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

BIMBT 12 S

SCH 2103 : ORGANIC CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

JULY 2013 SERIES 2 HOURS

Instructions to candidates:

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

Question ONE

a) (i) Give FOUR properties of carbon which enable carbon to form large number of compounds. **(4marks)**

(ii) Explain what is meant by the term functional group and give the structure of the functional group in each of the following compounds.

I. Alkene

II. Aldehyde **(3 ½ marks)**

b) (i) Differentiate between ionic bonds and covalent bonds. Use appropriate example. **(4marks)**

(ii) Label each bond in the following compounds as ionic or covalent

I. F_2

II. LiBr

III. C_2H_2

(1 ½ mark)

(iii) Draw a Lewis structure for each compound. **(3marks)**

I. Ethylene, C_2H_4

II. Acetylene, C_2H_2

III. Chlorate ion, ClO_3^-

c) (i) Define formal charge **(1mark)**

(ii) Calculate the charge on each atom in the following species and verify the totals charge indicated on each species

I. NH_4

II. H_3O

(3marks)

(iii) Distinguish between positional isomerism and functional group isomerism. Use a suitable example. **(4marks)**

d) (i) State TWO physical properties of alkanes **(2marks)**

(ii) Define:

(i) Hybridization

(ii) Electronegativity **(2marks)**

(iii) Determine whether each of the following molecules is polar (i.e has a net dipole).

(2marks)

I. CO_2

II. BF_3

Question TWO

a) (i) Caffeine, a stimulant found in coffee, tea, chocolate, and some medications, contains 49.48% carbon, 5.15% hydrogen, 28.87% nitrogen, and 16.49% oxygen by mass and has a molar mass of 194.2. Determine the molecular formula of caffeine. [C=12, 0 =16, N=14, H=1] **(4marks)**

(ii) Give TWO major sources of alkanes **(2marks)**

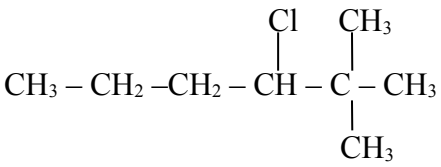
Explain briefly the meaning of each of the following terms:

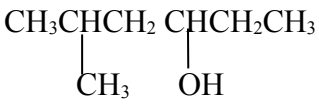
I. Cracking

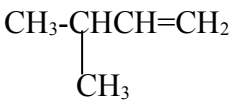
II. Reforming

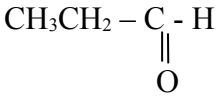
(3marks)

b) (i) Give the IUPAC names for each of the following compounds. **(4marks)**

I. 

II. 

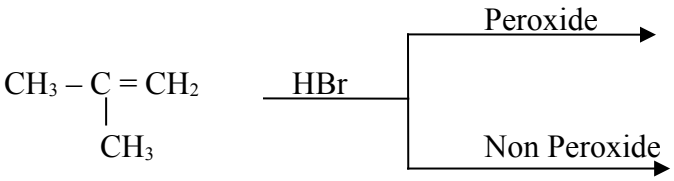
III. 

IV. 

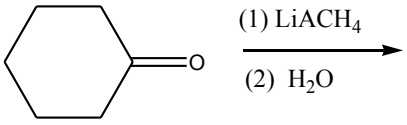
(ii) Complete the following reaction equations by writing down the structure of the major product formed in each case. (4marks)

I. $CH_3CH_2CH = CH_2 \xrightarrow[\Delta]{H_2/Pd}$

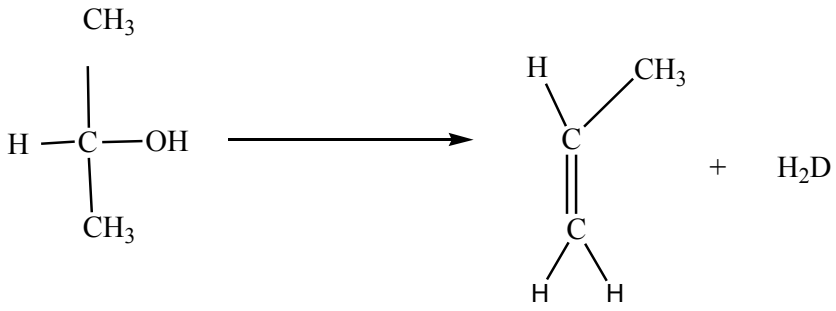
But-l-ene

II. 

