AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.2.3

Alcohols

Past-paper questions

Tier	**Higher**
Question groups	**46**
Available paper years	**2007–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.2.3 Alcohols

Question 01

March 2007 | CHY1A | Original Q3 | Legacy

QUESTION THREE

Crude oil is a non-renewable energy source. Petrol is a fuel obtained from the fractional distillation of crude oil.

Gasohol is also a fuel. It is a mixture of 90 % petrol and 10 % ethanol. The ethanol can be produced from the waste stems and leaves when crops have been harvested. So ethanol is a renewable energy source.

	Mass in grams of gas produced by completely burning 10 cm^3 of fuel		
Fuel	Carbon dioxide from petrol	Carbon dioxide from ethanol	Water vapour
Petrol	26.4	0	12.6
Gasohol	23.8	1.5	12.2

3A What is the total mass of carbon dioxide produced when 10 cm^3 of gasohol is burned?

1 22.3 g

2 23.8 g

3 25.3 g

4 26.4 g

3B How much more carbon dioxide is produced when 10 cm^3 of petrol is burned than when 10 cm^3 of gasohol is burned?

1 0.4 g

2 1.1 g

3 1.6 g

4 24.9 g

4.7.2.3 Alcohols

3C Why is the water vapour produced by burning fuels not a problem?

1 It condenses to a liquid.

2 It does not cause corrosion.

3 It is not a pollutant.

4 Very little is produced.

3D Carbon dioxide causes environmental problems.

Why is carbon dioxide from burning ethanol thought to be less of a problem than carbon dioxide from burning petrol?

1 Not as much carbon dioxide is produced.

2 The carbon dioxide produced has different chemical properties.

3 It is just recycling carbon dioxide removed from the air by plants.

4 The ethanol is not produced from crude oil.

4.7.2.3 Alcohols

Question 02

March 2007 | CHY1B | Original Q9 | Legacy

QUESTION NINE

Read this extract from a magazine article.

BIODIESEL

Biodiesel is a fuel made by the chemical reaction of alcohol with vegetable oils such as soya bean oil. This process also produces glycerine which is used in soap making.

Biodiesel can be used in engines which normally run on petroleum diesel. Biodiesel can be mixed with petroleum diesel in any proportions.

Biodiesel is biodegradable and contains very little sulfur. The complete combustion of biodiesel forms more carbon dioxide, less carbon monoxide and much less particulate, smoke-type emissions than petroleum diesel.

Some of the disadvantages of biodiesel include attacking engine hoses that were intended for a different fuel and loosening deposits within the engine left from previous fuels which can cause blockages.

9A The main advantage of using biodiesel instead of petroleum diesel is that . . .

1 it does not cause any damage to engines.

2 it guarantees the soap industry a plentiful supply of glycerine.

3 it increases the amount of carbon dioxide released into the atmosphere.

4 it is a renewable fuel.

9B From the information given, it is possible to conclude that biodiesel will contribute to . . .

1 a decrease in acid rain formation.

2 an increase in fog formation.

3 a decrease in soap production.

4 a reduction in global warming.

Question 02 · continued

9C Which one of the following is a correct statement?

1 Biodiesel production will eventually make the distillation of crude oil unnecessary.

2 During combustion, fewer toxic emissions are produced by petroleum diesel than by biodiesel.

3 Plants used to make biodiesel use up carbon dioxide as they grow, so offsetting the carbon dioxide produced when the fuel burns.

4 There is nothing to limit the amount of crops a country can grow economically each year to produce biodiesel.

9D Which of the following statements about biodiesel compared with petroleum diesel is **not** based on scientific measurements?

1 Both the fuel and its combustion products are less carcinogenic than ordinary diesel.

2 For transportation, biodiesel is classed as less flammable than petroleum diesel.

3 The exhaust gases from a biodiesel-fuelled engine contain less unburnt hydrocarbons.

4 Biodiesel has a much more pleasant odour than petroleum diesel.

END OF TEST

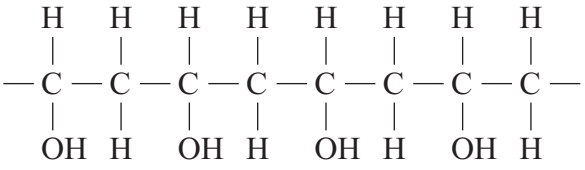
4.7.2.3 Alcohols

Question 03

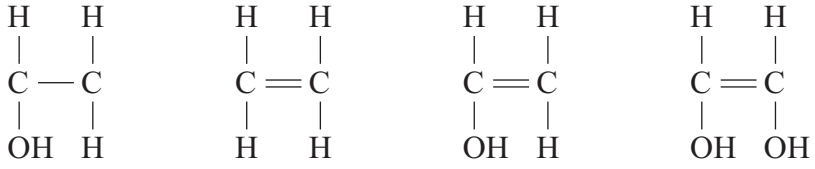
June 2007 | CHY1B | Original Q4 | Legacy

QUESTION FOUR

Poly(vinyl alcohol) has this structure:



4A The monomer from which poly(vinyl alcohol) is made can be represented by . . .



1 **2** **3** **4**

Poly(vinyl alcohol) reacts with a solution of sodium borate to form 'slime'.
Slime can be fluid or, when almost solid, it can retain its shape.

A student measured the relationship between the spread of a lump of slime and the concentration of the sodium borate solution used to make it.
She called this 'the slump test'.

The student followed this procedure:

- make a sample of slime using 50 cm^3 of 4 % poly(vinyl alcohol) solution and 5 cm^3 of a 1 % solution of sodium borate
- stir the mixture for 2 minutes
- measure out 50 cm^3 of the slime produced and make this into a disc shape
- place this disc on paper and mark its outline with a pencil line
- leave for 5 minutes
- mark the new outline of the slime with a pencil
- calculate the increase in area of the disc
- repeat, using different concentrations of sodium borate to make the slime.

4B The student would have achieved greater accuracy in the test if she had . . .

1 used a smaller piece of slime.

2 stirred the reacting mixture for more than 2 minutes.

3 allowed the slime to spread for less than 5 minutes.

4 controlled the starting area of the slime discs.

Question 03 · continued

4C One variable that she did not control was . . .

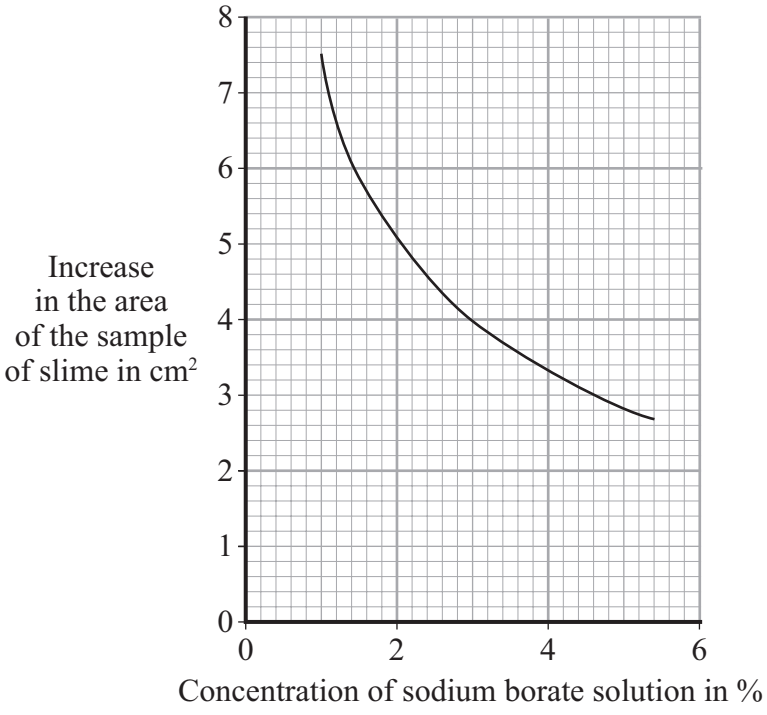
1 the concentration of the poly(vinyl alcohol).

2 the room temperature during the slump test.

3 the volume of the sodium borate solution.

4 the volume of the slime.

4D The student's results are shown on the graph.



The graph shows that . . .

1 the increase in area is directly proportional to the concentration of the sodium borate solution.

2 there is a linear relationship between the increase in area and the concentration of the sodium borate solution.

3 the increase in area is reduced as the sodium borate solution becomes more concentrated.

4 there is no relationship between the size of the disc and the concentration of the sodium borate solution.

4.7.2.3 Alcohols

Question 04

June 2007 | CHY1H | Original Q5 | Legacy

5 Known crude oil reserves are being used up rapidly. Crude oil is used to produce many useful fuels, such as petrol. One way to conserve crude oil reserves would be to increase the production of bio-fuels.

(a) Ethanol can be produced for use as a bio-fuel. Cars can be powered by ethanol or ethanol–petrol mixtures.

Sugar cane can be fermented to give a mixture of water (boiling point 100 °C) and ethanol (boiling point 78 °C).

(i) How can ethanol be separated from water?

.....

.....

(1 mark)

(ii) Ethanol, C_2H_5OH, burns to release heat energy.

Complete the balanced symbol equation by writing in the formulae of the two products.

$C_2H_5OH + 3O_2 \rightarrow 2..... + 3.....$

(2 marks)

4.7.2.3 Alcohols

Question 04 · continued

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(b) The cost of producing a bio-fuel, such as ethanol, by fermentation, is at least three times higher than the production cost of petrol. It costs less to produce ethanol from alkanes. In the production, the vapour of an alkane is passed over a hot catalyst.

$$\underset{\text{hexane}}{C_6H_{14}} \xrightarrow{\text{Hot catalyst}} \underset{\text{ethane}}{C_2H_6} + \underset{\text{ethene}}{2C_2H_4}$$

Ethene is then converted into ethanol.

(i) What has happened to the hexane to produce ethene?

.....

(1 mark)

(ii) Complete the structural formula for ethene, C_2H_4.

C C

(1 mark)

(iii) Name the compound that is added to ethene to produce ethanol, C_2H_5OH.

.....

(1 mark)

(c) As explained in parts (a) and (b), ethanol can be made using either sugar or alkanes as the starting material.

Evaluate the advantages and disadvantages of using these two starting materials to produce ethanol.

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.....

(4 marks)

10

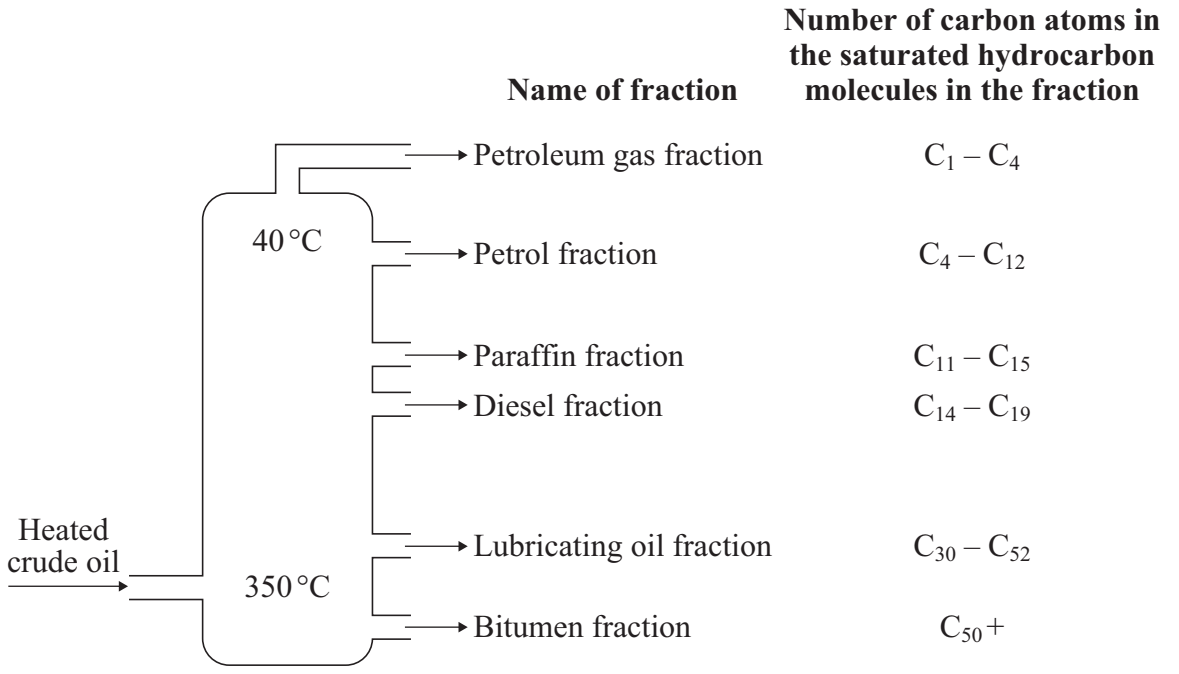
4.7.2.3 Alcohols

Question 05

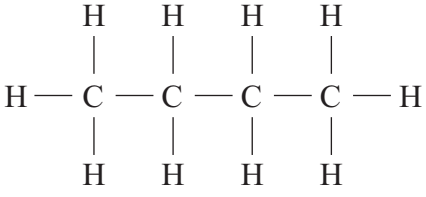
November 2007 | CHY1A | Original Q8 | Legacy

QUESTION EIGHT

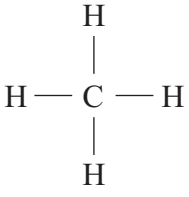
Crude oil can be separated into fractions.
Each fraction contains several different saturated hydrocarbons.



