Chapter_12

Aldehydes, Ketones and Carboxylic Acids

Practice Questions

- **1.** Carbonyl compounds are the constituents of
 - (a) fabrics (b) flavouring
 - (c) plastics and drugs (d) All of these
- **2.** The name of simplest aromatic aldehyde carrying the aldehyde group on a benzene ring is/are
 - (a) carbaldehyde
 - (b) benzene carbaldehyde
 - (c) benzaldehyde
 - (d) Both (b) and (c) d
- 3. Write IUPAC name of the following :



- (a) 2-bromo-2-ethyl hexanal
- (b) 3-bromo-2-methyl hexanal
- (c) 2-methyl-3-bromo hexanal
- (d) 3-bromo-2-formyl hexane
- **4.** The bond angle and structure of carbonyl compounds respectively are
 - (a) 120° and trigonal planar
 - (b) $109^{\circ}28'$ and tetrahedral
 - (c) 120° and tetrahedral
 - (d) 109°28' and trigonal planar
- 5. The most suitable reagent for the conversion of $R \longrightarrow CH_2 \longrightarrow OH \longrightarrow R \longrightarrow CHO$ is (a) KMnO₄ (b) K₂Cr₂O₇ (c) V2C²
 - (c) H_2SO_4
 - (d) PCC (pyridinium chlorochromate)
- **6.** Alcohol vapours are passed over which of the following catalysts to give aldehydes and ketones?

(a)	S or Pd	(b)	Ag or Cu
(c)	F or Cl	(d)	Li or K

7. The reaction,

 $RCN + SnCl_2 + HCl \longrightarrow RCH = NH \xrightarrow{H_3O^+} RCHO$

- is known as
- (a) Etard reaction
- (b) Haloform reaction
- (c) Gattermann-Koch reaction
- (d) Stephen reaction
- 8. The major product of following reaction is

$$R \longrightarrow C \Longrightarrow \mathbb{N} \xrightarrow{(i) \text{ AIH } (i \text{ Bu})_2}{(ii) \text{ H}_2 \text{ O}}$$

- 9. Which of the following substrates give the same product on the reduction with DIBAL-H?
 (a) CH₃ (CH₂)₉ CN and CH₃(CH₂)₉ COOH
 (b) CH₃ (CH₂)₉ CN and CH₃(CH₂)₉ COOC₂H₅
 (c) CH₃ (CH₂)₉ COOH and CH₃(CH₂)₉ CHO
 (d) CH₃(CH₂)₉ COOH and CH₃(CH₂)₉ COOC₂H₅
- **10.** Reaction by which benzaldehyde cannot be prepared is

(a)

$$CH_3 + CrO_2Cl_2 \text{ in } CS_2 \text{ followed by } H_3O^+$$

(c)
 $+ CO + HCl \text{ in the presence of anhyd. } AlCl_3$
(b)
 $+ H_2 \text{ in the presence of } Pd-BaSO_4$
(d)
 $+ Zn/Hg \text{ and conc. } HCl$

- **11.** The compounds methanal, ethanal and propanone are miscible with water because they form
 - (a) van der Waals' forces with water
 - (b) 'H'-bonding with water
 - (c) dipole-dipole bond with water
 - (d) ion-dipole bond with water
- **12.** Identify the example in which nucleophilic addition followed by elimination reaction occur respectively in the carbonyl compound.
 - (a) Addition of Grignard reagent
 - (b) Addition of sodium sulphide
 - (c) Addition of HCN
 - (d) Addition of NH_3
- **13.** Consider the reaction given below.

 $CH_2 = CH - CHO \xrightarrow{?} CH_2 = CH - CH_2 - OH$

Which of the following is the suitable reagent for the conversion of following reaction? (*a*) NaBH₄ (*b*) Ni / H₂

(c)
$$\operatorname{Zn} / \operatorname{Hg} / \operatorname{HCl}$$
 (d) $\operatorname{Red} P + \operatorname{Hi}$

14. On heating an aldehyde with Fehling's reagent, a reddish brown precipitate is obtained due to the formation of(a) CuO(b) Cu₂O

(c)
$$CuSO_4$$
 (d) $Cu^{2+} + \overline{O}H$

- **15.** Which of the following compounds produces an orange-red precipitate with 2, 4-DNP reagent? (a) Acetamide (b) Dimethyl ether
 - (d) Propylbutanoate (c) Butanone
- **16.** Predict the products in the given reaction.



17. Some higher members of aliphatic carboxylic acids known as fatty acids occur in natural fats as esters of glycerol. How many C-atoms do they contain?

