



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SPECIAL NEEDS EDUCATION)

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

BACHELOR OF EDUCATION (SCIENCE)

SCH 402: CONCEPTS OF ORGANIC SYNTHESIS

DATE: 24/8/2022

TIME: 11.00-1.00 PM

INSTRUCTIONS:

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

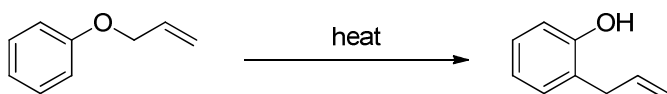
SECTION A

QUESTION ONE (30 MARKS)

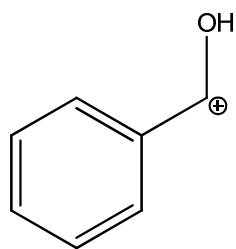
- a) Discuss the importance of organic synthesis in our day to day life. (5 marks)
- b) Explain the following terms as used in organic synthesis. (5 marks)
- Retrosynthetic Analysis
 - Functional group protection
 - Michael Acceptor
 - Enolate ion
 - Tautomerism

c) Discuss the two main differences between Aldol reaction and Claisen condensation reaction. (4 marks)

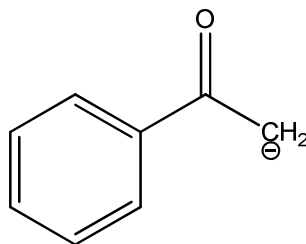
d) Provide the mechanism for the Claisen rearrangement to form the product shown below. (3 marks)



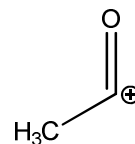
e) Provide the possible synthetic equivalents for the following synthons. (4 marks)



(i)



(ii)

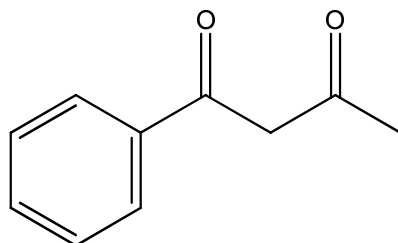


(iv)



(v)

- f) Discuss the importance of protecting groups in organic synthesis. (2 marks)
- g) Show how the following, β-diketone can be prepared by Claisen condensation reaction (7 marks)

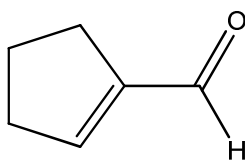


1-phenyl-1,3-butanedione

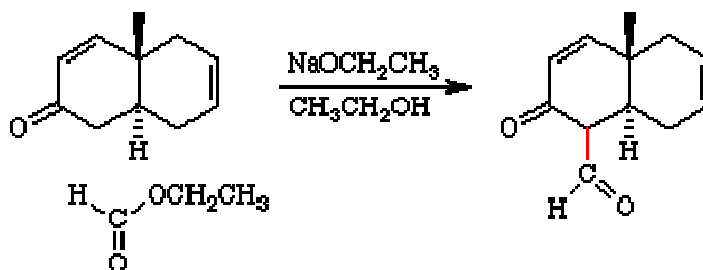
SECTION B

QUESTION TWO (20 MARKS)

- a) Explain one factor to consider with regards to the base used during Claisen condensation. (2 marks)
- b) i. Perform a retrosynthetic analysis on the target molecule shown below showing clearing the synthons and synthetic equivalents (SEs). (3 marks)
- ii. Following the correct mechanism, use the identified SEs to perform a forward reaction for the target molecule (3 marks)



- c) Devise a mechanism to show how the product in the reaction below is formed by using curly arrows to indicate the movement of electrons. Your mechanism must account for the role of the base. (6 marks)



