



**MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
FOURTH YEAR FIRST SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH  
SCIENCES  
BACHELOR OF SCIENCE (BSc.)**

**COURSE CODE: CHE 4133**

**UNIT NAME: POLYMER CHEMISTRY**

**DATE: 4<sup>TH</sup> APRIL 2022**

**TIME: 1100 – 1300 HOURS**

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**INSTRUCTIONS TO CANDIDATES**

1. Answer the compulsory question ONE and any other TWO in section B.
2. All University Examinations rules and regulations apply.

*This paper consists of 5 printed pages. Please turn over:*

## SECTION A

### Question One (30 marks)

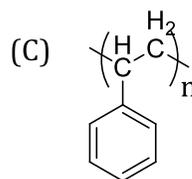
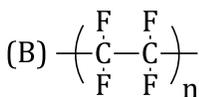
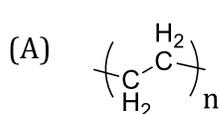
a) Give brief definitions of the following polymer chemistry terminologies. Give examples in each case. **(8 marks)**

- i. Chain-growth polymerization
- ii. Copolymers
- iii. Elastomer
- iv. Ziegler Natta catalysis

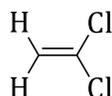
b) Briefly explain the following observations: **(6 marks)**

- i) Once the thermosetting polymers have been hardened, they cannot be remolded by heating.
- ii) Poly(ethylene terephthalate) (1-PET), is preferably used to make soft drink bottles over polystyrene (6-PS).
- iii) Oriented polymers can conduct electricity whereas conventional polymers do not.

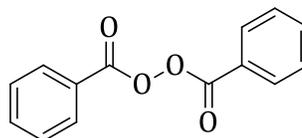
c) Name the following chain-growth polymers and state their uses. **(6 marks)**



d) The Vinylidene chloride monomer below can undergo free radical polymerization.



vinylidene chloride

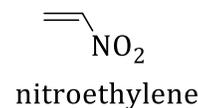
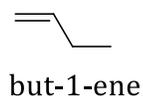
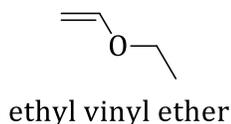


benzoyl peroxide

- i) Provide a detailed arrow-pushing mechanism for the first two propagation steps, using benzoyl peroxide as the initiator **(3 marks)**
- ii) Draw a condensed formula for the polymer, showing the repeating unit **(2 marks)**
- iii) Provide the name of the polymer **(1 mark)**

e) From the list of monomers given below, choose one monomer that is most likely to undergo each of the following processes. Justify your choice.

- i) Anionic polymerization. **(2 marks)**
- ii) Cationic polymerization **(2 marks)**



## SECTION B

### Question Two (20 marks)

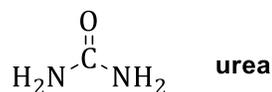
a) Differentiate between the following polymer chemistry terminologies giving examples in each case) **(8 marks)**

- i. Isotactic and atactic isomerism
- ii. Thermosetting and thermoplastic polymers
- iii. Anionic and Cationic polymerization
- iv. Block and Graft copolymers

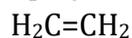
b) Polyureas are used to make truck bed liners. Propose a synthesis of polyurea and draw the condensed formula of this polymer. The structure of urea is shown below.

(Hint: follows mechanism for synthesis of polyurethanes)

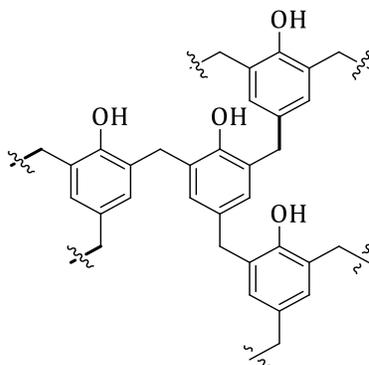
**(4 marks)**



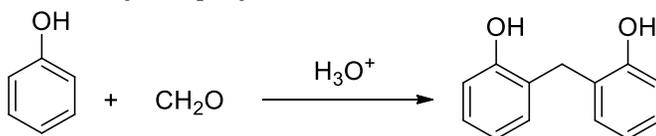
c) Order the following monomers with respect to their expected reactivity towards cationic polymerization and explain your answer: **(3 marks)**



d) Bakelite is a phenolic resin, produced by reaction of phenol and formaldehyde.



