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(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**THIRD/FOURTH YEAR FIRST SEMESTER EXAMINATIONS
SUPPLEMENTARY EXAM**

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE (CHEMISTRY)**

COURSE CODE: SCH 332

COURSE TITLE: POLYMER CHEMISTRY

DATE: 28TH JULY 2022

TIME: 8.00 AM TO 10.00 AM

INSTRUCTIONS TO CANDIDATES

1. Answer all questions

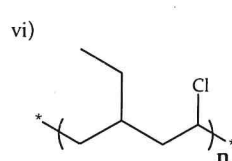
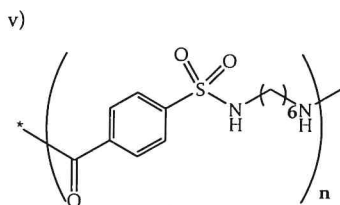
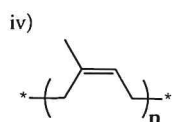
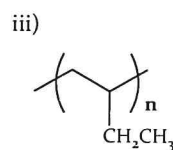
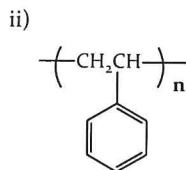
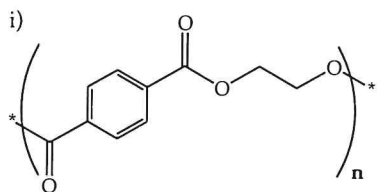
TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over.

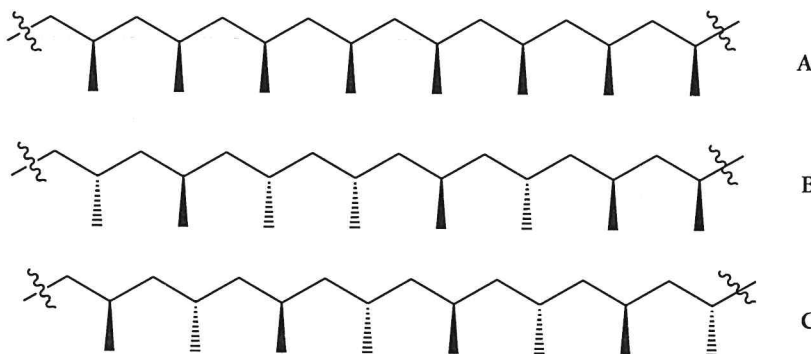
QUESTION 1 (19)

- a) Suggest structures of the monomer or monomers used to synthesize the following polymers and for each, indicate whether it is a chain-growth polymer or a step-growth polymer **9 Marks**



- b) Which of the polymers in question 1 a, above is polyester? Explain. **2 Marks**

- c) Study the three segments A, B, and C of a well known polymer all produced from the same monomer.



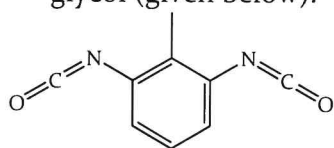
- i) Identify the polymers and then draw structure of the common monomer **2 Marks**

- ii) Determine the stereochemistry in each case **1.5 Marks**

- iii) What are the possible differences in the physical properties of the three polymers? Explain. **4.5 Marks**

QUESTION 2 (19)

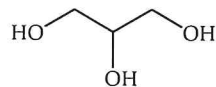
- a) A type of polyurethane can be formed the reaction mixture of toluene-2,6-diisocyanate and ethylene glycol (given below).



toluene-2,6-diisocyanate

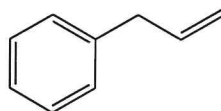


Ethylene glycol



glycerol

- i) Show the mechanism leading to the urethane functional group that joins the monomers of given 5 Marks
 - ii) Draw the structure of the polyurethane produced above 2 Marks
 - iii) If a small amount of glycerol is added to the reaction mixture of during the synthesis of polyurethane foam, a much stiffer foam is obtained. Explain using diagrams. 3 Marks
- b) 1-allylbenzene, structure provided, is said to form a random copolymer rather than a homopolymer, following cationic polymerization.

