7. SPIN SYSTEM (8 points) Let us consider a system of N independent magnetic dipoles (spins) in a magnetic field B and temperature T. Our goal is to determine some properties of this system by using statistical physics. It is known that the energy of a single spin is $E = \varepsilon m$, where $m = \pm\frac{1}{2}$ and $\varepsilon = \alpha B$.

i) *(2 points)* What is the probability $p_\uparrow$ for a spin to be in exited state, i.e. have positive energy?

ii) *(2 points)* What is the average value of the total energy E_s of the spin system as a function of B and T?

iii) *(2 points)* Using high temperature approximation $T \gg \frac{\alpha B m}{k}$, simplify the expression of E_s.

iv) *(2 points)* Using high temperature approximation $T \gg \frac{\alpha B m}{k}$, find the heat capacity C of the spin system.