NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

POLYMER SCIENCE I
SCH 2107

First Semester Examination Paper

DECEMBER 2017

This examination paper consists of 3 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: NONE

Examiner's Name: DR C T PAREKH

INSTRUCTIONS
1. Answer <u>all</u> questions from Section A and <u>any three</u> from Section B. Section A carries 40 marks and each question in Section B carries 20 marks.

2. Show mechanism, chemical steps or synthesis by means of curved arrows.

MARK ALLOCATION

QUESTION	MARKS
1.	40
2.	20
3.	20
4.	20
5.	20
TOTAL POSSIBLE MARKS	100

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1. (a) What is the degree of polymerization of each of the following?
       (i)   PVC with molecular weight 15625
       (ii)   PE with molecular weight 17500
       (iii)   PMA with molecular weight 550
       (iv)   PS with molecular weight 5200   (2x4 Marks)

    (b) What are the properties of a thermoplastic polymer?   (5Marks)

    (c) Differentiate between "polymer" and "macromolecule".   (2 Marks)

    (d) Draw the structure of any living polymer.   (2 marks)

    (e) Draw the monomer structures for the following polymers.

       (i)   polypropylene
       (ii)   polymethylmethacrylate
       (iii)   polytetrafluoroethene   (1x3 Marks)

    (f) You are given five different polymers and their examples of their names are mixed up.
        Rewrite the polymers with their correct names.

       (i)   natural polymers   (i) poly butadiene
       (ii)   addition polymers   (ii) wool
       (iii)   crossed link polymers   (iii) rayon
       (iv)   condensation polymer   (iv) UF
       (v)   regenerated fibres   (v) terylene   (1x5 Marks)

    (g) Draw the structures of the following polymers.

       (i)   spandex
       (ii)   bakelite   (2x3 marks)

    (h) What do you understand by the term "mercerization"?   (4 Marks)

    (i) How can a Ziegler/Natta catalyst be synthesised? Write a chemical equation for one of the known
        catalysts.   (5 Marks)

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SECTION B:

2. (a) Using chloroisoprene (2-chloro-1,3-butadiene) as an example, draw (i) isotactic (ii) syndiotactic and (iii) atactic structures. Indicate the characteristics of these stereoisomers.

(4x3 Marks)

   (b) With the aid of a labelled schematic diagram, describe emulsion polymerisation.

(8 Marks)

3. (a) Describe the art of latex tapping. (6 Marks)

   (b) Why is vulcanisation of rubber necessary? Write a chemical equation for the process. (8 Marks)

   (c) Explain, with the aid of chemical equations, why polyvinyl alcohol cannot be synthesised from vinyl alcohol but can be synthesised from polyvinyl acetate. (6 Marks)

4. (a) Differentiate between step-growth polymerization and addition polymerization. Give one example of each. (6 Marks)

   (b) Taking styrene as an example, write chemical equations for the initiation, propagation and termination steps in cationic polymerisation. (10 Marks)

   (c) Draw a possible structure of ABS if it is describe as "…Graft of styrene and acrylonitrile on butadiene backbone". (Please do not use the abbreviation). (4 Marks)

5. (a) Given the following pairs:

Compound	Q	e
styrene	+1.00	-0.80
Vinyl acetate	+0.03	-0.22

   Calculate r_1 and r_2 and suggest the type of polymer that will be produced. (8 Marks)

   (b) When 1,4-diaminobenzene (A) reacts with 1,4-benzenedicarboxylic acid (B) it produces an alternate polymer (- A-B-A-B-A-B-)$_n$.

   (i) Write a reaction mechanism between A and B.

(6 marks)

   (ii) Draw a polymer structure for the product and circle the functional group present and label it.

(2+2 Marks)

   (iii) What is the common name for the polymer and indicate one of its uses?

(1+1 Marks)

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

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