



UNIVERSITY OF RUHUNA

FACULTY OF SCIENCE

BACHELOR OF SCIENCE (GENERAL) DEGREE LEVEL I SEMESTER I

EXAMINATION (JUNE/JULY 2023)

ACADEMIC YEAR 2021/2022

SUBJECT: Chemistry

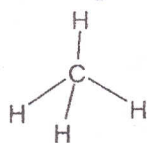
COURSE UNIT: CHE 1122 (Fundamentals in organic chemistry) TIME: Two (02) hours

Answer **four (04)** questions only by selecting at least **one (01)** question from section **A, B,** and **C**

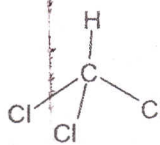
Section, - A

1) Answer **all** parts.

(a) Consider two molecules given below.



methane



1,1,1-trichloromethane

- What is the hybridization state of C in above two molecules?
- Giving reasons compare bond length and bond energy of all C-H bonds of methane.
- Which molecule above has shorter C-H bond than normal value? Give reasons for your answer.
- If conc. NaOH is added, which molecule above can react with NaOH? Explain your answer with appropriate structures.
- Compare the polarity of 1,1,1,1-tetrachloromethane with 1,1,1-trichloromethane.

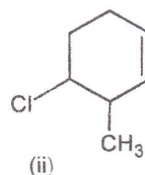
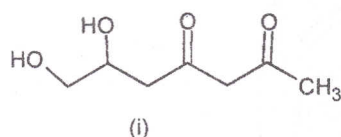
(30 marks)

(b) Answer all the questions given below.

- Draw the structure of allylic cation.
- Show the resonance structures of above cation drawn in part (i).
- BF₃ acts as a Lewis acid in some reactions. Using concept of hybridization, explain why does BF₃ show the characteristic of a Lewis acid.

(30 marks)

(c) Name the compounds given below according to the IUPAC system of nomenclature.



(20 marks)

(d) Draw the structures of the following compounds according to their IUPAC name given below.

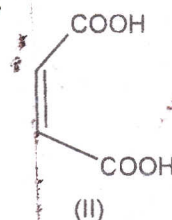
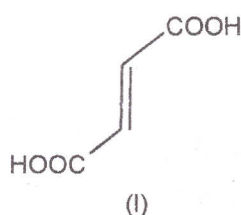
- propanoic anhydride
- bicyclo[1,1,0]butane

(20 marks)

2) Answer **all** parts.

(a)

- Why geometrical isomers are categorized as diastereoisomers. Giving an example explain the answer.
- Consider the two molecules given below.



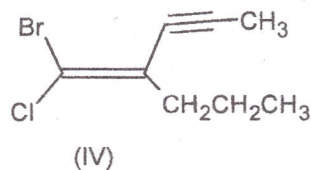
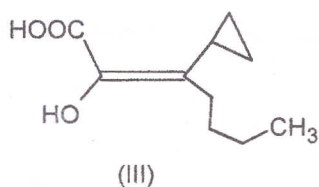
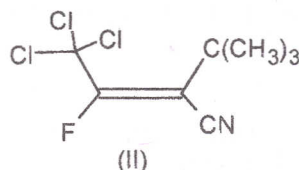
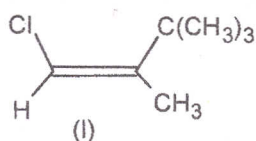
A) Which molecule out of above (I) & (II) has higher melting point? Give reasons for your answer.

B) Give a chemical method to distinguish above two isomers.

(26 marks)

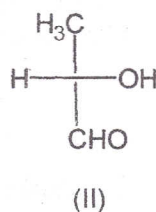
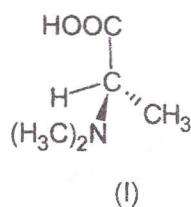
(b)

- Assign the configuration of each of the double bond (I to VI) of the molecule given below into E/Z.



