Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN INDUSTRIAL MICROBIOLOGY AND BIOTECHNOLOGY
BACHELOR OF SCIENCE IN FOOD QUALITY ASSURANCE

BSFQ 13S
BTMBT 13S

ACH 4118 : ORGANIC CHEMISTRY I

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consists of FIVE questions
Answer question ONE (compulsory) and any other TWO questions

QUESTION ONE

a) (i) Define the following terms

I. Catenation

II. Hybridization

III. Constitutional isomers

IV. Formal charge

(8marks)

(ii) Determine the formal charges in the following Lewis structure:

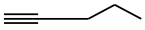
O N O OR O N O

O O

(2marks)

(iii) Distinguish between covalent bond and polar covalent bond. **(3marks)**

b) (i) Name the following compounds using IUPAV nomenclature

I. 

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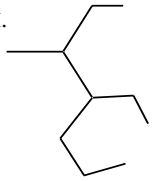
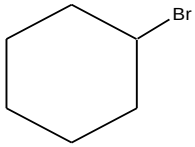
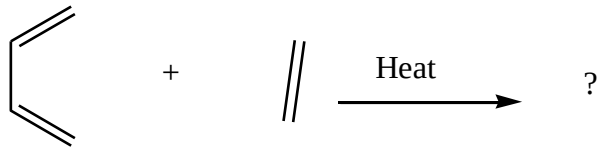
III. 

IV. 

(ii) A sample of CH_4 weighing 9.67mg produced 26.53mg of CO_2 and 21.56mg of H_2O. Determine the % of C and H in the sample. **(2marks)**

c) (i) Give the structural formula of the major products formed in the following reactions

(I)

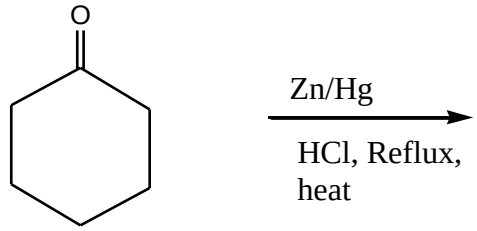


(1marks)

(II) $2CH_3CH_2Cl + 2Na \xrightarrow{\text{Dry ether}} ?$ **(1mark)**

(III) $CH_3CH = CHCH_3 + H_2 \xrightarrow{Ni} ?$ **(1mark)**

(IV)

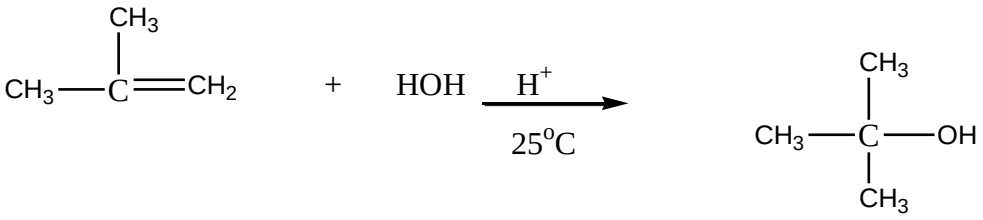


(ii) State THREE physical properties of alkanes. **(3marks)**

d) (i) An unknown alkene with the formula C_8H_{16} was found on oxidation with hot permanganate to yield a five –carbon carboxylic acid (pentatonic acid) and a three –carbon carboxylic acid (propanoic acid). Deduce the structure and systematic name of the alkene . **(2marks)**

(ii) List FOUR factors affecting the rates of $S_N2$and S_N1 reaction mechanisms. **(2marks)**

(iii) Using curly arrows provide the mechanical leading to formation of alcohol by hydrolysis of alkene in the reaction below.

