



MACHAKOS UNIVERSITY

University Examinations 2019/2020 Academic year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION SCIENCE

**SCH 303: STEREOCHEMISTRY, CONFORMATIONAL STUDIES AND REACTION
MECHANISMS**

DATE:

TIME:

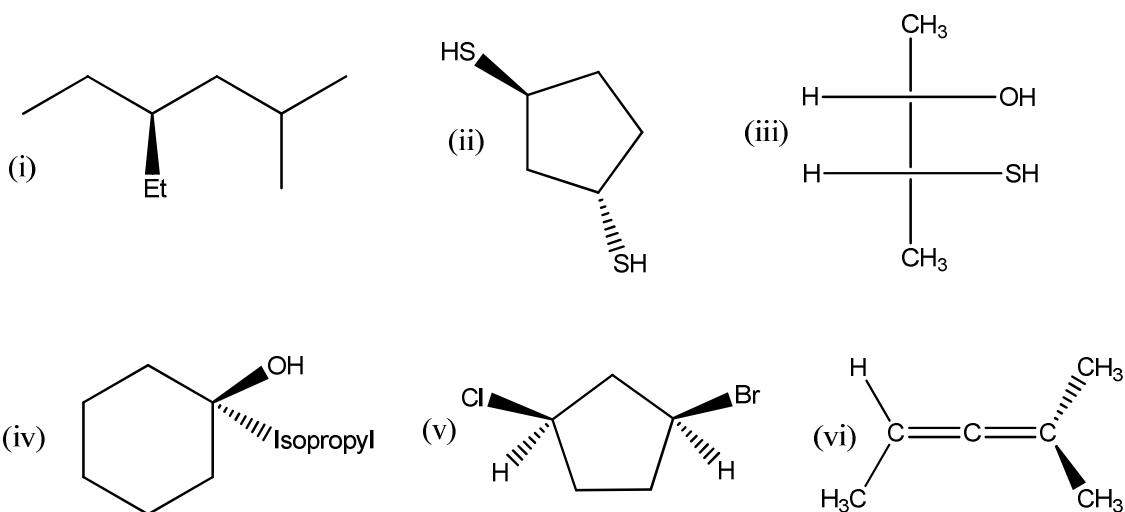
INSTRUCTIONS TO CANDIDATES

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

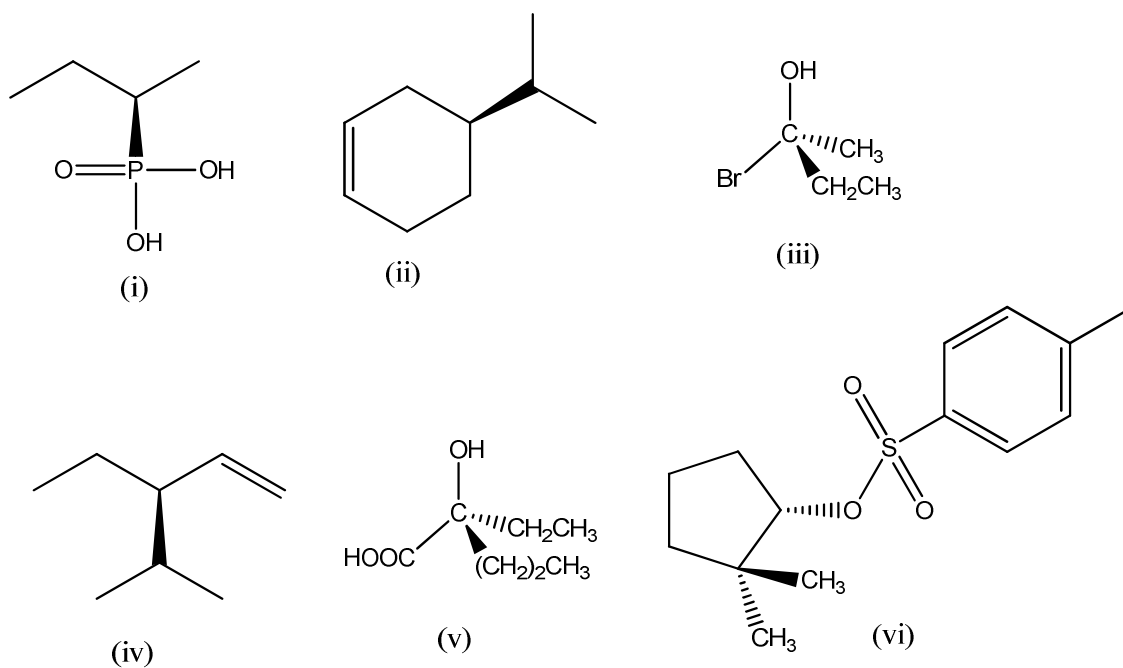
SECTION A

QUESTION ONE (30 MARKS)

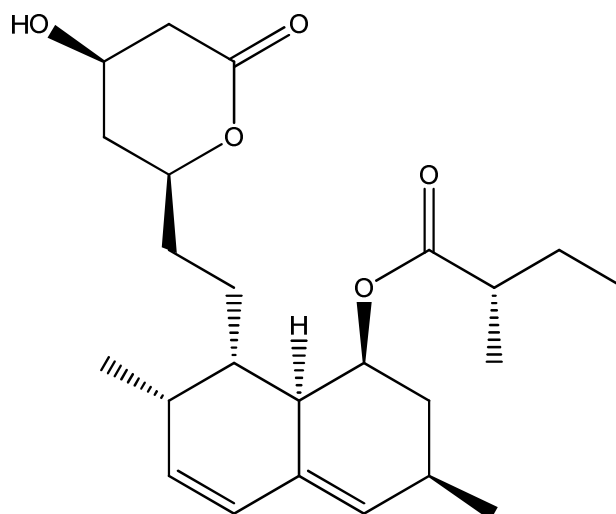
- (a) Illustrate the various subdivision of isomers (5 marks)
- (b) Define the following terms (2 marks)
- i. Optical activity
- ii. Axial Chirality
- (c) Determine if the following molecules are chiral or achiral (6 marks)



d) Find the absolute configuration (R, S) of the following chiral compounds (6 marks)

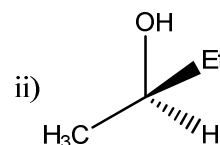
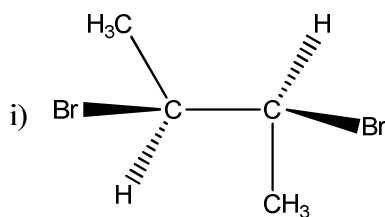


e) Using an asterisk (*) identify all the stereogenic centres in the molecule shown below and calculate the possible stereoisomers (6 marks)



