



**MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
THIRD YEAR FIRST SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES  
BACHELOR OF SCIENCE**

**COURSE CODE: CHE 3122**

**COURSE TITLE: ARICYCLIC AND HETEROCYCLIC  
CHEMISTRY**

DATE: 30<sup>TH</sup> MARCH 2022

TIME: 0830 – 1030 HRS

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**INSTRUCTIONS TO CANDIDATES**

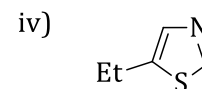
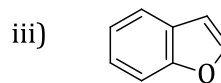
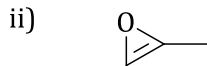
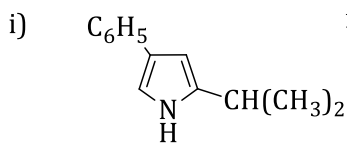
This examination paper consist of two sections **A** and **B**. Section **A** is compulsory. Answer any other TWO questions in section **B**.

*This paper consists of 4 printed pages. Please turn over:*

## SECTION A

### Question ONE (30 marks)

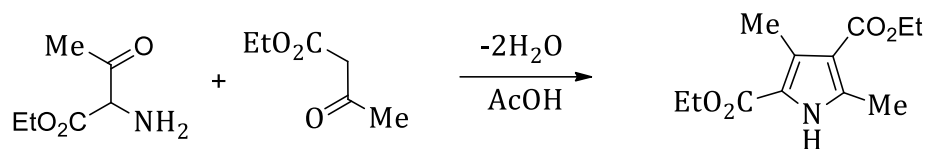
a) Name the following compounds systematically using IUPAC system. **(8 marks)**



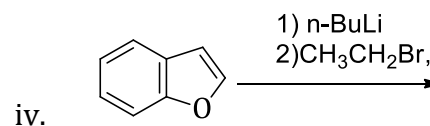
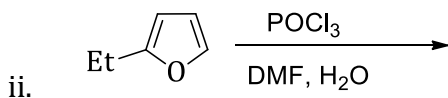
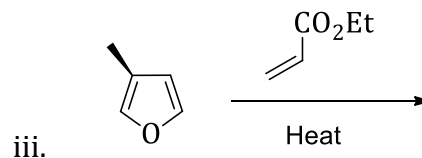
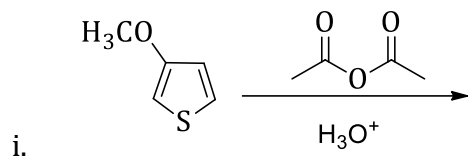
b) Draw the structures for the following compounds. **(8 marks)**

- 3-methylazete
- 1,3,5-trimethylpyridinium ion
- 2,5-diisopropylpyrazine
- 3-ethyl-4-phenylpyrrolidine

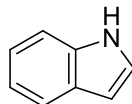
c) Provide a detailed arrow pushing mechanism for the following reaction that gives substituted pyrrole. **(6 marks)**



d) Provide the products for the following reactions **(8 marks)**



e) Predict the preferred site of electrophilic aromatic substitution in Indole. Explain your choice. **(2 marks)**

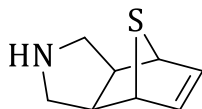


## SECTION B

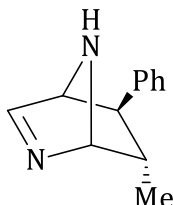
### Question TWO (20 marks)

- a) Rank the compounds given below in increasing order of the indicated property in parenthesis. Briefly explain your ordering criteria **(6 marks)**
- Water, hydroxide, pyridine, pyrrole, ammonia (*basicity*)
  - Thiophene, Furan, Pyrrole. (*aromatic nature*)
- b) Heterocyclic compounds can undergo Diels Alder reactions. Identify the diene and the dienophile used to synthesize each of the following compounds by performing retrosynthetic analysis. **(9 marks)**

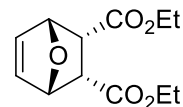
i.



ii.



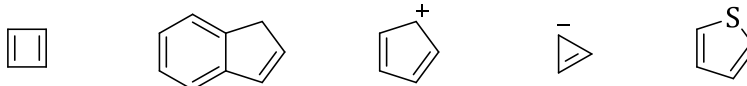
iii.



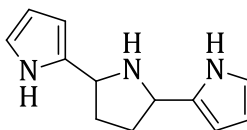
- c) Explain using resonance structures why electrophilic aromatic substitution of pyridine occurs at C3. **(3 marks)**
- d) 2-methyloxacyclobutane reacts with HCl to give two products. Write their structures. **(2 marks)**

### Question THREE (20 Marks)

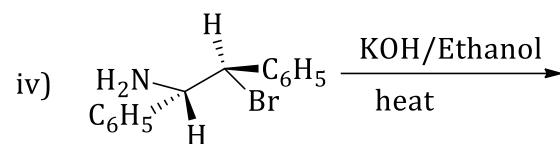
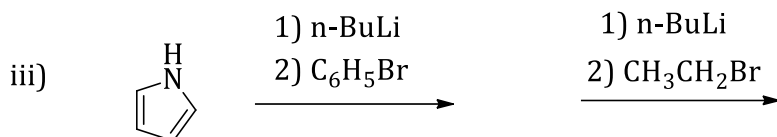
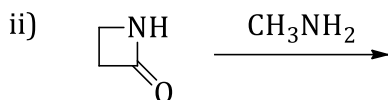
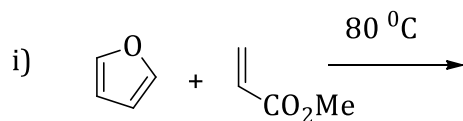
- a) Categorize the following compounds as either aromatic or non-aromatic. Justify your reasoning. **(4 marks)**



- b) Treatment of Pyrrole with acids has been known to polymerize. Under controlled conditions, a trimer can be isolated though in low yield. Provide a reasonable arrow pushing mechanism showing how this trimer is formed. **(6 marks)**

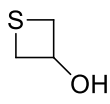


c) Provide the major products formed in the following chemical reactions. **(10 marks)**

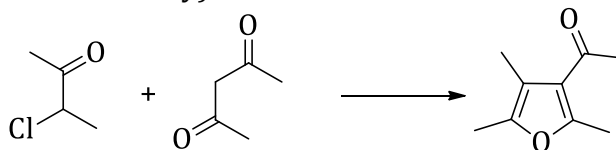


#### Question FOUR (20 Marks)

a) 2-(chloromethyl)oxirane reacts with hydrogen sulphide ion  $\text{HS}^-$  to give

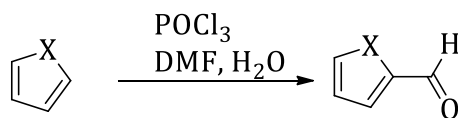
thiacyclobutan-3-ol.  Explain by arrow-pushing mechanism. **(4 marks)**

b) Provide a detailed arrow pushing mechanism for the Fiest-Benary synthesis of furan. (Follows enolate chemistry) **(5 marks)**



c) Give some of the applications of heterocycles in industry/medical field. **(3 marks)**

d) Heterocycles can undergo formylation (Vilsmeier reaction). Using furan, provide a reasonable arrow-pushing mechanism that lead to the product. **(5 marks)**



e) Monohalogenation of thiophene-3-carboxylic acid gives only one product. Draw the structure of this product and explain why only one product is formed. **(3 marks)**

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