

Name of the Student: _____

Max. Marks :26 Marks

Time :26 Minutes

Q1.

Aqueous NaBH_4 reduces aldehydes but does not reduce alkenes.

- (a) Show the first step of the mechanism of the reaction between NaBH_4 and 2-methylbutanal. You should include two curly arrows.

Explain why NaBH_4 reduces 2-methylbutanal but has no reaction with 2-methylbut-1-ene.

First step of mechanism

Explanation _____

(5)

- (b) A student attempted to reduce a sample of 2-methylbutanal but added insufficient NaBH_4 . The student confirmed that the reduction was incomplete by using a chemical test.

Give the reagent and observation for the chemical test.

Reagent _____

Observation _____

(2)

(Total 7 marks)

Q2.

Ethanal reacts with potassium cyanide, followed by dilute acid, to form 2-hydroxypropanenitrile.

- (a) Name the mechanism for the reaction between potassium cyanide and ethanal.

(1)

- (b) The 2-hydroxypropanenitrile formed by the reaction in part (a) is a mixture of equal amounts of two isomers.

State the name of this type of mixture.

Explain how the structure of ethanal leads to the formation of two isomers.

Draw 3D representations of the two isomers to show the relationship between them.

Name _____

Explanation _____

3D representations

(5)

- (c) 2-Hydroxypropanenitrile can be used in the synthesis of the monomer, acrylonitrile, $\text{CH}_2=\text{CHCN}$

Suggest a suitable reagent and conditions for the conversion of 2-hydroxypropanenitrile into acrylonitrile.

Reagent _____

Conditions _____

(2)

(d) Draw a section of the polymer polyacrylonitrile, showing three repeating units.

(1)

(Total 9 marks)

Q3.

Acyl chlorides are useful reagents in synthesis. They react with aromatic compounds and also with alcohols.

- (a) $\text{CH}_3\text{CH}_2\text{COCl}$ reacts with benzene in the presence of AlCl_3 in an electrophilic substitution reaction.

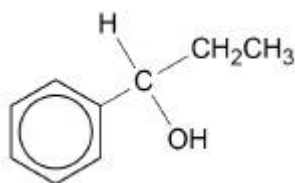
Give an equation for the reaction of $\text{CH}_3\text{CH}_2\text{COCl}$ with AlCl_3 to form the electrophile.
Outline a mechanism for the reaction of this electrophile with benzene.

Equation _____

Mechanism _____

(4)

- (b) The organic product in **part (a)** can be converted into the alcohol shown.



Give the IUPAC name of the alcohol.

Give the reagent needed for this reaction and name the mechanism.

IUPAC name _____

Reagent _____

Name of mechanism _____

(3)

- (c) The alcohol shown in **part (b)** reacts with ethanoyl chloride to form an ester.

Describe what would be observed when the alcohol reacts with ethanoyl chloride.

Name the mechanism for the reaction to form the ester.

Draw the structure of the ester.

Observation _____

Name of mechanism _____

Structure of ester _____

