ILODIBE ANTHONY UDENNA
COMPUTER ENGINEERING
CHM 102
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1 Alcohols are important organic compounds. Discuss briefly their classification and give one example each

i This is based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group. Example: primary alcohol (1°) e.g Methanol (1°), Secondary alcohol (2°) e.g Propan-2-ol (2°), Tertiary alcohol (3°) e.g Methyl propan-2-ol (3°)

ii This is based on the number of hydroxyl groups they possess. That is monohydric alcohol, dihydric alcohol or glycol and Trihydric alcohol. E.g $CH_3CH_2CH_2OH$, Propanol (Monohydric alcohol), $H_2CH_2CH_2OH$, Ethane-1,2-diol (Dihydric alcohol), $OHCH_2CH(OH)CH_2OH$, Propane-1,2-3-triol (Trihydric alcohol)

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

i Solubility in water: 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

ii Solubility in organic solvents: 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 molecule

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

i The starch containing material include molasses, potatoes, cereals etc and on warming with malt to 60°C for a specific period of time and converted into maltose by the enzyme diastate contained in malt.

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

Carbohydrate → Maltose

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

$C_{12}H_{22}O_{11} + H_2O \xrightarrow[15°C/\text{maltase}]{} 2C_6H_{12}O_6$

maltose → glucose

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

$C_6H_{12}O_6 \xrightarrow[15°C/\text{zymase}]{} 2CH_3CH_2OH + 2CO_2$

glucose → Ethanol

c

4 Show the reaction between 2-methylpropanal and butylmagnesiumchloride

Hint: Grignard synthesis

$RRC=O + RMgX \longrightarrow RR''RC-OMgX \xrightarrow[\text{dil. acid}]{H^+} RR'R''C-OR + Mg(OH)X$

Steps

i $CH_3CH_2-C(CH_3)=O + CH_3CH_2CH_2CH_2MgCl$

↓

ii $CH_3CH_2-C(CH_3)(CH_2CH_2CH_2CH_3)-OMgCl$

↓ H^+/dil. acid

iii $CH_3CH_2-C(CH_3)(CH_2CH_2CH_2CH_3)-OH + Mg(OH)Cl$

Octa-4-ol

Question 5 & 6 aren't correct

7 Show the reduction reaction of 2-methylpropanol

$RCHO \xrightarrow{LiAlH_4(C_2H_5)_2O} RCH_2OH$

$\therefore CH_3CH(CH_3)CHO \xrightarrow{LiAlH_4(C_2H_5)_2O} CH_3CH(CH_3)CH_2OH$

Aldehyde → Primary Alcohol (1°)

2methyl propan-1-ol

4 Propose a scheme for the conversion of propan-1-ol to propan-2-ol

Propan-1-ol $\longrightarrow$ $CH_3CH_2CH_2OH$

Step 1:

$$CH_3CH_2CH_2OH + H_2SO_4 \longrightarrow CH_3CH_2CH_2OHOSO_3H$$

Step 2:

$$CH_3CH_2CH_2(OH_2)OSO_3H \xrightleftharpoons{-H_2O} CH_3CH_2CH_2OS_3H + H_2O$$

Step 3:

$$CH_3CH_2CH_2OSO_3H \xrightarrow{-H_2SO_4} CH_3CH_2CH_2 + H_2SO_4$$

$$CH_3CH_2=CH_2 + H_2O \longrightarrow CH_3\underset{\underset{OH}{|}}{CH}CH_3$$