Material for Week 6

Physics 4488/6562: Statistical Mechanics

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

Exercises due Mon. Mar 06

Last correction at December 22, 2022, 2:09 pm

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

Wednesday

In-class question: 6.6 *Lagrange*
In-class question: 6.5 *Laplace*
In-class question: 6.7 *Legendre*

Friday

Read: Chapter 7, Sec. 7.1 (Mixed states and density matrices), Sec. 7.2 (Quantum harmonic oscillator), and 7.3 (Bose and Fermi statistics).
Pre-class question: 7.5 *Photon density matrices*
In-class question: 7.11 *Phonons on a string*

Monday

Read: Chapter 7, Sec. 7.4 (Non-interacting bosons and fermions) and 7.5 (Maxwell-Boltzmann 'quantum' statistics)
Pre-class question: 7.10 *Crystal defects*

Exercises for everyone

6.11 *Barrier crossing.* Deriving the Arrhenius formula for reaction rates.

Select one (4488) or two (6562)

6.25 *Epidemics and zombies.* (Biology, Epidemiology, Computation) Epidemiology studies the spread of disease through a population. The foundation of the field is the SIR model, tracking the susceptible, infected, and recovered people in the population. Our group had fun analyzing the SZR model, which illustrates stochastic effects in chemical reactions and gene mutation propagation.

N1.10 *Taste & smell with ensembles.* (Biology) Studying flavor receptor binding using the grand canonical ensemble.

6.4 *Molecular motors and free energies.* (Biology) Using Gibbs free energies to understand molecular motors and RNA unzipping

7.25 *Quantum measurement and entropy.* (Quantum) Using statistical mechanics to explain the collapse of the wavefunction after a measurement.

N1.16 *Emittance and particle beams.* (Accelerator) Maximizing beam brightness in accelerators by minimizing beam entropy.

6.26 *Nucleosynthesis as a chemical reaction.* (Astrophysics) Viewing nuclear fusion in the early Universe as a chemical reaction

6.24 *Word frequencies: Zipf's law.* (Linguistics) Minimizing the effort per communication.