Reduction of carbonyl Compound

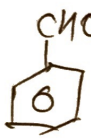
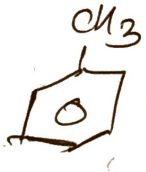
(1) clemmensen reduction

Aldehyde and Ketones fluxed with amalgamated zinc and hydrochloric acid. Carbonyl group get reduced to methylene group.

$$R-\overset{O}{\overset{\|}{C}}-R \xrightarrow[\text{reflux}]{2Zn\text{-}Hg + 4HCl} R-CH_2-R + 2ZnCl_2 + 2Hg + H_2O$$

(i) $CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow[\text{reflux}]{2Zn\text{-}Hg + 4HCl} CH_3-CH_3 + 2ZnCl_2 + 2Hg + H_2O$

Acetaldehyde — Ethane

(ii)  $\xrightarrow{2Zn\text{-}Hg + 4HCl}$  $+ 2ZnCl_2 + 2Hg + H_2O$

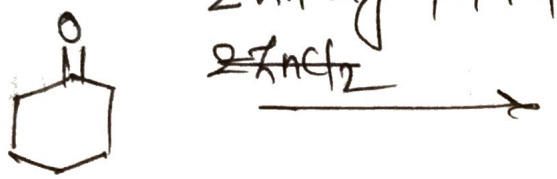
Benzaldehyde — Toluene.

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{2Zn\text{-}Hg + 4HCl} CH_3-CH_2-CH_3 + 2ZnCl_2 + 2Hg + H_2O$

Acetone — propane

 $\xrightarrow{2Zn\text{-}Hg + 4HCl}$  $+ 2ZnCl_2 + 2Hg + H_2O$

Acetophenone — Ethyl benzene.

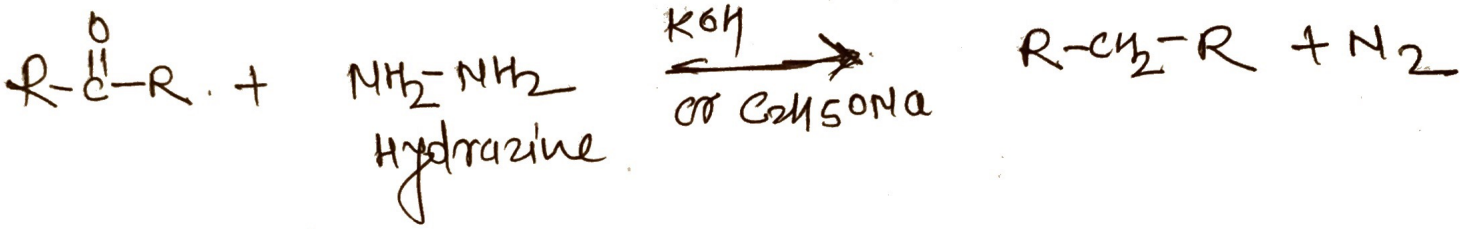


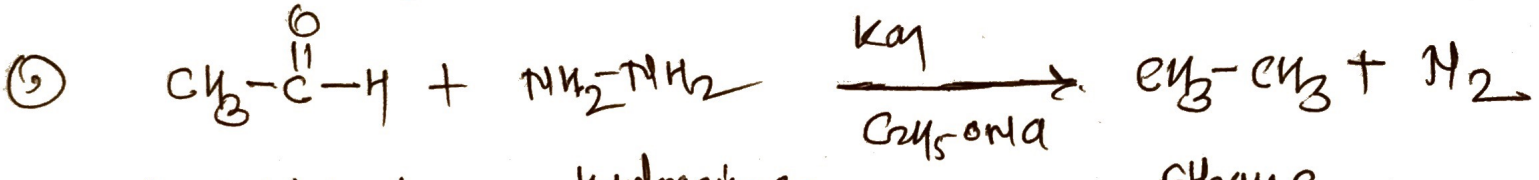
Cyclohexanone

Cyclohexane

Wolf-Krishner reduction

Aldehyde and ketones on heating with hydrazine and strong base like KOH or sodium ethoxide, carbonyl group get reduced to methylene group.

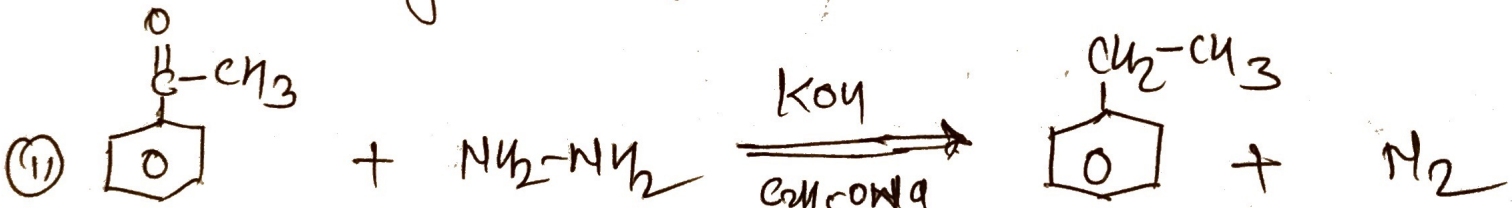


(i) 

Acetaldehyde

hydrazine

Ethane

(ii) 

