

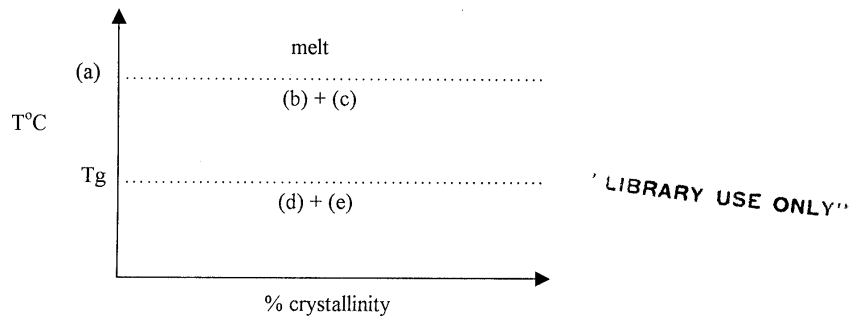
**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**DEPARTMENT OF APPLIED CHEMISTRY**  
**END OF SEMESTER EXAMINATIONS – MAY 2002**  
**POLYMER SCIENCE II – SCH 2207**  
**TIME – (3) THREE HOURS**

**INSTRUCTIONS TO CANDIDATES**

Answer **ALL** questions from Section A and **ANY THREE** questions from Section B.

**SECTION A** (Answer all questions).

1. (a) What do you understand by Molecular Weight Distribution (MWD) of a polymer? (3 marks)
- (b) Name five properties of a polymer that are dependant on the molecular weight. (5 marks)
- (c) Explain the relationship between the number average molecular weight ( $M_n$ ) and the weight average molecular weight ( $M_w$ ) for mono-disperse and poly-disperse systems. (6 marks)
- (d) Give an expression of the degree of crystallinity based on densities of components involved. (3 marks)
- (e) What are the basic requirements for polymer to crystallize? (4 marks)
- (f) Define  $T_g$  of a polymer and explain how it affects general processing of polymers. (6 marks)
- (g) Give an expression of an ideal solution in thermodynamic terms i.e. using Gibbs energy. (4 marks)
- (h) What four factors affect the solubility of a polymer? (4 marks)
- (i) Complete the diagram by naming components (a) to (e). (5 marks)



**SECTION B** (Answer 3 questions)

2. (a) What do you understand by the term 'morphology' of a polymer? (2 marks)
- (b) Illustrate four morphological structures of a crystalline polymer. (6 marks)
- (c) Outline the mechanism of polymer crystallization with special emphasis to the following steps:
- (i) nucleation
- (ii) rate of growth of the crystal (12 marks)

3. Given the following Small/Hoy (F) factors:

-CH <sub>3</sub>	303.4
-CH <sub>2</sub>	269
-CH-	176

- (a) Calculate the solubility parameters of ethylene (density 0.98g/cm<sup>3</sup> and propylene (density 0.968g/cm<sup>3</sup>) (10 marks)
- (b) Describe the compatibility of these polymers based on your results. (10 marks)

4. (a) Which colligative property method is preferred for determining the weight average molecular weight of polymers and why? (5 marks)
- (b) In a solution viscosity experiment the efflux time for the pure solvent was 84.2 sec. The efflux time for the solution of different concentrations are given in the data table below:

Concentration g/dl	0.40	0.50	0.67	1.00
Efflux time in sec.	112.7	121.4	134.6	164.6

Find the viscosity average molecular weight (M<sub>v</sub>) of the polymer if:  
 $K = 1.34 \times 10^{-4} \text{ dl g}^{-1}$  and  $a = 0.71$ . (15 marks)

5. Explain the underlying principles of *any two* of the following methods of polymer analysis:
- (i) differential thermal analysis
- (ii) differential scanning calorimetry
- (iii) x-ray diffraction analysis
- (iv) spectroscopic method of analysis (20 marks)

**END OF QUESTION PAPER!!! ' LIBRARY USE ONLY''**