



Physics. You work it out.

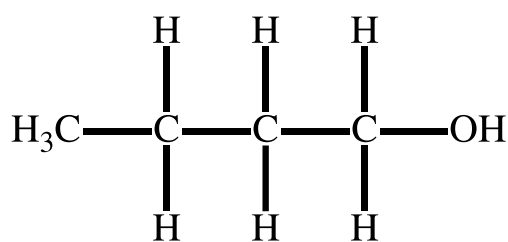
[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Reactions](#) [Butanol Dehydration](#)

Butanol Dehydration

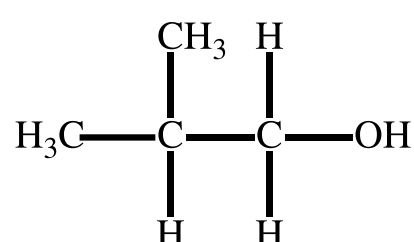
A Level



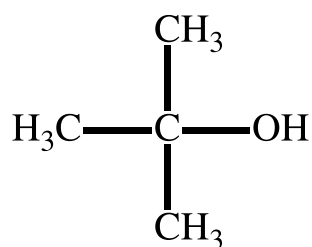
The four different isomers of butanol (**1 - 4**) can be dehydrated to give four isomers of butene (**A - D**)



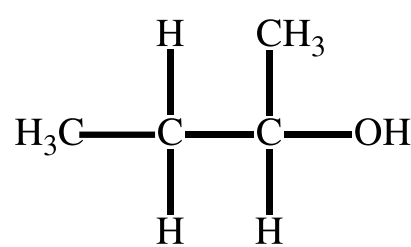
1



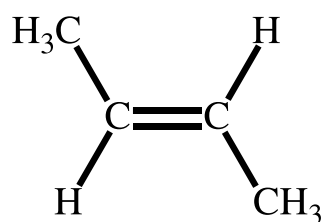
2



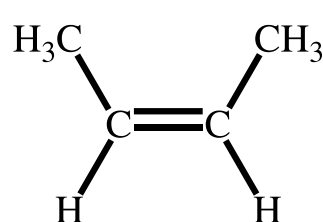
3



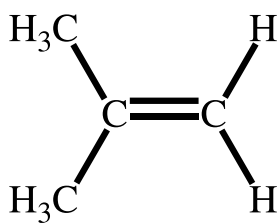
4



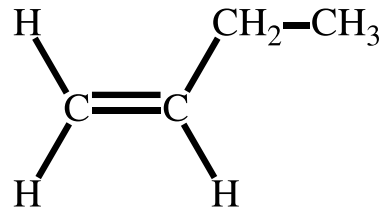
A



B



C



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.

Created for isaacphysics.org by R. Less

All materials on this site are licensed under the [Creative Commons license](https://creativecommons.org/licenses/by/4.0/), unless stated otherwise.

Alcohol Dehydration

A Level



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?

