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19/Mitsol/052

Assignment on Carboxylic Acids

Q1 With equations and brief explanation discuss the synthetic preparation of Carboxylic acids.

(A) Oxidation of primary alcohols and aldehydes: can be used to prepare Carboxylic acids using the usual oxidizing agents (i.e.  $K_2Cr_2O_7$  or  $KMnO_4$ ) in acidic solution.  
 $RCH_2OH \xrightarrow{[O], \text{excess acid}/KMnO_4} RCHO \xrightarrow{[O]} RCOOH$

(B) Carboxylation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling Carbon Dioxide into the Grignard reagent and then hydrolyzed with dilute acid.  
 $RMgBr + CO_2 \xrightarrow{(C_2H_5)_2O} RCOOMgBr \xrightarrow{\text{H}_2O/\text{dil. acid}} RCOOH + MgBrOH$

(C)  $RCHO + 2H_2O \xrightarrow{H^+} RCOOH + MH_4^+$   
 Hydrolysis of Nitriles (Cyanides) or esters  
 $C_6H_5CH_2CN + 2H_2O \xrightarrow{H^+} C_6H_5CH_2COOH + MH_4^+$

Q2 With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

(A) Reduction:  $4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2 \xrightarrow{4H_2O} 4RCH_2OH + Al(OH)_3 + LiOH$   
 $CH_3CH_2CH_2COOH \xrightarrow{2LiAlH_4} CH_3CH_2CH_2CH_2OH$

(B) Decarboxylation:  $CH_3CH_2CH_2COONa + NaOH \xrightarrow{\text{fuse}} CH_3CH_2CH_3 + Na_2CO_3$   
 $2CH_3CH_2COONa + 2H_2O \xrightarrow{\text{electrolysis/aq. } CH_3COOH} CH_3(CH_2)_2CH_3 + CO_2 \text{ (anode)} + 2NaOH + H_2$

(C) Esterification  
 $CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$