(24 marks)

(c) Consider the structures of two of chiral molecules given below.



i) Assign the priorities to the atoms/ groups connected to the chiral center of two molecules.

ii) Based on that, assign the configuration of chiral centers into R/ S.

(20 marks)

(d) Answer the questions below related to conformations of cyclic and acyclic molecules.

i) Draw the most stable and least stable conformation for the chloropropane.

ii) Of two conformations drawn, which conformation has the highest Van der Waals strain?

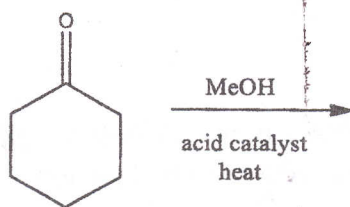
iii) Draw the most stable conformation for the methylcyclohexane. Why it is stable?

(30 marks)

Section - B

3) Answer **all** parts.

(a) Consider the reaction below.



(i) What is the product of the above reaction?

(ii) Give a plausible mechanism for the proposed product formation.

(30 marks)

(b) Consider the following substitution reactions,



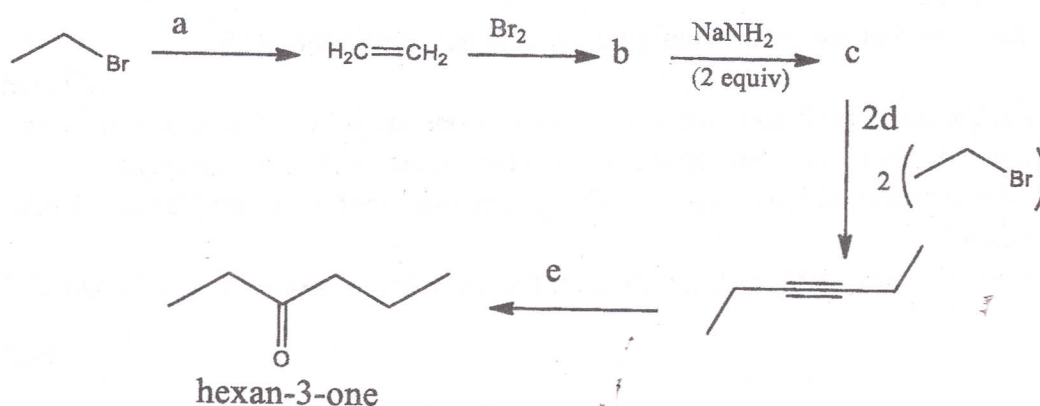
(i) Giving reasons identify the relevant reaction type ($\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$) for the reactions (A) and (B).

(ii) State how many steps are involved in each reaction and draw the transition state of the steps involved in the reaction (A).

(iii) What would be the effect of changing the solvent from CH_3OH to $(\text{CH}_3)_2\text{S}=\text{O}$ on reaction A and B?

(40 marks)

(c) The synthesis of hexan-3-one starting from $\text{CH}_3\text{CH}_2\text{Br}$ is given below. Fill in the blanks (a-e) with suitable reagents, intermediates and reaction conditions.

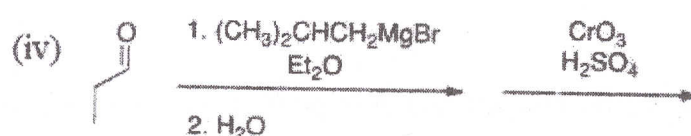
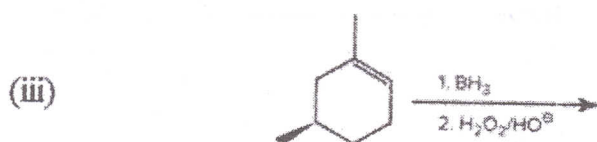
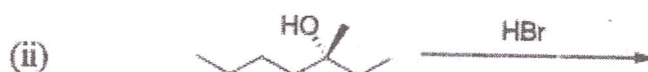
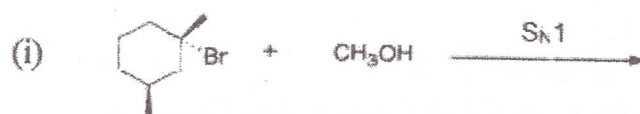


(30 marks)

4) Answer all parts.

