



UNIVERSITY OF KELANIYA - SRI LANKA
FACULTY OF SCIENCE

Bachelor of Science General Degree Examination-June 2023
Academic Year 2020/2021 – Semester II

STEREOCHEMISTRY AND REACTION MECHANISMS IN ORGANIC CHEMISTRY
CHEM 12652 / CHEM 12652 (R)

Number of Questions: Four (04)

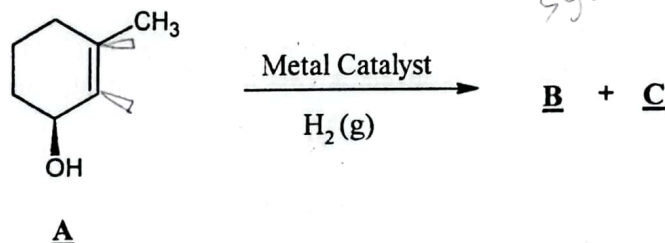
Time: Two (02) hours

Number of pages: Six (06)

Answer ALL questions.

[01]

- (a) When compound A was reacted with H_2 gas in the presence of a metal catalyst such as Pd, Pt or Ni, two products (B and C) were obtained. Products B and C have the same molecular formula, $C_7H_{14}O$.

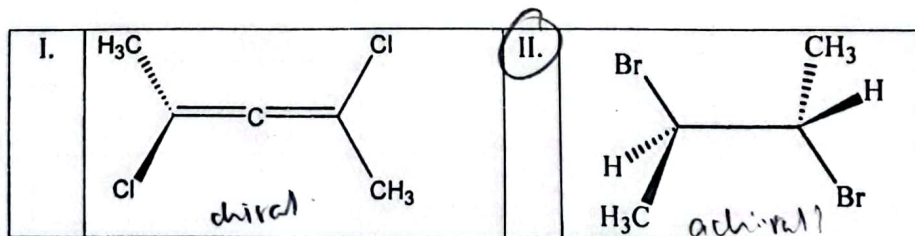


- I. Determine the structures of B and C.
- II. Indicating the priority order of the groups attached to the stereocenters according to Cahn-Ingold-Prelog rules, determine the configurations of **chiral centers** (as *R* or *S*) and **double bond** (as *E* or *Z*) in the A, B and C.
- III. Determine the isomeric relationship of B and C. Are they constitutional isomers, enantiomers, diastereomers or the same? Provide a brief explanation. *Conformation*

(40 marks)

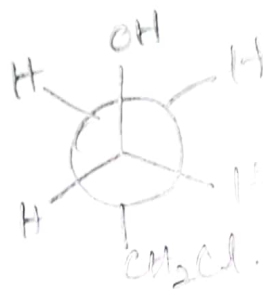
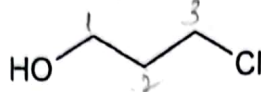
- (b) By giving reasons, state whether each of the following compounds is

- I. chiral or achiral.
- II. optically active or inactive.



(20 marks)

(c) The structure of 3-chloropropan-1-ol is given below.



I. Draw Newman projections of the conformations result by the rotation of C1-C2 bond of 3-chloropropan-1-ol through a full 360° rotation. Start with the **staggered** Newman projection of the **most stable** conformation.

II. Label each Newman projection results in at every 60° degrees of rotation.

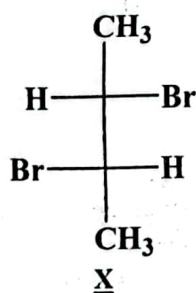
(25 marks)

(d) A 10.0 g of pure stereoisomer P, dissolved in 50.0 mL of water had an observed rotation of $+2.3^\circ$ in a 20 cm tube at 589.6 nm (the sodium D line) and 25°C . Calculate its **specific rotation** in degrees, $[\alpha]_D$ at 25°C .

