

CME 300 Properties of Materials

Homework 7 November 8, 2011

- 1) Show the behavior of molecular weight (number average) as a function of time in step growth polymerization and chain growth polymerization. Explain why these two behaviors differ.
- 2) For the interfacial polymerization of nylon is the behavior described in question 1 followed? Why?
- 3) The synthesis of polydimethylsiloxane by ring opening polymerization has some features of chain growth polymerization and some features of step growth polymerization. Explain this.
- 4) Polycarbonate is synthesized by a reaction of bisphenol-A and phosgene. Explain the hazards associated with these two organic compounds. Does polycarbonate display any hazards? For a condensation reaction do you expect residual monomer in a polycarbonate polymer?
- 5) Give the reaction mechanism for glyptal and for polyethylene terephthalate (PET). Glyptal is a brittle glue like material while PET is the material used to make water bottles. From the molecular structure and functionality explain why these two polymers have different mechanical properties.
- 6) Explain what percolation is for a condensation reaction between trifunctional and bifunctional monomers. How can the extent of reaction at percolation, p_c , be determined analytically? Explain how this could be determined in a computer simulation. Explain how this could be determined in an experiment, i.e. what physical property might indicate that percolation had occurred.
- 7) Why is polyurethane used for furniture finishes? Show the chemical reaction and explain what feature is important to this application.
- 8) Why is polyurethane used to make foam? Show what modification of the chemical reaction is needed to produce a foam. How is polystyrene foam made (styrofoam)?
- 9) What is an aerogel and how is it made? Explain how sol-gel chemistry is used to make an aerogel.
- 10) Crosslinking of hydroxyl terminated polydimethylsiloxane (PDMS) involves a sol-gel reaction. Sketch how this reaction proceeds.
- 11) Benzoyl peroxide is used in dishwashing detergents to remove tomato stains from plastic dishes. Explain how this works and what hazards might be involved in the use of benzoyl peroxide. How is benzoyl peroxide used in polymerization reactions?

- 12) Sketch the initiation, propagation and termination reactions for the synthesis of polystyrene using free radical chain polymerization.
- 13) Why is anionic polymerization used to make SBR rubber for tires?
- 14) What is the advantage of Ziegler-Natta polymerization compared to free radical polymerization? Is Ziegler-Natta polymerization an example of chain growth polymerization? Explain your answer.