

Chapter 12: Aldehydes, Ketones and Carboxylic Acids

NCERT Exemplar · Class 12 · Chemistry

I. Multiple Choice Questions (Type-I)

Question 1

Addition of water to alkynes occurs in acidic medium and the presence of

Hg^{2+} ions as a catalyst. Which of the following products will be formed on

addition of water to but-1-yne under these conditions.

- (i) $\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—C(=O)—H}$ (ii) $\text{CH}_3\text{—CH}_2\text{—C(=O)—CH}_3$
- (iii) $\text{CH}_3\text{—CH}_2\text{—C(=O)—OH} + \text{CO}_2$ (iv) $\text{CH}_3\text{—C(=O)—OH} + \text{H—C(=O)—H}$

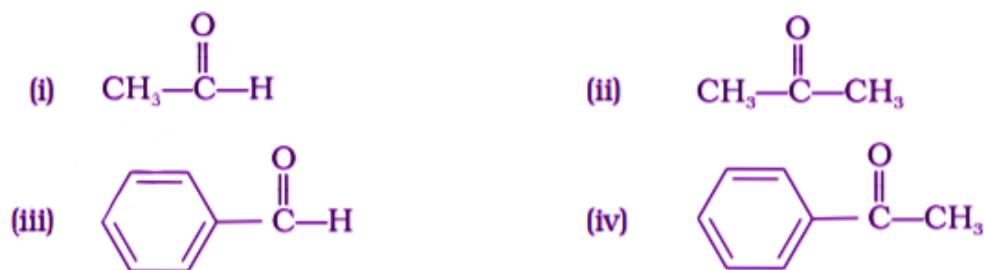
Solution

Option (ii) is the answer.

Question 2

Which of the following compounds is most reactive towards nucleophilic

addition reactions?



Solution

Option (i) is the answer.

Question 3

The correct order of increasing acidic strength is _____.

A.

Phenol < Ethanol < Chloroacetic acid < Acetic acid

B.

Ethanol < Phenol < Chloroacetic acid < Acetic acid

C.

Ethanol < Phenol < Acetic acid < Chloroacetic acid

D.

Chloroacetic acid < Acetic acid < Phenol < Ethanol

Answer

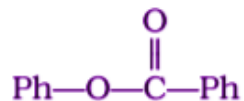
Correct option: C

Solution

Option (iii) is the answer.

Question 4

Compound can be prepared by the reaction of _____.



A.

Phenol and benzoic acid in the presence of NaOH

B.

Phenol and benzoyl chloride in the presence of pyridine

C.

Phenol and benzoyl chloride in the presence of ZnCl₂

D.

Phenol and benzaldehyde in the presence of palladium

Answer

Correct option: B

Solution

Option (ii) is the answer.

Question 5

The reagent which does not react with both, acetone and benzaldehyde.

A.

Sodium hydrogen sulphite

B.

Phenyl hydrazine

C.

Fehling's solution

D.

Grignard reagent

Answer

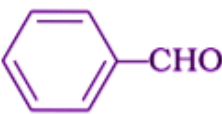
Correct option: C

Solution

Option (iii) is the answer.

Question 6

Cannizaro's reaction is not given by _____.

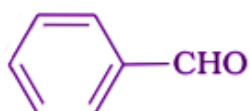
- (i) 
- (ii) 
- (iii) HCHO
- (iv) CH_3CHO

Solution

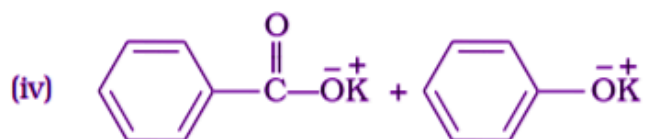
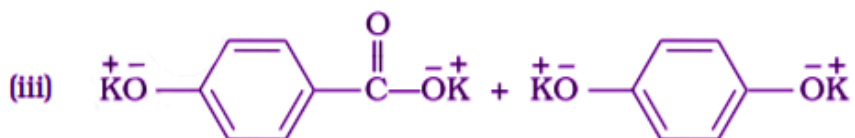
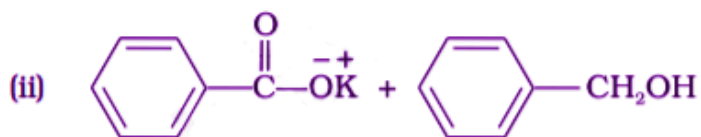
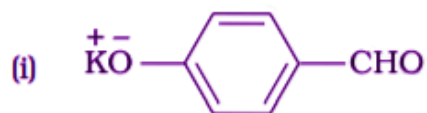
Option (iv) is the answer.

