

















Test		Aldehyde	Ketone
1. Toller's reagent test	Give red mirror	Give red mirror	No action
2. Fehling's solution test	Give red ppt. (Benzaldehyde is an exception)		No action
3. Schiff reagent test	Restore pink colour		No action
4. Reaction with LiAlH <sub>4</sub>	Form primary alcohols	Form secondary alcohols	Distinguishes

**ALDEHYDES AND KETONES:**

(i) Physical:  
Boiling points are higher than hydrocarbons and ethers of comparable molecular masses.

(ii) Chemical: Nucleophilic addition reactions :  
Aldehydes are more reactive than ketones due to steric and electronic reasons.

$\text{HCN} + \text{OH}^- \xrightarrow{\text{R-C(=O)-CH}_2} \text{C}=\text{N}^- + \text{H}_3\text{O}^+ \quad \text{C}=\text{O} + \text{CN}^- \xrightarrow{\text{HCl gas}} \text{R}-\overset{\delta^+}{\underset{\text{CH}_3\text{OH}}{\text{C}}}(\text{O})-\text{CH}_2 + \text{H}_2\text{O}$

$\text{R}-\overset{\delta^+}{\underset{\text{CH}_3\text{OH}}{\text{C}}}(\text{O})-\text{CH}_2 \quad \text{R}'-\overset{\delta^-}{\underset{\text{HCl}}{\text{C}}}(\text{O})-\text{CH}_2$

Reduction (a) To alcohols – aldehydes and ketones reduce to primary and secondary alcohols respectively by NaBH<sub>4</sub> or LiAlH<sub>4</sub>

(b) To hydrocarbons –

$\text{C=O} \xrightarrow[\text{H}_2\text{O}]{\text{Zn/Hg}} \text{CH}_2 + \text{H}_2\text{O} \quad (\text{Clemmensen Reduction})$

$\text{C=O} \xrightarrow{-\text{H}_2\text{O}} \text{C}=\text{NNH}_2 \xrightarrow[\text{Heat}]{\text{KOH/Ethyleneglycol}} \text{CH}_2 + \text{N}_2 \quad (\text{Wolff-Kishner reduction})$

Oxidation:  $\text{R-CHO} \xrightarrow{[\text{O}]} \text{R-COOH}$

Tollen's test:  $\text{R-CHO} + 2[\text{Ag(NH}_3)_2]^+ + 3\text{OH}^- \rightarrow \text{RCO}^- + 2\text{Ag}^{+} + 2\text{H}_2\text{O} + 4\text{NH}_3$

Fehling's test:  $\text{R-CHO} + 2\text{Cu}_2^{+} + 5\text{OH}^- \rightarrow \text{RCOO}^- + \text{Cu}_2\text{O} + 3\text{H}_2\text{O}$

Haloform reaction:  $\text{R-CH}_3 \xrightarrow{\text{NaOCl}} \text{R-Cl} + \text{CH}_3\text{COCH}_3$

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Reactions due to  $\alpha$ -hydrogen:

$\text{CH}_3\text{C}_2\text{H}_5 \xrightarrow{\text{Ba(OH)}_2} \text{CH}_3\text{C}_2\text{H}_5 + \text{H}_2\text{O} \quad \text{CH}_3\text{C}_2\text{H}_5 \xrightarrow[\text{H}_2\text{O}]{\Delta} \text{CH}_3\text{C}_2\text{H}_5 + \text{H}_2\text{O}$

$2\text{CH}_3\text{COCH}_3 \xrightleftharpoons{\text{Ba(OH)}_2} \text{CH}_3\text{C}_2\text{H}_5 + \text{H}_2\text{O} \quad \text{CH}_3\text{C}_2\text{H}_5 \xrightarrow{\Delta} \text{CH}_3\text{C}_2\text{H}_5 + \text{H}_2\text{O}$

Cannizzaro reaction:  $2\text{HCHO} + \text{cone KOH} \xrightarrow{\Delta} \text{CH}_3\text{OH} + \text{HCOOK}$

Electrophilic substitution reaction:

$\text{C}_6\text{H}_5\text{CHO} \xrightarrow[273-285 \text{ K}]{\text{HNO}_3/\text{H}_2\text{SO}_4} \text{C}_6\text{H}_5\text{CHO} + \text{H}_2\text{O}$

**Carboxylic Acids:**

(i) Physical : Higher boiling points than aldehydes, ketones or alcohols.  
(ii) Functional Derivatives of carboxylic acid

(iii) Chemical :  $2\text{RCOOH} + 2\text{Na} \longrightarrow 2\text{RCOONa} + \text{H}_2$   
Forms corresponding anhydride on heating with mineral acids  
 $\text{RCOOH} + \text{ROH} \xrightleftharpoons{\text{H}_2\text{O}} \text{RCOOR} + \text{H}_2\text{O}$

1) Acetaldehyde

$\text{R}-\overset{\parallel}{\underset{\text{O}}{\text{C}}}-\text{X} \quad \text{R}-\overset{\parallel}{\underset{\text{O}}{\text{C}}}-\text{O}-\text{C}-\text{R}$

2) Acid Anhydrides

$\text{CH}_3\text{COOH} + \text{NH}_3 \rightleftharpoons \text{CH}_3\text{COONH}_4 \xrightarrow{\text{H}_2\text{O}} \text{CH}_3\text{CONH}_2$

3) Esters

$\text{RCOONa} \xrightarrow{\text{R-CH}_2\text{COOH}} \text{R-CH}_2\text{COOCH}_3 \quad \text{R-CH}_2\text{COOCH}_3 \xrightarrow{\text{NaOH & CaO}} \text{R-CH}_2\text{COOH} \quad (\text{HZV reaction})$

4) Amides

$\text{CHO} \xrightarrow{\text{Conc HNO}_3} \text{CHO} \quad \text{Conc HNO}_3 \xrightarrow{\text{Conc H}_2\text{SO}_4} \text{NO}_2$



