Very Short Answer Questions

Very Short Answer Questions (PYQ)

Q.1. Write the IUPAC name of the following compound:

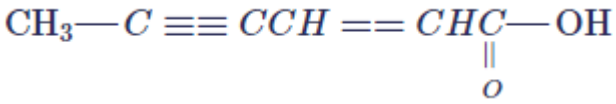
[*CBSE Delhi 2008*]

$CH_3COCH_2COCH_3$

Ans. Pentane-2, 4-dione.

Q.2. Write the IUPAC name of:

[*CBSE Delhi 2011C*]

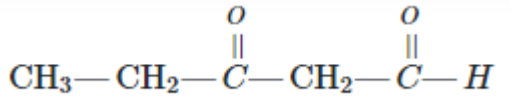


Ans. Hex-2-en-4-ynoic acid

Q.3. Write the structure of the following compound : 3-oxopentanal.

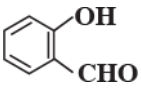
[*CBSE (F) 2011*]

Ans.



Q.4. Write the IUPAC name of the following compound:

[*CBSE (F) 2014*]



Ans. 2-hydroxybenzaldehyde

Q.5. Rearrange the following compounds in the increasing order of their boiling points:

[*CBSE (AI) 2013*]

CH_3—CHO, CH_3—CH_2—OH, CH_3—CH_2—CH_3

Ans. $CH_3CH_2CH_3$ < CH_3CHO < CH_3CH_2OH.

Q.6. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions: ethanal, propanal, propanone, butanone.

[*CBSE Delhi 2012*]

Ans. Butanone < Propanone < Propanal < Ethanal

Q.7. What is Tollens' reagent? Write one usefulness of this reagent.

[*CBSE (AI) 2010*]

Ans. Ammonical silver nitrate ($AgNO_3$ + NH_4OH) solution is known as Tollens' reagent. It is used to detect the presence of —CHO group in an organic compound.

Q.8. Arrange the following compounds in an increasing order of their acid strengths:

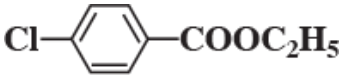
[*CBSE Delhi 2008*]

$(CH_3)_2CHCOOH$, $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$

Ans. $(CH_3)_2CHCOOH$ < $CH_3CH(Br)CH_2COOH$ < $CH_3CH_2CH(Br)COOH$

Very Short Answer Questions (OIQ)

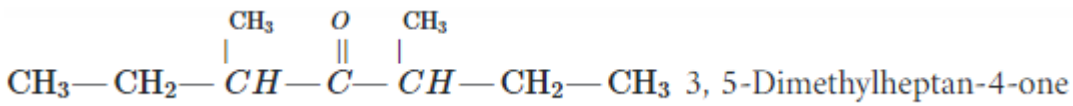
Q.1. Write the IUPAC name of the following compound:



Ans. Ethyl-4-chlorobenzoate

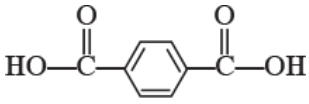
Q.2. Write the structural formula and IUPAC name of the compound: di-sec. butylketone.

Ans.



3, 5-Dimethylheptan-4-one

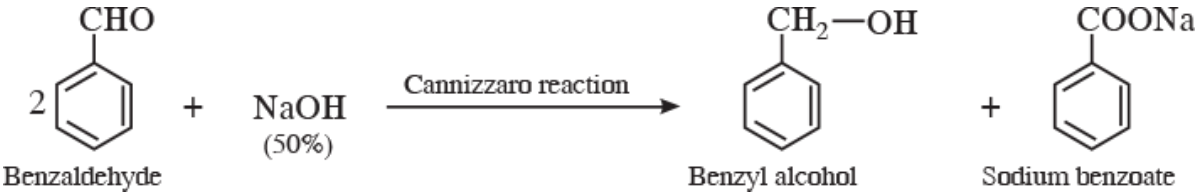
Q.3. Write the structural formula and IUPAC name of terephthalic acid.

Ans.  Benzene-1, 4-dicarboxylic acid

Q.4. How will you prepare benzyl alcohol from benzaldehyde without using a reducing agent?

[*HOTS*]

Ans.

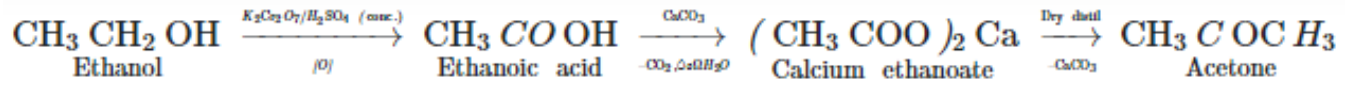


Here, a concentrated solution of NaOH is used which is not a reducing agent.

Q.5. How is acetone obtained from ethanol?

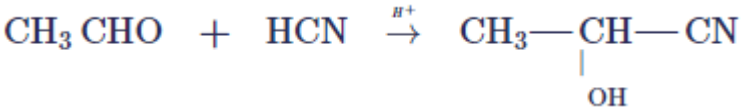
[*HOTS*]

Ans.

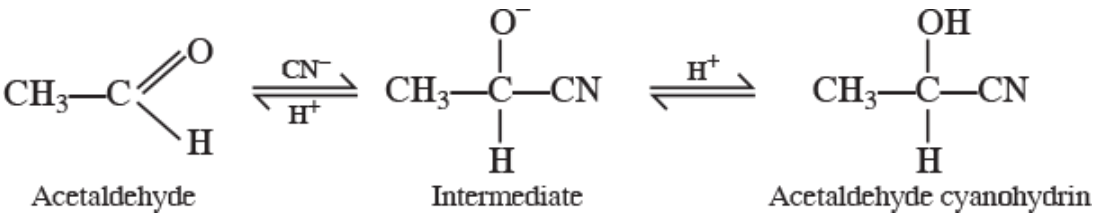


Q.6. Propose the mechanism for the following reaction:

[*HOTS*]



Ans. The reaction proceeds through the nucleophilic attack of CN^- ion as follows:



Q.7. Give the name of the reagent that bring the following transformation: But-2-ene to ethanal.

Ans. O_3/H_2O—Zn dust

Q.8. Name the aldehyde which does not give Fehling's solution test.

Ans. Benzaldehyde

Q.9. What do you mean by Schiff's base? Give an example.

Ans. Aldehydes and ketones react with primary aliphatic or aromatic amines to form azomethines or Schiff's bases.

$$\underset{\text{Aldehyde}}{R—CH=O} + \underset{1^\circ\text{ Amine}}{H_2N—R'} \xrightarrow[\text{Heat}]{\text{Trace of } H^+} \underset{\text{Schiff's base}}{R—CH=N—R'} + H_2O$$

Q.10. What is vinegar?

Ans. An 8-10% solution of acetic acid in water is known as vinegar.

Q.11. Write two important uses of formalin.

[*CBSE Sample Paper 2011*]

Ans. Formalin is used in the

i. preservation of biological specimens.
ii. manufacture of bakelite.

Q.12. Why do hydrazones of aldehydes and ketones not prepared in highly acidic medium?

Ans. In highly acidic medium, the —NH_2 group of hydrazine gets protonated.

$$\underset{\text{Hydrazine}}{NH_2—\ddot{N}H_2} + H^+ \longrightarrow \underset{\text{Protonated hydrazine}}{NH_2—\overset{+}{N}H_3}$$

Due to electron-withdrawing effect of the $^+NH_3$ group, the lone pair of electrons on the —NH_2 group of protonated hydrazine is not available for nucleophilic attack on the C==O and hence hydrazone formation does not occur.

Q.13. Why does benzoic acid not undergo Friedel-Crafts reaction?

Ans. It is due to

i. deactivation of benzene ring by electron withdrawing effect of the —COOH group.
ii. bonding of $AlCl_3$ to the —COOH group.

Q.14. pK_a of chloroacetic acid is lower than pK_a of acetic acid. Explain.

Ans. Due to –I effect of chlorine electron density in the O—H bond in chloroacetic acid is lower than in acetic acid. Consequently, O—H bond in chloroacetic acid is weaker than acetic acid and hence stronger the acid smaller is the value of pK_a. Therefore, pK_a value of chloroacetic acid is lower than acetic acid.

Q.15. Arrange the following in the increasing order of their boiling points:

CH_3—CH_2—CH_2—COOH, CH_3—CH_2—O—CH_2—CH_3, CH_3 CH_2 CH_2 CH_2 OH

Ans. CH_3—CH_2—O—CH_2—CH_3 < CH_3—CH_2—CH_2—CH_2—OH < CH_3—CH_2—CH_2—COOH

Q.16. Arrange the following in the decreasing order of their boiling points:

$CH_3CH_2CH_2CHO$, $CH_3CH_2CH_2CH_2OH$, $C_2H_5OC_2H_5$, $CH_3CH_2CH_2CH_2CH_3$

Ans. $CH_3CH_2CH_2CH_2OH$ > $CH_3CH_2CH_2CHO$ > $C_2H_5OC_2H_5$ > $CH_3CH_2CH_2CH_2CH_3$

Short Answer Questions-1

Short Answer Questions-1 (PYQ)

Q.1. Write the reagents required in the following reactions:

[*CBSE Allahabad 2015*]

Q.

$$CH_2 == CH — CH_2OH \xrightarrow{?} CH_2 == CH — CHO$$

Ans. Pyridinium chlorochromate ($C_5H_5NHCrO_3Cl$) or Cu at 573 K.

Q.

$$CH_3 — COOH \xrightarrow{?} CH_3 — CONH_2$$

Ans. NH_3, Δ (Heat)

Q.2. Name the reagents used in the following reactions:

[*CBSE Delhi 2015*]

Q.

$$CH_3 — CO — CH_3 \xrightarrow{?} CH_3 — \underset{\displaystyle OH}{\overset{\displaystyle |}{CH}} — CH_3$$

Ans. Sodium borohydride ($NaBH_4$) or Lithium aluminium hydride ($LiAlH_4$)

Q.

$$C_6H_5 — CH_2 — CH_3 \xrightarrow{?} C_6H_5 — COO^- K^+$$

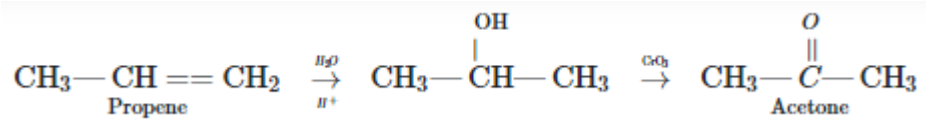
Ans. Alkaline potassium permanganate ($KMnO_4$—KOH)

Q.3. Do the following conversions in not more than two steps:

[*CBSE (F) 2017*]

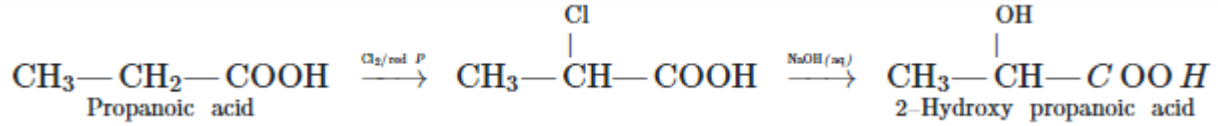
Q. Propene to Acetone

Ans.



Q. Propanoic acid to 2-hydroxypropanoic acid

Ans.

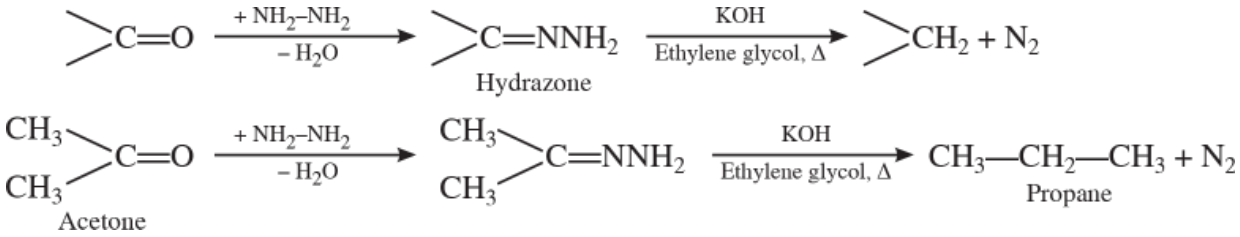


Q.4. Write the equations involved in the following reactions:

[*CBSE Delhi 2017*]

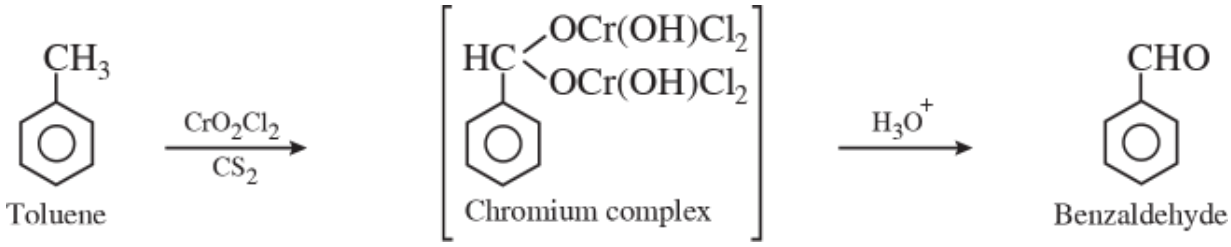
Q. **Wolff-Kishner reduction**

Ans.



Q. Etard reaction

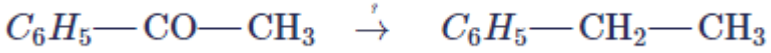
Ans. Etard reaction:



Q.5. Write the reagents used in the following reactions:

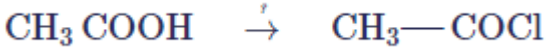
[*CBSE Ajmer 2015*]

Q.



Ans. Zn—Hg, conc. HCl or H_2NNH_2 and KOH/ethylene glycol, Heat

Q.



Ans. PCl_5 or $SOCl_2$

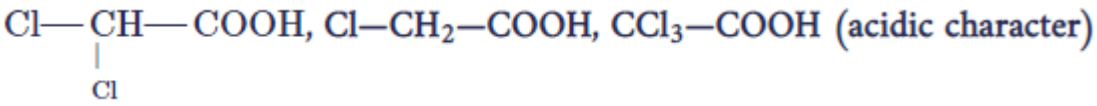
Q.6. Arrange the following compounds in increasing order of their property as indicated:

[*CBSE Bhubaneshwar 2015*]

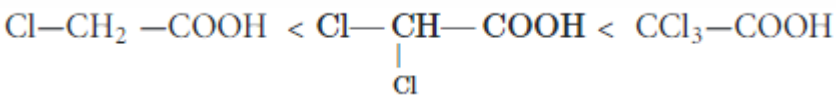
Q. CH_3COCH_3, C_6H_5—CO—C_6H_5, CH_3CHO (reactivity towards nucleophilic addition reaction)

Ans. $C_6H_5COC_6H_5 < CH_3COCH_3 < CH_3CHO$

Q.



