

Assignment Title: Assignment on carboxylic acid

Course Title: General Chemistry II

Course Code: CHM 102

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COLLEGE: Medicine and Health Sciences **DEPARTMENT:** Medicine and Surgery
LEVEL: 100

Question

Assignment

1. Give the IUPAC names of the following compounds

ANS.

1. HCOOH = Methanoic acid
2. $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ = H Pentan-1,5-dioic acid
3. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ = Butanoic acid
4. $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ = Ethanedioic acid
5. $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ = Hexanoic acid
6. $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ = Hex-4-eneoic acid
2. Discuss briefly the physical properties of carboxylic acids under the following headings

ANSWER.

- i. Physical appearance

All simple aliphatic carboxylic acids up to C_{10} 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 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.

- iii. Solubility

iv. 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. Write two industrial preparations of carboxylic acids

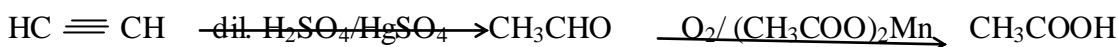
1. From Carbon(II) oxide (methanoic acid=carbon 11 oxid under pressure+hot aqueous solution of sodium hydroxide)

Methanoic acid (formic 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 (H_2SO_4)



2. 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



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

1. 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

Butanoic acid

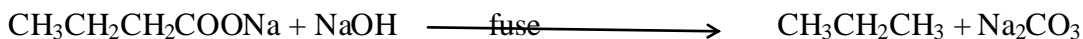
Butanol

2. Decarboxylation

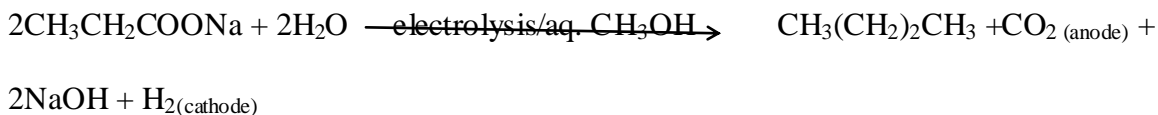
This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivative.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group eg $-\text{COOH}$, $-\text{CN}$, NO_2 , $\text{C}=\text{O}$ decarboxylate readily on heating to $100\text{--}150^\circ\text{C}$ while others decarboxylate when their salts are heated with soda lime



Kolbe synthesis



3. Esterification

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

