UNIVERSITY OF NAIROBI

THIRD YEAR FIRST SEMESTER EXAMINATIONS 2018-2019
FOR THE DEGREE OF
BACHELOR OF SCIENCE (CHEMISTRY, ANALYTICAL AND INDUSTRIAL CHEMISTRY)

SCH 302: STEREOCHEMISTRY AND SYNTHESIS OF ORGANIC COMPOUNDS

DATE: **TIME:**

Instructions: Answer ALL Questions and begin answering a new question on a new page in your answer booklet.

Q1.

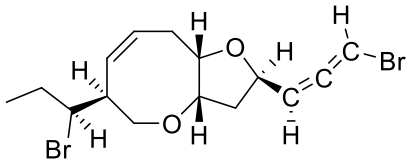
(a) Differentiate between the following stereochemical terms: (2 Marks each)

(i) Resolution and racemization

(ii) Chiral centre and chiral axis

(Total Marks: 4 Marks)

(b) Nipponallene (**A**), a brominated marine natural allene, was isolated from the Japanese red algae (Laurencia nipponica).



A

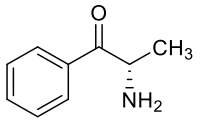
(i) Assign the absolute configuration to all the stereochemical units of nipponallene. (7 Marks)

(ii) How many stereoisomers of nipponallene are expected? (2 Marks)

(iii) Draw \the structure of the enantiomer of nipponallene (2 Marks)

(Total Marks: 11 Marks)

(c) Draw the Fischer projection of cathinone (**B**), one of the psychoactive principles in khat (*Catha edulis* Forsk), and determine its configuration based on the D/L notation. (4 Marks)



Cathinone

(**B**)

(Total Marks: 4 Marks)

Q2.

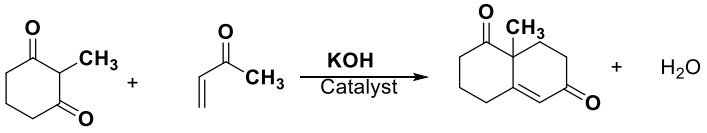
(a) Explain the following observations in organic synthesis:

(i) Protecting groups are considered a "necessary evil" in multistep organic synthesis. (2 Marks)

(ii) Chiral auxiliary synthesis is more versatile over chiral pool synthesis in asymmetric synthesis. (2 Marks)

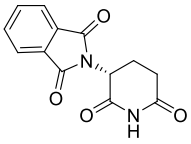
(Total Marks: 4 Marks)

(b) The Wieland Miescher ketone has been used in the synthesis of 50 synthetic and natural steroids. Propose a reasonable and stepwise reaction mechanism for the reaction formation of the Wieland Miescher ketone ion below:



(Total Marks: 7 Marks)

(c) The sedative, R-thalidomide, was once used to address symptoms of morning sickness in expectant mothers, however, when it was discovered that S-thalidomide causes deformities in infants, the use of R-thalidomide as a sedative was discontinued.

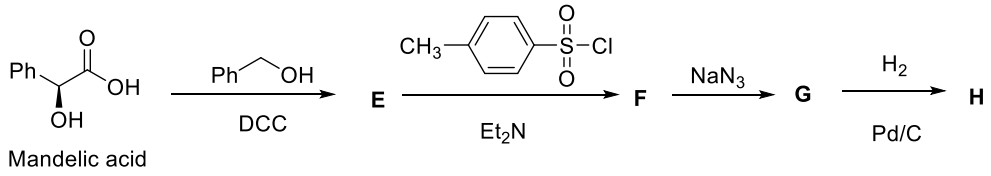


With the help of a reaction mechanism, explain why enantiopure R-thalidomide can not be safely used as a sedative without affecting infants (5 Marks)

(Total Marks: 5 Marks)

Q3.

(a) Mandelic acid occurs naturally in sweet almonds. The partial sequence highlighted below illustrates the conversion of mandelic acid into an unnatural amino acid.

