Physics 301

Homework due 20 November 2024

1) Stowe problem 21-12.

2) (a) Stowe problem 21-21.

(b) Stowe problem 21-22.

3) Recall that a massive particle that has spin s has $(2s+1)$ allowed values for its z-direction spin component, s_z. Consider a particle with $s = \frac{1}{2}$. This particle is placed in a magnetic field B. Its allowed energies are given by $E_i = 2s_{z,i}\mu_B B$, where μ_B is the Bohr magneton.

(a) List the allowed values of s_z.

(b) List the energy levels it can have in this magnetic field.

(c) Calculate this particle's partition function.

(d) Use the partition function to find the particle's mean energy, $\overline{E}$, as a function of temperature and magnetic field strength.

4) Stowe figure 23.10 shows a discontinuous change in the slope of the line of minimum Gibbs free energy at point "1,4". Explain why this implies a sudden change in volume, and how that is related to a phase transition.

5) Make a qualitative sketch of the phase diagram of a substance for which the solid and liquid phases are equally dense. Explain your reasoning.