



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

MAY – JULY 2015 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

CHEM 410: CHEMISTRY OF HETEROCYCLIC COMPOUNDS

SCHOOL FOCUSED PROGRAMME

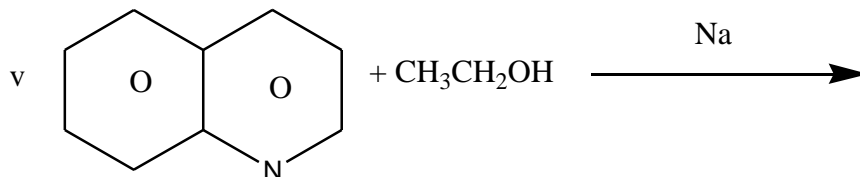
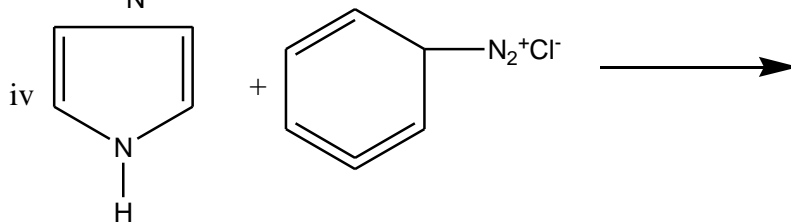
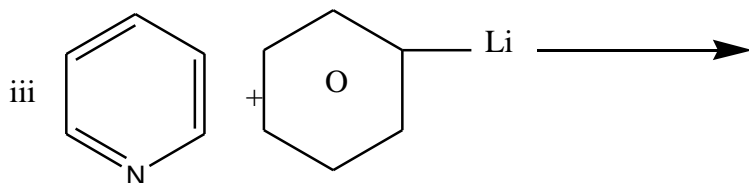
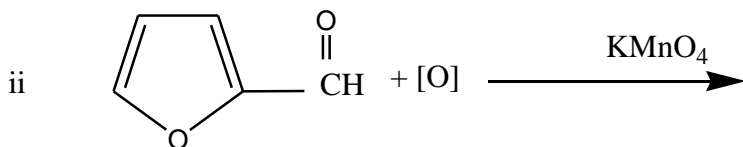
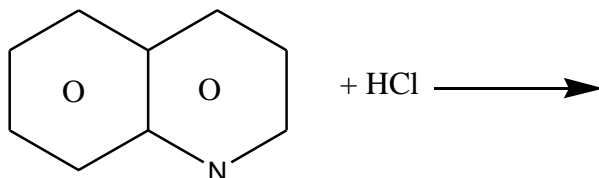
Date: JULY 2015

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions

- Q1. a) Explain how pyridine is isolated from coal and show its resonance structures as predicted by the resonance theory. **(8 marks)**
- b) Explain how indole is synthesized by the Fischer indole synthesis. **(5 marks)**
- c) Give the products of the following reactions

i



(10 marks)

d) How would you distinguish between pyridine and aminobenzene?

(7 marks)

Q2. a) Explain why pyridine undergoes nucleophilic substitution at 2-position?

(6 marks)

b) How is pyrrole synthesized and what happens when it is treated with the following reagents

i Nitric acid in acetic anhydride at $-10^{\circ}C$

ii Sulphur trioxide in pyridine

iii Bromine in alcohol

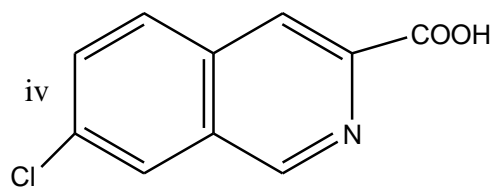
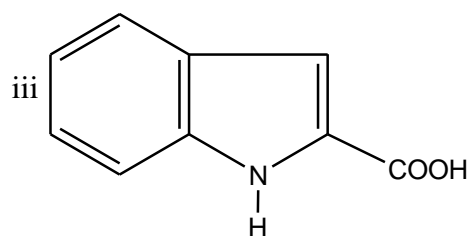
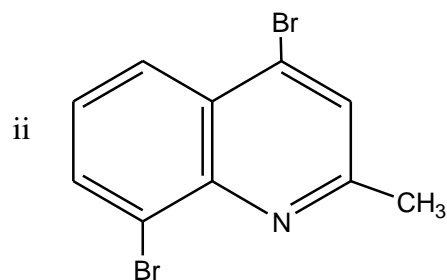
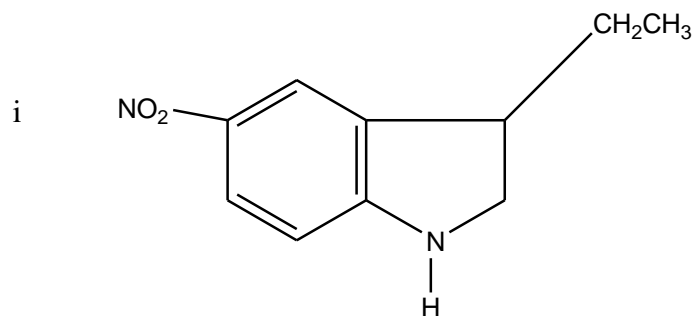
iv Benzenediazonium chloride.

(10 marks)

c) Why is pyridine more basic than pyrrole.

(4 marks)

Q3. a) Name the following benzene fused heterocyclic compounds:



(6 marks)

b) Why is aniline ($K_b = 4.2 \times 10^{-10}$) less basic than pyridine ($K_b = 2.3 \times 10^{-9}$)?
(5 marks)

c) Give the mononitration products of the following compounds and account for their formation.

- i 3 – Nitropyrrole
- ii 2 – Methoxy -5-methylthiophene
- iii 5 –Methylfuran – 2- carboxylic acid

- iv 2 –Methoxypyrrole.

(9 marks)

Q4. a) Explain why pyridine does not undergo the Friedel Craft's reactions. **(5 marks)**

b) Give the structures and names of the products from the reactions of furfural (2-furancarboxaldehyde) with

i Concentrated aqueous NaOH

ii $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{CH}/\text{CH}_3\text{CH}_2\text{Na} \end{array}$

iii ZnO/Cr₂O₃ and heat. **(6 marks)**

c) Describe how quinoline is synthesized by the skrap's synthesis and explain what are the roles of

i H₂SO₄

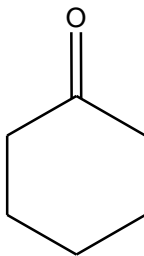
ii C₆H₅NO₂ in the reaction process. **(9 marks)**

Q5. a) Explain what is furfural and compare its properties with those of benzaldehyde. **(6 marks)**

b) Discuss the molecular orbital structure of pyridine elaborating the bonds involved. **(6 marks)**

c) Explain each of the following observations

i Pyridine is less basic than trimethylamine



ii The compound is not aromatic

iii Aldol condensation and show how 2-butenal can be formed starting from acetaldehyde in the presence of NaOH_(aq) **(8 marks)**

END