AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.1.2

Mixtures

Past-paper questions

Tier	**Higher**
Question groups	**142**
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.

4.1.1.2 Mixtures

Question 01

January 2007 | CHY1H | Original Q5 | Legacy

5 Crude oil is a mixture of mostly alkanes.

(a) Crude oil is separated into useful fractions by fractional distillation.

(i) Describe and explain how the mixture of alkanes is separated by fractional distillation.

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.....

.....

(3 marks)

(ii) The table gives the name and formula for each of the first three alkanes.

Complete the table to show the formula of butane.

Name of alkane	Formula
Methane	CH_4
Ethane	C_2H_6
Propane	C_3H_8
Butane	

(1 mark)

4.1.1.2 Mixtures

Question 01 · continued

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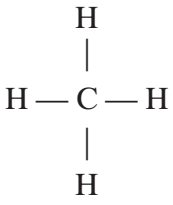
(b) The structural formula of methane, CH_4, is:



Draw the structural formula of propane, C_3H_8

(1 mark)

Question 5 continues on the next page

Question 01 · continued

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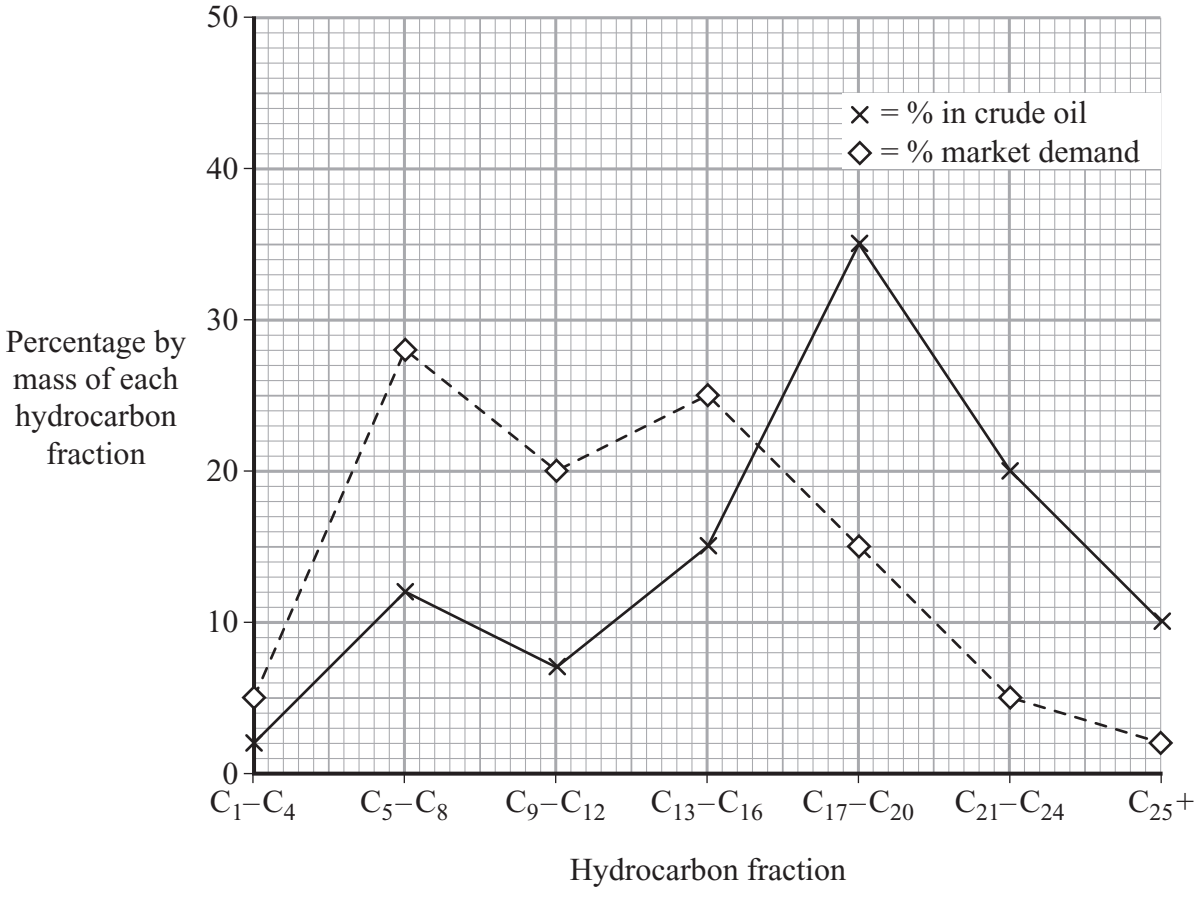
(c) The relative amounts of and the market demand for some hydrocarbons from the fractional distillation of crude oil are shown in the graph.



