THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER –DECEMBER 2021

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

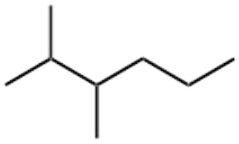
REGULAR PROGRAMME

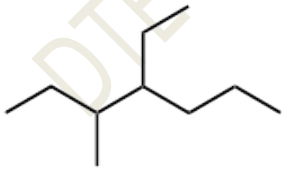
CHEM 101: ORGANIC CHEMISTRY I

Date: DECEMBER 2021	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any TWO Questions	

Q1.

a. Give the IUPAC names of the following molecules **[4marks]**

i. 

ii. 

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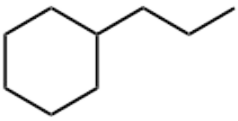
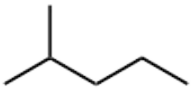
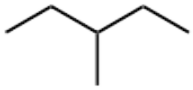
iv. 

b. The two sets of molecules are isomers. Classify them as configurational or constitutional isomers. **[2marks]**



i.



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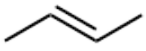

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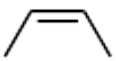


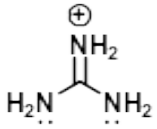
iv.

c. Sigma (**?**) bond is stronger than pi (☕) bond in unsaturated hydrocarbons. Use the C=C bond in ethene molecule to explain this observation **[4marks]**

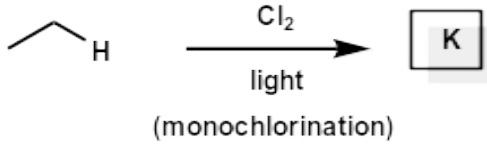
d. Propane is a gas at room temperature while propanol is a liquid. Explain

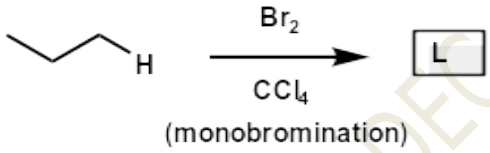
[4marks]

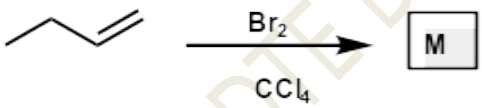
e. Using curved arrows to show the movement of electrons, draw the other two resonance forms of guanidinium and its resonance hybrid. **[5marks]**



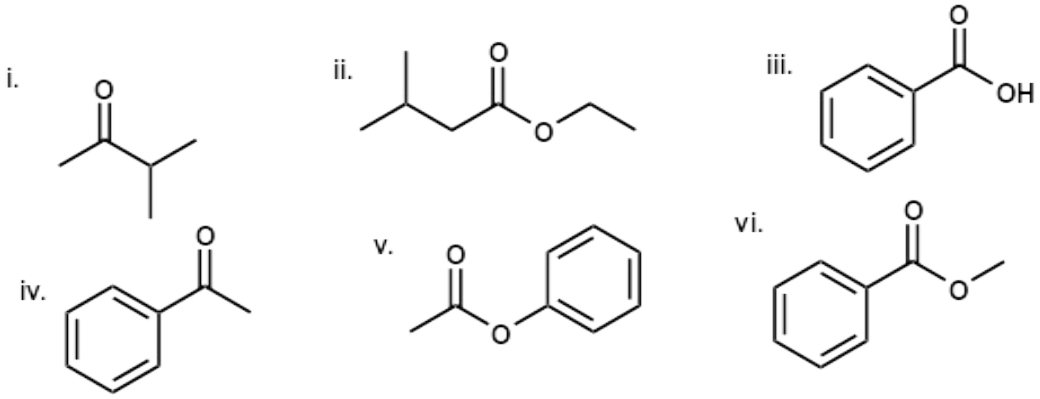
f. Give the organic products of the following reactions **[5marks]**

i. 

ii. 

iii. 

g. The various functional groups present are shown in the molecules below



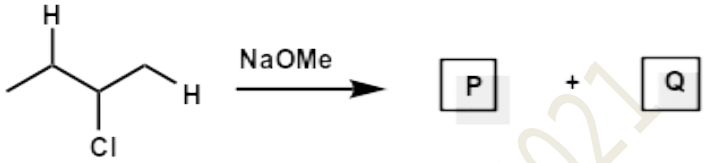
Classify the molecules as aromatic ketone, aliphatic ketone, aromatic carboxylic acid and aliphatic ester, aromatic ester. **[3marks]**

h. Explain the following terms: electronegativity of an atom, polarizability of an atom and bond polarity. **[3marks]**

