

# Ethanol

## Question Paper

Level	GCSE
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2C)
Topic	Organic Chemistry
Sub-Topic	Ethanol
Booklet	Question Paper

**Time Allowed:** 62 minutes

**Score:** /52

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

- 1 The table shows percentage by mass of the fractions obtained from a sample of crude oil and the percentage market demand for these fractions.

Fraction	Percentage by mass in crude oil	Market demand (%)
refinery gases	3	5
gasoline	12	28
kerosene	9	20
diesel	15	25
fuel oil	51	20
bitumen	10	2

- (a) Why is the market demand for the gasoline fraction greater than that for the fuel oil fraction? (1)

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- (b) Cracking is used to make long-chain hydrocarbon molecules into shorter-chain hydrocarbon molecules.

- (i) Complete the equation to show the other hydrocarbon molecule formed when  $C_{20}H_{42}$  is cracked. (1)



- (ii) Give the name of a catalyst used in industry to crack long-chain hydrocarbons and state a temperature at which cracking is carried out. (2)

Catalyst .....

Temperature .....

(c) Ethene (C<sub>2</sub>H<sub>4</sub>) can be produced by cracking long-chain hydrocarbon molecules obtained from crude oil. The ethene produced can then be used to make ethanol.

Ethanol can also be made by the fermentation of sugars.

(i) Give **two** advantages of making ethanol from ethene, rather than by fermentation.

(2)

1 .....

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2 .....

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(ii) Suggest **two** reasons why ethanol is sometimes made by fermentation, rather than from ethene.

(2)

1 .....

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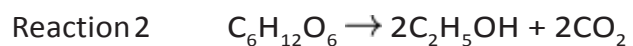
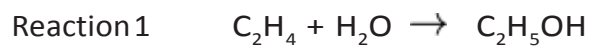
2 .....

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**(Total for Question 1 = 8 marks)**

2 There are two important ways to manufacture ethanol.



(a) (i) Identify one raw material that could be used as the source of  $C_6H_{12}O_6$  (1)

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(ii) Reaction 2 uses a catalyst called zymase, which is present in yeast.

Identify the catalyst used in reaction 1. (1)

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(iii) In both reactions it is important to control the temperature.

State why the temperature in reaction 2 is kept below 35 °C. (1)

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(b) A manufacturing company plans to build a factory to produce ethanol on a large scale. The factory will be near an oilfield. The ethanol will be used as a solvent for perfume.

Suggest why the company should use reaction 1 rather than reaction 2.

(3)

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(c) In the future, it may be necessary to convert the ethanol (produced by reaction 2) into ethene.

Write the equation for this reaction and state the type of reaction that occurs.

(2)

Equation .....

Type of reaction .....

**(Total for Question 2 = 8 marks)**

3 This is a recipe for making plum wine.

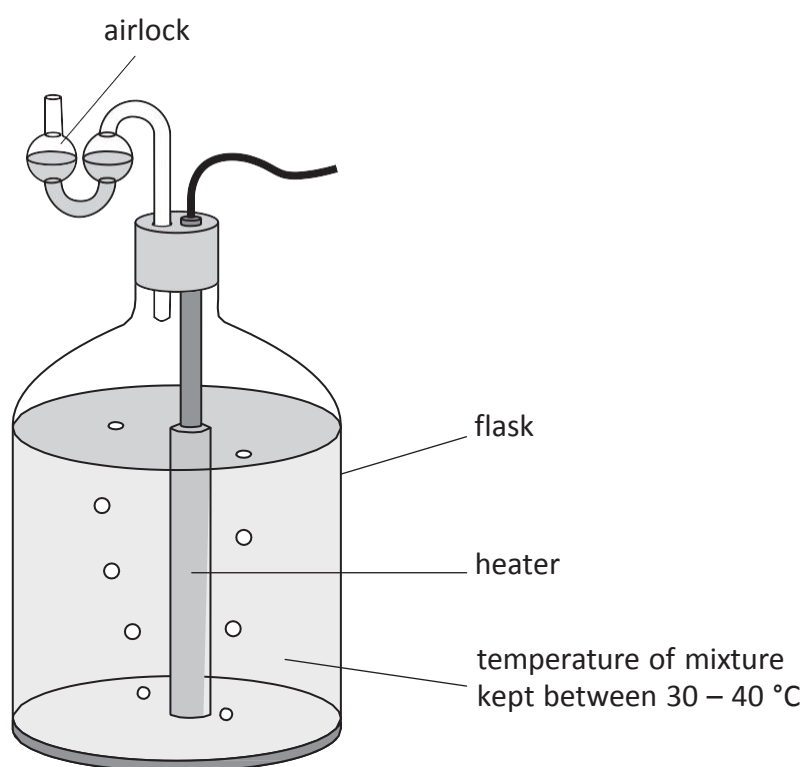
Dissolve 1.5 kg of sugar in 5 dm<sup>3</sup> of warm water.

