

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH KOLKATA

Spring Semester 2019; Mid-Sem Examination – Polymer Chemistry (ID4210)

Time : 90 min

Date: February 19, 2019

Name:

Roll Number:

Part A: Answer All Questions

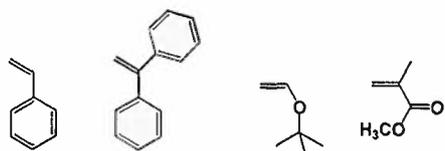
1. Give the IUPAC nomenclature for Nylon-6 and polytetrafluoroethylene. (1)
2. What property differences are there between statistical copolymers and block copolymers? (1)
3. i) Write the correct hierarchically self-assembled structure of the following two conditions. ii) Using a correct Instrument, explain how those hierarchically self-assembled structures shall be differed from a collapsed vesicle. (2)
  - a) Solutions having wedge-like aggregates with the size of 50 nm
  - b) Solution having sphere-like aggregates with the size of 60 nm
4. For the following abbreviations write the name and chemical structure of the polymer. (1)
  - a) PVA
  - b) SBS
  - c) PVOH
  - d) PET
5. The question is concerned with a comparison between step and chain polymerization. (2)

Indicate which of these statements is appropriate to step and which to chain processes:

  1. a) High MW obtained initially and continuously.  
b) High MW at high conversion
  2. a) monomer concentration decreases rapidly in early stages of reaction.  
b) monomer concentration decreases continuously throughout reaction.
  3. a) Reaction mixture contains only high polymer, monomer and reactive species.  
b) Reaction mixture contains a range of different sized species.
6. Nylon vs Kevlar: Give the chemical structure and site 2 important differences. (1.5)
7. What is CAC? Mention 2 important properties to differentiate micelle and vesicle. (1.5)

Part B: Answer all questions (Marks: 10 × 1)

1. From the following four vinyl monomers, write down which monomer can be polymerized by what method, such as cationic, radical and anionic polymerization? Explain your answer.



2. Write down two major types of chain-breaking reactions in cationic polymerization.
3. How branched polyethylene or polypropylene is formed?

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4. Why  $\alpha$ -methylstyrene cannot be polymerized by radical polymerization using AIBN as an initiator at 50-70 °C?

5. Give an example of following things (chemical structure):

(a) An initiator for RAFT polymerization

(b) An initiator for ATRP polymerization

(c) An initiator for NMP polymerization

6. From the following list of compounds, which one will have highest chain transfer constant ( $C_{tr}$ ) for the polymerization of styrene at 70 °C? Which chemical will have lowest  $C_{tr}$  value?

Toluene; CCl<sub>4</sub>; Benzene; CH<sub>3</sub>SH; CH<sub>3</sub>OH

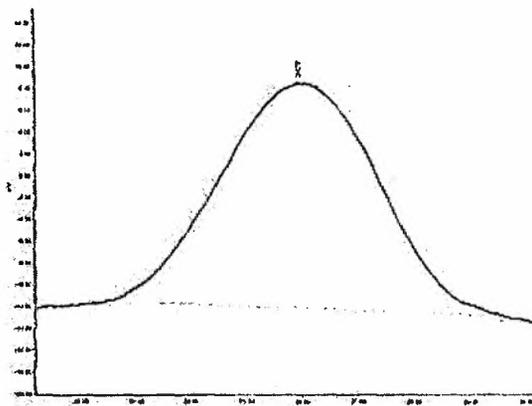
7. Following sentences are true or false? Explain your answer.

(a) -NH<sub>2</sub> containing monomers cannot be polymerized by RAFT technique.

(b) ATRP derived polymers are not good for medicinal applications.

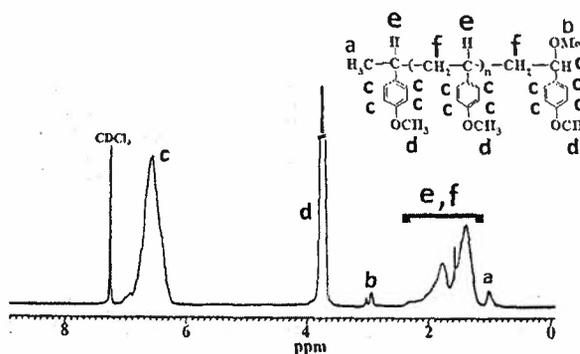
(c) NMP polymerization happens mostly with styrene and methacrylate monomers.

8. The following SEC trace was obtained for polystyrene in tetrahydrofuran solvent at 30 °C, where X-axis corresponds to elution volume and Y-axis indicates signal intensity. In the curve, define the position of  $M_n$ ,  $M_w$ ,  $M_v$ ,  $M_p$ , and  $M_z$ .



9. What is the head-to-head microstructure of PVC,  $[-CH_2-CH(Cl)-]_n$ ? How this configuration can be synthesized? Give an example and explain your answer.

10. Living cationic polymerization of *p*-methoxystyrene produced poly(*p*-methoxystyrene) (PMeOSt) at -60 °C in CH<sub>2</sub>Cl<sub>2</sub>. The <sup>1</sup>H NMR spectrum of PMeOSt in CDCl<sub>3</sub> is shown in the following Figure. From the NMR analysis, the area under the peaks a, b, c, d and (e+f) were obtained as 6.03, 5.97, 201.4, 148.3 and 150.8, respectively. Determine degree of polymerization ( $DP_n$ ) for PMeOSt.



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