

points than their aliphatic counterparts of comparable relative molecular mass.

III SOLUBILITY

Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this is largely due to their 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. All carboxylic acids are soluble in water.

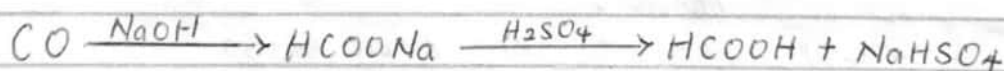
3. Write two industrial preparations of carboxylic acids.

Answers.

INDUSTRIAL PREPARATIONS OF CARBOXYLIC ACIDS

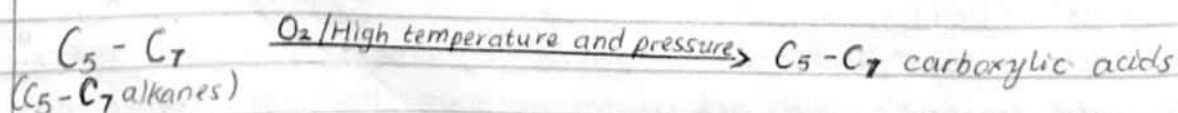
i FROM CARBON(II) OXIDE

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 careful reaction with tetraoxosulphate (VI) acid (H_2SO_4)



ii FROM PETROLEUM

Liquid phase air oxidation of $C_5 - C_7$ alkanes, obtainable from petroleum at high temperature and pressure will give $C_5 - C_7$ carboxylic acids with methanoic, propanoic and butanedioic acids as by-products:

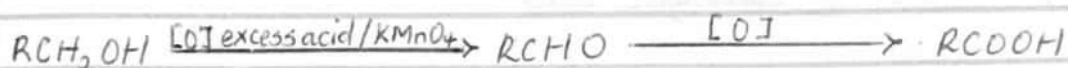


4 With equations and brief explanation discuss the synthetic preparation of carboxylic acid.

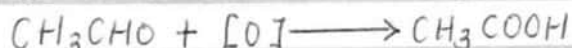
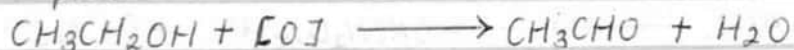
SYNTHETIC PREPARATION OF CARBOXYLIC ACID.

1 OXIDATION OF PRIMARY ALCOHOLS AND ALDEHYDES

Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e. $K_2Cr_2O_7$ (potassium dichromate (VI)) or $KMnO_4$ (potassium manganate (VII)) in acidic solution.

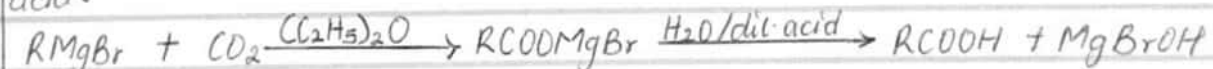


Example: OXIDATION OF ETHANOL TO ETHANOIC ACID



2. CARBONATION OF GRIGNARD REAGENT

Aliphatic carboxylic acids are obtained by bubbling carbon (IV) oxide into the Grignard reagent and then hydrolyzed with dilute acid.



N/B: R may be 1° , 2° , 3° aliphatic alkyl or aryl radical.

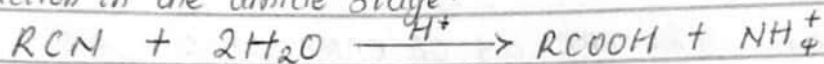
In the preparation of benzoic acid, the reagent is added to the solid carbon (IV) oxide (dry ice) which also serves as coolant to the reaction mixture.



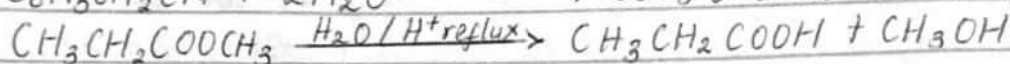
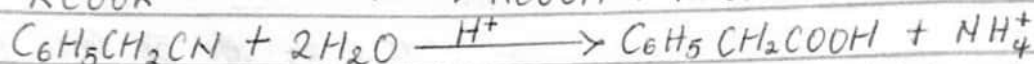
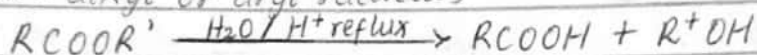
3 HYDROLYSIS OF NITRILES (CYANIDES) OR ESTERS.

