Solution

Class 12 - Chemistry

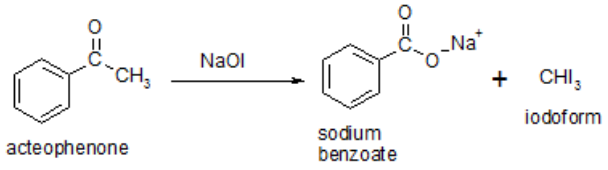
2020-21 paper 4

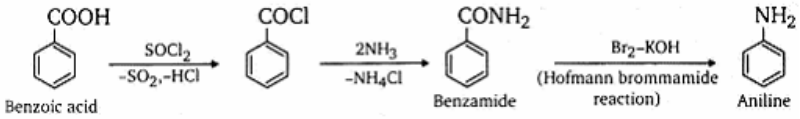
Section A

1. i. By adding Ferric chloride, Phenol will give violet colour whereas benzoic acid will not react.

$$C_6H_5OH \ + \ FeCl_3 \rightarrow \underset{Coloured\ Complex}{[Fe(OC_6H_5)_6]^{3+}} \ + \ 6H^+ \ + \ 3Cl^-$$

ii. Adding I_2 and NaOH, Acetophenone will give yellow precipitate of iodoform whereas benzaldehyde will not react.

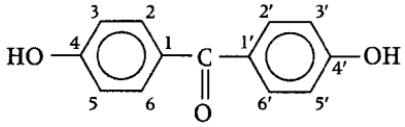


2. 

3. IUPAC name of the given compound is Cyclohexanecarbaldehyde.

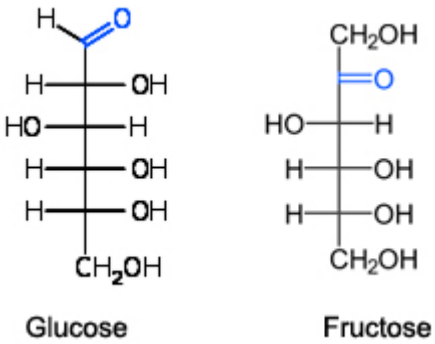
4. The structure of allylamine is $\mathrm{H_2\overset{3}{C} = \overset{2}{C}H - \overset{1}{C}H_2NH_2}$ and this compound's IUPAC name is prop-2-en-1-amine.

OR

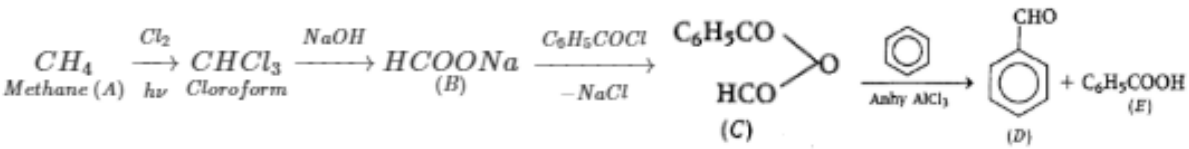


IUPAC Name: 4,4-dihydroxybenzophenone

5. Glucose has aldehydic group. Glucose is called as aldose
Fructose has ketonic group. Fructose is called as ketose.
Structures:



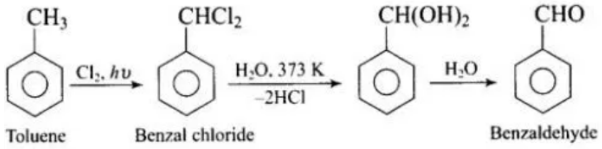
OR



6. 4-Methylpentanal
7. p-Hydroxyazobenzene.
8. Isomers which differ only in the configuration of hydroxyl group at C_1 are called anomers. e.g. α and β form of glucose.

OR

Reactions for obtaining benzal chloride then benzaldehyde from it -



9. The IUPAC name for $CH_3NHCH(CH_3)_2$ is N-methylpropan-2-amine.
10. The structure of N-methylethanamine is

$\overset{2}{C}H_3 - \overset{1}{C}H_2 - NH - CH_3$

OR

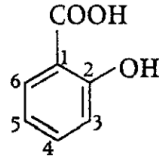
IUPAC name of the given compound is Benzene-1, 4-dicarbaldehyde.

