



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIOENGINEERING
TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE	: CQB 10803
COURSE NAME	: ANALYTICAL & ORGANIC CHEMISTRY
PROGRAMME NAME	: BACHELOR OF FOOD SAFETY AND QUALITY TECHNOLOGY WITH HONOURS
DATE	: 23 JANUARY 2026
TIME	: 9.00 AM – 12.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections, Section A and Section B.
4. Answer **ALL** questions in Section A and **ONLY THREE (3)** questions in Section B.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language **ONLY**.

THERE ARE 13 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

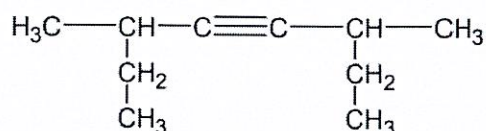
SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

1. Hydrocarbons are organic compounds made up of
- A. carbon and hydrogen C. oxygen and hydrogen
B. carbon and nitrogen D. carbon and oxygen
2. The general formula for alkanes is
- A. C_nH_{2n} C. C_nH_{2n+2}
B. C_nH_{2n-2} D. C_nH_{2n+1}
3. The structural formula for hexane contains:
- A. 4 carbon atoms and 10 hydrogen atoms
B. 6 carbon atoms and 14 hydrogen atoms
C. 5 carbon atoms and 12 hydrogen atoms
D. 7 carbon atoms and 16 hydrogen atoms
4. The functional group contained in the compound $CH_2=CH_2$ is an
- A. alkane C. alkyne
B. alkene D. aromatic

5. Select the correct IUPAC name for the following compound:

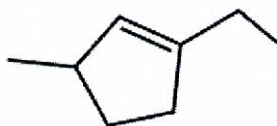


- A. 2,5-diethyl-3-hexyne C. 1,4-diethyl-1,4-dimethyl-2-butyne
B. 3,6-dimethyl-4-octyne D. 2-ethyl-5-methyl-3-heptyne
6. The reaction of propane with bromine is called
- A. halogenation C. addition
B. elimination D. combustion

7. A student reacts 2-pentene with bromine (Br_2) in the laboratory. Choose the correct IUPAC name of the product of the reaction.

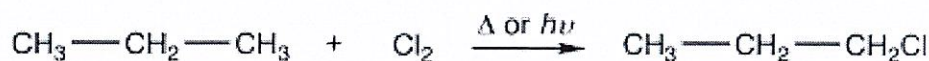
A. 1,1-dibromopentane
B. 1,2-dibromopentane
C. 2,2-dibromopentane
D. 2,3-dibromopentane

8. Select the correct IUPAC name for the following compound:



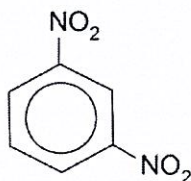
A. 1-ethyl-4-methylcyclopentene
B. 1-ethyl-3-methyl-1-cyclopentene
C. 1-ethyl-3-methylcyclopentene
D. 1-ethyl-3-methyl-2-cyclopentene

9. Name the following reaction:



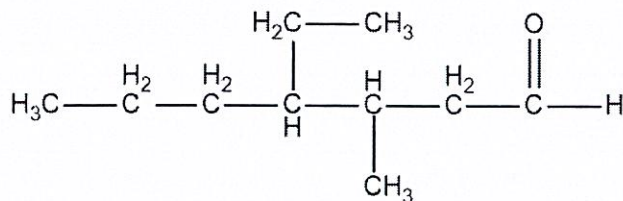
A. hydrohalogenation
B. dehydrogenation
C. halogenation
D. dehydration

10. Select the correct IUPAC name for following aromatic compound:



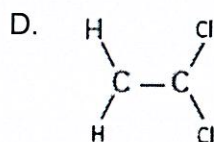
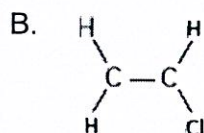
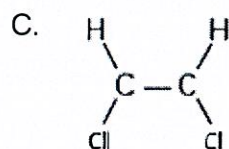
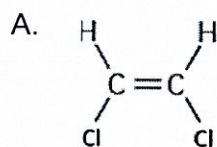
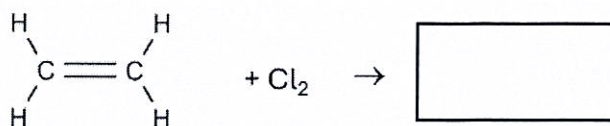
A. o-dinitrobenzene
B. p-dinitrobenzene
C. m-dinitrobenzene
D. b-dinitrobenzene