Question 7

Which product is formed when the compound



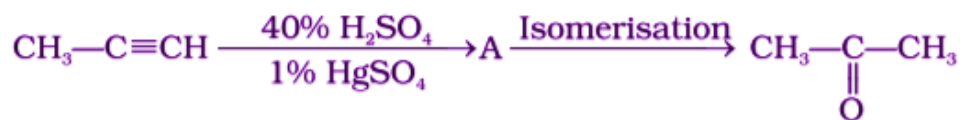
is treated with concentrated aqueous KOH solution?



Solution

Option (ii) is the answer.

Question 8



Structure of 'A' and type of isomerism in the above reaction are respectively.

A.

Prop-1-en-2-ol, metamerism

B.

Prop-1-en-1-ol, tautomerism

C.

Prop-2-en-2-ol, geometrical isomerism

D.

Prop-1-en-2-ol, tautomerism

Answer

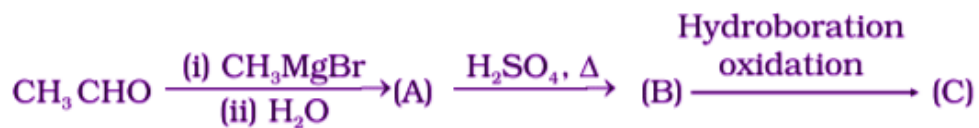
Correct option: D

Solution

Option (iv) is the answer.

Question 9

Compounds A and C in the following reaction are _____.



A.

identical

B.

positional isomers

C.

functional isomers

D.

optical isomers

Answer

Correct option: B

Solution

Option (ii) is the answer.

Question 10

Which is the most suitable reagent for the following conversion?



A.

Tollen's reagent

B.

Benzoyl peroxide

C.

I₂ and NaOH solution

D.

Sn and NaOH solution

Answer

Correct option: C

Solution

Option (iii) is the answer.

Question 11

Which of the following compounds will give butanone on oxidation with alkaline KMnO₄ solution?

A.

Butan-1-ol

B.

Butan-2-ol

C.

Both of these

D.

None of these

Answer

Correct option: B

Solution

Option (ii) is the answer.

Question 12

In Clemmensen Reduction carbonyl compound is treated with _____.

A.

Zinc amalgam + HCl

B.

Sodium amalgam + HCl

C.

Zinc amalgam + nitric acid

D.

Sodium amalgam + HNO₃

Answer

Correct option: A

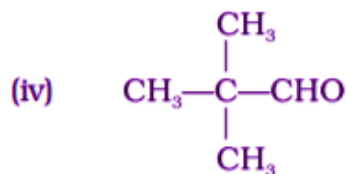
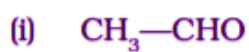
Solution

Option (i) is the answer.

II. Multiple Choice Questions (Type-II)

Question 13

Which of the following compounds do not undergo aldol condensation?

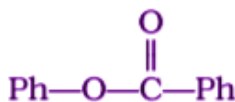


Solution

Option (ii) and (iv) are the answers.

Question 14

Treatment of compound with NaOH solution yields



(i) Phenol

(ii) Sodium phenoxide

(iii) Sodium benzoate

(iv) Benzophenone**Solution**

Option (ii) and (iii) are the answers.

Question 15

Which of the following conversions can be carried out by Clemmensen

Reduction?

- (i) Benzaldehyde into benzyl alcohol
- (ii) Cyclohexanone into cyclohexane
- (iii) Benzoyl chloride into benzaldehyde
- (iv) Benzophenone into diphenylmethane

Solution

Option (ii) and (iv) are the answers.

