

● **Alcohol, phenol and ether**

Alcohol : Compounds obtained by substitution of H-atom attached with sp^3 hybridised carbon of alkane, alkene, alkyne and alkyl benzene by $-OH$ group are called alcohols.

general formula of alcohol is $R-OH$.

● **Classification of alcohols**

- According to number of $-OH$ group, alcohols are classified into monohydric, dihydric, trihydric alcohols etc.

- Alcohols can also be classified into 1° ($-CH_2OH$), 2° ($>CH_2OH$) and 3° ($-\overset{\overset{|}{|}}{C}-OH$), based on number of other carbons attached to $-OH$ group containing sp^3 hybridised carbon.

Isomerism in alcohols : Structural isomerism and stereoisomerism is observed in alcohol compounds.

1. Number of isomers of primary alcohols containing molecular formula with $C_5H_{12}O$ are
(A) 6 (B) 5 (C) 4 (D) 3
2. Cyclopentanol is type of compound.
(A) secondary alcohol (B) phenolic (C) tertiary alcohol (D) primary alcohol
3. Which of the following compound is not possible ?
(A) Propan -1, 3-diol (B) butan 2, 3-diol (C) butan 2,2-diol (D) Pentan-1,2-diol
4. Number of optically active isomeric alcohol having molecular formula $C_5H_{12}O$ is
(A) 5 (B) 4 (C) 6 (D) 2

Answers : 1. (C), 2. (A), 3. (C), 4. (D).

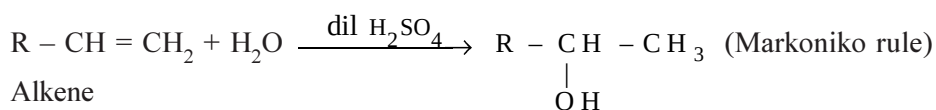
● **Preparation of alcohol :**

Hydrolysis of alkyl halide :



alkyl halide

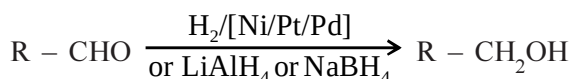
Hydration of alkene :



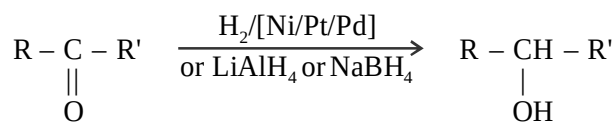
Hydroboration oxidation of alkene :



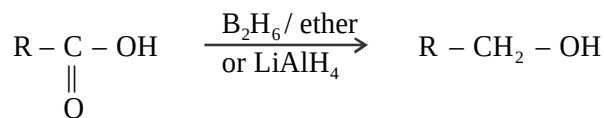
Reduction of carbonyl compounds :



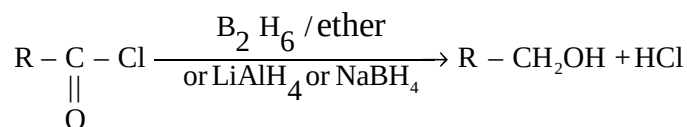
Aldehyde



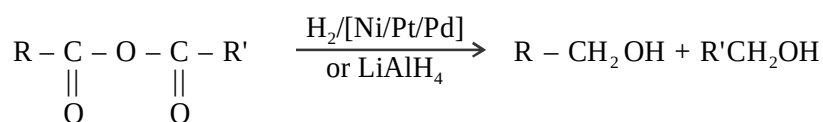
Ketone



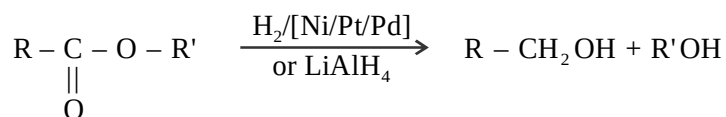
carboxylic acid



Acid chloride

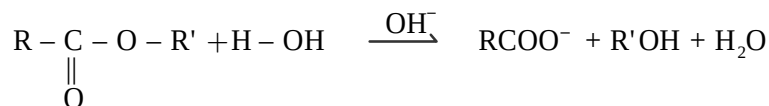
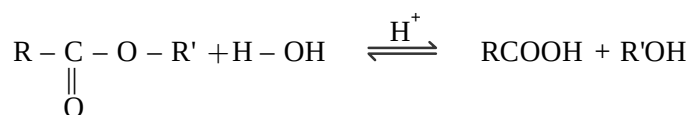


Anhydride

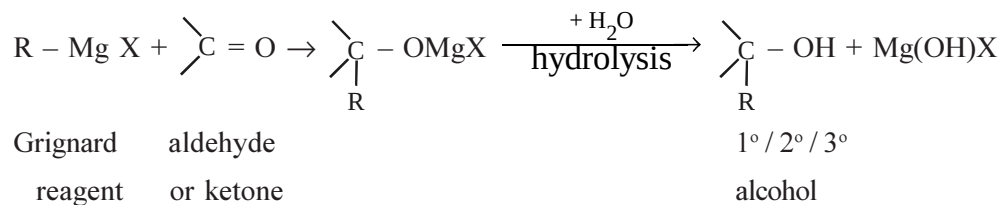


Ester

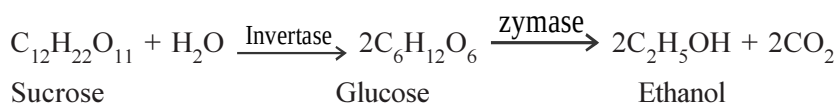
Hydrolysis of ester :



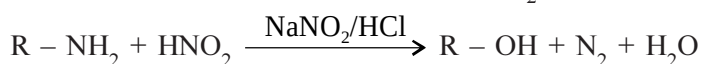
Addition reaction of Grignard reagent with aldehyde and ketone :



Fermentation reaction :



Reaction of alkyl amine (1°) with HNO₂ :



5. is formed by reaction of phenylmethanamine with nitrous acid.
 (A) Phenol (B) Nitrobenzene (C) Phenylmethanol (D) O-cresol
6. Between which of the following substances reaction can be carried out to obtain ethanol ?
 (A) CH_3MgI and CH_3COCH_3 (B) CH_3MgI and $\text{C}_2\text{H}_5\text{OH}$
 (C) CH_3MgI and $\text{CH}_3\text{COOC}_2\text{H}_5$ (D) CH_3MgI and HCOOC_2H_5
7. $\text{Q} \xleftarrow[\text{(ii) H}_2\text{O}_2/\text{OH}^-]{\text{(i) B}_2\text{H}_6} \text{Cyclohexyl-CH=CH}_2 \xrightarrow{\text{H}_3\text{O}^+} \text{P}$ what are products P and Q respectively ?
 (A) Both $\text{Cyclohexyl-CH}_2\text{OH}$ (B) Both $\text{Cyclohexyl-C(CH}_3\text{)(OH)-CH}_2\text{OH}$
 (C) $\text{P} = \text{Cyclohexyl-CH}_2\text{OH}$ and $\text{Q} = \text{Cyclohexyl-C(CH}_3\text{)(OH)-CH}_2\text{OH}$ (D) $\text{P} = \text{Cyclohexyl-C(CH}_3\text{)(OH)-CH}_2\text{OH}$ and $\text{Q} = \text{Cyclohexyl-CH}_2\text{OH}$
8. Which reagent should be used to obtain but-2-en-1-ol from but-2-enal ?
 (A) H_2/Ni (B) NaBH_4 (C) Zn/HCl (D) Zn-Hg/HCl
9. $\text{HC} \equiv \text{CH} \xrightarrow[\text{Pd+C}]{\text{H}_2} \text{P} \xrightarrow{\text{HBr}} \text{Q} \xrightarrow[\text{NaOH}]{\text{aq.}} \text{R (organic product)}$
 Which is final organic product R in above reaction ?
 (A) Ethanol (B) Ethenol (C) Propan-1-ol (D) Prop-2-enol
10. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{MgBr} + \text{CH}_3\text{CHO} \xrightarrow{\text{H}_2\text{O/H}^+}$ what is product 'X' of reaction ?
 (A) 3-methylhexan-1-ol (B) 3-methylhexan-2-ol
 (C) 2-methylpentan-2-ol (D) 4-methylhexan-2-ol

Answers : 5. (C), 6. (D), 7. (D), 8. (B), 9. (A), 10. (D)

● Physical properties of alcohols

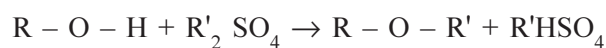
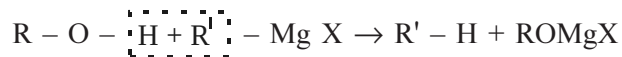
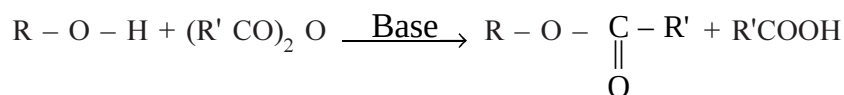
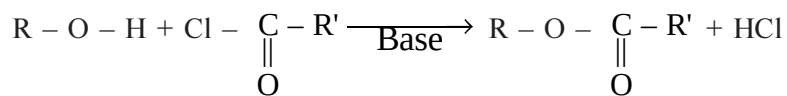
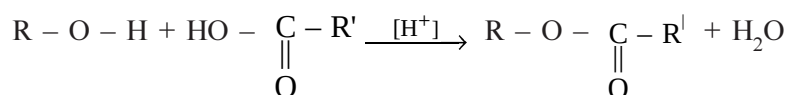
- Alcohols having lower molecular mass are volatile compounds containing characteristic smell.
- Due to formation of intermolecular H-bond between alcohol molecules, their boiling points are higher than corresponding alkane, alkyl halide and ether compounds.
- Order of boiling point of isomeric alcohol : $1^\circ > 2^\circ > 3^\circ$
- Alcohols form intermolecular H-bond with water molecules. So lower molecular mass containing alcohols are soluble in water.
- When number of $-\text{OH}$ groups in alcohol increases then boiling point and solubility in water increases.

● Chemical properties of alcohols

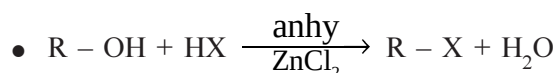
(I) Reaction involving cleavage of O-H bond of alcohol :

● Acidic nature of alcohols :

- It is proved from the reaction of alcohol with strong metal, metal hydride and metal amide that alcohol contains acidic nature.
- Acidic strength of alcohol is less than that of H_2O [Exception-Methanol]
 It means that alcohols are weak acid.
- + I effect decreases acidic strength of alcohol while - I effect increases acidic strength of alcohol.

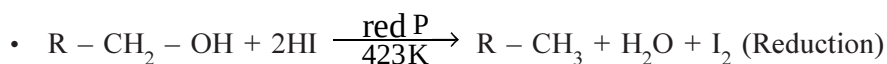
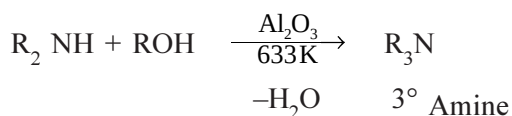
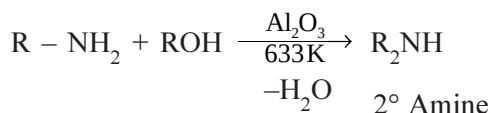
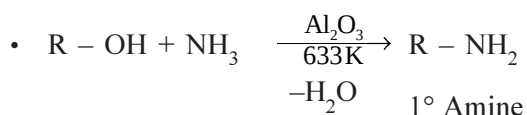
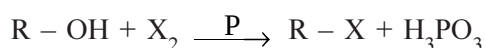
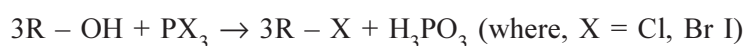
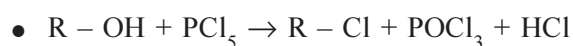


(II) Reaction involving cleavage of (C – O) bond :



Reactivity order of HX : $HI > HBr > HCl > HF$

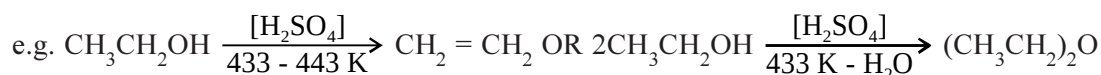
Reactivity order of R-OH : $3^\circ > 2^\circ > 1^\circ$



(III) Reactions involving alcohol molecule as whole :

Dehydration :

(a) Dehydration of alcohol is possible in two ways, so that possible one product out of two is obtained based on temperature.



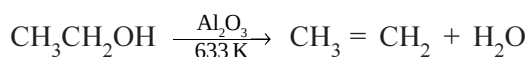
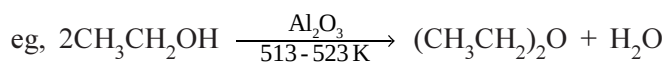
Ethanol

Ethene

Ethanol

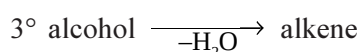
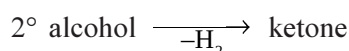
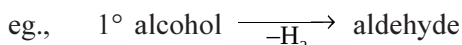
Diethylether

- In case of dehydration reaction of alcohol to obtain alkene depends on stability of carbocation from this reactivity order of alcohol is : $3^\circ > 2^\circ > 1^\circ$.
 - If there is possibility of getting more than one product on dehydration of alcohol then according to Saytzeff's rule and rearrangement (carbocation) main product is decided.
- (b) By passing a vapour of alcohol over, heated alumina at 513-523 K temperature gives ether while at 633 K temperature gives alkene



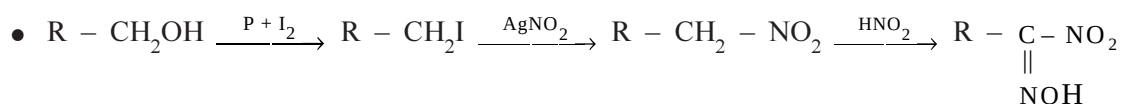
● Oxidation

- (a) Product obtained on oxidation of alcohol depends upon type of alcohol and oxidizing agent.
- 1° Corresponding aldehyde is obtained on oxidation of 1° alcohol by weak oxidizing agent (PCC) in presence of CH_2Cl_2 . While corresponding acid is obtained by strong oxidizing agent like conc. HNO_3 /acidic $\text{K}_2\text{Cr}_2\text{O}_7$ /acidic KMnO_4 /basic KMnO_4 / neutral KMnO_4 .
 - Corresponding ketone is obtained on oxidation of 2° alcohol by strong oxidizing agent.
 - Oxidation of 3° alcohol can not be done by neutral or alkaline KMnO_4 . But when 3° alcohol is treated with $\text{H}_2\text{SO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4 it gives alkene and then give mixture of lower number of carbon containing ketone and acid.
- (b) Different types of alcohols gives different products when their vapours are passed over heated copper at 573 K.

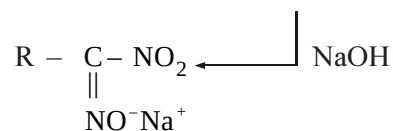


Note :

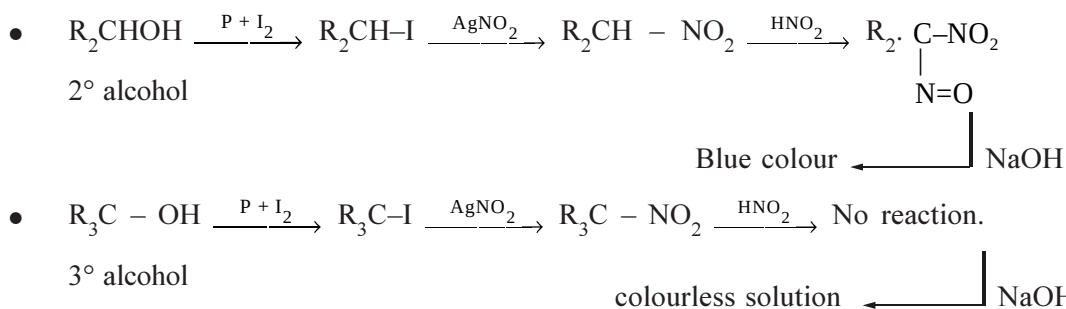
- On the basis of product obtained by oxidation reaction, type of alcohol can be identified.
- In laboratory, determination of type of alcohol can also be done by Lucas test.
- **Victor-Meyer's Test :** In laboratory, identification of type of alcohol can also be done by this test which is as under.



1° alcohol



Blood red colour



11. 3-Methylbutan-2-ol $\xrightarrow{\text{HBr}}$

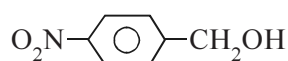
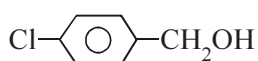
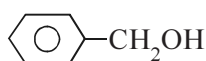
(A) 2-Bromo-3-methylbutane

(B) 3-Bromobutan-2-ol

(C) 2-Bromo-2-methylbutane

(D) 2-Bromobutan-2-ol

12. Which order of reactivity of following compounds with HBr is true ?



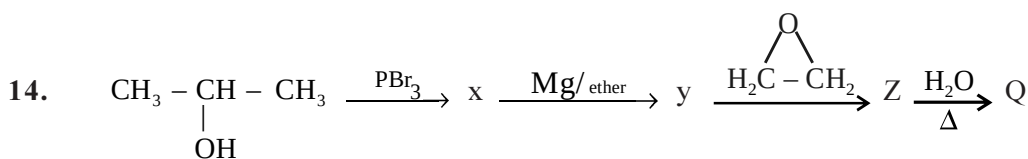
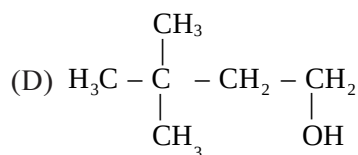
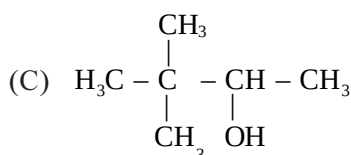
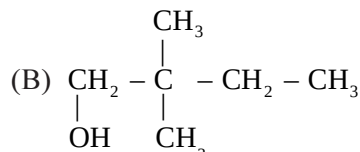
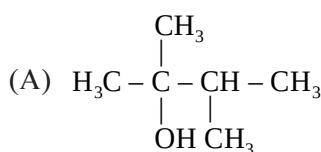
(A) $r > q > p$

(B) $p > q > r$

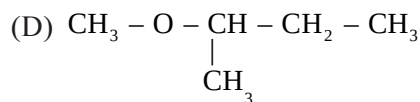
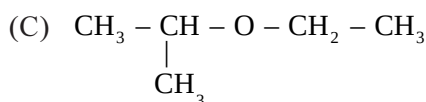
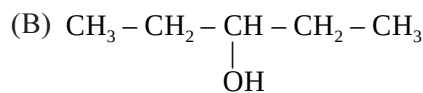
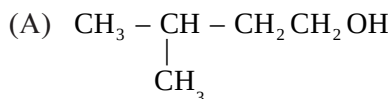
(C) $q > p > r$

(D) $r > q > p$

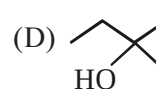
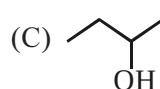
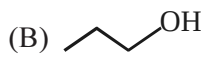
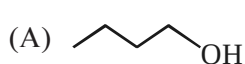
13.  $\xrightarrow{\text{H}_2\text{O} / \text{H}^+}$ Main product + Subsidiary product. What is main product in the reaction ?

