Aldol Condensation Chemistry Questions with Solutions

Q1. Aldol condensation takes place in-

a.) Aldehyde
b.) Ketone
c.) Both (a) and (b)
d.) None of the above

Correct Answer. (c.) Both (a) and (b)

Q2. Aldol condensation will not take place in-

a.) HCHO
b.) CH_3CHO
c.) CH_3COCH_3
d.) CH_3CH_2CHO

Correct Answer- (a.) HCHO

Q3. The catalyst used in aldol condensation reaction can be-

a.) acid
b.) alkali
c.) Both (a) and (b)
d.) None of the above

Correct Answer- (c.) Both (a) and (b)

Q4. Which of the following is/are correct conditions for aldol condensation to take place?

a.) Presence of atleast one α–hydrogen.
b.) An alkali as a catalyst.
c.) Aldol condensation takes place only in aldehydes and ketones.
d.) All of the above.

Correct Answer. (d.) All of the above

Q5. Aldol condensation will not be observed in ?

a.) Chloral
b.) Phenyl acetaldehyde

c.) Hexanal
d.)Ethanal

Correct Answer- (a.) Chloral

Q6. Aldol condensation does not involve formaldehyde. Why?

Answer. Formaldehyde does not contain an α-hydrogen atom. As a result, it does not participate in aldol condensation.

Q7. What type of aldehydes undergo Aldol condensation?

Answer. Aldol condensation occurs when an aldehyde contains an α–hydrogen atom.

Q8. Describe and illustrate
a) Aldol condensation.
b) Cross Aldol Condensation

Answer.
a) Aldol condensation: This occurs when two molecules of aldehydes or ketones with α–hydrogen atoms are treated with dil. NaOH condenses to form β-hydroxy aldehydes or β--hydroxy ketones.

b) Cross Aldol Condensation: Cross aldol condensation occurs when aldol condensation occurs between two different aldehydes or ketones.

Q9. What role does NaOH play in aldol condensation?

Answer. Since it contains an alpha-hydrogen atom, NaOH undergoes self-condensation, forming β–hydroxy aldehyde (an aldol), namely 3-Hydroxy butanal. This compound will eliminate a water molecule when heated further, forming the aldol condensation product Crotonaldehyde or But-2-en-al.

Q10. What's the difference between an aldol reaction and an aldol condensation?

Answer. The Aldol Reaction occurs when a carbonyl compound enolates with aldehydes and ketones to form a β–hydroxy carbonyl compound. If conditions result in a subsequent dehydration to form the α,β–unsaturated compound, the reaction is known as the Aldol Condensation.

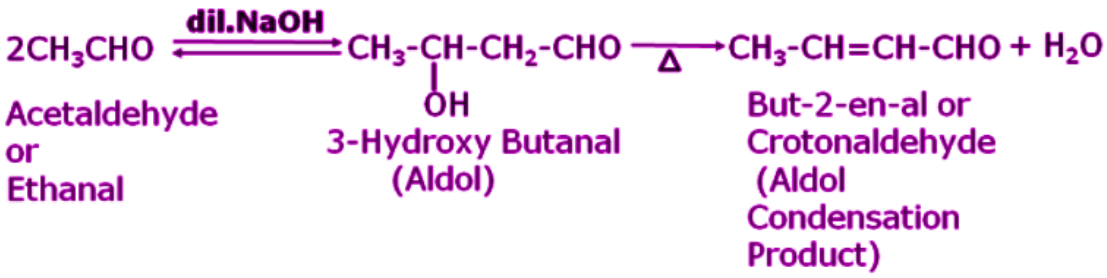
Q11. Explain the Aldol condensation mechanism.

Answer. The Aldol condensation mechanism is as follows-

- Aldol condensation is an organic reaction that occurs when an enolate ion reacts with a carboxyl compound to produce β–hydroxy aldehyde or β–hydroxy ketone.
- Hydroxide acts as a base, causing the acidic a-hydrogen to move, resulting in the reactive enolate ion. This is an example of an acid-base reaction.
- The nucleophilic enolate ion attacks the aldehyde at the electrophilic carbonyl carbon. This is a nucleophilic addition reaction that produces an alkoxide intermediate.
- The alkoxide deprotonates the water molecule, resulting in hydroxide and β–hydroxy aldehyde.

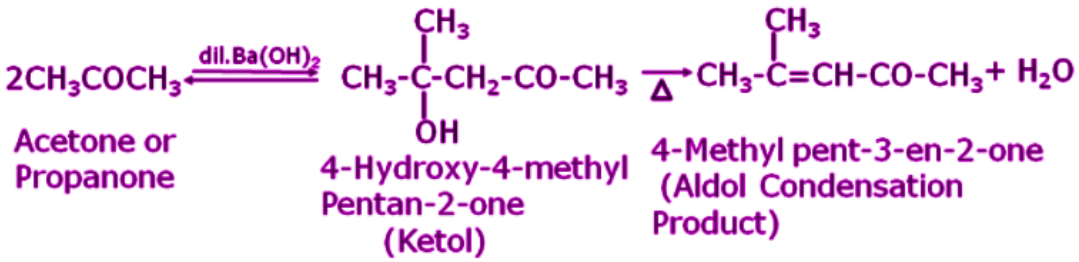
Q12. What happens when acetaldehyde is made to react with dilute NaOH?

