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MATRIC NO: 17/ENG06/056

DEPT: MECHANICAL ENGINEERING

CHM 102 assignment

① : $HCOOH$ — Methanoic acid

ii: $CH_3CH_2CH_2COOH$ — Butanoic acid

iii: $HOOCCH_2CH_2CH_2COOH$ — Pentan-1-5, dioic acid

iv: HO_2C-CO_2H — Ethanedioic acid

v: $CH_3CH=CHCH_2CH_2COOH$

② : Physical appearance:

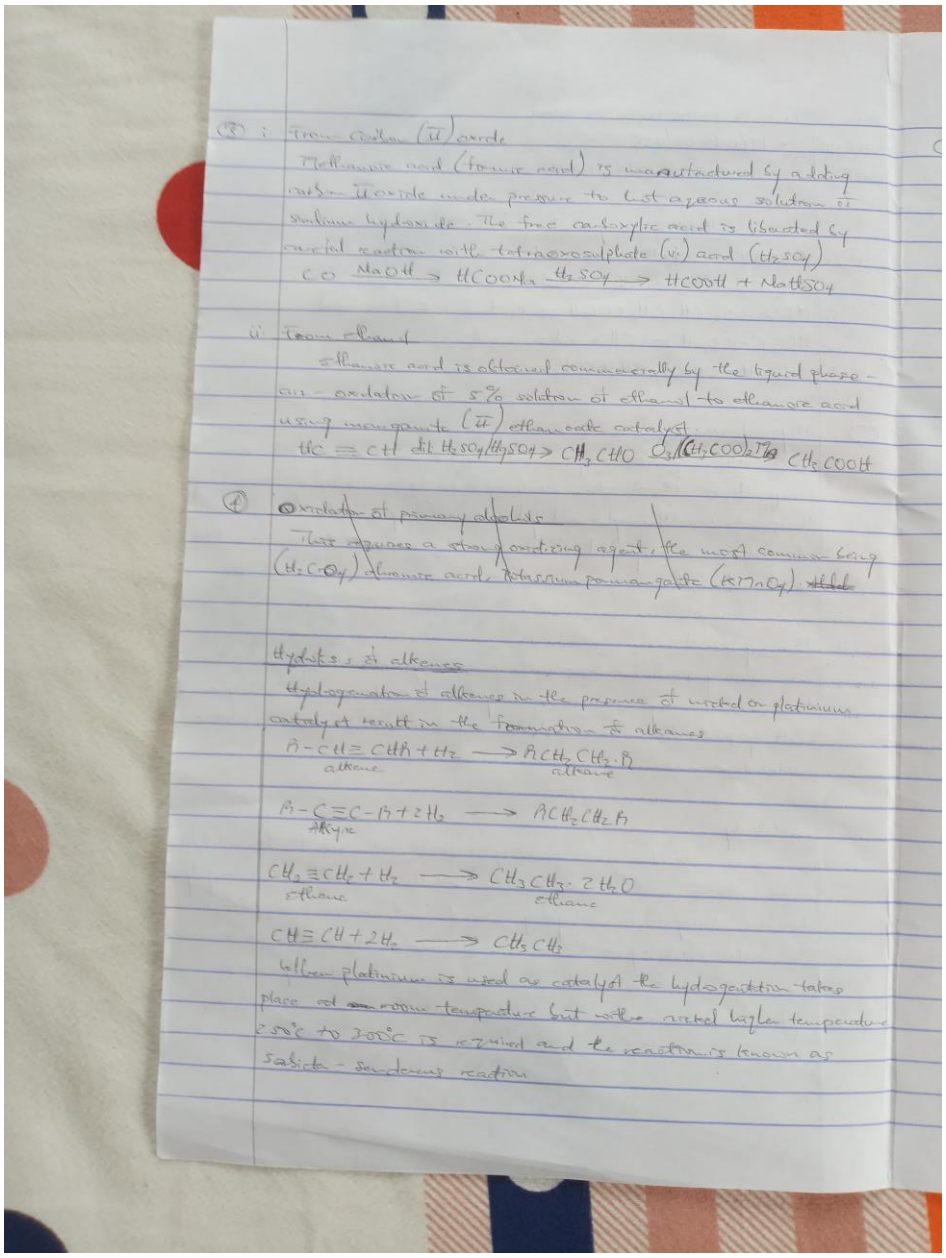
All simple carboxylic acids up to C_{10} are liquid at room temperature. The other carboxylic acids are solid at room temperature although anhydrous carboxylic acids (acetic acid) also remain as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

ii Boiling points

Boiling point increases with increasing relative molecular mass. The water carboxylic acids are crystalline solids and have higher melting points than their diplatre counterparts of comparable relative molecular mass.

iii. Solubility

Lower molecular mass carboxylic acids with up to four (4) carbon atoms in their molecules are soluble in water, this largely due to ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent.



(3) i. From carbon (II) oxide

Methanoic acid (formic acid) is manufactured by adding carbon II oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by mineral reaction with tetraoxosulphate (vi) acid (H_2SO_4)

$CO \xrightarrow{NaOH} HCOONa \xrightarrow{H_2SO_4} HCOOH + NaHSO_4$

ii. From ethanol

Ethanoic acid is obtained commercially by the liquid phase air - oxidation of 5% solution of ethanol to ethanoic acid using manganate (II) ethanoate catalyst.

