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

Alkanols can be classified based on the number of hydrogen atoms attached to the carbon atom containing hydroxyl group.

(a) PRIMARY ALKANOLS ( $1^\circ$ ): These are alkanols that have two or three hydrogen atoms attached to the carbon atom bearing the hydroxyl group.

E.g.  $\text{CH}_3\text{OH}$  (Methanol),  $\text{CH}_3\text{CH}_2\text{OH}$  (Ethanol)

(b) SECONDARY ALKANOLS ( $2^\circ$ ): These are alkanols that have only one hydrogen atom attached to the carbon atom bearing the hydroxyl group.

E.g.  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$  (Propan-2-ol),  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$  (Butan-2-ol)

(c) TERTIARY ALKANOLS ( $3^\circ$ ): These are alkanols that have no hydrogen atom attached to the carbon atom bearing the hydroxyl group.

E.g.  $(\text{CH}_3)_3\text{C}-\text{OH}$  (2-Methylpropan-2-ol),  $\text{CH}_3-\text{CH}_2-\overset{\text{OH}}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_3$  (2-methylbutan-2-ol)

(ii) based on the number of hydroxyl groups they possess

(a) MONOHYDRIC ALCOHOLS/ALKANOLS: These are alkanols that have one hydroxyl group present in the alcohol structure

E.g.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$  (Propanol),  $\text{CH}_3\text{CH}_2\text{OH}$  (Ethanol)

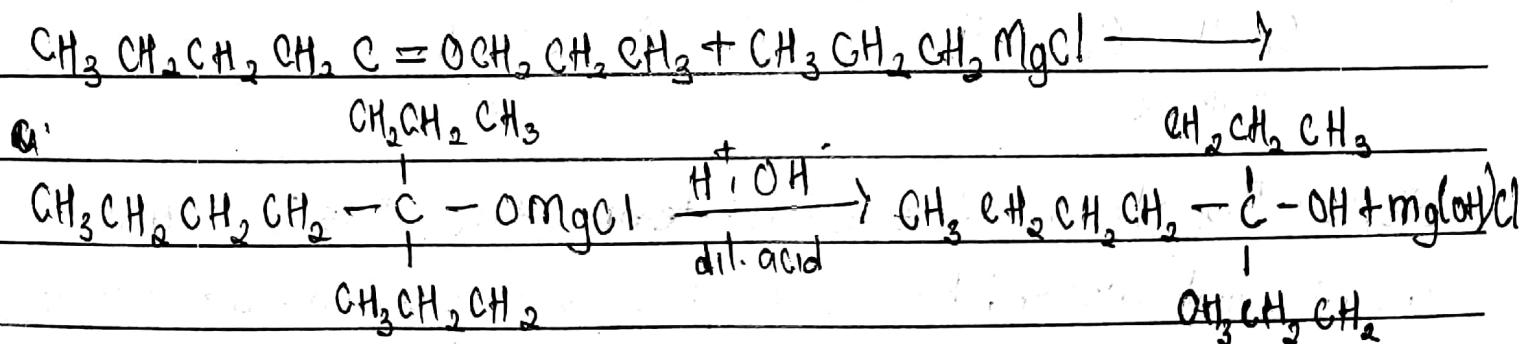
(b) DIHYDRIC ALKANOLS: These are also called GLYCOLS, they have two hydroxyl groups present in the alcohol structure. E.g.  $\text{HOCH}_2\text{CH}_2\text{OH}$  (Ethane-1,2-diol),  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$  (Hexane-2,4-diol)

(c) TRIHYDRIC ALKANOLS (TRIOLS): These are alkanols that have three hydroxyl groups present in the structure of the alcohol. E.g.  $\text{OHCH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$  (Propane-1,2,3-triol),  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{OH}$  (Butane-2,3,4-triol)

(d) POLYHYDRIC ALKANOLS (POLYOLS): They are alkanols with more than three hydroxyl groups present in the structure of the alcohol. E.g.  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$  (Heptane-2,3,4,5,6-pentanol),  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$  (Hexane-2,3,4,5-butanol)

2) In the Grignard synthesis of alkanols, reacted a named Grignard reagent with  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C}=\text{OCH}_2\text{CH}_2\text{CH}_3$ . Show the reaction steps.

Grignard reagent =  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgCl}$

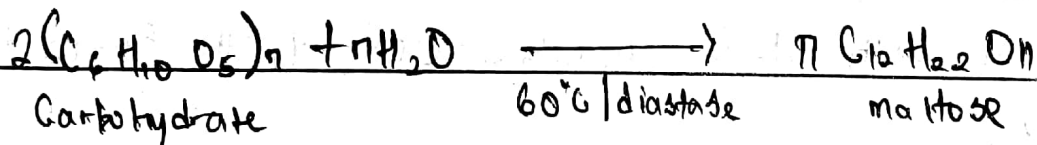


4-propyloctan-4-ol

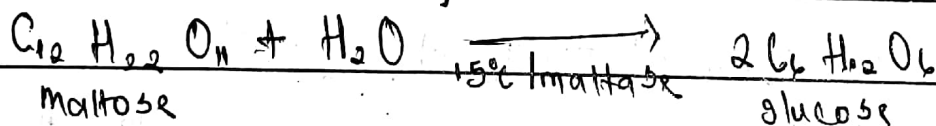
3) Discuss the industrial manufacture of ethanol showing all reaction equations and necessary enzymes and temperature of reaction.

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%.

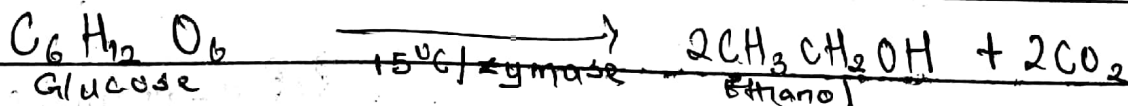
STEP 1: The starch containing materials include molasses, potatoes, cereals, rice and on warming with malt to  $60^{\circ}\text{C}$  for a specific period of time are converted into maltose by the enzyme diastase contained in the malt.



STEP 2: The maltose is broken down into glucose on addition of yeast which contains the enzyme maltase and at a temperature of  $15^{\circ}\text{C}$ .

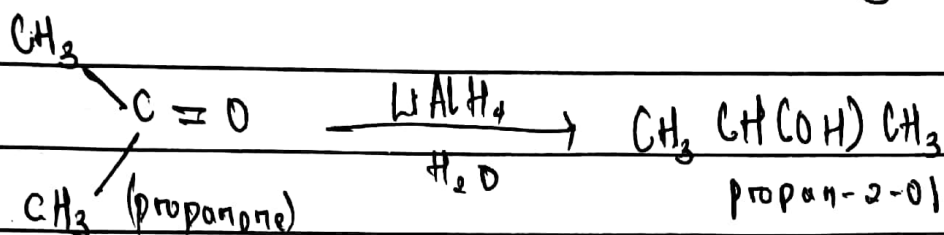


STEP 3: The glucose at constant temperature of  $15^{\circ}\text{C}$  is then converted into alcohol by the enzyme zymase contained also in yeast.



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

Example is the reduction of Propanone will give Propan-2-ol



⇒ Reduction of alanal gives primary alcohols

Example is the reduction of propanal give propanol

