

Name: Bello Nimath Lola

Department: Nursing

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### QUESTION 1

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

#### Answer

Alcohol is classified based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group. If the number of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are three or two, it is called **primary alcohol (1<sup>o</sup>)**. If it is one hydrogen atom, it is called **secondary alcohol (2<sup>o</sup>)** and if no hydrogen atom is attached to the carbon atom bearing the hydroxyl group, it is called a **tertiary alcohol (3<sup>o</sup>)**. Examples are;

CH<sub>3</sub>OH-Methanol (1<sup>o</sup>), CH<sub>3</sub>CH<sub>2</sub>-Ethanol (1<sup>o</sup>), CH<sub>3</sub>CH(OH)CH<sub>3</sub>-Propan-2-ol(2<sup>o</sup>), (CH<sub>3</sub>)<sub>3</sub>C-OH- 2-Methylpropan-2-ol(3<sup>o</sup>)

Alcohols are also classified 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**, 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. **Polyhydric alcohols** or **polyols** have more than three hydroxyl groups. Examples are;

CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH-Propanol (Monohydric alcohol)

HOCH<sub>2</sub>CH<sub>2</sub>OH-Ethane-1-2-diol (Dihydric alcohol)

CH<sub>3</sub>CH(OH)CH<sub>2</sub>CH(OH)CH<sub>2</sub>CH<sub>3</sub>-Hexane-2-4-diol (Dihydric alcohol)

OHCH<sub>2</sub>CH(OH)CH<sub>2</sub>OH-Propane-1-2-3-triol (Trihydric alcohol)

CH<sub>3</sub>CH(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH<sub>3</sub>-Pentanol(polyhydric alcohol)

### QUESTION 2

Discuss the solubility of alcohols in water and organic solvents.

#### Answer

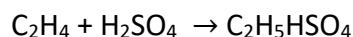
Solubility: Lower alcohols with up to three carbon atoms in their molecules are soluble in water because these lower alcohols can form hydrogen bond with water molecules. Therefore, water solubility decreases with increasing relative molecular mass. All monohydric alcohols are soluble in organic solvents. The solubility of simple alcohols and polyhydric alcohols is largely due to their ability to form hydrogen bonds with water molecules.

### QUESTION 3

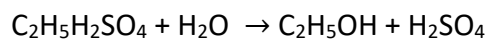
Show the three steps in the industrial manufacture of ethanol. Equations of reaction are mandatory

#### Answer

- **Preparation from ethene:** The ethene is first absorbed in concentrated tetraoxosulphate (VI) acid at 80°C and 30atm to form ethyl hydrogen tetraoxosulphate (VI).

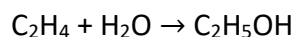


This is then hydrolyzed by boiling with water.

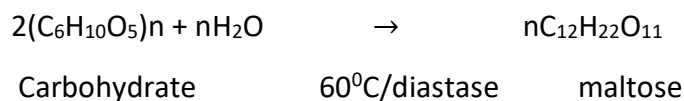


The ethanol formed is distilled off, leaving the acid which can be concentrated and used again.

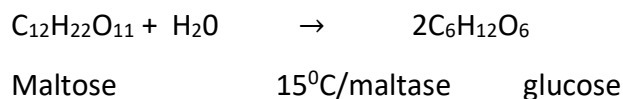
In more recent process, ethene is hydrated directly by passing a mixture of ethene and steam over tetraoxosulphate (VI) acid as catalyst, at 600°C and 80 atm. Most of the ethanol required for industrial purpose is prepared from ethene by this process.



- 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%. 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.



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



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