(15 marks)

[02]

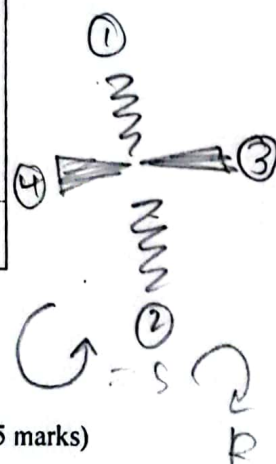
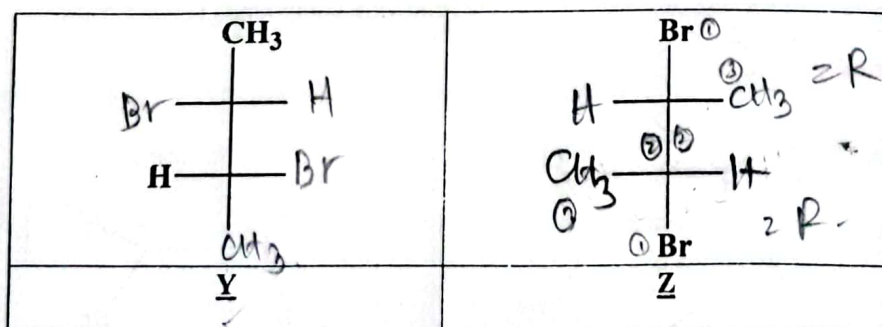
(a) The Fischer Projection formula of 2,3-dibromobutane (X) is given below. Copy the structure of X onto your answer script and answer the following questions based on X.



I. How many **stereoisomers** are possible for 2,3-dibromobutane?

II. Assign *R* or *S* configuration to each chiral carbon atom in X.

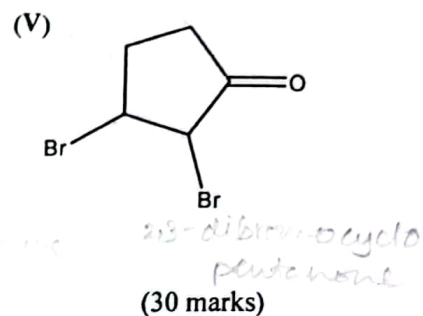
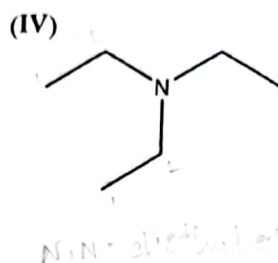
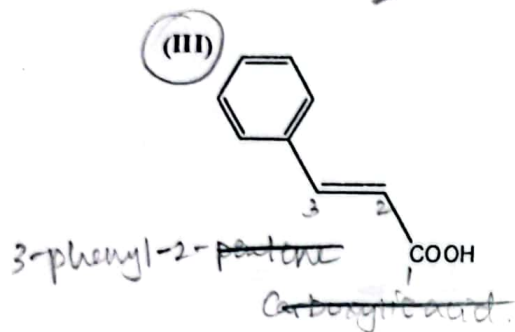
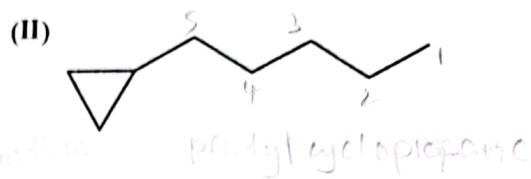
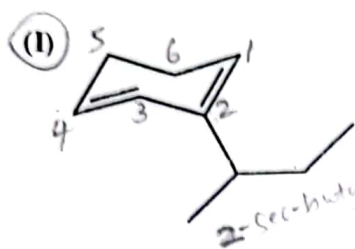
III. Complete the following structures Y and Z so that they are enantiomers of X.



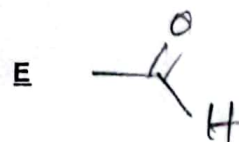
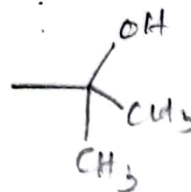
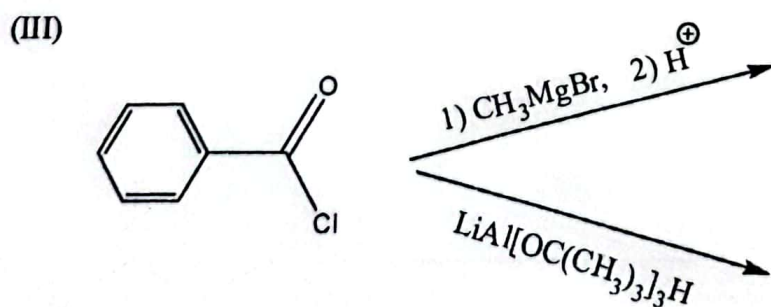
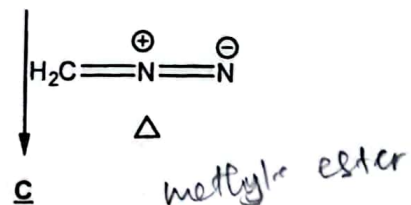
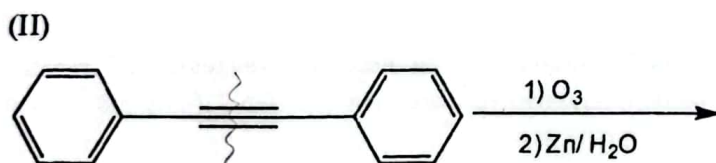
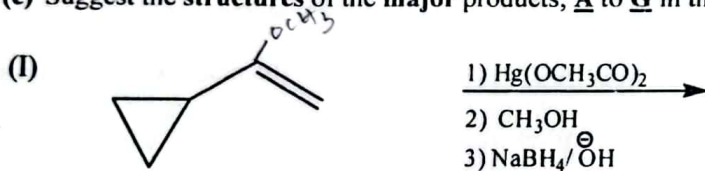
IV. Draw the Fischer Projection formula of a diastereomer of X.