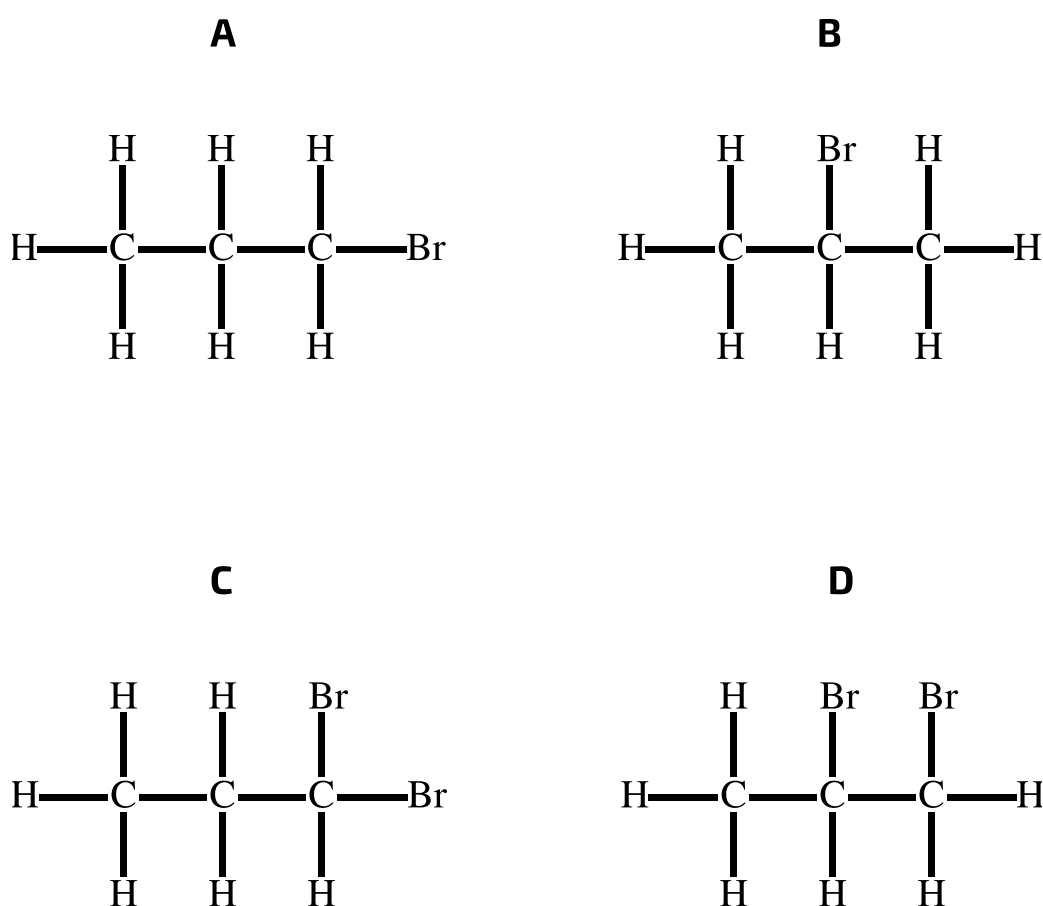


Figure 1: Possible structures after dehydration and bromination of propan-1-ol

- ☐ **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

Gameboard:

STEM SMART Chemistry Week 26



Physics. *You work it out.*

[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Reactions](#) [Butanol Oxidation](#)

Butanol Oxidation

A Level



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 $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$

$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3 \longrightarrow$

Part B $(\text{CH}_3)_3\text{COH}$

$(\text{CH}_3)_3\text{COH} \longrightarrow$

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

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the [Creative Commons license](#), unless stated otherwise.

Aldehyde and Alcohol Reactions



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
- ☐ Substitution
- ☐ Addition

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

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



Alcohol Reactions



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.

