

Butanol Dehydration

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

The four different isomers of butanol (1 - 4) can be dehydrated to give four isomers of butene (A - D)

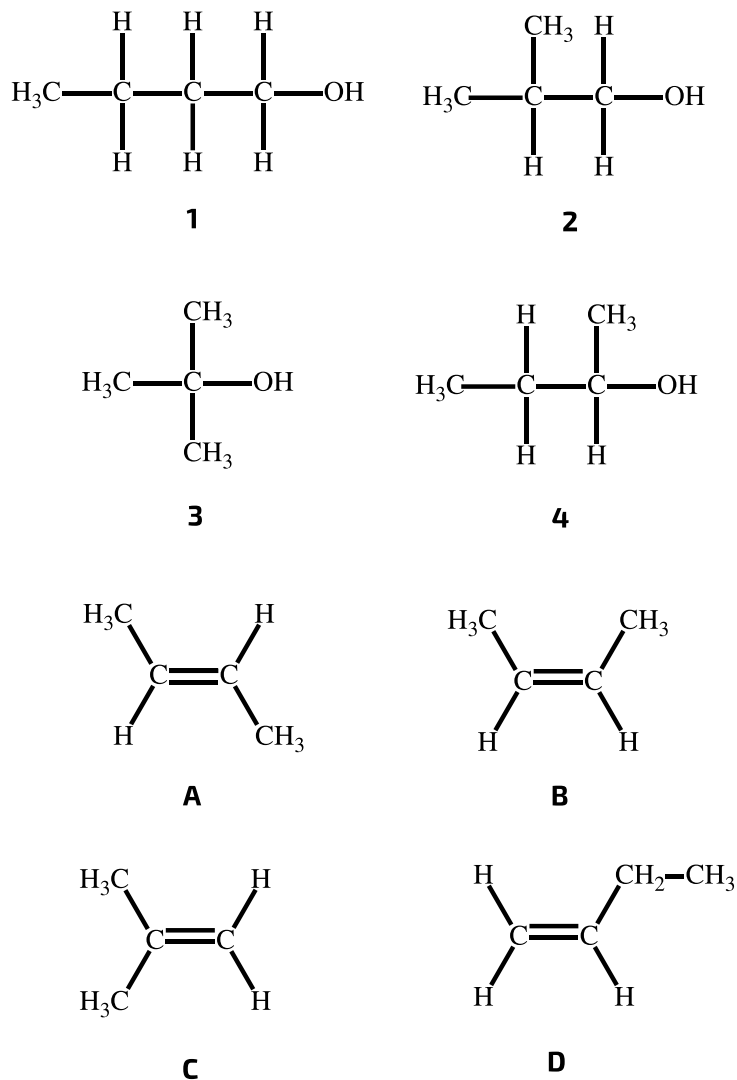


Figure 1: Isomers of butanol and butene

Part A

A

Which isomer(s) of butanol could give rise to butene **A**?

- ☐ 1 only
- ☐ 2 only
- ☐ 3 only
- ☐ 4 only
- ☐ 1 and 2 only
- ☐ 2 and 3 only
- ☐ 3 and 4 only
- ☐ 1 and 4 only

Part B

B

Which isomer(s) of butanol could give rise to butene **B**?

- ☐ 1 only
- ☐ 2 only
- ☐ 3 only
- ☐ 4 only
- ☐ 1 and 2 only
- ☐ 2 and 3 only
- ☐ 3 and 4 only
- ☐ 1 and 4 only

Part C

C

Which isomer(s) of butanol could give rise to butene **C**?

- ☐ 1 only
- ☐ 2 only
- ☐ 3 only
- ☐ 4 only
- ☐ 1 and 2 only
- ☐ 2 and 3 only
- ☐ 3 and 4 only
- ☐ 1 and 4 only

Part D

D

Which isomer(s) of butanol could give rise to butene **D**?

- ☐ 1 only
- ☐ 2 only
- ☐ 3 only
- ☐ 4 only
- ☐ 1 and 2 only
- ☐ 2 and 3 only
- ☐ 3 and 4 only
- ☐ 1 and 4 only

Part E

Reaction type

What type of reaction is this? e.g. addition, elimination, substitution, oxidation, reduction etc.

