NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE

END FIRST SEMESTER EXAMINATIONS – FEBRUARY 2010

POLYMER SCIENCE I – SCH 2107

TIME: THREE HOURS

INSTRUCTIONS TO CANDIDATES:

ANSWER ALL QUESTIONS IN SECTION A AND ANY THREE QUESTIONS FROM THE SECTION B.

SECTION A CARRIES 40 MARKS AND IN SECTION B EACH QUESTION CARRIES 20 MARKS. MARKS ARE INDICATED IN BRACKET.

THIS QUESTION PAPER CONSISTS OF THREE PRINTED PAGES (ON ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

SECTION A:

1.   (a)   Illustrate the following **tacticity** structures using polypropylene:

             (i)   isotactic
             (ii)   syndiotactic
             (iii)   atactic   (6 marks)

    (b)   Give an example of each of the following polymer classes:

             (i)   copolymer;
             (ii)   crosslinked polymer   (2 marks)

    (c)   Draw the repeating unit of each of the following polymers:

             (i)   polyvinyl acetate,
             (ii)   poly(methyl methacrylate),
             (iii)   polypropylene,
             (iv)   polytetrafluoroethylene

                                                    (4 marks)

    (d)   Give **five** factors that characterise chain-growth polymerisation.
                                                    (5 marks)

    (e)   (i)   Define the concept *'degree of polymerisation'*.
                                                    (2 Marks)
             (ii)   If the average weight of a given PVC sample is 275000g/mol, what is the degree of polymerisation of the sample?   (4 marks)

    (f)   Give **five** factors that characterise step-growth polymerisation.
                                                      (5 marks)

    (g)   Draw a possible structure of ABS if it is described as……'a graft of styrene and acrylonitrile on a butadiene backbone.'

                                                  (4marks)

    (h)   Draw structures of Nomex and Kevlar polyamide. Indicate one use of each.

                                                  (4 marks)

    (i)   What properties distinguish a thermoplastic polymer from a thermosetting polymer?

                                                  (4 Marks)

SECTION B:

2. (a) Natural rubber is the cis-isomer of isoprene while gutta percha is the trans isomer. Write the repeating units of each of these polymers.

(4 Marks)

(b) Describe the art of latex tapping.

(8 Marks)

(c) What do you understand by vulcanisation of rubber?

(4 Marks)

(d) Explain with the aid of chemical equations why polyvinyl alcohol can not be synthesised from vinyl alcohol but it can be synthesised from polyvinyl acetate.

(4 Marks)

3. (a) Taking styrene as an example, write chemical equations for the initiation, propagation and termination steeps involved in anionic polymerisation of this monomer.

(10 Marks)

(b) Given the following pairs:

Compound	Q	e
Acrylonitrile	0.06	1.20
Butadiene	2.39	-1.05

Calculate r_1 and r_2 and suggest the type of polymer will produce.

(10 Marks)

4. (a) Describe how Tencel fibre is produced from wood pulp.

(3 Marks)

(b) Draw structures of the following polymers.
   (i) urea formaldehyde
   (ii) malemine formasldehyde

(6 Marks)

(c) Write synthetic steps with reaction conditions for the formation of carbon fibre from acrylonitrile.

(7 Marks)

5. (a) With the aid of a labelled diagram, outline the production of HDPE.

(10 Marks)

(b) Draw the labelled schematic diagram for emulsion polymerisation. State advantages and disadvantages of the polymerisation.

(6 Marks)

(c) Draw the structure of cotton [poly(1,4-β-anhydroglucopyranose)] fibre.

(2 Marks)

(j) What is the name used to describe the negatively charged counterion in cationic chain reaction polymerisation? Draw the structure of the ion.

(2 Marks)

END OF QUESTION PAPER!!!!