Ans.



Q.7. Give reasons:

[*CBSE East 2016*]

Q. Oxidation of aldehydes is easier than ketones.

Ans. As aldehydes contain H atom on the carbonyl group but ketones do not. Cleavage of C—H bond in aldehydes is easier than cleavage of C—C bond in ketones.

Q. CH_2—CH—COOH is more acidic than CH_3CH_2—COOH.

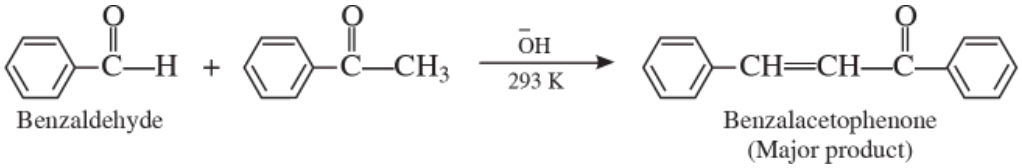
Ans. This is because in CH_2—CH—COOH, the carbonyl group attached to sp^2 hybridised carbon atom which is more electronegative and makes release of H^+ ion easy.

Q.8. Illustrate the following reactions giving a suitable example for each:

[*CBSE Delhi 2012*]

Q. **Cross aldol condensation**

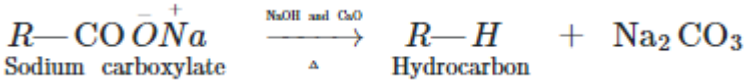
Ans. When aldol condensation is carried out between two different aldehydes and/or ketones, it is called cross aldol condensation.



Benzaldehyde — Benzalacetophenone (Major product)

Q. Decarboxylation

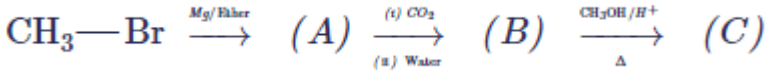
Ans. Sodium salt of carboxylic acids on heating with soda lime lose carbon dioxide and form hydrocarbons. This reaction is called decarboxylation.



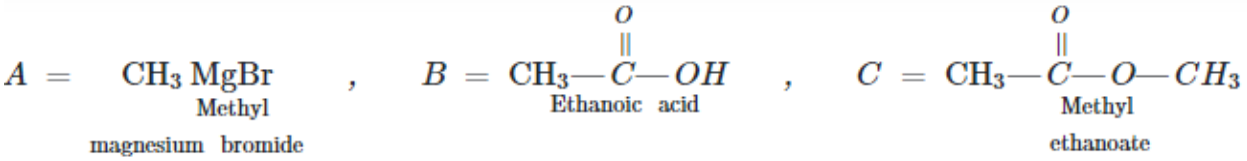
Sodium carboxylate — Hydrocarbon

Short Answer Questions-1 (OIQ)

Q.1. Identify the compounds *A*, *B* and *C* in the following reaction:



Ans.



Q.2. Complete the following reactions by identifying *A*, *B* and *C*.

Q.

$$A + H_2(g) \xrightarrow{Pd/BaSO_4} (CH_3)_2CH—CHO$$

Ans.

$$A = (CH_3)_2CH—\underset{\underset{O}{\|}}{C}—Cl$$

Q.

$$CH_3—\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}—\underset{\underset{O}{\|}}{C}—CH_3 + NaOI \rightarrow B + C$$

Ans.

$$B = CH_3—\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}—COONa\,; \quad C = CHI_3$$

Q.3. Complete the following reaction sequence:

[*NCERT Exemplar*]

$$CH_3—\underset{\underset{O}{\|}}{C}—CH_3 \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgBr} (A) \xrightarrow[Ether]{Na\ metal} (B) \xrightarrow{+CH_3—Br} (C)$$

Ans.

$$A = CH_3—\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}—OH$$
2–methyl propan–2–ol

$$B = CH_3—\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}—\overset{-}{O}\overset{+}{Na}$$
Sodium tert. butoxide

$$C = CH_3—\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}—OCH_3$$
2–methoxy–2–methylpropane

Q.4. Name the electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous $AlCl_3$. Name the reaction also.

[*NCERT Exemplar*]

Ans. $C_6H_5CO^{\oplus}$ (benzoylium cation)

Friedel–Crafts acylation reaction

Q.5. Mention a chemical property in which methanoic acid differs from acetic acid.

Ans. Methanoic acid acts as a reducing agent and hence decolourises the pink colour of acidified $KMnO_4$solution but acetic acid does not.

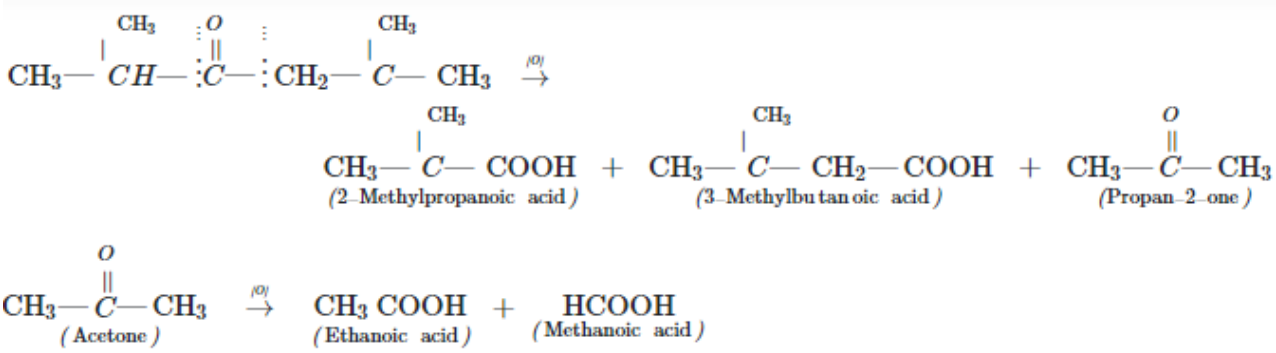
$$\underset{\text{Methanoic acid}}{5HCOOH} + \underset{(Pink)}{2KMnO_4} + 3H_2SO_4 \rightarrow 5CO_2 + K_2SO_4 + \underset{(Colourless)}{2MnSO_4} + 8H_2O$$

$$\underset{\text{Acetic acid}}{CH_3COOH} \xrightarrow{KMnO_4/H_2SO_4} \text{No change in pink colour of } KMnO_4 \textit{ solution.}$$

Q.6. Oxidation of ketones involves carbon–carbon bond cleavage. Name the products formed on oxidation of 2, 5-dimethylhexan-3-one.

[*NCERT Exemplar*]

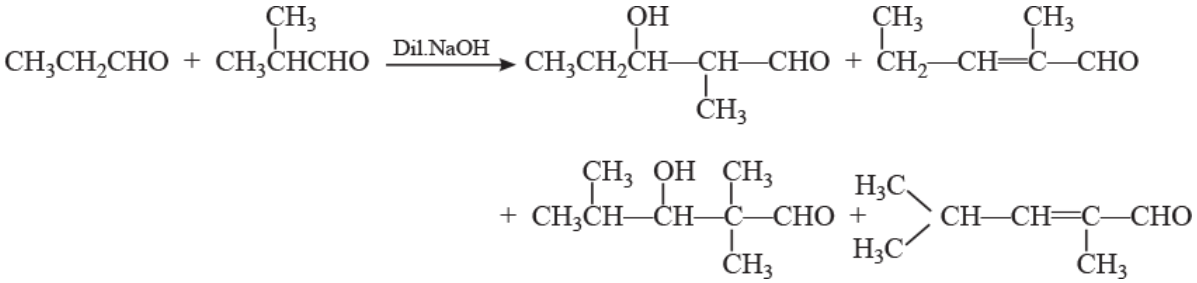
Ans.



Q.7. What product will be formed on reaction of propanal with 2-methylpropanal in the presence of NaOH? Write the name of the reaction also.

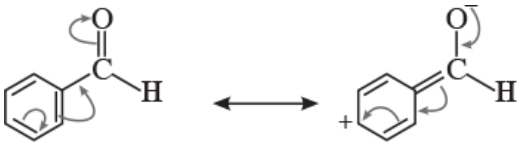
[*NCERT Exemplar*] [*HOTS*]

Ans. The reaction taking place is cross aldol condensation.



Q.8. Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal? Explain your answer.

Ans. The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal. The polarity of the carbonyl group is reduced in benzaldehyde due to resonance as shown below and hence it is less reactive than propanal.



Q.9. Give reasons for the following:

[*HOTS*]

Q. **Benzaldehyde reduces Tollens' reagent but not the Fehling's or Benedict's solution.**

Ans. Due to + R effect of benzene ring, the electron density in the carbonyl group of benzaldehyde increases. This in turn, increases the electron density in the C—H bond of aldehyde group. As a result, the C—H bond becomes stronger and hence only oxidising agent like Tollens' agent; $Ag(NH_3)_2^+$ ($E^o_{Ag+/Ag}$ = 0.8 V) can oxidise C—H to C—OH to form carboxylic acids but weaker oxidising agents like Fehling's solution or Benedict's solution ($E^o_{Cu2+/Cu+}$ = 0.18 V) fail to oxidise benzaldehyde to benzoic acid.

Q. CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.

Ans. The methyl group due to its +I effect reduce the magnitude of positive charge on carbonyl carbon atom. Moreover, it also hinders the approach of nucleophile CN^-. Since in acetaldehyde there is one methyl group while in acetone there are two methyl groups attached to carbonyl group therefore acetaldehyde is more reactive than acetone towards nucleophilic addition with HCN.

Q.10. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.

Q. Ethanal, Propanal, Propanone, Butanone

Ans. The reactivity in nucleophilic addition reactions increases in the order:

Butanone < Propanone < Propanal < Ethanal

Q. Benzaldehyde, *p*-Tolualdehyde, *p*-Nitrobenzaldehyde, Acetophenone.

Ans. Acetophenone is a ketone. All the other three compounds are aldehydes. Hence, acetophenone is least reactive.

p -Tolualdehyde has an electron-donating methyl group at the para position of the benzene ring whereas *p*-nitrobenzaldehyde has an electron-withdrawing nitro group at the para position. Thus, *p*-tolualdehyde is less reactive and *p*-nitrobenzaldehyde is more reactive than benzaldehyde.

Therefore, the required order is as follows:

Acetophenone < *p*-Tolualdehyde < Benzaldehyde < *p*-Nitrobenzaldehyde

Q.11. Arrange the following in the decreasing order of their acidic character.

i. **C_6H_5COOH, FCH_2COOH, NO_2CH_2COOH**
ii. **CH_3CH_2OH, CH_3COOH, $ClCH_2COOH$, FCH_2COOH, $C_6H_5CH_2COOH$**

Ans.

i. $NO_2CH_2COOH > FCH_2COOH > C_6H_5COOH$
ii. $FCH_2COOH > ClCH_2COOH > C_6H_5CH_2COOH > CH_3COOH > CH_3CH_2OH$

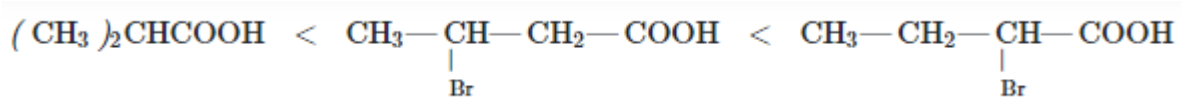
Q.12. Arrange the following in order of property indicated for each set.

CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$ (increasing order of boiling points)

Ans. $CH_3CH_2CH_3 < CH_3OCH_3 < CH_3CHO < CH_3CH_2OH$

Q. $(CH_3)_2CHCOOH$, $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$ (increasing order of their acid strengths)

Ans.



Q.13. An organic compound 'A' with molecular formula $C_5H_8O_2$ is reduced to *n*-pentane on treatment with Zn–Hg/HCl. 'A' forms a dioxime with hydroxylamine and gives a positive Iodoform test and Tollens' test. Identify the compound A and deduce its structure.

[*HOTS*]

Ans.

As '*A*' gives positive iodoform test, so it has $CH_3-\overset{\overset{O}{\|}}{C}-$ group.

As '*A*' gives positive Tollens' test, so it must have —CHO group.

So '*A*' is $CH_3-\overset{\overset{O}{\|}}{C}-CH_2\,CH_2\,CHO$

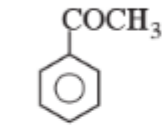
4–oxopentanal

Q.14. An organic compound 'A' with molecular formula C_8H_8O gives positive DNP and iodoform tests. It does not reduce Tollens' or Fehling's reagent and does not decolourise bromine water also. On oxidation with chromic acid (H_2CrO_4), it gives a carboxylic acid (B) with molecular formula $C_7H_6O_2$. Deduce the structures of A and B.

[*HOTS*]

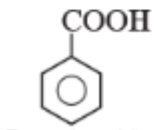
Ans.

As '*A*' does not give Fehling's or Tollens' test, so it does not have —CHO group but it gives positive iodoform test and DNP test so it has $CH_3-\overset{\overset{O}{\|}}{C}-$ group.

So '*A*' is 

Acetophenone

B is carboxylic acid obtained by oxidation of *A* with H_2CrO_4.

So '*B*' is 

Benzoic acid

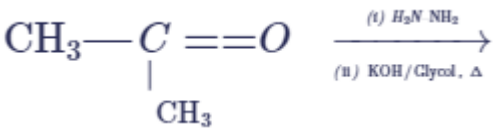
Short Answer Questions-II

Short Answer Questions-II (PYQ)

Q.1. Predict the products of the following reactions:

[*CBSE Delhi 2015*]

Q.



Ans. $CH_3—CH_2—CH_3$ (Propane)

Q.

Ans. $C_6H_5COO^-Na^+$ (Sodium benzoate) and CHI_3 (Iodoform)

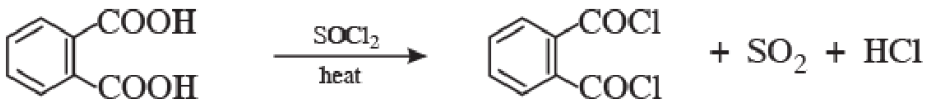
Q. $CH_3—CH_2—CH_3$ (Propane)

Ans. CH_4 (Methane)

Q.2. Complete each synthesis by giving missing reagents or products in the following:

Q.

