CHAPTER 17
ALDEHYDES AND KETONES

17.1 NOMENCLATURE OF ALDEHYDES

Trivial Nomenclature

Aldehydes are named after the corresponding acids by replacing the ending -ic acid or -oic acid with -al.

Acid	Aldehyde
Formic acid	Formaldehyde
Acetic acid	Acetaldehyde
Propionic acid	Propionaldehyde
Butyric acid	Butyraldehyde

IUPAC Nomenclature

Aldehydes are named by replacing the ending -e of the parent alkane with -al.

17.2 NOMENCLATURE OF KETONES

Trivial Nomenclature

Ketones are named by adding the ending -one to the name of the alkyl or aryl groups attached to the carbonyl group.

IUPAC Nomenclature

Ketones are named by replacing the ending -e of the parent alkane with -one.

17.3 PREPARATION OF ALDEHYDES AND KETONES

Oxidation of Primary Alcohols

Primary alcohols are oxidized to aldehydes by pyridinium chlorochromate (PCC) in dichloromethane.

Oxidation of Secondary Alcohols

Secondary alcohols are oxidized to ketones by chromic acid.

Ozonolysis of Alkenes

Ozonolysis of alkenes followed by reductive workup with dimethylsulfide (DMS) gives aldehydes and ketones.

Hydroboration of Alkynes

Hydroboration of alkynes followed by oxidation with hydrogen peroxide gives aldehydes and ketones.

Friedel-Crafts Acylation

Friedel-Crafts acylation of aromatic compounds with acyl chlorides gives aromatic ketones.

Gattermann-Koch Reaction

Gattermann-Koch reaction of aromatic compounds with carbon monoxide and hydrogen chloride gives aromatic aldehydes.

Gattermann Reaction

Gattermann reaction of aromatic compounds with hydrogen cyanide and hydrogen chloride gives aromatic aldehydes.

Rosenmund Reduction

Rosenmund reduction of acyl chlorides with hydrogen and palladium on barium sulfate gives aldehydes.

Stephen Reduction

Stephen reduction of nitriles with stannous chloride and hydrochloric acid gives aldehydes.

Gilman Reagent

Gilman reagent reacts with acyl chlorides to give ketones.

Grignard Reagent

Grignard reagent reacts with nitriles to give ketones.

Wacker Process

Wacker process oxidizes terminal alkenes to methyl ketones.

Hydration of Alkynes

Hydration of alkynes gives methyl ketones.

Friedel-Crafts Alkylation

Friedel-Crafts alkylation of aromatic compounds with primary alkyl halides gives aromatic

EXERCISE

Q1. Select the right answer from the choices given with each question.

Q1. The carbon atom of carbon atom of a carbonyl group is

(1) sp hybridised (2) sp3 hybridised

(3) sp2 hybridised (4) none of these

Q2. Ketones are prepared by the oxidation of

(1) primary alcohol (2) secondary alcohol

(3) tertiary alcohol (4) none of these

Q3. Acetone reacts with HCN to form a Cyanohydrin. It is an example of

(1) nucleophilic addition (2) electrophilic

addition

(3) nucleophilic substitution (4) nucleophilic substitution

Q4. Cannizzaro's reaction is not given by

(1) formaldehyde (2) acetaldehyde

(3) benzaldehyde (4) trimethylacetaldehyde

Q5. Which of the following compounds will react with both acetaldehyde and Ketones?

(1) Fehling's reagent (2) Tollen's reagent

(3) Fehling's reagent (4) Benedict's reagent

Q6. Aldehydes are the substitute product of

(1) C_2H_5-OH (2) $C_2H_5-O-C_2H_5$ (3) CH_3-OH (4) C_6H_5-OH

Q7. Which of the following compounds will not give aldol condensation but will undergo Cannizzaro reaction?

(1) Acetaldehyde (2) Propanal (3) Benzaldehyde (4) Ethanal

Q8. Acetaldehyde and Ketones are carbonyl compounds. Which of them react both with Hydrid and with Tollen's reagent?

(1) Both aldehydes and ketones (2) Aldehydes only

(3) Ketones only (4) Neither aldehydes nor

ketones

Q9. Which one of the following can undergo aldol condensation reaction?

(1) Acetaldehyde (2) Acetophenone (3) Benzaldehyde (4) Formaldehyde

Q10. Aldol condensation is not successful with compounds

(1) having no α- hydrogen (2) having α'- hydrogen

(3) having α'- methyl group (4) none

Q11. Phenylhydrazone on treatment with carbonyl compounds produces

(1) hydrazyl derivatives (2) phenylhydrazone

(3) oximes (4) none of these

Q12. Formaldehyde reacts with NaOH to give?