Q2.

a. Alkenes can be synthesized by elimination reactions of alkyl halides using strong bases.

i. Give the possible products of the following reaction **[2marks]**

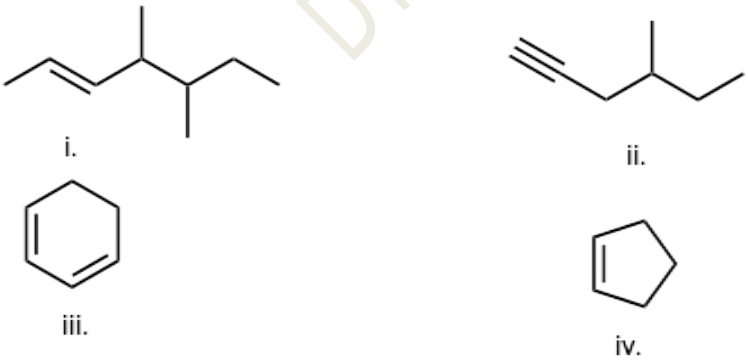


ii. Identify with reason which of the product is the major product. **[2marks]**

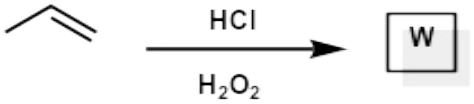
iii. State Zaitsev's rule **[2marks]**

iv. If potassium *tert*-butoxide ($KOC(CH_3)_3$ is used instead of sodium methoxide(NaOMe), what would be the major product? Explain **[3mks]**

b. Give the IUPAC names for the following compounds **[4mks]**



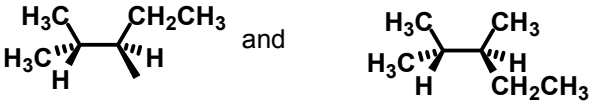
c. (i) Give the product of the following reaction **[2marks]**



(ii) Explain the role of hydrogen peroxide in the reaction **[1mark]**

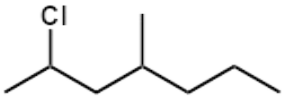
d. Explain whether the following pairs of molecules are the same molecule or different molecules **[4marks]**

(i) 

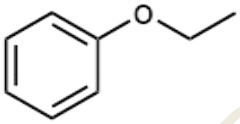
(ii) 

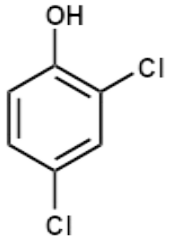
Q3.

a. Give the IUPAC names of the following compounds **[4marks]**

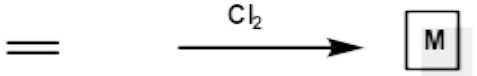
i. 

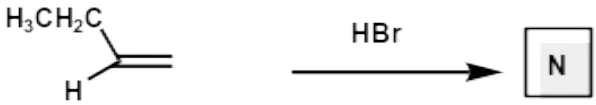
ii. 

iii. 

iv. 

b. Give the products of the following reactions **[4marks]**

i. 

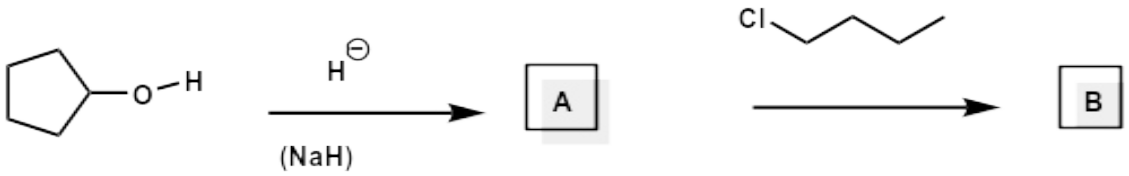
ii. 

c. i. State Markovnikov's rule as used in addition of hydrohalides to alkenes.

