



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER II SESSION 2022/2023

COURSE NAME	:	MATERIALS TESTING
COURSE CODE	:	BDB 40203
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	<ol style="list-style-type: none">SECTION A : ANSWER ALL QUESTIONS SECTION B: ANSWER THREE (3) OUT OF FOUR (4) QUESTIONSTHIS FINAL EXAMINATION IS CONDUCTED VIA CLOSED BOOK.STUDENTS ARE PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSIST OF **SEVEN (7)** PAGES

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SECTION A

- Q1**
- (a) Describe the info that can be provided by Fourier Transform-Infrared (FT-IR) Spectroscopy data. (3 marks)
 - (b) Recognize the differences between the microscopy characterization techniques of transmission electron microscopy (TEM) and scanning electron microscopy (SEM). (4 marks)
 - (c) The various radiographic image densities used for material inspection are displayed in **Figure Q1 (c)**. Determine its density profile. (6 marks)
 - (d) Consider that you are an emerging research scientist tasked with developing the next generation of battery materials.
 - (i) Identify chemical, physical, and spectroscopic techniques would you use to characterize your materials? (3 marks)
 - (ii) Support why would you employ these techniques and what would the results tell you about the materials? (4 marks)
- Q2**
- (a) Thermal analysis employs a variety of techniques to evaluate physical attributes as a function of temperature, time, and other variables. Determine THREE (3) thermal analysis methodologies and describe how they work in relation to the capacity to characterise inorganic materials. (6 marks)
 - (b) **Figure Q2(b)** shows the physical and chemical alterations that can occur to polymeric materials. From the provided differential thermogram, evaluate the thermal behaviour changes that occur. (6 marks)
 - (c) What does "glass transition temperature" mean in terms of polymers? How is it measure? (4 marks)
 - (d) Styrene-Butadiene-Rubber (SBR) is a compound that is utilised in many different ways for making tyres. It is possible to utilise various butadiene isomers, styrene-butadiene ratios, and additions such carbon black. Compare and contrast the thermal behaviour of SBR using the data from Dynamic Mechanical Analysis as illustrated in **Figure Q2(d)**. (4 marks)

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SECTION B

- Q3** (a) You have been asked to checked the leakage parts of a storage tank that has been fabricated. Sketch the leakage testing of non-destructive testing (NDT) method that can be applied and clearly explain the testing procedure. (8 marks)
- (b) List TWO (2) type of abrasives materials used for polishing sample. (2 marks)
- (c) When analysing surfaces that are electrically nonconductive, micrography analysis frequently runs into charging problems. Comment on this situation and suggest a strategy to stop the charging. (10 marks)
- Q4** (a) Identify TWO (2) purposes of sectioning in sample preparation for microscopy sample. (2 marks)
- (b) Schematically draw creep curve conducted under constant load and constant stress conditions. Explains the different stages of creep from the sketch. (6 marks)
- (c) A graph showing the effect of stress and temperature on creep curve is given in **Figure Q4(c)**. Interpret the graphic. (4 marks)
- (d) Grazing incident XRD (GIXRD) is a surface sensitive diffraction technique that utilises a small incident angle X-ray beam ($<5^\circ$). Analyze the impact of incidence angle on X-ray spectrum output (sketch the spectra in your explanation). (8 marks)
- Q5** (a) Eddy Current testing is a NDT testing to evaluate surface and subsurface defects. Determine FOUR (4) application of this testing. (4 marks)
- (b) Justify the calibration modes to use for quantitative analysis of X-ray Fluorescence (XRF). (5 marks)

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- (c) Issue arises that leads to many product manufacturers being reluctant to use recycled plastics because the quality variations across batches can have a serious impact on maintaining the quality of the end-products. Explain how Differential Scanning Calorimetry can control the quality of recycled plastic materials (sketch the curve in your explanation).

(8 marks)

- (d) Define Poisson's ratio in isotropic materials. Provide related sketch and equation.

(3 marks)

- Q6** (a) Briefly explain with suitable sketch about working principle of Ultrasonic testing (10 marks)

- (b) Differentiate between a differential scanning calorimetry (DSC) and a thermal gravimetric analysis (TGA) technique of thermal characterization.

(6 marks)

- (c) A circular aluminum tube of length $L = 400$ mm is loaded in compression by forces P . The outside and inside diameters are 60 mm and 50 mm, respectively. A strain gage is placed on the outside of the bar to measure normal strains in the longitudinal direction. If the compressive stress in the bar is intended to be 40 MPa, what should be the load P ?

