



Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF
TECHNOLOGY IN ANALYTICAL CHEMISTRY
BTAC 12J

ACH 4203: THE CHEMISTRY OF AROMATIC COMPOUNDS

SUPPLEMENTARY EXAMINATION

MARCH 2014 SERIES

2 HOURS

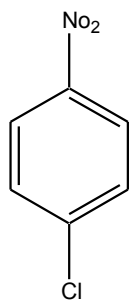
Instructions to candidates:

This paper consist of **FIVE** questions

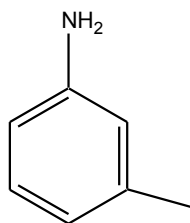
Answer question **ONE** (compulsory) and any other **TWO** questions

Question ONE

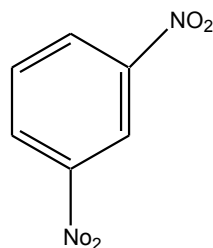
- a) Draw the structure corresponding to the following IUPAC names **(3marks)**
- (i) M-t-butylaniline
 - (ii) 3-nitrobiphenyl
 - (iii) 2-acetylfuran
 - (iv) 4-methylpyridinium chloride
- b) Indicate with an arrow where an electrophile would add to the following benzene derivatives. **(3marks)**



(i)



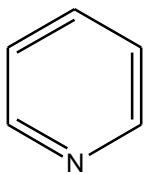
(ii)



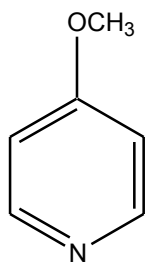
(iii)

c) (i) Arrange with reasons the following compounds in order of decreasing basicity.

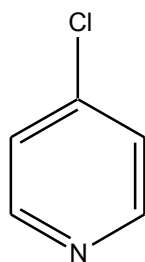
(3marks)



(i)



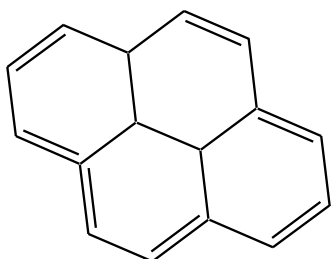
(ii)



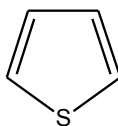
(iii)

(ii) Classify the following compound as either aromatic, anti-aromatic or non-aromatic

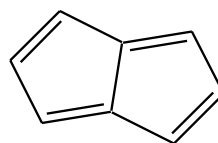
(4marks)



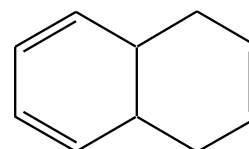
I



II



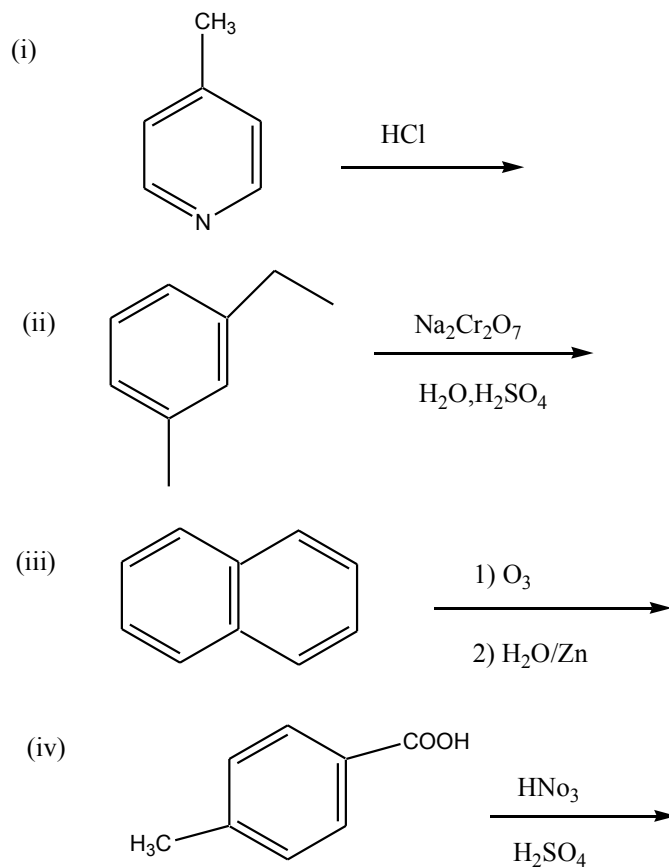
III



IV

d) With reasons, arrange the following compounds in the order of increasing reactivity towards electrophilic substitution: Phenol, benzaldehyde, Benzene **(4marks)**

e) Complete the following reactions: **(4marks)**



f) Determine the structure of the compound with the formula $\text{C}_{14}\text{H}_{20}\text{O}_2$ and the $^1\text{H-NMR}$ and IR data given below: **(8marks)**