Ans.



Q.

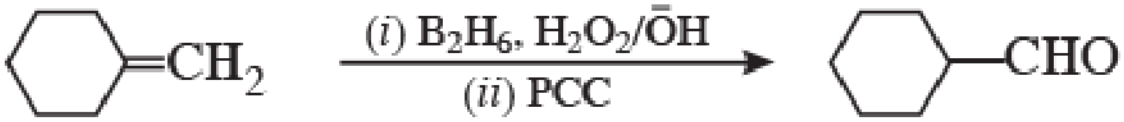
$$C_6H_5CHO \xrightarrow{H_2NCONHNH_2}$$

Ans.

$$C_6H_5CHO \xrightarrow{H_2NCONHNH_2} C_6H_5CH == NNHCONH_2 + H_2O$$

Q.

Ans.



Q. 3. Write structures of compounds *A*, *B* and *C* in each of the following reactions:

[*CBSE Delhi 2017*]

Q.

$$C_6H_5Br \xrightarrow{Mg/dry\ ether} A \xrightarrow[(b)\ H_3O^+]{(a)\ CO_2(g)} B \xrightarrow{PCl_5} C$$

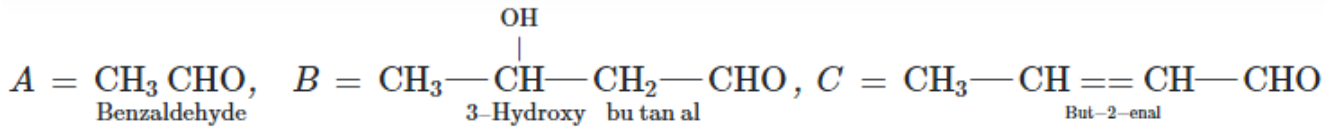
Ans.

$$A = \underset{\text{Phenyl magnesium bromide}}{C_6H_5MgBr}, \quad B = \underset{\text{Benzoic acid}}{C_6H_5COOH}, \quad C = \underset{\text{Benzoyl chloride}}{C_6H_5COCl}$$

Q.

$$CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} A \xrightarrow{dil.\ NaOH} B \xrightarrow{\Delta} C$$

Ans.

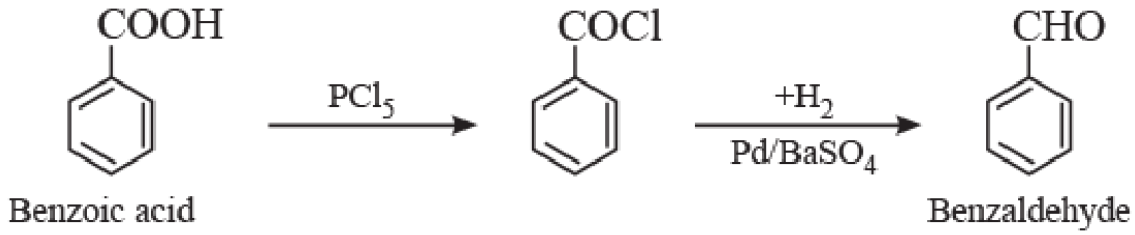


Q.4. Do the following conversions in not more than two steps:

[*CBSE Delhi 2017*]

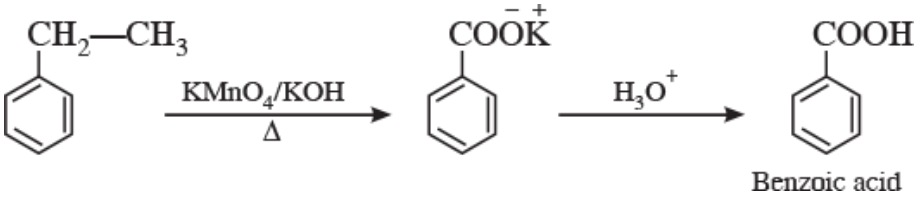
Q. Benzoic acid to Benzaldehyde

Ans.



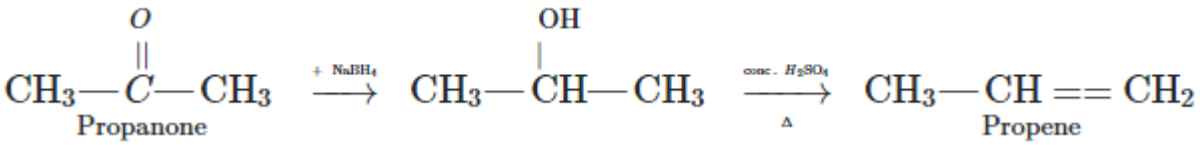
Q. Ethyl benzene to Benzoic acid

Ans. Ethyl benzene to Benzoic acid



Q. Propanone to Propene

Ans. Propanone to Propene

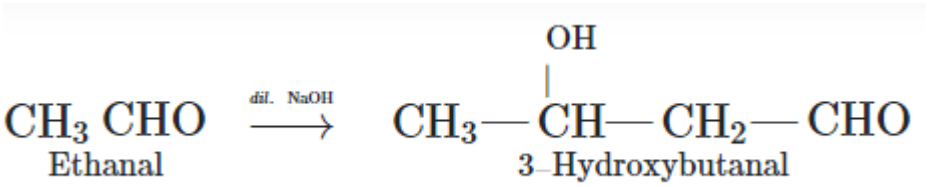


Q.5. How would you bring about the following conversions? Write the complete equation in each case.

[*CBSE (AI) 2011*]

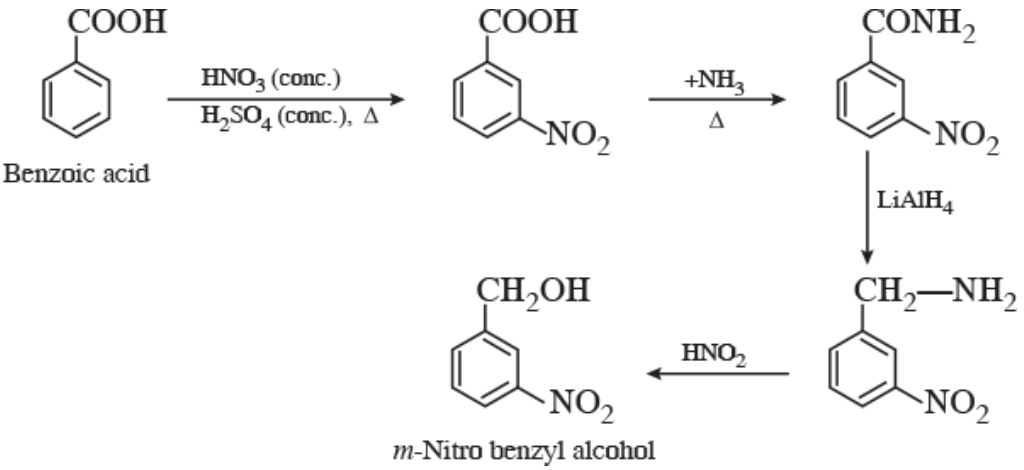
Q. Ethanal to 3-hydroxybutanal

Ans.



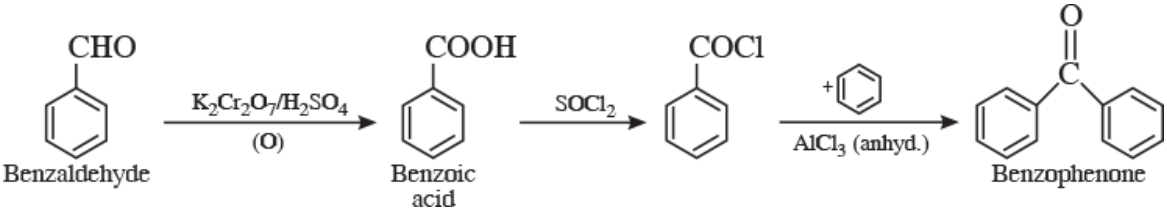
Q. Benzoic acid to *m*-nitrobenzyl alcohol

Ans.



Q. Benzaldehyde to benzophenone

Ans.

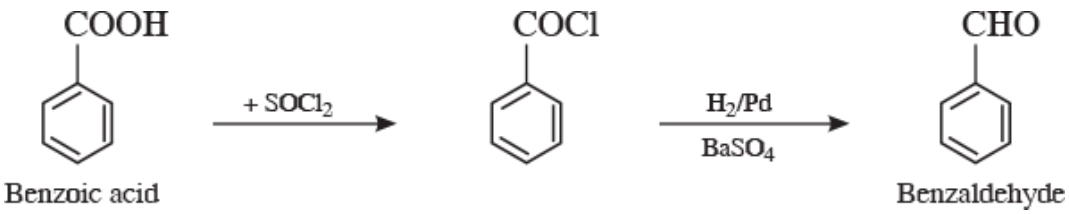


Q.6. How do you convert the following?

[*CBSE (F) 2015*]

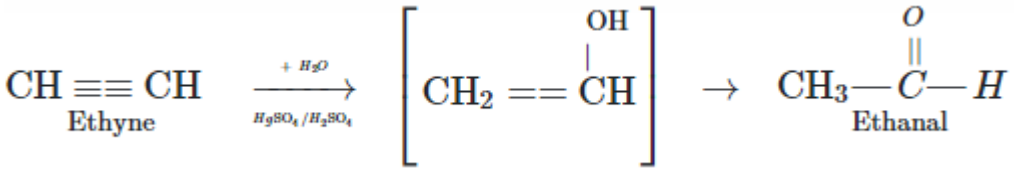
Q. Benzoic acid to Benzaldehyde

Ans.



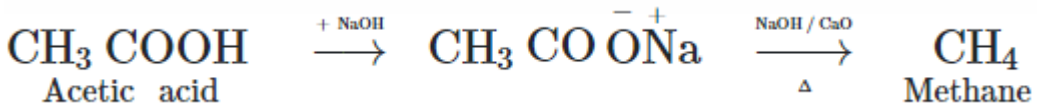
Q. Ethyne to Ethanal

Ans.



Q. Acetic acid to Methane

Ans.



Q.7. Give reasons:

[*CBSE (F) 2017*]

Q. Propanone is less reactive than ethanal towards nucleophilic addition reactions.

Ans. The methyl group due to its +I effect reduce the magnitude of positive charge on carbonyl carbon atom. Moreover, it also hinders the approach of the nucleophile. Since in propanone, there are two methyl groups while in acetaldehyde there is one methyl group, therefore, propanone is less reactive than acetaldehyde towards nucleophilic addition reactions.

Q. $O_2N–CH_2–COOH$ has lower pK_a value than CH_3COOH.

Ans. Nitroacetic acid is stronger acid than acetic acid as –I effect of —NO_2 group weakens O—H bond in nitroacetic acid and facilitate the release of H^+ ions. Since nitroacetic acid is a stronger acid than acetic acid, therefore, it has lower pK_a value than acetic acid.

Q. $(CH_3)_2CH–CHO$ undergoes aldol condensation whereas $(CH_3)_3C—CHO$ does not.

Ans.

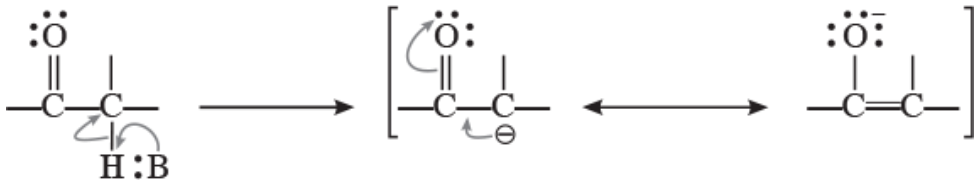
This is because $(CH_3)_2\overset{\alpha}{C}H-CHO$ has one α-hydrogen whereas $(CH_3)_3-\overset{\alpha}{C}-CHO$ does not have any.

Q.8. Give reasons:

[*CBSE (F) 2016*]

Q. The α-hydrogen atoms of aldehydes and ketones are acidic in nature.

Ans. The acidity of **α**-hydrogen atom of carbonyl carbon is due to the strong withdrawing effect of the carbonyl group and resonance stabilisation of the conjugate base.



Q. Propanone is less reactive than ethanal towards addition of HCN.

Ans. This is due to steric and electronic reasons. Sterically, the presence of two methyl groups in propanone hinders more the approach of nucleophile to carbonyl carbon than in ethanal having one methyl group. Electronically two methyl groups reduce the positivity of the carbonyl carbon more effectively in propanone than in ethanal.

Q. Benzoic acid does not give Friedal-Crafts reaction.

Ans. Benzoic acid does not give Friedel Craft reaction because:

- **a.** the carboxyl group is strongly deactivating.
- **b.** the catalyst $AlCl_3$ which is a lewis acid gets bonded to the carboxyl group strongly.

Q.9. Answer the following questions

[*CBSE (AI) 2014*]

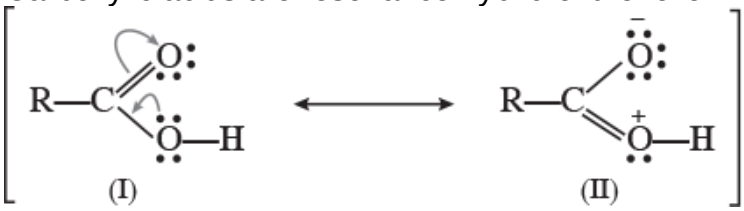
Q. Account for the following:

- **a. Cl—CH_2COOH is a stronger acid than CH_3COOH.**
- **b. Carboxylic acids do not give reactions of carbonyl group.**

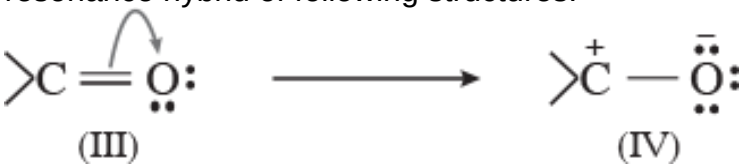
Ans.

a. Because of –I effect of Cl atom in $ClCH_2COOH$ and +I effect of CH_3 group in CH_3COOH the electron density in the O—H bond in $ClCH_2COOH$ is much lower than CH_3COOH. As a result O—H bond in $ClCH_2COOH$ is much weaker than in CH_3COOH therefore loses a proton more easily than CH_3COOH. Hence $ClCH_2COOH$ acid is stronger acid than CH_3COOH.

b. Carboxylic acids are resonance hybrid of the following structures:



Similarly, a carbonyl group of aldehydes and ketones may regarded as resonance hybrid of following structures.



