**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**
**SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**
**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)**
**1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR**
**REGULAR**

COURSE CODE: SCH 103

COURSE TITLE: BASIC ORGANIC CHEMISTRY

EXAM VENUE:LAB 1                                       STREAM: (BSc. Science)

DATE: 12/8/14                                              EXAM SESSION: 9.00 – 11.00AM

TIME: 2 HOURS

**Instructions:**

1. **Answer question 1 (compulsory) in Section A and any other 2 questions in Section B .**

2. **Candidates are advised not to write on the question paper.**

3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**SECTION A**

**Question 1 (30 marks)**

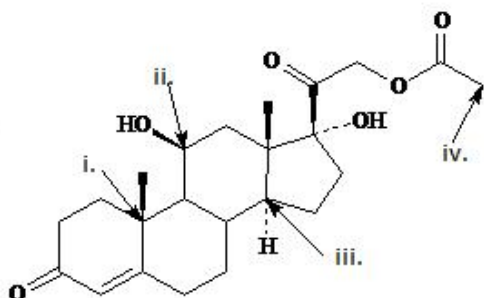a)    Determine the hybridization for the indicated atoms in each structure below.

[2 marks]
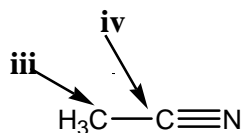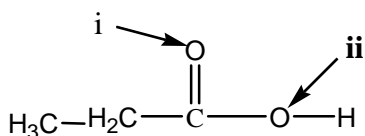


i-----------------ii------------------          iii------------------          iv----------------

b)    Label the indicated atoms in the structure below as 1°, 2°, 3°, or 4°.          [2 marks]



i.          --------------          ii. ------------------ iii. ------------------ iv. -------------
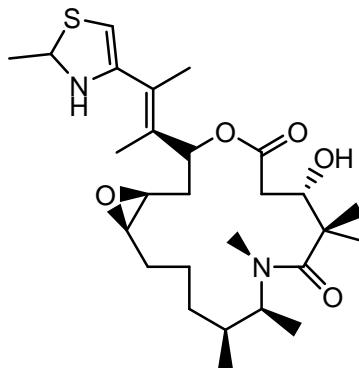
c)    i.    Draw an orbital picture for acetylene, $C_2H_2$.  Clearly label each bond type and indicate the type of orbitals involved in each bond.          [4 marks]

ii.  Draw Lewis structure for formaldimine, $CH_2NH$. [1 marks]

d)    Identify the functional groups in the molecule below.          [4 marks]



e)    The combustion of an 8.23 mg sample of unknown substance gave 9.62 mg of carbon dioxide and 3.94 mg of water. Another sample of the same unknown substance, weighing 5.32 mg, gave 13.49 mg of silver chloride in a halogen analysis.

      i.        Calculate the quantity in milligrams of carbon in the sample.      [1 mark]

      ii.      Determine the percentage of carbon in the sample.      [1 mark]

      iii.     Calculate the quantity in milligrams of hydrogen gas liberated.      [1 mark]

      iv.     Determine the percentage of hydrogen gas liberated.      [1 mark]

      v.      Calculate the quantity in milligrams of chlorine in the sample.      [1 mark]

      vi.     Determine the percentage of chlorine in the sample.      [1 mark]

      vii.    Calculate the empirical formula of the unknown substance.      [4 mark]

      viii.   If the molecular mass of the substance is 113g/mol, determine its molecular formula.

                    [2 mark]

      ix.     Draw all the possible structures of the molecule with the molecular formula in (viii) above.      [2 mark]

f)      Write the steps involved (mechanism) in the reaction between methane ($CH_4$) and chlorine in the presence of sunlight.
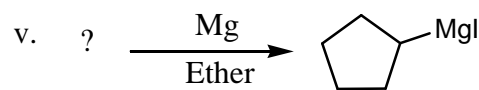
                    [4 mark]

**SECTION B**
**Question 2 (20 marks)**
a)      Give IUPAC names for the following structures:      [7 marks]

i.

ii.

iii.

iv.

v.

vi.

