RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Third year Semester I Examination – November / December 2016

CHE 3203 –Chemistry of Polymers

Time: Two (2) hours.

Answer question **no. 01** compulsory and any other **three** questions.
The use of non-programmable calculator is permitted.

1) (a) Polyether [poly(ethylene oxide)] and polyamide (nylon 6) are produced by ring opening reactions in the formation of polymers. Identify the monomer for each polymer and give the structures of polymers.

(b) Identify the monomers of polyester [(poly(ethylene terephthalate)] and write down the structures of polymer. List two uses of polyester.

(c) Three samples of a monodisperse poly(decanediol adipate) are mixed together as follows: 10 g of A, which has a molecular weight of 40,000; 5 g of B, which has a molecular weight of 100,000; and 3 g of C, which has a molecular weight of 200,000. Calculate the number average and the weight average molecular weight of the mixture.

(d) (i) Why are olefins good monomers for polymerization reactions?

(ii) What kinds of structural changes accompany bond-breaking and bond-forming in olefin polymerization?

(e) What is the role of a catalyst in polymerization reaction? What is the difference between a heterogeneous and a homogeneous catalyst?

(f) Write a chemical formula for Teflon and give three properties of Teflon?

(g) Explain the difference between a step growth and a chain growth polymerization. Draw one structure of monomer that can be polymerized in each process.

(h) What is the glass transition (Tg) of a polymer?

(i) Write down the structure of main phospholipids present in the field latex.

(j) (i) Give four commonly used anticoagulants for preserving the field latex.

(ii) Write down the suitable anticoagulant used for the preservation of latex in the process of ribbed smoked sheets (RSS) and crepe productions.

(13 x 10 = 130 marks)

2). (a) Draw the isotactic, syndiotactic and atactic structures of poly(vinyl chloride).

(30 marks)

(b) Define the terms homopolymer and copolymer and name one polymer for each type. Draw the shapes of four different types of molecular structure of copolymer.

(30 marks)

(c) Briefly discuss the following polymerization processes and give one advantage in each process.
(i) Suspension polymerization process.
(ii) Emulsion polymerization process.

(30 marks)

3). (a) Write down the Mark-Houwink equation. Briefly explain how it is used to determine the molecular weight of a polymer?

(30 marks)

(b) A polymer with $Mv = 100000$ obeys the Mark-Houwink equation with $K' = 1 \times 10^{-4}$ and $a = 0.80$. Calculate the relative viscosity at $c = 0.003$ mol/dm^3. Huggins' constant $= 0.33$.

(30 marks)

(c) Draw different types of stress versus strain graphs for the following types of polymers. (Show the shape of the curves in one graph).
(i) Hard, brittle polymer,
(ii) Rigid and high impact thermoplastics,
(iii) Polymer fibres,
(iv) Rubbery polymer.

(30 marks)

4). (a) Give one possible monomer and initiator for free radical, anionic, and cationic polymerizations.

(30 marks)

(b) What are the three main steps in polymerization. Write down the reactions that occur in each step in the polymerization of fluoroethene ($CH_2=CHF$) when benzoyl peroxide used as an initiator.

(30 marks)

(c) Draw the structure of the following polymers and state two uses of each polymer:
(i) Nylon 6,10
(ii) Phenol formaldehyde
(iii) Melamine formaldehyde.

(30 marks)

5). (a) Discuss the reactions of natural rubber with each of the following chemicals and indicate briefly any changes in the physical and chemical properties of the polymer after the reactions.
(i) Chlorine,
(ii) Sulphuric acid,
(iii) Hydrogen chloride.

(36 marks)

(b) Discuss the technological differences between the following pairs:
(i) Butyl rubber and halogenated butyl rubber,
(ii) Thermoplastic rubber and raw natural rubber.

(24 marks)

(c) Write short notes on the following:
(i) Silicone rubber,
(ii) Functions of activators and accelerators used in sulphur vulcanization, and name two compounds in each case used as an activator and an accelerator.

(30 marks)

"END"