



MathsNET

A joined up approach to
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mathematics

The generalised partition function

- How is the average energy, $\langle E \rangle$, calculated from the probabilities of being in the various microstates P_i and the energies of the various microstates E_i
- Explain what two types of constraints are introduced on extensive thermodynamic variables when constructing thermodynamic states from the various microstates in phase space.
- Complete the following sentence: We can determine the probability of being in any given microstate by...
- Write down the function for which we are finding the constrained minimum and the two constraints on this function



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- Write down the extended function whose unconstrained optimum is found in order to find the required constrained optimum.
- Write down the partial derivative of the function you have just written down with respect to P_j .
- Explain why the derivative of $f = \sum_i P_i$ with respect to P_j is equal to one.
- Give an expression for the derivative of $g = \sum_i \lambda B_i P_i$ with respect to P_j .



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The generalised partition function

- Give an expression for the derivative of $h = \sum_i P_i \ln P_i$ with respect to P_j .
- Explain (by making reference to the results that you have written down to the previous questions) why the probability of being in a microstate is given by: $P_j = \frac{e^{-\sum_k \lambda_k B_j^{(k)}}}{e^\Psi}$
- Give an expression for the generalised partition function and explain how this is derived.