11. Select the correct IUPAC name for the following compound:

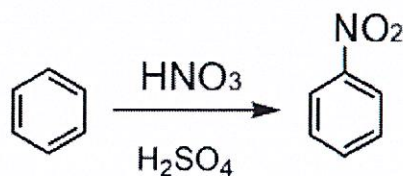


A. 4-ethyl-3-methylheptanone
B. 4-ethyl-3-methylheptanol
C. 4-ethyl-3-methylheptanal
D. 4-ethyl-3-mentylheptanoic acid

12. Choose the major product formed from the following reaction:



13. Name the following reaction:



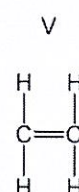
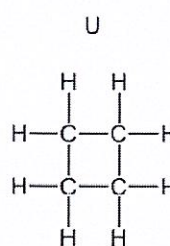
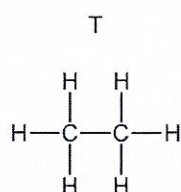
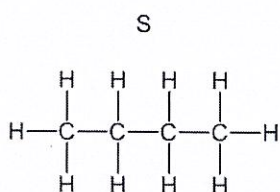
A. Friedel craft acylation

C. Friedel craft alkylation

B. Nitration

D. Halogenation

14. Select the unsaturated compound(s) from the four organic compounds listed below:



A. S only

C. V only

B. T and U

D. U and V

15. Reduction of an aldehyde produce

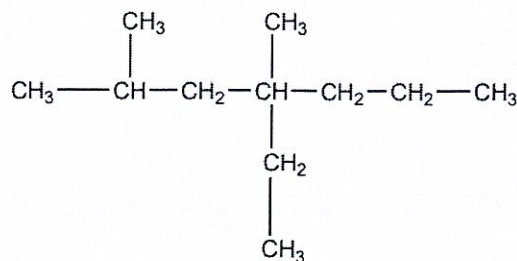
A. a tertiary alcohol

C. a carboxylic acid

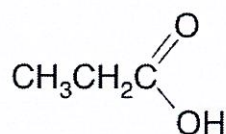
B. a primary alcohol

D. a secondary alcohol

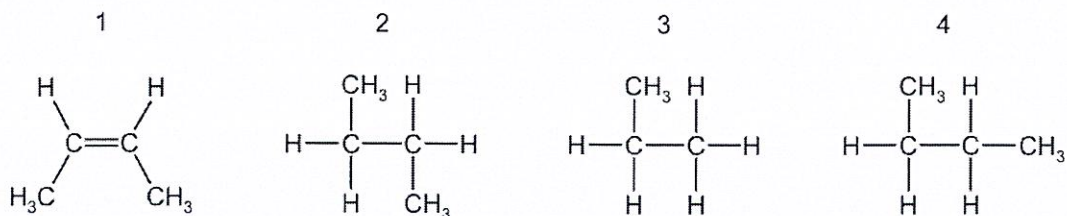
16. Select the correct IUPAC name for the following compound:



- A. 4-ethyl-2,4-dimethylheptane
 B. 4-ethyl-4,6-dimethylhexane
 C. 2,4-dimethyl-4-propylhexane
 D. 4-isobutyl-4-methylhexane
17. Select the correct IUPAC name for the following compound:



- A. propanal
 B. 1-propanone
 C. 1-propanol
 D. propanoic acid
18. Choose the structure that represents an alkane with four carbon atoms from the molecules provided below:

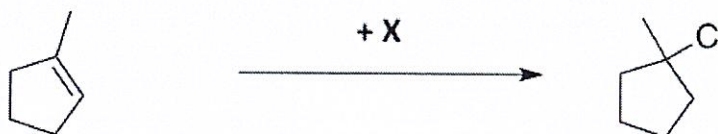


- A. 1 only
 B. 2 and 3
 C. 2 and 4
 D. 3 and 4
19. Oxidation of a ketone produces
- A. an aldehyde
 B. a carboxylic acid
 C. no reaction
 D. a secondary alcohol

