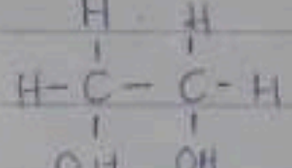
1) Discuss the two major classification of Alkanols. Give two examples each for each class.

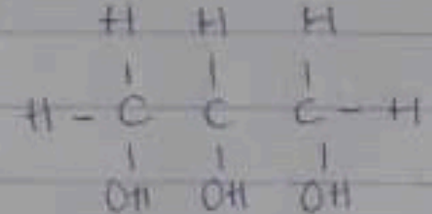
Answer:

1) Monohydric Alkanols :- These are alkanols with only one hydroxyl group (OH) in their molecule. The first three members of the family are:
   - Methanol : CH_3OH (commonly known as wood spirit)
   - Ethanol : CH_3CH_2OH or C_2H_5OH
   - Propanol : $CH_3CH_2CH_2OH$ or C_3H_7OH

2) Polyhydric Alkanols :- This class of alkanols contains more than one hydroxyl groups per molecule.
It occurs in two sub class namely the dihydric alkanol and the trihydric alkanol.
examples :- Dihydric alkanol; Ethane-1,2-diol (ethylene glycol)



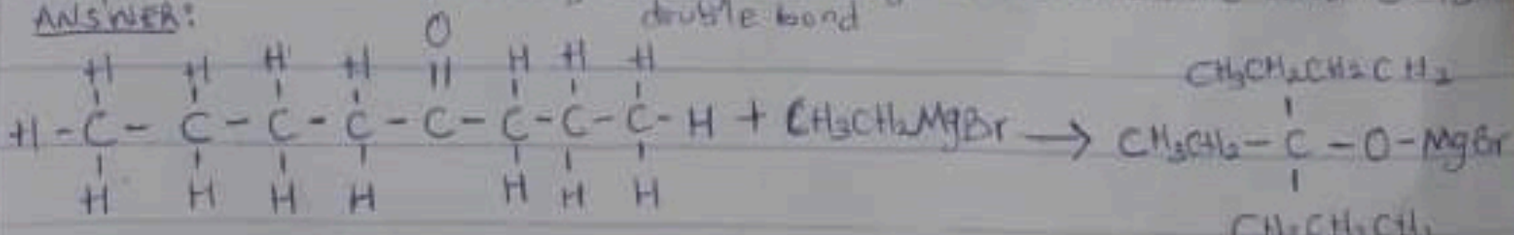
Trihydric alkanol Propan-1,2,3,triol (glycerol)



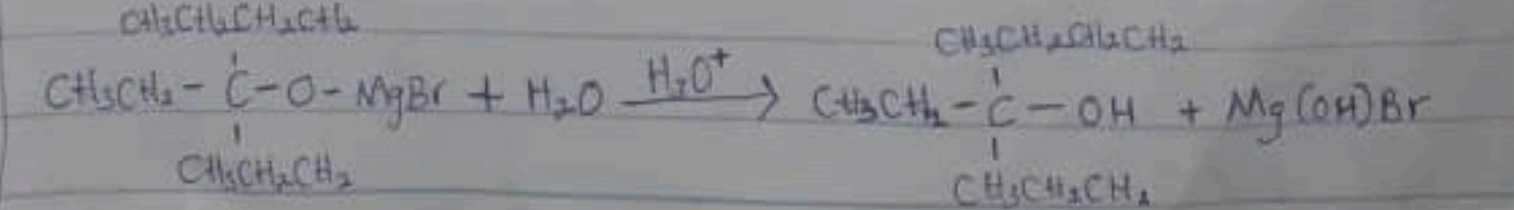
2) In the Grignard synthesis of Alkanols, react a named Grignard reagent with $CH_3CH_2CH_2CH_2C=OCH_2CH_2CH_3$. Show the reaction steps.

ANSWER:

First stage: The grignard reagent adds across the carbon oxygen double bond



Dilute acid is then added to hydrolyse it:



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

ANSWER:

Reduction of Alkanone:- Alkanone are reduced to the corresponding Secondary alkanol.

Reduction of Alkanone using Conc H_2SO_4.

Propan-1-ol to Propan-2-ol.

$$CH_3-CH_2-CH_2-OH \xrightarrow[170^oC]{Conc.\ H_2SO_4} CH_3-CH=CH_2 + H_2O$$

Propan-1-ol — Prop-1-ene

$$CH_3-CH=CH_2 \xrightarrow{HBr} CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$$

2-Bromopropane

$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{KOH(aq)} CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$$

Propan-2-ol

Reduction of Alkanal —: Alkanals are reduced to the corresponding primary alkanol by reducing agents such as lithium tetrahydridoaluminate (III), ($LiAlH_4$).

e.g Ethanal is reduced to ethanol.

$$CH_3-\overset{\overset{O}{||}}{C}-H + 2(H) \xrightarrow{\Delta} CH_3-\overset{\overset{OH}{|}}{CH_2}$$

Ethanal — Ethanol

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

Fermentation is the chemical process that involves the breaking down of molecules such as glucose anaerobically with the release of carbon dioxide gas and alcohol.

The production of ethanol by fermetation occurs in three basic steps:-

The temperature of the reactions occur at a minimum teperature of (25-35)°C

From starch (grans).

$$2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[\text{Yeast}]{\text{Diatase}} C_{12}H_{22}O_{11}$$

maltose

$$C_{12}H_{22}O_{11} + nH_2O \xrightarrow[\text{Yeast}]{\text{Maltase}} 2C_6H_{12}O_6$$

Glucose

$$C_6H_{12}O_6 \xrightarrow[\text{Yeast}]{\text{zymase}} 2C_2H_5OH + 2CO_2$$