Material for Week 2

Physics 4488/6562: Statistical Mechanics

https://sethna.lassp.cornell.edu/Teaching/562/

Exercises due Mon. Feb 05

Last correction at November 29, 2023, 9:46 pm

The exercises with numbers N1.xxx are to be found in https://sethna.lassp.cornell.edu/StatMech/SethnaExercises.pdf

All exercises are from the second edition of the text: https://sethna.lassp.cornell.edu/StatMech/EntropyOrderParametersComplexity20.pdf

Monday

In-class question: 2.15 *Diffusion of nonconserved particles*

In-class question: 2.16 *Density dependent diffusion*

Wednesday

Read: Chapter 2, Sec. 2.4 (Solving: Fourier & Green)

Pre-class question: 2.18 *Absorbing boundary conditions*

In-class question: 2.6 *Fourier and Green*

Friday

Read: Chapter 3, Sec. 3.1 (Microcanonical), 3.2 (Ideal Gas), 3.3 (Temperature) and pressure parts of 3.4 (Pressure & Chemical Potential)

Pre-class question: 3.13 *Weirdness in high dimensions*

In-class question: 3.5 *Hard sphere gas*

Monday

Read: Chapter 3, chemical potential parts of 3.4 (Pressure & Chemical Potential; 3.4.1 is optional) and Sec. 3.5 (Entropy & fussy stuff).

Pre-class question: 3.10 *Triple product relation*

Exercises for everyone

2.5 *Generating random walks.* (Computation) Hints at https://sethna.lassp.cornell.edu/StatMech/EOPCHintsAndMaterials.html

Select zero – one (4488) or one – two (6562)

N1.22 *Random walks on a lattice.* Vacancy diffusion in silicon.

8.4 *Red and green bacteria.* (Mathematics, Biology) Analyze the system as a random walk in the number of red bacteria. Full credit for sensible arguments that get within a factor of two of the right answer. (Assigned to me for my qualifying exam at Princeton.)

2.11 *Stocks, volatility, and diversification.* (Finance, Computation) Stock prices are random walks, but with 'fat tails'. Hints at https://sethna.lassp.cornell.edu/StatMech/EOPCHintsAndMaterials.html

N1.9 *Chiral waves: Fourier and Green.* Chiral edge state motion in topological materials.

2.20 *Flocking.* (Active matter) Animal migration as a random walk in orientation space.

2.19 *Run & tumble.* (Active matter, Biology) Here we study the eating strategies of bacteria. When to sit and wait for food to come by? When to swim, when to turn?

3.19 *Random energy model.* The simplest model exhibiting a glass transition.