

CARBONYL COMPOUND

Preface

Organic compound containing - CHO or > CO group are called aldehydes and ketones. It is a classic topic to know various reactions and their mechanism and a number of name reactions. In this topic we will discuss general methods of preparation of these compounds, differentiation between aldehyde and ketone, general chemical properties, chemical reactions of aldehydes and ketones, a number of polymerisation reactions and their uses.

This book consists of theoretical & practical explanations of all the concepts involved in the chapter. Each article followed by a ladder of illustration. At the end of the theory part, there are miscellaneous solved examples which involve the application of multiple concepts of this chapter.

Students are advised to go through all these solved examples in order to develop better understanding of the chapter and to have better grasping level in the class.

Total No. of questions in **Carbonyl Compound** are -

In chapter Examples	09
Solved Examples	25
Total No. of questions	34

1. INTRODUCTION ::

(a) Organic compounds in which $\begin{array}{c} \text{O} \\ \parallel \\ \text{C} \end{array}$ group is

present are called 'Aldehyde & Ketone'.

(b) The group $\begin{array}{c} \text{O} \\ \parallel \\ \text{C} \end{array}$ is called as carbonyl group

so, compound are also called carbonyl compounds. If H atom is attached with this carbonyl group then compound is called **aldehyde** and if alkyl group is present on both sides then compound is called **Ketone**.

(c) In ketone if both alkyl group are same then they are called simple ketone, if different then called mixed ketone.

(d) Their general formula is $C_nH_{2n}O$. Hybridisation state of carbon is sp^2 and C = O bond length is 1.23 \AA .

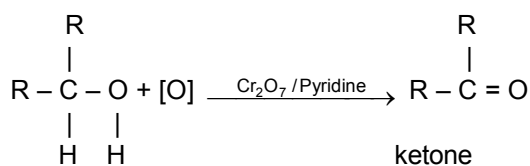
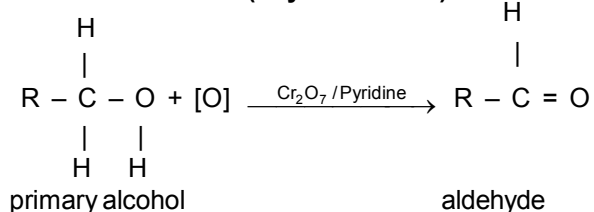
(e) The ratio of C, H & O in formaldehyde is 1 : 2 : 1 (CH_2O). It is called simplest sugar.

(f) Aldehyde shows chain, position and functional isomerism.

(g) Ketone shows chain, position, functional and metamerism also. Aldehyde and ketone both are functional isomers with each other.

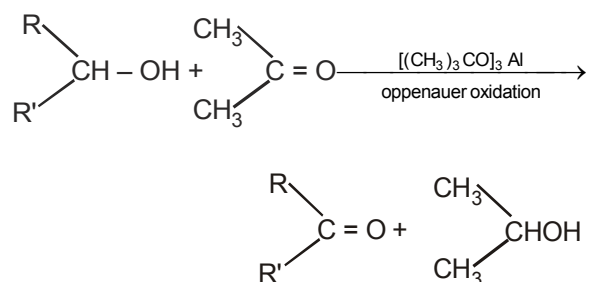
2. GENERAL METHODS OF PREPARATION

2.1 From Alcohol (By Oxidation) : -

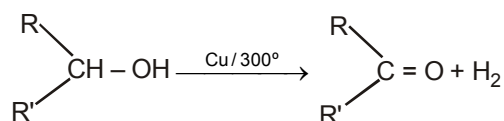
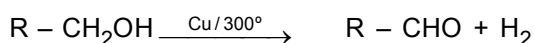


NOTE : - In this reaction if we take acidic $KMnO_4$ or $K_2Cr_2O_7$ then reaction will not stop on aldehyde or ketone because they are strong oxidising agent. They further oxidise aldehyde, ketone into acid. So, to stop the reaction on aldehyde & ketone, we use mild oxidant Cr_2O_7 in pyridine solution. For better yield, we can use CrO_3 in 3° butyl alcohol. For 2° alcohol we can use

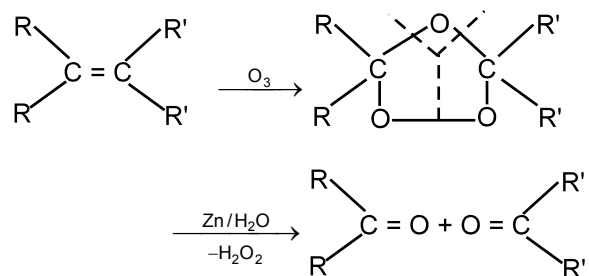
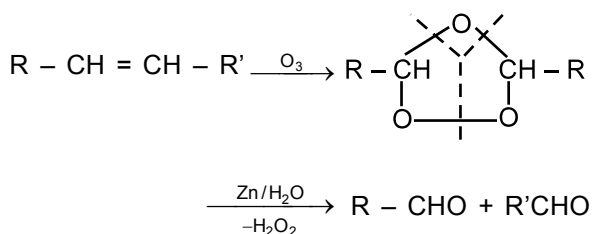
aluminium tertiary butoxide $[(CH_3)_3CO]_3Al$



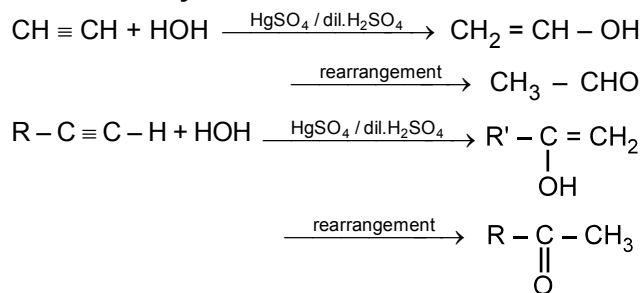
2.2 From Alcohol (By Catalytic Oxidation) : -



2.3 From Alkene (Ozonolysis) : -

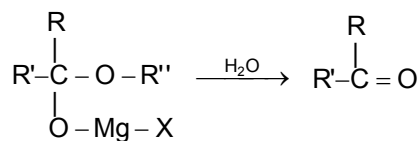
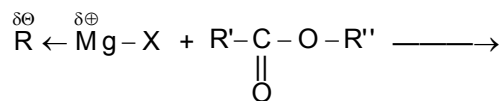


2.4 From Alkyne : -



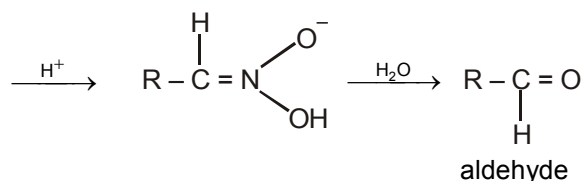
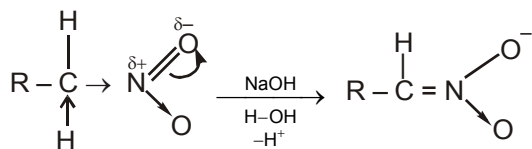
NOTE : Methanal cannot be formed from the above reaction.

2.5 From Grignard's Reagent : -

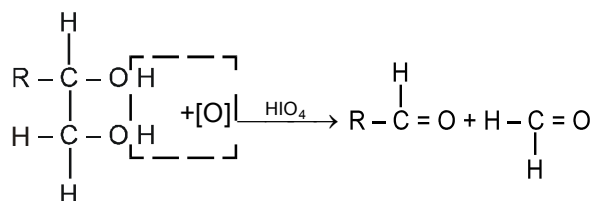


NOTE : Formaldehyde cannot be formed from the above reaction.

