

AQA A-Level Chemistry

Organic synthesis

Questions only

The newest questions, about an hour. All 7 are in the exam generator.

Questions

6

Total marks

43

Time allowed

56 min

Name

Class or teacher

Date

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the AQA Data Sheet.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2021 A-level P2 Q8	13	
2	2024 A-level P2 Q8	12	
3	2023 A-level P2 Q4	15	
4	2023 A-level P3 Q31	1	
5	2023 A-level P3 Q26	1	
6	2021 A-level P3 Q30	1	

Total _____ / 43 **Percentage** _____ %

Questions from AQA past papers, 2021–2024, reproduced for revision. Practise these topics online, with instant marking:

whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions?topics=organic-synthesis&len=0

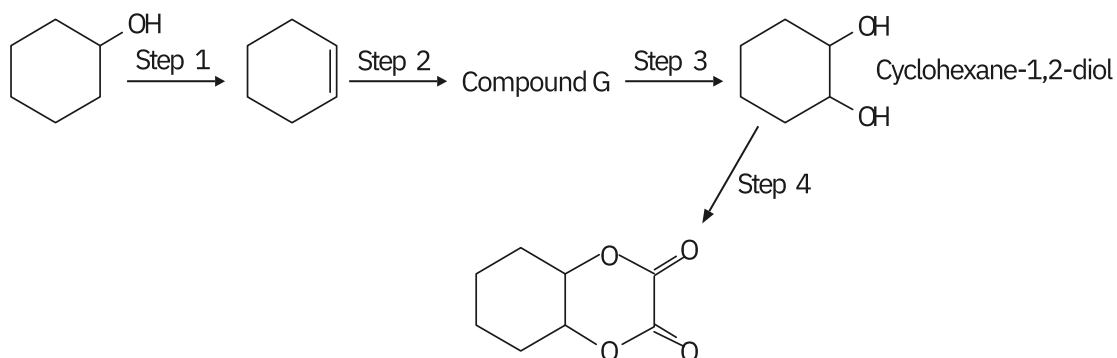
Questions

Organic synthesis · 6 questions · 43 marks · time allowed 56 min

Q1 · November 2021 · Paper 2 · Q8 · [13 marks]

This question also needs Alcohols, Alkenes and Halogenoalkanes.

This question is about making a diester from cyclohexanol.



(a) State the type of reaction in step 1.

Give the name of the reagent needed for step 1.

[2 marks]

Type of reaction

Reagent

(b) State the reagents needed and give equations for step 2 and step 3.

Show the structure of Compound G in your equations.

[4 marks]

Step 2 reagent

Step 2 equation

Step 3 reagent

Step 3 equation

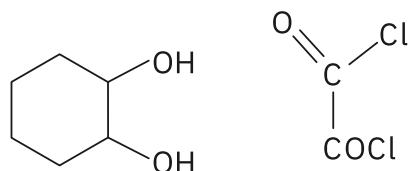
(c) Cyclohexane-1,2-diol reacts with ethanedioyl dichloride.

Give the name of the mechanism for this reaction.

Complete the mechanism to show the formation of one ester link in the first step of this reaction.

Mechanism name

Mechanism



[5 marks]

Draw your answer on the figure above.

(d) Suggest why chemists usually aim to design production methods

- with fewer steps
- with a high percentage atom economy.

[2 marks]

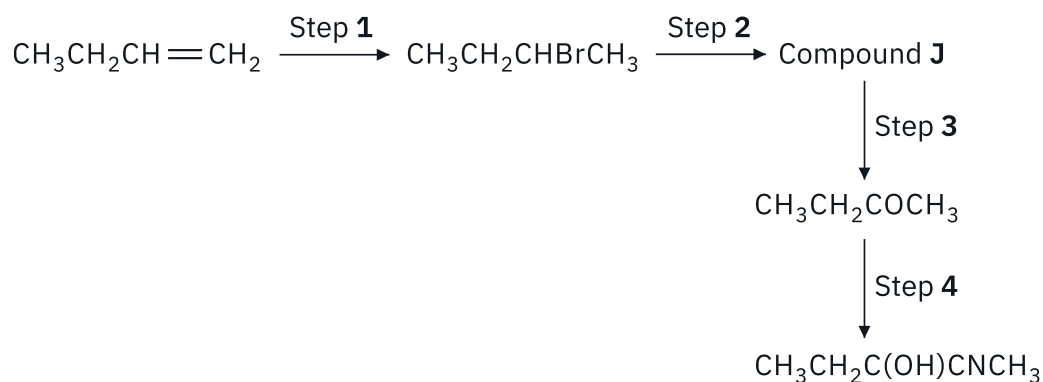
Fewer steps

High percentage atom economy

Q2 · June 2024 · Paper 2 · Q8 · [12 marks]

This question also needs Alkenes and Halogenoalkanes.

