



# TECHNICAL UNIVERSITY OF MOMBASA

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Faculty of Applied and Health Sciences

Department of Pure & Applied Sciences

## UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH.4216: POLYMER CHEMISTRY

SPECIAL SUPPLEMENTARY EXAMINATION

**SERIES: JULY 2025**

**TIME: 2 HOURS**

**DATE: Pick Date Jul 2025**

### Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

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### Question ONE

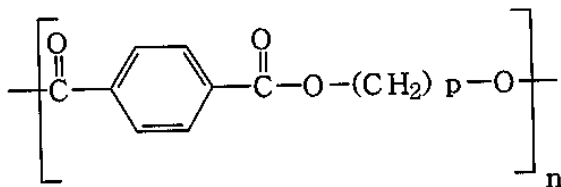
- a) Explain the following terms
- i) Glass transition temperature (2 marks)
  - ii) Functionality (2 marks)
- b) Show the mathematical relationship between
- i) Degree of polymerisation and conversion of monomer functional groups (3 marks)
  - ii) Polydispersity and average molecular weights  $M_n$  and  $M_w$  (3 marks)
- c) Draw the structures of various monomers that are used to form the following condensation polymers.
- i) Polyurethane (4 marks)
  - ii) Nylon 6,6 (4 marks)
- d) List three types of properties that depend on the degree of crystallinity of polymers. (3 marks)
- e) Describe the dissolution of a typical polymer and related thermodynamics. (5 marks)
- f) List any four techniques used to analyse polymeric fibres (4 marks)

## Question TWO

- a) i) Explain the dilatometric method of determination of  $T_g$  of amorphous polymers. (3 marks)
- ii) Sketch thermomechanical curves for an amorphous polymer and crystalline polymer showing  $T_g$  and  $T_f$  on the curves (4 marks)
- iii) Calculate the number average molecular weight of a polymer comprising of 5 moles of polymer molecules having molecular weight of 40,000 g/mol and 15 moles of polymer molecules having molecular weight of 30,000 g/mol.. (2 marks)
- b) i) Explain the concept of copolymerization. (2marks)
- ii) Provide with relevant examples the different types of copolymers (6marks)
- iii) Discuss how the arrangement of monomeric units affects the physical properties of the final copolymer. (3marks)

## Question THREE

- a) Use the polyester structures below to answer the questions that follow



$$p = 2, mp = 235 \text{ } ^\circ\text{C}$$

$$p = 4, mp = 265 \text{ } ^\circ\text{C}$$

- i) Draw and name the structure of possible monomers in each polymer that would release  $\text{H}_2\text{O}$  as the small molecule. (6 marks)
- ii) Explain the difference in melting points (3marks)
- iii) Explain the type of polymerisation reaction exhibited above (3 marks)
- b) i) Explain the role of temperature and initiator initial concentration on free radical polymerization. (2 marks)

- ii) Derive the expression for overall rate of polymerization  $R_p$  in free radical polymerization as a function of efficiency factor  $f$  assuming steady state free radical concentration  $[M\cdot]$ . **(6 marks)**

#### Question FOUR

- a) i) Differentiate between homopolymer and copolymers (2 marks)
- ii) Describe the mechanism of polycondensation in the synthesis of polymers. (3 marks)
- iii) Discuss the role of functional groups and the importance of molecular weight control in polycondensation. (4 marks)
- b) Explain role played by the following additives in a blood pouch formulation
- i) plasticiser (2 marks)
- ii) stabilizer (2 marks)
- iii) fillers (2 marks)
- iv) impact modifier (2 marks)
- c) Give three applications of acrylic fibres (3 marks)

#### Question FIVE

- a) i) Explain the significance of solubility parameter  $\delta$  in polymer dissolution. (3 marks)
- ii) Describe the mathematical determination of solubility parameter  $\delta$  of a substance of given structural formula. (5 marks)
- b) i) Define the term hydrodynamic volume. (2 marks)
- ii) Explain the variation of expansion factor in relation to hydrodynamic volume of linear and branched polymers. (2 marks)
- c) Describe the initiation and propagation steps in typical free radical polymerization of polyethene. (4 marks)
- d) Discuss the significance of temperature and reaction time in the kinetics of polycondensation. (4 marks)