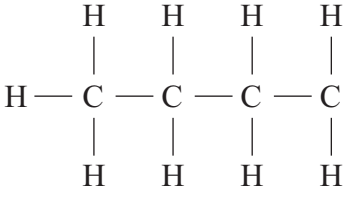
8A One of the hydrocarbons in the petrol fraction can be represented by . . .



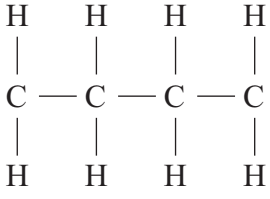
1



2



3



4

4.7.2.3 Alcohols

8B Which statement is **not** true of saturated hydrocarbons?

1 When burned completely, they produce carbon dioxide and water.

2 They have the general formula C_nH_{2n+1}

3 They can be solids, liquids or gases.

4 Those with a small number of carbon atoms in each molecule are useful as fuels.

8C When compared with diesel, petrol . . .

1 is more difficult to ignite.

2 is more volatile.

3 has a higher boiling point.

4 is more viscous.

8D Which one of these statements about ethanol is **false**?

1 Ethanol is a renewable resource.

2 Ethanol does not release carbon dioxide when it burns.

3 Ethanol, produced from plant material, can be carbon-neutral.

4 Ethanol does not release sulfur dioxide when it burns.

4.7.2.3 Alcohols

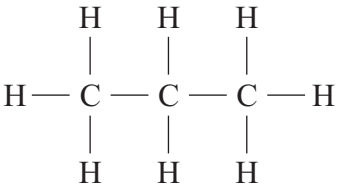
Question 06

November 2007 | CHY1B | Original Q2 | Legacy

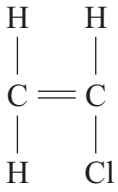
QUESTION TWO

This question is about the formulae of four organic compounds.

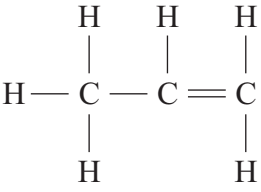
Match the formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.



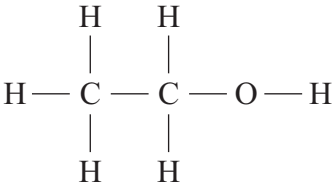
A



B



C



D

	What we can say about the organic compound
1	It is a saturated hydrocarbon useful as a fuel.
2	It is a monomer from which the polymer, polyvinylchloride, can be made.
3	It is the formula for ethanol.
4	It belongs to a group of hydrocarbons with the general formula C_nH_{2n}

4.7.2.3 Alcohols

Question 07

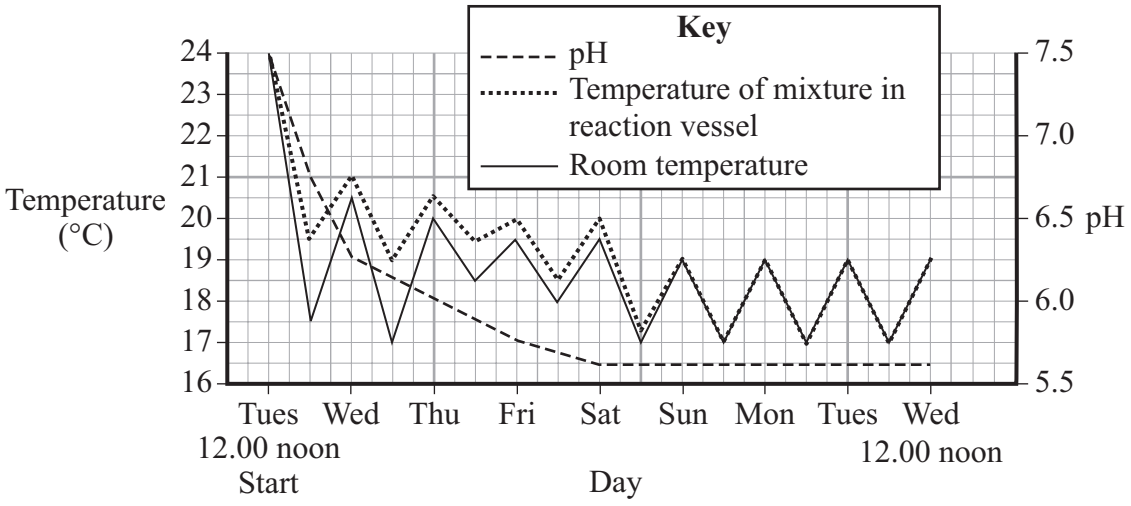
November 2007 | CHY1B | Original Q8 | Legacy

QUESTION EIGHT

Ethanol can be made by the action of yeast on a solution of sugar. This is called fermentation. The sugar is converted to ethanol and carbon dioxide. Carbon dioxide is a slightly acid gas. During fermentation, some of the energy is transferred as thermal energy.

A sugar solution and yeast were put into a reaction vessel.
The temperature of the mixture, the pH of the mixture and the room temperature were recorded over an eight-day period.

The results are shown on the graph.



8A There is a larger difference between the temperature of the mixture and the room temperature during the first few days than there is later.

The probable reason is that . . .

1 fermentation is quicker at the start.

2 the room temperature is steadily decreasing.

3 the pH value of the mixture is decreasing.

4 the room temperature fluctuates.

4.7.2.3 Alcohols

8B From the information on the graph, . . .

1 fermentation is completed after 4 days.

2 fermentation is completed after 5 days.

3 fermentation is completed after 6 days.

4 fermentation continues after 8 days.

8C A general conclusion from the graph is that . . .

1 the yeast cannot survive for more than 8 days.

2 the acidity of the mixture increases in the first 4 days.

3 the acidity of the mixture is greater at the start than when fermentation is completed.

4 the temperature of the mixture does not fall below 18.0 °C.

8D One advantage of producing ethanol by fermentation rather than from ethene is that . . .

1 less carbon dioxide is produced in fermentation.

2 there are no waste products.

3 the raw materials are renewable.

4 the ethanol does not need further processing.

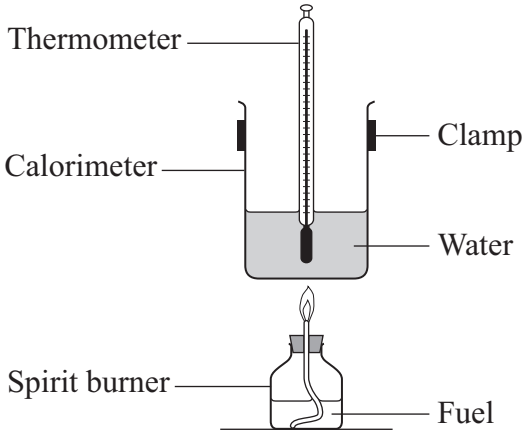
4.7.2.3 Alcohols

Question 08

January 2008 | CHY3H | Original Q1 | Legacy

1 A student burned four fuels and compared the amounts of energy they produced.

The student set up the apparatus as shown in the diagram.



The heat produced when each fuel was burned was used to raise the temperature of 100 g of water. The student noted the mass of fuel burned, the increase in temperature and whether the flame was smoky.

The results are shown in the table.

Fuel	Mass of fuel burned (g)	Temperature increase (°C)	Type of flame
Ethanol	4	24	Not smoky
Methanol	3	9	Not smoky
Peanut oil	2	20	Smoky
Vegetable oil	1	15	Smoky

(a) The student suggested that the vegetable oil was the best fuel for producing heat.

Explain why.

.....

.....

.....

.....

(2 marks)

4.7.2.3 Alcohols

Question 08 · continued

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(b) Suggest an environmental problem that could be caused when large amounts of vegetable oil are burned. Suggest how the problem could be overcome.

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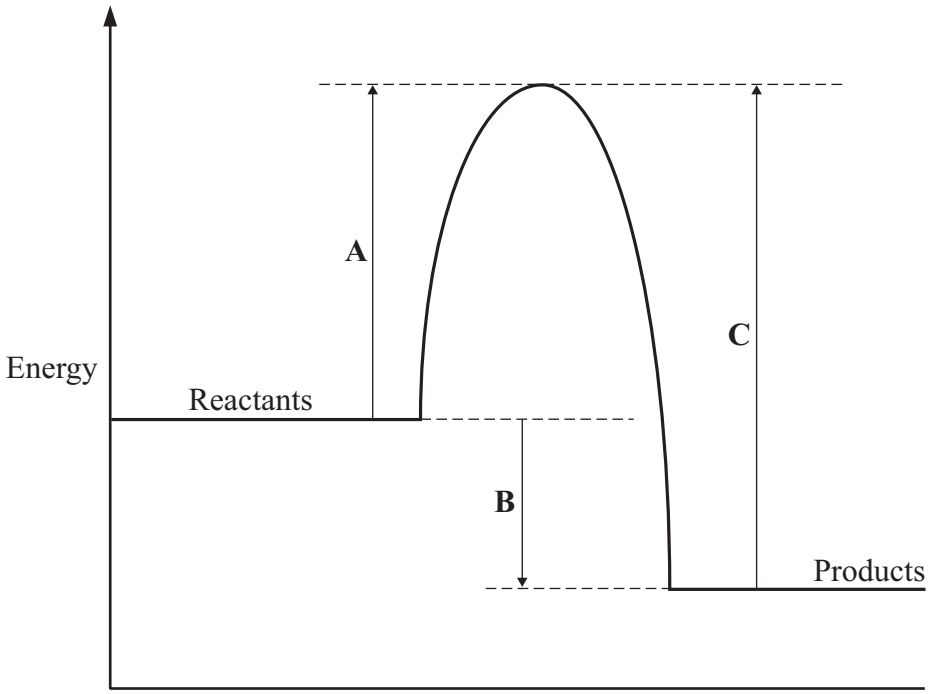
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.....

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(2 marks)

(c) An energy level diagram for the burning of vegetable oil is shown below.



Which of the energy changes **A**, **B** or **C**:

(i) represents the activation energy .....

(1 mark)

(ii) shows the amount of energy given out during the reaction? .....

(1 mark)

6

4.7.2.3 Alcohols

Question 09

March 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This question is about Brazil and its energy reserves available to run cars, and the effect that burning fuels have on the environment.

Brazil is a poor country and is deeply in debt to many nations. It does not have enough oil and coal to meet its needs and importing these fuels is very expensive. It does not produce enough electricity to meet its needs, which makes electricity very expensive in Brazil.

However, Brazil has a massive land area and a favourable climate for growing a large amount of crops such as sugar cane.

The table shows the products formed by burning four different fuels in a car engine.

Fuel	Sulfur dioxide formed	Carbon monoxide formed	Carbon dioxide formed	Water formed
Hydrogen	✗	✗	✗	✓
Ethanol	✗	✗	✓	✓
Syngas	✗	✓	✓	✓
Petrol	✓	✓	✓	✓

8A Which one of the four fuels would produce the least air pollution?

1 hydrogen

2 ethanol

3 syngas

4 petrol

8B Brazil could try to improve its economy and reduce its debt by using cars powered by . . .

1 hydrogen obtained by the electrolysis of water.

2 ethanol obtained from plants.

3 syngas obtained from coal.

4 petrol obtained from crude oil.

4.7.2.3 Alcohols

Question 09 · continued

8C To investigate the possible effects of burning fuels on the temperature of the Earth, it would be best to consult past records giving . . .

1 temperatures accurate to 1 °C over 5 years.

2 temperatures accurate to 1 °C over 50 years.

3 temperatures accurate to 0.1 °C over 5 years.

4 temperatures accurate to 0.1 °C over 50 years.

8D To assess the evidence about fuels, it would be best to consult scientists . . .

1 employed by car manufacturers.

2 employed by farmers.

3 employed by oil companies.

4 employed by universities.

4.7.2.3 Alcohols

Question 10

June 2008 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

Scientists are researching new catalysts to convert compounds in coal into small hydrocarbon molecules.

These small molecules can be used to make liquid fuels such as petrol.

4A Scientists are trying to develop processes that convert coal into liquid fuels, such as petrol, because . . .

1 they have found new supplies of catalysts.

2 oil reserves are running out quickly.

3 there is no alternative to using coal.

4 catalysts are being used up.

4B Petrol is made from small molecules and **not** large molecules because hydrocarbons with small molecules . . .

1 have a higher boiling point.

2 are more viscous.

3 are darker in colour.

4 ignite more easily.

4C Both petrol and coal produce carbon dioxide when burned.

To compare the volume of the gas produced by a sample of coal with the volume of gas produced by a sample of petrol, a control variable would be . . .

1 how much carbon dioxide is produced.

2 the amount of coal and petrol used.

3 the speed at which each fuel is set alight.