2.6 From Nitroalkane (Nef reaction) : -

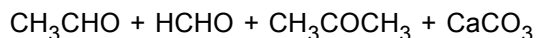
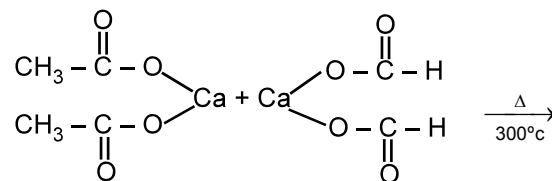
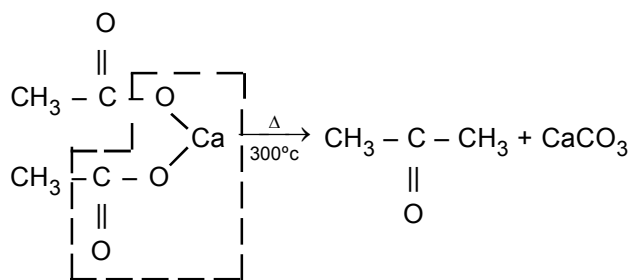
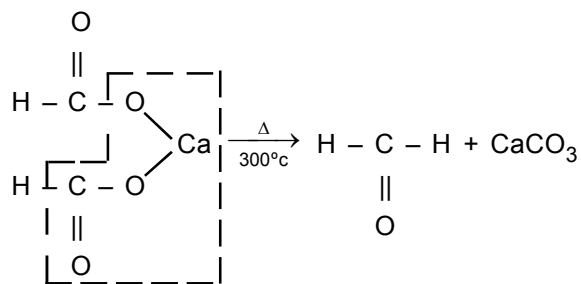


2.7 From Vicinal Glycol (Oxidation) : -

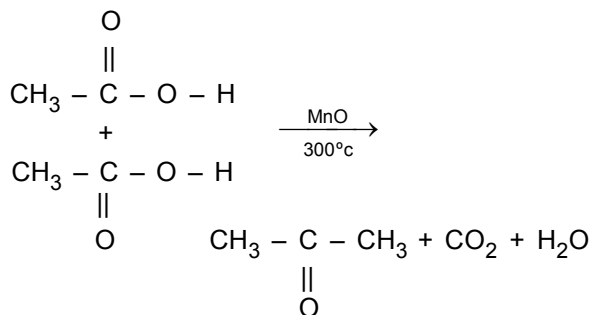
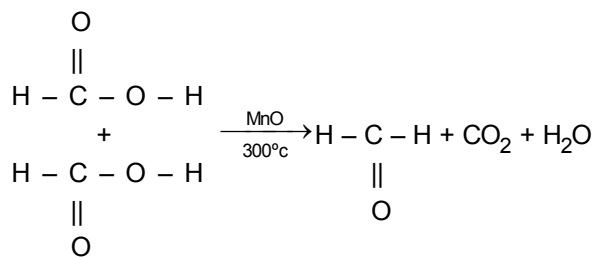


We can obtain every type of carbonyl compound from this reaction.

2.8 From Calcium or Barium salt of Carboxylic acid : -



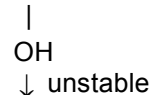
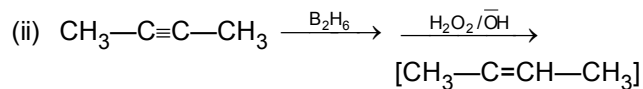
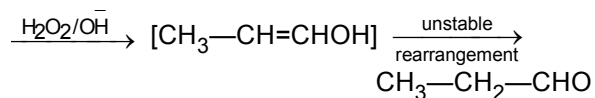
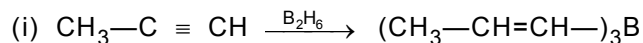
2.9 From Carboxylic Acid : - When vapours of carboxylic acid are passed on manganese oxide MnO at 300°C, then carbonyl compounds are formed.



2.10 From Alkyne (Hydroboration) :-

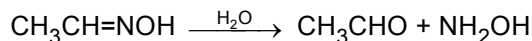
1-Alkyne \longrightarrow Aldehyde

Other alkynes \longrightarrow Ketone

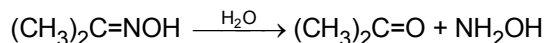


2-Butanone

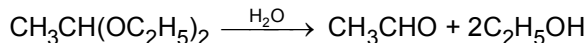
2.11 From Hydrolysis of oximes and acetals :-



Acetaldoxime

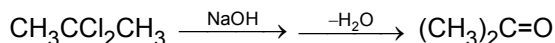
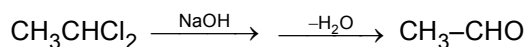
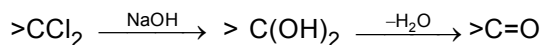


Acetone-oxime



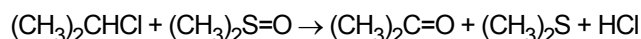
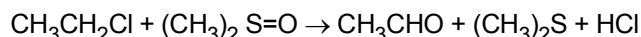
Acetal

2.12 From Hydrolysis of gemdihalide :-



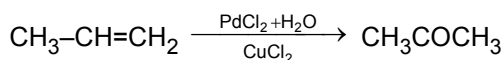
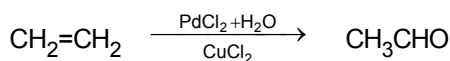
2.13 From Oxidation of alkyl halides :-

Reagent-dimethyl sulphoxide



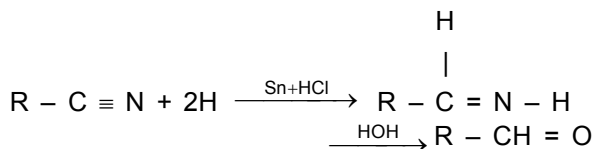
2.14 From Wacker process :-

Reagent : Acidified aqueous solution of PdCl_2 and CuCl_2

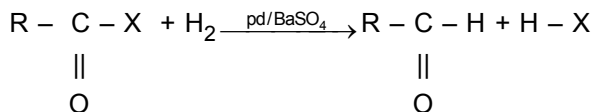


3. METHODS OF PREPARATION ONLY FOR ALDEHYDES ::

3.1 Stephen's Method :-

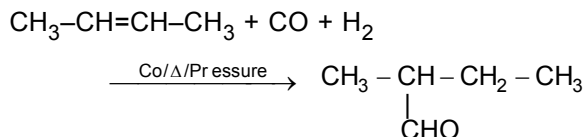


3.2 Rosenmund Reaction :- Acyl halide forms aldehyde by partial reduction.



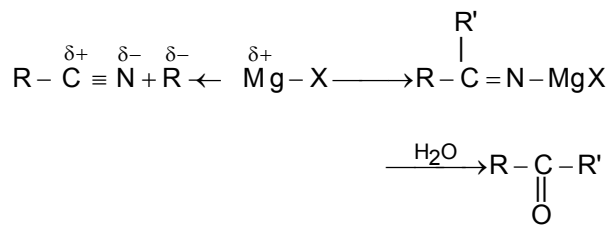
NOTE :- Here BaSO_4 acts as a poison and deactivates the catalyst Pd so that the aldehyde formed in the reaction is protected from further reduction to alcohol.

3.3 Oxo-reaction :-



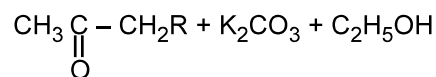
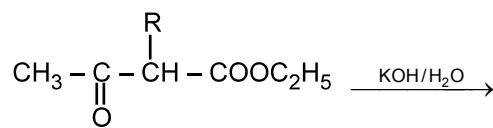
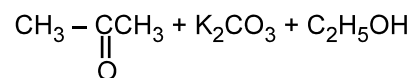
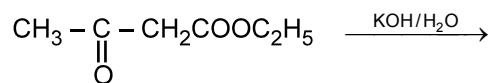
4 METHODS OF PREPARATION ONLY FOR KETONES ::

4.1 From Alkyl Cyanide :-



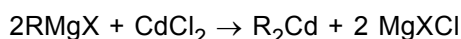
In this reaction if we take HCN with G.R., product will be aldehyde but major product will be alkane because HCN is an example of active H compound and with active hydrogen compound GR forms alkane.

4.2 By Ketonic Hydrolysis of Acetoacetic Ester and their Alkyl derivatives :-



4.3 Dialkyl cadmium with acid chlorides :-

One of the most valuable methods for the synthesis of ketones.

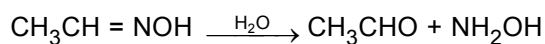


[Here $\text{R}' = \text{Ar}$ or 1° alkyl]

Ex.1 Choose the compound whose oxime on hydrolysis yields ethanal –

- (A) HCHO (B) CH₃CHO
(C) CH₃CH₂OH (D) CH₃COCH₃
(Ans.B)

Sol. Oxime of ethanal on hydrolysis gives ethanal



Ex.2 On dipping red hot copper wire in isobutyl alcohol, we get –

- (A) An alkene (B) A ketone
(C) An aldehyde (D) None of the above
(Ans.C)

Sol. Isobutyl alcohol contains primary alcoholic group –CH₂OH which on oxidation converts to –CHO group

Ex.3 $\text{CH}_3\text{COCl} \xrightarrow[\text{[H}_2\text{]}]{\text{Pd/BaSO}_4} \text{A}$

The isomers of CH₃COCl and A will be respectively –

- (A) CH₂ClCHO, oxirane
(B) Chloral, vinyl alcohol
(C) α-chloroethyl alcohol, epoxyethane
(D) None of the above (Ans. A)

Sol. α-chloroacetaldehyde and oxirane ethane are the isomers of CH₃COCl and CH₃CHO respectively.