Add yeast and 8 kg of plums.

Pour the mixture into a flask.

Leave the flask for several weeks until the reaction has stopped.

Remove the solid yeast and pour the clear liquid into bottles.



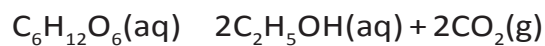
(a) Sugar contains sucrose,  $C_{12}H_{22}O_{11}$

When yeast is added, water reacts with sucrose to form glucose,  $C_6H_{12}O_6$

Write a chemical equation for this reaction.

(1)

(b) The glucose is then converted into ethanol by the yeast



(i) How would you know when the reaction has stopped? (1)

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(ii) How could the solid yeast be removed from the mixture? (1)

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(c) Ethanol can be converted into chloroethene,  $\text{CH}_2=\text{CHCl}$ , in three stages.

Stage 1 Ethanol is dehydrated to form ethene,  $\text{CH}_2=\text{CH}_2$

Stage 2 Ethene is converted into 1,2-dichloroethane,  $\text{CH}_2\text{ClCH}_2\text{Cl}$

Stage 3 1,2-dichloroethane is converted into chloroethene and hydrogen chloride

(i) Why is the reaction in **Stage 1** described as dehydration? (1)

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(ii) Identify the catalyst used in the reaction in **Stage 1**. (1)

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(iii) Suggest the name or formula of the substance used to react with ethene in **Stage 2**. (1)

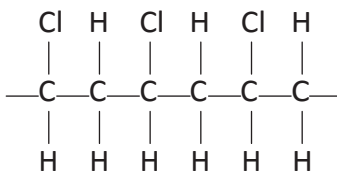
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(iv) Write a chemical equation for the reaction in **Stage 3**. (1)

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(d) Chloroethene can be used to make the polymer poly(chloroethene), also known as PVC.

The displayed formula for part of the PVC molecule is



(i) Draw a displayed formula for a chloroethene molecule.

(1)

(ii) Describe, in terms of structure and bonding, what happens when chloroethene molecules are converted into poly(chloroethene).

(3)

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(Total for Question 3 = 11 marks)



4 (a) The first two members of the homologous series of alcohols are methanol and ethanol.

(i) Give two characteristics of the compounds in a homologous series.

(2)

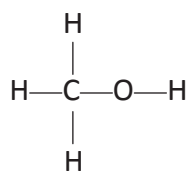
1 .....

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2 .....

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(ii) The displayed formula for methanol is

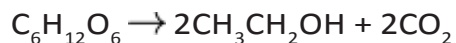


Suggest a displayed formula for ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$

(1)



(c) The equation for the fermentation of glucose is



A mass of 3 600 kg of glucose was completely fermented.

- (i) Calculate the amount, in moles, of glucose that was fermented.  
( $M_r$  of glucose = 180)

(2)

amount of glucose = ..... mol

- (ii) Deduce the amount, in moles, of ethanol produced in this reaction.

(1)

amount of ethanol = ..... mol

- (iii) Calculate the volume, in  $\text{dm}^3$  at rtp, of carbon dioxide produced in this reaction.  
(1 mol of carbon dioxide occupies  $24 \text{ dm}^3$  at rtp)

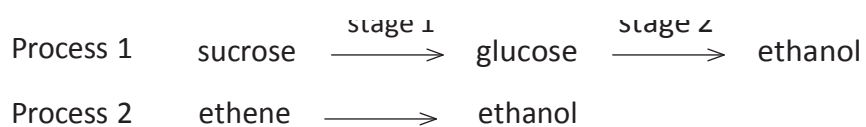
(2)

volume of carbon dioxide = .....  $\text{dm}^3$

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**(Total for Question 4 = 11 marks)**

5 (a) Ethanol can be manufactured by two different processes.