4 the time taken to burn all the fuel.

4.7.2.3 Alcohols

4D Ethanol, made from plant material, is another liquid fuel used in cars.

Ethanol and petrol produce similar amounts of carbon dioxide when they burn.

Burning ethanol made from plant material, in cars, is thought to be less of an environmental problem than burning petrol.

This is because . . .

1 ethanol does **not** produce water when it burns.

2 using ethanol made from plants as a fuel does **not** change the amount of carbon dioxide in the atmosphere.

3 ethanol will burn without using oxygen.

4 in the car engine, only partial combustion of the ethanol occurs.

Turn over for the next question

4.7.2.3 Alcohols

Question 11

June 2008 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about unsaturated hydrocarbons.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A catalysis

B polymerisation

C combustion

D thermal decomposition

Heating large hydrocarbon molecules so that they break down into smaller molecules, such as ethene, is an example of . . . **1** . . . .

Ethanol is formed when ethene reacts with steam. The reaction is speeded up using phosphoric acid. This reaction is an example of . . . **2** . . . .

Individual ethene molecules can be made to link together to form very long chains in a process called . . . **3** . . . .

Ethene reacts with oxygen to produce carbon dioxide and water. This reaction is an example of . . . **4** . . . .

4.7.2.3 Alcohols

Question 12

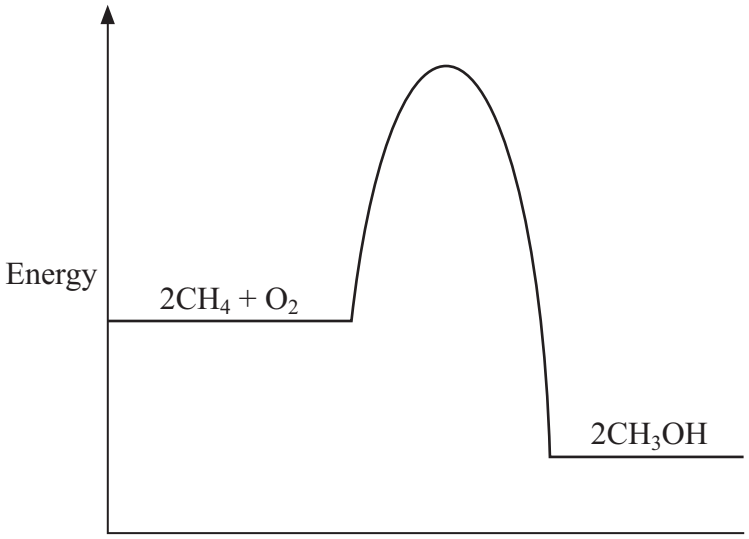
June 2008 | CHY3H | Original Q7 | Legacy

7 Methanol (CH_3OH) can be made by reacting methane (CH_4) and oxygen (O_2) in the presence of a platinum catalyst. The reaction is exothermic.

An equation that represents the reaction is:

$$2CH_4 + O_2 \rightarrow 2CH_3OH$$

7 (a) The energy level diagram for this reaction is given below.



7 (a) (i) Use the diagram to explain how you know that this reaction is exothermic.

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.....

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(1 mark)

7 (a) (ii) Explain, in terms of the energy level diagram, how the platinum catalyst increases the rate of this reaction.

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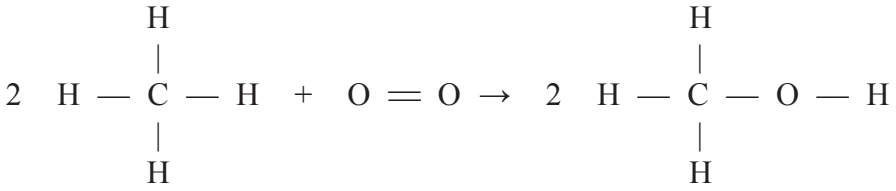
(1 mark)

4.7.2.3 Alcohols

Question 12 · continued

for mark

7 (b) The equation can also be written showing the structural formulae of the reactants and the product.



7 (b) (i) Use the bond energies given in the table to help you to calculate the energy change for this reaction.

Bond	Bond energy in kJ
C — H	435
O = O	498
C — O	805
O — H	464

.....

.....

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.....

.....

Energy change = ... kJ

(3 marks)

7 (b) (ii) In terms of the bond energies, explain why this reaction is exothermic.

.....

.....

(1 mark)

6

4.7.2.3 Alcohols

Question 13

November 2008 | CHY1AP | Original Q3 | Legacy

QUESTION THREE

Hydrocarbon fuels, **K**, **L**, **M** and **N**, were burned and the products were collected and identified.

The results are shown in the table below.

	Hydrocarbon fuels			
Products of burning	**K**	**L**	**M**	**N**
Carbon monoxide	✓	✓	✓	✗
Carbon dioxide	✓	✓	✓	✓
Water vapour	✓	✓	✓	✓
Soot	✓	✓	✗	✗
Sulfur dioxide	✗	✗	✓	✓

Key:
✓ indicates that the substance is one of the products
✗ indicates that the substance is **not** one of the products.

3A The results show that combustion was **only** complete for . . .

1 hydrocarbon fuel **K**.

2 hydrocarbon fuel **L**.

3 hydrocarbon fuel **M**.

4 hydrocarbon fuel **N**.

4.7.2.3 Alcohols

Question 13 · continued

3B The table of results shows that the hydrocarbon fuels that do **not** contain sulfur are . . .

1 **M** and **N**.

2 **K** and **L**.

3 **L** and **M**.

4 **K** and **M**.

3C When hydrocarbon fuels are burned, some of the products cause problems.

Which one of the following statements correctly describes a problem that is caused by the products of burning?

1 Sulfur dioxide in the air causes heavier rainfall.

2 Releasing large amounts of carbon dioxide into the atmosphere produces ‘acid rain’.

3 A build-up of particles in the air causes ‘global dimming’.

4 Releasing large amounts of carbon dioxide into the atmosphere causes ‘global dimming’.

3D Ethanol is a compound of carbon, hydrogen and oxygen.
Ethanol can be used as a fuel in vehicles together with, or in place of, hydrocarbon fuels.

An advantage of ethanol as a fuel is that when it burns . . .

1 no carbon dioxide is produced.

2 carbon dioxide and water are produced.

3 no sulfur dioxide is produced.

4 only water is produced.

4.7.2.3 Alcohols

Question 14

June 2009 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

This question is about obtaining useful substances from crude oil fractions.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A polymerisation

B thermal decomposition

C unsaturation

D hydration (addition of water)

Alkenes can be made from oil fractions by . . . **1** . . . .

Bromine can be used to test for . . . **2** . . . in any alkenes formed.

Ethene formed from oil fractions can be made into ethanol by . . . **3** . . . .

Alkene molecules can be joined together into long-chain molecules in the process called . . . **4** . . . .

4.7.2.3 Alcohols

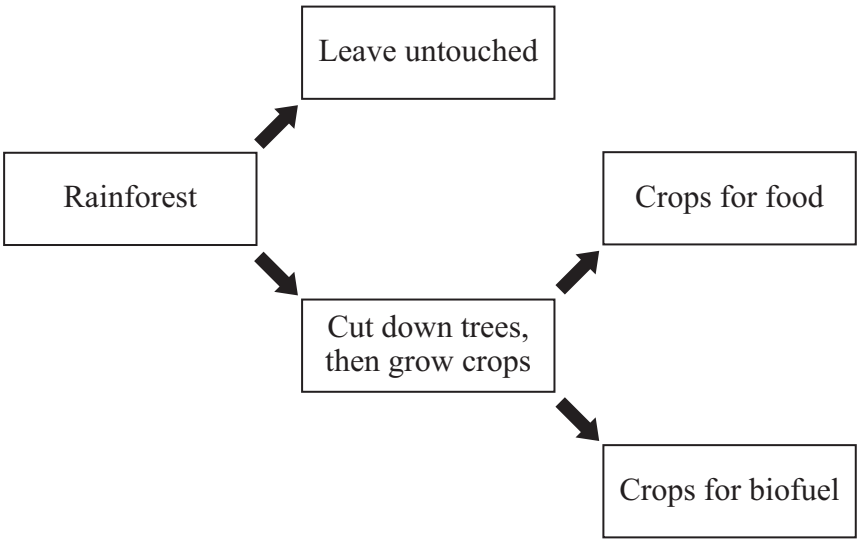
Question 15

June 2009 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Rainforests have an important global role in absorbing carbon dioxide. They are also a habitat for many endangered species.

Many countries have to make difficult decisions about the use of land. This is summarised in the flow chart. Biofuels that are produced include biodiesel and bioethanol. The trees that are cut down are not always replaced.



7A Why is there a large worldwide demand for biofuels?

1 The carbon dioxide produced by the use of the fuel is completely matched by the carbon dioxide taken in when the fuel is grown.

2 They are a renewable source of energy.

3 Their use is always sustained.

4 No greenhouse gases are produced.

Question 15 · continued

7B Which row in the table correctly shows two likely consequences of a long-term increase in the demand for biofuel?

1	fewer crops will be grown for food	more species will be endangered
2	fewer trees in rainforests will be cut down	more land will be used for crops
3	less carbon dioxide will be absorbed by the rainforests	more crops will be grown for food
4	land will not be used and will be returned to rainforest	fossil fuel reserves will run out sooner

7C Scientists have been asked to carry out research to produce evidence about the consequences of developing the use of biofuels.

Which row in the table gives the correct description of an issue and its impact?

	Issue	**Impact**
1	ethical	effect on endangered species
2	social	effect on price of fossil fuels
3	environmental	effect on price of wood
4	economic	effect on levels of oxygen in the atmosphere

7D Some of the vegetable oils grown as a food crop are reacted with hydrogen at 60 °C using a nickel catalyst.

The purpose of this process is to . . .

1 remove single carbon carbon bonds in the oil.

2 add double carbon carbon bonds to the oil.

3 change the oil so that its melting point is higher than room temperature.

4 make the chemicals in the oil detectable with bromine.

4.7.2.3 Alcohols

Question 16

November 2009 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

The equation shows a chemical reaction.

$$\underset{\text{Substance } \mathbf{K}}{C_{10}H_{22}} \longrightarrow \underset{\text{Substance } \mathbf{L}}{C_8H_{18}} + \underset{\text{Substance } \mathbf{M}}{C_2H_4}$$

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A polymerisation

B thermal decomposition

C unsaturation

D hydration

Substances **L** and **M** are obtained from substance **K** by . . . **1** . . . .

Iodine or bromine can be used to test the products for . . . **2** . . . .

Ethanol can be made from substance **M** by . . . **3** . . . .

Molecules of substance **M** can be joined together into long chains by . . . **4** . . . .

4.7.2.3 Alcohols

Question 17

November 2009 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This question is about ethanol. Some ethanol is used as a fuel to replace petrol.

The table compares two different industrial processes for making ethanol.

Process	Raw material	Type of process	Purity of product	Rate of ethanol production
Fermentation using yeast	Sugar	Batch – one tank of sugar solution is fermented at a time	Dilute solution of ethanol	Slow
Hydration using steam	Ethene	Continuous – ethene and steam flow steadily into the reaction vessel and ethanol flows steadily out	Almost pure ethanol	Fast

8A Ethene is obtained from the hydrocarbons in crude oil by . . .

1 thermal decomposition.

2 hydration.

3 fractional distillation.

4 polymerisation.

8B In some countries, very little ethanol for fuel is produced by fermentation because . . .

1 ethene is obtained from a non-renewable resource.

2 they have a hot climate suitable for growing sugar cane.

3 they are wealthy enough to import oil from abroad.

4 the ethanol from fermentation produces more carbon dioxide when burnt.

8C Which of the following is **not** a reason why an ethanol factory using sugar takes longer to produce ethanol than a factory using ethene?

1 A fermentation tank has to be emptied and cleaned after each batch.

2 After fermentation, the ethanol needs to be separated from water.

3 Sugar cane plants take a long time to grow.

4 Yeast takes several days to convert sugar into ethanol.

4.7.2.3 Alcohols

8D Who would benefit economically if ethanol was made by hydration of ethene rather than by fermentation?

