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

CLASSIFICATION OF ALCOHOLS

(a) This is a based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group. 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 (1°). If it is one hydrogen atom, it is called SECONDARY ALCOHOL (2°) and if no hydrogen atom is attached to the carbon atom bearing the hydroxyl group, it is called a TERTIARY ALCOHOL (3°). Examples are CH_3OH methanol (1°), CH_3CH_2OH ethanol (1°), $CH_3CH(OH)CH_3$ propan-2-ol (2°), $(CH_3)_3C-OH$ 2-methylpropan-2-ol 2-methylpropan-2-ol (3°)

(b) This is based on the number of hydroxyl group they possess. Monohydric alcohols have one hydroxyl group present in the alcohol structure. DIHYDRIC ALCOHOLS are also called GLYCOLS have two hydroxyl groups present in the alcohol structure while TRIHYDRIC ALCOHOLS or TRIOLS have three hydroxyl groups present in the structure ~~structure~~ of the alcohol. POLYHDRIC ALCOHOLS OR POLYOL

have more than three hydroxyl groups.
Examples are $CH_3CH_2CH_2OH$ propanol (monohydric alcohol), $HOCH_2CH_2OH$ ethane-1,2-diol (dihydric alcohol), $OHCH_2CH(OH)CH_2OH$ propane-1,2,3-triol (trihydric alcohol). $CH_3CH(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH_3$ Heptane-2,3,4,5,6-pentanol (polyhydric alcohol).

(2) Discuss the solubility of alcohols in water, organic solvent
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) Show the three steps in the industrial manufacture of ethanol. Equations of reaction are mandatory.
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.

$$2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[60^\circ C \,/\, \text{diastase}]{} nC_{12}H_{22}O_{11}$$

carbohydrate — maltose.

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

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

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

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow[15^\circ C / \text{zymase}]{} \underset{\text{ethanol}}{2CH_3CH_2OH} + 2CO_2$$

④ Show the reaction between 2-methylpropanal and butylmagnesiumchloride

HINT GRIGNARD SYNTHESIS.

$$C_4H_9MgCl_{(aq)} + (CH_3)_2CH\overset{O}{\overset{\|}{C}}H \longrightarrow (CH_3)_2CH\overset{OH}{\overset{|}{C}H}CH_2CH_2CH_2CH_2CH_3$$

⑦ Show the reduction reaction of 2-methylpropanal

$$\underset{\text{2-methylpropanal}}{H_3C-\overset{CH_3}{\overset{|}{CH}}-\overset{O}{\overset{\|}{C}}-H} \xrightarrow[H_3O^+]{NaBH_4} \underset{\text{2-methylpropanol}}{H_3C-\overset{CH_3}{\overset{|}{CH}}-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-H}$$

⑧ propose a scheme for the conversion of propan-1-ol to propan-2-ol

$$CH_3CH_2CH_2OH + H_2SO_4 \longrightarrow CH_3CH_2CH_2OH_2OSO_3H \xrightarrow{-H_2O}$$

$$CH_3CH_2CH_2OSO_3H \xrightarrow{-H_2SO_4} CH_3CH=CH_2 \xrightarrow{H^+, OH} CH_3-\underset{OH}{\underset{|}{CH}}-CH_3$$