



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: BPE 2134
COURSE	: POLYMER STRUCTURE AND CHARACTERIZATION
SEMESTER/SESSION	: 1-2023/2024
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1 (33 MARKS)

Fourier Transform Infrared (FT-IR) is a technique that uses infrared radiation to identify different materials based on their absorption spectrum.

- a) An analysis by FT-IR suggests a spectrum as shown in Figure 1. The hydrocarbon compound consists of *four carbons* and *alcohol group*. (12 marks)
Identify the functional group of each peak appeared and the specific frequencies. Determine a possible chemical structure.

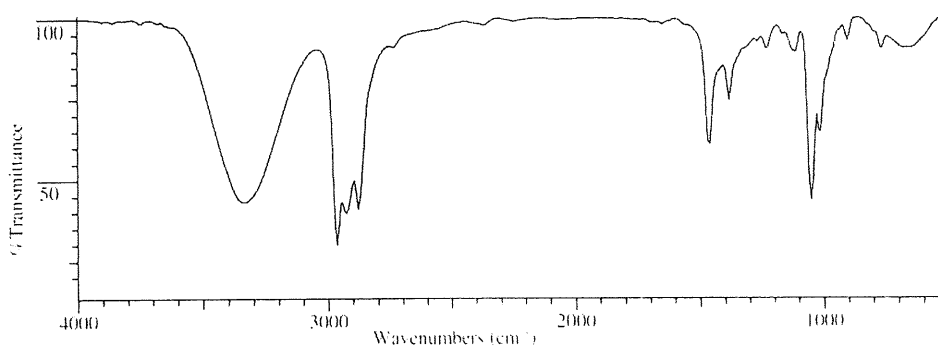
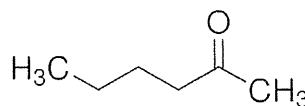
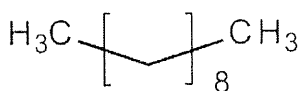
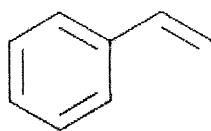
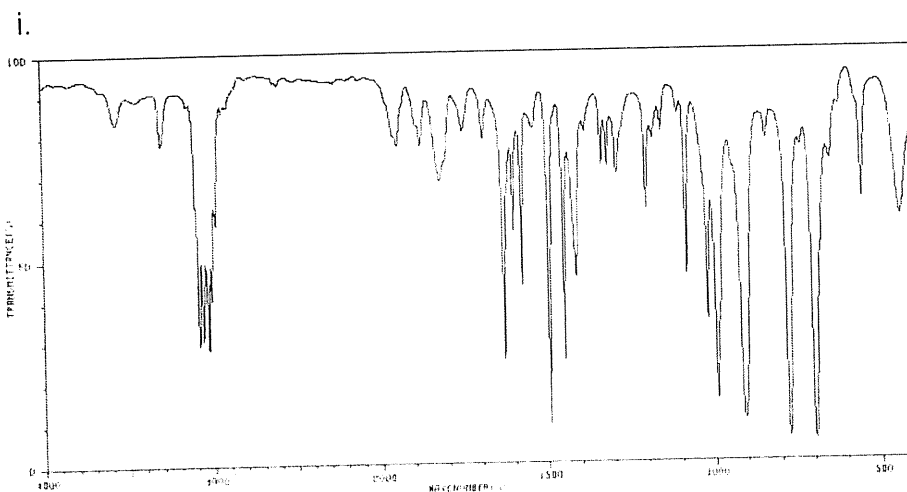


Figure 1. FT-IR spectrum.

