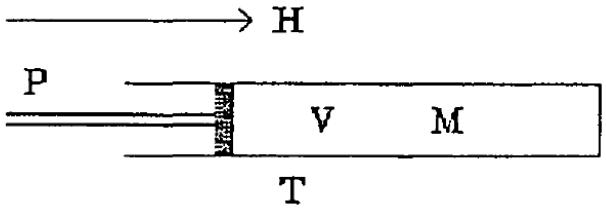
Exam January 1992 (Part 1 and 2)

Translated by Bo Jakobsen (Autumn 2010)

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

The exam consisted of 6 (related) questions, of which only 2 are included here.

A paramagnetic gas is enclosed in an oblong container with a piston. The container is placed in a homogeneous magnet field H which is parallel to the long axis of the container. The magnetic properties of the container are to be neglected.



The total magnetic moment M of the gas is given by:

$$M = \frac{nCH}{T - \Theta\frac{nb}{V}} \tag{1}$$

where n is the number of mole, T the absolute temperature, V the volume of the container, and where c, Θ, and b are positive constants. The expression above is true for $T > \Theta$ and $V > nb$ which in the following are assumed to be the case.

We first consider a magnetization process, where the gas has fixed temperature and volume, while the magnet field is slowly raised from 0 to H.

1) State the size and sign of the magnetic work, that is done on the gas during the process.

2) Show that the entropy S is a decreasing function of M for fixed T and V. Furthermore, calculate the heat supplied from the surroundings during the process.