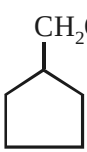
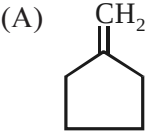
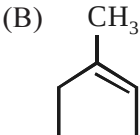
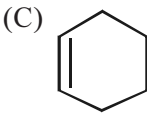
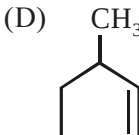
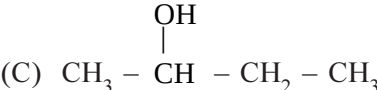


What is final product 'Q' ?



15. For which of the following compound k_a is lowest ?



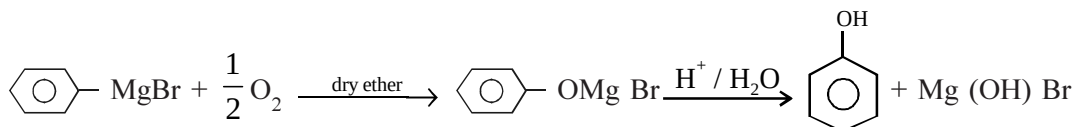
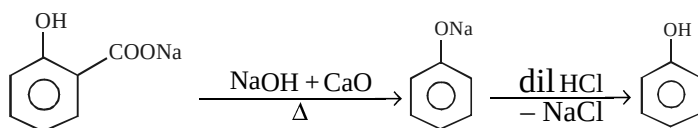
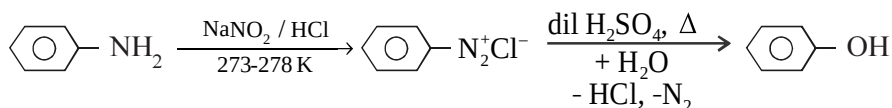
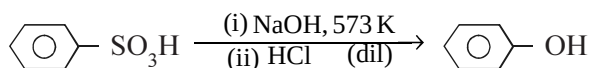
16. The correct order of basic strength is
 (A) $\text{H}_2\text{O} < \text{OH}^- < \text{CH}_3\text{OH} < \text{CH}_3\text{O}^-$ (B) $\text{CH}_3\text{OH} < \text{H}_2\text{O} < \text{CH}_3\text{O}^- < \text{OH}^-$
 (C) $\text{H}_2\text{O} < \text{CH}_3\text{OH} < \text{OH}^- < \text{CH}_3\text{O}^-$ (D) $\text{OH}^- < \text{H}_2\text{O} < \text{CH}_3\text{O}^- < \text{CH}_3\text{OH}$
17.  $\xrightarrow{\text{H}_3\text{PO}_4}$ what is the major product ?
 (A)  (B)  (C)  (D) 
18. $(\text{CH}_3)_3\text{C} - \underset{\text{OH}}{\text{CH}} - \text{CH}_3 \xrightarrow{\text{Lucas reagent}}$
 (A) 2-chloro-3-methylbutan (B) 1-chloro-3-methyl butan
 (C) 2-chloro-2, 3-dimethyl butan (D) 2,3-dimethyl but-2-en
19. An organic compound A reacts with $\text{C}_2\text{H}_5\text{MgI}$ to form an addition product which on hydrolysis forms the compound B. Compound B gives blood red colour in Victor-Meyer's test. What are compounds A and B respectively ?
 (A) Acetaldehyde, propanol (B) Formaldehyde, n-propyl alcohol
 (C) Acetaldehyde, isopropyl alcohol (D) Acetone, n-propyl alcohol
20. $\text{P} \xleftarrow{\text{HCl} / \text{ZnCl}_2} (\text{CH}_3)_3\text{C} - \text{CH}_2\text{OH} \xrightarrow{\text{SOCl}_2} \text{Q}$
 Which are products P and Q in above reaction ?
 (A) $\text{P} = (\text{CH}_3)_3\text{C} - \text{CH}_2\text{Cl}$, $\text{Q} = (\text{CH}_3)_3\text{C} - \text{CH}_2\text{Cl}$
 (B) $\text{P} = (\text{CH}_3)_2\text{C}(\text{Cl}) - \text{CH}_2 - \text{CH}_3$, $\text{Q} = (\text{CH}_3)_3\text{C} - \text{CH}_2\text{Cl}$
 (C) $\text{P} = (\text{CH}_3)_3\text{C} - \text{CH}_2\text{Cl}$, $\text{Q} = (\text{CH}_3)_2\text{C}(\text{Cl}) - \text{CH}_2 - \text{CH}_3$
 (D) $\text{P} = (\text{CH}_3)_2\text{C}(\text{Cl}) - \text{CH}_2\text{CH}_3$, $\text{Q} = (\text{CH}_3)_2\text{C}(\text{Cl}) - \text{CH}_2\text{CH}_3$
21. Isobutylalcohol $\xrightarrow{\text{H}_2\text{SO}_4}$ 'X' $\xrightarrow{\text{HBr}}$ 'Y' $\xrightarrow{\text{aq.KOH}}$ 'Z'
 X and Y are organic product in above reaction. What is product Z ?
 (A) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$ (B) $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$
 (C)  (D) $(\text{CH}_3)_3\text{C} - \text{OH}$
22. gas is formed when ethanol is heated with methylmagnesium iodide.
 (A) Methane (B) Ethane (C) Carbondioxide (D) Propane
23. Which of the following alcohol has lowest reactivity for esterification reaction ?
 (A) Butan-1-ol (B) Butan-2-ol
 (C) 2-Methylpropan-1-ol (D) 2-Methylpropan-2-ol

24. If 5.6 ml gas is obtained at STP during the reaction of 0.0185 g ethanal with methyl magnesium bromide, then what will be molecular mass of alcohol ?
 (A) 74 (B) 46 (C) 32 (D) 60
25. CH_3OH with which substance methanol can not form ester by reaction ?
 (A) Ethanoic acid (B) Ethanol (C) Ethanoicanhydride (D) Ethanoylchloride

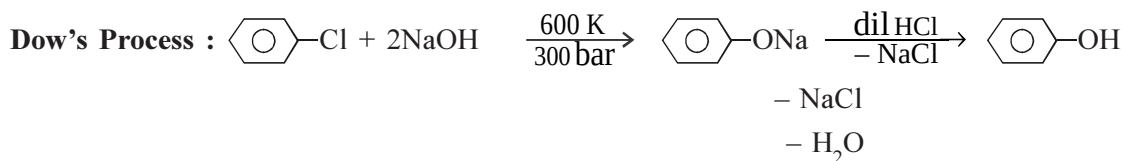
Answers : 11. (C), 12. (B), 13. (A), 14. (A), 15. (D), 16. (C), 17. (C), 18. (C), 19. (B), 20. (B), 21. (D), 22. (A), 23. (D), 24. (A), 25. (B).

● Phenol

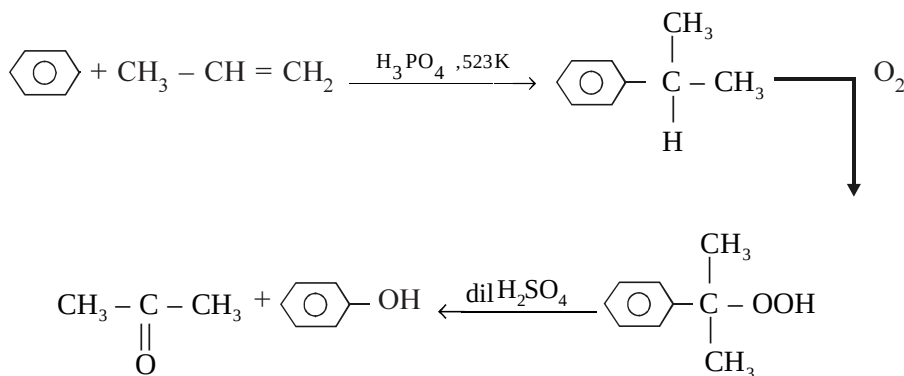
- Compound formed by substitution of H attached to C in aromatic ring by $-\text{OH}$ group is called phenol, general formula of phenol is $\text{Ar}-\text{OH}$.
- Phenol can be classified into monohydric, dihydric, trihydric and polyhydric on the basis of number of $-\text{OH}$ groups.
- Alkyl substituted phenol contains functional isomerism with aryl alcohol and alkylaryl ether.
- Preparation of phenol :**



Industrially phenol is obtained by Dow's and Cumene's processes



Cumene's Process :



● Physical properties of phenol

- Intermolecular H-bond is formed between molecules of phenol, its boiling point is higher than corresponding aromatic hydrocarbon and arylhalide.
- Phenol can be soluble in lesser amount than alcohol by forming H-bond with water.
- With increasing number of –OH group in phenol, boiling point and solubility in water increases.
- Difference is observed on the basis of boiling point in substituted isomeric phenols (o, m and p)

● Acidic property of Phenol

- Phenol is stronger acid than alcohol but acidic strength is less than strong acid so it can be neutralized by strong alkali like NaOH but can not be neutralized by Na_2CO_3 or NaHCO_3 (weak base)
- Order of acidic strength of different substituted phenol is as under :
 - (1) 2,4,6 -Trinitrophenol > 2, 4 Dinitrophenol > 4 Nitrophenol > 2 Nitrophenol > 3 Nitrophenol > phenol
 - (2) phenol > m-cresol > p-cresol > o-cresol
 - (3) o-Halophenol > m-Halophenol > p-Halophenol > phenol
 - (4) o-chlorophenol > o-Bromophenol > o-Iodophenol > o-Fluorophenol
 - (5) m-Methoxyphenol > o-Methoxyphenol > p-Methoxyphenol

26. Which of the following is strongest acid ?

- (A) o-Fluorophenol (B) o-Chlorophenol (C) o-Iodophenol (D) o-Bromophenol

27. $\text{O}_2\text{N}-\text{C}_6\text{H}_4-\text{NH}_2 \xrightarrow[273-278\text{ K}]{\text{NaNO}_2 / \text{HCl}} \text{'X'} \xrightarrow[\text{H}_2\text{O}, \Delta]{\text{dil H}_2\text{SO}_4} \text{Mention the product 'Y' of reaction.}$

- (A) p-Nitrophenol (B) Benzene- 1,4 diol (C) Nitrobenzene (D) phenol

28. Which order of reaction is correct to obtain resorcinol from m-Nitrophenol ?

- (A) Hydrolysis, diazotisation, reduction (B) Diazotisation, reduction, hydrolysis
(C) Reduction, diazotisation, hydrolysis (D) Hydrolysis, reduction, diazotisation

29. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \xrightarrow[\text{KOH}]{\text{alcohol}} \text{P} \xrightarrow[\text{H}_3\text{PO}_4, \Delta]{\text{C}_6\text{H}_6} \text{Q} \xrightarrow{\text{O}_2} \text{R} \xrightarrow{\text{dil. H}_2\text{SO}_4} \text{T} + \text{S}$

What is the main aromatic product of above reaction ?

- (A) Phenylmethanol (B) O-cresol (C) Phenol (D) p-cresol

30. $x \xrightarrow[\Delta]{\text{conc. H}_2\text{SO}_4} \text{Mix. of two isomers} \xrightarrow[\text{(ii) (dil) HCl}]{\text{(i) solid NaOH, } \Delta} \text{P-cresol} + \text{O-Cresol}$ starting substance $x = \dots\dots$

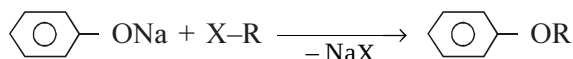
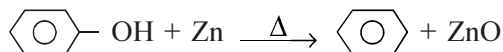
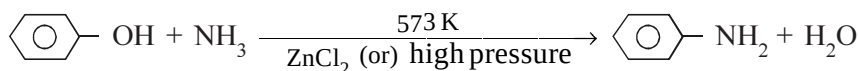
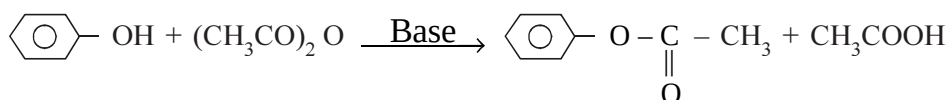
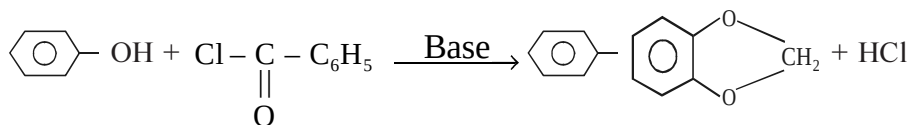
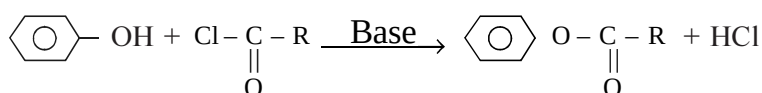
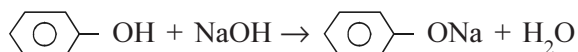
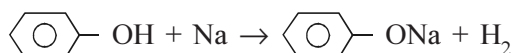
- (A) Nitrobenzene (B) Benzenesulphonic acid (C) Benzene (D) Toluene

31. What is true for comparison of acidic strength of phenol and ethanol ?
- (A) Both phenol and ethanol form stable negative ions, so that acidic strength of both is same
- (B) Phenol forms stable negative ion and ethanol forms unstable negative ion so that phenol is stronger acid than ethanol
- (C) Ethanol forms stable negative ion, and phenol forms unstable negative ion so that ethanol is stronger acid than phenol
- (D) Phenol forms readily negative ion while ethanol forms slowly negative ion, so that phenol is stronger acid than ethanol.
32. Arrange phenolic isomers containing molecular formula C_7H_8O according to their acidic strength.
- (A) o-cresol > m-cresol > p-cresol (B) m-cresol > o-cresol > p-cresol
- (C) m-cresol > p-cresol > o-cresol (D) p-cresol > o-cresol > m-cresol

Answers : 26. (B), 27. A 28. (C), 29. (C), 30. (D), 31. (B), 32. (C)

● **Properties of phenol**

(A) Reactions of -OH Group :



33. $\text{C}_6\text{H}_5\text{ONa} + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{NaHCO}_3$, reaction show that,

- (A) Carbonic acid is stronger acid than phenol
- (B) Water is stronger acid than phenol.
- (C) Acidic strength of phenol is more than carbonic acid
- (D) Carbonic acid is stronger base than phenol

34. Phenol $\xrightarrow[\text{(ii) CO}_2/413\text{K}]{\text{(i) NaOH}}$ X $\xrightarrow{\text{H}^+/\text{H}_2\text{O}}$ Y $\xrightarrow{(\text{CH}_3\text{CO}_2)\text{O}}$ Z What is final product Z ?

- (A) Salicylaldehyde (B) Salicylic acid (C) Phenylacetate (D) Aspirin

35. Which intermediate is associated with Reimer-Tiemann reaction ?
 (A) Carbocation (B) Carbene (C) Carbanion (D) Free radical
36.  $\xrightarrow[\text{(ii) H}^+]{\text{(i) 6 to 8\% NaOH, 600 K, 300 bar}}$ 'X' $\xrightarrow[\text{C}_2\text{H}_5\text{COCl}]{\text{NaOH}}$ 'Y' $\xrightarrow{\text{only AlCl}_3}$ 'Z'
- X, Y and Z are organic products in above reaction. What is the relation between Y and Z ?
 (A) Z is eliminate product of Y. (B) Z is substituted product of Y.
 (C) Z is rearrangement product of Y. (D) Z is addition product of Y.
37. Which of the following compound does not give effervescences with sodium bicarbonate ?
 (A) Benzoic acid (B) Picric acid (C) Benzenesulphonic acid (D) phenol
38. With which reagent, reaction of phenol is different than that of ethanol ?
 (A) Neutral FeCl_3 (B) Sodium metal (C) Grignard reagent (D) Ethanol chloride
39. With which, reaction of aqueous solution of phenol is known as Williamson synthesis ?
 (A) Alkylhalide (B) Acidhalide (C) Acidanhydride (D) Halogen acid
40. Which reagent is required for identification of phenol in laboratory ?
 (i) Neutral FeCl_3 (ii) Diazonium salt (iii) Bromine water
 (A) only (i), (ii) (B) only (i), (iii) (C) only (ii), (iii) (D) (i), (ii) and (iii)
41. Which option is not correct for the given reaction and its corresponding product ?
 (A) Fries rearrangement $\rightarrow$ phenolic ketone
 (B) Kolbe-Schmitt reaction $\rightarrow$ hydroxy ketone
 (C) Reimer-Tiemann reaction $\rightarrow$ hydroxyaldehyde
 (D) Williamson synthesis $\rightarrow$ alkyl phenylether

Answers : 33. (A), 34. (D), 35. (B), 36. (C), 37. (D), 38. (A), 39. (A), 40. (D), 41. (B)

● Ether

The compounds formed by substitution of H atom of hydroxyl group of alcohol or phenol by alkyl and/or aryl group called ether.

general molecular formula of ether compound is : $\text{R} - \text{O} - \text{R}'$.

general molecular formula of alcohols and ether compounds is $\text{C}_n\text{H}_{2n+2}\text{O}$ (For saturated alcohol/ether).

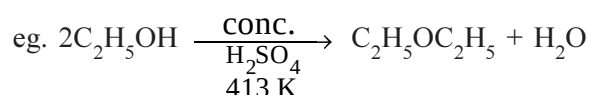
Symmetrical (eg., $\text{CH}_3 - \text{O} - \text{CH}_3$) and unsymmetrical (eg. $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_3$) ethers are two types of ether.

Boiling point of ether is lower than its isomeric alcohol.

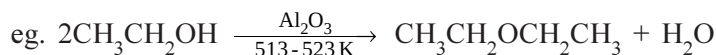
● Preparation of ether

(A) From alcohol :

(i) (a) Symmetrical ether is obtained from the reaction carried out between excess alcohol and conc. H_2SO_4 at 413 K temperature by removal of water molecule.



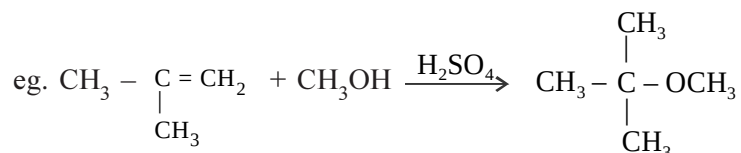
- (b) By passing vapour of alcohol over heated alumina at 513-523 K temp symmetrical ether is obtained by removal of water molecule.



