# Alcohols

## Question Paper 1

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|---|---|
| **Level** | International A Level |
| **Subject** | Chemistry |
| **Exam Board** | Edexcel |
| **Topic** | Application of Core Principles of Chemistry |
| **Sub Topic** | Alcohols |
| **Booklet** | Question Paper 1 |

**Time Allowed:** **57 minutes**

**Score:** **/47**

**Percentage:** **/100**

**Grade Boundaries:**

| A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

**1** 1-bromobutane can be made from butan-1-ol.

$$CH_3CH_2CH_2CH_2OH + HBr \rightarrow CH_3CH_2CH_2CH_2Br + H_2O$$

What mass of 1-bromobutane is formed from 3.7 g of butan-1-ol if the yield is 56%?

(Relative molecular masses: butan-1-ol = 74, 1-bromobutane = 137)

- ☒ **A** 3.84 g
- ☒ **B** 6.85 g
- ☒ **C** 12.23 g
- ☒ **D** 76.72 g

**(Total for Question 1 = 1 mark)**

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**2** Compounds containing oxygen are sometimes added to hydrocarbon fuels to reduce incomplete combustion and improve engine performance.

Which contains the greatest number of oxygen atoms?

(Relative molecular masses: $CH_3OH$ = 32, $C_2H_5OH$ = 46, $CH_2OHCH_2OH$ = 62, $C_4H_9OH$ = 74)

- ☒ **A** 8.0 g of methanol, $CH_3OH$
- ☒ **B** 9.2 g of ethanol, $C_2H_5OH$
- ☒ **C** 6.2 g of ethane-1,2-diol, $CH_2OHCH_2OH$
- ☒ **D** 7.4 g of butan-1-ol, $C_4H_9OH$

**(Total for Question 2 = 1 mark)**

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**3** A compound with empirical formula $C_3H_6O$ could be

- ☒ **A** hexane-1,2-diol.
- ☒ **B** hexan-2-ol.
- ☒ **C** hexan-2-one.
- ☒ **D** hexanoic acid.

**(Total for Question 3 = 1 mark)**

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**4** In the preparation of 1-bromobutane from butan-1-ol, it is preferable to react the sodium bromide with 50% sulfuric acid, rather than concentrated sulfuric acid.

The main reason for **not** using concentrated sulfuric acid is because it

☒ **A** makes the reaction too exothermic.

☒ **B** oxidizes HBr to $Br_2$.

☒ **C** is a dehydrating agent.

☒ **D** is more hazardous.

**(Total for Question 4 = 1 mark)**

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**5** The table below gives the boiling temperatures of some alcohols.

| Alcohol | Boiling temperature / °C |
|---|---|
| Ethanol | 78 |
| Propan-1-ol | 97 |
| Butan-1-ol | 117 |

From the data in the table, the boiling temperature of hexan-1-ol is most likely to be

☒ **A** 138°C

☒ **B** 148°C

☒ **C** 158°C

☒ **D** 168°C

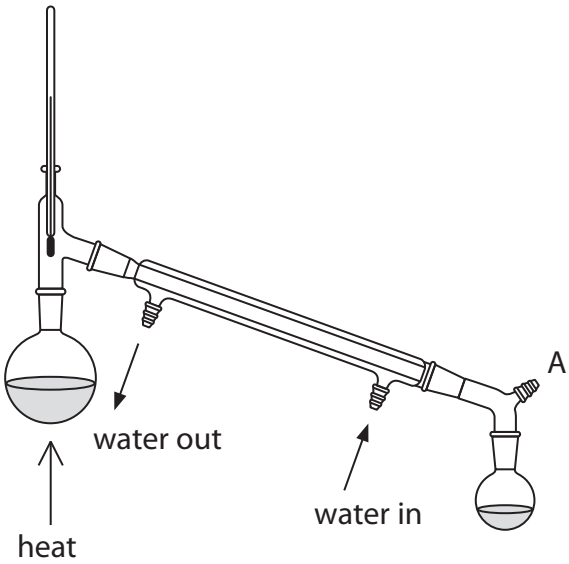
**(Total for Question 5 = 1 mark)**

**6** Alcohols, such as ethanol, undergo a number of reactions.

(a) Write the balanced equation for the oxidation of ethanol to ethanoic acid. Use displayed formulae to show **all** the bonds in the reactants and products. Use the symbol, [O], to represent an oxygen atom from the oxidizing agent. State symbols are not required.

**(3)**

(b) Ethanol can be oxidized to the aldehyde, ethanal, using the apparatus shown below.




(i) State the class of alcohols that can be oxidized to aldehydes.

**(1)**

(ii) Explain fully why ethanal, rather than ethanoic acid, is produced and collected when the apparatus in (b) is used.

**(3)**

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.....

(iii) State the purpose of the part of the apparatus labelled **A**.

**(1)**

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.....

(c) (i) The distillation product, ethanal, is dried.

