

3.11 Problem Set #8

Due Nov. 14th

RUBBER ELASTICITY PROBLEMS

(Only three problems because of the Holiday Monday and Tuesday)

1. Explain why a freely jointed chain left to itself tries to coil itself. What is it trying to maximize or minimize by doing that?
2. In class, while deriving the expression for the Helmholtz free energy of a single Gaussian chain, an approximation was made. Show what that approximation was by deriving the expression for Helmholtz free energy starting with $A(r) = -T \cdot k_b \cdot \ln P(r)$. $P(r)$ is the probability that the end of the chain is located at a distance, r , from the origin of the chain.
3. (a) A polymer chain with a statistical segment length of 5nm and containing 10,000 segments is stretched with a force of $0.25 \cdot 10^{-12}$ N at room temperature (25°C). What is the end-to-end distance of the chain?
(b) If the temperature is raised to 100°C, what does the end-to-end distance become if you assume the polymer does not degrade? What if the statistical segment length is 2nm instead of 5nm, but the contour length remains the same at room temperature? (Careful with your conversions)