

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS – DECEMBER 2001
POLYMER SCIENCE I – SCH 2107
TIME – (2 ½) TWO AND HALF HOURS

LIBRARY USE ONLY

INSTRUCTIONS TO CANDIDATES

Answer **ALL** questions from Section A and **ANY THREE** questions from Section B.

SECTION A (Answer all questions – 40 marks).

1. (a) Illustrate the following structures using polypropylene:
- (i) Isotactic
 - (ii) Syndiotactic
 - (iii) Atactic
 - (iv) Which of these structures has a greater percentage of crystallinity and why. (5 marks)
- (b) Give an example of each of the following polymer classes:
- (i) Homochain polymer
 - (ii) Heterochain polymer
 - (iii) Copolymer
 - (iv) Crosslinked polymer (5 marks)
- (c) Differentiate between thermoplastics and thermosetting polymers and give one example of each of the polymers. (5 marks)
- (d) (i) What do you understand by 'degree of polymerization'? (5 marks)
- (ii) If the average weight of a given PVC sample is 275000g/mol, what is the degree of polymerization of the sample. (5 marks)
- (e) Give **five** factors that characterize step-growth polymerization. (5 marks)
- (f) (i) Differentiate between monomer and repeating unit.
- (ii) Draw possible structure of ABS if it is described as 'a graft of styrene and acrylonitrile on a butadiene backbone'. (5 marks)
- (g) Write the repeating units of each of the following polymers:
PAN, PS, Nylon 6, PMMA and PVA₁ (10 marks)

SECTION B (60 marks)

2. (a) What is step-reaction polymerization. (2 marks)
- (b) How does the functionality of reactants in a step-growth reaction affect the growth of the polymer chain? (3 marks)
- (c) Explain the relationship between number average degree of polymerization and extent of reaction as deduced by Carothers. (10 marks)
- (d) Under what condition(s) is Carothers' Equation applicable in condensation polymerization. (5 marks)
3. (a) Discuss briefly the following stages in chain polymerization:
- (i) Generation of radicals (5 marks)
 - (ii) Inhibition and retardation (5 marks)
 - (iii) Chain propagation (5 marks)
 - (iv) Termination by combination and disproportionation. (5 marks)
4. (a) Compare and contrast the commercial production of LDPE and HDPE and closely account for the differences in the structures of the two polymers. (12 marks)
- (b) Outline some of the properties of PE and assess where the polymer could be used based on the chosen properties. (8 marks)
5. Compare by giving examples, the differences between *Anionic* and *Cationic* polymerization with special emphasis on:
- (i) Initiators
 - (ii) Propagation mechanism
 - (iii) Termination (20 marks)

END OF QUESTION PAPER!!!