

20.12: The Degeneracy of an Isolated System and Its Entropy

In [Section 20.9](#), we find that the sum of the probabilities of the population sets of an isolated system is

$$1 = \sum_{\{N_i\}, E} W(N_i, g_i) \rho_{MS, N, E}.$$

By the principle of equal *a priori* probabilities, $\rho_{MS, N, E}$ is a constant, and it can be factored out of the sum. We have

$$1 = \rho_{MS, N, E} \sum_{\{N_i\}, E} W(N_i, g_i)$$

Moreover, the sum of the thermodynamic probabilities over all allowed population sets is just the number of microstates that have energy E . This sum is just the **degeneracy of the system energy, E** . The symbol Ω_E is often given to this system-energy degeneracy. That is,

$$\Omega_E = \sum_{\{N_i\}, E} W(N_i, g_i)$$

The sum of the probabilities of the population sets of an isolated system becomes

$$1 = \rho_{MS, N, E} \Omega_E$$

In [Section 20.9](#), we infer that

$$\rho_{MS, N, E} = \prod_{i=1}^{\infty} \rho(\epsilon_i)^{N_i}$$

so we have

$$1 = \Omega_E \prod_{i=1}^{\infty} \rho(\epsilon_i)^{N_i}$$

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