MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF EDUCATION (SPECIAL EUCATION)

SCH 302 :CHEMISTRY OF AROMATIC COMPOUNDS

DATE: 26/9/2019 **TIME: 11:00 – 1:00 pm**

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

a) Briefly explain the following terms (4 marks)

(i) Spectroscopy
(ii) Aliphatic compounds
(iii) Heterocyclic compounds
(iv) Annulenes

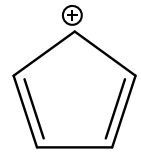
b) Attempts to come up with the structure of benzene started in the early 19^{th} century. One of the first people to attempt was August Kekulé. Describe the Kekulé proposal on the structure of benzene and give reasons why it was latter disapproved. [6 marks]

c) Aromatic compounds are defined as having planar structures, containing a certain number of electrons in a continuous overlapping cyclic arrangement of p orbitals. Name two characteristic physical or chemical properties of aromatic compounds. [2 marks]

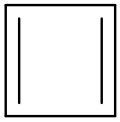
d) Molecules are said to be aromatic if the satisfy the Hückel's rule.

(i) Describe the Hückel's rule for aromaticity. [3 marks]

(ii) With reasons, identify the following structures as aromatic, antiaromatic or non-aromatic



(i)



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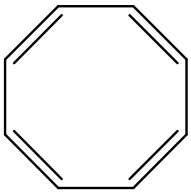

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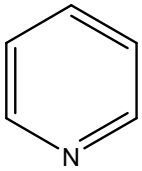

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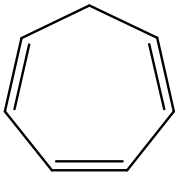

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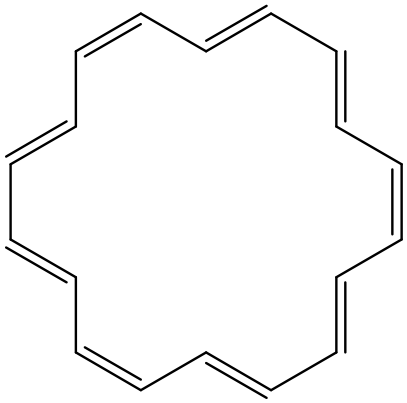


(vi)

[9 marks]

e) Discuss the two main sources of aromatic hydrocarbons. [4 marks]

f) List two ways in which Naphthalene is used. [2 marks]

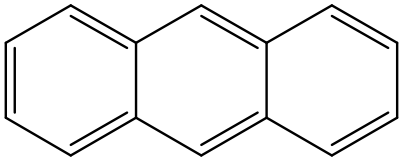
PART B (ANSWER ANY TWO QUESTIONS)

QUESTION TWO

(a) Using the Molecular orbital description of benzene, describe the basis of Hückel's rule [6 marks]

(b) The electron cloud of benzene is said to be below and above the ring. With illustration, justify this observation. [4 marks]

(c) Draw all the resonance structures for the molecule anthracene shown below.



[6 marks]

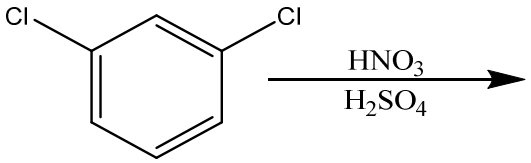
(d) In alkylation of benzene using I-chlorobutane, it is expected that butylbenzene is formed as the major product. However, this is not the case and instead (1-methylpropyl) benzene is the major product. With illustration, explain this observation.

