KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

FOURTH YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF EDUCATION SCIENCE AND ANALYTICAL CHEMISTRY AND INDUSTRIAL AGRICULTURE
SECOND SEMESTER 2021/2022
(FEBRUARY-JUNE, 2022)

CHEM 462: ADVANCED HETROCYCLIC CHEMISTRY

STREAM: Y4 S2 **TIME: 2 HOURS**

DAY: THURSDAY, 9.00 AM – 11.00 AM **DATE: 12/05/2022**

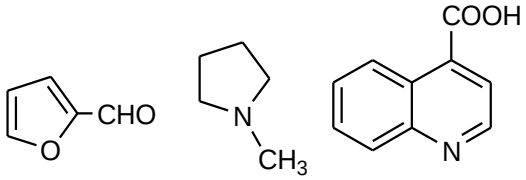
INSTRUCTIONS:

1. ***Do not write anything on this question paper.***
2. ***Answer ALL Questions in Section A and any other TWO in Section B.***

SECTION A (40MKS)

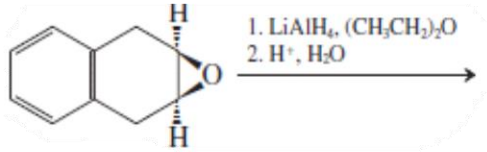
1. a. Draw the following compounds. (6 marks)
   i. *cis*-2,3-Diphenyloxacyclopropan
   ii. 1,3-oxathiacyclopentane;
   iii. 2-butanoyl-1,3-dithiacyclohexane;

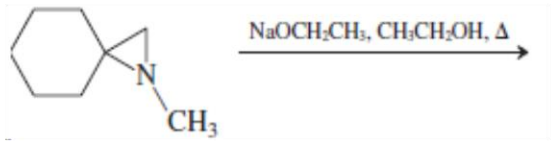
   b. Name the following compounds (6 marks)

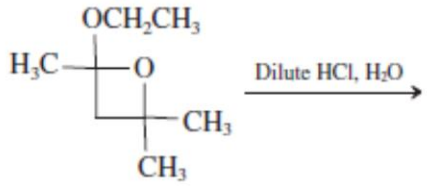


i ii iii

c. Give the expected product of each of the following reaction sequences (6 marks)

i. 

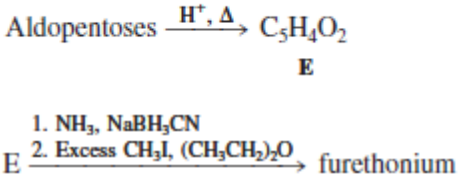
ii 

iii. 

d. Rank the following compounds in increasing order of basicity: water, hydroxide, pyridine, pyrrole and ammonia (6 marks)

e. Give the reasons as to why Pyrrole is a much weaker base than azacyclopentane (pyrrolidine) (6 marks)

f. In the following reaction scheme compound E is a valuable synthetic starting material. The following sequence convertsit into furethonium, which is useful in the treatment of glaucoma.



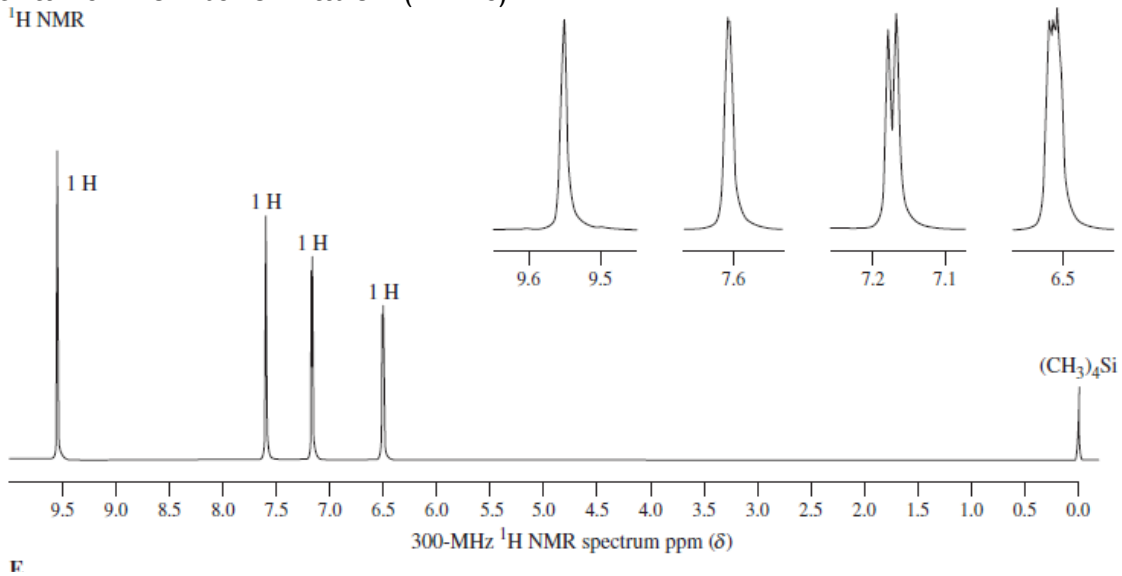
i. What is structure of furethonium? (3 marks)

