

**I. Multiple Choice Questions (Type-I)**

1. Addition of water to alkynes occurs in acidic medium and the presence of  $\text{Hg}^{2+}$  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.

2. Which of the following compounds is most reactive towards nucleophilic addition reactions?

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

**Solution:**

Option (i) is the answer.

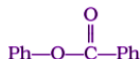
3. The correct order of increasing acidic strength is \_\_\_\_\_.

- (i) Phenol < Ethanol < Chloroacetic acid < Acetic acid  
 (ii) Ethanol < Phenol < Chloroacetic acid < Acetic acid  
 (iii) Ethanol < Phenol < Acetic acid < Chloroacetic acid  
 (iv) Chloroacetic acid < Acetic acid < Phenol < Ethanol

**Solution:**

Option (iii) is the answer.

4. Compound \_\_\_\_\_ can be prepared by the reaction of \_\_\_\_\_.



- (i) Phenol and benzoic acid in the presence of NaOH
- (ii) Phenol and benzoyl chloride in the presence of pyridine
- (iii) Phenol and benzoyl chloride in the presence of  $\text{ZnCl}_2$
- (iv) Phenol and benzaldehyde in the presence of palladium

**Solution:**

Option (ii) is the answer.

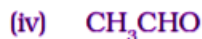
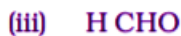
**5. The reagent which does not react with both, acetone and benzaldehyde.**

- (i) Sodium hydrogen sulphite
- (ii) Phenyl hydrazine
- (iii) Fehling's solution
- (iv) Grignard reagent

**Solution:**

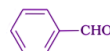
Option (iii) is the answer.

**6. Cannizaro's reaction is not given by \_\_\_\_\_.**



**Solution:**

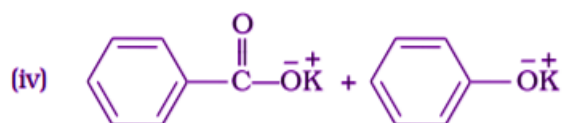
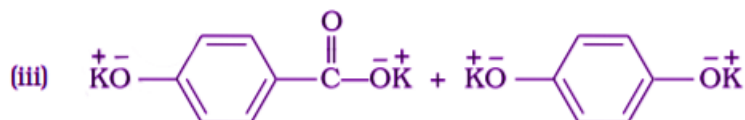
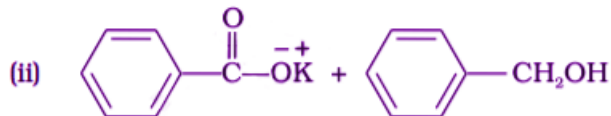
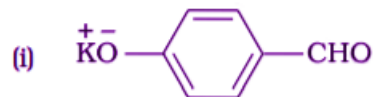
Option (iv) is the answer.



**7. Which product is formed when the compound**

**is**

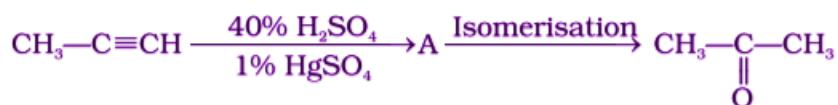
treated with concentrated aqueous KOH solution?



**Solution:**

Option (ii) is the answer.

8.



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

(i) Prop-1-en-2-ol, metamerism

(ii) Prop-1-en-1-ol, tautomerism

(iii) Prop-2-en-2-ol, geometrical isomerism

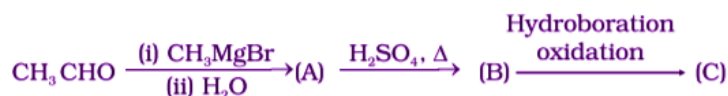
(iv) Prop-1-en-2-ol, tautomerism

**Solution:**

Option (iv) is the answer.

9.

Compounds A and C in the following reaction are \_\_\_\_\_.



- (i) identical
- (ii) positional isomers
- (iii) functional isomers
- (iv) optical isomers

**Solution:**

Option (ii) is the answer.

**10. Which is the most suitable reagent for the following conversion?**



- (i) Tollen's reagent
- (ii) Benzoyl peroxide
- (iii) I<sub>2</sub> and NaOH solution
- (iv) Sn and NaOH solution

**Solution:**

Option (iii) is the answer.