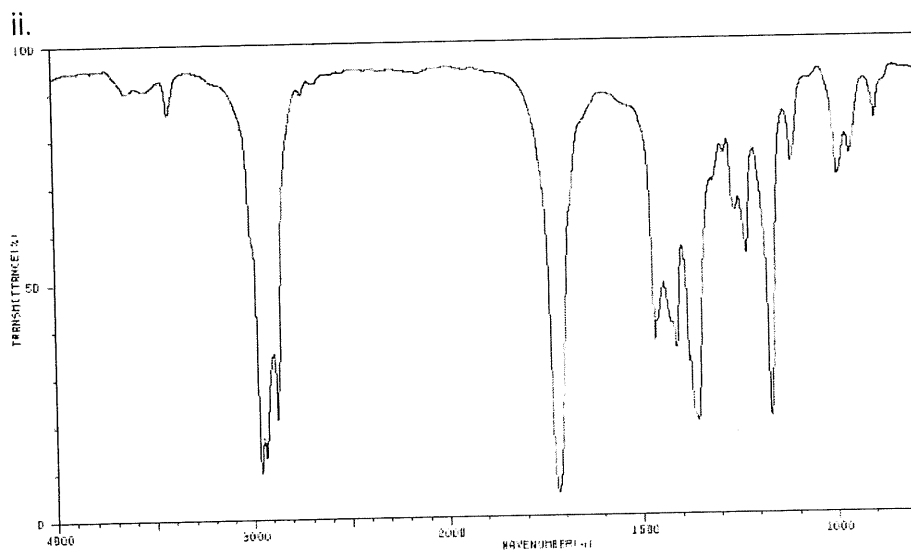
- b) List the possible functional groups that could appear in the FT-IR spectrum of these compounds. (6 marks)
- Pentanoic acid
 - Pentanal
- c) The three compounds were examined in an analysis. Examine which of the following three (3) compounds correspond to each of the IR spectra shown below. Debate all the significant absorptions on the spectra by drawing the functional group at each significant peak.



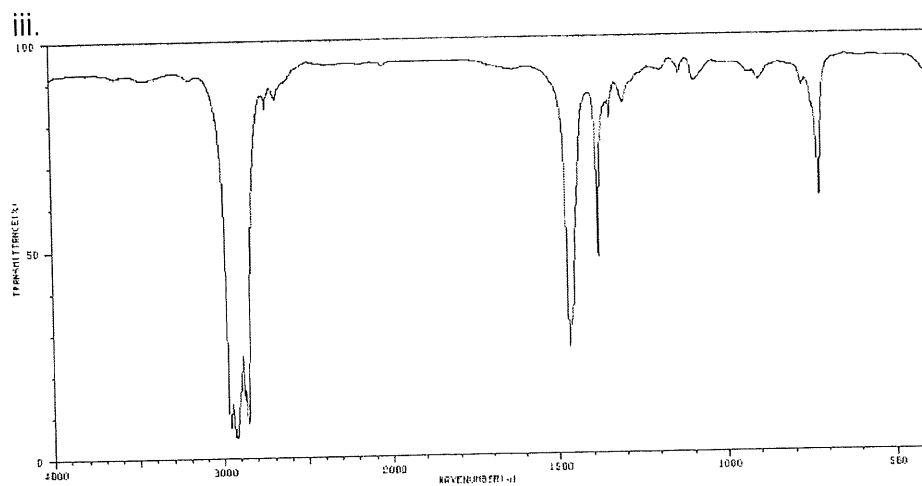
(6 marks)



(5 marks)



(4 marks)



QUESTION 2 (17 MARKS)

A thermogravimetric analysis (TGA) continuously measures mass while the temperature of a sample is changed over time.

- a) Discuss briefly the basic principles of TGA. (5 marks)
- b) Write three (3) applications of TGA. (3 marks)
- c) By referring to Figure 2 below, diagnose the polyamine changing behavior over time in regions (a), (b) and (c). (9 marks)