(a) $C_{12} - C_{18}$ (c) $C_5 - C_{10}$ (b) $C_{10} - C_{15}$ (d) $C_{20} - C_{30}$

- **18.** What is the common name of 2-methylpropanoic acid?
 - (a) Adipic acid
 - (b) Crotonic acid
 - (c) Isobutyric acid
 - (d) Acrylic acid

- **19.** Select the acid(s) which cannot be prepared by Grignard reagent? (a) Acetic acid
 - (b) Succinic acid
 - (c) Formic acid (d) All of these
- **20.** Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to
 - (a) more extensive association of carboxylic acid via van der Waals' force of attraction
 - (b) formation of carboxylate ion
 - (c) formation of intramolecular H-bonding
 - (d) formation of intermolecular H-bonding
- **21.** Which of the following reagents is/are used for the conversion of ethanoic acid to ethanoic anhydride? (b) PCl_3, Δ (a) $SOCl_2, \Delta$
 - (d) All of these (c) P_2O_5, Δ
- **22.** Diborane easily reduce the functional group such as (a) acid (b) ester
 - (d) halo (c) nitro
- **23.** Name the product formed during the decarboxylation of malonic acid.
 - (a) Acetic acid (b) Ethanone
 - (d) Formic acid (c) Propanone
- 24. Aromatic carboxylic acids do not undergo Friedel-Crafts reaction because
 - (a) carboxyl group acts as an activating and meta-directing group
 - (b) carboxyl group act as a deactivating and ortho and para directing group
 - (c) carboxyl group act as an activating and ortho-directing group
 - (d) carboxyl group acts as deactivating and the catalyst
- **25.** Which of the following acid is used in rubber, textile, dyeing, leather and electroplating industries?
 - (a) Hexanedioic acid
 - (b) Ethanoic acid
 - (c) Methanoic acid
 - (d) Sodium benzoate

ANSWERS

1. (d)	2. (d)	3. (b)	4. (a)	5. (d)	6. (b)	7. (d)	8. (a)	9. (b)	10. (d)
11. (b)	12. (d)	13. (a)	14. (b)	15. (C)	16. (C)	17. (a)	18. (c)	19 . (a)	20. (d)
21. (c)	22. (a)	23. (a)	24. (b)	25. (C)					

Hints & Solutions

- **1.** (*d*) Carbonyl compounds are of almost importance to organic chemistry. They are the constituents of fabrics, flavourings, plastics and drugs.
- (b) The priority order of functional group is —CHO > Br.Therefore, IUPAC name of the given compound is as follows :





4. (*a*) The bond angles are approximately 120° as expected of a trigonal planar structure in the carbonyl compounds.



5. (*d*) The most suitable reagent for the conversion of alcohol (*R*CH₂—OH) to aldehyde (*R*—CHO) is PCC :

$$R \longrightarrow CH_2OH \longrightarrow R \longrightarrow CHO$$

Pyridinium chlorochromate is a mild oxidising agent which causes the conversion of alcohol to aldehyde and not carboxylic acid.

Whereas, $K_2Cr_2O_7$ and $KMnO_4$ are strong oxidising agents which causes conversion of alcohol directly to acid and H_2SO_4 is a dehydrating agent.

Thus, they cannot be used for the conversion.

- **6.** (*b*) Alcohol vapours are passed over heavy metal catalysts (Ag or Cu) to give aldehydes and ketones. Primary and secondary alcohols give aldehydes and ketones respectively.
- **7.** (d) $RCN + SnCl_2 + HCl \rightarrow RCH = NH \xrightarrow{H_3O^+} RCHO$

This reaction is called Stephen reaction, where nitriles are reduced to corresponding imine with stannous chloride in the presence of HCl, which on hydrolysis gives corresponding aldehyde.

8. (a) The mechanism of the reaction is as follows :



9. (*b*) Nitrile are selectively reduced by DIBAL-H to imines followed by hydrolysis to aldehyde. Esters are also reduced to aldehydes with DIBAL-H.

$$CH_3 \longrightarrow (CH_2)_9 \longrightarrow CN \xrightarrow{(i) \text{ DIBAL-H}} (CH_2)_9 CHO$$

$$CH_{3}(CH_{2})_{9} - \underbrace{C}_{O} - OC_{2}H_{5} \xrightarrow{(i) \text{ DIBAL-H}}_{(ii) H_{2}O} CH_{3}(CH_{2})_{9} - CHO$$

10. (d) Reaction (d) will not give benzaldehyde.

$$\begin{array}{c} & \text{COCH}_3 \\ & + Zn/\text{Hg} \xrightarrow{\text{Conc. HCl}} & \text{CH}_2\text{CH}_3 \\ & \text{Ethyl benzene} \end{array}$$

This reaction is known as Clemmensen reduction.

Rest of the reactions will give benzaldehyde.



This reaction is known as Etard reaction.

(b)
$$(Bold Pd/BaSO_4/H_2)$$
 (Bold Pd/BaSO_4/H_2) CHO
(Bold Benzaldehyde) (Benzaldehyde) (Benzald

This reaction is known as Rosenmund reduction.