(35 marks)

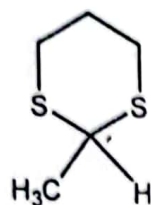
(b) Name the following compounds using IUPAC system of the nomenclature.



(c) Suggest the structures of the major products; **A** to **G** in the following reactions.



(IV)

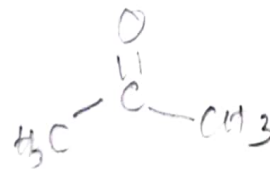


1) BuLi

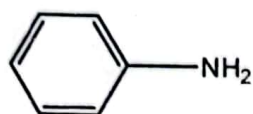
2) CH₃Br

3) H⁺, HgCl_{2(aq)}

E



(V)



1) NaNO₂ + HCl (0 - 5 °C)

2) H₃PO_{2(aq)}

G

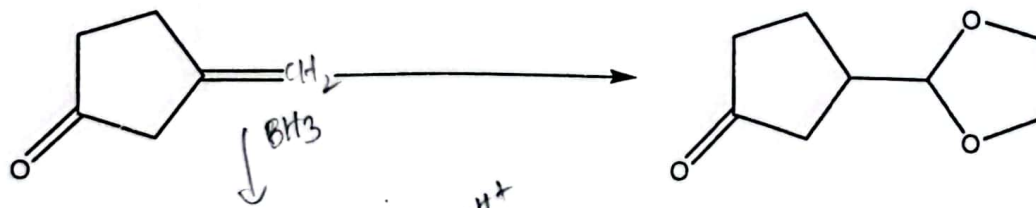


(05 marks x 7 = 35 marks)

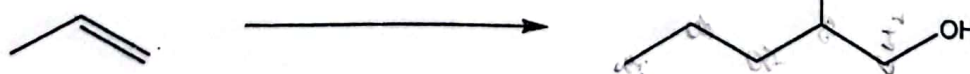
[03]

(a) Carry out the following transformations, giving necessary reagents and reaction conditions. (Each transformation may involve more than one step). If any intermediate products are formed, indicate their structures.

(I)



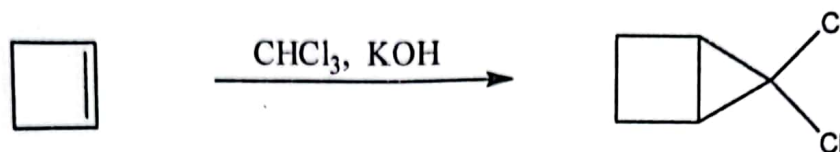
(II)



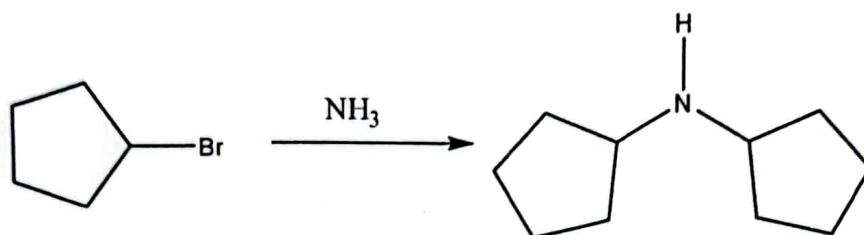
(50 marks)

(b) Write the **mechanism** for each of the following chemical reactions.

