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**DEPT: OPTOMETRY**

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**COURSE: CHM 102**

**Assignment on Carboxylic acids**

1. The Iupac names of the following compounds
* 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. The physical properties of carboxylic acids
* **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 molecule are soluble in water; this is 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. Two industrial preparations of carboxylic acids
* From Carbon(II) oxide:

CO NaOH HCOONa H2SO4 HCOOH + NaHSO4

* From Petroleum:

C5-C7 O2/High temperature and pressure C5-C7 carboxylic acids

1. **Synthetic preparation of carboxylic acids**
* Oxidation of primary alcohols and aldehydes

Oxidation of primary alcohols and aldehyde 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

* 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 a coolant to the reaction mixture

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

* 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. **Reduction**:

4RCOOH + 3LiAlH4 (C2H5)2O (RCH2O)4AlLi + 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+ CH3CH2CH2COOCH2CH2CH3+ H2O