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Give the IUPAC name of the following carboxylic acid

Answer

$HCOOH$ ⟶ Methanoic acid

$HOOCCH_2CH_2CH_2COOOH$ ⟶ Pentan-1,3-dioic acid

$CH_3CH_2CH_2COOH$ ⟶ Butanoic acid

HO_2C-CO_2H ⟶ Ethan-dioic acid

$CH_3(CH_2)_4COOH$ ⟶ Hexanoic acid

$CH_2CH=CHCH_2CH_2COOH$ ⟶ Hex-4-enoic acid

Discuss briefly the physical properties of carboxylic acid under the following heads

Physical appearance:

All simple aliphatic carboxylic acid up to C_{10} are liquids at room temperature. Most other carboxylic acid are solid at room temperature anhydrous carboxylic acid (acetic acid) are known as glacial ethanoic acid freezes to an ice like solid at room temperature

Boiling point

This increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting point than the aliphatic counterparts of comparable relative molecular mass.

Solubility

Low molecular mass carboxylic acids whose have five to fewer carbon atoms in their molecules are soluble in water this is largely due to their ability to form hydrogen bond with water the water solubility of acids

decreases as relative molecular mass however this is because the structure becomes relatively non hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents

7) Write two preparation of carboxylic acids

i) from carbon (II) oxide

Methanoic acid is manufactured by adding CO to sodium hydroxide under pressure. The free carboxylic acid is liberated by addition to H_2SO_4

$$CO \xrightarrow{NaOH} HCOONa \xrightarrow{H_2SO_4} HCOOH + Na_2SO_4$$

ii) from petroleum

Liquid phase air oxidation of $C_5 - C_7$ alkanes obtainable from petroleum at high temperature and pressure could give $C_5 - C_7$ carboxylic acids while methanoic, propanoic and butanoic acids as by-products

$$C_5 - C_7 \xrightarrow{O_2 / \text{high temperature \& pressure}} C_5 - C_7 \text{ carboxylic acid}$$

) Write equations and brief explanation of synthetic preparation of carboxylic acids

Answer

) Oxidation of primary alcohols and aldehydes

Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using oxidizing agents such as $K_2Cr_2O_7$ & $KMnO_4$ in acidic solution

$$RCH_2OH \xrightarrow[KMnO_4]{[O] \text{ oxidizes}} RCHO \xrightarrow{[O]} R$$

2nd

(2) Carbonation of Grignard reagent

Aliphatic carboxylic acids are obtained by bubbling CO_2 into $RMgX$ and then hydrolyze with dilute acid

$$RMgBr + CO_2 \xrightarrow{(C_2H_5)_2O} RCOOMgBr \xrightarrow{hydrolysis} RCOOH + MgBrOH$$

R may be 1°, 2°, 3° aliphatic alkyl or aryl radical.

In preparation of benzoic acid reagent is also added to CO_2 which serves as a catalyst

$$C_6H_5MgBr + CO_2 \xrightarrow{(C_2H_5)_2O} C_6H_5COOMgBr \xrightarrow{H_2O/H^+} C_6H_5COOH + MgBrOH$$

Hydrolysis of nitriles or esters

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$

R = alkyl or aryl radicals

$$RCOOR' \xrightarrow{H_2O/H^+ \text{ reflux}} RCOOH + R'OH$$

$$C_6H_5CH_2CN + 2H_2O \xrightarrow{H^+} C_6H_5CH_2COOH + NH_4^+$$

$$CH_3CH_2COOCH_3 \xrightarrow[\text{reflux}]{H_2O/H^+} CH_3CH_2COOH + CH_3OH$$

3) with chemical equation only outline the reduction, decarboxylation and esterification of carboxylic acid

Answer

Reduction

$$4RCOOH + LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)AlLi + 2LiAlO_2 + H_2$$

$$\downarrow H_2O$$

$$4RCH_2OH + Al(OH)_3 + LiOH$$

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Butanoic acid — Butanol