IR: 1720cm^{-1} (strong)

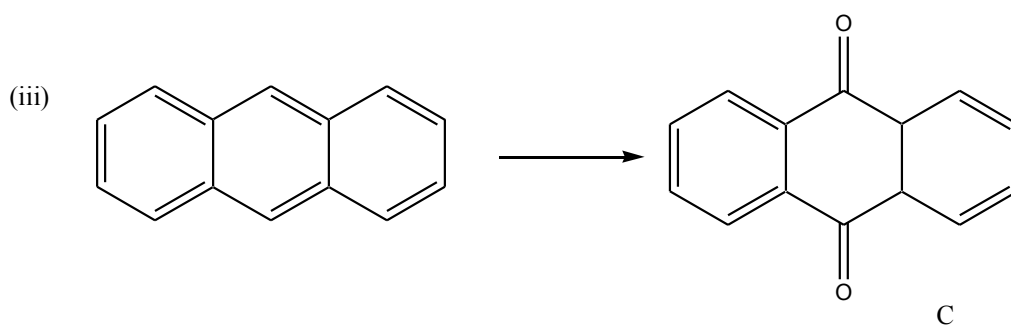
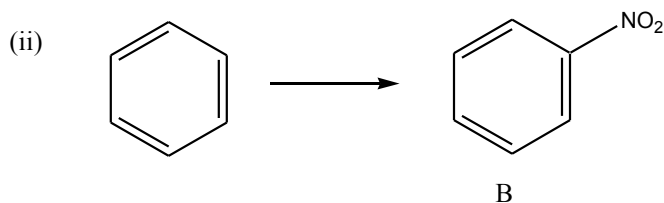
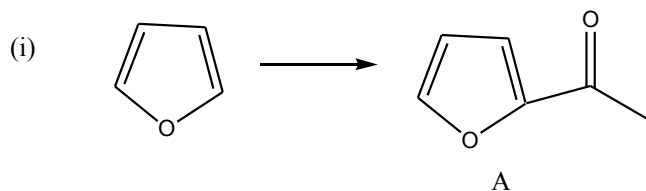
2800cm^{-1} (broad)

$^1\text{H-NMR}$:

- 0.90 ppm (triplet, 3H)
- 1.20 ppm (doublet, 6H)
- 1.67 ppm (quintet, 2H)
- 2.74 ppm (quintet, 1H)
- 2.87 ppm (septet, 1H)
- 3.08 ppm (doublet, 2H)
- 7.02 ppm (doublet, 2H)
- 7.25 ppm (doublet, 2H)
- 11.0 ppm (broad singlet, 1H)

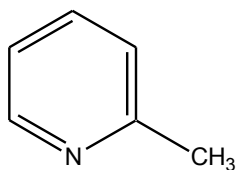
Question TWO

a) Provide the missing reagents and name products A, B and C (6marks)

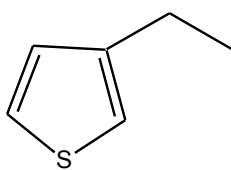


b) Name the following heterocyclic compounds and account for their aromaticity

(4marks)

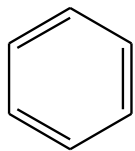


(i)

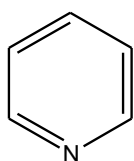


(ii)

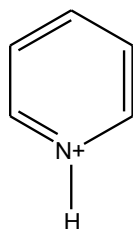
c) Arrange with reasons the following compounds in order of decreasing reactivity towards electrophilic substitution (3marks)



(i)

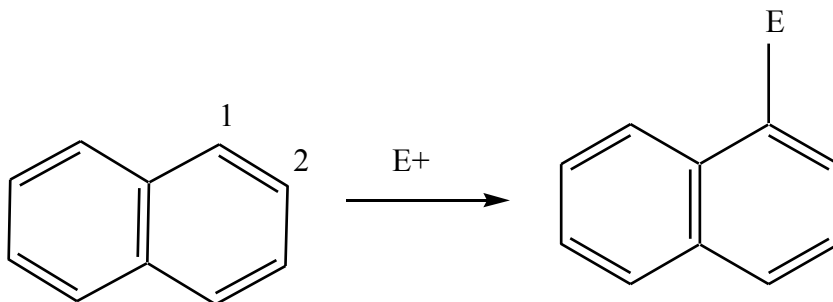


(ii)



