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DEPARTMENT: MBBS

MATRIC NO: 19/MHS01/385

COURSE: CHM 102

1. Give the IUPAC names of the following compounds i)  $\text{HCOOH}$  ii)  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$   
iii)  $(\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH})$  iv)  $\text{HO}_2\text{C}-(\text{CO}_2\text{H})$  v)  $(\text{CH}_3(\text{CH}_2)_4\text{COOH})$  vi)  $(\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH})$

Organic compounds

IUPAC names

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

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

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

Discuss

2. Briefly the physical properties of carboxylic acids under the following headings:

i) Physical appearance ii) Boiling point iii) Solubility

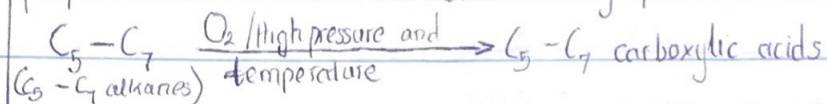
i) Physical appearance: All simple aliphatic carboxylic acids up to  $\text{C}_{10}$  are liquids at room temperature. Most other carboxylic acids are solids at room temperature although anhydrous carboxylic acid / acetic acid / glacial ethanoic acid freezes to an ice-like solid below the room temperature.

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

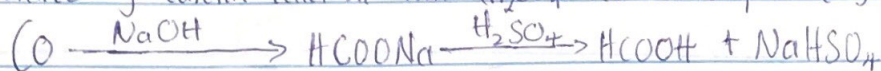
iii) Solubility: Lower molecular mass carboxylic acid with up to four carbon atoms in their molecules are soluble in water, this is largely due to their ability to form hydrogen bond with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the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

3 Write two industrial preparations of carboxylic acids.

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

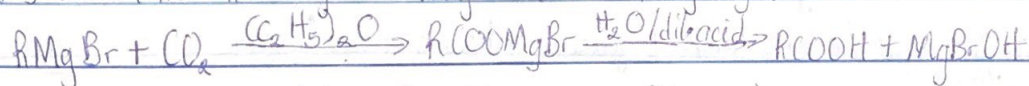


ii From carbon (II) oxide: Methanoic acid (formic acid) is manufactured by adding carbon(II)oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with  $(H_2SO_4)$  tetraoxosulphate(vi) acid.



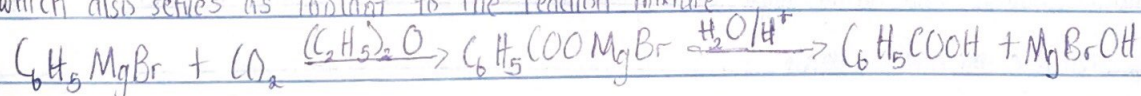
4 With equations and brief explanation discuss the synthetic preparation of carboxylic acid.

i Carbonation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling carbon (iv) oxide into the Grignard reagent and then hydrolyzed with dilute acid.

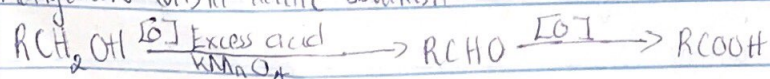


Note: R may be  $1^\circ$  (primary),  $2^\circ$  (secondary),  $3^\circ$  (tertiary) aliphatic alkyl.

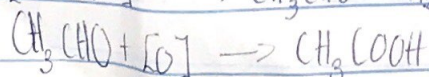
In the preparation of benzoic acid, the reagent is added to solid carbon(IV)oxide (dry ice) which also serves as solvent to the reaction mixture.



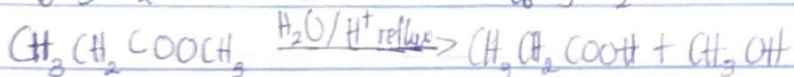
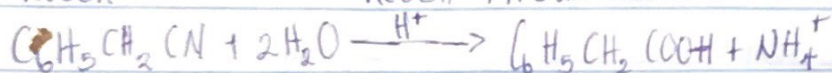
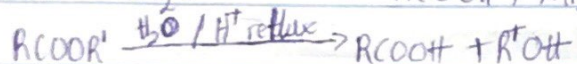
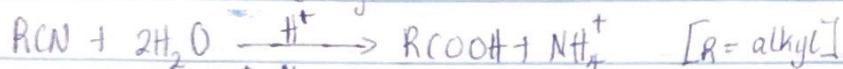
ii Oxidation of primary alcohols and aldehydes: It can be used to prepare carboxylic acids using the usual oxidizing agents i.e potassium dichromate (vi) ( $K_2Cr_2O_7$ ) or potassium manganate (vii) in acidic solution.



E.g Oxidation of ethanol to ethanoic acid

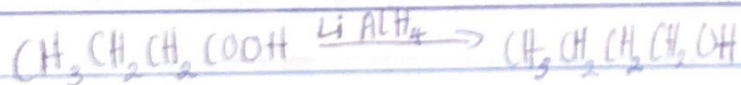
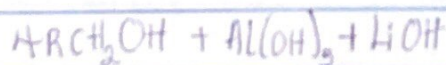
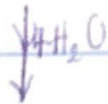
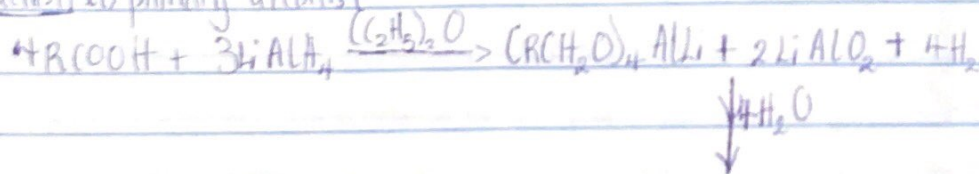


iii) Hydrolysis of nitriles (amides) / esters: They undergo hydrolysis to form amides. The amides further undergo reaction in the presence of a catalyst which then forms carboxylic acid. The catalyst for this reaction is  $H^+$  or  $OH^-$ . Furthermore, the application of mild reaction condition helps increasing the reaction in the amide stage.

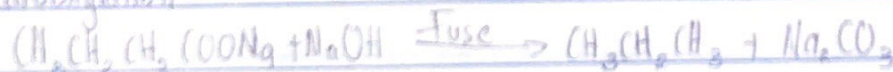


5) With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

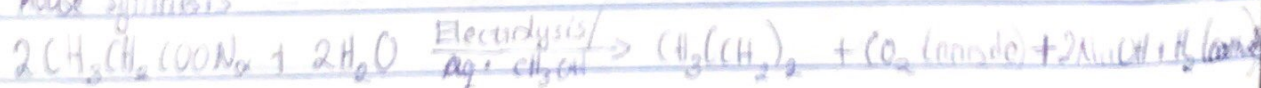
i) Reduction to primary alcohol



ii) Decarboxylation



Kolbe synthesis



iii) Esterification

