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Department: Mechatronics
Course Title: General Chemistry II
Course Code: CHM 102

Assignment

1) Alkanols are organic compounds formed when a hydroxyl group (-OH) get linked to the alkyl groups. All alkanols contain at least one hydroxyl group (OH) as a functional group. They have the general formula represented by $C_nH_{2n+1}OH$. Alkanols can be classified 1) on the basis of number of -OH group 2) on the basis of nature of C-atoms containing -OH group.

On the Basis of number of -OH group: they are classified as i) monohydric alkanol, ii) dihydric alkanol iii) trihydric alkanol and iv) polyhydric alkanol.

Monohydric - an alkanol with only one hydroxyl group (-OH) in their molecule example: i) CH_3OH - methanol 2) C_2H_5OH - ethanol.

Dihydric alkanol: an alkanol containing

two -OH group. example:

1) $CH_2(OH)-CH_2(OH)$ – 1,2-Ethandiol

2) $CH_2(OH)-CH_2-CH_2(OH)$ – 1,3-Propandiol

Trihydric: an alkenol containing 3 -OH groups. example:

1) $CH_2(OH)-CH(OH)-CH_2(OH)$ – 1,2,3-Propantriol

2) $CH_2(OH)-CH(OH)-CH(OH)-CH_3$ – 1,2,3-Butantriol

Polyhydric: they are organic molecules that have more than 1 hydroxyl (-OH) group in them. example:

1) Glycerol

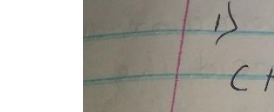
2) Neopentyl

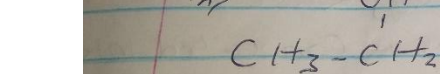
On the basis of nature of C-atom containing monohydric alcohol are classified into three groups

Primary alkanol: If carbon containing -OH group is bonded to non or one carbon atom, it is called primary alcohol or 1°.

example: i) CH_3OH - Methanol ii) C_2H_5OH - Ethanol.

Secondary alkanol: In a secondary (2°) alcohol, the carbon atom with the -OH group attached is joined directly to two alkyl groups, which may be the same or different. examples:

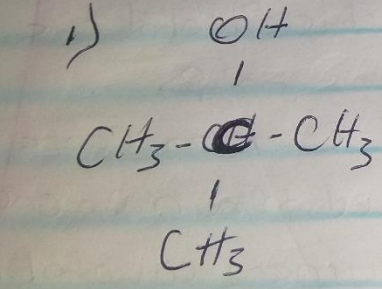
i) 
- Propan-2-ol

ii) 
- Pent-3-ol

Tertiary alkanol: In a tertiary (3°) alcohol, the carbon atom holding the -OH group is attached directly to three alkyl groups which may be any combination of the

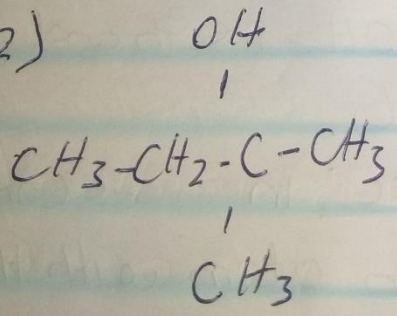
same or different groups. examples

1)



- 2-methylpropan-2-ol

2)



- 2-methylbutan-2-ol

3)

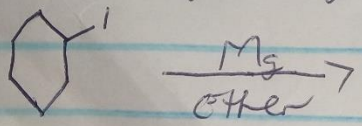
2) Grignard Reagents: these are of the formal type R-Mg-X.

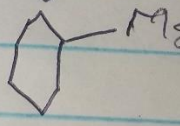
R-X + Mg $\xrightarrow{CH_3CH_2OCH_2CH_3}$ R—Mg—X

(X = Cl, Br, or I)

organomagnesium halide (Grignard reagent) reacts like R:⁻ MgX

they are made via the reaction of metallic Mg with the corresponding alkyl halide, usually in either type solvents. this reaction is versatile; primary, secondary and tertiary alkyl halides can be used and also vinyl, allyl and aryl halides.

