MACHAKOS UNIVERSITY

University Examinations 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SUPPLEMENTARY/SPECIAL EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

BACHELOR OF EDUCATION (SPECIAL NEEDS)

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF SCIENCE (BIOLOGY)

SCH 102: ORGANIC CHEMISTRY I

DATE: 17/03/2022 **TIME: 8:30-10:30 AM**

INSTRUCTIONS:

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

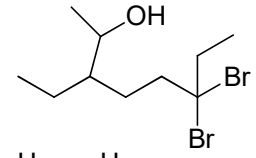
Some useful information

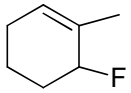
The following constants may be useful: Atomic mass of carbon(C) = 12.01, Hydrogen (H) = 1.008, oxygen (O) = 15.99

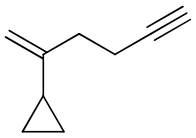
Section A - Compulsory

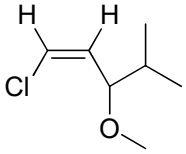
QUESTION ONE (COMPULSORY) (30 MARKS)

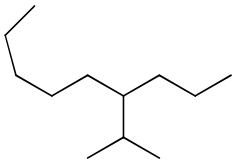
a) Provide a systematic (IUPAC) name for each of the following compounds indicating stereochemistry where appropriate (9 marks)

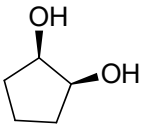
i) 

ii) 

iii) 

iv) 

v) 

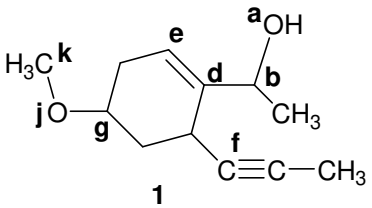
vi) 

b) Use equations to show how compound 2 may be prepared from ethyne. (3 marks)

$$H_3C-C\equiv C-CH_2CH_2CH_2CH_3$$

2

c) Use the structure of compound **1** below to answer the questions that follow



1

i) Draw and name all the functional groups in the compound **1** (4 marks)

ii) Indicate the type of hybridization of carbons labelled b and f (2 marks)

iii) Using the letter(s) in compound 1, name any one primary and quarternary carbon. (2 marks)

iv) Draw and indicate by using **δ+** and **δ-** the direction of polarity in the bond between **a** and **b** (1 mark)

v) Determine the number of pi (Π) bonds in compound 1. (1 mark)

d) Draw structures of each of the following indicating stereochemistry where appropriate.

(6 marks)

i) 7,7-dimethylbicyclo[2.2.1]heptane

ii) 3-butyn-2-ol

iii) 4-(1-Methylethyl)heptane

iv) 3-ethyl-2,6-dimethyl-4-propyloctane

v) 5- chloro-7-methylbicyclo[2.2.1]hept-2-ene

vi) 3-bromo-(3*Z*,5*E*)-octadiene

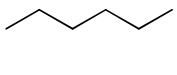
e) State the main applications of determining the melting points of organic compounds prepared in the laboratory by chemists. (2 marks)

SECTION B
ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Compound **5,** isolated from lanolin (sheep's fat), has a pungent smell of dirty sweat socks. A careful analysis showed that compound **5** contained 62.0 % carbon and 10.4 % hydrogen. No halogen or nitrogen was found. Calculate the empirical formula of the compound 5. (4 marks)

b) Determine which of the following compounds has higher octane number and explain your answer. (2 marks)



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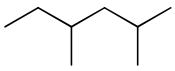


4

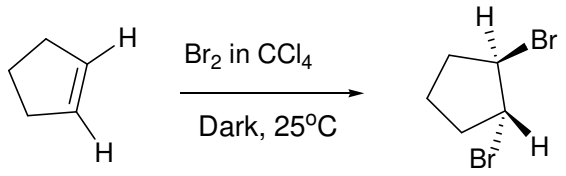
c) If the molecular mass of the compound **5** was found to be approximately 117. What is the molecular formula of the compound? Π (2 marks)

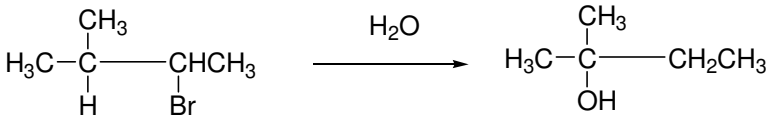
d) Monochlorination of methylcyclopropane with molecular chlorine in presence of light gives a mixture of monochlorinated products.

i) Draw all possible monochlorinated isomers of the above reaction. Ignore the cis-trans isomers (3 marks)

ii) Draw the isomer in (2d. i), above that would be formed in highest quantity and give a reason (2 marks)

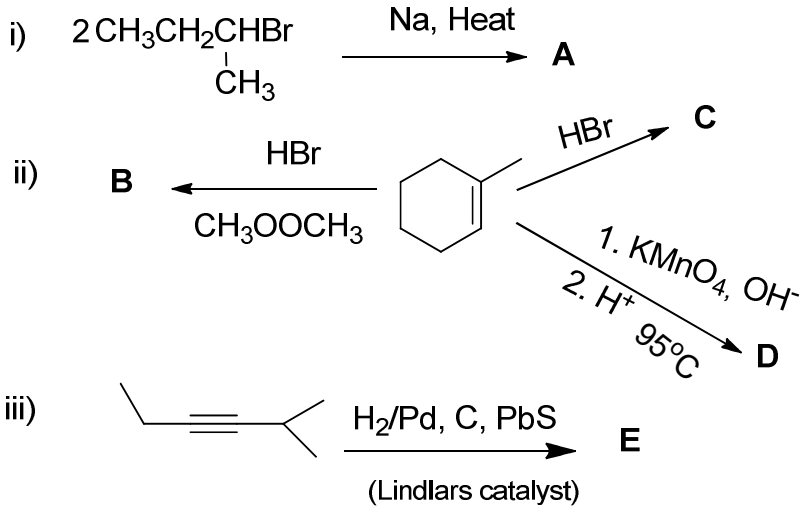
e) Using curly arrows, show the movement of electrons in the following reactions that lead to the products given (7 marks)

i) 

ii) 