1 investors in the fermentation industry

2 oil companies

3 environmental pressure groups

4 sugar cane farmers

Turn over for the next question

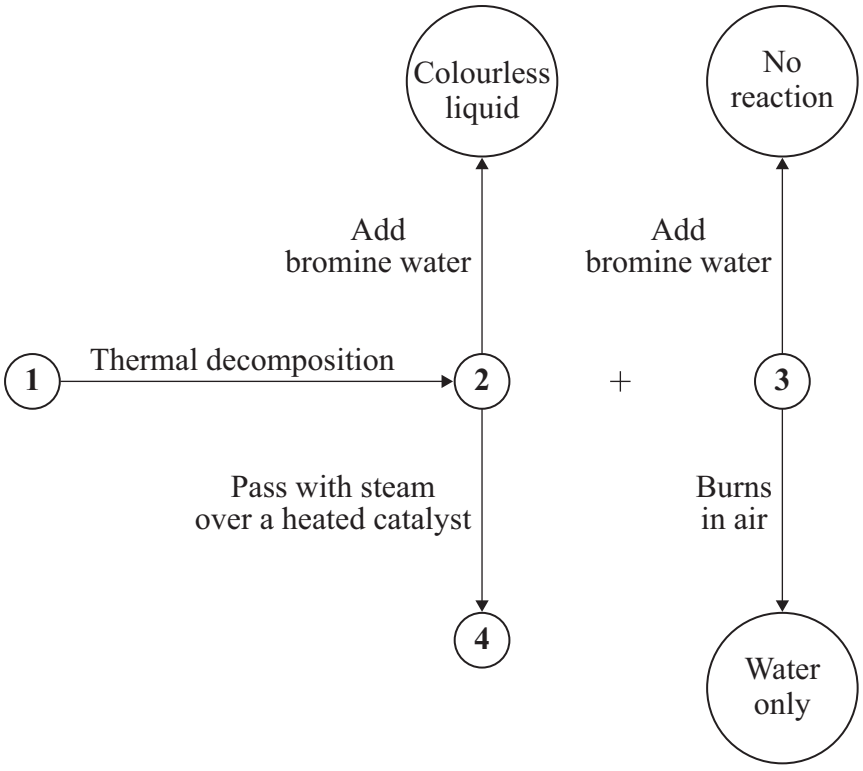
4.7.2.3 Alcohols

Question 18

March 2010 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

The flow chart shows a series of chemical reactions.



Match chemicals, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A Ethane

B Ethene

C Ethanol

D Hydrogen

4.7.2.3 Alcohols

Question 19

June 2010 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Biofuels are made from plants. Ethanol is an example of a biofuel. It can be made by fermentation of material from a variety of plants.

These claims were published on an ethanol producer's website:

- ethanol can be made from maize
- motorists who use ethanol instead of petrol will save money
- using ethanol helps to reduce greenhouse gas emissions
- making ethanol is not responsible for the increase in global food prices
- future biofuels will remove concern about effects on food production.

7A Why is the ethanol producer claiming that using ethanol helps to reduce greenhouse gas emissions?

It is because . . .

1 ethanol is not a fossil fuel.

2 crops take in carbon dioxide as they grow.

3 fermentation uses very little energy.

4 when ethanol burns it does not produce carbon dioxide.

7B There is a debate about whether land should be used for crops to produce food or crops to produce fuel.

Which of the following is a correct statement?

1 Crops used to produce food are different from those used to produce fuels.

2 Both food and fuel provide a lot of energy.

3 Demand for biofuels will increase if the price of fossil fuels falls.

4 The debate is only about economics.

4.7.2.3 Alcohols

Question 19 · continued

7C The claims on the website could be criticised.

Which is a valid criticism?

1 The use of biofuels increases global warming.

2 There is a connection between biofuel production and food prices.

3 Ethanol can be made from maize.

4 Ethanol production can be from crops or from ethene.

7D Which row in the table correctly describes the nature of some of the information on the website?

	Information	Description
1	Ethanol can be made from maize	Political
2	Savings to consumer	Technological
3	Reduction in greenhouse gas emissions	Environmental
4	Not responsible for increase in food prices	Ethical

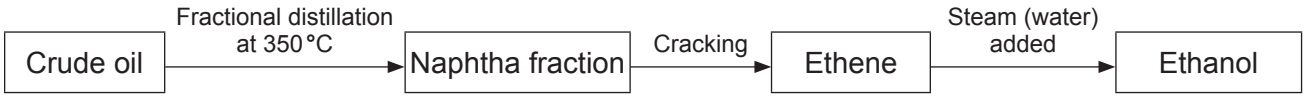
4.7.2.3 Alcohols

Question 20

June 2010 | CHY1H | Original Q6 | Legacy

6 Petrol sold in most countries now contains at least 5% ethanol.
The production of ethanol, for use as a fuel, is being increased.

The flow diagram shows how ethanol can be produced from crude oil.



6 (a) Why does crude oil need to be fractionally distilled?

.....

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(1 mark)

6 (b) Hydrocarbons, such as decane, in the naphtha fraction are cracked to produce ethene.
The balanced chemical equation shows the cracking of decane.

$$\underset{\text{decane}}{C_{10}H_{22}} \rightarrow \underset{\text{octane}}{C_8H_{18}} + \underset{\text{ethene}}{C_2H_4}$$

6 (b) (i) Describe how cracking is done.

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(2 marks)

6 (b) (ii) Complete the structural formula of ethene by drawing lines to represent each covalent bond.

H H

C C

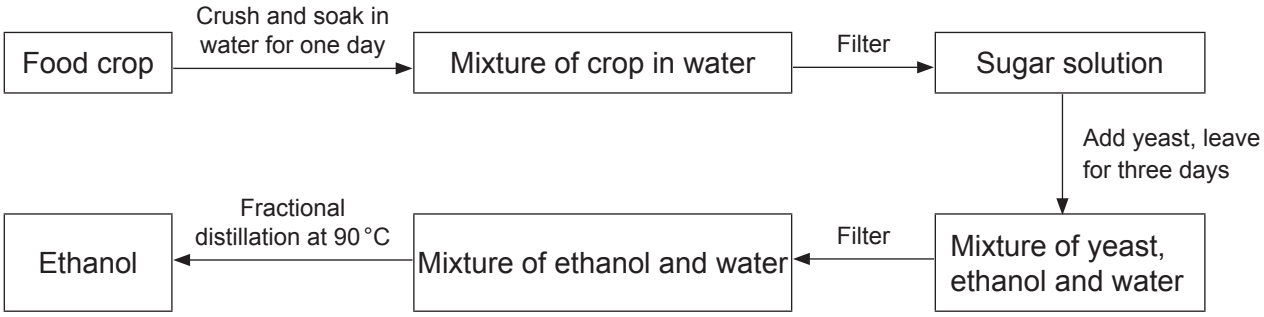
H H

(1 mark)

4.7.2.3 Alcohols

Question 20 · continued

6 (c) The flow diagram below shows how ethanol, for use as a fuel, can also be produced from food crops.



Use the information in the two flow diagrams and your own knowledge and understanding to evaluate whether more of this ethanol should be produced from food crops or from crude oil.

Remember to give a conclusion to your evaluation.

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(5 marks)

9

4.7.2.3 Alcohols

Question 21

January 2011 | CHY2H | Original Q6 | Legacy

6 The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.



The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

> I use different coloured dyes dissolved in methanol.
> I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time.
> The bowl dries more quickly if I use methanol instead of water.

6 (a) (i) Why is using methanol an advantage to the artist?

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(1 mark)

6 (a) (ii) The bonds within a methanol molecule are strong, covalent bonds.

Explain why methanol has a low boiling point.

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(2 marks)

4.7.2.3 Alcohols

Question 21 · continued

6 (b) Methanol is made by reacting carbon monoxide with hydrogen.

The equation for this reaction is:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The forward reaction is exothermic.

The best equilibrium yield of methanol is obtained when the temperature is low and when the pressure is high.

Explain why the best equilibrium yield is obtained:

6 (b) (i) when the temperature is low

.....

.....

(1 mark)

6 (b) (ii) when the pressure is high.

.....

.....

(1 mark)

6 (b) (iii) In industry a high temperature is used for this reaction. This gives a fast rate of reaction. The increase in temperature gives the particles more energy.

Explain, in terms of particles, why this makes the reaction go faster.

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(2 marks)

Question 6 continues on the next page

4.7.2.3 Alcohols

Question 21 · continued

6 (c) (i) Calculate the maximum mass of methanol that could be made from 14 g of carbon monoxide.

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$$

Relative formula masses (M_r): CO = 28; CH_3OH = 32.

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Maximum mass of methanol = ... g
(2 marks)

6 (c) (ii) In an experiment the actual mass of methanol made from 14 g of carbon monoxide was 12 g. Use this information and your answer from part (c)(i) to calculate the percentage yield of methanol in this experiment.

(If you did not get an answer to part (c)(i) then assume that the maximum yield is 18 g. This is **not** the correct answer to part (c)(i).)

.....

.....

Percentage yield of methanol = ...%
(2 marks)

6 (c) (iii) Suggest **one** reason why the yield obtained is less than the maximum yield.

.....

.....
(1 mark)

12

4.7.2.3 Alcohols

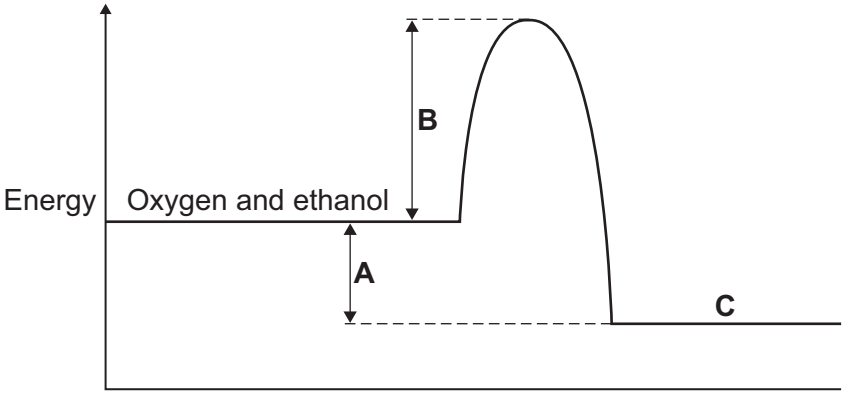
Question 22

3 V2 rockets were used during the Second World War.



V2 rockets were powered by liquid oxygen and ethanol. Oxygen and ethanol react to produce carbon dioxide and water.

The energy level diagram represents the energy changes during this reaction.



3 (a) On the energy level diagram what is represented by the letter:

A .....

B .....

C .....

(3 marks)

3 (b) What type of reaction is represented by this energy level diagram?

.....

.....

(1 mark)

4

4.7.2.3 Alcohols

Question 23

March 2011 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Alcohols have the general formula $C_nH_{2n+1}OH$
The OH group is known as the functional group for alcohols.
Alcohols with a value of 'n' less than 4 burn completely in air without producing any carbon particles.
Alcohols with a value of 'n' greater than 4 do not burn completely in air and produce carbon particles.

Some properties of alcohols are listed in the table.

'n' value of the alcohol	Melting point in ºC	Boiling point in ºC	Solubility in water
2	−117	79	Very soluble
4	−89	117	Soluble
6	−47	158	Slightly soluble
8	−17	195	Insoluble

6A Which of the following formulae represents the alcohol with a value of n = 4?

1 C_4H_5OH

2 C_4H_8OH

3 C_4H_9OH

4 $C_4H_{10}OH$

6B An alcohol has a value of n = 10.

Which row in the table shows the likely properties of this alcohol?

	Melting point in ºC	Boiling point in ºC	Solubility in water
1	10	230	Insoluble
2	−4	235	Slightly soluble
3	0	200	Insoluble
4	5	200	Slightly soluble

4.7.2.3 Alcohols

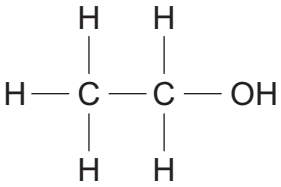
Question 23 · continued

March 2011 | CHY1AP | Original Q6 | Legacy

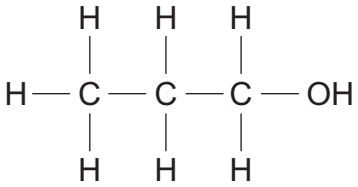
6C There are two possible structures for an alcohol with a value of n = 3.

Which are the two correct structures?

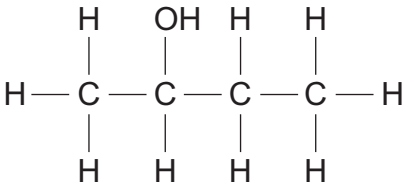
1



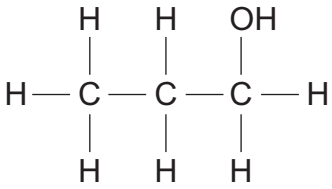
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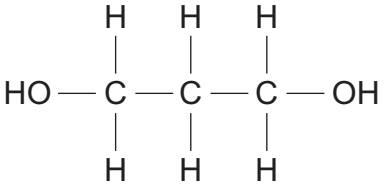
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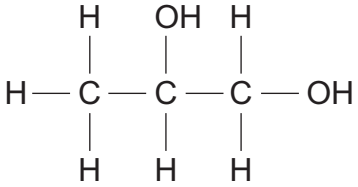
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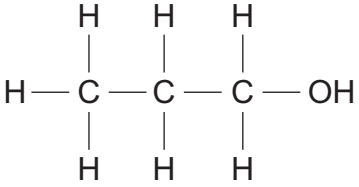
3



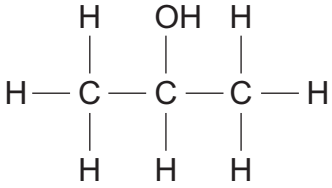
and



4



and



6D What are the likely products from burning in air an alcohol with a value of n = 8?

