KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
SUPPLEMENTARY/SPECIAL EXAMINATIONS

FOR THE DEGREE OF BSc (CHEMISTRY)

COURSE CODE: SCH 314

COURSE TITLE: CHEMISTRY OF AROMATIC COMPOUNDS

DURATION: 2 HOURS

DATE: 21/11/2022 **TIME:** ~~2:00PM-4:00PM~~

INSTRUCTIONS TO CANDIDATES:

TIME: 2 Hours

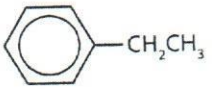
Answer question ONE and any TWO of the remaining

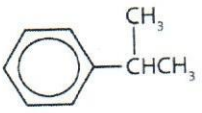
Question 1

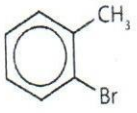
a i) State the polygon MO rule **(1 mark)**

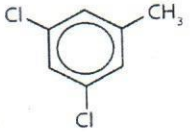
ii) Draw energy level diagram showing polygons of benzene, cyclobutadiene and cyclooctatetraene. State whether it is an open or closed system. **(6 marks)**

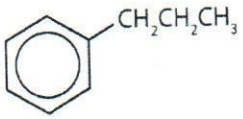
b) Name each compound with its IUPAC name. . **(5 marks)**

i 

ii 

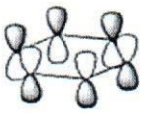
iii 

iv 

v 

c) Basing on the six MO of benzene which of these molecular orbitals has: **(4 marks)**

I



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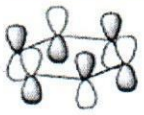

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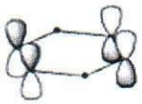
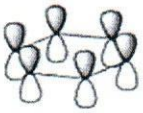
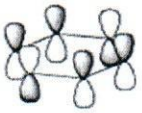


IV



V



VI

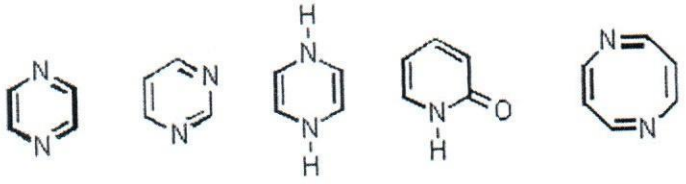
i) Lowest energy

ii) Highest energy

iii) How many of these orbitals will contain electrons?

iv) Does it form a closed or open system

d) Which of the following compounds are aromatic? **(3 marks)**



a b c d e

e) With respect to the electrophilic aromatic substitution of benzene which of the following is **not** true? **(1 mark)**

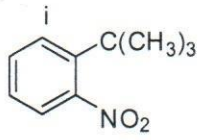
i. A non-aromatic intermediate is formed

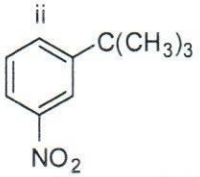
ii. b) Benzene acts as an electrophile

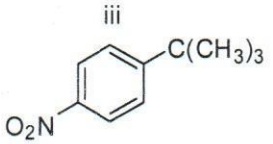
iii. c) A proton is lost in the final step

iv. d) Resonance forms are important

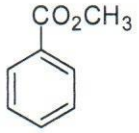
f) Arrange the following products according to the % yield obtained from the nitration of *t*-butylbenzene. Justify the order. **(2 marks)**

i 

ii 

iii 

g) Arrange the following according to their relative rate of reaction with ethanoyl chloride / $AlCl_3$. Justify the order. **(4 marks)**



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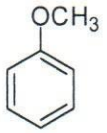

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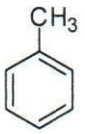
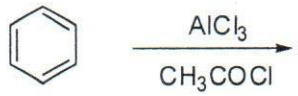


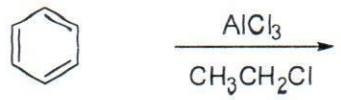
iii

h) Draw the canonical forms or anthracene. **(4 marks)**

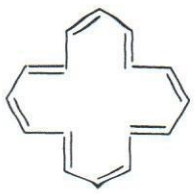
Question 2

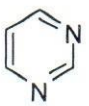
a) Use curly arrows and any required charges to complete the step-by-step mechanisms for each of the following reaction schemes. **(10 marks)**