- (ii) For preparation of methyl ether reaction is carried out between diazomethane and alcohol in presence of HBF_4



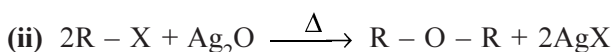
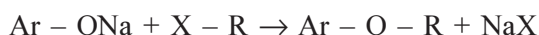
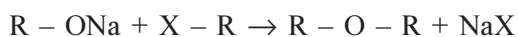
- (iii) When alcohol is treated with alkene in the presence of acid catalyst due to addition reaction ether is formed.



Note : In some cases, from alkene carbocation is formed which undergoes rearrangement. So, other ether is obtained.

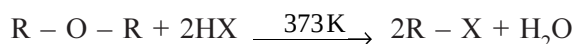
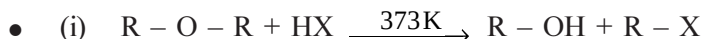
(B) From alkylhalide :

- (i) **Williamson's Synthesis :** Ether can be obtained by nucleophilic substitution of primary alkylhalide with sodium alkoxide/sodium phenoxide.



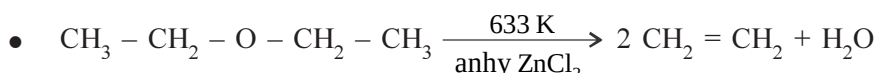
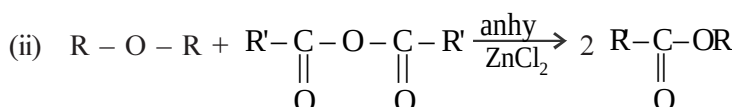
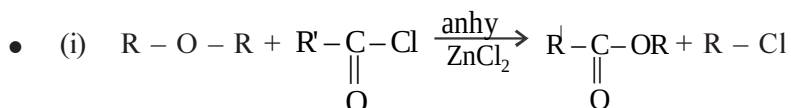
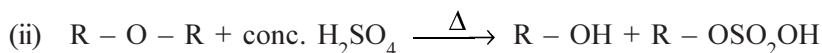
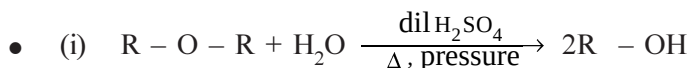
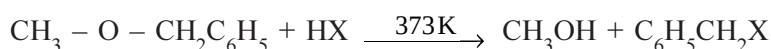
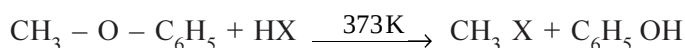
● Chemical properties of ether

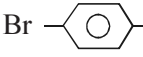
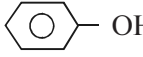
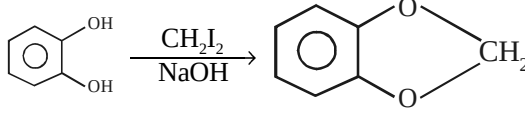
(A) Reaction involving cleavage of C - O bond :



Reactivity order of HX in both reaction is : $\text{HI} > \text{HBr} > \text{HCl}$.

- (ii) For unsymmetrical ether



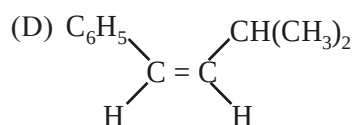
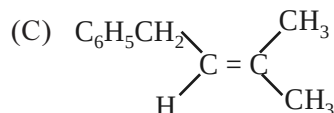
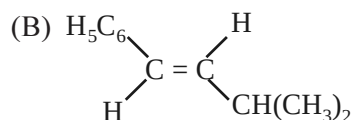
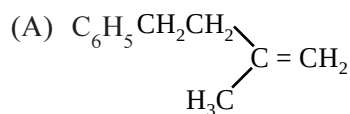
42. Which is the proper reaction to prepare tertiary butyl methyl ether ?
 (A) $\text{CH}_3\text{Br} + (\text{CH}_3)_3\text{CONa} \rightarrow$ (B) $(\text{CH}_3)_3\text{CCl} + \text{CH}_3\text{ONa} \rightarrow$
 (C) $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3\text{Cl} \rightarrow$ (D) $(\text{CH}_3)_3\text{C}-\text{Cl} + \text{CH}_3\text{OH} \rightarrow$
43. Which products are obtained respectively, when $\text{CH}_3\text{OC}_2\text{H}_5$ and $(\text{CH}_3)_3\text{COCH}_3$ are heated with HI ?
 (A) $\text{CH}_3\text{I} + \text{C}_2\text{H}_5\text{OH}$; $\text{CH}_3\text{I} + (\text{CH}_3)_3\text{C}-\text{OH}$ (B) $\text{CH}_3\text{I} + \text{C}_2\text{H}_5\text{OH}$; $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3\text{OH}$
 (C) $\text{CH}_3\text{OH} + \text{C}_2\text{H}_5\text{I}$; $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3\text{OH}$ (D) $\text{CH}_3\text{OH} + \text{C}_2\text{H}_5\text{I}$; $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3\text{I}$
44. $\text{C}_6\text{H}_5\text{OCH}_3 + \text{HBr} \rightarrow$
 (A)  and H_2 (B)  and CH_3Br
 (C)  and CH_3Br (D)  and CH_3OH
45.  example of,
- (A) Wurtz reaction (B) Fittig reaction
 (C) Williamson synthesis (D) Wurtz-Fittig reaction
46. $\text{C}_6\text{H}_5\text{ONa} + \text{CH}_3\text{I} \rightarrow \text{'P'}$ $\xrightarrow[\text{CH}_3\text{COCl}]{\text{anhy. AlCl}_3}$ 'Q' Which are organic products P and Q respectively ?
 (A) phenol, methoxybenzene and acetophenone
 (B) Methoxybenzene, mixture of acetophenone and phenol
 (C) Methoxybenzene, o and p methoxyacetophenone
 (D) Iodobenzene, acetophenone
47. In which of the following compound C – O – C bond angle is maximum ?
 (A) $\text{CH}_3 - \text{O} - \text{CH}_3$ (B) $\text{CH}_3 - \text{O} - \text{C}_2\text{H}_5$
 (C) $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$ (D) $(\text{CH}_3)_2\text{CH} - \text{O} - \text{CH}(\text{CH}_3)_2$

Answers : 42. (A), 43. (B), 44. (C), 45. (C), 46. (C), 47. (D)

● Based on whole Unit :

48.  + $\text{Cl}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \xrightarrow{\text{AlCl}_3} \text{P} \xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) O}_2/\Delta} \text{Q} +$ What are products P and Q respectively ?
 (A)  and $\text{CH}_3\text{CH}_2\text{CHO}$ (B)  and CH_3COCH_3
 (C)  and CH_3COCH_3 (D)  and $\text{CH}_3\text{CH}_2\text{CHO}$
49. From which of the following mixture of substances, two substances can be separated by $\text{NaOH}_{(\text{aq})}$ and $\text{NaHCO}_{3(\text{aq})}$?
 (A) $\text{C}_6\text{H}_5\text{OH}$ and $\text{C}_6\text{H}_5\text{COOH}$ (B) $\text{C}_6\text{H}_5\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{OH}$
 (C) $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{C}_6\text{H}_5\text{COOH}$ (D) $\text{CH}_3\text{CH}_2\text{OH}$ and CH_3OH
50. Which of the following substance cannot form phenol and phenoxide ion ?
 (A) $\text{C}_6\text{H}_5\text{Cl}$ (B) $\text{C}_6\text{H}_5\text{N}_2\text{Cl}$ (C) $\text{C}_6\text{H}_5\text{COOH}$ (D) $\text{C}_6\text{H}_5\text{SO}_3\text{Na}$
51. Which organic product is obtained on heating a mixture of CH_3OH and $\text{C}_2\text{H}_5\text{OH}$ in presence of conc. H_2SO_4 ?
 (A) $\text{CH}_3\text{OC}_2\text{H}_5$ (B) CH_3OCH_3 and $\text{CH}_3\text{OC}_2\text{H}_5$
 (C) $\text{CH}_3\text{OC}_2\text{H}_5$ and $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ (D) CH_3OCH_3 , $\text{CH}_3\text{OC}_2\text{H}_5$ and $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

52. Which is the major product of the following reaction ?



53. o-Nitrophenol is less soluble in water compared to p-Nitrophenol because,

- (A) o-Nitrophenol is more volatile gas than p-Nitrophenol
 (B) Melting point of o-Nitrophenol is more than p-Nitrophenol.
 (C) Intramolecular H-bond is present in o-Nitrophenol
 (D) Molecular mass of o-Nitrophenol is higher

54. Which of the following compounds will not give yellow ppt with the mixture of Iodine and NaOH ?

- (A) Ethanol (B) Methanol (C) Propan-2-ol (D) Butan-2-ol

55. How the following compounds can be arranged in proper order on the basis of their acid strength ?
 (I) Cyclohexanol, (II) Acetic acid, (III) 2,4,6-trinitrophenol (IV) phenol.

- (A) II > III > IV > I (B) III > IV > II > I (C) III > II > IV > I (D) III > II > I > IV

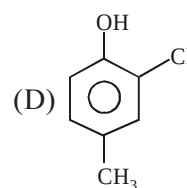
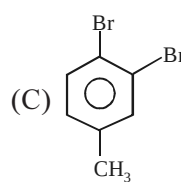
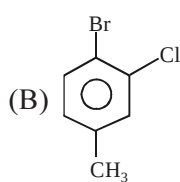
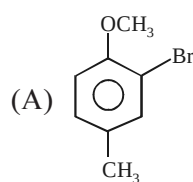
56. Which of the following compound is the strongest acid ?



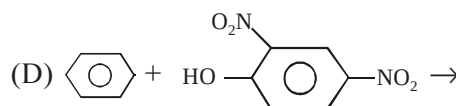
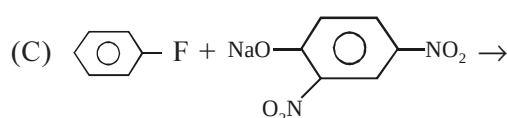
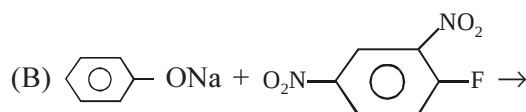
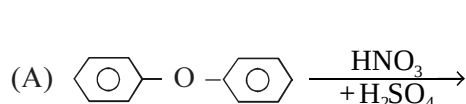
57. Substance 'A' having molecular formula $\text{C}_3\text{H}_8\text{O}$ reacted with 2 mole of HI, X and Y are obtained. Z is obtained on a boiling of Y with aqueous alkali. Substance Z gives iodoform test, then what is substance A ?

- (A) Propan-2-ol (B) Methoxy ethane (C) Propan-1-ol (D) Ethoxy ethane

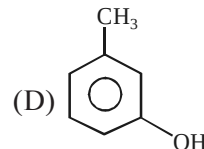
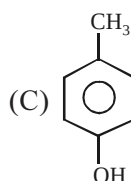
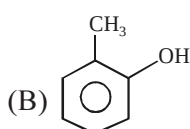
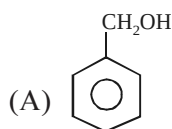
58. Anisole $\xrightarrow[\text{anly. AlCl}_3]{\text{CH}_3\text{Cl}}$ P $\xrightarrow{\text{Cl}_2/\text{FeCl}_3}$ Q $\xrightarrow[\Delta]{\text{HBr}}$ S, What is final product "S" in the reaction ?



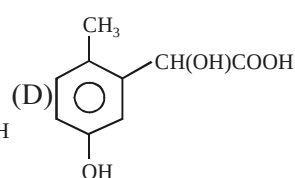
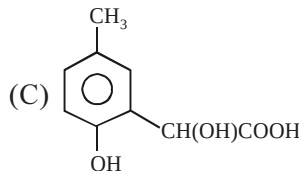
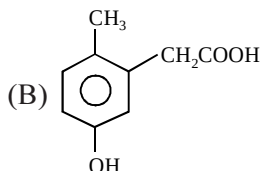
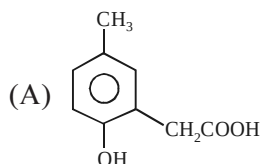
59. To prepare $\text{O}_2\text{N}-\text{C}_6\text{H}_3(\text{NO}_2)_2-\text{O}-\text{C}_6\text{H}_5$ compound which reaction is proper ?



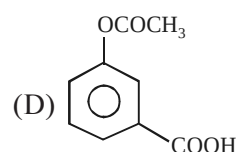
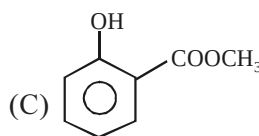
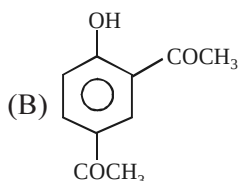
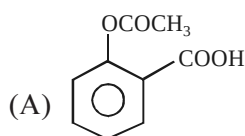
60. Which of the following reaction is possible ?
 (A) $(\text{CH}_3)_3\text{C} - \text{ONa} + (\text{CH}_3)_3\text{C} - \text{Br} \rightarrow (\text{CH}_3)_3\text{C} - \text{O} - \text{C}(\text{CH}_3)_3$
 (B) $(\text{CH}_3)_2\text{CH} - \text{ONa} + (\text{CH}_3)_2\text{CH} - \text{Br} \rightarrow (\text{CH}_3)_2\text{CH} - \text{O} - \text{CH}(\text{CH}_3)_2$
 (C) $\text{C}_6\text{H}_5\text{ONa} + \text{C}_6\text{H}_5\text{Br} \rightarrow \text{C}_6\text{H}_5\text{OC}_6\text{H}_5$
 (D) $\text{C}_6\text{H}_5\text{ONa} + \text{CH}_3\text{Br} \rightarrow \text{C}_6\text{H}_5\text{OCH}_3$
61. Which reagent is useful to obtain cyclohexene from cyclohexanal ?
 (A) Conc. $\text{HCl} + \text{ZnCl}_2$ (B) Conc. H_3PO_4 (C) HBr (D) Conc. HCl
62. Which order is true for reactivity towards Williamson's synthesis ?
 (I) $(\text{CH}_3)_3\text{C} - \text{CH}_2\text{Br}$ (II) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (III) $\text{CH}_2 = \text{CHCH}_2\text{Cl}$ (IV) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
 (A) $\text{III} > \text{II} > \text{IV} > \text{I}$ (B) $\text{I} > \text{II} > \text{IV} > \text{III}$ (C) $\text{II} > \text{III} > \text{IV} > \text{I}$ (D) $\text{I} > \text{III} > \text{II} > \text{IV}$
63. Which of the following substance cannot form iodoform ?
 (A) Isopropyl alcohol (B) 3-Methylbutan-2-ol
 (C) Isobutyl alcohol (D) Ethylmethyl ketone
64. $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{P, I}_2} \text{A} \xrightarrow[\text{ether}]{\text{Mg}} \text{B} \xrightarrow{\text{HCHO}} \text{C} \xrightarrow{\text{H}_2\text{O}} \text{D}$. Final product D in the reaction is =
- (A) n-Butylalcohol (B) n-propylalcohol (C) Propanal (D) Butanal
65. is obtained, when phenol first reacts with conc. H_2SO_4 and then nitric acid.
 (A) Nitrobenzene (B) 2,4,6-triNitrobenzene (C) O-Nitrophenol (D) m-Nitrophenol
66. Which of the following compounds give tribromo derivative on treatment with brominewater ?



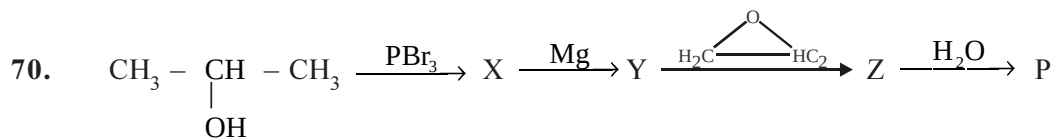
67. p-cresol gives product A on treatment with chloroform in alkali medium. Product B is obtained on a reaction of substance A with HCN . Chiral compound is obtained on hydrolysis of substance B. which compound is chiral ?



68. + $\text{CO}_2 \xrightarrow[5 \text{ atm.}]{125^\circ\text{C}}$ B $\xrightarrow[\text{AC}_2\text{O}]{\text{H}^+}$ C, product c of the reaction is



69. Which of the following alcohol gives lucas test fast ? By which mechanism ?
 (A) Secondary alcohol, SN^1 (B) tertiary alcohol, SN^1
 (C) Secondary alcohol, SN^2 (D) tertiary alcohol, SN^2



Which is the final product 'D' of the reaction ?

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

Answers : 48. (C), 49. (A), 50. (C), 51. (D), 52. (B), 53. (C), 54. (B), 55. (C), 56. (B), 57. (B), 58. (D), 59. (B), 60. (D), 61. (B), 62. (C), 63. (C), 64. (B), 65. (C), 66. (D), 67. (C), 68. (A), 69. (B), 70. (D),

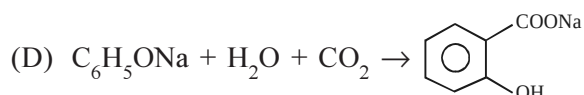
● **Questions having one or more than one option :**

71. From which of the following substances, 2-Methyl-propan-2-ol can be prepared by reaction with methylmagnesium iodide ?
 (A) Propanone (B) Ethyl ethanoate (C) Ethanal (D) Ethylene oxide
72. 1° , 2° and 3° alcohols can be identified by
 (A) $\text{Cu}/573 \text{ K}$ (B) Victor meyer test (C) conc. HCl/ZnCl_2 (D) Brominewater
73. Phenol is less acidic than
 (A) Acetic acid (B) p-methoxy phenol (C) p-Nitrophenol (D) Ethanol
74. Grignard's reagent on treatment with gives alkane.
 (A) Alcohol (B) phenol (C) water (D) Ether
75. By which of the following reaction ether can be prepared ?
 (A) $\text{C}_6\text{H}_5\text{Br} + \text{CH}_3\text{ONa} \rightarrow$ (B) $\text{C}_6\text{H}_5\text{ONa} + \text{CH}_3\text{Br} \rightarrow$
 (C) $(\text{CH}_3)_3\text{CONa} + \text{C}_2\text{H}_5\text{Br} \rightarrow$ (D) $(\text{CH}_3)_3\text{CBr} + \text{C}_2\text{H}_5\text{ONa} \rightarrow$
76. From which of the following reaction phenol can be prepared ?
 (A) By hydrolysis reaction of chlorobenzene with $\text{KOH}_{(\text{aq})}$
 (B) On heating sodiumsalicylate with $\text{NaOH} + \text{CaO}$
 (C) Treatment of cummine hydroperoxide with dilute H_2SO_4
 (D) On heating benzene diazonium salt with dilute H_2SO_4
77. By which of the following, substitution of $-\text{OH}$ group of alcohol cannot be done ?
 (A) SOCl_2 (B) Cl_2 (C) PCl_5 (D) $\text{P} + \text{Cl}_2$
78. Which of the following statements are true ?
 (A) Phenol can easily oxidized than benzene.
 (B) Benzaldehyde and phenol can be separated by NaHSO_3 .
 (C) p-Cresol and benzoic acid can be separated by NaOH .
 (D) Difference between phenol and ethanol can be identified by neutral FeCl_3 .

