Soft Matter Theory Homework 2 Due: 24 May 2022

- 1. Consider a 3D ideal chain of N=50 effective segments each with a Kuhn length b = 10 nm at T = 300 K.
 - a. Calculate the rms end-to-end distance.
 - b. Calculate the effective spring constant.
- 2. The most probable end-to-end distance $R = R_0$ of a Gaussian chain is also called the most probable radius.
 - a. Find the most probable radius using the probability distribution p(r, N) of a Gaussian chain in a spherical coordinate system.
 - b. Plot the distribution p(r, N) in the spherical coordinate system (along r = |r|). Verify that your answer from part a is correct by identifying the maximum.
 - c. One can also find R_0 using the free energy. Write the free energy of a Gaussian chain in spherical coordinates.
 - d. Find R_0 by minimizing the free energy.
- 3. Take a wide rubber band. Hold it to your upper lip and rapidly stretch it. Leave it stretched for a moment, then rapidly let it relax while still in contact with your lip. You should feel a distinct thermal phenomenon during each process. Discuss what is happening during both stretching and relaxation in terms of energy and entropy.