(1) Methyl ethanoate resonance (2) Methoxyfuranose

tetrosone

(3) Trans crotonaldehyde tetrosone (4) Lactonitrile

Q13. Conversion of benzaldehyde to benzyl alcohol

(1) CH_3OH (2) CH_3CH_2OH (3) $C_6H_5CH_2CH_3$ (4)

$C_6H_5-CH_2-OH$

Q14. Which of the following nodes prepared in the laboratory by dry distillation of calcium salts of fatty acids

(1) CH_3CHO (2) CH_3COCH_3 (3) C_6H_5CHO (4) C_6H_5CHO

Q15. The value of Isoelectric is

(1) 4.000 (2) 5.000 (3) Uncertain (4) Data Answers

Answer

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Q1. Give short answers of the following questions.

Q1. How is benzaldehyde prepared industrially?

Answer

Industrially formaldehyde is prepared by the oxidation of methanol

(Formaldehyde)

Q2. Describe briefly the nucleophilic addition, mechanism to the carbonyl compounds.

Answer

Mechanism

Q3. Give detailed answers of the following questions.

Q1. What is meant by the nucleophilic addition, mechanism to the carbonyl compounds.

Answer

Please see answer of Q1 in all chapter notes.

Q2. How is aldehyde prepared by Acetic acid?

Answer

Please see answer of Q1 in all chapter notes.

Q3. What is meant by the carbonyl compounds?

Answer

Please see answer of Q1 in all chapter notes.

Q4. Give the mechanism of aldol condensation reaction?

Answer

Please see answer of Q1 in all chapter notes.

Q5. What is Ketones reaction?

Q6. What is the addition product of Grignard reagent to formaldehyde, acetaldehyde and ketones?

Answer

Please see answer of Q1 in all chapter notes.

Q7. Why formaldehyde do not give aldol condensation reaction?

Answer

Aldol condensation is given by only those compounds which have α'-hydrogen. Formaldehyde does not give aldol condensation reaction.

Answer

Please see answer of Q1 in all chapter notes.

Q8. Give aldehyde and ketone

Answer

Please see answer of Q1 in all chapter notes.

Q9. Give information of aldehyde and ketone

Answer

Please see answer of Q1 in all chapter notes.

(Formaldehyde)

Industrial preparation of acetaldehyde

Acetaldehyde is prepared industrially by oxidation of ethanol using potassium chromate contact with a metal catalyst palladium

(Acetaldehyde)

Q10. Give formaldehyde reacts with following

(1) KCN (2) NaOH (3) NaAlH4

Answer

(1 Formaldehyde with KCN

(1) Formaldehyde with H_2SO_4

(2) Formaldehyde with NaOH(

Q4. Define and explain aldol condensation along with mechanism.

Answer

Please see answer of Q1 in all chapter notes.

Q5. Give detail of Ketoform reaction why it is called so?

Answer

Please see answer of Q1 in all chapter notes.

Q6. Give the following reductions of aldehydes and ketones along with mechanism.

1 Hydro (2 Catalytic reduction

Answer

1 Reduction of aldehydes and ketones with NaBH4

Clemmensen Reduction

Mechanism of Reaction

Q7. Reduction of aldehydes and ketones through catalytic reduction

Clemmensen Reduction

Q7. What is the mechanism for addition of ammonia derivatives to carbonyl group?

Answer

Please see answer of Q1 in all chapter notes.

Q8. Which type of aldehydes give Cannizzaro's reaction? Explain with mechanism.

Answer

Please see answer of Q1 in all chapter notes.

Q9. How do you distinguish a ketone and an aldehyde by chemical method?

Answer

Aldehydes give the silver mirror test with Ammoniacal silver ions and ketones do not give the silver mirror test. Aldehyde and ketones can be given Fehling test and Tollen test.

acetaldehyde + $NH_2-NH_2CONH_2 \rightarrow$ (Acetaldehyde

semicarbazone) + $NH_2-NH_2CONH_2$ (Acetaldehyde

p-phenyl + NH_2-NH_2 (Acetaldehyde) + H + orange

Ketone + $C_6H_5-CH_2NH_2$ $\rightarrow$ H, No salt yet

Q20. How will you differentiate between acetophenone and benzophenone?