5. PHYSICAL PROPERTIES ::

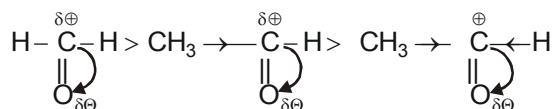
- (a) Aldehydes are colourless with pungent smell liquid while ketones are pleasant smell liquids but formaldehyde is gaseous in nature.
(b) Lower carbonyl compounds are soluble in water. It is due to polarity in carbonyl group.
(c) Higher carbonyl compounds are insoluble in water due to more covalent character.
(d) Melting point & Boiling point ∝ Molecular mass

$$\propto \frac{1}{\text{No. of branches}}$$

- (e) Melting point and boiling point of carbonyl compounds are more than to corresponding alkanes due to dipole-dipole attraction present

between molecules in carbonyl compounds.

- (f) Reactivity of carbonyl compound is dependent on alkyl group which is linked with carbonyl group.



- (g) 40% solution of formaldehyde is known as 'FORMALIN' (40% HCHO, 54-56% H₂O, 4-6% methanol)

- (h) Mixture of formaldehyde and lactose sugar is called 'FORMAMINT' which is used in medicine of throat infection.

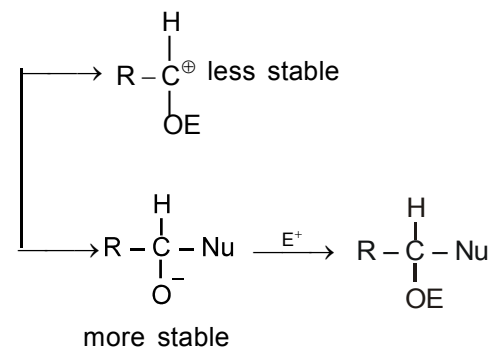
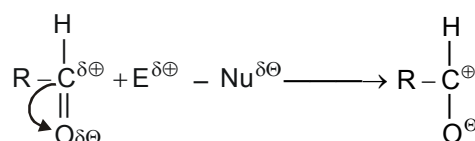
(i) Boiling point of carbonyl compounds are as under

Compound Boiling Point

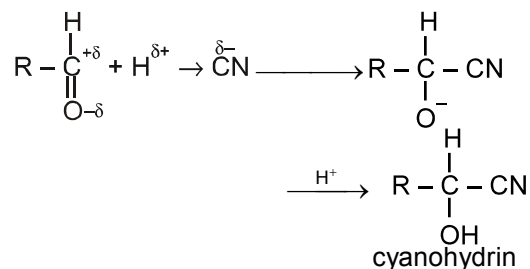
1. Formaldehyde – 21°C
2. Acetaldehyde + 21°C
3. Acetone 56°C

6. CHEMICAL PROPERTIES ::

Main reaction of carbonyl compounds are nucleophilic addition reaction.

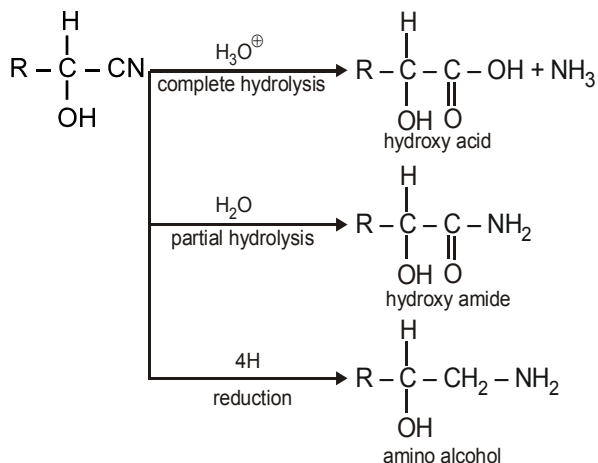


6.1 Reaction with Hydrogen Cyanide : –



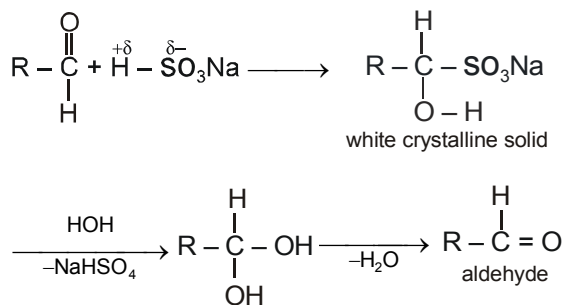
NOTE : -

- (a) If R = H then product will be formaldehyde cyanohydrin.
 (b) Cyanohydrin is an important compound which gives the following product on hydrolysis and reduction.



6.2 Reaction with Sodium bisulphite :

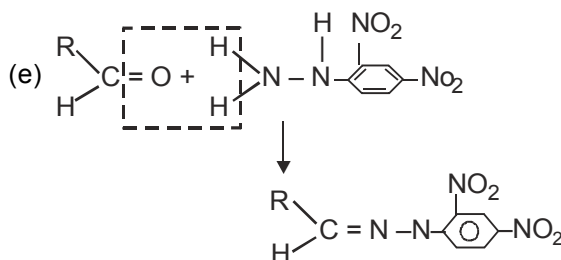
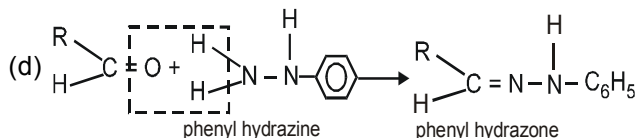
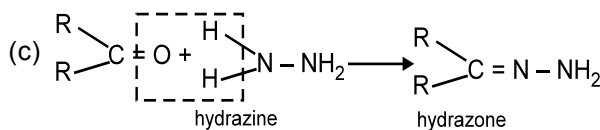
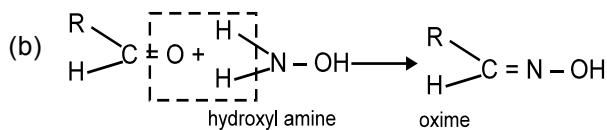
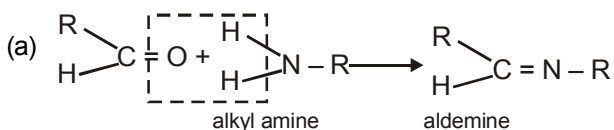
Carbonyl compound form a white crystalline addition product with sodium bisulphite called **Aldehyde / Ketone sodium bisulphite adduct**.



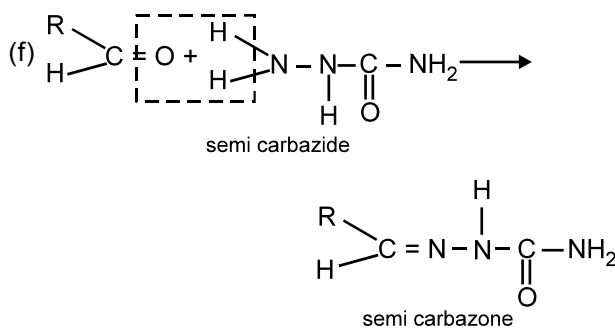
NOTE : -

- (a) Bisulphite adduct is an important compound because it gives carbonyl compound on further hydrolysis.
 (b) The above reaction is used in purification of carbonyl compound.

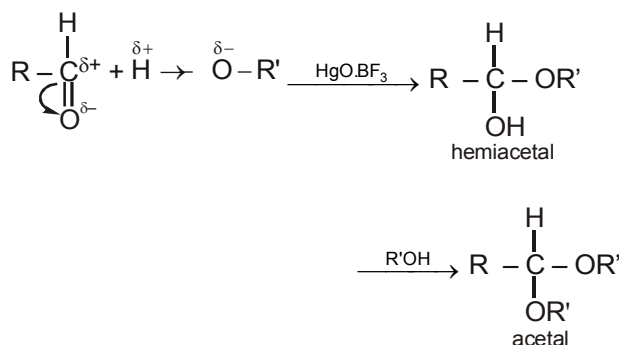
6.3 Reaction with Ammonia derivatives : -

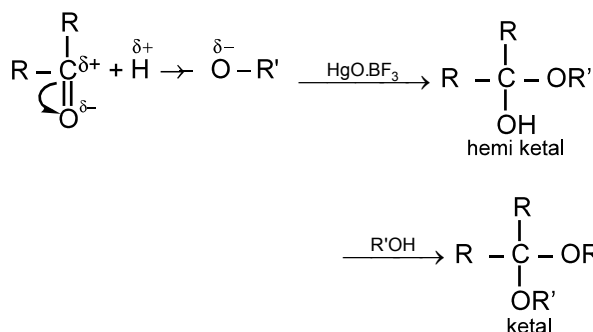


2,4-dinitrophenyl hydrazone or DNP

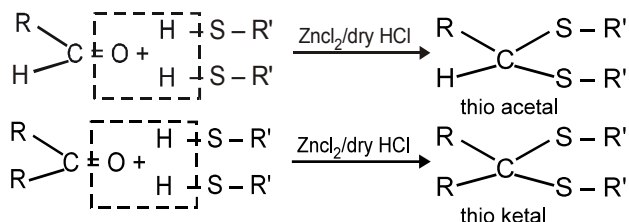


6.4 Reaction with Alcohol : In the presence of catalyst (HgO·BF₃) aldehyde form acetal with alcohol while ketone form ketal with alcohol.