1 carbon dioxide and water only

2 carbon dioxide, carbon particles and water

3 carbon dioxide and carbon particles

4 carbon dioxide, sulfur dioxide and water

4.7.2.3 Alcohols

Question 24

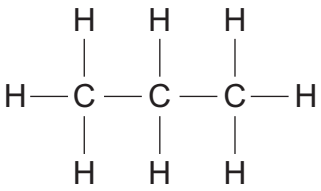
March 2011 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

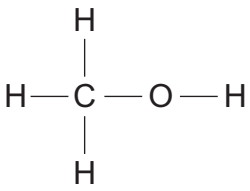
This question is about the formulae of four compounds.

Match formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

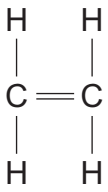
A



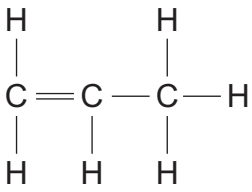
B



C



D



1	It is the alkene used to make ethanol.
2	It is a saturated hydrocarbon useful as a fuel.
3	It is not a hydrocarbon but burns to produce carbon dioxide and water vapour.
4	It belongs to the group with the general formula C_nH_{2n} where n = 3.

4.7.2.3 Alcohols

Question 25

June 2011 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

Crude oil is a mixture made up mainly of alkanes.

4A The alkanes are a series of hydrocarbons . . .

1 all of which are gases at room temperature (20 °C).

2 that have the general formula C_nH_{2n}.

3 in which the molecules have a carbon : hydrogen ratio of 1 : 4.

4 that are saturated.

Crude oil can be separated into fractions by fractional distillation.

4B In the fractionating column, the crude oil separates into fractions because . . .

1 the crude oil changes from a liquid into a vapour.

2 the alkanes condense at different temperatures.

3 the crude oil decomposes when it is heated.

4 the alkanes have different densities.

4C The petrol fraction has a boiling range from 40 °C to 70 °C.

The fraction does not have a fixed boiling point because it . . .

1 contains only one alkane.

2 contains several alkanes.

3 collects near the top of the column.

4 decomposes at 40 °C.

4D The petrol fraction is used as a fuel. Ethanol (C_2H_5OH), made from plant material, can be used as a fuel instead of petrol.

One advantage of ethanol over petrol is that ethanol . . .

1 does not produce carbon dioxide when it burns.

2 is a renewable fuel.

3 produces only water when it burns.

4 is a compound, not a mixture.

4.7.2.3 Alcohols

Question 26

June 2011 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

About 90 % of the world's supply of ethanol is produced by using yeast for the fermentation of sugars obtained from plants. A solution of about 8 % ethanol in water is obtained.
Ethanol can be used to produce ethene.

Reaction **P** shows carbon dioxide being removed from the atmosphere by plants to make sugar.
Reaction **Q** shows carbon dioxide being released by yeast into the atmosphere during respiration.
Reaction **R** shows the formation of ethene from ethanol.

Reaction **P** $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Reaction **Q** $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Reaction **R** $C_2H_5OH \rightarrow C_2H_4 + H_2O$

7A In these reactions, what is the net change in the number of molecules of carbon dioxide in the atmosphere during the production of one molecule of ethene?

1 1

2 2

3 4

4 6

Ethanol can also be produced by the reaction of ethene with steam.

This is a continuous process because the reactants flow steadily into the reactor and the ethanol flows out.

7B How is the ethene for this process obtained?

1 by fractional distillation of crude oil

2 by cracking fractions from crude oil

3 by polymerisation of crude oil

4 by vaporisation of crude oil

4.7.2.3 Alcohols

Question 26 · continued

7C An advantage of producing ethanol from ethene rather than by fermentation is that . . .

1 higher temperatures are required.

2 catalysts are used.

3 the ethanol is purer.

4 the reaction is slower.

7D It may be better to obtain ethene from biologically-produced ethanol rather than from crude oil.

One reason for this is that . . .

1 ethene can be produced in unlimited quantities.

2 crude oil is a non-renewable resource.

3 poly(ethene) made from biologically produced ethanol will be biodegradable.

4 the fermentation of sugar is done in batches, whereas production of ethene from crude oil is continuous.

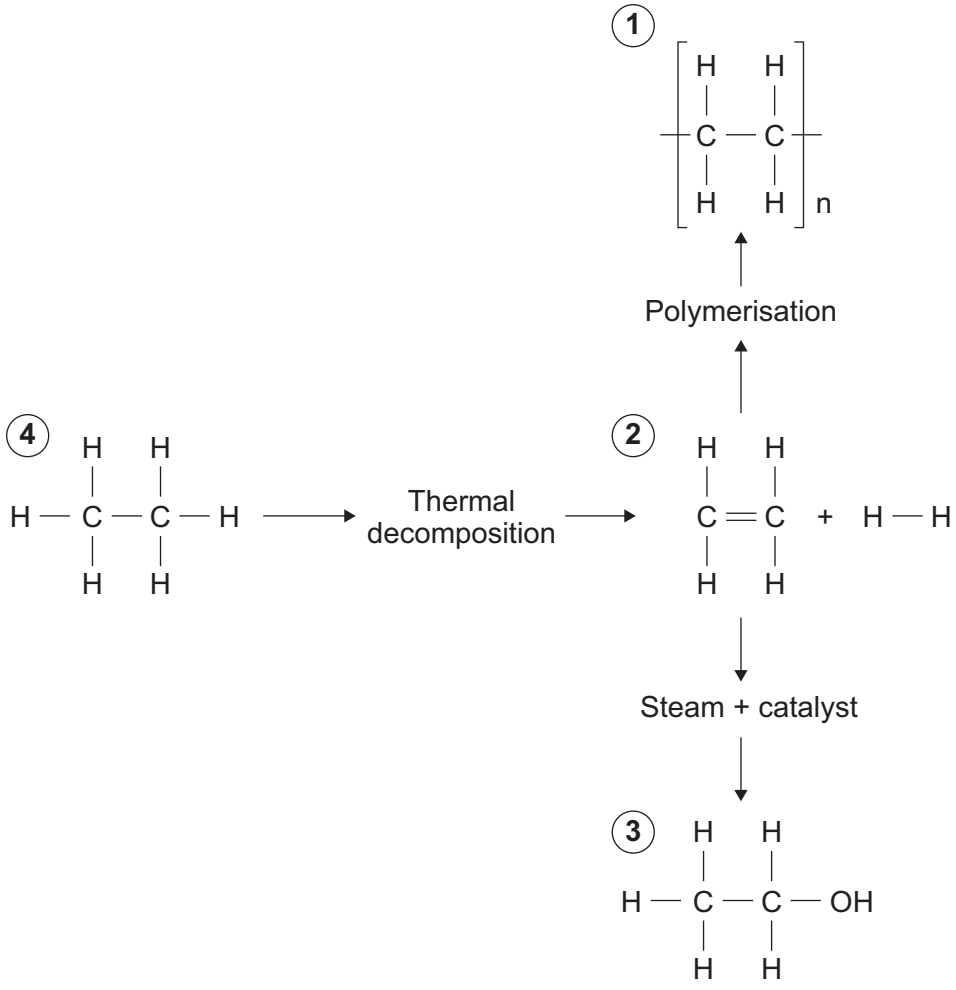
4.7.2.3 Alcohols

Question 27

November 2011 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

The flow chart shows a series of chemical reactions.



Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A Ethane

B Ethanol

C Ethene

D Poly(ethene)

4.7.2.3 Alcohols

Question 28

January 2012 | CH1HP | Original Q7 | Legacy

7 Ethene is used as a starting material for the production of many other substances, including ethanol.

7 (a) Ethene is produced when hydrocarbons are cracked. To do this hydrocarbons are heated to vaporise them. The vapours are then passed over a hot catalyst. The symbol equation shows the reaction for one hydrocarbon.

$$C_{28}H_{58} \rightarrow C_{11}H_{24} + C_{11}H_{22} + C_4H_8 + C_2H_4$$

7 (a) (i) One of the products is a different type of hydrocarbon to the other products.

Complete the sentences.

The formula of the product that is a different type of hydrocarbon is ..... .

The chemical structure of this product is different to the other products because

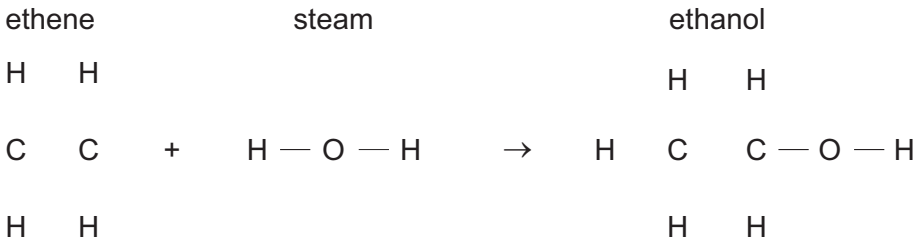
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(2 marks)

7 (a) (ii) Ethanol is produced when ethene reacts with steam in the presence of a hot catalyst.

Draw the missing bonds to complete the displayed structures in the equation.



(2 marks)

7 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

In 1970, the Brazilian Government had stated that all petrol must contain more than 25 % ethanol. The reasons for this statement in 1970 were:

- the oilfields in Brazil at that time only supplied 20 % of the crude oil needed to make petrol
- Brazil has a climate suitable for growing sugar cane.

To produce ethanol the sugar cane plants are crushed and soaked in water for one day. The sugar solution is separated from the plant material by filtration. Yeast is added to the sugar solution and fermented for three days. The yeast is separated from the solution of water and ethanol by filtration. Ethanol is separated from water by fractional distillation.

4.7.2.3 Alcohols

Question 28 · continued

In 2011, the Brazilian Government decided to reduce the amount of ethanol in petrol to 18%. The reasons were that in 2011:

- the demand for ethanol and the price of ethanol had greatly increased
- very large offshore oilfields had been discovered. These offshore oilfields would make Brazil one of the biggest crude oil producers in the world.

Use the information above and your own knowledge and understanding to evaluate whether Brazil should in future produce ethanol from crude oil or produce ethanol from sugar cane.

You should include environmental and economic or social factors in your evaluation.

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(6 marks)

10

4.7.2.3 Alcohols

Question 29

June 2012 | CH1HP | Original Q7 | Legacy

7 Ethanol (C_2H_5OH) is produced from ethene or from sugar cane.

The two different methods to produce ethanol are summarised in the table.

Ethanol from sugar cane is a batch process	Ethanol from crude oil is a continuous process
Sugar cane plants are crushed and soaked in water for one day.	Crude oil is distilled to separate the naphtha fraction.
The sugar solution is separated by filtration.	The naphtha fraction is cracked when the vaporised hydrocarbons are passed over a hot catalyst.
Yeast is added to the sugar solution and fermented for three days.	The ethene produced is separated by distillation.
The solution of water and ethanol produced is separated by filtration.	Ethene is reacted with steam in the presence of a catalyst.
Distillation of this solution produces a 50% solution of ethanol.	This hydration reaction produces 100% ethanol.

7 (a) Complete and balance an equation for the cracking of the hydrocarbon C_6H_{14} to produce ethene.

C_6H_{14} ⟶ ..... + ...

(2 marks)

7 (b) What is **seen** when the sugar solution and yeast are fermented?

.....

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(1 mark)

4.7.2.3 Alcohols

Question 29 · continued

7 (c) Evaluate the issues involved with the production of ethanol from sugar cane compared with the production of ethanol from crude oil.
You should explain why each issue you describe is important.

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(5 marks)

8

4.7.2.3 Alcohols

Question 30

January 2013 | CH1HP | Original Q6 | Legacy

6 Most petrol used in cars contains about 5% ethanol (C_2H_5OH).

6 (a) The complete combustion of ethanol produces carbon dioxide and water.

Complete and balance the symbol equation for the complete combustion of ethanol.

C_2H_5OH + ...O_2 → ..... + ...

(2 marks)

6 (b) Ethanol can be produced from octane (C_8H_{18}).
The two chemical equations represent the production of ethanol from octane.

Equation 1: $C_8H_{18} \rightarrow C_4H_{10} + 2C_2H_4$

Equation 2: $C_2H_4 + H_2O \rightarrow C_2H_5OH$

6 (b) (i) In **Equation 1** the products are a mixture of two gases.

Describe a chemical test that would indicate the presence of ethene (C_2H_4) in the mixture.

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(2 marks)

4.7.2.3 Alcohols

Question 30 · continued

6 (b) (ii) Describe, as fully as you can, the conditions used for the two reactions to produce ethanol from octane.

Use **Equation 1** and **Equation 2** to help you with your answer.

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(4 marks)

8

4.7.2.3 Alcohols

Question 31

June 2013 | CH1HP | Original Q7 | Legacy

7 There has been research into fuels for car engines.

Fuel	Content	Melting point in °C	Flashpoint in °C	Energy released in MJ per litre
Ethanol	C_2H_5OH	–114	+14	21.2
Diesel	hydrocarbons	About –24	+64	38.6
Petrol	hydrocarbons	About –57	–45	34.8
Rapeseed oil	fats	About +5	+130	32.8

The flashpoint is the lowest temperature a fuel vapour ignites in air.

