Statistical Physics B

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1. **Exercise 1:** (Chapter 3.9 Pathria) Classical model of paramagnetism - N localised, non-interacting dipole magnetic moments of a magnitude μ, which can freely align in 3-D space. (You can interpret them as magnetic moments of some atoms in a crystal).
   (a) Calculate the partition function of such a system in external magnetic field H.
   (b) Plot the mean magnetisation as a function of $x = \mu\beta H$
   (c) Derive an expression for magnetic susceptibility at high temperetures $T \to \infty$ (Curie Law).

   Definition: Magnetic susceptibility is defined as:

$$\chi_T = \lim_{H \to 0} \frac{\partial M}{\partial H}$$

2. **Exercise 2:** (Chapter 3.9 Pathria) Analyze the quantum analog of the model from previous exercise. Evaluate the magnetisation in:
   (a) low T limit,
   (b) high T limit.