Answer. When acetaldehyde is treated with dil. NaOH, it undergoes self condensation because it contains an alpha-hydrogen atom in its compound resulting in the formation of 3-Hydroxy butanal. This compound upon further heating will eliminate a molecule of water which will result in the formation of aldol condensation product namely crotonaldehyde or But-2-en-al.



Q13. Explain the reaction when acetone is treated with an alkali?

Answer. When acetone is treated with dilute $Ba(OH)_2$, it undergoes self condensation as it contain alpha-hyfrogen atom in its compound resulting in the formation of β—hydroxy ketone namely 4-Hydroxy-4-methyl Pentan-2-one. This compound upon further heating will eliminate a molecule of water which will result in the formation of aldol condensation product namely 4-methyl pent-3-en-2-one.

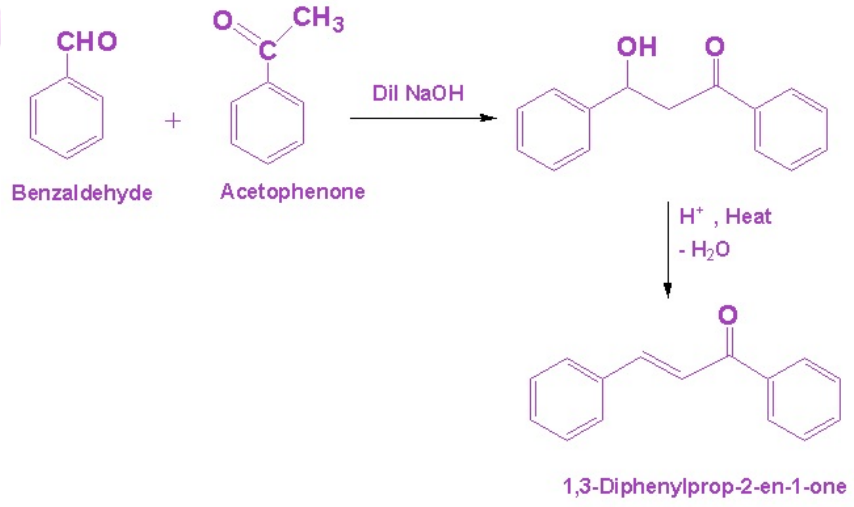


Q14. What is crossed aldol condensation?

Answer. Crossed aldol condensation is a type of aldol condensation in which two dissimilar carbonyl compounds (each containing alpha hydrogens) react together. Up to four different products can be formed in such reactions.

Q15. Explain the reaction of Benzaldehyde and Acetophenone.

Answer. In the presence of dil. NaOH, the reaction between benzaldehyde and acetophenone undergoes cross aldol condensation. Since benzaldehyde lacks alpha hydrogen in this reaction, acetophenone undergoes aldol condensation to form β-hydroxy ketone. Dehydration also results in the formation of the, α, β – unsaturated ketone.



Practise Questions on Aldol Condensation

Q1. The product formed in an aldol condensation is-

a.) β-hydroxyaldehyde
b.) β-hydroxyketone
c.) α-hydroxyketone
d.) α-hydroxyaldehyde

Correct Answer- (a.) β-hydroxyaldehyde and (b.) β-hydroxyketone

Q2. Aldol condensation is-

a.) self condensation of aldehydes
b.) self condensation of ketones
c.) self condensation of aldehydes and ketones
d.) self condensation of aldehydes and ketones with atleast one alpha hydrogen

Correct Answer. (d.) self condensation of aldehydes and ketones with atleast one alpha hydrogen.

Q3. In aldol condensation reaction ___ react with carbonyl compounds.

Answer. In aldol condensation reaction enol or enolates react with carbonyl compounds to form β–hydroxyaldehyde or β–hydroxy ketone followed by dehydration to give a conjugated compound.

Q4. Which of the following statements is incorrect for aldol condensation reaction?

a.) The first step is deprotonation at the α-Hydrogen position
b.) An aldol reaction occurs between two aldehydes or ketones, and at least one reactant must contain an α-Hydrogen atom
c.) The product of an aldol reaction between two aldehydes is a β-diketone
d.) An aldol reaction is a C–C bond-forming reaction

Correct Answer- (c.) The product of an aldol reaction between two aldehydes is a β-diketone.

Q5. Which among the following do not undergo aldol condensation?
1. 2-phenylethanal
2. trichloroethanal
3. benzaldehyde
4. ethanal

a.) 2 and 3 only
b.) 1, 2 and 3 only

c.) 2, 3 and 4 only
d.) 3 and 4 only

Correct Answer- (a) 2 and 3 only