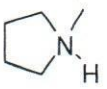
i 

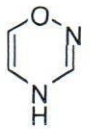
ii 

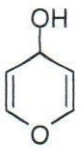
b) Describe the following as aromatic, anti-aromatic or non-aromatic assume all are planar. **(10 marks)**

i 

ii 

iii 

iv 

v 

Question 3

a) Explain why p-nitrophenol is much more acidic than a normal alcohol. Your answer should include a mechanism that is consistent with the increased acidity. **(7 marks)**

b) State three factors that affect Friedel-Crafts alkylation. **(3 marks)**

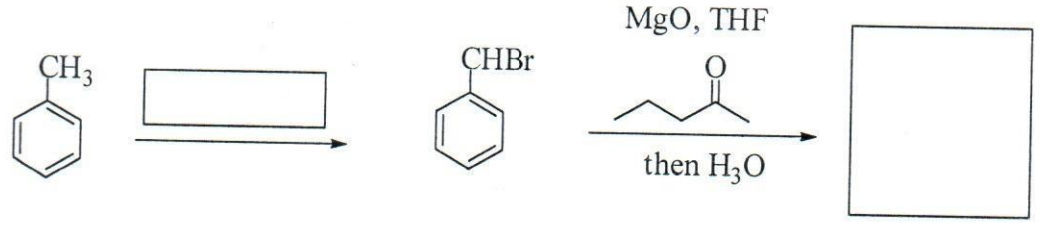
c) Based on the resonance energies, polycyclic aromatics like naphthalene and phenanthrene are more reactive then benzene. Why? **(3 marks)**

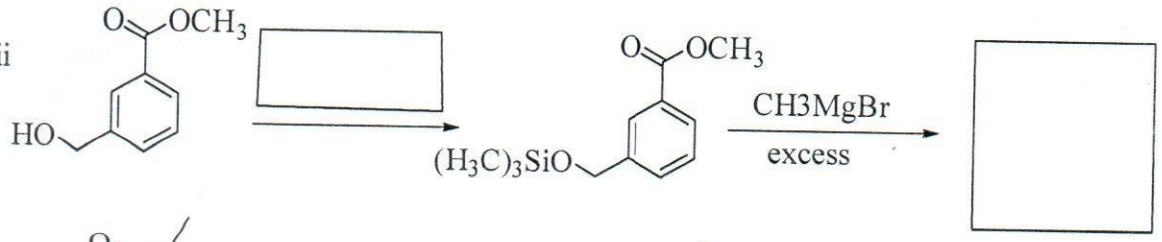
d) Differentiate between anthracene and phenanthrene (diagram added advantage) **(2 marks)**

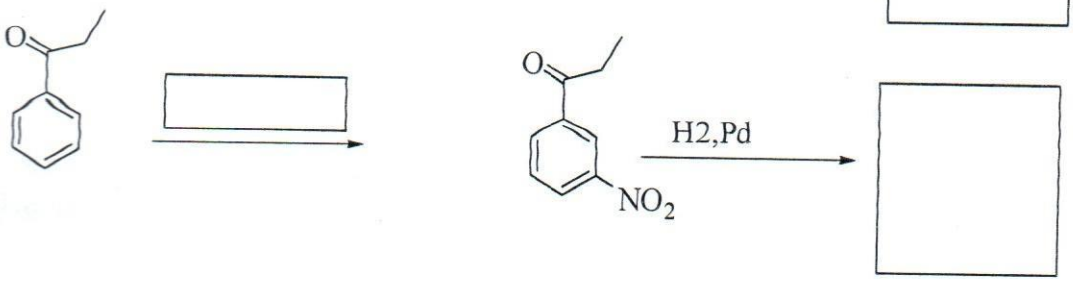
e) Explain why phenanthrene is more stable than anthracene **(5 marks)**

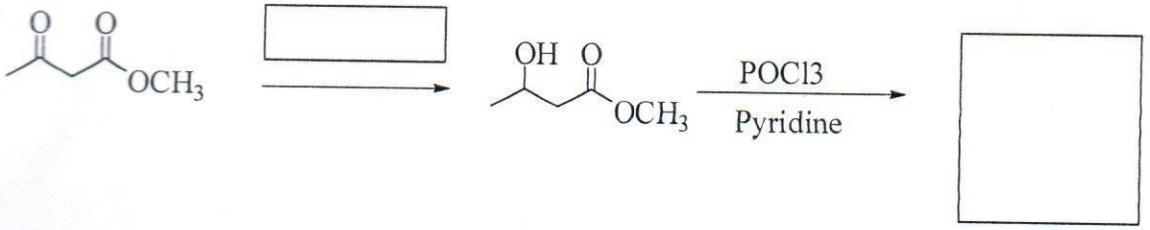
Question 4

a) Provide the necessary reagents and give the products for the following reactions: **(10 marks)**

i 

ii 

iii 

iv 

b) Starting with toluene, outline the synthesis of naphthalene. **(10 marks)**