Because of contribution of structure (IV), the carbonyl carbon in aldehydes and ketones is electrophilic. On the other hand, electrophilic character of carboxyl carbon is reduced due to contribution of structure (II). As carbonyl carbon of carboxyl group is less electropositive than carbonyl carbon in aldehydes and ketones, therefore, carboxylic acids do not give nucleophilic addition reactions of aldehydes and ketones.

Q. Out of CH_3CH_2—CO—CH_2—CH_3 and CH_3CH_2—CH_2—CO—CH_3, which gives iodoform test?

Ans. CH_3—CH_2—CH_2—$COCH_3$

Q.10. Arrange the following compounds in increasing order of their property as indicated:

[*CBSE (AI) 2012*]

Q. Acetaldehyde, Acetone, Methyl tert-butyl ketone (reactivity towards HCN)

Ans. Methyl tert-butyl ketone < Acetone < Acetaldehyde

Q. Benzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)

Ans. 4-Methoxy benzoic acid < Benzoic acid < 3,4-Dinitrobenzoic acid

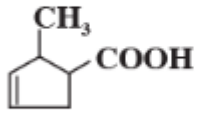
Q. $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$ (acid strength)

Ans. $(CH_3)_2CHCOOH$ < $CH_3CH(Br)CH_2COOH$ < $CH_3CH_2CH(Br)COOH$

Short Answer Questions-II (OIQ)

Q.1. Give the IUPAC name of the following organic compounds:

(*i*) $(CH_3)_2C = CH—\underset{\underset{O}{\|}}{C}—CH_3$

(*ii*) 

(*iii*) $CH_3CH(Br)CH_2CONHCH_3$

Ans. (*i*) 4-Methylpent-3-en-2-one.

(*ii*) 2-Methyl cyclopent-3-enecarboxylic acid

(*iii*) N-Methyl-3-bromobutanamide

Q.2. Draw the structures of the following derivatives:

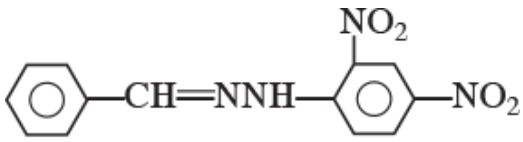
[*CBSE Sample Paper 2016*]

(*i*) The 2,4-Dinitrophenylhydrazone of benzaldehyde

(*ii*) Acetaldehyde dimethyl acetal

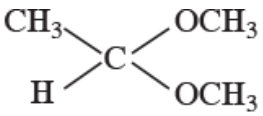
(*iii*) Cyclopropanone oxime

Ans. (*i*)



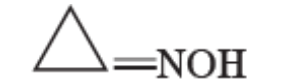
2, 4–Dinitrophenyl hydrazone of benzaldehyde

(*ii*)



Acetaldehyde dimethyl acetal

(*iii*)



Cyclopropanone oxime

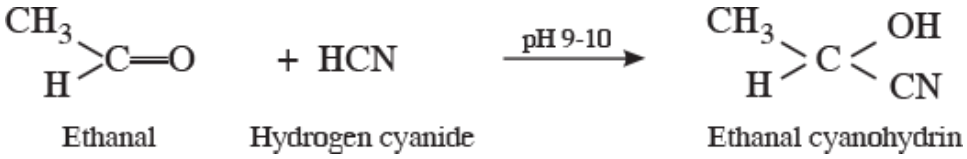
Q.3. Write the products formed when CH_3CHO reacts with the following reagents:

(*i*) HCN

(*ii*) $H_2N—OH$

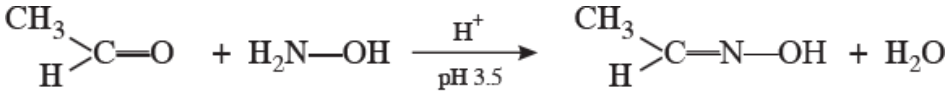
(*iii*) CH_3CHO in the presence of dilute NaOH

Ans. (*i*)



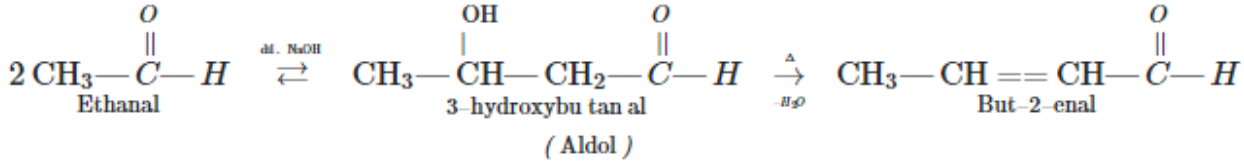
Ethanal Hydrogen cyanide Ethanal cyanohydrin

(*ii*)



Ethanal Ethanal oxime

(*iii*)

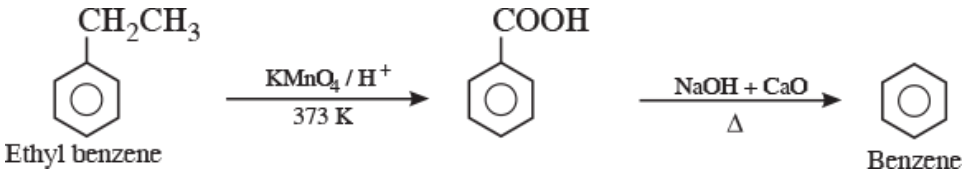


Ethanal 3–hydroxybu tan al (Aldol) But–2–enal

Q.4. Write the chemical equations for the following conversions (not more than 2 steps):

Q. Ethyl benzene to benzene

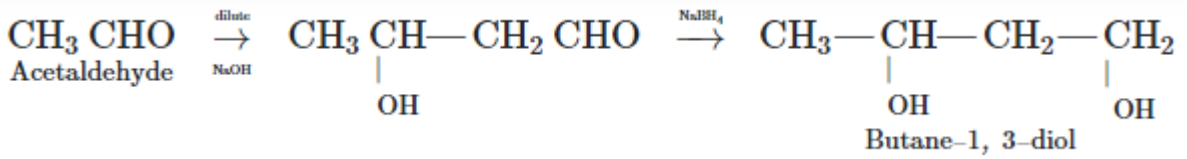
Ans.



Ethyl benzene Benzene

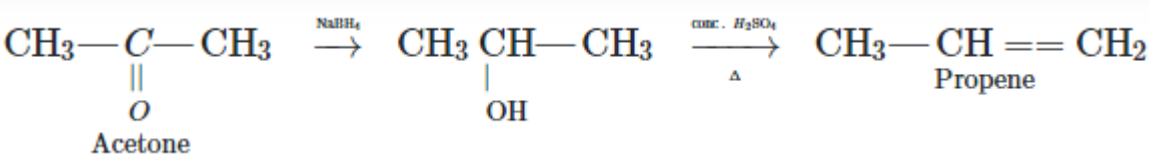
Q. Acetaldehyde to butane-1, 3-diol

Ans.



Q. Acetone to propene

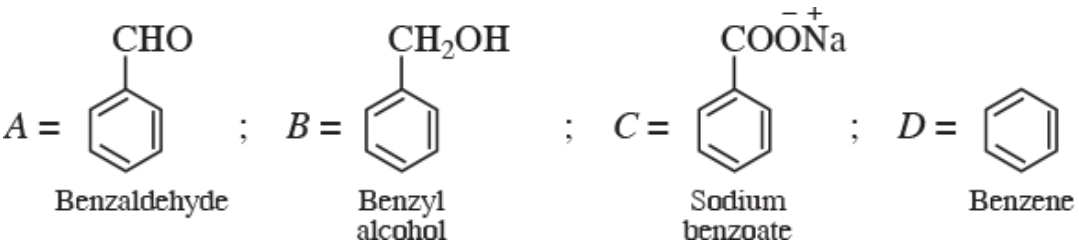
Ans.



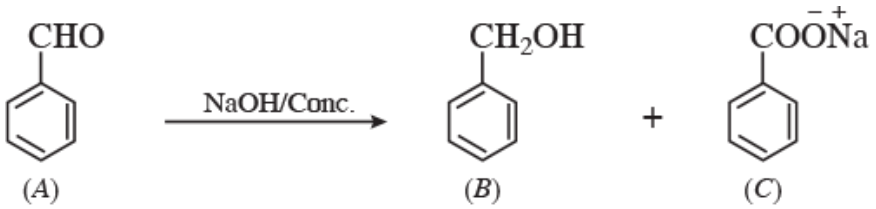
Q.5. An organic compound (*A*) has characteristic odour. On treatment with NaOH, it forms compounds (*B*) and (*C*). Compound (*B*) has molecular formula C_7H_8O which on oxidation gives back (*A*). The compound (*C*) is a sodium salt of an acid. When (*C*) is treated with soda-lime, it yields an aromatic compound (*D*). Deduce the structures of (*A*), (*B*), (*C*) and (*D*). Write the sequence of reactions involved.

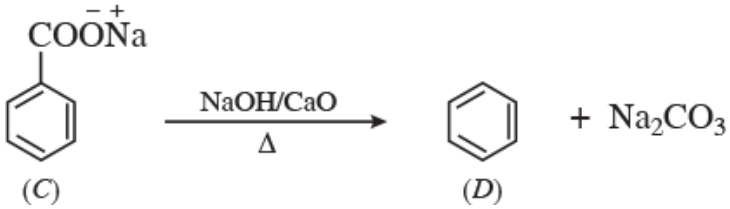
[*CBSE Sample Paper 2015*]

Ans.



Reaction involved are:

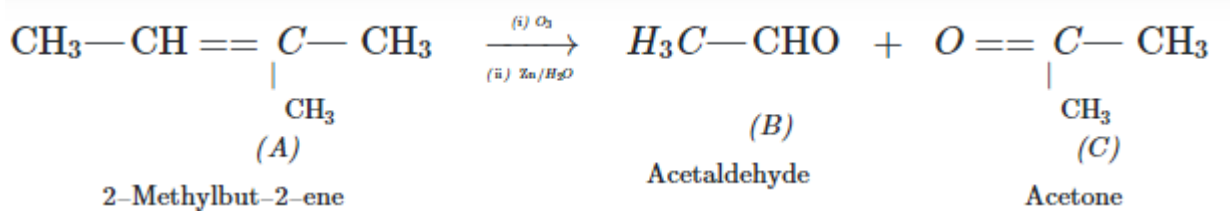




Q.6. An alkene 'A' molecular formula (C_5H_{10}) on ozonolysis gives a mixture of two compounds 'B' and 'C'. Compound 'B' gives positive Fehling's test and also reacts with iodine and NaOH solution. Compound 'C' does not give Fehling's test but forms iodoforms. Identify the compounds 'A', 'B' and 'C' giving suitable explanation and write the reactions of ozonolysis and iodoform formation from either 'B' or 'C'.

[*NCERT Exemplar*] [*HOTS*]

Ans.



Other isomers of 'A' will not give products corresponding to the given test.

Q.7. A compound 'X' (C_2H_4O) on oxidation gives 'Y' ($C_2H_4O_2$). 'X' undergoes haloform reaction. On treatment with HCN 'X' forms a product 'Z' which on hydrolysis gives 2-hydroxy propanoic acid.

(*i*) Write down structures of 'X' and 'Y'.

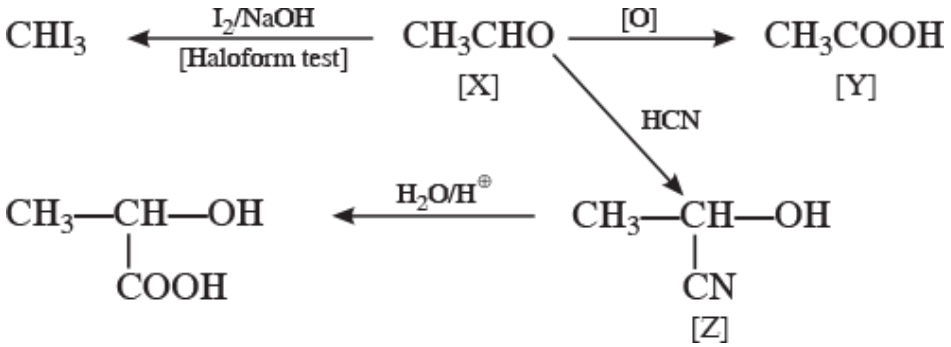
(*ii*) Name the product when 'X' reacts with dil. NaOH.

(*iii*) Write down the equations for the reactions involved.

Ans. (*i*) *X* = CH_3CHO and *Y* = CH_3COOH

(*ii*) 3-Hydroxybutanal.

(*iii*)



Q.8. An unknown aldehyde 'A' on reacting with alkali gives a β-hydroxy aldehyde, which loses water to form an unsaturated aldehyde, 2-butenal. Another aldehyde 'B' undergoes disproportionation reaction in the presence of conc. alkali to form products C and D. C is an arylalcohol with the formula, C_7H_8O.

(*i*) Identify A and B.

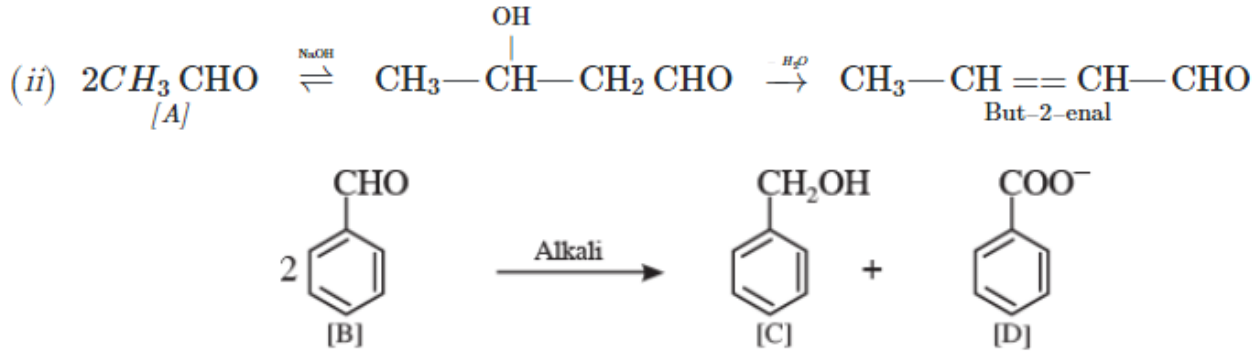
(*ii*) Write the sequence of reactions involved.

(*iii*) Name the product, when 'B' reacts with zinc amalgam and hydrochloric acid.

