MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SUPPLEMENTARY/SPECIAL EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF EDUCATION SCIENCE (SPECIAL NEEDS)

BACHELOR OF SCIENCE (ANALYTICAL CHEMISTRY)

SCH 303: STREOCHEMISTRY, CONFORMATIONAL STUDIES AND REACTION MECHANISMS

DATE: 16/03/2022 **TIME: 8:30-10:30 AM**

INSTRUCTIONS:

- 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)

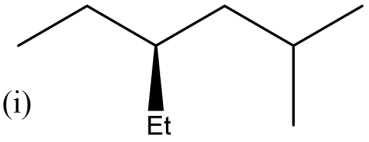
(b) Define the following terms (2 marks)

(i) Optical activity

(ii) Axial Chirality

(c) Determine if the following molecules are chiral or achiral (6 marks)

(i)



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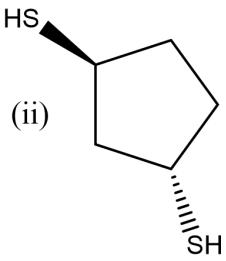

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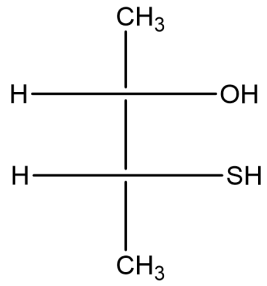

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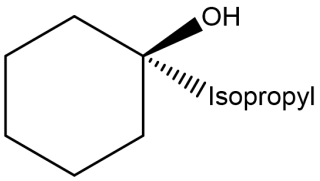

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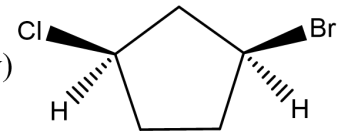

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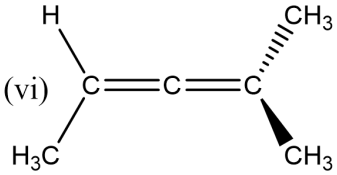
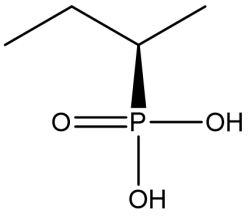


d) Find the absolute configuration (R, S) of the following chiral compounds (6 marks)

(i)



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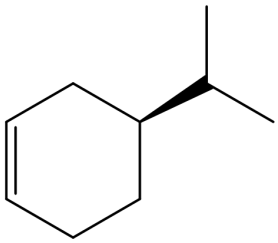

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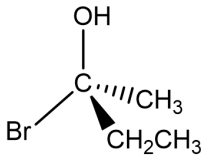

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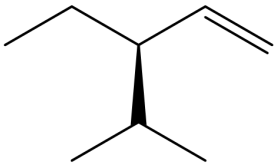
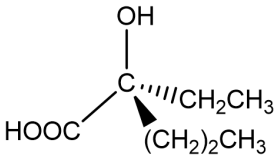
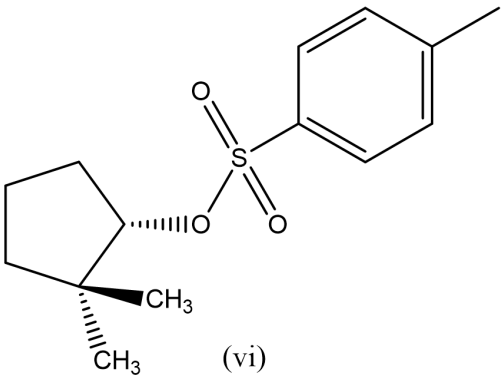


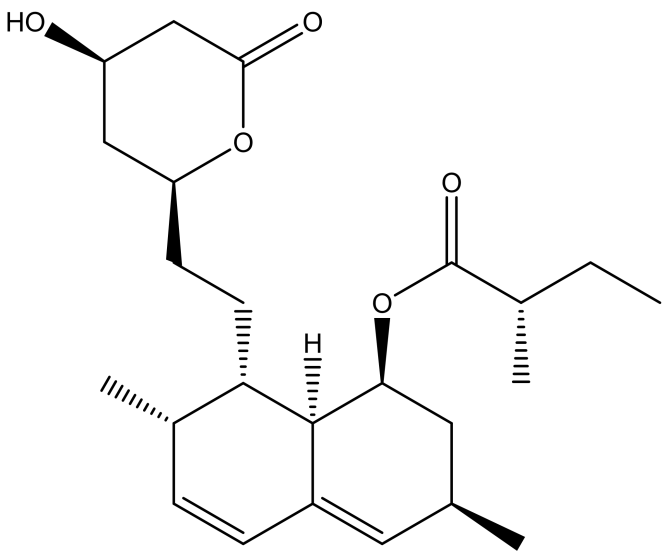
(v)