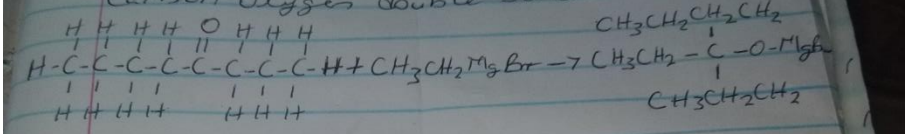




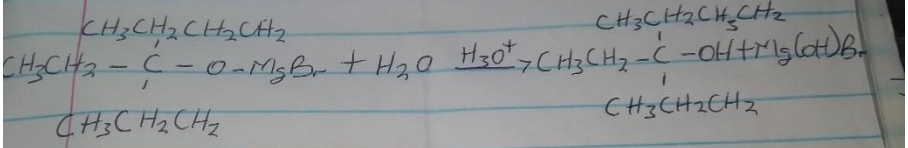
$H_3C-Br \xrightarrow[ether]{Mg} H_3C-Mg-Br$

the reaction stop $CH_3CH_2CH_2CH_2C{=}OCH_2CH_2CH_3$

11) the grignard reagent adds across the carbon oxygen double bond.



Dilluted acid is then added to hydrolyse it

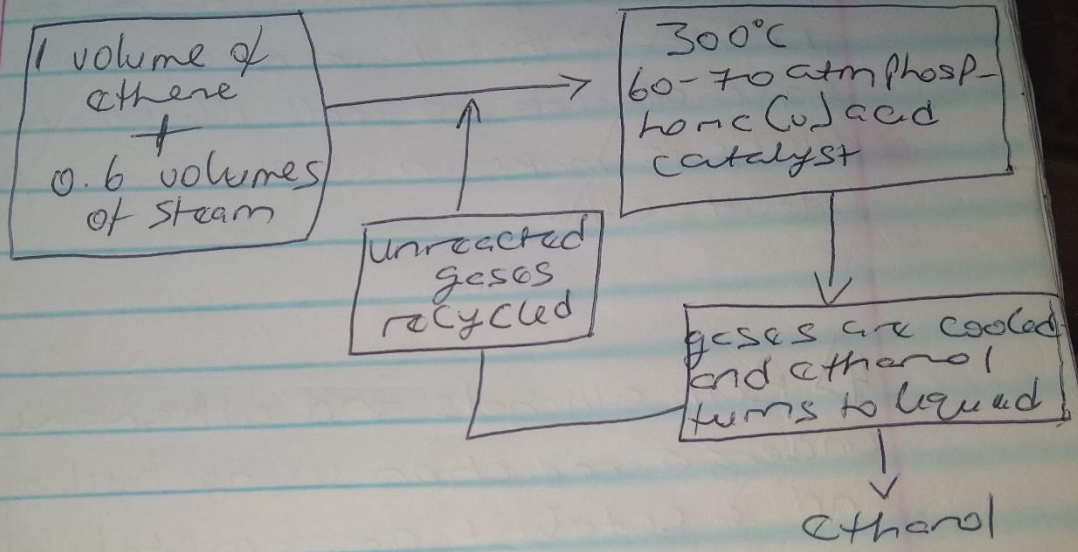


3) Ethanol is industrially manufactured by reacting ethene with steam. The catalyst used is solid silicon dioxide coated with phosphoric(v) acid. The reaction is reversible.

$$CH_2=CH_{2(g)} + H_2O_{(g)} \rightleftharpoons[H_3PO_4] CH_3CH_2OH_{(g)}$$

Only 5% of the ethene is converted into ethanol at each pass through the reactor. By removing the ethanol from the equilibrium mixture and recycling the ethene, it is possible to achieve an overall 95% conversion.

A flow scheme for the reaction looks like this:



Note: This is a bit of a simplification: when the gases from the reactor are cooled, then excess steam will condense as well as the ethanol. The ethanol will have be separated from the water by fractional distillation.

Ethanol can also be manufactured through fermentation. It is the chemical process that involves the breaking down of molecules such as glucose anaerobically with the release of carbon dioxide gas and alcohol. the production of ethanol by fermentation occurs in three basic steps: the temperature of the reactions occur at a minimum temperature of (25-35)°C

form starch(grains)

$2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[\text{yeast}]{\text{Diatase}} C_{12}H_{22}O_{11}$

maltase

$C_{12}H_{22}O_{11} + nH_2O \xrightarrow[\text{yeast}]{\text{maltase}} 2C_6H_{22}O_6$