Alcohol Dehydration

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Preparation of ethene

In a preparation of ethene, ethanol is added a drop at a time to a heated reagent **Y**. The impure ethene is washed by being bubbled through a solution **Z** and then collected. What are reagent **Y** and solution **Z** likely to be?

	reagent Y	solution Z
A	acidified $\text{K}_2\text{Cr}_2\text{O}_7$	dilute NaOH
B	concentrated H_2SO_4	dilute H_2SO_4
C	concentrated H_2SO_4	dilute NaOH
D	ethanolic NaOH	concentrated H_2SO_4
E	ethanolic NaOH	dilute NaOH

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**
- ☐ **E**

Part B

Dehydration of propan-1-ol

Propan-1-ol, $\text{C}_3\text{H}_7\text{OH}$, is dehydrated by passing its vapour over hot aluminium oxide to give a hydrocarbon.

Which structural formula represents the product obtained when the hydrocarbon reacts with bromine?

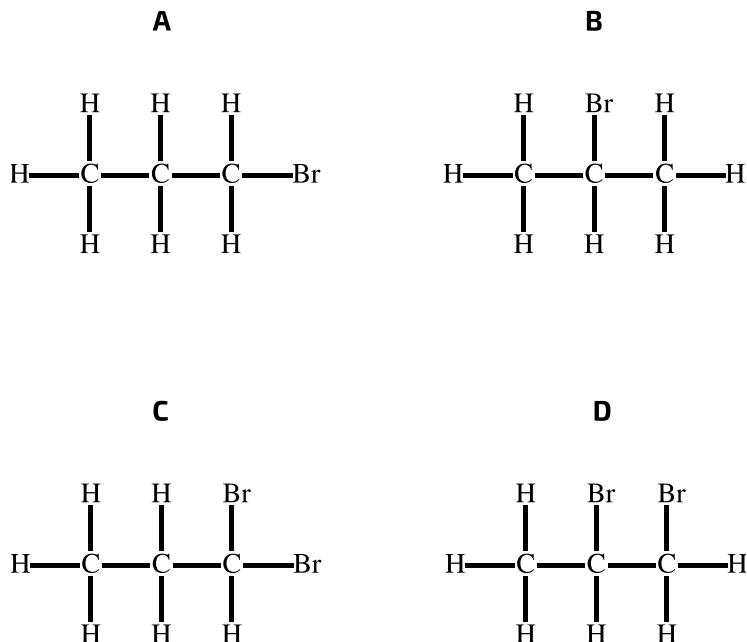


Figure 1: Possible structures after dehydration and bromination of propan-1-ol

- ☐ A
- ☐ B
- ☐ C
- ☐ D

Part A adapted with permission from UCLES, A-Level Chemistry, June 1990, Paper 1, Question 27;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1996, Paper 3, Question 21

Question deck:

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Butanol Oxidation

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

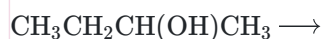
Dilute acidified sodium dichromate(VI) is used to distinguish between primary, secondary and tertiary alcohols. Draw full structural formulae of the final organic products (if any) when the following alcohols are treated with this reagent under reflux.

Use the [structure editor](#) to generate a SMILES string.

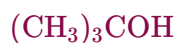
In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part A



Part B



Adapted with permission from UCLES, A-Level Chemistry, June 1990, Paper 2, Question 3

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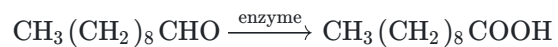
Aldehyde and Alcohol Reactions

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Bioluminescence

The production of light by animals and plants is known as bioluminescence. It sometimes involves the following reaction:



What type of reaction is this?

- ☐ Oxidation
- ☐ Reduction
- ☐ Elimination
- ☐ Addition
- ☐ Substitution

Part B

Butan-2-ol with potassium dichromate(VI)

Which of the following are produced when an aqueous solution of butan-2-ol is refluxed with potassium dichromate(VI) in dilute sulfuric acid?

1 butanal

2 butanoic acid

3 butanone

- ☐ **1, 2 and 3** are correct
- ☐ **1 and 2** only are correct
- ☐ **1 and 3** only are correct
- ☐ **2 and 3** only are correct
- ☐ **1** only is correct
- ☐ **2** only is correct
- ☐ **3** only is correct

Part A adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 4, Question 25;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1993, Paper 3, Question 38

Question deck:

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Alcohol Reactions

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

The compound C_3H_8O has two isomers that are alcohols. These isomers can undergo a series of reactions with the reagents shown giving organic products.