(vi)



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

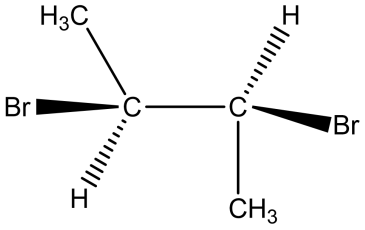


lovastatin

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)

i)



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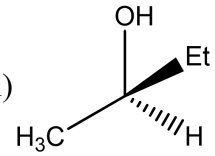
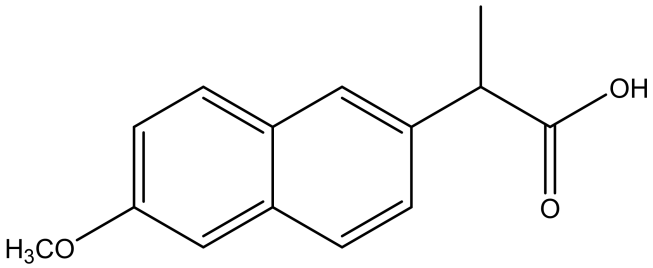


QUESTION TWO (20 MARKS)

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°. 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° in a 10 cm (1 dm) polarimeter.

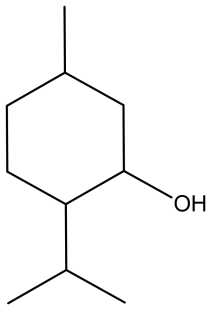


(i) Draw the R-enantiomer of Naproxen (2 marks)

(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)



menthol

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)

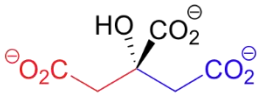
QUESTION THREE (20 MARKS)

(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, [α] = +13.52°, and (R)-(-)-2-butanol, [α]=-13.52°, with a specific rotation [α]= +6.76° (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: (i) Torsional strain
(ii) Steric Strain
(iii) Angle strain (6 marks)

(b) Using one example in each case discuss the importance of chirality in nature and in pharmaceutical industry (6 marks)

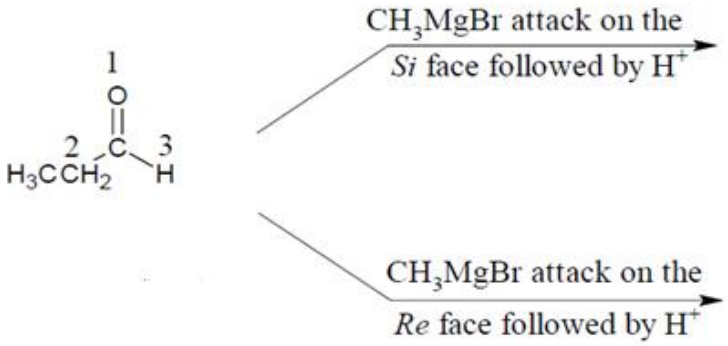
(c) Draw the Newman projection of all conformations 2-methylpropane and indicate the most and least stable (4 marks)

(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).

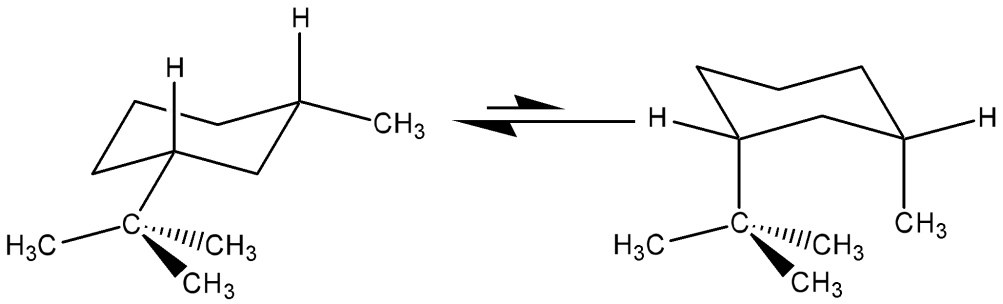
(b) Provide the products formed when ketone shown below reacts with a Grignard reagent through attack on Si face and Re face. Be careful to show the correct stereochemistry of the products
(4 marks)



(c) Draw a dash-wedge structure for the following molecules. Be careful to show the stereochemistry. (8 marks)

(i) (3R)- 3-methyl-5-hexen-3-ol
(ii) (1R)-1-bromo-1,3,3-trimethylcyclohexane
(iii) (1R, 3R)-1,3-dibromo-1,3-dimethylcyclohexane
(iv) (1S, 3R)-1-ethyl-1,3-dimethylcyclopentane

e) *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)


H
H
CH3
H3C
C
CH3
CH3
H
H
CH3
H3C
C
CH3
CH3