

**The Open University of Sri Lanka**  
**Faculty of Natural Sciences**  
**B.Sc Degree Programme**



Department	: Chemistry
Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	: CYU5313, Polymer Chemistry
Academic Year	: 2020/2021
Date	: 29.12.2021
Time	: 1.30 pm-3.30 pm
Duration	: 2 hours
Index number	:

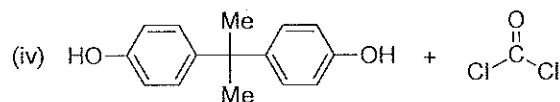
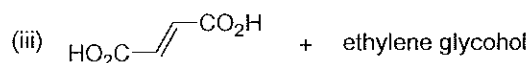
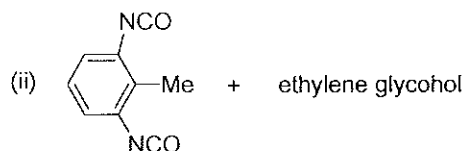
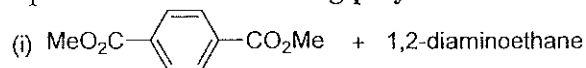
**General Instructions**

1. Read all instructions carefully before answering the questions.
  2. This question paper consists of 4 essay questions in 03 pages. Answer all questions.
  3. Answer for each essay question should commence from a new page.
  5. Non programmable calculators are permitted.
  6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense
  7. Use blue or black ink to answer the questions.
  8. Circle the number of the questions you answered in the front cover of your answer script.
  9. Clearly state your index number in your answer script
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1. (a) (i) Give names of **two common free radical** initiators.  
 (ii) Write the chemical equations for initiation, propagation, termination steps of polymerization of **acrylonitrile** using a **free radical initiator**.

(25 marks)

- (b) Draw the **structures** of the products of the following **polymerization** reactions.



(32 marks)

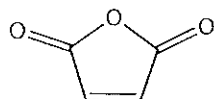
- (c) Draw the **structure** of the **polymer formed** when **urea** ( $\text{H}_2\text{N}(\text{C}=\text{O})\text{NH}_2$ ) is reacted with a large excess of  $\text{HCHO}$ .

(15 marks)

- (d) Briefly explain the “bulk polymerization”. List four advantages and disadvantages of bulk polymerization.

(18 marks)

- (e) Draw the **structure** of the **alternative copolymer** formed when styrene is reacted with maleic anhydride.



(maleic anhydride)

(10 marks)

2. (a) (i) Explain the difference between homo polymers and hetero polymers. Give examples.  
 (ii) What is meant by the term “microstructure of polymers”? Explain using chemical structures of polymers.

(15 marks)

- (b) (i) Explain the structure of amorphous polymers.  
 (ii) What do you mean by the term “glass transition temperature”? Briefly explain.  
 (iii) “Glass transition temperature of a given polymer can be changed using plasticizers and copolymerization techniques”. Justify the statement.  
 (iv) List down the techniques that determine  $T_g$  of a given polymer?  
 (v) Briefly describe how one of the above techniques is used to measure  $T_g$ .  
 (v) Explain the difference in glass transition temperatures of polyethylene (188K) and poly(vinylbiphenyl) (418K).

(45 marks)

- (c) (i) Compare amorphous polymers with crystalline polymers.  
 (ii) Define the degree of crystallinity in terms of density.  
 (iii) How does the temperature affect on nucleation and chain mobility during crystallization.  
 (iv) Compare the melting points of ice and crystalline natural rubber.

(40 marks)

3. (a) Molar masses of three fractions of polyethylene with the molar ratio of 3:2:1 are  $2 \times 10^6$ ,  $3 \times 10^6$  and  $6 \times 10^6$  g/mol respectively. Calculate the number average molar mass,  $\bar{M}_n$ , weight average molar mass,  $\bar{M}_w$ , weight average degree of polymerization,  $[\bar{D}_p]_w$  and the polydispersity factor of this polyethylene sample.

(70 marks)

- (b) At the end group analysis, polyester sample of 0.9510g was neutralized by  $6.00 \text{ cm}^3$  of 0.1 M KOH solution. Calculate the number average molar mass ( $\bar{M}_n$ ) of given polyester sample.

(30 marks)

4. (a) i. What is meant by cure reactions in polymer industry?  
 ii. What are pre polymers or resin or half cured polymers?  
 iii. List down three commercially important cure reactions.

(20 marks)

- (b) (i) What is the importance of using a cationic stabilizer during cyclisation reaction of natural rubber? Explain briefly.

(ii) Briefly describe what is meant by vulcanization of rubber?

(iii) Stearic acid is used to improve the compatibility of zinc oxide with rubber during vulcanization process. Why?

(iv) "During rubber vulcanization, the sulphur/accelerator ratio is an important factor in formulating different rubber products for desired applications". Discuss this statement.

(40 marks)

- (c) What do you mean by photo degradation? How do you prevent it? Explain briefly.

(20 marks)

- (d) Write brief accounts on

(i) Compounding of plastics

(ii) Curing agents

(iii) Fillers

(iv) Antioxidants

(20 marks)

