

Using *Entropy* to Calculate Macrostate Multiplicities Spring 2004

Introduction

The following instructions use a Microsoft Excel spreadsheet called *Entropy*¹ that will enable you to perform the same calculations as those described in Moore, Chapter T5, with his *STATMECH* program.

Experiment

1. Opening the spreadsheet

Start Microsoft Excel, and open *Entropy* from T:\phys151 (be sure to click the **Enable Macros** button). Since the spreadsheet is available on the campus network, you can play around with the values using any campus computer.

In the spreadsheet you'll find the following quantities:

N_A, N_B	The number of atoms in each solid.
U	The total combined energy of the two solids, in units of ϵ .
Ω_A, Ω_B	The number of microstates (the <i>multiplicity</i>) for each solid at their respective energies U_A, U_B
Ω_{AB}	The total number of microstates per macropartition, $\Omega_{AB} = \Omega_A \Omega_B$. At the top of the spreadsheet the total number of <i>all</i> microstates ($\Sigma\Omega_{AB}$) is calculated.
% of Total	This column calculates the percentage of each Ω_{AB} compared to the total number of <i>all</i> microstates, and indicates the probability of finding solids A and B in a particular macropartition.

In addition, there is a graph of Ω_{AB} as a function of U_A that will change as you perform your calculations.

2. Calculating multiplicities & macropartitions

To calculate all the possible macropartitions, simply enter the values of N_A, N_B , and U , and click the **Calculate** button (be sure to click outside the last cell before hitting **Calculate**). Click the **Print 1 Copy** button on the spreadsheet for a hard copy of your data and graph (*this will print one copy of the first page of data only!*). Keep in mind that the possible number of macropartitions depends upon the value of U .

Entropy contains multiple copies of its calculation sheet. This way you can compare results for different solids by clicking on the tab name at the bottom of the sheet.

¹ Spreadsheet developed from "A different approach to introducing statistical mechanics", Am. J. Phys. 65(1), 26-36 (1997)

3. Exercises

Use *Entropy* to do exercise **T5.X1** (Moore, p. 60) for factors of 1, 10, and 30. You can't do the last two cases (factors of 100 and 1000); Excel can't handle values this large. Describe the results of your calculations, and circle the most probable macropartition on the printout.

In addition, do the following problems from the end of the chapter:

- T5B.6
- T5S.2 (parts *a* and *c*)
- T5S.4 (Use $N_A = N_B = 333$, $U = 200 \epsilon$)
- T5S.6
- T5S.7