

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

(a) Based on Hydrogen atoms attached to the carbon atom containing the hydroxyl group.

(i) Primary Alcohol ( $1^\circ$ ): - 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 e.g.  $\text{CH}_3\text{OH}$  - Methanol ( $1^\circ$ )

(ii) Secondary Alcohol ( $2^\circ$ ): - A secondary alcohol is formed, when the numbers of hydrogen atoms attached to the carbon atom bearing the hydroxyl group is one. e.g.  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$  - Propan-2-ol ( $2^\circ$ )

(iii) Tertiary Alcohol ( $3^\circ$ ): If no hydrogen is attached to the carbon atom bearing the hydroxyl group. It is called tertiary alcohol e.g.  $(\text{CH}_3)_3\text{C}-\text{OH}$  - Methyl propan-2-ol ( $3^\circ$ )

(b) Based on the number of hydroxyl groups they possess

(i) Monohydric Alcohols: They have one hydroxyl group present in the alcohol structure e.g.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$  - Propanol

(ii) Dihydric Alcohols: they are also called Glycols. They have two hydroxyl groups present in the alcohol structure e.g.  $\text{HOCH}_2\text{CH}_2\text{OH}$  - Ethane-2,2-diol

(iii) Polyols: they have more than three hydroxyl groups for example;  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$  - Heptane-2,3,4,5-tetraol (Polyhydric alcohol).

## 2 Solubility of alcohols in water and in organic solvents

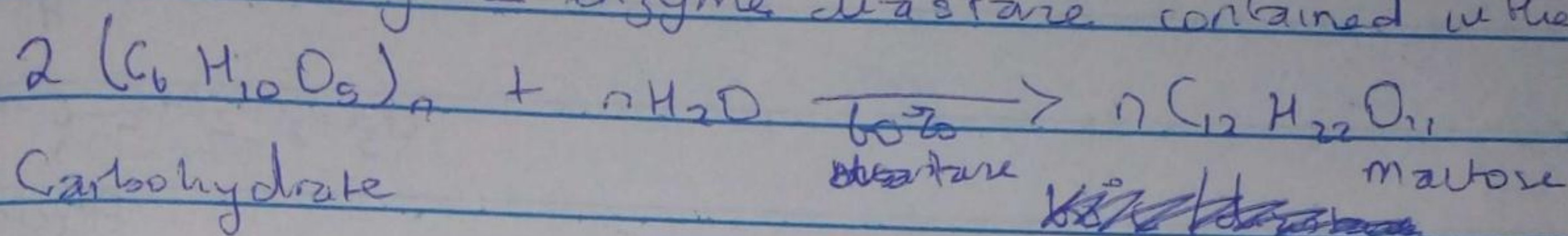
Alcohols are soluble in water. This is due to the hydroxyl group in the alcohol which is able to form hydrogen bonds with water molecules. Alcohols with a small hydrocarbon chain are very soluble. As the length of the hydrocarbon chain increases, the solubility in water decreases with four carbon in the hydrocarbon chain and higher, the decrease in solubility becomes visible as the mixture forms with immiscible liquid layers. The reason why solubility decreases as the length of HC chain increases is because it requires more energy to overcome the hydrogen bonds between the alcohol molecules as they are tightly packed together as the size of mass increases. All monohydric alcohols are soluble in organic solvents. The solubility of simple alcohols and polyhydric alcohol is largely due to their ability to form hydrogen bonds with water molecules.