Cl (iii)

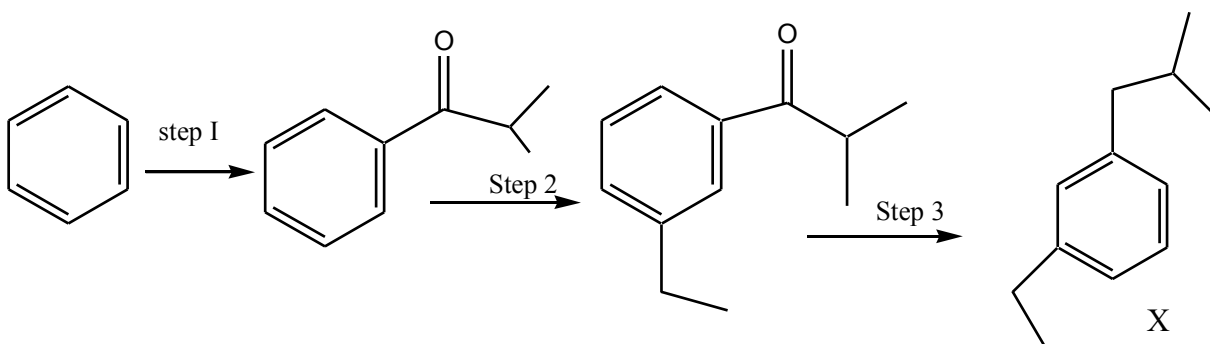
- d) Using resonance structures, explain why an electrophile mainly attacks C-1 and not C -2 in the reaction below. **(4marks)**



- e) Compare the reactivity of aniline and benzoic acid towards electrophilic aromatic substitution **(3marks)**

Question THREE

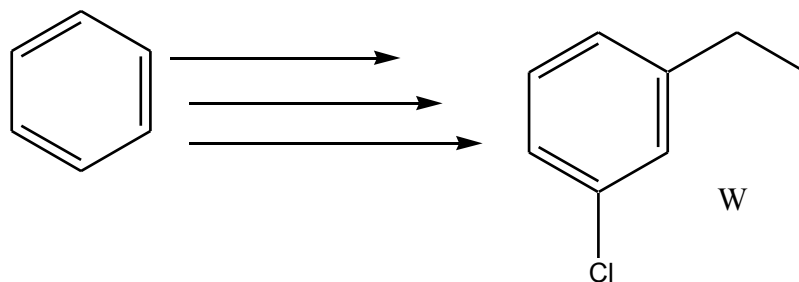
- a) Draw all the resonance structure of para-attack of aniline by an electrophile E^+ **(4marks)**
 b) Product X can be obtained from benzene in three steps:



- (i) Name the type of reaction for step 1 and 2 and suggest a suitable reagent or combination of reagents **(4marks)**
 (ii) Show the mechanism of the formation of the electrophile in step 1 **(4marks)**
 (iii) Outline a mechanism for subsequent reaction between benzene and the electrophile in (ii) above **(4marks)**
 (iv) Provide reagents for step 3 **(1mark)**
- c) Name any THREE uses of benzene and its derivatives. **(3marks)**

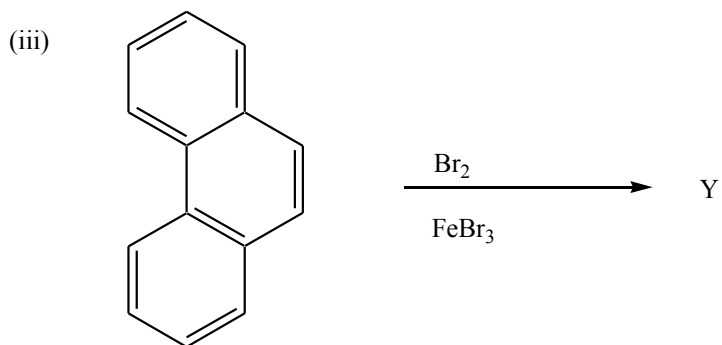
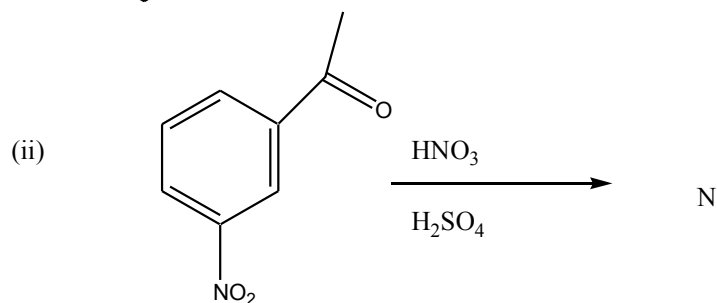
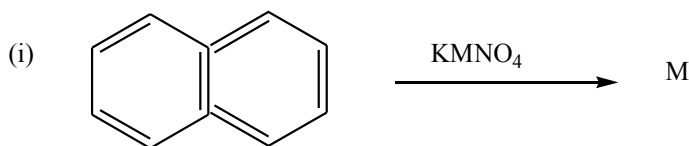
Question FOUR

a) Provide a reasonable synthesis of W using benzene as the starting material (5marks)