III.



c) (i) Give the mechanism of acid catalysed dehydration of alcohols to alkenes according to the reaction shown below. **(2marks)**



(ii) Give ONE industrial application of alcohols. **(1mark)**

Question THREE

a) (i) Write down the IUPAC names for the following compounds, respectively.

(4marks)

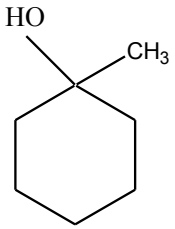
I. CH_3-CH-CH_2-CH-CH_2-CH_3

CH_3 CH_2CH_3

II. CH_3-CH_2-CH-CH_3

Br

III.



III. CH_3-CH-CH_2-CH_2-NH_2

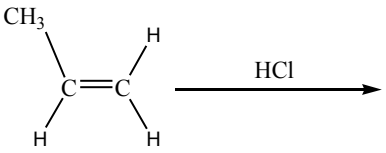
CH_3

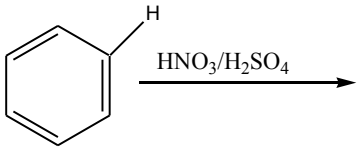
b) (i) Explain the observation that the boiling points of aldehydes are lower than those of alcohols and carboxylic acids of comparable molecular weights. **(1mark)**

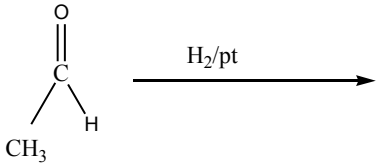
(ii) State Markovnikov's Rule **(1mark)**

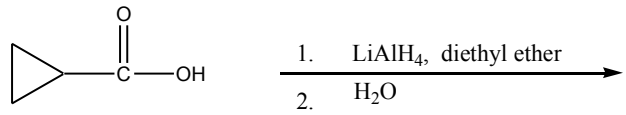
c) Give the structure of the major product formed from each of the following reactions

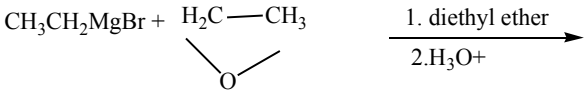
(5marks)

(i) 

(ii) 

(iii) 

(iv) 

(v) 

d) (i) Distinguish between S_N1 and S_N2 reaction mechanisms. **(2marks)**

(ii) State THREE factors that influence S_N2 and S_N1 reactions. **(3marks)**

(iii) Name the FOUR alcohols represented by the molecular formula C_4H_9OH and write down their structural formulae. **(4marks)**

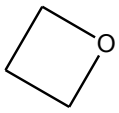
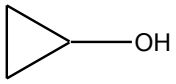
Question FOUR

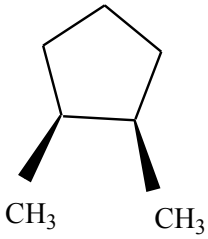
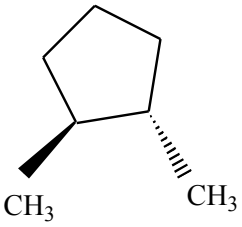
a) (i) A white powder is analyzed and found to contain 43.64% phosphorus and 56.36% oxygen by mass. The compound has a molar mass of 283.88g. What are the compound's empirical and molecular formulas? (P =30.97, 0 =16) **(4marks)**

(ii) Preliminary investigation performed on a certain compound (A) suspected to be organic reveals that it is a new compound. Briefly explain the procedure or sequence of steps that would have to be followed in order to determine the structure of the new compound A. **(6marks)**

b) (i) Classify each pair of compounds as constitutional isomers or stereoisumers.