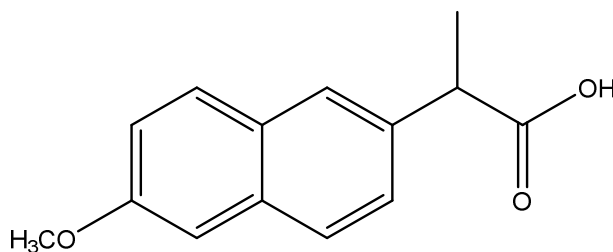
lovastatin

- f) Explain why meso compounds are said to be optically inactive (1 mark)
- g) Convert the wedge formula for the molecules shown below into a Fischer projection (4 marks)



QUESTION TWO (20 MARKS)

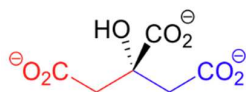
- a) Discuss three ways of predicting whether a molecule is chiral or achiral (6 marks)
- b) Chiral drugs are recommended for prescriptions as a single enantiomer. Naproxen (shown below) is an anti-inflammatory drug, which is mandated to be sold at greater than 97% enantiomeric excess (e.e.). The specific rotation of the R-enantiomer (in CHCl_3) is $+65.5^\circ$. During a quality control exercise, a chemist sampled from a 50 kg batch of Naproxen produced at a pharmaceutical industry. She dissolved 2.6 g of product in 10 mL of chloroform and measured an optical rotation of $+15.2^\circ$ in a 10 cm (1 dm) polarimeter.



