MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

DEPARTMENT: CHEMICAL AND PROCESSING ENGINEERING

MODULE: ORGANIC CHEMISTRY FOR ENGINEERS/ ORGANIC SYNTHESIS

CODE: CHEP122/HCHE213

SESSIONAL EXAMINATIONS

DECEMBER 2022

DURATION: 3 HOURS

EXAMINER: DR BC NYAMUNDA

INSTRUCTIONS

1. *Answer any **four questions***
2. *Total marks 100*

Additional material(s): *None*

Question 1

a) Make use of 1-choro 2-methy butane to draw a wedge and line 3-Dimensional structure of an organic molecule clearly explain the meaning of bonds. [5]

b) i) Draw staggered and eclipsed organic structures of propane. [2]

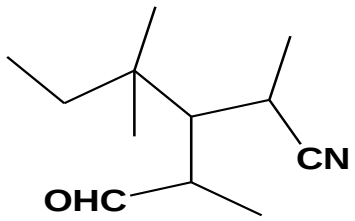
ii. Construct a fully labeled graph of potential energy versus bond rotation from 0 to180^{o} for the eclipsed and staggered conformations of ethane. [4]

c) Assign R and S configurations for 2-methly butane amine. [2]

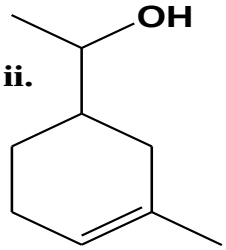
d) Draw organic Z and E structures for 2-bromo-but-1-ene. [2]

e) Encircle all asymmetric carbon atoms in the following organic structures stating the **number** of optically active isomers possible and **type** of hybridization on carbon atoms for each of the organic compounds? [10]

i.

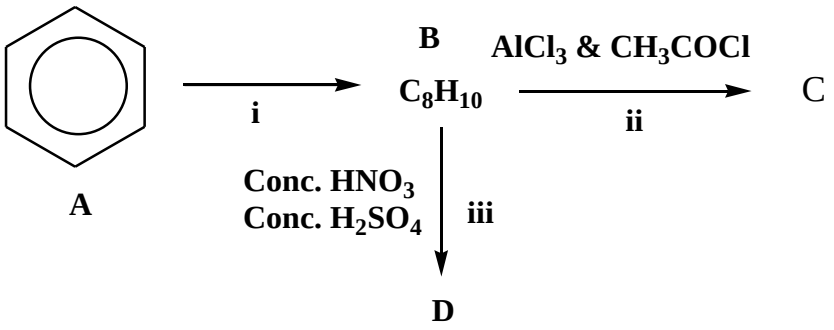


ii.



Question 2

Benzene is a starting material for the industrial processes shown in reaction scheme shown below:



a) Draw structures of compounds B, C and D. [3]

b) Identify *reagents* and *conditions* required for reaction i [3]

c) Name the type of reactions (i - iii) [3]

d) Outline the mechanism for the formation of compound C from B. [6]

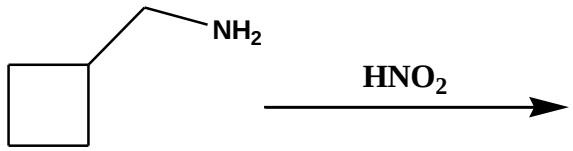
e) Outline the reaction mechanism for the reaction of C with ethanal [8]

f) Compound C and D are formed together with second isomers. Draw the structures of the isomers. [2]

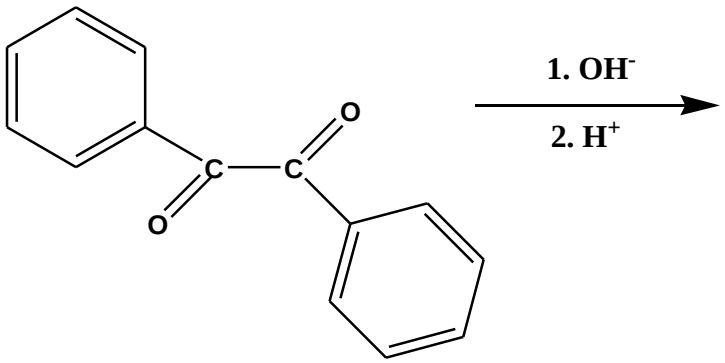
Question 3

Predict the structural products for the following reactions and outline the reaction mechanism of each. [25]

a.



