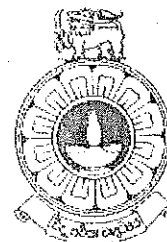


18  
2019/20

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



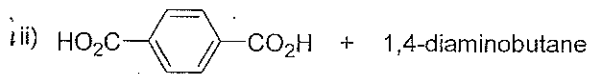
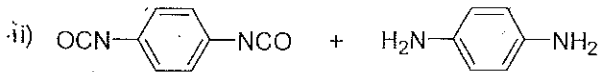
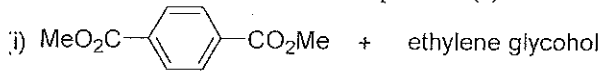
Department	: Chemistry
Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	: CYU5313 Polymer Chemistry
Academic Year	: 2019/20
Date	: 17.01.2020
Time	: 2.00 pm to 4.00 pm
Duration	: 2 hours
Index number	:

**General Instructions**

1. Read all instructions carefully before answering the questions.
  2. This question paper consists of 4 questions in 2 pages. Answer **all questions**.
  3. Answer for each question should commence from a new page.
  4. Having any unauthorized documents/ mobile phones in your possession is a punishable offense
  5. Use blue or black ink to answer the questions.
  6. Circle the number of the questions you answered in the front cover of your answer script.
  7. Clearly state your index number in your answer script.
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- Q1. (a) (i) Give names of **two** common cationic initiators.  
 (ii) Write the chemical equations for initiation, propagation, termination steps of polymerization of styrene using a **cationic initiator**. (24 marks)

(b) Draw the **structures** of the product(s) of the following **polymerization** reactions.



iv) isoprene (32 marks)

Q2. Draw the **structure** of the **polymer formed** when phenol is reacted with a large excess of HCHO. (10 marks)

Q3. Write an account on "suspension polymerization". (18 marks)

Q4. Draw the **structure** of the graft copolymer formed when polystyrene is reacted with acrylonitrile. (10 marks)

Q5. Average molar mass of polypropylene is 8400 g/mol. Calculate the degree of polymerization of this polymer. (06 marks)

- Q6. (a) (i) What are stereo regular polymers?  
 (ii) Briefly describe the types of stereo isomers that arise due to asymmetric carbon?  
 (iii) Which of the following polymers are optically active? Give reasons.  
 a) Polypropylene oxide      b) Polyethylene      c) Poly(vinyl chloride) (24 marks)

- (b) (i) How do you differentiate amorphous polymers from crystalline polymers?  
 (ii) What is meant by glass transition temperature?  
 (iii) What are the physical properties that change at glass transition temperature? List 5 of them.  
 (iv) Polyethylene terephthalate (PET) has higher  $T_g$  compare to Polyethylene. Explain. (42 marks)

(c) What are the factors that change the ratio of crystalline to amorphous polymers? Explain briefly. (12 marks)

- (d) (i) How do you express Degree of crystallinity in terms of density?  
 (ii) Assume that the density of the crystalline rubber increases by 5% that of the amorphous rubber, calculate the degree of crystallinity in crystalline rubber. Densities of amorphous rubber and 100% crystalline rubber are  $850 \text{ kgm}^{-3}$  and  $980 \text{ kgm}^{-3}$  respectively. (22 marks)

03 (a) A polypropylene sample with molar ratios of 1:3:2 have molar masses  $1.3 \times 10^5$ ,  $1.2 \times 10^5$  and  $4.5 \times 10^5$  respectively.

- (i) Calculate the number average molar mass,  $\overline{M}_n$ , and the number average degree of polymerization,  $[\overline{D}_p]_n$  of polypropylene sample.  
 (ii) If the polydispersity factor of this sample is 1.8, what is the weight average molar mass,  $\overline{M}_w$  of polypropylene? (48 marks)

(b) (i) Write down mathematical expressions for the followings.

1. Relative viscosity                      2. Specific viscosity

(ii) If the flow time taken by a polymer solution and the solvent are 2000s and 200s respectively, calculate the specific viscosity. (12 marks)

(c) (i) Polymer dissolution is a very slow process. Give reasons.

(ii) What is the importance of polymer solubility in industry? Explain. (12 marks)

(d) (i) Write down Mark-Houwink equation and define terms.

(ii) If  $\alpha = 0.60$ ,  $K = 1.6 \times 10^{-4}$  dl/g and  $\eta = 0.04$  dl/g, calculate the viscosity average molecular mass of a given polymer sample. (28 marks)

04. (a) (i) What is meant by thermal degradation?

(ii) Teflon is stable even at  $400^\circ\text{C}$ . Explain the reason. (12 marks)

(b) (i) What is meant by vulcanization of rubber? Briefly explain.

(ii) What are the ingredients necessary for sulphur vulcanization and explain their role.

(iii) Explain how rubber is milled or masticated?

(iv) What are the changes of physical properties of polymer during this process?

(v) What are the advantages of this process during vulcanization? (48 marks)

(c) (i) What is meant by yellow discoloration of rubber latex?

(ii) What are the ways of removing it? Briefly explain.

(iii) Write short description on

a) Plasticizers      ii. Nitrile rubber      iii. Polystyrene (24 marks)

(d) (i) What are the structural difference between thermosets and thermoplastics?

(ii) Thermosets cannot be recycled like thermoplastics. Explain the reason. (16 marks)

