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**Course : Chm102**

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

## •Classification of Alcohols

1. They may be classified as primary( $1^\circ$ ),secondary( $2^\circ$ ) or tertiary ( $3^\circ$ ) depending on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group.

a)it is a **primary alcohol( $1^\circ$ )** If the number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are three or two e.g Methanol( $1^\circ$ ) ;

b)it is a **secondary alcohol ( $2^\circ$ )** if it is one hydrogen atom , e.g Propan-2-ol( $2^\circ$ )

c)it is a **tertiary alcohol( $3^\circ$ )** if no hydrogen atom is attached to the carbon atom bearing the hydroxyl group. E.g 2-Methyl propan-2-ol( $3^\circ$ )

2. Alcohols are also classified as mono, di, tri, or polyhydric depending upon the number of hydroxyl groups they possess . Alcohols containing one hydroxyl group are described as MONOHYDRIC ALCOHOLS , those containing two hydroxyl groups as DIHYDRIC ALCOHOLS, DIOLS or GLYCOLS , those containing three groups as TRIHYDRIC ALCOHOLS or TRIOLS and those containing more than three hydroxyl groups as POLYHYDRIC ALCOHOLS or POLYOLS

Examples : Propanol (Monohydric alcohol) , Ethane-1,2-diol(Dihydric alcohol), Propan-1,2,3-triol(Trihydric alcohol) , Heptan 2,3,4,5,6-pentanol(Polyhydric alcohol)

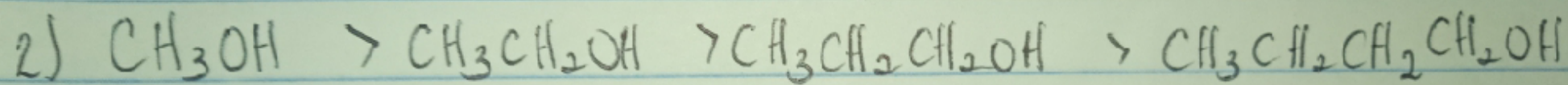
- 2. Discuss the solubility of alcohols in water, organic solvents.

### **Solubility of alcohols in water**

Lower alcohols with up to three carbon atoms in their molecules are soluble in water because these lower alcohols can form hydrogen bonds with water molecules. The water solubility of alcohols decreases as their relative molecular mass increases, because the structure becomes relatively more hydrocarbon in nature.

### **Solubility of alcohols in organic solvents**

All monohydroxyl alcohols are soluble in organic solvents. Addition of hydroxyl(OH) group without increasing the number of carbon atoms increases the solubility in water and decreases the solubility in ether and ethanol, and increases the melting point, boiling point, sweetness, density and viscosity at the same time.



Decreasing order of solubility in water →

### 3. Show the three steps in the industrial manufacture of ethanol. Equations of reactions are mandatory

- Carbohydrates such as starch are a major group of natural compounds that can be made to yield ethanol by the biological process of FERMENTATION. The biological catalyst, enzymes, found in the 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 e.t.c and on warming with malt to 60°C for a specific period of time are converted to maltose by enzyme **DIASTASE** contained in the malt.

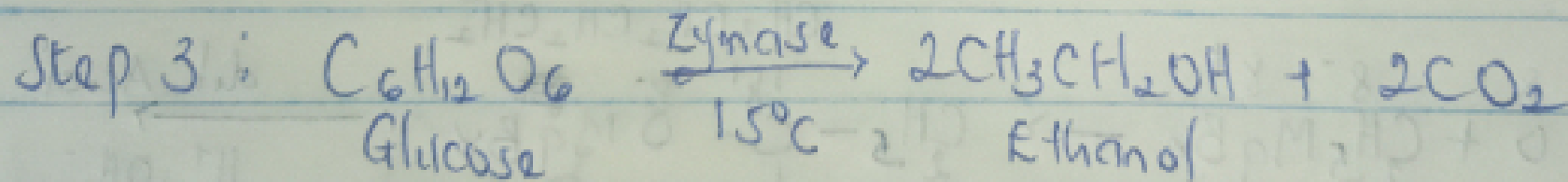
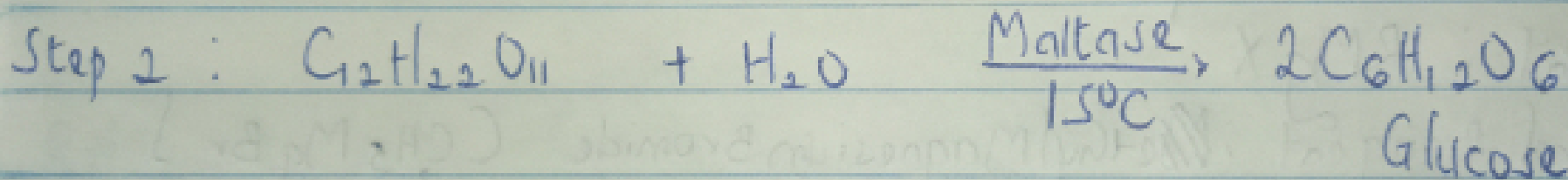
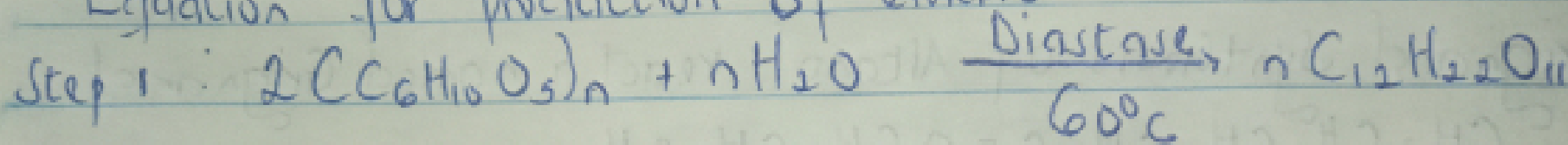
#### **STEP 2**

The maltose is broken down into glucose on addition of yeast, which contains the enzyme **MALTASE**, and at a temperature of 15°C.

