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MBBS, MHS, Chemistry 102,

Assignment on Carboxylic acid.

① Compounds Answers

① Compounds	IUPAC Names
* HCOOH	Methanoic acid
* $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$	Penta-1-5, diol acid
* $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	Butanoic acid
* $\text{HO}_2\text{C}-\text{CO}_2\text{H}$	Ethanedioic acid
* $\text{CH}_3(\text{CH}_2)_4\text{COOH}$	Hexanoic acid
* $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$	Hex-4-enoic acid

2 a) Physical appearance: All simple aliphatic carboxylic acids upto C_{10} are liquid at room temperature, while other carboxylic acids are solid at room temperature. Although anhydrous carboxylic acid also known as glacial ethanol acid freezes to an ice-like solid below the room temperature.

b) Boiling point: The 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.

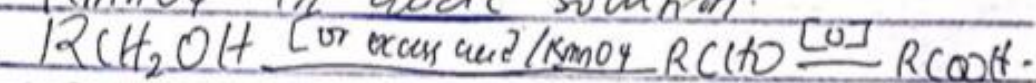
c) Solubility: Lower molecular mass carboxylic acid with zero to few carbon atoms in their molecules are soluble in water, this is largely due to their ability to form hydrogen bond with water molecules. The water solubility of the acid decreases as the relative molecular mass increases because the structure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

3a) From carbon (II) oxide: Methanoic acid [formic acid] is manufactured by adding carbon (II) oxide under pressure to the aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by reaction with tetrasulphate (VI) acid (H_2SO_4).

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

b) From petroleum: Liquid phase air oxidation of C₅-C₇ alkanes obtainable from petroleum at high temp. and pressure will give C₅-C₇ carboxylic acid with methanoic, propanoic and butanoic acids as by-products.

4a) Oxidation of primary alcohols and aldehydes: Oxidation of primary alcohol and aldehydes 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) $KMnO_4$ in acidic solution.

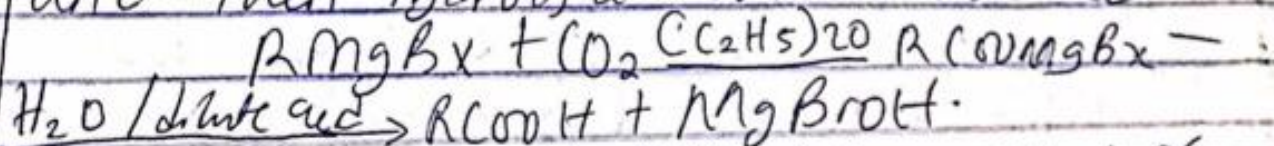


e.g. Oxidation of ethanol to ethanoic acid.

$$CH_3CH_2OH + [O] \longrightarrow CH_3CHO + H_2O$$

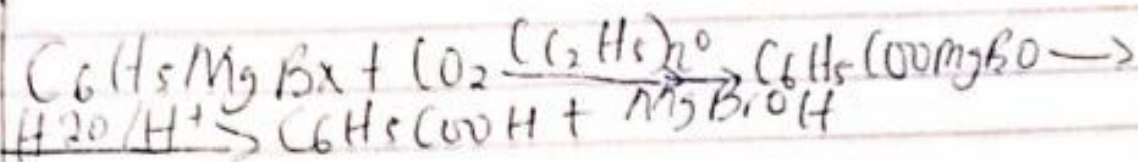
$$CH_3CHO + [O] \longrightarrow CH_3COOH$$

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



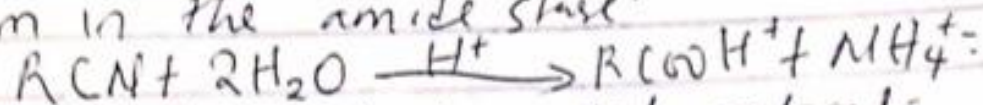
[R can be 1°, 2°, 3° aliphatic alkyl or aryl radical]

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

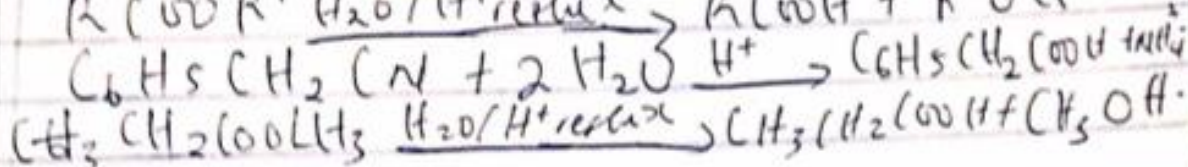
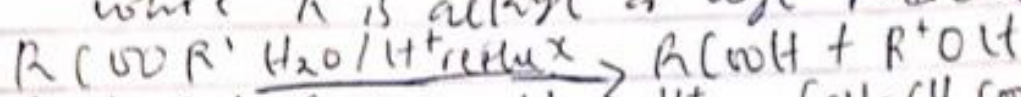


C. Hydrolysis of nitriles or esters.

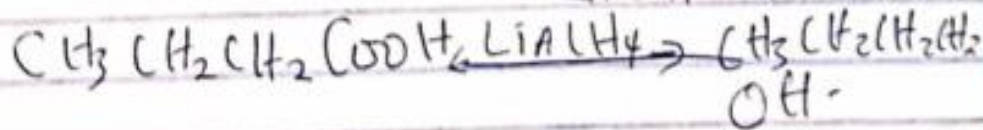
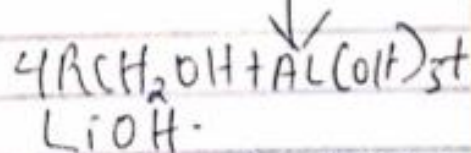
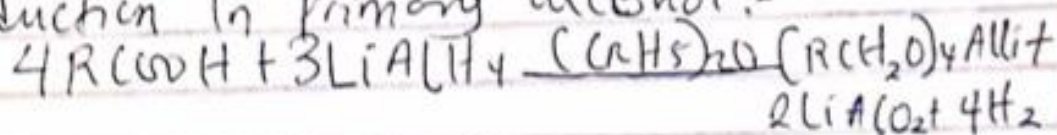
Nitriles undergo hydrolysis to form amides. The amides further undergo reaction in the presence of a catalyst which then form carboxylic acid. The catalyst for the reaction is OH^- or H^+ . Further more application of mild reaction condition helps in ceasing the reaction in the amide stage.



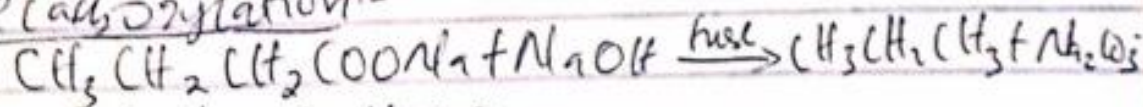
where R is alkyl or aryl radical.



5a) Reduction in primary alcohol:-



b. Decarboxylation:-



using Kolbe synthesis.