**11. Which of the following compounds will give butanone on oxidation with alkaline KMnO<sub>4</sub> solution?**

- (i) Butan-1-ol
- (ii) Butan-2-ol
- (iii) Both of these
- (iv) None of these

**Solution:**

Option (ii) is the answer.

**12. In Clemmensen Reduction carbonyl compound is treated with \_\_\_\_\_.**

- (i) Zinc amalgam + HCl
- (ii) Sodium amalgam + HCl
- (iii) Zinc amalgam + nitric acid

(iv) Sodium amalgam +  $\text{HNO}_3$

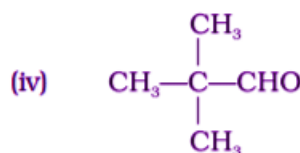
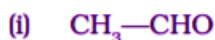
**Solution:**

Option (i) is the answer.

## II. Multiple Choice Questions (Type-II)

**Note:** In the following questions two or more options may be correct.

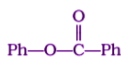
**13. Which of the following compounds do not undergo aldol condensation?**



**Solution:**

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

**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.

**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.

**16. Through which of the following reactions number 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.

17. Benzophenone can be obtained by \_\_\_\_\_.

(i) Benzoyl chloride + Benzene +  $\text{AlCl}_3$

(ii) Benzoyl chloride + Diphenyl cadmium

(iii) Benzoyl chloride + Phenyl magnesium chloride

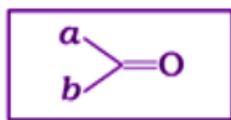
(iv) Benzene + Carbon monoxide +  $\text{ZnCl}_2$

**Solution:**

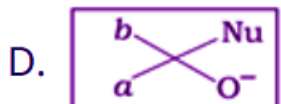
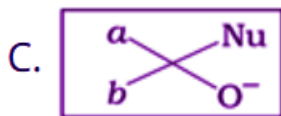
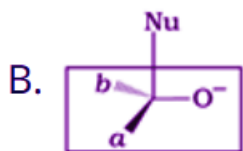
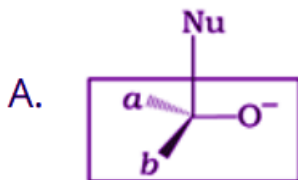
Option (i) and (ii) are the answers

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

(A)



(A)



**Solution:**

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

### III. Short Answer Type

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

**Solution:**

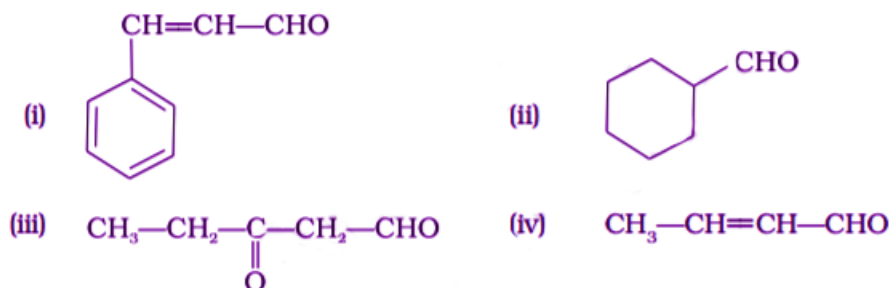
Butanal has no intermolecular hydrogen bonding but butan-1-ol has intermolecular hydrogen bonding. This bonding in butan-1-ol makes more stable at a higher temperature than butanal.

**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  $\text{CO-CH}_3$  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  $\text{CO-CH}_3$  group.

**21. Give the IUPAC names of the following compounds**



**Solution:**

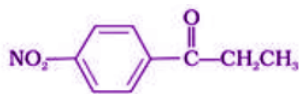
- (i) 3-Phenylprop-2-ene-1-al.
- (ii) Cyclohexanecarbaldehyde
- (iii) 3-Oxopentan-1-al
- (iv) IUPAC name: But-2-enal

**22. Give the structure of the following compounds.**

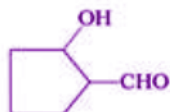
- (i) 4-Nitropropiophenone
- (ii) 2-Hydroxycyclopentanecarbaldehyde
- (iii) Phenyl acetaldehyde

**Solution:**

- (i)

