



MACHAKOS UNIVERSITY

University Examinations 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF AGRICULTURAL EDUCATION AND EXTENSION

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF EDUCATION (SPECIAL EDUCATION)

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF SCIENCE (BIOLOGY)

SCH 102: ORGANIC CHEMISTRY I

DATE: 16/06/2021

TIME: 2:00 – 4:00 PM

INSTRUCTIONS:

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

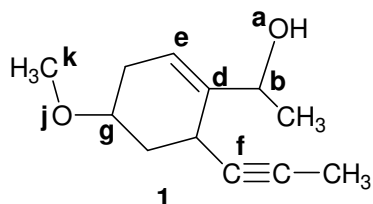
Some useful information

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

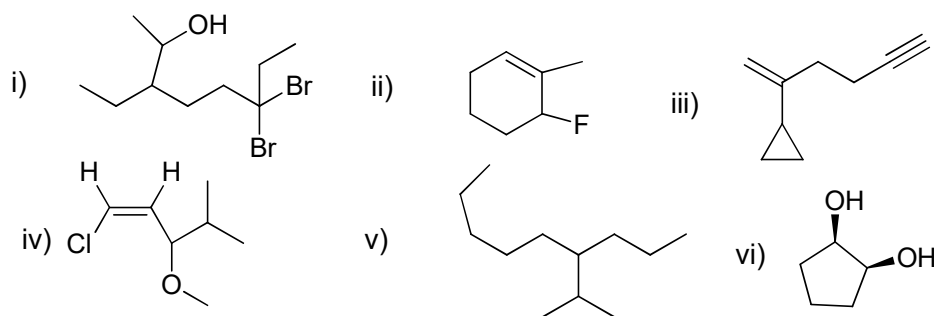
SECTION A - COMPULSORY

QUESTION ONE (30 MARKS)

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



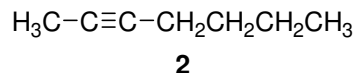
- i) Draw and name all the functional groups in the compound **1** (4 marks)
 - ii) Indicate the type of hybridization of carbons labelled **b** and **f** (2 marks)
 - iii) Using the letter(s) in compound **1**, name any one primary and quaternary carbon (2 marks)
 - iv) Draw and indicate by using δ^+ 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)
- b) Provide a systematic (IUPAC) name for each of the following compounds indicating stereochemistry where appropriate (9 marks)



c) 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-(3Z,5E)-octadiene

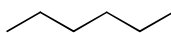
- d) State the main applications of determining the melting points of organic compounds prepared in the laboratory by chemists. (2 marks)
- e) Use equations to show how compound 2 may be prepared from ethyne. (3 marks)



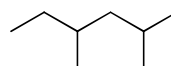
SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

