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MATRIC NO- 19/MHS11/117

COURSE CODE – CHEM 102

ASSIGNMENT TITLE- ASSIGNMENT ON CARBOXYLIC ACID

**QUESTION 1**-Give the IUPAC name of the following compounds.

(i)HCOOH- Methanoic acid

(ii)HOOCCH2CH2CH2COOH-Pentan-1, 5-dioc acid

(iii) CH3CH2CH2COOH- Butanoic acid.

(iv) HO2C-CO2H- Ethanedioc acid.

(v) CH3(CH2)4COOH-Hexanoic acid.

(vi) CH3 CH=CHCH2CH2COOH-Hex-4-eneioc acid.

**QUESTION 2-**DISCUSS BRIEFLY THE PHYSICAL PROPERTIES OF CARBOXYLIC ACIDS UNDER THE FOLLOWING HEADINGS: (I) Physical appearance (ii) Boiling point (ii) Solubility

1. *Physical appearance*-

 All simple aliphatic carboxylic acid up to C10 are liquid at room temperature, while 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 room temperature.

1. *Boiling point-*

The boiling point of carboxylic acids increases with in increasing relative molecular mass. Aromatic carboxylic acid are crystalline solids 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 because of their ability to form hydrogen bonds with water molecule. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature hence making it covalent.

*N/B*-all carboxylic acids are soluble in organic solvents.

**QUESTION 3-** Write two industrial preparations of Carboxylic acids.

1. From Carbon (ii) Oxide-

 Methanoic acid also known as (*FORMIC ACID)* can be produced or manufactured by the addition of carbon (ii) oxide under pressure to hot aqueous solution of sodium hydroxide (NaOH). The free carboxylic acid is liberated by the careful reaction with tetraoxosulphate(iv)acid (H2SO4).

EQUATION-

CO + NaOH(aq) HCOONa + H2SO4 HCOOH +NaHSO4

1. From Ethanal-

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution ethanol to ethanoic acid using Maganite(ii)ethanoate as the catalyst.

Ethanal itself is obtained from ethylene.

EQUATION-

HC CH dil. H2SO4 CH3CHO (CH3COO)2Mn CH3COOH

**QUESTION 4-** With equations and brief explanations discuss the synthetic preparation of carboxylic acid.

**(i)**Oxidation of Primary alcohols and Aldehydes-

Through the oxidation of primary alcohols and aldehydes, carboxylic acid can be prepared synthetically using the oxidizing agents (K2Cr2O7) or (KMnO4).

EQUATION-

RCH2OH[O] excess acid/KMnO4 RCHO [O] RCOOH

**(ii)**Carbonation of Gringard Reagent-

Aliphatic carboxylic acids can be produced synthetically by the bubbling of carbon (iv) oxide (CO2) into the gringard reagent and then hydrolyzed by dilute acid.

EQUATION-

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

Where R=1°, 2°, 3° Aliphatic alkyl or Aryl radical

Note- In the preparation of Benzoic acid, the reagent is added to solid carbon (iv) oxide (dry ice) which serves as a coolant to the reaction mixture.

C6H5MgBr + CO2 (C2H5)2O C6H5COOMgBr H2O/H+ C6H5COOH+MgBrOH

**QUESTION 5-**With chemical equation only, outline the [(i)reduction (ii)decarboxylation (ii)esterification] of carboxylic acid.

1. **Reduction of Carboxylic acid to Primary Alcohol**

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EQUATION OF REACTION- CH3-CH2-C-OH LiAH4 CH3-CH2-CH2-OH

 Propanoic acid Propanol

1. **Decarboxylation**

Thermal decarboxylation

EQUATION OF REACTION- CH3CH2CH2COONa + NaOH CH3CH2CH3 + Na2CO3

1. **Esterification of Carboxylic Acid**

EQUATION OF REACTION-

CH3CH2CH2COOH + CH3CH2CH2OH H+ CH3CH2CH2COOHCH2CH2CH3 + H2O