Glucose

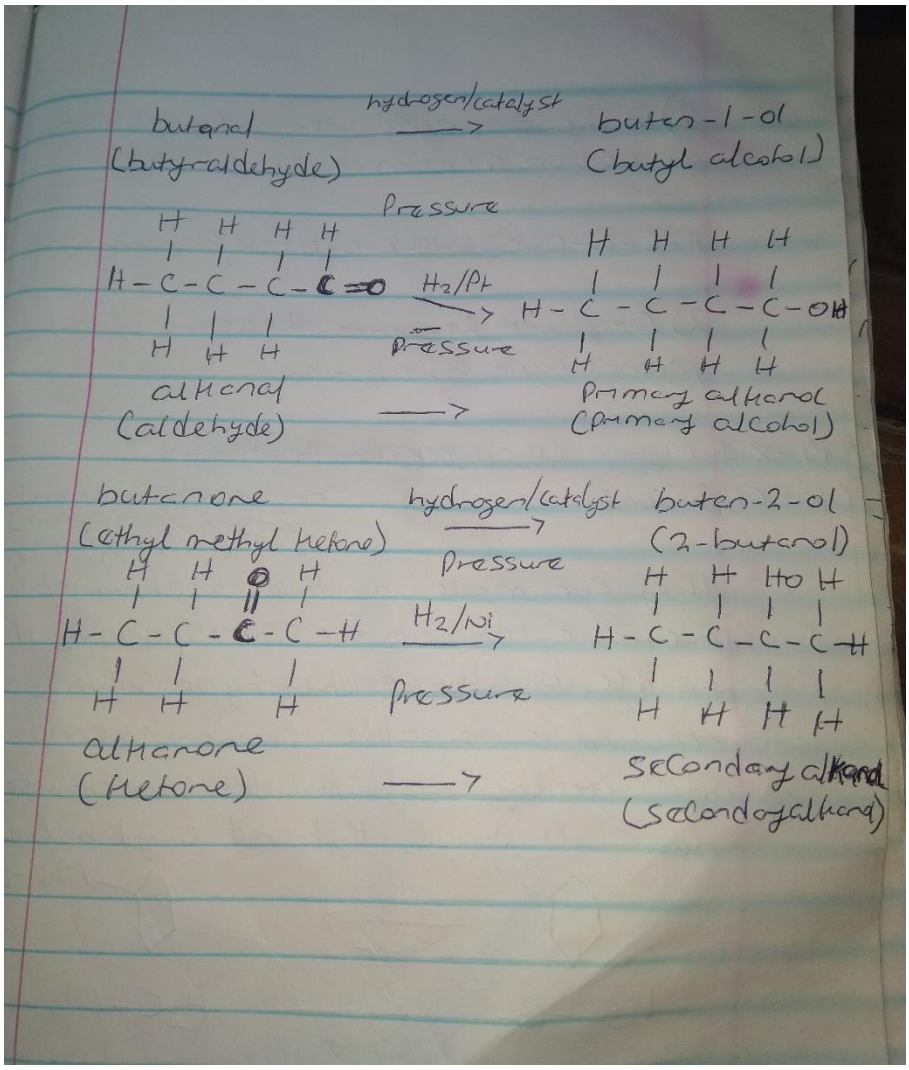
$C_6H_{12}O_6 \xrightarrow[\text{yeast}]{\text{Zymase}} 2C_2H_5OH + 2CO_2$

4) Both alkanals and alkanones can undergo reduction using hydrogen gas and a catalyst, or a metal hydride reducing agent. In effect we are adding a hydrogen atom (H) to the Carbon of the Carbonyl functional group, and, to the oxygen present in the carbonyl functional group (C=O) to produce a new functional group, the hydroxyl functional group (OH). When we do this to an alkanal, R-CHO, the hydroxyl group will be present at the end of the Carbon chain and hence a primary alkanol is produced, R-CH_2OH. Whe

we do this to an alkanone, R-Co-R', the hydroxyl group will be present, not at the end of a chain, but somewhere between the ends of the chain, R-CH(OH)-R', The hydroxyl group will be present on a carbon atom which is itself Covalently bonded to two other carbon atoms, therefore this will be a secondary alkanol.

- The reduction of an alkanal produces a primary alkanol.
- The reduction of an alkanone produces a secondary alkanol.

For example: using a Platinum catalyst with hydrogen gas under pressure, we can convert butanal to butan-1-ol, and we can convert butanone to butan-2-ol using a nickel catalyst as shown below:


butanal
(butyraldehyde)
hydrogen/catalyst
Pressure
H_2/Pt
Pressure
alkanal
(aldehyde)
butan-1-ol
(butyl alcohol)
Primary alkanol
(Primary alcohol)
butanone
(ethyl methyl ketone)
hydrogen/catalyst
Pressure
H_2/Ni
Pressure
alkanone
(ketone)
butan-2-ol
(2-butanol)
secondary alkanol
(secondary alkanol)