MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
THIRD YEAR FIRST SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES
BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: CHE 3118-1

COURSE TITLE: ORGANIC SYNTHESIS I

DATE: DEC 2023 TIME: 0830 – 1030 HRS

INSTRUCTIONS TO CANDIDATES

This examination paper consist of two sections **A** and **B**. Section **A** is compulsory. Answer any other TWO questions in section **B**.

This paper consists of 5 printed pages. Please turn over:

SECTION A

Question ONE (20 marks)

a) Define the following organic chemistry terminologies giving example(s) in each case. (4 marks)

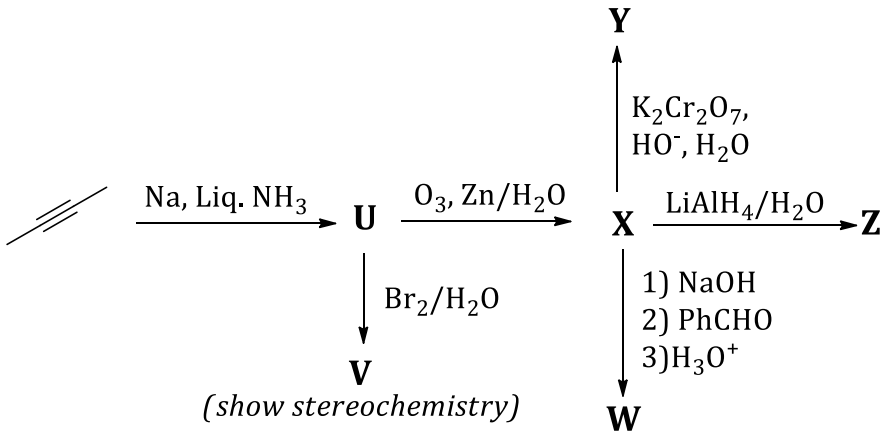
i. Robinson Annulation

ii. Retrosynthetic analysis

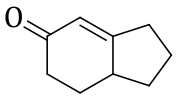
iii. Synthon

iv. Convergent synthesis

b) Complete the reactions by filling in the missing product or starting material **U – Z.** Show stereochemistry where applicable. (6 marks)

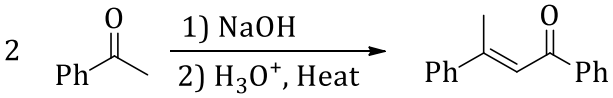


c) What two carbonyl compounds are needed to synthesize each of the following compounds, using Robinson annulation? Perform retrosynthetic analysis. (3 marks)



d) Discuss the factors that one must consider before designing a chemical synthesis. (3 marks)

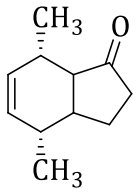
e) Suggest the *curved arrow-pushing mechanism* for the following reaction. (4 marks)



SECTION B

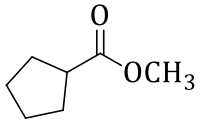
Question TWO (15 marks)

a) The following compound was synthesized via intramolecular aldol condensation (*to form dienophile*) then followed by Diel's Alder reaction. Perform retrosynthesis and show the structures of the starting diene, and the oxo-aldehyde used. (4 marks)

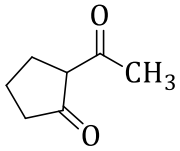


b) Using relevant examples, explain why β-diketones are easily enolized than ɗ-diketones. (2 marks)

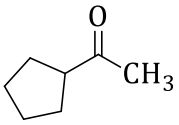
c) Consider the following molecules:



I



II

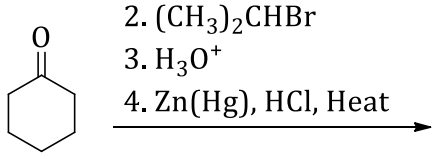


III

i. Rank the above molecules from the one with the most acidic α-hydrogens to the least. Justify your ordering criteria. (2 marks)

ii. Compound II can form two enolates. Draw their structures. Which is more stable? Which is easily formed? Justify your reasoning. (3 marks)

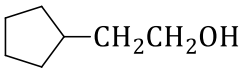
d) For the following sequences of reactions, provide the final product. (4 marks)

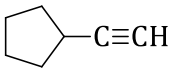


Question THREE (15 Marks)

a) How can you synthesize the following products from the given starting materials? (4 marks)

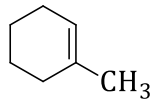
i. Butanal from acetaldehyde

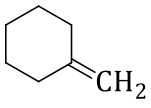
ii. 

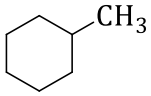
from 

b) A hydrocarbon **A** (C_6H_{12}) undergoes reaction with HBr to yield compound **B** ($C_6H_{13}Br$). Treatment of **B** with sodium ethoxide in ethanol yields **C**, an isomer of **A**. Reaction of **C** with ozone followed by treatment with water and Zinc gives acetone, $(CH_3)_2CO$, as the only product. Provide the structures of **A**, **B** and **C**, and outline the reaction pathway. (4 marks)

c) Give the reagents necessary to convert cyclohexanone into each of the following compounds: (6 marks)

i. 

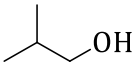
ii. 

iii. 

d) Why is ozonolysis not an important chemical reaction for determining the synthetic routes when performing retrosynthetic analysis? (1 mark)

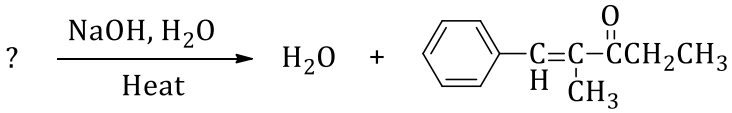
Question FOUR (20 Marks)

a) How can you synthesize the following products from the given starting materials? (4 marks)

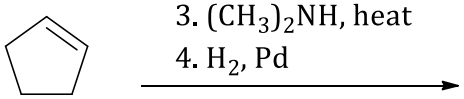
i.  from 

ii. 4-methyl-3-penten-2-ol from acetone

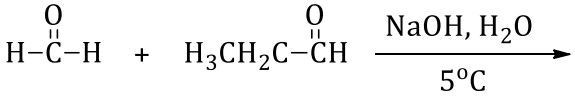
b) Identify the two starting materials needed to make the following compound. (4 marks)



c) For the following sequences of reactions, provide the final product. Consider formation of only the major product in each step. (4 marks)



d) Write out the mechanism, using curved arrows to show electron movement of the following aldol addition reaction. (3 marks)



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