[4 marks]

QUESTION THREE

(a) With reasons, provide the major product in the following reactions

(i)



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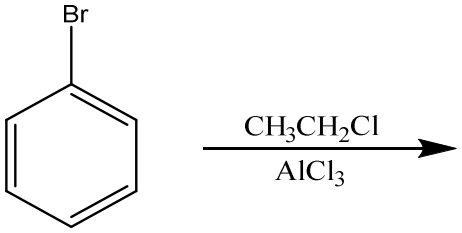

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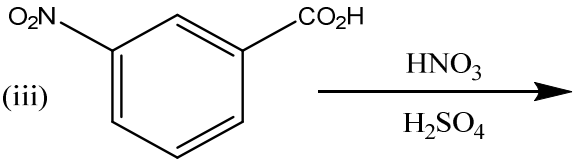

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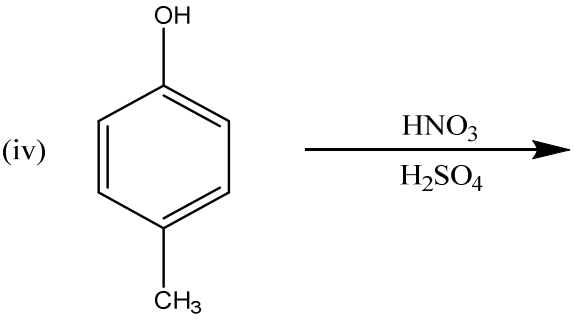
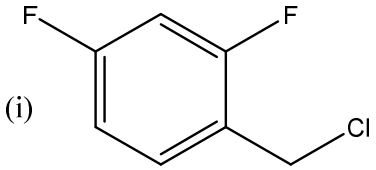


[8 marks]

b) Provide the IUPAC names for the following aromatic compounds

(i)



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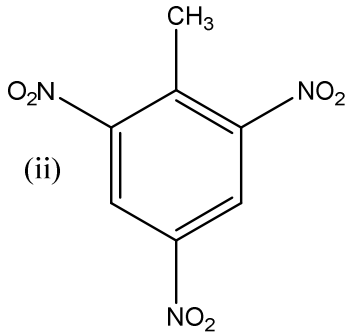
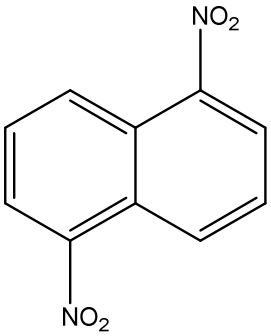


(iii)



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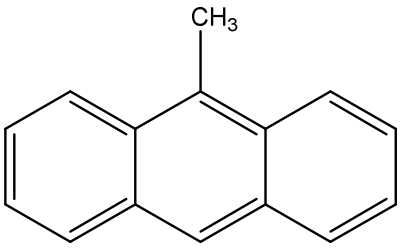
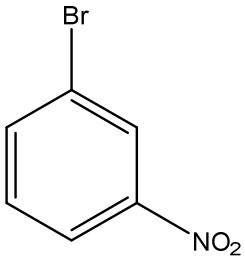


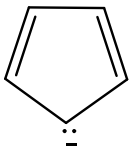
[6 marks]

c) Describe how you would go about to synthesized the compound shown below.



[4 marks]

d) Draw all the resonance structures of cyclopentadienyl anion shown below. [2 marks]



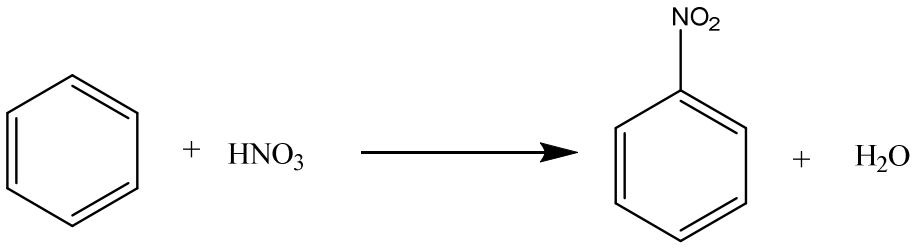
QUESTION FOUR

a) Benzene is said to be highly stable compared to other unsaturated compounds. Confirm this statement using heats of hydrogenation.