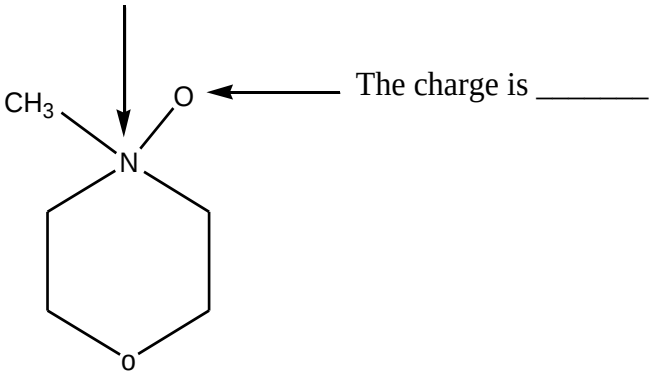


QUESTION TWO

a) (i) A hydrocarbon C_4bon C_4 H_{10} (A) on monochlorination gives a compound C_4H_9Cl
(b). Compound B on treatment with sodium metal given 2,2,3,3-tetramethylbutane. Give the structural formulas of (A) and (B) and the reactions involved. **(4marks)**

(ii) Determine the formal charge on the indicated atoms in the following molecule

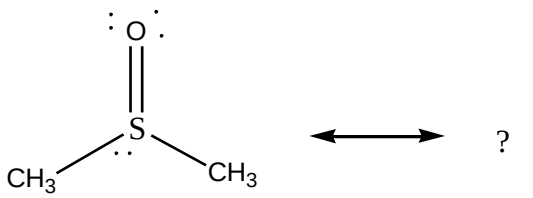
The charge is _____



The charge is _____

(iii) Name TWO major sources of alkanes **(2marks)**

b) (i) Dimethyl sulfoxide (DMSO shown below) is a common solvent



DMSO

(1) (2)

(I) Draw a second resonance (2) form for DMSO.

(II) The geometry of sulfur in DMSO is tetradral. Based on this , identify the resonance form that must be the major contributor to the hybrid. **(2marks)**

(ii) Give the type of bonds which will be formed when the atoms in each pair react .

I. Na and F

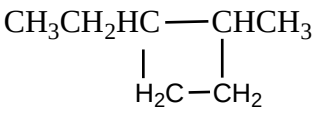
II. H and Cl

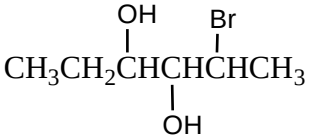
III. F and F

(iii) Indicate the type of hybridizatrion for the carbon atoms in the following compound

$CH_2 = CHC \equiv CCH_2CH_2OH$ **(3marks)**

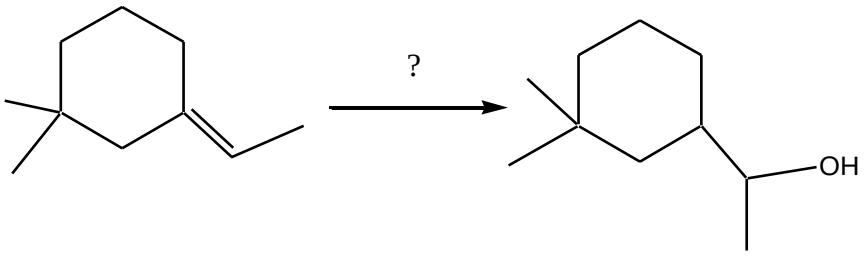
c) (i) Give the bond line formular for the following molecules

I. 

II. 

(2marks)

(ii) Provide the reagent(s) which would best accomplish the following transformation



(2marks)

QUESTION THREE

a) (i) Draw the sigma (σ) and pie (π) bonding interactions for ethene (C_2H_4)

(4marks)

(ii) Arrange the following molecules in order of increasing boiling points. Give reason(s) for this trend.

$CHCl_3$, CH_2Cl_2, CCl_4, CH_3Cl **(3marks)**

(iii) Write equations showing the preparation of the following halides from the starting materials indicated.

