We assume that the energy splittings between adjacent energy levels are equal to $2mB$ in both systems, so that the magnetic energy given up by system 1 when one spin is reversed can be taken up by the reversal of one spin of system 2 in the opposite sense. Any large physical system will have enough diverse modes of energy storage so that energy exchange with another system is always possible. The value of $s = s_1 + s_2$ is constant because the total energy is constant, but when the two systems are brought into thermal contact a redistribution is permitted in the separate values of s_1, s_2 and thus in the energies U_1, U_2.

The multiplicity function $g(N,s)$ of the combined system $\mathcal{S}$ is related to the product of the multiplicity functions of the individual systems $\mathcal{S}_1$ and $\mathcal{S}_2$ by the relation:

$$g(N,s) = \sum_{s_1} g_1(N_1,s_1)g_2(N_2,s - s_1) , \tag{6}$$

where the multiplicity functions g_1, g_2 are given by expressions of the form of (1.15). The range of s_1 in the summation is from $-\frac{1}{2}N_1$ to $\frac{1}{2}N_1$, if $N_1 < N_2$. To see how (6) comes about, consider first that configuration of the combined system for which the first system has spin excess $2s_1$ and the second system has spin excess $2s_2$. A **configuration** is defined as the set of all states with specified values of s_1 and s_2. The first system has $g_1(N_1,s_1)$ accessible states, each of which may occur together with any of the $g_2(N_2,s_2)$ accessible states of the second system. The total number of states in one configuration of the combined system is given by the product $g_1(N_1,s_1)g_2(N_2,s_2)$ of the multiplicity functions of $\mathcal{S}_1$ and $\mathcal{S}_2$. Because $s_2 = s - s_1$, the product of the g's may be written as

$$g_1(N_1,s_1)g_2(N_2,s - s_1). \tag{7}$$

This product forms one term of the sum (6).

Different configurations of the combined system are characterized by different values of s_1. We sum over all possible values of s_1 to obtain the total number of states of all the configurations with fixed s or fixed energy. We thus obtain (6), where $g(N,s)$ is the number of accessible states of the combined system. In the sum we hold s, N_1, and N_2 constant, as part of the specification of thermal contact.

The result (6) is a sum of products of the form (7). Such a product will be a maximum for some value of s_1, say $\hat{s}_1$, to be read as "s_1 hat" or "s_1 caret". The configuration for which g_1g_2 is a maximum is called the **most probable configuration**; the number of states in it is

$$g_1(N_1,\hat{s}_1)g_2(N_2,s - \hat{s}_1). \tag{8}$$