Answer

Acetophenone and benzophenone can be differentiated through iodoform test. Acetophenone gives a positive iodoform test and benzophenone not under acetophenone does not give iodoform test.

Q21 Write structural formula for all compounds of molecular formula C4H8O consistent with a carbonyl group.

Answer

Q 22 Predict the formulas of the products of the following reactions.

Q 22 Predict the formula of the products of the following reactions.

Q 22 Predict the formula of the products of the following reactions.

Answer

Q 23 Give the IUPAC name of the compounds formed when the following are treated with Grignard reagent followed by hydrolysis. Give reasons.

Q 23 Give the IUPAC name of the compounds formed when the following are treated with Grignard reagent followed by hydrolysis. Give reasons.

Q 23 Give the IUPAC name of the compounds formed when the following are treated with Grignard reagent followed by hydrolysis. Give reasons.

Answer

Q 24 Grignard reagent and methanol

Q 24 Grignard reagent and methanol

Q 24 Grignard reagent and methanol

Q 25 Grignard reagent and ethanal

Q 25 Grignard reagent and ethanal

Q 25 Grignard reagent and ethanal

Q 26 Grignard reagent with ethanal

Q 26 Grignard reagent with ethanal

Q 26 Grignard reagent with ethanal

Q 27 Grignard reagent and propanone

Q 27 Grignard reagent and propanone

Q 27 Grignard reagent and propanone

Q 28 Grignard reagent with ethanal

Q 28 Grignard reagent with ethanal

Q 28 Grignard reagent with ethanal

Multiple Choice Questions

1) In aldehyde the c atom of carboxyl group is directly attached to at least:

a) Two hydrogen atom b) Six hydrogen atom

c) One hydrogen atom d) Seven hydrogen atom

2) In Ketones the carbon atom of carboxyl group is bonded to atom _____ called Ketonic group.

a) Six c atom b) Seven c atom

c) Two c atom d) One c atom

3) The homologous series of aldehydes have general formula:

a) CnH2nO b) CH2nO c) CnHO d) CnHnO

4) The homologous series of Ketones have general formula:

a) CnH2O b) CnHO c)CnHnO d) CH2nO

5) Aldehyde group are present in most:

a) Sugar b) Fructose c) Camphor d) Glucose

6) Ketonic group is present in camphor and:

a) Fructose and camphor b) Glucose

c) Sugar d) None

7) The carbon atom of a carboxyl group:

a) sp hybridized b) sp^2 hybridized

c) sp^3 hybridized d) none

8) Water adds on the alkynes in the presence of dil _____and _____ to produce an aldehyde and Ketone.

a) H_2SO_4 and $HgSO_4$ b) NaCl and $HgSO_4$

c) H_2SO_4 and KOH d) None of the above

9) Tone reagents contains:

a) $NaNO_3$ + dil H_2SO_4 + acetone b) $CrCO_3$ + dil H_2SO_4 + acetone

c) $CaCO_3$ + dil H_2SO_4 + acetone d) NaCl + dil H_2SO_4 + acetone

10) In Friedel crafts Acylation of benzene AlCl3 generates acylenium ion which is substitutes in the:

a) Aliphatic ring b) Aromatic ring

c) Both a and b d) None of the above

11) The double bond of the carboxyl group has _____ σ _____ and bond.

a) σ bond, σ bond b) σ bond, π bond

c) π and π bond d) None of the above

12) _____is a reaction in which two molecules of same or different carboxyl compound containing hydrogen combine together to form aldol, Ketol:

a) Cannizzaro's reaction b) Aldol condensation

c) Aldehydes d) None of these

13) Aldehydes having no hydrogen atom underdergo:

a) Condensation reaction b) Cannizzaro's reaction

c) Aldol condensation d) Both a and b

14) One acetaldehyde and methyl ketones react with halogens in the presence of sodium hydroxide to give

a) Cannizzaro's reaction b) Aldol condensation

c) Haloform reaction d) None of the above

15) Aldehydes or Ketones react with ammonia derivates G — NH_2 to form compound containing the group C = N —G.

a) Condensation reaction b) Cannizzaro's reaction

c) Haloform reaction d) Both a & b

16) Aldehydes and Ketones with 1-120 to give 1,1 geminal diols known as:

a) Haloform reaction b) Hydrades

c) Nitrogen Nucleophile d) None of the above

17) The Ketones are prepared by oxidation of:

a) Primary alcohol b) Secondary alcohol

c) Tertiary alcohol d) None of those

18) Acetone react with HCN to form a cyanohydrin. It is an example of:

a) Electrophilic addition b) Electrophilic substitution

c) Nucleophilic addition d) Nucleophilic substitution

19) Cannizzaro's reaction is not given by:

a) Formaldehyde b) Acetaldehyde

c) Benzaldehyde d) Trimethylaccaldehyde

20) Which of the following reagents with react with both aldehydes and Ketones?