79. Which of the following statements are correct ?
 (A) 4-Chlorophenol is soluble in aqueous NaOH but 4-chlorobenzaldehyde is not soluble in aqueous NaOH.
 (B) 4-Methylbenzoic acid is soluble in $\text{NaHCO}_{3(\text{aq})}$ but 4-methyl phenol is not soluble in $\text{NaHCO}_{3(\text{aq})}$.
 (C) 2,4,6 trinitrophenol is stronger acid than 4-methyl phenol.
 (D) Difference between o-Cresol and anisole can be identified by aqueous NaOH.

80. Which of the following is acid base reaction ?

- (A) $\text{C}_6\text{H}_5\text{ONa} + \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{CH}_3\text{CH}_2\text{ONa}$
 (B) $\text{C}_6\text{H}_5\text{OH} + \text{NaOH} \rightarrow \text{C}_6\text{H}_5\text{ONa} + \text{H}_2\text{O}$
 (C) $\text{C}_6\text{H}_5\text{ONa} + \text{aqueous HCl} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{NaCl}$



81. Select proper choice by joining column-I having pair of substances and column-II having different substance/test for differentiating substances :

Column-I	Column-II
(p) Methanol and Propan-2-ol	(i) Sodium metal
(q) Phenol and cyclohexanol	(ii) Lucas test
(r) n-butylalcohol and tertiary butylalcohol	(iii) $\text{NaOH} + \text{I}_2$
(s) Functional group isomers having molecular formula $\text{C}_2\text{H}_6\text{O}$	(iv) FeCl_3

- (A) (p)-(iii), (q)-(iv), (r)-(ii), (s)-(i)
 (B) (p)-(ii), (q)-(iii), (r)-(iv), (s)-(i)
 (C) (p)-(iii), (q)-(i), (r)-(ii), (s)-(iv)
 (D) (p)-(ii), (q)-(iv), (r)-(i), (s)-(iii)

82. Select proper choice by joining column-I having reactions with column-II having name of reaction

Column-I	Column-II
(p) $\text{C}_6\text{H}_5\text{ONa} + \text{CH}_3\text{I} \rightarrow$	(i) Kolbe-schmitt reaction
(q) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow[\text{(ii) H}_2\text{O}_2 / \text{OH}]{\text{(i) B}_2\text{H}_6}$	(ii) Reimer-Tiemann reaction
(r) $\text{C}_6\text{H}_5\text{ONa} + \text{CO}_2 \xrightarrow[\text{Pressure}]{\Delta}$	(iii) Williamson synthesis
(s) $\text{C}_6\text{H}_5\text{OH} + \text{CHCl}_3 + \text{NaOH} \rightarrow$	(iv) Hydroboration-oxidation

- (A) (p)-(iii), (q)-(iv), (r)-(ii), (s)-(i) (B) (p)-(iii), (q)-(iv), (r)-(i), (s)-(ii)
 (C) (p)-(ii), (q)-(iii), (r)-(i), (s)-(iv) (D) (p)-(ii), (q)-(iv), (r)-(i), (s)-(iii)

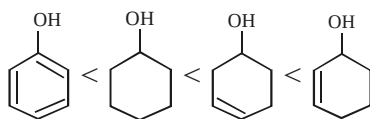
Answers : 71. (A), 72. (A), (B), (C), 73. (A), (C), 74. (A), (B), (C), 75. (B), (C), 76. (B), (C), (D), 77. (B), 78. (A), (B), (C), 79. (A), (B), (C), (D), 80. (B), (C), (D), 81. (A), 82. (B)

- In the following questions two sentences are given. One of them is Assertion (A) and another one is Reason (R). Study sentences carefully and select proper choice according to given below instructions :

Options :

- (A) Both assertion (A) and reason (R) are correct and reason (R), gives correct explanation of assertion (A).
 (B) Both assertion (A) and reason (R) are correct and reason (R), does not give correct explanation of assertion (A).
 (C) Assertion (A) is correct but reason (R) is wrong.
 (D) Assertion (A) is wrong but reason (R) is correct.

83. **Assertion (A)** : Boiling point of alcohol is higher than ether having same molecular mass.
Reason (R) : Alcohol and ether are isomers of each other.
84. **Assertion (A)** : Order of ease of dehydration reaction of following compounds is :



Reason (R) : If -OH group is conjugated with double bond then dehydration is easy.

85. **Assertion (A)** : On heating $C_6H_5CH_2OCH_3$ with HI, $C_6H_5CH_2I$ and CH_3OH are obtained.
Reason (R) : Stability of benzyl carbocation is more than methyl carbocation.

● **Integer type questions** : The answer to each of the following questions is a single digit integer, ranging from 0 to 9.

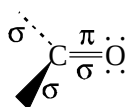
86. How many numbers isomers having molecular formula will give red colouration in Victor-Meyer's test ?
 87. How many grams of dihydrogen gas is involved by complete reaction of 64 gram methanol with sodium metal ?
 88. How many number of of isomers having molecular formula $C_4H_{10}O$ do not react with Na metal ?
 89. On which carbon of benzene ring substitution takes place when phenol is reacted with bromine in presence of carbon disulphide at $0-5^\circ C$?
 90. How many numbers of isomers having molecular formula C_7H_8O do not give violet colour with neutral $FeCl_3$?

Answers : 83. (B) 84. (D), 85. (A), 86. 4 87. 2 88. 3 89. 4 90. 3
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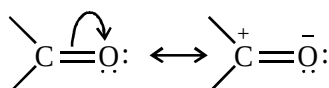
● Carbonyl Compounds

Group containing carbon-oxygen double bond (>C=O) is called carbonyl group. >C=O group containing organic compounds are called carbonyl compounds.

Structure of carbonyl group : Carbon and oxygen have sp^2 hybridisation in carbonyl group. sp^2 hybridised carbon forms three σ -bond with one "O" atom and two other atoms by using its sp^2 hybridised orbitals. These three bonds are arranged in one plane at 120° angle. Carbonyl carbon, overlap its 2p orbital with 2P orbital of "O" atom and forms π -bond. 'O' atom contained two lone pair of electron.

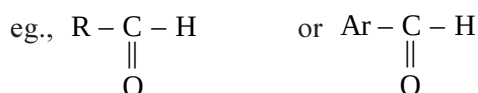


Due to more electronegativity of 'O' atom than "C" atom carbonyl group have high dipole moments.

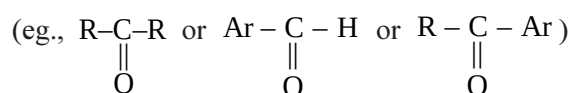


● Aldehyde and Ketone

- When one alkyl (or aryl) group and one H is attached to carbonyl carbon then it is called aldehyde.



- If one alkyl and one aryl groups or two same or different alkyl or aryl groups are attached to carbonyl carbon then it is called ketone.



- $\text{R}-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{R}'$ If R and R' groups in ketone are same then it is called simple ketone but if R

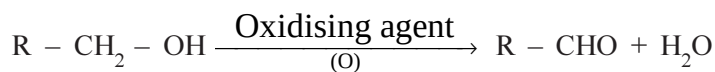
and R' groups are not same then it is called mixed ketone.

- If molecular formula of aldehyde and ketone are same then they exhibit functional group isomerism with each other.

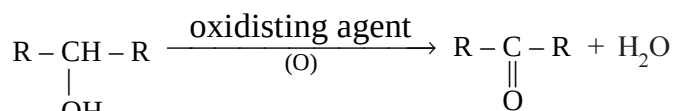
• Preparation of aldehyde and ketone

(A) From alcohol :

(i) Oxidation



1° alcohol



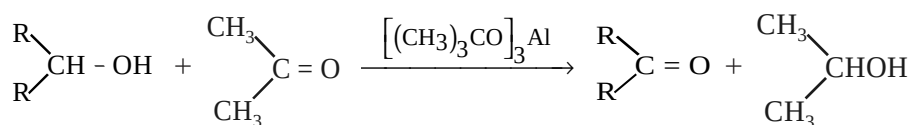
2° alcohol

Strong oxidising agent : Acidic $\text{K}_2\text{Cr}_2\text{O}_7$, alkaline KMnO_4 , $\text{CrO}_3/\text{H}_2\text{SO}_4$ are used for controlled oxidation.

Weak oxidising agent : $\text{CrO}_3 \cdot 2\text{C}_5\text{H}_5\text{N}$ (In pyridine), $\text{CrO}_3 \cdot 2\text{C}_5\text{H}_5\text{N}$ (In CH_2Cl_2),
(Collin's reagent) (Sarett reagent)

By PCC [pyridinium chlorochromate (Corey's reagent)] and PDC (pyridinium dichromate) 1° alcohol can be oxidised into aldehyde.

(ii) Oppenauer oxidation



Saturated or unsaturated

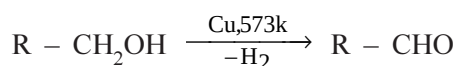
Acetone (excess)

ketone

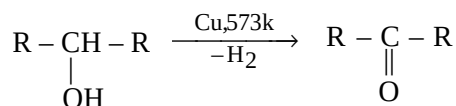
Isopropylalcohol

2° alcohol

(iii) Dehydrogenation

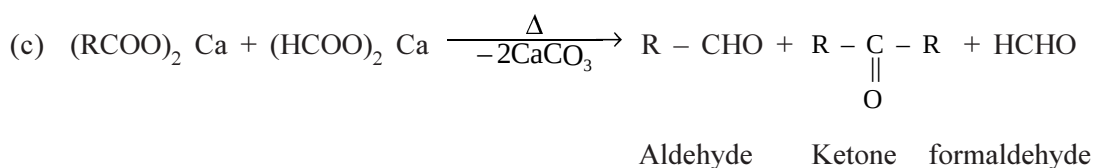
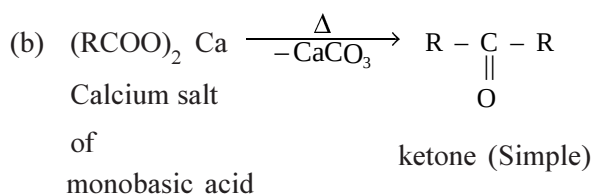
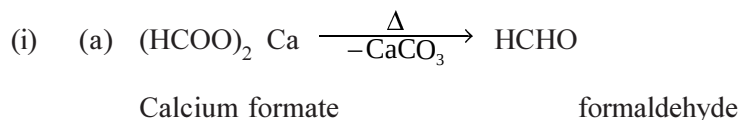


1° alcohol

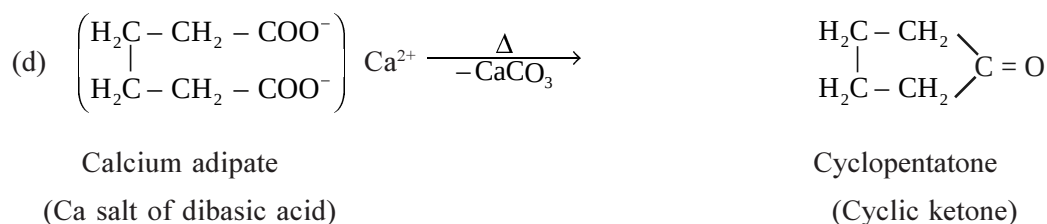


2° alcohol

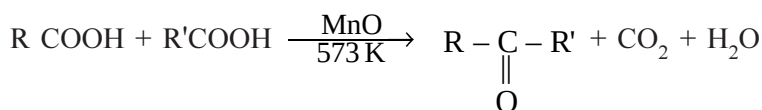
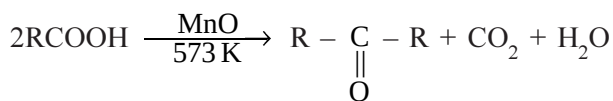
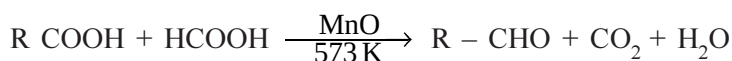
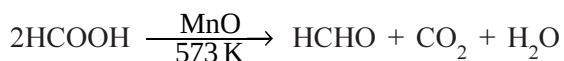
(B) From Carboxylic acid :



Note : In above (b) and (C) reactions $(RCOO)_2 Ca$ is a calcium salt of any monobasic acid except formic acid.

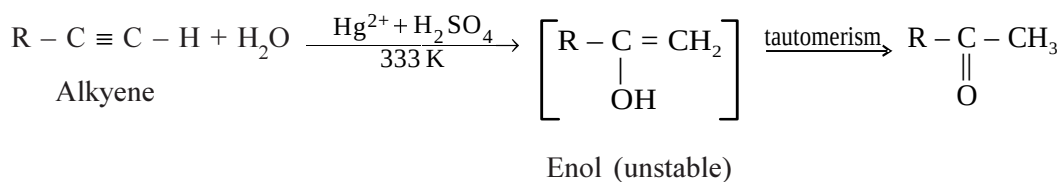


(ii) Aldehyde and Ketone are obtained by passing vapour of acid or vapour mix of different acid over MnO catalyst at 573 K temperature.

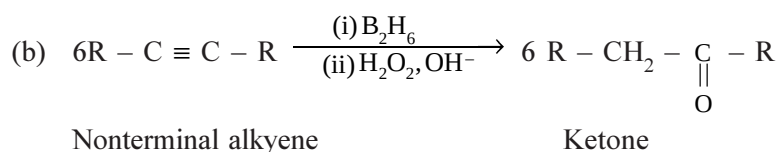
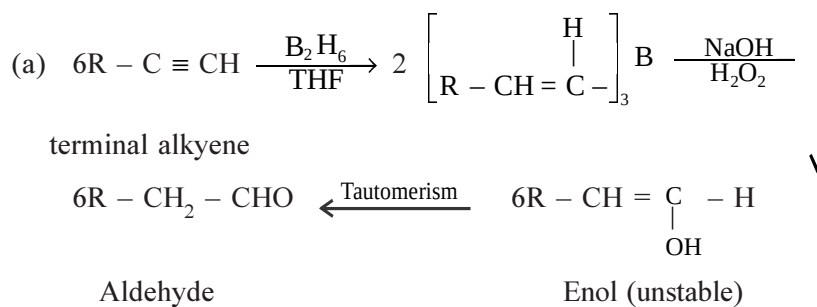


(C) From hydrocarbon :

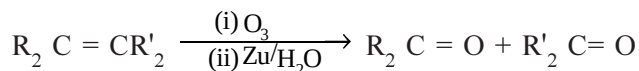
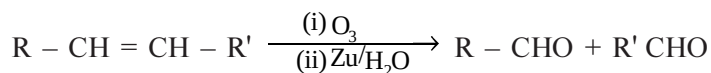
(i) Hydration of alkyene : Ethanol is obtained by hydration of only ethylene, while ketone is obtained by hydration of any alkyene.



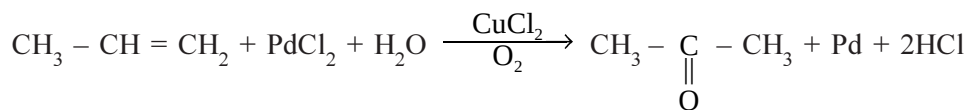
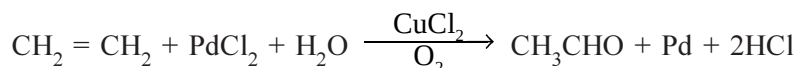
(ii) Hydroboration-oxidation of alkyne :



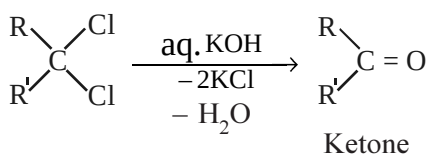
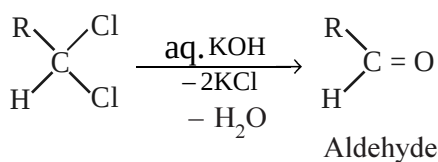
(iii) **Ozonolysis of alkene** : Reaction of alkene with O_3 produces ozonide, which on treatment with $Zn + H_2O$ gives aldehyde and/or ketone based on structure of alkene.



(iv) Oxidation of alkene (Wacker Process) :

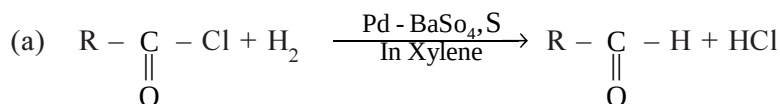


(D) From Gem-Dihalides

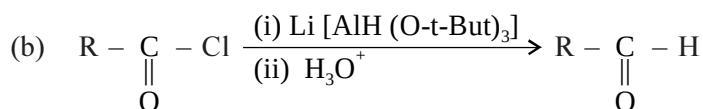


● Preparation of only aldehyde

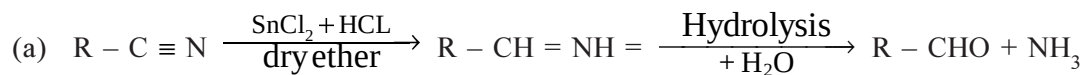
- **Reduction of acylchloride (acid chloride) :**



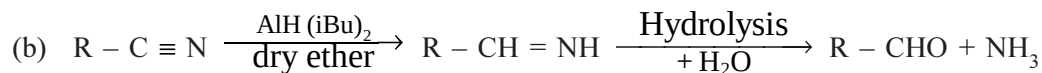
This reaction is called Rosenmund reduction.



