

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS – DECEMBER 2002
POLYMER SCIENCE I – SCH 2107
TIME – (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

Answer **ALL** questions from Section A and **ANY THREE** questions from Section B.
Each question in Section B carries 20 marks.

SECTION A (Answer all questions.)

1. (a) What is referred to as “degree of polymerization?” (2 marks)
- (b) What type of molecular weight average is determined through colligative properties? (2 marks)
- (c) List in order of increasing value: M_w ; M_n ; M_z and M_v . (4 marks)
- (d) Draw the structures of the repeating units of each of the following polymers: N6,6; PAN; PP and SBR. (8 marks)
- (e) What is a ‘gegen’ ion? Give an example. (4 marks)
- (f) Define reactivity ratios r_1 and r_2 and indicate their values for an ideal copolymer and an alternating copolymer. (6 marks)
- (g) Give two examples for each of the following classes of polymers:
- (i) natural polymers;
 - (ii) thermosets;
 - (iii) addition polymers;
 - (iv) branched polymers;
 - (v) thermoplastics. (10 marks)
- (h) What do you understand by conformation (arrangements) and configuration (arrangements) in polymer structures? (4 marks)

SECTION B (Answer any three questions. Each question carries 20 marks)

2. (a) What do you understand by the term 'polymerization'? (2 marks)
- (b) Describe the addition polymerization of styrene through initiation with benzoyl peroxide. Detail the three major steps of initiation, propagation and termination of the system. (18 marks)
3. (a) Explain the relationship between degree of polymerization and molecular weight of a polymer. (4 marks)
- (b) Given that the degree of polymerization of PP is 457, calculate the molecular weight of the polymer. (4 marks)
- (c) Calculate the Average Number Molecular weight (M_n) and Average Weight Molecular weight (M_w) of a mixture of five molecules each having the following molecular weights:
- (i) 1.25×10^6
 - (ii) 1.35×10^6
 - (iii) 1.50×10^6
 - (iv) 1.75×10^6
 - (v) 2.00×10^6
- (10 marks)
4. (a) State and justify the steady-state assumptions used in deriving the kinetic equations for radical chain polymerization. (10 marks)
- (b) Give an expression of the rate of polymerization of radical initiated chain polymer system and explain the parameters involved. (6 marks)
- (c) Differentiate between chain-growth polymerization and step-growth polymerization. (4 marks)
5. (a) What is the role of a co-catalyst in ionic polymerization? (2 marks)
- (b) Compare and contrast the differences and similarities between anionic and cationic polymerization. (8 marks)
- (c) Discuss the structure of Ziegler – Natta catalysts and the mechanisms of coordination polymerization in which they are used. (10 marks)
6. Draw all possible structures for the polymerization of isoprene $\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}=\text{CH}_2$ and label them. (20 marks)

END OF QUESTION PAPER!!!