11. Lactose is the type of sugar that occurs naturally in milk. It is found in the milk of animals such as cows and goats, as well as human breast milk.

OR

$\overset{5}{C}H_3 - \overset{4}{\underset{OH}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}} - \overset{3}{C}H_2\overset{2}{C}O\overset{1}{C}H_3$

The IUPAC name is 4-hydroxy-4-methyl pentane-2-one.

12. 

2-hydroxybenzoic acid

13. **(a)** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
14. **(d)** Both assertion and reason are correct statements and reason is correct explanation of assertion.
Explanation: Fe + 2HCl > $FeCl_2$ + 3[H]

Nascent hydrogen reduces nitro compounds

$FeCl_2 + H_2O(g) > FeO + 2HCl$

OR

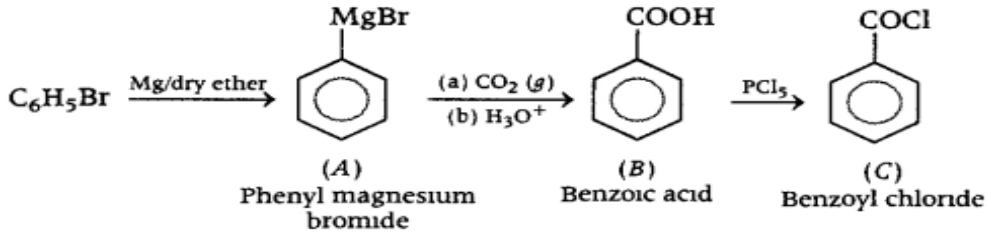
To distinguish between **formic acid (HCOOH)** and **acetic acid (CH_3COOH),** use tollens test (silver mirror test, **tollens reagent** = **ammonical silver nitrate [$Ag(NH_3)_2$]OH solution**)) or fehling solution . Formic acid gives positive test indicated by the formation of a silver mirror(Silver oxide precipitate on the walls of the test tube) but acetic acid fails to form a silver mirror. This is because the formic acid behaves as an aldehyde as there is a CHO group the other side of the OH group and it is easily oxidised to CO_2.

$$HCOOH + 2[Ag(NH_3)_2]OH \rightarrow 2Ag + 2H_2O + CO_2 + 4NH_3$$

$$CH_3COOH + 2[Ag(NH_3)_2]OH \rightarrow No\ reaction$$

15. **(c)** The assertion is the correct statement and reason is the wrong statement.
Explanation: 'D' corresponds to the position of -OH group on the right side on the farthest asymmetric C-atom.
16. **(b)** Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Section B

17. i. 

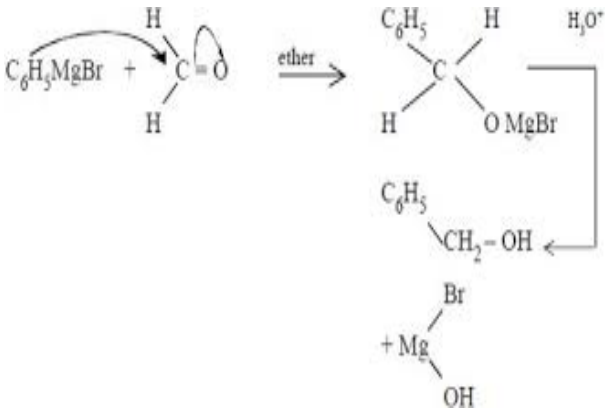
ii. $CH_3CN \xrightarrow[(i)H_3O^+]{(i)SnCl_2/HCl} \underset{(A)}{CH_3CHO} \xrightarrow{Dil.NaOH} \underset{(B)}{CH_3-\overset{OH}{\overset{|}{C}}H-CH_2-CHO} \xrightarrow{\Delta}$

$\underset{(C)}{CH_3-CH=CH-CHO}$

18. $C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$
19. Because one or more carbon atoms present in view contain asymmetric carbon atom.
20. 1. **C_2H_5MgBr**

$$CH_3\overset{O}{\overset{||}{C}}C_6H_5 \xrightarrow{CH_3CH_2MgBr} CH_3-\overset{OMgBr}{\overset{|}{\underset{|}{C}}}-CH_2CH_3 \xrightarrow{H_2O/H^+} CH_3-\overset{OH}{\overset{|}{\underset{|}{C}}}-CH_2CH_3$$

2. **C_6H_6MgBr**



21. It is because -NH_2 group is electron releasing, powerful activating group which increases electron density at ortho and para positions of the benzene ring.