(i) What is the general name for compounds such as sucrose and glucose? (1)

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(ii) What type of reaction occurs in stage 2? (1)

.....  
(iii) What is the catalyst used in stage 2? (1)

.....  
(iv) What type of reaction occurs in process 2? (1)

.....

(b) The table shows the displayed formulae of four organic compounds.

ethene	propene
ethanol	compound D

Ethanol and compound D are members of the homologous series of alcohols.

(i) The first member of this homologous series is methanol.

Draw the displayed formula of methanol.

(1)

(ii) Suggest the name of compound D.

(1)

(c) In industry, the conversion of propene to compound D uses the same conditions as those used in the conversion of ethene to ethanol.

Identify a suitable catalyst and temperature for these conversions.

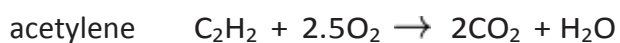
(2)

catalyst .....

temperature ..... °C

(d) Ethene and acetylene can both be used for welding metals.

The equations for the reactions of these gases in welding are



One problem with using hydrocarbons as fuels is incomplete combustion.

(i) Incomplete combustion is a bigger problem with ethene than with acetylene.

Suggest why.

(1)

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(ii) One of the gases produced during incomplete combustion is dangerous to humans.

Identify this gas and explain how it is dangerous.

(3)

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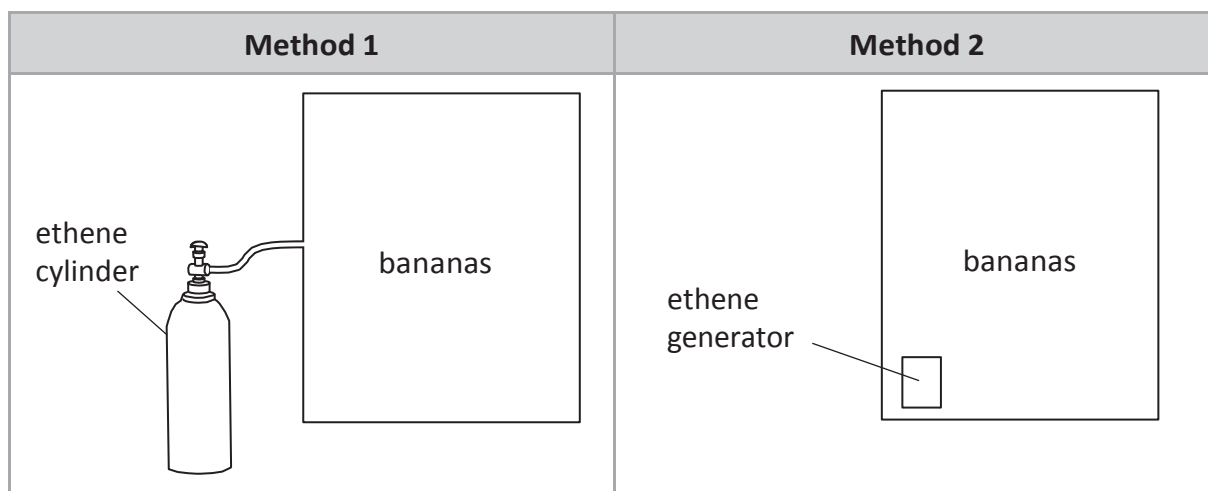
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(e) Ethene can be used to ripen bananas.

Bananas are placed in a large container and ethene is added. The ethene can be added in two different ways.



(i) In method 1, ethene is stored under pressure and passed through a pipe into the container.

Suggest one risk in using this method.

(1)

(ii) In method 2, the generator contains a known quantity of ethanol that is slowly decomposed to ethene using a catalyst.

Write a chemical equation for this decomposition.

(1)

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**(Total for Question 5 = 14 marks)**

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