vii
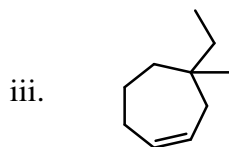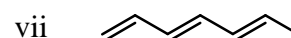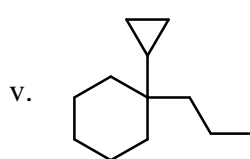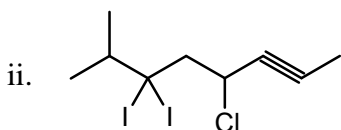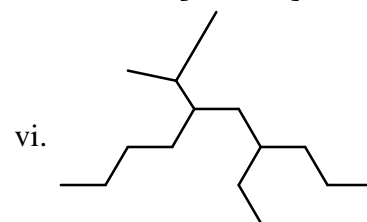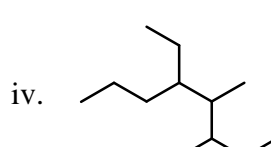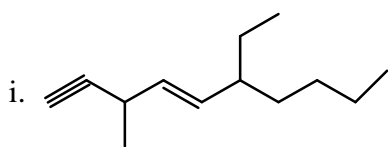
b)      Complete the following reactions:      [5 marks]

      i.     $CH_3CH_3$ $\xrightarrow[\text{uv}]{\text{Cl}_2}$ ?

      ii.   $\underset{H_3C}{\overset{H}{>}}=CH_2$ $\xrightarrow[\text{Ether}]{\text{HBr}}$ ?

      iii.   $H_2C{=}CH(CH_2)_8COOH$ $\xrightarrow[\text{peroxide}]{\text{HBr}}$ ?

      iv    ? $\xrightarrow[\text{CCl}_4]{\text{Br}_2}$

      v.   ? $\xrightarrow[\text{Ether}]{\text{Mg}}$
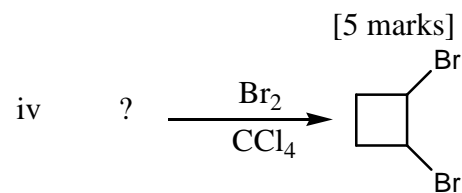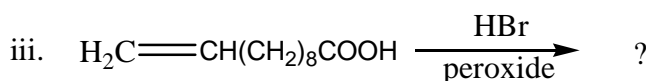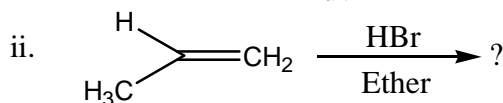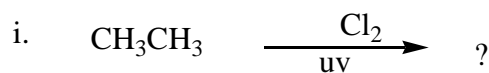
c)      Study the scheme shown below and answer the questions that follow:

A ($C_{10}H_{16}$)  →  1. $O_3$ in $CHCl_3$ / 2. $Zn/H^+$  →  **C** + **D**

A ($C_{10}H_{16}$)  →  $2H_2$  →  **B** ($C_{10}H_{20}$)
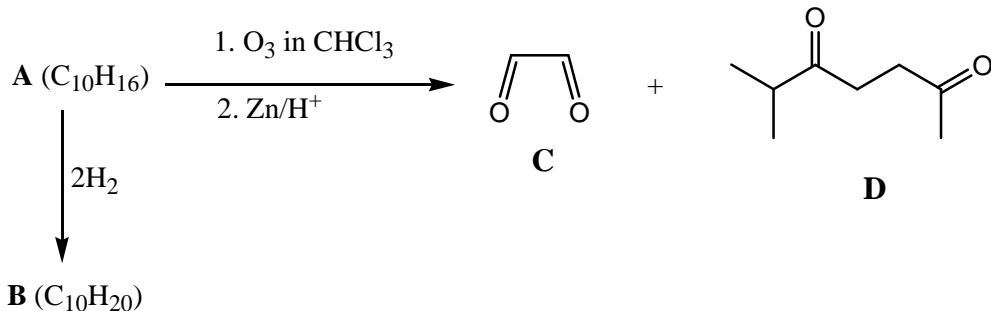
i. How many degrees of unsaturation does **A** have? [2 mark]

ii. How many double bonds are present in **A**, and how many rings are present in **B**? [2 marks]

iii. Propose structures for **A** and **B** consistent with the above information. [2 marks]

iv. Identify the functional groups in compounds **C** and **D**. [2 marks]

