(1.) Chandler 3.18

[20 pt]

(2.) [15 pt] Consider a system of N classical magnetic dipoles of magnitude μ and direction given by the spherical angles (θ, φ). The dipoles have a moment of inertia I for rotations normal to their axis.

(a) Write the Lagrangian for this system when it is subjected to an external magnetic field $\vec{B} \uparrow\uparrow \hat{z}$:

$\uparrow^{z} \uparrow \vec{B}$

(b) Write the corresponding Hamiltonian and evaluate the canonical partition function.

(c) Compute $m(B)$, the average magnetization per spin, at $T = $ const.

3. 15 pt Consider a simple fluid described by a grand canonical ensemble. Express the following quantities in terms of the grand canonical partition function Σ :

$$\begin{cases} \langle \Delta E^2 \rangle = \langle E^2 \rangle - \langle E \rangle^2, \\ \langle \Delta N^2 \rangle = \langle N^2 \rangle - \langle N \rangle^2, \\ \langle \Delta E \Delta N \rangle = \langle EN \rangle - \langle E \rangle \langle N \rangle. \end{cases}$$