Home assignments for the Course of Polymer Physical Chemistry

Third section of the course: Polymer Conformations

1. Calculate the mean unperturbed radius of gyration Rg for poly(methyl methacrylate) with molecular weight 100,000; and for polyisoprene with molecular weight 6,800.

$$R_g = \sqrt{\frac{2\frac{M}{m_o}C_\infty l^2}{6}} = 0.154nm\sqrt{\frac{1000*9}{3}} \approx 8.4nm \quad \text{for PMMA}$$

$$R_g = \sqrt{\frac{4\frac{M}{m_o}C_\infty l^2}{6}} = 0.154nm\sqrt{\frac{2*100*4.6}{3}} \approx 2.7nm \quad \text{for PI}$$

2. Calculate the mean radius of gyration for DNA molecule with 1 million base pairs. Assume that the distance between base-pairs is 0.33 nm, and the persistence length is 50 nm.

$$R_g = \sqrt{\frac{2aR_{\max}\left[1-\frac{a}{R_{\max}}\left\{1-\exp\left(-\frac{R_{\max}}{a}\right)\right\}\right]}{6}} \approx \sqrt{\frac{50*330,000}{3}}nm \approx 2.35\mu m$$

3. Assume a chain with 1000 segments, each has length 2 nm. Calculate how much larger will be the mean end-to-end distance of this chain in good solvent relative to its end-to-end distance in Θ-solvent.

$R_n(\theta) = b\sqrt{N} \approx 63nm;$

$R_n(good) \approx bN^{3/5} \approx 126nm;$ The end-to-end distance of the given molecule in good solvent is ~2 times larger than in Θ-solvent. The same can be obtain in easier way:

$$\frac{R_n(good)}{R_n(\theta)} \approx \sqrt{N^{1/5}} \approx 2$$