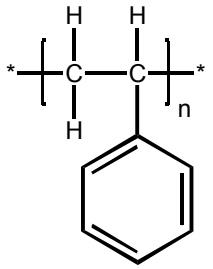
Polymer Course – HW #2 Due date: **Wednesday, Oct. 15th, 2008**

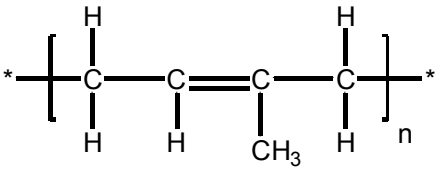
(All problems from Chapter 6 of Lodge.)

1. Problem 6.2, following:

   a) From the data given in Table 6.1 on p. 224, explain which values indicate that polystyrene (PS) is considered stiff and 1,4-polyisoprene (PI) is considered flexible.

   b) What about the chemical structures of the two polymers account for this difference is stiffness/flexibility?

PS 

PI 

   c) From the data given in Table 6.1, calculate R_{EE} and R_g for melts of PS and PI using both the characteristic ratio C_∞ and the statistical segment length b.
      i) PS with M_n = 104,000 and M_n = 1,040,000
      ii) PI with M_n = 68,000 and M_n = 680,000
      (Bond lengths: C – C single bond is 1.54 Å, C = C double bond is 1.33 Å)

   d) Problem 6.2: Explain why the values for the statistical segment length b between the two polymers are nearly identical despite the difference in stiffness/flexibility.

2. Problem 6.3

3. Mostly Problem 6.9, following:

   a) Plot the data given in the question and calculate the best-fit values for the scaling exponents. How do the calculated exponents compare with theoretical expectations? (Skip the rest of the question in Lodge, but answer part b) instead.)

   b) Extrapolate the best-fit lines to lower M_w and determine at what value of M_w the two lines intersect. After reading Rubinstein & Colby's discussion of thermal blobs on pages 113-115 (in particular Fig 3.15), comment on the meaning of the value of M_w at which the two lines intersect. What is the scaling exponent ν in both good and theta solvents for M_w values less than this intersection point?

4. Problem 6.12

5. Problem 6.15

6. Basically Problem 6.16, following:

   a) Determine a scaling relation for how the polymer concentration c inside an individual coil varies with degree of polymerization N in good and theta solvents (i.e., c goes as N to what exponent?). Hint: You may find it useful to read pages 13-14 in Rubinstein and Colby.

   b) Estimate this polymer concentration inside an individual polymer coil in g/cm^3 for polystyrene with $M_w = 10^6$ g/mol in a good and theta solvent. Use the equations of R_g versus M_w with the best-fit values of the prefactor and exponent that you determined in Problem 6.9 for polystyrene in benzene and cyclohexane. Comment on the magnitude of this concentration value.

   c) After reading pages 13-14 in Rubinstein and Colby, explain why this concentration is often referred to as the coil overlap concentration c^*.