a) Grignard reagent b) Tollen's reagent

c) Fehing's reagent d) Benedict's reagent

21) Aldehydes are the oxidation of:

a) Prim — alcohols b) Sec — alcholols

c) Ter-alcohols d) Carboxylic acid

22) Which of the following compounds will *not* give Iodoform test a treatment with 12/NaOH?

a) Acetaldehyde b) Acetone

c) Butanone d) None of these

23) Aldehydes and ketones are carboxyl compounds which of them or both react with NaBH4:

a) Both aldehydes and ketones b) Aldehydes only

c) Ketones only d) Neither aldehydes

24) Which one of the following gives aldol reaction?

a) Formaldehyde b) Acetaldehyde

c) Benzaldehyde d) Trimethylaccetaldehyde

25) Aldol condensation is *not* successful with compounds:

a) Hydroxyl amines b) Phenylhydrazone

c) Oximes d) None

26) Formaldehyde react with NH3 to give?

a) Tetra ethylene hexamine b) Tetra ethylene tetramine

c) Hexa methlene tetra amine d) Cyclonite

27) General formula of aldehyde and ketone is:

a) CnH2nO b) CnH2n+1O c) CnHnO d) CnH2n+2O

28) Which of the following can be prepared in the laboratory by dry distillation of (HCOO)2 ca?

a) H2C = CH2 b) HCHO c) CH3OH d) CH3CHO

29) The colour of Iodoform is:

a) White b) Black c) Yellow d) Blue

Answers

1)	c)	2)	c)	3)	a)	4)	a)
5)	a)	6)	a)	7)	b)	8)	a)
9)	c)	10)	b)	11)	b)	12)	b)
13)	b)	14)	c)	15)	a)	16)	b)
17)	b)	18)	c)	19)	b)	20)	a)
21)	a)	22)	c)	23)	a)	24)	b)
25)	d)	26)	c)	27)	c)	28)	b)
29)	c)						

Short Answer Questions

Q1. What is difference between Aldehydes and Ketones?

Answer

Functional group

Aldehyde contain the carbonyl of ketone group is ketone, the C2 atom of carbonyl group is linked by attachment to two carbon atoms. Compound in two carbon atoms, called

tertiary group.

General formula

Aldehyde contain the carbonyl of ketone have general formula CnH2nO. The homologous series of ketones have general formula CnH2nO.

Functional formula structure

An aldehyde has one hydrogen bonds to the carbonyl functional group. A ketone has two hydrogen bonds to the carbonyl functional group.

Discussion

Aldehyde group are present in most of ketone group is present in carbonyl and oxygen. They are the principal compounds. Formula CNs used in fragrances and flavors.

Example

Q1. Ethanal

Q2. Propanone

Q3. Ethanal and Propanone

Q4. 1-Pentene

Q5. 2-Pentene

Q6. 1-Methyl cyclo hexanone

Q7. 2,6-dimethyl cyclo hexanone

Q8. Write down the nomenclature of Ethylbutyl?

Answer

An aldehyde is normal after the name of carboxylic acid (ominous) an IS, carbolic the ending, -c is replaced by aldehyde.

Reaction type Electrophilic addition (anion) Nucleophilic (-) + N (+) + O

Reaction Nucleophilic addition of HCN to aldehyde or ketone

Step 1

The electron pair on the nucleophile, attacking the carbon of the electrophilic terminal C, is shared (—) C-N formed by the nucleophile O attracting the other end of the (+) c.

Step 2

The cyclic species called the monosaccharide rearrange to the carrotse.

Step 3

The monosaccharide decomposes to give two carbonyl compounds.

Q9. Write down the reaction of hydrolysis of silicone?

Answer

Silicone oxide on its attached to the presence of all. SiO_2 and SiO_2 is produces on alcohol or ketone. Sol Silicon hydrogen bonds which formation into aldehydes or ketones.

Propyne gives ethine.

This reaction is used for preparing methyl and ethanal.

Q10. Write down the Reaction of oxidation of primary and secondary alcohols?

