

POLYMERS

Examples Sheet 4

Chain Configurations

1. You leave the Eagle drunk and execute 1,000 random steps, each of 0.6 m along Bene't Street. Determine the probability that you will find yourself back outside the Eagle front door. Estimate the probability that you will end up on King's Parade.
2. A polymer chain consists of 10^3 random links each of length 0.5 nm. If one end is tethered, determine
 - (a) the probability that the other end is within a small volume of 1 nm^3 in a specified direction of 10 nm from the tethered end.
 - (b) The probability that the other end is within a shell of depth 1 nm and with the radius of the shell 10 nm from the tethered end.
3. Using the Gaussian probability distribution function for a random coil, derive expressions in terms of r and a for,
 - (a) The radius of maximum probability.
 - (b) The average radius.
 - (c) The root mean square end-to-end distance.

For a random chain with $r = 800$ and $a = 0.7 \text{ nm}$, determine the total probability that at any instant in time the end-to-end separation is

- (a) Less than the radius of maximum probability.
- (b) Lies between the radius of maximum probability and the root mean square end-to-end distance.

Comment on your result.

4. Evaluate the tension between two ends of a random chain held at the following separations, $a = 0 \text{ nm}$, $b = 10 \text{ nm}$, $c = \text{full extended}$. The chain is at 25°C , $r = 10^4$ and $a = 1 \text{ nm}$. Comment on the result. Estimate the relaxation time of the chain, stating what assumptions you have made.
5. Tripos taster 1997.3.4