



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CFB40503
COURSE TITLE : INSTRUMENTAL FOOD ANALYSIS
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY (FOOD)
WITH HONOURS
DATE : 03 FEBRUARY 2026
TIME : 9:00AM - 12:00PM
DURATION : 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

A well-organized laboratory system is essential to ensure accurate, reliable, and legally acceptable food analysis results.

- (a) Describe the purpose of the Food Analyst Act 2011 and Food Analyst Regulation 2013 enforcement in Malaysia.

(2 marks)

- (b) A food analyst is preparing to issue a food analysis report. Predict **TWO (2)** legal requirements that must be fulfilled according to the Food Analyst Act 2011.

(2 marks)

- (c) Identify **THREE (3)** factors that one would need to consider when choosing method analysis for food product.

(3 marks)

- (d) Using a relevant example, analyze the effects of improper sample preparation on the accuracy of food analysis results.

(3 marks)

Question 2

Water activity is a critical physical property that influences food stability, safety, and shelf life. It is widely used in quality control and product development.

- (a) Define water activity (a_w).

(2 marks)

- (b) Explain the difference between water activity and moisture content in foods.

(4 marks)

- (c) A dried fruit product has a water activity of 0.65. Predict whether microorganisms are likely to grow in this product. Explain your answer.

(4 marks)

Question 3

Spectroscopy is widely used instrumental analytical techniques in food analysis based on the interaction between light and matter to determine chemical composition and concentration.

- (a) Determine how spectroscopic techniques are used in food analysis to measure the amount of tartrazine present in children's snacks.

(4 marks)

- (b) A compound has a molar absorptivity of $5.0 \times 10^3 \text{ L mol}^{-1} \text{ cm}^{-1}$. Calculate the absorbance of a $2.0 \times 10^{-6} \text{ M}$ solution measured in a 1 cm cuvette.

(2 marks)

- (c) Analyze how interference and stray light can affect the accuracy of spectroscopic measurements. Suggest **ONE (1)** method to minimize each problem.

(4 marks)

Question 4

Chromatography is a widely used separation technique in food and chemical analysis, involving the interaction between a mobile phase and a stationary phase.

- (a) State **TWO (2)** of information that can be obtained from a High-Performance Liquid Chromatography (HPLC) chromatogram.

(2 marks)

- (b) The figure below shows two analytes A and B separated using a chromatographic method. Predict the analyte that elutes first. Explain the reason.

Refer Below - Figure1 : Chromatogram of Analytes A and B .

(3 marks)

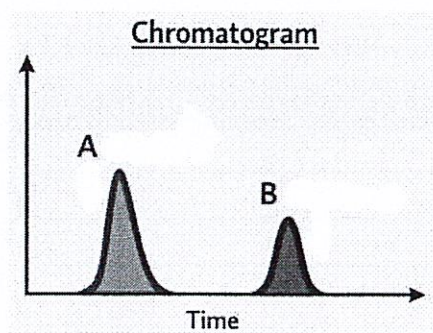


Figure 1: Chromatogram of Analytes A and B

- (c) Given a separation of analytes involving non-polar analytes. Select either normal-phase or reversed-phase HPLC. Justify your selection.

(3 marks)

- (d) Differentiate between ion-exchange chromatography and size-exclusion chromatography in HPLC based on their separation principles.

(2 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

A food quality control laboratory was asked to evaluate the reducing sugar content of fresh durian fruit using UV-Visible spectrophotometry. Ten grams of mango pulp were homogenized and diluted with distilled water to a final volume of 100 mL. The reducing sugar content was determined using a UV-Vis spectrophotometer at 540 nm. The absorbance readings obtained for the glucose standards and mango extract are shown in table below.

Refer Below - Table1 : Absorbance of Mango Extract . Table2 : Absorbance of Glucose Standard Solution .