[*HOTS*]

Ans. (*i*) A is CH_3CHO (ethanal).

B is C_6H_5CHO (benzaldehyde).



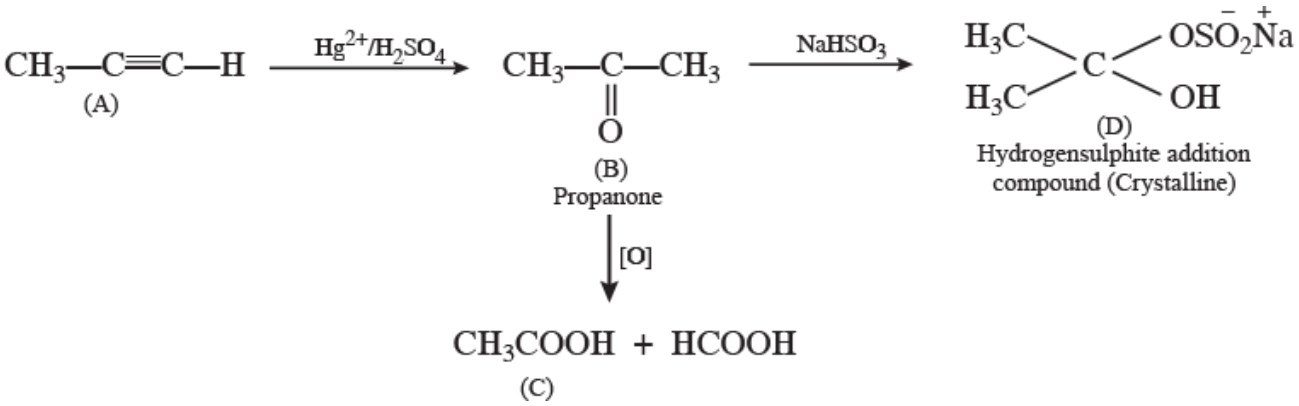
(*iii*) Toluene.

Q.9. An organic compound 'A' (C_3H_4) on hydration in presence of $H_2SO_4/HgSO_4$ gives compound 'B' (C_3H_6O). Compound 'B' gives white crystalline product (D) with sodium hydrogensulphite. It gives negative Tollens' test and

positive iodoform's test. On drastic oxidation 'B' gives compound 'C' ($C_2H_4O_2$) along with formic acid. Identify compounds 'A', 'B' and 'C' and explain all the reactions.

[*HOTS*]

Ans. Compound B (propanone) is a ketone therefore Fehling's test and Tollens' tests are negative.

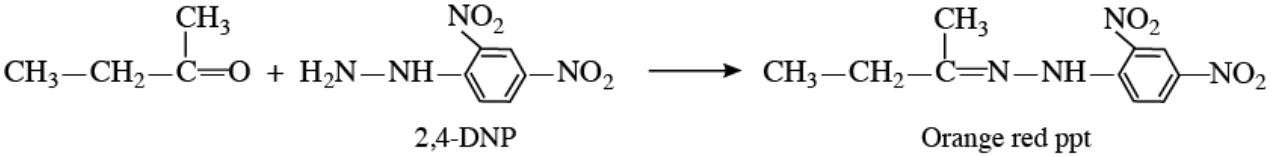


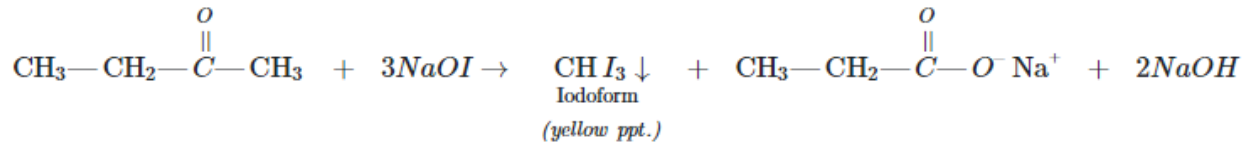
Q.10. An organic compound '*X*' having molecular formula C_4H_8O gives orange-red ppt. with 2, 4-DNP reagent. It does not reduce Tollens' reagent but gives yellow ppt. of iodoform on heating with NaOI. Compound X on reduction with $LiAlH_4$ gives compound '*Y*' which undergoes dehydration reaction on heating with conc. H_2SO_4 to form but-2-ene. Identify the compounds X and Y and explain the reactions.

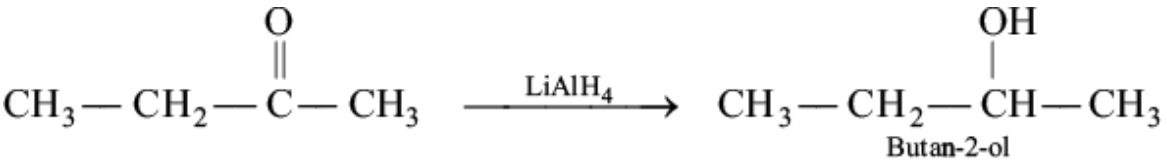
[*HOTS*]

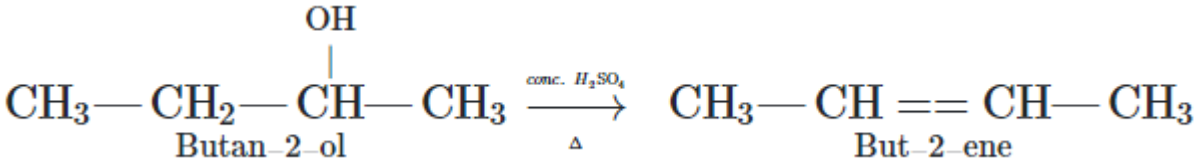
Ans.

Reactions involved:









Q.11. Write down functional isomers of a carbonyl compound with molecular formula C_3H_6O. Which isomer will react faster with HCN and why? Explain the mechanism of the reaction also. Will the reaction lead to the completion with the conversion of whole reactant into product at reaction conditions? If a strong acid is added to the reaction mixture what will be the effect on concentration of the product and why?

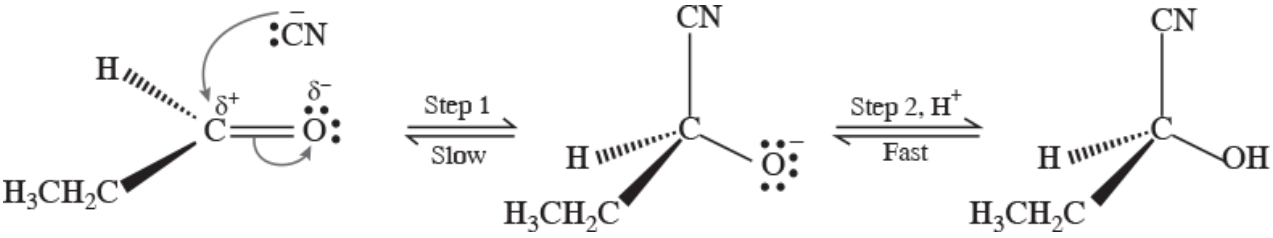
[*NCERT Exemplar*] [*HOTS*]

Ans. CH_3CH_2CHO H_3COCH_3

I) **II)**

(*a*) Compound I will react faster with HCN due to less steric hinderance and electronic reasons than II.

Mechanism: Nucleophilic addition reaction:



(*b*) No, it is a reversible reaction. Hence, equilibrium is established.

(*c*) Addition of acid inhibits the reaction because the formation of CN^- ions is prevented.

Long Answer Questions

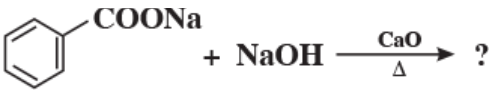
Long Answer Questions (PYQ)

Q.1. Answer the following questions

[*CBSE (AI) 2017*]

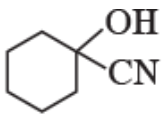
Q. Write the product(s) in the following reactions:

(*a*) 

(*b*) 

$$(c)\quad CH_3-CH=CH-CN \xrightarrow[(b)\ H_2O]{(a)\ DIBAL\text{-}H} ?$$

Ans.

(*a*) 

Cyclohexane cyanohydrin

(*b*) 

Benzene

(*c*) $CH_3-CH=CH-CHO$

But-2-en-1-al

Q. Give simple chemical tests to distinguish between the following pairs of compounds:

Ans. (*a*) Butanal being an aldehyde reduces Tollens' reagent to give silver mirror but butan-2-one being a ketone does not.

$$\underset{\text{Bu tan al}}{CH_3-CH_2-CH_2-CHO} + \underset{\text{Tollens' reagent}}{2[Ag(NH_3)_2]^+} + 3OH^- \rightarrow$$

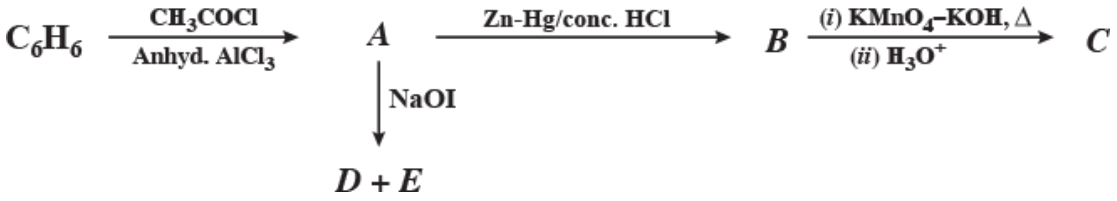
$$\underset{\text{Buta no } ateion}{CH_3-CH_2-CH_2-COO^-} + \underset{\text{Silver mirror}}{Ag\downarrow} + 4NH_3 + 2H_2O$$

(*b*) Benzoic acid decomposes $NaHCO_3$ to produce brisk effervescence due to evolution of CO_2 while phenol does not.

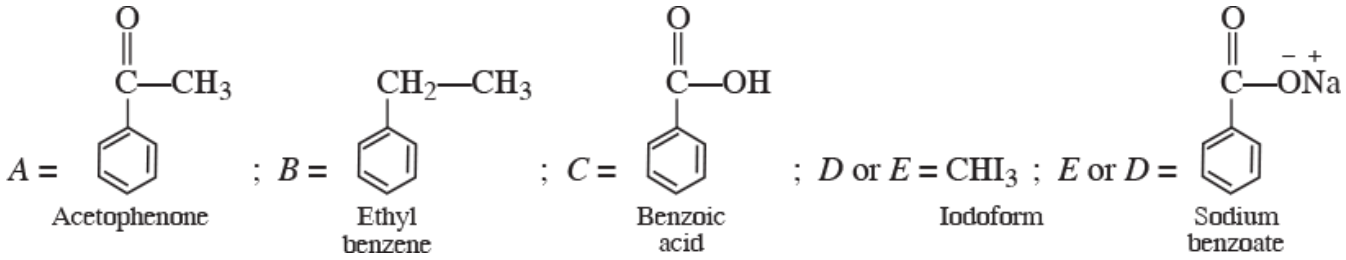
$$\underset{\text{Benzoic acid}}{C_6H_5COOH} + NaHCO_3 \rightarrow \underset{\text{Sodium benzoate}}{C_6H_5CO\overset{-}{O}\overset{+}{N}a} + CO_2\uparrow + H_2O$$

Q.2. Write the structures of *A, B, C, D* and *E* in the following reactions:

[*CBSE Delhi 2016*]



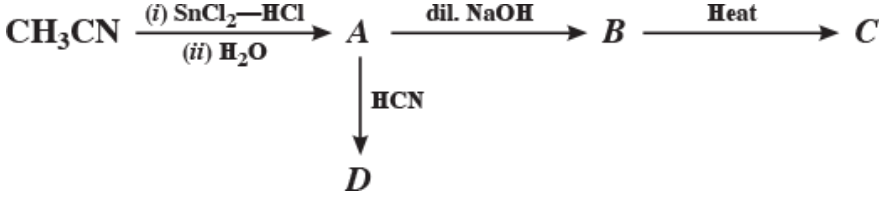
Ans.



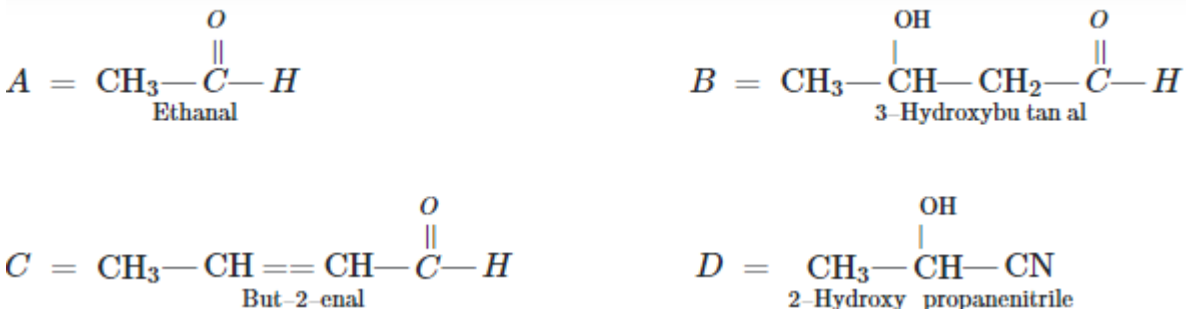
Q.3. Answer the following questions

[*CBSE North 2016*]

Q. Write the structures of A, B, C and D in the following reactions:



Ans.



Q. Distinguish between:

(*a*) C_6H_5—CH—CH—$COCH_3$ and C_6H_5—CH—CH—$COCH_2CH_3$

(*b*) CH_3CH_2COOH and $HCOOH$

Ans. (*a*) $C_6H_5CH{=}CH{-}COCH_3$ on warming with NaOI (I_2/NaOH) gives yellow precipitate of iodoform while $C_6H_5CH{=}CH{-}CO{-}CH_2{-}CH_3$ does not.

$$C_6H_5CH{=}CHCOCH_3 + 3NaOI \rightarrow \underset{\text{Iodoform}}{CHI_3\downarrow} + C_6H_5CH{=}CH{-}CO\bar{O}Na^+ + 2NaOH$$

(Yellow ppt.)

