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 Mn bar and Mw 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 Tg of polymers. (3 marks)

ii) Sketch thermomechanical curves for an amorphous polymer and crystalline polymer showing Tg 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)

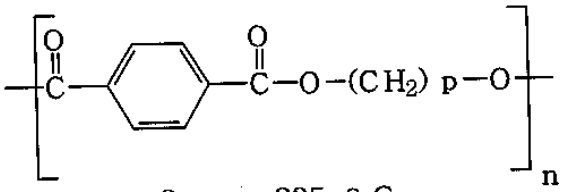
ii) Give any two house hold products manufactured by the process in (i). (2marks)

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 °C

p = 4, mp = 265 °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
i) plasticiser
ii) stabiliser
iii) antioxidants
iv) impact modifier
(8marks)

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? (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.

(4marks)

d) State four types of synthetic fibres (4marks)