



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH 4404 : POLYMER TECHNOLOGY

END OF SEMESTER EXAMINATION

SERIES:

TIME: 2 HOURS

DATE:

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 and any other TWO.

Do not write on the question paper.

Question ONE

- a) Explain the following terms
- i) Glass transition temperature
 - ii) Functionality
- (4marks)
- b) Show the mathematical relationship between
- i) Degree of polymerisation and conversion of monomer functional groups
 - ii) Polydispersity and average molecular weights M_n bar and M_w bar
- (6marks)
- c) Show by structural drawings the various monomers that are used to form the following condensation polymers accompanied by release of water.
- i) Terylene (4marks)
 - ii) Nylon 6,10 (4 marks)

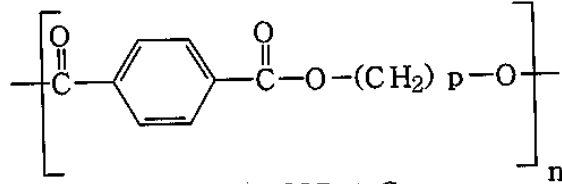
- d) List three types of properties that depend on the degree of crystallinity of polymers. (3marks)
- e) Describe the dissolution of a typical polymer and related thermodynamics. (5marks)
- f) List any four techniques used to analyse polymeric fibres (4marks)

Question TWO

- a) i) Explain the dilatometric method of determination of T_g of 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 containing 9 moles of molecular weight 30,000 and 5 moles of molecular weight 50,000. (2 marks)
- b) i) Describe extrusion blow moulding process. (5marks)
- ii) Give any two house hold products manufactured by the process in (i). (2marks)
- c) i). What is rubber compounding? (2marks)
- ii) Explain the role of vulcanising agents in rubber compounding (2marks)

Question THREE

- a) Use the polymeric 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) Suggest and draw the structure of possible monomers in each polymer that would release HCl 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. (2marks)
- 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 $[M\cdot]$. (6marks)

Question FOUR

- a) i) Differentiate between thermoplastic and thermosetting polymers (2 marks)
 - ii) PE cooking oil jars can be recycled while Urea – formaldehyde switches and sockets cannot. Explain (3marks)
- b) Explain role played by the following components in PVC leather jacket formulation (8marks)
- i) plasticiser
 - ii) stabiliser
 - iii) antioxidants
 - iv) impact modifier
- c) Describe emulsion polymerisation method (4 marks)
- d) Give three applications of polyamide fibres (3marks)

Question FIVE

- a) i) What is the significance of solubility parameter δ in polymer dissolution? (3marks)
- ii) Describe the mathematical determination of solubility parameter δ of a substance of given structural formula. (5marks)
- b) i) What is hydrodynamic volume? (2marks)
- 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. (4marks)
- d) State four types of synthetic fibres (4marks)