

CHUKA



UNIVERSITY

## UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE AND  
BACHELOR OF EDUCATION (SCIENCE)

## CHEM 231: ORGANIC CHEMISTRY II

STREAMS: BED SCI & BSC (CHEM, INDUSTRIAL CHEM, BIOC, BMET, BIO &  
MATHS

TIME: 2 HOURS

DAY/DATE: MONDAY 16/12/2024

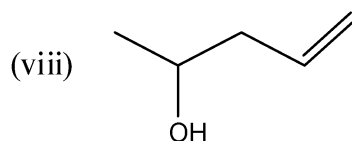
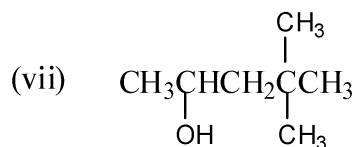
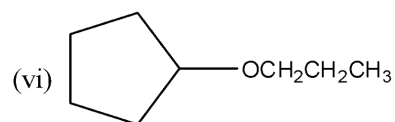
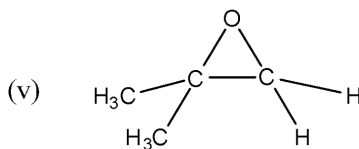
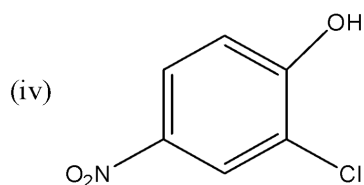
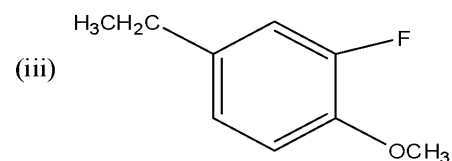
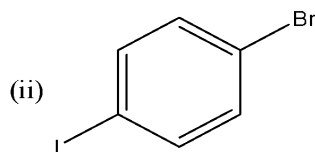
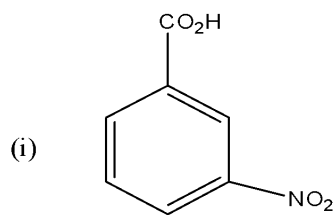
8.30 A.M – 10.30 A.M.

## INSTRUCTIONS

- Answer question **One** (Compulsory) and any other **Two** questions

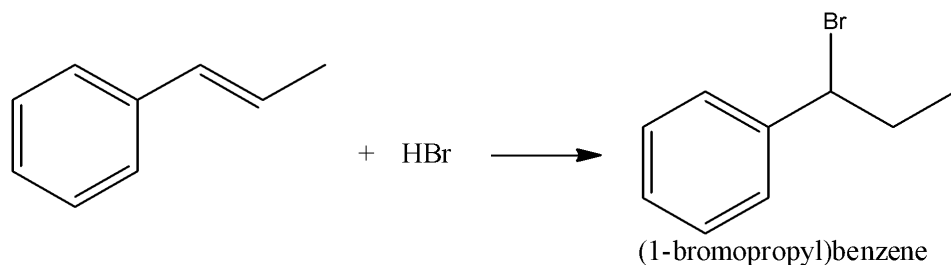
## QUESTION ONE (30 MARKS)

a) Name the following compounds according to the IUPAC system of nomenclature. (8 marks)

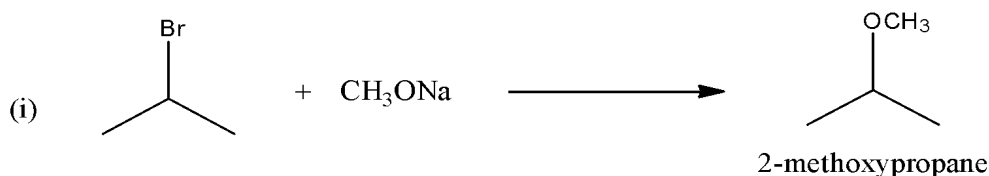


b) A solution of a pure chiral molecule has a specific rotation of  $-32^\circ$ . Determine the specific rotation of a solution that is 90% of the (+) enantiomer and 10% of the (-) enantiomer. (3 marks)

