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Assignment

1. The two major classifications of alcohols are as follows:

a. This is 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:

CH_3CH_2OH [Ethanol: Primary alcohol]

$CH_3CH_2CH(OH)CH_3$ [Butan-2-ol: secondary alcohol]

$(CH_3)_3C-OH$ [2-Methylpropan-2-ol: Tertiary alcohol]

b. This is based on the number of hydroxyl groups they possess. Monohydric alcohols have one hydroxyl group present in the alcohol structure. Dihydric alcohols are also called glycols and they have two hydroxyl groups present in the alcohol structure while trihydric alcohols (or triols) have three hydroxyl groups present in the structure of the alcohol. Polyols have more than three hydroxyl groups.

Examples:

$CH_3CH_2CH_2CH_2OH$ ÷ Butanol [Monohydric alcohol]

$HOCH_2CH_2OH$ ÷ Ethane-1,2-diol [Glycol]

$CH_3CH(OH)CH(OH)CH_2OH$ ÷ Butan-1,2,3-triol [Triol]

$CH_3CH_2\overset{*}{C}H(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH_3$ ÷ Nonan-2,3,4,5,6,7-hexaol [Polyol]

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. Step 1: Starch is warmed with malt to 60°C to be converted to maltose by 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 water Maltose

Step 2: The maltose is broken down into glucose on addition of yeast which contains enzyme maltase and at a temperature of 15°C

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[15^\circ C]{\text{Maltase}} 2C_6H_{12}O_6$$

Maltose water Glucose

Step 3: The glucose at constant temperature of 15°C is converted into alcohols by enzyme zymase also contained in yeast.

$$C_6H_{12}O_6 \xrightarrow[15^{\circ}C]{\text{Zymase}} 2CH_3CH_2OH + 2CO_2$$

Glucose — Ethanol — Carbon dioxide

4. $CH_3CH_2CH_2CH_2MgCl + CH_3CH(CH_3)-\underset{\underset{H}{|}}{C}=O \rightarrow CH_3CH(CH_3)-\underset{\underset{CH_3CH_2CH_2CH_2}{|}}{\overset{\overset{H}{|}}{C}}-OMgCl$

butylmagnesiumchloride — 2-methylpropanal

Hydrolysis ↓

$$CH_3CH(CH_3)-\underset{\underset{CH_3CH_2CH_2CH_2}{|}}{\overset{\overset{H}{|}}{C}}-OH + Mg(OH)Cl$$

2-Methylheptan-3-ol

7. $CH_3CH(CH_3)CHO \xrightarrow[[H_2]]{LiAlH_4/(C_2H_5)_2O} CH_3CH(CH_3)CH_2OH$

2-methylpropanal — 2-methylpropanol (1° alcohol)

8. $CH_3CH_2CH_2OH + H_2SO_4 \longrightarrow CH_3CH_2CH_2OH_2OSO_3H$

Propanol

$\downarrow -H_2O$ (Dehydration)

$CH_3CH=CH_2 \leftarrow CH_3CH_2CH_2OSO_3H$

Propene — Propyl hydrogensulphate

$\downarrow +H_2O$

$CH_3CH(OH)CH_3$

Propan-2-ol