

# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

## DEPARTMENT OF APPLIED CHEMISTRY

END OF SECOND SEMESTER EXAMINATIONS: APRIL/MAY 1999

POLYMER SCIENCE II - SCH 2207

TIME: THREE HOURS

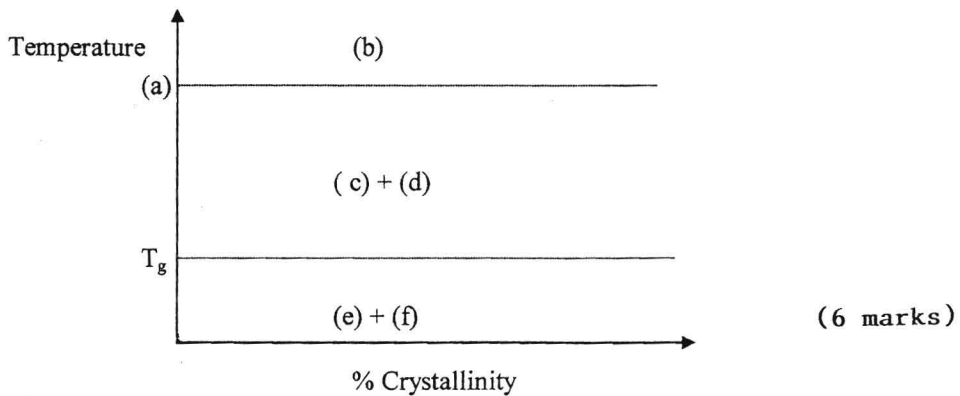
### INSTRUCTIONS TO CANDIDATES

Answer ALL questions in Section A and ANY THREE in Section B.

### SECTION A:

1. (a) Give FIVE (5) parameters that affect the dissolution of polymers.  
(5 marks)
- (b) Differentiate between solubility and compatibility of polymers.  
(4 marks)
- (c) Define the following concepts:
  - (i) intermolecular interactions
  - (ii) long-range order
  - (iii) short-range order
  - (iv) first order transitions(4marks)
- (d) What formula relates solubility parameter of a polymer to the cohesive energy density of the same material?  
5 marks)
- (e) What do you understand by MORPHOLOGY of a polymer?  
(3 marks)
- (f) Name FIVE (5) morphological structures of a crystalline polymer.  
(5 marks)
- (g) What are the basic requirements for a polymer to crystallize and how can these be enhanced?  
(4 marks)
- (h) What is  $T_g$  and how does the  $T_g$  of a polymer affect its processing?  
(5 marks)
- (i) What necessitates BLENDING of polymer materials?  
(4 marks)

(j) Complete the following diagram:



**SECTION B:**

1. Outline the mechanism of polymer crystallization with special emphasis on:
  - (i) Nucleation process (6 marks)
  - (ii) Growth of the crystallite (6 marks)
  - (iii) Morphology of the crystallites- illustrations (8 marks)
  
2.
  - (a) Define an IDEAL solution (3 marks)
  - (b) Give reasons why polymer solutions cannot be ideal even at extreme dilutions. (5 marks)
  - (c) Give an expression of the heat of mixing ( $\Delta H^m$ ) which involves solubility parameters of the interacting polymers- name all the parameters involved. (8 marks)
  - (d) What conditions are necessary for complete miscibility in polymer-polymer interactions? (4 marks)
  
3. Describe in details how any TWO of the following methods are applied in the thermal analysis of polymers.
  - (i) Differential Thermal Analysis (DTA)
  - (ii) Differential Scanning Calorimetry (DSC)
  - (iii) X-Ray Diffraction Analysis (20 marks)

- 4 (a) Describe the technique of determining the average crystallinity of a polymer specimen using densities. (10 marks)
- (b) With the aid of a diagram, explain the "volume change" on heating behavior of crystalline and amorphous polymers. (10 marks)
5. (a) Given the following information, calculate the solubility parameter ( $\delta$ ) of poly (methyl methacrylate) (10 marks)

<u>Group</u>	<u>Small/Hoy [F] factor</u>
-CH <sub>3</sub>	303.4
-CH <sub>2</sub>	269
-COO-	668.2
-C-	65
-OH	462
-CH	176

- (b) Describe the solubility of polymers resulting in:
- (i) incomplete dissolution (5 marks)
- (ii) complete dissolution (5 marks)

**END OF QUESTION PAPER!!!**