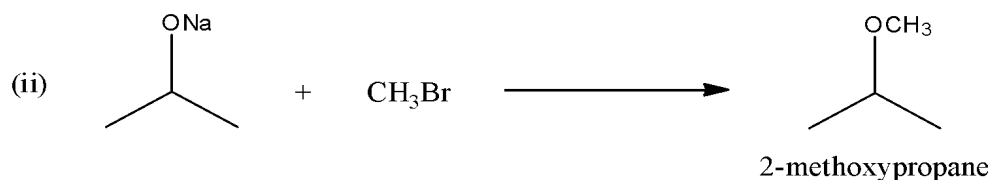
c) Addition of HBr to 1-phenylpropene yields only (1-bromopropyl) benzene. Propose a mechanism for the reaction, and explain why none of the other regioisomer is produced. (4 marks)



d) The following reactions can be used to prepare 2-methoxypropane.

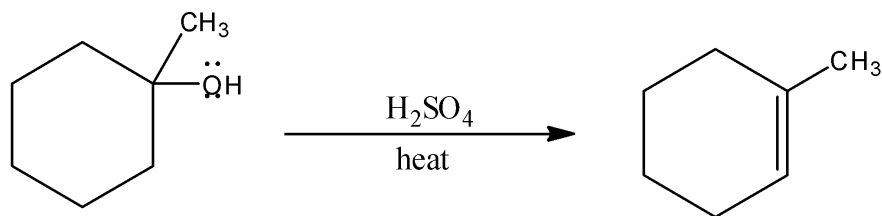


or

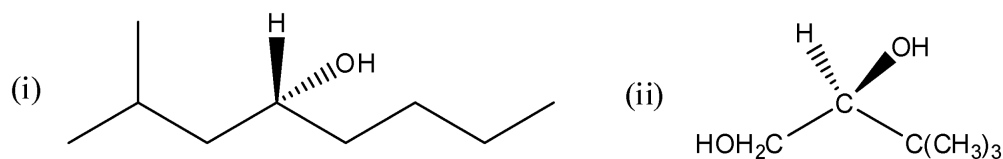


Explaining your answer, identify the reaction that would give better yield of 2-methoxypropane. (3 marks)

e) Draw the mechanism for the following acid-catalyzed dehydration reaction. (3 marks)

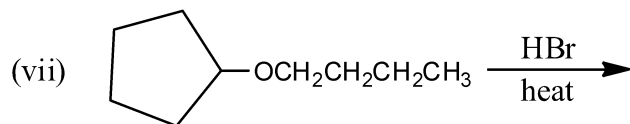
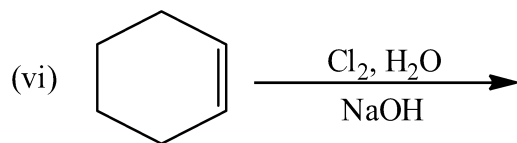
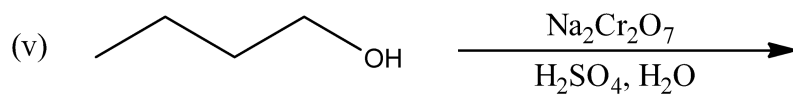
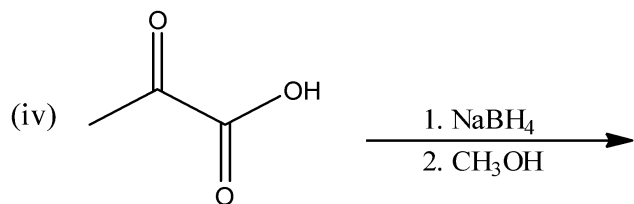
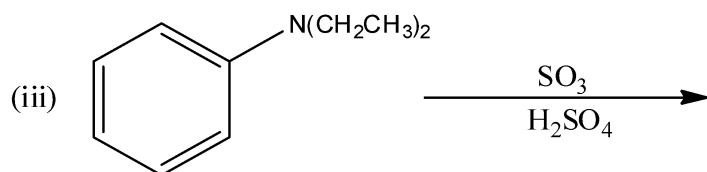
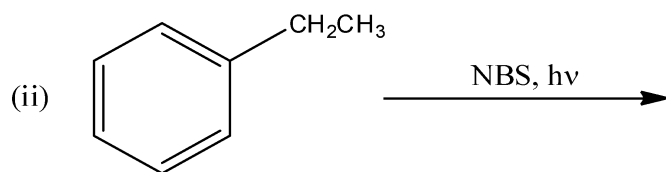
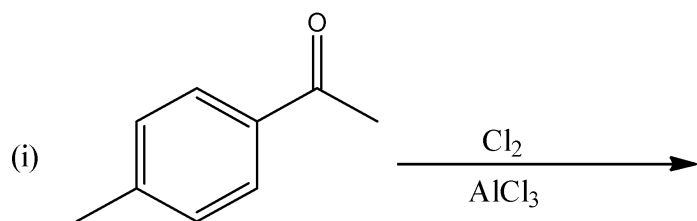


