



DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2021/2022 ACADEMIC
SESSION

COURSE CODE: CHM 451

COURSE TITLE: POLYMER SYNTHESIS (3 UNITS)

TIME ALLOWED: 2 ½ HRS

INSTRUCTION: ANSWER ANY THREE (3) QUESTIONS ONLY

Q1a. State the basic characteristics of a step-growth polymerization. [5mks]

b. Give a typical equation for Schotten Baumann's reaction. [4 mks]

c. 1.0M styrene monomer was polymerized in a suitable solvent at 60°C in presence of di- t-butylperoxide (0.01M) as initiator. If the rates of initiation and propagation are $4.0 \times 10^{-11} \text{ML}^{-1}\text{S}^{-1}$ and $1.5 \times 10^{-7} \text{ML}^{-1}\text{S}^{-1}$, respectively,

(i) State what type of polymerization is described here. [1mk]

(ii) Calculate the average molecular weight if termination occurred 20% by coupling and 80% by disproportionation. [10 mks]

Q2a. (i) State the significance of molecular mass control in step growth polymerization. [2mks] (ii) How can molar mass control be achieved in step growth polymerization? State any relevant relations. [6 mks]

b. (i) Outline the three assumptions for simplifying the kinetic analysis of a step growth polymerization. [3 mks]

(ii) Calculate the feed ratio of adipic acid and hexamethylene diamine required to produce a polyamide of molecular weight $19,000 \text{gmol}^{-1}$ if the extent of reaction is 0.995. [9mks]

3.a Using the subtitles given below, differentiate between anionic, cationic, coordination complex and free radical mechanisms [**12 mks**]:

(i) Nature of substituent on the vinyl monomer

(ii) Initiator type

(iii) Termination

b. Define the following terms: [**2 mks each**]

(i) Efficiency factor

(ii) Kinetic chain length

(iii) An Einstein of photons

(iv) Half-life

Q4 a. State any four important advantages of copolymerization [**8 mks**].

b. What is the significance of each of the following values of monomer reactivity ratios [**1 mk each**]:

(i) $r_1 = r_2 = 1.0$

(ii) $r_1 = r_2 = 0$

c. The monomer reactivity ratios for the copolymerization of a monomer M1 and another monomer M2 are 0.1 and 0.2, respectively. Determine the composition of the copolymer that will result at low conversion from equimolar mixtures of the two monomers. How is a copolymer different from a normal polymer? [**10 mks**].