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Elect/Elect Engineering
19/ENG04/004
CHM 102 Assignment

1 Major Classification of Alkanols.

① The first classification is based on the hydrogen atoms attached to a ~~the~~ carbon atom containing the hydroxyl group.
If the number of hydrogen atoms attached to the hydroxyl group is 3 or 2 its called primary alcohol / alkanol (1°). If it is one hydrogen atom, then its called secondary alcohol / alkanol (2°). If it none its called tertiary alkanol / alcohol (3°)
Examples are

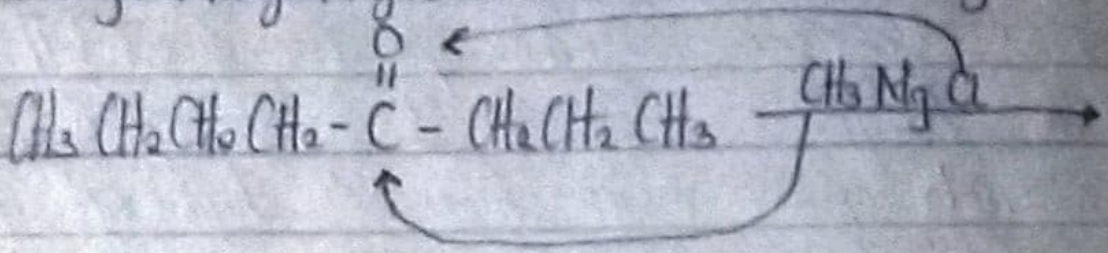
CH_3OH :- Methanol (1°).
~~CH_3CH_2OH :- Ethanol (2°)~~
$CH_3CH(OH)CH_2CH_3$:- Butan-2-ol (2°).
$(CH_3)_3C-OH$:- 2-Methylpropan-2-ol (3°).

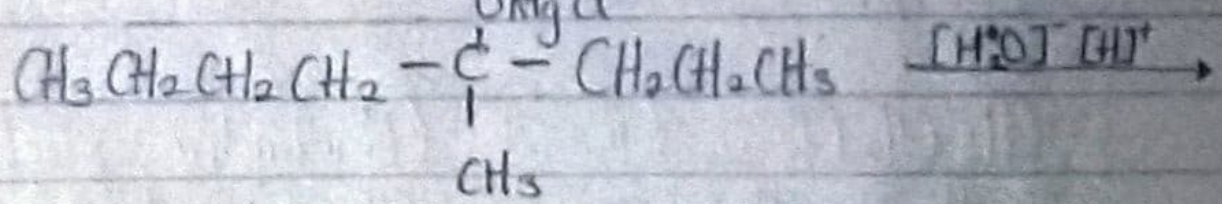
(ii) this is based off the number of hydroxyl (OH) groups possessed by the organic compound.
They are split into four types:
The Monohydric alcohols which have one hydroxyl group present in their structure.
The Dihydric alcohols possess two (-OH) groups.
The Trihydric have 3 while the Polyhydric alcohols have more than 3 hydroxyl groups.
Examples include

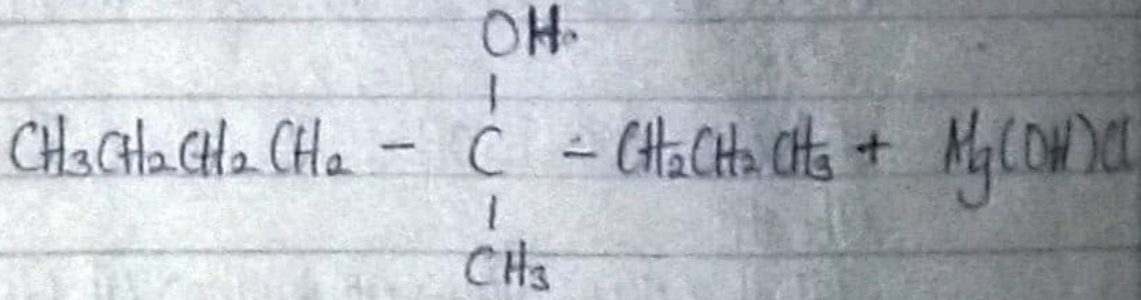
CH_3CH_2OH : Ethanol (Monohydric alcohol)
~~$HOCH_2CH_2CH_2OH$: P~~ $CH_3CH(OH)CH_2OH$: Propane-1,2-diol (Dihydric alcohol)
$OHCH_2CH(OH)CH_2OH$: Propane-1,2,3,-triol (Trihydric alcohol)
~~CH_3CH~~
$OHCH_2CH(OH)CH(OH)CH(OH)CH(OH)CH_2OH$: Sorbitol (Polyhydric alcohol).

2) Grignard synthesis of Alkanols, react a named reagent with $CH_3CH_2CH_2CH_2C{=}OCH_2CH_2CH_3$ Show reaction steps.

Using Methyl Magnesium Chloride CH_3MgCl as 'RMgX'







3.) Industrial Manufacturing of Ethanol

Ethanol by Fermentation

This method of preparation / manufacturing is specified for ethanol and can't be used for other alcohols.

Process

The starting material for the process varies widely but will normally be some form of starchy plant material such as maize, wheat, barley.

Starch is a complex carbohydrate. Although, in the lab sucrose (sugar) is used for production of ethanol. Industrially, this wouldn't be the best way as you would have to first refine a load of sugar before using it for fermentation.

The first step is to break complex carbohydrates into simpler ones. For example, if starting with grains like wheat, the grain would be heated with hot water to extract its starch and then warmed with malt. Malt contains enzyme

which break the starch into a simpler carbohydrate called maltose. $C_{12}H_{22}O_{11}$.

Yeast is then added and the mixture is kept warm (about 35°C) for several days until fermentation is complete. Air is kept out of the mixture to prevent the ethanol from turning into ~~it~~ vinegar.

Enzymes in the yeast first convert carbohydrates like maltose or sucrose into even simpler ones like glucose and fructose, both $C_6H_{12}O_6$ and then convert these in turn into ethanol and CO_2.

~~CH CH~~

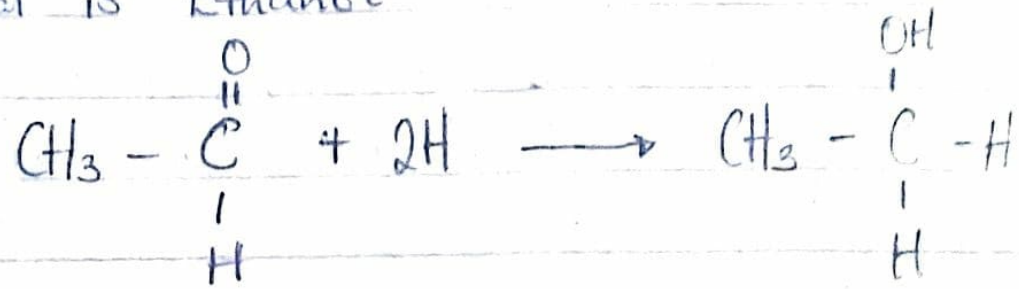
$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{maltase}]{\text{yeast}} 2C_6H_{12}O_6$$

$$C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2CH_3CH_2OH + CO_2$$

Yeast is killed by ethanol concentrations in excess of about 15% and that limits the purity of the ethanol that can be produced. The ethanol is separated from the mixture by fractional distillation to give 96% pure ethanol. For theoretical reasons 100% isn't attainable.

4.) Reduction of Alkanal leads to a primary Alcohol. Reduction of Alkanone leads to a secondary Alcohol. Examples, reduction of

- Ethanal is Ethanol



- Propanone is Propan-2-ol