UNIVERSITY OF SWAZILAND
MAIN EXAMINATION 2009/10

TITLE OF PAPER	:	Introductory Organic Chemistry
COURSE NUMBER	:	C203
TIME	:	Three Hours
INSTRUCTIONS	:	Answer any **FOUR** questions. Each question carries **25** marks.

You are not supposed to open this paper until permission to do so has been granted by the Chief Invigilator.

QUESTION 1

(a) Give the mechanism involved in the synthesis of lactic acid (2-hydroxypropanoic acid) by addition of hydrogen cyanide to acetaldehyde (ethanal) and hydrolysis. Why is the lactic acid produced optically inactive? (9)

(b) Write the Fischer projection formulae for the following compounds:

(i) (R)-2-Hydroxypropanoic acid

(ii) (S)-2-Aminopropanoic acid

(iii) (R)-2,3-Dihydroxypropanal

(iv) (R,R)-2,3-Dihydroxybutanedioic acid

(v) (Z)-Butenedioic acid (10)

(c) Define the following terms and give examples:

(i) enantiomers (ii) meso compound

(iii) chiral centre (6)

QUESTION 2

(a) What do you understand by the term "Walden inversion"?
Show how S_N2 mechanism would lead to Walden inversion. (8)

(b) Using 2-bromobutane to illustrate, write the mechanism of E2. Name the possible products and indicate the major one. (5)

(c) Show how S_N1 mechanism can lead to racemization and inversion of configuration. (7)

(d) Describe a chemical method of resolving a racemic modification into its enantiomers. (5)

QUESTION 3

(a) (i) What is a Grignard reagent?

(ii) Describe how a Grignard reagent is usually produced in the laboratory and write the possible structure of the complex it forms with the solvent used to prepare it. (5)

(b) Write the mechanism involved in the reaction of ethylmagnesium bromide with ethylacetate to form 3-methylpentan-3-ol. (8)

(c) Write the formula and name of each organic product of the following reactions:

(i) $CH_3CH_2CH_2CH_2Br + KOH \rightarrow ?$

(ii) $CH_3CH_2OH + H_2SO_4/CrO_3 \rightarrow ?$

(iii) $CH_3CH{=}CH_2 + HBr \rightarrow ?$

(iv) $CH_3COOH + CH_3OH \rightarrow ?$

(v) $C_6H_5MgBr + H_2O \rightarrow ?$

(vi) $CH_3CH_2COOH + C_6H_5CH_2OH \rightarrow ?$

(vii) $CH_3CH_2CH_2CH_2MgBr + CH_3C{\equiv}CH \rightarrow ?$

(viii) $CH_3CH_2OH + PBr_3 \rightarrow ?$

(12)

QUESTION 4

(a) Write the mechanisms of the reactions involved and explain why acid-catalysed hydration of 3,3-dimethylbut-1-ene gives 2,3-dimethylbutan-2-ol as a major product while hydration of the same substance in oxymercuration-demercuration gives 3,3-dimethylbutan-2-ol. (10)

(b) Write the structure and name of an example of each of the following:

(i) secondary alcohol (ii) dihydric alcohol (iii) aromatic alcohol

(6)

(c) Write an explanation for the following observations:

(i) alcohols have higher boiling points than hydrocarbons of the same molecular mass.

(ii) the solubility of alcohols in water decreases with increase in molecular masses of the alcohols.

(5)

(d) Write the mechanism of the reaction of ethanol in the presence of concentrated sulphuric acid to give diethyl ether (ethoxy ethane). (4)

QUESTION 5

(a) What do you understand by the term "Aldol condensation"? Give an example and write the mechanism of the reaction. (8)

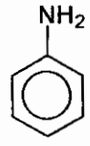
(b) Describe how the Hinsberg test can be used to demonstrate whether an amine is primary, secondary, or tertiary and write equations of the reactions involved. (7)

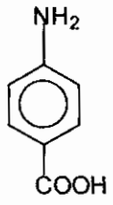
(c) In the nitration of benzene with a mixture of concentrated nitric acid and sulphuric acid.

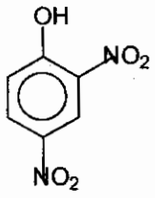
(i) name the electrophile for the reaction and write equations to show how it is generated.
(ii) Write the mechanism of the electrophilic substitution.

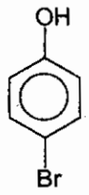
(5)

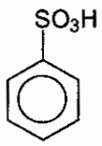
(d) Give the IUPAC names the following compounds: (5)

(i) 

(ii) 

(iii) 

(iv) 

(v) 

QUESTION 6

(a) Starting with p-toluenesulphonic acid or methanesulphonic acid and any alcohol and inorganic reagents, write how you would prepare each of the following compounds:

(i) methyl p-toluenesulphonate (ii) isopropyl p-toluenesulphonate, and

(iii) tert.-butylmethane sulphonate

(9)

(b) Outline the steps in the following conversions:

(i) o-Toluidine to o-chlorotoluene

(ii) m-Chloroaniline to m-bromochlorobenzene

(iii) o-Nitroaniline to o-Nitrobenzonitrile

(iv) p-Nitroaniline to p-Iodonitrobenzene

(10)

(c) Write the mechanism of the reaction of thionyl chloride with butanoic acid. (6)

The Periodic table