

**UNIVERSITY OF SWAZILAND
SUPPLEMENTARY 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) Write the mechanism of the bromination of benzene and name a catalyst that is usually used for the reaction. (4)
- (b) Starting with p-toluenesulphonic acid or methanesulphonic acid and any alcohol or inorganic reagent, write how you would prepare each of the following compounds:
- (i) methyl p-toluenesulphonate
 - (ii) isopropyl p-toluenesulphonate
 - (iii) tert-butylmethanesulphonate
- (12)
- (c) (i) Outline the steps in the conversion of nitrobenzene to benzyl alcohol. (5)
- (ii) Write the mechanism of the reaction of benzene with 1-chloro-2,2-dimethylpropane in the presence of aluminium chloride and name the product. (4)

QUESTION 2

- (a) Write the Fischer projection formulae for the following compounds:
- (i) (S)-2-Bromopropanoic acid
 - (ii) (R)-2-Iodopropanoic acid
 - (iii) (S)-2,3-Dichloropropanal
 - (iv) (S,S)-2,3-Dibromobutanedioic acid
 - (v) (E)-Butenedioic acid
- (10)
- (b) Define the following terms and give an example in each case:
- (i) diastereomers
 - (ii) internal compensation
 - (iii) geometrical isomers
- (6)
- (c) (i) What do you understand by the term "solvolysis"?
- (ii) Write the mechanism for the solvolysis of a named alkyl halide
- (iii) Describe the factors which favour S_N1 mechanism. (9)

QUESTION 3

- (a) (i) Name the solvent that is usually used in the preparation of a Grignard reagent and explain why the solvent must be dry.
- (ii) Write the possible mechanism that is involved in the formation of a Grignard reagent. (5)
- (b) Outline the steps in the conversion of 4-hydroxybutan-2-one to 3-methylbutan-1,3-diol and indicate the conditions required for the reaction. (5)
- (c) Outline the steps in the following conversions:
- (i) $C_6H_5COCl \rightarrow (C_6H_5)_3COH$ (3)
- (ii) $CH_3CN \rightarrow CH_3COCH_3$ (3)
- (iii) $CH_3CH_2CH_2CH_2OH \rightarrow CH_3CH_2CH_2CH_2C(CH_3)_2OH$ (3)
- (d) (i) Outline how you would prepare butyllithium in the laboratory.
- (ii) Write the mechanism for the reaction of butyllithium with 2,3-epoxybutane and name the product. (6)

QUESTION 4

- (a) Write the mechanisms of the reactions involved and explain why acid-catalysed hydration of hex-1-en gives hexan-2-ol while hydration of the same substance with hydroboration-oxidation gives hexan-1-ol. (10)
- (b) Write the structure of each of the following alcohols and indicate the type of alcohol in each case:
- (i) 2-methylpropan-2-ol (ii) propan-1,2,3-triol (iii) 2-phenyl ethanol (6)
- (c) Write an explanation for the following observation:
- (i) Butan-1-ol and ethoxyethane (diethyl ether) have the same molecular mass, 74, and pentane has molecular mass of 72 but their boiling points are 117.7°C, 34.6°C, and 36°C respectively.
- (ii) Butan-1-ol and ethoxyethane (diethyl ether) have the same solubility in water. (5)

- (d) Write the formulae and names of the products of the following reactions:
- (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH} + \text{LiAlH}_4 \rightarrow$
- (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOC}_2\text{H}_5 + \text{Na} / \text{C}_2\text{H}_5\text{OH} \rightarrow$
- (iii) $\text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{PBr}_3 \rightarrow$
- (iv) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + \text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4 \rightarrow$ (4)

QUESTION 5

- (a) Account for the following observations with appropriate structures:
- (i) chloroethanoic acid is more acidic than ethanoic acid. (2)
- (ii) methylamine is more basic than ammonia but aniline is less basic than ammonia. (5)
- (iii) o-nitrophenol is more volatile than p-nitrophenol. (3)
- (iv) phenols are stronger acids than alcohols. (3)
- (b) (i) Name the three classes of the aliphatic amines and give an example in each case. (3)
- (ii) Describe how you can use sodium nitrite and dilute hydrochloric acid to identify the three types of amines. Equations are essential. (6)
- (c) Describe how a diazonium salt can be prepared and write its structure. (3)

QUESTION 6

- (a) (i) What is a racemic modification? (5)
- (ii) Describe with a suitable example how a laboratory synthesis can lead to the formation of a racemic modification. (5)
- (b) Describe five methods by which a racemic modification can be resolved to its enantiomers and indicate the advantages and disadvantages of each method. (20)

