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MBBS

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### Assignment on carboxylic acids

1) Give the IUPAC names of the following compounds

Answers

$\text{HCOOH}$  - Methanoic acid

$\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$  - Pentan-1,5-dioic 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) Physical properties of carboxylic acids

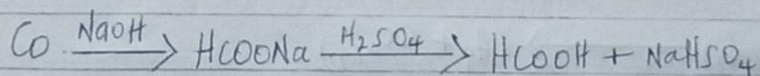
i) Physical appearance: All simple aliphatic carboxylic acids up to  $\text{C}_{10}$  are liquids at room temperature. Most other carboxylic acids are solid at room temperature although glacial ethanoic acid freezes below the room temperature.

ii) Boiling point: This 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.

iii) Solubility: As the number of carbon atoms in the alkyl group increases, the acidic nature and the solubility of the alkanoic acids in water decreases, because the oxygen-hydrogen bond becomes stronger. All carboxylic acids are soluble in organic solvents.

3) Industrial preparations

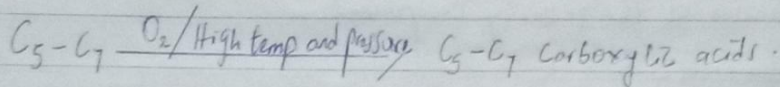
i) from Carbon(II)oxide: Methanoic acid (formic acid) is manufactured by adding Carbon(II)oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate(VI) acid ( $\text{H}_2\text{SO}_4$ ).



ii) From petroleum: Liquid phase air oxidation of  $\text{C}_5 - \text{C}_7$  alkanes, obtainable from petroleum at high temperature and pressure will give  $\text{C}_5 - \text{C}_7$  carboxylic acids with methanoic, propanoic and

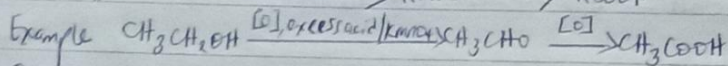
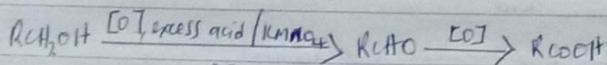
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butanedioic acids as by-products.

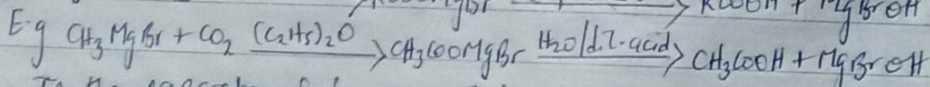
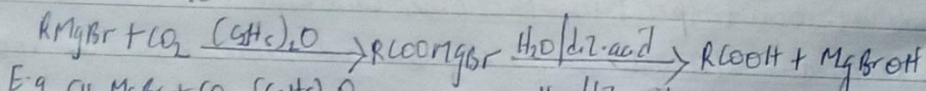


4) Synthetic preparations of carboxylic acid

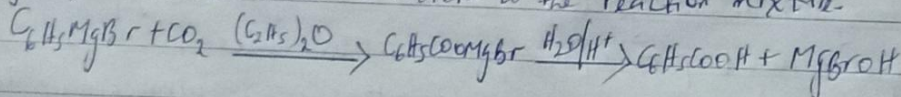
i) Oxidation of primary alcohols and aldehydes: This can be used to prepare carboxylic acids using either  $K_2Cr_2O_7$  or  $KMnO_4$  as catalyst in acidic solution



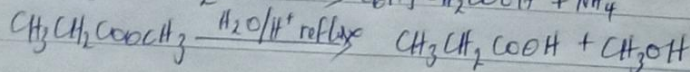
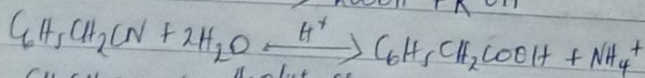
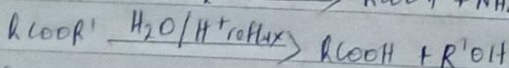
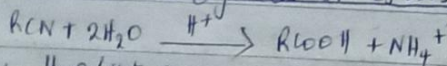
ii) Carboxylation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling carbon(iv) oxide into the grignard reagent and then hydrolysed with dilute acid.



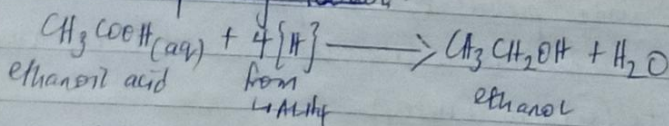
In the preparation of benzoic acid however, the reagent is added to solid  $CO_2$  (dry ice) which also serves as coolant to the reaction mixture.



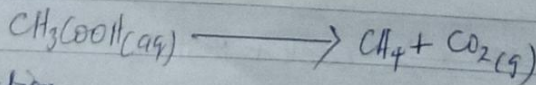
iii) Hydrolysis of nitriles (cyanides or esters)



4) Reduction to primary alcohol.



v) Decarboxylation



vi) Esterification