Question 16

Through which of the number of the following reactions of carbon atoms can be increased in the chain?

- (i) Grignard reaction
- (ii) Cannizaro's reaction
- (iii) Aldol condensation
- (iv) HVZ reaction

Solution

Option (i) and (iii) are the answers.

Question 17

Benzophenone can be obtained by _____.

- (i) Benzoyl chloride + Benzene + AlCl_3

(ii) Benzoyl chloride + Diphenyl cadmium

(iii) Benzoyl chloride + Phenyl magnesium chloride

(iv) Benzene + Carbon monoxide + ZnCl_2

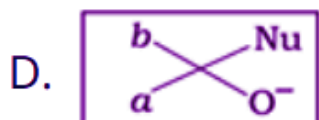
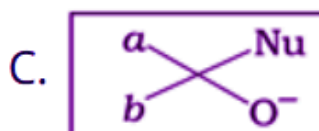
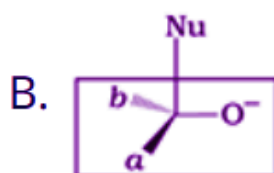
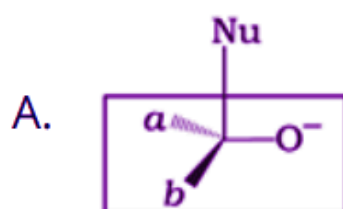
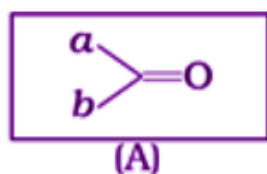
Solution

Option (i) and (ii) are the answers

Question 18

Which of the following is the correct representation for intermediate of nucleophilic addition reaction to the given carbonyl compound (A) :

(A)



Solution

Option (A) and (B) are the answers.

III. Short Answer Type

Question 19

Why is there a large difference in the boiling points of butanal and butane-1-ol?

Solution

Butanal has no intermolecular hydrogen bonding but butan-1-ol has intermolecular hydrogen bonding. This bonding in butan-1-ol makes it more stable at a higher temperature than butanal.

Question 20

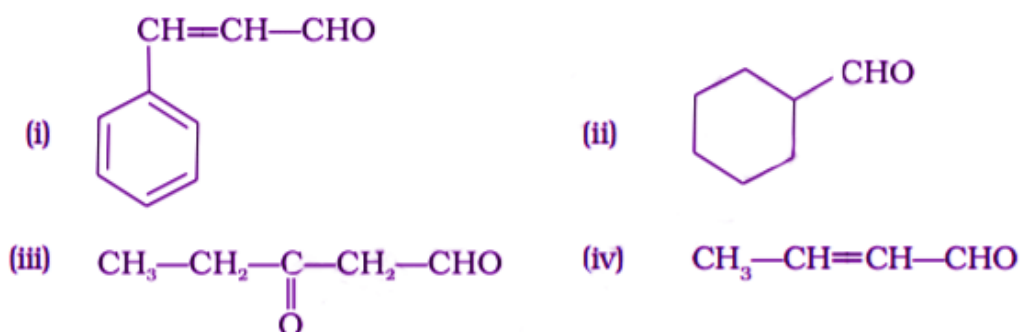
Write a test to differentiate between pentan-2-one and pentan-3-one.

Solution

One can differentiate between pentan-2-one and pentan-3-one by iodoform test. Pentan-2-one have a -CO-CH_3 group and therefore forms a yellow precipitate of Iodoform. Pentan-2-one gives a positive iodoform test, whereas, and pentan-3-one does not give a positive iodoform test because they don't have a -CO-CH_3 group.

Question 21

Give the IUPAC names of the following compounds



Solution

- (i) 3-Phenylprop-2-ene-1-al.
- (ii) Cyclohexanecarbaldehyde
- (iii) 3-Oxopentan-1-al
- (iv) IUPAC name: But-2-enal

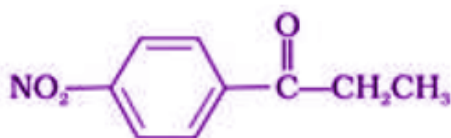
Question 22

Give the structure of the following compounds.

