

J03T.3—Spin Gas in a Magnetic Field

Problem

Consider an ideal Boltzmann gas of N spin $\frac{1}{2}$ particles in a thermally isolated container at initial temperature T_i in a strong magnetic field H .

- a) Compute the free energy and the entropy of the gas.
- b) The magnetic field is slowly reduced to $H = 0$. Compute the final temperature of the gas. Express your answer in terms of the variable $x = \mu_B H / kT_i$.
- c) Show that

$$T_i > T_f > 2^{-\frac{2}{3}} T_i.$$