(4 marks)

- END OF QUESTION -

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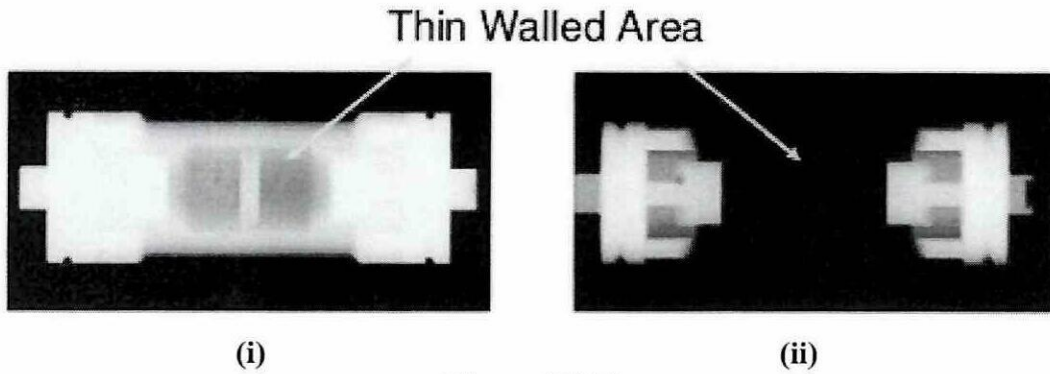


Figure Q1(c)

