360

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY
(MMUST)

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE
OF

BSC (CHEMISTRY), BSC (INDUSTRIAL CHEMISTRY) & B. ED (SCIENCE)

COURSE CODE: SCH 131

COURSE TITLE: BONDING AND REACTION MECHANISMS IN ORGANIC MOLECULES

DATE: 11th April 2023, Tuesday TIME: 12.00 to 2.00 PM

INSTRUCTIONS TO CANDIDATES

- Answer ALL questions

MMUST observes ZERO tolerance to examination cheating

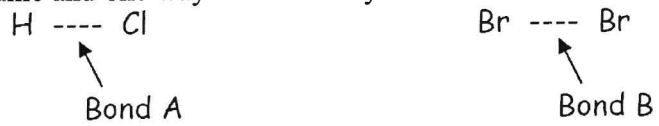
This Paper Consists of 6 Printed Pages. Please Turn Over

QUESTION ONE (17 Marks)

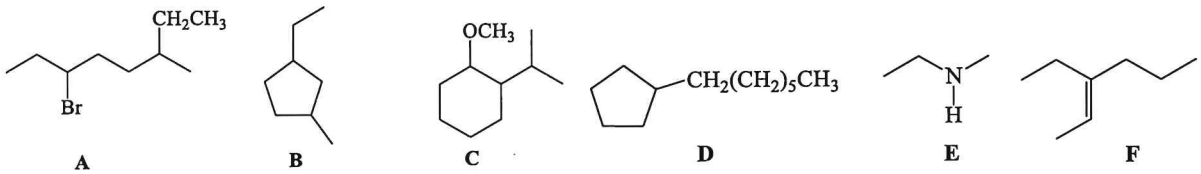
a) Explain the following terms using relevant examples **3 Marks**

i) Catenation
ii) Octet rule
iii) Hybridization

b) Consider the bonding in the molecules given below. State one way in which bond A and bond B (shown) are the same and one way in which they are different **2 Marks**



c) Consider compounds A through H listed below



i) Classify the above compounds depending on their functional groups. **5 Marks**
ii) Determine which, between compounds **D** and **F**, has a higher boiling point. Give reason for your answer. **2 Marks**

d) Classify the reagents below as strong/weak nucleophile and as strong/weak base. **5 Marks**

i) NaH
ii) t-BuO-
iii) OH-
iv) HS-
v) MeOH

QUESTION TWO (18 Marks)

a) Draw the Lewis structures for each of the following chemical compounds **3 Marks**

i) CH_3CH_3
ii) $(CH_3)_3COH$
iii) CH_3CN

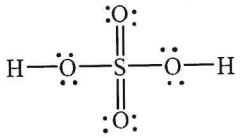
b) The following questions refer to the compound propyne, shown below

$$HC{\equiv}C{-}CH_3$$

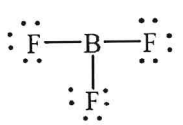
Propene

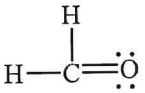
i) On the structure above, identify the hybridization state of all carbon atoms **2 Marks**
ii) Draw a picture that clearly shows the interacting orbitals of all of the C–C single bonds in propyne **2 Marks**
iii) Draw a picture that clearly shows the interacting orbitals of all of the multiple bonds in propyne **2 Marks**

c) Determine the formal charges of all the atoms in the sulfuric acid structure shown below **2 Marks**



d) Consider the following Lewis structures. Would you expect these molecules to have the same shape or a different shape? Explain **3 Marks**





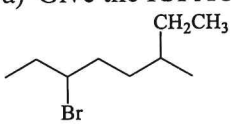
e) Explain the following observations **4 Marks**

i) Propan-1-ol is soluble in water but 1-chloropropane is insoluble

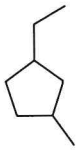
ii) Butan-1-ol and ethoxyethane have the same relative molecular mass but very different boiling points, 117 °C and 35 °C, respectively

QUESTION THREE (18 Marks)

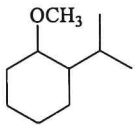
a) Give the IUPAC names for the compounds given below **6 Marks**



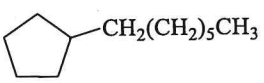
A



B



C



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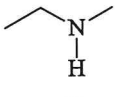
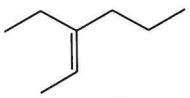


E



F

b) Draw the structure of each of the following compounds: **3 Marks**

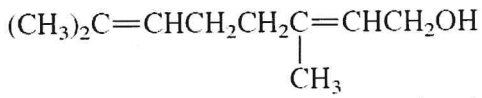
i) 5-Bromo-4-chloroHept-1-ene

ii) *N*-Ethylethanamine

iii) 1-Bromo-5-methylhex-3-yne

c) Draw and label the *E* and *Z* isomers for each of the following compounds. **3 Marks**

d) Geraniol is a naturally occurring substance present in the fragrant oil of many plants. It has a pleasing, roselike odor. Geraniol is the *E* isomer of



i) Write a structural formula for geraniol, showing its stereochemistry. **1 Mark**

ii) Nerol is a naturally occurring substance that is a stereoisomer of geraniol. Write its structure. **1 Mark**

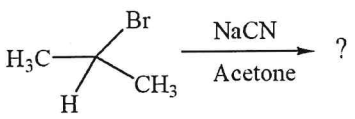
e) Give at least five isomers of methylcyclobutane and then give the IUPAC names for each of them **5 Marks**

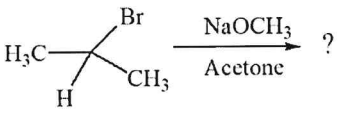
methylcyclobutane

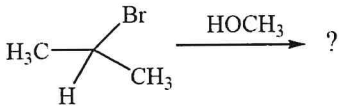
Molecular Formula: C_5H_{10}

QUESTION FOUR (17 Marks)

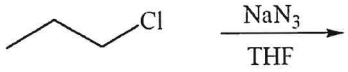
a) For the following, please determine what type of reaction is occurring and predict the products **6 Marks**

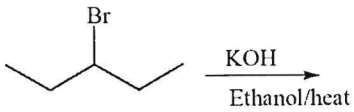
i) 

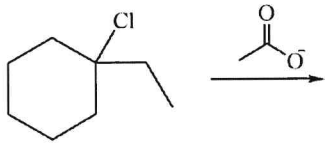
ii) 

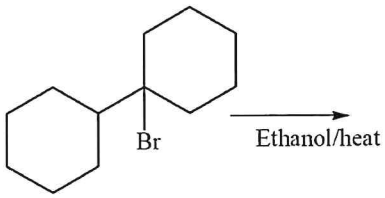
iii) 

b) Identify the dominant reaction mechanism (S_N1, S_N2, E1, or E2) and predict the major product for the following reactions. **6 Marks**

i) 

ii) 

iii) 

v) 

c) Using appropriate curly arrows show the reaction mechanism leading to product given in question 4, b), ii) above. **5 Marks**