



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF EDUCATION (SPECIAL EDUCATION)

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF SCIENCE (BIOLOGY)

SCH 102: ORGANIC CHEMISTRY I

DATE: 11/8/2021

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)**

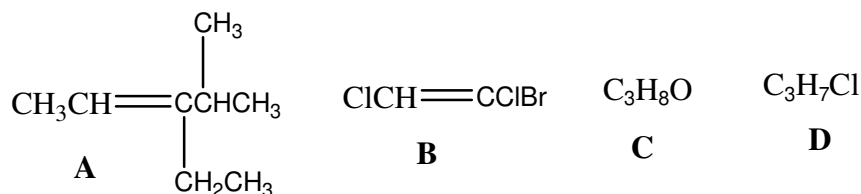
Some useful information

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

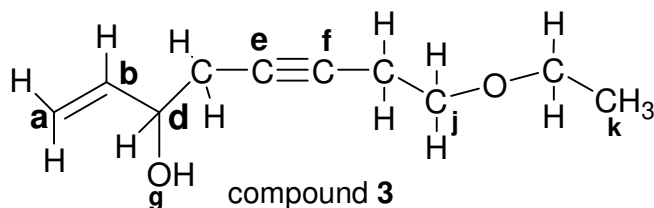
SECTION A - COMPULSORY

QUESTION ONE (30 MARKS)

- a) The molecular formulae of four different organic compounds are represented as **A**, **B**, **C** and **D**. Studies show that each these compounds can have different arrangements of atoms on the main carbon chain

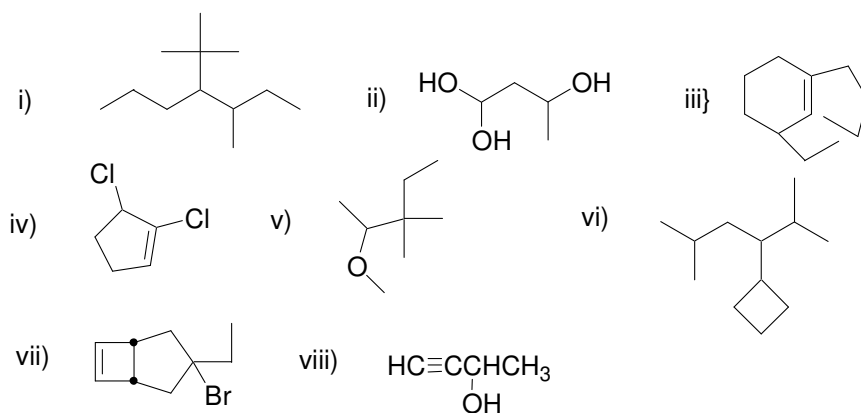


- (i) Name the type of isomerism that would be exhibited by each of compounds **B** and **D** (2 marks)
- (ii) For compound **A**; draw the trans isomer and give its systematic (IUPAC) name (3 marks)
- (iii) For compound **B**; draw the **Z** isomer and give its systematic (IUPAC) name. (3 marks)
- iv) Draw the Lewis structures of the primary alcohol represented by the molecular formula **C**. (1 mark)
- v) Draw the bond line structure of secondary alkyl halide represented by the formula **D**. (1 mark)
- (b) Use the structure of compound **3** below to answer the questions that follow



- (i) Draw the structural part of non-carbon-carbon functional groups in the compound **3** and give the general name of such functional groups. (3 marks)
- (ii) Name the type of hybridization in carbon labeled **a**, **b** and **e** (3 marks)

- (c) Provide systematic (IUPAC) names for the following compounds, indicating stereochemistry where appropriate. (8 marks)



- (d) Draw the structure of each of the following compounds including the stereochemistry where appropriate. (4 marks)

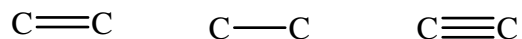
- 4-ethyl-2,3-dimethylheptane
- But-1-en-3-yne
- 4-penten-2-ol
- 2,4-dimethylbicyclo[2.2.2]octan-1-ol

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

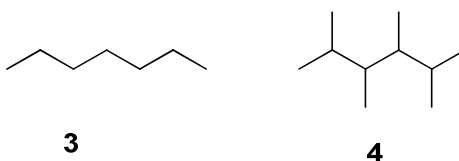
SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Arrange the following in the increasing order of bond length (2 marks)

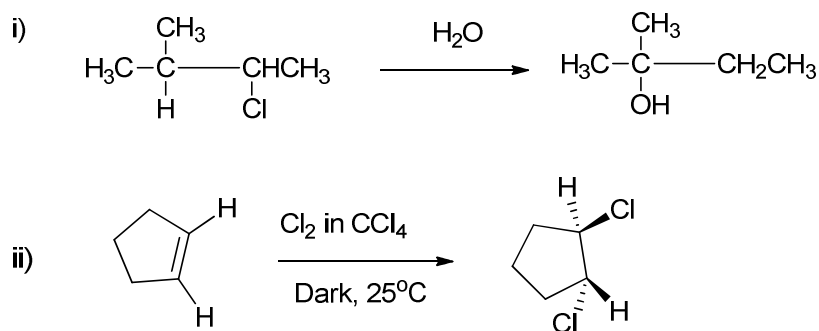


- b) Determine which of the following compounds has higher octane number and explain your answer. (2 marks)