I. 2-Chloropropane from 2-propanol

II. 1-bromopane from 1- propene

III. CH_3 CHBr CH_3 from $CH_3CHOHCH_3$

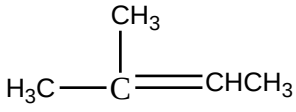
(6marks)

b) Explain briefly the effect of branching in the alkyl halide on the rate of S_N2 reactive.

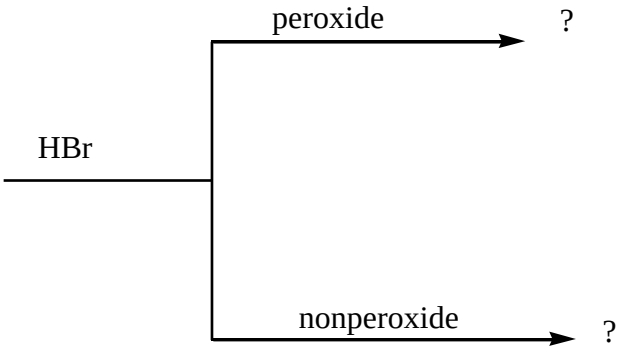
(2marks)

c) (i) State markovnikov's rule **(2marks)**

(ii) Complete the following reactions by giving the structure of the product formed in presence of peroxide and in absence of peroxide.



2-methyl-2-butene



Suggest what would be observed if instead of HBr, HCl is used.

QUESTION FOUR

a) (i) Define the following terms

I. Nucleophilicity

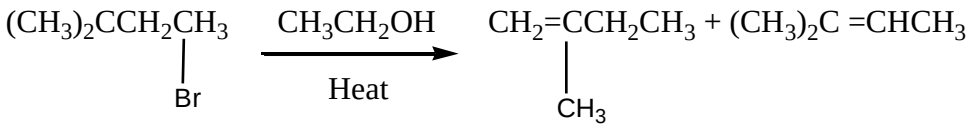
II. Solvolysis reaction

(3marks)

(ii) Give the conditions which favour E1 mechanism **(2marks)**

(iii) The dehydrohalogenation of 2-bromo-2methylbutane in ethanol shown below in an example of E1 reaction. Show the mechanism for this reaction.

The reaction:



2-Bromo-2-methyl butane

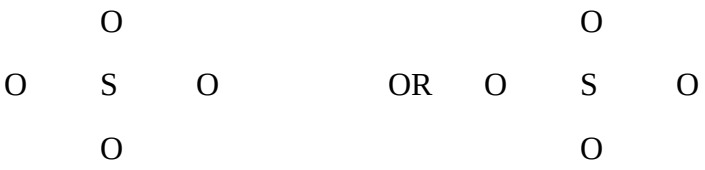
2-methyl-1-butene (25%)

2-methyl-2-butene (75%)

(6marks)

b) (i) Describe briefly how SP hybridized atomic orbitals are formed in carbon **(4marks)**

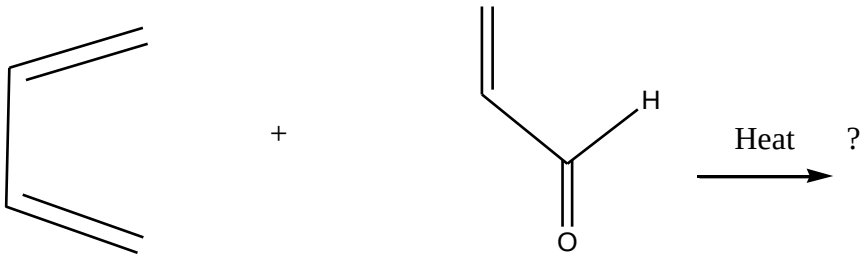
(ii) Determine the formal charges in the following Lewis structure and the ionic charge of the structure.



(3marks)

c) Complete the following reactions by writing the structure of the major product formed.

I.

