CHEM/MATS/CHEN 5221/8221 **Fall 2005**

Problem Set #1

1.-7. Hiemenz and Lodge, Chapter 1, Problems 1, 2, 3, 6, 7, 8, 10

8. Give the overall chemical reaction(s) involved in the polymerization of these monomers, the resulting repeat unit structure, and an acceptable name for the polymer.

(a) $CH_2=C(CH_3)COOH$

(b) $H_2N–(CH_2)_4–NH_2 + ClOC–(CH_2)_4–COCl$

(c) $HO–(CH_2)_5–COOH$

(d) $CH_2=CHCN$

(e) $OCN–\phi–NCO + HO–(CH_2)_4–OH$

(f) $NH_2–C(CH_3)–COOH$

9. A MALDI-TOF analysis of a polystyrene sample exhibited a peak (one of many) at 1206. The sample was prepared in dithranol, with silver nitrate as the salt. Assuming no head-to-head defects, how many distinct chemical structures could this peak represent? Propose structures for the end-groups of the polymer as well.

10. A narrow-distribution polystyrene molecular weight standard for SEC calibration came with a certificate that indicated M = 93,100 by osmotic pressure, M = 92,500 by light scattering, and a polydispersity of 1.05 by SEC. How much confidence would you put in these numbers?

11. How many distinct conformations could be adopted by one polystyrene molecule from the peak in Problem 9?

12. Estimate a typical radius for a random coil of polystyrene, poly(ethylene oxide) and polyethylene, each with M = 100,000. The statistical segment lengths (b) at 140 ºC are 6.7 Å, 6.0 Å, and 5.9 Å, respectively. Why are the dimensions different, given that the b values are so similar?

13. A poly(methyl methacrylate) sample was divided in two, and T_g was measured by DSC in two different labs. The reported results were 98 ºC and 106 ºC. Propose three simple explanations for this difference.

14. Measurement of density is a very reliable way to measure the % crystallinity in a polyethylene sample. The density of amorphous polyethylene is easy to measure above the melting point, and the values can be extrapolated to lower temperatures. The unit cell dimensions of crystalline polyethylene are also precisely known. Explain how these two sets of information can be used to relate measured density to % crystallinity.