7 (a) The melting point of ethanol is precise but the other melting points are approximate. Suggest why.

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(2 marks)

7 (b) Ethanol is produced by fermentation of sugar cane. Rapeseed oil is produced by pressing rapeseeds. Waste plant material from both processes is used to feed animals.

7 (b) (i) Describe how the process of fermentation is done.

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(2 marks)

7 (b) (ii) Carbon neutral fuels do **not** increase the amount of carbon dioxide in the atmosphere.

Suggest why using a biofuel, such as ethanol or rapeseed oil, is thought to be carbon neutral.

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(2 marks)

4.7.2.3 Alcohols

Question 31 · continued

7 (c) When any fuel from the table is used in a car engine, the exhaust gases contain nitrogen oxides.

Explain why.

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(2 marks)

7 (d) Evaluate replacing petrol with ethanol as a fuel for cars.

To gain full marks you should give a justified conclusion.

Use the information from the table and your knowledge to answer this question.

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(4 marks)

12

4.7.2.3 Alcohols

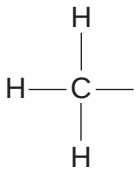
Question 32

June 2013 | CH3HP | Original Q2 | Legacy

2 This question is about organic compounds.

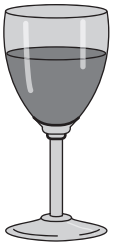
2 (a) Wine contains ethanol (CH_3CH_2OH).

2 (a) (i) Complete the displayed structure of ethanol.



(1 mark)

2 (a) (ii) Wine left in a glass for several days turns sour.
The sour taste is caused by ethanoic acid.



Complete the sentences.

The ethanoic acid is produced from a reaction between ethanol

and ..... .

This type of reaction is ..... .

(2 marks)

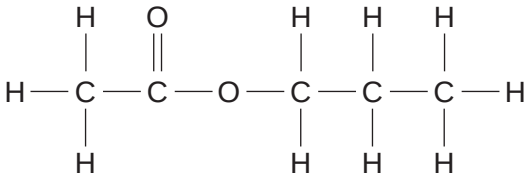
4.7.2.3 Alcohols

Question 32 · continued

2 (b) Propyl ethanoate, a fragrance, can be produced by reacting ethanoic acid with an alcohol.

Propyl ethanoate is a member of a series of organic compounds. The members of the series all have the same functional group.

The displayed structure of propyl ethanoate is:



2 (b) (i) Draw a ring around the functional group for this series on the displayed structure of propyl ethanoate.

(1 mark)

2 (b) (ii) Name the series of organic compounds with this functional group.

.....

(1 mark)

2 (b) (iii) The alcohol used to make propyl ethanoate has the formula $CH_3CH_2CH_2OH$

Name this alcohol.

.....

(1 mark)

6

4.7.2.3 Alcohols

Question 33

June 2014 | CH1HP | Original Q2 | Legacy

2 Ethanol and vegetable oil are used as fuels.

2 (a) There are two different ways to produce ethanol:

- using ethene from crude oil
- using sugar from plants.

2 (a) (i) Ethanol is produced from ethene by **hydration** in the presence of a catalyst.

What is **hydration**?

[1 mark]

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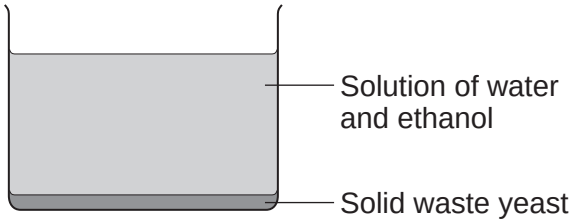
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2 (a) (ii) Fermentation is used to produce ethanol from sugar by:

- dissolving the sugar in water
- adding yeast to the sugar solution
- leaving the mixture for three days.

Figure 2 shows the substances after three days.

Figure 2



Suggest:

- how the solid waste yeast is removed
- how ethanol is obtained from the solution.

[2 marks]

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4.7.2.3 Alcohols

Question 33 · continued

2 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Crude oil is separated to produce the fraction petroleum diesel.

Worries about low supplies of crude oil have led to the growing of large areas of crops to produce vegetable oil.

Vegetable oils are used to produce biodiesel.

There are economic, ethical and environmental issues about the use of biodiesel.

Biodiesel and petroleum diesel are used as a fuel for cars. In a car engine the fuel burns and releases waste products through the car exhaust system.

Table 1 shows the amount of waste products formed by biodiesel compared with the amount of waste products formed by petroleum diesel.

(Note that ppm is parts per million.)

Table 1

	Carbon dioxide in ppm	Nitrogen oxides in ppm	Sulfur dioxide in ppm	Particulates in g per m^3
Biodiesel	20 000	760	0	0.3
Petroleum diesel	80 000	700	300	0.6

Use this information and your knowledge and understanding to give advantages and disadvantages of using biodiesel instead of petroleum diesel.

[6 marks]

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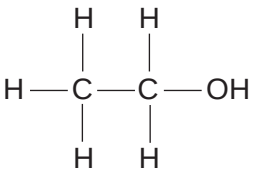
4.7.2.3 Alcohols

Question 34

June 2014 | CH3HP | Original Q2 | Legacy

2 (a) The structure of an alcohol is shown in **Figure 2**.

Figure 2



2 (a) (i) Draw a circle around the functional group in the structure of the alcohol.

[1 mark]

2 (a) (ii) What is the chemical name of this alcohol?

[1 mark]

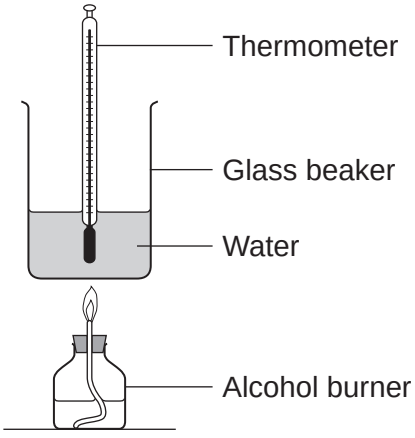
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2 (b) Alcohols are used as fuels.

A student plans an experiment to find the energy released per gram of alcohol burned.

The student uses the apparatus shown in **Figure 3**.

Figure 3



2 (b) (i) Suggest **two** ways that this apparatus could be improved to obtain accurate results.

[2 marks]

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4.7.2.3 Alcohols

Question 34 · continued

2 (b) (ii) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe how the student should do this experiment.

You should include any measurements the student should make.

Do **not** describe any improvements to the apparatus.

Do **not** describe how to do any calculations.

[6 marks]

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Extra space .....

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4.7.2.3 Alcohols

Question 35

June 2015 | CH3HP | Original Q5 | Legacy

5 This question is about organic compounds.

5 (a) Ethanol is an alcohol.
One use of ethanol is in alcoholic drinks.

Give **two** other uses of ethanol.

[2 marks]

.....

.....

5 (b) Which gas is produced when sodium reacts with ethanol?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide ☐

Carbon monoxide ☐

Hydrogen ☐

Oxygen ☐

5 (c) Ethanoic acid (CH_3COOH) can be produced from ethanol (CH_3CH_2OH).

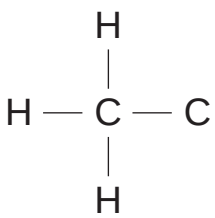
5 (c) (i) What type of reaction produces ethanoic acid from ethanol?

[1 mark]

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5 (c) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



4.7.2.3 Alcohols

Question 35 · continued

5 (c) (iii) Solutions of ethanoic acid and hydrochloric acid with the same concentration have different pH values.

Explain why the solution of ethanoic acid has a higher pH than the solution of hydrochloric acid.

[2 marks]

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5 (d) Ethanol and ethanoic acid react in the presence of a catalyst to form an ester.

5 (d) (i) Name the ester made from ethanol and ethanoic acid.

[1 mark]

.....

5 (d) (ii) What type of chemical is used as a catalyst in this reaction?

[1 mark]

.....

5 (d) (iii) Esters are used in perfumes because they smell pleasant and are volatile.

What does volatile mean?

[1 mark]

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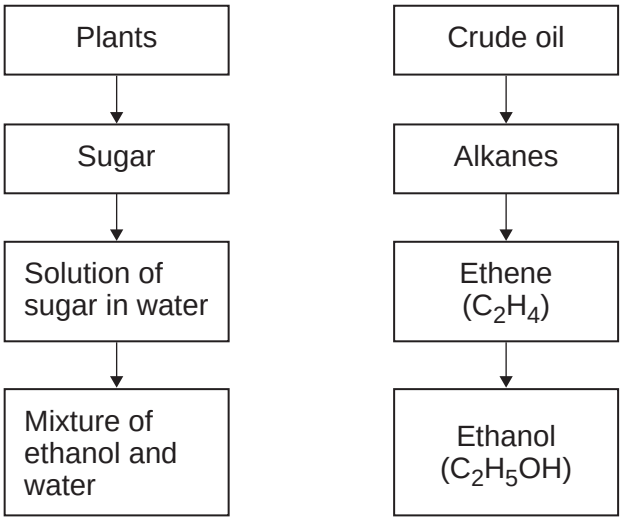
4.7.2.3 Alcohols

Question 36

June 2016 | CH1HP | Original Q4 | Legacy

4 Ethanol can be made from plants and from crude oil as shown in **Figure 6.**

Figure 6



4 (a) (i) Describe how the solution of sugar in water is used to produce the mixture of ethanol and water.

[2 marks]

4 (a) (ii) Describe how ethanol is produced from ethene.

[2 marks]

4.7.2.3 Alcohols

Question 36 · continued

4 (b) Explain **one** advantage and **one** disadvantage of using crude oil to make ethanol instead of using plants.

[4 marks]

4 (c) Ethanol has a boiling point of 78 °C.
Water has a boiling point of 100 °C.

Describe how distillation is used to separate a mixture of ethanol and water.

[3 marks]

11

4.7.2.3 Alcohols

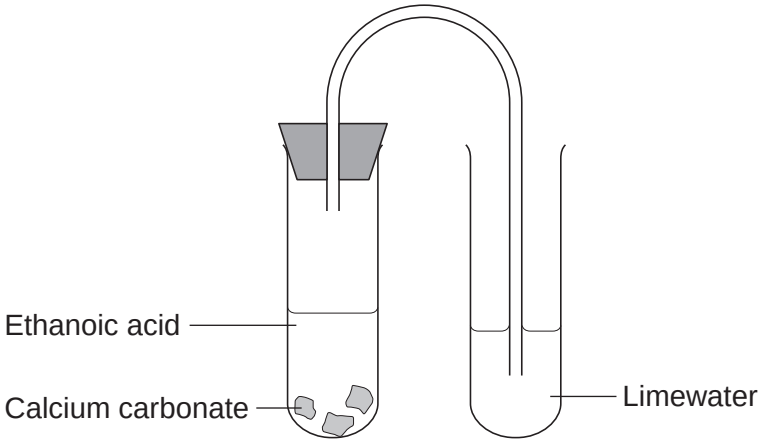
Question 37

June 2016 | CH3HP | Original Q1 | Legacy

1 This question is about reactions of ethanoic acid and the analysis of salts.

1 (a) **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.

Figure 1



1 (a) (i) Describe a change that would be seen in each test tube.

Give a reason for each change.

[4 marks]

Test tube 1 _____

_____

_____

_____

Test tube 2 _____

_____

_____

_____

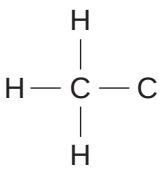
Question 1 continues on the next page

4.7.2.3 Alcohols

Question 37 · continued

1 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



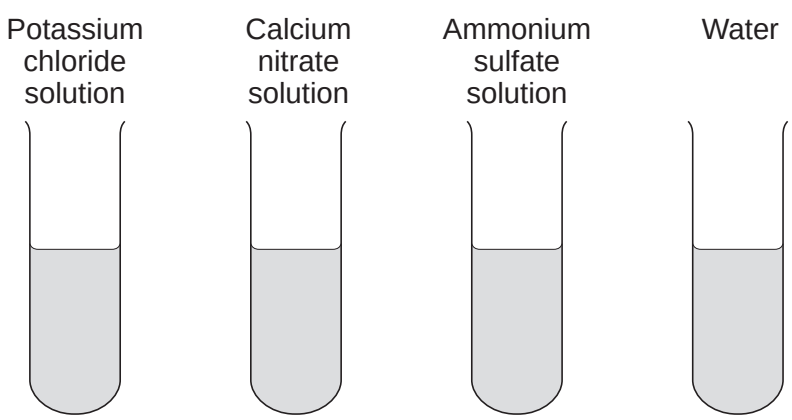
1 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

[2 marks]

Carboxylic acids react with alcohols in the presence of an _____ catalyst to produce pleasant-smelling compounds called _____ .

1 (b) **Figure 2** shows four test tubes containing three different salt solutions and water.

Figure 2



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

4.7.2.3 Alcohols

Question 37 · continued

Complete the table of results.

[2 marks]

	Potassium chloride solution	Calcium nitrate solution	Ammonium sulfate solution	Water
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

1 (c) Flame tests can be used to identify metal ions.