f) Determine the configuration (R/S) of each chirality center in the following compounds: (2 marks)

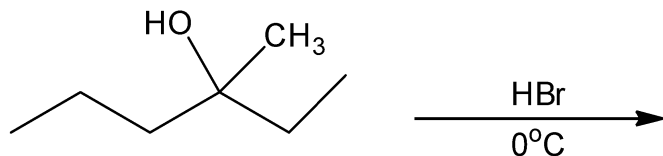


g) Draw the major product in each of the following reactions.

(7 marks)

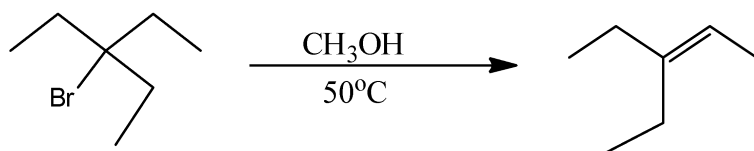
**QUESTION TWO (20 MARKS)**

a) Consider the following reaction.



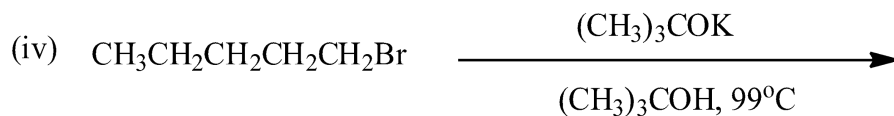
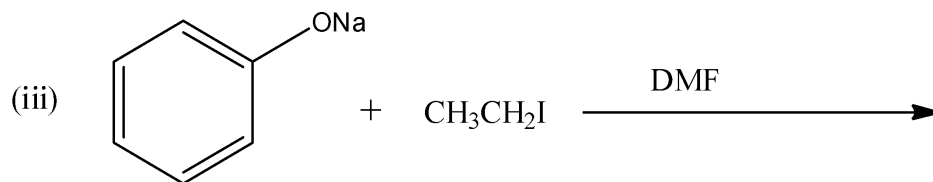
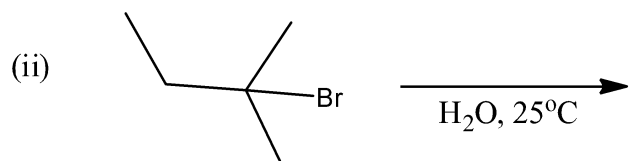
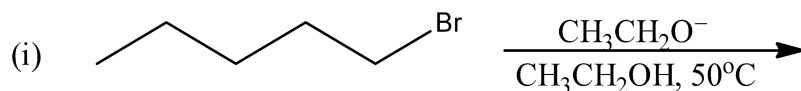
- (i) Write a detailed stepwise mechanism of the reaction. (3 marks)  
 (ii) State the physical evidence that should exist to prove the reaction has occurred. (1 mark)

b) The following reaction occurs via E1 mechanism:



- (i) Write a detailed stepwise mechanism of the reaction. (3 marks)  
 (ii) Write the rate law equation for the reaction. (1 mark)  
 (iii) Draw an energy diagram for the reaction (Label the axes, starting materials, product, activation energy, and draw the structures of intermediate(s) and any transition states). (4 marks)

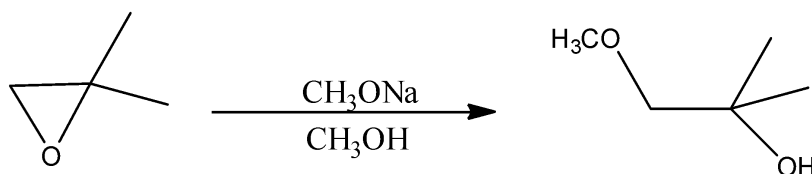
h) Draw the structure of the product(s) from each of the following reactions. In each part determine the mechanism (SN1, SN2, E1, or E2) by which each product is formed and predict the relative amount of each product (i.e., whether the product would be the only product, the major product or minor product). (8 marks)



