TECHNICAL UNIVERSITY OF MOMBASA

School of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH 4105: ORGANIC CHEMISTRY I

END OF SEMESTER EXAMINATION

SERIES: December 2024 SERIES

TIME: 2 HOURS

DATE: December 2024

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attemptquestion ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question One (30 Marks)

(**a**) Arrange each of the following groups of organic molecules in increasing order of boiling point and explain your ordering: [**6 marks**]

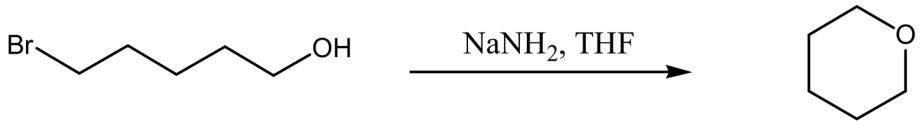
i. Heptane, Dodecane, Propane

ii. Butan-1-ol, 1,3-dimethylhexane, 2-methylcyclohexanol

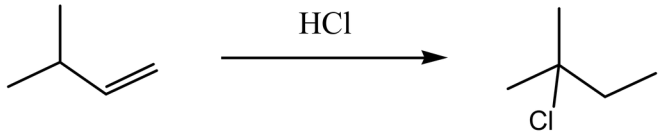
iii. Butan-1-ol, Butan-2-ol, 2-methylpropan-2-ol

(**b**) Make use of curly arrows to provide the arrow-pushing mechanism for each of the following reactions: [**5 marks**]

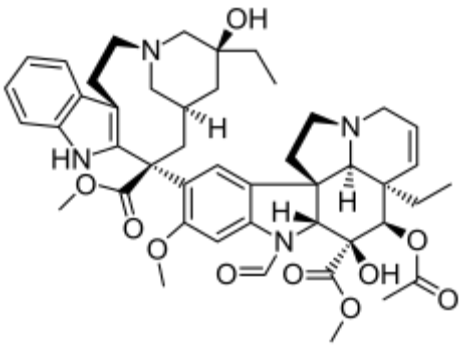
(i)



(ii)



(**c**) Vincristine (Structure shown below) is an alkaloid used in cancer treatment. Trace its structure, circle and provide names of distinct functional groups in the molecule. [**6 marks]**



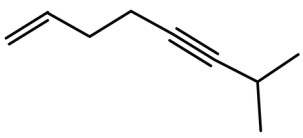
(**d**) Different organic molecules may have the molecular formula C_4H_8O. [**9 marks**]

i. Determine the Unsaturation Index (UI) of compounds with the molecular formula C_4H_8O. [**1 mark**]

ii. Provide the structural implication of the determined UI value and provide three possible classes of organic compounds the molecules may belong to. [**2 marks**]

iii. Provide line bond structures and IUPAC names of any three molecules with molecular formula C_4H_8O. [**6 marks**]

(**e**) What is hybridization of atomic orbitals? Trace the structure of the following molecule and indicate the type of hybridization for each of the carbon atoms in the molecule. [**4 marks**]



Question Two (20 Marks)

(a) Alkyl halides can be classified as primary, secondary, or tertiary. Draw the line-bond structure of one primary, secondary, and tertiary alkyl halide with the molecular formula C_4H_9Br and give their IUPAC names. **[6 marks]**

(b) Define the following terms as used in nucleophilic substitution reactions: **[3 marks]**

i. Leaving group

ii. Nucleophile

iii. Carbocation

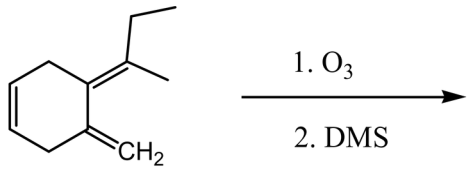
(c) Arrange the following compounds in increasing order of reactivity towards the S_N2 mechanism and explain your reasoning: **[4 marks]**

1-bromo-2-methylpropane, 2-bromo-2-methylpropane, 1-bromobutane

(d) Explain three factors that influence the rate of S_N1 reactions in alkyl halides. **[9 marks]**

Question Three (20 Marks)

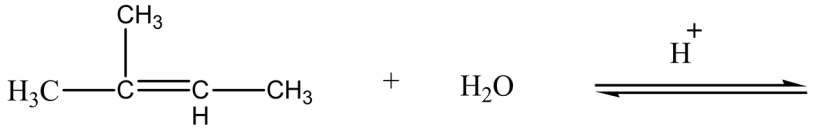
(a) Draw the structure of the organic product(s) of each of the following reactions of alkenes.

i. 

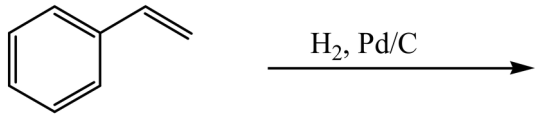
[4 marks]

ii. 

[3 marks]

iii. 

[3 marks]

iv. 

[2 marks]

(b) Make use of curly arrows to provide for the reaction mechanism leading to the major products in (a) (ii) and (iii) above. **[8 marks]**

Question Four (20 Marks)

(a) Describe how to synthesize 2-pentyne using the acetylide ion. Show the reaction mechanism using curly arrows. [**4 marks**]

(b) Draw the line-bond structures of the products formed in the following alkyne reactions with one equivalent and excess reagent: [**12 marks**]

i. Pent-1-yne with hydrogen bromide in acetic acid

ii. Hex-2-yne with hydrogen chloride in acetic acid

iii. Oct-2-yne with hydrogen and Lindlar's catalyst

iv. Prop-1-yne with bromine in dichloromethane

(c) Alkynes can undergo hydration to yield enols, which are further converted to carbonyl compounds. Draw the structure and provide the IUPAC name of the products when hex-2-yne undergoes this transformation. [**4 marks**]

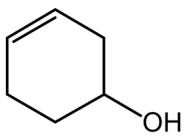
Question Five (20 Marks)

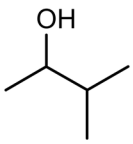
(a) Draw the line-bond structures and give the IUPAC names for six constitutional isomers of alcohols with molecular formula $C_5H_{11}OH$. [**6 marks**]

(b) Explain how you would use Lucas reagent ($ZnCl_2$/HCl) to differentiate between primary, secondary, and tertiary alcohols. [**4 marks**]

(c) How does the solubility of alcohols vary with the increasing number of carbon atoms in the respective molecules? Give an account for your answer. [**4 marks**]

(d) Provide the dehydration products of the following alcohols indicating the major product where applicable. [**6 marks**]

i. 

ii. 

iii.