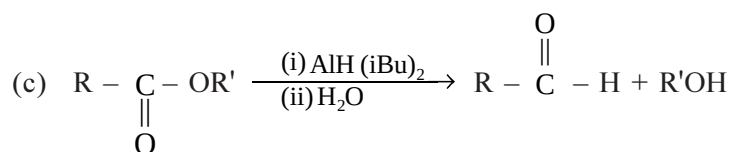
● **Reduction of nitrile and ester**



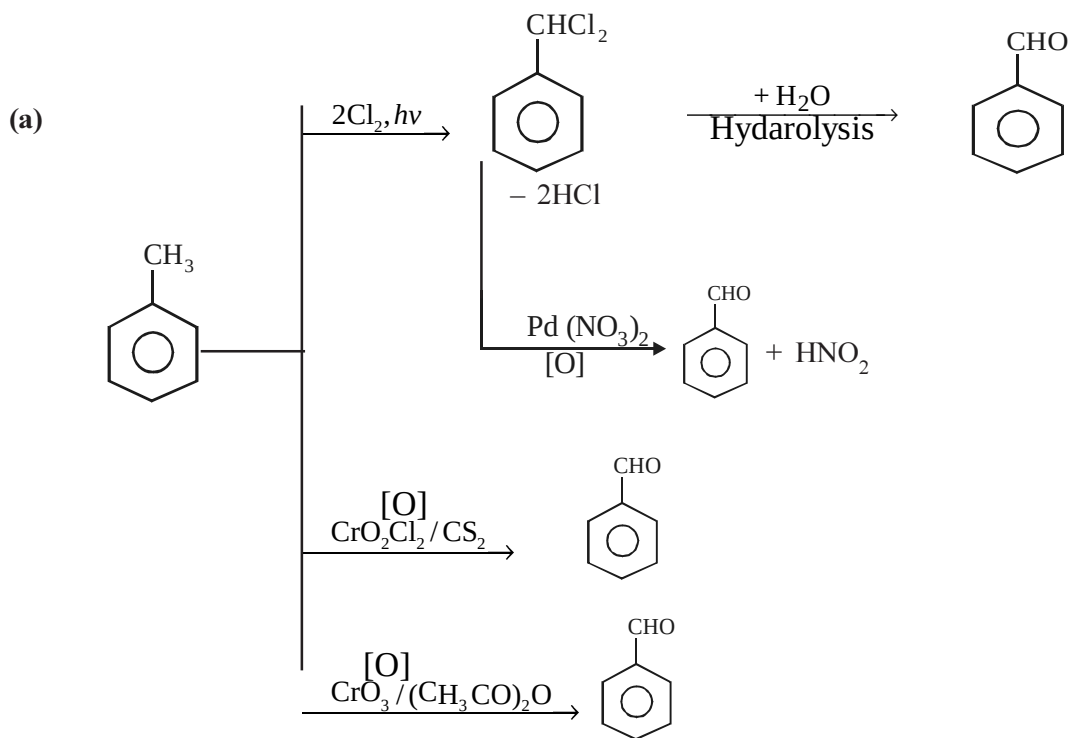
This reaction is called **Stephen reduction**.



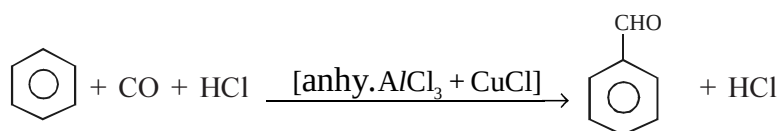
AlH (iBu)₂ – Disobutylaluminium hydride.



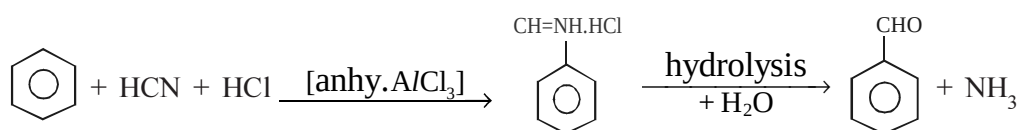
● **From aromatic hydrocarbon**



(b) **Gatterman-Koch reaction :**



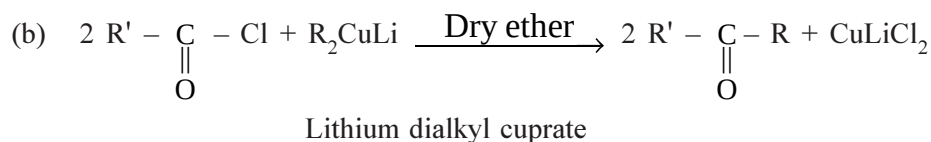
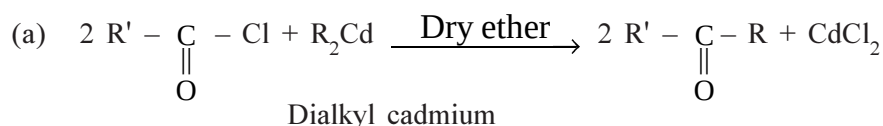
(c) **Gatterman aldehyde synthesis :**



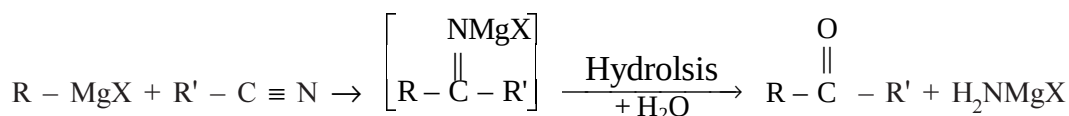
Reimer-Tiemann reaction of phenol : It is mentioned in a reaction of phenol.

● **Synthesis of only ketone**

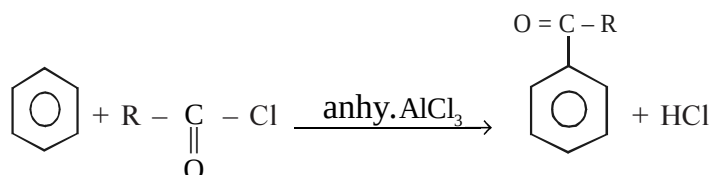
● **From acidchloride :**



● **From Nitrile :**

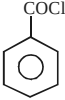
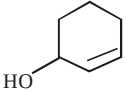
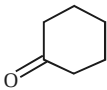
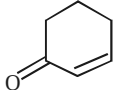
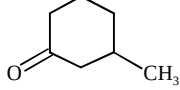


● **Acylation of benzene or substituted benzene**



● **Phenolic ketone is also obtained by rearrangement of phenyl ester (Fries rearrangement). It is given in the reaction of phenol.**

91. One mole of symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44u, the alkene is
 (A) but-2-ene (B) ethene (C) propene (D) but-1-ene
92. Ozonolysis of an organic compound gives formaldehyde based the products. This confirms the presence of
 (A) a vinyl group (B) an isopropyl group
 (C) an acetylene triple bond (D) two ethylenic double bonds
93. $\text{PhC} \equiv \text{C} \cdot \text{Me} \xrightarrow{\text{H}_3\text{O}^+, \text{Hg}^{2+}} \dots\dots$
 (A) $\text{PhCH}_2\text{CH}_2\text{CHO}$ (B) $\text{PhCOCH}_2\text{CH}_3$ (C) $\text{PhCH}_2\text{COCH}_3$ (D) PhCOCOME
94. Which reagent is useful to introduce formyl group in benzene ring ?
 (A) $\text{CrO}_2\text{Cl}_2/(\text{CH}_3\text{CO})_2\text{O}$ (B) $\text{CHCl}_3 + \text{KOH}$
 (C) $\text{CO} + \text{HCl}$ (D) acidic KMnO_4
95. substance on heating with aqueous KOH gives acetaldehyde.
 (A) $\text{CH}_3\text{CH}_2\text{Cl}$ (B) $\text{CH}_2\text{Cl} \cdot \text{CH}_2\text{Cl}$ (C) CH_3CHCl_2 (D) CH_3COCl
96. $\text{CH}_3\text{CH}_2 - \text{C} \equiv \text{N} \xrightarrow{\text{"X"}} \text{CH}_3\text{CH}_2 - \text{CHO}$ what is reagent "X" in the reaction ?
 (A) $\text{SnCl}_2/\text{HCl}, \text{H}_2\text{O}/\Delta$ (B) $\text{H}_2/\text{Pd}-\text{BaSO}_4$ (C) $\text{LiAlH}_4/\text{Ether}$ (D) $\text{NaBH}_4/\text{Ether}, \text{H}_3\text{O}^+$
97. The dipole moment is the highest for
 (A) trans but-2-ene (B) 1, 3-dimethylbenzene
 (C) acetophenone (D) ethanol

98.  $\xrightarrow{\text{H}_2, \text{Pd-BaSO}_4}$ Which one is the organic product of reaction ?
 (A) $\text{C}_6\text{H}_5\text{CHO}$ (B) $\text{C}_6\text{H}_5\text{OH}$ (C) $\text{C}_6\text{H}_5\text{COCH}_3$ (D) $\text{C}_6\text{H}_5\text{Cl}$
99.  $\xrightarrow[\text{acetone}]{\text{Aluminium tertiary butoxide}}$
 (A)  (B)  (C)  (D) 
100. Which substance is required to convert Grignard reagent into aldehyde ?
 (A) Ethyl formate (B) Ethyl acetate
 (C) Ethyl cyanide (D) Hydrogen cyanide
101. Calcium acetate on heating gives distilled product.
 (A) acetaldehyde and calcium oxide (B) Calcium carbonate and acetic acid
 (C) acetone and calcium carbonate (D) calcium oxide and CO_2
102. $\text{CH}_3 - \underset{\text{OH}}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_2 - \text{OH} \xrightarrow{\text{H}_2\text{SO}_4}$
 (A) $(\text{CH}_3)_2\text{C}=\text{CH}_2$ (B) $\text{CH}_3\cdot\text{CH}_2\cdot\text{CO}\cdot\text{CH}_3$
 (C) $(\text{CH}_3)_2\underset{\text{OH}}{\text{C}} - \text{CHO}$ (D) $(\text{CH}_3)_2\text{CH}-\text{CHO}$
103. Which of the following factors increases polarity of >C=O group ?
 (i) Presence of positive inductive effect creating group
 (ii) Presence of negative inductive effect creating group
 (iii) Presence of large alkyl group
 (A) Only (i) (B) Only (ii) (C) (ii) and (iii) (D) (i) and (ii)

Answers : 92. (A), 93. (B), 94. (C), 95. (C), 96. (A), 97. (C), 98. (A), 99. (C), 100. (D), 101. (C), 102. (D), 103. (B)

● Physical Properties

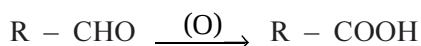
- Order of boiling point for organic compounds having almost equal molecular mass is :
 Carboxylic acid > alcohol > isomeric ketone > isomeric aldehydes > ether > hydrocarbon
- Due to polar nature of >C=O group, in aldehyde and ketone compounds dipole attraction force is present.
- Lower molecular mass containing aldehyde and ketone compounds are water soluble due to formation of intermolecular H-bond with water.

● **Chemical properties**

● **Oxidation**

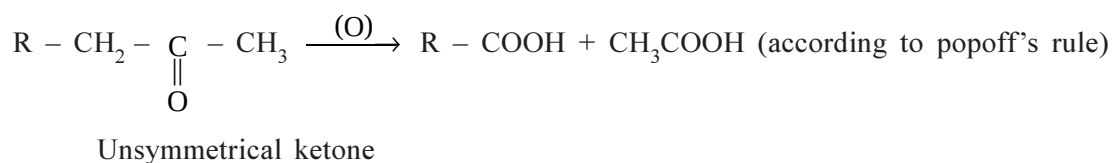
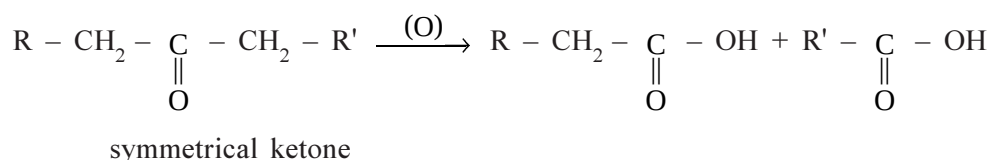
(i) **Oxidation of aldehyde :**

- By weak oxidising agent like, Tollen's reagent (ammonical silver nitrate), Fehling's reagent (alkaline solution of Cu^{2+} complexed with tartrate ion) and Benedict's reagent (alkaline solution of Cu^{2+} complexed with citrate ion) aldehyde oxidised into corresponding acid.
- Oxidation of aldehyde into corresponding acid is also possible by strong oxidising agent like, conc. HNO_3 , $\text{KMnO}_4 / \text{H}^+$, $\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}^+$.



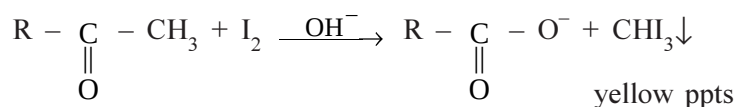
(ii) **Oxidation of Ketone :**

- (a) Only by strong oxidising agent ketone oxidised into acid having lower number of carbons than original compound.

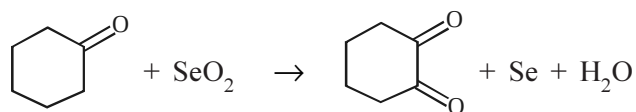


(iii) **Oxidation of aldehyde and ketone**

- (a) $\text{CH}_3 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} -$ group containing (only ethanol or any ketone) compound gives yellow ppts. of iodoform on oxidation by NaOI or $(\text{NaOH} + \text{I}_2)$.

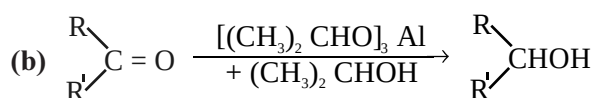
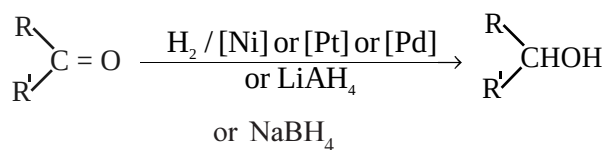
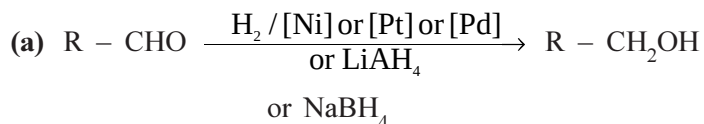


- (b) $\text{CH}_3 - \text{CHO} + \text{SeO}_2 \rightarrow \text{OHC} - \text{CHO} + \text{Se} + \text{H}_2\text{O}$
 $\text{CH}_3 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{CH}_3 + \text{SeO}_2 \rightarrow \text{CH}_3\text{CO} - \text{CHO} + \text{Se} + \text{H}_2\text{O}$

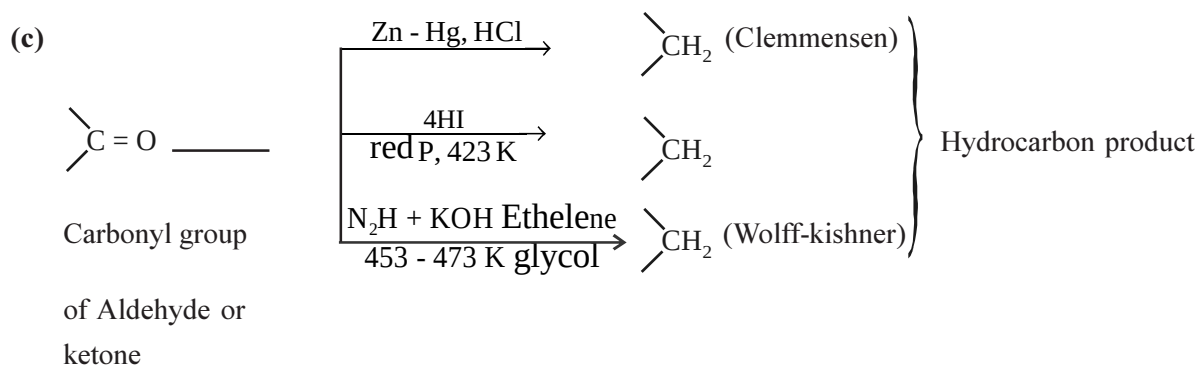


In above reaction $[\text{CH}_3 -]$ Or $[- \text{CH}_2 -]$ group, which are neighbour of $\text{>C} = \text{O}$ group oxidised into $\text{>C} = \text{O}$ group.

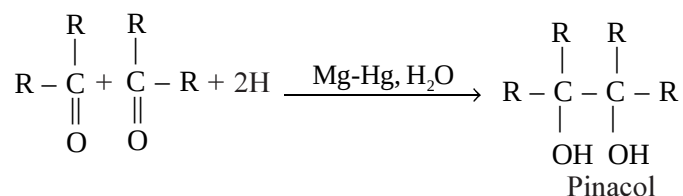
● Reduction



This reaction is called Meerwein Ponndorf verley reduction.



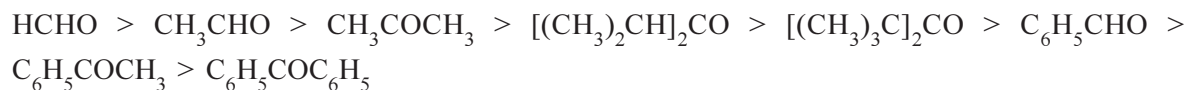
(d) Bimolecular reduction of Ketone :



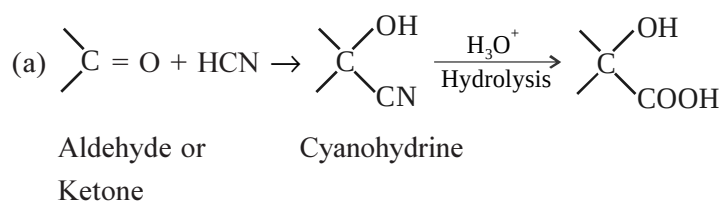
● Nucleophilic addition reaction

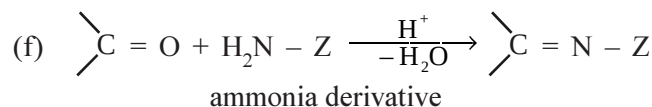
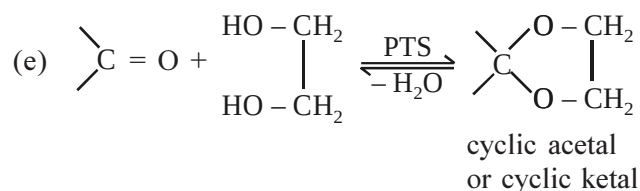
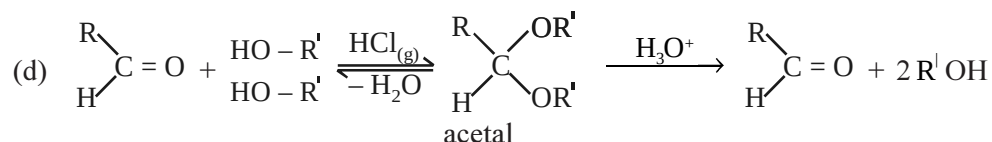
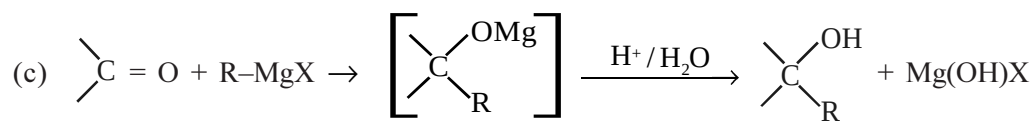
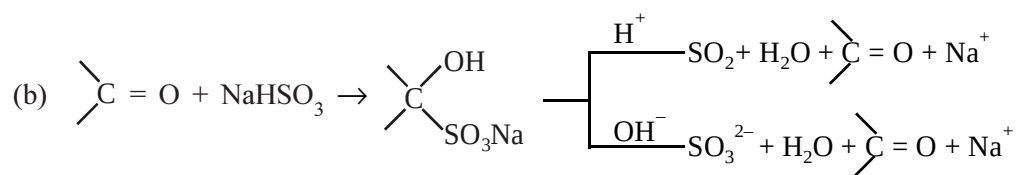
- $\begin{array}{c} \diagdown \\ \text{C} = \text{O} \\ \diagup \end{array}$ group in aldehyde and ketone is polar and 'O' is negative charged and 'C' is positive charged. So nucleophile is attracted towards 'C' and gives addition product.
- Reactivity towards nucleophilic addition reaction of aldehyde and ketone depend on steric hindrance and inductive effect.

