3. Consider again the lattice of *N* spin-1*/*2 particles in an external homogeneous magnetic field, where each particle has two possible states: spin "down" with energy *e* = 0 and spin "up" with energy *e* = 1/2*"*. The microstate of the system is specified by the energy states of all the particles, i.e. the list (*e*1*, e*2*…*$e\_{n}$), while the macrostate is specified by the total energy of the system *E*, i.e. the sum$ E=\sum\_{i=1}^{N}e\_{i}$.

1. Calculate the entropy of the system as a function of the total energy, *S*(*E*), by assuming that both the number of particles in the "down" state *N- n* and the number of particles in the "up" state *n* are large, i.e. $N-n\gg 1 and n\gg 1$
2. Calculate the temperature of the system by using the relation $T^{-1}=\frac{∂S}{∂E}$
3. Calculate the heat capacity of the system, $C=\frac{∂E}{∂T}$
4. Calculate the partition function *Z* for the system.
5. By assuming the Boltzmann distribution, calculate the average energy $<E>$of the

system.

1. Calculate the heat capacity of the system by using the average energy, $C=\frac{∂E}{∂T}$.