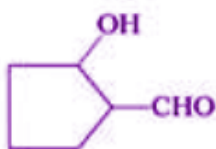
- (i) 4-Nitropropiophenone
- (ii) 2-Hydroxycyclopentanecarbaldehyde
- (iii) Phenyl acetaldehyde

Solution

(i)

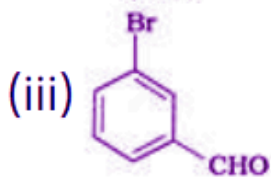
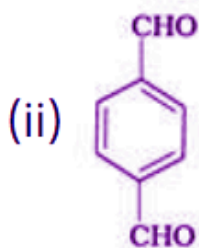
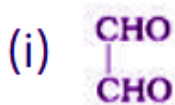


(ii)



Question 23

Write IUPAC names of the following structures.



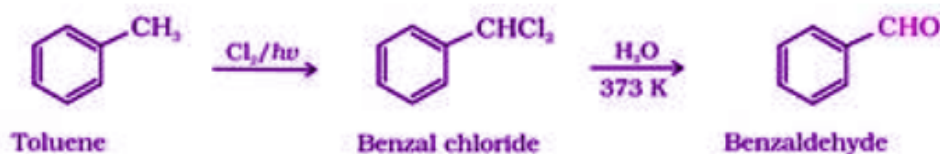
Solution

- (i) Ethane-1,2-dial.
- (ii) Benzene-1, 4-dicarbaldehyde.
- (iii) 3-Bromobenzaldehyde.

Question 24

Benzaldehyde can be obtained from benzal chloride. Write reactions for obtaining benzyl chloride and then benzaldehyde from it.

Solution



Toluene is first converted to benzal chloride by side-chain chlorination, in presence of Chlorine gas and light. Benzal chloride on hydrolysis at 373K gives benzaldehyde.

Question 25

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

Solution

The electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous AlCl_3 is benzoylium cation. The product formed in this reaction is benzophenone. This reaction is called Friedel Craft's acylation reaction.

Question 26

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

Solution

The products formed on oxidation of 2, 5-dimethylhexan-3-one are the mixtures of ketone and carboxylic acids. Ketone is then further oxidized to carboxylic acids. Overall the products formed in this reaction are 2-Methylpropanoic acid, 3-Methylbutanoic acid, ethanoic acid and methanoic acid.

Question 27

Arrange the following in decreasing order of their acidic strength and give the reason for your answer.

$\text{CH}_3\text{CH}_2\text{OH}$, CH_3COOH , ClCH_2COOH , FCH_2COOH , $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$

Solution

$\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{C}_6\text{H}_5\text{CH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{OH}$.

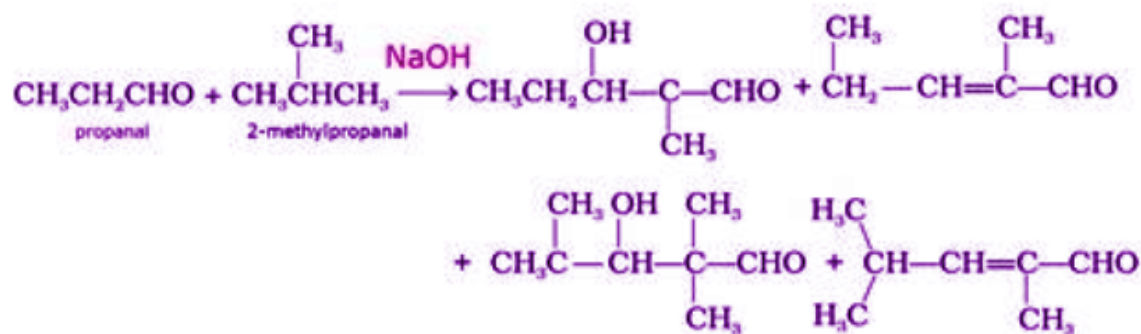
$\text{CH}_3\text{CH}_2\text{OH}$ is least acidic among the given compounds. $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$ is more acidic than CH_3COOH due to the resonance in $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$. FCH_2COOH and ClCH_2COOH are highly acidic due to the $-\text{I}$ effect of halogen.