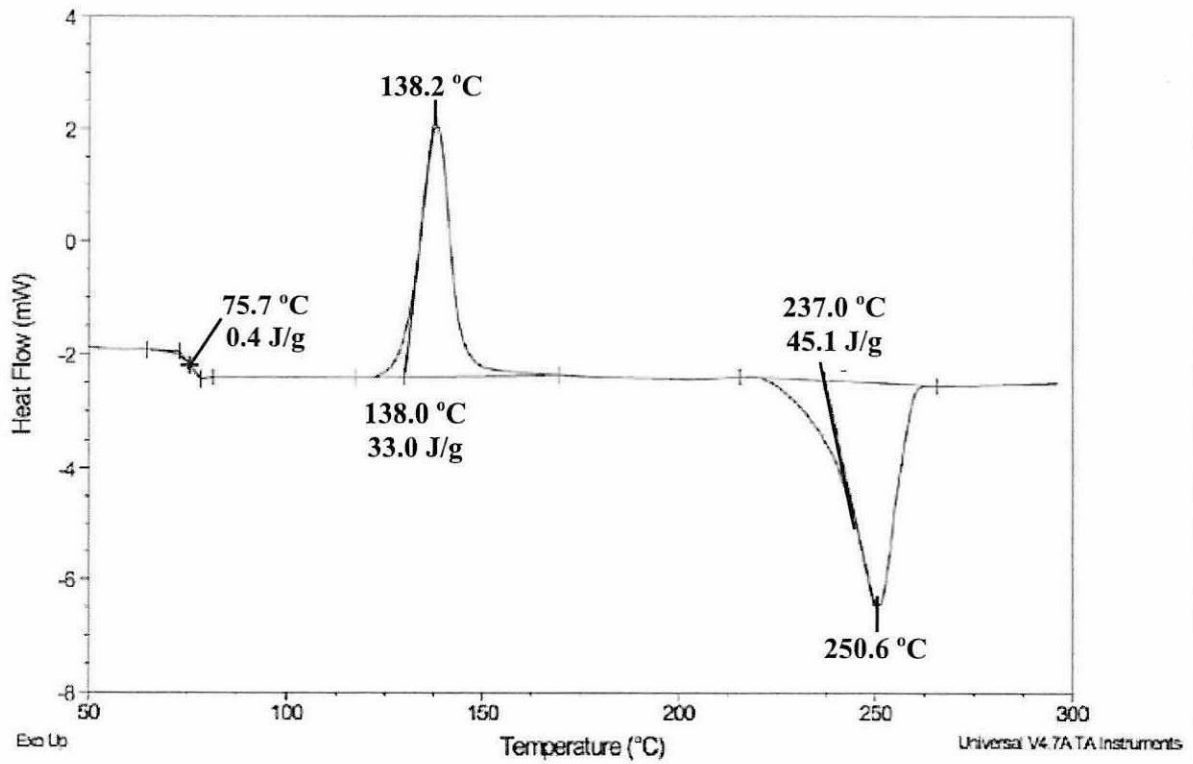


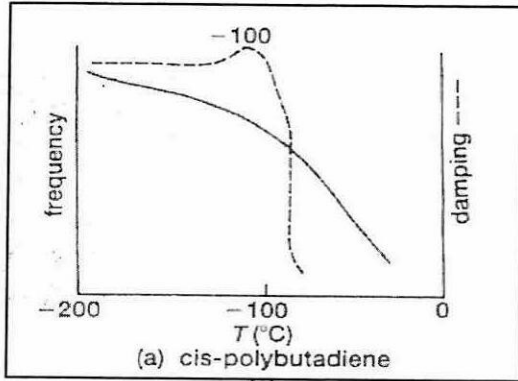
Figure Q2(b)

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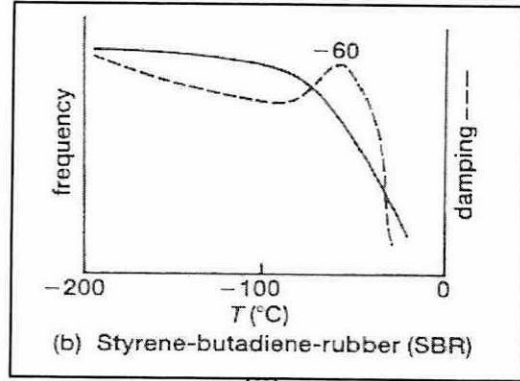
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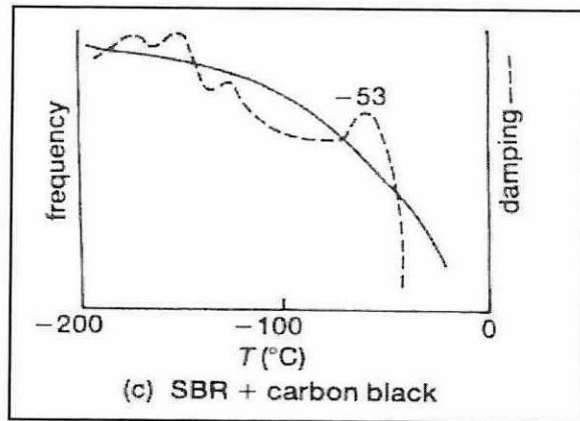
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(i)



(ii)



(iii)

Figure Q2(d)

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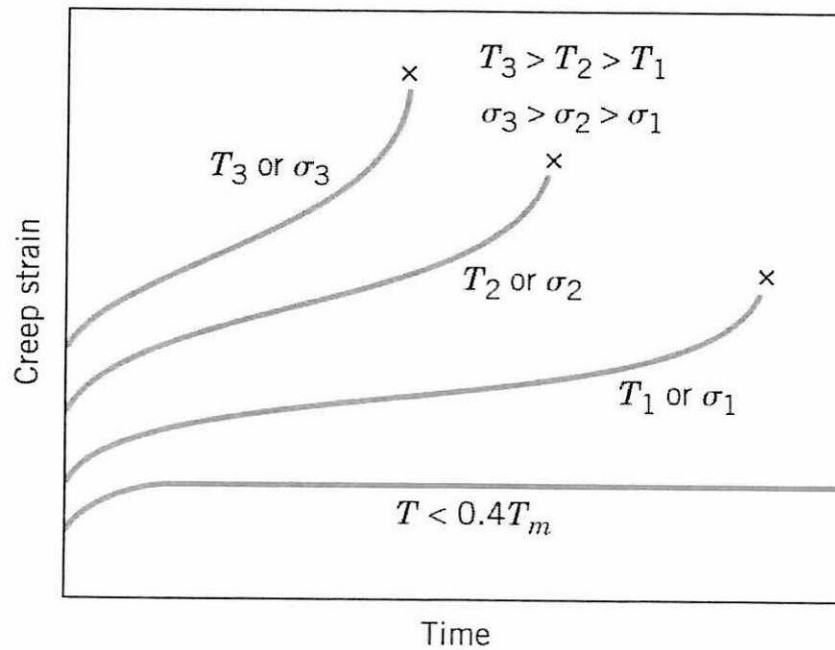


Figure Q4(c)

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