This question is about an organic synthesis.



(a) Name the mechanism in Step 1.

State the reagent(s) used for Step 1.

[2 marks]

Name of mechanism

Reagent(s)

(b) Identify compound J.

State the reagent(s) and conditions needed for Step 2.

[2 marks]

Compound J

Reagent(s) and conditions

(c) State the reagent(s) used for Step 4.

Outline the mechanism for Step 4.

[5 marks]

Reagent(s)

Mechanism

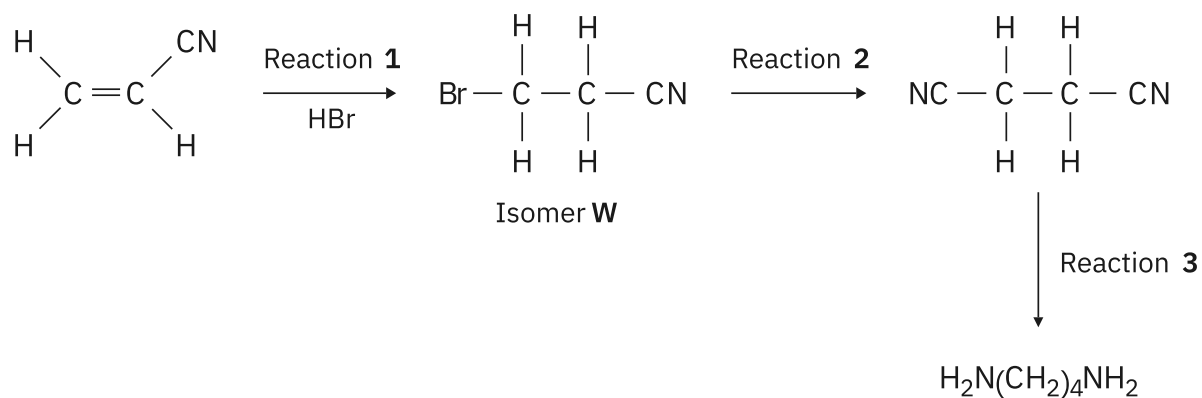
(d) Explain why Step 4 produces a racemic mixture.

[3 marks]

Q3 · June 2023 · Paper 2 · Q4 · [15 marks]

This question also needs Amines, Halogenoalkanes, Optical isomerism and Polymers.

Acrylonitrile, $\text{H}_2\text{C}=\text{CHCN}$, can be used as a starting material for the synthesis of butane-1,4-diamine, as shown in this reaction scheme.



(a) Use IUPAC rules to name isomer W.