- i. Draw the R-enantiomer of Naproxen (2 marks)
 - ii. Calculate the optical purity of the sample and determine whether it meets the set standard for it to be marketed (4 marks)
 - iii. Determine the mass of the 50 kg batch, which is actually the (+)(R)-enantiomer (2 marks)
- c) Menthol is a member of the terpene family of natural products. It exists in a (1R,2S,5R) form and a (1S,2R,5S) form. Draw the two enantiomers. (4 marks)
- d) The alkane formed by hydrogenation of (S)-4-methyl-1-hexene is optically active while the one formed by hydrogenation of (S)-3-methyl-1-pentene is not. Explain. (2 marks)

QUESTION THREE (20 MARKS)

- a) Using the appropriate examples, discuss three ways in which enantiomers can be separated (9 marks)
- b) Draw two different chair conformations of Cis-1, 3-dimethylcyclohexane and determine which of the two conformations is most stable (4 marks)
- c) Determine the percent composition of a mixture of (S)-(+)-2-butanol, $[\alpha] = +13.52^\circ$, and (R)-(-)-2-butanol, $[\alpha] = -13.52^\circ$, with a specific rotation $[\alpha] = +6.76^\circ$ (3 marks)
- d) Explain the term prochiral carbon and identify the two similar groups in the molecule below as either Pro-R or Pro-S (4 marks)

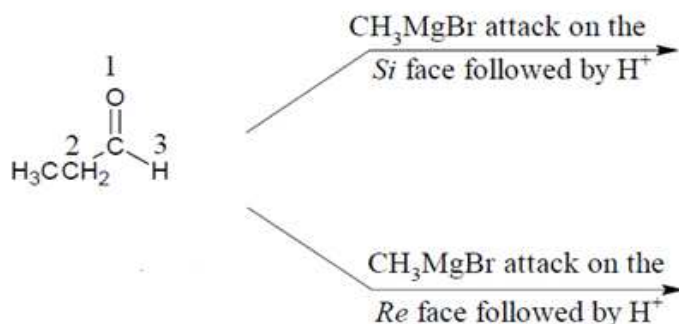


QUESTION FOUR (20 MARKS)

- a) Explain the following terms:
- Torsional strain
 - Steric Strain
 - Angle strain (6 marks)
- b) Using one example in each case discuss the importance of chirality in nature and in pharmaceutical industry (6 marks)
- c) Draw the Newman projection of all conformations 2-methylpropane and indicate the most and least stable (4 marks)
- d) Draw dash-wedge structures for all stereoisomers of 1-bromo-3-isopropylcyclohexane, giving stereochemical details for each structure. (4 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss Baeyer strain theory and give reasons why it was disapproved (5 marks)
- b) Provide the products formed when ketone shown below reacts with a Grignard reagent through attack on Si face and Re face. Be careful to show the correct stereochemistry of the products (4 marks)



- c) Draw a dash-wedge structure for the following molecules. Be careful to show the stereochemistry. (8 marks)
- (3R)- 3-methyl-5-hexen-3-ol
 - (1R)-1-bromo-1,3,3-trimethylcyclohexane
 - (1R, 3R)-1,3-dibromo-1,3-dimethylcyclohexane
 - (1S, 3R)-1-ethyl-1,3-dimethylcyclopentane
- d) *cis*-1-*tert*-butyl-3-methylcyclohexane can exist in one of the two conformations shown below. Providing reasons, indicate the most stable conformation (3 marks)