#### **STEP 3**

The glucose at constant temperature of 15°C is then converted into alcohol by the enzyme **ZYMASE** also contained in the yeast.

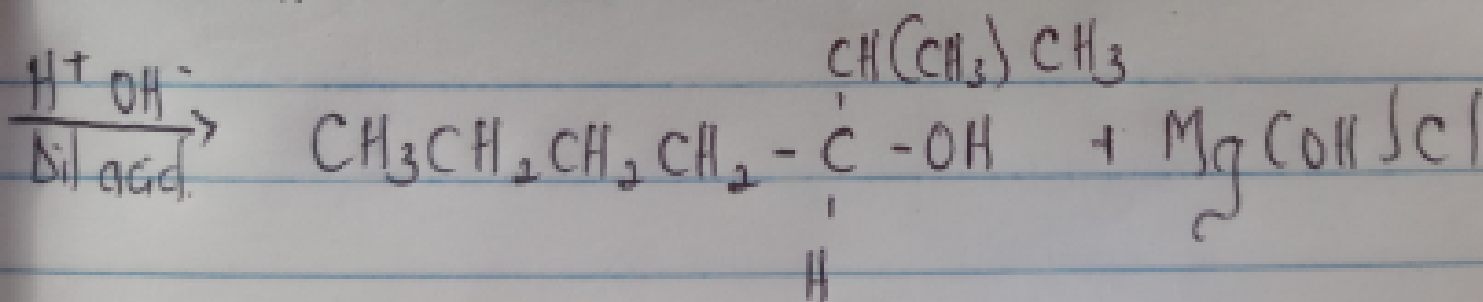
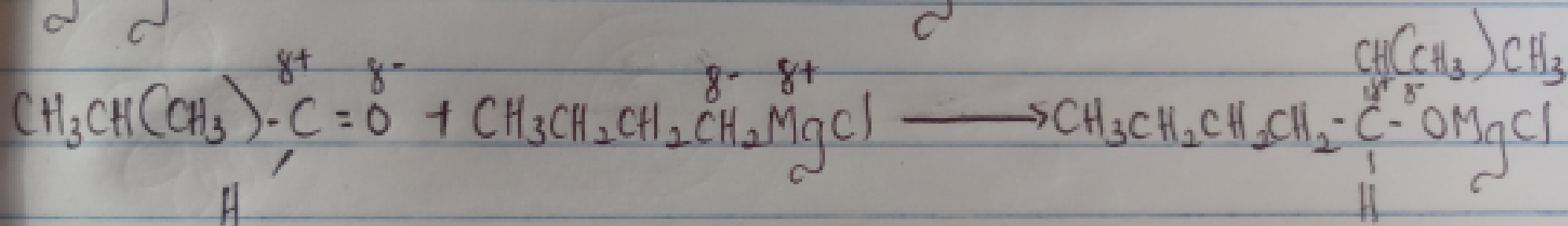
Equation for production of ethanol.



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

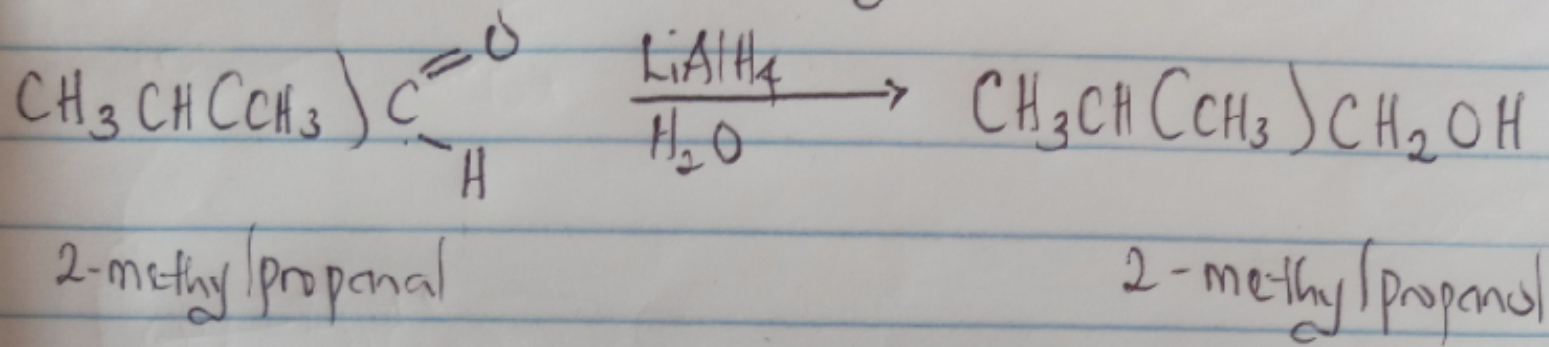
2-methylpropanal :  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CHO}$

Butylmagnesium chloride :  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{MgCl}$



2-methylheptan-3-ol  
(secondary alcohol)

reduction  
7) Show the reaction of 2-methylpropanal



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

