Chem/MatS/ChEn 4223W

Assignment 1
Due: *In Lab,* Tuesday, January 29/Thursday, January 31

1. (You should read the instructions for Lab 1 before attempting this assignment.)

   In Lab 1, you will be polymerizing styrene via free-radical polymerization. How long do you think the polymerization will take? One goal of the lab is to determine the rate constant for polymerization (k_p) under your bulk polymerization conditions. During the initial stages of free-radical polymerization, the rate of polymerization (R_p) can be calculated by the equation

$$R_p = -\frac{d[\mathrm{M}]}{dt} = k_p\left(\frac{k_d f [\mathrm{I}]_0}{k_t}\right)^{1/2} [\mathrm{M}]_0 .$$

   It would be helpful to use this equation to guess the amount of time it will take your polymerizations to finish. Some rate constants (k_t & k_d) and initiator efficiencies (f) for polystyrene and benzoyl peroxide are provided in the Lab 1 handout. Though the purpose of this lab is to determine k_p(styrene), you will have to assume a k_p to make a guess. You can find k_p values for of a wide range of monomers in the online *Wiley Database of Polymer Properties* (http://tinyurl.com/wileypolyprops). (In the menu on the left, click "Contents" to get to a list of topics, and work from there.) Pick a value for styrene closest to your polymerization conditions (no solvent, 70 °C).

   Given these k values, a "molarity" for styrene dictated by ρ = 0.91 g/mL, and the quantities of initiators you plan to use, calculate how long you will have to run each styrene polymerization to achieve 10% conversion. (I.e., if $\Delta[M] = 0.1[M]_o$, then what is Δt?)

   Δt(0.25 g peroxide): Δt(0.40 g peroxide):

   Δt(0.55 g peroxide): Δt(0.70 g peroxide):

2. In Lab 1, you will be isolating your polystyrene from unreacted styrene monomer via precipitation, by adding a “nonsolvent” for polystyrene. This is an extremely common first step in obtaining pure polymer material from a polymerization mixture. But how do you know what solvents are “good” or “poor” for a particular polymer? We will be discussing solubility parameter calculations briefly in lecture, but a more common approach is to consult a listing of polymer-solvent compatibilities. One source for this information is James Mark’s *Polymer Data Handbook* (*available online at http://tinyurl.com/polydatahandbk*).

   Below, list three “good” organic solvents for polystyrene that could be used to dissolve the polymer effectively, and list three “poor” organic solvents for polystyrene that could be used to precipitate the polymer from solution.