(i) Why is the market demand for the $C_5–C_8$ fraction higher than the market demand for the $C_{21}–C_{24}$ fraction?

.....

.....

(1 mark)

(ii) Cracking is used to break down large hydrocarbon molecules into smaller hydrocarbon molecules.

Complete the symbol equation by writing in the formula of the other hydrocarbon.

$C_{20}H_{42} \rightarrow C_{16}H_{34} + 2$ .....

(1 mark)

4.1.1.2 Mixtures

Question 01 · continued

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(iii) The C_5-C_8 fraction has low supply and high market demand.

Suggest **three** ways in which the oil industry could overcome this problem.

1 .....

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2 .....

.....

3 .....

.....

(3 marks)

10

4.1.1.2 Mixtures

Question 02

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

4.1.1.2 Mixtures

Question 02 · continued

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.

4.1.1.2 Mixtures

Question 03

March 2007 | CHY1A | Original Q7 | Legacy

QUESTION SEVEN

In the engine cylinders of petrol-driven cars, a mixture of petrol and air is ignited.

- Petrol consists mainly of alkanes in the $C_5 - C_{10}$ range.
- Air consists of nitrogen (79 %), oxygen (20 %) and small amounts of other gases.

The petrol/air mixture is ignited by an electrical spark causing an explosive reaction to drive the pistons in the cylinders.

Some of the elements in the petrol/air mixture combine with oxygen at the very high temperatures reached.

Modern engines are very efficient but are still not capable of complete combustion. The gases produced during combustion are released as exhaust gases.

The table shows some of the exhaust gases from a typical petrol engine.

Gas	Percentage
carbon dioxide	15.0
carbon monoxide	1.0
oxygen	0.7
hydrocarbons	0.05
nitrogen oxides	0.2
sulfur dioxide	0.007

7A The gases in the table make up less than 20 % of the exhaust gases.

Which substance will make up most of the remainder of the exhaust gases?

1 hydrogen

2 methane

3 nitrogen

4 water vapour

4.1.1.2 Mixtures

7B One piece of evidence that suggests there is incomplete combustion is . . .

1 the high percentage of carbon dioxide.

2 the presence of carbon monoxide.

3 the presence of nitrogen oxides.

4 the low percentage of sulfur dioxide.

Nitrogen oxides are acidic oxides.
The equation shows how nitrogen monoxide is formed in the cylinders.

$$N_2 + O_2 \rightarrow 2NO$$

7C Nitrogen monoxide reacts with more oxygen to produce nitrogen dioxide.

Which is the correct equation for this reaction?

1 $N_2 + O_2 \rightarrow NO_2$

2 $NO + O_2 \rightarrow NO_2$

3 $2NO + O_2 \rightarrow 2NO_2$

4 $2NO + 2O_2 \rightarrow 2NO_2$

7D Why is it important to remove nitrogen oxides from the exhaust gases?

1 They are brown gases.

2 They can cause global dimming.

3 They can cause acid rain.

4 They cause carbon deposits in the exhaust pipe.

4.1.1.2 Mixtures

Question 04

March 2007 | CHY1A | Original Q8 | Legacy

QUESTION EIGHT

This question is about crude oil.
Crude oil is separated into fractions by fractional distillation.

8A In the fractionating column, the crude oil separates into fractions because . . .

1 it evaporates.

2 the vapour condenses at 100 °C.

3 the vapour condenses at different temperatures.

