Chapter 3 Homework: Properties of Polymers
Due:
Available Points: 50

1. Please draw a polymer ball in a dilute solution, semi-dilute solution, and concentrated solution. (3 points)

2. In general, what is the end-to-end distance in a poor solvent? In a good solvent? (2 points)

3. Define the following qualitatively: (7 points)

a. Radius of gyration

b. Glass Transition Temperature

c. Characteristics of rubber elasticity

d. Ideal Elastic

e. Stress Relaxation

f. Creep

g. Time Temperature Superposition Principle

4. Define the following quantitatively (7 points)

a. Value for fraction of free volume at Tg
b. Equations for Tg of symmetric molecules vs Tg of asymmetric molecules
c. Value for Poisson's ratio of an ideal rubber
d. Equation for Dynamic Storage Modulus
e. Equation for Dynamic Loss Modulus
f. Equation for Loss Tangent
g. Equation for Hildebrand Solubility Parameter

5. What are the 4 assumptions of the Flory-Huggins Theory? What are the shortcoming of these assumptions? (7 points)

6. How does the end-to-end distance in the restricted bond angle case compare to the end-to-end distance in the unrestricted bond angle case? (1 point)

7. For a given polymer with end-to-end distance of 24 nm, what is the radius of gyration? (1 points)

8. You are creating an alternating copolymer between two monomers, monomer A and monomer B, and want to estimate the Tg of this copolymer. Estimate the Tg of the following blends. (3 points)

a. Monomer A has a Tg of 150°C. Monomer B has a Tg of 200°C. Both monomers have the same molecular weight.

b. Monomer A has a Tg of 150°C. Monomer B has a Tg of 20°C. Both monomers have the same molecular weight.

c. Monomer A has a Tg of 150°C. Monomer B has a Tg of 200°C. The weight fraction of Monomer A is 0.68.

9. Draw the following (10 points)

a. Maxwell Model (1 point)

b. Voigt Model (1 point)

c. Four Element Model, as presented in class (1 point)

d. Stress Relaxation Curve (1 point)

e. Strain Curve (1 point)

f. Four Element Curve, indicate which aspect of the model is reacting at each transition point on the curve (5 points)

10. Plot the dynamic storage and dynamic loss moduli as a function of frequency and strain. Indicate at which areas on the graph the material is viscous and elastic. Include axes labels and a key. (4 points)

11. The solubility parameter of n-hexane is 7.24 and ethyl acetate is 9.10. Which solvent is a better solvent to dissolve poly(methyl methacrylate)? Show your work. (5 points)