[2marks]

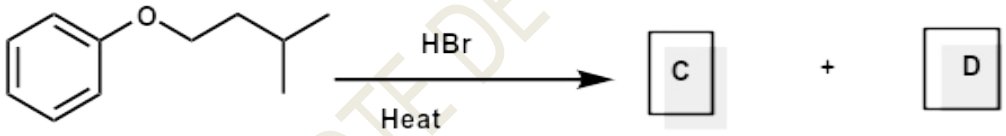
ii. Using the reaction in b(ii) above, using curved arrows to represent the flow of electrons, suggest the mechanism of addition of hydrogen bromide to 1-butene given above **[3marks]**

d. Complete the reaction below by giving the structures of product **A** and **B** **[2marks]**



e. State **two** uses of alcohols **[2marks]**

f. Ethers are unreactive to many reagents used in organic reactions. However, they can be cleaved by strong acids. Give the structure and names of the products of the following reaction. **[3marks]**

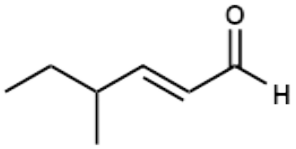


Q4.

a. Give the names of the following compounds

[4marks]

i.



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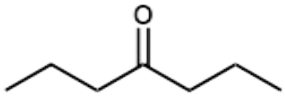

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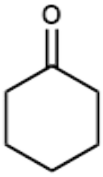

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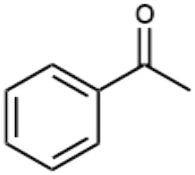
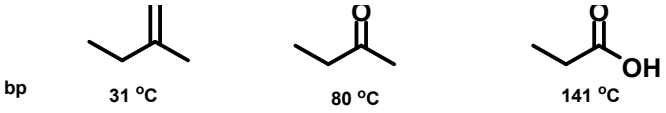


b. Propanone is less reactive than propanal as electrophile in nucleophilic addition reactions. Explain **[3marks]**

c. The molecules below have the following boiling points

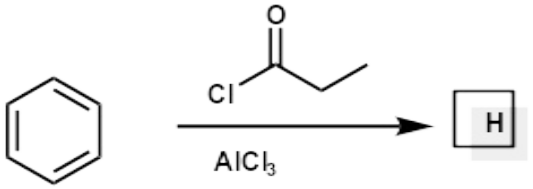


Account for the observed high boiling point of; **[4marks]**

i. 2-butanone compared to 2-methyl-1-butene

ii. Propanoic acid compared to 2-butanone

d. Give and name the product of the following reaction **[3marks]**



e. Chloromethane can be prepared from a reaction between chlorine and methane as shown below.

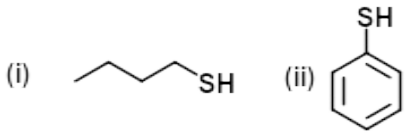
i) Define the term photochemical reaction **[2marks]**

ii) Using curved arrows, show the mechanism of chlorination of methane

[4marks]

Q5.

a. Give the names of the compounds below **[2marks]**



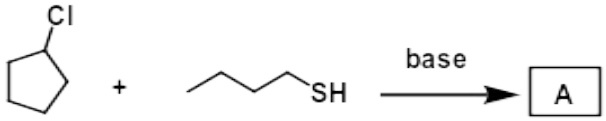
b. Using carbon atom in ethane, show the stages of hybridization leading to the tetravalent carbon. **[3marks]**

c. Construct an orbital diagram of nitrogen in ammonia, assuming sp^3 hybridization.

Identify the orbital occupied by the unshared pair of electrons and the type of orbital overlap involved in the N-H bond.

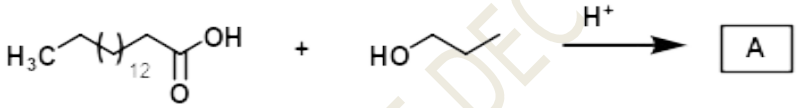
[5marks]

d. Suggest the product of the reaction between cyclopentyl chloride and n-butyl thiol in the presence of a base. Use curved arrows to illustrate the mechanism of the reaction. **[5marks]**



e. Ethyl chloride is insoluble in water while ethanol is soluble in water yet they have the same number of carbon atoms. Explain this observation. **[2marks]**

f. Palmitic acid isolated from palm oil can be further transformed to useful organic compounds as illustrated by its reaction with propanol.



Give the structure and the name of compound **A**. **[3marks]**

END