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Matric No: 19/ENG05/008

Course: CHE 102

QUESTION

1) Discuss the two major classification of Alkanols. Give two Examples each for each class

2) In the Grignard synthesis of Alkanols, react a named Grignard reagent with CH3CH2CH2CH2C=OCH2CH2CH3. Show the reaction steps.

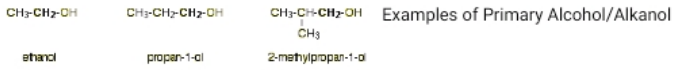
3) Discuss the industrial manufacture of ethanol showing all reaction equations and necessary enzymes and temperature of reaction

4)Determine the product obtained in the reduction of Alkanone and Alkanal. use a specific example for each and show the equation of reaction

ANSWERS

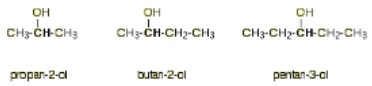
1a) 1. *Primary Alcohols/Alkanols*

Primary alcohols are those alcohols where the carbon atom of the hydroxyl group(OH) is attached to only one single alkyl group. Some of the examples of these primary alcohols include Methanol (, propanol, ethanol, etc. The complexity of this alkyl chain is unrelated to the classification of any alcohol considered as primary. The existence of only one linkage among –OH group and an alkyl group and the thing that qualifies any alcohol as a primary.



b)2. *Secondary Alcohols/Alkanols*

Secondary alcohols are those where the carbon atom of the hydroxyl group is attached to two alkyl groups on either side. The two alkyl groups present may be either structurally identical or even different. Some of the examples of secondary alcohols are given below-



3) *Industrial Manufacturing of Ethanol*

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Ethene is obtained in large quantities by cracking of petroleum. It is first absorbed in 95% tetraoxosulphate(vi) acid at 80°C and 30 atm to form ethyl hydrogentetraoxosulphate(vi). This is then hydrolyzed by boiling with water

$C_2H_{4\,(g)} + H_2SO_{4\,(aq)} \rightarrow C_2H_5HSO_{4\,(aq)}$

$C_2H_5HSO_{4\,(aq)} + H_2O_{\,(l)} \rightarrow C_2H_5OH_{\,(aq)} + H_2SO_{4\,(aq)}$

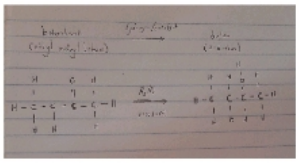
The ethanol formed is distilled off, leaving the acid which can be concentrated and used again. In a more recent process, ethene is hydrated directly by passing a mixture of ethene and steam over tetraoxophosphate(v) acid, the catalyst at 500 to 600°C and 80 to 100 atm. Most of the ethanol required for industrial use is prepared from ethene by this process.

$C_2H_{4\,(g)} + H_2O_{\,(g)} \rightarrow C_2H_5OH_{\,(l)}$

4i) *Alkanones*

The reduction of an alkanone produces a secondary alkanol.

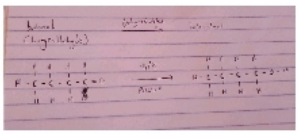
For example, we can convert butanone to butan-2-ol using a nickel catalyst with hydrogen gas under pressure as shown below:



ii) *Alkanals*

The reduction of an alkanal produces a primary alkanol.

For example, using a platinum catalyst with hydrogen gas under pressure, we can convert butanal to butan-1-ol as shown below:



2.) *Synthesis of alcohols by Brignard reagents*

An extremely useful reaction for making alcohols is the Grignard reaction (pronounced grin-yard). To make alcohols using the Grignard reaction, you react a "Grignard reagent" with a carbonyl compound. Making a Grignard reagent is fairly simple: You simply add magnesium to an alkyl halide, as shown here, which inserts the magnesium into the C-X bond to make the Grignard reagent.

$$R-X \xrightarrow[\text{Ether}]{Mg} R-MgX$$

(X=Cl, Br, I) A Grignard reagent

Making a Grignard reagent.

A Grignard reagent is an extremely powerful nucleophile (nucleus lover), and can react with electrophiles like carbonyl compounds. To determine the products made in a Grignard reaction,

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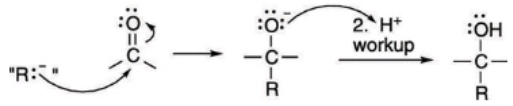
$$R-MgX = \text{"}R:^-\text{"}$$

A Grignard reagent.

The mechanism for the addition of a Grignard reagent to a carbonyl is shown in the next figure.



The Grignard reaction.

Although you can make only primary and secondary alcohols by reduction, you can make all kinds of alcohols using the Grignard reaction. If you react a Grignard reagent with formaldehyde, as shown in the next figure, you can make primary alcohols. If you react it with an aldehyde, you get secondary alcohols. If you react it with ketones, you get tertiary alcohols.

The formation of alcohols via the addition of Grignard reagents to carbonyl compounds.