Preparation of aldehyde :- →

1. By nitriles or Cyanides :→ (Stephen reaction)
When alkyl Cyanide or alkane nitrile is reduced by the help of $SnCl_2 + HCl$ first it form imine (unstable product or intermidéate) which on further hydrolysis in acidic midium it gives aldehyde.

Note: During reaction of $-C\equiv N$ with 2H (in presence of $SnCl_2$ & HCl) one π bond of $C\equiv N$ will break, hence on C & N each atom one valency will rise on that position hydrogen will get bonding hence imine is formed, further on hydrolysis in acidic midium $=NH$ is removed by $=O$, & we get aldehyde.

Instead of $SnCl_2$ & HCl we can use DIBAL-H (Di- isobutyl- aluminium hydride) also as reducing agent, one property is with DIBAL-H if any double bond is present in between C & C in Cyanide Compound then in product also double bond will be maintained it will convert CN only into CHO.

$$R-C\equiv N + 2[H] \xrightarrow{SnCl_2+HCl} R-\underset{\text{Imine}}{\overset{H}{\underset{|}{C}}=N} \xrightarrow{+H_2O^+} R-\underset{H}{\overset{O}{\underset{|}{C}}=O}\ (\text{Aldehyde})$$

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OR $R-C\equiv N \xrightarrow[H_2O]{DIBAL-H} R-\underset{H}{\overset{H}{C}}=N \xrightarrow{H_3O^+} R-\underset{H}{C}=O$ (Aldehyde)
$+2[H]$

$R-CH=CH-CH_2-CH_2-CN + 2[H] \xrightarrow[H_2O]{DIBAL-H}$

$R-CH=CH-CH_2-CH_2-\underset{H}{C}=N$

$\xrightarrow{H_3O^+}$

$R-CH=CH-CH_2-CH_2-\underset{H}{C}=O$

(B) By esters:

When ester is reduced by the help of DIBAL-H then it form aldehyde.

$CH_3-(CH_2)_8-\overset{O}{\overset{\|}{C}}-OC_2H_5 \xrightarrow[H_2O]{DIBAL-H} CH_3-(CH_2)_8-\overset{O}{\overset{\|}{C}}-H + C_2H_5OH$

(Ethyl decanoate) $+2[H]$ Decanal

2- By Hydrocarbon (Aromatic): → Oxidation reaction

1. When aromatic hydrocarbon like Toluene is oxidised in presence of strong Oxidising agent like $KMnO_4$ or $K_2Cr_2O_7/H^+$ then benzoic acid is formed.

[A] ETARD REACTION: →

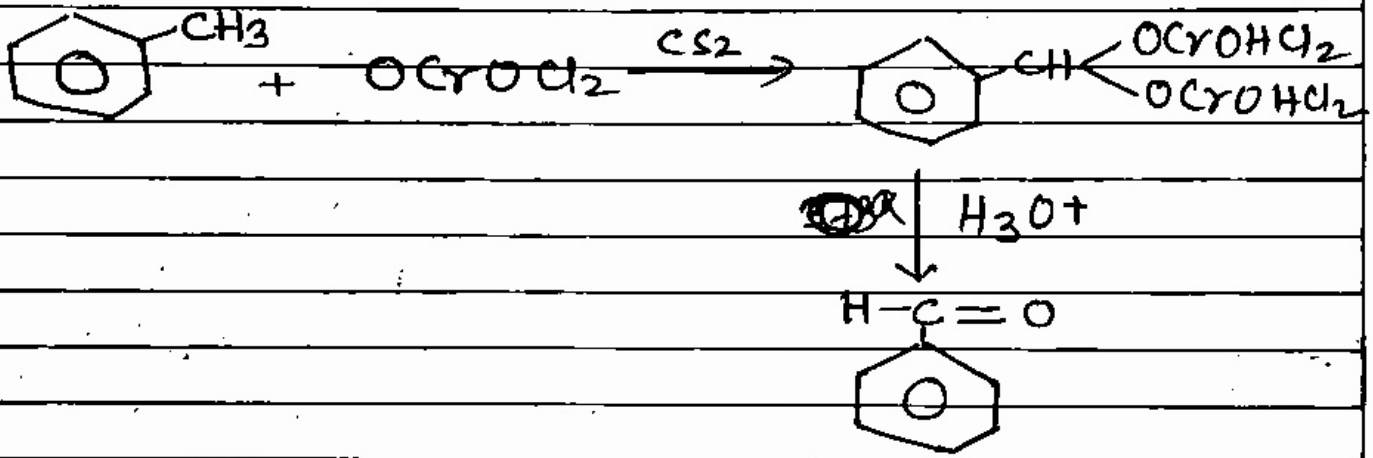
2. When aromatic hydrocarbon i.e Toluene is Oxidised by weak oxidising agent like Chromyl Chloride (CrO_2Cl_2) in non aqueous midium like CS_2 then first Chromium complex is formed and

On the further hydrolysis in acidic midium benzaldehyde is formed. This reaction is called Etard reaction.

