CHEMISTRY Assignment

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DEPARTMENT: MBBS

MATRIC NO: 19/MHS01/385

COURSE: CHM 102

1. Alcohols are very important organic compounds. Discuss briefly their classification and give one example each

a Classification based on hydrogen atoms attached to the carbon atom containing the hydroxyl group

If the numbers of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are three or two, it is called a primary alcohol (1°), the carbon which carries the -OH group is only attached to one alkyl group e.g CH_3-CH_2-OH. If it is one hydrogen atom, it is called secondary alcohol (2°), the carbon with the -OH group attached is joined directly to two alkyl groups, which may be the same or different e.g $CH_3-\overset{OH}{\underset{|}{C}}H-CH_3$. If no hydrogen atom is attached to the carbon atom bearing the hydroxyl group, it is called a tertiary alcohol (3°), the carbon atom holding the -OH group is attached directly to three alkyl groups, which may be any combination of same or different e.g $CH_3-\overset{OH}{\underset{CH_3}{C}}-CH_3$

E.g: Ethanol (primary alcohol) - CH_3CH_2OH : $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-O-H$

b Classification based on the number of hydroxyl groups they possess

Monohydric alcohols have one hydroxyl group present in the alcohol structure. Dihydric alcohols are also called Glycols have two hydroxyl groups present in the alcohol structure. Trihydric alcohols also known as Triols have three hydroxyl groups present in the structure of the alcohol. Polyhdric alcohols or polyols have more than three hydroxyl groups.

E.g Propanol (Monohydric alcohol) - $CH_3CH_2CH_2OH$

2 Discuss the solubility of alcohols in water, organic solvents

a) Solubility of alcohol in water : This is due to the hydroxyl group in the alcohol which is able to form hydrogen bonds with water molecules. Alcohol with a smaller hydrocarbon chain are very soluble. As the length of the hydrocarbon chain increases, the solubility in water decreases because it requires more energy to overcome the hydrogen bond between the alcohol molecules as the molecules are more tightly packed together as the size and mass increases.

b) Solubility of alcohol in ~~universal~~ organic solvents: All monohydric alcohols are soluble in organic solvents. The solubility of simple alcohols and polyhydric alcohols is largely due to their ability to form hydrogen bonds with other molecules.

3. Show the three steps in the industrial manufacture of ethanol. Equations of reaction are compulsory.

Carbohydrates such as starch are major group of natural compounds that can be made to yield ~~ethanol~~ by the biological process of fermentation. The biological catalysts, enzymes found in yeast break down the carbohydrate molecules into ethanol to give a yield of 95%.

STEP 1: The starch containing materials include molasses, potatoes, cereals, rice and on warming with malt to 60°C for a specific period of time is converted into maltose by the enzyme diastase contained in the malt

$$2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[\text{diastase}]{60^\circ C} nC_{12}H_{22}O_{11}$$

carbohydrate → maltose

STEP 2: The maltose is broken down into glucose on addition of yeast which contains the enzyme maltase and at a temperature of 15°C

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{maltase}]{15^\circ C} 2C_6H_{12}O_6$$

maltose → glucose

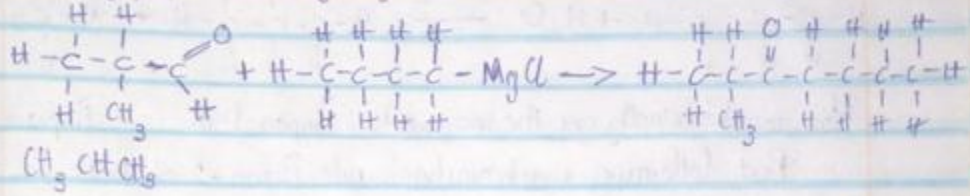
STEP 3: The glucose at constant temperature of 15°C is then converted into alcohol by the enzyme zymase contained also in yeast.

$$C_6H_{12}O_6 \xrightarrow[\text{Zymase}]{15^\circ C} 2CH_3CH_2OH + 2CO_2$$

Glucose — Ethanol

4 Show the reaction between 2-methylpropanal and butylmagnesium chloride : Hint Grignard synthesis

2-methylpropanol + Butylmagnesium chloride ⟶ 2-methyl-3-heptanol

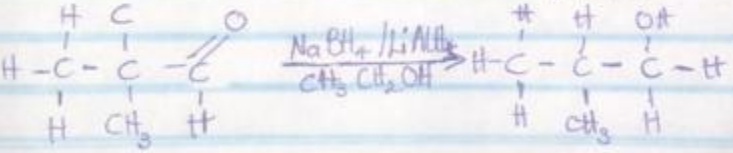


CH_3CHCH_3

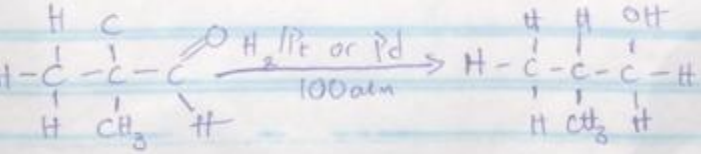
5 Show the reaction between 2-methylpropanone and butylmagnesium chloride Hint: Grignard synthesis Note: show all structures

7. Show the reduction reaction of 2-methylpropanal

a)

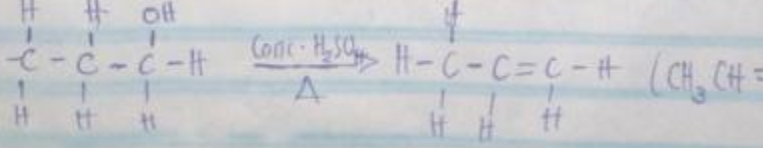


b)



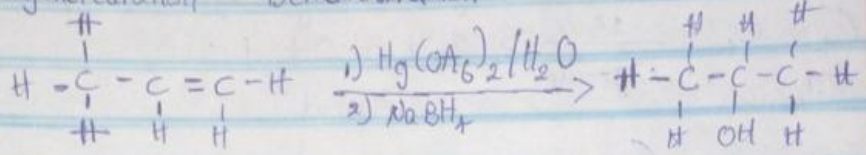
8 Propose a scheme for the conversion of propan-1-ol to propan-2-ol

Step 1 : Dehydration of Propan-1-ol to propene using Conc. H_2SO_4

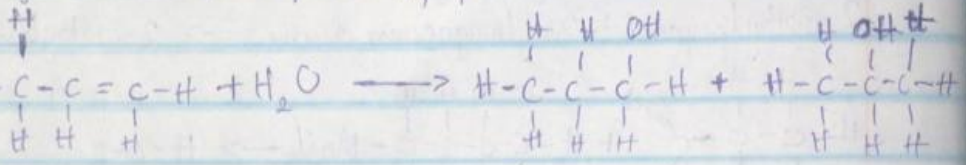


For STEP 2 : two methods could be used either a or b

a) Oxymercuration - Demercuration



b Since propene is assymetrical on hydrolysis or addition of water, using a markovnikov procedure, propan-2-ol can be obtained



You would actually get the two products : Propan-1-ol , Propan-2-ol

But following markovnichov's rule, Propan-2-ol would be the major product.