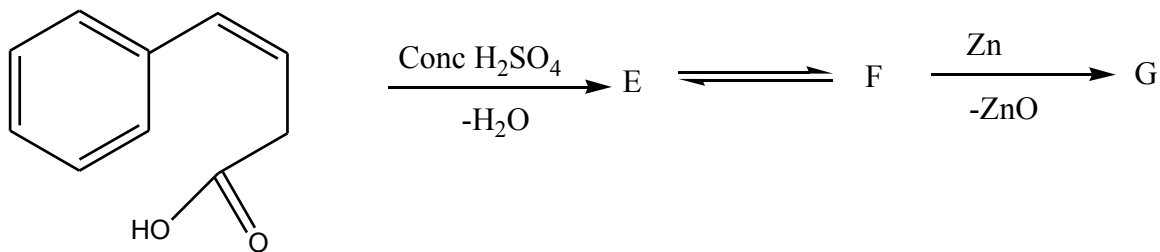


b) Draw All possible resonance structures of biphenyl (3marks)

c) Draw and name the structures of product M, N and Y (6marks)



d) (i) Draw the structures of E, F and G below; (3marks)

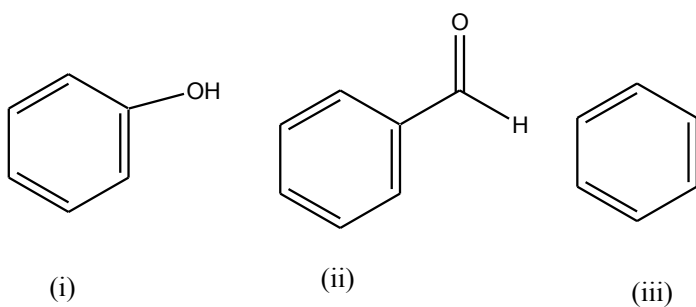


(ii) Name G and State any TWO uses of it. (3marks)

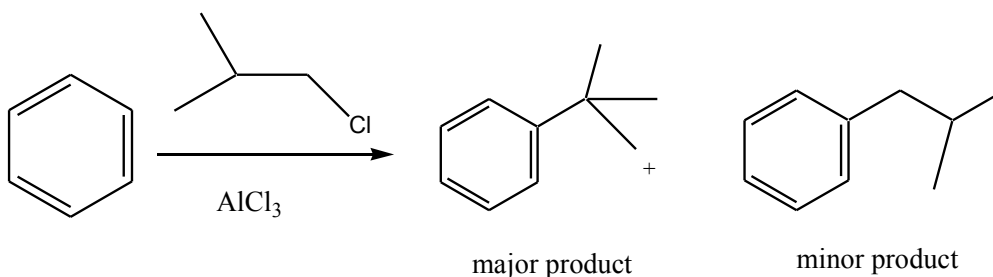
Question FIVE

a) Arrange with reasons the following compounds in order of increasing rate of bromination

(3marks)



b) Provide a reaction mechanism for the formation of the major product in the reaction below (5marks)

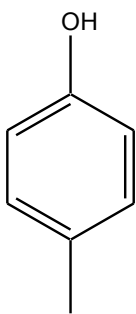


c) Suggest an efficient synthesis of the minor product in (b) above. (4marks)

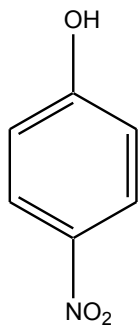
d) With a reason, identify the stronger base: phenylmethanamine or phenylamine

(4marks)

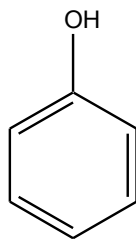
e) Arrange with reasons the following compounds in order of decreasing acidity of the phenolic proton (3marks)



(i)



(ii)



(iii)

- f) Compound x has the molecular $C_{10}H_{14}Cl_2O$. X has exactly one ring. How many pi bonds are present in the structure of X? **(2marks)**