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# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER  
MAIN EXAMINATIONS

FOR THE DEGREE OF EDS & BSC (CHEMISTRY)

**COURSE CODE:** SCH 325

**COURSE TITLE:** STEREOCHEMISTRY

**DURATION:** 2 HOURS

**DATE:** 29/08/2022

**TIME:** 9:00AM-11:00AM

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## INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

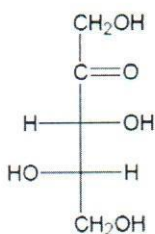
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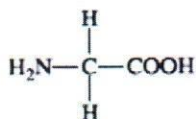
KIBU observes ZERO tolerance to examination cheating

**QUESTION ONE (30 MARKS)**

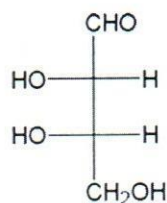
- a. Define the following terms (5 marks)
- i. Polarimeter ii. Chiral center iii. Diastereomers iv. Levorotatory v. Racemic mixture
- b. Name the 3D representations of organic molecules (4 marks)
- c. List two types of configurational isomers (2 marks)
- d. State three properties of diastereomers (3 marks)
- e. Use an asterisk (\*) to indicate the asymmetric centers on the molecules below (5 marks)



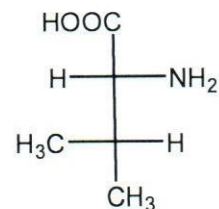
A



B

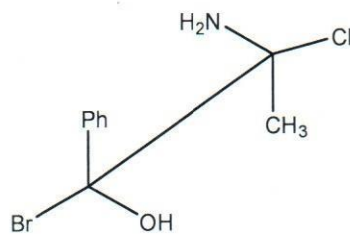


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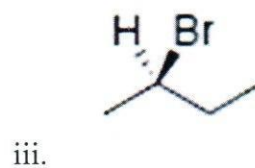
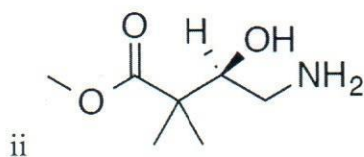
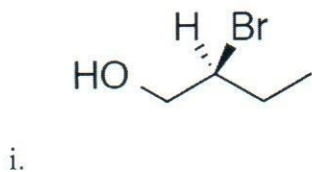
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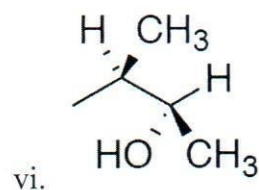
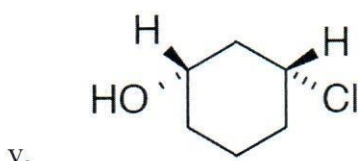
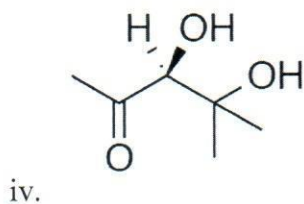
- f. Identify the relative configuration of the molecules in e. above (4 marks)
- g. Calculate the number of stereoisomers present for structures B and C in e above (4 marks)
- h. Convert the molecule below from Sawhorse formula to Newmann projection to Fischer projection (3 marks)



**QUESTION 2 (20 MARKS)**

- a. Designate the absolute configuration for the chiral centers in the molecules (7 marks)





b. Given the absolute configurations below. Draw the corresponding Fischer projections (4 marks)

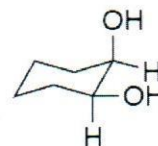
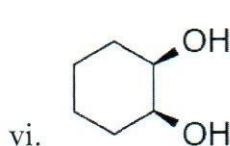
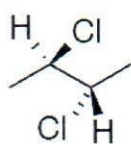
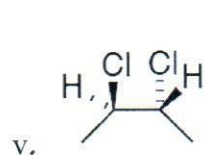
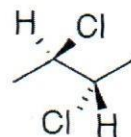
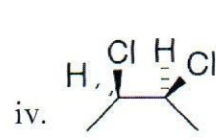
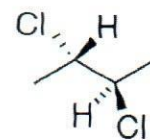
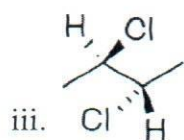
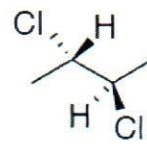
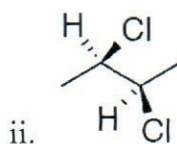
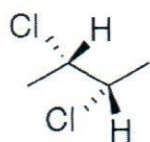
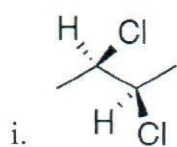
i. (2S, 3R)-2-hydroxy-3-chlorobutanoic acid

ii. (2R, 3S)-2-bromo-3-chloropentane

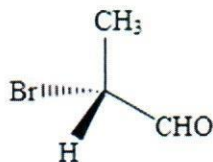
iii. (2S, 3R)-3-bromo-2-butanol

iv. (2S, 3R)-2,3-dichloropentane

c. State the relationships between the following structures as either "same", "enantiomers", or "diastereomers" (6 marks)



d. Given the dash wedge formula below convert it to Fischer projection (3 marks)



### QUESTION 3 (20 MARKS)

- a. Name and discuss the different types of strain experienced by organic molecules (16 marks)
- b. Draw the major product for the reactions shown. (There may be some side products or isomers formed in addition to the major products, but you don't need to draw them.)



### QUESTION 4 (20 MARKS)

- a) State the optical activity of following compounds (4 marks)

- i. Sucrose ( $[\alpha]_D = -66.7$ )
- ii. Cholesterol ( $[\alpha]_D = +31.5$ )
- iii. Cocaine ( $[\alpha]_D = -16$ )
- iv. Chloroform ( $[\alpha]_D = 0$ )

b. A student prepared compound D in lab. She was sure the compound contained no impurities; a number of physical analyses confirmed the structure and purity of the compound. A sample of compound D (0.10 g) is dissolved in methanol (2.0 mL) and the solution is placed in a 1.0 dm cell. Three polarimetry readings are recorded with the sample:  $0.9950^\circ$ ,  $0.904^\circ$ ,  $0.936^\circ$ .

- i. Calculate  $[\alpha]$ ? (4 marks)
- ii. The optical rotation of D has previously been reported as  $25^\circ$ . What is the optical purity of this sample? (2 marks)
- iii. What is the enantiomeric excess of this sample? (1 mark)

iv. What is the composition of this sample?

**(3 marks)**

v. Why did the previous analyses show that there was only one compound present? **(2 marks)**

c. Given that (S)-bromobutane has a specific rotation of  $+23.1^\circ$  and (R)-bromobutane has a specific rotation of  $-23.1^\circ$ . What is the optical purity and % composition of a mixture whose specific rotation was found to be  $+18.4^\circ$  **(4**

**marks)**

#### **QUESTION FIVE (20 MARKS)**

a. Consider 3,3-dimethylpentane. Using Newman projection, name and draw four possible "extreme" conformations viewing along **C2-C3** bond **(8 marks)**

b. Draw a potential energy diagram showing conformers 3,3,4-trimethylhexane at different angles from  $0-360^\circ$  viewing along the **C2-C3** bond **(7 marks)**

c. Cyclohexane has five different conformations with different strain energy. Use an energy level diagram to illustrate the position and strain energy of each conformer **(5 marks)**