OR

Proteins are the polymers of about twenty different α-amino acids which are linked by peptide bonds.

22. $\underset{\text{Propan-2-one}}{CH_3-\overset{O}{\overset{||}{C}}-CH_3} \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgBr} \underset{\substack{2-Methylpropan-2-ol \\ (A)}}{CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\overset{|}{C}}}}-OH}$

$\xrightarrow[Ether]{Na\ metal} \underset{\substack{Sodium\ tert-butoxide \\ (B)}}{CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\overset{|}{C}}}}-\bar{O}Na^+} \xrightarrow[(Williamson's\ synthesis)]{CH_3Br} \underset{\substack{2-Methoxy-2-methylpropane \\ (C)}}{CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\overset{|}{C}}}}-OCH_3}$

23. 100% acetic acid which is free from water is called glacial acetic acid. The melting point of pure anhydrous acetic acid is 17^0 C. It is solid below this temperature and look like 'icy' i.e., glacial.

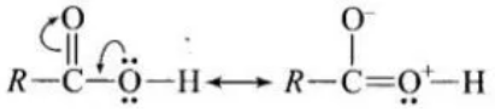
24. $CH_3CHO \xrightarrow[KMnO_4]{(O)} CH_3COOH \xrightarrow{slaked\ lime,\ Ca(OH)_2} (CH_3COO)_2Ca \xrightarrow{Heat} CH_3-\overset{O}{\overset{||}{C}}-CH_3$

25. Carbylamine reaction can be used as a test for primary amines. In this reaction, 1^0 amines produces a bad-smelling compound isocyanide when treated with chloroform in the presence of alkali.

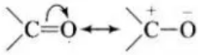
$RNH_2 + CHCl_3 + 3KOH \longrightarrow R\text{-}N \overset{\rightarrow}{=} C + 3KCl + 3H_2O$

OR

It is due to resonance as shown below. The partial positive charge on the carbonyl carbon atom is reduced.



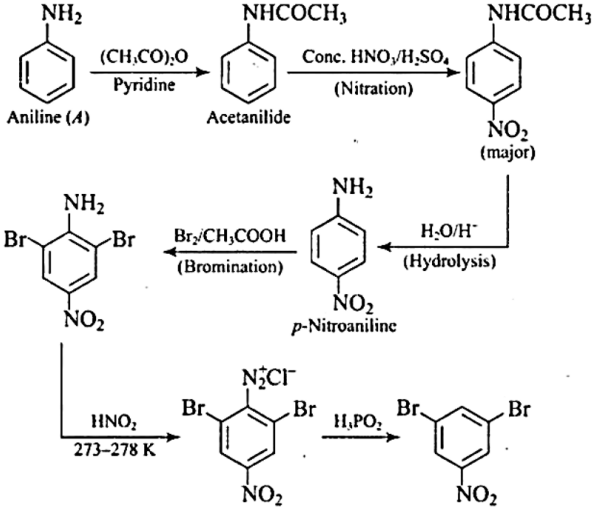
Similarly, a carbonyl group of aldehydes and ketones may be regarded as the resonance hybrid of the following structures.



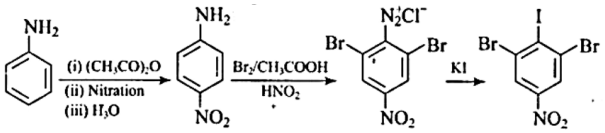
The carbonyl carbon of the carboxylic group is less electrophilic than carbonyl carbon in aldehydes and ketones the polarity of the carbonyl group is reduced due to resonance. Hence nucleophilic addition reactions of aldehydes and ketones do not take place with carboxylic acids.

