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COURSE TITLE: GENERAL CHEMISTRY II

COURSE CODE: CHM 102

Question

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

i.) Based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group. In this method of classification, if there are two or three hydrogen atoms attached to the carbon atom bearing the hydroxyl group it is called a primary alcohol. If it is one hydrogen atom, it is called a secondary alcohol and if there is no hydrogen atoms attached to the carbon atom bearing the hydroxyl group, it is called a tertiary alcohol. An example is Ethanol.

ii.) Based on the number of hydroxyl group they possess.

When there is one hydroxyl group present in the alcohol structure it is called a monohydric alcohol. If there are two hydroxyl groups present in the alcohol structure it is called a dihydric alcohol or a glycol and if there are three hydroxyl groups present in the alcohol structure it is called a trihydric alcohols or triols. Also an alcohol with more than three hydroxyl group is called a polyols or polyhydric alcohol. An example is hexane-2, 4-diol.

2) Discuss the solubility of alcohols in water, organic solvents.

Lower alcohols that have up to three carbon atoms in their molecules are soluble in water because they can form hydrogen bond with water molecules. The solubility of alcohols in water decreases with increasing relative molecular mass. All monohydric alcohols are soluble in organic solvents. Simple alcohols and polyhydric alcohols are soluble because of 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.

i) Carbohydrates such as starch are major group of natural compounds that can be made to yield ethanol by the biological process of fermentation. Enzymes found in yeast break down the carbohydrate molecules into ethanol to give a yield of 95%. The starch containing materials like molasses, potatoes, cereals, rice 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.

 $2(C_6H_{10}O_5)_n + nH_2O \longrightarrow nCH_{12}H_{22}O_{11}$ Carbohydrate $60^0C / Diastase$ Maltose

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

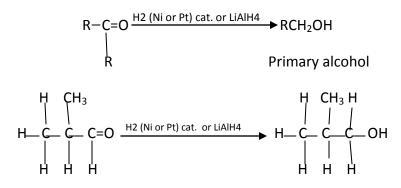
 $C_{12}H_{22}O_6 + H_2O \longrightarrow 2C_6H_{12}O_6$ Maltose $15^0C / Maltase$ Glucose

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

 $C_{6}H_{12}O_{6} \longrightarrow 2CH_{3}CH_{2}OH + 2CO_{2}$ Glucose $15^{0}C / Zymase$ Ethanol

4) Show the reaction between 2-methylpropanal and butylmagnesiumchloride Hint: Grignard synthesis.

7) Show the reduction reaction of 2-methylpropanal.



8) Propose a scheme for the conversion of propan-1-ol to propan-2-ol.

i) Dehydration of Propan-1-ol

Propan-1-ol is treated with concentrated H_2SO_4 a molecule of water is eliminated to form Propene.

 $CH_{3}CH_{2}CH_{2}OH \xrightarrow{Conc H2SO4} CH_{3}CH=CH_{2}$

ii) Hydrolysis of Propene

This is done according to Markownikoffs addition that states that when an unsymmetrical reagent is used, the negative part of the reagent attaches itself to the carbon atom of the alkene which has less number of hydrogen atoms. The unsymmetrical reagent that is used in this reaction is H_2O . Due to the hydrolysis of water the negative part attaches itself to the propene and it forms Propan-2-ol.

 $CH_3-CH=CH_2 \xrightarrow{H2O} CH_3-CH_2-OH-CH_3$