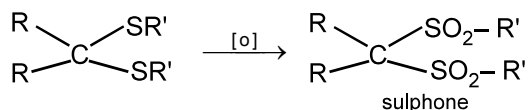
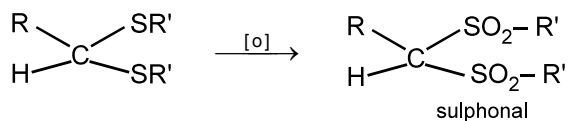




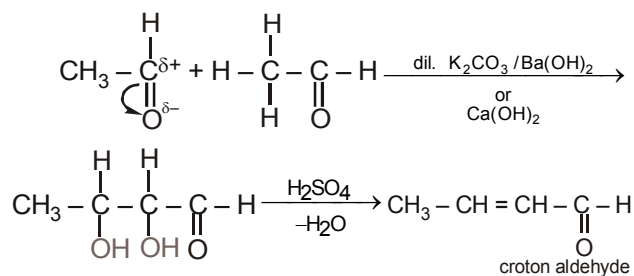
6.5 Reaction with Alkane Thiol : Aldehyde form thio acetal with alkane thiol while ketone form thio ketal with alkane thiol.



These are important compounds because they form sulphonyl compounds on oxidation which are used as hypnotic drugs.



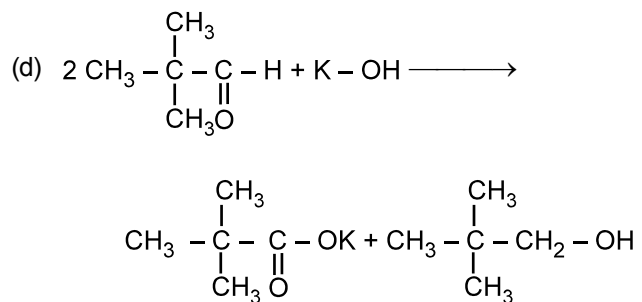
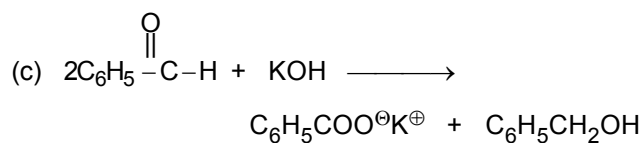
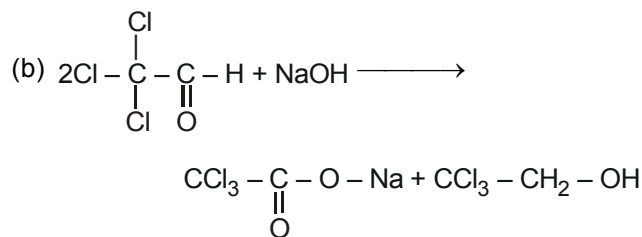
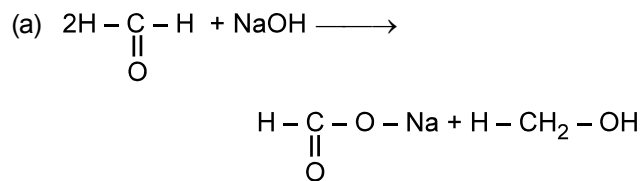
6.6 Aldol Condensation : Carbonyl compounds in which α -H atoms are present, undergoes to self condensation in presence of dilute alkali or dilute base. The product formed contains both -OH and >C=O group. So, the compound is called Aldol or Ketol which on β -elimination gives unsaturated carbonyl compound. The complete reaction is called 'Aldol - Condensation'. Formaldehyde cannot show aldol condensation due to absence of α -Hydrogen atoms.



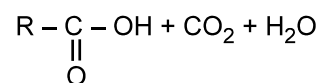
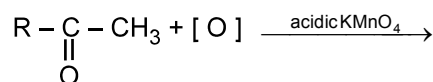
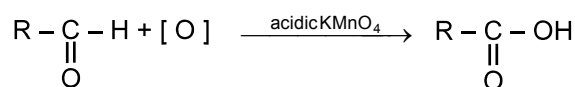
NOTE : In aldol condensation, if we take two different type of aldehyde or ketone then it is called mixed aldol condensation.

6.7 Cannizaro Reaction : Carbonyl compound in which α -H atoms is absent, when react with strong base like NaOH or KOH then forms sodium and potassium salt of carboxylic acid and alcohol. It is an example of the reaction in which one mole of the compounds is reduced. Such type of reaction is called disproportionation reaction, also known as cannizaro reaction. In this reaction elimination of hydride ion takes place. In this reaction oxidation number changes from 0 to +2 and 0 to -2.

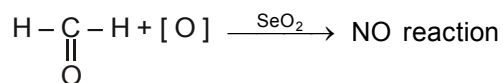
Compounds showing cannizaro reaction are -



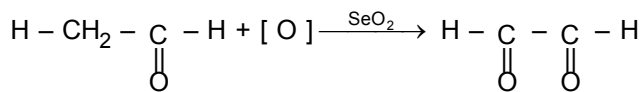
6.8 Oxidation : Aldehyde on oxidation forms respective acid while ketone forms less carbon carboxylic acid on oxidation according to popoff's rule (As discussed in Alcohol theory)



NOTE : (a) If oxidising agent is selenium oxide SeO_2 then, α -methylene group of carbonyl compound oxidises into $-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-$ group and resultant dicarbonyl compound will be formed.

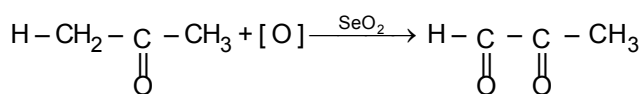


α - methylene group is absent.



glyoxal

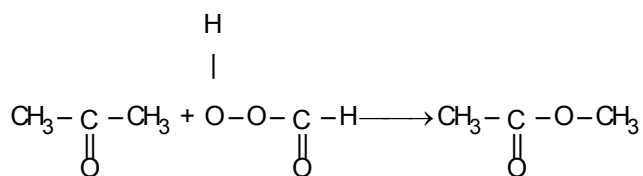
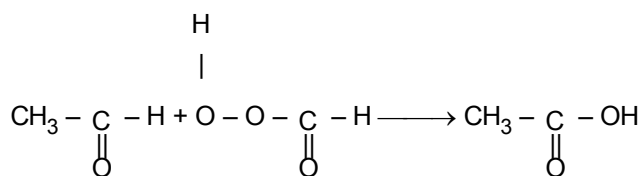
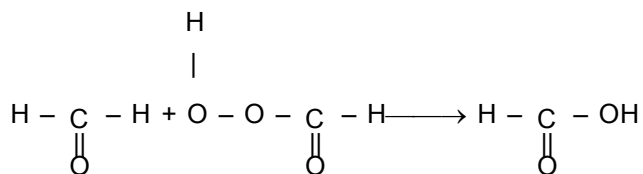
(dicarbonyl compound)



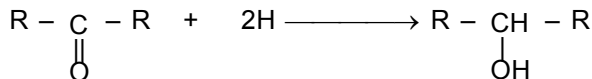
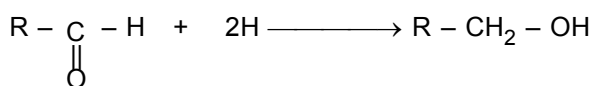
pyruvic aldehyde

(methyl glyoxal)

(b) If the oxidising agent is performic acid then aldehyde oxidises into respective acid while ketone oxidises into ester. The reaction is called '**Baeyer-villiger Oxidation**'.