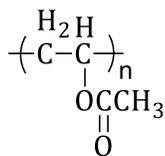
Using detailed arrow-pushing mechanism, account for the formation of the Bakelite segment below via acid catalyzed polymerization mechanism. **(5 marks)**



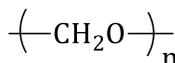
### Question Three (20 marks)

a) Identify the monomer units from which each of the following polymers is made from and indicate whether each is a chain-growth or step-growth polymer: **(6 marks)**

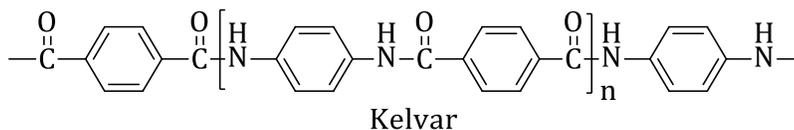
i.



ii.



iii.



b)

i. Why is Ziegler-Natta catalyzed polymerization preferred over free radical polymerization? Briefly explain. **(4 marks)**

ii. The configuration of a polymer of 1,1-dichloroethene, is neither isotactic, syndiotactic, nor atactic. Briefly explain **(4 marks)**

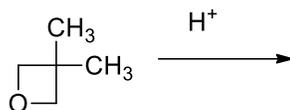
c) Poly(ethylene terephthalate) PET, also known as Dacron is a synthetic polymer.

i) Briefly explain how Dacron is made. **(3 marks)**

ii) What are some of the uses of this synthetic polymer? **(3 marks)**

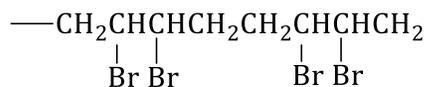
### Question Four (20 marks)

a) Propose a detailed arrow-pushing mechanism for the ring-opening polymerization of 3,3-dimethyloxacyclobutane. Draw a short segment of the polymer. **(4 marks)**

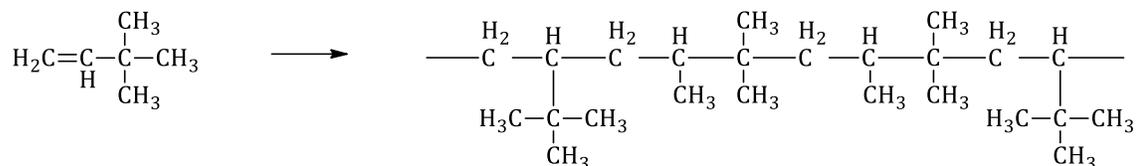


b) Unsymmetrical vinyl monomers can polymerize either via head-to-tail or head-to-head addition mechanism. Why head-to-tail addition is favoured addition? **(2 marks)**

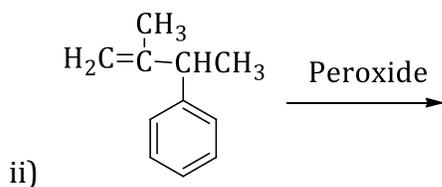
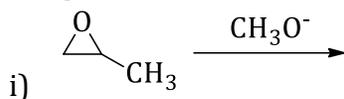
c) How can head-to-head poly(vinyl bromide) below be synthesized? **(4 marks)**



d) Explain why a random co-polymer is obtained when 3,3-dimethyl-1-butene undergoes cationic polymerization. **(4 marks)**



e) Draw short segments of the polymers obtained from the following compounds under the given reaction conditions: **(6 marks)**



**//END**