Stat Mech (PHYS 370) Guide 6

Fall 2024 v1.0

This week we will have a quick stop in Chapter 4 for an introduction to heat engines before turning to "free energy" its role in reaching equilibrium.

Looking ahead, after we have developed techniques of stat mech in Chapters 6 and 7 we will return to phase changes and the later sections of Chapter 5. If there is time we may also return to real engines.

The first few problems are those delayed form last week.

On Thursday we have a workshop devoted to a stat mech-flavored intro to Mathematica. If you haven't yet done so please install Mathematica on your computer this week. See **this LITS page** to request a license and begin the process.

Reading:

Chapter 4 Sections 4.1 - 4.2
Chapter 5 Sections 5.1 - 5.2

Problems: (Due on Thursday October 10 at the beginning of class)

(1) 3.10 The change in entropy as ice melts

(2) 3.13 On life and entropy

(3) 3.14 Comment on your results. Where does the linear term dominate? What do you make of the entropy in fundamental units falling below the number of particles?

(4) 3.16 An intriguing and perhaps fundamental link between information and entropy. See https://www.nature.com/articles/nature10872.

(5) 3.24 Spreadsheeting the multiplicity. As Schroeder tells us on his website for the book, "[M]ost spreadsheet programs will overflow ... if you try to compute the multiplicities in terms of factorials. Instead, you need to use the built-in function to compute 'combinations'. In most of the spreadsheet programs currently in use, the name of the combination function is COMBIN. For example, to compute the number of combinations of 20 objects chosen from 100, or '100 choose 20', you would type '=COMBIN(100,20)'. ... The COMBIN function works the same way in Excel, OpenOffice, Numbers, and Google [Sheets], except that in OpenOffice you need to use a semicolon, instead of a comma, to separate its two arguments."

(6) Using your spreadsheet (or the data from your spreadsheet) for the house modeling question from PS 2 problem 10 find the change in entropy of the universe due to heat escaping your box house on the same cold winter day (with an interior temperature of 65° F and an average exterior temperature of 15° F). Comment on your result.

(7) 3.25 (2 pts.) To match the results for the metals, either use SI units and match a point or use dimensionless quantities and work out the ϵ require to reach half the maximum value at the temperatures given in the plot.

(8) 3.34 Rubber bands - to get started consider another two-state system

(9) 3.37 Adding gravitational potential energy and seeing the effect on the chemical potential

(10) 4.2 Power plant thermodynamics