## 3 Industrial Production of alcohols

### STEP 1: Fermentation

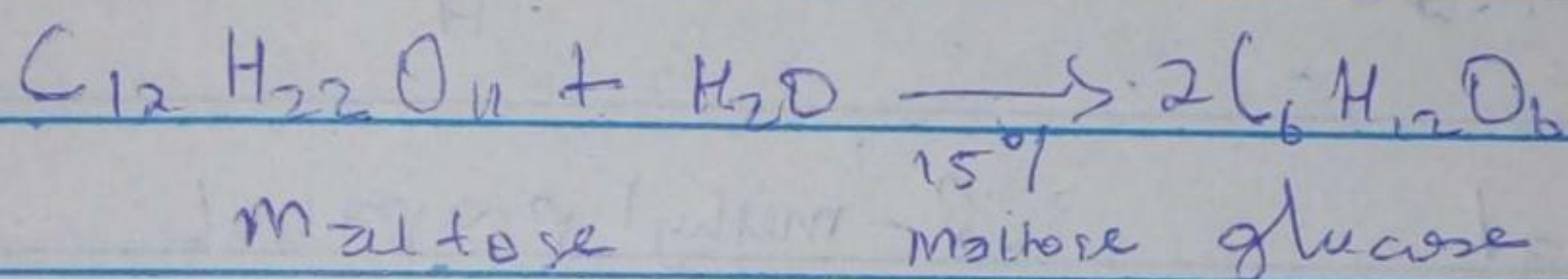
Carbohydrates such as starch are a major group of natural compounds that can be made to yield ethanol by the biological process of fermentation. The biological catalysts, enzymes found in yeast breaks down the carbohydrate molecules into

ethanol to give a yield of 95%. The starch containing materials include molasses, potatoes, cereals, rice and on warming with malt to 60°C for a specific period of time are converted into maltose by the enzyme diastase contained in the malt