(c)
$$(C) + CO + HCl \xrightarrow{Anhyd. AlCl_3} CHO$$

This reaction is known as Gattermann-Koch aldehyde synthesis.

11. (*b*) The lower members of aldehydes and ketones such as methanal, ethanal and propanone are miscible with water in all proportions because they form hydrogen bonding with water.

$$\overset{R}{\underset{\text{H/R}}{\longrightarrow}} C \overset{\delta^{+}}{\underset{\text{O}}{\longrightarrow}} O^{---H} \overset{\delta^{+}}{\underset{\text{H}}{\longrightarrow}} O^{\delta^{+}} \overset{\delta^{+}}{\underset{\text{H}}{\longrightarrow}} O^{\delta^{+}} \overset{\delta^{+}}{\underset{\text{H}}{\longrightarrow}} C \overset{\delta^{+}}{\underset{\text{H}}{\longrightarrow}} C \overset{R/H}{\underset{R'}{\longrightarrow}} C \overset{R/H}{\underset{R'}{\longrightarrow}} C \overset{R/H}{\underset{R'}{\longrightarrow}} C \overset{R/H}{\underset{R'}{\longrightarrow}} C \overset{R'}{\underset{R'}{\longrightarrow}} C \overset{R'}{\underset{R'}{\overset{R'}{\underset{R'}{\longrightarrow}} C \overset{R'}{\underset{R'}{\overset}} C \overset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R'}{\underset{R$$

12. (*d*) The addition of NH_3 to carbonyl compound is an example in which nucleophilic addition is followed by elimination reaction occur respectively.

F

$$\sum C = O \xrightarrow{(i) \text{ NH}_3} C = \text{NH} + \text{H}_2 O$$

Here, ammonia is added to carbonyl group and water molecules gets eliminated.

Another example in which the nucleophilic addition is followed by elimination is the addition of alcohols.

13. (a) The suitable reagent for the given conversion is NaBH₄.

$$CH_2 = CH - CHO \xrightarrow{NaBH_4} CH_2 = CH - CH_2 - OH$$

It is a selective reagent and does not reduce carbon-carbon double bond. Thus, unsaturated alcohols can be prepared by this reagent.

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14. (b) On heating an aldehyde with Fehling's reagent, a reddish brown precipitate is obtained due to the formation of Cu₂O. Aldehydes are oxidised to corresponding carboxylate anion. The reaction involved is as follows :

$$RCHO + 2Cu^{2+} + 5OH \longrightarrow RCOO^{-} + Cu_2O \downarrow + 3H_2O$$

Red brown
ppt.

- **15.** (*c*) 2, 4-DNP reagent reacts with carbonyl compounds (aldehydes and ketones) to produce orange-red precipitate. Among the given compounds, butanone is a carbonyl compound and, thus can react with 2, 4-DNP reagent.
- **16.** (*c*) When *m*-chlorobenzaldehyde is treated with 50% alkali, it undergoes oxidation to give an acid salt as well as reduction to give an alcohol. This reaction is called Cannizzaro's reaction and the products formed as shown below :



17. (*a*) Some higher members of aliphatic carboxylic acids containing C_{12} - C_{18} are known as fatty acids and they occur in natural fats as esters of glycerol.

Therefore, the correct option is (a).

18. (*c*) The structure of compound 2-methyl propanoic acid is shown below :

$$H_{3}C - CH_{3}$$

The common name of the given compound is isobutyric acid or α -methyl propanoic acid.

19 (*a*) The major product of the given reaction is benzoic acid (C_6H_5COOH) . On vigorous oxidation of alkyl benzene with acidic or alkaline KMnO₄, aromatic acids are obtained. During oxidation of alkyl benzene. the aromatic nucleus remains intact and the entire chain is oxidised to —COOH group irrespective of the length of carbon chain.



20. (*d*) Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass because of the formation of intermolecular hydrogen bonding with water due to which they exist as associated molecules.



21. (c) Reagents that are used for the conversion of ethanoic acid to ethanoic anhydride are mineral acids such as H_2SO_4 or with P_2O_5 .

Reaction is as follows :

$$2\text{CH}_{3}\text{COOH} \xrightarrow{\text{H}^{+}, \Delta} (\text{CH}_{3}\text{CO})_{2}\text{O}$$

- **22.** (*a*) Diborane does not easily reduce functional groups such as ester, nitro, halo etc. Carboxylic acids are reduced to primary alcohols by lithium aluminium hydride or with diborane.
- **23.** (*a*) The decarboxylation of malonic acid is shown below :

$$HO \xrightarrow{\beta}_{C} \xrightarrow{\alpha}_{C} CH_{2} \xrightarrow{C}_{C} COOH \xrightarrow{\Delta}_{Acetic acid} H_{3}C \xrightarrow{C}_{C} COOH + CO_{2} \uparrow_{Acetic acid}$$
Malonic acid

Therefore, acetic acid is formed by the decarboxylation of malonic acid.