(*b*) Formic acid reduces Tollens' reagent to metallic silver while propionic acid does not.

$$\underset{\text{Formic acid}}{HCOOH} + 2[Ag(NH_3)_2]^+ + 2OH^- \rightarrow \underset{\text{Silver mirror}}{2Ag\downarrow} + CO_2 + 2H_2O + 4NH_3$$

Q. Arrange the following in the increasing order of their boiling points:

CH_3CH_2OH, CH_3COCH_3, CH_3COOH

Ans. $CH_3{-}CO{-}CH_3 < CH_3{-}CH_2{-}OH < CH_3{-}COOH$

Q.4. Answer the following questions

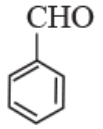
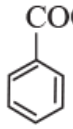
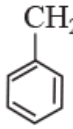
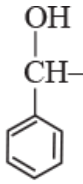
[*CBSE Chennai 2015*]

Q. Write the structures of *A*, *B*, *C* and *D* in the following reactions:

$$C_6H_5COCl \xrightarrow{H_2/Pd-BaSO_4} A \xrightarrow{\text{conc. NaOH}} B + C$$

$$A \xrightarrow{CH_3MgBr/H_3O^+} D$$

Ans.

A =  Benzaldehyde , B or C =  Sodium benzoate , C or B =  Benzyl alcohol , D =  1-Phenyl ethanol

Q. Distinguish between the following:

(*a*) $C_6H_5 - COCH_3$ and $C_6H_5 - CO\ CH_2CH_3$

(*b*) Benzoic acid and Phenol

Ans. (*a*) $C_6H_5COCH_3$ being a methyl ketone gives iodoform test while $C_6H_5COCH_2CH_3$ does not.

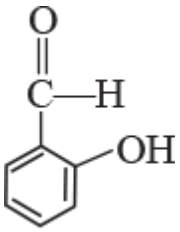
$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \rightarrow C_6H_5COONa + \underset{\substack{\text{Iodoform}\\ (\textit{Yellow ppt.})}}{CHI_3\downarrow} + 2NaOH$$

(*b*) Benzoic acid gives brisk effervescence with $NaHCO_3$ solution whereas phenol does not.

$$\underset{\text{Benzoic acid}}{C_6H_5COOH} + NaHCO_3 \rightarrow C_6H_5CO\overset{-}{O}\overset{+}{N}a + \underset{\substack{\text{Brisk}\\ \text{effervescence}}}{CO_2\uparrow} + H_2O$$

Q. Write the structure of 2-hydroxybenzaldehyde.

Ans.



Q.5. Answer the following questions

[*CBSE (F) 2014*]

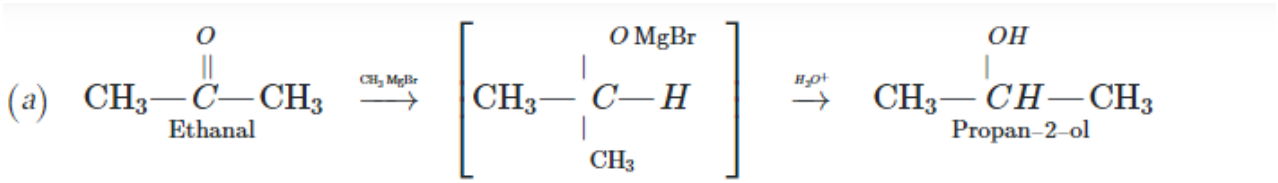
Q. Write the products formed when ethanal reacts with the following reagents:

(*a*) CH_3MgBr and then H_3O^+

(*b*) Zn-Hg/conc. HCl

(*c*) C_6H_5CHO in the presence of dilute NaOH

Ans.

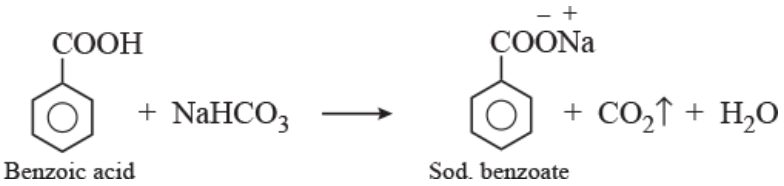


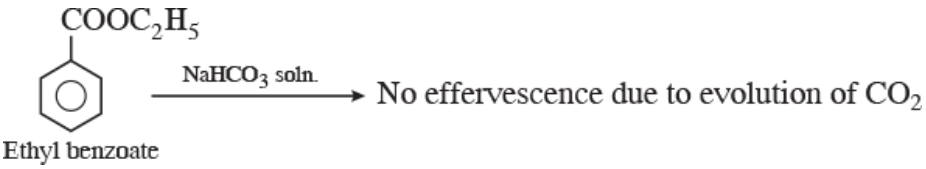
Q. Give simple chemical tests to distinguish between the following pairs of compounds:

(*a*) Benzoic acid and Ethyl benzoate

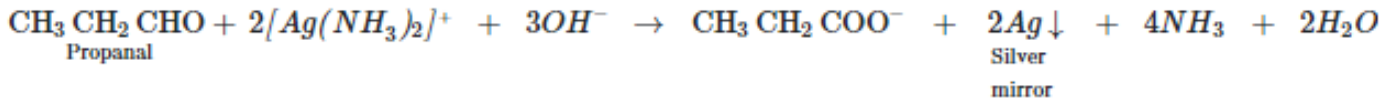
(*b*) Propanal and Butan-2-one

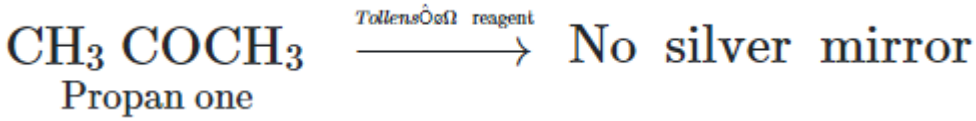
Ans. (*a*) Benzoic acid being an acid reacts with $NaHCO_3$ solution to produce brisk effervescence due to evolution of CO_2 while ethyl benzoate does not give this test.





(*b*) Propanal being an aldehyde reduces Tollens' reagent to silver mirror but propanone being a ketone does not





Q.6. Answer the following questions

[*CBSE (F) 2013*]

Q. Give reasons for the following:

a. **Ethanal is more reactive than acetone towards nucleophilic addition reaction.**
b. **$(CH_3)_3C$—CHO does not undergo aldol condensation.**
c. **Carboxylic acids are higher boiling liquids than alcohols.**

Ans.

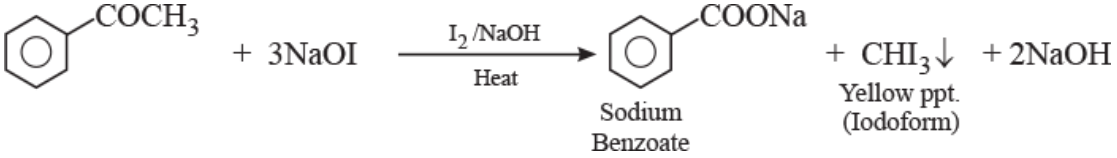
a. This is due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically two alkyl groups reduce the positivity of the carbonyl carbon more effectively in ketones than in aldehydes.
b. This is because for aldol condensation to take place, at least one a-hydrogen (*i.e*., hydrogen at carbon adjacent to carbonyl carbon) should be available, which is not present in $(CH_3)_3C$—CHO.
c. This is due to more extensive association of carboxylic acid molecules through intermolecular hydrogen bonding. The hydrogen bonds do not break completely even in the vapour phase.

Q. Give a simple chemical test to distinguish between

a. **Acetophenone and Benzophenone**
b. **Benzaldehyde and Ethanal**

Ans. (*a*) Acetophenone and benzophenone

Acetophenone responds to iodoform test and gives a yellow precipitate on addition of NaOH and I_2, but benzophenone does not.

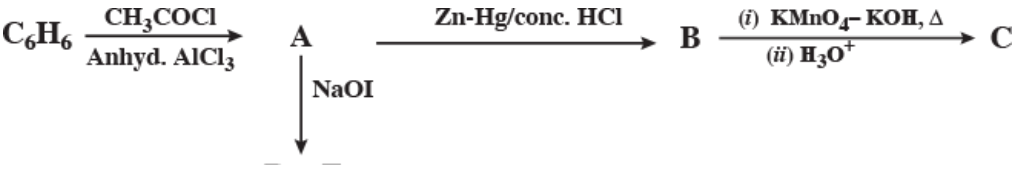


(*b*) Benzaldehyde and Ethanal

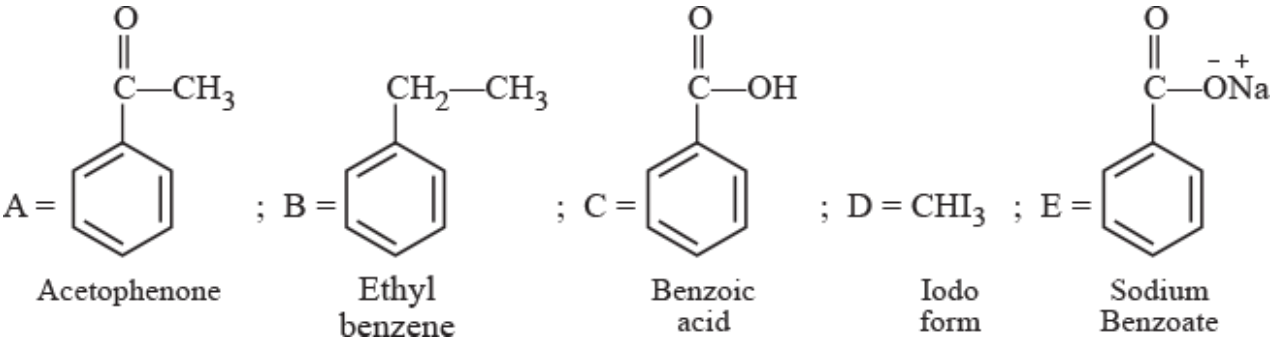
Ethanal reacts with NaOI (I_2/NaOH) to form yellow precipitate of iodoform while benzaldehyde does not give this test.

Q.7. Write the structures of *A, B, C, D* and E in the following reactions:

[*CBSE Delhi 2016*]



Ans.



Long Answer Questions (OIQ)

Q.1. Give names of the reagents that bring about the following transformations:

Q. Hexan-1-ol to hexanal

Ans. $C_5H_5NH^+CrO_3Cl^-$(PCC)

Q. *p*-Fluorotoluene to *p*-fluorobenzaldehyde

Ans. CrO_3 in the presence of acetic anhydride/1. CrO_2Cl_2 2. HOH

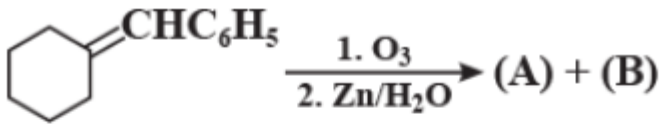
Q. Ethanenitrile to ethanol

Ans. (Diisobutyl) aluminium hydride (DIBAL-H)

Q. Allyl alcohol to propenal

Ans. PCC

Q.2. Identify the unknown organic compounds (A) to (E) in the following series of chemical reactions.

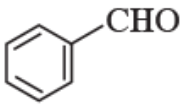
(i) 

(ii) $(A) + (B) \xrightarrow{\text{dil. NaOH}} (C) + H_2O$

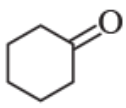
(iii) $(C) \xrightarrow[2.\ Zn/H_2O]{1.\ O_3} (A) + (D)$

(iv) $(D) \xrightarrow[\Delta]{H_2/Ni} (E)$

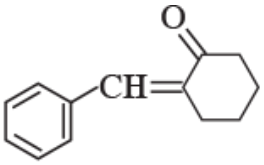
Ans.



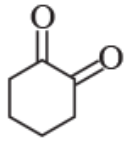
A = Benzaldehyde



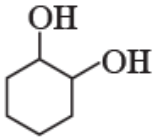
B = Cyclohexanone



C = 2-Benzylidene cyclohexanone



D = Cyclohexane-1, 2-dione

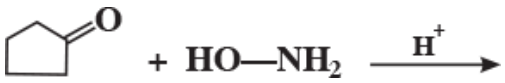


E = Cyclohexane – 1, 2-diol

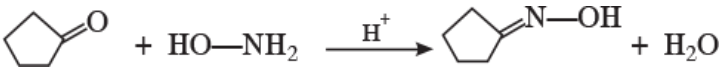
Q.3. Complete each synthesis by giving missing starting material, reagent or products:

[*CBSE Sample Paper 2017*]

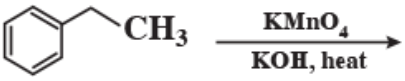
Q.



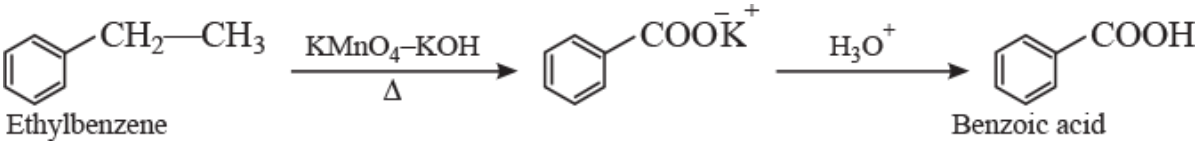
Ans.



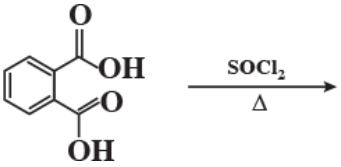
Q.



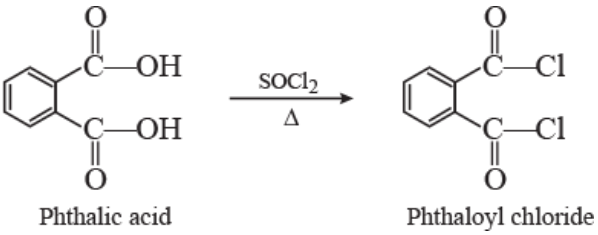
Ans.



Q.

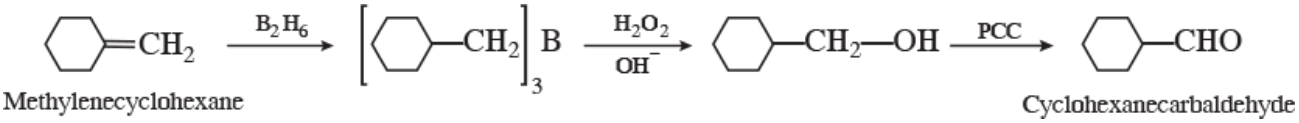


Ans.

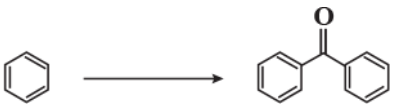


Q.