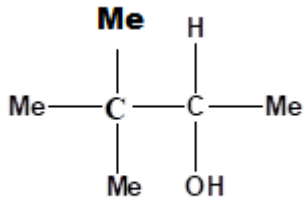
b.



c. $CH_3COH + HCN \longrightarrow$

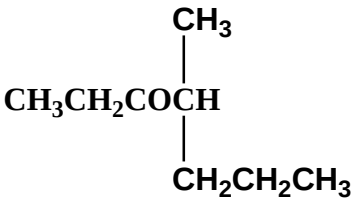
Question 4

a) Outline the mechanism for the acid catalysed dehydration of the alcohol D clearly showing methyl 1,2-rearrangement reaction to form **two** products. [9]



D

b) Norrish reactions are examples of photochemical reactions. Make use of the following organic structure to show how a **Norrish 1** photochemical reaction produces **five** different products. [5]



c) Distinguish SN_1 from SN_2 reactions based on *solvent effects* and *nature of nucleophiles*. [4]

d) Explain fully what is meant by the following terms used in organic synthesis:

i. Free radical

ii. Solvolysis

iii. Carbocation

iv. Concerted mechanism

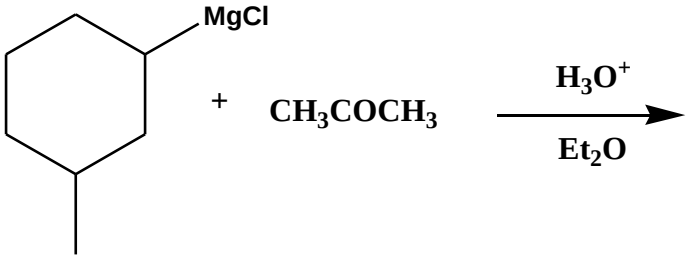
v. Electrophile

vi. Stereochemical inversion

vii. Constitutional isomers [7]

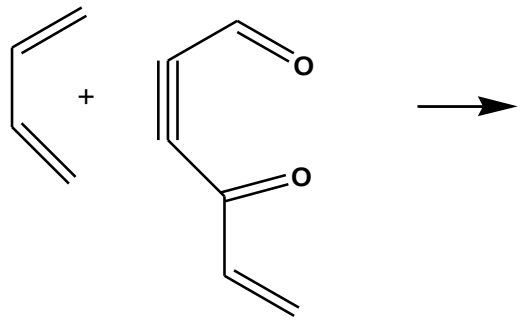
Question 5

a) Identify the organic product and describe the mechanism of the following reaction: [3]

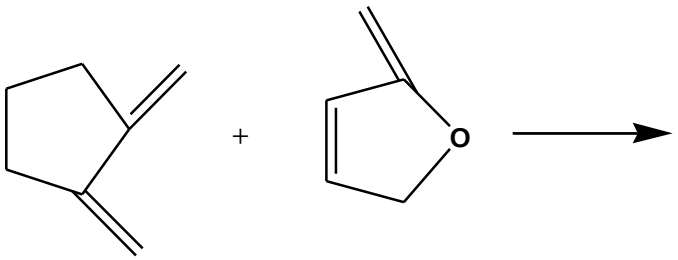


b) Give the chemical structures of products of the following Diels-Alder reactions showing the **electron** movement in each reaction. [2 x 3]

i.

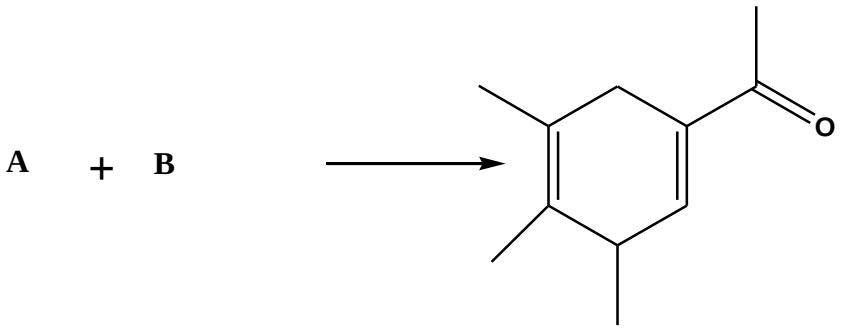


ii.



c) Identify the starting materials and complete the following Diels-Alder reactions showing arrows for movement of electrons/bonds: [3 x2]

i.



