Aldehydes and ketones

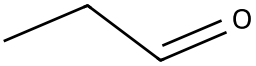
AQA 7405 · A level

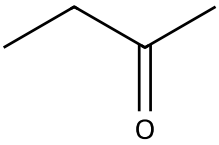
Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Classify and name each structure

Classify A and B as an aldehyde or a ketone, then name each. Use the atoms bonded to the carbonyl carbon to justify each classification.

A 

B 

2. Identify an unlabelled sample

Two unlabelled samples contain butanal and butan-2-one. Name a reagent that distinguishes them, give a separate observation for each and explain the positive result.

3. Oxidise an aldehyde

Write the equation for complete oxidation of $CH_3CH_2CH_2CHO$ with acidified dichromate(VI), using [O]. Name the organic product and state the colour change.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-aldehydes-and-ketones

Aldehydes and ketones

AQA 7405 · A level

4. Reduce two carbonyl compounds

Write condensed formulae for the products when ethanal and pentan-3-one are reduced separately with sodium borohydride. Classify each alcohol.

5. Mechanism of propanone reduction

Draw the first step when propanone reacts with aqueous sodium borohydride. Represent the nucleophile as H^- and show the carbonyl partial charges.

6. A product of butan-2-one

Butan-2-one forms a hydroxynitrile. Draw its structure, state its total number of carbons and explain which atom of CN^- forms the new bond.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-aldehydes-and-ketones

Aldehydes and ketones

AQA 7405 · A level

7. When do two enantiomers form?

Compare the hydroxynitriles made from propanal and propanone. Which product has a chiral centre? Explain using the groups bonded to that carbon.

8. Diagnose a failed test

A student uses Fehling's solution to distinguish propanal from propanone. Both cold samples stay blue. Explain why that result is inconclusive and describe a repeat that distinguishes them.

9. Extra challenge · Use a test and predict stereochemistry

An unknown C_4H_8O compound is butanal, butan-2-one or 2-methylpropanal. It gives no precipitate with warm Fehling's solution. Identify it and explain your choice.

Draw the first step of its reaction with aqueous $NaBH_4$. Give the final structure and explain its stereochemical composition in an achiral environment.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-aldehydes-and-ketones

Worked answers

Aldehydes and ketones · AQA 7405 · A level

1. Classify and name each structure

A is propanal, $CH_3CH_2CH{=}O$. Its carbonyl carbon is bonded to H. B is butan-2-one, $CH_3C(=O)CH_2CH_3$. Its carbonyl carbon is bonded to two carbon groups.

2. Identify an unlabelled sample

Tollens' reagent gives a silver mirror or a grey silver deposit with butanal. The aldehyde is oxidised and silver(I) is reduced to silver metal. Butan-2-one gives no silver deposit.

Acidified dichromate(VI) changes from orange to green with butanal and stays orange with butan-2-one.

3. Oxidise an aldehyde

$CH_3CH_2CH_2CHO + [O] \rightarrow CH_3CH_2CH_2COOH$. Butanoic acid forms. The dichromate(VI) changes from orange to green.

4. Reduce two carbonyl compounds

$CH_3CHO + 2[H] \rightarrow CH_3CH_2OH$, a primary alcohol.

$CH_3CH_2COCH_2CH_3 + 2[H] \rightarrow CH_3CH_2CH(OH)CH_2CH_3$, a secondary alcohol.

5. Mechanism of propanone reduction

Draw from a lone pair on H^- to the δ^+ carbonyl carbon and from the C=O bond to $O\delta^-$. Show the new C-H bond and the intermediate $(CH_3)_2CHO^-$.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-aldehydes-and-ketones

Worked answers

Aldehydes and ketones · AQA 7405 · A level

6. A product of butan-2-one

$CH_3C(OH)(C{\equiv}N)CH_2CH_3$ contains five carbons. The carbon end of CN^- attacks the carbonyl carbon and makes the new C-C bond.

The C=O π electrons move to O, and protonation gives the OH group.

7. When do two enantiomers form?

The product $CH_3CH_2CH(OH)CN$ from propanal has four different groups at the new centre: ethyl, H, OH and CN. Attack from either face of the planar carbonyl can produce opposite enantiomers.

The propanone product $(CH_3)_2C(OH)CN$ has two identical methyl groups at that carbon.

8. Diagnose a failed test

Repeat with fresh Fehling's solution and warm each mixture. Propanal is oxidised as Cu^{2+} is reduced to brick-red Cu_2O. Propanone leaves the solution blue. A cold negative result does not distinguish a ketone from an aldehyde that has not reacted detectably.

9. Extra challenge · Use a test and predict stereochemistry

Butan-2-one. Both alternatives are aldehydes, which give a brick-red precipitate with warm Fehling's solution.

Draw from a lone pair on H^- to the carbonyl carbon and from the C=O π bond to O. $CH_3CH(O^-)CH_2CH_3$ forms. Protonation gives butan-2-ol, $CH_3CH(OH)CH_2CH_3$.

Either face of the planar carbonyl can be attacked with equal probability. The product has four different groups at C2, so a racemic mixture forms.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-aldehydes-and-ketones