



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

**A. M. E. C. E. A**

**MAIN EXAMINATION**

**JANUARY - APRIL 2017 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF CHEMISTRY**

**REGULAR PROGRAMME**

**CHEM 302: AROMATIC COMPOUNDS**

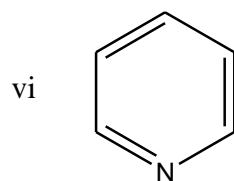
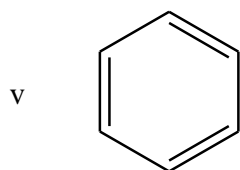
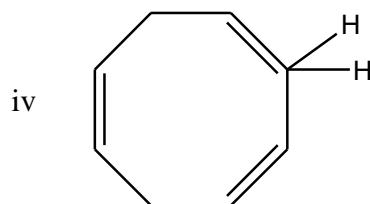
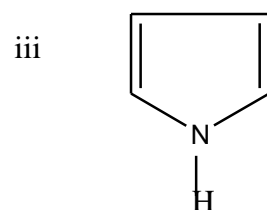
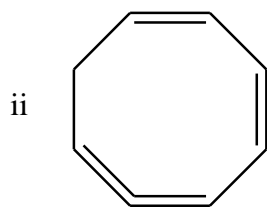
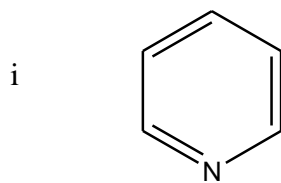
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**Date: APRIL 2017**

**Duration: 2 Hours**

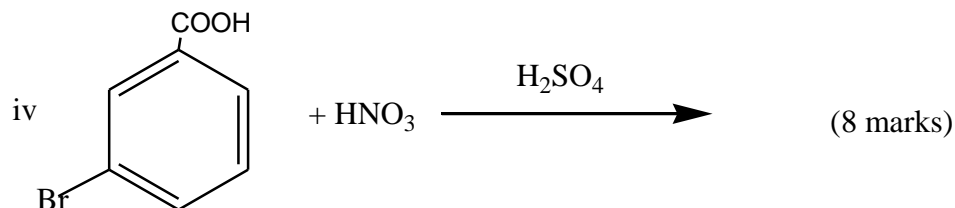
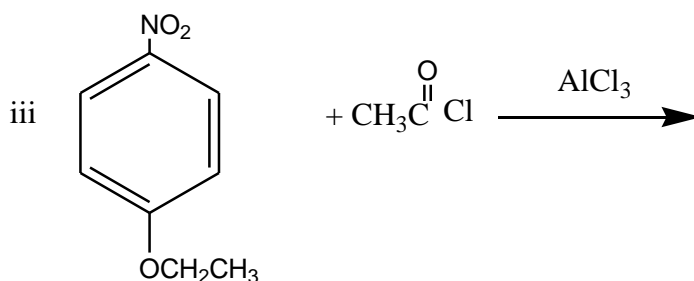
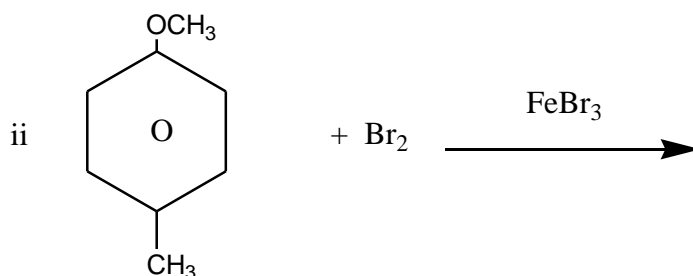
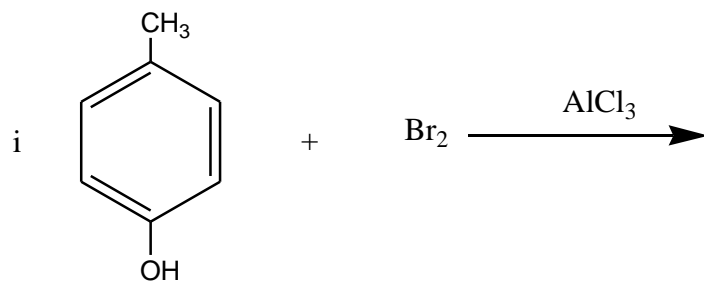
**INSTRUCTIONS: Answer Question ONE and any other Two Questions**

Q1. a) Which of the following compounds are aromatic?



- b) Explain why the Friedel – Craft's reaction of 1 – Chloro – 2 – Methylpropane with benzene yields only tert – butylbenzene? **(6 marks)**

- c) Explain with the help of examples the following terms
- Resonance
  - Hyperconjugation
  - Activating group
  - Meta-directors. **(8 marks)**
- d) Suggest an explanation for the fact that primary amines form sulphonamides which are soluble in alkali whereas those formed from secondary amides are insoluble in alkali **(7 marks)**
- e) Why can 1,3,5 – tribromobenzene NOT be obtained by direct bromination of benzene? **(3 marks)**
- Q2. a) Rank the compounds in each group in order of their reactivity to electrophilic substitution
- Nitrobenzene, phenol, toluene, benzene
  - Phenol, benzene, bromobenzene and benzoic acid
  - Benzene, chlorobenzene, benzaldehyde and aniline **(12 marks)**
- b) Propose a mechanism for the synthesis of 4 – chloro – 1 – nitro – 2 – propyl benzene from benzene. **(4 marks)**
- c) Why is an OH<sup>-</sup> group on a benzene ring an ortho/para director and an activating group to further electrophilic substitution? **(4 marks)**
- Q3. a) Give the product of each of the following reactions