Deduce the identity of each of the organic products **A** to **D**. Use the [structure editor](#) to generate SMILES strings as your answers.

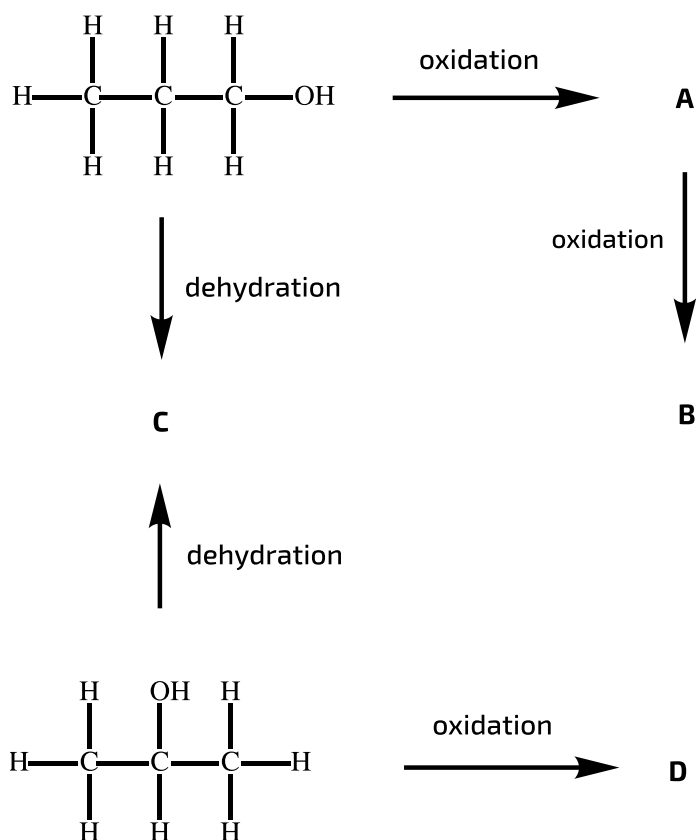


Figure 1: Reactions of alcohols

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part A

A

A is:

Part B

B

B is:

Part C

C

C is:

Part D

D

D is:

Adapted with permission from UCLES, A-Level Modular Sciences, November 1996, Chains and Rings, Question 3

Question deck:

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Reactions of $C_4H_{10}O$

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

Part A

Elimination

A compound $C_4H_{10}O$ reacts with sodium, is not affected by warm acidified potassium dichromate(VI) solution, and eliminates water when warmed with concentrated sulfuric acid. What could the compound be?

- ☐ $CH_3CH_2CH_2CH_2OH$
- ☐ $CH_3CH_2CH(OH)CH_3$
- ☐ $CH_3CH_2OCH_2CH_3$
- ☐ $CH_3CH_2CH_2OCH_3$
- ☐ $(CH_3)_3COH$

Part B

Oxidation

A compound **X**, $C_4H_{10}O$, gives the compound **Y**, C_4H_8O , on oxidation. **Y** does **not** give a silver mirror on the addition of Tollens' reagent. Which of the following could **X** be?

- ☐ $CH_3CH_2CH_2CH_2OH$
- ☐ $CH_3CH_2CH(OH)CH_3$
- ☐ $CH_3CH_2OCH_2CH_3$
- ☐ $CH_3CH_2CH_2OCH_3$
- ☐ $(CH_3)_3COH$

Part A adapted with permission from OCSEB, A-Level Chemistry, June 1995, Paper 1, Question 28;

Part B created for isaacphysics.org by R. Less

Question deck:

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Tollens' Reagent

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P1

When propanal reacts with Tollens' reagent, what are the principal inorganic and organic products?

- ☐ Ag and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- ☐ Ag and $\text{CH}_3\text{CH}_2\text{COOH}$
- ☐ AgNO_3 and $\text{CH}_3\text{CH}_2\text{COOH}$
- ☐ Ag_2O and $\text{CH}_3\text{CH}_2\text{COOH}$

Adapted with permission from UCLES, A-Level Chemistry, June 1994, Paper 4, Question 24

Question deck:

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Ketones with KCN Mechanism

Subject & topics: Chemistry | Organic | Reactions

Stage & difficulty: A Level P1

Part A

Mechanism

In the reaction between a ketone and KCN followed by addition of acid, which of the following statements about the reaction mechanism are true?

