UNIVERSITI TEKNOLOGI PETRONAS

FINAL EXAMINATION
MAY 2024 SEMESTER

COURSE	:	**YBB2013 - ORGANIC CHEMISTRY II**
DATE	:	**1 AUGUST 2024 (THURSDAY)**
TIME	:	**9:00 AM - 12:00 NOON (3 HOURS)**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

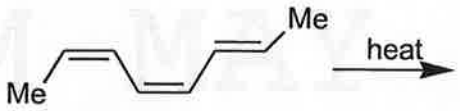
Note :

i. There are **EIGHT (8)** pages in this Question Booklet including the cover page and appendices.

ii. **DOUBLE-SIDED** Question Booklet.

1. a. Illustrate the mechanism using the curved arrows and draw the major product of each pericyclic reaction, clearly indicating the relative stereochemistry.

i.

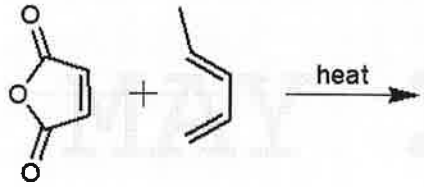


[3 marks]

ii.

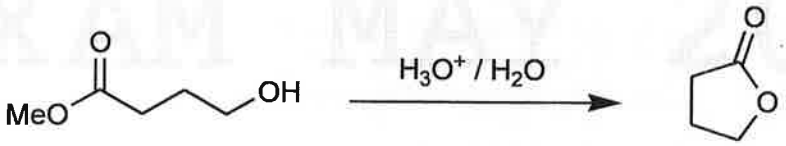
[3 marks]

iii.



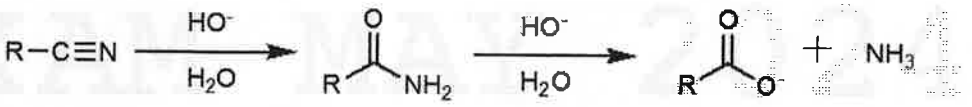
[4 marks]

b. Illustrate the complete and detailed mechanism with curved arrows for the intramolecular esterification of 4-hydroxybutanoic acid to produce cyclic ester.



[10 marks]

2. a. i. Under basic hydrolysis conditions, a nitrile goes through a primary amide intermediate before becoming a carboxylate. Draw the mechanism with the curved arrows for the reaction below.

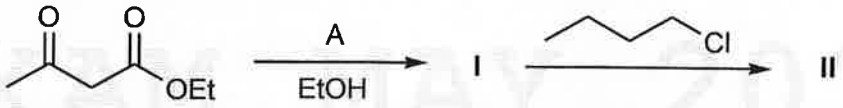


[8 marks]

ii. Explain why it is not a facile method for converting nitriles into carboxylates.

[2 marks]

b. The following reaction shows the acetoacetic ester synthesis.



i. Complete the two steps acetoacetic ester synthesis by naming the reagent **A** and drawing the structure of compounds **I** and **II**.

[3 marks]

ii. Compound **II** can be hydrolyzed in the presence of basic condition and subsequent acidification to produce mono-butylacetoacetic acid. If heat is applied after acidification, decarboxylation takes place to produce 2-heptanone. Draw the detailed mechanism with curved arrows for this transformation.

[7 marks]

3. a. Determine the molecular formula and draw the structure of the unknown compound that has the ^{1}H and ^{13}C NMR spectra and following data:
MW (g/mol) = 107; Elemental analysis; C, 78.50; H, 8.41; N, 13.08

