

**UNIVERSITY OF SWAZILAND****SUPPLEMENTARY EXAMINATION****ACADEMIC YEAR 2011/2012**

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**TITLE OF PAPER:                   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.**

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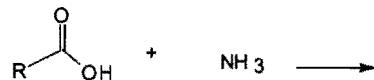
**A PERIODIC TABLE HAS BEEN PROVIDED WITH THIS EXAMINATION PAPER.**

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**Question One**

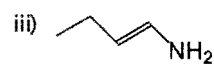
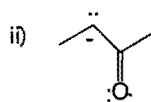
- a) Consider the acid-base reactions given below. Complete each equation and expand the structural formulas to show all the unshared electron pairs. Identify the acid and its conjugate base. In each case show the flow of electrons with curved arrows

i)



[10]

- 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.



[9]

- c) Draw the line structural formulas for the following:

- i) Three ethers with the formula  $\text{C}_4\text{H}_{10}\text{O}$   
 ii) Two esters with the formula  $\text{C}_3\text{H}_6\text{O}_2$

[6]

**Question two**

- a) Write a line structure for each of the following:

i) 6-isopropyl-2,3-dimethylnonane

ii) 4-*tert*-Butyl-3-methylheptaneiii)  $(\text{CH}_3\text{CH}_2)_3\text{CCH}(\text{CH}_2\text{CH}_3)_2$ 

[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.

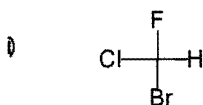


[7.5]

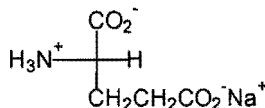
- c) Chloroethane,  $\text{CH}_3\text{CH}_2\text{Cl}$ , has been prepared by the free radical chlorination of ethane,  $\text{CH}_3\text{CH}_3$ . Write a stepwise mechanism for this reaction. Your answer should include initiation, propagation and termination steps.

[6.5]

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



- ii) Monosodium L-glutamate



[5]

### Question Three

- a) Write structural formulas for six of the isomeric chlorinated aldehydes and ketones that have the molecular formula  $\text{C}_4\text{H}_7\text{ClO}$ . For structures, you may use any one of line, condensed, or dash formulas.

[9]

- b) Predict the product of the reaction of propanal,  $\text{CH}_3\text{CH}_2\text{CHO}$  with each of the following:

- Hydroxylamine,  $\text{NH}_2\text{OH}$
- Phenyl hydrazine,  $\text{C}_6\text{H}_5\text{NHNH}_2$
- Sodium cyanide,  $\text{NaCN}$ , followed by dilute sulphuric acid
- Chromic acid

[8]

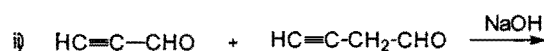
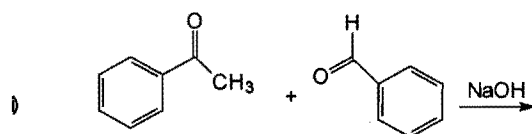
c) Give enol form of each of the following:

i) Propanone,  $\text{CH}_3\text{COCH}_3$

ii)  $\text{HC}\equiv\text{C}-\text{CH}_2\text{CHO}$

[4]

d) Write the structure of the major product formed in each of the following cross-aldol reactions:



[4]

#### Question Four

a) Write chemical equations showing all the necessary reagents for the preparation of 1-butanol,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ , by each of the following methods.

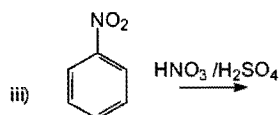
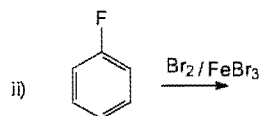
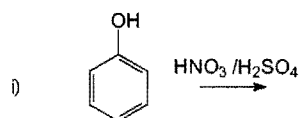
- Use of a Grignard reagent
- Reduction of a carboxylic acid
- Hydrogenation of an aldehyde
- Reduction with  $\text{NaBH}_4$

[8]

b) Write a stepwise mechanism for the formation of diethyl ether,  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$  from ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$ , in the presence of an acid catalyst.

[8 mks]

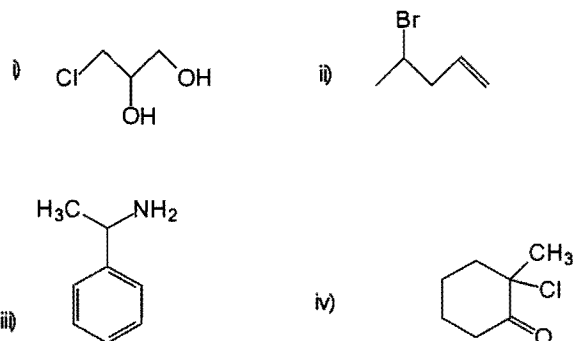
c) Give the structure of the major product resulting from each of the following reactions:



[9]

**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 ( $\text{H}_2\text{CrO}_4$ ):

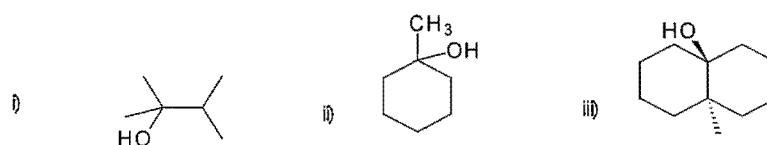
- i)  $\text{CH}_3\text{CH}_2\text{OH}$   
 ii)  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$   
 iii)  $(\text{CH}_3)_3\text{COH}$

[6]

c) Write line structures and give IUPAC names for all the alkenes of molecular formula  $\text{C}_6\text{H}_{12}$  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]

**Question Six**

- a) Consider the acid-catalysed dehydration of tert-butyl alcohol,  $(\text{CH}_3)_3\text{COH}$ .
- Write the overall reaction equation
  - 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 ( $1^\circ$ ,  $2^\circ$ , or  $3^\circ$ ) and IUPAC names of all the isomeric alkyl chlorides that have the molecular formula  $\text{C}_4\text{H}_9\text{Cl}$ .
- [7.5]
- c) Write a structural formula for a free radical (only one is required for each case) that has the formula  $\text{C}_5\text{H}_{11}$  and can be classified as a
- A primary radical
  - secondary radical
  - tertiary radical
- [4.5]
- d) Ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$ , and dimethyl ether,  $\text{CH}_3\text{OCH}_3$ , are constitutional isomers. At room temperature ethanol is a liquid whereas dimethyl ether is a gas. Suggest an explanation for this observation.
- [5]