(a) What is the major organic product obtained from the following reactions (i)-(iv)?

Note: stereochemistry of the products needs to be highlighted whenever necessary.



(40 marks)

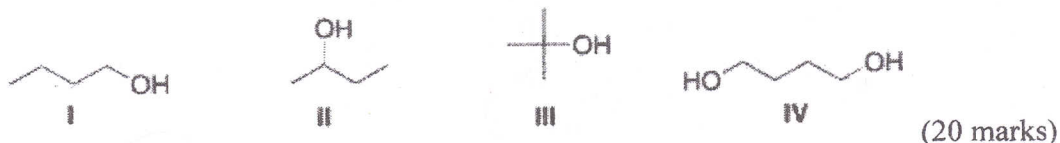
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$(\text{CH}_3)_2\text{S}=\text{O}$ on

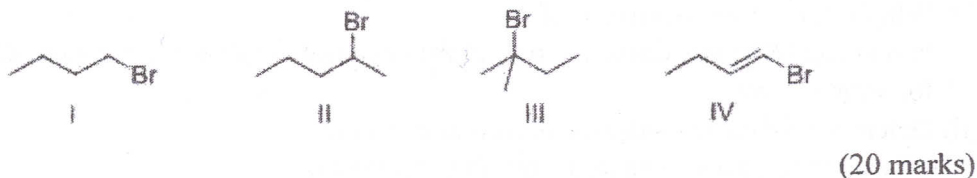
(40 marks)

the blanks

- (b) Giving reasons, rank the following compounds in order of increasing their boiling point.



- (c) Giving reasons, rank the following compounds in increasing order of $\text{S}_{\text{N}}1$ reactivity.



- (d) Consider the following alkenes.



- (i) Write down the products of the reaction of following alkenes with HCl .
(ii) Giving reasons explain which alkene reacts faster with HCl than other alkenes.

(20 marks)

Section - C

- 5) Answer all parts.

- (a) Cyclobutadiene is not stable, thus has a great tendency for dimerization under normal conditions.

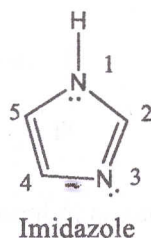


cyclobutadiene

- (i) Using criteria for aromaticity, show why cyclobutadiene is not stable at room temperature.
(ii) Draw the molecular orbitals (MO) diagram using inscribed polygon method (frost circle) and pi (π) electron filling on the MO of cyclobutadiene.
(iii) With the support of diagram drawn in (ii) prove your answer in (i).
(iv) Write down the possible structure for the dimerized product of cyclobutadiene.

(40 marks)

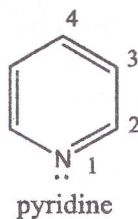
- (b) Imidazole is an unsaturated heterocyclic five membered ring consists of two nitrogen atoms at 1st and 3rd positions.



- (i) Which lone pair electrons of two nitrogens of imidazole are part of the conjugated cycle of *p* orbitals? Give reasons for your answer.
- (ii) Determine whether imidazole is aromatic or not?
- (iii) Imidazole can act as a base. Justify this statement.

