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DEPARTMENT: PHARMACY

MATRIC NO: 191M1311137

COURSE CODE: CHM 102

① Give the IUPAC names of the following compounds

①  $\text{HCOOH}$  = Methanoic acid

②  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$  = Pentan-1,5-dioic acid

③  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$  = Butanoic acid

④  $\text{H}_2\text{C}=\text{CO}_2\text{H}$  = Ethanedioic acid

⑤  $\text{CH}_3(\text{CH}_2)_4\text{COOH}$  = Hexanoic acid

⑥  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$  = Hexanoic acid

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

① Physical appearance: All simple aliphatic carboxylic acids up to  $\text{C}_6$  are liquids at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

② Boiling points: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

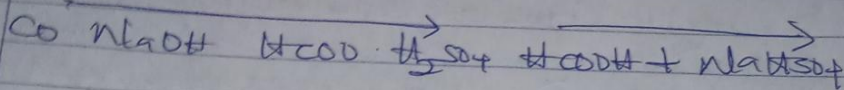
③ Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water, this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of the acid decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.



Write two industrial preparations of carboxylic acids

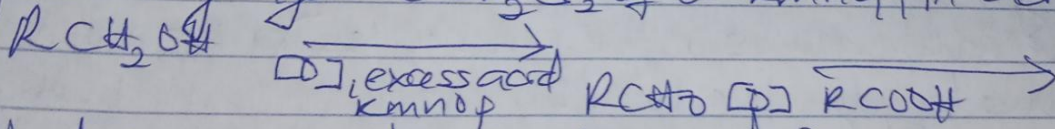
(i) from ethanal  
 Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganese(II) ethanoate catalyst. Ethanal itself is obtained from ethylene.

(ii) 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 action with tetraoxosulphate(VI) acid ( $H_2SO_4$ )

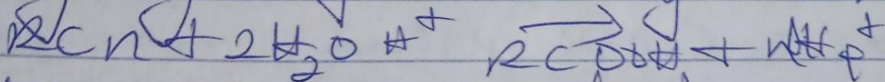


Write equations and brief explanation discuss the synthetic preparation of carboxylic acid  
 There are a lot of ways to prepare the carboxylic acid synthetically, but I will state two briefly with the respective equations.

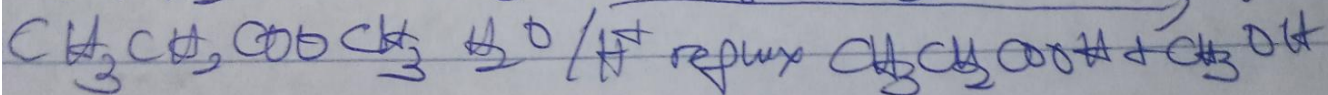
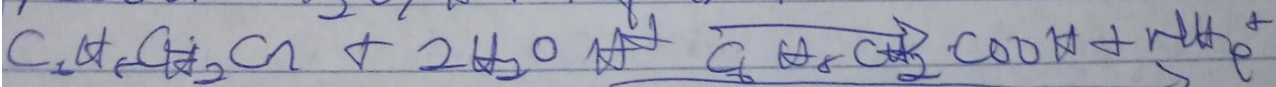
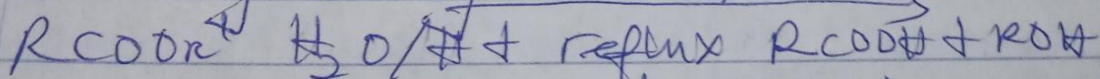
(1) Oxidation of primary alcohols and aldehydes  
 Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidising agents (i.e.  $K_2Cr_2O_7$  or  $KMnO_4$ ) in acidic solution



(2) Hydrolysis of nitriles (cyanides) or esters



(R = alkyl or aryl radical)

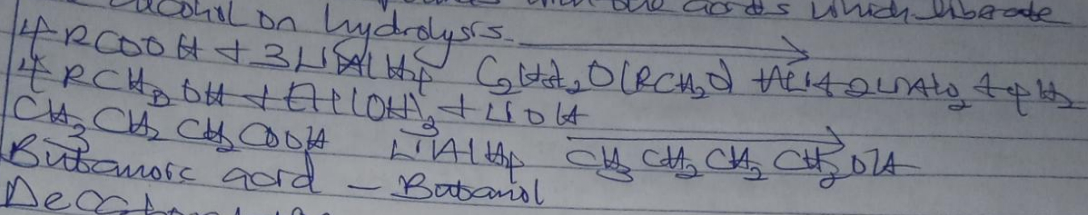


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③ With chemical equations only outline the reduction decarboxylation and esterification of carboxylic acid

④ Reduction to primary alcohol.  
Carboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals by lithium tetrahydridoaluminate (LiAlH<sub>4</sub>) and diisopropylaluminium hydride compounds with the acids which liberate the alcohol on hydrolysis.

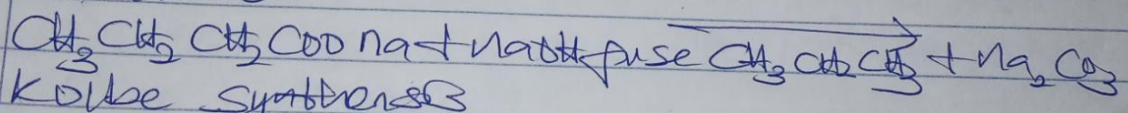


⑤ Decarboxylation

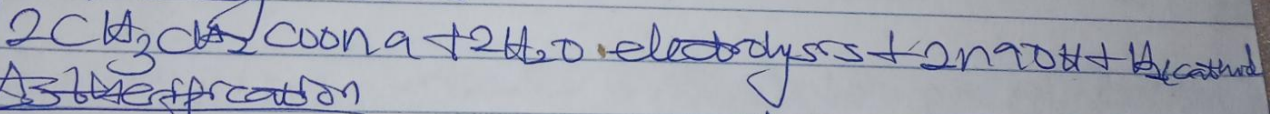
This involves removal of the carbonyl group from the acid to give a hydrocarbon or its derivative.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group e.g. -COOH, CN, NO<sub>2</sub> etc decarboxylate readily on heating to 100-150°C while others decarboxylate when their salts are heated with soda lime.



Kolbe synthesis



⑥ Esterification

In the presence of strong acid catalyst, carboxylic acids react with alcohols to form esters

