MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

MAIN EXAMINATION

FOR THE DEGREE
OF
BACHELOR OF SCIENCE CHEMISTRY & EDUCATION SCIENCE

COURSE CODE: SCH 130

COURSE TITLE: ORGANIC CHEMISTRY I

DATE:19 TH APRIL 2022   **TIME:** 8-10 AM

INSTRUCTIONS TO CANDIDATES
Answer all the Questions
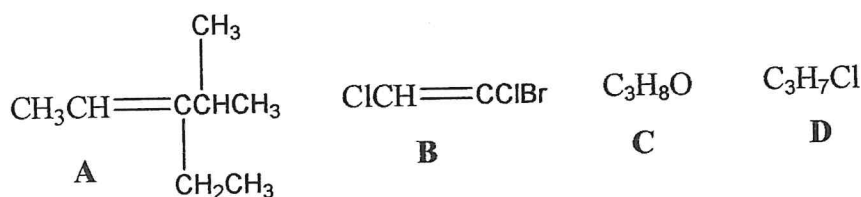
TIME: 2 HOURS

Question 1 (18 marks)

(a) Draw the structure of each of the following compounds including the stereochemistry where appropriate. **4 mks**

   i.   4-ethyl-2,3-dimethylheptane

   ii. But-1-en-3-yne

   iii. 4-penten-2-ol

   iv   3-chloropropene

(b)) (i) Draw all the possible isomeric alcohols with molecular formula $C_4H_{10}O$ indicating which ones are primary, secondary or tertiary **4 mks**

(ii) Give a simple visual chemical test you would perform to differentiate between the above isomeric alcohols **2 mks**

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

$$CH_3CH = \underset{\underset{CH_2CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}CHCH_3 \qquad ClCH = CClBr \qquad C_3H_8O \qquad C_3H_7Cl$$

        A   **B**   **C**   **D**

i) For compound **A**; draw the trans isomer and give its systematic (IUPAC) name. **[3mks]**

ii) For compound **B**; draw the **Z** isomer and give its systematic (IUPAC) name. **3mks**
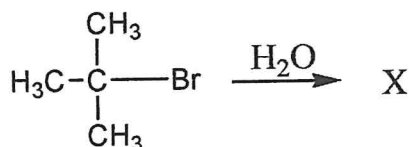
iii) Draw the Lewis structures of the primary alcohol represented by the molecular formula **C**. **1 mk**

iv) Draw the bond line structure of secondary alkyl halide represented by the molecular formula **D**. **1 mk**

Question 2 (18 marks)

a) Provide the structures of the major organic compounds **A-D** expected in the following reactions. Indicate the stereochemistry where appropriate. **12mks**
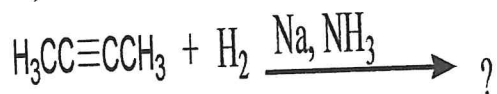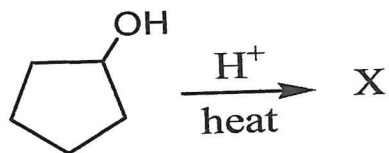
i)

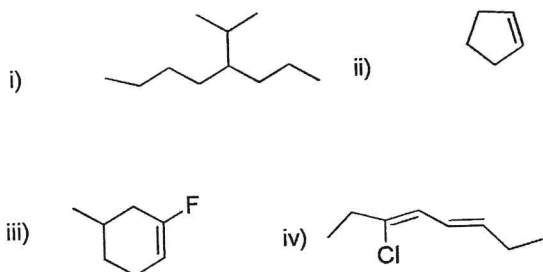$$H_3C - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - Br \xrightarrow{H_2O} X$$

ii)

$$R-O-R + HI \xrightarrow{\text{heat}} X$$

iii)

$$H_3CC\equiv CCH_3 + H_2 \xrightarrow{Na, NH_3} ?$$

iv

$$\xrightarrow[\text{heat}]{H^+} X$$

v)

$$CH_3CH_2Br + Mg \xrightarrow{\text{Ether}} X \xrightarrow{H^+} Y$$

b) Provide systematic (IUPAC) names for the following compounds, indicating stereochemistry where appropriate.   **4mks**
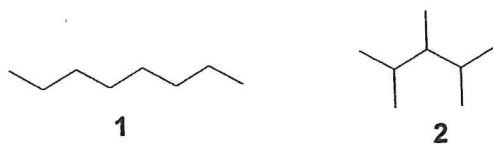
i)   ii)