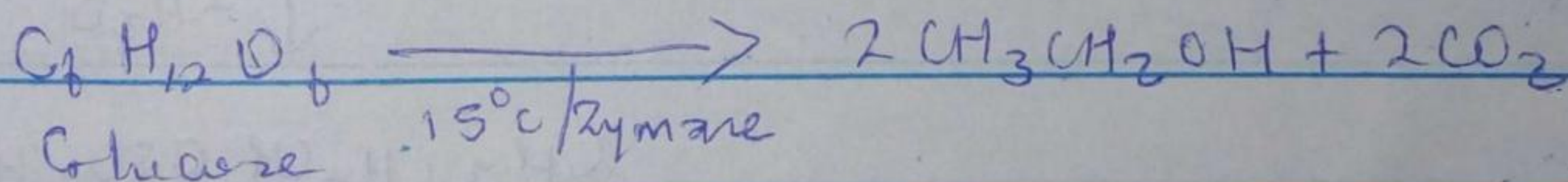
### STEP 2

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

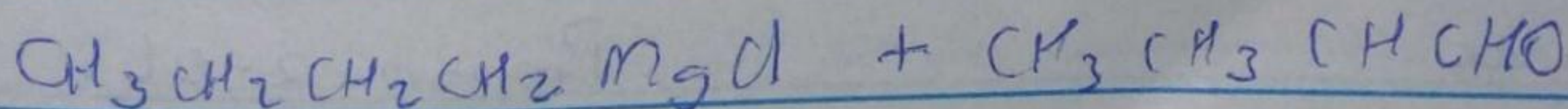


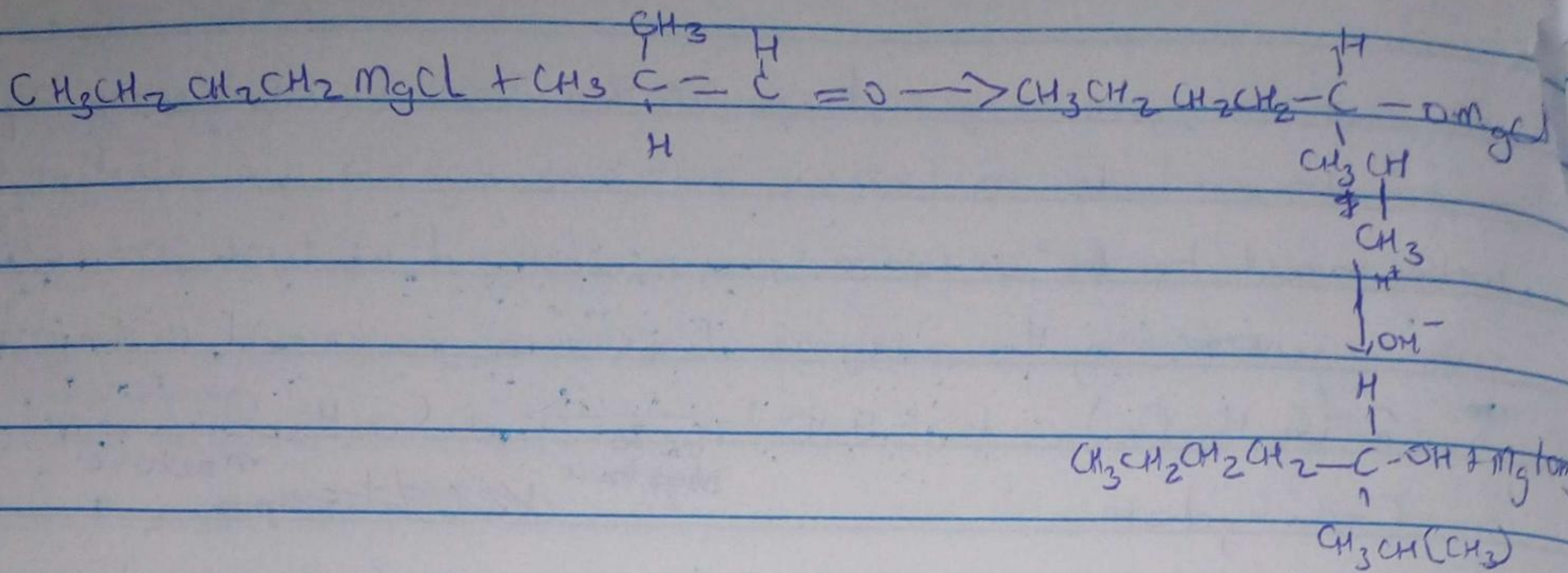
### STEP 3

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

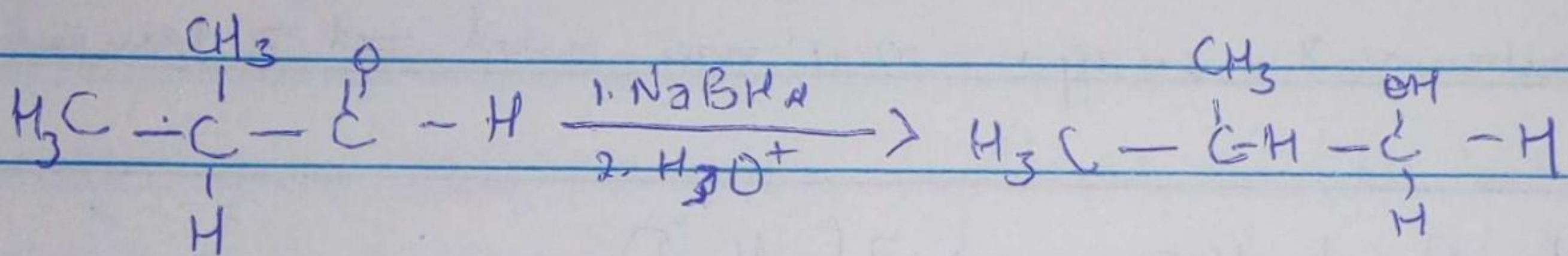


A) Grignard synthesis using butyl magnesium chloride & 2-methyl propanal





7 Reduction reaction of 2-methyl propanal. [Using Sodium tetrahydride borohydride in water]



2-methyl propanal

2-methyl propanol

8 Conversion of propan-3-ol to propan-2-ol

- Dehydrate Propan-3-ol using  $\text{H}_2\text{SO}_4$