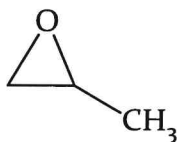


1-allylbenzene

- i) What is a copolymer? 1 Mark
- ii) Give two examples of initiators used in cationic polymerization process. 2 Marks
- iii) Using appropriate equations explain why 1-allylbenzene forms a random copolymer instead of homopolymer. 6 Marks

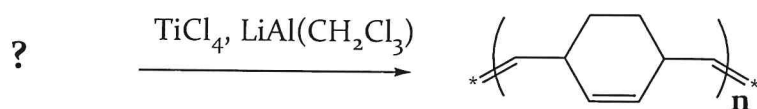
QUESTION 3 (18)

- a) Explain why when propylene oxide undergoes anionic polymerization, nucleophilic attack occurs at the less substituted carbon of the epoxide, but when it undergoes cationic polymerization, nucleophilic attack occurs at the more substituted carbon. 4 Marks

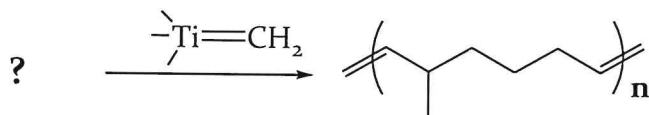


- b) Give monomers for the following polymerization reactions. 3 Marks

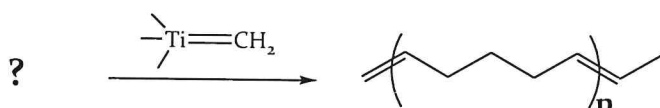
i)



ii)



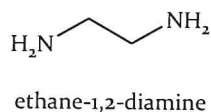
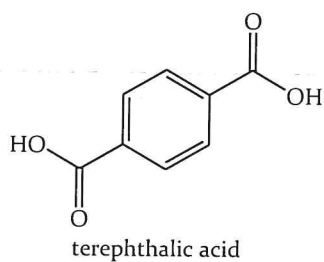
iii)



c) Show mechanism for polymerization process in question 3, a, iii) above.

4 Marks

d) A particularly strong and rigid polyamide whose trade name is urigal, used fire fighter jackets, is made from terephthalic acid and ethane-1,2-diamine whose structures are given below.



i) Give the structure of this polymer.

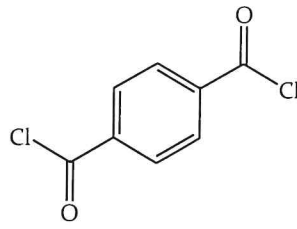
2 Marks

ii) What in your understanding makes the polymer so strong? Show using diagrams where applicable.

2 Marks

iii) In your opinion would terephthaloyl dichloride (structure given below) be a suitable replacement for terephthalic acid in the manufacture of the material urigal. Give reasons either way.

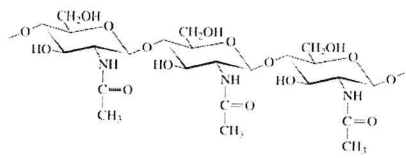
3 Marks



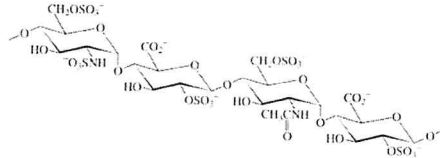
terephthaloyl dichloride

QUESTION 4 (14)

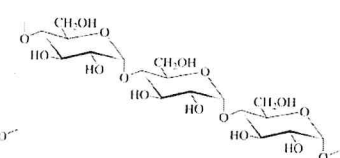
a) Structures A to E given below are sub-units for the polysaccharides cellulose, Heparin, amylopectin, amylose and chitin



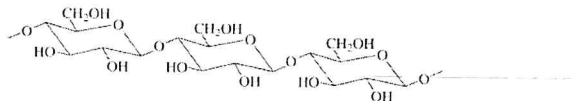
A



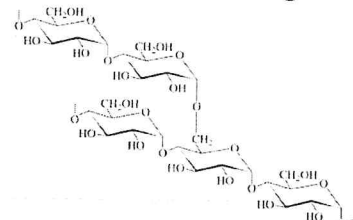
B



C



D



E

- Match the compounds with the structures **5 Marks**
- What name is given to the bonding between monomers of the polysaccharides above? **1 Marks**
- Describe the differences and/or similarities, if any, in bonding between the monomers of amylose and amylopectin. **2 Marks**
- The linkage in the monomers of cellulose causes the polymers to line in linear arrays. Explain using diagram/structures. **2 Marks**

d) Answer the following questions related to proteins and peptides

- Describe using structural formulae types of bonding linking amino acids together in Peptides and proteins. **2 Marks**
- Free rotation about the bonds connecting amino acids in peptides is not possible (see diagram below). Explain using structures. **2 Marks**

