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

There are two ways of classifying alkanols;
They are classification based on:

1 The number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group.

a If the number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are three or two, it is called a primary alcohol (1°). e.g. CH_3OH (Methanol), CH_3CH_2OH (Ethanol)

b If the number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group is one, it is called a secondary alcohol (2°) e.g. $CH_3CH(OH)CH_3$ (Propan-2-ol)

c If there is no hydrogen atom attached to the carbon atom bearing the hydroxyl group, it is called a tertiary alcohol (3°) e.g. $(CH_3)_3C-OH$ (2-methylpropan-2-ol)

2. The number of 'OH' functional group present in the structure of the alcohol.

a When there is only one 'OH' functional group present in the structure of the alcohol, it is called monohydric alcohol. e.g. $CH_3CH_2CH_2OH$ (Propanol)

b When there are two 'OH' functional groups present in the structure of the alcohol, it is called dihydric alcohol or glycol. e.g. $HOCH_2CH_2OH$ (Ethane-1,2-diol), $CH_3CH(OH)CH_2CH(OH)CH_2CH_3$ (Hexane-2,4-diol) (Dihydric alcohol)

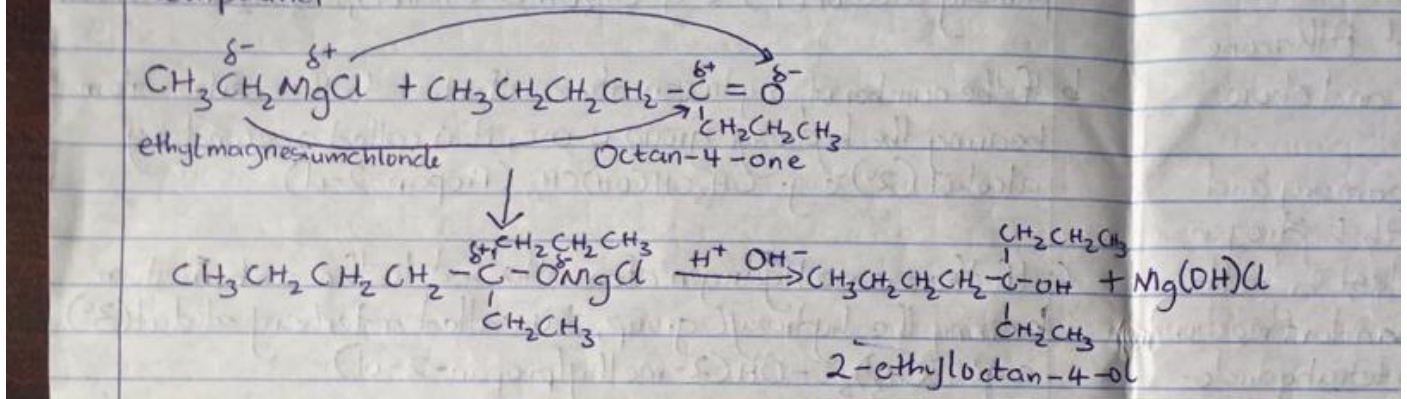
c. When there are more than three 'OH' functional groups present in the structure of the alcohol, it is called polyhydric alcohols or polyols. e.g. $CH_3CH(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH_3$ (Heptane-2,3,4,5,6-pentanol)

d When there are three 'OH' functional groups present in the

structure of the alcohol, it is called trihydric alcohol of triol
e.g. $OHCH_2CH(OH)CH_2OH$ (Propane-1,2,3-triol)

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

Using CH_3CH_2MgCl as the grignard agent and $CH_3CH_2CH_2CH_2C{=}OCH_2CH_2CH_3$ as the carbonyl compound.



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

Industrial manufacture of ethanol

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 breakdown 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 diatase contained in the malt.

$$\underset{\text{carbohydrate}}{2(C_6H_{10}O_5)n} + nH_2O \xrightarrow[60°C\ /\ \text{diatase}]{} \underset{\text{maltose}}{nC_{12}H_{22}O_{11}}$$

The maltose is broken down into glucose on addition of yeast which contains the enzyme maltase and at

a temperature of 15°C.

$$\underset{\text{maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[15°C\ /\ \text{maltase}]{} 2C_6H_{12}O_6$$

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

$$C_6H_{12}O_6 \xrightarrow[15°C\ /\ \text{zymase}]{} \underset{\text{Ethanol}}{2C_2H_5OH} + 2CO_2\uparrow$$

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

Alkanones and Alkanals are reduced to primary and secondary alcohols respectively by reaction with hydrogen in the presence of a platinum or nickel catalyst or with aluminium isopropoxide (the Meerwein-Ponndorf reaction) or with complex metal hydride, such as lithium tetrahydridoaluminate (III) ($LiAlH_4$) or sodium tetrahydridoborate (III) ($NaBH_4$)

For Alkanal

$$CH_3CH_2C{=}O{-}H \xrightarrow[H_2O]{LiAlH_4} CH_3CH_2CH_2OH$$

For Alkanone