What test could you use to show that the dry sample is contaminated by ethanol or ethanoic acid?
Suggest **one** reagent that could be used to test for both ethanol and ethanoic acid in the presence of ethanal. Give the observation that would be seen if either were present.

**(2)**

Reagent .....

Observation .....

(ii) Physical methods can also be used to identify molecules.

Give the formula of a **fragment** that produces a peak in the mass spectrum of ethanal but **not** in the mass spectrum of ethanol.

Identify **one** feature in the infrared spectrum of ethanal that distinguishes it from ethanol. Wavenumber values are not required.

**(2)**

Mass spectrum fragment .....

Infrared spectrum feature .....

.....

.....

(d) Ethanol is a highly flammable liquid. However, some other larger and more complex alcohols can be more difficult to burn. One such example is propane-1,2,3-triol, commonly called glycerol, which has the formula $CH_2OHCHOHCH_2OH$ or $C_3H_8O_3$.

(i) Write the equation for the complete combustion of propane-1,2,3-triol, using its molecular formula. State symbols are not required.

**(1)**

$C_3H_8O_3$ + → 

(ii) Write a possible equation for the combustion of propane-1,2,3-triol in a limited supply of oxygen.
Suggest a likely observation of this reaction under these conditions. State symbols are not required.

**(3)**

$C_3H_8O_3$ + →

Observation .....

.....

(e) Halogenoalkanes react with aqueous hydroxide ions to form the corresponding alcohol.

(i) Name the type of reaction and mechanism.

**(2)**

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(ii) Choose a halogenoalkane that will react in this way to form ethanol.
Draw the mechanism for this reaction, using appropriate curly arrows.

Show clearly any dipoles present and the lone pair of electrons involved in the mechanism.

**(3)**

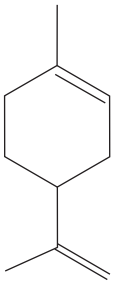
**(Total for Question 6 = 21 marks)**

**7**

Many organic compounds have characteristic odours.

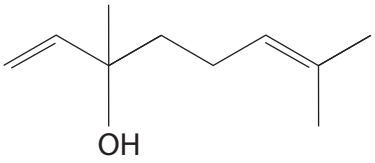
Some of these odours are pleasant, and the organic compounds are used in perfumes, soaps, deodorants, shampoos and other cosmetics.

Limonene is a colourless liquid which is present in the rind of lemons.



limonene

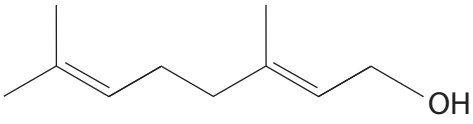
Linalool occurs in lavender oil.



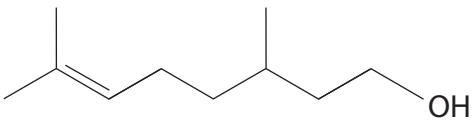

linalool

Geraniol and citronellol occur in lemon grass.

They have rose-like odours.




geraniol




citronellol

(a) (i) Give the **molecular** formula for linalool.

**(1)**

(ii) Give the **empirical** formula for limonene.

**(1)**

(iii) Which of these four compounds are structural isomers?

**(1)**

(iv) Which of these four compounds show(s) geometric isomerism?

**(1)**

(b) Describe simple test tube reactions to identify the two functional groups present in linalool.

Give the reagents required and the observations you would make.

**(4)**

*(c) (i) Explain whether it is possible to distinguish between limonene, linalool, geraniol and citronellol using **only** infrared spectroscopy.

**(2)**

(ii) Describe a chemical test that could be used to distinguish between samples of linalool and geraniol. Give the result of the test for both compounds.

**(2)**

(d) The four organic compounds react with hydrogen gas, in the presence of a suitable catalyst.

(i) Name a suitable catalyst for the reaction with hydrogen.

**(1)**

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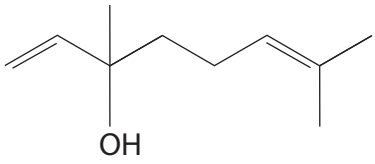
(ii) Complete the balanced equation for the reaction of linalool with excess hydrogen.

**(1)**



(iii) A sample of lavender oil contained 70.0% by mass of linalool and no other unsaturated compounds. Calculate the minimum volume of hydrogen gas, measured at room temperature and pressure, needed to completely reduce 2.55 g of this lavender oil.

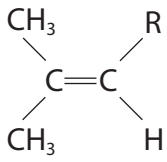
(The molar volume of hydrogen at room temperature and pressure is 24.0 $dm^3$ $mol^{-1}$. The molar mass of linalool is 154 g $mol^{-1}$)

**(3)**

(e) Hydrogen bromide reacts with C═C bonds such as those in citronellol.

Draw the mechanism for the reaction of hydrogen bromide with citronellol.

You should use the formula




to represent a molecule of citronellol.

Include the dipole on the hydrogen bromide molecule.

**(4)**

**(Total for Question 7 = 21 marks)**