

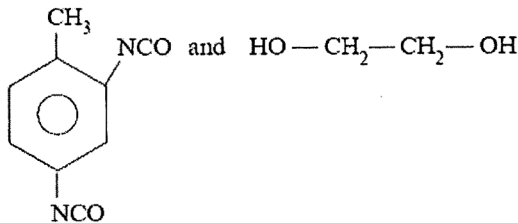
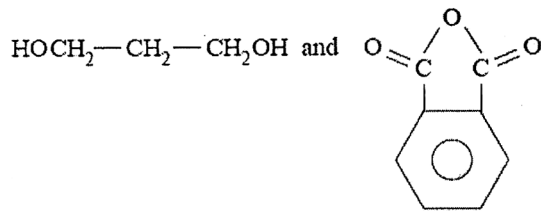
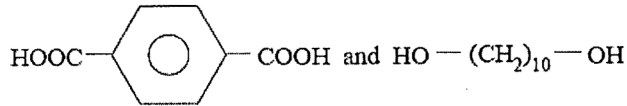
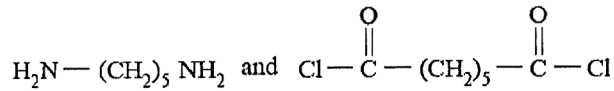
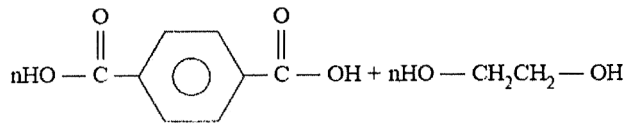
B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY
EXAM 2024

Subject: HIGH POLYMER TECHNOLOGY

Time :3hrs

Full Marks: 100

1. (a) Write down the repeat unit structure (10)



(b) Consider a polyesterification reaction.

- Suppose 1 mol each of dicarboxylic acid and glycol is used. What is the degree of polymerization when the extent of reaction is 0.20, 0.5, and 1.0?
- Suppose 110 mol glycol is reacted with 100 mol of the dicarboxylic acid. What is the maximum degree of polymerization?
- Suppose the dicarboxylic acid contains 2 mol% monoacid impurity. What is the maximum degree of polymerization? (15)

2. (a) Show the steps of chain polymerization of vinyl chloride using benzoyl peroxide as initiator considering all possible intermediate formation. (10)

[Turn over

(b) The data for the bulk polymerization of styrene at 60°C with benzoyl peroxide as initiator are as follows:

$$[M] = 8.5 \times 10^3 \text{ mol/m}^3; [I] = 3.0 \text{ mol/m}^3; k_p^2/k_d = 1.2 \times 10^{-6} \text{ m}^3/\text{mol-s}$$

If the initial rate of polymerization of styrene is 0.025 mol/m³-s and the spontaneous decomposition of benzoyl peroxide in styrene is 3.0 × 10⁻⁶ s⁻¹, what is the efficiency of the initiator? (5)

(c) Write short notes on (any two): (i) Chain Transfer Reaction (ii) Ziegler Natta catalysis (iii) Metathesis Polymerization (10)

3. (a) Consider the isothermal solution polymerization of styrene at 60°C in the following formulation: 100 g styrene; 400 g benzene; 0.5 g benzoyl peroxide.

Assume that the initiator is 100% efficient and has a half-life of 44 h. At 60°C, $k_p = 145 \text{ l/mol-s}$, $k_t = 0.130 \text{ l/mol-s}$. All ingredients have unit density.

Derive the rate expression for this polymerization reaction. (5)

(b) Estimate the feed and copolymer compositions for the azeotropic copolymerization of Acrylonitrile and Vinyl acetate at 50°C. (5)

Monomer 1	Monomer 2	r ₁	r ₂	T (°C)
Acrylonitrile	1,3-Butadiene	0.02	0.30	40
	Methyl methacrylate	0.15	1.22	80
	Styrene	0.04	0.40	60
	Vinyl acetate	4.2	0.05	50
	Vinyl chloride	2.7	0.04	60
1,3-Butadiene	Methyl methacrylate	0.75	0.25	90
	Styrene	1.35	0.58	50
	Vinyl chloride	8.8	0.035	50
Methyl methacrylate	Styrene	0.46	0.52	60
	Vinyl acetate	20	0.015	60
	Vinyl chloride	10	0.1	68
Styrene	Vinyl acetate	55	0.01	60
	Vinyl chloride	17	0.02	60
Vinyl acetate	Vinyl chloride	0.23	1.68	60

(c) Explain the steps of glass-rubber transition behaviour. Write down the recipe of Emulsion Polymerization. State the differences between Bulk and Solution Polymerization (7+3+5)

4. (a) Explain in detail the operation of injection molding unit. (10)

(b) Discuss the steps of manufacturing of Nylon 6,6 (show the PFD). (10)

(c) Discuss the roles of expander and coating head in foaming operation. (5)