Nitriles undergo hydrolysis to form amides. The amides further undergo reaction in the presence of a catalyst which then to form

Carboxylic acids. The catalyst for this reaction is H^+ or OH^- . Further, application of mild reaction condition helps in ceasing the reaction in the amide stage.



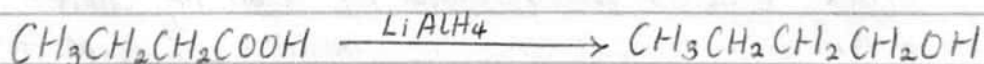
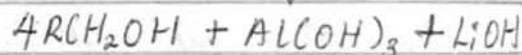
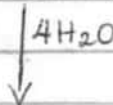
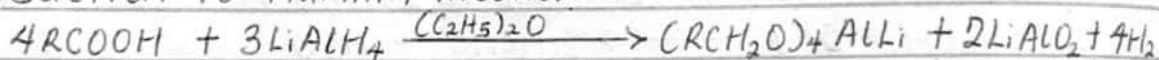
(R = alkyl or aryl radical)



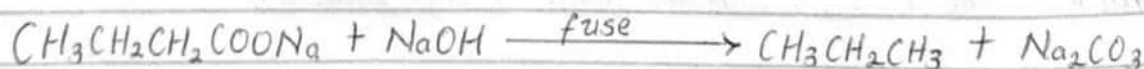
5. With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

CHEMICAL REACTIONS

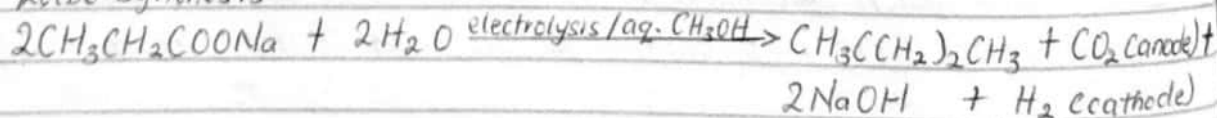
1. REDUCTION TO PRIMARY ALCOHOL



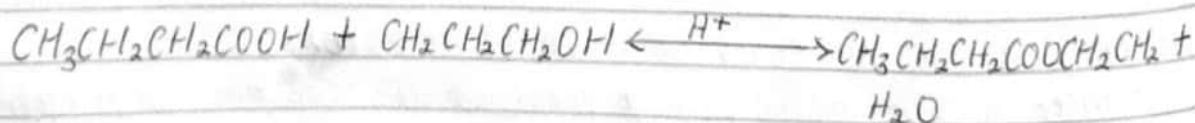
2. DECARBOXYLATION



Kolbe synthesis:



3. ESTERIFICATION



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Assigned on Carboxylic acid

1) Give the IUPAC names of the following compounds

i) $\text{HCOOH} \rightarrow$ Methanoic acid

ii) $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$ Pentan-1,5-dioic acid

iii) $\text{HO}_2\text{C}-\text{CO}_2\text{H} \rightarrow$ Ethanedioic acid

iv) $\text{CH}_3(\text{CH}_2)_4\text{COOH} \rightarrow$ Hexanoic acid

v) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{COOH} \rightarrow$ Hex-4-enoic acid

2) Discuss briefly the physical properties of carboxylic acids under the following headings.

i) physical appearance ii) Boiling point iii) Solubility.

Answers

i) Physical properties of carboxylic acids: All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most other carboxylic acids are solid at room temperature, although glycolic acid (acetic acid) also known as glacial acetic acid freezes to an ice-like solid below the room temperature.

ii) Boiling point: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have low crystalline solids and have high melting