

Key points lectures 01/26/2022:

- Within Statistical mechanics, using the microcanonical ensemble, the temperature is defined through

$$\frac{1}{T} = \left(\frac{\partial S(E, V, N)}{\partial E} \right)_{V, N} = k \frac{\partial}{\partial E} \left(\log(\Omega(E, V, N)) \right)_{V, N}$$

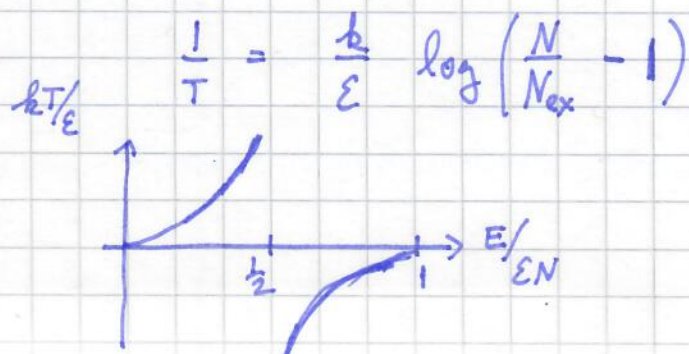
This definition can be used for systems of any size (it does not require $N \rightarrow \infty$ or large N).

- Stirling approximation: $\log(N!) \approx N \log N - N$
- For a two-level system consisting of N distinguishable particles the number of microstates is

$$\Omega(E, N) = \frac{N!}{N_{\text{ex}}! (N - N_{\text{ex}})!},$$

where N_{ex} is the number of particles in the excited state.

- The calculation for the two-level system yields



where 0 and E denote the single-particle energy of the two states