Question 28

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

Solution

When propanal reacts with 2-methyl propanal in the presence of NaOH, the mixture of aldehydes are formed. Both the reactants have an α -hydrogen and hence, can undergo cross aldol reaction in the presence of NaOH.



Question 29

Compound 'A' was prepared by oxidation of compound 'B' with alkaline KMnO_4 . Compound 'A' on reduction with lithium aluminium hydride gets converted back to compound 'B'. When compound 'A' is heated with compound B in the presence of H_2SO_4 it produces the

fruity smell of compound C to which family the compounds 'A', 'B' and 'C' belong to?

Solution

Compound 'A' belongs to the carboxylic acid.

Compound 'B' belongs to alcohol.

Compound 'C' belongs to an ester group.

Question 30

Arrange the following in decreasing order of their acidic strength. Explain the arrangement.

$\text{C}_6\text{H}_5\text{COOH}$, FCH_2COOH , $\text{NO}_2\text{CH}_2\text{COOH}$

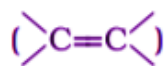
Solution

$\text{NO}_2\text{CH}_2\text{COOH} > \text{FCH}_2\text{COOH} > \text{C}_6\text{H}_5\text{COOH}$.

$\text{NO}_2\text{CH}_2\text{COOH}$ is most acidic among the given three compounds. Electron withdrawing groups like $-\text{NO}_2$, increases the acidity of carboxylic acids by stabilizing the conjugate base through resonance effects

Question 31

Alkenes and carbonyl compounds both contain a π bond but alkenes show electrophilic addition reactions whereas carbonyl compounds show nucleophilic addition reactions. Explain.



Solution

Both the compounds carbon atom is attached to the electronegative atom oxygen. Thus the oxygen pulls more shared pair of electron towards them and a partial positive charge will be acquired by carbon and a partial negative charge by oxygen. So carbonyl atom is attacked by a nucleophile.

Question 32

Carboxylic acids contain carbonyl group but do not show the nucleophilic addition reaction like aldehydes or ketones. Why?

Solution

The oxygen atom in carbonyl compound pull more shared pair of electron towards itself and so, carbon acquires partial positive charge and oxygen acquires partial negative charge in carbonyl compounds.

So, the carbon in the carbonyl atom is attacked by a nucleophile. Due to the resonance, carboxylic acids contain carbonyl group do not show the nucleophilic addition reaction like aldehydes or ketones

Question 33

Identify the compounds A, B and C in the following reaction.

Solution

Compound A = $\text{CH}_3\text{-MgBr}$

Compound B = $\text{CH}_3\text{-COOH}$

Compound C = $\text{CH}_3\text{COOCH}_3$

Question 34

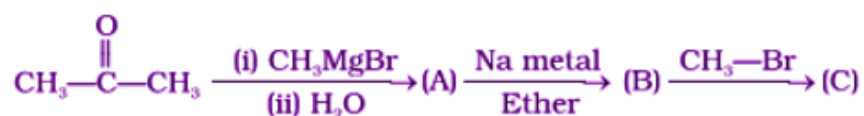
Why are carboxylic acids more acidic than alcohols or phenols although all of them have a hydrogen atom attached to an oxygen atom (—O—H)?