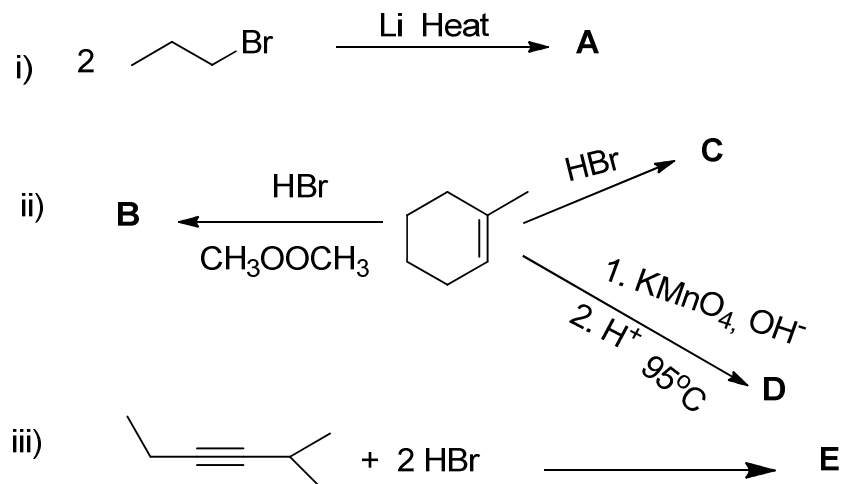
- c) A compound of carbon (C), boron (B) and hydrogen (H) was found to contain 32.77% C and 59.00 % B by mass. Determine its empirical formula. (4 marks)

- 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)



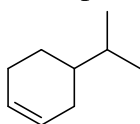
QUESTION THREE (20 MARKS)

- Draw all the possible isomeric alcohols with molecular formula $\text{C}_4\text{H}_{10}\text{O}$ indicating which ones are primary, secondary or tertiary (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)

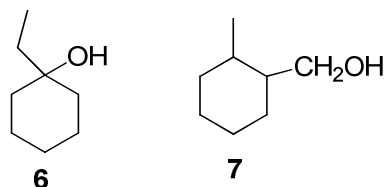


QUESTION FOUR (20 MARKS)

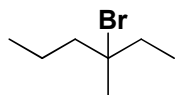
- a) Write a balanced equation to show the products formed when the following compound is completely burnt in oxygen (4 marks)



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

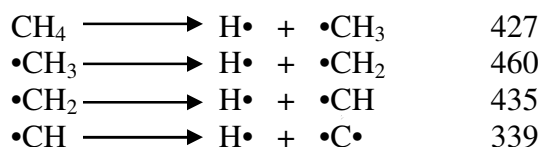


- c) Three different alkenes yield the alkyl halide shown when they are reacted using the same reagent(s). Draw the structures of the three possible alkenes and give the reagent(s). (6 marks)

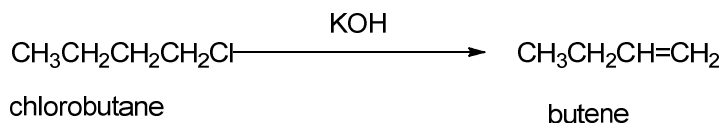


alkylhalide

- 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)

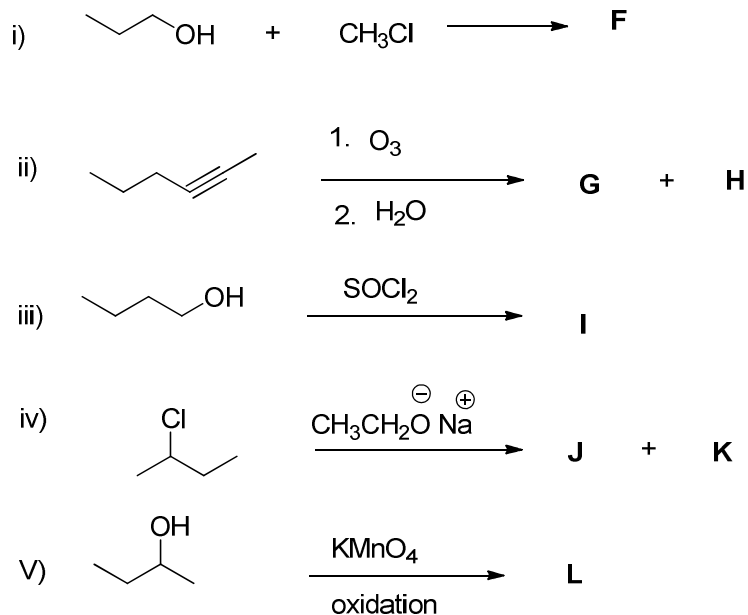


- e) Using Curly arrows, show the movement of electrons in the following reaction that lead to the product given. (3 marks)



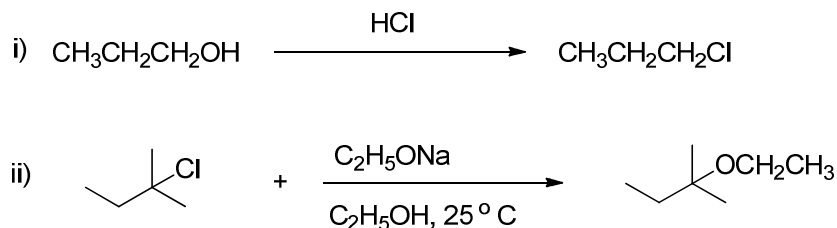
QUESTION FIVE (20 MARKS)

- 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)