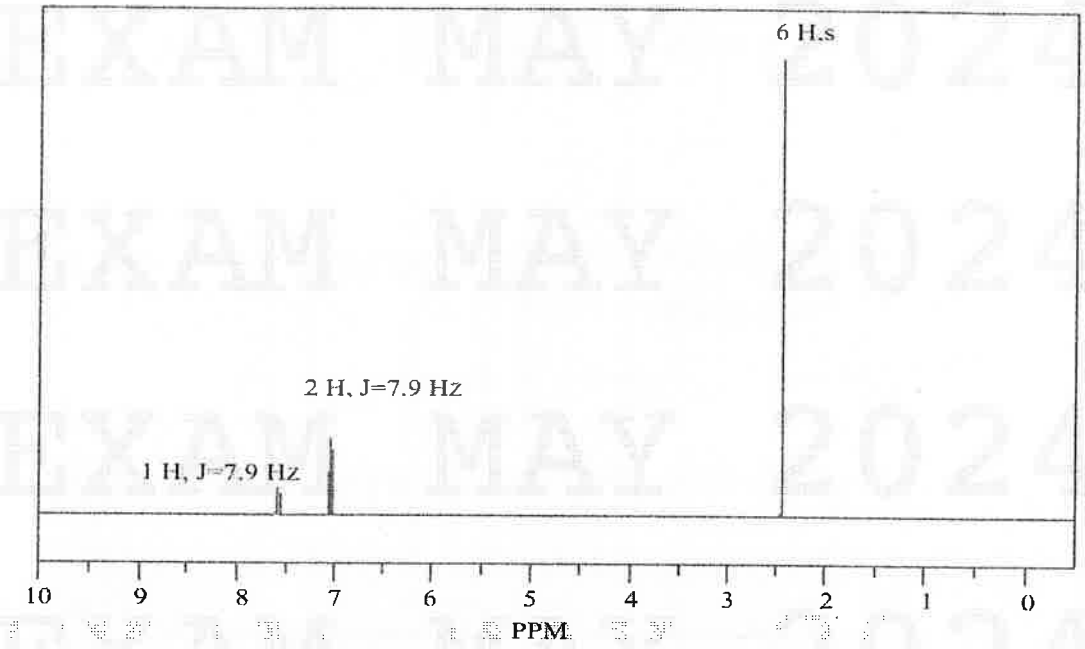


FIGURE Q3a. ^{1}H NMR spectrum

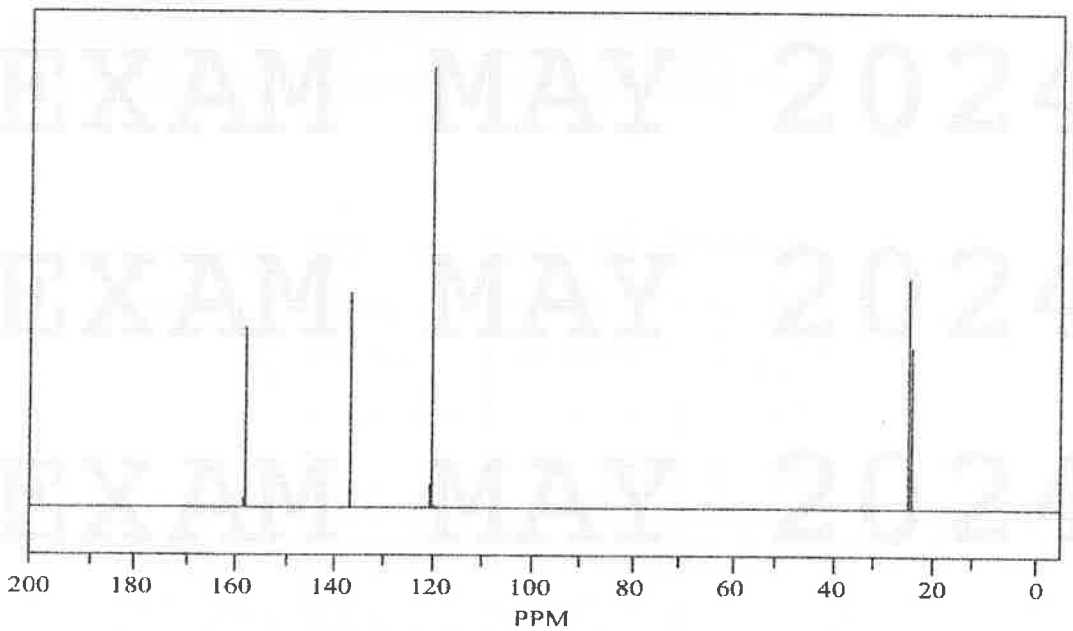


FIGURE Q3a. ^{13}C NMR spectrum

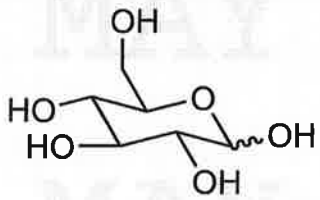
[5 marks]

b. A peptide with nine amino acids has the following composition: Asn Cys Gln Gly Cys Ile Leu Pro Tyr (not in sequence). It also has Cys as the N-terminal residue and Gly as C-terminal. Partial acid hydrolysis gave these peptide sequence as below. Determine the sequence of the original peptide.