- 1 A new carbon-carbon bond is formed.
- 2 In the intermediate, the oxygen carries a negative charge.
- 3 The last stage involves the formation of a hydrogen-oxygen bond.

- ☐ 1, 2 and 3 are correct
- ☐ 1 and 2 only are correct
- ☐ 1 and 3 only are correct
- ☐ 2 and 3 only are correct
- ☐ 1 only is correct
- ☐ 2 only is correct
- ☐ 3 only is correct

Part B

Why ketones not alkenes?

Why does the cyanide ion add to propanone but not to propene?

- ☐ The C=C bond is more polar than the C=O bond.
- ☐ Propanone is more susceptible to nucleophilic attack than propene.
- ☐ Propanone is more susceptible to electrophilic attack than propene.
- ☐ Propanone is more susceptible to free radical attack than propene.
- ☐ The two methyl groups in propanone donate electron density more effectively than the single methyl group in propene.

Part A adapted with permission from UCLES, A-Level Chemistry, June 1993, Paper 4, Question 39;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1992, Paper 4, Question 26

Question deck:

STEM SMART Chemistry Week 26

Nucleophilic Addition Mechanism

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level P2

Aldehydes and ketones typically react by nucleophilic addition reactions.

Part A

HCN with ketones first step

What is the sequence of curly arrows denoting movement of electrons in the first step of the reaction between propanone and HCN catalysed by KCN?

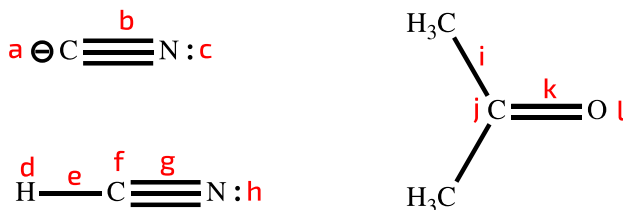


Figure 1: First step of HCN with propanone catalysed by KCN

For example in the reaction below, if you think the mechanism is as shown, your answer would be **cdef**.

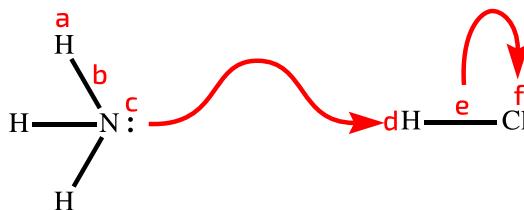


Figure 2: Sequence **cdef**

Part B

HCN with ketones second step

What is the sequence of curly arrows denoting possible movement of electrons in the second step of the reaction between propanone and HCN catalysed by KCN that would regenerate the catalyst?

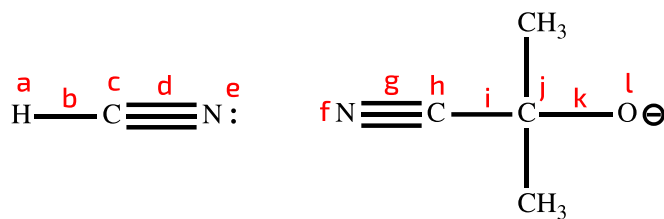


Figure 3: Second step of HCN with propanone catalysed by KCN

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Apples

Subject & topics: Chemistry | Organic | Reactions **Stage & difficulty:** A Level C1

Compound **A**, a diacid that occurs in apples and other fruit, has the following composition by mass:

C : 35.8 % H : 4.5 % O : 59.7 %

A reacts with ethanol in the presence of concentrated sulfuric acid under reflux to give **B**, $C_8H_{14}O_5$. Compound **B** evolves hydrogen gas when treated with sodium metal and reacts with acidified potassium dichromate(VI) to give compound **C**. Compound **C** produces an orange precipitate with 2,4-dinitrophenylhydrazine* but has no reaction with Fehling's or Tollens' reagent.

* 2,4-dinitrophenylhydrazine gives an orange precipitate in the presence of aldehydes and ketones.

Part A

Empirical formula

Calculate the empirical formula of **A**.

Part B

Compound A

Suggest a structure for compound **A**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part C

Compound B

Suggest a structure for compound **B**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part D

A \longrightarrow B reaction

What kind of reaction is the transformation **A \longrightarrow B**?

Part E

Compound C

Suggest a structure for compound **C**.

Draw the structure using the [structure editor](#) and give your answer as a SMILES string.

Part F

B \longrightarrow C reaction

What kind of reaction is the transformation **B \longrightarrow C**?