• Order of reactivity :



• Some nucleophilic addition reactions :

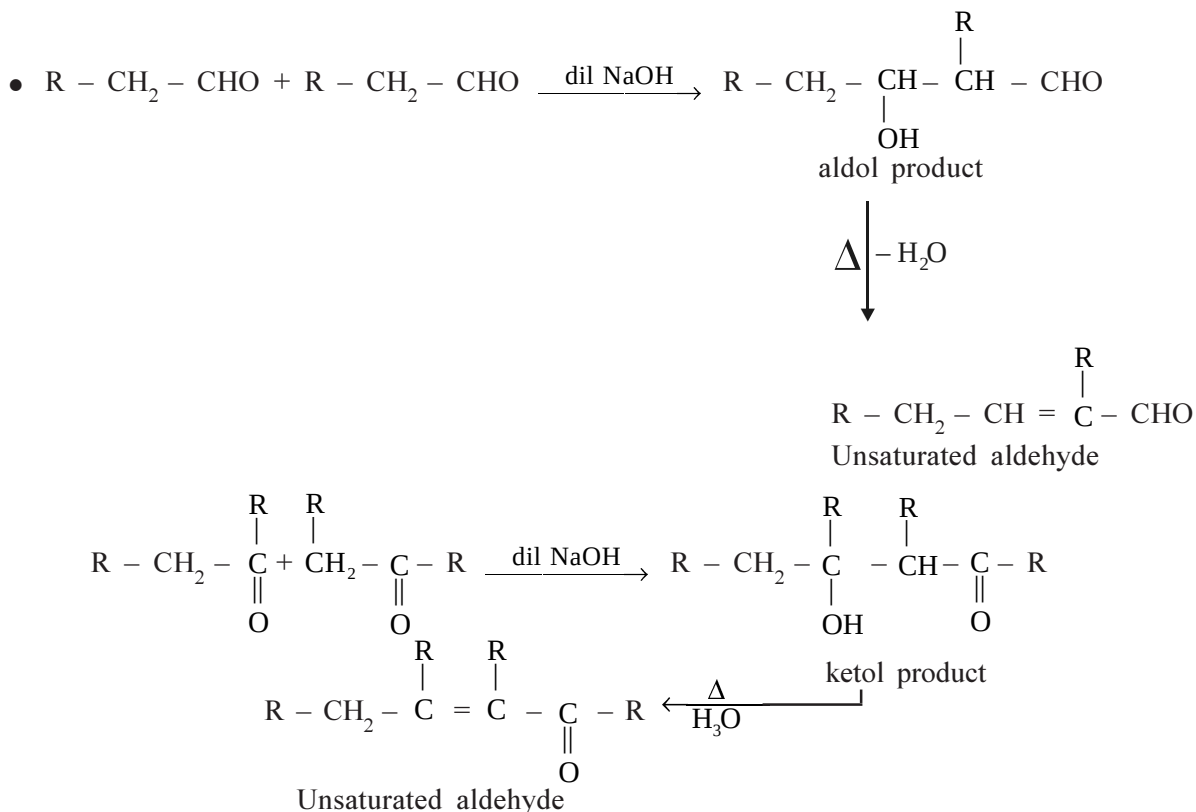




● Aldol condensation

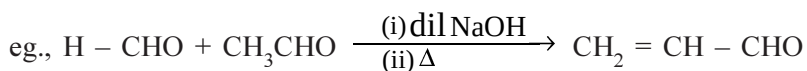
- Due to presence of acidic hydrogen on α -carbon in aldehyde and ketone, it reacts with alkali. So aldehyde and ketone gives condensation reaction.

(a) Self condensation : α -Hydrogen containing aldehyde or ketone on reaction gives β -hydroxy aldehyde or ketone in presence of dil alkali.

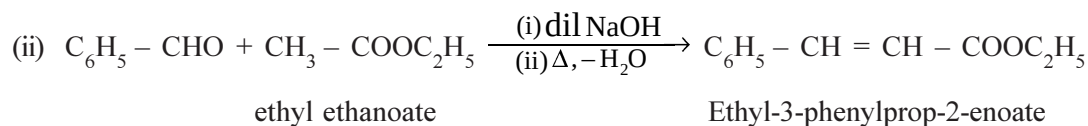


Note : In above reactions **R = H** or **alkyl** or **aryl** group.

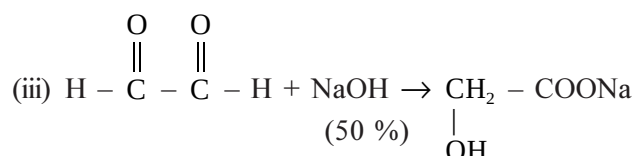
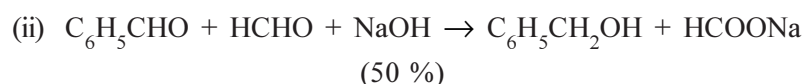
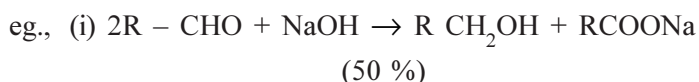
- If in two different aldehydes or ketones or one aldehyde and one ketone compounds, one compound does not contain $\alpha - \text{H}$ atom then only one product is obtained due to cross aldol condensation.

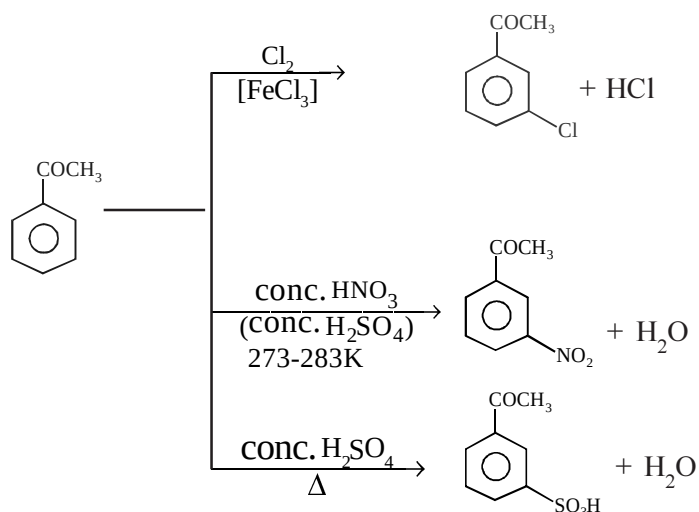

$$\text{eg., (i) } \text{C}_6\text{H}_5 - \text{CHO} + \text{CH}_3 - \text{CO} - \text{CH}_3 \xrightarrow[\text{(ii) } \Delta, -\text{H}_2\text{O}]{\text{(i) dil NaOH}} \text{C}_6\text{H}_5 - \text{CH} = \text{CH} - \text{CO} - \text{CH}_3$$

4 - phenyl but-3-en-2-on



- Aldehyde which do not have α -H atom when treated with strong alkali, due to disproportion gives alcohol and acid product. This reaction is called Cannizzaro reaction.





Note : >C=O group reacts with anhy. AlCl_3 . So, that aromatic aldehydes and ketones do not give Friedel-Crafts reaction.

● Reactions showing difference between aldehyde and ketone.

Test	Aldehyde	Ketone
(i) Tollen's reagent	silver mirror	no reaction
(ii) Fehling's reagent	red ppts. of Cu_2O (only aliphatic aldehyde)	no reaction
(iii) Benedict's reagent	red ppts of Cu_2O (only R-CHO)	no reaction
(iv) Reduction by LiAlH_4	1° alcohol	2° alcohol
(v) Reaction with alcohol in presence of HCl gas	acetal	no reaction
(vi) Schiff's reagent	pink colour	no reaction

104. Methyl ketone can be identified by

- (A) Schiff's reagent (B) $\text{NaOH} + \text{I}_2$ reagent
(C) alkaline Cu^{2+} reagent (D) ammonical AgNO_3 reagent

105. Which compound does not give alcohol and salt of acid on treatment with concentrated alkali ?

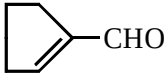
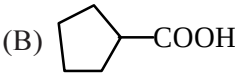
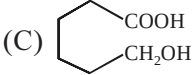
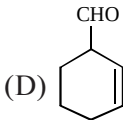
- (A) Formaldehyde (B) Acetaldehyde (C) Trichloroethanol (D) Benzaldehyde

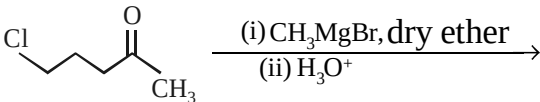
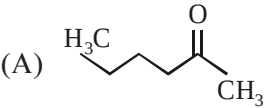
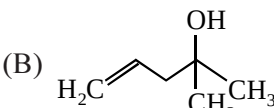
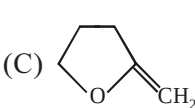
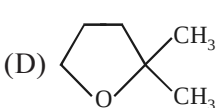
106. compound is obtained, when acetophenone and hydrazine is heated at 453 K temp with KOH in ethylene glycol.

- (A) $\text{C}_6\text{H}_5\text{COOH}$ (B) $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ (C) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3$ (D) $\text{C}_6\text{H}_5\text{COCH}_3$

107. On arranging in increasing order of boiling point which of the following compounds comes second position ?

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ (B) $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$ (C) $(\text{C}_2\text{H}_5)_2\text{O}$ (D) $\text{CH}_3\cdot(\text{CH}_2)_3\cdot\text{CH}_3$

108. Which reactivity order is correct towards addition reaction with HCN of following compounds ?
 I : CH_3CHO , II : CH_3COCH_3 , III : $\text{C}_6\text{H}_5\text{COCH}_3$, IV : HCHO
 (A) $\text{III} < \text{II} < \text{I} < \text{IV}$ (B) $\text{IV} < \text{I} < \text{II} < \text{III}$ (C) $\text{III} < \text{I} < \text{II} < \text{IV}$ (D) $\text{IV} < \text{II} < \text{I} < \text{III}$
109. Which of the following reagent does not react with acetone and benzaldehyde ?
 (A) Sodium hydrogensulphite (B) Phenyl hydrazine
 (C) Fehling's solution (D) Grignard reagent
110. Calcium acetate $\xrightarrow{\Delta}$ x $\xrightarrow{\text{Zn-Hg} + \text{HCl}}$ y what is final product Y in the reaction ?
 (A) Penten dial (B) Cyclopentanal (C) Cyclopentanol (D) Cyclopentanone
111. Substance 'X' + $\text{HCN} \rightarrow \text{Y} \xrightarrow{\text{H}_2\text{O}}$ mixture of α -hydroxy acid. What is substance 'X' in this reaction ?
 (A) HCHO (B) CH_3CHO (C) CH_3COCH_3 (D) $\text{C}_6\text{H}_5\text{COC}_6\text{H}_5$
112. Which reagent is necessary to separate CH_3CHO from mixture of CH_3CHO and $\text{C}_6\text{H}_5\text{COCH}_3$?
 (A) NaHSO_3 (B) $\text{C}_6\text{H}_5\text{NHNH}_2$ (C) NH_2OH (D) $\text{NaOH} + \text{I}_2$
113. $\text{CH}_3\text{CHO} + \text{H}_2\text{N} - \text{OH} \xrightarrow{[\text{H}^+]}$ $\text{CH}_3\text{CH} = \text{N} - \text{OH}$ reaction is of which type ?
 (A) Electrophilic addition-elimination reaction (B) Free radical addition-elimination reaction
 (C) Electrophilic elimination reaction (D) Nucleophilic addition reaction
114. $\text{HO} - \text{C}_6\text{H}_{10} - \text{CH} = \text{CHCOCH}_3 \rightarrow \text{HO} - \text{C}_6\text{H}_{10} - \text{CH} = \text{CHCH}_2\text{CH}_3$ which reagent is proper for the reaction ?
 (A) Zn-Hg/HCl (B) $\text{NH}_2\cdot\text{NH}_2/\text{OH}^-$ (C) NaBH_4 (D) Liquid NH_3 and Na
115. By the help of which reagent difference between butanone and pentan-3-one can be identified ?
 (A) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$ (B) Zn-Hg/HCl (C) SeO_2 (D) $\text{I}_2 + \text{NaOH}$
116. Strong base can attract α -hydrogen from
 (A) ketone (B) alkane (C) alkene (D) amine
117.  $\xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3}$ x $\xrightarrow[\text{NaOH}]{\text{dil}}$ Y, which is the final organic product 'Y' ?
 (A)  (B)  (C)  (D) 
118. By which of the following reactions only one organic product, 3-hydroxy butanal is obtained ?
 (A) $\text{CH}_3\text{CHO} + (\text{CH}_3)_2\text{CO} \xrightarrow{\text{dil NaOH}}$ (B) $\text{CH}_3\text{CHO} + \text{CH}_3\text{CHO} \xrightarrow{\text{dil NaOH}}$
 (C) $(\text{CH}_3)_2\text{CO} + (\text{CH}_3)_2\text{CO} \xrightarrow{\text{dil NaOH}}$ (D) $\text{CH}_3\text{CHO} + \text{CH}_3\text{CHO} \xrightarrow{\text{dil NaOH}}$

119. $(\text{CH}_3)_3\text{C}-\text{CHO} + \text{CH}_3\text{CH}_2\text{CHO} \xrightarrow[\text{(ii) } -\text{H}_2\text{O}]{\text{(i) } \text{OH}^-} \text{x} \xrightarrow{\text{NaBH}_4} \text{which is product Y of the reaction ?}$
- (A) $(\text{CH}_3)_3\text{C}-\text{CH}=\text{CHCH}_2\text{CH}_2\text{OH}$ (B) $(\text{CH}_3)_3\text{C}-\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CH}_2\text{OH}$
- (C) $(\text{CH}_3)_3\text{C}-\text{CH}_2-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2\text{OH}$ (D) $(\text{CH}_3)_3\text{C}-\text{CH}_2-\text{CH}_2\text{CH}_2\text{OH}$
120. By which reagent conversion of butan-2-one into propanoic acid can be done ?
- (A) NaOH, NaI/H⁺ (B) Fehling's reagent (C) NaOH, I₂/H⁺ (D) Tollen's reagent
121. On heating the mixture of benzaldehyde and formaldehyde with aq. NaOH (50%) solution gives
- (A) benzyl alcohol and sodiumformate (B) sodium benzoate and methylalcohol
- (C) sodium benzoate and sodiumformate (D) benzylalcohol and methanol
122. $\text{CH}_3-\text{CH}_2-\text{CO}-\text{CH}_3 \xrightarrow{\text{CN}^-} \text{x} \xrightarrow{95\% \text{H}_2\text{SO}_4} \text{y}$, what is product y of reaction ?
- (A) $\text{CH}_3-\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{COOH}$ (B) $\text{CH}_3-\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CN}$
- (C) $\text{CH}_3-\text{CH}_2-\underset{\text{CH}_3}{\text{C}}(\text{OH})-\text{COOH}$ (D) $\text{CH}_3-\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CO}-\text{NH}_2$
123. 
- (A)  (B)  (C)  (D) 

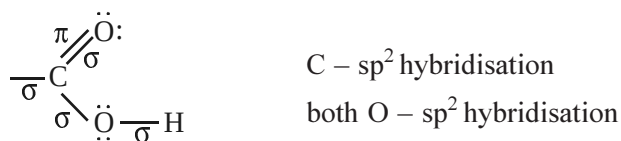
Answers : 104. (B), 105. (B), 106. (C), 107. (C), 108. (A), 109. (C), 110. (D), 111. (B), 112. (A), 113. (D), 114. (B), 115. (D), 116. (A), 117. (A), 118. (D), 119. (B), 120. (C), 121. (A), 122. (A), 123. (D)

● Carboxylic acid

When one alkyl or aryl group and another hydroxyl group is attached to carbonyl carbon of carbonyl group $\left(\text{>C=O} \right)$, then compounds are called carboxylic acid compounds. In these compounds $-\text{COOH}$ group (carboxyl group) is present.



● Structure of $-\text{COOH}$ group

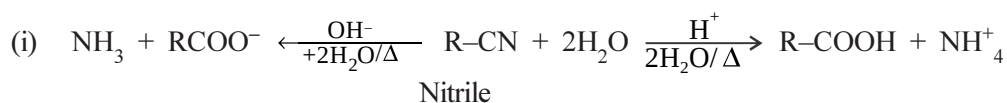


planar structure

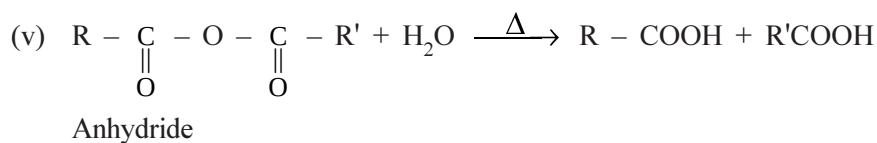
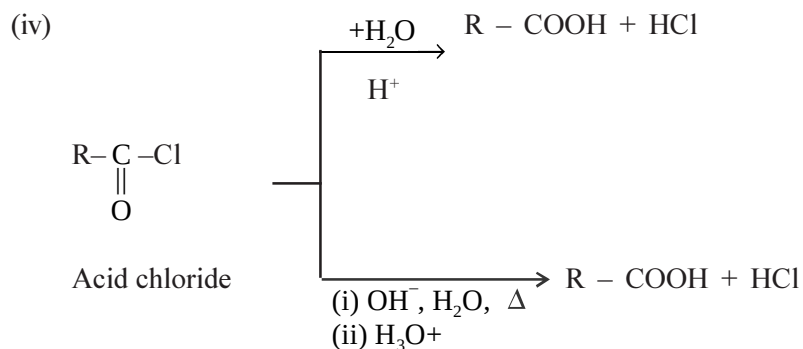
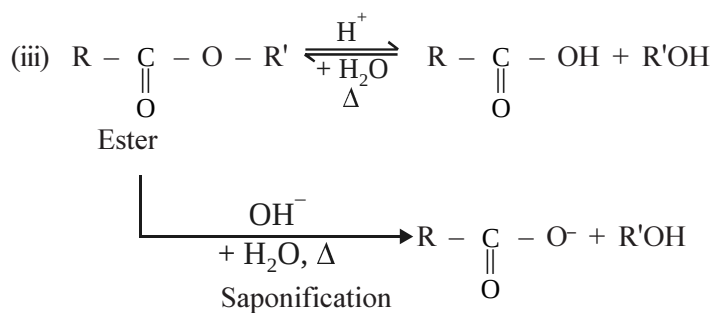
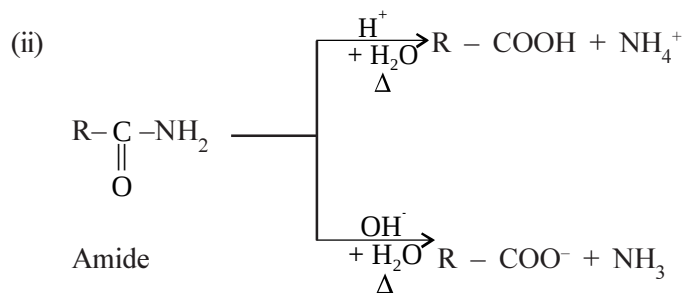
- In aldehyde and ketone carbonyl carbon is less electrophile than carboxylic carbon of acid.

