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1. Give the IUPAC names of the following Compand.

a. $HCOOH$ b). $HOOCCH_2CH_2CH_2COOH$ c). $CH_3CH_2CH_2COOH$

d. HO_2C-CO_2H e). $CH_3(CH_2)_4COOH$ f) $CH_3CH=CHCH_2CH_2COOH$

→ Answers.

a. $HCOOH$ → Methanoic acid

b. $HOOCCH_2CH_2CH_2COOH$ → Pentan-1,5-dioic acid

c. $CH_3CH_2CH_2COOH$ → Butanoic acid

d. HO_2C-CO_2H → Ethanedioic acid

e. $CH_3(CH_2)_4COOH$ → Hexanoic acid

f. $CH_3CH=CHCH_2CH_2COOH$ → Hex-4-enoic acid

2. Discuss briefly the physical properties of Carboxylic acid under the following heading...

a). Physical appearance b). Boiling point c. Solubility

→ Answers

a. Physical Appearance: Simple aliphatic Carboxylic acids up to C_{10} are liquid at room temprature. Most are solid Carboxylic acids at room temprature.

b. Boiling Point: An increase in the molecular mass brings about an increase in the boiling point. Aromatic Carboxylic acids have a higher melting points and they are crystalline solids.

c. Solubility: Carboxylic acids with up to C_4 are Soluble in water, due to their ability to form hydrogen bonds with water molecules. An increase in molecular mass brings about a decrease in Solubility. All Carboxylic acids are Soluble in organic solvents.

3. Write two industrial preparation of carboxylic acid

→ Answers

i From Carbon (II) oxide: Methanoic acid is produced by adding Carbon (II) oxide under pressure to hot Solution of Sodium hydroxide, the Carboxylic acid formed is

Carefully liberated by reaction with tetraoxosulphate (vi) acid.

$CO + NaOH \xrightarrow{Pressure} HCOONa \xrightarrow{H_2SO_4} HCOOH + NaHSO_4$

ii From Ethanal: Ethanoic acid is obtained from the liquid phase air-oxidation of 5% solution of ethanal in the presence of manganate (II) ethanoate catalyst.

$HC \equiv CH \xrightarrow{dil\ H_2SO_4/HgSO_4} CH_3CHO \xrightarrow{O_2/(CH_3COO)_2Mn} CH_3COOH$.

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

→ Answers

i Oxidation of primary alcohols and aldehydes: Primary alcohols and aldehydes can be oxidized in the presence of oxidizing agent ($K_2Cr_2O_7$ / $KMnO_4$) in acidic solution to form carboxylic acids.

$RCH_2OH \xrightarrow[KMnO_4]{[O],\ excess\ acid} RCHO \xrightarrow{[O]} RCOOH$

ii Nitriles (Cyanides) or esters can be hydrolised to form carboxylic acid.

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

$RCOOR' \xrightarrow[Reflux]{H_2O/H^+} RCOOH + R'OH$

iii Carbonation of Grignard reagent: When carbon (iv) oxide is bubbled into the Grignard reagent and then hydrolyzed with dilute acid, carboxylic acids are formed.

$RMgBr + CO_2 \xrightarrow{(C_2H_5)_2O} RCOOMgBr \xrightarrow{H_2O/dil\ acid} RCOOH + MgBrOH$.

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

→ Answers

i Reduction:

$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2 \xrightarrow{+4H_2O}$

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

Eg: $CH_3CH_2CH_2COOH \xrightarrow[(C_2H_5)_2O]{LiAlH_4} CH_3CH_2CH_2CH_2OH$

Butanoic acid — Butanol.

ii Decarboxylation:

$CH_3CH_2CH_2COONa + NaOH \xrightarrow{Fuse} CH_3CH_2CH_3 + Na_2CO_3$

iii) Esterification:

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xleftrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O.$$