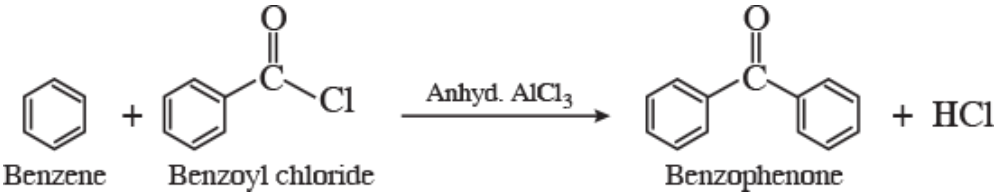
Ans.



Q.



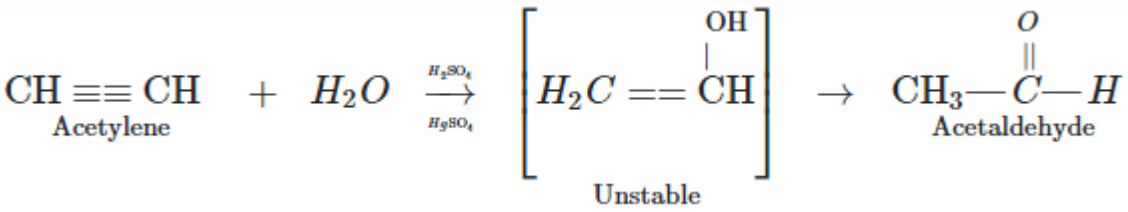
Ans.



Q.4. Bring out the following conversions:

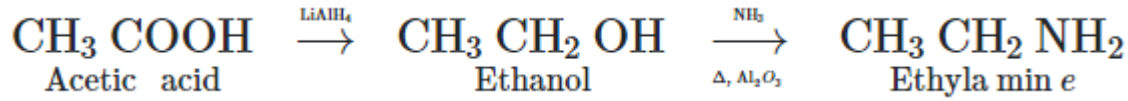
Q. Acetylene to Acetaldehyde

Ans.



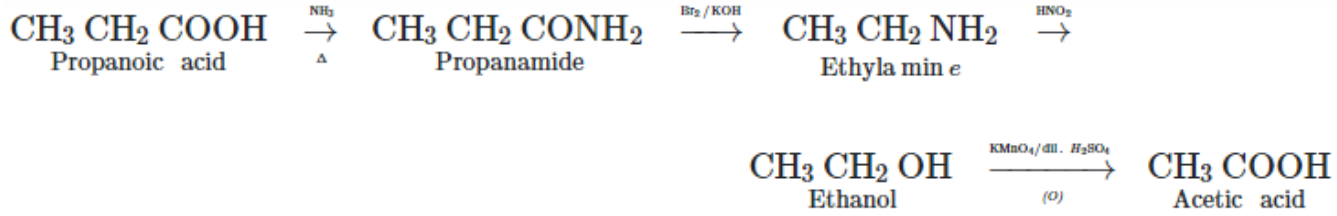
Q. Acetic acid to Ethyl amine

Ans.



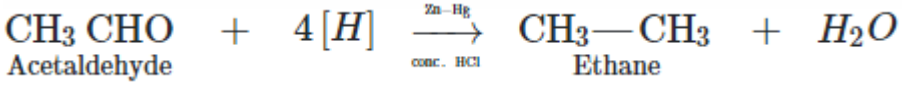
Q. Propanoic acid to Acetic acid

Ans.



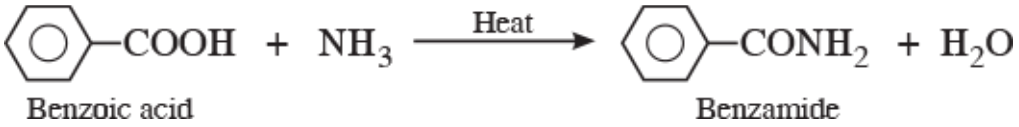
Q. Acetaldehyde to Ethane

Ans.



Q. Benzoic acid to Benzamide

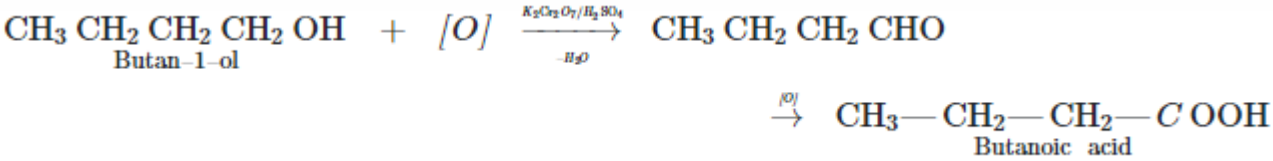
Ans.



Q.5. Write chemical reactions to affect the following transformations:

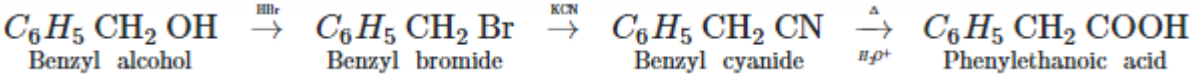
Q. Butan-1-ol to butanoic acid

Ans.



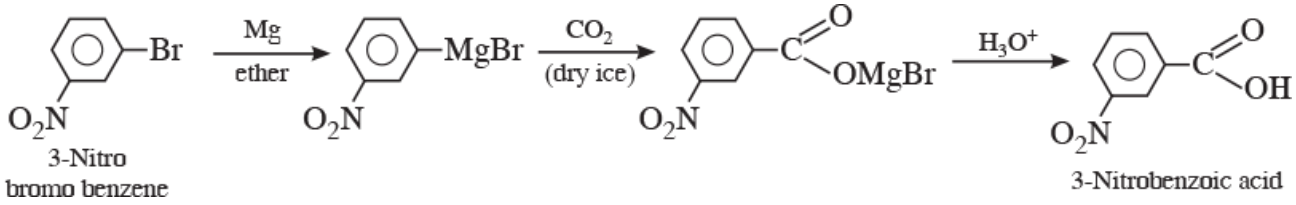
Q. Benzyl alcohol to phenylethanoic acid

Ans.



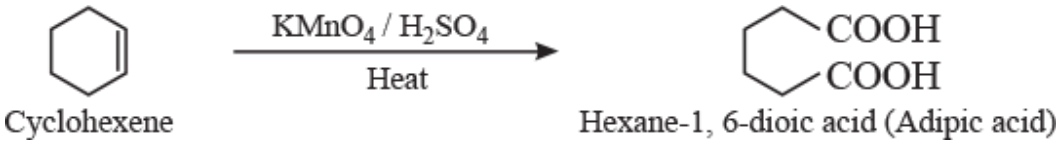
Q. 3-Nitrobromobenzene to 3-nitrobenzoic acid

Ans.



Q. Cyclohexene to hexane-1, 6-dioic acid

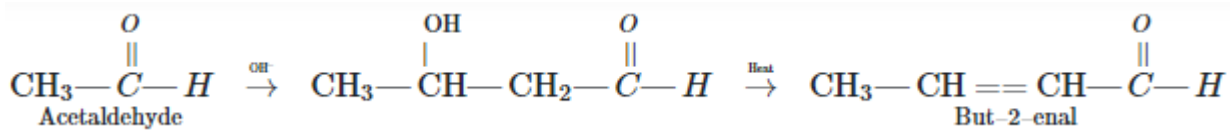
Ans.



Q.6. Bring out the following conversions:

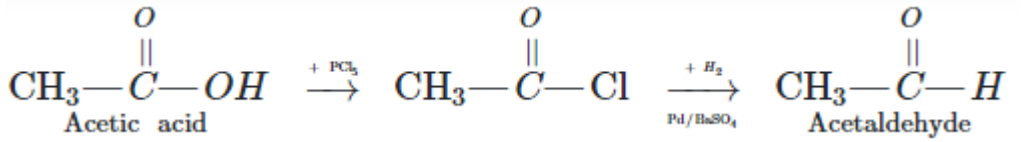
Q. Acetaldehyde to But-2-enal

Ans.



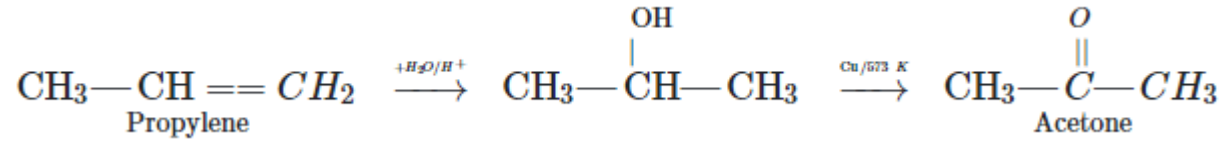
Q. Acetic acid to Acetaldehyde

Ans.



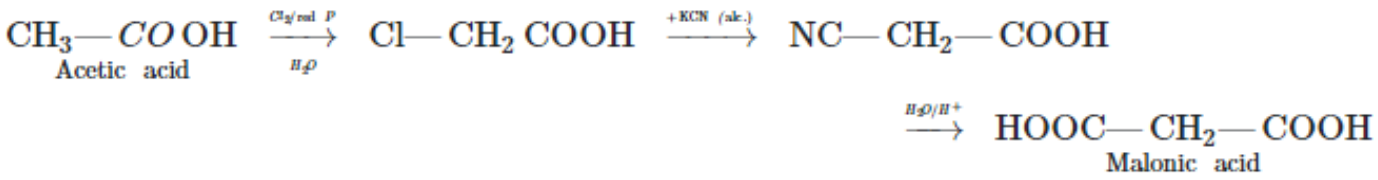
Q. Propylene to Acetone

Ans. Propylene to Acetone



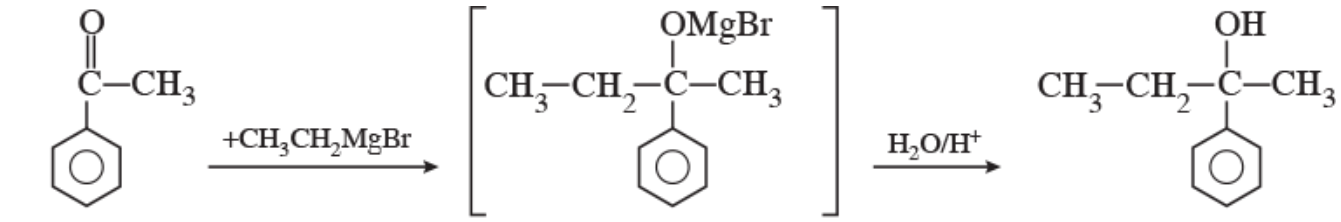
Q. Acetic acid to Malonic acid

Ans.



Q. Acetophenone to 2-phenyl butan-2-ol

Ans. Acetophenone to 2-phenyl butan-2-ol



Acetophenone 2-Phenylbutan-2-ol

Q.7. Answer the following questions

Q. How would you account for the following:

a. **Aldehydes are more reactive than ketones towards nucleophiles.**
b. **The boiling points of aldehydes and ketones are lower than of the corresponding acids.**
c. **The aldehydes and ketones undergo a number of addition reactions.**

Ans.

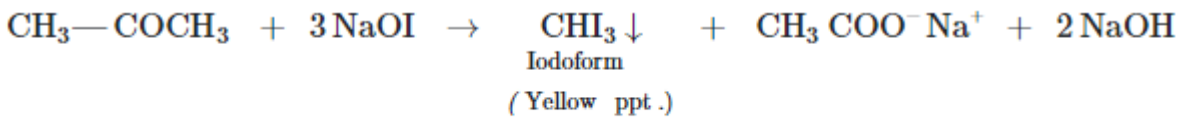
a. This is due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically two alkyl groups reduce the positivity of the carbonyl carbon more effectively in ketones than in aldehydes.
b. This is due to intermolecular hydrogen bonding in carboxylic acids.
c. Due to greater electronegativity of oxygen than carbon, the C atom of the $>C=O$ group acquires a partial positive charge in aldehydes and ketones and hence readily undergo nucleophilic addition reactions.

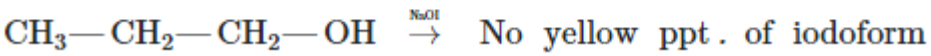
Q. Give chemical tests to distinguish between:

a. **Acetaldehyde and benzaldehyde**
b. **Propanone and propanol.**

Ans. (a). Acetaldehyde reacts with NaOI (I_2/NaOH) to form yellow ppt of iodoform while benzaldehyde does not give this test.

(b) Propanone gives orange-red ppt with 2, 4-DNP reagent and yellow precipitate of iodoform with sodium hypoiodite, whereas 1-propanol does not give these tests.





Q.8. Answer the following questions

Q. Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons.

Ans. Resonating structures of carboxylate ion are more stable than phenoxide ion.

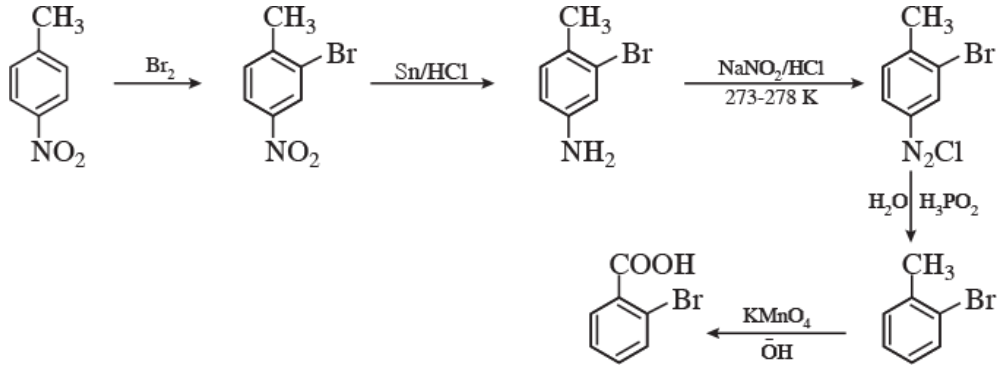
Negative charge is dispersing on two electronegative oxygens in carboxylate ion whereas it is on one oxygen atom in phenoxide ion.