[6 marks]

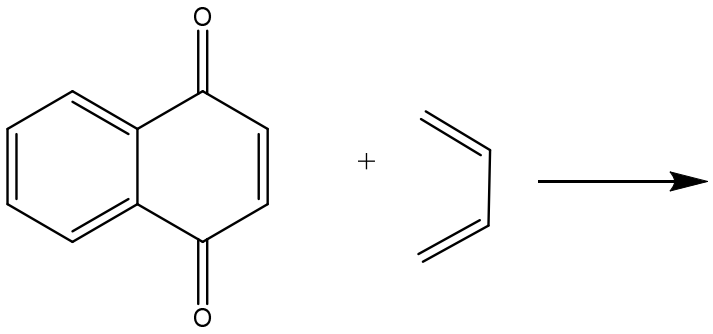
b) Alkenes undergoes addition reactions whereas benzene normally undergoes substitution reactions. Explain why benzene doesn't normally undergo addition reactions. [4 marks]

c) The nitration of benzene involves this overall reaction involving benzene and concentrated nitric acid:



(i) State the conditions for the reaction.
(ii) The electrophile in this case is the nitronium ion, NO_2^+. Write an equation showing its formation.
(iii) Give the mechanism for the reaction. [6 marks]

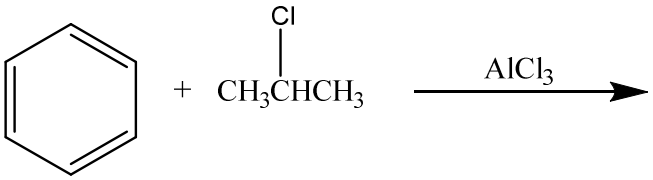
d) During the synthesis of anthracene, the first step is synthesis of an intermediate via diels-alder reaction. Following the proper mechanism, show the diels-alder product formed.



[4 marks]

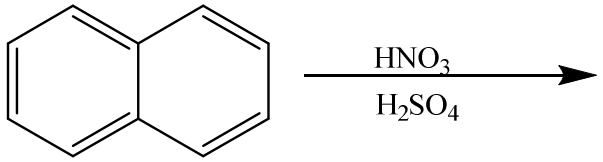
QUESTION FIVE

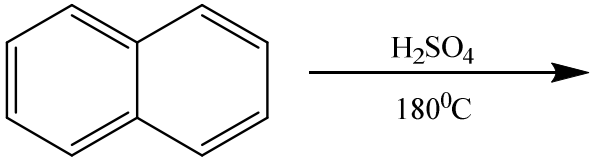
a) In the reaction below, show the major product formed with proper mechanism.

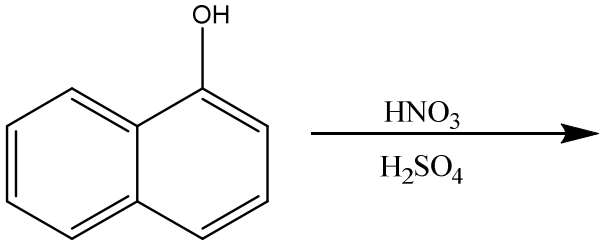


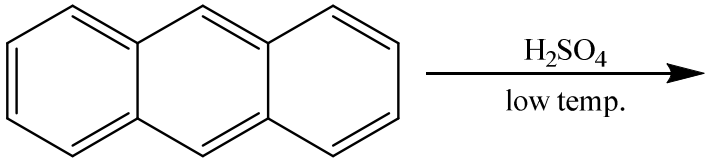
[4 marks]

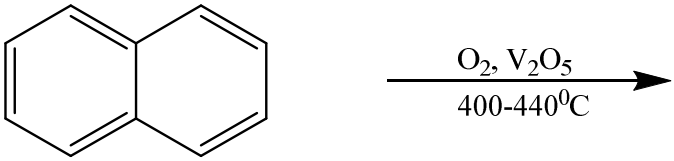
b) Provide the major product formed in the following reactions:











[10 marks]

c) Below is an Infrared (IR) spectra of o-Xylene. From the spectra, identify the characteristic peaks for this compound and their absorption frequencies. [6 marks]