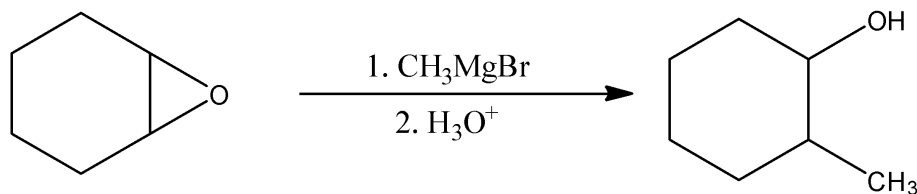
### QUESTION THREE (20 MARKS)

- a) (i) Using Newman projections, draw the structures of the following conformations of butane. Anti, totally eclipsed, eclipsed and gauche conformations. (6 marks)  
 (ii) Discuss the relative stabilities of the conformations in a(i) above. (4 marks)

- b) Provide a mechanistic explanation for the following reaction. (3 marks)

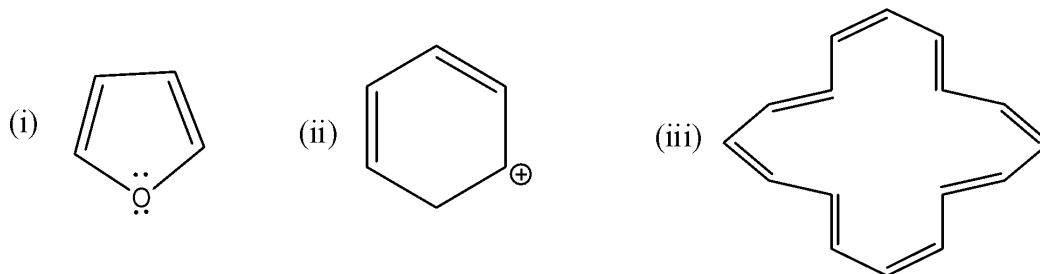


- c) Using suitable equations, discuss the following methods of synthesizing ethers.  
 (i) Williamson ether synthesis (3 marks)  
 (ii) Alkoxymercuration – demercuration (2 marks)
- d) Epoxides react with Grignard reagents to yield alcohols. Write a mechanism for the following reaction. (2 marks)

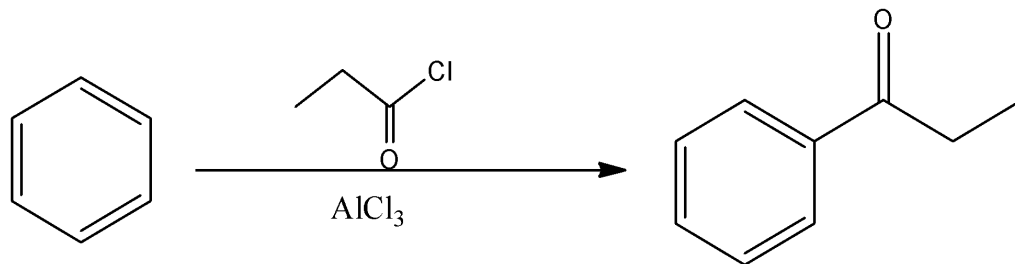


#### QUESTION FOUR (20 MARKS)

- a) State the Hückel's rule as used in aromaticity. (1 mark)
- b) Determine whether the following molecules/ions are aromatic, antiaromatic or non-aromatic. Show your working indicating clearly the value of  $n$  using Hückel's rule. (3 marks)



- c) Draw a stepwise mechanism for the following reaction using curved arrows to show the flow of electrons in each step. Include all important resonance structures. (8 marks)



- b) The Friedel-Crafts reaction of benzene with 2-chloro-3-methylbutane in the presence of AlCl<sub>3</sub> occurs with a carbocation rearrangement. Draw the structure of the initial carbocation, the more stable carbocation and the product of the reaction. (2 marks)

- c) Propose a multistep synthesis of the following compounds from benzene. (6 marks)