Table 1: Absorbance of Mango Extract

Sample replicate	Absorbance at 540 nm
1	0.415
2	0.420
3	0.410

Table 2: Absorbance of Glucose Standard Solution

Concentration of glucose standard (mg/mL)	Absorbance at 540nm
0.0 (Blank)	0.000
0.25	0.180
0.50	0.360
0.75	0.540
1.0	0.720

- (a) Construct a standard calibration curve using provided data.

(6 marks)

- (b) Determine the slope of the standard calibration curve.

(4 marks)

- (c) Using standard calibration curve, calculate the concentration of reducing sugar (mg/mL) in the diluted mango extract.
(4 marks)
- (d) Calculate the total reducing sugar content (mg) in the 100 mL mango extract.
(4 marks)
- (e) State **TWO (2)** possible sources of error in determining reducing sugar using UV-Vis spectrophotometry.
(2 marks)
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Question 2

A nutrition laboratory was required to verify the fatty acid labelling claims of a commercially marketed vegetable oil. The product label claims that the oil is low in saturated fat, rich in monounsaturated fatty acids, and contains a significant proportion of polyunsaturated fatty acids. To verify these claims, the laboratory performed fatty acid analysis using analytical instruments.

- (a) Name a suitable analytical instrument that can be used for fatty acid analysis. Justify your answer.

(2 marks)

- (b) Draw and label a schematic diagram of the analytical instrument.

(4 marks)

- (c) Describe the steps involved in sample preparation for fatty acid analysis using the selected method.

(6 marks)

- (d) Based on the chromatogram shown below, explain the separation mechanism for differentiate saturated, monounsaturated, and polyunsaturated fatty acids.
Hint: In your answer, relate the separation to chain length, degree of unsaturation, and retention time.

Refer Below - Figure2 : Chromatographic Profile of Fatty Acids .

(8 marks)

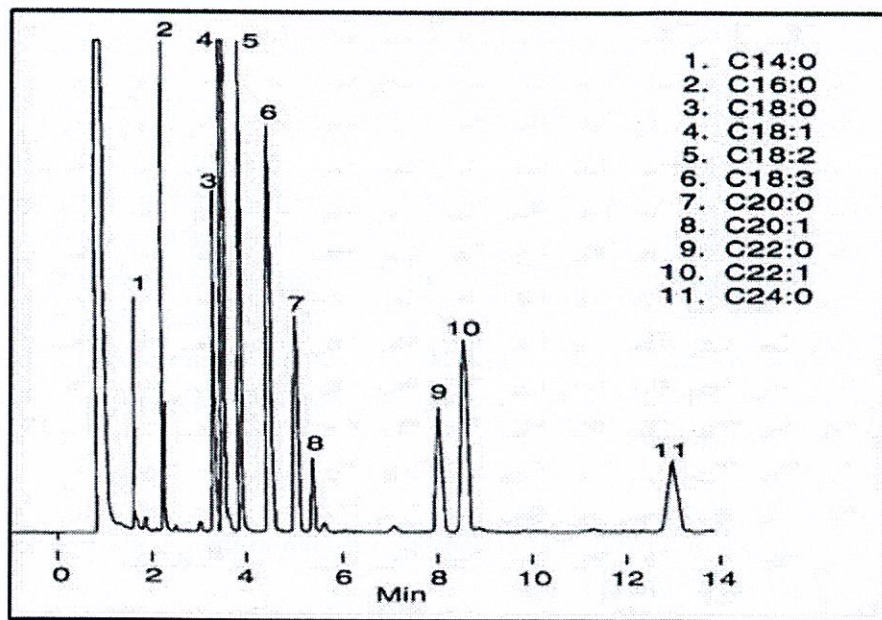


Figure 2: Chromatographic Profile of Fatty Acids

Question 3

A food biotechnology laboratory is analyzing a complex protein sample extracted from a processed food product. The objective is to identify protein components, estimate their molecular weight, and study their subunit composition. The researcher prepares a gel electrophoresis setup consisting of a buffer tank, electrodes, power supply, and a supporting medium. To determine the most effective separation technique, the researcher compares agarose gel electrophoresis and polyacrylamide gel electrophoresis (PAGE). Agarose gel provides separation of protein mixtures but shows limited resolution, whereas PAGE produces sharper bands.

