statemech: deriving entropy in micro cononical ensemble,

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1 solving for entropy starting with $S = -k\,\mathrm{tr}(\rho \ln(\rho))$

first i will use $\rho = \sum_n P_n \left|n\right\rangle \left\langle n\right|$ and use the trace property $\mathrm{tr}(A) = \sum_n \left\langle n\right| A \left|n\right\rangle$

$$S = -k \sum_n P_n \ln(P_n) \tag{1}$$

the sumation of all probabilities equals one, so S becomes

$$S = -k \ln P_n \tag{2}$$

now we use the definition

$$\sum_n P_n = \frac{1}{\Omega} \sum_n \int_E^{E+\Delta E} \delta\left(\lambda - E_n\right) d\lambda \therefore P_n \qquad = \frac{1}{\Omega} * 1$$

using this S becomes

$$\boxed{S = k \ln(\Omega)} \tag{3}$$