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***MATRIC NO: 19/ENG02/040***

***COURSE CODE: CHM102***

***COURSE TITLE: GENERAL CHEMISTRY II***

***QUESTION: 1.*** *Give the IUPAC names of the following compounds*

* *HCOOH*
* *HOOCCH2CH2CH2COOH*
* *CH3CH2CH2COOH*
* *HO2C-CO2H*
* *CH3(CH2)4COOH*
* *CH3CH=CHCH2CH2COOH*

***2.*** *Discuss briefly the physical properties of carboxyl acids under the following headings*

* *Physical appearance*
* *Boiling point*
* *Solubility*

***3.*** *Write two industrial preparations of carboxylic acids*

***4.*** *With equations and brief explanations discuss the synthetic preparation of carboxylic acids*

***5.*** *With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acids.*

***SOLUTION TO QUESTIONS LISTED ABOVE***

1. *HCOOH- Methanoic acid*

*HOOCCH2CH2CH2COOH Pentan-1,5-dioic acid*

*CH3CH2CH2COOH Butanoic acid*

*HO2C-CO2H Ethanedioic acid*

*CH3(CH2)4COOH Hexanoic acid*

*CH3CH=CHCH2CH2COOH Hex-4-eneoic acid*

1. *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.*

*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.*

*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*

1. *-From Carbon (II) oxide*

*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 (H2SO4).*

*-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.*

1. *Carbonation of Grignard reagent*

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

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

*R may be 1o, 2o, 3o aliphatic alkyl or aryl radical*

*In the preparation of benzoic acid, the reagent is added to solid carbon (IV) oxide (dry ice) which also serves as coolant to the reaction mixture*

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

1. *-Reduction*

4RCOOH + 3LiAlH4 (C2H5)2O (RCH2O)4AlLi + 2LiAlO2 + 4H2

4H2O

4RCH2OH + Al (OH)3 + LiOH

CH3CH2CH2COOH LiAlH4 CH3CH2CH2CH2OH

Butanoic acid Butanol

* *Decarboxylation*

CH3CH2CH2COONa + NaOH fuse CH3CH2CH3 + Na2CO3

Kolbe synthesis

2CH3CH2COONa + 2H2O electrolysis/aq. CH3OH CH3(CH2)2CH3 +CO2 (anode) + 2NaOH + H2(cathode)

* *Esterification*

CH3CH2CH2COOH + CH3CH2CH2OH H+ CH3CH2CH2COO CH2CH2CH3 + H2O.