1 (c) (i) Complete the following sentences.

[2 marks]

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

1 (c) (ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

[1 mark]

_____

_____

_____

12

4.7.2.3 Alcohols

Question 38

June 2016 | CH3HP | Original Q5 | Legacy

5 This question is about energy changes in chemical reactions.

5 (a) Balance the chemical equation for the combustion of methane.

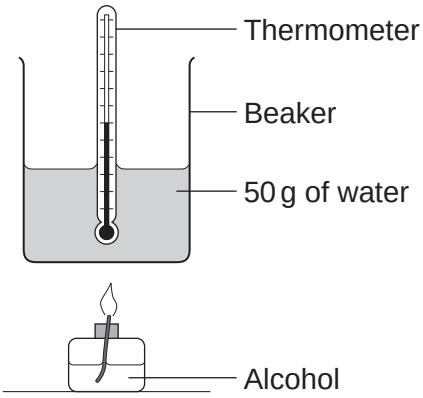
[1 mark]

$$CH_4 \quad + \quad O_2 \quad \longrightarrow \quad CO_2 \quad + \quad H_2O$$

5 (b) Alcohols are used as fuels.

A group of students investigated the amount of energy released when an alcohol was burned. The students used the apparatus shown in **Figure 5**.

Figure 5



In one experiment the temperature of 50 g of water increased from 22.0 °C to 38.4 °C. The mass of alcohol burned was 0.8 g.

Calculate the heat energy (Q) in joules, released by burning 0.8 g of the alcohol.
Use the equation:

$$Q = m \times c \times \Delta T$$

Specific heat capacity (c) = 4.2 J/g/°C

[3 marks]

Heat energy (Q) = _____ J

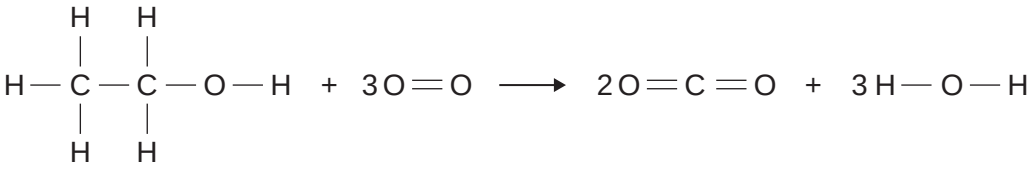
4.7.2.3 Alcohols

Question 38 · continued

5 (c) The chemical equation for the combustion of ethanol is:

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

5 (c) (i) The equation for the reaction can be shown as:



Bond	Bond energy in kJ per mole
C — H	413
C — C	347
C — O	358
C = O	799
O — H	467
O = O	495

Use the bond energies to calculate the overall energy change for this reaction.

[3 marks]

Overall energy change = _____ kJ per mole

Question 5 continues on the next page

4.7.2.3 Alcohols

Question 38 · continued

5 (c) (ii) The reaction is exothermic.
Explain why, in terms of bonds broken and bonds formed.

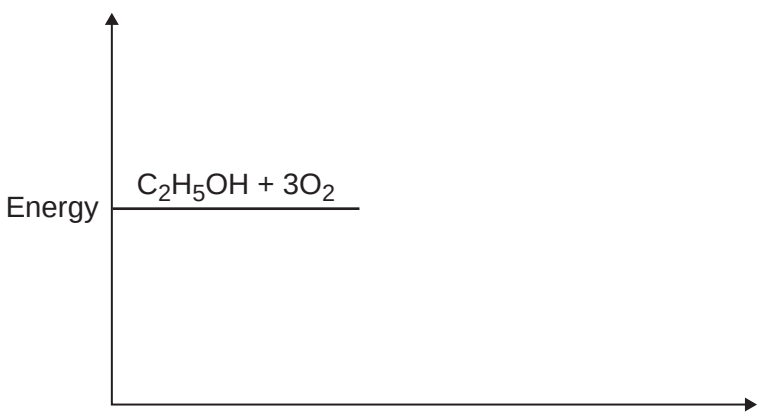
[2 marks]

5 (c) (iii) Complete the energy level diagram for the combustion of ethanol.

[3 marks]

On the completed diagram, label:

- activation energy
- overall energy change.



12

4.7.2.3 Alcohols

Question 39

June 2017 | CH3HP | Original Q2 | Legacy

2 This question is about the combustion of alcohols.

2 (a) What is the structure of methanol?

[1 mark]

Tick (✓) **one** box.

CH_3OH ☐

CH_3CH_2OH ☐

$CH_3CH_2CH_2OH$ ☐

$CH_3CH_2CH_2CH_2OH$ ☐

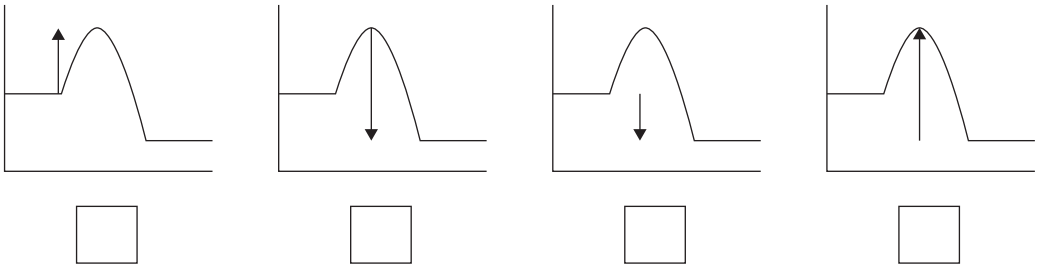
2 (b) **Figure 2** shows four energy level diagrams for the combustion of an alcohol.

Which diagram, **A**, **B**, **C**, or **D**, shows an arrow for the overall energy change?

[1 mark]

Tick (✓) **one** box.

Figure 2



☐ **A** ☐ **B** ☐ **C** ☐ **D**

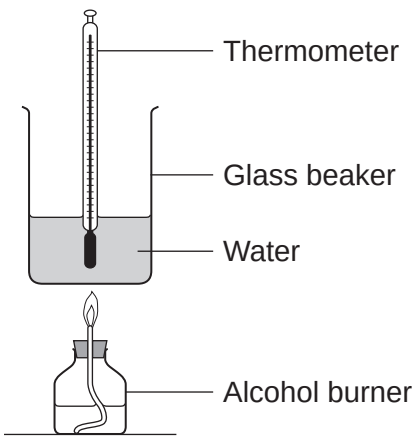
Question 2 continues on the next page

4.7.2.3 Alcohols

Question 39 · continued

2 (c) **Figure 3** shows apparatus used to measure the energy released when an alcohol is burned.

Figure 3



2 (c) (i) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate**.

Describe how a student could use the apparatus in **Figure 3** to compare the energy released when methanol and ethanol are burned.

You should include any measurements the student would need to make.

Do **not** describe how to do any calculations.

Do **not** describe any improvements to the apparatus.

[6 marks]

4.7.2.3 Alcohols

Question 39 · continued

Extra space

2 (c) (ii) The student calculated the energy released by the alcohols.

The calculated values were less than the values in a data book.

Explain how the apparatus in **Figure 3** could be improved to obtain more accurate results.

[2 marks]

10

4.7.2.3 Alcohols

Question 40

June 2018 | 8462/2H | Original Q2

0 2 Methylated spirit is a useful product made from a mixture of substances.

Table 1 shows the mass of the substances in a sample of methylated spirit.

Table 1

Substance	Mass in grams
Ethanol	265.5
Methanol	23.3
Pyridine	3.0
Methyl violet	1.5

0 2 . 1 What name is given to a useful product such as methylated spirit?

[1 mark]

0 2 . 2 Calculate the percentage by mass of methanol in methylated spirit.

Use **Table 1**.

[2 marks]

Percentage = _____ %

Question 2 continues on the next page

4.7.2.3 Alcohols

Question 40 · continued

Methylated spirit contains ethanol and is available cheaply.

Methylated spirit also contains:

- pyridine which has a very unpleasant smell
- methyl violet which makes the mixture purple.

0 2 . 3 Suggest why pyridine and methyl violet are added to ethanol to make methylated spirit.

[1 mark]

0 2 . 4 Suggest **one** use of methylated spirit.

[1 mark]

0 2 . 5 Describe how ethanol is produced from sugar solution.

Give the name of this process.

[3 marks]

4.7.2.3 Alcohols

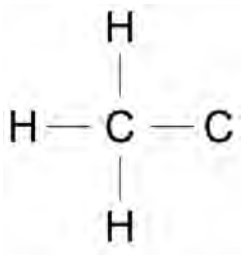
Question 40 · continued

0 2 . 6 **Figure 2** shows part of the displayed formula for ethanol.

Complete **Figure 2**.

[1 mark]

Figure 2



0 2 . 7 Name the gas produced when sodium is added to ethanol.

[1 mark]

0 2 . 8 Methanol is used to produce methanoic acid.

What type of substance reacts with methanol to produce methanoic acid?

[1 mark]

4.7.2.3 Alcohols

Question 41

June 2018 | 8462/2H | Original Q9

0 9 This question is about methanol.

0 9 . 1 Methanol is broken down in the body during digestion.

What type of substance acts as a catalyst in this process?

[1 mark]

Tick **one** box.

- Amino acid ☐
- Enzyme ☐
- Ester ☐
- Nucleotide ☐

In industry, methanol is produced by reacting carbon monoxide with hydrogen.

The equation for the reaction is:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

0 9 . 2 How many moles of carbon monoxide react completely with 4.0×10^3 moles of hydrogen?

[1 mark]

Tick **one** box.

- 1.0×10^3 moles ☐
- 2.0×10^3 moles ☐
- 4.0×10^3 moles ☐
- 8.0×10^3 moles ☐

4.7.2.3 Alcohols

Question 41 · continued

0 9 . 3 The reaction is carried out at a temperature of 250 ºC and a pressure of 100 atmospheres.

The forward reaction is exothermic.

Explain what happens to the yield of methanol if a temperature higher than 250 ºC is used.

[2 marks]

0 9 . 4 A pressure of 100 atmospheres is used instead of atmospheric pressure.

The higher pressure gives a greater yield of methanol **and** an increased rate of reaction.

Explain why.

[4 marks]

Question 9 continues on the next page

4.7.2.3 Alcohols

Question 41 · continued

A catalyst is used in the reaction to produce methanol from carbon monoxide and hydrogen.

0 9 . 5 Explain how a catalyst increases the rate of a reaction.

[2 marks]

0 9 . 6 Suggest why a catalyst is used in this industrial process.

Do **not** give answers in terms of increasing the rate of reaction.

[1 mark]

0 9 . 7 Suggest the effect of using the catalyst on the equilibrium yield of methanol.

[1 mark]

12

4.7.2.3 Alcohols

Question 42

November 2020 | 8462/2H | Original Q7

0 7 This question is about carboxylic acids.

Carboxylic acids belong to a homologous series.

Table 3 shows information about the first three carboxylic acids in this homologous series.

Table 3

Name	Formula	pH of a 0.01 mol/dm^3 solution
Methanoic acid		2.91
Ethanoic acid	CH_3COOH	3.39
	CH_3CH_2COOH	3.44

0 7 . 1 Complete **Table 3**.

[2 marks]

0 7 . 2 Ethanoic acid ionises in water.

The equation for the reaction is:

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$

Explain how the equation shows that ethanoic acid is a weak acid.

[2 marks]

4.7.2.3 Alcohols

Question 42 · continued

0 7 . 3 A student adds a solution of ethanoic acid to zinc carbonate in an open flask on a balance.

Explain what happens to the mass of the flask and its contents during the reaction.

[3 marks]

0 7 . 4 The student compares the rates of the reaction of zinc carbonate with:

- 0.01 mol/dm^3 methanoic acid
- 0.01 mol/dm^3 ethanoic acid.

The rate of the reaction with methanoic acid is greater than the rate of the reaction with ethanoic acid.

Explain why.

You should refer to ions in your answer.

Use **Table 3**.

[3 marks]

Question 42 · continued

Ethanoic acid reacts with ethanol to produce an ester.

0 7 . 5 Give the name of the ester produced when ethanoic acid reacts with ethanol.

[1 mark]

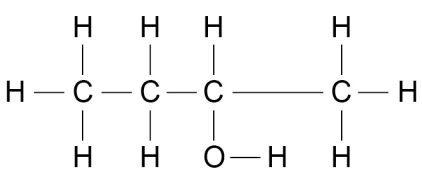
0 7 . 6 Hexanedioic acid and ethanediol join together to produce a polyester.

Ethanoic acid and ethanol join together in the same way to produce an ester.

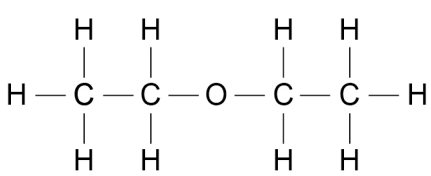
Which is the displayed structural formula of the ester produced when ethanoic acid reacts with ethanol?

[1 mark]

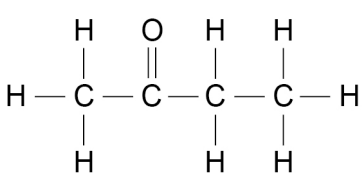
Tick (✓) **one** box.