Q. Bring out the following conversions:

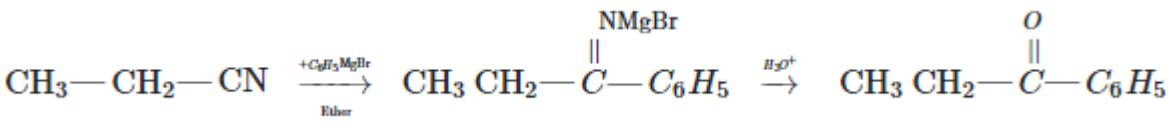
(*a*) 4-Nitrotoluene to 2-bromobenzoic acid

(*b*) Ethylcyanide to 1-phenyl propanone

Ans. (*a*) 4-Nitrotoluene to 2-bromobenzoic acid

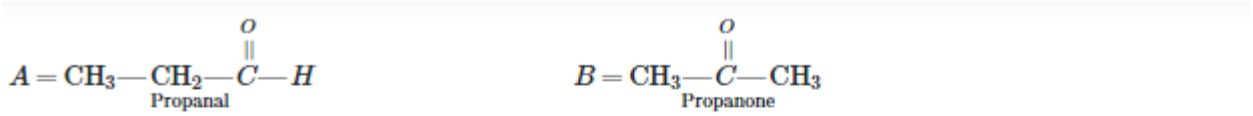


(*b*) Ethylcyanide to 1-phenyl propanone

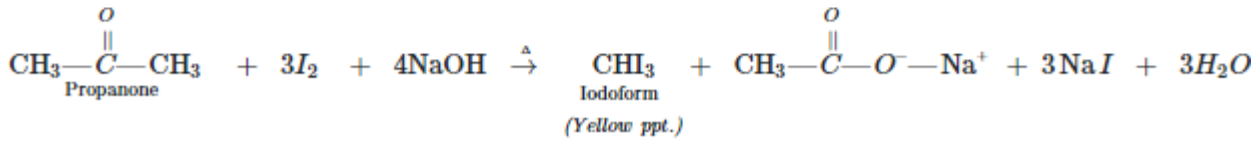


Q. A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B.

Ans.



Reaction involved:



Q.8. Answer the following questions

Q. Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons.

Ans. Resonating structures of carboxylate ion are more stable than phenoxide ion.

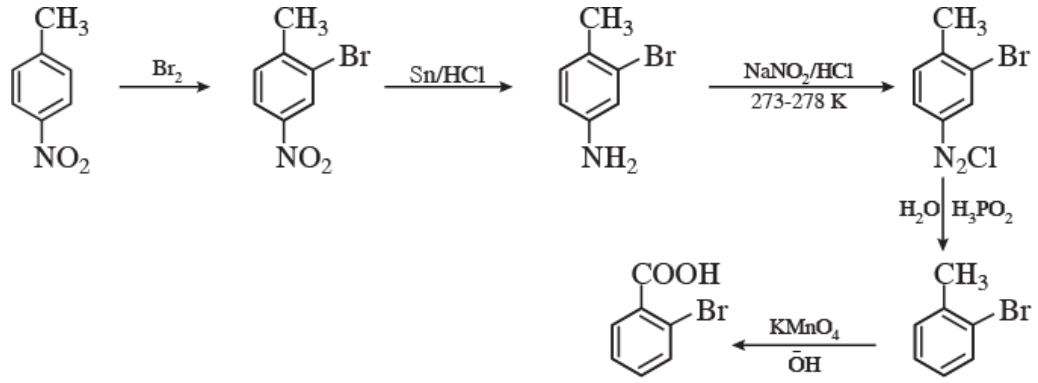
Negative charge is dispersing on two electronegative oxygens in carboxylate ion whereas it is on one oxygen atom in phenoxide ion.

Q. Bring out the following conversions:

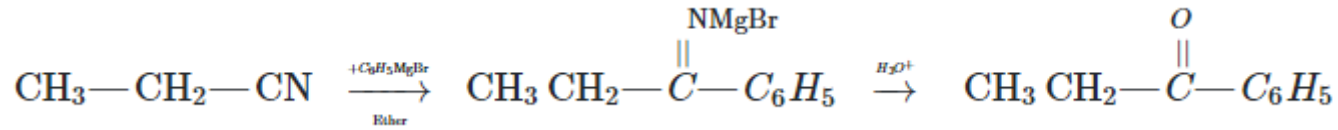
(*a*) 4-Nitrotoluene to 2-bromobenzoic acid

(*b*) Ethylcyanide to 1-phenyl propanone

Ans. (*a*) 4-Nitrotoluene to 2-bromobenzoic acid



(*b*) Ethylcyanide to 1-phenyl propanone



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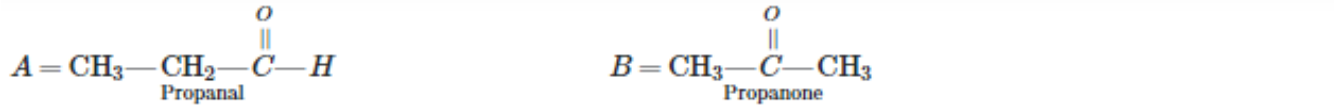
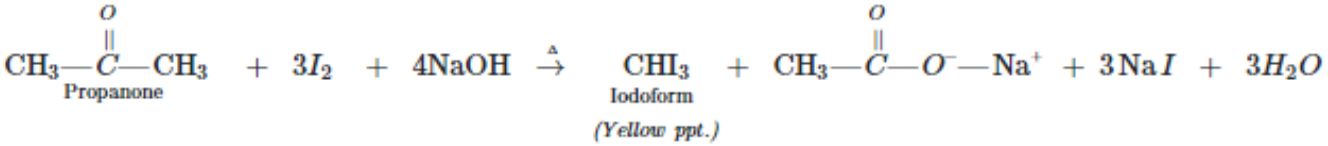
Ans.



Reaction involved:

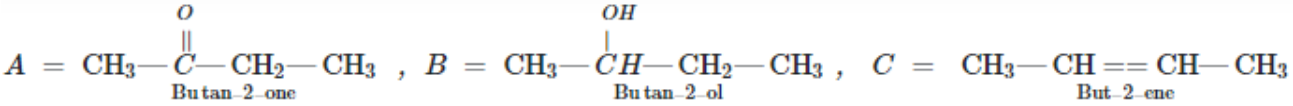


Q.9. Answer the following questions

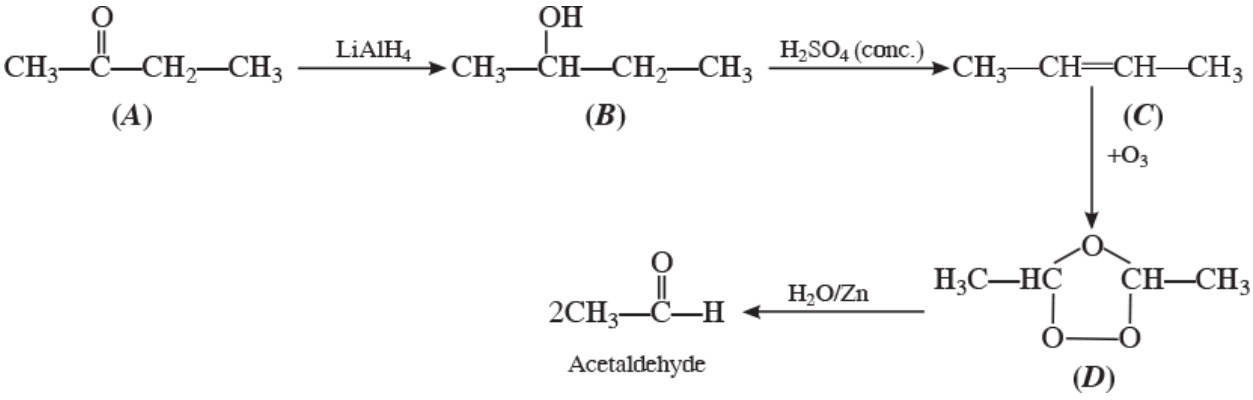
[*CBSE Sample Paper 2017*]

Q. A ketone *A* which undergoes haloform reaction gives compound *B* on reduction. *B* on heating with sulphuric acid gives compound *C*, which forms mono-ozonide *D*. The compound *D* on hydrolysis in presence of zinc dust gives only acetaldehyde. Write the structures and IUPAC names of *A, B* and *C*. Write down the reactions involved.

Ans.



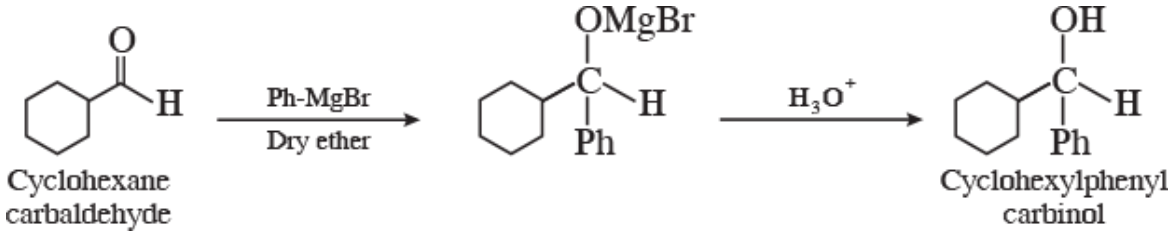
The reactions are as follows:



Q. Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents.

(*a*) PhMgBr and then H_3O^+ (*b*) Tollens' reagent.

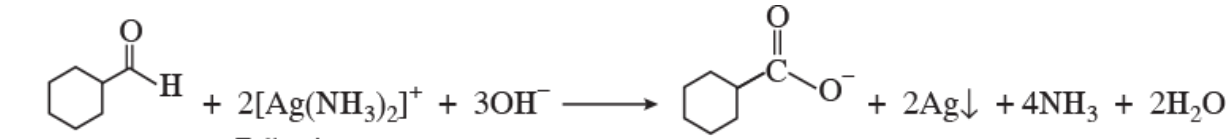
Ans. (*a*)



Cyclohexane carbaldehyde

Cyclohexylphenyl carbinol

(*b*)

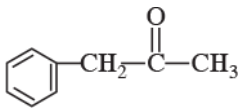


Cyclohexane carbaldehyde — Tollens' reagent — Cyclohexane carboxylate ion — Silver mirror

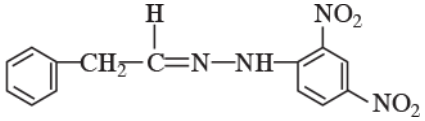
Q.10. An organic compound (A) having molecular formula $C_9H_{10}O$ forms an orange red precipitate (B) with 2, 4-DNP reagent. Compound (A) gives a yellow precipitate (C) when heated in the presence of iodine and NaOH along with a colourless compound (D). (A) does not reduce Tollens' reagent or Fehling's solution nor does it decolourise bromine water. On drastic oxidation of (A) with chromic acid, a carboxylic acid (E) of molecular formula $C_7H_6O_2$ is formed. Deduce the structures of the organic compounds (A) to (E).

[*HOTS*]

Ans. (A)



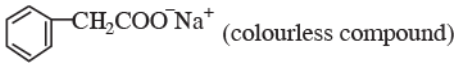
(B)



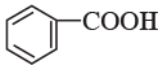
(C)

CHI_3 (yellow precipitate)

(D)



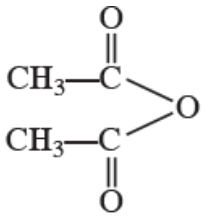
(E)

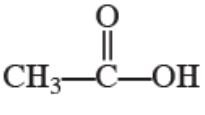


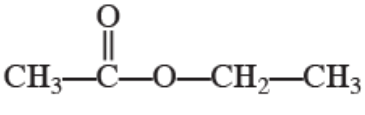
Q.12. An organic compound 'A' on treatment with ethyl alcohol gives carboxylic acid 'B' and compound 'C'. Hydrolysis of 'C' under acidic conditions gives 'B' and 'D'. Oxidation of 'D' with $KMnO_4$ also gives 'B'. B on heating with $Ca(OH)_2$ gives 'E' with molecular formula C_3H_6O. 'E' does not give Tollens' test or reduce Fehling solution but forms 2, 4-dinitrophenyl hydrazone. Identify A, B, C, D, E.

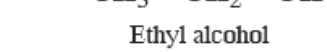
[*HOTS*]

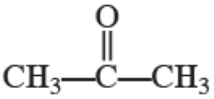
Ans.

A = 
Acetic anhydride

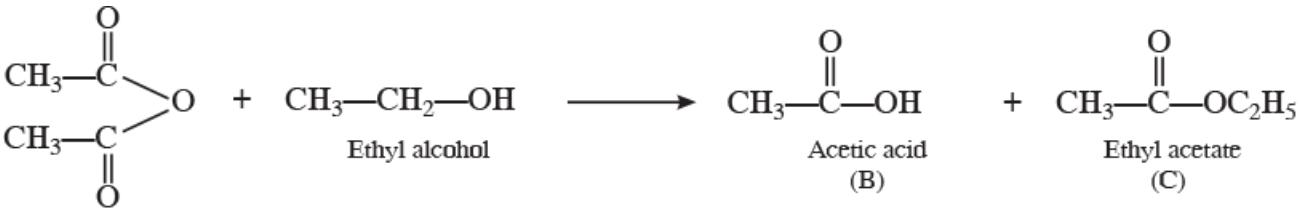
B = 
Acetic acid

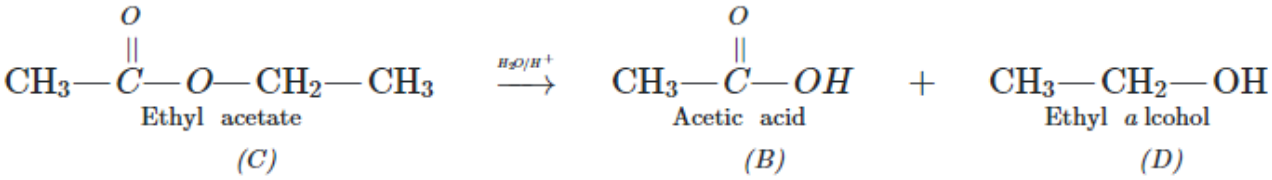
C = 
Ethyl acetate

D = 
Ethyl alcohol

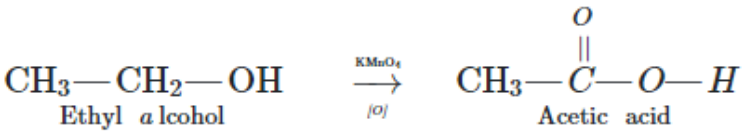
E = 
Acetone

Reactions are:

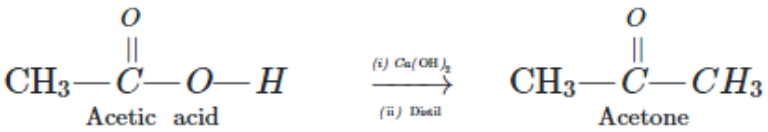




Ethyl acetate (C) | Acetic acid (B) | Ethyl alcohol (D)



Ethyl alcohol (D) → Acetic acid (B)



Acetic acid (B) → Acetone (E)