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Mbbs

CHM 102 ASSIGNMENT ON CARBOXYLIC ACIDS

1.

IUPAC NAMES OF GIVEN ORGANIC COMPOUNDS

HCOOH- Methanoic acid

HOOCCH₂CH₂CH₂CH₂COOH-

Pentan-1, 5-dioic acid

CH₃CH₂CH₂COOH-

Butanoic acid

HO₂C - CO₂H - Ethanedioic acid

CH₃(CH₂)₄COOH-

Hexanoic acid

CH₃CH=CHCH₂CH₂COOH-

Hex-4-enoic acid

2. PHYSICAL PROPERTIES OF CARBOXYLIC ACIDS

i. 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.

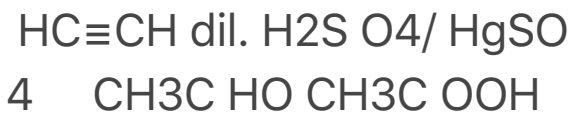
ii Boiling points: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

iii 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.

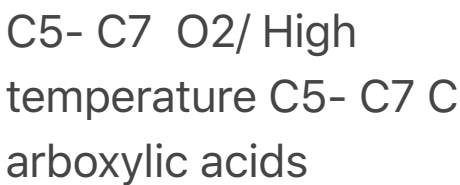
3 INDUSTRIAL PREPARATIONS OF CARBOXYLIC ACIDS

i From ethanol



ii. From petroleum

Equation:



4. SYNTHETIC PREPARATIONS OF CARBOXYLIC ACIDS

I. 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. $\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4) in acidic solution.

$$\text{RCH}_2\text{OH} \xrightarrow{[\text{O}], \text{excess acid}/\text{KMnO}_4} \text{RCHO} \xrightarrow{[\text{O}]} \text{RCOOH}$$

II. Carbonation of Grignard reagent

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

$$\text{RMgBr} + \text{CO}_2 \xrightarrow{(\text{C}_2\text{H}_5)_2\text{O}} \text{RCOOMgBr} \xrightarrow{\text{H}_2\text{O}/\text{dil. acid}} \text{RCOOH} + \text{MgBrOH}$$

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

III. Hydrolysis of nitriles (cyanides) or esters

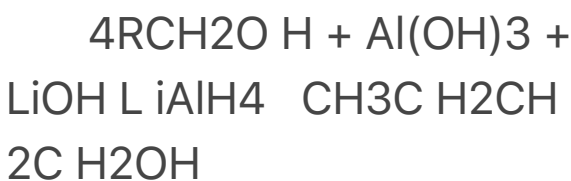
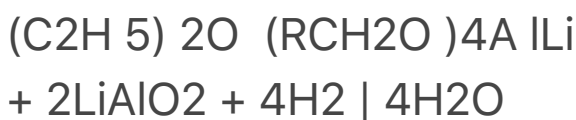
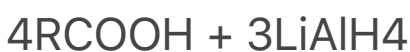
$$\text{RCN} + 2\text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{RCOOH} + \text{NH}_4^+$$

(R=alkyl or aryl radical)

$$\text{RCOOR}' \xrightarrow{\text{H}_2\text{O}/\text{H}^+ \text{ reflux}} \text{RCOOH} + \text{R}'\text{OH}$$

5. CHEMICAL REACTIONS OF CARBOXYLIC ACIDS

i Reduction to primary alcohol



ii Decarboxylation

This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivative

Thermal decarboxylation
butanol

Carboxylic acids with a strong electron attracting group e.g. $-\text{COOH}$, $-\text{CN}$, NO_2 , $\text{C}=\text{O}$ decarboxylate readily on heating to

100-1500 °C while others decarboxylate when their salts are heated with soda lime $\text{CH}_3\text{CH}_2\text{CH}_2\text{COONa}$

+ NaOH fuse $\text{CH}_3\text{C}_2\text{H}_5 + \text{Na}_2\text{CO}_3$

Kolbe synthesis

$2\text{CH}_3\text{C}_2\text{H}_5\text{OONa} + 2\text{H}_2\text{O}$

electrolysis/aq. $\text{CH}_3\text{C}_2\text{H}_5$
 $3(\text{CH}_2)_2\text{C}_2\text{H}_5$

+ CO_2 (anode) + $2\text{NaOH} + \text{H}_2$ (cathode) III.

iii Esterification

In the presence of strong acid catalyst, carboxylic acids react with alcohols to form esters

$\text{CH}_3\text{CH}_2\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \rightarrow$
+