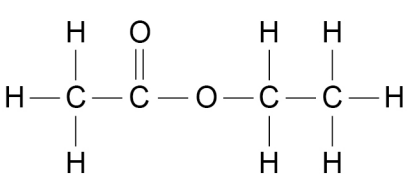
☐



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12

4.7.2.3 Alcohols

Question 43

November 2021 | 8462/2H | Original Q4

0 4 This question is about poly(ethene) and polyesters.

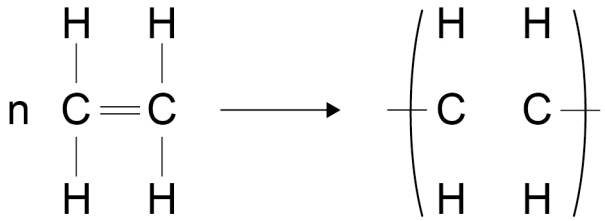
0 4 . 1 Poly(ethene) is produced from ethene.

Figure 3 shows part of the displayed structural formula equation for the reaction.

Complete **Figure 3**.

[2 marks]

Figure 3



0 4 . 2 Poly(ethene) is a thermosoftening polymer.

Suggest why poly(ethene) is easier to recycle than thermosetting polymers.

[2 marks]

0 4 . 3 Ethene produces different forms of poly(ethene).

How can different forms of poly(ethene) be produced from ethene?

[1 mark]

4.7.2.3 Alcohols

Question 43 · continued

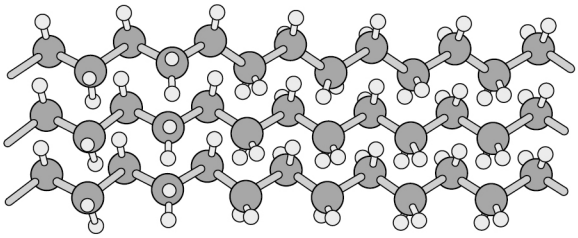
0 4 . 4 Two different forms of poly(ethene) are:

- high density poly(ethene) (HDPE)
- low density poly(ethene) (LDPE).

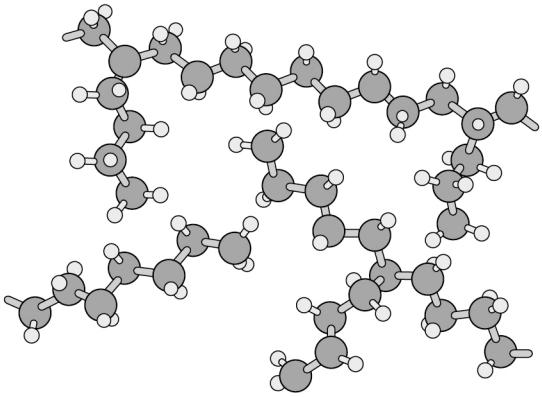
Figure 4 represents part of the structures of HDPE and LDPE.

Figure 4

HDPE



LDPE



Explain why HDPE has a higher density than LDPE.

[2 marks]

Question 4 continues on the next page.

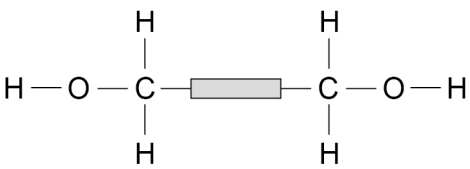
4.7.2.3 Alcohols

Question 43 · continued

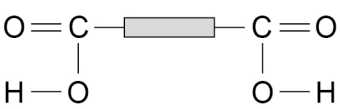
Figure 5 shows three monomers, **A**, **B** and **C**.

Monomer **A** can react with monomer **B** and with monomer **C** to produce polyesters.

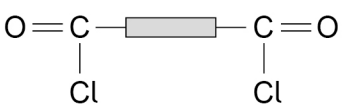
Figure 5



Monomer **A**



Monomer **B**



Monomer **C**

0 4 . 5 Draw a circle on **Figure 5** around an alcohol functional group.

[1 mark]

0 4 . 6 Complete **Table 2** to show the formula of the small molecule produced when:

- monomer **A** reacts with monomer **B**
- monomer **A** reacts with monomer **C**.

[1 mark]

Table 2

Reacting monomers	Formula of small molecule produced
A and **B**	
A and **C**	

9

4.7.2.3 Alcohols

Question 44

November 2021 | 8462/2H | Original Q10

1 0 This question is about alkenes and alcohols.

Ethene is an alkene produced from large hydrocarbon molecules.

Large hydrocarbon molecules are obtained from crude oil by fractional distillation.

1 0 . 1 Name the process used to produce ethene from large hydrocarbon molecules.

[1 mark]

1 0 . 2 Describe the conditions used to produce ethene from large hydrocarbon molecules.

[2 marks]

4.7.2.3 Alcohols

Question 44 · continued

1 0 . 3 Ethanol can be produced from ethene and steam.

The equation for the reaction is:

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

The forward reaction is exothermic.

Explain how the conditions for this reaction should be chosen to produce ethanol as economically as possible.

[6 marks]

4.7.2.3 Alcohols

Question 44 · continued

10.4 Ethanol can also be produced from sugar solution by adding yeast.

Name this process.

[1 mark]

10.5 Butanol can be produced from sugar solution by adding bacteria.

Sugar solution is broken down in similar ways by bacteria and by yeast.

Suggest the reaction conditions needed to produce butanol from sugar solution by adding bacteria.

[2 marks]

4.7.2.3 Alcohols

Question 44 · continued

Ethanol and butanol can be used as fuels for cars.

10.6 A car needs an average of 1.95 kJ of energy to travel 1 m

Ethanol has an energy content of 1300 kilojoules per mole (kJ/mol).

Calculate the number of moles of ethanol needed by the car to travel 200 km

[3 marks]

Number of moles = _____ mol

10.7 When butanol is burned in a car engine, complete combustion takes place.

Write a balanced equation for the complete combustion of butanol.

You do **not** need to include state symbols.

[2 marks]

17

4.7.2.3 Alcohols

Question 45

June 2023 | 8462/2H | Original Q2

0 2 This question is about alcohols and carboxylic acids.

Alcohols are used as fuels.

A student burned 1.00 g of six alcohols and determined the energy released from each.

Table 2 shows the results.

Table 2

Alcohol	Formula of one molecule of the alcohol	Energy released in kJ/g
Ethanol	C_2H_5OH	29.6
Propanol	C_3H_7OH	33.6
Butanol	C_4H_9OH	36.1
Pentanol	$C_5H_{11}OH$	37.7
Hexanol	$C_6H_{13}OH$	38.9
Heptanol	$C_7H_{15}OH$	39.8

0 2 . 1 Calculate the mass of ethanol that must be burned to release the same amount of energy as burning 1.00 g of heptanol.

[2 marks]

Mass = _____ g

0 2 . 2 The energy released in kJ/g varies with the number of carbon atoms in one molecule of each alcohol.

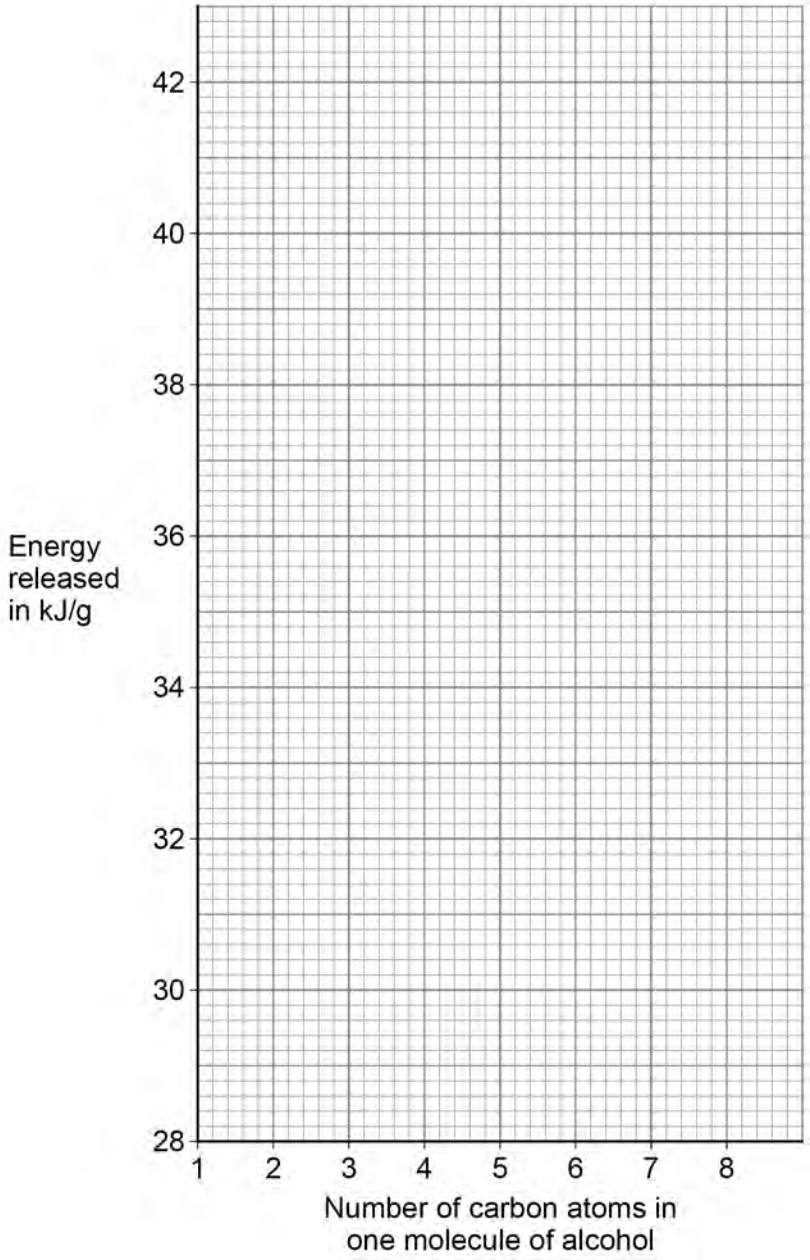
Plot the data from **Table 2** on **Figure 2**.

[2 marks]

4.7.2.3 Alcohols

Question 45 · continued

Figure 2



0 2 . 3 Estimate the energy released in kJ when 1.00 g of octanol ($C_8H_{17}OH$) is burned.

Use **Figure 2**.

[1 mark]

Energy released = _____ kJ

4.7.2.3 Alcohols

Question 45 · continued

Carbon dioxide is produced when alcohols are burned.

Carbon dioxide is identified by bubbling the gas through limewater.

0 2 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

calcium chloride	**calcium hydroxide**	**calcium nitrate**	**calcium sulfate**

Limewater is an aqueous solution of _____.

0 2 . 5 Give the result of the test when carbon dioxide is bubbled through limewater.

[1 mark]

_____

_____

4.7.2.3 Alcohols

Question 45 · continued

Ethanoic acid can be produced from ethanol.

0 2 . 6 What is reacted with ethanol to produce ethanoic acid?

[1 mark]

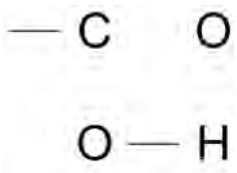
Tick (✓) **one** box.

- A halogen ☐
- An alkali metal ☐
- An oxidising agent ☐
- Water ☐

0 2 . 7 Ethanoic acid contains the functional group –COOH

Complete the displayed structural formula of this functional group.

[1 mark]



Question 2 continues on the next page

4.7.2.3 Alcohols

Question 45 · continued

0 2 . 8 Ethanoic acid reacts with different compounds.

Draw **one** line from each compound to a product of the reaction of the compound with ethanoic acid.

[2 marks]

Compound	Product of the reaction with ethanoic acid
Ethanol	Carbon dioxide
Sodium carbonate	Ethene
	Ethyl ethanoate
	Hydrogen
	Poly(ethene)

11

4.7.2.3 Alcohols

Question 46

June 2025 | 8462/1H | Original Q9

0 9 Zinc reacts with iodine to produce the salt zinc iodide.

The reaction is done in a solution using ethanol as the solvent.

Ethanol is a flammable liquid with a boiling point of 78 °C.

Table 5 shows the solubility of zinc, iodine and zinc iodide in ethanol.

Table 5

	Zinc	Iodine	Zinc iodide
Solubility in ethanol	Insoluble	Soluble	Soluble

0 9 . 1 Plan a method to obtain crystals of zinc iodide from zinc and iodine.

[6 marks]

Extra space

4.7.2.3 Alcohols

Question 46 · continued

0 9 . 2 A student used 6.35 g of iodine in the reaction.

6.29 g of zinc iodide was produced.

The equation for the reaction is:

$$Zn + I_2 \longrightarrow ZnI_2$$

Calculate the percentage yield of zinc iodide.

Give your answer to 3 significant figures.

Relative formula masses (M_r): $I_2 = 254$ $ZnI_2 = 319$

[5 marks]

Percentage yield (3 significant figures) = _____ %

11