Section C

26. 1. $C_5H_5NH^+CrO_3Cl^-(PCC)$ (PCC is pyridinium chlorochromate, is a better reagent for selective oxidation of primary alcohols to aldehydes stage only and it gives good yield of aldehydes.)
    2. $K_2Cr_2O_7\ in\ acidic\ medium$ (strong oxidizing agent)
    3. $CrO_2Cl_2,\ H_2O$ (Etard Reaction: Chromyl chloride(CrO_2Cl_2) oxidizes methyl group to a chromium complex, which on hydrolysis gives corresponding benzaldehyde)
    4. DIBALH (Di-isobutyl aluminium hydride) (mild reducing agent) followed by hydrolysis.
27. i. Conversion of Aniline to 3,4 dibromnitrobenzene involves the following step:



ii. Conversion of Aniline into 3,5 dibromo-4 iodonitro benzene involves the following steps:



OR

i. $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

ii. $C_6H_5NH_2 < C_2H_5NH_2 < (C_2H_5)_3N < (C_2H_5)_2NH$

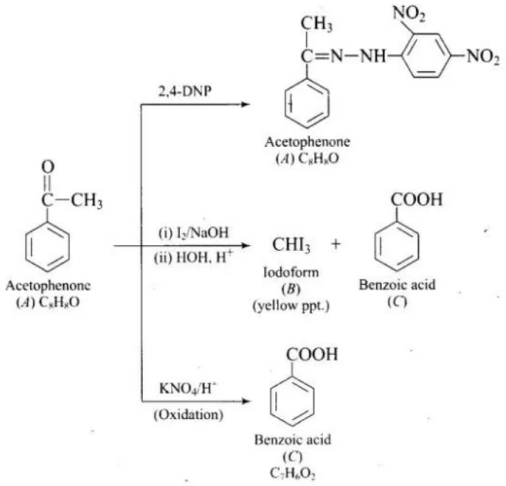
iii. $C_6H_5NH_2 < C_6H_5CH_2NH_2 < (CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$

28. Carbohydrate is essential for life and also used as storage molecules in plants and animals are as follows:
    i. The plant contains mainly starch, cellulose, sucrose, etc.
    ii. Animal contains glycogen in their body. So, glycogen is also known as animal starch. Glycogen is present in the liver, muscles, and brain when the body needs glucose, the enzyme breaks glycogen down to glucose.
    iii. Cellulose is present in the wood, and the fibre of clothes. Cell wall of bacteria is made up of cellulose.
29. Being unsymmetrical ketone oxidation involves the C-C bond cleavage, oxidation occurs on either side of the C=O group giving a mixture of 2-methyl propanoic acid, 3-methylbutanoic acid, and propan 2-one. Propan-2-one on further oxidation gives a mixture of ethanoic acid and methanoic acid.

$$\underset{2,5-Dimethylhexan-3-one}{CH_3-\overset{CH_3}{\overset{|}{C}}H-\overset{O}{\overset{||}{C}}-CH_2-\overset{CH_3}{\overset{|}{C}}H-CH_3} \xrightarrow{[O]} \underset{3-Methylbutanoic\ acid}{CH_3-\overset{CH_3}{\overset{|}{C}}H-CH_2-COOH} + \underset{Propan-2-one}{CH_3-\overset{O}{\overset{||}{C}}-CH_3}$$

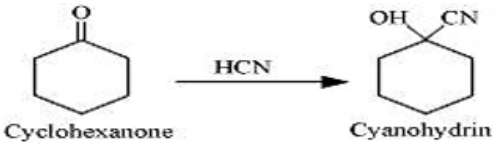
$$\rightarrow \underset{Ethanoic\ acid}{CH_3COOH} + \underset{Methanoic\ acid}{HCOOH}$$

30. The molecular formula of the compound is C_8H_8O. As A does not give Tollens or Fehling's test. It must be a ketone. It gives a positive test with 2, 4-DNP, and iodoform test. It means it is methyl ketone. B is iodoform and C is benzoic acid.

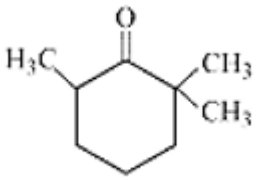


Section D

31. i. Cyclohexanones form cyanohydrins according to the following equation.



