



(University of Choice)

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

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2022/2023 ACADEMIC YEAR**

**THIRD YEAR EXAMINATIONS**

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

**COURSE CODE: SCH 332**

**COURSE TITLE: POLYMER CHEMISTRY**

**DATE: 25<sup>th</sup> Wednesday April 2023**

**TIME: 12.00 - 2.00 PM**

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**INSTRUCTIONS TO CANDIDATES**

Answer ALL questions

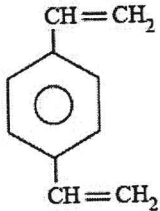
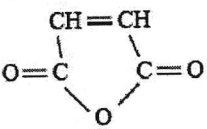
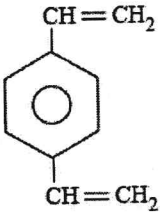
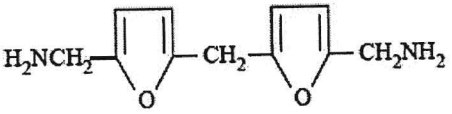
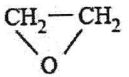
TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

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

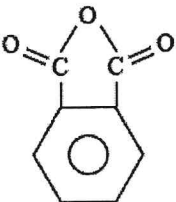
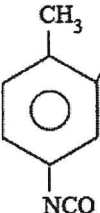
Q1.

i.) Complete the table by indicating whether the monomer(s) will form a polymer and, if so, whether the polymer formed will be linear or branched/cross-linked. (11 Marks)

Monomer A	Monomer B	Polymer		
		No	Yes	
			Linear	Branched/ Cross-linked
a. $\text{R}-\text{C}\begin{matrix} \text{O} \\ // \\ \text{OH} \end{matrix}$	$\text{HO}-\text{R}'-\text{OH}$ $\quad  $ $\quad \text{OH}$			
b. $\text{HOOC}-\text{R}-\text{COOH}$	$\text{HO}-\text{R}'-\text{OH}$			
c. $\text{HO}-\text{R}-\text{OH}$	$\text{R}'-\text{N}=\text{C}=\text{O}$			
d. 				
e. $\text{HO}-(\text{CH}_2)_5\text{COOH}$				
f. $\text{H}_2\text{N}-\text{R}-\text{NH}_2$ $\quad  $ $\quad \text{NH}_2$	$\text{HOOC}-\text{R}'-\text{COOH}$			
g. 				
h. $\text{H}_2\text{N}-\text{R}-\text{NH}_2$	$\text{OCN}-\text{R}'-\text{NCO}$			
i. $\text{CH}_2=\text{CHCOOH}$				
j. $\text{CH}_2\text{O}$				
k. 				

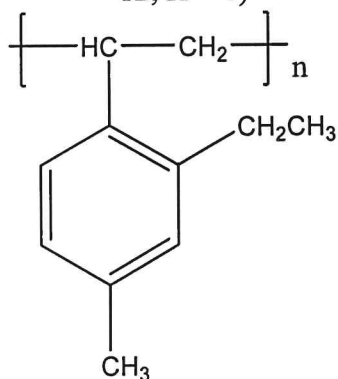
ii.) State the functionality of the monomers where you have indicated above that a polymer forms. (5 mks)

iii.) Show the repeating units that would be obtained from the reaction of the following monomer(s). (4 Mks)

- a.  $\text{H}_2\text{N}-(\text{CH}_2)_5\text{NH}_2$  and  $\text{Cl}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_5-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$
- b.  $\text{HOOC}-\text{C}_6\text{H}_4-\text{COOH}$  and  $\text{HO}-(\text{CH}_2)_{10}-\text{OH}$
- c.  $\text{HOCH}_2-\text{CH}_2-\text{CH}_2\text{OH}$  and 
- d.  and  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$

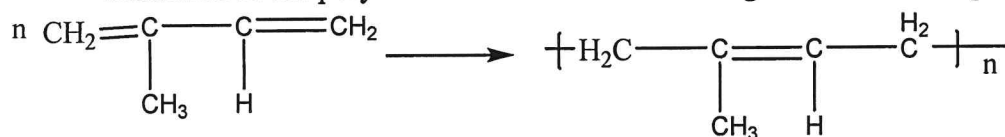
Q2.

- i) Define degree of polymerization and state its importance in polymer chemistry. (2 Mks)
- ii) What is the molecular weight of the following polymer if the degree of polymerization is 28600? (C = 12, H = 1)



(4 Mks)

- iii) Natural rubber is a polymer of isoprene. Illustrate its anionic polymerization mechanism that leads to the formation of the polymer shown below. Use an organometallic compound as chain initiator. (6 Mks)

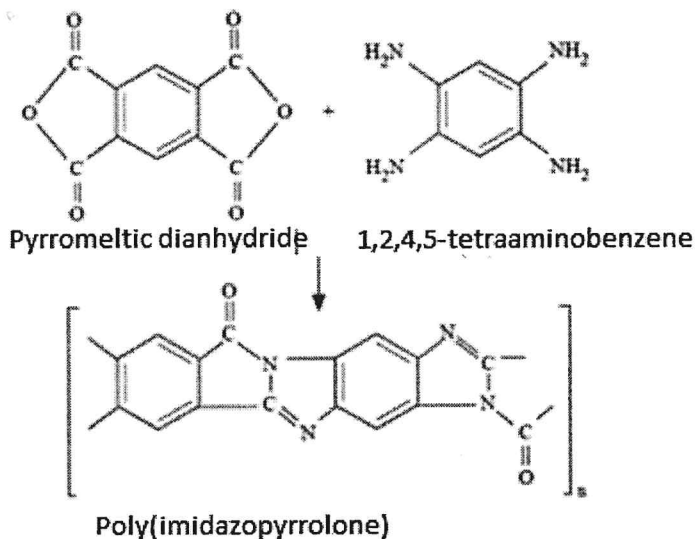


- iv) Using clear illustrations where possible distinguish between the following terms that are used to classify polymers

- a) Homo-polymers and Copolymers (2 Mks)
- b) Random copolymer and alternating copolymer (2½ Mks)
- c) Blocked copolymer and grafted copolymers (2½ Mks)

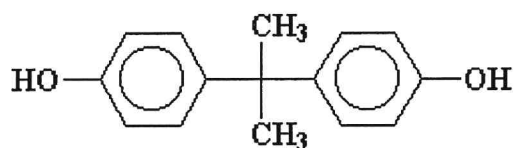
Q3.

Poly(imidazopyrrolone) is a ladder polymer that can be obtained from an aromatic dianhydride, pyromellitic dianhydride and an aromatic tetraamine, 1,2,4,5-tetraaminobenzene (see structures below).

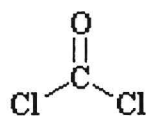


- What is a ladder polymer? (2 mks)
- Given the structure of the poly(imidazopyrrolone), give a detailed reaction mechanism that lead to the formation of the ladder linkages in the polymer (10 mks)

Q4. Polycarbonates can be produced by the reaction of bisphenol A and phosgene.



**bisphenol A**



**phosgene**

- Give the structure of the polycarbonate polymer that will result from the above reaction (2 Mks)
- Give the detailed reaction mechanism leading to the production of the polycarbonate (5 Mks)
- Explain any five applications of the polycarbonates (5 Mks)
- List any four properties of materials made of polycarbonates (4 Mks)