20. The product of the reaction ($\text{CH}_3\text{-CH=CH-CH}_2\text{-CH}_2\text{-CH}_3 + \text{Br}_2$) is

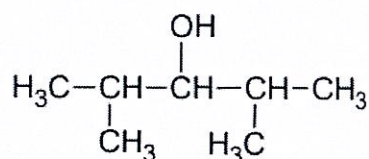
- A. $\text{CH}_3\text{-CHBr-CHBr-CH}_2\text{-CH}_2\text{-CH}_3$
 B. $\text{CH}_3\text{-CHBr}_2\text{-CHBr}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$
 C. $\text{CH}_2\text{=CHBr-CHBr-CH}_2\text{-CH}_2\text{-CH}_3$
 D. $\text{CH}_3\text{-CHBr=CHBr-CH}_2\text{-CH}_2\text{-CH}_3$

21. The following alkene undergoes an addition reaction with X. Choose the correct reagent of X.



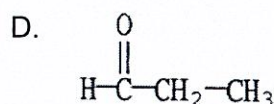
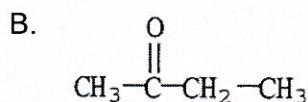
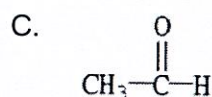
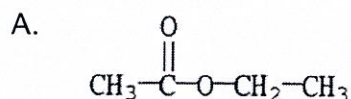
- A. HCl
 B. Cl_2
 C. CCl_4
 D. Cl_3

22. Select the correct IUPAC name for the following compound:

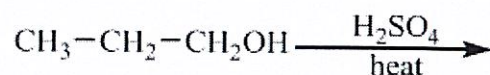


- A. 2,4-dimethyl-3-pentanol
 B. 1,1,3,3-tetramethyl-2-propanol
 C. 2,4-dimethyl-2-pentanone
 D. 1,1,3,3-tetramethyl-2-propanone

23. Choose the correct compound of 2-butanone:

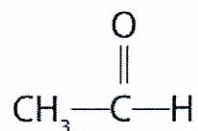


24. The product of the following reaction is

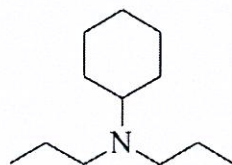


- A. $\text{CH}_3\text{-CH=CH}_2\text{OH}$
 B. $\text{CH}_3\text{-CHOH=CH}_2$
 C. $\text{CH}_3\text{-CH=CH}_2$
 D. $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{SO}_4$

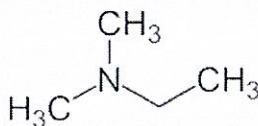
25. The functional group contained in the following compound is a(n):



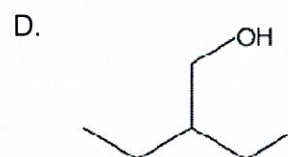
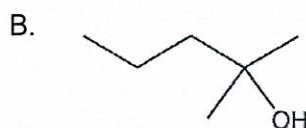
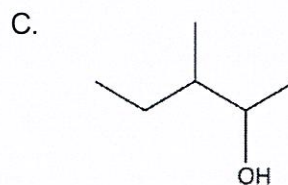
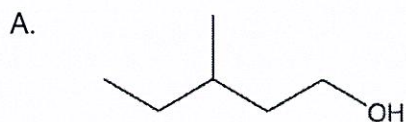
- A. carboxyl
B. alkene
C. carbonyl
D. hydroxy
26. Choose the correct class of the following amine.



- A. Primary amine
B. Tertiary amine
C. Secondary amine
D. Quaternary amine
27. Select the correct IUPAC name for the following compound:

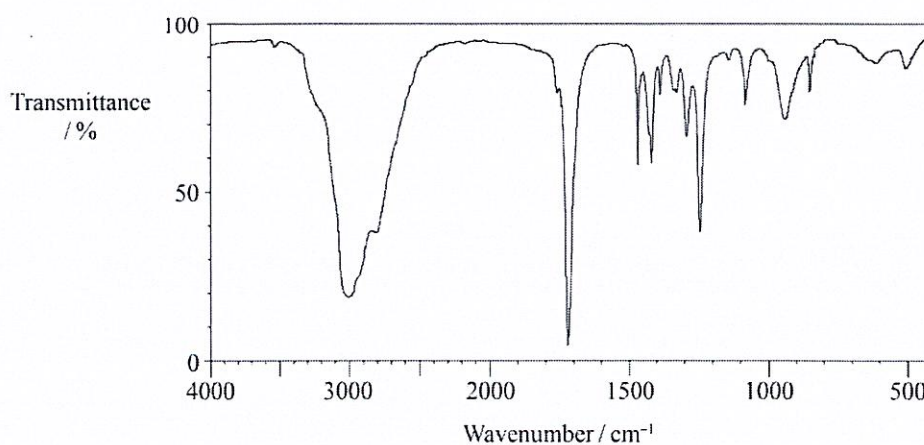


- A. *N,N*-dimethylethanamine
B. *N*-methylpropan-1-amine
C. Diethylethylamine
D. *N*-ethyl-*N*-methylmethanamine
28. Choose the correct alcohol that can be oxidised by $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2SO_4 to form a ketone.



29. Identify the fundamental property does UV-Visible Spectroscopy (UV-Vis) primarily measure.
- A. The boiling point of a liquid.
 - B. The mass of a sample.
 - C. The electrical charge of molecules.
 - D. The amount of light absorbs.
30. Choose the correct principle of the IR spectroscopy.
- A. Absorption
 - B. Adsorption
 - C. Emissions
 - D. Scattering
31. Find the vibrational mode that does not appear in an IR spectrum.
- A. Scissoring
 - B. Wagging
 - C. Rotating
 - D. Rocking
32. You need to determine the concentration of an unknown dye solution using UV-Vis spectroscopy method. After preparing several solutions of known concentrations and measuring their absorbance, identify the next logical step.
- A. Discard the known solutions and start with new ones.
 - B. Inject the unknown sample directly into an HPLC machine.
 - C. Vaporize the unknown sample and run it through GC.
 - D. Plot a calibration curve of absorbance versus known concentration.
33. The basis of the technique of chromatography for separating components of a mixture is
- A. the differing movement of particles of different masses in an electrical field.
 - B. the interaction of the components with stationery and a mobile phase.
 - C. the absorption of infrared radiation by the components.
 - D. the deflection of charged particles in a magnetic field.
34. A food scientist needs to identify and quantify different types of sugars (which are not volatile) in a fruit juice sample. Choose the analytical approach would be the most suited for this task.
- A. UV-Visible Spectroscopy (UV-Vis)
 - B. Atomic Absorption Spectroscopy (AAS)
 - C. High-Performance Liquid Chromatography (HPLC)
 - D. Gas Chromatography (GC)

35. Identify the primary use of infrared (IR) spectroscopy in organic chemistry.
- A. To determine molecular weight C. To identify functional groups
B. To determine nuclear structure D. To measure optical activity
36. Choose the correct stretching type of vibrational mode.
- A. Scissoring C. Asymmetrical
B. Twisting D. Wagging
37. Atomic absorption spectroscopy is used for the analysis of
- A. coloured sample. C. volatile compound.
B. metals. D. carbon contains compounds.
38. According to the Beer-Lambert law: $A = \epsilon bc$, A is the
- A. absorbance of the solution. C. path length.
B. concentration of the solution. D. molar absorptivity
39. In chromatography separation, the most appropriate method for the qualitative analysis of a substance is
- A. taking factor. C. retention time.
B. capacity factor. D. resolution.
40. Based on the following diagram, identify the instrument that produced this spectrum.



- A. UV-Vis spectroscopy C. Atomic Absorption spectroscopy
B. Infra-red spectroscopy D. Nuclear magnetic resonance

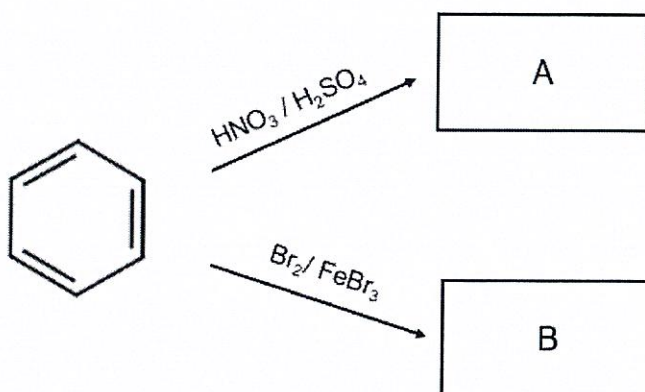
SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions ONLY.

