WORKED ANSWER KEY - Aldol and Claisen Condensations

Instructor and self-check copy. Full explanations for six multiple-choice questions plus two constructed-response tasks.

Part A. Concept and product prediction

1. An aldol addition gives a

Correct: A. beta-hydroxy carbonyl

Reason: Aldol addition creates a beta-hydroxy aldehyde or ketone.

2. Which reaction features alkoxide leaving-group departure?

Correct: B. Claisen condensation of esters

Reason: Claisen proceeds by nucleophilic acyl substitution at an ester.

3. Dehydration of 3-hydroxybutanal can yield

Correct: A. But-2-enal

Reason: Removing water creates the conjugated alpha,beta unsaturated aldehyde.

4. What is the self-Claisen product of ethyl acetate after workup?

Correct: A. Ethyl 3-oxobutanoate

Reason: Two ethyl acetate equivalents give the beta-keto ester ethyl acetoacetate.

5. Which question helps identify aldol versus Claisen?

Correct: B. Is the electrophile an aldehyde/ketone or ester?

Reason: Aldehydes/ketones give addition; esters undergo acyl substitution.

6. Why can uncontrolled crossed aldols give mixtures?

Correct: A. Both partners may form different enolates and react

Reason: Multiple potential enolate donors and electrophiles generate competing products.

Part B. Show your reasoning

7. Show aldol addition between two ethanal molecules. Name the beta-hydroxy product and give the product after dehydration.

Worked answer: Two ethanal molecules form 3-hydroxybutanal, CH3CH(OH)CH2CHO. Dehydration under suitable conditions forms but-2-enal, CH3CH=CHCHO. The new bond links enolate alpha C and electrophile carbonyl C.

8. Predict self-Claisen condensation of ethyl acetate with ethoxide and acidic workup; explain why it differs from aldol.

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Worked answer: The product is ethyl 3-oxobutanoate (ethyl acetoacetate), CH3COCH2CO2Et. Ester electrophile undergoes addition-elimination with ethoxide departure; acid workup reprotonates the beta-keto ester enolate.

Use the key to assess chemical reasoning, not just a matching final answer.