(30 marks)

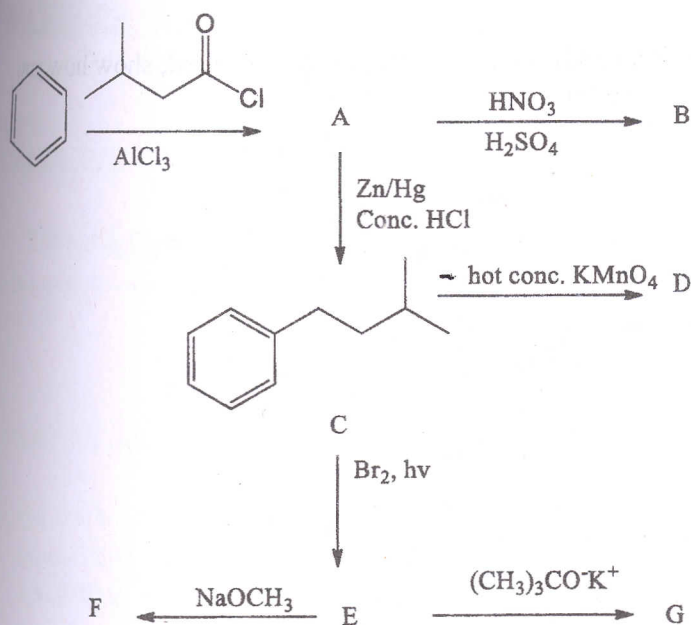
- (c) Pyridine is a heterocyclic aromatic structure, prefers electrophilic aromatic substitution at C-3 position over C-2 and C-4. Drawing all the possible intermediates discuss this statement.



(30 marks)

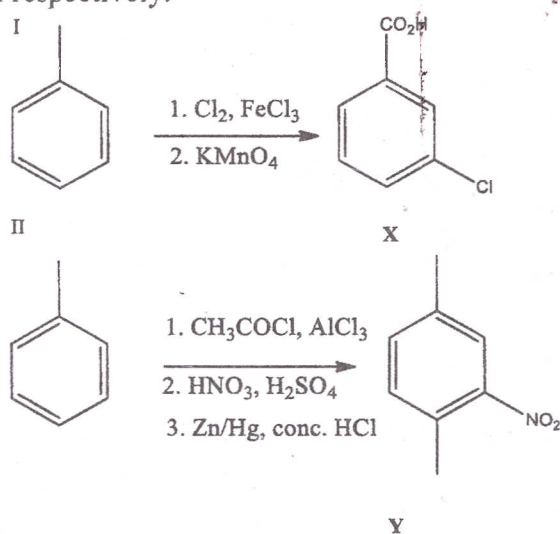
6) Answer **all** parts.

- (a) Consider the scheme given below and draw the structures of compounds **A** to **G** in the following series of reactions.



(36 marks)

(b) The following synthetic steps were proposed by a student to synthesize X and Y for synthesis I and II respectively.

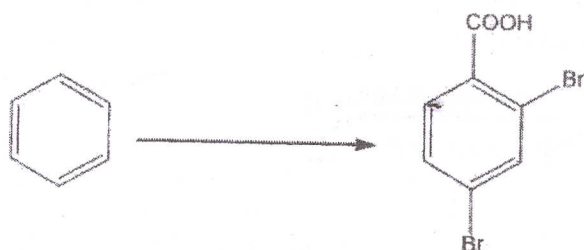


- Write down the intermediate product(s) he will obtain after each step, in reaction scheme I and II.
- Based on the proposed structures in (i) explain whether the student is successful in synthesizing X and Y with the proposed schemes.

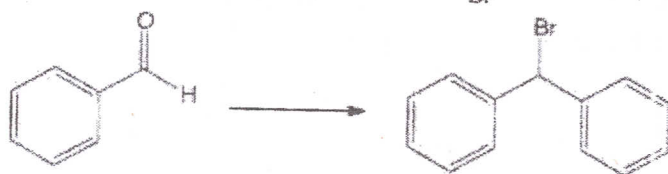
(24 marks)

(c) Giving necessary reagents, reaction conditions and intermediates formed, show how you would carry out the following conversions.

(i)



(ii)



(iii)



(iv)



(40 marks)

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