Solution

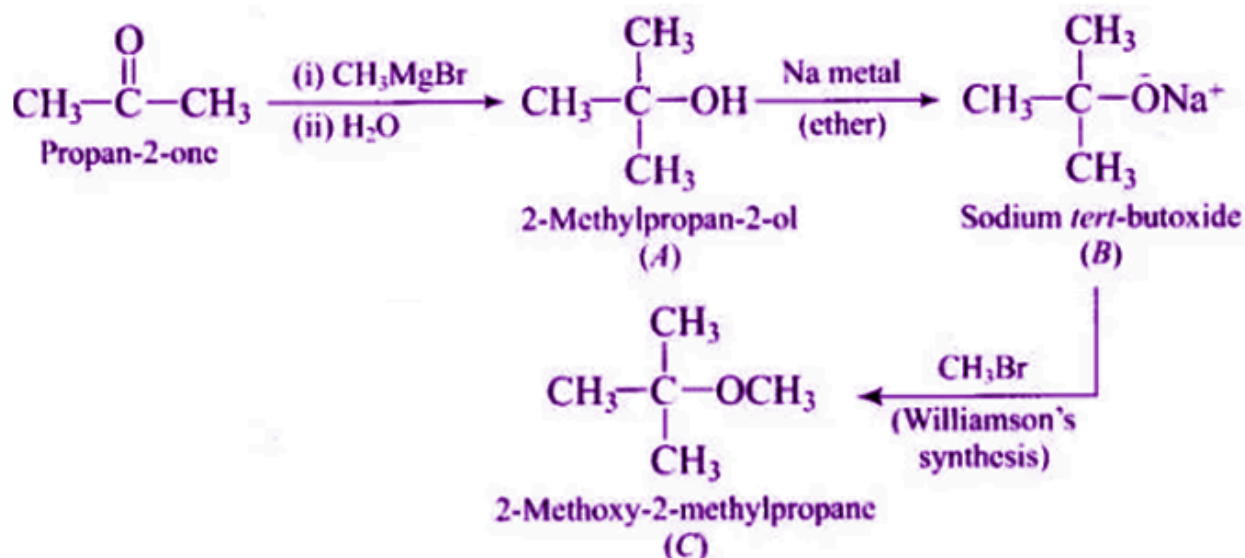
Due to the resonance in carboxylic acids, the negative charge is at the more electronegative oxygen whereas, in alcohols or phenols, the negative charge is on a less electronegative atom. Thus, carboxylic acids can release proton easier than alcohols or phenols.

Question 35

Complete the following reaction sequence.



Solution



Question 36

Ethylbenzene is generally prepared by acetylation of benzene followed by reduction and not by direct alkylation. Think of a possible reason.

Solution

This is due to the formation of polysubstituted products.

To avoid the formation of polysubstituted products Friedel-craft's alkylation reaction is not used for the preparation of ethylbenzene but one can use Friedel-craft's acylation reaction.

Question 37

Can Gatterman-Koch reaction be considered similar to Friedel Craft's acylation? Discuss.

Solution

Both reactions resemble each other. In Friedel Craft's acylation reaction, an aryl group or benzene is treated with an acid chloride in the presence of anhydrous AlCl_3 and corresponding aldehyde or ketone is formed. In Gatterman-Koch reaction, benzene is treated with CO and HCl in the presence of AlCl_3 and CuCl to yield benzaldehyde.

IV. Matching Type

Note: Match the items of Column I and Column II in the following questions.

Question 38

Match the common names given in Column I with the IUPAC names given in

Column II

Column I Common names	Column II (IUPAC names)
(i) Cinnamaldehyde	(a) Pentanal
(ii) Acetophenone	(b) Prop-2-enal
(iii) Valeraldehyde	(c) 4-Methylpent-3-en-2-one
(iv) Acrolein	(d) 3-Phenylprop-2-enal
(v) Mesityl oxide	(e) 1-Phenylethanone

Solution

(i) is d

(ii) is e

(iii) is a

(iv) is b

(v) is c

Question 39

Match the acids given in Column I with their correct IUPAC names given in

Column II.

Column I (Acids)	Column II (IUPAC names)
(i) Phthalic acid	(a) Hexane-1,6-dioic acid
(ii) Oxalic acid	(b) Benzene-1,2-dicarboxylic acid
(iii) Succinic acid	(c) Pentane-1,5-dioic acid
(iv) Adipic acid	(d) Butane-1,4-dioic acid

(v) Glutaric acid	(e) Ethane-1,2-dioic acid
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Solution

(i) is b

(ii) is e

(iii) is d

(iv) is a

(v) is c

Question 40

Match the reactions given in Column I with the suitable reagents given in

Column II.

