Aldol Condensation: The Alpha Hydrogen Key

Two small ethanal molecules join into one bigger molecule. How the alpha hydrogen makes it happen, and which compounds cannot do it.

Name: Date: Score: ____ / 19

A. Fill in the blanks

1. The carbon next to the carbonyl carbon is the ____ carbon.

2. Dilute NaOH removes an alpha H to give an ____ ion.

3. The aldol from ethanal is 3-____butanal.

4. Heating the aldol removes ____.

5. The final product from ethanal is but-2-____.

B. True or False

6. Methanal gives aldol condensation. True / False

7. Benzaldehyde gives aldol condensation. True / False

8. Propanone has 6 alpha H atoms. True / False

9. The enolate acts as a nucleophile. True / False

C. Assertion and reason

10. Assertion (A): Ethanal undergoes aldol condensation.
Reason (R): Ethanal has alpha hydrogens.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

11. Assertion (A): Benzaldehyde does not give aldol condensation.
Reason (R): Benzaldehyde has no alpha hydrogen.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

D. Choose the correct option

12. Which has alpha hydrogens?

(a) Methanal
(b) Benzaldehyde
(c) Propanal
(d) 2,2-Dimethylpropanal

Answer: _____

13. The aldol from ethanal is:

(a) $CH_3CH(OH)CH_2CHO$ (b) $CH_3CH=CHCHO$

(c) CH_3CH_2OH (d) CH_3COOH

Answer: _____

14. The base used for aldol condensation is:

(a) concentrated HCl (b) dilute NaOH

(c) Tollens' reagent (d) H_2 with Ni

Answer: _____

15. 2,2-Dimethylpropanal gives no aldol because:

(a) it has no H at all (b) its alpha carbon has no H

(c) it is a ketone (d) it has no C=O

Answer: _____

E. Numerical problems

16. How many alpha H atoms does ethanal have?

17. How many carbons are in the aldol from 2 ethanal molecules?

F. Short answer questions

18. Why does propanal give aldol condensation but methanal does not?

G. Match the columns

19. Match each item in Column A with the correct item in Column B.

Column A	Column B	Your answer
1. Enolate	(a) $CH_3CH=CHCHO$	1 → ____
2. Aldol	(b) $CH_3CH(OH)CH_2CHO$	2 → ____
3. But-2-enal	(c) nucleophile	3 → ____
4. Methanal	(d) no alpha carbon	4 → ____

Detailed solutions

1. alpha

2. enolate

3. hydroxy

4. water

5. enal

6. False. It has no alpha carbon.

7. False. It has no alpha H.

8. True. 3 on each side.

9. True. It attacks a carbonyl carbon.

10. (a) R explains A.

11. (a) R explains A.

12. (c) Propanal. The CH_2 next to CHO.

13. (a) $CH_3CH(OH)CH_2CHO$. A β-hydroxy aldehyde.

14. (b) dilute NaOH. Dilute alkali.

15. (b) its alpha carbon has no H. Its 10 H atoms are all on other carbons.

16. CH_3 next to CHO. **Answer: 3**

17. 2 + 2. **Answer: 4**

18. Propanal has 2 alpha H atoms that a base can remove. Methanal has no alpha carbon, so no enolate can form.

19. 1 → (c), 2 → (b), 3 → (a), 4 → (d). Each item matches its partner.