



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES
UNIVERSITY EXAMINATION FOR
BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY
ACH 4204 : STEREOCHEMISTRY AND CONFORMATIONAL
ANALYSIS

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: 17TH MAY 2016

Instructions to Candidates

You should have the following for this examination

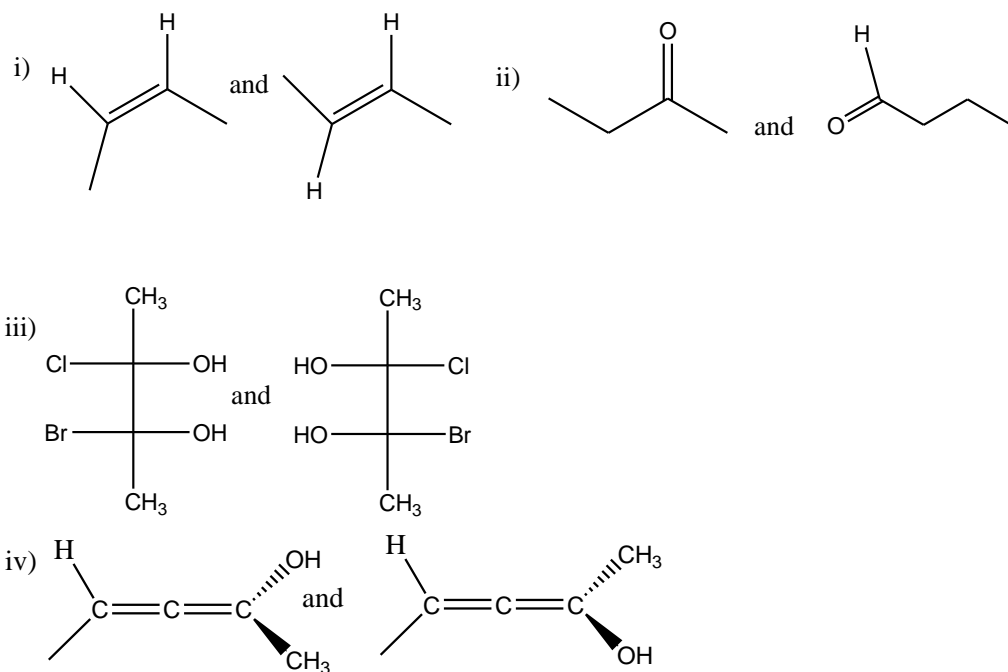
-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt Question ONE and any other TWO.

Do not write on the question paper.

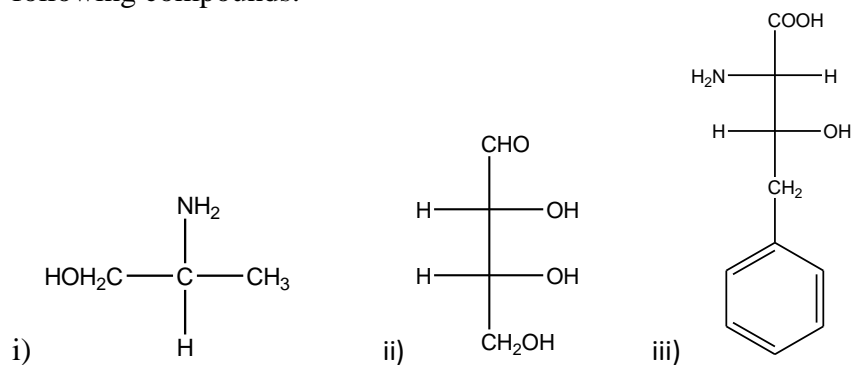
Question ONE

- a) Explain the following terms
- i) Trans isomer
 - ii) Chiral centre
 - iii) Fischer projection
 - iv) Dextrorotatory isomer
- (8marks)
- b) Indicate with reason whether the following pairs of compounds are identical, diastereomers, enantiomers or constitutional isomers.



(8marks)

- c) Redraw and assign R or S configuration to all the stereocentres in each of the following compounds.



(5marks)

- d) Draw the most stable chair conformations of the following compounds and state whether they are optically active or optically inactive.
- Trans-1-ethyl-2-propylcyclohexane
 - Trans-1,4-dibromocyclohexane
 - Cis-2-methylcyclohexanol

(6marks)

- e) The conformational free energy of a fluoro group is -1.0 KJmol^{-1} at 25°C . Calculate the conformational equilibrium constant of fluorocyclohexane.