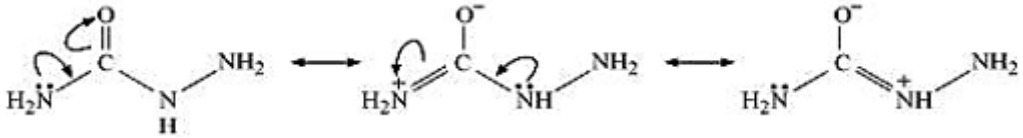
In this case, the nucleophile **CN^-** can easily attack without any steric hindrance. However, in the case of 2, 2, 6 trimethylcydohexanone, methyl groups at 2,2,6 positions offer steric hindrances and as a result, **CN^-** cannot attack effectively.



2, 2, 6 – Trimethylcyclohexanone

For this reason, it does not form a cyanohydrin.

ii. Semicarbazide undergoes resonance involving only one of the two - NH_2 groups, which is attached directly to the carbonyl-carbon atom.



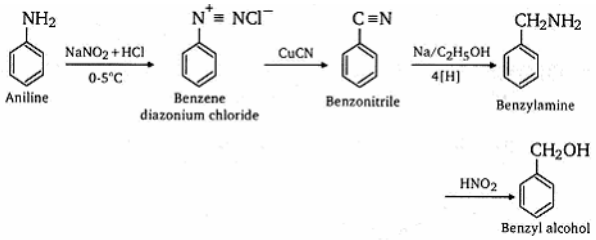
Therefore, the electron density on - NH_2group involved in the resonance also decreases. As a result, it cannot act as a nucleophile. Since the other - NH_2 group is not involved in resonance; it can act as a nucleophile and can attack carbonyl-carbon atoms of aldehydes and ketones to produce semicarbazones.

iii. Ester along with water is formed reversibly from a carboxylic acid and an alcohol in presence of an acid.

$$\underset{Carboxylic\ acid}{RCOOH} + \underset{Alcohol}{R'OH} \overset{H^+}{\longleftrightarrow} \underset{Ester}{RCOOR'} + \underset{water}{H_2O}$$

If either water or ester is not removed as soon as it is formed, then it reacts to give back the reactants as the reaction is reversible. Therefore, to shift the equilibrium in the forward direction i.e., to produce more ester, either of the two products should be removed (Le-Chateliers Principle).

OR



32. Not mention

OR

i. IUPAC name: Heptan-2-one Common name: Methyl n-propyl ketone
ii. IUPAC name: 4-Bromo-2-methylhexanal Common name: $\gamma - Bromo - \alpha -$ methylcaproaldehyde
iii. IUPAC name: Heptanal Common name: heptanaldehyde
iv. IUPAC name: 3-phenylprop-2-enal Common name: β-Pheynolacrolein
v. IUPAC name: Cyclopentanecarbaldehyde Common name: Cyclopentanealdehyde

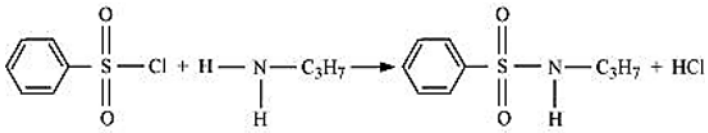
33. a. i. Carrot and cod liver oil.
ii. Nucleotides are monomers of nucleic acids. They consist of heterocyclic base, pentose sugar and phosphoric acid reside.

b. Carbohydrate are classified as:
i. Monosacchrides
ii. Oligosaccharides
iii. Polysacchrides.

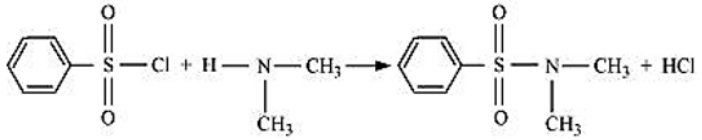
OR

Primary, secondary and tertiary amines can be identified and distinguished by Hinsberg's test. In this test, the amines are allowed to react with Hinsberg's reagent (benzene sulphonyl chloride $C_6H_5SO_2Cl$).

i. Primary amines react with benzenesulphonyl chloride to form N-alkyl benzenesulphonamide which is soluble in alkali.



ii. Secondary amines react with Hinsberg's reagent to form N, N-dialkyl benzene sulphonamide which is insoluble in alkali.



iii. Tertiary amines do not react with Hinsberg's reagent.