## Question 3 (20 marks)

a)  Draw structures for the following named compounds: [7 marks]

i. 4-(2,2-dibromoethyl)-3,5-dichloroheptane

ii. 4-Ethyl-7-nonen-1-yne

iii. 2-Chloro-1-penten-4-yne

iv. 3-Cyclobutylpentane

v. 3-bromo-2,5-dimethylhexane

vi. 3-Methyl-3-phenyl-4-octyne

vii. 4-ethyl-2,2,7-trimethyloctane

b)  4-Decyne (structure shown below) reacts with $2H_2$ in Pd/C and $H_2$, Lindler catalyst to yield products **A** and **B** respectively. Give the structures and names of these products. [4 marks]
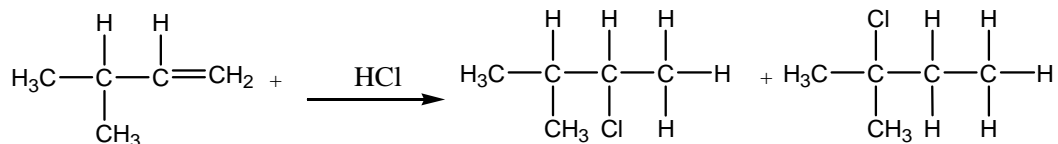
$CH_3(CH_2)_2C{\equiv}C(CH_2)_4CH_3$
4-Decyne

→ $2H_2$ / Pd/C → **A**

→ Lindlar catalyst → **B**
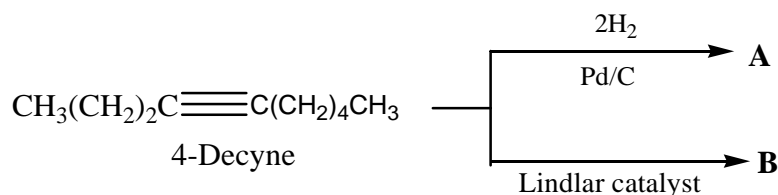
c)  Account for the fact that *n*-pentane boils at 36°C higher than 2-methylbutane and 2,2-dimethylpropane which boils at 28 and 9.5°C respectively. [1 mark]

d)  Show the mechanism for the following reaction: [4 marks]

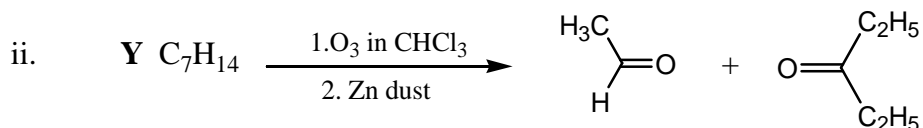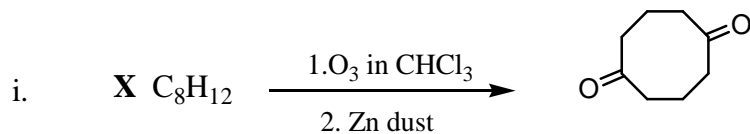$H_3C-C(H)(CH_3)-C(H)=CH_2$ + HCl → $H_3C-C(H)(CH_3)-C(Cl)(H)-CH_3$ + $H_3C-C(H)(CH_3)-C(H)(H)-CH_2H$

e)  Give structures of two compounds with the molecular formula $C_3H_8O$ and give their IUPAC names. [4 marks]

## Question 4 (20 marks)

a)  Draw 7 constitutional isomers of a cycloalkane with the formula $C_6H_{12}$. [7 marks]

4

b)   Deduce structural formulae for the alkenes A and B that give the following ozonolysis
     products:                                                                    [3 marks]

   i.   **X** $C_8H_{12}$   $\xrightarrow[\text{2. Zn dust}]{\text{1.}O_3 \text{ in } CHCl_3}$   

   ii.  **Y** $C_7H_{14}$   $\xrightarrow[\text{2. Zn dust}]{\text{1.}O_3 \text{ in } CHCl_3}$      +   

c)   Complete the following reactions by giving structures of the missing reagents/ products:
                                                                                [10 marks]

   i.   $H_3C(H_2C)_7C{\equiv}C(CH_2)_7COOH$   $\xrightarrow[\text{2. Zn, }H_3O^+]{\text{1. }O_3}$   ?

   ii.  $H_3C(H_2C)_{10}C{\equiv}CH$   $\xrightarrow[H_3O^+]{KMnO_4}$   ?

   iii. $CH_3CH_2C{\equiv}CH$   $\xrightarrow[H_2O_2]{2HBr}$   ?

   iv.  $CH_3C{\equiv}CH$   $\xrightarrow{NaNH_2/NH_3}$   ?   $\xrightarrow{CH_3(CH_2)_5Br}$   ?

   v.   $CH_3C{\equiv}CCH_3$   $\xrightarrow{?}$      $\xrightarrow[H_2SO_4]{H_2O}$   ?

   vi.  $CH_3CH_2C{\equiv}CH$   $\xrightarrow[CCl_4]{2Cl_2}$   ?

   vii. $CH_3CH_2C{\equiv}CH$   $\xrightarrow[H_2O_2]{2HCl}$   ?