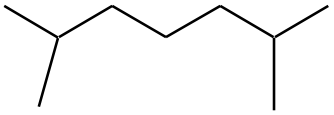


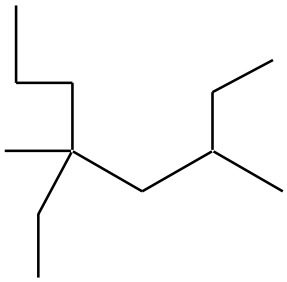
II. $2CH_3CH_2OH + 2Na \longrightarrow$?

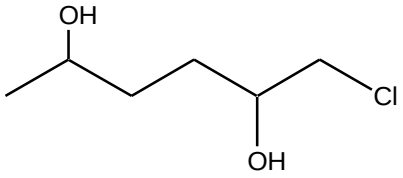
(2marks)

QUESTION FIVE

a) (i) Give the IUPAC names for the following compounds.

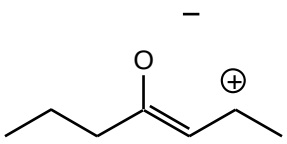
I. 

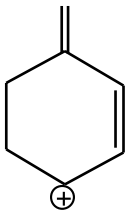
II. 

III. 

(3marks)

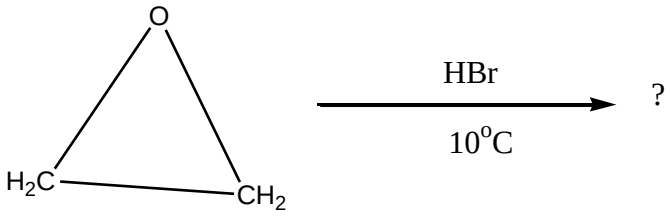
(iii) Draw the resonance structure for each of the species below using the arrows indicating electron flow

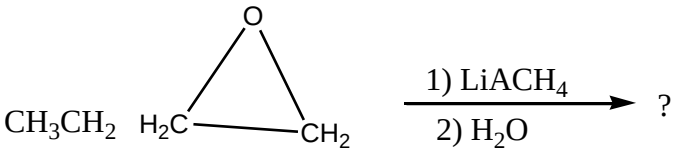
I. 

II. 

(2marks)

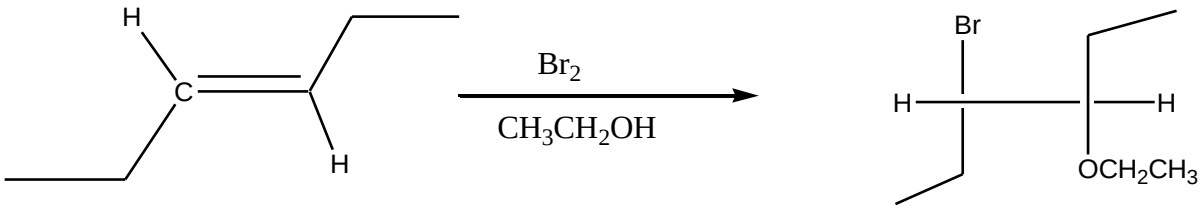
(iv) Give the structured formulas of the major organic products formed in the following reactions

I 

II. 

III. $C_{12}H_{22}O_{11} + H_2O \xrightarrow[30^oC]{\text{Maltase}} ?$

b) (i) Provide a detailed mechanisms for the following reaction



(4marks)

(ii) Arrange the following hydrogen halides in an increasing order of reactivity towards an alcohol. Give reason for this trend. HBr, HCl, HI, HF **(2marks)**

(iii) The reaction of primary alcohols with HCl occurs only in presence of Lewis acid catalyst, ZnC_2. Explain the role of $ZnCl_2$ catalyst in this particular reaction. **(3marks)**

c) Amphetamine has a molecular formula $C_9H_{13}N$. What is the percentage (by weight of each of the elements in amphetamine? (C= 12.011, H = 1.008 N = 14.007) **(3marks)**