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

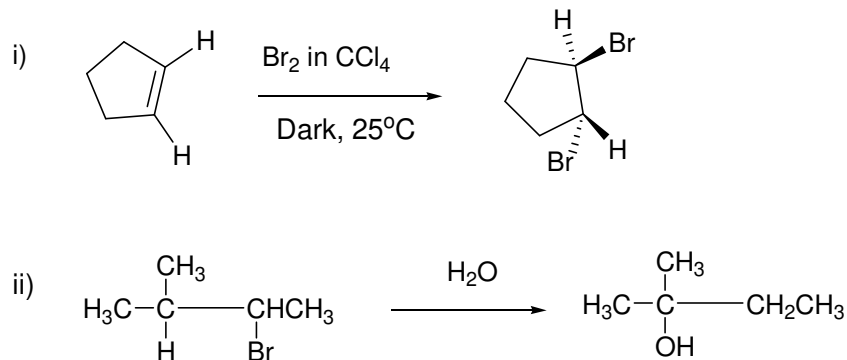


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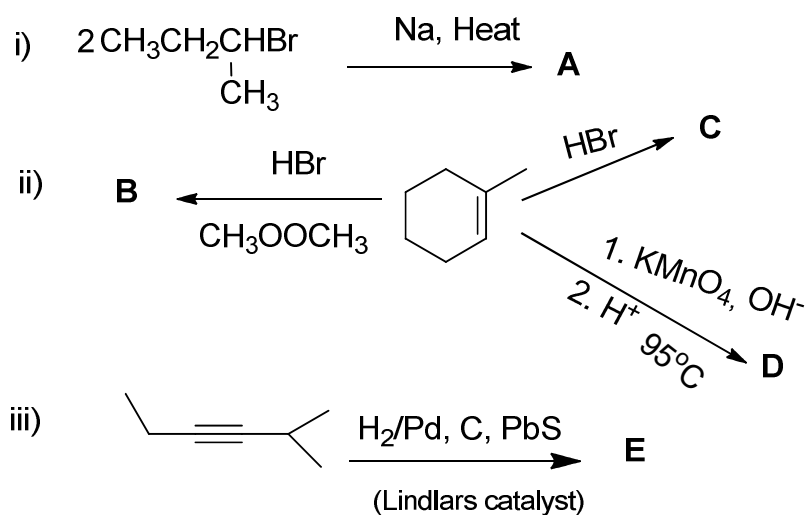
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- b) Compound **5**, isolated from lanolin (sheep's fat), has a pungent smell of dirty sweat socks. A careful analysis showed that compound **5** contained 62.0 % carbon and 10.4 % hydrogen. No halogen or nitrogen was found. Calculate the empirical formula of the compound **5**. (4 marks)
- 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.
- Draw all possible monochlorinated isomers of the above reaction. Ignore the cis-trans isomers (3 marks)
 - 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)



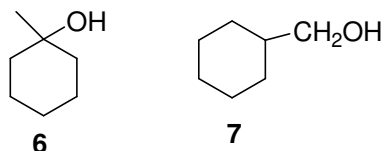
QUESTION THREE (20 MARKS)

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



QUESTION FOUR (20 MARKS)

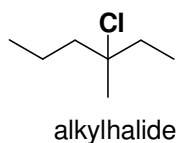
- a) Provide a simple visual chemical test including the observations that you would perform to differentiate between compounds **6** and **7**. (4 marks)



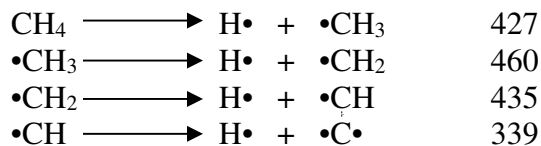
- b) Show using equations how the following compounds can be prepared from 1-methylcyclopentene. (4 marks)



- 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)



- 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)

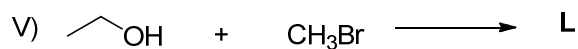
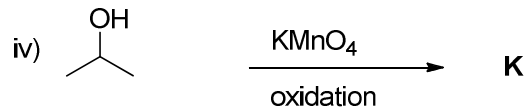
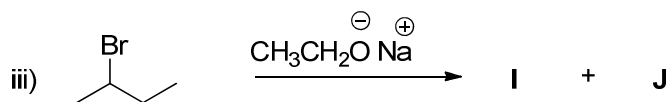
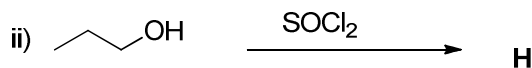
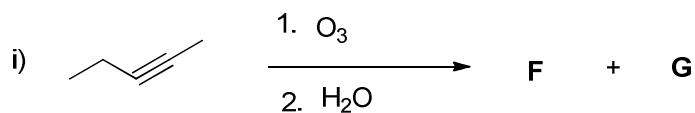


- e) Using Curly arrows, show the movement of electrons in the following reaction that lead to the product given. (3 marks)

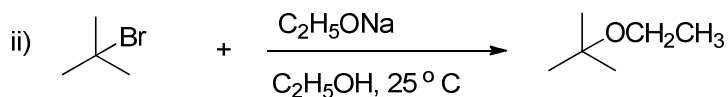
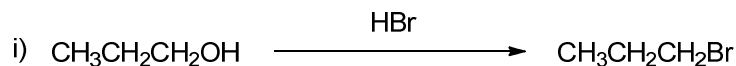


QUESTION FIVE (20 MARKS)

- 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)