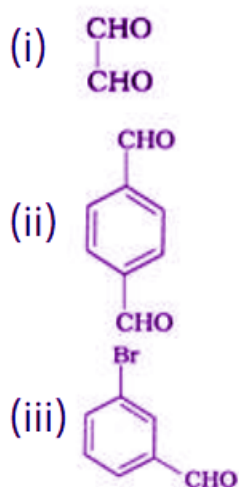


(ii)



23. Write IUPAC names of the following structures.



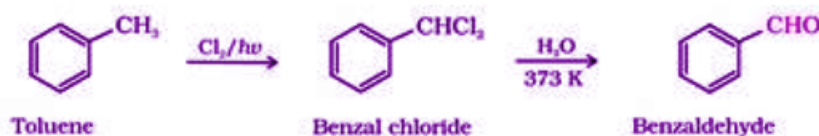


**Solution:**

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

**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.

**25. Name the electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous  $\text{AlCl}_3$ . Name the reaction also.**

**Solution:**

The electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous  $\text{AlCl}_3$  is benzoyl cation. The product formed in this reaction is benzophenone. This reaction is called Friedel Craft's acylation reaction.

**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.

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

**CH<sub>3</sub>CH<sub>2</sub>OH, CH<sub>3</sub>COOH, ClCH<sub>2</sub>COOH, FCH<sub>2</sub>COOH, C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>COOH**

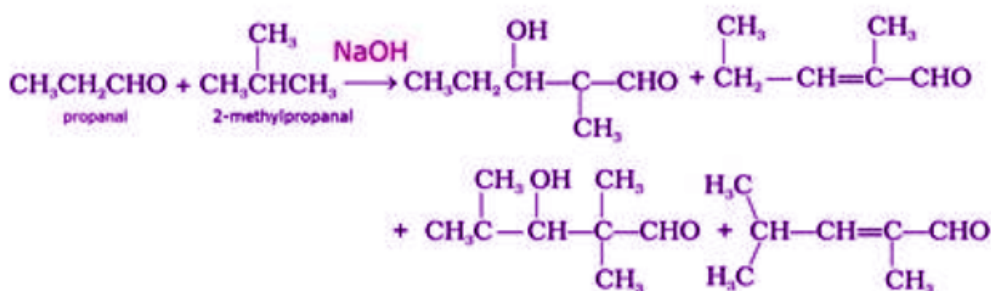
**Solution:**

FCH<sub>2</sub>COOH > ClCH<sub>2</sub>COOH > C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>COOH > CH<sub>3</sub>COOH > CH<sub>3</sub>CH<sub>2</sub>OH.

CH<sub>3</sub>CH<sub>2</sub>OH is least acidic among the given compounds. C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>COOH is more acidic than CH<sub>3</sub>COOH due to the resonance in C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>COOH. FCH<sub>2</sub>COOH and ClCH<sub>2</sub>COOH are highly acidic due to the -I effect of halogen.

**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 alpha-hydrogen and hence, can undergo cross aldol reaction in the presence of NaOH.


**29. Compound 'A' was prepared by oxidation of compound 'B' with alkaline KMnO<sub>4</sub>. 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<sub>2</sub>SO<sub>4</sub> it produces 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.

**30. Arrange the following in decreasing order of their acidic strength. Explain the arrangement.**  
**C<sub>6</sub>H<sub>5</sub>COOH, FCH<sub>2</sub>COOH, NO<sub>2</sub>CH<sub>2</sub>COOH**
**Solution:**

NO<sub>2</sub>CH<sub>2</sub>COOH > FCH<sub>2</sub>COOH > C<sub>6</sub>H<sub>5</sub>COOH.

NO<sub>2</sub>CH<sub>2</sub>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

**31. Alkenes and carbonyl compounds both contain a  $\pi$  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.

**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

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

**Solution:**

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

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

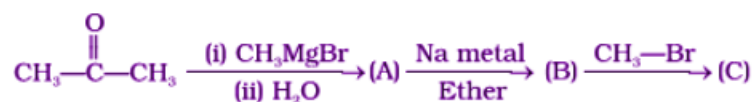
Compound C =  $\text{CH}_3\text{COOCH}_3$

**34. Why are carboxylic acids more acidic than alcohols or phenols although all of them have a hydrogen atom attached to an oxygen atom ( $\text{—O—H}$ )?**

