

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS – DECEMBER 2004
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 carries 40 Marks and each question in Section B carries 20 Marks.

TOTAL MARKS = 100

SECTION A:

1. (a) What is the degree of polymerization of each of the following?

- (i) PVC with molecular weight 23436
- (ii) PE with molecular weight 16492
- (iii) PMA with molecular weight 6032
- (iv) PS with molecular weight 6032
- (v) PsoB with molecular formula $C_{25}H_{52}$

(10 Marks)

(b) List with examples at least four classes of polymers.

(8 Marks)

(c) What properties distinguish a thermoplastic polymer from a thermosetting polymer? Give one example of each class.

(5 Marks)

(d) Differentiate between “polymer” and “macromolecule”.

(2 Marks)

(e) What function do the following ingredients fulfill in an SBR polymerization system?

- (i) Mercaptan
- (ii) Emulsifier
- (iii) Modifier
- (iv) EDTA
- (v) Sequestering agent

(5 Marks)

(f) Give the repeating unit of the following polymer.

- (i) polyvinylacetate
- (ii) polymethyl methacrylate
- (iii) polypropylene
- (iv) poly tetrafluoroethylene
- (v) polystyrene

(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

(5 Marks)

SECTION B:

2. (a) What do you understand by reaction ratios of a copolymerisation reaction?

(2 marks)

(b) Explain the Q – e method of determination of reaction ratios. When is this method used?

(2 marks)

(c) Given the following pairs:

(i)

Compound	Q	e
Styrene	1.00	-0.80
Vinyl acetate	0.03	-0.22

(ii)

Compound	Q	e
Acrylonitrile	0.06	1.20
Butadiene	2.39	-1.05

Calculate r_1 and r_2 for both pairs and suggest the type of polymer each will produce.

(16 Marks)

3. (a) 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)

(b) Describe the art of latex tapping.

(9 Marks)

(c) Describe briefly three commercial methods of latex concentration.

(3 Marks)

(d) What do you understand by vulcanization of rubber?

(4 Marks)

4. (a) Differentiate between step-growth polymerization and addition polymerization. Give one example of each.

(6 Marks)

(b) Describe the three essential steps in chain polymerization giving examples for each step.

(6 Marks)

(c) What is ionic polymerization? Write chemical equations for anionic as well as cationic polymerizations.

(8 Marks)

5. (a) Polyvinylalcohol can not be synthesised from vinyl alcohol but it can be synthesized from polyvinyl acetate. Explain this with the aid of chemical equations.

(4 marks)

(b) Define (i) isotactic (ii) syndiotactic and (iii) atactic and draw structure for each.

(6 Marks)

(c) Suppose in a polymer sample there are 100 polymer molecules of molecular mass 10^3 , 200 molecules of molecular mass 10^4 and 200 molecules of molecular mass 10^5 . Calculate :

(i) M_n

(ii) M_w

(iii) M_w/M_n

(iv) Is the polymer mono or disperse?

(10 Marks)

6. With the aid of a diagram, outline the production of polypropylene with direct reference to:

(i) raw material preparation

(ii) manufacturing process

(iii) structure and properties

(iv) application

(20 Marks)

END OF QUESTION PAPER