



**MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
THIRD YEAR FIRST SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES  
BACHELOR OF SCIENCE AND BACHELOR OF  
EDUCATION (SCIENCE)**

**COURSE CODE: CHE 3118**

**COURSE TITLE: ORGANIC SYNTHESIS I**

DATE: 7<sup>TH</sup> APRIL 2022

TIME: 0830 – 1030 HRS

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**INSTRUCTIONS TO CANDIDATES**

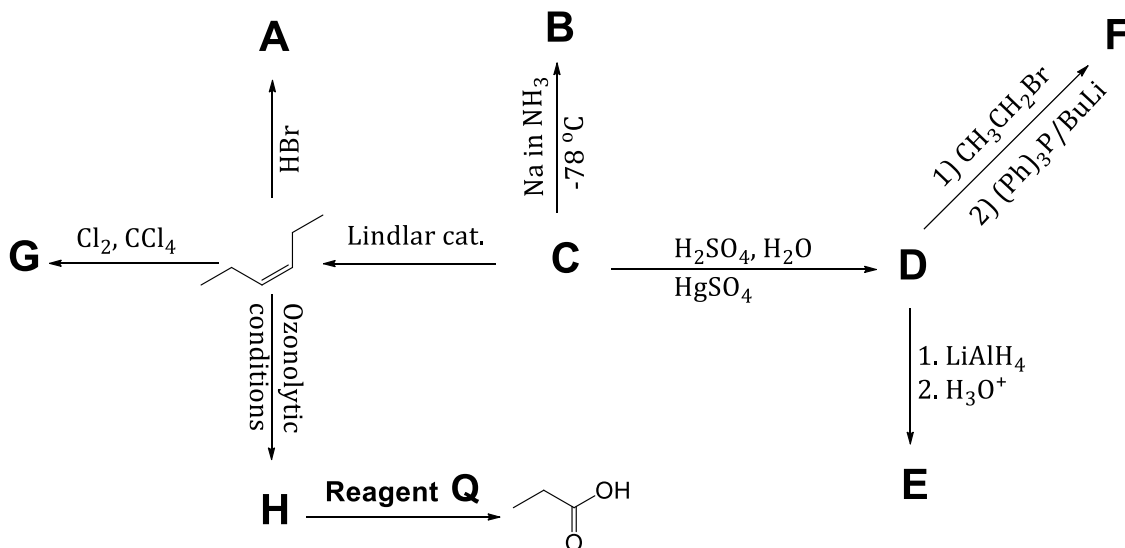
This examination paper consist of two sections **A** and **B**. Section **A** is compulsory. Answer any other TWO questions in section **B**.

*This paper consists of 5 printed pages. Please turn over:*

## SECTION A

### Question ONE (30 marks)

- a) Several factors must be considered before designing a multistep synthetic scheme. Briefly discuss these factors and their significance. **(6 marks)**
- b) Differentiate between each of the following organic chemistry terminologies. (Use relevant examples where applicable.) **(8 marks)**
- Regioselectivity and Stereoselectivity
  - Synthetic equivalent and Synthone
  - Markovnikov's rule and Zaitsev rule
  - Convergent synthesis and Linear synthesis
- c) Why is Wittig reaction the best route for synthesizing substituted alkenes over dehalogenation of alkyl halides (elimination reaction)? Briefly explain using relevant examples. **(4 marks)**
- d) Complete the reactions by filling in the missing product or starting material labeled **A - H** and reagent **Q**. Show stereochemistry where appropriate. **(9 marks)**

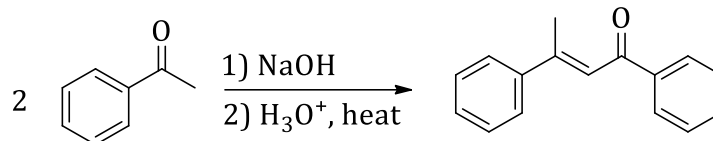


- e) If acetone,  $(\text{CH}_3)_2\text{CO}$ , is refluxed in NaOH and then an isotopically labeled formaldehyde  $\text{H}_2\text{CO}^{18}$  is added to the hot mixture, where will this labeled oxygen reside in the product? Show your work! **(3 marks)**

## SECTION B

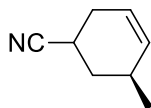
### Question TWO (20 marks)

a) Suggest the *curved arrow-pushing mechanism* for the following reaction. **(4 marks)**

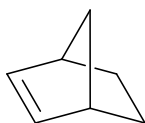


b) Identify the diene and the dienophile used to synthesize the following compounds **(6 marks)**

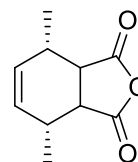
i.



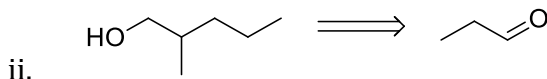
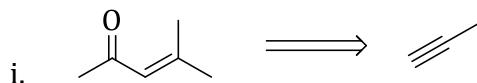
ii.



