MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

APRIL SESSION EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SCH 402:CONCEPTS OF ORGANIC SYNTHESIS

DATE: **TIME: 2 Hours**

INSTRUCTIONS

*(a) Answer **question One** and any other **Two questions***

(b) Question 1 carries 30 marks while the other questions carry 20 marks each

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Explain the following terms as used in organic synthesis (4 marks)
   i) Synthons
   ii) Synthetic equivalents

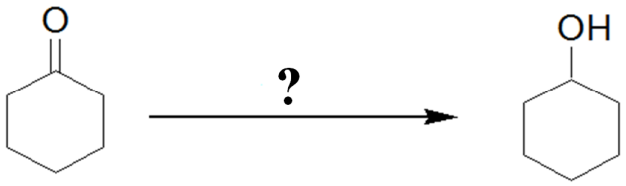
b) Convergent synthesis is preferred over linear synthesis. Give two reasons to defend this statement (4 marks)

c) Provide the reagents in the following transformations (10 marks)

(i) $H_3C-(CH_2)_3C\equiv CH \xrightarrow{?} H_3C-(CH_2)_3CH=CH_2$

(ii) $CH_3CH_2-C\equiv C-CH_2CH_3 \xrightarrow{?} CH_3CH_2-C(OH)=CH-CH_2CH_3$

(iii) $CH_3CH_2-C\equiv CH \xrightarrow{?} CH_3CH_2-C\equiv C-CH_2CH_3$

(iv) 

(v) $CH_3CH_2CH_2CH_2OH \xrightarrow{?} CH_3CH_2CH_2CHO$

d) Briefly define the following concepts using examples (6 marks)

(i) Markovnikov Rule
(ii) Tautomers
(iii)Functional group interconversion

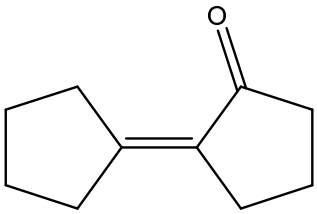
e) Provide the possible synthetic equivalents for the following synthons (6 marks)

i) $RCH_2\bar{C}H_2$ ii) $RCH_2\overset{+}{C}H_2$ iii) $\overset{+}{C}H_2CH_2OH$

QUESTION TWO (20 MARKS)

a) Write three key considerations when disconnecting any target molecule to get the synthetic equivalents (3 marks)

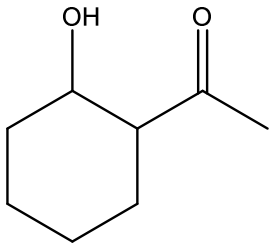
b) i) Using 1,1'-bi(cyclopentylidene)-2-one shown below, identify the synthons and the respective synthetic equivalents (Note: Functional group interconversion maybe necessary to ease the disconnection) (7 marks)



iii) Using the identified synthetic equivalents, show the forward reaction (synthesis) of the Target Molecule showing the mechanism and reagents (10 marks)

QUESTION THREE (20 MARKS)

a) Following the appropriate disconnection demonstrate how the molecule below can be synthesized (5 marks)



1-(2-hydroxycyclohexyl)ethan-1-one

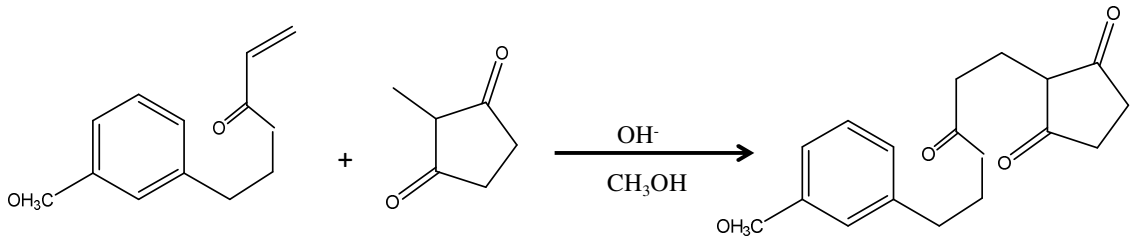
b) Upon heating the solution, the above compound is likely to be converted into α,β-unsaturated carbonyl. Show the mechanism for the base catalyzed dehydration of the above compound (5 marks)

c) Show the mechanism for the acid catalyzed dehydration of the above compound (5 marks)

d) In the aldol reaction between (i) propanal and acetaldehyde, and (ii) acetaldehyde and benzaldehyde, only one is synthetically useful. With reasons, identify the one which is useful and give the mechanism for the resulting product (5 marks)

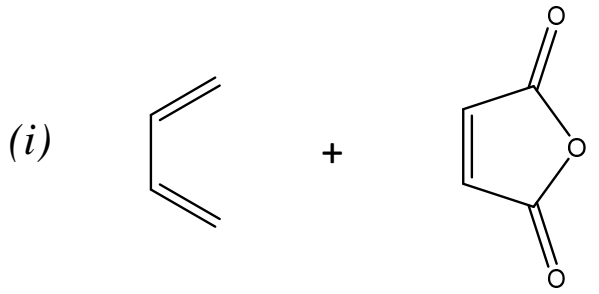
QUESTION FOUR (20 MARKS)

a) Estrone is one of the female sex hormones synthesized from C using the precursors A (α,β-unsaturated carbonyl) and B (carbonyl compound). Show the mechanism resulting into formation of compound C (5 marks)

