OFFICE OF THE DEPUTY VICE CHANCELLOR

ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER REGULAR

EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHE 403**

COURSE TITLE: **HETEROCYCLIC AND STEREOCHEMISTRY**

DATE: 23/04/2024 **TIME: 2.00 PM – 5.00 PM**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 5 PRINTED PAGES **PLEASE TURN OVER**

MAIN/REGULAR EXAM

CHE 403: HETEROCYCLIC AND STEREOCHEMISTRY

STREAM: BED (Science) **DURATION: 3 HOURS**

Instruction to candidates: answer **ALL** questions in section A and any other **TWO** questions in section B

SECTION A (30 Marks)

Question One

a) Define the following terms:

i. Stereochemistry (1 Mark)

ii. Cis – trans isomerism (1 Mark)

iii. Constitutional isomers (1 Mark)

iv. Stereoisomers (1 Mark)

v. Chiral molecule (1 Mark)

vi. Stereocenter (1 Mark)

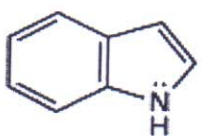
vii. Stereoselective reaction (1 Mark)

b) Draw Fischer projections of the two stereoisomers of 3 – Chlorohexane and assign them their relative configurations (2 Marks)

c) Give two constitutional isomers of molecular formula C_2H_6O (2 Marks)

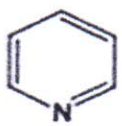
d) Name the following heterocyclic aromatic compounds:

i.



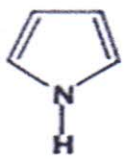
(1 Mark)

ii.



(1 Mark)

iii.

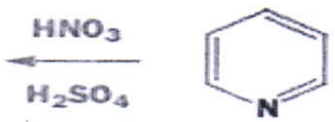


(1 Mark)

Question Two

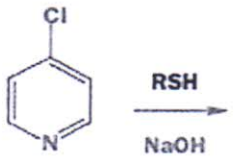
a) Complete the following reactions of pyridine

i.



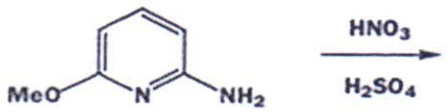
(2 Marks)

ii.



(2 Marks)

iii.



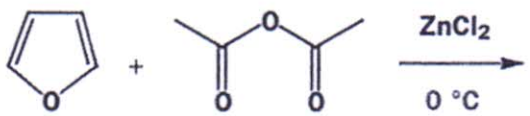
(2 Marks)

b) Complete the reactions of furan shown below:

i.

(2 Marks)

ii.

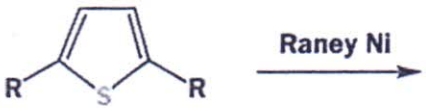


(2 Marks)

iii.

(2 Marks)

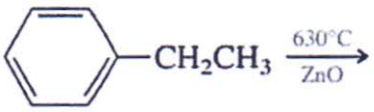
c) Complete the following reaction of thiophene:



(2 Marks)

d) Explain why halogens are ortho – para directors despite being deactivators of the benzene ring (1 Mark)

e) Complete the following reaction of benzene:



(1 Mark)

SECTION B

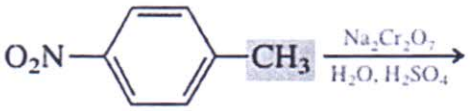
Question One (20 Marks)

a) Derive the reaction mechanism for sulphonation of benzene (3 Marks)

b) Derive the reaction mechanism for the Friedel – Crafts alkylation of benzene (3 Marks)

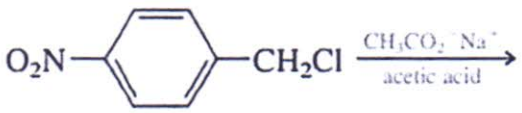
c) Complete the following side chain reactions of benzene:

i.



(1 Mark)

ii.



(1 Mark)

d) Using resonance stabilized structures, explain why the nitronium group is a meta director and a deactivating group towards electrophilic aromatic substitution (4 Marks)

e) Explain why nitrobenzene cannot undergo Friedel – Crafts alkylation reaction (2 Marks)

f) Design the synthesis of the following compounds from benzene or any other suitable derivative of benzene:

i. Orthobromophenol (3 Marks)

ii. *p* – Chloroethyl benzene (2 Marks)

g) Define the term resonance energy of benzene (1 Mark)

c) With the aid of a well labelled diagram, show how plane polarized light is produced (4 Marks)

d) Show the structures of the following heterocyclic aromatic compounds:

i. Benzothiophene (1 Mark)

ii. Isoindole (1 Mark)

iii. Isoquinoline (1 Mark)

e) Using equations demonstrate how pyridine can be used as a nucleophilic catalyst in acylation reactions (3 Marks)

f) Starting with 2 and 4 methoxypyridines, demonstrate how flupitrine can be synthesized (4 Marks)

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