3) Write 2 industrial Preparations of Carboxylic acid

a) From Petroleum: Liquid Phase air oxidation of $C_5 - C_9$ alkanes, obtainable from Petroleum at high temperature and Pressure will give $C_3 - C_7$ Carboxylic acids with methanoic, Propanoic and butanoic acid as by-Products

$C_5 - C_9$ O_2 high temperature and Pressure $C_3 - C_7$ Carboxylic acid

b) from ethanol: ethanoic acid is obtained Commercially by the liquid Phase air-Oxidation of 5% solution of ethanol to ethanoic acid using manganite (II) ethanoate Catalyst. Ethanol itself is obtained from ethylene.

$$HC \equiv CH \xrightarrow{dil.\ H_2SO_4 / HgSO_4} CH_3CHO \xrightarrow{O_2 / (CH_3COO)_2Mn} CH_3COOH$$

4) With equations and ~~brief~~ brief explanation, discuss the Synthetic Production of Carboxylic acid

Solution: Hydrolysis of nitriles (Cyanides) or esters

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$

$$RCOOR \xrightarrow{H_2O / H^+ \text{ reflex}} RCOOH + R'OH$$

$$C_6H_5CH_2CN + 2H_2O \xrightarrow{OH^+} C_6H_5CH_2COOH + NH_4^+$$

$$CH_3CH_2COOCH_3 \xrightarrow{H_2O / H^+ \text{ reflex}} CH_3CH_2COOH + CH_3OH$$

R = alkyl, aryl, radical

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(a) Give the IUPAC name of the following Compounds
(1) $HCOOH$ (Methanoic acid)
(2) $HOOC[H_2CH_2CH_2COOH$ (Pentan - 1,5. dioic acid)
(3) $CH_3CH_2CH_2COOH$ (Butanoic acid)
(4) HO_2C-CO_2H (Ethanedioic acid)
(5) $CH_3(CH_2)_4COOH$ (Hexanoic acid)
(6) $CH_3CH \equiv CHCH_2CH_2COOH$ (Hex - 4 - enoic acid)

(2) Discuss briefly the Physical Properties of Carboxylic acid Under the following headings: Physical appearance, boiling Point and Solubility.
(a) Physical appearance : All simple aliphatic Carboxylic up to C_{10} 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 room temperature.

(b) Boiling Point : This increases with increasing relative molecular masses. Aromatic Carboxylic acids are Crystalline solids and have higher melting Points than their aliphatic Counterparts of relative masses

(c) 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 have Covalent. All Carboxylic acids are soluble in organic Solvents.