



0038

The Open University of Sri Lanka
Faculty of Natural Sciences- Department of Chemistry
B.Sc. Degree Programme – Level 05
Final examination- Semester I – 2025/2026
CYU5313 – Polymer Chemistry

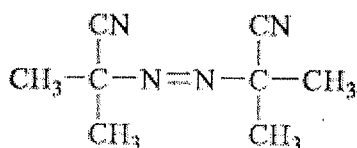
26th November, 2025 (Wednesday)

9.30 am – 11.30 pm

This question paper consists of 4 essay type questions in 4 pages. Answer all the questions.

Question 01

- (i) A hypothetical polymer is formed by linking 200 molecules of 1-butene to produce poly(1-butene). Calculate the theoretical molecular mass of this polymer. Write down the balanced stoichiometric chemical reaction for this polymerization process.
(Atomic masses: C = 12, H = 1) **(20 marks)**
- (ii) Mention one advantage and one disadvantage of free radical polymerization reactions. **(10 marks)**
- (iii) Azobisisobutyronitrile (AIBN) is a well-known initiator used in the polymer industry. The chemical structure of AIBN is given below. Write down the first step of the initiation process using a balanced chemical reaction. **(10 marks)**



Azobisisobutyronitrile (AIBN)

- (iv) Comment on the stability of the intermediate product formed in the reaction you mentioned in part (iii) of Question number 01. **(10 marks)**
- (v) The cationic initiation is thermodynamically and kinetically unfavorable for Acrylic esters ($\text{H}_2\text{C}=\text{CHCOOR}$). Scientifically explain this statement. **(10 marks)**
- (vi) Write balanced chemical equations for the reactions: (a) Condensation polymerization between terephthalic acid and ethylene glycol (b) Coordination polymerization of ethylene using a Ziegler–Natta catalyst. **(20 marks)**
- (vii) Name four types of copolymers and write the polymerization reaction for nitrile rubber (acrylonitrile–butadiene copolymer). **(20 marks)**

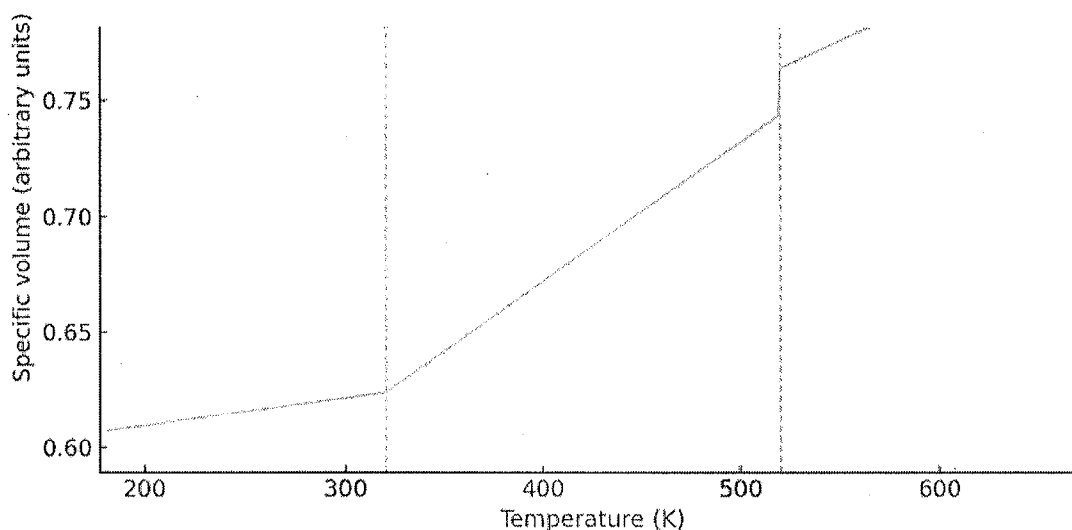
Question 02

(i) Define the term tacticity and illustrate isotactic, syndiotactic, and atactic arrangements with structural sketches using the arbitrary symbols l and d (d - right-handed and l - left-handed). Which are stereoregular? (20 marks)

(ii) Write the all-possible structural isomers that can form during the polymerization of 1,3-pentadiene. (25 marks)

(iii) Define the following terms and explain their significance: (a) Glass transition temperature (T_g) (b) Softening temperature (T_s). (10 marks)

(iv) The specific volume of a polymer changes with temperature as shown in a given plot. Estimate T_g and T_m , and explain how branching influences these thermal transitions. (20 marks)



(v) Briefly explain internal and external plasticization. How that affects the physical behavior of polymers. (10 marks)

(vi) The T_g of polystyrene is 373 K, while T_g of polyisobutylene is 200 K. Scientifically explain this difference based on their molecular structures. (15 marks)

Question 03

(i) Briefly describe the principles of the Osmometry with respect to the determination of the average molar mass of a polymer sample. (20 marks)

(ii) A dilute solution of a polymer in benzene was studied using a membrane osmometer at 25 °C. The experimental data were plotted as (π / c) (osmotic pressure divided by concentration) on the y-axis versus c (concentration) on the x-axis following the standard method. The extrapolated straight line intercepts the y-axis at 15 atm L g⁻¹. The osmotic pressure (π) of a

polymer solution relates to the number average molar mass ($\bar{M}_n$) of the polymer according to the following equation. Calculate the number average molar mass of this polymer. ($R=0.08206$ L atm mol⁻¹ K⁻¹) (30 marks)

$$\frac{\pi}{C} = RT \left\{ \frac{1}{\bar{M}_n} + BC \right\}$$

where R = gas constant

C = mass of polymer in one litre of solvent

T = temperature

B = force of interaction between the polymer molecules and solvent molecules

(iii) A polyester sample of 1.872 g is completely neutralized by 7.50 cm³ of 0.125 mol dm⁻³ KOH solution. Calculate the number average molar mass ($\bar{M}_n$) of the sample. (30 marks)

(iv) Define the term "Polydispersity factor". Discuss the importance of the value of the polydispersity factor in terms of molecular weight distribution in determining the physical and mechanical properties of polymers. (20 marks)

Question 04

(i) State the IUPAC name and draw the structural formula of the monomer used to produce neoprene rubber. Explain why it shows high oil resistance compared to natural rubber. (15 marks)

(ii) Define the Isoelectric point of a polymer. Explain the process of latex coagulation and describe an industrial method used to achieve it. (15 marks)

(iii) Give two examples of latex preservatives used in rubber processing. State two desirable properties expect from these preservatives. (10 marks)

(iv) Define Dry Rubber Content (DRC). What are the approximate DRC values of field latex and concentrated latex? List three methods used to increase DRC in the industry. (20 marks)

(v) Explain the role of the following additives in rubber vulcanization: (a) Sulphur (b) Mercaptobenzothiazole (MBT) (c) Stearic acid (d) Antioxidants (20 marks)

(vi) Explain photo-degradation and oxidative degradation of polymers. Suggest two practical methods to reduce each of these degradation. (20 marks)