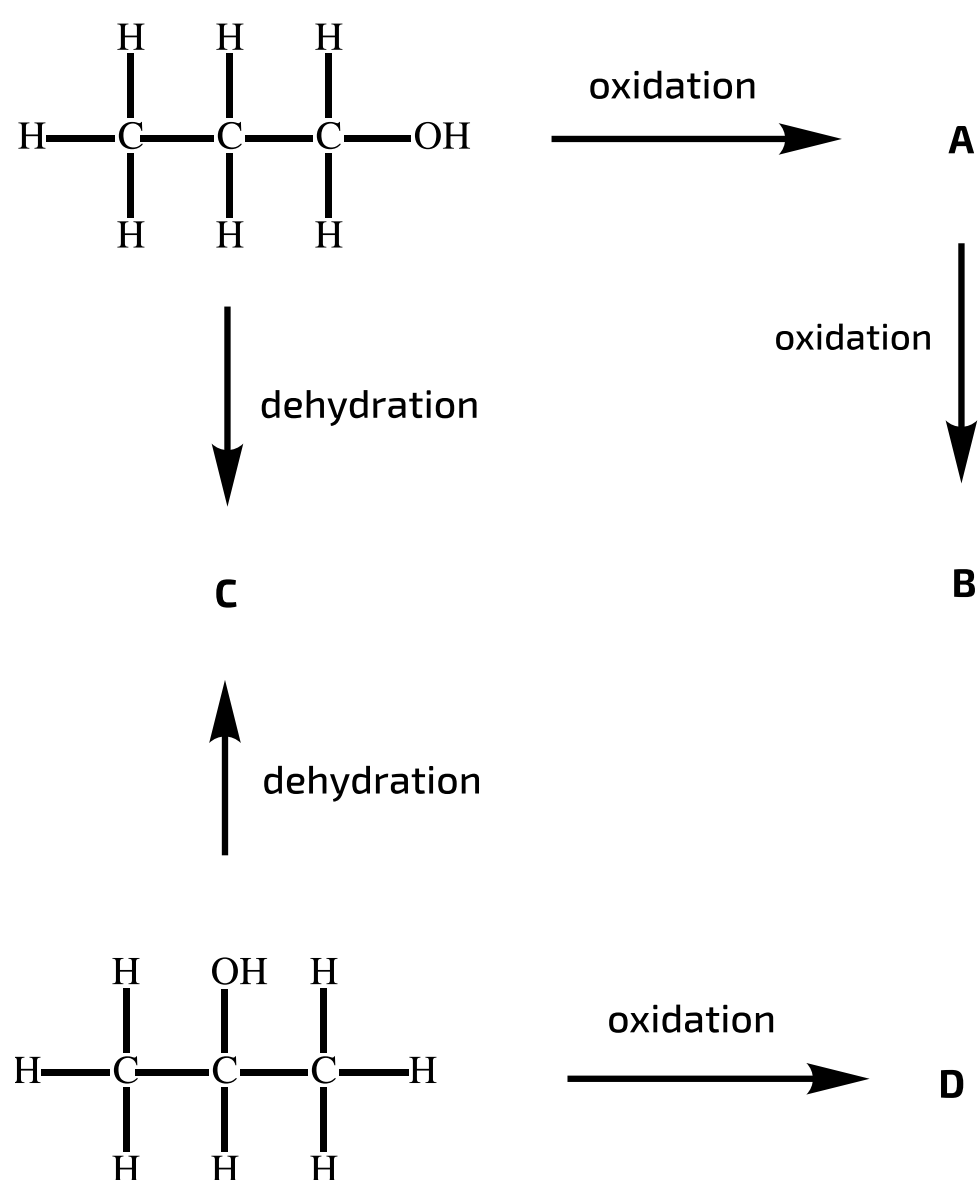


Figure 1: Reactions of alcohols

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

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



Physics. *You work it out.*

[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Reactions](#) [Reactions of C₄H₁₀O](#)

Reactions of C₄H₁₀O

A Level



Part A Elimination

A compound C₄H₁₀O 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?

- ☐ CH₃CH₂CH(OH)CH₃
 - ☐ CH₃CH₂OCH₂CH₃
 - ☐ CH₃CH₂CH₂OCH₃
 - ☐ CH₃CH₂CH₂CH₂OH
 - ☐ (CH₃)₃COH
-

Part B Oxidation

A compound **X**, C₄H₁₀O, gives the compound **Y**, C₄H₈O, on oxidation. **Y** does **not** give a silver mirror on the addition of Tollens' reagent. Which of the following could **X** be?

- ☐ CH₃CH₂CH(OH)CH₃
 - ☐ CH₃CH₂CH₂CH₂OH
 - ☐ CH₃CH₂OCH₂CH₃
 - ☐ (CH₃)₃COH
 - ☐ CH₃CH₂CH₂OCH₃
-

Tollens' Reagent

A Level



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

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

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



Physics. *You work it out.*

[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Reactions](#) [Ketones with KCN Mechanism](#)

Ketones with KCN Mechanism

A Level
P P P

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

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



Nucleophilic Addition Mechanism



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?

