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1.)

a.) The classification based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group.

There are 3 divisions under this classification. If the number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are two or three, then it is called a PRIMARY ALCOHOL. If it has only one hydrogen atom attached, then it is called a SECONDARY ALCOHOL. If there is no hydrogen atom attached to the carbon atom bearing the hydroxyl group, then it is called a TERTIARY ALCOHOL.

E. G.

I.) (CH3)3C-OH {2-methyl propan-2-ol}. This is a typical example of a tertiary alcohol.

ii.) CH3CH2CH2CH(OH)CH3 {Pentan-2-ol}. This is a typical example of a secondary alcohol.

III.) CH_3CH_2OH {Ethanol}. This is a typical example of a primary alcohol.

b.) The classification based on the number of hydroxyl groups they possess.

There are also four divisions under this classification. They are the monohydric, the dihydric (GLYCOLS), the trihydric (TRIOLS) and the polyhydric (POLYOLS). The monohydric alcohol has only one hydroxyl group present in the alcohol structure. The dihydric alcohol has two hydroxyl groups present in the alcohol. The trihydric alcohol has three hydroxyl groups present in the alcohol structure. Lastly is the polyhydric alcohol which has more than three hydroxyl groups.

E. G.

I.) $CH_3CH_2CH_2OH$ [Propanol]. This is a typical example of the monohydric alcohol.

II.) CH2(OH)CH(OH)CH(OH)CH2CH3 [Pentane-1,2,3-triol]. This is a typical example of the trihydric alcohol.

III.) CH3CH(OH)CH(OH)CH(OH)CH(OH)CH3 [Hexane-2,3,4,5-butaol]. This is a typical example of the polyhydric alcohol.

2.) Lower alcohols with up to three carbon atoms in their molecules are soluble in water because these lower alcohols can form hydrogen bond with water molecules. The water solubility of alcohols decreases with increasing relative molecular mass.

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 water molecules.

3.) The industrial manufacture of ethanol involves the fermentation of carbohydrate. The three steps involved in the fermentation are;

STEP 1: The material (molasses, potato, cereals, rice, etc.) which contains starch are heated with malt to **60 degrees** for a specific period of time and they are converted into maltose by the enzyme **DIASTASE** contained in the malt.

$$2(C_6H_{10}O_5)\ n + nH_2O \text{ ----------> } nC_{12}H_{22}O_{11}$$

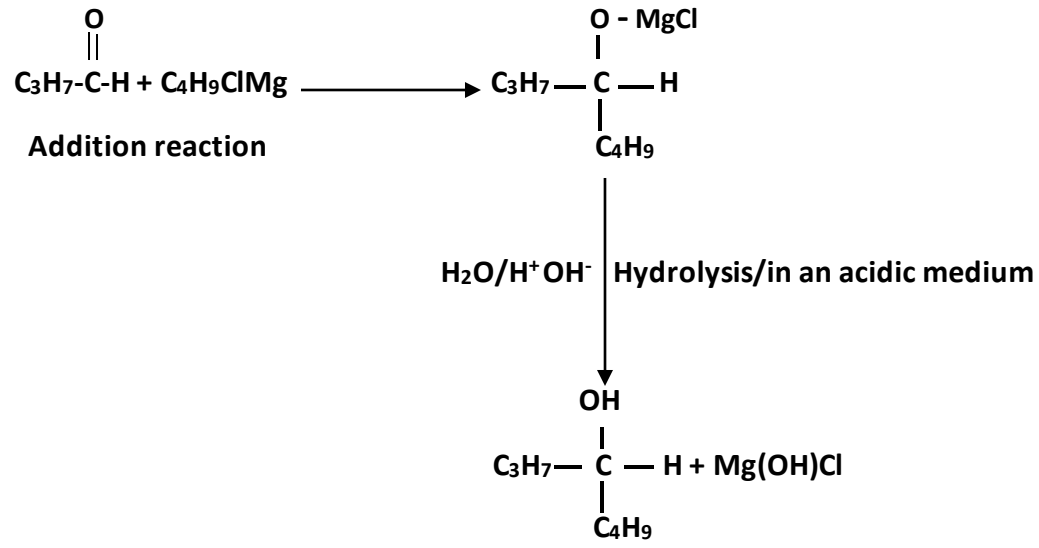
STEP 2: The maltose is broken down into glucose on addition of yeast which contains the enzyme **MALTASE** and at a temperature of **15 degrees**.

$$C_{12}H_{22}O_{11} + H_2O \text{ ----------> } 2C_6H_{12}O_6$$

STEP 3: The glucose at a constant temperature of **15 degrees** is then converted into alcohol by the enzyme **ZYMASE** contained also in the yeast.

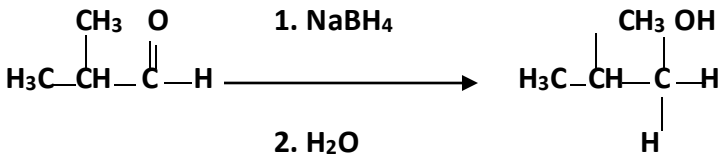
$$C_6H_{12}O_6 \text{ ----------> } 2CH_3CH_2OH + 2CO_2$$

4.)



7.) Sodium borohydride ($NaBH_4$) is used as a reducing agent for the conversion of aldehydes and ketones to alcohols.

Treatment of 2-methylpropanal with $NaBH_4$ followed by the hydrolysis gives 2-methylpropanol. Thus, the reaction is shown as follows;

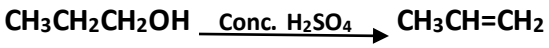


2-methylpropanal 2-methylpropanol

8.) The conversion of PROPAN-1-OL to PROPAN-2-OL involves two processes.

I.) Dehydration of propan-1-ol to propene.

When propan-1-ol Is treated with concentrated sulfuric acid [H_2SO_4], the phenomenon called dehydration occurs due to which a water molecule from propan-1-ol gets eliminated. Due to this, propan-1-ol gets converted to propene.

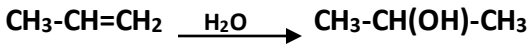


Propan-1-ol Propene

II.) Hydrolysis of Propene to Propan-2-ol.

Propene can be hydrolyzed to propan-2-ol in accordance with mechanism known as MARKOWNIKOFFS ADDITION. It states that, in hydrohalogenation of an unsymmetrical alkene, the hydrogen atom in the hydrogen halide forms a bond with the doubly bonded carbon atom in the alkene, bearing the greater number of hydrogen atoms.

In this case, the unsymmetrical reagent used is H_2O which is made up of H^+ and OH^- part. Due to the hydrolysis of water, the negative part attaches itself to the propene and thus converts it to propan-2-ol.



Propene Propan-2-ol