

Sl. No. of Question Paper: 1785

Unique Paper Code: 114101

Name of the Paper: Introduction to Polymer Science

F-3

Name of Course: B.Tech . Polymer Science

Semester: I

Duration: Three hours

Maximum marks: 75

Medium of setting of Question Paper: English

Instructions for candidates: Attempt five questions in all. Question No.1 is compulsory. Use of calculator is allowed. Log tables may be provided.

Q.1

- a) How does the root-mean-square end-to-end distance of a flexible polymer depend on:
- Molecular weight at the Flory temperature θ
 - Temperature at the Flory point
 - Molecular weight, well above the Flory temperature for a good solvent ?
- b) Which of each of the following pairs has a higher T_g or T_m & Why?
- Polyethylene or a random copolymer of polyethylene and polypropylene
 - Poly(vinyl chloride) or poly(tetrafluoroethylene)
 - Nylon 6 or Nylon 11
- c) Illustrate 3_1 helix type structure of a polymer.
- d) A linear amorphous polymer has a T_g of 10°C . At 27°C it has a melt viscosity of 4×10^8 . Estimate its viscosity at 50°C .
- e) Explain objectives and limitations of Izod / Charpy impact tests.
- f) For linear polymers like polyethylene, RMS end to end distance increase by a factor $2^{1/2}$ from that of the freely jointed chain. Explain
- g) Discuss effect of crystallization temperature on lamellar thickness.
- h) Write essential requirements for molecular weight determination by end group analysis.
- i)) What are ideal solutions? Show why polymer solutions can never be ideal, even at extreme dilutions. (9X3)

Q.2

- a) Explain following
- Shear thinning fluids
 - Shear thickening fluids
 - Apparent viscosity
- b) Illustrate Chip impact test. What are its advantages?
- c) The table below shows the density and enthalpy of vaporization [ΔH_{vap}] of two solvents: methylethyl ketone and acetone.

Solvent	Density (g/cm^3)	ΔH_{vap} (cal/g)
Methylethyl ketone	0.8	106
acetone	0.8	125

Which is a better solvent for polystyrene at room temperature? The CED for polystyrene is 75 cal/cm^3 . Assume room temperature is 27°C . (5, 4, 3)

Q.3

- a) Estimate the fraction of crystalline material in a sample of polyethylene of density 0.983 g/cm^3 .
Data: density of amorphous Polyethylene = 0.866 g/cm^3
Unit cell dimensions of polyethylene containing 4 CH_2 groups are $a = 7.41 \text{ \AA}$, $b = 4.94 \text{ \AA}$,
 $c = 2.55 \text{ \AA}$, $\alpha = \beta = \gamma = 90^\circ$
- b) Discuss the effect of the following on viscosity
- Effect of molecular weight
 - Effect of branching
 - Effect of molecular weight distribution
- c) Explain effect of pressure on crystallization on polyethylene (5, 4, 3)

Q.4

- a) Discuss test variables and limitations of Heat Deflection Test.
- b) Discuss experimental arrangement of Gel Permeation Chromatography.
- c) Explain change in free energy for nucleation process during polymer crystallization. (5, 4, 3)

Q.5

- a) The T_g of a linear polymer with $M_n = 2500$ was found to be 120°C , but it increased to 150°C for a sample of the same linear polymer with $M_n = 10000$. A branched version of the same polymer with $M_n = 6000$ was found to have a T_g of 114°C . Determine the average number of branches per chain of branched polymer
- b) Discuss differences between test procedure of Durometer and Rockwell Hardness.
- c) Cryoscopy is used in molecular weight measurement of polymers. Discuss (5, 4, 3)

Q.6

- a) Using free volume concept, prove the dependence of glass transition temperature on molar mass.
- b) Using the entropy change equation of the lattice model, calculate the change in entropy when equal amounts (100g) of two components are mixed of Toluene and Methyl Ethyl Ketone
- c) Discuss criteria for polymer solubility. (5, 4, 3)