CHUKA



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EXAMINATION FOR THE AWARD OF MASTER OF SCIENCE IN CHEMISTRY

CHEM 831: MODERN METHODS OF ORGANIC SYNTHESIS

STREAMS: BSC (CHEM) TIME: 3 HOURS

DAY/DATE: MONDAY 06/04/2020 2.30 P.M. – 4.30 P.M.

INSTRUCTIONS: ANSWER ALL QUESTIONS

QUESTION ONE (20 marks)

a) Write the mechanism and the products A and B in the following reaction (3 marks)

$$R_2CHOH + HCrO_4 + H^+$$
 \longrightarrow $A+B$ \longrightarrow $R_2C=O + HCrO_3^- + H^+$

b) Write the product(s) of the following reactions below

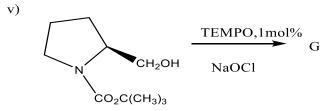
(7 marks)

i)
$$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{H}_2\text{CrO}_4} \text{C}$$

ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)(\text{CH}_2)_4\text{CH}_2\text{OH} \xrightarrow{\text{CrO}_3\text{-Pyridine}} \text{D}$

iii) (CH₃)₂C=CHCH₂CH₂CH(CH₃)CH₂CH₂OH
$$\stackrel{\text{PCC}}{\longrightarrow}$$
 E

iv)
$$OH \longrightarrow F$$
 $H_2C=C-C=CH-CHCH_3 \longrightarrow F$
 CH_3



vi)
$$CH_2$$
= $CHCH(OC_2H_5)_2 + KMnO_4$ \longrightarrow H
vii) OH

vii) Peroxy benzoic acid

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c) Write the mechanism of the following reaction

(3 marks)

$$A \xrightarrow{R_2CHOH} B \longrightarrow R_2C=O + (CH_3)_2S$$

- d) Write one way to protect and deprotect the following functional groups (6 marks)
 - i) Amino group
 - ii) Hydroxyl group
 - iii) Carbonyl group
- e) Differentiate between constitutional and stereoisomers

(1 mark)

QUESTION 2 (20 MARKS)

a) Write the reagents required for the following reactions

(4 marks)

ii) $B+C \longrightarrow O=CH(CH_2)_4CH=O$

iii)
$$CH_2$$
 $D+E$ O CH_3 CH_3

$$\begin{array}{c} \text{iv)} \\ \\ \\ \text{CH}_3 \\ \\ \text{CH}_3 \\ \end{array} \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 \\ \end{array} \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 \\ \end{array}$$

b) Draw the cis and trans isomers for the following compounds

(2 marks)

- i) 1-ethyl-3-methylcyclobutane
- ii) 1-bromo-4-chlorocyclohexane

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c) Indicate whether each of the following structures has the R or the S configuration (3 marks)

$$i) \begin{picture}(200,0){\line(1,0){C}} \hline CH_1(CH_3)_2 & CH_2Br & CH_2CH_3 \\ \hline CH_2CH_3 & iii) & CH_2CH_2CI & CH_2CH_3 \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI & CI \\ \hline CH_2Br & H_2CH_3C & CI \\ \hline CH_2Br & H$$

- d) A solution prepared by mixing 10 ml of a 0.10 M solution of the R enantiomer and 30 ml of a 0.10 M solution of the S enantiomer was found to have an observed specific rotation of + 4.8 °. What is the specific rotation of each enantiomer (4 marks)
- e) Write the mechanism of the following reaction

f) Write the mechanism and products of the following reaction

(2 marks)

(5 marks)

$$\begin{array}{c|c}
R & H \\
 & \downarrow \\
 & + \text{KMnO}_4
\end{array}$$

$$A \xrightarrow{\text{IO}_4^-} B \xrightarrow{\text{2RCH=O H}_2\text{O} + \text{IO}_3}$$

QUESTION THREE (20 marks)

- a) i) Define a protective group (1mk)
 - ii) Enumerate three considerations when choosing an appropriate protective group

(3 marks)

b) Differentiate between the following terms

(3 marks)

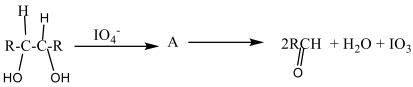
- i) Regioselective and stereospecific reaction
- ii) Chiral and achiral compound
- iii) Erythro enantiomers and threo enantiomers
- c) Write the mechanism of the following acid catalyzed aldol reaction of cyclopentanone

(5 marks)

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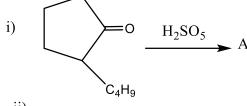
d) Write the mechanism of the following cleavage of glycols

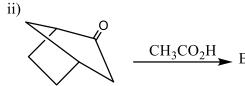
(2 marks)



e) Write the products of the following reactions

(2 marks)





f) Indicate the asymmetric carbons in the following compounds

(2 marks)

- i) CH₃CH₂CH₂CH₂CH₃
 - ii) CH₃CH₂CH(Br)CH₂CH₃
- g) Write the product of the following reaction

(2 marks)