(I)



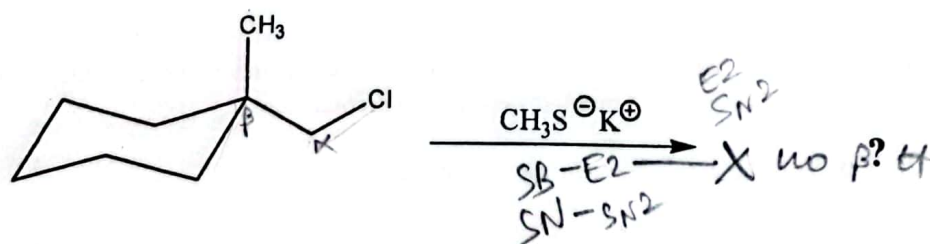
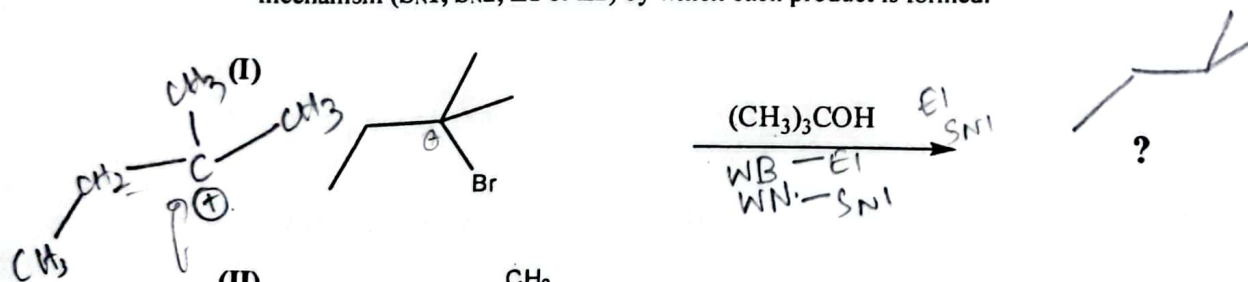
(II)



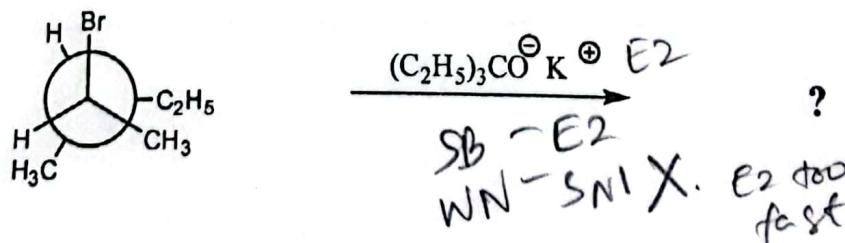
(50 marks)

[04]

(a) Predict the **major organic** products of the following reactions and **name** the type of mechanism ($\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$, $\text{E}1$ or $\text{E}2$) by which each product is formed.

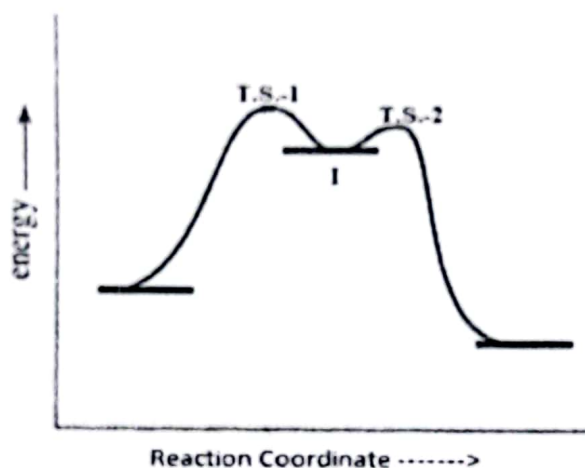


(III)



(60 marks)

(b) Energy profile for the following reaction is given below.



- (I) Draw the structures for transition state-1 (T.S.-1), intermediate product (I), transition state-2 (T.S.-2) and final major product(s).
- (II) Name the type of mechanism (S_N1 , S_N2 , E1 or E2) by which final product(s) is/are formed.
- (III) Trace this energy profile on your answer script and mark **activation energy** required to carry out the first step and the second step.
- (IV) What is the **rate determining step** of the overall reaction?

(40 marks)

***** The End *****