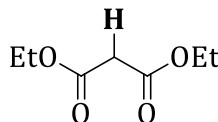
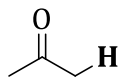
iii.



c) Rewrite each of the following transformations into a synthetic scheme in the forward direction from the given starting material. Clearly provide all the multi-steps (including those leading to intermediates), reagents and conditions. All the Carbons originate from the starting material. (Arrow pushing mechanisms are not necessary) **(6 marks)**

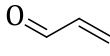


d) Rank the indicated protons in the following molecules from the least to the most acidic. Briefly justify your ranking criteria. **(4 marks)**

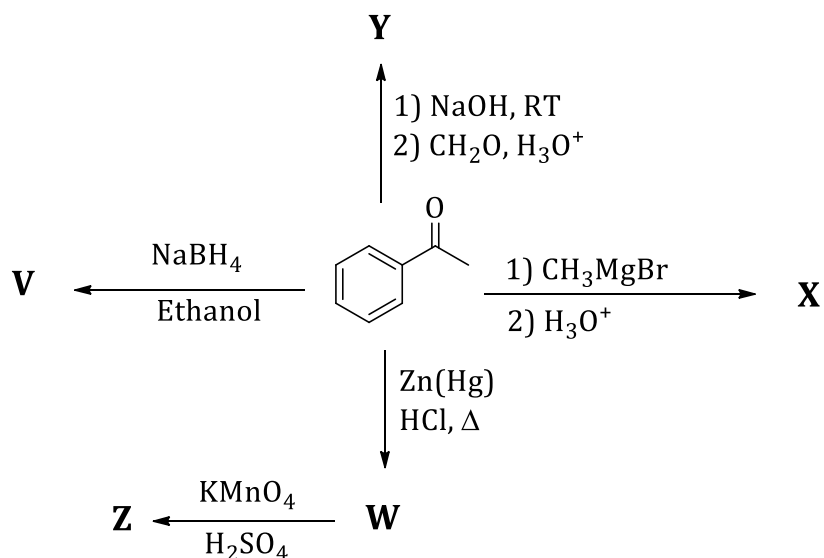


### Question THREE (20 marks)

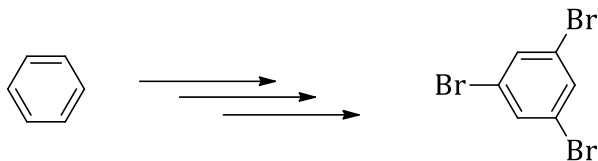
- a) Consider the following alkene:  $\text{C}_6\text{H}_5\overset{\text{H}}{\text{C}}=\text{C}(\text{CH}_3)_2$
- What best sets of reagents (each consisting of a carbonyl compound and phosphonium ylide) can be used for the synthesis of this alkene? **(3 marks)**
  - What alkyl halide is required to prepare each of the phosphonium ylides? **(2 marks)**
  - What best alkyl halide can be used to synthesize the above olefin via dehalogenation? **(2 marks)**

- b) Heating a mixture of 1,3-diphenylacetone and acrolein,  in trimethylamine gives a product,  $\text{C}_{18}\text{H}_{16}\text{O}$ , in 53% yield. The mechanism for product formation is a Michael addition followed by an intramolecular aldol condensation. Provide the structure of the product of this reaction. Show your work! **(4 marks)**

- c) Complete the reactions by filling in the missing reactants or products **V - Z**. **(5 marks)**

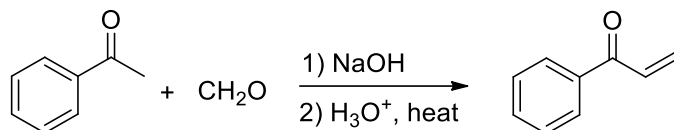


- d) Propose multi-step synthetic pathway that lead from the starting material to the product given below. You need to show an accurate reaction scheme using the proper reagents/conditions and show the major products made along the way. The arrows indicate multi-step reaction sequence. All the carbons in the product originate from the starting material. (Arrow pushing mechanism is not necessary). **(4 marks)**

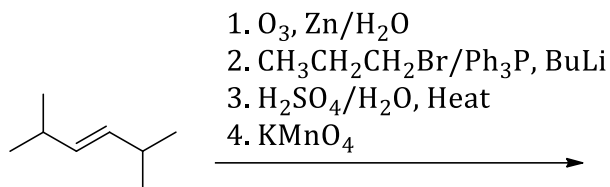
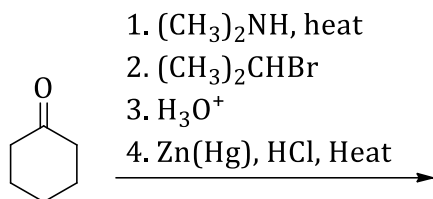


### Question FOUR (20 marks)

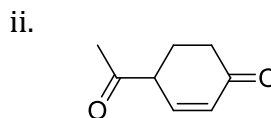
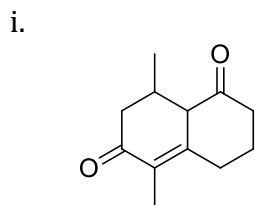
- a) Suggest the *curved arrow-pushing mechanism* for the following aldol condensation reaction. **(4 marks)**



- b) Why is Ozonolysis not an important chemical reaction for determining the synthetic routes when performing retrosynthetic analysis? **(2 marks)**
- c) For the following sequences of reactions, provide the final product. **(8 marks)**



- d) What two carbonyl compounds are needed to synthesize each of the following compounds, using Robinson annulation? Perform retrosynthetic analysis. **(6 marks)**



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