● **Preparation of carboxylic acid**

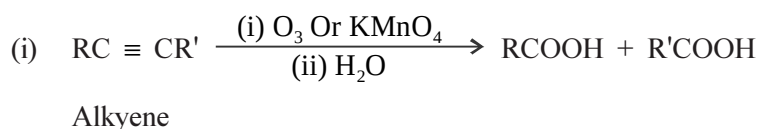
- Oxidation of aldehyde, ketone, methyl ketone and alcohol (1°, 2°) :
- This is mentioned ahead in the chapter.
- **By hydrolysis reaction :**

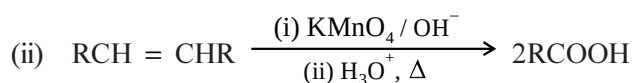


● **Intermediate amide is obtained in the above reaction.**

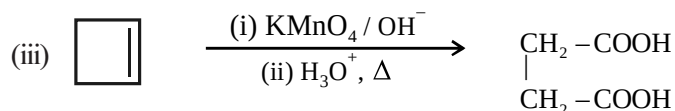


● **Oxidation of alkene, alkyene and cyclo alkene :**



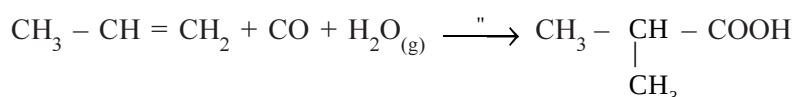
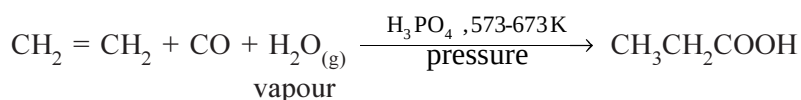


Alkene

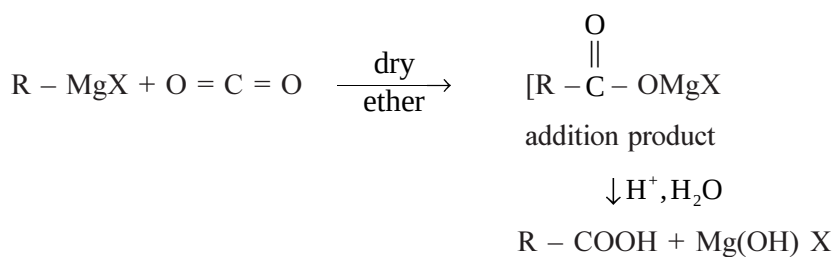


Cyclic alkene

• **From olefins (Koch reaction) :**



• **From Grignard reagent :**

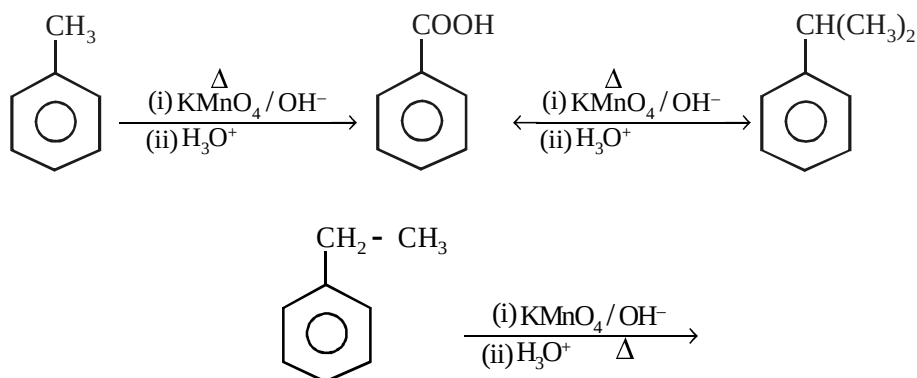


• **From sodiualcalcoxide :**

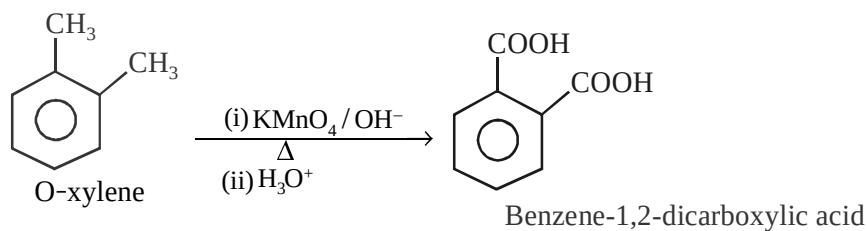


• **Oxidation of alkylbenzene :**

(i) Monoalkyl benzene



(ii) Dialkyl benzene



124. Substance 'X' $\xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) CO}_2, \text{dry ether}}$ -CH₂COOH what is the substance "X" in the reaction ?

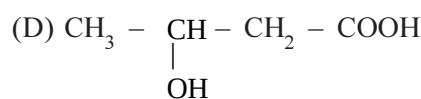
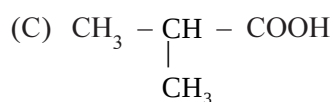
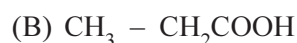
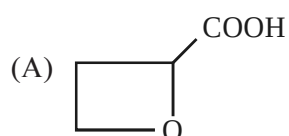
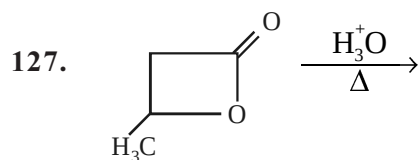
- (A) C₆H₅MgBr (B) C₆H₅OH (C) C₆H₅CH₂MgBr (D) C₆H₅CHO

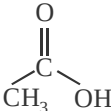
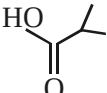
125. On hydrolysis of which substance benzoic acid cannot be prepared ?

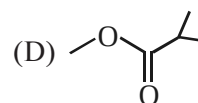
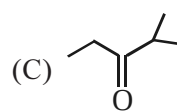
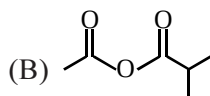
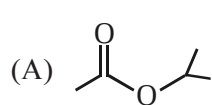
- (A) Ethylbenzene (B) Phenylcyanide (C) Methylbenzoate (D) Benzylchloride

126. R-CH₂-OH $\xrightarrow{\text{"X"}}$ R-CH₂Cl $\xrightarrow{\text{KCN}}$ 'y' $\xrightarrow{\text{"Z"}}$ R-CH₂COOH Mention substances X, Y and Z in the reaction.

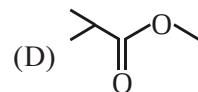
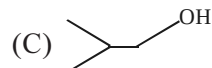
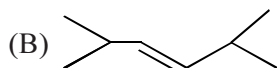
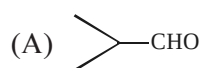
- | x | y | z |
|----------------------|---------------------|--------------------------------------|
| (A) PCl ₅ | RCH ₂ CN | H ⁺ , 2H ₂ O |
| (B) HCl | RCN | OH ⁻ , +2H ₂ O |
| (C) PCl ₃ | RCH ₂ NC | KMnO ₄ / OH ⁻ |
| (D) Cl ₂ | RCH ₂ CN | OH ⁻ , +2H ₂ O |

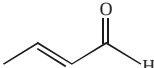


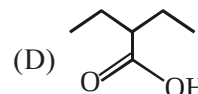
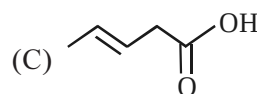
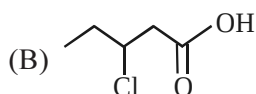
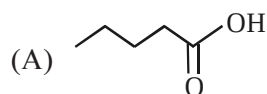
128.  and  which of the following substances should be hydrolyzed ?



129. Which substance on oxidation by acidic or basic KMnO₄ does not give isobutyric acid ?



130.  $\xrightarrow{\text{NaBH}_4}$ 'P' $\xrightarrow{\text{ZnCl}_2 + \text{HCl}}$ 'Q' $\xrightarrow{\text{KCN}}$ 'R' $\xrightarrow{\text{H}_3\text{O}^+}$ which is final product 's' in the reaction ?



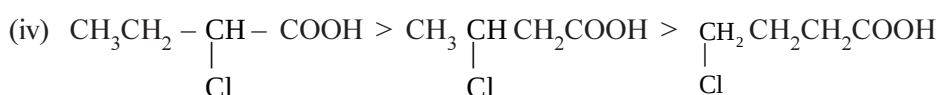
Answers : 124. (B), 125. (A), 126. (A), 127. (D), 128. (B), 129. (D), 130. (C)

● **Physical properties of carboxylic acids**

- RCOOH forms intermolecular H-bond with water, lower molecular mass containing acids are soluble in water.
- Due to formation of stronger H-bond between mole of RCOOH, they have higher boiling point. It exist as dimer in vapourphase.

● **Acidic nature of carboxylic acid**

- RCOOH can be neutralize by strong and weak base. CO_2 gas is produce during the reaction of RCOOH with NaHCO_3 or Na_2CO_3 in labouratary.
- Stability of RCOO^- is more than $\text{C}_6\text{H}_5\text{O}^-$. So that, RCOOH is stronger acid than phenol.
- The acidic strength of different aliphatic corboxylic acid depends on + I or – I effect of substituent group, which is mentioned in the following examples :

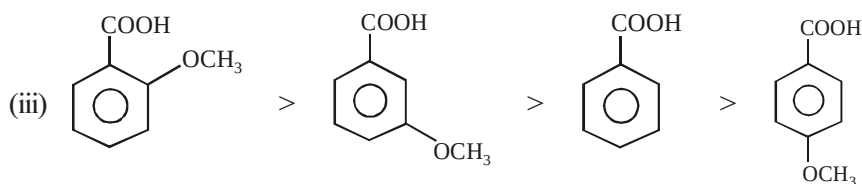
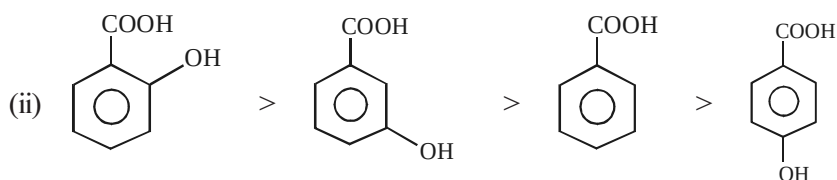
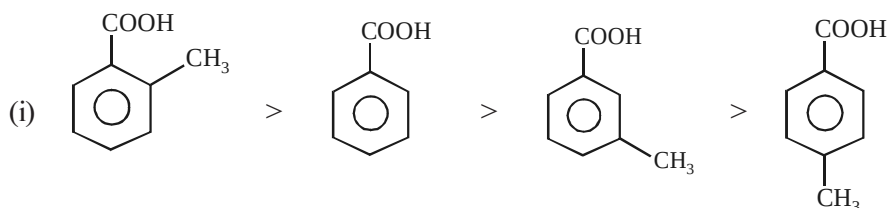
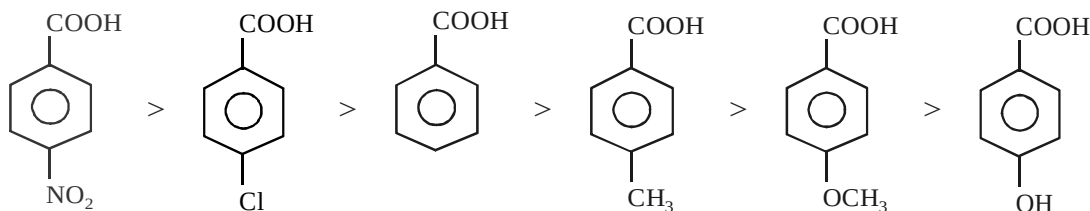


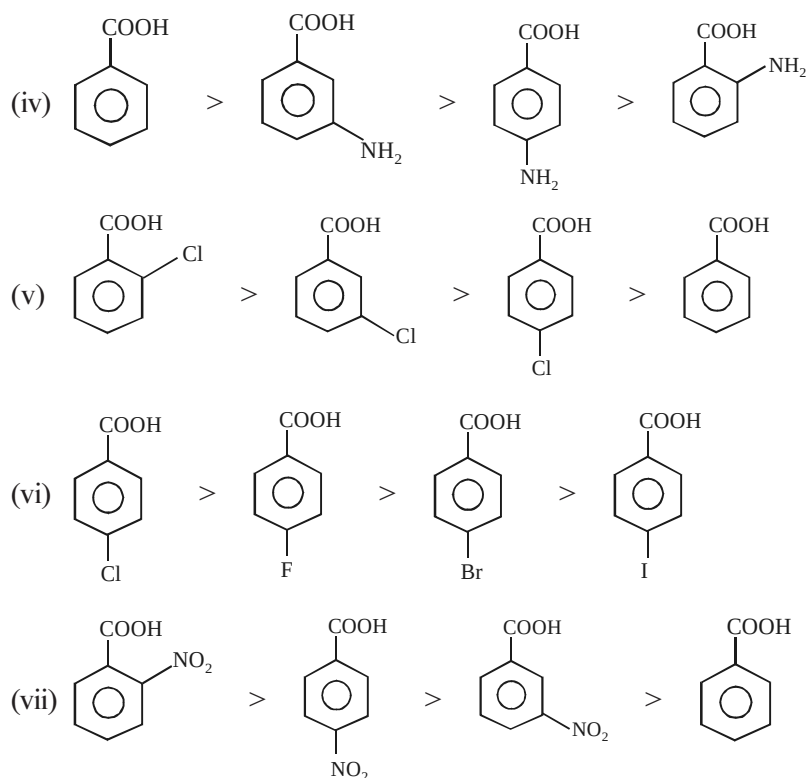
● **Order in general form :**



● **Order of acidic strength for different substituted aromatic carboxylic acid is as under :**

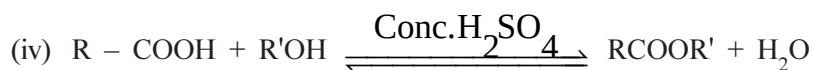
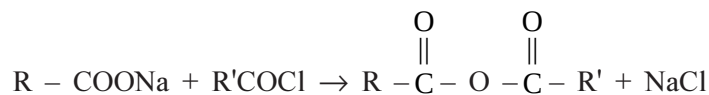
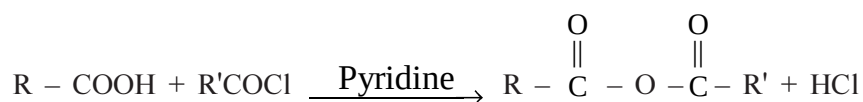
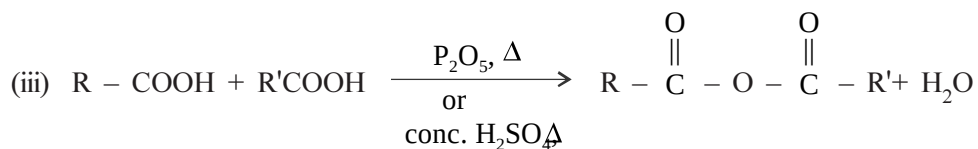
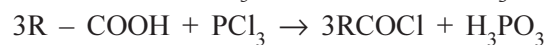
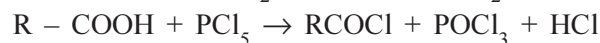
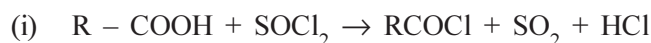
(Resonance effect should not be consider at m-position)





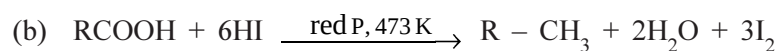
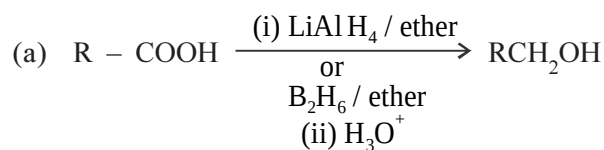
● **Reaction involving cleavage of C – OH bond**

(Preparation of derivatives of carboxylic acid)

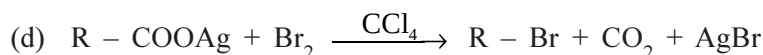
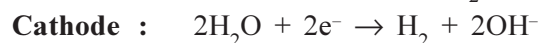
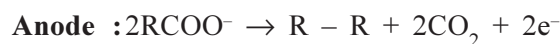
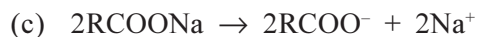
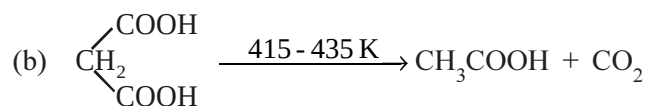
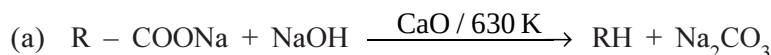


● **Reaction involving – COOH group as a whole :**

(i) Reduction :

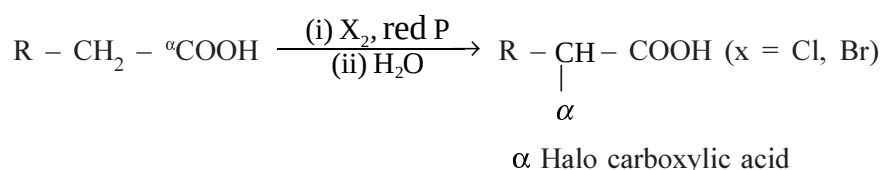


(ii) Decarboxylation



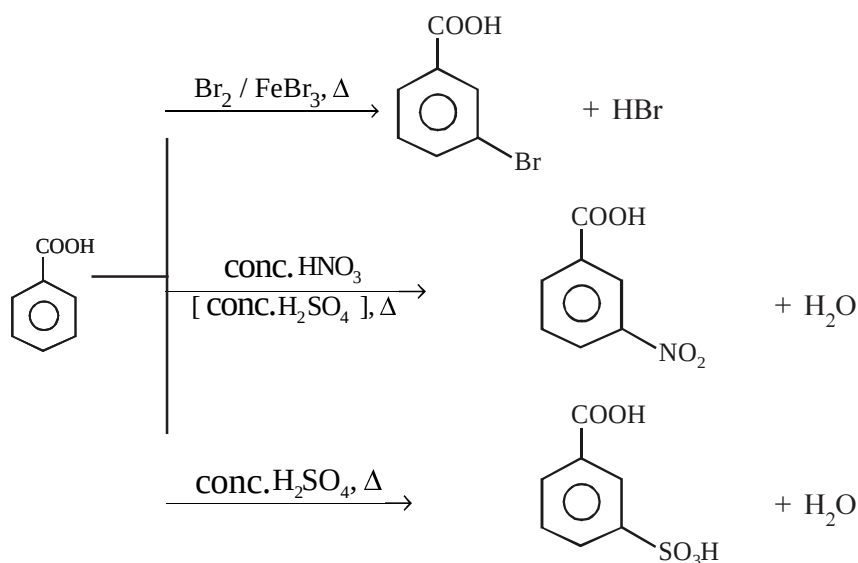
(e) On distillation of calcium salt of acid, aldehyde and ketone are obtained. It is discussed in previous section.

