PROBLEM SET 9

Reading: Handout on NMR

1. Thermodynamics of a Simple System of Spin-1/2 Particles

Consider a solid with $N$ weakly interacting spin-1/2 particles, each with magnetic moment of magnitude $\mu_B$. The solid is in a uniform external magnetic field $\vec{H}$ pointing along the z-axis. The solid is in contact with a heat bath at temperature $T$. The Hamiltonian $\mathcal{H}$ is

$$\mathcal{H} = -\vec{\mu} \cdot \vec{H}$$

(1)

where $\vec{\mu}$ is the magnetic moment. Find, as a function of temperature,

(a) the magnetization $M$

(b) the susceptibility $\chi$. Plot or sketch the susceptibility vs. $T$. (This is called the Curie susceptibility.)

(c) the specific heat at constant volume $C_V$. Plot or sketch the $C_V$ vs. $T$. (This is called the Schottky specific heat.)