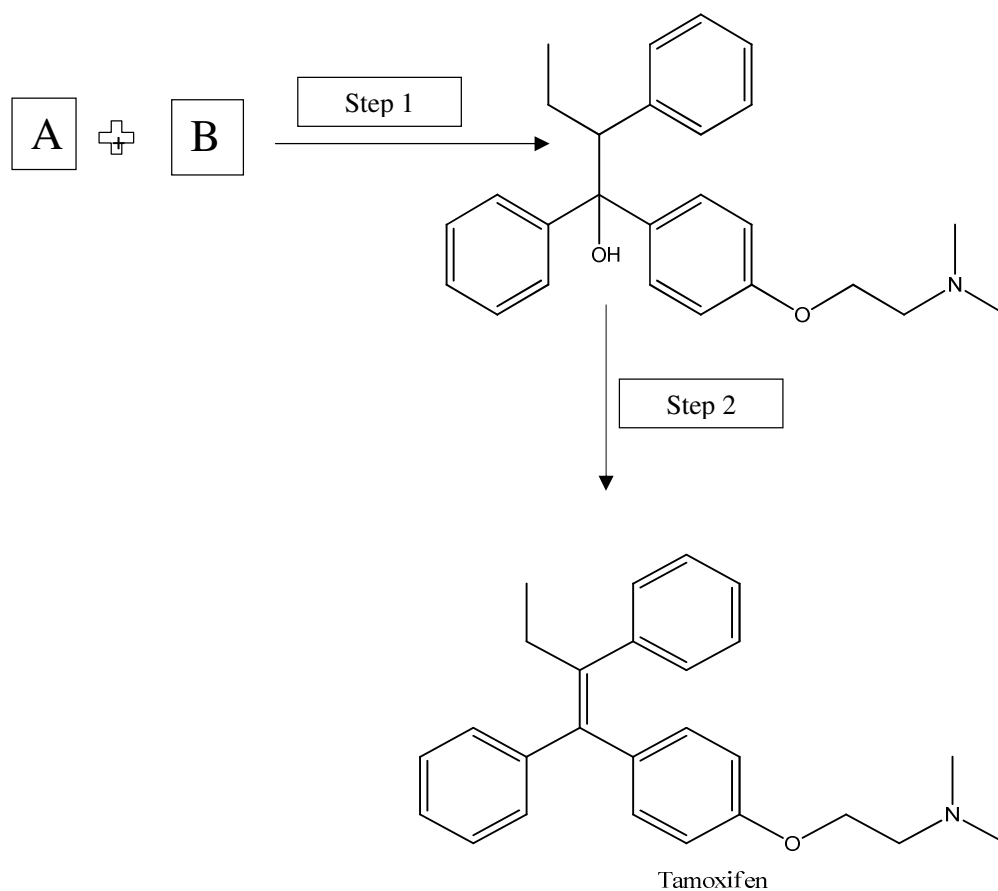
- d) Describe two ways of synthesizing cycloalkane (B) from cyclohexanone and indicate the preferred route. (6 marks)



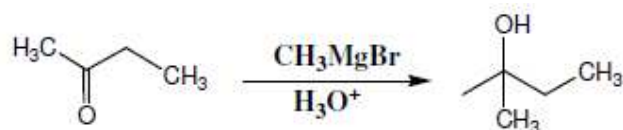
- e) Discuss three points to consider when designing a chemical synthesis. (3 marks)

QUESTION THREE (20 MARKS)

- a) It is recommended that Grignard reagent is prepared in under special conditions. Provide these special conditions and the reason behind these conditions. (4 marks)
- b) Congratulations, you just landed a job at a pharmaceutical company and they have asked you to devise an alternative synthesis for Tamoxifen; a drug used to treat estrogen receptor (ER)-positive breast cancer. Part of the synthesis is shown below.