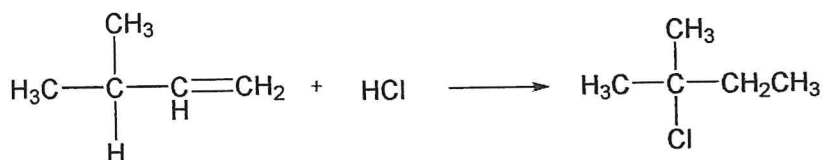iii)   iv)

c) Which of the following is expected to have a higher octane number and why?   **2mks**
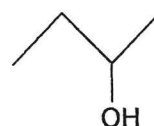

1   2

Question 3   **(18 marks)**

a) Use curley arrows to show how the product in the following reaction is formed   **4mks**

$$\underset{\substack{|\\H}}{\overset{\substack{CH_3\\|}}{H_3C-C}}-\underset{H}{\overset{}{C}}=CH_2 \;+\; HCl \longrightarrow \underset{\substack{|\\Cl}}{\overset{\substack{CH_3\\|}}{H_3C-C}}-CH_2CH_3$$
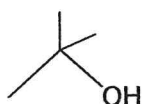
b) Show using equations how the following compound can be prepared from cyclopentene   **2mks**
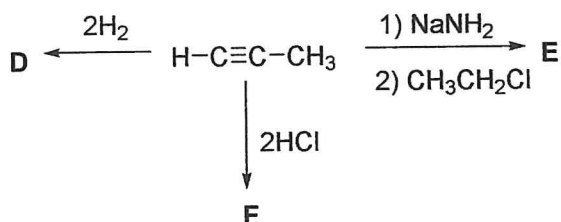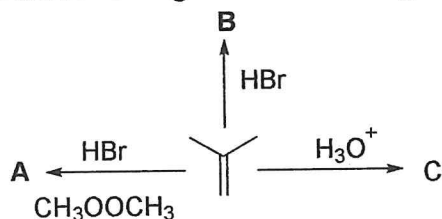
1-butanol
primary alcohol

2-butanol
Secondary alcohol

2-methyl-2-propanol
tertiary alcohol

c) Provide the structures of the major organic product(s) [**A to F**] that can be obtained from each of the following reaction showing the stereochemistry where possible **12mks**

Question 4   (16 marks)

a) A compound of carbon (**C**), boron (**B**) and hydrogen (**H**) was found to contain 32.77 % **C** and 59.00% **B** by mass. Use $C = 12.01$, $H = 1.01$, $B = 10.81$ as relative atomic masses to answer the following:

i) Determine its empirical formula. **3mks**

ii) State the information usually obtained from empirical formula and hence its
   Importance in organic chemistry. **2mks**

b) A reaction of 42.5 ml of ethanoic acid (density 1.049g/ml) and 87.9 ml of ethanol (density 0.785 g/ml) in a small amount of concentrated sulphuric acid (1ml) yielded 43.6 g of ethanoate (ester) according to the following equation.

$$CH_3CO_2H + CH_3CH_2OH \xrightarrow{H^+} CH_3CO_2CH_2CH_3 + H_2O$$

Ethanoic acid   Ethanol   Ester
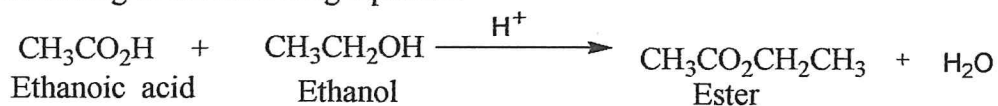
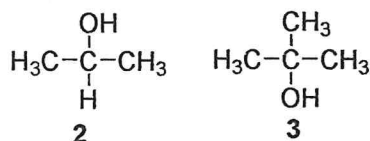i)   What is the role of the acid? **1mk**

ii)   Determine by calculations, the limiting reagent **3mks**

iii)   Calculate the percentage yield of the ester **2mks**

c) Identify the class of each of the following alcohols labeled **2** and **3**
2mks

$$\underset{2}{H_3C-\overset{\displaystyle OH}{\underset{\displaystyle H}{C}}-CH_3} \qquad \underset{3}{H_3C-\overset{\displaystyle CH_3}{\underset{\displaystyle OH}{C}}-CH_3}$$

d) Butane burns in air to give products as shown

Butane + air ⟶ products + energy

i) Write a balanced chemical equation to show complete combustion of butane **2mks**

ii) Suggest one possible use of butane from the information in the equation **1mk**

e) Give at least one physical properties of alkynes **1mk**