

Material for Week 2

Physics 4488/6562: Statistical Mechanics

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

Exercises due Mon. Feb 06

Last correction at December 22, 2022, 2:08 pm

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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 one (4488) or two (6562)

- [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.