Please use the answer booklet provided.

Question 1

- (a) Aromatic hydrocarbons are a class of organic compounds containing carbon and hydrogen with unique ring structures, they can be found in fuels, plastics, dyes, detergents, insecticides, and medicines. The following diagram shows an aromatic hydrocarbon undergoing a substitution reaction:



- Draw the structural formulae of compounds (A) and (B).
- Give the IUPAC name for the compounds (A) and (B) in (i).

(4 marks)

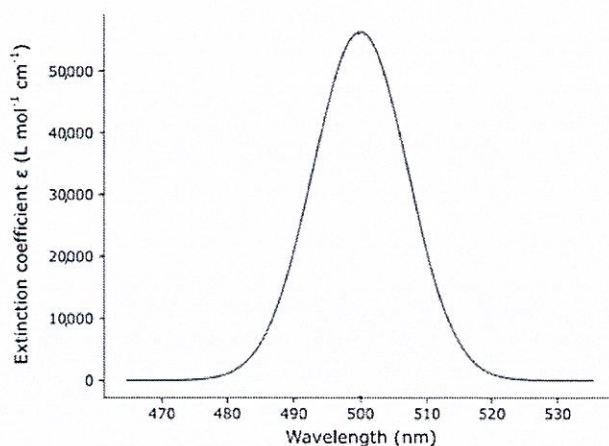
(4 marks)

- (b) Carmoisine, also known as Azorubine (E122), is a synthetic red food coloring used in various food and beverage products, particularly those that are heat-treated after fermentation. The presence of Carmoisine in soft drink sample was determined by UV-Vis spectroscopy and the results were summarized in Table 1 below:

Table 1: Absorbance of Carmoisine standard solutions and unknown sample

Sample	Concentration (M)	Absorbance (nm)
Blank	0	0
Standard 1	0.15	0.24
Standard 2	0.30	0.50
Standard 3	0.45	0.72
Standard 4	0.60	0.99
Unknown Sample	?	0.39

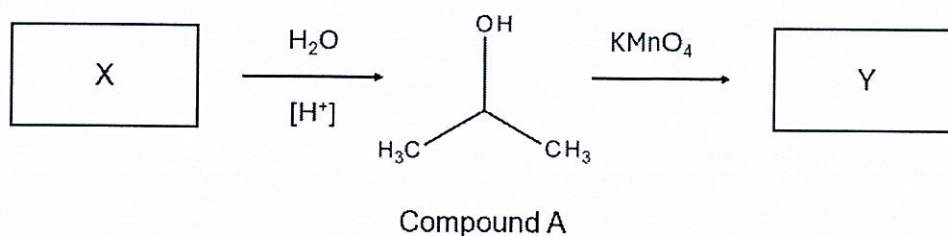
- Plot a standard calibration curve for Carmoisine on graph paper.
(5 marks)
 - Determine the concentration of the sample Carmoisine solution using the calibration curve in (i).
(2 marks)
- (c) The following figure shows the spectrum of methylene blue dye.



- Identify the lambda max ($\lambda_{\max}$) from the following spectrum.
(2 marks)
- Calculate the molar absorptivity (ϵ) of Carmoisine at $\lambda_{\max}$, assuming a 1 cm path length and a 0.1 M solution with absorbance of 0.209.
(3 marks)

Question 2

(a) The following diagram shows the synthesis and reaction of compound A:



- Give an IUPAC name for compound A.
(2 marks)
 - Draw the structural formulae of compounds (X) and (Y).
(4 marks)
 - Give the IUPAC names for compounds (X) and (Y) in (ii).
(4 marks)
- (b) An atomic absorption spectrometer can be used to determine the level of copper in soils. The results are shown in Table 2 below.