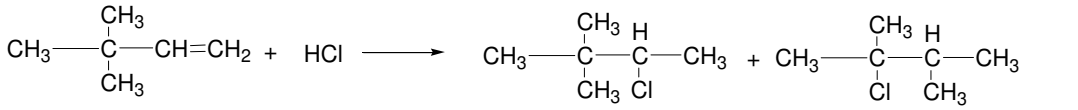


(A) (B) (C)

b) Indicate the dienophile, the diene and the product formed showing the mechanism leading to its formation (10 Marks).



c) It is expected that addition of HCl to 3,3-dimethyl-1-butene should give 3-chloro-2,2-dimethylbutane as the major product. However this in never the case and 2-chloro-2,3-dimethylbutane is isolated as the major product. Explain this observation and show the mechanism resulting in the formation of the major product (5 marks)



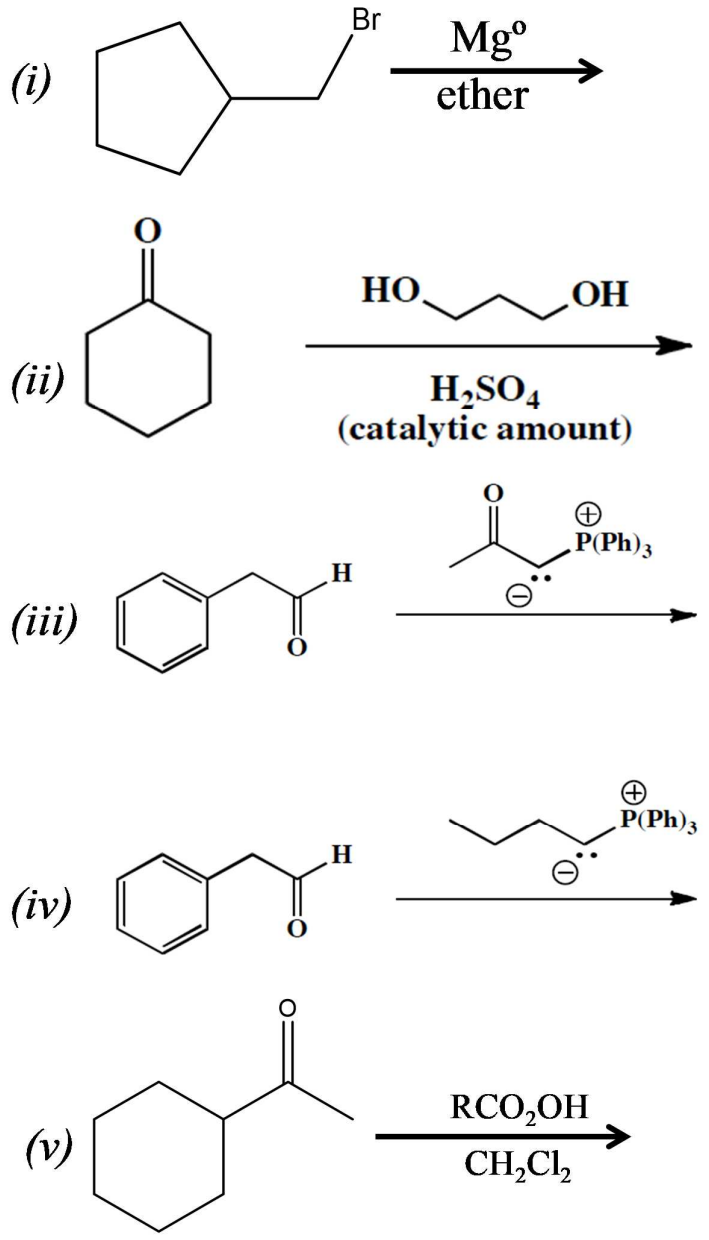
3,3-dimethyl-1-butene

3-chloro-2,2-dimethylbutane
minor product

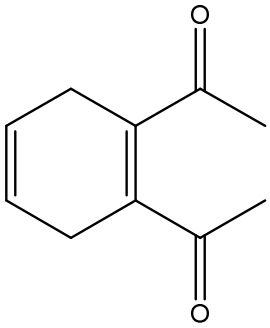
2-chloro-2,3-dimethylbutane
major product

QUESTION FIVE (20 MARKS)

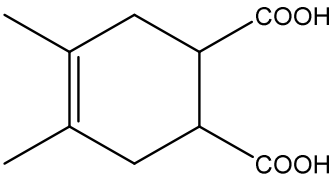
a) Write the predominant product that will occur for each transformation in the reactions below. Show the mechanism where appropriate (14 marks)



b) What are the starting materials for each of the following Diels Alder reaction products? (6 marks)



(i)



(ii)