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**ANSWERS**

1. Give the IUPAC names of the following organic compounds.

HCOOH: Methanoic acid

HOOCCH2CH2CH2COOH: Pentan-1, 5-dioic acid

CH3CH2CH2COOH: Butanoic acid

HO2C-CO2H: Ethanedioic acid

CH3(CH2)4COOH: Hexanoic acid

CH3CH=CHCH2CH2COOH: Hex-4-eneoic acid

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

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.

1. BOILING POINT

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.

1. 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 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.

1. Write two industrial preparations of carboxylic acids.

* From petroleum

Liquid phase air oxidation of C5-C7 alkanes, obtainable from petroleum at high temperature and pressure will give C5-C7 carboxylic acids with methanoic, propanoic and butanedioic acids as by products.

* From ethanal

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.

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

* Carbonation of Grignard reagent.

Aliphatic carboxylic acids are obtained by bubbling carbon (IV) oxide into the Grignard reagent and then hydrolysed with dilute acid.

RMgBr + CO2 → (C2H5)2O RCOOMgBr H2O/dil.acid→ RCOOH + MgBROH

* Oxidation of primary alcohols and aldehydes.

It can be used to prepare carboxylic acids using the usual oxidising agents (i.e.K2Cr2O7 or KMnO4) in acidic solution.

RCH2OH[O] → excess acid/KMno4→ RCHO[0]→ RCOOH

* Hydrolysis of nitriles (cyanides) or esters

RCN +2H2O H+ →RCOOH + NH4+

(R=alkyl or aryl radical)

RCOORI H2O/H+ reflux→ RCOOH +RIOH

C6H5CH2CN + 2H2O H+ → C6H5CH2COOH + NH4+

CH3CH2COOH3 H2O/H+ reflux→ CH3CH2COOH + CH30H

1. With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.
2. Esterification

CH3CH2CH2COOH + CH3CH2CH2OH ↔H+ CH3CH2CH2COOH2CH2CH3 + H20

1. Decarboxylation

CH3CH2CH2COONa + NaOH fuse→ CH3CH2CH3 + Na2CO3

Kolbe synthesis

2CH3CH2COONa + 2H2O electrolysis/CH3OH→ CH3(CH2)2CH3 + CO2 + 2NaOH + H2

1. Reduction

4RCOOH + 3LiAlH4  (C2H5)2O → (RCH2O)4  AlLi + 2LiAlO2 + 4H2 4H2O→4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH LiALH4→ CH3CH2CH2CH2OH

(BUTANOIC ACID) (BUTANOL)