ii. Show the mechanism for this raction for the formation offurethonium (7 marks)

SECTION B (30MKS)

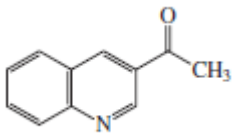
2. a. The commercial synthesis of a useful heterocyclic derivative requires treatment of a mixture of aldopentoses (derived from corncobs, straw, etc.) with hot acid under dehydrating conditions. The product, E, has 1H NMR spectrum G, shows a strong IR band at 1670 cm-2, and is formed in

nearly quantitative yield. Identify compound E and formulate a mechanism for its formation (7mks)



E

B The structure below is that of acetylquinoline



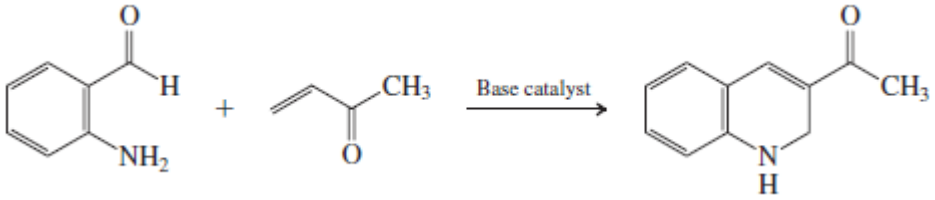
3-Acetylquinoline

i. Which position(s) do you expect 3- (margin) to undergo nitrationin the presence of a mixture of sulfuric and fuming nitric acids?

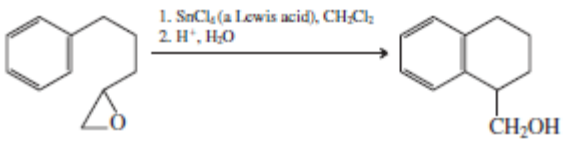
(2 marks)

ii. Compare this reaction that of nitration of quinoline itself (6marks)

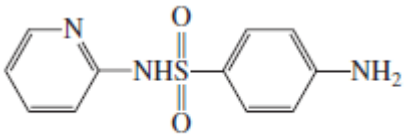
3. a Quinolines are heterocycles that are widely used in medicinal chemistry because of the diversity of biological activity — including anticancer utility — that their derivatives display. A short synthesis of 3-cyldihydroquinolines (which may be converted into 3-acylquinolines by mild oxidation) is shown below. Propose a mechanism for this process. (7mks)



b. Propose reasonable mechanisms for the following transformations (8marks)

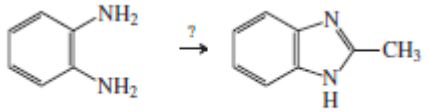


4 a. Starting with benzenamine (aniline) and pyridine, propose a synthesis for the antimicrobial sulfa drug sulfapyridine (8 marks)



Sulfapyridine

b. Derivatives of benzimidazole possess biological activity somewhat like that of indoles and purines (of which adenine,is an example). Benzimidazoles are commonly prepared from benzene-1,2-diamine. Devise a short synthesis of 2-methylbenzimidazole from benzene-1,2-diamine. (7marks)



Benzene-1,2-diamine **2-Methylbenzimidazole**