**CHM 102: GENERAL CHEMISTRY II**

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**MATRIC NUMBER:** 19/MHS01/063

**DEPARTMENT:** Pre-medicine and Surgery

**COLLEGE:** Medicine and Health Sciences

**LEVEL:** 100

Assignment

1. Give the IUPAC names of the following compounds
2. HCOOH Methanoic acid
3. HOOCCH2CH2CH2COOH Pentan-1,5-dioic acid
4. CH3CH2CH2COOH Butanoic acid
5. HO2-C-CO2H Ethanedoic acid
6. CH3(CH2)4COOH Hexanoic acid
7. CH3CH=CHCH2CH2COOH Hex-4-eneoic acid
8. Discuss briefly the physical properties of carboxylic acids under the following headings
9. 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.

1. 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.

1. 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. Write two industrial preparations of carboxylic acids
2. 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)

CO NaOH HCOONa H2SO4 HCOOH + NaHSO4

1. 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 is obtained from ethylene

HC≡CH dil. H2SO4/HgSO4 CH3CHO O2/ (CH3COO)2Mn CH3COOH

1. With equations and brief explanation discuss the synthetic preparations of carboxylic acids.
2. 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 K2Cr2O7 or KMnO4) in acidic solution

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

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 1°, 2°, 3° 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. Hydrolysis of nitriles (cyanides) or esters

RCN + 2H2O H⁺ RCOOH + NH4⁺

(R=alkyl or aryl radical)

RCOOR’ H2O/H⁺ reflux RCOOH + R’OH

C6H5CH2CN + 2H2O H⁺ C6H5CH2COOH + NH4⁺

CH3CH2COOCH3 H2O/H⁺ reflux CH3CH2COOH + CH3OH

1. With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.
2. Reduction:

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

4H2O

4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH LiAlH4 CH3CH2CH2CH2OH

Butanoic acid Butanol

1. Decarboxylation:
2. Thermal decarboxylation;

CH3CH2CH2COONa + NaOH fuse CH3CH2CH3 + Na2CO3

1. Kolbe synthesis;

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

1. Esterification:

CH3CH2CH2COOH + CH3CH2CH2OH H⁺ CH3CH2CH2COOCH2CH2CH3 + H2O.