



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

**POLYMER SCIENCE II
SCH 2207**

FOR SCH STUDENTS ONLY

Second Semester Examination Paper

May 2017

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph Paper

Examiner's Name: DR C T PAREKH

INSTRUCTIONS

1. Answer all questions from Section A and any three from Section B. Section A carries 40 marks and each question in Section B carries 20 marks.
2. Show mechanism, chemical steps or synthesis by means of curved arrows.

MARK ALLOCATION

QUESTION	MARKS
1.	40
2.	20
3.	20
4.	20
5.	20
TOTAL	100

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SCH 2207

SECTION A:

1. (a) With the aid of labelled diagrams explain the following terms in your own words.
(i) long range order:
(ii) short range order: (6 Marks)
- (b) Draw a polymer Stress/Strain graph and indicate the following on the graph:
Dilatant polymer; Newtonian Fluid , Pseudoplastic polymer and Bingham plastic. (5 Marks)
- (c) What are the characteristics of a true polymer solution? (3 Marks)
- (d) What do you understand by nucleation process? Indicate how many ways nucleation can take place? (4 Marks)
- (e) You are given the following substances:
Tomato sauce, tooth paste, nail polish, mayonnaise, corn starch dissolved in water and printing ink.
Identify them as:
(i) pseudoplastic (Shear thinning):
(ii) dilatant (Shear thickening) :
(iii) Bingham plastic: (6 Marks)
- (f) Indicate four characteristics of a crystallisable polymer. (4 Marks)
- (g) What does a crystalline polymer and an amorphous polymer look like on X-ray diffraction? (2 marks)
- (h) Draw a labelled diagram for second order phase transition from melt of a given crystallisable polymer. (5 Marks)
- (i) What is the function of a good solvent and a poor solvent in polymer chemistry? (2 Marks)
- (j) There are three reflected light microscopy techniques that are used for examining the texture of solid opaque polymers. Name the three microscopy techniques. (3 marks)

SECTION B:

2. (a) Draw an Oswald viscometer. Briefly explain how one can measure viscosity. (5 Marks)
- (b) In a solution viscosity experiment, the efflux time for a pure solvent was 84.5 sec. The efflux times for the solution of different concentrations are given in the data below:

Concentration g/dl	0.30	0.40	0.55	0.70	0.90
Efflux time in sec,	105	113	125	138	156

Find the viscosity average molecular weight (M_v) of the polymer if:

$$K = 1,34 \times 10^{-4} \text{ dl g}^{-1} \text{ and } a = 0.71$$

(15 Marks)

3. (a) Given the following information, calculate the solubility parameter (δ) of poly(methyl methacrylate). The density of polypropylene is 1.188 g/cm^3 .

GROUP	SMALL/HOY FACTOR $[(J\text{-CM}^3)^{1/2}]$	GROUP	SMALL/HOY FACTOR $[(J\text{-CM}^3)^{1/2}]$
-CH ₃	303	-CH ₂ -	269
CH ₂ =	259	-CH=	249
>CH-	176	>C<	65
- O -ether,	235	-COO-	668
>C=O	538	-CHO-	599
>C=	173	>C<	65

(6 Marks)

- (b) Sketch a graph of relaxation modulus vs temperature and indicate all distinguishable stages which are within the amorphous range.

(6 marks)

- (c) What is T_g ? List the five factors affecting the T_g ?

(8 Marks)

4. (a) Suppose in a polymer sample there are 10 polymer molecules of molecular mass 103, 20 molecules of molecular mass 104 and 20 molecules of molecular mass 105.

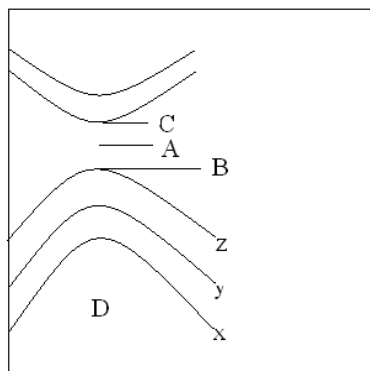
Calculate:

- Mn
- Mw
- Mw/Mn
- Is the polymer monodispersed or polydispersed?

(10 marks)

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(b) From the labelled diagram below:



- (i) Identify B and C. (2 Marks)
- (ii) Comment on position A, D and E. (3 Marks)
- (iii) Comment on x, y and z. (2 Marks)
- (iv) What does the curve on the diagram indicate? (1 Marks)
- (v) Explain briefly the effect of increasing temperature from C to E on polymer. (2 Marks)

5. (a) The DTA technique is used for assessing the effect of temperature on a semi-crystalline polymer. Plot a graph of heat capacity against temperature. Label T_g , T_c , T_m , T_{oxi} and decomposition.

(10 Marks)

(b) Fractionation of a polymer into various molecular weights can be carried out by various methods. One of them is fractionation by temperature. Explain with the aid of diagrams how the fractions can be achieved.

(10 Marks)

*****END OF EXAMINATION PAPER*****