UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	ANALYTICAL CHEMISTRY
COURSE CODE	:	DAK 12603 / DAS 12403
PROGRAMME	:	DAK / DAU
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS IN **SECTION A** AND **THREE (3)** QUESTIONS IN **SECTION B**

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

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SECTION A

Q1 (a) A solution was made by dissolving 6.02 g of Mg_2SO_4 (120.37 g/mol) in 100 ml of distilled water. Assume the density of the solution is d = 1.0160 g/ml. Calculate the concentration in

(i) molarity

(2 marks)

(ii) molality

(3 marks)

(iii) ppm

(2 marks)

(iv) % w/w

(3 marks)

(v) % w/v

(2 marks)

(b) A solution was prepared by dissolving 12.00 ml of concentrated hydrochloric acid (HCl) (molar mass = 36.50 g/mol, d= 1.75 g/ml, 97% w/w) in 100 ml volumetric flask. The solution is then further diluted to 0.05 M in 50 ml volumetric flask.

(i) Calculate the molarity of concentrated HCl.

(3 marks)

(ii) Calculate the molarity of HCl solution in 100 ml volumetric flask.

(3 marks)

(iii) Determine the volume of HCl solution from (ii) to prepare the 0.05 M solution.

(3 marks)

(iv) Explain the overall procedure to prepare the 0.05 M solution from concentrated HCl 97%w/w.

(4 marks)

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SECTION B

Q2 (a) Differentiate the terms below.

(i) Quantitative and qualitative analysis

(4 marks)

(ii) Classical methods and instrumental methods

(4 marks)

(b) Explain the steps required to perform quantitative analysis.

(10 marks)

(c) Proper sampling and preservation methods are important when handling samples for quantitative analysis. Explain the correct ways in conducting out both methods. Assume the quantitative analysis is for organic pollutants in river water.

(7 marks)

Q3 (a) Answer the followings.

(i) Definition of functional group.

(2 marks)

(ii) Explain the **four (4)** types of vibrational modes.

(4 marks)

(iii) Draw the structure of carboxylic acid and alkene group.
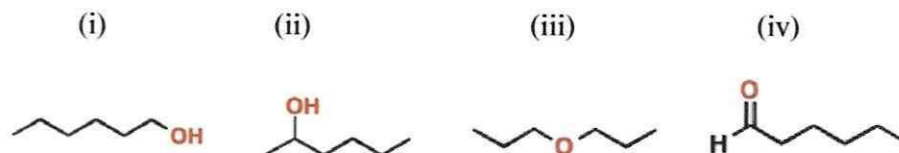
(4 marks)

(b) Calculate the absorbance of an IR peak with a 25% transmittance.

(4 marks)

(c) An unknown compound is analyzed using FTIR. A strong, sharp peak is observed at a frequency of $1750cm^{-1}$. Identify the functional group present and draw the structure.

(3 marks)

(d) Match the given IR spectrum shown in **Figure Q3 (b)** to one of the following compounds. Label at least **3 (three)** absorbance bands (or absence thereof) in the IR that allow you to conclusively identify the compound.

(i)　　　　　　(ii)　　　　　　(iii)　　　　　　(iv)

(8 marks)

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Q4 (a) (i) Write the Beer's Law. State the unit for each parameter.

(3 marks)

(ii) Draw the diagram to show the instrument components in UV Visible. Name each component.

(5 marks)

(b) **Table Q4(b)** shows the UV/Vis analysis of **five (5)** standard chemicals A at different concentrations. Answer the following questions.

(i) Redraw the table and fill in the table completely. Show all the calculations.

(12 marks)

(ii) Determine the value of molar absorptivity, ε if the pathlength of the cuvette is 1cm.

(2 marks)

(iii) Determine the concentration of unknown sample labeled as Sample A if the absorbance detected is 0.85.

(3 marks)

Q5 (a) (i) Write the definition of chromatography.

(2 marks)

(ii) Explain **three (3)** types of chromatography.

