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**MATRIC NUMBER: 19/MHS09/010**

**DEPARTMENT: DENTISTRY AND DENTAL SURGERY**

**COURSE: CHM 102**

**QUESTION 1:**

1. HCOOH: Methanoic acid.
2. HOOCCH2CH2CH2COOH: Pentan-1,5-dioc acid.
3. CH3CH2CH2COOH: Butanoic acid.
4. HO2C-CO2H: Ethanedioc acid.
5. CH3(CH2)4COOH: Hexanoic acid.
6. CH3CH=CHCH2CH2COOH: Hex-4-enoic acid.

**QUESTION 2:**

1. Physical appearance: All simple aliphatic carboxylic acids up to C10 are liquid 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.
2. 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.
3. Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water, this is due to their ability to form hydrogen bonds with water molecules. Water solubility of acids decreases as the relative molecular mass increases because the structure becomes more hydrocarbon in nature and covalent. All carboxylic acids are soluble in organic solvent.

**QUESTION 3:**

Industrial preparation of carboxylic acid:

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).

CO NaOH HCOONa H2SO4 HCOOH + NaHSO4

1. From Ethanal: Ethanoic acid is obtained commercially by the liquid phase air oxidation of 5% solution of ethanol to ethanoic acid using manganite(II) ethanoate catalyst. Ethanal itself is obtained from ethylene.

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

**QUESTION 4:**

Synthetic preparation of carboxylic acid:

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 K2Cr2O7 or KMnO4) in acidic solution.

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

1. Hydrolysis of Nitriles 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

**QUESTION 5:**

1. Reduction to primary alcohol.

4RCOOH + 3LiAlH4 (C2H5)2O (RCH2O)4AlLi + 2LiAlO2 + 4H2 4H2O

 4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH LiAlH4 CH3CH2CH2CH2OH

Butanoic acid Butanol

1. Decarboxylation.

CH3CH2CH2COONa + NaOH fuse CH3CH2CH3 + Na2CO3

1. Esterification:

CH3CH2CH2COOH + CH3CH2CH2OH H+ CH3CH2CH2COO CH2CH2CH3 + H2O