Column I (Reactions)	Column II(Reagents)
(i) Benzophenone → Diphenylmethane	(a) LiAlH_4
(ii) Benzaldehyde → 1-Phenylethanol	(b) DIBAL—H
(iii) Cyclohexanone → Cyclohexanol	(c) Zn(Hg)/Conc. HCl
(iv) Phenyl benzoate → Benzaldehyde	(d) CH_3MgBr

Solution

(i) is c

(ii) is d

(iii) is a

(iv) is b

Question 41

Match the example given in Column I with the name of the reaction in Column II

Column I (Examples)		Column II (Reaction)	
(i)	$\text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C—Cl} + \text{H}_2 \xrightarrow{\text{Pd-C/BaSO}_4} \text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C—H}$	(a)	Friedel–Crafts acylation
(ii)	$\text{C}_6\text{H}_5\text{CHO} \xrightarrow{\text{NaOH}} \text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{C}_6\text{H}_5\text{COO}^-\text{Na}^+$	(b)	HVZ reaction
(iii)	$\text{C}_6\text{H}_6 + \text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C—Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{—}\overset{\text{O}}{\parallel}\text{C—CH}_3$	(c)	Aldol condensation
(iv)	$\text{R—CH}_2\text{—COOH} \xrightarrow{\text{Br}_2/\text{Red P}} \text{R—}\underset{\text{Br}}{\text{CH}}\text{—COOH}$	(d)	Cannizzaro's reaction
(v)	$\text{CH}_3\text{—CN} \xrightarrow[\text{(ii) H}_2\text{O/H}^+]{\text{(i) SnCl}_2/\text{HCl}} \text{CH}_3\text{CHO}$	(e)	Rosenmund's reduction
(vi)	$2\text{CH}_3\text{CHO} \xrightarrow{\text{NaOH}} \text{CH}_3\text{—CH=CHCHO}$	(f)	Stephen's reaction

Solution

(i) is e

(ii) is d

(iii) is a

(iv) is b

(v) is f

(vi) is c

V. Assertion and Reason Type

Note: In the following questions a statement of assertion followed by a

statement of reason is given. Choose the correct answer out of the following choices.

- (i) Assertion and reason both are correct and the reason is the correct explanation of assertion.
- (ii) Assertion and reason both are wrong statements.
- (iii) The assertion is a correct statement but the reason is the wrong statement.
- (iv) The assertion is a wrong statement but the reason is the correct statement.
- (v) Assertion and reason both are correct statements but the reason is not the correct explanation of assertion.

Question 42

Assertion: Formaldehyde is a planar molecule.

Reason: It contains sp^2 hybridised carbon atom.

Solution:
Option (i) is correct.

Solution

Solution coming soon.

Question 43

Assertion: Compounds containing —CHO group are easily oxidised to corresponding carboxylic acids.

Reason: Carboxylic acids can be reduced to alcohols by treatment with LiAlH_4

Solution

Option (v) is correct

Question 44

Assertion: The α -hydrogen atom in carbonyl compounds is less acidic.

Reason: The anion formed after the loss of the α -hydrogen atom is resonance stabilised.

Solution

Option (iv) is correct.

Question 45

Assertion: Aromatic aldehydes and formaldehyde undergo Cannizaro reaction.

Reason: Aromatic aldehydes are almost as reactive as formaldehyde.

Solution:
Option (iii) is correct.

46. Assertion: Aldehydes and ketones, both react with Tollen's reagent to form a silver mirror.

Reason: Both, aldehydes and ketones contain a carbonyl group.

Solution

Option (iv) is correct

Class 12 Chemistry NCERT Exemplar for Aldehydes, Ketones and Carboxylic Acids

Studying the chapter Aldehydes, Ketones and Carboxylic Acids will help you to understand IUPAC names and common names of ketones, aldehydes and carboxylic acids. It will also aid in understanding

- The structures of the compounds containing functional groups of carboxyl and carbonyl groups.
 - The physical properties and chemical reactions of aldehydes, ketones and carboxylic acids with their structures.
 - Various factors affecting the acidity of carboxylic acids and their reactions.
-