(6 marks)

(iii) Describe **three (3)** major gas chromatography (GC) components and their functions.

(6 marks)

(b) Explain the following terms that are used in chromatography.

(i) mobile phase

(2 marks)

(ii) stationary phase

(2 marks)

(iii) column

(2 marks)

(iv) retention time

(2 marks)

(c) An internal standard is used in the lab experiments using gas chromatography (GC) but not high performance liquid chromatography (HPLC). Explain the reason for this statement.

(3 marks)

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Q6 (a) Explain the followings.

    (i) High performance liquid chromatography (HPLC)

                    (3 marks)

    (ii) **Three (3)** major HPLC components and their functions

                    (3 marks)

    (iii) Differentiate between HPLC and classical liquid chromatography

                    (4 marks)

  (b) Calculate the number of theoretical plates N and the plate height H, when the retention time is 15.20 minutes, half of the base width (given in minutes) is 0.55 minutes and the column length is 25cm.

                    (6 marks)

  (c) The amount of caffeine in an analgesic tablet was determined by HPLC using a normal calibration curve. Standard solutions of caffeine were prepared and analyzed using a 10µL fixed-volume injection loop. Results for the standards are summarized in the **Table Q6(c)**.

    (i) Draw the calibration curves and find the correlation between caffeine concentration and peak area.

                    (7 marks)

    (ii) The sample was prepared and when analyzed by HPLC, the peak area for the caffeine was found to be 21469. Calculate the caffeine concentration.
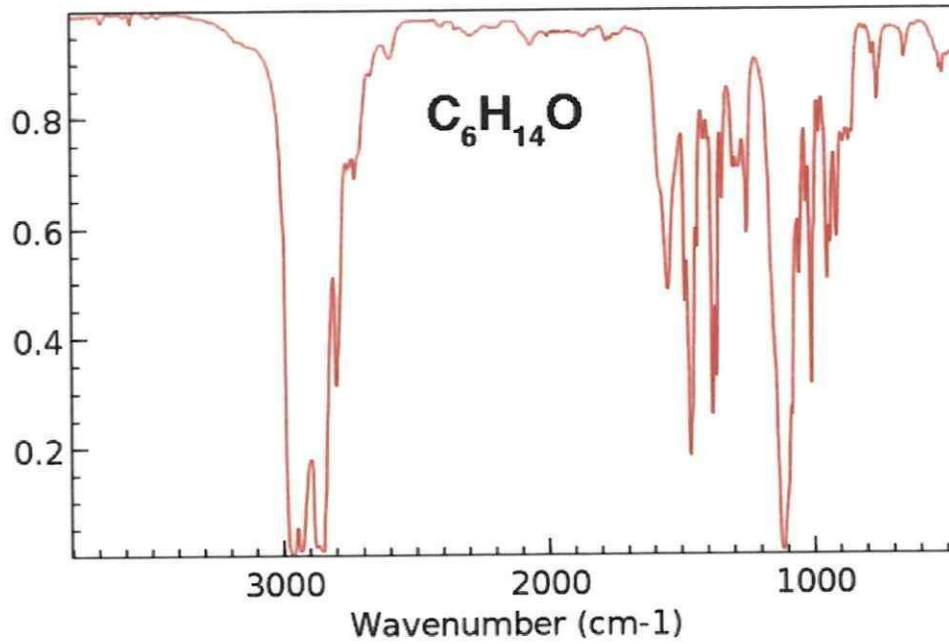
                    (2 marks)

-END OF QUESTIONS-

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Figure Q3(b)

Table Q4(b) : UV/Vis analysis of samples

Absorbance at 454 nm	I	Io	T	Concentration (mol/L)
0		0.3		
0.15		0.3		
0.5		0.3		
1	0.03	0.3		0.04
1.5		0.3		
4.0		0.3		

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Table Q6(c) : HPLC analysis of samples

Caffeine concentration (ppm)	HPLC peak area
50.0	8354
100.0	16925
150.0	25218
200.0	33584
250.0	42002

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