

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF POLYMER AND TEXTILE ENGINEERING
2006/2007 HARMATTAN SEMESTER EXAMINATIONS
PTE 503: POLYMER CHAIN PROPERTIES AND SOLUTION

Date: 20/06/07

TIME: 3HOURS

Instructions: attempt any five questions

Q1 (a) State the basic assumptions of the freely -jointed chain model. (b) A polyethylene molecules has a degree of polymerization of 2000. Calculate (i) the total length of the chain, and (ii) the contour length of the planar zig zag if the bond length and valence angle are 1.54\AA and 110° , respectively.

Q2 (a) State the general rules for polymer solubility. (b) Explain the observation that the rate of polymer solubility increases with short branches but decreases with longer branches. (c) Calculate the solubility parameters of (i) Low density polyethylene (LDPE) and (ii) High density polyethylene (HDPE) using the following information where applicable.

Density of LDPE = $0.92 \times 10^3 \text{ Kg m}^{-3}$

Density of HDPE = $0.95 \times 10^3 \text{ kg m}^{-3}$

M_o (HDPE) = $28 \times 10^3 \text{ kg m}^{-3}$

M_o (LDPE) = $28 \times 10^3 \text{ kg m}^{-3}$

G [$10^{-3} (\text{Jm}^3)^{1/2}$] mol⁻¹ values are:

>CH - = 175.94

-CH₂ - = 269.05

-CH₃ = 306.42

-CH = (olefin) = 248.65

Q3 (a) State the assumptions that formed the basics of flory and Huggins theoretical calculation of entropy of mixing of a polymer with a low molecular weight solvent. (b) Give two different expressions for the entropy of mixing of a polymer with a low molecular weight solvent obtained by flory and Huggins. (c) Give a brief account of flory -krigbaum theory of dilute polymer solutions.

Q4 (a) Differentiate between regular and ideal solutions, (b) Show schematically the three different types of phase diagrams of polymer- solvent system. Indicate in each diagram, the regions of unlimited polymer solubility. (c) List the methods available for assessing the thermodynamic affinity of a solvent to a polymer. Briefly describe any one of them.

Q5 (a) With a suitable sketch, explain the dependence of intrinsic viscosity on the molecular mass of dilute polymer solution. (b) If a dilute polymer solution has the following data AT 27°C

Conc (g/i00ml)	Times
0	59.90
0.49	100.00
1.00	150.00
1.22	198.00
2.02	255.00

Determine,

i. the intrinsic viscosity of the polymer sample. (ii) the Huggins const (iii) if the mark - Houminks constant, K and a are 1.0×10^{-1} and 6.9×10^{-1} respectively.

Q6 (a) Describe any absolute method that can be used to determine the numbers average molecular weight of a polymer sample. (b) What are the limitations of membrane Osmometry. (c) With the aid of a suitable sketch, describe the operation principle of Gel permeation chromatography.