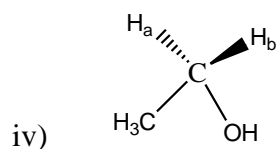
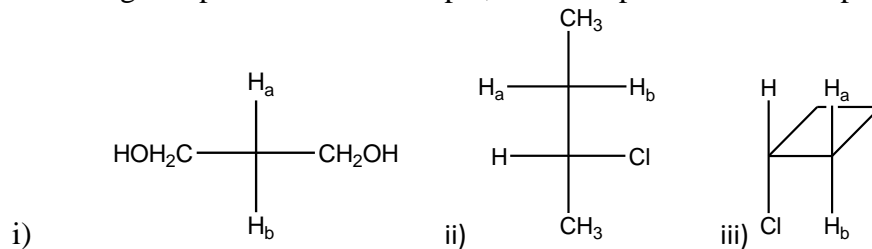
(3marks)

Question TWO

- a) Differentiate between the following terms
- Pro-R and Pro-S
 - Re-face and Si-face
- (4marks)
- b) 28mg of a sample of Mandelic acid was dissolved in 1 cm³ of ethanol and the solution placed in a 10cm polarimeter cell. An optical rotation of +4.34° was measured at 20°C with light of wavelength 589nm.
- Calculate the specific rotation of the sample. (4marks)
 - If the specific rotation of pure (R) – Mandelic acid is +158 work out the % optical purity. (3marks)
 - Calculate the % of (R)- and (S)- Mandelic acid in the sample. (3marks)
- c) Using Newmann projections draw the preferred conformation(s) of the following compounds and give reason(s) for your choice.
- ClCH₂CH₂Cl (2marks)
 - HOCH₂CH₂OH (2marks)
 - CH₃CH₂CH₂CH₃ (2marks)

Question THREE

- a)
 - Explain the term allenes. (2marks)
 - State and explain the conditions for allenes to be chiral or achiral. (4marks)
- b) Draw the cis and trans forms of 4-t-butylcyclohexanol dash structures. (4marks)
- c) Indicate with reason whether the hydrogen atoms Ha and Hb in each of the following compounds are homotopic, enantiotopic or diastereotopic.



- d) Explain the term threo enantiomer

(8marks)

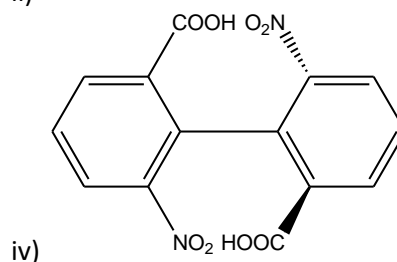
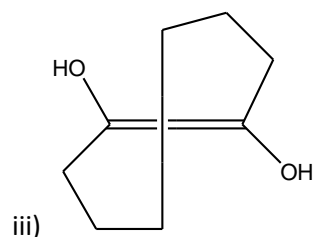
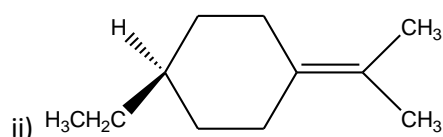
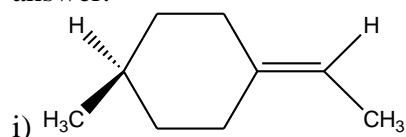
(2marks)

Question FOUR

- a) Explain the following terms
- Biphenyls
 - Spiranes
 - Helical molecules

(6marks)

- b) Indicate whether the following molecules are chiral or achiral and explain your answer.



(7marks)

- c) At 32°C the dipole moment of gaseous 1,2-dichloroethane was found to be 1.12D. Given that $\mu_{\text{gauche}} = 3.2\text{D}$ and $\mu_{\text{anti}} = 0$ calculate

- i) The % of each of the anti and gauche conformers at 32°C.

(3marks)

- ii) The equilibrium constant K.

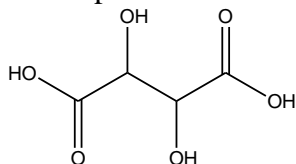
(2marks)

- iii) The Gibbs free energy difference (ΔG^θ) between the two conformations given that $\Delta G^\theta = -RT \ln K$ and $R = 8.314\text{Jmol}^{-1}\text{K}^{-1}$

(2marks)

Question FIVE

- a) Using the compound below to answer questions that follow



- i) Determine the maximum number of stereoisomers possible for this compound.

(2marks)

- ii) Draw the Fischer projections of the stereoisomers.

(6marks)

- iii) Which of the isomers in (ii) above are optically inactive. Explain your answer.

(2marks)

- b) i) Explain the term sigmatropic reaction. (2marks)
- ii) Differentiate between [2,3] and [3,3] – sigmatropic rearrangements giving an example of reactions in each case. (6marks)
- c) Explain how enzymes act as resolving agents in resolution of enantiomeric mixture of 5- norbornen-2-ol. (2mks)