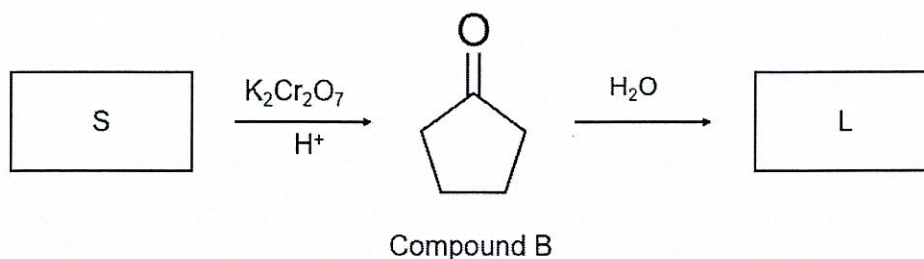
Table 2: Absorbance of copper standard solutions and unknown sample

Sample	Concentration (mg/L)	Absorbance (nm)
Blank	0	0
Standard 1	2	0.16
Standard 2	4	0.32
Standard 3	6	0.48
Standard 4	8	0.65
Unknown Sample	?	0.40

- Plot a standard calibration curve for copper on graph paper.
(5 marks)
- Determine the unknown concentration of copper in mg/L from standard calibration curve in (i).
(2 marks)
- Draw and name the two (2) types of vibrational modes of molecules when they absorb an infra range (IR) range.
(3 marks)

Question 3

- (a) The following diagram illustrates the synthesis and reaction of compound B, a carbonyl compound:



- Give an IUPAC name for compound B. (2 marks)
 - Draw the structural formulae of compounds (S) and (L). (4 marks)
 - Give the IUPAC name for compounds (S) and (L) in (ii). (4 marks)
- (b) The presence of caffeine in a soft drink was determined by high performance liquid chromatography (HPLC) and the results were summarized in Table 3.

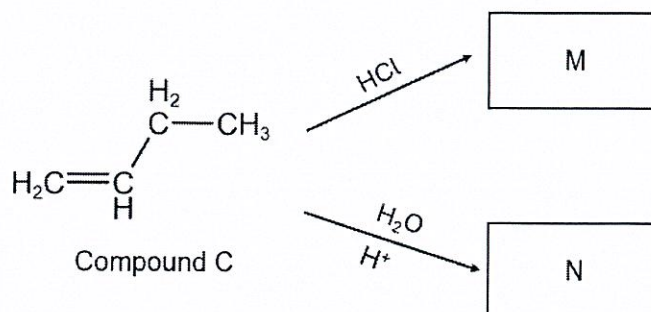
Table 3: Peak Area of caffeine standard solutions and unknown samples

Sample	Concentration (ppm)	Retention Time (min)	Peak Area (cm ²)
Standard 1	10	1.63	1000
Standard 2	20	1.67	2000
Standard 3	30	1.62	3000
Standard 4	40	1.65	4000
Unknown 1	X	2.72	3000
Unknown 2	Y	1.66	3500

- Plot a standard calibration curve for caffeine on graph paper. (5 marks)
- Choose the correct compound of caffeine, either compound X or Y. Justify your answer. (3 marks)
- Determine the concentration of caffeine from the standard calibration curve. (2 marks)

Question 4

(a) The following diagram illustrates the reaction of compound C:



- i. Give an IUPAC name for compound C. (2 marks)
 - ii. Draw the structural formulae of compounds (M) and (N). (4 marks)
 - iii. Give the IUPAC name for compounds (M) and (N) in (ii). (4 marks)
- (b) The following data was obtained from the gas chromatography (GC) analysis on three standard alcohols namely ethanol, 1-propanol, 1-butanol and unknown sample.

Table 4: Peak Area of alcohol standard solution and unknown sample

Peak	Retention Time (min)	Peak Area
Standard ethanol	4.384	1017252.34
Standard 1-propanol	7.123	11397286.86
Standard 1-butanol	10.764	7592544.75
Unknown sample	7.098	7378484.28

- i. Based on the data in Table 4, identify the unknown sample. (2 marks)
 - ii. Justify your answer in (i). (4 marks)
 - iii. Give the IUPAC name for compounds (M) and (N) in (ii). (4 marks)
- (c) Draw a schematic diagram of the gas chromatography (GC). Label all the components. (5 marks)

END OF QUESTION

