



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024**

- COURSE NAME : ANALYTICAL CHEMISTRY
- COURSE CODE : DAS 22403
- PROGRAMME CODE : DAU
- EXAMINATION DATE : JANUARY / FEBRUARY 2024
- DURATION : 2 HOURS 30 MINUTES
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA **CLOSED BOOK**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

- Q1**
- (a) Describe the terms below:
(i) Spectroscopy
(ii) Spectrophotometry
(4 marks)
- (b) Write the relation between energy, frequency, and wavelength.
(4 marks)
- (c) Determine the frequency of 410 nm wavelength purple light radiation.
(4 marks)
- (d) (i) Differentiate between absorption and transmittance.
(4 marks)
- (ii) Write Beer Lambert's Law and the relationship between transmittance and absorbance.
(3 marks)
- (iii) When a solution is placed in a 2.5 cm thick cell, it has a transmittance of 20%. If the molar absorption coefficient is $12000 \text{ Lmol}^{-1}\text{cm}^{-1}$, calculate its concentration.
(6 marks)
- Q2**
- (a) Describe the principle of infrared (IR) spectroscopy.
(3 marks)
- (b) In order for a vibrational mode in a sample to be IR active, it must be associated with changes in the molecular dipole moment.
- (i) Describe the **three (3)** types of vibrational modes.
(3 marks)
- (ii) Draw structure in a molecule for each vibrational mode in **Q2(b)(i)**.
(6 marks)
- (iii) Illustrate the aldehyde and amine group structures.
(4 marks)
- (c) Calculate the absorbance of an IR peak with a 25% transmittance.
(4 marks)
- (d) The FTIR analysis of the unknown compound is carried out (see **Figure Q2(d)**). A strong, sharp peak is observed at a frequency of 3650 cm^{-1} . Draw the structure and state the functional group.
(5 marks)

- Q3**
- (a) Explain the terms below:
(i) Chromatography
(ii) Stationary phase
(iii) Gradient elution
(6 marks)
- (b) Describe **two (2)** practical applications for chromatography.
(2 marks)
- (c) Draw and label **three (3)** basic components of gas chromatography and state their functions.
(6 marks)
- (d) Name **two (2)** characteristics of compounds that are compatible with application using gas chromatography.
(2 marks)
- (e) Describe the criteria for mobile phase in gas chromatography and give **two (2)** examples.
(3 marks)
- (f) Describe the criteria used in liquid chromatography to select the mobile phase.
(3 marks)
- (g) **Figure Q3(g)** shows compounds on normal phase HPLC using CN column. Determine the order of elution in this HPLC.
(3 marks)
- Q4**
- (a) **Figure Q4(a)** shows a chromatogram for a separation HPLC Analysis of Excedrin Pain Medication on Reversed-Phase Aromatic Phase. Based on the figure, answer the followings.
- (i) Evaluate the resolution quality of the caffeine and aspirin based on the selectivity and efficiency of the peaks.
(4 marks)
- (ii) Describe **three (3)** methods to improve the selectivity separation of the chromatogram.
(3 marks)
- (b) (i) Describe the significance of theoretical plates.
(2 marks)
- (ii) When the retention duration is 15.20 minutes, half of the base width is 0.55 minutes, and the column length is 25 cm, calculate the number of theoretical plates N and the plate height H .
(6 marks)

- (c) The amount of bromelain in a pineapple juice was determined by HPLC using a normal calibration curve. Standard solutions of bromelain were prepared and analysed using a 10 μL fixed-volume injection loop. Results for the standards are summarized in the **Table Q4(c)**.
- (i) Draw the calibration curves and find the correlation between bromelain concentration (%) and peak area by using graph paper. The sample was prepared and the peak area for bromelain was determined to be 12590 by HPLC analysis. (8 marks)
- (ii) Determine the bromelain concentration (%). (2 marks)

-END OF QUESTIONS -

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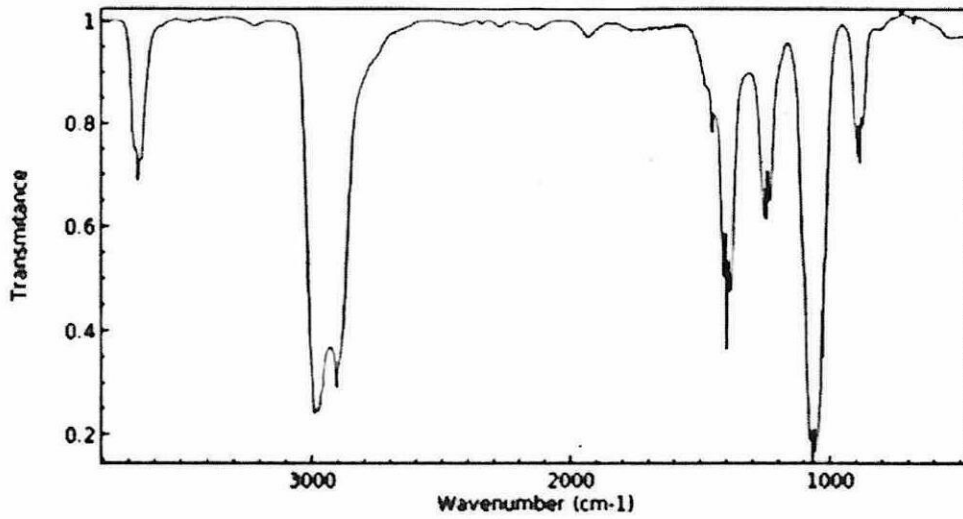
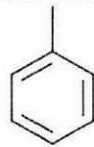


Figure Q2(d)



Toluene

(polarity index: 2.4)

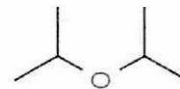
Boiling point: 110.6
 °C



Ethanol

(polarity index: 4.3)

Boiling point: 78.37
 °C



Isopropyl ether

(polarity index: 2.4)

Boiling point: 69.0
 °C

Figure Q3(g)

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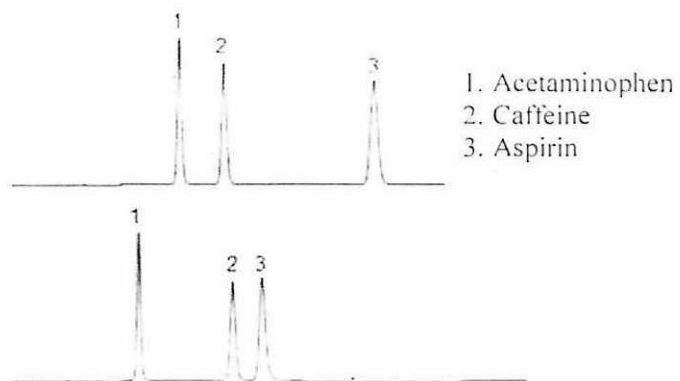


Figure Q4(a)

Table Q4(c) : HPLC analysis of samples

Bromelain concentration (%)	HPLC peak area
0.0	0
2.0	2854
4.0	6250
6.0	10050
8.0	13380
10.0	16410

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