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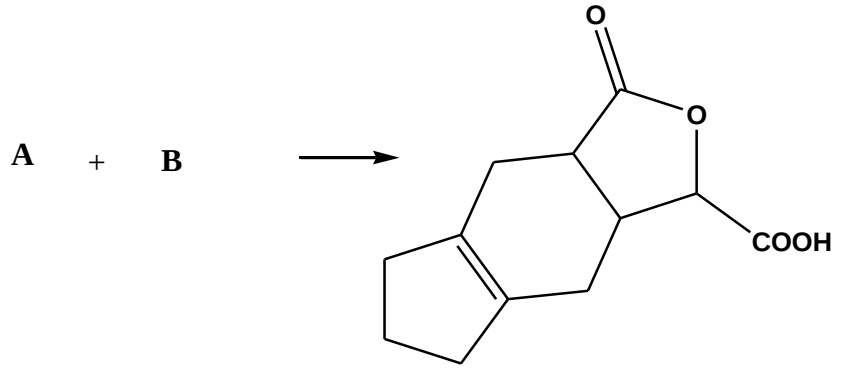
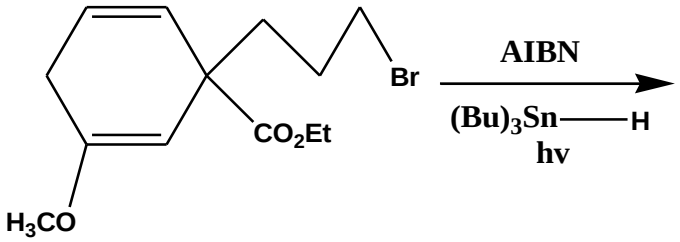


d) Identify structures of organic products of the following free radical reactions [10]

i.



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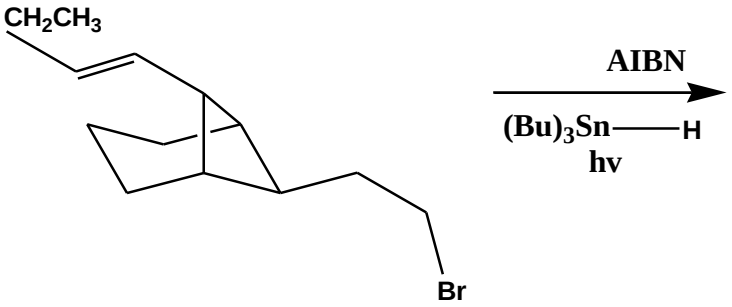
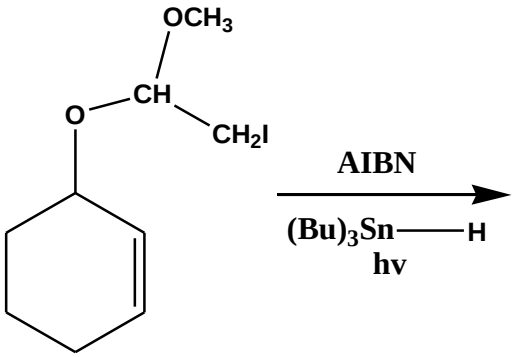
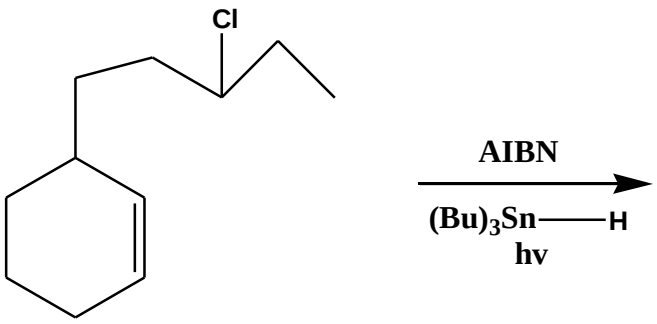


iii.



iv.



END OF EXAMINATION