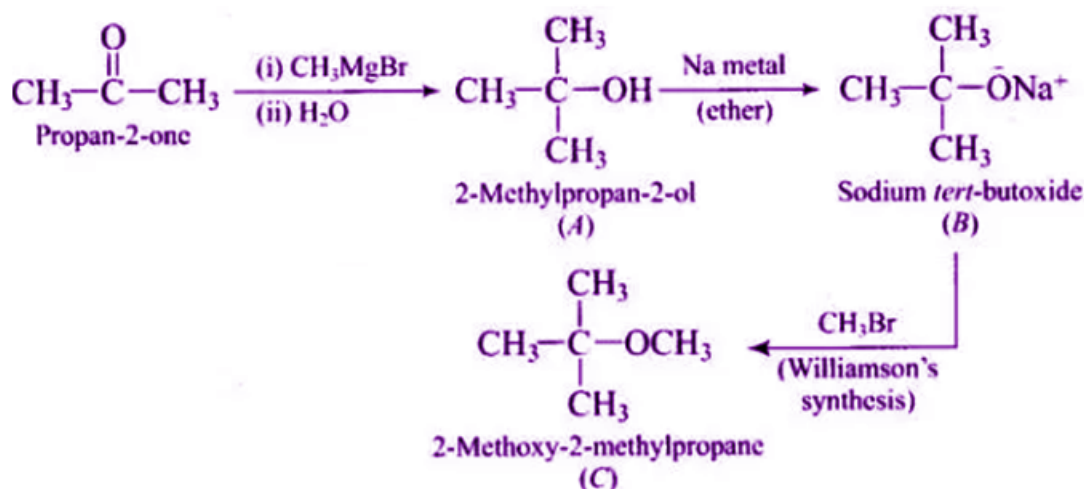
**Solution:**

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.

**35. Complete the following reaction sequence.**



**Solution:**



**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.

**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  $\text{AlCl}_3$  and corresponding aldehyde or ketone is formed. In Gatterman-Koch reaction, benzene is treated with  $\text{CO}$  and  $\text{HCl}$  in the presence of  $\text{AlCl}_3$  and  $\text{CuCl}$  to yield benzaldehyde.

#### IV. Matching Type

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

**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

**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

**Solution:**

- (i) is b
- (ii) is e
- (iii) is d
- (iv) is a
- (v) is c

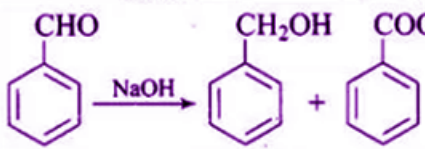
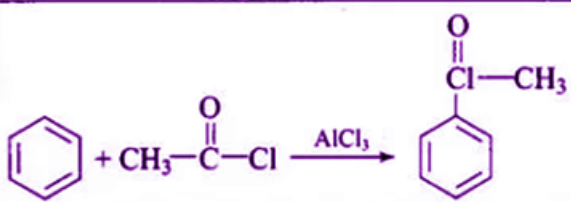
**40. Match the reactions given in Column I with the suitable reagents given in Column II.**

Column I (Reactions)	Column II (Reagents)
(i) Benzophenone $\rightarrow$ Diphenylmethane	(a) $\text{LiAlH}_4$
(ii) Benzaldehyde $\rightarrow$ 1-Phenylethanol	(b) $\text{DIBAL-H}$
(iii) Cyclohexanone $\rightarrow$ Cyclohexanol	(c) $\text{Zn(Hg)/Conc. HCl}$
(iv) Phenyl benzoate $\rightarrow$ Benzaldehyde	(d) $\text{CH}_3\text{MgBr}$

**Solution:**

- (i) is c
- (ii) is d
- (iii) is a
- (iv) is b

**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)		(b)	HVZ reaction
(iii)		(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.



**42. Assertion:** Formaldehyde is a planar molecule.

**Reason:** It contains  $sp^2$  hybridised carbon atom.

**Solution:**

Option (i) is correct.

**43. Assertion:** Compounds containing  $\text{—CHO}$  group are easily oxidised to corresponding carboxylic acids.

**Reason:** Carboxylic acids can be reduced to alcohols by treatment with  $\text{LiAlH}_4$

**Solution:**

Option (v) is correct

**44. Assertion:** The  $\alpha$ -hydrogen atom in carbonyl compounds is less acidic.

**Reason:** The anion formed after the loss of the  $\alpha$ -hydrogen atom is resonance stabilised.

**Solution:**

Option (iv) is correct.

**45. Assertion:** Aromatic aldehydes and formaldehyde undergo Cannizzaro 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