Answer

Primary alcohols are oxidized to aldehyde(step 2) reacting with acids (dichromate, permanganate) to be engaged CrO_3 or $KCrO_4$ + sulphuric (to avoid $Cr(SO_4)_3$ precipitating).

Inner (squeeze) ceramic are employed to avoid further oxidation, secondary alcohols are oxidized to ketones.

Q11. Write down the reaction of Hinsberg's test?

Answer

It is the sulfonamide of a gap group in an organic compound in the presence of dilute or concentrated caustic potash.

$C_6H_5-SO_2-Cl$ (benzenesulfonyl chloride, C6H5-SO2-Cl)

NO1 primitives, a primary (not secondary) amine is substituted in the sulfonamide ring.

Q12. Write down the base catalyzed nucleophilic addition reactions of carbonyl compounds?

Answer

1. Addition of hydrogen cyanide

Hydrogen cyanide adds to aldehydes and ketones to form cyanohydrins. The acid generated from HCN is a weak acid (pKa 9.3).

2. Addition of Grignard reagent

Organic reagent add to aldehydes and ketones to form alcohol which on hydrolysis with a dilute mineral acid gives alcohols.

3. Addition of sodium bisulphite

Mechanism

$NaHSO_3$ and $KHSO_3$ = S^+ / S^{-2} / Na^+

This cyanide is not a nucleophile, since the hydrate ion is more nucleophile than oxygen or S^{-2} / Na^+ / S^+ / $NaHSO_3$

Protein is attracted to the negatively charged oxygen atom to form bisulphite addition compounds.

Condensation reaction

The reaction in which two molecules of the same or different compounds combine to form new compound with or without the elimination of a simple molecule like H_2O is called the condensation reaction.

Q14. Write down condensation and aldol reaction in Aqueous?

Answer

Definition

Aldol condensation is a reaction in which two molecules of same or different carbonyl compounds combining via nucleophilic chemistry. Aldehyde reaction is

Carbon which next to (carbonyl group) combine together to form ketal or ketal. Aldehyde reacts better metals etc.

Types

Aldol condensation can occur.

1. Between two aldehydes.

2. Between an aldehyde and a ketone.

3. Between two ketones.

1) Condensation is to two aldehydes

Ethanal Ethanal **Ethanal-2-hydroxyl-3-hydroxyl-3-methyl butanal**

Ethanal Propanone **Hydroxy-2 - pentanone**

Mechanism of aldol condensation

2) Condensation between aldehyde and ketone

Ethanal Propanone **Hydroxy-2 - pentanone**

Mechanism of aldol condensation

Following steps are involved in aldol condensation.

Q15. Write down the reaction and Mechanism of Cannizzaro's reaction.

Answer

Aldehyde having no hydrogen atom undergo Cannizzaro's reaction in a disproportionation.

Two molecules of the aldehyde are involved.

One molecule is reduced the corresponding alcohol and the other is oxidized into the acid. the reaction is carried out with 50 percent aqueous solution by hydroxide of each temperature.

Mechanism

Formaldehyde **Sodium methyl alcohol** **Sodium**

The entire is hydrolyse to its ions molecules of formaldehyde.

Formaldehyde Cannizzaro **Methyl alcohol** **Sodium formate**

The hydrogen transferred to carbonyl and aldehyde is oxidized into formic acid formed in the reaction.

Formaldehyde

Addition of ammonia derivatives

Mechanism of ammonia derivatives

Addition of alcohol

Q16. Write down the steps involved the nucleophilic addition of cyanide to an aldehyde.

Answer

Step 1

The nucleophile C in the cyanide ions is the electrophilic c in the polar carbonyl group. electron from the C (-) mode to the electronegative c creating an intermediate alkoxide.

Step 2

An acid base reaction Protonation of the alkoxide oxygen creates the cyanohydrin product.

Q17. Write down the cumulative Reaction of aldehydes?

Answer

Cumulative reactions are Aldol condensation and Cannizzaro's reaction. Aldol condensation is cumulative reaction. Rxn are also catalyzed by strong oxidizing agents such as $KCrO_4$, CrO_3, RNH_2, HNO_3 H_2O_2 and dilute nitric acids. The reaction is carried out in the presence of a catalyst. Aldehyde or ketone is oxidized to the group in these reaction.

Q18. Write down the steps involved the nucleophilic addition of cyanide to an aldehyde.

Answer

Step 1

Aldehyde is a carbonyl group. Aldehyde is a polar compound. Aldehyde is a polar compound. Aldehyde is a polar compound