UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION

ACADEMIC YEAR 2011/2012

TITLE OF PAPER:

7

INTRODUCTORY ORGANIC CHEMISTRY

COURSE NUMBER: C203

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS: THERE ARE SIX (6) QUESTIONS. ANSWER ANY FOUR (4) QUESTIONS. EACH QUESTION IS WORTH 25 MARKS.

A PERIODIC TABLE HAS BEEN PROVIDED WITH THIS EXAMINATION PAPER.

PLEASE DO NOT OPEN THIS PAPER UNTIL AUTHORISED TO DO SO BY THE CHIEF INVIGILATOR.

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Question One

- a) Consider the acid-base reactions given below. Complete each equation and expand the structural formulas to show all the unshared electron pairs. Identify the acid and its conjugate base. In each case show the flow of electrons with curved arrows
 - i) $R \rightarrow OH + NH_3 \rightarrow$ ii) $CH_3CH_2OH + OH \rightarrow$
- b) For each of the following, write all the possible reasonable resonance structures. Your structures should include formal charges and lone electron pairs where appropriate.Use curved arrows to track electron movement.



c) Draw the line structural formulas for the following:
i) Three ethers with the formula C₄H₁₀O
ii) Two esters with the formula C₃H₆O₂

Question two

- a) Write a line structure for each of the following:
 - i) 6-isopropyl-2,3-dimethylnonane
 - ii) 4-tert-Butyl-3-methylheptane
 - iii) (CH₃CH₂)₃CCH(CH₂CH₃)₂

[6]

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[10]

[9]

[6]

b) Photochemical chlorination of 2,4,4-trimethylhexane (whose structure is sketched below) gives five isomeric monochlorides. Write structural formulas for these five isomers.



c) Chloroethane, CH₃CH₂Cl, has been prepared by the free radical chlorination of ethane, CH₃CH₃. Write a stepwise mechanism for this reaction. Your answer should include initiation, propagation and termination steps.

[6.5]

[5]

[9]

[7.5]

d) Specify the configuration of the chirality center as R or S in each of the following:

CI---H Br

Q

ii) Monosodium L-glutamate

 CO_2^{-} H_3N^{+} $H_2CO_2^{-}Na^{+}$ $CH_2CH_2CO_2^{-}Na^{+}$



a) Write structural formulas for six of the isomeric chlorinated aldehydes and ketones that have the molecular formula C₄H₇ClO. For structures, you may use any one of line, condensed, or dash formulas.

b) Predict the product of the reaction of propanal, CH₃CH₂CHO with each of the following:

- i) Hydroxylamine, NH₂OH
- ii) Phenyl hydrazine, C₆H₅NHNH₂

iii) Sodium cyanide, NaCN, followed by dilute sulphuric acid

iv) Chromic acid

[8]

- 3 -

- c) Give enol form of each of the following:
 - i) Propanone, CH₃COCH₃
 - ii) $HC \equiv C CH_2 CHO$
- d) Write the structure of the major product formed in each of the following cross-aldol reactions:



Question Four

- a) Write chemical equations showing all the necessary reagents for the preparation of 1-butanol, CH₃CH₂CH₂CH₂OH, by each of the following methods.
 - i) Use of a Grignard reagent
 - ii) Reduction of a carboxylic acid
 - iii) Hydrogenation of an aldehyde
 - iv) Reduction with NaBH₄

[8]

[4]

b) Write a stepwise mechanism for the formation of diethyl ether, CH₃CH₂OCH₂CH₂ from ethanol, CH₃CH₂OH, in the presence of an acid catalyst.

[8 mks]

[4]

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



[9]

- 4 -

Question Five

a) In each of the following compounds, identify the chiral center, if any:



- [6]
- b) Predict the major product when each of the following is reacted with chromic acid (H_2CrO_4) :
 - i) CH_3CH_2OH
 - ii) CH₃CH₂CH(OH)CH₃
 - (CH₃)₃COH iii)

[6]

c) Write line structures and give IUPAC names for all the alkenes of molecular formula C₆H₁₂ that contain a tri-substituted double bond. Where appropriate, indicate the type of stereochemistry present.

[6]

d) Identify the major alkene (product) obtained upon acid-catalyzed dehydration of each of the following alcohols:





[7]

- a) Consider the acid-catalysed dehydration of tert-butyl alcohol, (CH₃)₃COH.
 - i) Write the overall reaction equation
 - ii) Give the mechanism for the reaction. Use curved arrows to show the movement for the electrons

[8]

- b) Give structural formulas and give the functional class (1°, 2°, or 3°) and IUPAC names of all the isomeric alkyl chlorides that have the molecular formula C₄H₉Cl.
 [7.5]
- c) Write a structural formula for a free radical (only one is required for each case) that has the formula C_5H_{11} and can be classified as a
 - i) A primary radical ii) secondary radical iii) tertiary radcal

[4.5]

d) Ethanol, CH₃CH₂OH, and dimethyl ether, CH₃OCH₃, are constitutional isomers. At room temperature ethanol is a liquid whereas dimethyl ether is a gas. Suggest an explanation for this observation.

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The Periodic Table

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