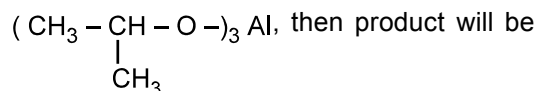
6.9 Reduction : Aldehyde on reduction form primary alcohol while ketone on reduction form secondary alcohol.



secondary alcohol

NOTE :

- In the above reaction if reducing agent is $\text{Na} + \text{C}_2\text{H}_5\text{OH}$ then reaction is called '**Bouveault - Blanc Reaction**'.
- If reducing agent is NaH reaction is called '**Darzen's Reaction**'. We can also use LiAlH_4 in this reaction.
- If reducing agent is (red P / HI) then product will be alkane.
- If reducing agent is $\text{Zn-Hg}/\text{conc. HCl}$ then product will be alkane. Reaction is called '**Clemmenson-Reduction**'.
- If reducing agent is alkaline solution of hydrazine, product will be alkane. Reaction is called '**Wolf - kishner Reduction**'.
- The percentage yield of alkane can be increased by using diethylene glycol in wolf kishner reduction then reaction is called '**Huang-Millan Conversion**'.
- If reducing agent is aluminium iso propoxide

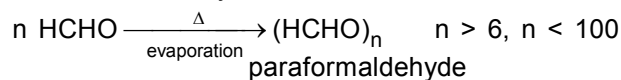


then product will be alcohol. Reaction is called '**Meerwein-Pondorff Verley Reduction**'.

6.10 Polymerisation Reactions : Aldehyde shows addition as well as condensation polymerisation reactions while ketone shows only condensation polymerisation reactions.

6.10.1 Addition Polymerisation reaction of Formaldehyde : -

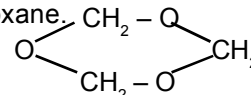
(a) When aqueous solution of formaldehyde is heated then it converts into a white crystalline solid called 'Paraformaldehyde'.

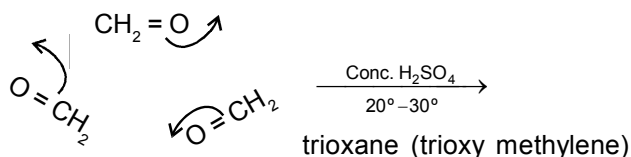


If $n \leq 50$ Linear structure polymer

If $n > 50$ Cyclic structure polymer

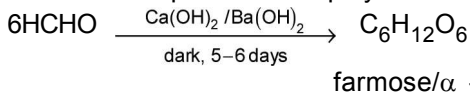
(b) If formaldehyde is kept with conc. H_2SO_4 at room temperature then it forms a cyclic trimer called meta formaldehyde or trioxane.





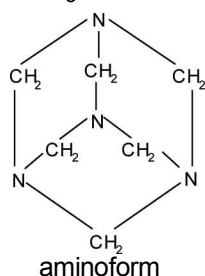
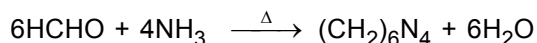
(c) If aqueous solution of formaldehyde is kept with lime water in dark room for 5-6 days then it converts into a sweet solution called 'FARMOS' or 'α - ACROSE'.

It is an example of linear polymer.



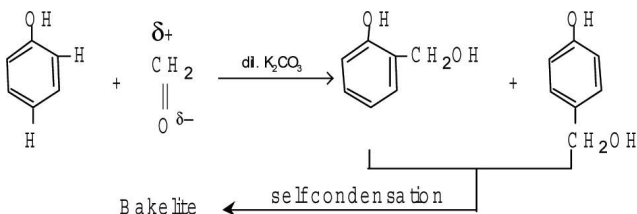
6.10.2 Condensation Polymerisation reaction of Formaldehyde :

(a) **With Ammonia:**— When formaldehyde is heated with NH_3 then a white crystalline heterocyclic compound is formed called 'Hexamethylene tetramine' or urotropene' or 'Aminoform'.



It is used in medicine or diabetics or urinary infection.

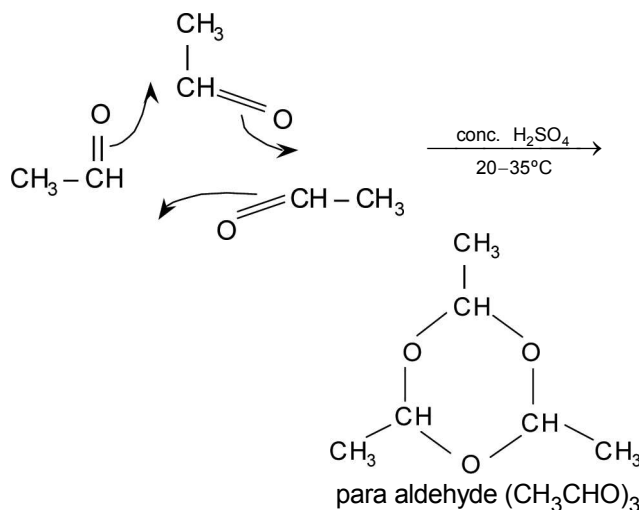
(b) **With Phenol :**—In presence of dilute alkali formaldehyde first form o- & p- hydroxy benzyl alcohol with phenol which on self condensation form a cross link polymer called 'Bakelite'.



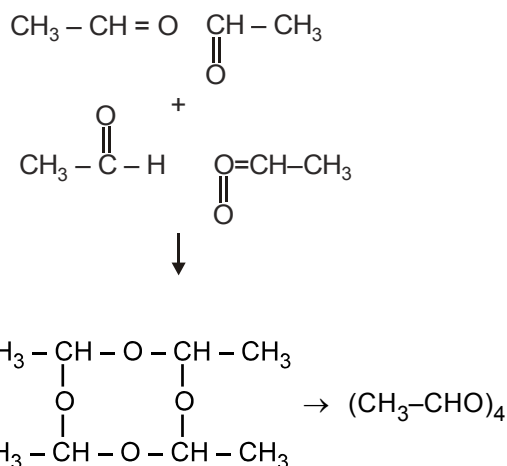
Bakelite is electric and thermal resistant. So, used in formation of electric appliances. Reaction is called 'Lederer-Manasse Reaction'.

6.10.3 Addition Polymerisation of Acetaldehyde :

(a) When acetaldehyde is kept with conc. H_2SO_4 at room temperature then it form a cyclic trimer called paraaldehyde.



(b) If acetaldehyde is kept with highly conc. HCl at low temperature then it forms a cyclic tetramer called metaaldehyde.

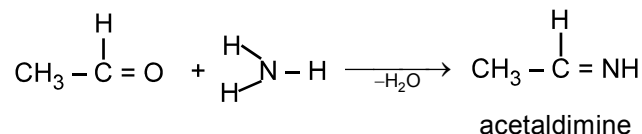


NOTE : Para aldehyde is used as a sedative while meta aldehyde is used as a solid fuel.

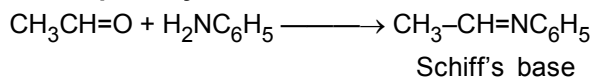
6.10.4 Condensation Polymerisation of Acetaldehyde : -

(a) **Aldol condensation** - Discussed earlier.

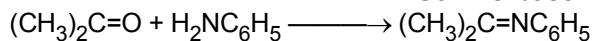
(b) **Reaction with NH_3 :**



6.15 With primary amine :-



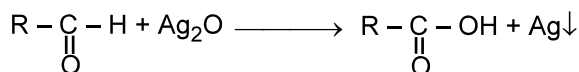
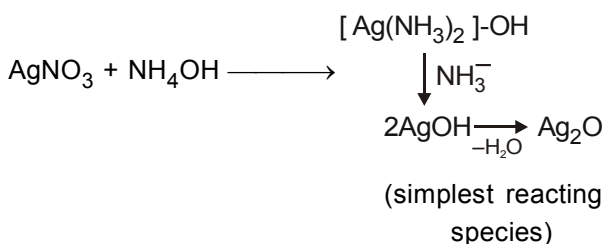
Schiff's base



7. REACTIONS SHOWN BY ALDEHYDES ONLY ::

7.1 Reducing nature of Aldehyde : Aldehyde are reducing in nature, they can reduce Tollen's reagent, Fehling solution and mercuric chloride solution.

(a) Reaction with Tollen's Reagent : - Ammonical silver nitrate solution is called Tollen's reagent. Aldehyde reduce the Tollen's reagent and form silver mirror. Aldehyde oxidises itself into carboxylic acid.

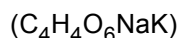
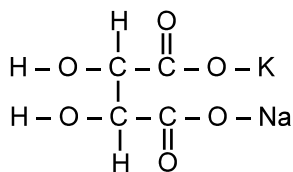


NOTE : In the above reaction oxidation number of Ag varies from +1 to 0.

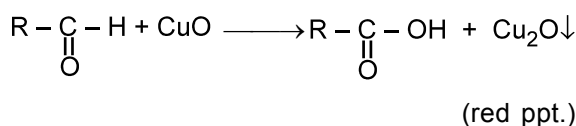
(b) Reaction with Fehling Solution : It is the mixture of two solutions called Fehling solution A and Fehling solution B.

Fehling Solution A : Aqueous solution of CuSO_4 (blue)

Fehling Solution B : Alkaline solution of Roschelle salt (sodium potassium tartarate)

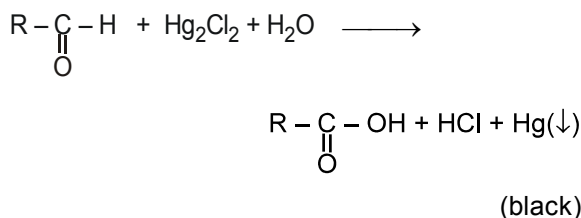
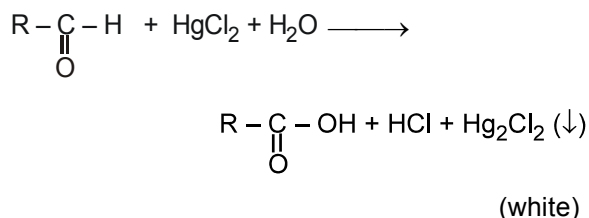


By the mixing of both solutions we get a dark blue colour solution called final Fehling solution. Reacting species of this solution is cupric oxide CuO .



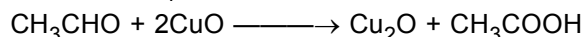
NOTE : Oxidation number of copper varies from +2 to +1

(c) Reaction with Mercuric Chloride solution : Aldehyde reacts with mercuric chloride solution and initially forms white ppt. of mercurous chloride solution, which further reacts with excess of aldehyde and forms black ppt. of mercury.



(d) Benedict solution :

[$\text{A}-\text{CuSO}_4$ soln, β - NaOH , Sodium citrate]



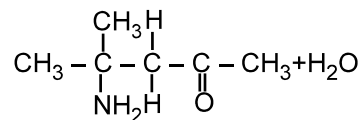
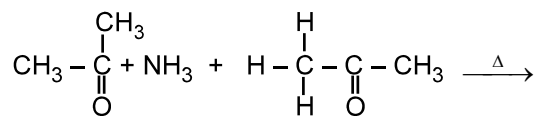
(e) Schiff's reagent :

Magenta dye $\xrightarrow{\text{SO}_2}$ Colourless soln.

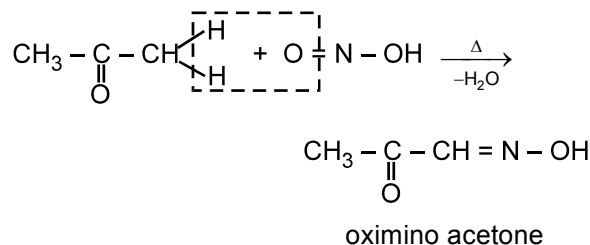
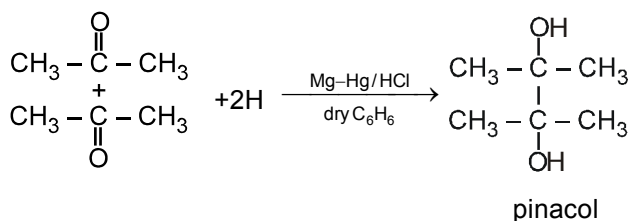
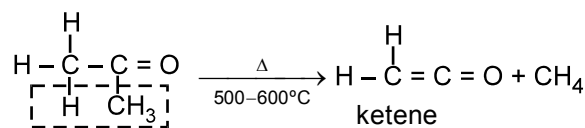
$\xrightarrow{\text{CH}_3\text{CHO}}$ Pink colour restored

8. REACTIONS SHOWN BY KETONES ONLY ::

(a) Reaction with NH_3 : If acetone is heated with ammonia then it forms diacetone amine.



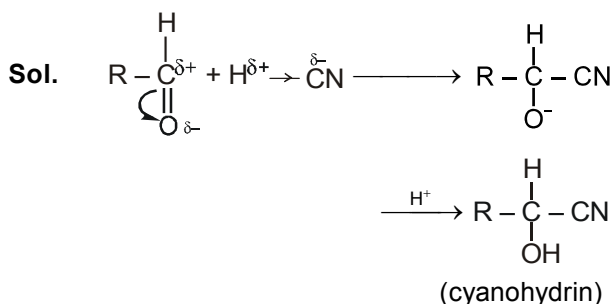
If acetone and ammonia would be in excess then the product would be triacetone amine. If triacetone amine is heated at high temperature then it converts into a heterocyclic compound by the elimination of water.

(b) Reaction with Nitrous Acid :**(c) Bimolecular Reduction : -****(d) Pyrolysis : -**

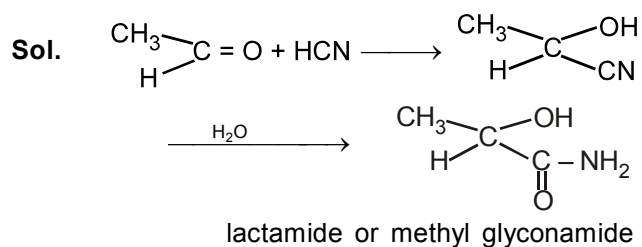
Examples based on

Chemical Reaction**Ex.4** What would be the product when carbonyl compound reacts with HCN -

- (A) Cyanohydrin (B) Hydroxy acid
(C) Hydroxy amide (D) Amino alcohol

(Ans.A)**Ex.5** What would be the product when acetaldehyde reacts with HCN and the product is partially hydrolysed -

- (A) Lactamide
(B) Methyl glyconamide
(C) Both A & B
(D) None

(Ans.C)**Ex.6** Which carbonyl compound will be purified with sodium bisulphite -

- (A) 2-Pentanone (B) 3-Hexanone
(C) 4-Heptanone (D) All above

(Ans.A)**Sol.** The reaction is used in purification of all types of aldehydes and methyl ketones only because the ketones having bulky alkyl group form unstable adduct.**Ex.7** Reaction involving formation of trioxane from methanal is called :

- (A) Aldol condensation
(B) Addition polymerisation
(C) Condensation polymerisation
(D) Cannizzaro's reaction

(Ans. B)**Sol.** $3\text{CH}_2\text{O} \xrightarrow{\text{dil. H}_2\text{SO}_4} [\text{CH}_2\text{O}]_3$ trioxane [addition polymer]**Ex.8** $>\text{C}-\text{CN}$ group is called -

- (A) Hydroxy nitrile (B) Hydroxy cyanide
(C) Cyanohydrin (D) Hydroxy isocyanide

(Ans. C)**Sol.** Carbonyl compound on addition with HCN gives a compound containing cyanohydrin group.**Ex.9** Butanone does not show any reaction with the reagent -

- (A) $\phi-\text{NHNH}_2$ (B) CH_3NH_2
(C) $[\text{Ag}(\text{NH}_3)_2]^+$ (D) NH_2OH

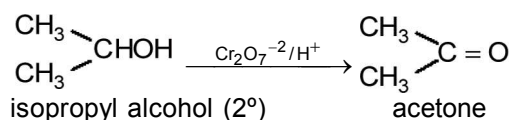
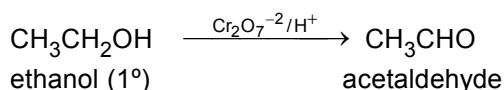
(Ans. C)**Sol.** Tollen's reagent does not react with ketone.

SOLVED EXAMPLES

- Ex.1** Which of the following statement is correct in case of aliphatic aldehydes and ketones -
- (A) Aldehydes are formed by oxidation of primary alcohols and ketones by that of secondary alcohols
- (B) Aldehydes are obtained by oxidation of secondary alcohols and ketones by that of primary alcohols
- (C) Aldehydes and ketones cannot be represented by the same general formula
- (D) Aldehydes and ketones cannot be oxidised further

(Ans. A)

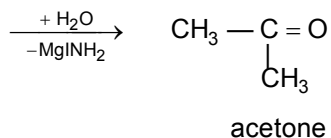
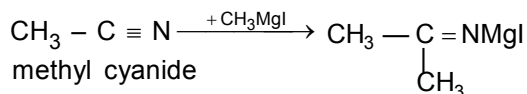
- Sol.** The correct statement in case of aliphatic aldehydes and ketones is that aldehydes are formed by oxidation of primary alcohols and ketones by that of secondary alcohols.



- Ex.2** Which gives a ketone on treating with a Grignard's reagent -
- (A) Formaldehyde (B) Ethyl alcohol
- (C) Methyl cyanide (D) Methyl iodide

(Ans. C)

- Sol.** Methyl Cyanide on reacting with a Grignard's reagent produces a ketone



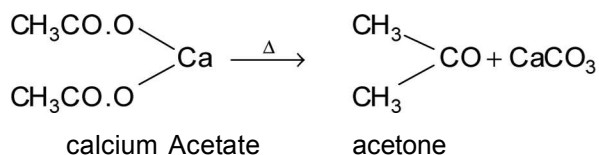
- Ex.3** The specific reagent for the reducing aldehyde and ketone to alcohol is -
- (A) Sodium and ethanol
- (B) Aluminium isopropoxide
- (C) Amalgamated zinc and concentrated hydrochloric acid
- (D) Sodium bisulphite **(Ans. B)**

- Ex.4** On strongly heating anhydrous calcium acetate, which of the following compound is formed ?

- (A) Acetone (B) Ether
- (C) Acetic anhydride (D) Carbon monoxide

(Ans. A)

- Sol.** On strongly heating (dry distillation) of anhydrous calcium acetate, acetone is formed.

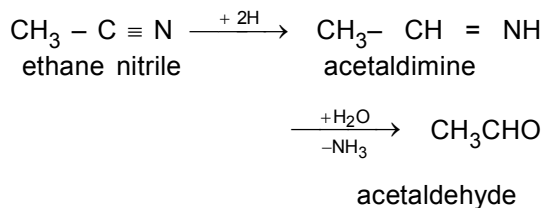


- Ex.5** In the Stephen's reaction -

- (A) An alkyl Cyanide is reduced with LiAlH_4
- (B) An alkyl Cyanide is reduced with SnCl_2 and HCl
- (C) An alkyl isocyanide is reduced with sodium and alcohol
- (D) An alkanoyl chloride is reduced in the presence of Pd/BaSO_4

(Ans. B)

- Sol.** Alkyl Cyanides on reduction with SnCl_2 and HCl give aldimines which on hydrolysis yield aldehydes. This reaction is known as Stephen's reaction.

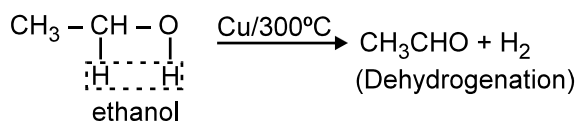


- Ex.6** When red hot copper wire is plunged in ethanol, we get:

- (A) A ketone (B) HCHO
- (C) CH_3CHO . (D) $(\text{C}_2\text{H}_5)_2\text{O}$

(Ans. C)

- Sol.**



Ex.7 Which of the following is more reactive towards nucleophilic reagents -

- (A) HCHO (B) CH₃COCH₃
(C) CH₃CHO (D) None of the above

(Ans. A)

Sol. The more reactive substance towards nucleophilic reagents is HCHO because in this case the carbon atom of carbonyl >C=O group has greatest + charge, so it is more susceptible to attack of nucleophilic reagents. In CH₃CHO and CH₃COCH₃, the positive charge on the carbon atom of >C=O group is decreased due to +I effect of CH₃ groups attached to it.

Ex.8 An organic compound contains C = 40%, H = 6.7% and O = 53%. Its V.D. is 15. It reduces feehling's solution. A is -

- (A) Acetaldehyde (B) Formaldehyde
(C) Formic acid (D) Glucose

(Ans. B)

Sol. The composition of the organic compound is as follows :

C = 40%, H = 6.7% and O = 53%

$$\begin{aligned} \text{C} : \text{H} : \text{O} &= \frac{40}{12} : \frac{6.7}{1} : \frac{53}{16} \\ &= 3.33 : 6.7 : 3.33 \\ &= 1 : 2 : 1 \end{aligned}$$

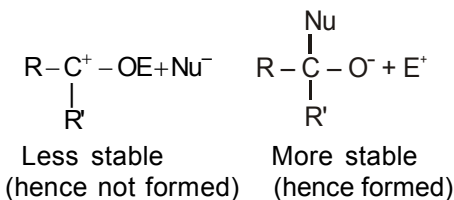
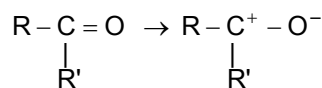
Empirical Formula is CH₂O
Empirical Weight = 12 + 2 + 16 = 30
V.D. = 15
Mol. weight = 30
Hence molecular formula is CH₂O.
Since, it reduces Fehling's solution, Hence A is an aldehyde. So it is formaldehyde (HCHO)

Ex.9 Select the true statement -

- (A) Carbonyl compounds undergo nucleophilic addition reaction
(B) Carbonyl compounds undergo nucleophilic substitution reaction
(C) All carbonyl compounds give iodoform reaction
(D) Carbonyl compounds are non polar.

(Ans. A)

Sol. The true statement is that carbonyl compounds undergo nucleophilic addition reactions

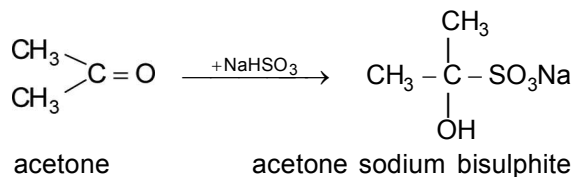
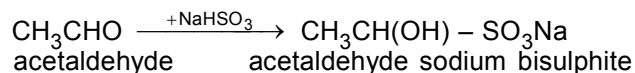


Ex.10 Carbonyl compounds react with which of the following reagent to form a colorless crystalline precipitate-

- (A) PCl₅ (B) HCN
(C) NH₂OH (D) NaHSO₃

(Ans. D)

Sol. Carbonyl compounds reacts with NaHSO₃ to form a colorless crystalline product.



Ex.11 Which one of the following reagents is not used in making derivatives of aldehydes and ketones -

- (A) Hydroxyl amine hydrochloride
(B) Phenyl hydrazine
(C) 2,4-Dinitrophenyl hydrazine
(D) 2,4-dinitrofluoro benzene

(Ans. D)

Sol. Substituted ammonia derivatives react with carbonyl compounds (aldehydes and ketones) to give stable crystalline products, which are used for the identification of aldehydes and ketones. Since 2,4-dinitrofluoro benzene is not a substituted ammonia derivative, hence it is not used in making derivatives of aldehydes and ketones.

Ex.12 The conversion CH₂=CH-CHO → CH₂=CHCH₂OH can be effected by:

- (A) Na + alcohol (B) Zn + HCl
(C) H₂/Ni (D) LiAlH₄

(Ans. D)

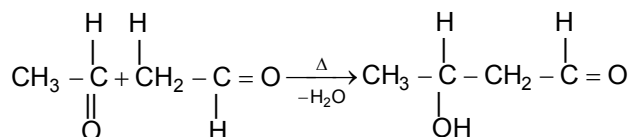
Sol. C = C not effected by LiAlH₄.

Ex.13 Acetaldehyde reacts with K_2CO_3 solution to give -

- (A) 4-Hydroxy butanal
 (B) 3-Hydroxy butanal
 (C) 2-Hydroxy butanal
 (D) 3-Hydroxy butanone

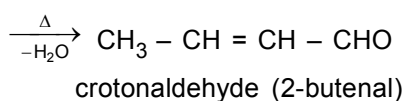
(Ans. B)

Sol. Acetaldehyde reacts with K_2CO_3 solution to give 3-hydroxybutanal (aldol). It is called aldol condensation.



Acetaldehyde

aldol (3-hydroxy butanal)



Ex.14 The following statement is true for Cannizzaro reaction -

- (A) The aldehyde is oxidised as well as reduced
 (B) The aldehydes not containing α -Hydrogen atoms give the reaction
 (C) The reaction is not given by aldehydes containing α -Hydrogen atoms
 (D) All of these

(Ans. D)

Sol. All aldehydes, not containing α -Hydrogen atoms, react with cold conc., alkali to form a corresponding alcohol and a salt of the corresponding acid. The aldehyde gets oxidised as well as reduced, hence all the statements given above are true.

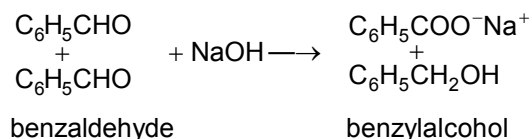


Ex.15 Which of the following compounds would under go the Cannizzaro's reaction -

- (A) Acetaldehyde (B) Benzaldehyde
 (C) Propionaldehyde (D) Anisole

(Ans. B)

Sol. Aldehydes, not containing α -Hydrogen atoms under go cannizzaro's reaction hence benzaldehyde will undergo this reaction in the presence of cold concentrated alkali.

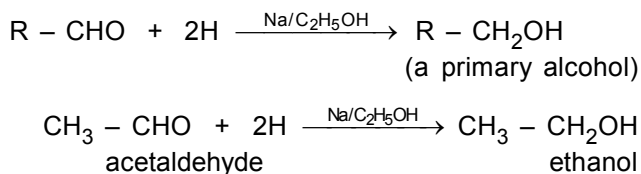


Ex.16 The catalytic reduction of acetaldehyde by Hydrogen yields -

- (A) Methanol (B) Ethanol
 (C) Acetic acid (D) Acetone

(Ans. B)

Sol. The catalytic reduction of acetaldehyde by Hydrogen yields ethanol.

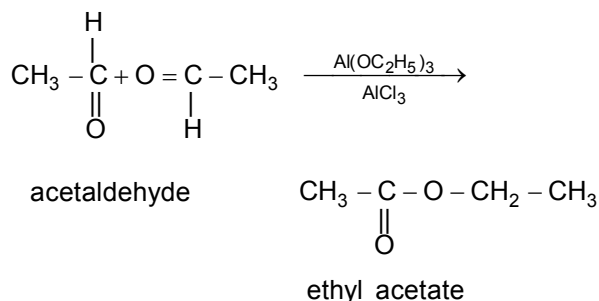


Ex.17 When acetaldehyde is treated with Aluminium ethoxide, it forms -

- (A) Ethyl alcohol (B) Ethyl acetate
 (C) Acetic acid (D) Methyl propionate

(Ans. B)

Sol. When acetaldehyde is treated with Aluminium ethoxide in the presence of a little anhydrous Aluminium chloride, it undergoes esterification and forms an ester ethyl acetate. This reaction is known as Tischenko reaction

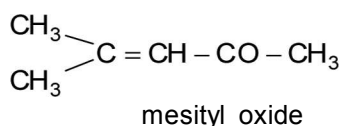
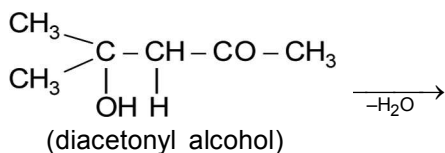
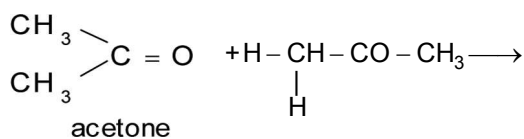


Ex.18 Which of the following reaction is a condensation reaction -

- (A) $\text{HCHO} \longrightarrow$ Paraformaldehyde
 (B) $\text{CH}_3\text{CHO} \longrightarrow$ Paraldehyde
 (C) $\text{CH}_3\text{COCH}_3 \longrightarrow$ Mesityl oxide
 (D) $\text{CH}_2 = \text{CH}_2 \longrightarrow$ Polyethylene

(Ans. C)

Sol. The formation of mesityl oxide from acetone is a condensation reaction. On treatment with dry HCl gas, acetone forms mesityl oxide through the intermediate formation of diacetyl alcohol.

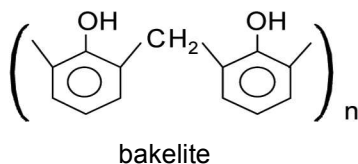
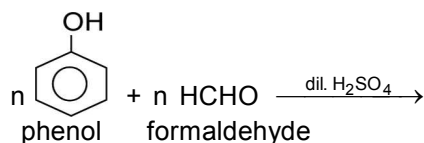


Ex.19 Formaldehyde condenses with phenol in the presence of dil. H_2SO_4 to yield -

- (A) Bakelite (B) Nylon
(C) Lewisite (D) Formose

(Ans. A)

Sol. Formaldehyde condenses with phenol in the presence of dil. H_2SO_4 to yield Bakelite. It is a thermoplastic resin. It is a crosslinked polymer.



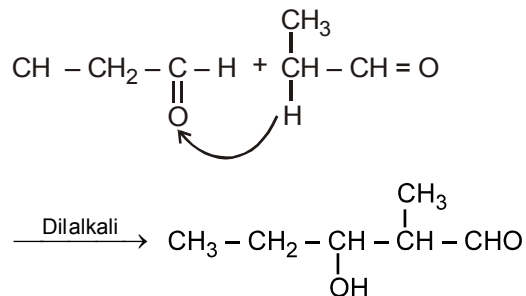
Q.20 $\text{CH}_3-\text{CH}_2-\text{CHO} \xrightarrow[\text{alkali}]{\text{Dil.}}$ Product. The product in the above reaction is:

- (A) $\text{CH}_3-\text{CH}_2\text{COOH}$
(B) $\text{CH}_3-\text{CH}_2-\text{CH}_2\text{OH}$
(C) $\text{CH}_3-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CHO}$

- (D) $\text{CH}_3-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\overset{\text{CH}_3}{\text{CH}}-\text{CHO}$

(Ans. D)

Sol. It is an example of Aldol condensation.



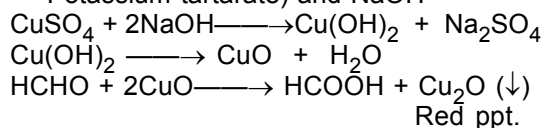
Ex.21 A famous reagent having CuSO_4 , Rochelle salt and NaOH is known as -

- (A) Benedict solution (B) Schiff's reagent
(C) Fehling solution (D) Fenton's reagent

(Ans. C)

Sol. Fehling solution is a mixture of two solutions -
(a) Fehling solution A : It is a CuSO_4 solution (blue colour)

(b) Fehling solution B : It is a colorless solution of Rochelle salt (Sodium Potassium tartarate) and NaOH

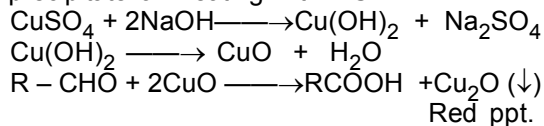


Ex.22 Doctors detect diabetes disease by testing the presence of glucose in urine with -

- (A) Nessler's reagent (B) Fehling's solution
(C) Fenton's reagent (D) AgNO_3 solution

(Ans. B)

Sol. Doctors detect diabetes disease by testing the presence of glucose in urine with Fehling's solution. Glucose has an aldehyde group present in its molecule hence it gives a red precipitate on heating with F.S.

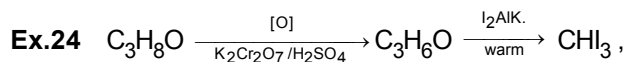
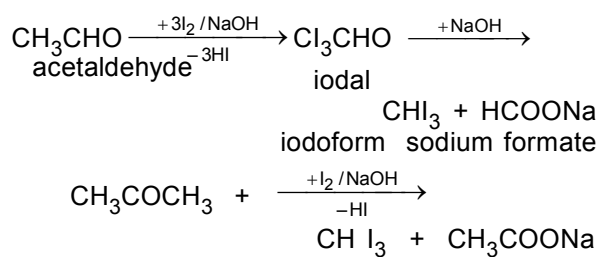


Ex.23 Acetaldehyde and acetone can be distinguished by all the following except -

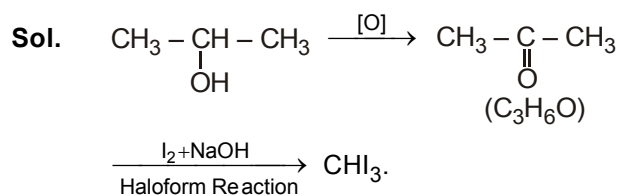
- (A) Iodine + alkali (B) Tollen's reagent
(C) Fehling solution (D) Schiff reagent

(Ans. A)

Sol. Acetaldehyde and acetone can be distinguished by Tollen's reagent Fehling solution and Schiff's reagent. However they can not be distinguished by I_2 & alkali, because both contain CH_3CHO -group, form iodoform (yellow precipitate) on treatment with I_2 & NaOH .



In this reaction the first compound is:



Ex.25 The most probable structural formula for the compound whose empirical formula is $\text{C}_3\text{H}_6\text{O}$ and which can reduce Benedict's reagent -
(A) $\text{CH}_3\text{OCH}=\text{CH}_2$ (B) $\text{CH}_3\text{CH}_2-\text{CH}_3$
(C) $\text{CH}_3-\text{CH}_2\text{CHO}$ (D) All above

(Ans. C)

Sol. Only aldehydes can reduce Benedict's solution. Hence the most probable structural formula for the compound whose empirical formula is $\text{C}_3\text{H}_6\text{O}$ is $\text{CH}_3\text{CH}_2\text{CHO}$ (propanal).