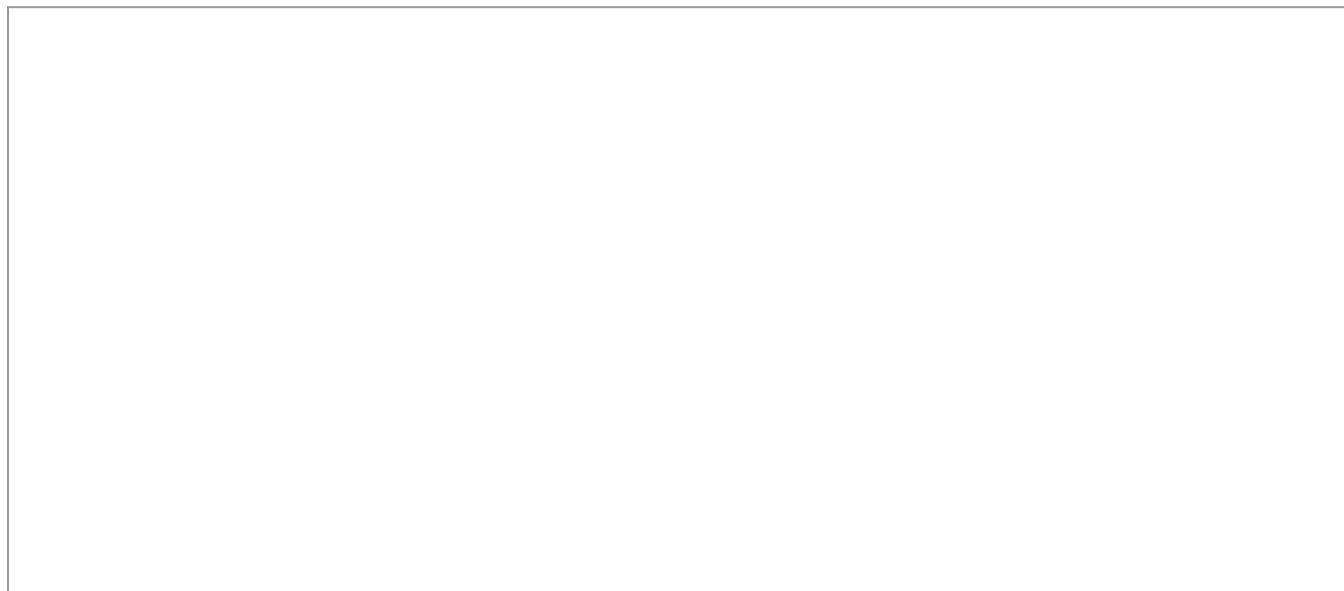
[1 mark]

(b) Reaction 1 produces a mixture of W and two other isomers.

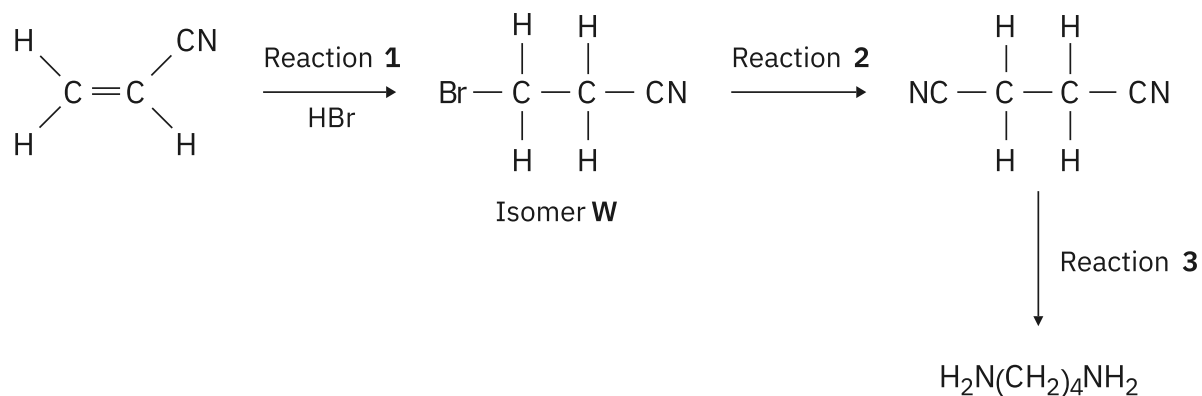
Draw the structures of the two other isomers.

Explain, by considering the mechanism of this reaction, why all three isomers are formed.

[6 marks]



The reaction scheme is repeated here.



(c) Identify the reagent that is warmed with isomer W in reaction 2.

State the other reaction condition needed.

[2 marks]

Reagent

Condition

(d) State the reagent and reaction conditions needed for reaction 3.

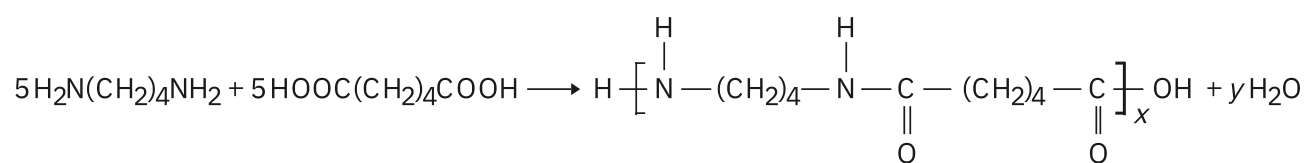
Give an equation for reaction 3.