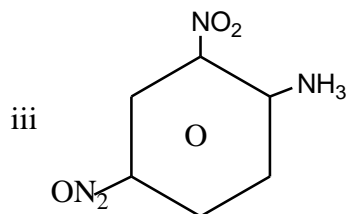
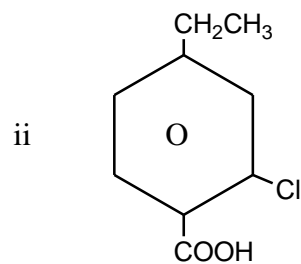
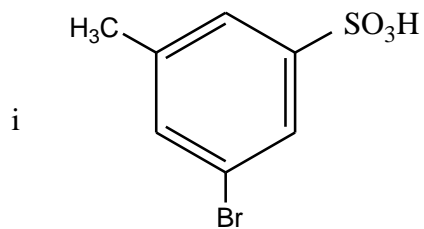
b) Write a mechanism for the reaction of toluene with chlorine in the presence of UV light. **(8 marks)**

c) How will you synthesize p-nitrobenzoic acid from benzene? **(4 marks)**

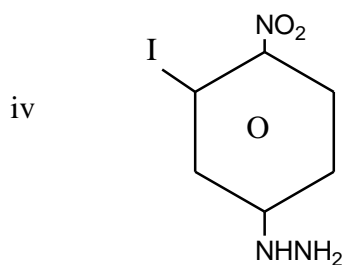
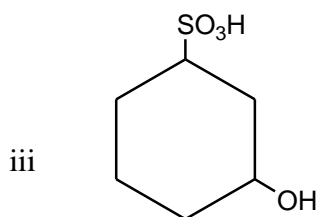
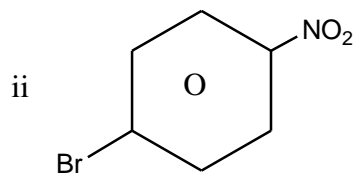
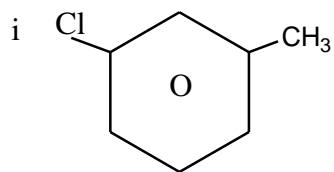
Q4. a) What are the THREE parameters that are limitations of Friedel-Crafts' alkylation? **(6 marks)**

b) Write down the reaction that occurs when aniline is treated with  $\text{NaNO}_2$  and hydrochloric acid at  $0-5^\circ\text{C}$  **(4 marks)**

c) Give IUPAC names to each of the following compounds:



d) Indicate whether the following compounds are artho, meta or para distributed



(4 marks)

Q5. a) Draw structure corresponding to the following IUPAC names

i) P – Bromochlorobenzene

ii) P – Chlorotoluene

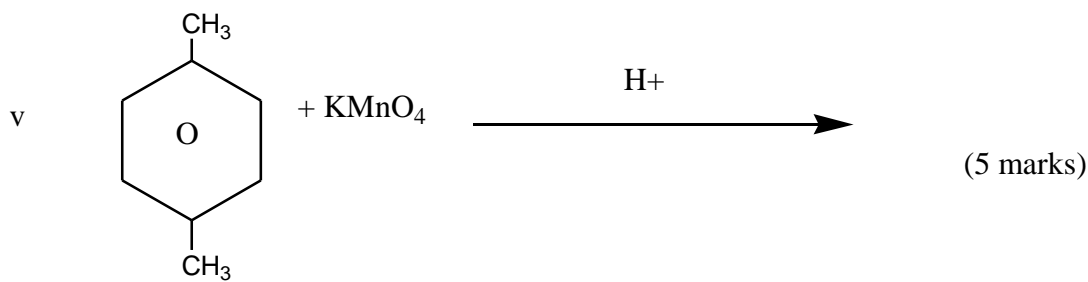
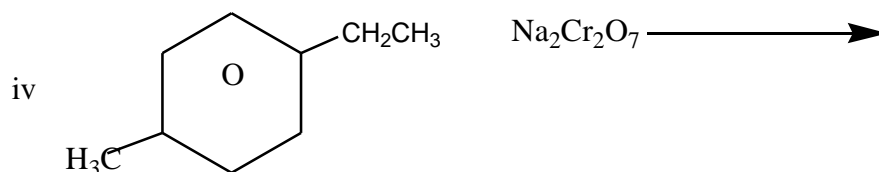
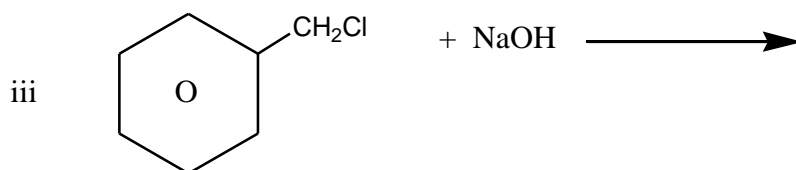
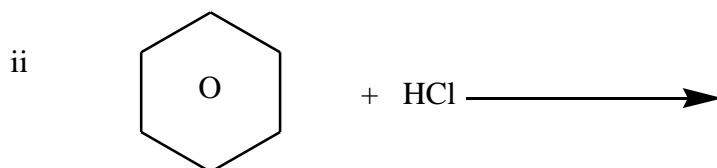
iii) M – Xylene

iv) O – Isopropylphenol

v) I – Chloro – 3,5 – dimethylbenzene

(5 marks)

b) Give the products of the following equations



c) Explain why a nitro group on a benzene ring is meta directing and deactivating? (illustrate your answer using resonance structures) (6 marks)

d) Rank the following compounds in each group in increasing order of their reactivity to electrophilic substitution

- Nitrobenzene, phenol, toluene, benzene
- Benzene, benzaldehyde, chlorobenzene and aniline (4 marks)

**\*END\***