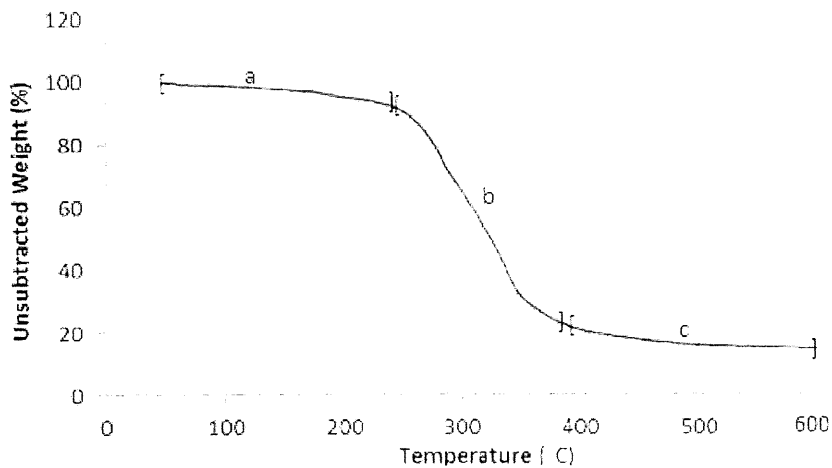


Figure 2. TGA analysis of polyamine polymer.

QUESTION 3 (35 MARKS)

The thermal analysis is used to monitor the changes in material after a heating process.

- a) Differential thermal analysis (DTA) is one of the analyses that have been classified in thermal analysis.
 - i. Give three (3) applications of DTA. (3 marks)
 - ii. Figure 3 shows the DTA graph of kaolin. Examine what are the (x) and (y); and the changes happened in the regions. (6 marks)
 - iii. Find three (3) factors that could affect the DTA curves. Also, identify the effect of the factors and give the suggestions to overcome the problems. (9 marks)

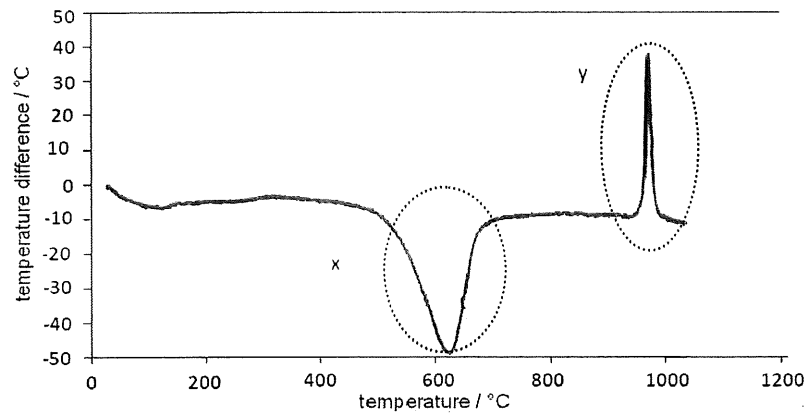


Figure 3. DTA graph of kaolin.

b) Differential scanning calorimetry (DSC) is a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference are measured as a function of temperature.

- i. Indicate (a), (b) and (c) based on graph in Figure 4. (3 marks)
- ii. Analyse the graph by debating the transformation process of each curve. (8 marks)

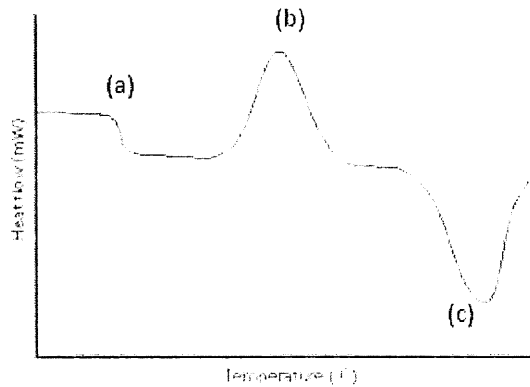


Figure 4. DSC curves.

- iii. Present the differences between DSC and DTA. (6 marks)

QUESTION 4 (15 MARKS)

X-rays is a form of electromagnetic radiation having a wavelength in the range of 0.01 to 10 nanometres.

- a) Show three (3) similarities between X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) analyses. (3 marks)
- b) Examine briefly the basic principles of XRF. (5 marks)
- c) Give the definition of XRD. (3 marks)
- d) List two (2) applications of XRF and two (2) applications of XRD. (4 marks)

-----End of question-----