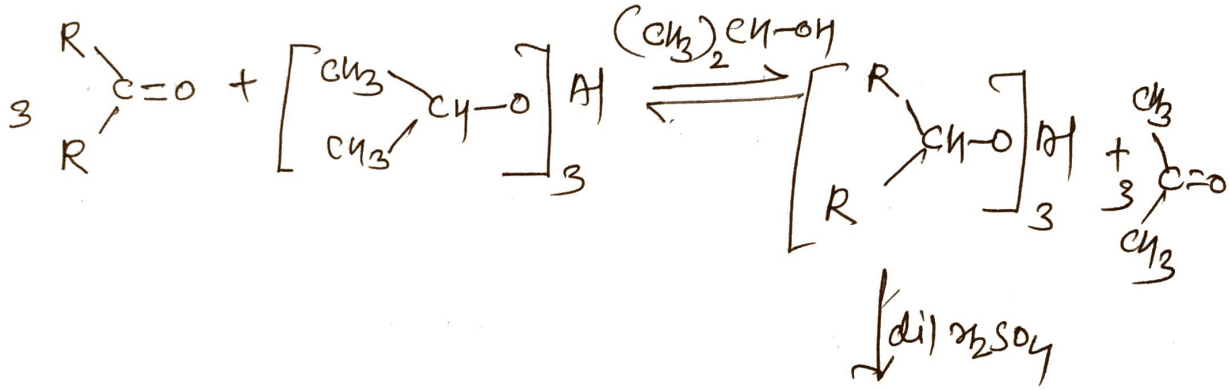
Acetophenone

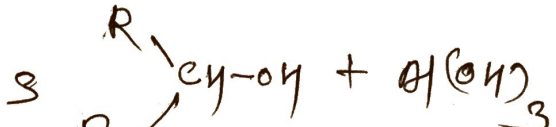
Ethyl benzene.

(5) Meerwein-Ponndorf-Verley (MPV) reduction.

Aldehyde and ketones when treated with aluminum isopropoxide in isopropanol, carbonyl group get reduced to alcoholic group to give corresponding alcohol.

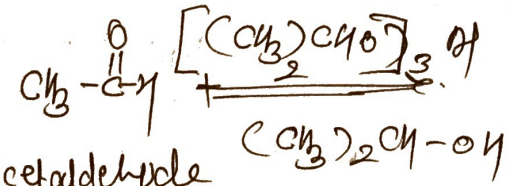
During the reaction aluminum isopropoxide is oxidized to acetone.





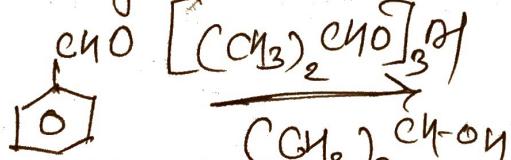
Alcohol

(i) Acetaldehyde



Ethanol

(ii) Benzaldehyde

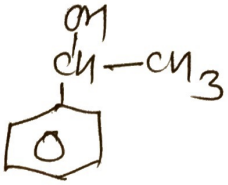


Benzyl Alcohol.

(iii) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ $\xrightarrow[(CH_3)_2CH-OH]{[(CH_3)_2CHO]_3Al}$ $CH_3-\underset{OH}{CH}-CH_3$

Acetone

2-propanol

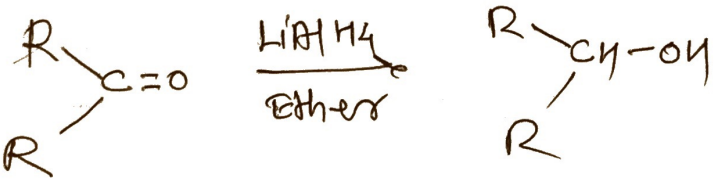
(iv)  $\xrightarrow[(CH_3)_2CH-OH]{[(CH_3)_2CHO]_3Al}$ 

Acetophenone

1-Phenyl ethanol

(4) Reduction by using $[LiAlH_4]$

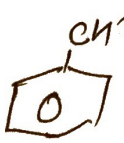
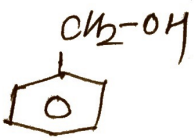
Aldehyde and Ketones reacted with lithium aluminum hydride in ether, carbonyl group get reduced to alcoholic group to give corresponding alcohols.



(i) CH_3-CHO $\xrightarrow[Ether]{LiAlH_4}$ CH_3-CH_2-OH

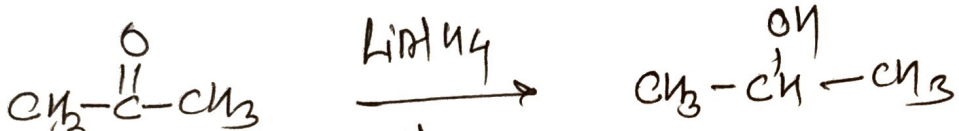
Acetaldehyde

Ethanol

(ii)  $\xrightarrow[Ether]{LiAlH_4}$ 

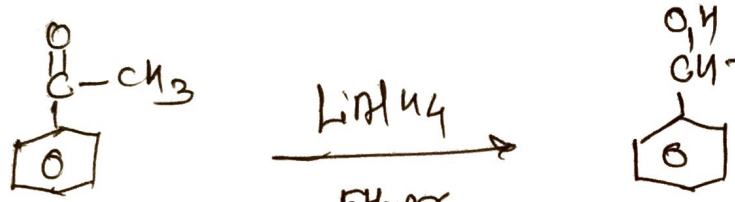
Benzaldehyde

Benzyl alcohol.

(III) 

Acetone

2-propanol

(IV) 

Acetophenone

1-phenylethanol.