Asn-Cys
Cys-Tyr
Tyr-Ile-Gln
Cys-Pro-Leu
Ile-Gln
Leu-Gly
Gln-Asn-Cys

[5 marks]

c. Cyclic structure of *D*-glucose is presented below.



i. Draw the opened Fisher structure of *α*-*D*-glucose based on monosaccharide nomenclature.

[2 marks]

ii. Determine whether the structure is classified as an acetal, ketal, hemiacetal, or hemiketal. Justify your answer.

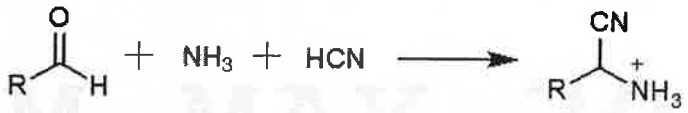
[2 marks]

iii. Acid-catalyzed addition of methanol to D-(+)-glucose results in the formation of anomeric methyl acetals called glucosides. Illustrate the complete mechanism with curved arrows for the formation of α- and β-glucosides and label them correctly.

[6 marks]

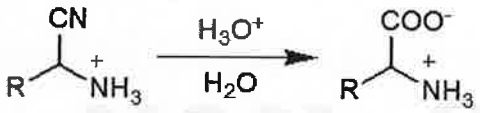
4. a. The Strecker reaction, followed by a hydrolysis reaction, is an excellent method for synthesizing amino acids. This reaction involves the conversion of an aldehyde or ketone into an amino acid through a multi-step process.

i. Draw the detailed mechanism with curved arrows for the conversion of aldehyde to α-aminonitrile as shown below.



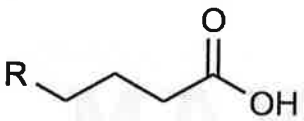
[5 marks]

ii. Draw the detailed mechanism with curved arrows for the hydrolysis of a-aminonitrile α-amino acid.



[6 marks]

b. Predict the structure of products formed when the fatty acid below reacts with the following reagents.



i. $SOCl_2$

[3 marks]

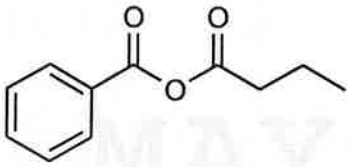
ii. Br_2

[3 marks]

iii. Methanol in the presence of H^+

[3 marks]

5. a. The noncyclic acid anhydride as the target molecule (TM) is given below.



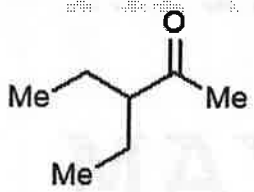
i. Name the compound and indicate the synthons and corresponding synthetic equivalents

[5 marks]

ii. Using retrosynthetic analysis, provide a possible general scheme of the synthesis of the compound.

[5 marks]

b. Design the retrosynthesis analysis and illustrate the complete mechanism with curved arrows to produce the structure below.

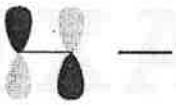


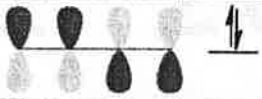
[10 marks]

-END OF PAPER-

APPENDIX

MOLECULAR ORBITALS

Orbital	Orbital Diagram	Homo / Lumo
ψ_2^* / π_2^*		LUMO
ψ_1 / π_1		HOMO

Orbital	Orbital Diagram	Homo / Lumo
ψ_4 / π_4^*		-
ψ_3 / π_3^*		LUMO
ψ_2 / π_2		HOMO
ψ_1 / π_1		-

Orbital	Orbital Diagram	Homo / Lumo
ψ_6 / π_6^*		-
ψ_5 / π_5^*		-
ψ_4 / π_4^*		LUMO
ψ_3 / π_3		HOMO
ψ_2 / π_2		-
ψ_1 / π_1		-