Str. of Chromyl chloride $O=\underset{\underset{Cl}{|}}{\overset{\overset{O}{||}}{Cr}}-Cl$

When π bond breaks in between Cr & O then it is

$O^-\text{—}\underset{\underset{Cl}{|}}{\overset{\overset{O^-}{|}}{Cr}}\text{—}Cl$ or $OCrOCl_2$



Benzaldehyde.

[B] By Toluene using chromic oxide as oxidising agent in presence of acetic anhydride at 273-283K.

When Toluene react with acetic anhydride in presence of chromic oxide (CrO_3) at 273-283K first it give Benzylidene diacetate, and on further hydrolysis in acidic midium it gives Benzaldehyde.

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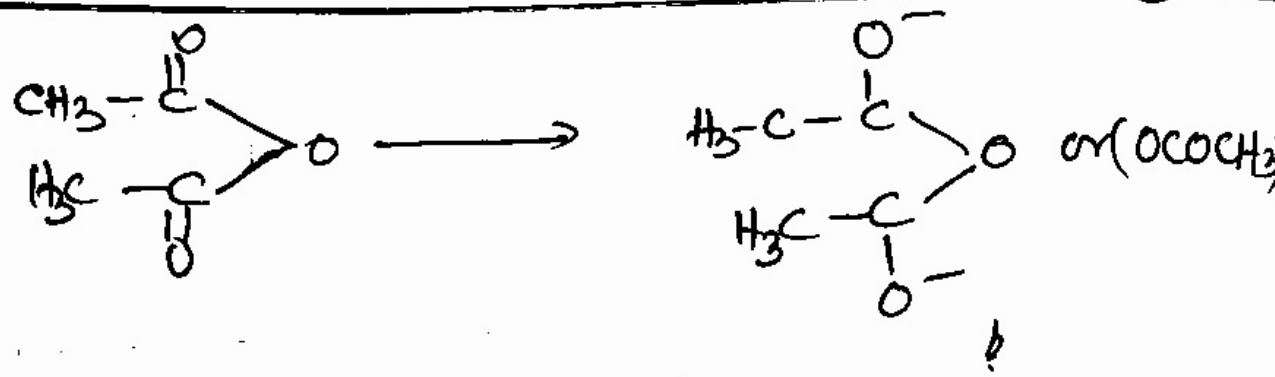

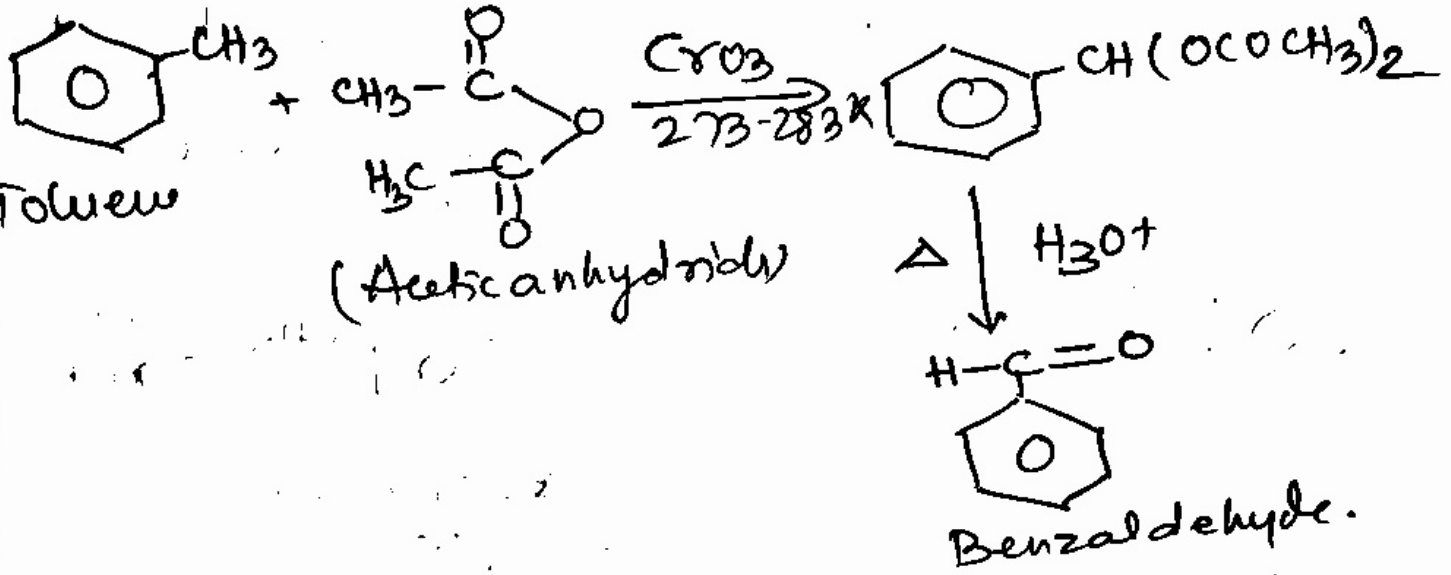

[C] By Side chain Chlorination :— (It is manufacturing method of Benzaldehyde] → When toluene is treated with Cl_2 in presence of diffused Sunlight ($h\nu$) then it form Benzalchloride which on hydrolysis in acidic midium at 100°C or 373K it gives Benzaldehyde.