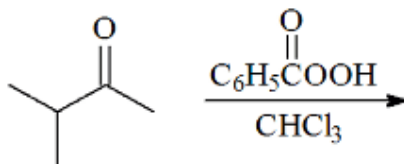
- i. Provide the structures of reagents A and B that need to react to make the alcohol intermediate in step 1. (4 marks)
- ii. Provide the reaction mechanism leading to the formation of the alcohol intermediate. (5 marks)
- c) Using curly arrows, write a possible reaction mechanism for the following reactions. (3 marks)



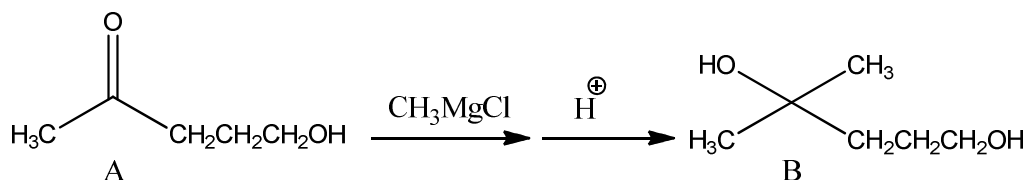
- d) Show how carboxylic acid can be synthesized from Grignard reaction. (4 marks)

QUESTION FOUR (20 MARKS)

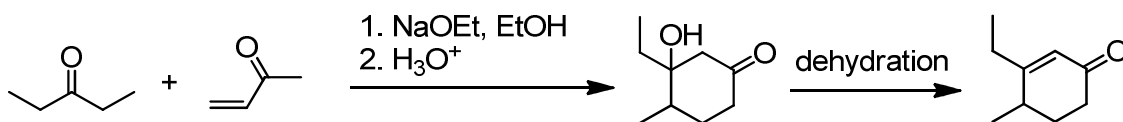
- a) Following the appropriate mechanism, discuss why the product of aldol addition between two propanals is 3-hydroxy-2-methylpentanal and not 4-hydroxyhexanal. (4 marks)
- b) One of the ways known to convert ketones into esters is a reaction known as a Baeyer-Villiger oxidation. Show the mechanism for the Baeyer-Villiger oxidation shown below. Discuss one factor to consider for unsymmetrical ketones. (5 marks)



- c) The compound (A) below requires to undergo Grignard reaction to form an alcohol (B). Before the Grignard reagent can be added, the alcohol functional group must be protected. Provide the appropriate steps that must be followed until the desired product is formed. (2 marks)



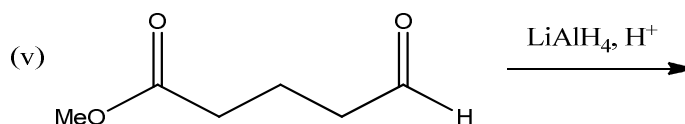
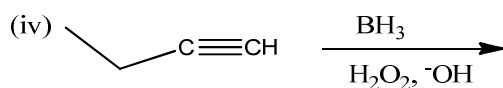
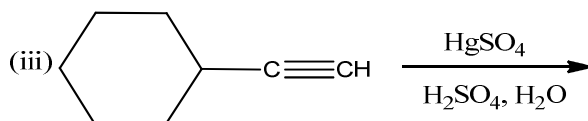
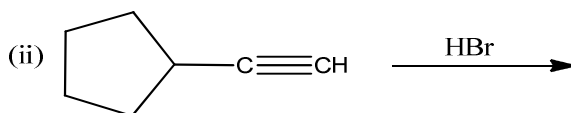
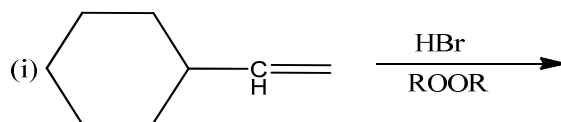
- d) Using relevant examples, differentiate between stabilized and unstabilized ylides. (4 marks)
- e) Provide the mechanism for the following reaction. (5 marks)



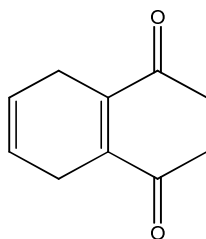
QUESTION FIVE (20 MARKS)

a) Provide the product in the following reactions.

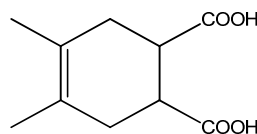
(10 marks)



b) By carrying out a retrosynthetic analysis, identify the reactants required to form the Diels-alder products shown below. (4 marks)



(i)



(ii)

c) Determine the intermediates formed in each step and the final product. (6 marks)

