



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: APRIL 2016

TIME: 2 HOURS

DATE: 11TH MAY 2016

Instructions to Candidates

You should have the following for this examination

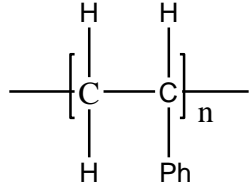
-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt Question ONE and any other TWO.

Do not write on the question paper.

Question ONE

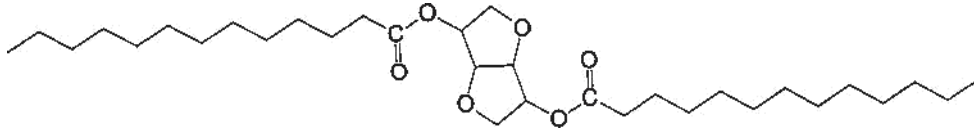
- a) Suggest reasons for the following observations
- i) Polydisperse polymers have average molecular weights
 - ii) For a substance to act as a condensation monomer it must have at least two reactive sites. (4marks)
- b) Explain the following terms
- i) Amorphous polymer
 - ii) Atacticity
 - iii) Copolymer (6marks)
- c) Poly (styrene) is represented by the formula



- i) Draw molecular structures for tetramers (n=4) of the atactic, isotactic, and syndiotactic forms of polystyrene. (6marks)
- ii) Draw the structure and name the monomer that forms polystyrene (2 marks)
- d) High-density polyethylene (HDPE) has a higher melting point and more rigid than low-density polyethylene (LDPE). Explain. (4marks)
- e) Describe the kinetics of the termination process by coupling in free radical polymerization. (4marks)
- f) List any four types of components in rubber compounding (4marks)

Question TWO

- a) Use isosorbide diester, whose structure is given below to answer questions that follow



$$\text{Volume of molecule (V)} = 355.80 \text{ cm}^3$$

$$\rho \text{ (density)} = 1.51 \text{ g/cm}^3$$

Assume the following molar attraction constants (G) ($\text{J}^{1/2} \text{ cm}^{3/2} \text{ mol}^{-1}$)

-CH ₃	420
-CH ₂ -	280
-COO-	511
-CH-	140
-O-	137

- i) Estimate the solubility parameter of isosorbide diester (6 marks)
- ii) Suggest the derived units of solubility parameter δ . (2 marks)
- b) i) Explain the differential scanning calorimetric (DSC) method for determination of T_g of polymers. (3 marks)
- ii) Sketch a DSC plot for an amorphous polymer and label T_g on this curve. (3 marks)
- c) i) Calculate the weight average molecular weight of a polymer containing 9 moles of molecular weight 30,000 and 5 moles of molecular weight 50,000. (3 marks)
- iii) work out the polydispersity index for the polymer in (i) above (3 marks)

Question THREE

- a) Describe the determination of polymer molecular weight distribution by gel permeation chromatography. (6 marks)
- b) i) What is theta state? (2 marks)
- ii) Give two parameters that constitute a theta state.

- c) Discuss the thermodynamics of dissolution of a polymer (2 marks)
(5 marks)
- d) Give three advantages and two disadvantages of emulsion polymerisation method
(5marks)

Question FOUR

- a) i) Explain the term birefringence (2 marks)
ii) What is the significance of birefringence in fibre characterisation? (3marks)
- b) Describe melt spinning of polymeric fibres (6marks)
- c) With the help of a tree diagram show the classification of natural and man made fibres (6 marks)
- d) Give three applications of polyester fibres (3marks)

Question FIVE

- a) i) Derive the expression for overall rate of polymerization as a function of conversion in step growth polymerization. (6marks)
- ii) State two ways of controlling molecular weight in step growth polymerisation reactions (2marks)
- b) i) Explain injection molding process. (5 marks)
- ii) Enlist any three industrially important products prepared by this process. (3 marks)
- c) i) Differentiate between extenders and blowing agents in rubber compounding.
- ii) Explain their role in the production cost of moulded goods. (4 marks)