[2 marks]

Reagent and conditions

Equation

(e) An incomplete equation for the formation of nylon 4,6 from five molecules of butane-1,4-diamine and five molecules of hexanedioic acid is shown.

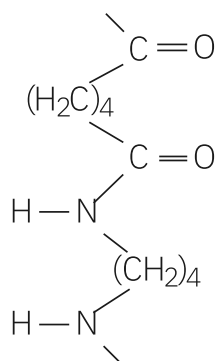


Deduce the values of x and y in this equation.

x y

[2 marks]

(f) The figure below shows a section of the nylon 4,6 polymer molecule.



Draw, on the figure above, another section of nylon 4,6 polymer showing two hydrogen bonds between the two sections.

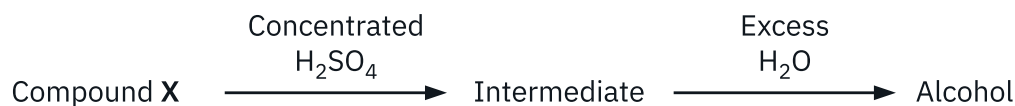
[2 marks]

Draw your answer on the figure above.

Q4 • June 2023 • Paper 3 • Q31 • [1 mark]

This question also needs Alkenes.

Compound X can be converted into an alcohol in a two-stage process.



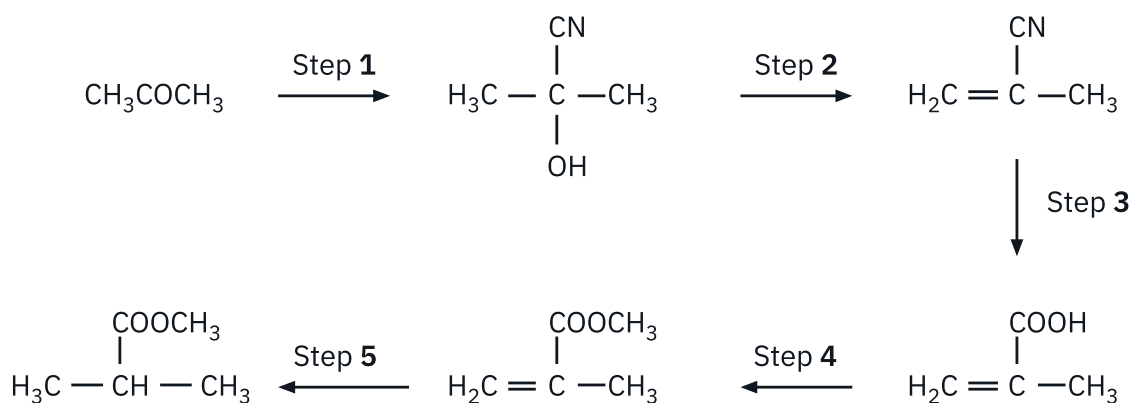
What is the name of compound X?

Tick (✓) one box.

- ☐ **A** propene
- ☐ **B** propanal
- ☐ **C** methylbenzene
- ☐ **D** ethanamide

Q5 • June 2023 • Paper 3 • Q26 • [1 mark]

Consider this reaction scheme.



Which step is shown with a correct reagent and a correct condition?

Tick (✓) one box.

- ☐ **A** Step 1 HCN dissolved in water
- ☐ **B** Step 2 KOH dissolved in warm water
- ☐ **C** Step 4 CH₃OH with an alkaline catalyst
- ☐ **D** Step 5 H₂ with a nickel catalyst

Q6 · November 2021 · Paper 3 · Q30 · [1 mark]

This question also needs Amines and Halogenoalkanes.

A two-step preparation of propylamine is shown. bromoethane → X → propylamine What is X?

Tick (✓) one box.

☐ **A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

☐ **B** $\text{CH}_3\text{CH}_2\text{CN}$

☐ **C** $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

☐ **D** $\text{CH}_3\text{CH}_2\text{NH}_2$

Source: AQA A-Level Chemistry past papers. Reproduced for revision at whiteboardchemistry.com.

Mark scheme:

whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions/pdf/organic-synthesis-mark-scheme.pdf