$HC \equiv CH \xrightarrow[HgSO_4]{dil\ H_2SO_4} CH_3CHO \xrightarrow[(CH_3COO)_2Mn]{O_2} CH_3COOH$

(4) Oxidation of primary alcohols

This requires a strong oxidizing agent, the most common being ($H_2C_2O_4$) ethanoic acid, potassium permanganate ($KMnO_4$).

Hydrolysis of alkenes

Hydrogenation of alkenes in the presence of nickel or platinum catalyst result in the formation of alkanes

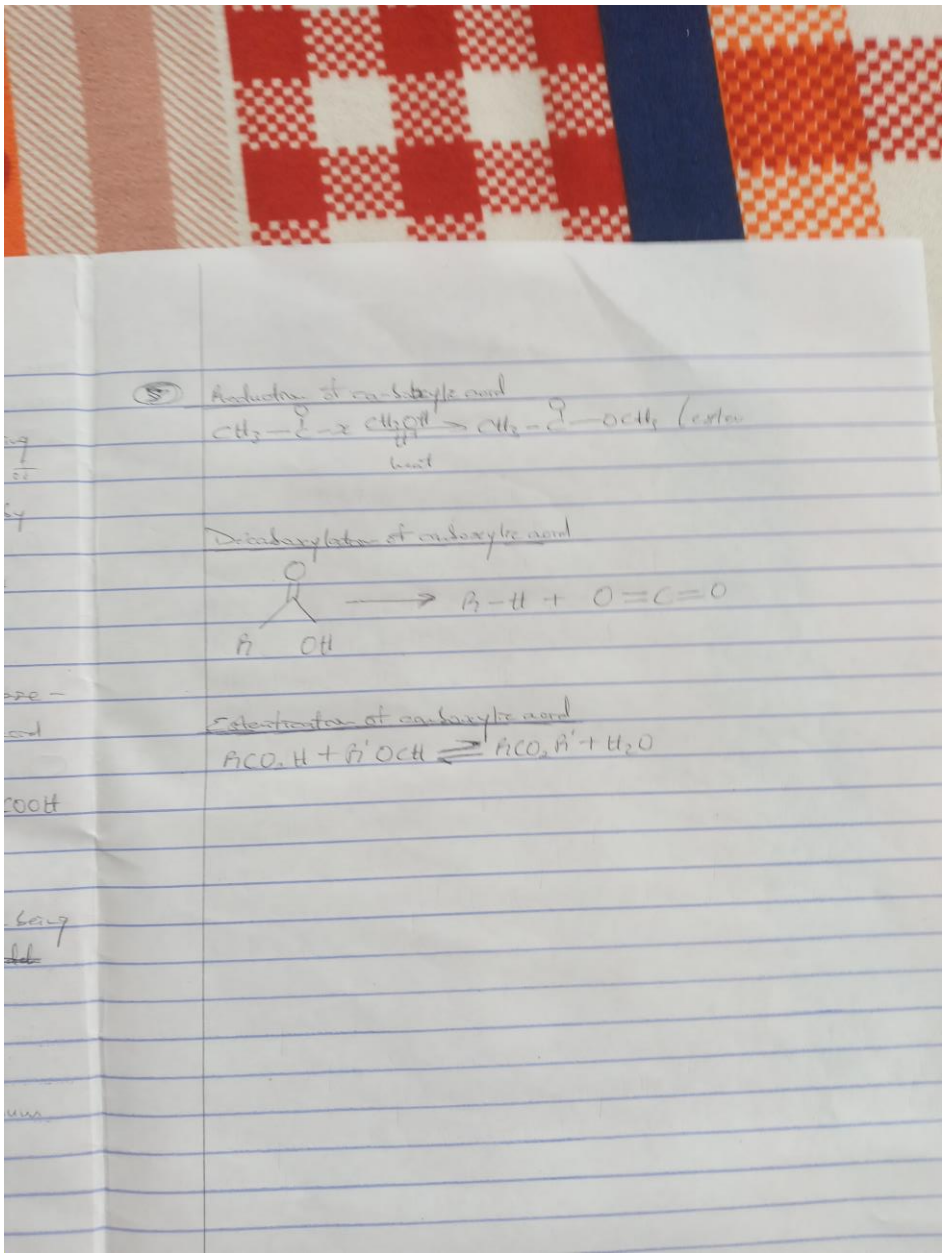
$R-CH=CHR + H_2 \longrightarrow \underset{\text{alkane}}{RCH_2CH_2R}$
(alkene)

$R-\underset{\text{Alkyne}}{C\equiv C-R} + 2H_2 \longrightarrow RCH_2CH_2R$

$\underset{\text{ethene}}{CH_2=CH_2} + H_2 \longrightarrow \underset{\text{ethane}}{CH_3CH_3} \cdot 2H_2O$

$CH \equiv CH + 2H_2 \longrightarrow CH_3CH_3$

When platinum is used as catalyst the hydrogenation takes place at room temperature but when nickel higher temperature 250°C to 300°C is required and the reaction is known as Sabatier - Senderens reaction



Reduction of carboxylic acid

$CH_3-\overset{O}{\overset{\|}{C}}-x \xrightarrow[H^+]{CH_3OH} CH_3-\overset{O}{\overset{\|}{C}}-OCH_3$ (ester)

Decarboxylation of carboxylic acid

Esterification of carboxylic acid

$RCO_2H + R'OH \rightleftharpoons RCO_2R' + H_2O$