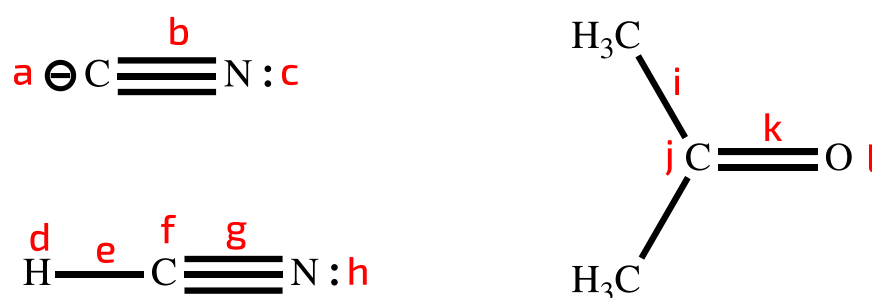


Figure 1: First step of HCN with propanone catalysed by KCN

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

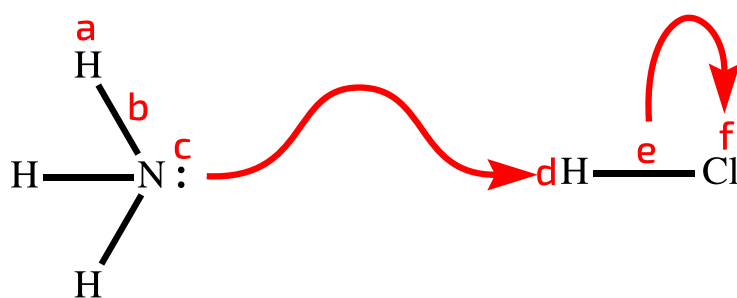


Figure 2: Sequence **cdef**

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?

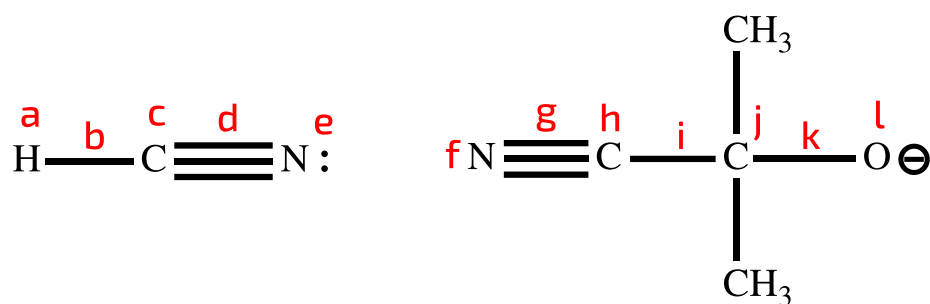


Figure 3: Second step of HCN with propanone catalysed by KCN

Created for isaacphysics.org by R. Less

Gameboard:

STEM SMART Chemistry Week 26

All materials on this site are licensed under the **Creative Commons license**, unless stated otherwise.



Physics. *You work it out.*

[Home](#) [Gameboard](#) [Chemistry](#) [Organic](#) [Reactions](#) [Apples](#)

Apples

A Level



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

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

B reacts with ethanol in the presence of concentrated sulfuric acid under reflux to give **C**, $C_8H_{14}O_5$. Compound **C** evolves hydrogen gas when treated with sodium metal and reacts with acidified potassium dichromate(VI) to give compound **D**. Compound **D** 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 **B**.

Part B Compound B

Suggest a structure for compound **B**.

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

Part C **Compound C**

Suggest a structure for compound **C**.

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

Part D **B \longrightarrow C reaction**

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

Part E **Compound D**

Suggest a structure for compound **D**.

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

Part F **C \longrightarrow D reaction**

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

Adapted with permission from UCLES, A-Level Chemistry, June 1992, Paper 1, Question 11.