QUESTION THREE (20 MARKS)

a) Provide the structures of the major product [**A to E**] that can be obtained from each of the following reactions showing the stereochemistry where possible. (10 marks)

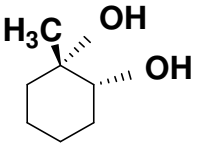


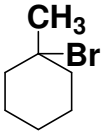
b) Write down both the condensed and bond line formula of all isomeric compounds with molecular formula of C_3H_8O (6 marks)

c) 10.0 g of methane is burnt in 20.0g of oxygen. Write a balanced chemical equation showing the products formed and hence determine the limiting reagent in this reaction. (4 marks)

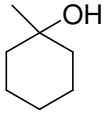
QUESTION FOUR (20 MARKS)

a) Show using equations how the following compounds can be prepared from 1-methylcyclopentene. (4 marks)

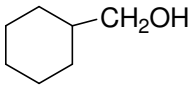
i) 

ii) 

b) Provide a simple visual chemical test including the observations that you would perform to differentiate between compounds **6** and **7.** (4 marks)

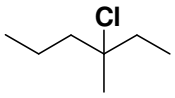


6



7

c) Three different alkenes yield the alkyl halide shown when they are reacted using the same reagent(s). Draw the structures of the three possible alkenes and give the reagent(s). (6 marks)

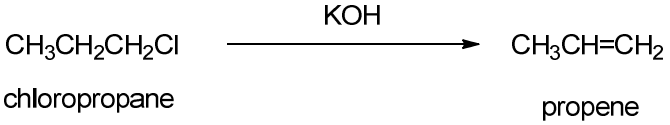


alkylhalide

d) Provided below are the bond dissociation energies in kJ mol^{-1} for each step of methane molecule (CH_4). Using this information, calculate the bond energy of **C-H** bond in methane (CH_4) molecule. (3 marks)

$CH_4 \longrightarrow H\bullet + \bullet CH_3$		427
$\bullet CH_3 \longrightarrow H\bullet + \bullet CH_2$		460
$\bullet CH_2 \longrightarrow H\bullet + \bullet CH$		435
$\bullet CH \longrightarrow H\bullet + \bullet C\bullet$		339

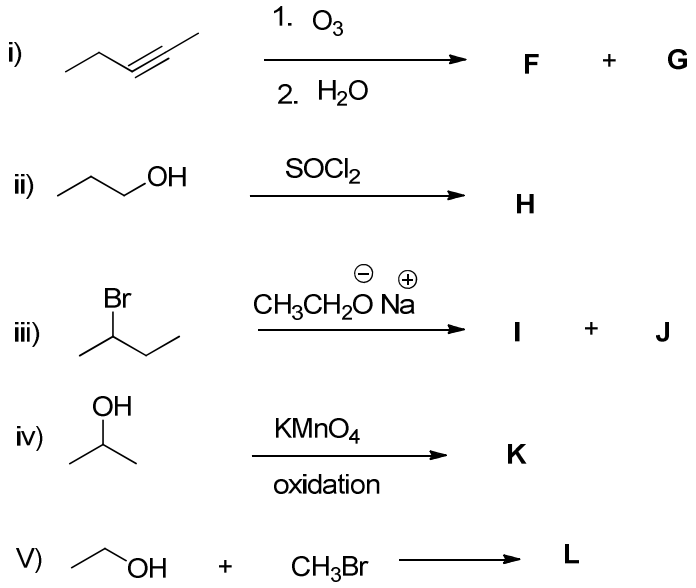
e) Using Curly arrows, show the movement of electrons in the following reaction that lead to the product given. (3 marks)



chloropropane propene

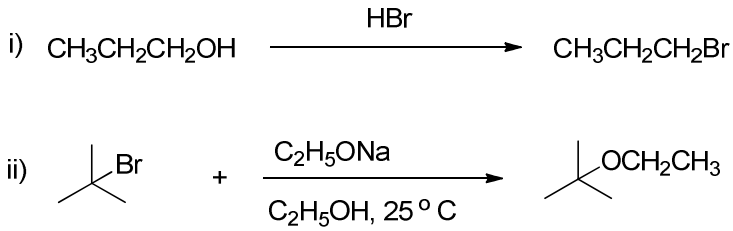
QUESTION FIVE (20 MARKS)

a) Provide the structures of the major product [**F to L**] that can be obtained from each of the following reactions showing the stereochemistry where possible. (7 marks)



b) Explain why alcohols have higher boiling points than alkanes of corresponding molecular weights? (3 marks)

c) Using Curly arrows, show the movement of electrons in the following reactions that lead to the products given (7 marks)



d) Indicate which of the following molecules have ionic, covalent or coordinate covalent bond: (3 marks)

(i) (ii) (iii)