(3marks)

I.  and 

II.  and 

III. $CH_3CHCH_2CH_2CH_3$ (with CH_3 branch) and $CH_3CH_2CHCH_2CH_3$ (with CH_3 branch)

(ii) Explain precisely how any ONE of the following carbon hybrid orbitals are formed and give one example of each case. Use illustrations. **(4marks)**

I) SP^2 hybrid orbitals

II) SP hybrid orditals

III) Draw resonance structures for benzene **(2marks)**

IV) State ONE commercial use for benzene **(1mark)**

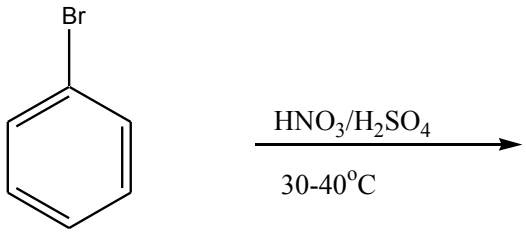
Question FIVE

a) (i) Give the IUPAC name for each of the following compounds **(5marks)**

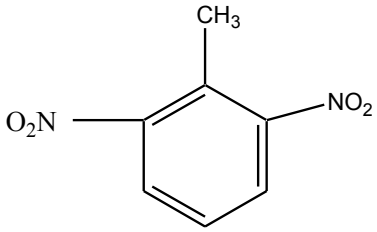
I. $CH_3CHCH_2CH_2COOH$ (with CH_3 branch)

II. $CH_3CH{=}CHCOOH$

III.

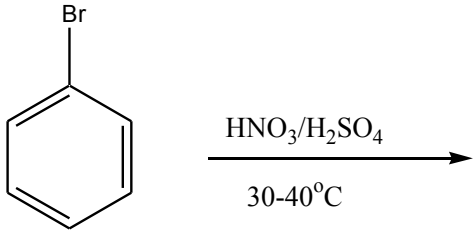


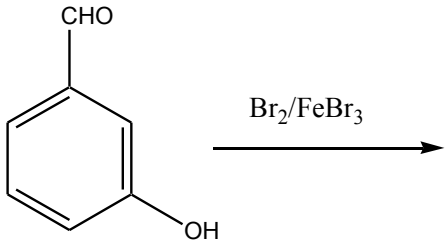
IV.



V. $ClCH_2CH_2CH_2CH_3$

(ii) Write down the structural formula of the major product formed from each of the reaction given below **(5marks)**

I. 

II. 

III. $CH_3COOH + Cl_2 \xrightarrow[\text{OR } PCl_3]{P}$

IV. 

V. $CH_3CH_2OH \xrightarrow{K_2Cr_2O_7,H+}$

b) (i) Write down the structural formula for each of the following compounds

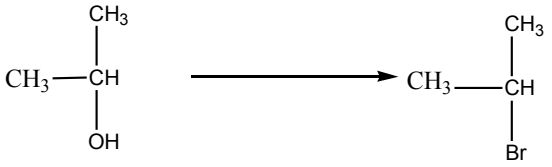
(3marks)

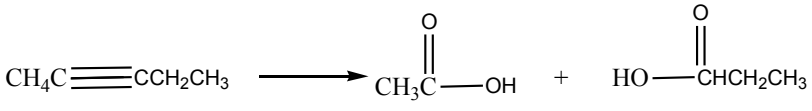
I. Phenol

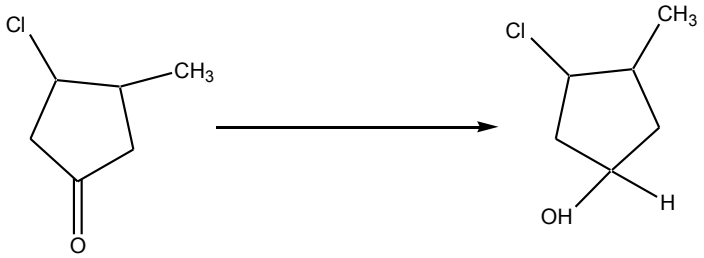
II. 1,2,3-propanetriol

III. 3-chlono-2-methylpentane.

(ii) Give the missing reagent(s) and condition where appropriate needed to carry out the following transformations **(3marks)**







c) Describe briefly a simple chemical test you would perform to distinguish between the following pairs of compounds **(4marks)**

I. Propene and propane

II. CH_3CH_2OH and $CH_3\underset{\underset{OH}{|}}{C}HCH_3$