● Halogenation of alkyl group of aliphatic acid



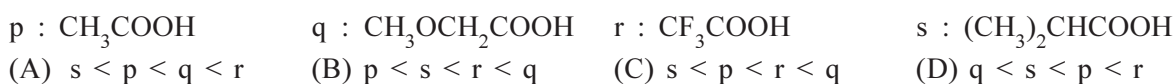
This reaction is called Hell-Volhard-Zelinsky reaction.

● Electrophilic substitution in aryl group of aromatic acid



– COOH group combine with AlCl_3 , so acid do not undergo Friedel Crafts reaction.

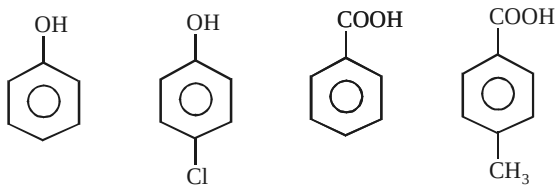
131. How the following acid compounds can be arranged in correct order for their acidic strength :



132. Which of the following order for acidic strength is correct ?

- (A) 4- methoxy benzoic acid < Benzoic acid < 4-Nitrobenzoic acid < 3,4 Dinitrobenzoic acid
(B) Benzoic acid < 4- Methoxybenzoic acid < 4-Nitrobenzoic acid < 3-4 Dinitrobenzoic acid
(C) 3-4- Dinitrobenzoic acid < 4-Nitrobenzoic acid < 4-Methoxybenzoic acid < Benzoic acid
(D) 4-Methoxybenzoic acid < 4-Nitrobenzoic acid < Benzoic acid < 3,4 Dinitrobenzoic acid

133. Which is correct order about acidic strength of the following compounds ?



(I) (II) (III) (IV)

(A) III > IV > II > I (B) IV > III > I > II (C) III > II > I > IV (D) II > III > IV > I

134. Which of the following pair of compounds give effervescences of CO_2 gas with aqueous solution of NaHCO_3 ?

(i) CH_3COCl (ii) CH_3COCH_3 (iii) $\text{CH}_3\text{COOCH}_3$ (iv) $\text{CH}_3\text{CO} - \text{O} - \text{COCH}_3$

(A) (i), (ii) (B) (i), (iv) (C) (ii), (iii) (D) (i), (iii)

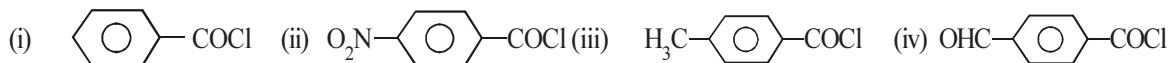
135. Which compound has high volatility ?

(A) o-Hydroxy benzoic acid (B) p-Hydroxy benzoic acid
(C) m-Hydroxy benzoic acid (D) Benzoic acid

136. Reactivity order towards nucleophilic substitution reaction of acyl compounds is :

(A) Acid anhydride > amide > ester > acylchloride
(B) Acylchloride > ester > acid anhydride > amide
(C) Acylchloride > acid anhydride > ester > amide
(D) Ester > acyl chloride > amide > acid anhydride

137. How the following compounds can be arrange in decreasing order of reactivity towards hydrolysis reaction ?



(A) (ii) > (iv) > (i) > (iii) (B) (ii) > (i) > (iii) > (iv)
(C) (i) > (ii) > (iii) > (iv) (D) (iv) > (ii) > (i) > (iii)

138. Which product is obtained on reduction of prop-2-enoic acid by LiAlH_4 ?

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

139. Which product is obtained on reaction of acetyl chloride with sodium propionate ?

(A) Aceticanhydride (B) n-propyl acetate
(C) Acetic propionicanhydride (D) Pentan-2, 4-dione

140. Which of the following compound has lowest pK_a ?

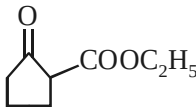
(A) p-Nitrophenol (B) p-Hydroxy benzoic acid
(C) o-Hydroxy benzoic acid (D) p-Toluic acid

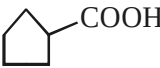
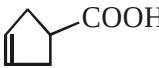
141. $(\text{CH}_3)_2\text{CHCOOH} \rightarrow$ Which set of reagents is correct for the above reaction ?

(A) P_4 / Cl_2 , Na, dil. H_2SO_4 (B) P_2O_5 , LiAlH_4
(C) $\text{P}_2\text{O}_5 / \Delta$, H_2O , P_4 / Cl_2 , Na (D) P_4 / Cl_2 , Na, $\text{P}_2\text{O}_5 / \Delta$

142. Phenol $\xrightarrow[\text{dust, } \Delta]{\text{Zn}}$ P $\xrightarrow[\text{[anhy AlCl}_3\text{]}]{\text{CH}_3\text{Cl}}$ Q $\xrightarrow[\text{H}_3\text{O}^+]{\text{KMnO}_4/\text{OH}^-}$ product R in the reaction is

- (A) Benzaldehyde (B) Benzoic acid (C) Benzene (D) Toluene

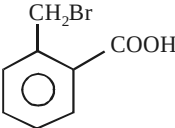
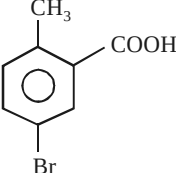
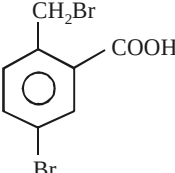
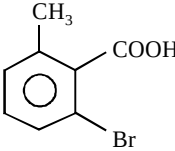
143.  $\xrightarrow[\text{hydrolysis}]{\text{H}_3\text{O}^+}$ P $\xrightarrow{\Delta}$ Q, Which is organic product Q of the reaction ?

- (A)  (B)  (C)  (D) 

144. $\text{CH}_3\text{COOH} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) Red P / Br}_2}$ x $\xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) KCN}}$ y, What is final product Y in the reaction ?

- (A) Glycolic acid (B) Succinic acid
(C) α -Hydroxy propionic acid (D) Malonic acid

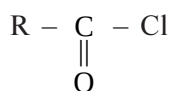
145. Which product is obtained on reaction of o-Tolueic acid with Br_2 in presence of FeBr_3 ?

- (A)  (B)  (C)  (D) 

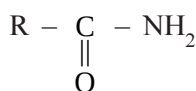
Answers : 131. (A), 132. (A), 133. (B), 134. (B), 135. (A), 136. (C), 137. (A), 138. (C), 139. (B), 140. (C), 141. (D), 142. (B), 143. (A), 144. (D), 145. (B),

● Derivatives of Carboxylic acid

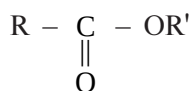
Derivatives of carboxylic acid are as under :



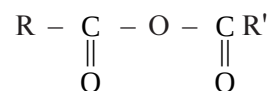
Acid chloride



Acid amide



Ester



Acid anhydride

These compounds are also called carbonyl compounds because in each $\text{C}=\text{O}$ (Carbonyl group) is present.

Preparation and chemical reactions of these compounds are mentioned in different parts of this unit.

146. When a liquid is mixed with ethanol and few drops of conc. H_2SO_4 are added then fruity smell is obtained. Which liquid is that ?

- (A) HCHO (B) CH_3COCH_3 (C) CH_3COOH (D) CH_3OH

147. $\text{CH}_2=\text{CH}_2 \xrightarrow{\text{HBr}}$ x $\xrightarrow[\text{NaOH}]{\text{aqueous}}$ y $\xrightarrow[\text{I}_2 \text{ excess}]{\text{Na}_2\text{CO}_3}$ z $\downarrow$ what is substance "Z" in the reaction ?

- (A) $\text{C}_2\text{H}_5\text{I}$ (B) $\text{C}_2\text{H}_5\text{OH}$ (C) CHI_3 (D) CH_3CHO

148. If for complete oxidation of 1 mole organic compound to obtain acid, 0.5 mole of O_2 gas is required then which compound it may be ?

- (A) Alcohol (B) Aldehyde (C) Ether (D) Ketone

149. Hydrocarbon having molecular formula C_6H_{12} decolourizes of bromine water and gives n-hexane on hydrogenation. This compound on oxidation by $KMnO_4$ gives two different carboxylic acid ($R-COOH$) then which compound is that ?
 (A) Cyclohexene (B) Hex-2-ene (C) Hex-1-ene (D) Hex-3-ene

150. $PhMe \xrightarrow[(ii) H_3O^+]{(i) KMnO_4 / OH^-} P \xrightarrow{SOCl_2} Q \xrightarrow{PhCOONa} R$. What is the final product R in above reaction ?

(A) C_6H_5COCl (B) $C_6H_5CONH_2$ (C) C_6H_5COOH (D) $(C_6H_5CO)_2O$

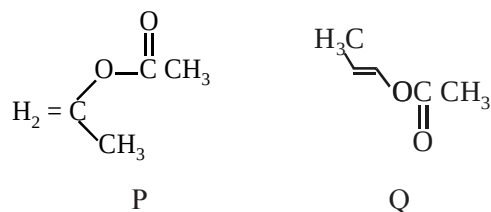
151. $CH_3CH_2COOH \xrightarrow{NH_3} P \xrightarrow{Br_2 + KOH} Q \xrightarrow{HNO_2} R$. Which is the final organic product of the reaction ?

(A) CH_3OH (B) C_2H_5OH (C) $C_2H_5NH_2$ (D) $CH_3CH_2CH_2OH$

152. $CH_3COOH + PCl_5 \rightarrow X \xrightarrow[anhy AlCl_3]{C_6H_6} Y \xrightarrow[H_2O]{C_6H_5MgBr} Z$ What is final organic product Z in this reaction ?

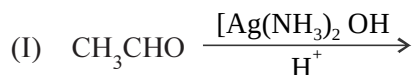
(A) $CH_3CH(OH)C_6H_5$ (B) $CH_3C(C_2H_5)(OH)C_6H_5$
 (C) $(C_6H_5)_2C(OH)(CH_3)$ (D) $CH_3COC_6H_5$

153. By which reagent, the product obtained by hydrolysis of following compounds P and Q can be differentiated ?



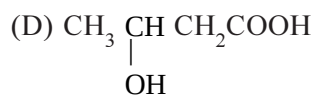
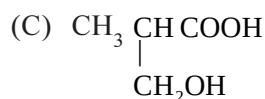
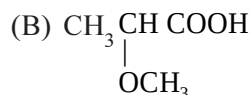
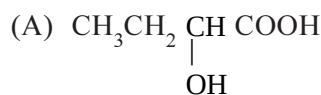
(A) Lucas reagent (B) 2,4 DNP (C) Fehling reagent (D) $NaHSO_3$

154. Consider the following reactions and decide that product of which reactions is carboxylic acid ?



(A) I, II, III (B) I, III (C) I, II (D) I

155. An organic compound "X" having molecular formula $C_4H_8O_3$ is optically active. It gives effervescence of CO_2 with $NaHCO_3$. This substance on treatment with $LiAlH_4$ gives optically inactive compound. What is substance "X" ?



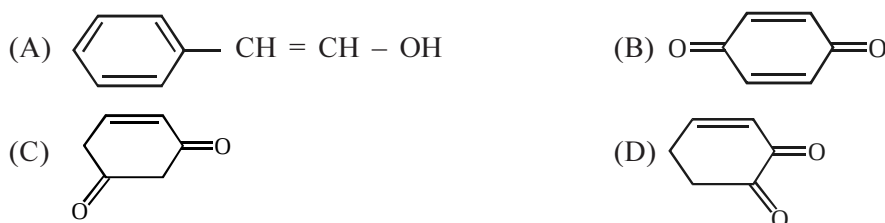
156. $CH_3COOH \xrightarrow{LiAlH_4} X \xrightarrow{PCl_5} Y \xrightarrow[alcohol]{KOH} Z$ what is final product Z ?

(A) Acetaldehyde (B) Acetylene (C) Ethylene (D) Acetyl chloride

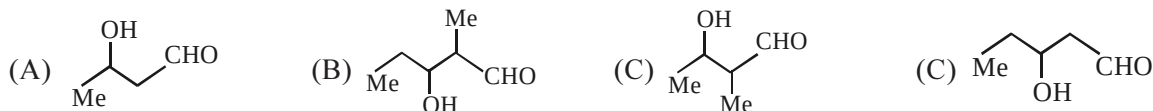
157. An organic compound "A" reacts with ammonia and gives product "B". "C" is obtained on heating "B". Substance "C" on treatment with Br_2 and KOH gives $\text{CH}_3\text{CH}_2\text{NH}_2$. Substance A is
 (A) CH_3COOH (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (C) $(\text{CH}_3)_2\text{CH}-\text{COOH}$ (D) $\text{CH}_3\text{CH}_2\text{COOH}$
158. Substance does not give CO_2 gas by reaction with sodium carbonate.
 (A) Benzoic acid (B) Benzene sulphonic acid
 (C) Salicylic acid (D) Carbolic acid
159. When an organic compound having molecular mass 188 u undergo acylation by CH_3COCl gives compound having molecular mass 390 u. How many number of NH_2 groups present in original organic compound ?
 (A) 2 (B) 5 (C) 4 (D) 6
160. $\text{C}_2\text{H}_5\text{Br} \xrightarrow[\text{KOH}]{\text{alcoholic}} \text{x} \xrightarrow[\text{CCl}_4]{\text{Br}_2} \text{y} \xrightarrow[\text{excess}]{\text{KCN}} \text{Z} \xrightarrow{\text{H}_3\text{O}^+} \text{M}$ What is product "M" in above reaction ?
 (A) Succinic acid (B) Malonic acid (C) Maleic acid (D) Oxalic acid

● Questions having one or more than one option :

161. Which compound contain tautomerism ?



162. Difference between phenol and benzoic acid can be identified by the reaction with
 (A) aq. NaOH (B) aq. NaHCO_3 (C) neutral FeCl_3 (D) Br_2 water
163. is the reaction in which new C-C bond is formed ?
 (A) Cannizzaro reaction (B) Friedel-Crafts reaction
 (C) Reimer-Tiemann reaction (D) Clemmensen reaction
164. Which of the following conversion is done by Wolff-Kishner reduction ?
 (A) Benzyl alcohol from benzaldehyde (B) Cyclohexane from cyclohexanone
 (C) Benzaldehyde from benzoyl chloride (D) di phenyl methane from benzophenone
165. What is cross-aldol product of the following reaction ?
 $\text{MeCHO} + \text{MeCH}_2\text{CHO} \xrightarrow{\text{OH}^+}$



166. Chose proper option by joining given substances of column-I with their characteristics of column-II :

Column-I	Column-II
(p) Acetic acid	(i) Sodium hypodite
(q) Formic acid	(ii) Disproportionation
(r) Acetone	(iii) Fehling's solution
(s) Benzaldehyde	(iv) Hell-volhard-zelinsky

- (A) (p)-(iv), (q)-(i), (r)-(ii), (s)-(iii) (B) (p)-(iv), (q)-(iii), (r)-(i), (s)-(ii)
 (C) (p)-(iii), (q)-(ii), (r)-(i), (s)-(iv) (D) (p)-(iii), (q)-(iv), (r)-(i), (s)-(ii)

- In the following questions two sentences are given. One of them is Assertion (A) and another one is Reason (R). Study sentences carefully and select proper choice according to given below instructions :

- (A) Both assertion (A) and reason (R) are correct and reason (R), gives correct explanation of assertion (A).
- (B) Both assertion (A) and reason (R) are correct but reason (R), does not give correct explanation of assertion (A).
- (C) Assertion (A) is correct but reason (R) is wrong.
- (D) Assertion (A) is wrong but reason (R) is correct.

167. **Assertion (A) :** Both Grignard reagent and dialkyl cadmium reacts with acid chloride and give tertiary alcohol.

Reason (R) : Grignard reagent is active like dialkyl cadmium.

168. **Assertion (A) :** >C=O group present in acetamide is more polar than ethyl acetate.

Reason (R) : $-\text{NH}_2$ group is more electrodonating than $-\text{OC}_2\text{H}_5$ group.

169. **Assertion (A) :** Boiling point of p-hydroxy benzoic acid is less than o-hydroxybenzoic acid.

Reason (R) : Intra molecular H-bond is present in O- hydroxy benzoic acid.

170. **Assertion (A) :** $\text{CH}_2 = \text{CH} - \text{COOH}$ is weak acid than $\text{C}_2\text{H}_5\text{COOH}$.

Reason (R) : Ethelene double bond is less electrondonating than benzene.

- Integer type questions :

171. Total number of isomeric aldehydes and ketones having molecular formula $\text{C}_5\text{H}_{10}\text{O}$ are ?

172. How many of the isomeric ketones having molecular formula $\text{C}_5\text{H}_{10}\text{O}$ undergo iodoform test ?

173. How many disubstituted derivatives of benzene having molecular formula C_8H_{10} on oxidation by alkaline KMnO_4 gives salts of acid ?

Answers : 146. (B), 146. (C), 147. (C), 148. (B), 149. (B), 150. (D), 151. (B), 152. (C), 153. (C), 154. (D), 155. (C), 156. (C), 157. (A), 158. (D), 159. (B), 160. (A), 161. (A), 162. (B), 163. (B), 164. (B), 165. (C), (D), 166. (B), 167. 1, 168. (A), 169. (D), 170. (C), 171. 7, 172. 2, 173. 3.