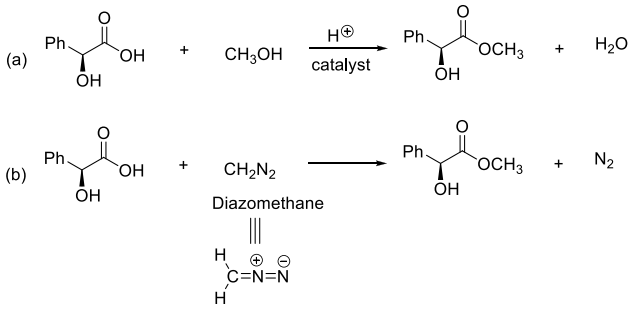


(i) Which strategy or approach to asymmetric synthesis does the above pathway illustrate? (2 Marks).

(ii) Deduce the structures of the missing intermediate compounds (**E-H**) in this synthesis. (2 Marks each)

(Total Marks: 10 Marks)

(b) A chemist investigated the two routes, shown below, of protecting (S)-mandelic acid as the methyl ester to obtain (S)-methyl mandelate.



A sample of 0.5 g of (S)-methyl mandelate obtained in approach (a) dissolved in 1 mL of methanol in a cell of 10cm gave an optical rotation of +60^{o}, while a similar weight of sample from approach (b) in the same sample cell gave an optical rotation of +72^{o}.

(i) Determine the specific rotation of the (S)-methyl mandelate from approach (a) and (b) (4 Marks)

(ii) Considering that enantiopure (S)-methyl mandelate has a specific rotation of +144^{o}, determine the enantiomeric excess of the mendalate from approach (a) and (b) (4 Marks)

(iii) Using a reaction mechanism, rationalize the basis for the less preferred pathway (4 Marks)

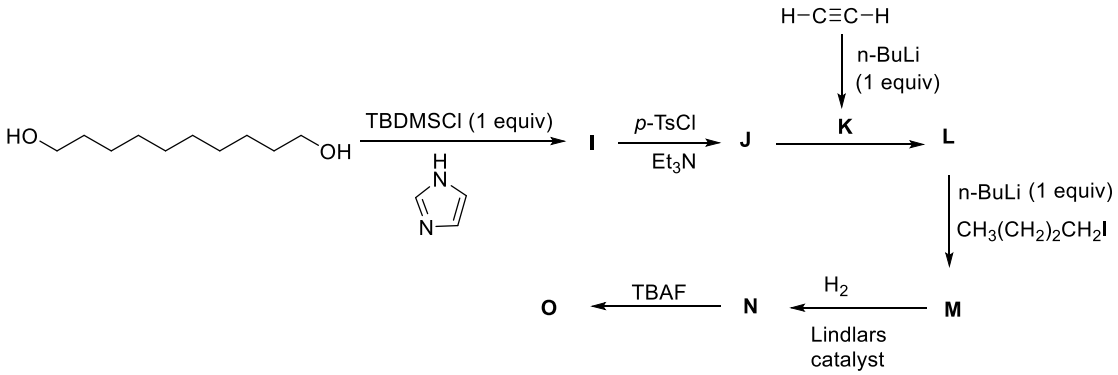
(Total Marks: 14 Marks)

Q4.

(a) Give any three reasons why convergent syntheses are preferred over linear syntheses.

(Total Marks: 3 Marks)

(b) Pheromone **G** of the maize stalk borer, *chilo partelus*, can be synthesized based on the partial scheme shown below:



(i) Complete the scheme by identifying the structures of the intermediate compounds **I**, **J**, **K, L, M**, **N** and pheromone **O**. Indicate stereochemistry where relevant (1 Mark each)

(ii) Based on the complete synthetic pathway generated in **4b(i)** above, propose the associated retrosynthetic pathway for the synthesis of pheromone **O**. (3 Marks)

(Total Marks: 10 Marks)