JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES
SECOND YEAR SECOND SEMESTER EXAMS
SCH 411: ORGANIC STEREOCHEMISTRY (SCHOOL BASED GROUP)

ANSWER ALL QUESTIONS IN SECTION A AND ANY TWO QUESTIONS IN SECTION B

SECTION A: ANSWER ALL QUESTIONS (30 MARKS)

QUESTION 1

a) Explain the following terms; (10 marks)

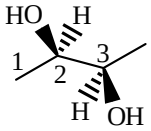
(i) Stereochemistry
(ii) Optical activity
(iii) Racemic mixture
(iv) Molecular geometry
(v) Chirality

b) Discuss the principles underlying the naming of enantiomers. (5 marks)

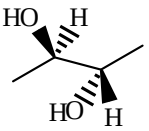
c) Account for the following observations; (6 marks)

(i) 1,3-dimethylcyclohexane exists only in three rather than four isomers though it has two stereogenic centres.
(ii) A pair of enantiomers has identical infra red spectra, indexes of reflection, solubilities and reaction kinetics in ordinary solvents.
(iii) Molecular geometries can be specified in terms of bond lengths, bond angles and torsional angles.

d) The following are stereorepresentations for the three stereoisomers of 2,3-butanediol. The carbons are numbered beginning from left as shown in (I).



(1)



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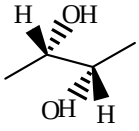


(3)

(i) Assign an *R* or *S* configuration to each chiral centre. (3 marks)
(ii) Which are enantiomers? (1 mark)
(iii) Which is the meso compound? (1 mark)
(iv) Which are diastereomers? (1 mark)

e) Draw the stereoisomers that exist for 1,2-cyclopentanediol molecule. (3 marks)

SECTION B (40 MARKS):

ANSWER ANY TWO QUESTIONS FROM THIS SECTION-EACH

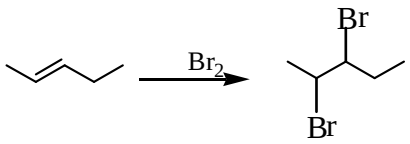
QUESTION CARRIES <u>20 MARKS</u>

QUESTION 2

a) Define each of the following terms: (10 marks)

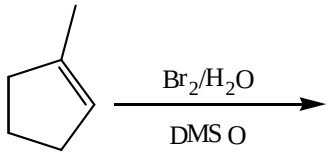
(i) Diastereomers
(ii) Stereogenic centre
(iii) Meso compound
(iv) Enantiometrically pure substances
(v) Solvolysis reaction

b) Consider the reaction below: (6 marks)



How many stereoisomers of the product are possible? Draw them. Are the products optically active?

c) What products are formed from the following reaction? Are the product(s) optically active? (4 marks)



QUESTION 3

a) Distinguish the following terms; (4 marks)

(i) Stereoisomers and constitutional isomers
(ii) Stereospecific and regiospecific reactions

b) At 24°C, a sample of S-2-iodobutane whose specific rotation is: $[\alpha]^{24}_{D} = 22.4°$ was put in a1 dm vial of solution of 1 gml^{-1} showed an optical rotation of +3.975°.

(i) What is the optical purity? (4 marks)
(ii) What is the enantiomeric excess? (4 marks)

c) Which of the following compounds are chiral? (4 marks)

(i) 2,4-dimethylheptane
(ii) 5-ethyl-3,3-dimethyloctane
(iii) Cis-1.4-dichlorocyclohexane
(iv) 4,5-dimethyl-2,6-octadiyne

d) What is the relationship between the specific rotatios of; (4 marks)

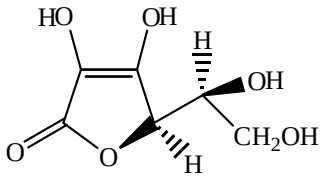
(i) (2R,3R)-dichloropentane and (2S,3S)-dichloropentane
(ii) (2R,3S)-dichloropentane and (2S,3R)-dichloropentane.

QUESTION 4

a) Draw the tetrahedral representations of the following compounds; (4 marks)

(i) (S)-2-chlorobutane
(ii) (R)-chloro-1-pentene

b) Assign *R* or *S* configurations to the chiral centers of ascorbic acid. (2 marks)



b) Give an example of a compound with the following molecular structure. (8 marks)

(i) Linear
(ii) Trigonal planar
(iii) Bent
(iv) Tetrahedral

c) The specific rotation of progesterone a female hormone is +172º. Calculate the observed rotation for a solution prepared by dissolving 300 mg of progesterone in 15.0 ml of dioxane and placing it in a sample tube of 10.0 cm long. (6 marks)

QUESTION 5

a) Giving relevant examples, describe how racemic mixtures can be resolved using any **TWO** of the following methods.

(i) Use of chiral bases or acids (6 marks)
(ii) Chromatography (6 marks)
(iii) Use of enzymes (6 marks)

b) Many drugs are isolated directly from plants and bacteria while others are obtained by modification of naturally occurring compounds. Such compounds are usually chiral and are found as a single enantiomer rather than a racemic mixture. Giving relevant names and structures, discuss application of four such drugs. (8 marks)

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