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MATRIC NUMBER: 19/ENG06/031

DEPARTMENT: Mechanical Engineering

COURSE CODE:CHM102

1. Give the IUPAC names of the following compounds

- **HCOOH- Methanoic acid**
- **HOOCCH₂CH₂CH₂COOH- Pentan-1,5-dioic acid**
- **CH₃CH₂CHCOOH- Butanoic acid**
- **HO₂C-CO₂H- Ethanedioic acid**
- **CH₃(CH₂)₄COOH-Hexanoic acid**
- **CH₃CH=CHCH₂CH₂COOH- Hex-4-eneoic acid**

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

- **Physical appearance: All simple aliphatic carboxylic acids up to C₁₀ 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.**
- **Boiling points: Boiling points increase 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.**
- **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 organic solvents.**

3. Write two industrial preparations of carboxylic acids.

- From carbon(ii) oxide: Methanoic 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 (H₂SO₄)



- From Ethanol: Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganite(ii) ethanoate catalyst. Ethanal itself is obtained from ethylene.

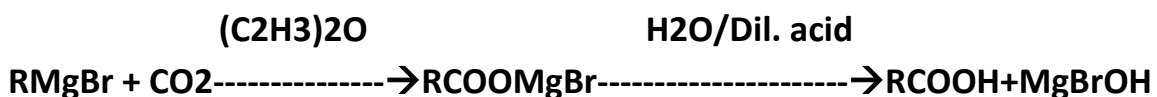


4. With equations and brief explanations discuss the synthetic preparation of carboxylic acid

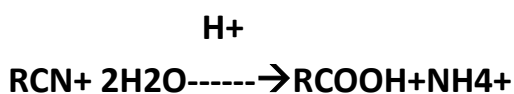
- Oxidation of primary alcohols and aldehydes: oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e. K₂Cr₂O₇ or KMnO₄) in acidic solution



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



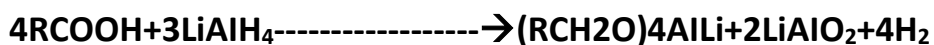
- Hydrolysis of nitriles(cyanides) or esters



H₂O/H+reflux



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



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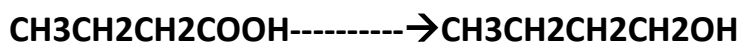
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4H₂O

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LiAlH₄

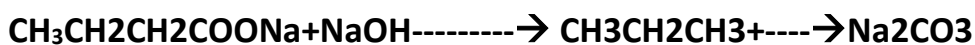


Butanoic acid

butanol

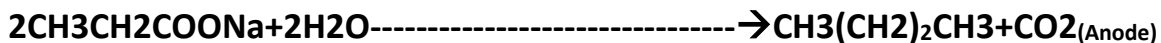
- Decarboxylation

fuse



Kolbe synthesis

Electrolysis/aq. CH₃OH



+2NaOH+H₂(cathode)

- Esterification

H⁺