- (a) Identify the role of the buffer and supporting medium in the gel electrophoresis setup used by the researcher.

(2 marks)

- (b) Describe the principle on which separation of proteins occurs in this technique.

(4 marks)

- (c) Based on the case study, explain the suitability of using PAGE over agarose gel for estimating the molecular weight of proteins.

(6 marks)

- (d) Analyze the differences between agarose gel electrophoresis and PAGE in terms of principle, separation and applications in protein analysis.

(8 marks)

Question 4

A food processing company makes an instant cereal powder that is mixed with water before eating. Lately, customers have been complaining about several quality problems. The powder does not flow well, caking during storage, and the texture after mixing with water is uneven. Some customers have also noticed that the product does not last as long as expected on the shelf. To investigate the problem, the quality control laboratory evaluates the product using physical property measurements and Fourier Transform Infrared (FTIR) spectroscopy to study possible changes in chemical structure and composition.

- (a) State **ONE (1)** physical property of food and **ONE (1)** feature of FTIR spectroscopy that can be used to assess the quality of the cereal powder in this case study. Briefly describe your answer.

(2 marks)

- (b) During analysis, the product shows caking and poor flowability. Its FTIR spectrum exhibits a broad absorption band in the region $3200\text{--}3600\text{ cm}^{-1}$.

- i. Identify the food property most closely related to this problem.

(1 marks)

- ii. Explain how the FTIR absorption in this region is related to the observed quality issue.

(3 marks)

- (c) Propose **TWO (2)** practical changes in processing or packaging that can reduce caking and improve the flowability of cereal powder. Support your suggestions using relevant physical or chemical properties of food.

(6 marks)

- (d) Analyze the role of physical property measurements and FTIR spectroscopy in providing a more reliable quality assessment of instant cereal powder.

(8 marks)

END OF EXAMINATION PAPER

APPENDIX

Table 1.0 Characteristic Infrared Absorption frequencies

Bond	Compound Type	Frequency range, cm ⁻¹
C-H	<u>Alkanes</u>	2960-2850(s) stretch
		1470-1350(v) scissoring and bending
	<u>CH₃ Umbrella Deformation</u>	1380(m-w) - Doublet - isopropyl, t-butyl
C-H	<u>Alkenes</u>	3080-3020(m) stretch
		1000-675(s) bend
C-H	<u>Aromatic Rings</u>	3100-3000(m) stretch
	<u>Phenyl Ring Substitution Bands</u>	870-675(s) bend
	<u>Phenyl Ring Substitution Overtones</u>	2000-1600(w) - fingerprint region
C-H	<u>Alkynes</u>	3333-3267(s) stretch
		700-610(b) bend
C=C	<u>Alkenes</u>	1680-1640(m,w) stretch
C≡C	<u>Alkynes</u>	2260-2100(w,sh) stretch
C=C	<u>Aromatic Rings</u>	1600, 1500(w) stretch
C-O	<u>Alcohols, Ethers, Carboxylic acids, Esters</u>	1260-1000(s) stretch
C=O	<u>Aldehydes, Ketones, Carboxylic acids, Esters</u>	1760-1670(s) stretch
O-H	Monomeric – Alcohols, Phenols	3640-3160(s,br) stretch
	Hydrogen-bonded – <u>Alcohols, Phenols</u>	3600-3200(b) stretch
	<u>Carboxylic acids</u>	3000-2500(b) stretch
N-H	<u>Amines</u>	3500-3300(m) stretch
		1650-1580 (m) bend
C-N	<u>Amines</u>	1340-1020(m) stretch
C≡N	<u>Nitriles</u>	2260-2220(v) stretch
NO ₂	<u>Nitro Compounds</u>	1660-1500(s) asymmetrical stretch
		1390-1260(s) symmetrical stretch

v - variable, m - medium, s - strong, br - broad, w - weak

