entropy of the system is given by

$$S = k_B \left[\ln(1 + X) - \frac{X}{1 + X} \ln \left(\frac{X}{N} \right) \right] \quad (1)$$

where $X = N \exp(-E/(k_B T))$.

- 3) Find the entropy in the limit $T \rightarrow 0$ and the limit $T \rightarrow \infty$, and give a physical interpretation of the results.