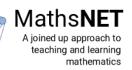
## The generalised partition function A joined up approach to teaching and learning mathematic. mathematic.

•	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 $P_i$
•	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

## The generalised partition function



• 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  $P_j$ .

## 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.