

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATION – DECEMBER 2005
POLYMER SCIENCE - I – SCH 2107

TIME – THREE (3) HOURS

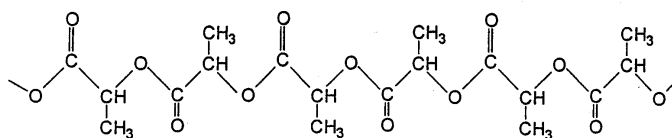
INSTRUCTION TO CANDIDATES:

Answer **ALL** questions in Section A and **ANY THREE** questions from Section B.
Section A carried 40 Marks and each question in Section B carries 20 Marks.

This question paper consists of **three** printed pages (on one side only) including the top page.

SECTION A

1. (a) Give the repeating unit for the following polymer.
- (i) polystyrene
 - (ii) poly tetrafluoroethylene
 - (iii) polyvinylchloride
- (3 Marks)
- (b) Draw the structures for the following polymers.
- (i) melamine formaldehyde
 - (ii) nylon6,6
 - (iii) poly (ethyleneterphelate)
- (6 Marks)
- (c) Write chemical equations for the industrial synthesis for the following compounds.
- (i) methyl methacrylate
 - (ii) acrylonitrile
 - (iii) vinyl chloride
- (3x3 Marks)
- (d) With an appropriate structural example, define following terms:
- (i) graft polymer
- (3 Marks)
- (ii) random polymer
- (3 Marks)
- (e) One form of biodegradable polymer, used for 'plastic bags' has the following structure.



- (i) What could be the structure/s of monomer/s for this polymer?
(2 Marks)
- (ii) Classify the polymer.
(1 Marks)

- (f) What do you understand by 'degree of polymerization?' (2 Marks)
- (g) If the average molecular weight of a given PVC sample is 275000 g/mol, what is the degree of polymerization of the sample. (3 Marks)
- (h) Polyvinylalcohol cannot be synthesised from vinyl alcohol. How, with an explanation, then this polymer can be synthesise. Write chemical equation for the reaction involved. (4 Marks)
- (i) Natural rubber is the cis-isomer of isoprene while gutta percha is the trans- isomer. Write the structures of the repeating units of each of these polymers. (4 marks)

SECTION B :

2. (a) Write chemical equations for the following reactions in the benzoyl peroxide initiated polymerization of vinyl chloride.
- Initiation
 - Propagation
 - Termination by recombination, by disproportionation and by chain transfer. (10 Marks)
- (b) Differentiate between thermoplastics and thermosetting polymers and give one example each of the polymer. (5 Marks)
- (c) What function do the following ingredients fulfill in an SBR polymerization.
- Emulsifier
 - Modifier
 - Mercaptan
 - EDTA
 - Sequestering agent (5 Marks)
3. (a) Given the following values of Q and e, calculate r_1 and r_2 for both pairs and suggest the type of polymer each will produce.

(i)

Compound	Q	e
1,3-butadiene	2.39	-1.05
Methyl methacrylate	0.74	0.40

(ii)

Compound	Q	e
Styrene	1.00	-0.80
Vinyl chloride	0.044	0.20

(10 Marks)

(b) Differentiate between chain-growth polymerization and step-growth polymerisation. (5 Marks)

(c) Write Carother's equation and modified Carother's equation. Under what conditions both Carothers' Equations applicable in condensation polymerisation? (5 Marks)

4. (a) 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

Is the polymer monodisperse or polydisperse? (10 Marks)

(b) Taking **styrene** as an example, write chemical equations for the initiation, propagation and termination steps involved in the cationic polymerisation of this monomer. (5 Marks)

(c) Describe the art of latex tapping. (5 Marks)

5. (a) Draw
(i) Isotactic
(ii) Syndiotactic atactic
(iii) cis and
(iv) trans
structures for the polymerisation of chloroprene. (5 Marks)

(b) What is ionic polymerisation? Write chemical equations for an anionic polymerisation. (5 Marks)

(c) Sketch labeled flow chart diagram for the manufacture of HDPE. (10 Marks)

*****END OF PAPER*****