6TH APRIL, 2020.

AKPOFURE TESE
19/MHS01/077
100 LEVEL
MEDICINE AND SURGERY
MEDICINE AND HEALTH SCIENCES

CHEM 102 - GENERAL CHEMISTRY II

ASSIGNMENT

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

Classification 1

It is based on the **number of hydrogen atoms** attached to the carbon atom carrying the OH (hydroxyl) functional group. If the number of hydrogen atoms attached to the carbon atom carrying the OH group are three (3) or two (2), then it is a **primary** alcohol (1°). If it is just one hydrogen atom, then it is a **secondary** alcohol (2°). If there are no hydrogen atoms attached to the carbon atom containing the OH group at all, then it is a **tertiary** alcohol (3°). Examples are

- Primary alcohols: CH_3OH (Methanol), CH_3CH_2OH (Ethanol)
- Secondary alcohols: $CH_3CH(OH)CH_3$ (Propan-2-ol)
- Tertiary alcohol: $(CH_3)_3C\text{-}OH$ (2-Methylpropan-2-ol)

Classification 2

This classification is based on the **number of hydroxyl (OH) functional groups** in the structure of the alcohol. When there is just one hydroxyl (OH) functional group present in the alcohol structure, it will be called a **monohydric** alcohol. When there are two hydroxyl functional groups, it is called a **dihydric** alcohol or glycol. If ther

are three hydroxyl functional groups, it will be a trihydric alcohol triol. If there are more than three hydroxyl functional group, it is a polyhydric alcohol or polyol.

Examples are:

- Monohydric alcohols: $CH_3CH_2CH_2OH$ (Propanol)
- Dihydric alcohol: $HOCH_2CH_2OH$ (Ethan-1,2-diol), $CH_3CH(OH)CH_2CH(OH)CH_2CH_3$
- Trihydric alcohols: Propan-1,2,3-triol
- Polyhydric alcohols: Heptan-2,3,4,5,6-pentanol

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

Step 1: This involves the reaction of the ketones with a grignard reagent, $RMgX$ where R can be an alkyl group.

$$CH_3CH_2CH_2CH_2C=OCH_2CH_2CH_3 + CH_3CH_2MgCl \longrightarrow (CH_3CH_2CH_2CH_2)(CH_3CH_2CH_2)(CH_3CH_2)C-OMgCl$$

Step 2: The intermediate alkyl magnesium halide is hydrated with dilute acid which would lead to the yield of an alcohol.

$$(CH_3CH_2CH_2CH_2)(CH_3CH_2CH_2)(CH_2CH_3)C-OMgCl \xrightarrow{H_2O} (CH_3CH_2CH_2CH_2)(CH_3CH_2CH_2)(CH_3CH_2)C-OH + Mg(OH)Cl$$

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

Ethanol is derived from the biological process of fermentation of carbohydrates. Carbohydrates such as starch is a major group of natural compounds that can yield ethanol by fermentation. The biological catalysts enzymes found in yeast break down the carbohydrate molecules into ethanol to give a yield of 95%. The starch containing material include molasses, potatoes, cereals, rice and when warmed with malt to 60°C for a specific period of time are converted into maltose by the enzyme

diastase contained in the malt. This describes the first step.

Step 1: $2(C_6H_{10}O_5)_n + nH_2O \longrightarrow n C_{12}H_{22}O_{11}$

Carbohydrate — 60°C/Diastase — Maltose

Step 2: The Maltose is broken down into glucose on addition of yeast which contains the enzyme, **maltase** and a temperature of 15°C

$C_{12}H_{22}O_{11} + H_2O \longrightarrow 2C_6H_{12}O_6$

Maltose — 15°C/Maltase — Glucose

Step 3: The glucose at constant temperature of 15°C is then converted into alcohol by the enzyme **zymase**, also contained in yeast.

$C_6H_{12}O_6 \longrightarrow 2CH_3CH_2OH + 2CO_2$

Glucose — 15°C/zymase — Ethanol

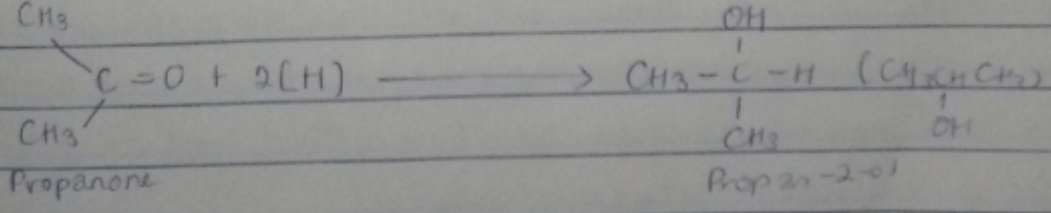
4. Determine the product obtained in the reduction of Alkanone and Alkanal: Use a specific example for each and show the equation of reaction.

a) Reduction of Alkanones (Ketones)

$RR'C=O \longrightarrow RR'CHOH$

Ketone — $LiAlH_4/(C_2H_5)_2O$ — secondary alcohol

For example, with propanone you get propan-2-ol:



b) Reduction of Alkanals (Aldehydes)

$RCHO \longrightarrow RCH_2OH$

Aldehyde — $LiAlH_4/(C_2H_5)_2O$ — primary alcohol

For example, with ethanal you get ethanol: