

1. Introduction

These have general formula $C_nH_{2n}O$ and contains $>C=O$ group which is present in aldehyde

$\begin{array}{c} R \\ \diagdown \\ C=O \\ \diagup \\ H \end{array}$ and $\left[\begin{array}{c} R \\ \diagdown \\ C=O \\ \diagup \\ R \end{array} \right]$ ketone. Thus aldehydes and ketones are collectively called as carbonyl compounds

(a) The group $\begin{array}{c} -C- \\ || \\ O \end{array}$ 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.

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

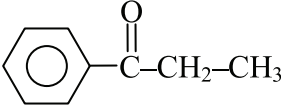
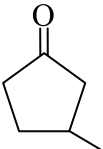
(c) Their general formula is $C_nH_{2n}O$. Hybridisation state of carbon is sp^2 and $C=O$ bond length is 1.23 \AA .

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

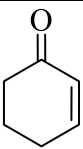
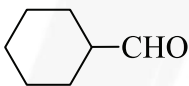
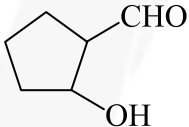
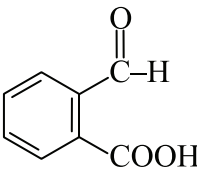
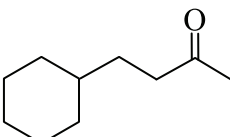
(e) Aldehyde shows chain, position and functional isomerism.

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

5. IUPAC Nomenclature of Aldehydes and Ketones

S.N.	Ketones	IUPAC name
1.	$\begin{array}{c} O \\ \\ CH_3-C-CH_3 \end{array}$	Propanone
2.	$\begin{array}{c} O \\ \\ CH_3-C-CH_2-CH_3 \end{array}$	Butanone
3.	$\begin{array}{c} O \\ \\ CH_3-C-CH_2-CH_2-CH_3 \end{array}$	Pentan-2-one
4.	$\begin{array}{c} O \quad O \\ \quad \\ CH_3-C-C-CH_3 \end{array}$	Butanedione
5.	$\begin{array}{c} CH_3 \quad O \quad CH_3 \\ \quad \quad \\ CH_3-CH-C-CH-CH_3 \end{array}$	2, 4-Dimethyl pentan-3-one
6.		1-Phenylpropan-1-one
7.		3-Methylcyclopentanone

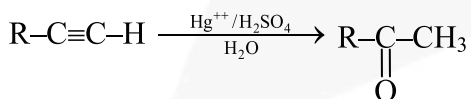
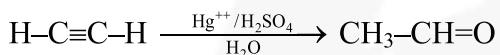
(Organic Chemistry) **CARBONYL COMPOUND**

S.N.	Ketones	IUPAC name
8.		Cyclohex-2-en-1-one or 2-Cyclohexenone
9.	$\begin{array}{c} \text{O} \quad \text{OH} \\ \parallel \quad \\ \text{CH}_3-\text{C}-\text{CH}_2-\text{C}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	4-Hydroxy-4-methyl pentan-2-one
10.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{C}-\text{H} \end{array}$	Ethanol
11.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{H} \end{array}$	Propanol
12.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{C}-\text{H}_3 \end{array}$	Butanol
13.	$\begin{array}{c} \text{OH} \quad \text{O} \\ \quad \parallel \\ \text{CH}_3-\text{CH}-\text{CH}_2-\text{C}-\text{H} \end{array}$	3-Hydroxybutanal
14.	$\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}-\text{CHO}$	Pent-2-en-1-el or Pen-2-enal
15.	$\begin{array}{c} \text{Br} \quad \text{CH}_3 \quad \text{O} \\ \quad \quad \parallel \\ \text{CH}_2\text{CH}_2\text{CH}_2-\text{CH}-\text{CH}-\text{CH}_2-\text{C}-\text{H} \end{array}$	4-Bromo-3-methyl heptanal
16.		Cyclohexanecarbaldehyde
17.		2-Hydroxycyclopentane -1-carbaldehyde
18.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}_2-\text{CHO} \end{array}$	3-Oxopentanal
19.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{C}-\text{CH}_2-\text{COOH} \end{array}$	3-Oxobutanoic acid
20.		2-Formylbenzoic acid
21.		2-(3-oxobutyl)-cyclohexanone

S.N.	Ketones	IUPAC name
22.		2-ethylhex-2-en-1-al
23.		2,5-dimethylheptan-3-one
24.	$\text{CH}_3\text{---CH---CH---CH=O}$ Cl CH ₃	3-chloro-2-methylbutanal
25.		3-ethylcyclobutanone

GENERAL METHODS OF PREPARATION OF ALDEHYDE AND KETONES**(I) Hydration of Alkyne :**

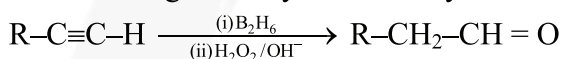
It is addition of water in the presence of heavy metal ion. acetylene on hydration gives aldehyde while any higher alkyne gives ketone.



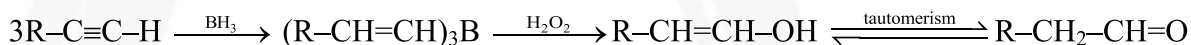
The preparation of carbonyl compounds from alkyne depends upon R part of (A) and also presence of inductive effect group attached to R.

(II) Hydroboration of alkyne :

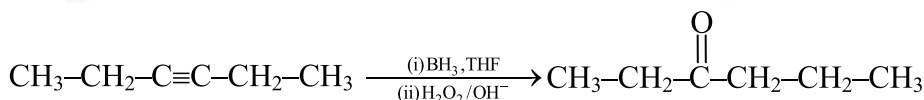
It is used to get aldehyde from alkyne-1. Here reagent is (i) diborane (B₂H₆) (ii) H₂O₂(OH⁻)

**Mechanism:**

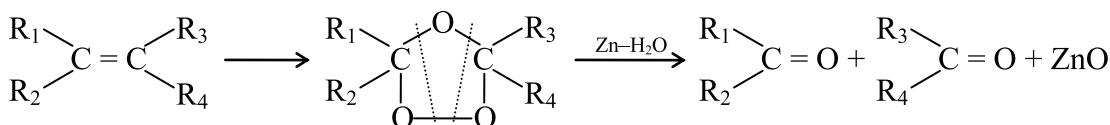
– In this reaction Borane (BH₃) is electrophile.

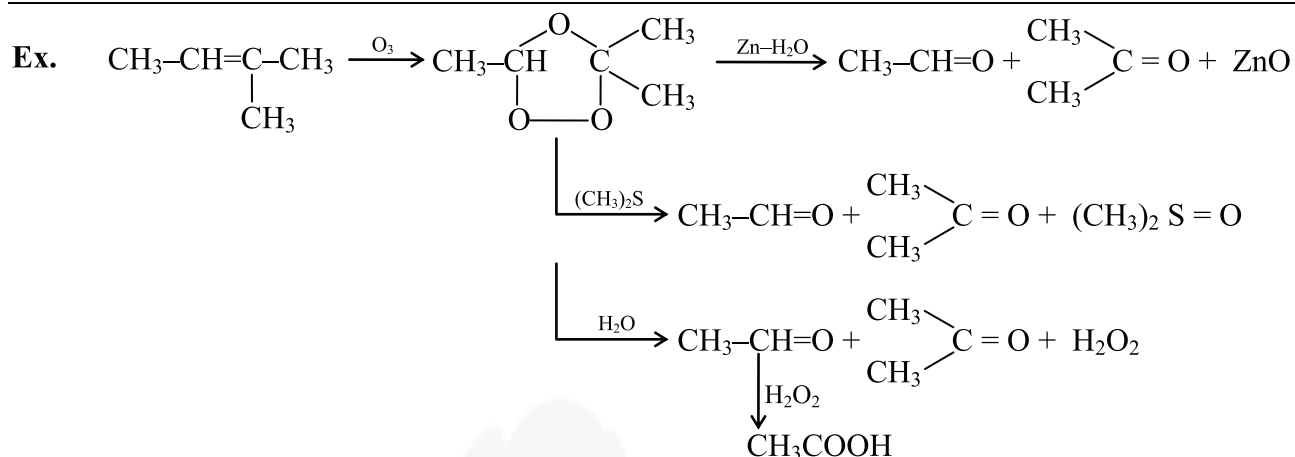


Higher alkyne except alkyne-1 will give ketone during hydroboration

**(III) Ozonolysis of alkene :**

It is used to get carbonyl compounds from alkene. The reaction is



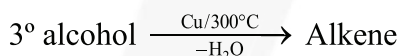
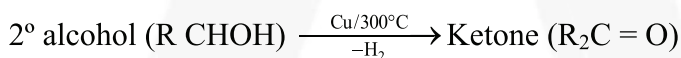
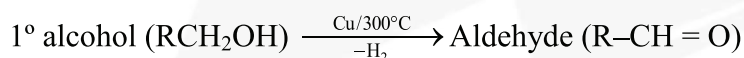
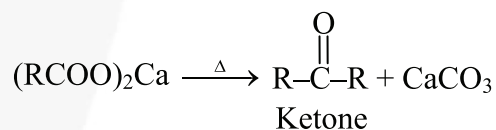
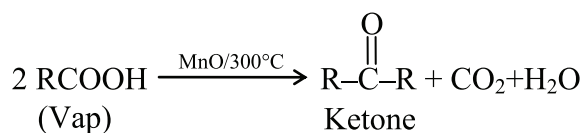
(Organic Chemistry) **CARBONYL COMPOUND****Note :**

(I) During the cleavage of ozonide Zn is used to check further oxidation of aldehyde into acid.

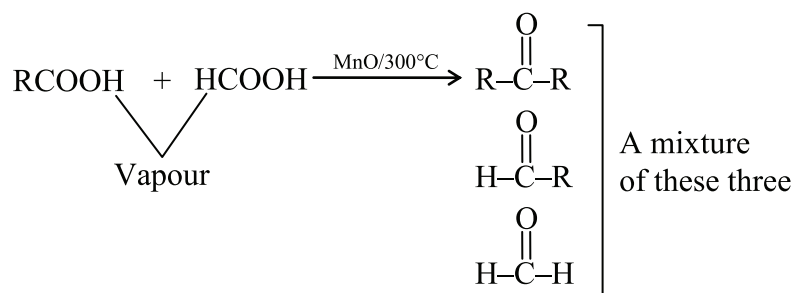
(II) By this method we can locate double bond in olefin or exact structure of hydrocarbon can be determined by knowing ozonolysis product i.e. by placing double bond at the place of two carbonyl oxygen of two carbonyl compounds.

(V) Dehydrogenation of Alcohol :

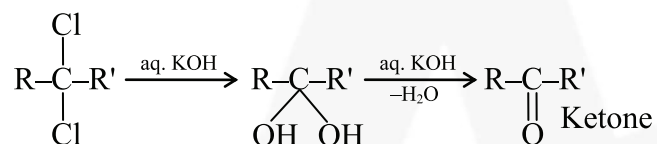
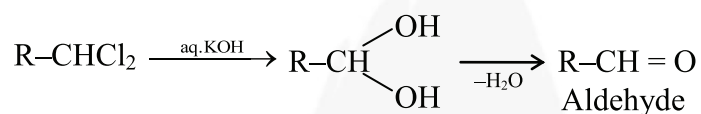
Dehydrogenation means removal of hydrogen and reagent used is heated copper.

**(VI) Dry distillation of Calcium salt of acid :****(VII) On passing vapours of fatty acids over Magnous oxide at 300°C.**

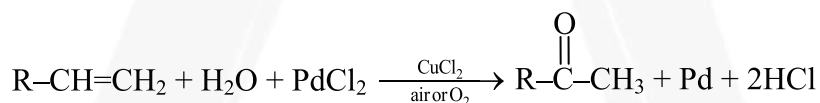
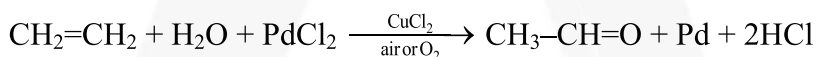
On passing mixture of vapours of fatty acid with formic acid we get a mixture of aldehyde, ketone and formaldehyde.

**(VIII) On aqueous alkali hydrolysis of gem-dihalides :**

Terminal gemdihalides will give aldehyde while non-terminal will give ketones as follows

**(IX) Wacker Process :**

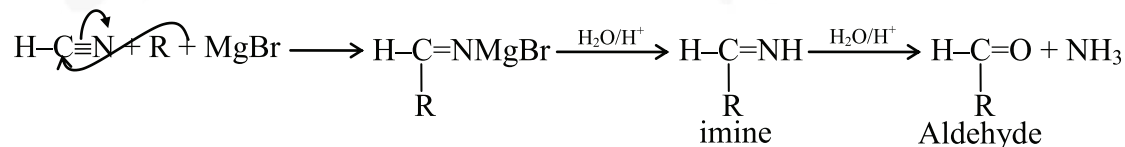
Alkenes can directly be oxidised to corresponding aldehydes or ketone by treating them with a solution of PdCl_2 containing a catalytic amount of CuCl_2 in presence of air or O_2 . Except ethene any higher alkene will give ketone.



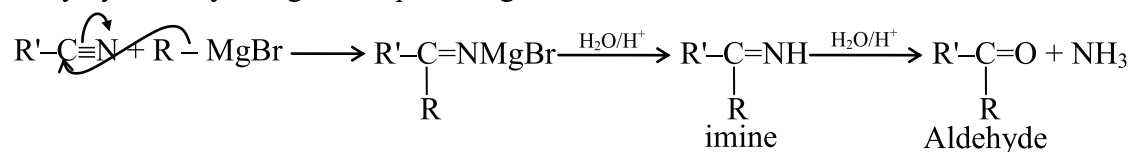
Note : During the reaction PdCl_2 is reduced to Pd and CuCl_2 is reduced to Cu(I)

(X) Preparation of Carbonyl compounds using Grignard's Reagent :

(a) Hydrogen cyanide on treating with Grignard reagent followed by double decomposition with water gives aldehyde via imine.

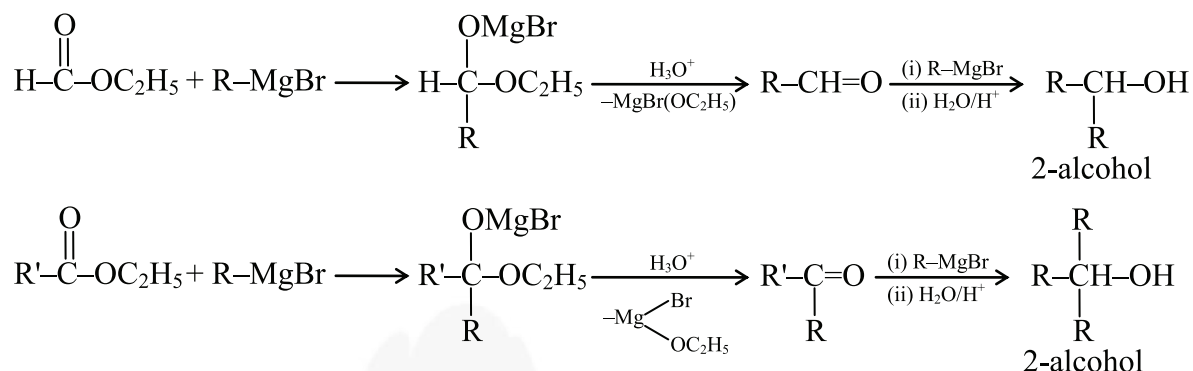


Alkylcyanide by using above process gives ketone via ketimine

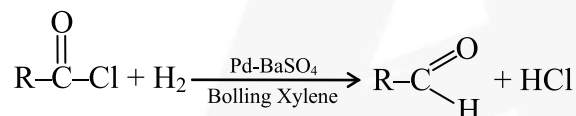
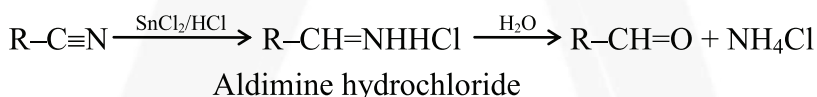


(Organic Chemistry) **CARBONYL COMPOUND**

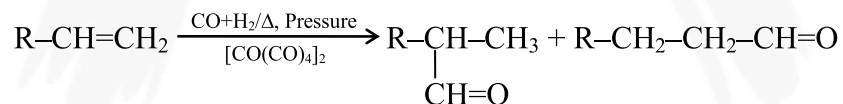
(b) Alkylformate with Grignard reagent gives 2° alcohol via aldehyde while alkyl alkanoate under similar condition gives 3° alcohol via ketone

**(A) Methode used for the preparation of Aldehydes only.****(i) Rosenmund's reaction :**

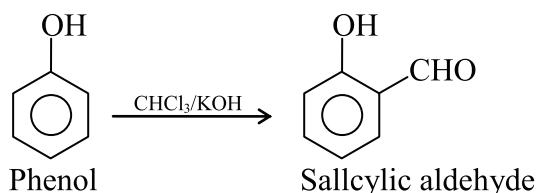
Here acid chlorides are reduced to aldehyde with H_2 in boiling xylene using palladium as a catalyst supported on barium sulphate.

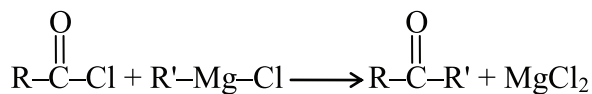
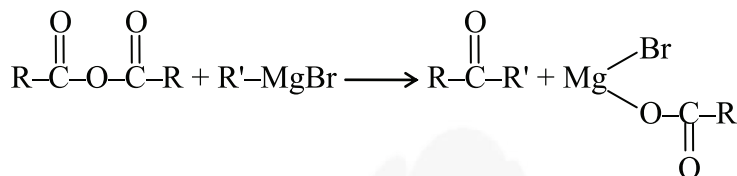
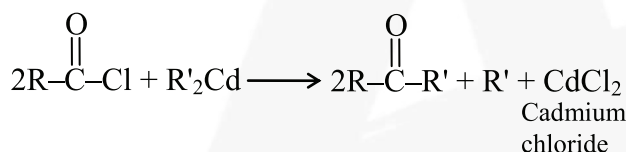
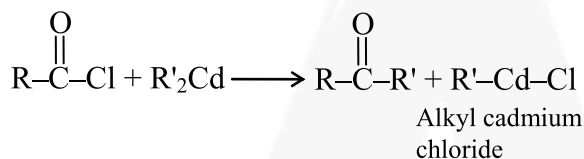
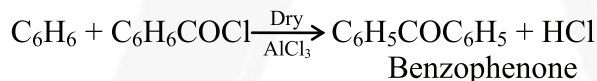
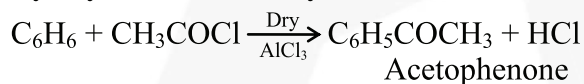
**(ii) Stephen's reduction :****(iii) Oxo-process :**

It is also called as carbonylation here alkene reacts with water gas at high temperature and pressure in the presence of cobalt carbonyl catalyst to give aldehyde.

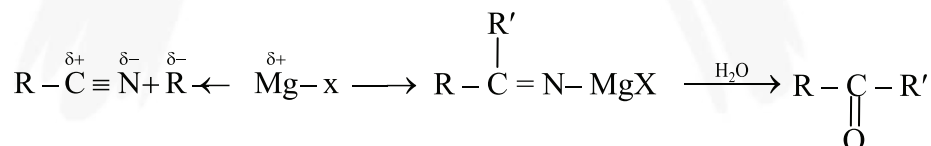
**(iv) Reimer-Teimann Reaction :**

By this method phenolic aldehyde is prepared



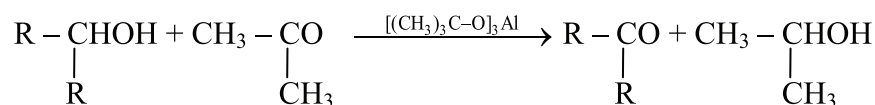
(B) Methods used for the preparation of Ketones only**(i) Using alkanoyl chloride and Grignard reagent****(ii) Using alkanoyl anhydride and Grignard reagent****(iii) Using alkanoyl chloride and dialkyl cadmium****(iv) By acylation or benzoylation of aromatic hydrocarbon (Friedel-Carft Reaction)****(v) From Alkyl Cyanide :**

Alkanones are formed on hydrolysis after reaction of an alkyl magnesium halide with ethyl cyanide or its higher homologue.

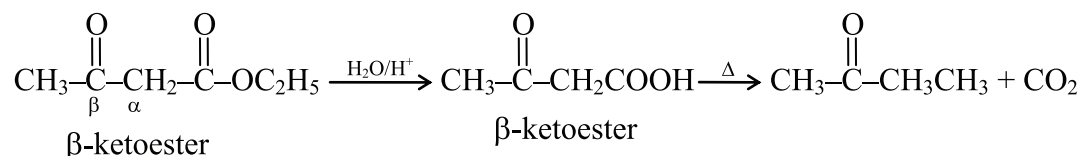


In this reaction if we take HCN with G.R., product will be aldehyde but major product will be alkane because HCN is an example of active H compound and with active hydrogen compound GR forms alkane.

(vi) Oppenaur Oxidation : In order to prepare alkanone easily, Oppenauer oxidation of secondary alkanols is done. In this process, a secondary alkanols is refluxed with aluminumtert-but oxide in excess amount in acetone. Acetone is reduced to isopropyl alcohol.

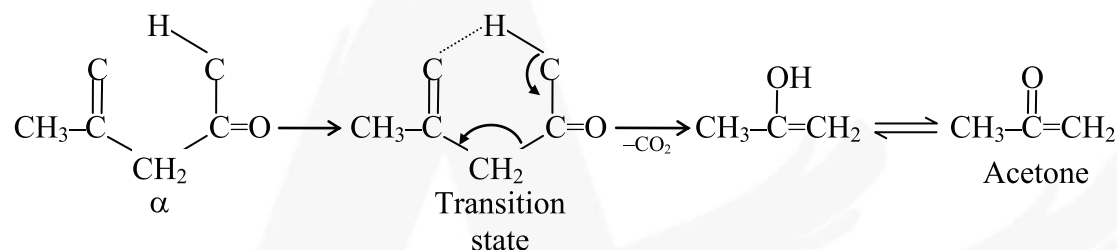


(vii) **By Acid hydrolysis followed by heating of β -Ketoester.**



Mechanism:

(i) It is β -ketoacid which decarboxylate more readily as it proceeds via six membered cyclic

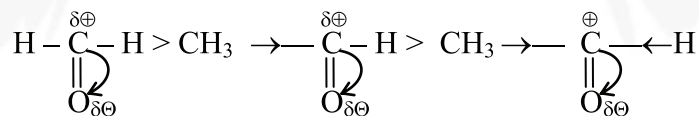


PHYSICAL PROPERTIES

- Aldehydes are colourless with pungent smell liquid while ketones are pleasant smell liquid but formaldehyde is gaseous in nature.
- Lower carbonyl compounds are soluble in water. It is due to polarity in carbonyl group.
- Higher carbonyl compounds are insoluble in water due to more covalent character.
- Melting point & Boiling point \propto 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 –

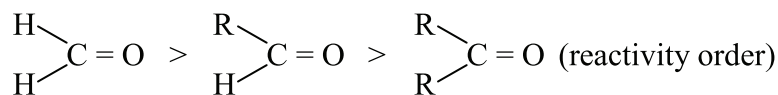
S.No.	Compound	Boiling Point
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(Organic Chemistry) CARBONYL COMPOUND

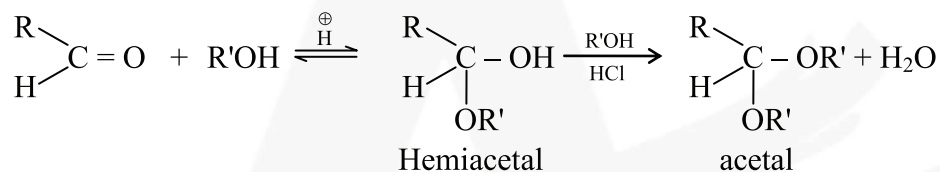
1.	Formaldehyde	- 21°C
2.	Acetaldehyde	+ 21°C
3.	Acetone	+ 56°C

CHEMICAL REACTIONS OF CARBONYL COMPOUNDS

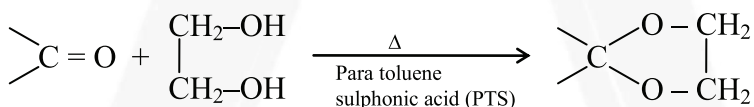
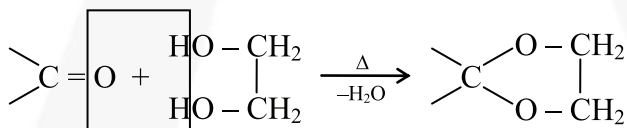
Carbonyl compounds undergo nucleophilic addition reaction and reactivity order will be :

(A) Nucleophilic Addition Reaction :**(i) Reaction with alcohol :**

Carbonyl compounds react with alcohols in the presence of dry HCl gas to give acetal (if aldehyde) and ketal if ketone via formation of unstable hemiacetal and hemiketal respectively.

**Note :**

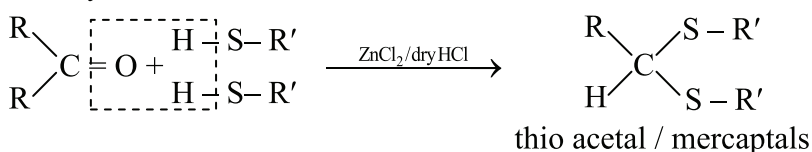
- (i) Acetal is formed to protect aldehyde for a long time.
- (ii) Acetal has functional groups ether.
- (iii) Acetal formed can be decomposed to original aldehyde by dilute acid.
- (iv) On treating with ethyleneglycol we get cyclic acetal or ketal (1, 3-dioxolans)

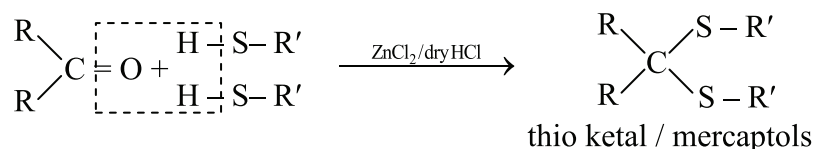
**Mechanism :**

- (v) Acetal formation is founded to be more favourable than ketal formation. If both the carbonyl groups are present within the molecule.

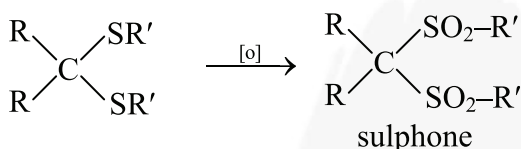
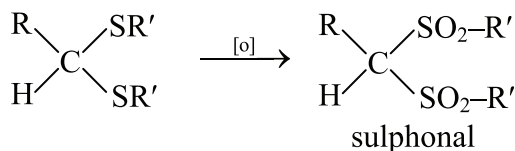
(ii) Reaction with Alkane Thiol :

Aldehyde form thio acetal with alkane thiol while ketone form thio ketal with alkane thiol.

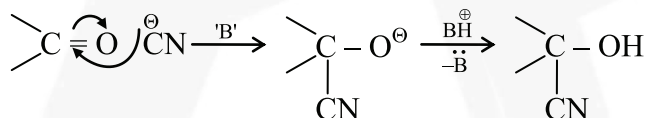
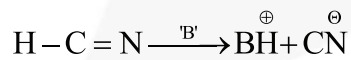
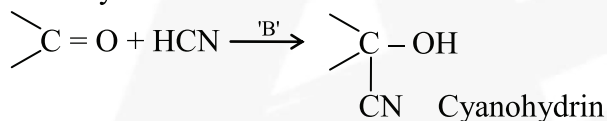


(Organic Chemistry) **CARBONYL COMPOUND**

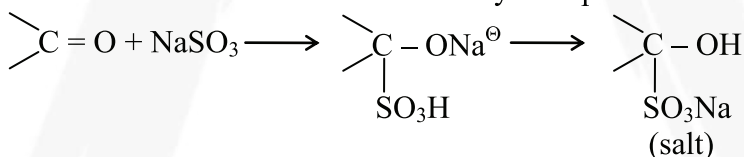
These are important compounds because they form sulphonyl compounds on oxidation which are used as hypnotic drugs.

**(iii) Addition of HCN :**

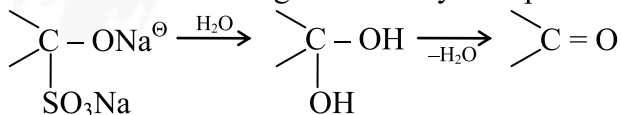
If is base catalysed addition

**(iv) Addition of sodiumbisulphite (NaHSO₃) :**

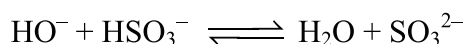
This addition is used to isolate carbonyl compounds from the mixture as we get salt.



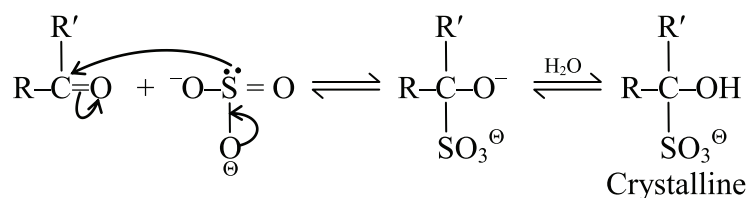
Salt on acidification gives carbonyl compounds again.

**Mechanism :**

The attacking nucleophile is SO_3^{2-} rather than HSO_3^{\ominus}



Though HSO_3^{\ominus} is present in higher concentration, SO_3^{2-} is a better nucleophile.

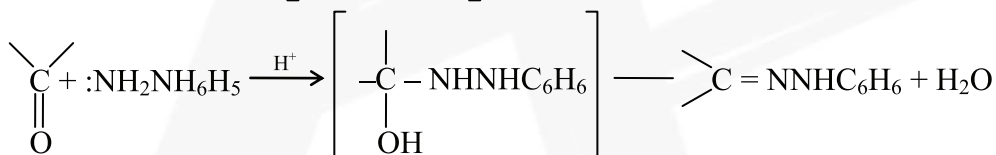
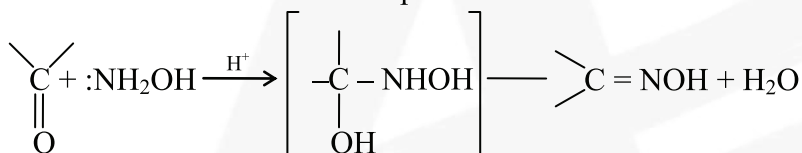


Note : –

- (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.
- (c) The reaction is given by only methyl ketone & aldehyde.

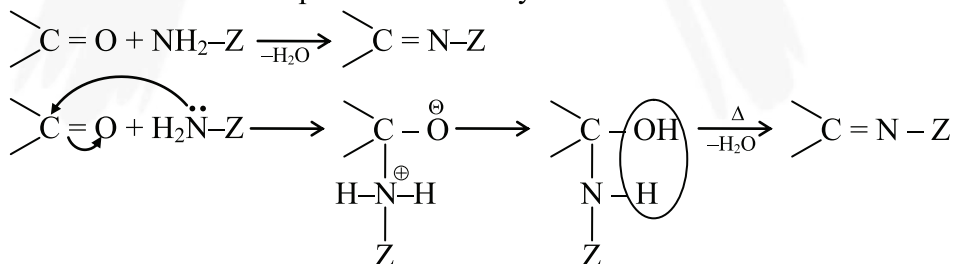
(B) Addition elimination reactions :

Certain compounds related to ammonia add to the carbonyl group to form derivatives that are important chiefly for the characterization and identification of aldehydes and Ketones the product contain a carbon nitrogen double bond resulting from elimination of a molecule of water from the initial addition products.

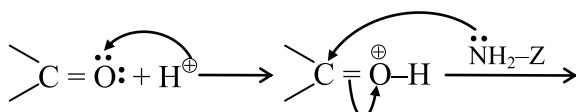


(i) Reaction with ammonia derivatives ($\text{H}_2\ddot{\text{N}}-\text{Z}$) :

This reaction is nucleophilic followed by water elimination :

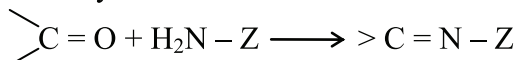
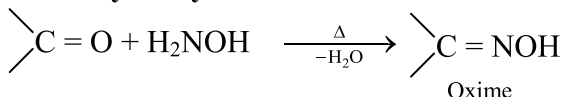
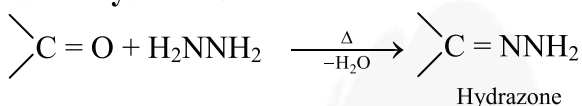
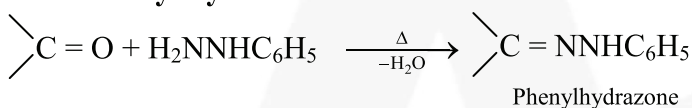
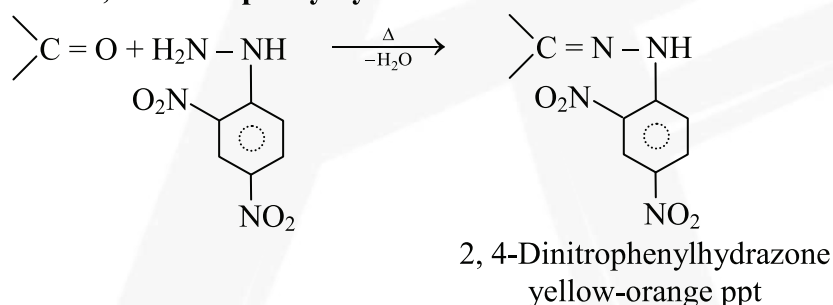
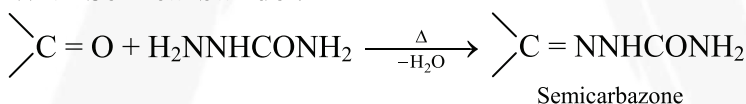
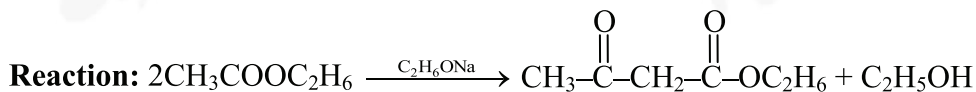
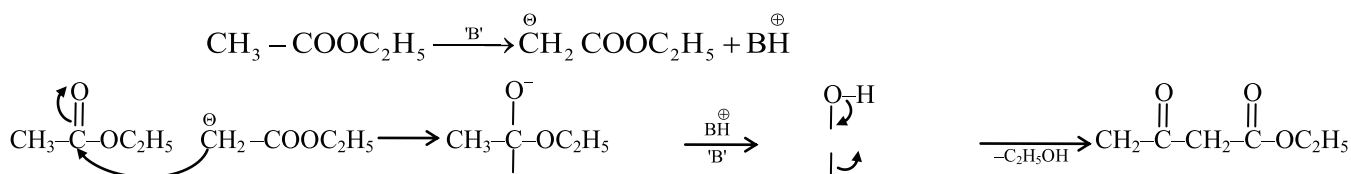


This reaction is carried out in slightly acidic media which will generate a nucleophilic centre for weak base ammonia derivatives.



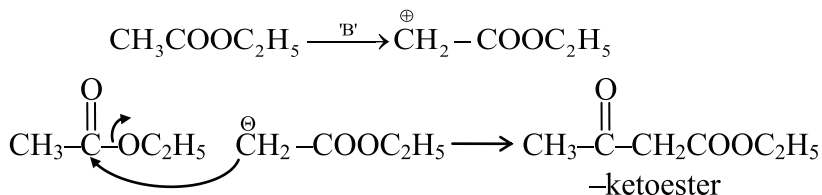
(Organic Chemistry) **CARBONYL COMPOUND**

On using strong acidic media lone pair of electrons present at N-atom of ammonia derivatives will accept proton forming protonated ammonia derivatives which cannot act as nucleophile for carbonyl carbon.

**(i) With Hydroxylamine :****(ii) With Hydrazine :****(iii) With Phenyl hydrazine :****(iv) With 2,4-Dinitrophenylhydrazine :****(v) With Semicarbazide :****NAME REACTION****(1) CLAISEN ESTER CONDENSATION****Mechanism :**

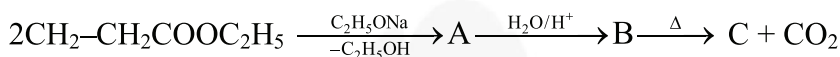
(Organic Chemistry) CARBONYL COMPOUND

The product β ketoester can be easily obtained by placing anion of one ester at the place of ethoxy part of other ester as –

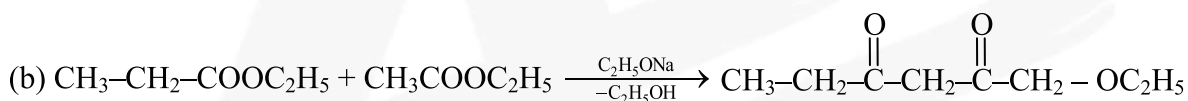
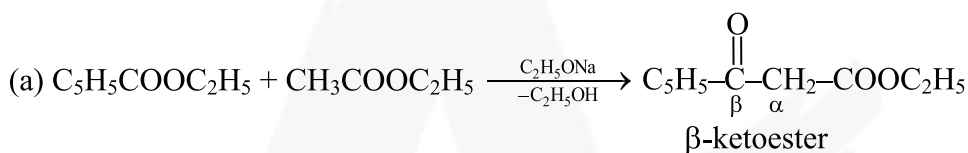


Note : (iii) If two ester units are same then it is inter molecular claisen ester condensation

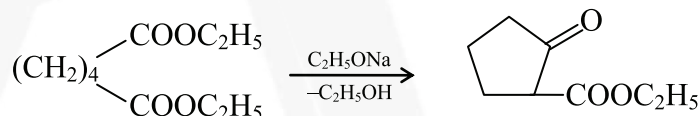
Q. Predict the unknown (s) for the following :



Note : (iv) If two ester units are different then it is crossed Claisen ester condensation



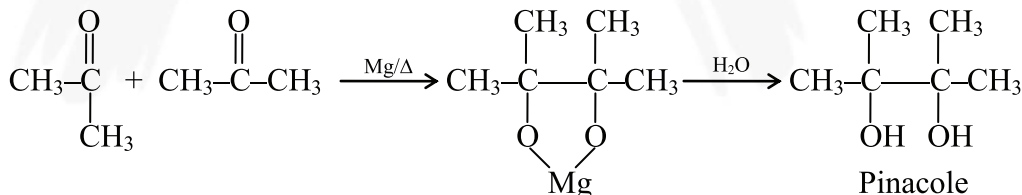
Note : (v) If two ester units are present within the same molecule then we get cyclic β -ketoester and the reaction is intramolecular Claisen ester condensation.



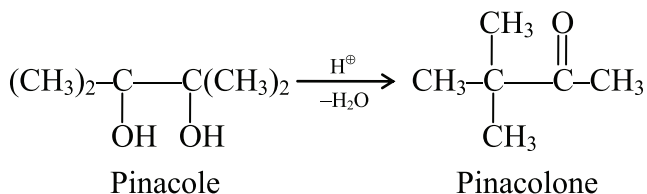
Note : (vi) Active methylene group hydrogen is too acidic that it can be replaced by alkyl of arylalkyl halide in the presence of base like sodium ethoxide.

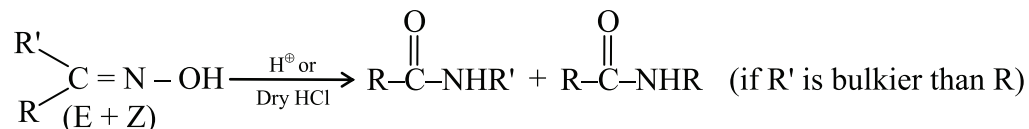
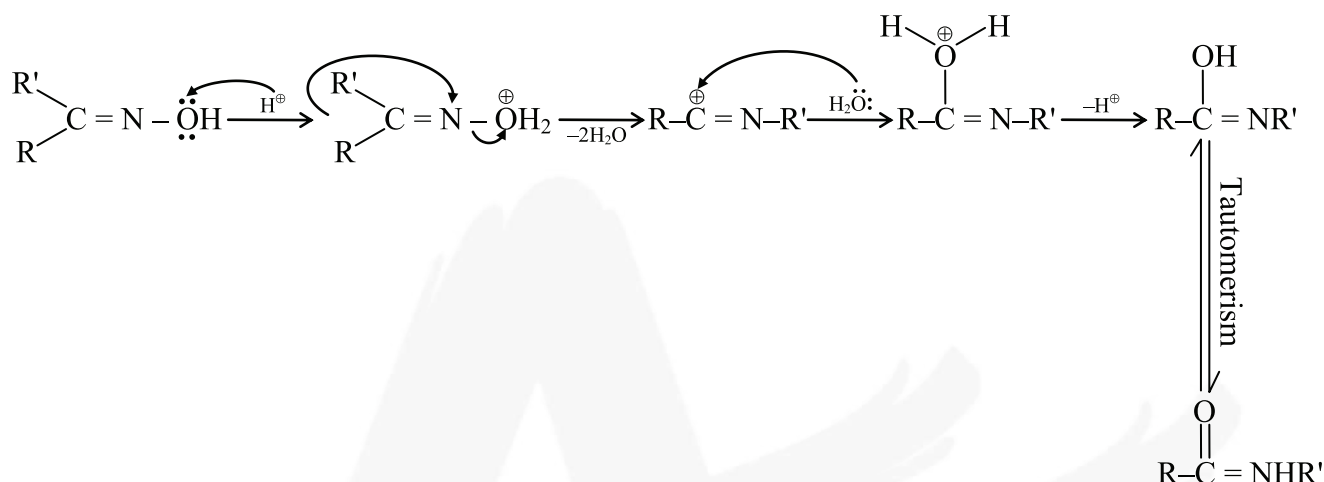
(2) Pinacol-Pinacolone rearrangement :

Pinacole is obtained when 2 moles of acetone are heated with divalent active metal magnesium followed by treating with water.

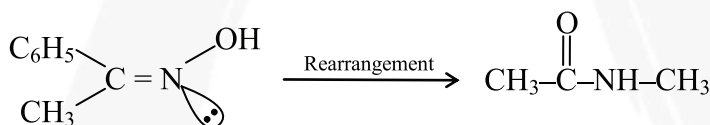
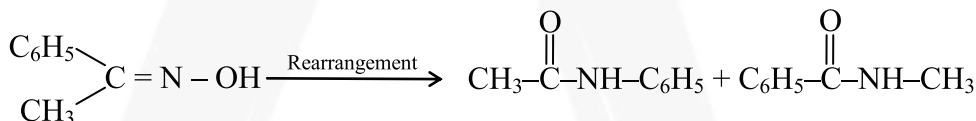


Pinacole undergoes rearrangement in acidic media to give pinacolone

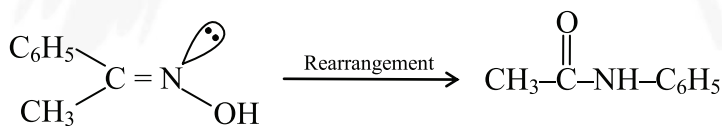


(Organic Chemistry) **CARBONYL COMPOUND****(3) Beckmann Rearrangement in Oxime :****Mechanism :****Note :**

- (i) Brady's reagent is used to distinguish carbonyl compounds from the mixture.
- (ii) Oxime undergoes Beckmann rearrangement to give its isomer amide.
- (iii) In this reaction the group which is anti to $-\text{OH}$ group migrates.



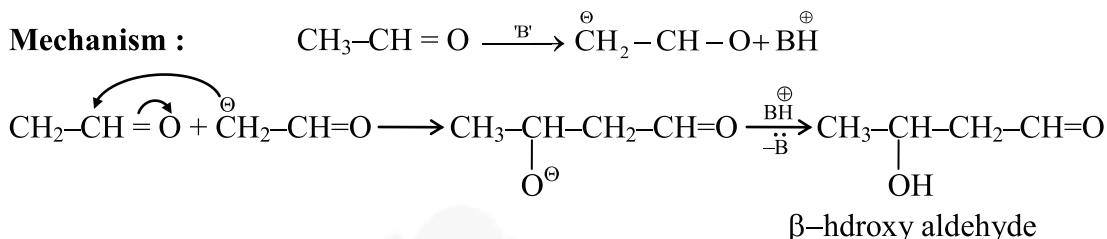
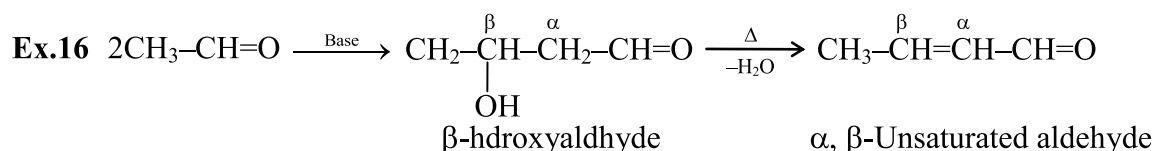
($-\text{CH}_3$ is anti $-\text{OH}$)



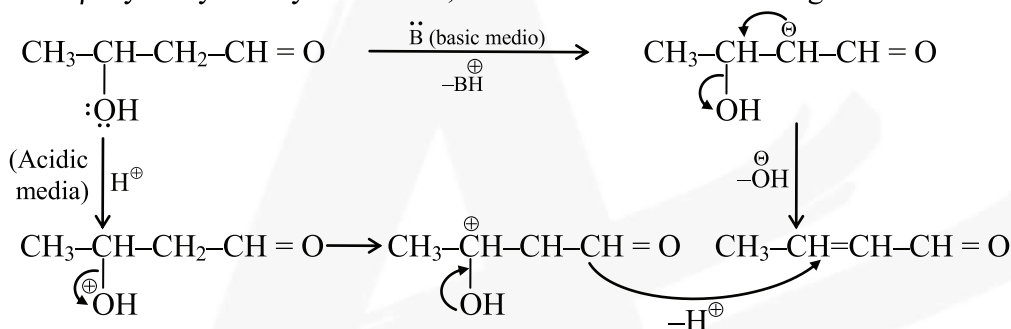
($-\text{C}_6\text{H}_5$ is anti $-\text{OH}$)

4) Aldol Condensation :

It is condensation between two moles of carbonyl compounds among which at least must have one α -hydrogen atom in dilute basic media to get α, β -unsaturated aldehyde / ketone via the formation of β -hydroxy aldehyde / ketone.

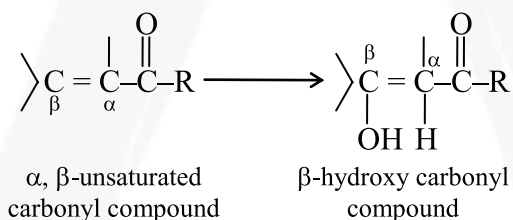
(Organic Chemistry) **CARBONYL COMPOUND**

from β -hydroxy aldehyde / ketone, water is eliminated on using either acidic or basic media as

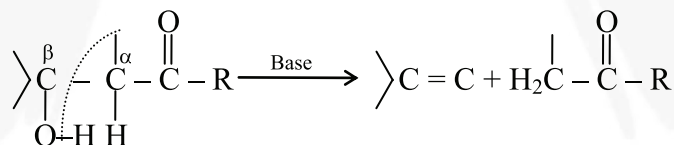


Now try to get carbonyl compounds from α, β -unsaturated carbonyl compounds as-

Keep 'H' at α -position and -OH at β -position of α, β unsaturated carbonyl compounds to get β -hydroxy carbonyl compounds.



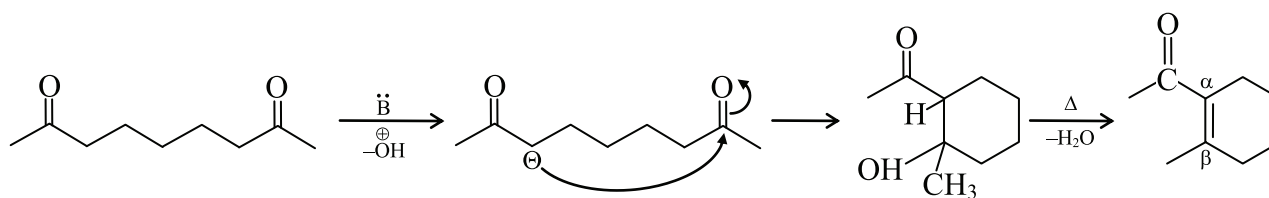
Now break α and β carbon as shown below to get carbonyl compound.



These two carbonyl compounds can be obtained on ozonolysis of hydrocarbon $\text{>C}=\underset{\text{R}}{\text{C}} + \text{CH}_2$

if it is asked.

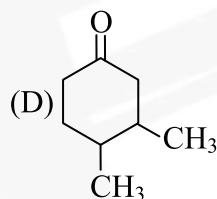
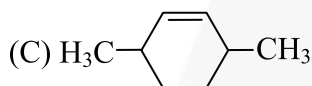
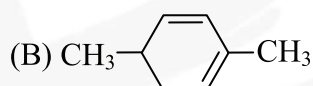
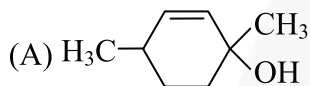
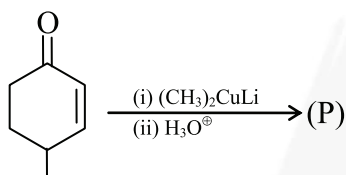
Intramolecular aldol condensation :

Cyclic β -hydroxy-ketone

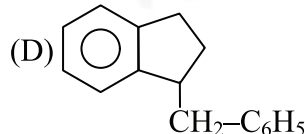
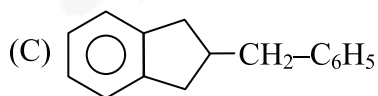
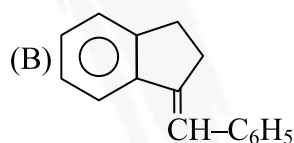
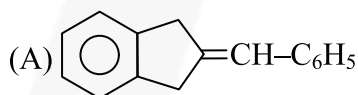
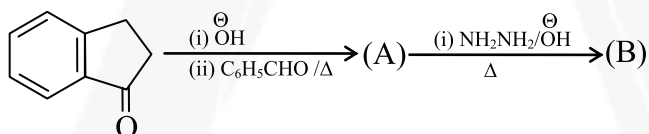
By knowing product we can get reactant as in case of intermolecular aldol condensation.

DO YOURSELF – 1

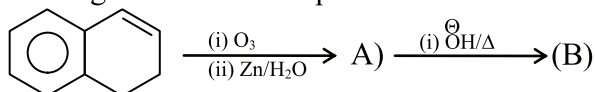
1. In the given reaction, (P) will be



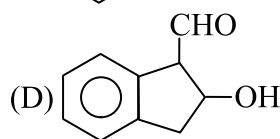
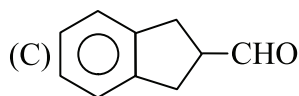
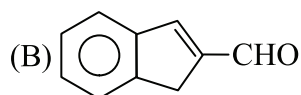
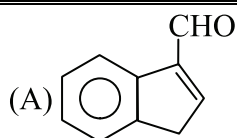
2. In the given reaction sequence, compound (B) is



3. In the given reaction sequence

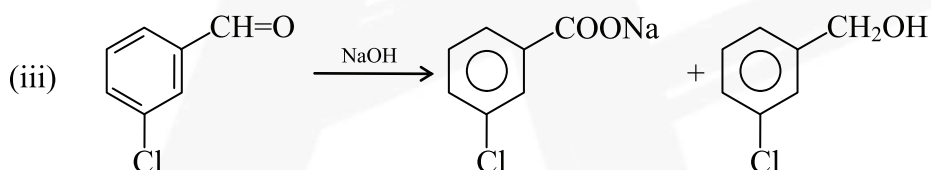
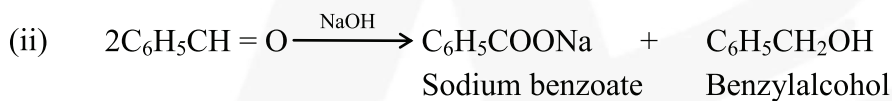
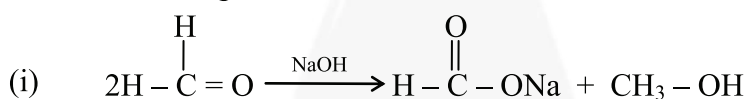


CARBONYL COMPOUND



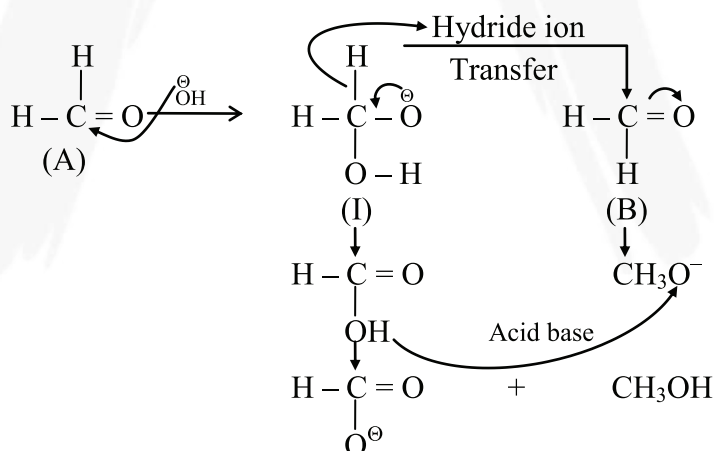
(5) Cannizzaro reaction :

Carbonyl compounds not having α -hydrogen atom undergo disproportionation or redox reaction in strong basic media.



These reaction are intermolecular cannizzaro reaction :

Mechanism :

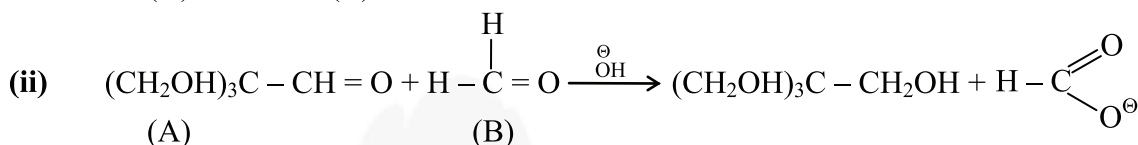
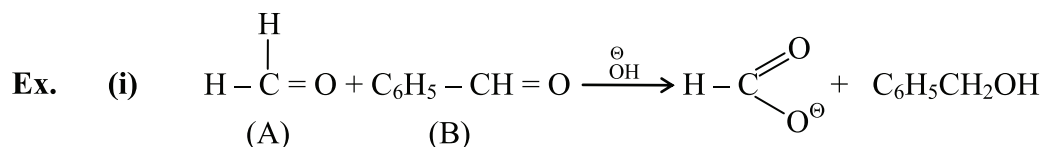


By this mechanism it clear that acid is corresponding to that carbonyl compound over which OH is going easily as nucleophile.

Note : It is observed that hydride ion transfer from (I) to Carbonyl compound (B) is rate

Crossed Cannizzaro reaction :

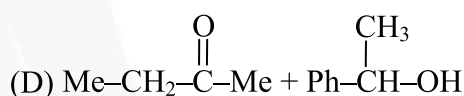
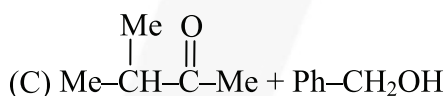
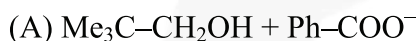
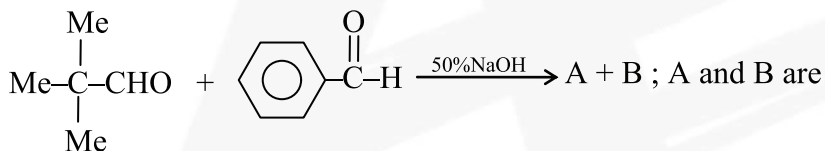
On using two types of carbonyl compounds not having α -hydrogen atom, acid will be corresponding to that aldehyde over which OH will approach without any hindrance.



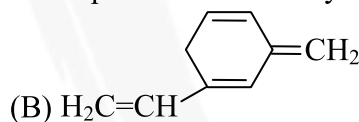
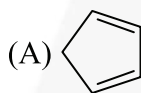
in case (i) OH will easily go to (A) and in case (ii) it will go to (B) hence acid will be formate ion in both the cases.

DO YOURSELF – 2

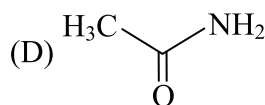
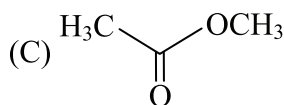
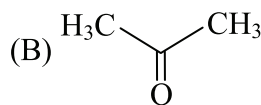
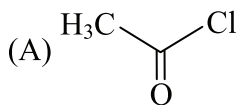
1. In the given reaction



2. Which of the following gives glyoxal as one of the product on ozonolysis



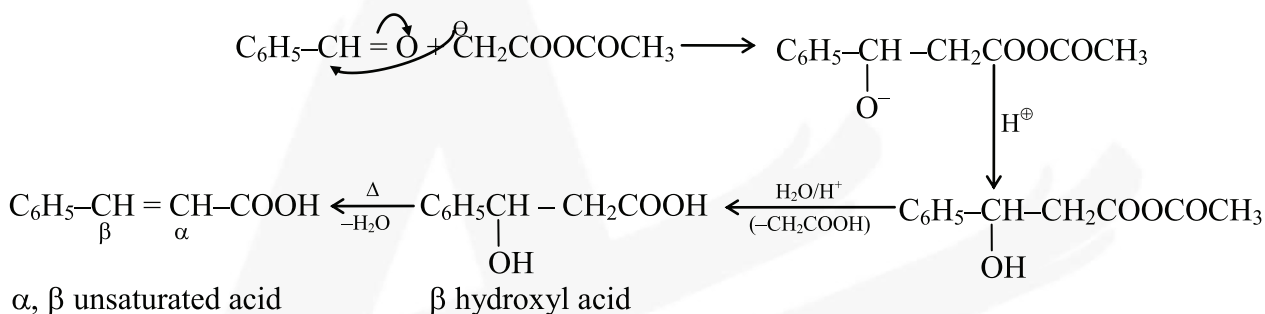
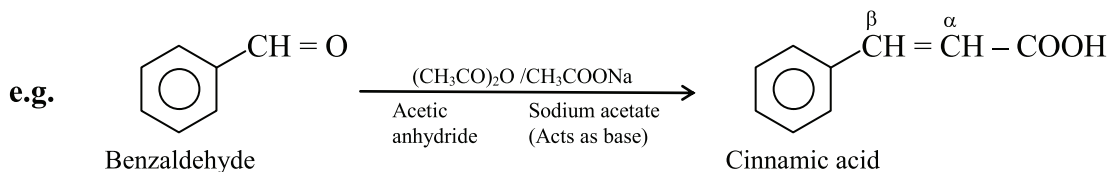
3. The maximum reactive towards the nucleophilic attack is



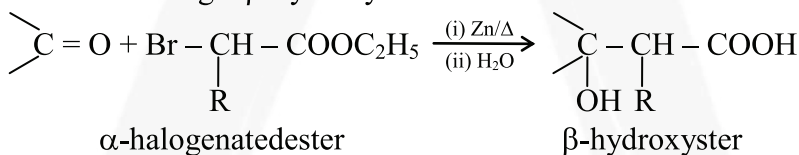
(6) **Perkin reaction:**

(Organic Chemistry) **CARBONYL COMPOUND**

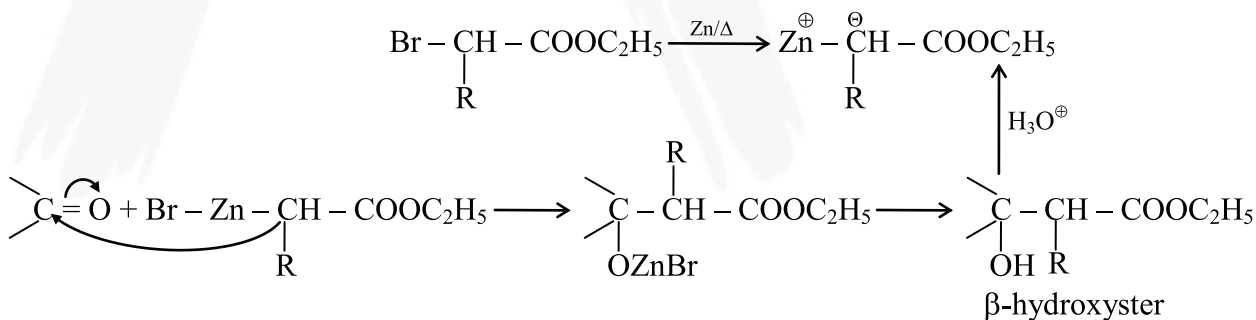
When aromatic aldehyde like benzaldehyde is treated with anhydride in the presence of sodium salt of acid from which anhydride is derived we get α, β -unsaturated acid.

**(7) Reformatsky reaction :**

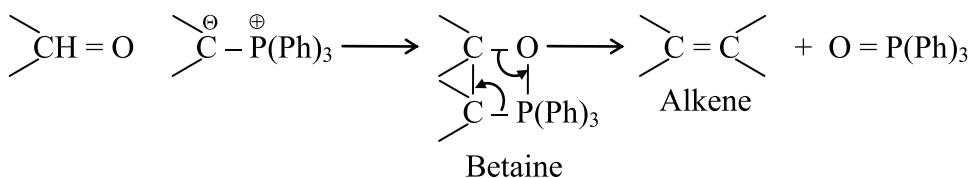
When carbonyl compound and α -halogenated ester are heated with zinc followed by treating with water we get β -hydroxyester.



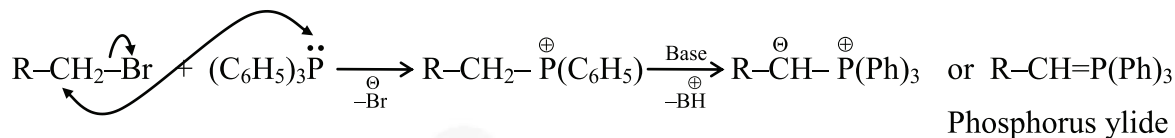
This reaction can be represented as

**(8) Wittig reaction :**

It is used to get alkene from carbonyl compound using phosphorus ylide via the formation of cyclic structure betaine.

(Organic Chemistry) **CARBONYL COMPOUND**

Note : Phosphorus ylides are prepared from alkylhalide and triphenylphosphine in the presence of base like sodium ethoxide as

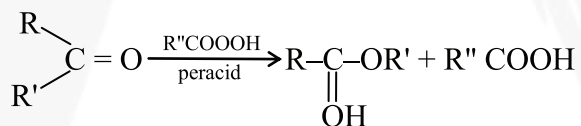
**DO YOURSELF – 3**

Q. Complete the following reaction

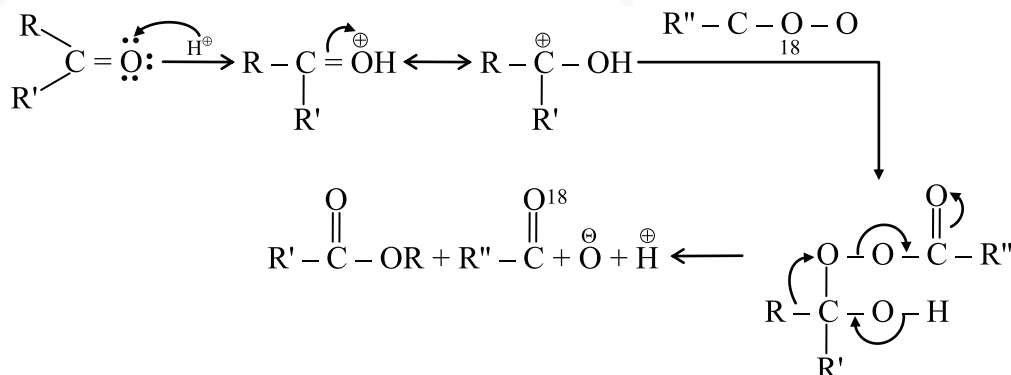
- $\text{Cyclohexanone} + \text{CH}_2 = \text{P}(\text{Ph})_3 \longrightarrow$
- $\text{Isobutyraldehyde} + \text{Triphenylphosphonium ylide} \longrightarrow$
- $\text{Acetone} + \text{Triphenylphosphonium ylide} \longrightarrow$
- $\text{Cyclohexanecarbaldehyde} + \text{Triphenylphosphonium ylide} \longrightarrow$
- $\text{Propionaldehyde} \xrightarrow[\text{(ii) LiAlH}_4]{\text{(i) KCN/H}_2\text{SO}_4}$

(9) Baeyer-Villiger oxidation :

It is preparation of ester from ketone using peracid.

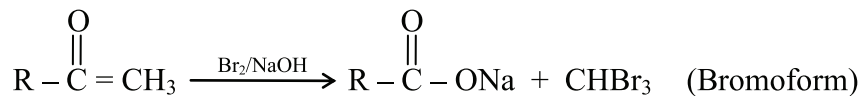


Mechanism :

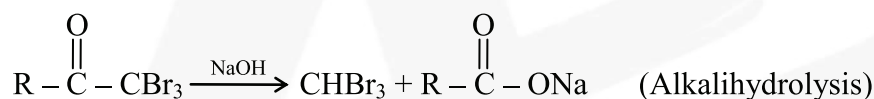
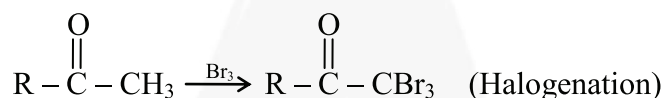


(Organic Chemistry) **CARBONYL COMPOUND****(10) Haloform reaction :**

Acetaldehyde and methylalkyl ketones react rapidly with halogen (Cl_2 , Br_2 or I_2) in the presence of alkali to give haloform and acid salt.



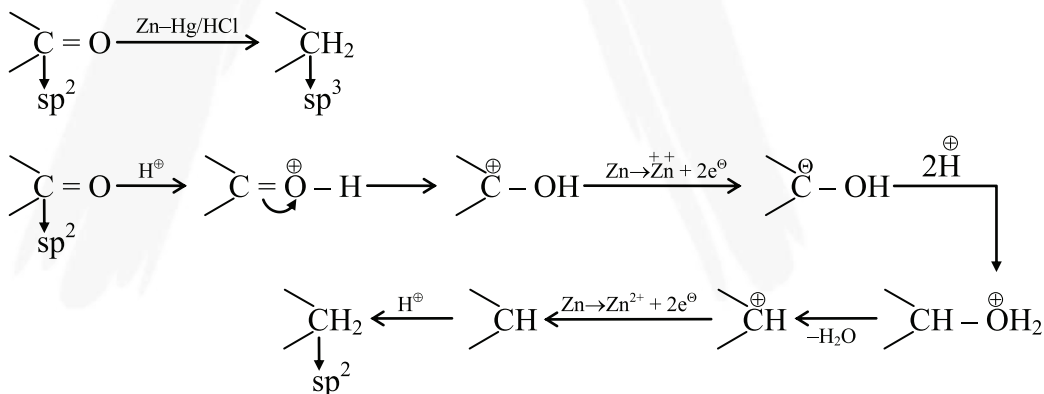
In this reaction $-\text{CH}_3$ of $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-$ group is converted into haloform as it contains acidic hydrogen atom and rest-part of alkyl methyl ketone gives acid salt having carbon atom corresponding to alkyl ketone.

(a) Halogenation**(b) Alkali hydrolysis**

Note : This reaction is used to distinguish the presence of $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-$ group.

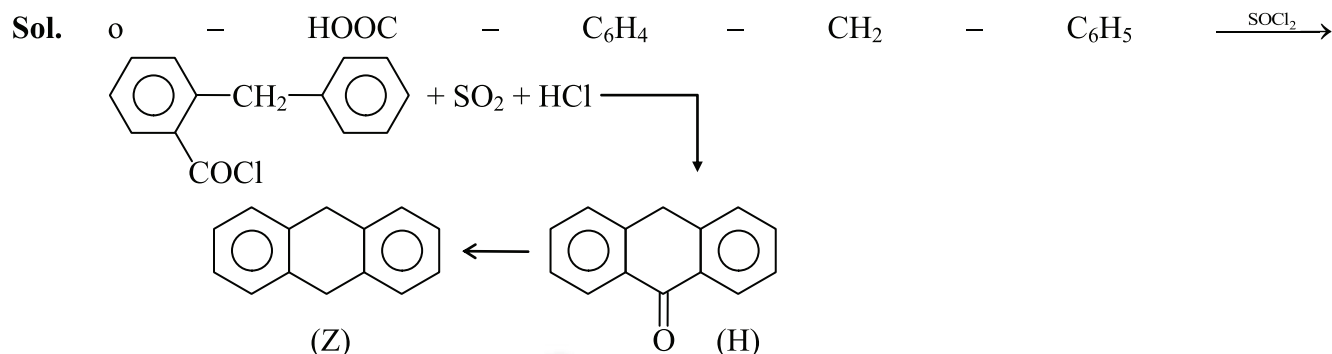
(XI) Clemmensen reduction :

Used to get alkane from carbonyl compounds.

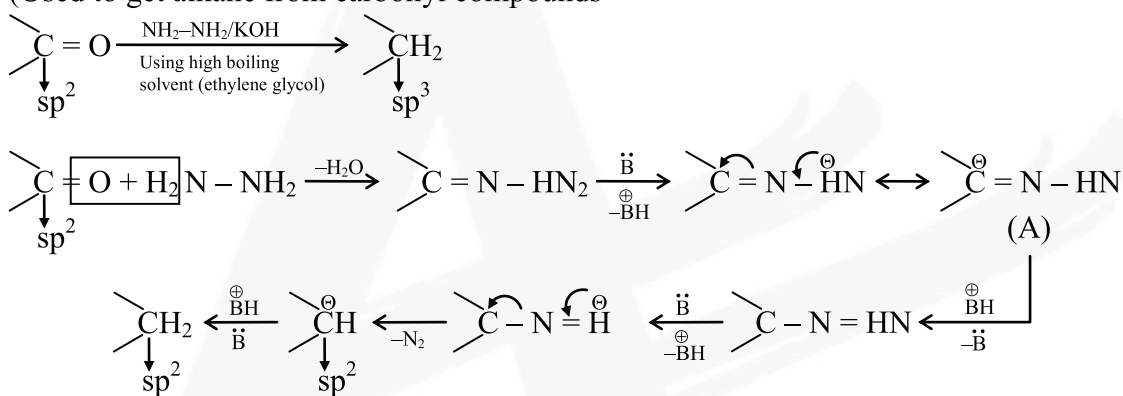


Ex. Fill in the blanks with appropriate structures of reaction products in the following transformations

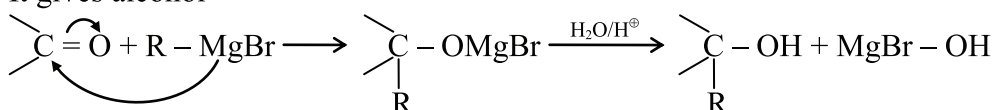


(Organic Chemistry) **CARBONYL COMPOUND****(XII) Wolf-Kishner reduction :**

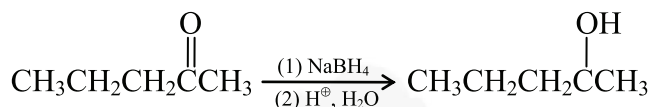
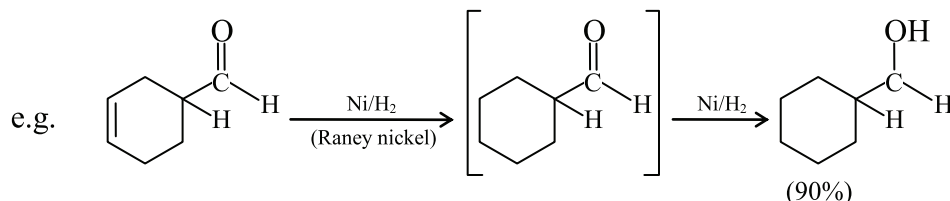
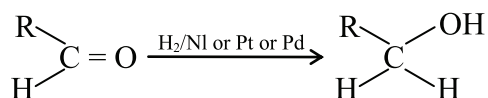
(Used to get alkane from carbonyl compounds)

**DO YOURSELF – 4****(XIII) Addition of Grignard reagent over Carbonyl compound :**

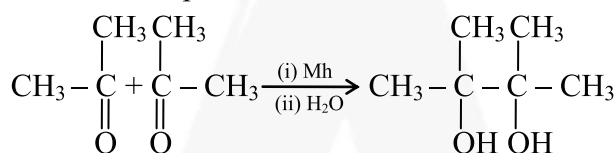
It gives alcohol

**(XIV) Reduction of Carbonyl Compounds :**

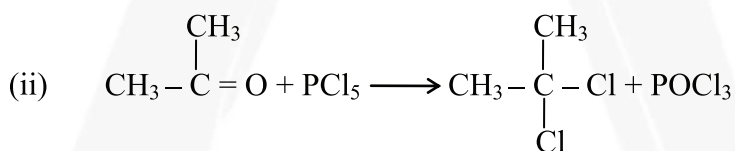
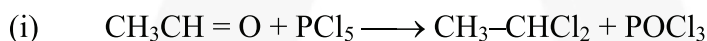
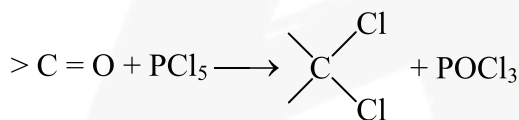
(i) Reduction to alcohols

(Organic Chemistry) **CARBONYL COMPOUND**

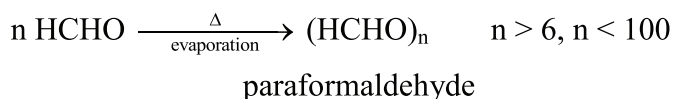
(ii) Reduction to pinacols

**(XV) Reaction with PCl_5 :**

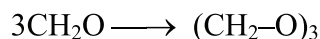
Carbonyl compounds give gemdihalides

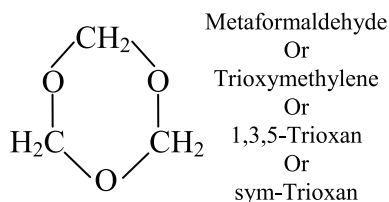
**OTHER REACTION :****(1) Addition polymerisation reaction of formaldehyde:**

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

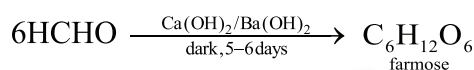
If $n \leq 50$ Linear structure polymerIf $n > 50$ Cyclic structure polymer

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



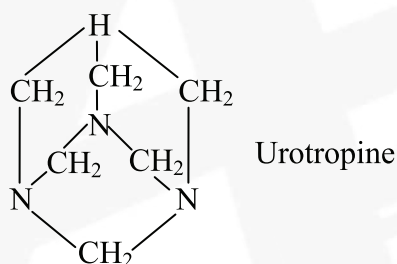
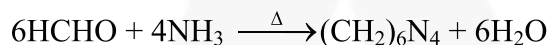
(Organic Chemistry) **CARBONYL COMPOUND**

- (c) If aqueous solution of formaldehyde is kept with limewater in dark room for 5-6 days then it converts into a sweet solution called 'FARMOSE'. It is an example of linear polymer



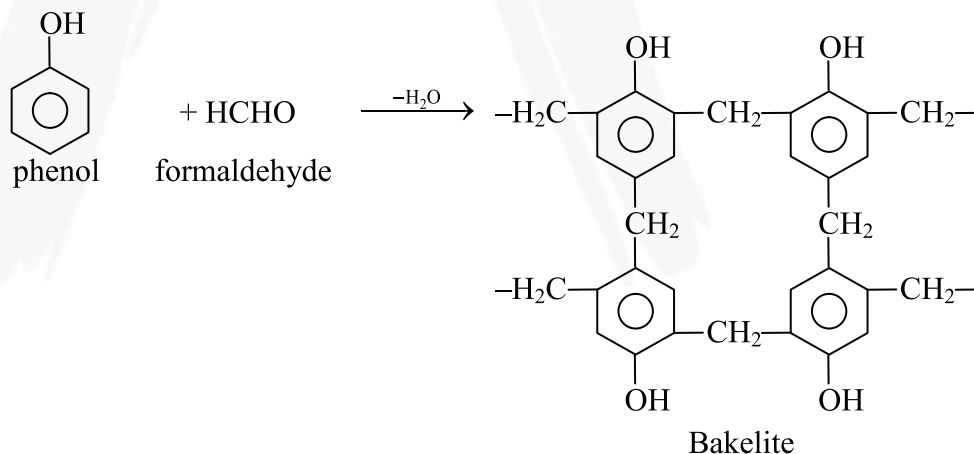
(2) **Condensation polymerisation reaction of formaldehyde**

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



It is used in medicine or diabetics or urinary infection.

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

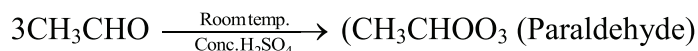


Bakelite is electric and thermal resistant. So, used in formation of electric appliances. Reaction is called '**Lederer-Manasse Reaction**'.

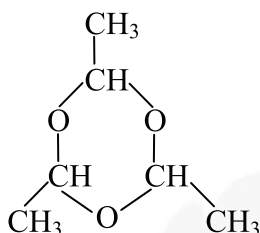
(3) **Addition Polymerisation of Acetaldehyde :**

(Organic Chemistry) **CARBONYL COMPOUND**

- (a) When acetaldehyde is kept with conc. H_2SO_4 at room temperature then it forms a cyclic trimer called paraldehyde.



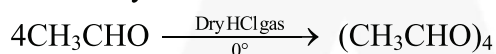
Paraldehyde has nonaromatic heterocyclic structure and it is called 2,4,6-trimethyl-1,3,5-trioxan.



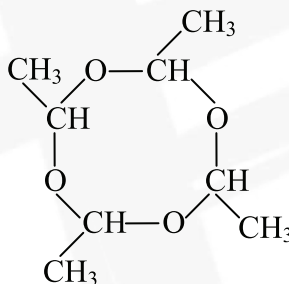
Paraldehyde or 2,4,6-trimethyl-1,3,5-trioxan

Paraldehyde is used as mild hypnotic

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



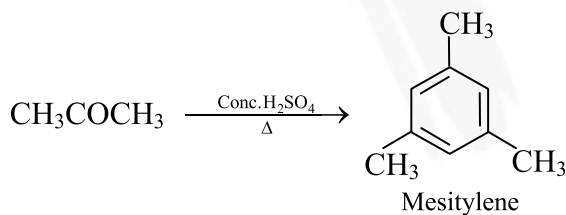
Metaldehyde has the following nonaromatic eight-membered heterocyclic structure.



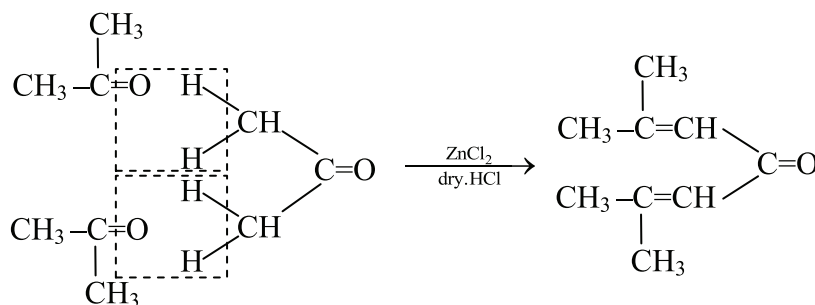
Note : Metaldehyde is used as smokeless powder and Paraldehyde is used as a sedative while metaldehyde is used as a solid fuel.

(4) **Condensation Polymerisation of Acetone :**

- (a) If acetone is heated with conc. H_2SO_4 then an aromatic compound is formed called 1,3,5-trimethyl benzene or mesitylene.

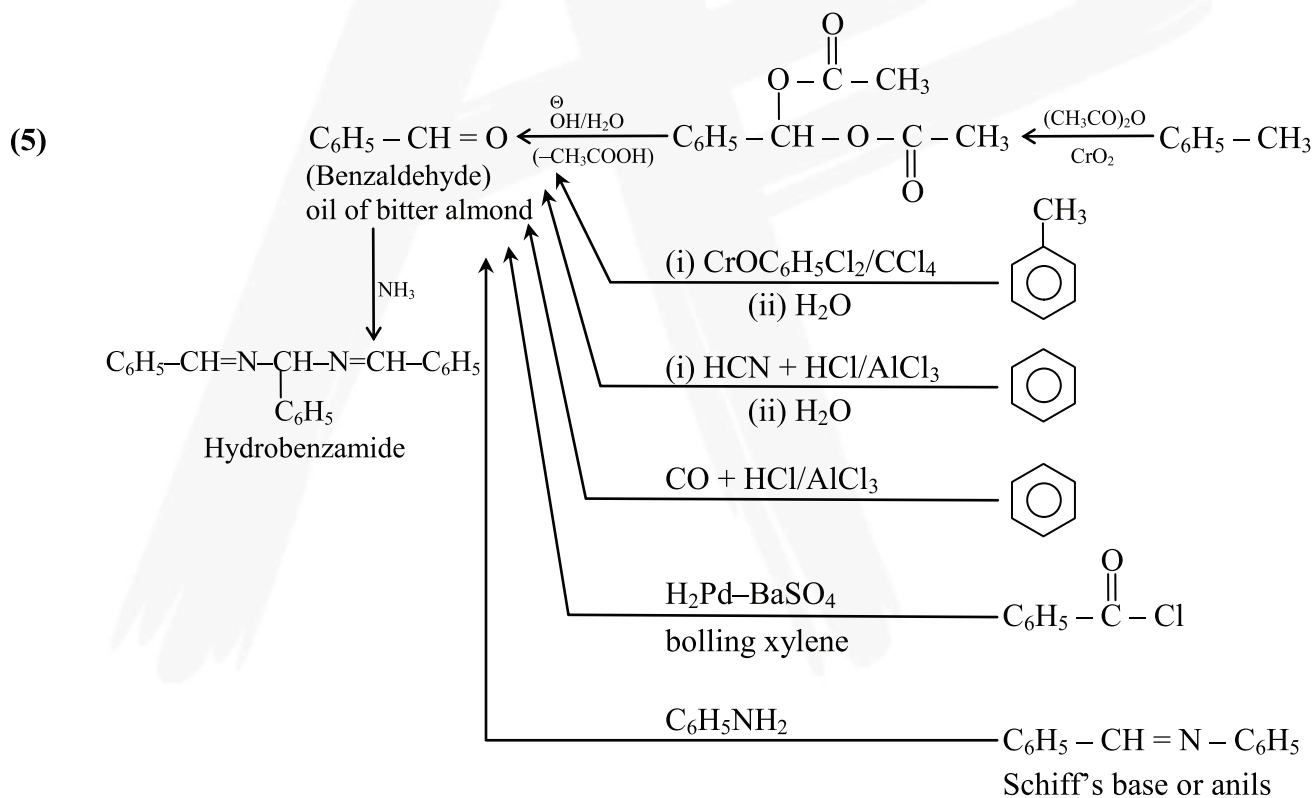
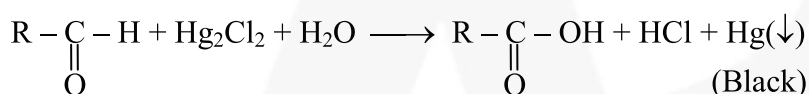
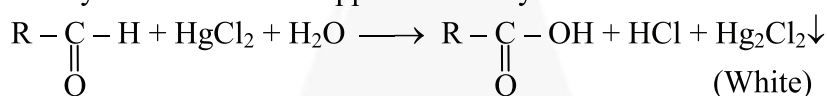


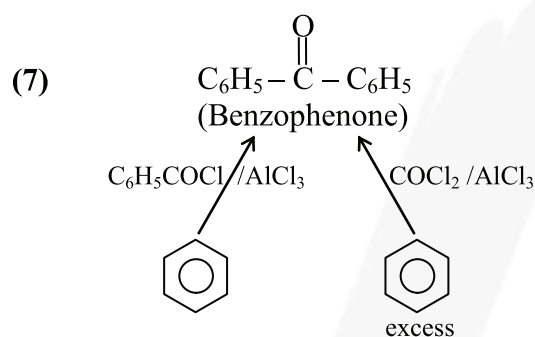
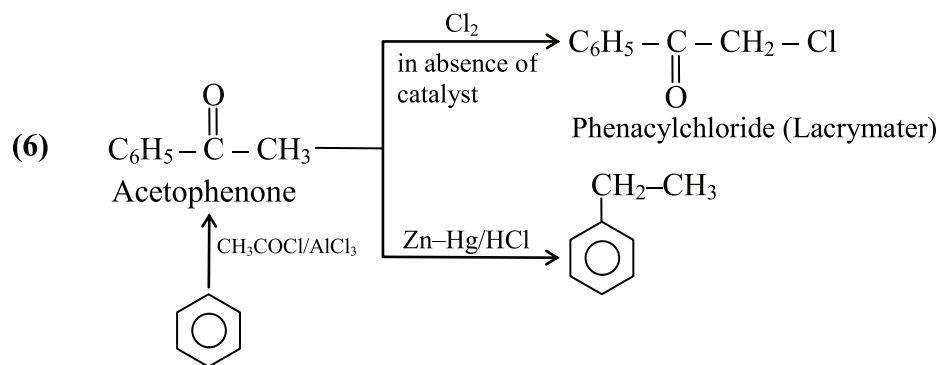
- (b) If acetone would be in excess in ketal condensation or catalyst (ZnCl_2 / dry HCl) is used then three moles of acetone undergoes condensation polymerisation and forms a compound called 'Phorone'.



[molecular wt. of phorone = 3 mole of acetone – 2 mole of H₂O]

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

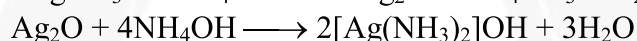
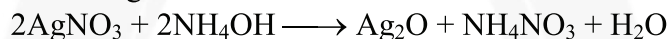




SOME IMPORTANT REAGENTS USED FOR IDENTIFICATION OF ALDEHYDE

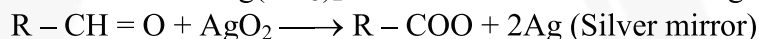
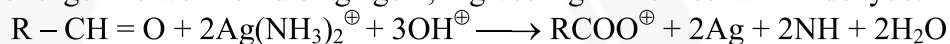
(i) **Tollen's reagent**

It is ammoniacal silver nitrate solution, prepared by adding ammonium hydroxide to AgNO_3 solution. During reaction, first Ag_2O is formed which is dissolved in ammonium hydroxide to give Tollen's reagent.



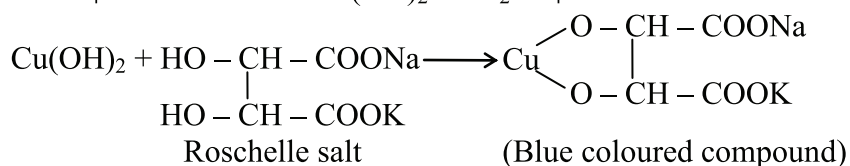
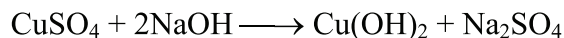
Tollen's reagent

Tollen's reagent is weak oxidising agent, it gives Ag mirror test with aldehyde.



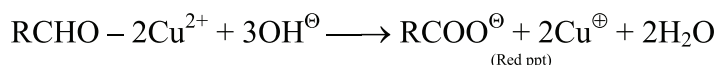
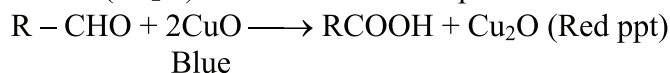
(ii) **Fehling's solution :**

It is an alkaline solution of cupric ion complexed with sodium potassium tartarate. Two solutions are kept by naming Fehling solution (I) (CuSO_4 solution) and Fehling solution (II) (Alkaline solution of sodium potassium tartarate). When these two solutions are mixed we get deep blue coloured solution.

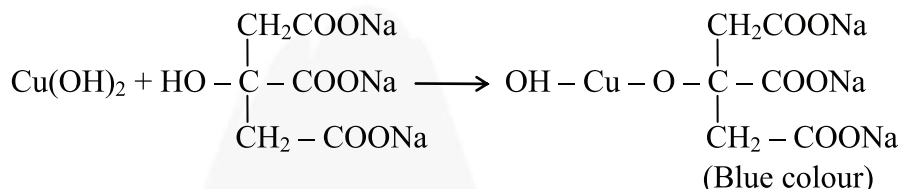
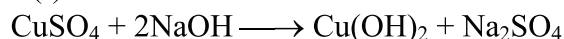


(Organic Chemistry) **CARBONYL COMPOUND**

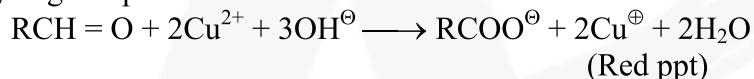
Equal volume of both the solution are heated with aldehyde to give red brown precipitate of cuprous oxide (Cu_2O) which confirms the presence of aldehyde.

**(iii) Banadict solution :**

It is solution of CuSO_4 , sodium citrate and sodium carbonate. It also consists of two solution. Solution (I) is alkaline solution of sodium citrate and solution (II) is CuSO_4 solution.



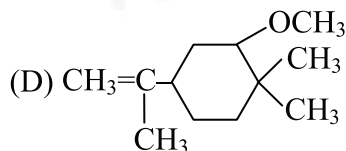
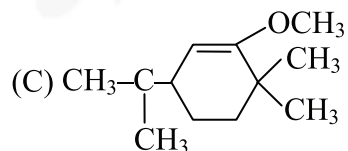
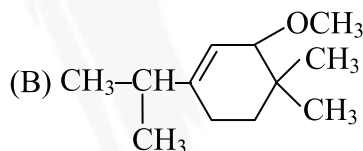
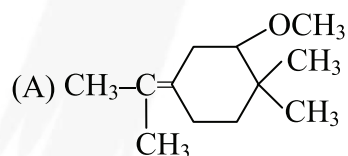
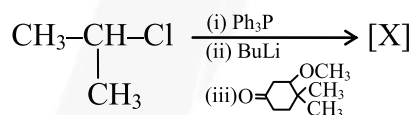
Aldehyde gives positive test with Benedict solution.

**(iv) Schiff's reagent :**

It is dilute solution of rosniline hydrochloride whose red colour has been discharged by passing SO_2 . Aldehyde reatores red colour when treated with Schiff's reagent (Magenta solution in H_2SO_4).

DO YOURSELF – 5

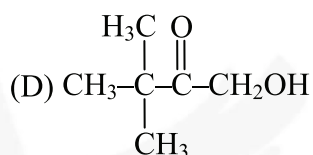
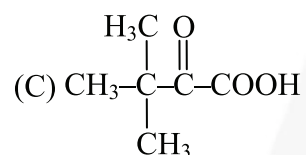
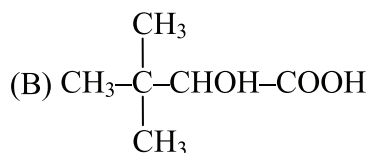
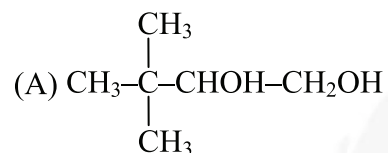
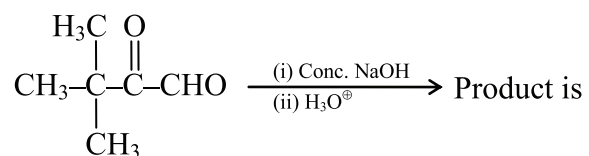
1. The product of the given reaction is



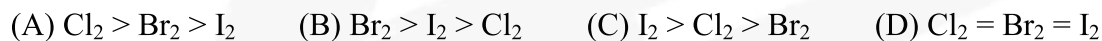
2. Which of the following gives positive Fehling's solution test



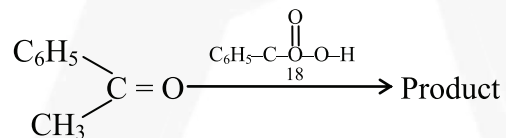
3. In the given reaction



4. Which of the following is correct order of rate of halogenation of acetone ?



5. Predict product for the following



ANSWER KEY

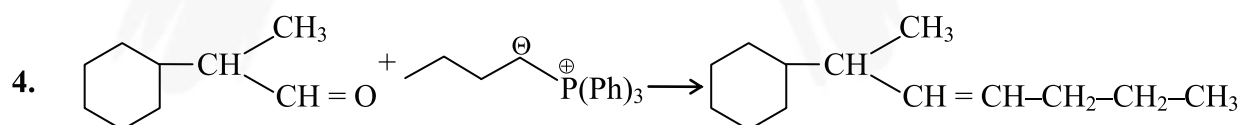
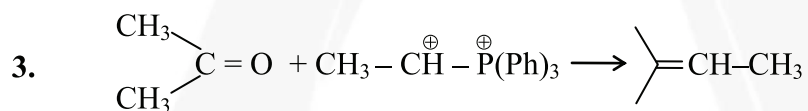
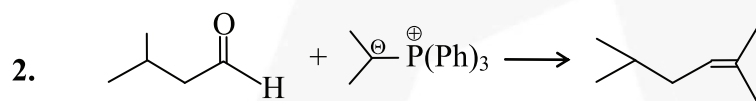
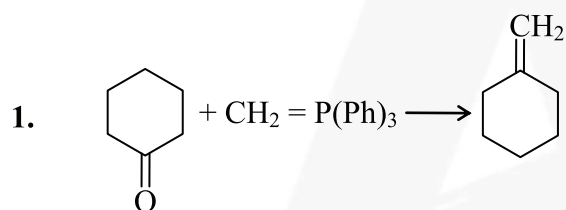
Do yourself – 1:

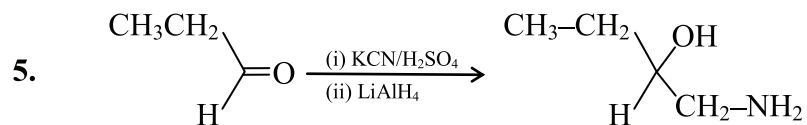
1. (D) 2. (A) 3. (B)

Do yourself – 2:

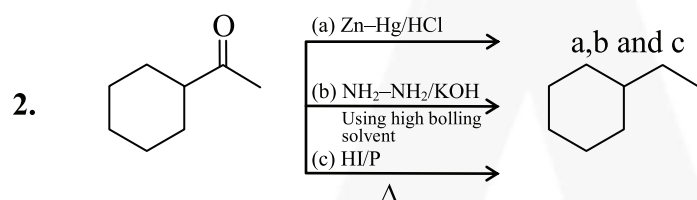
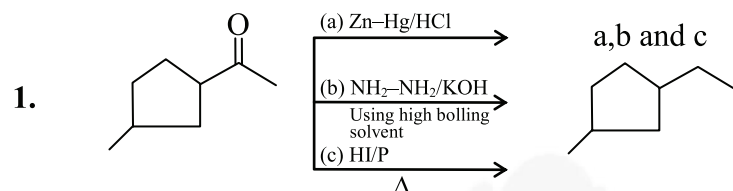
1. (B) 2. (D) 3. (A)

Do yourself – 3:





Do yourself – 4:



Do yourself – 5:

1. (A) 2. (B,C) 3. (B) 4. (A)