4 thermal decomposition occurs.

8B Fractional distillation is possible because the hydrocarbons in the crude oil have . . .

1 different boiling points.

2 different chemical properties.

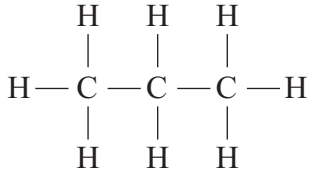
3 exactly the same boiling points.

4 the same ignition temperature.

The simplest alkane in crude oil is methane, CH_4
Another alkane is propane, C_3H_8

8C A molecule of propane can be represented by . . .

1



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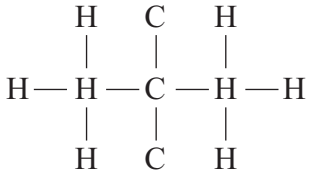

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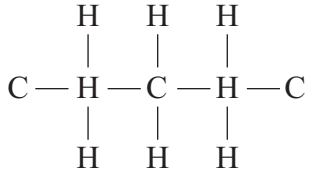

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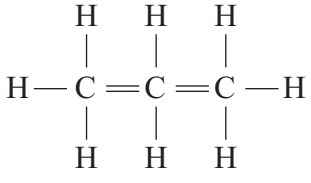


4.1.1.2 Mixtures

8D Compared with methane, propane will . . .

1 ignite more easily.

2 boil at a lower temperature.

3 have a higher boiling point.

4 be less saturated.

Turn over for the next question

4.1.1.2 Mixtures

Question 05

March 2007 | CHY1B | Original Q3 | Legacy

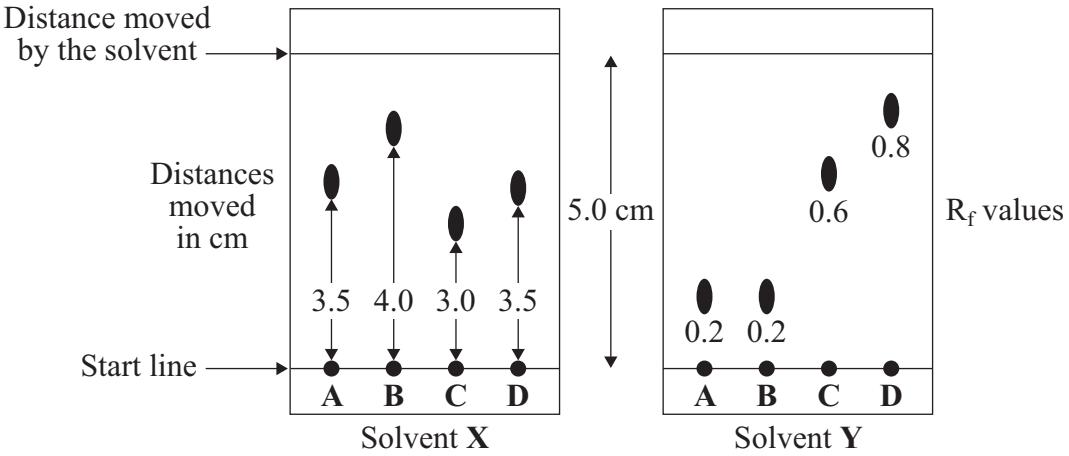
QUESTION THREE

In chromatography, substances can be identified by their R_f value.

The R_f value can be calculated using the formula:

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent}}$$

The R_f value for a substance is different in different solvents.



Four red substances, **A**, **B**, **C** and **D**, were tested. The test was done using two different solvents, **X** and **Y**.

For solvent **X**, the distances the substances moved and the distance the solvent moved are shown (in cm). For solvent **Y**, the R_f values are shown.

3A What is the R_f value of substance **B** in solvent **X**?

1 0.6

2 0.7

3 0.8

4.1.1.2 Mixtures

Question 05 · continued

3B Which statement is true?

1 Substances **A** and **B** are the same.

2 Substances **A** and **D** are the same.

3 Substances **B** and **D** are the same.

4 The four substances are different.

3C Which statement about chromotography is true?

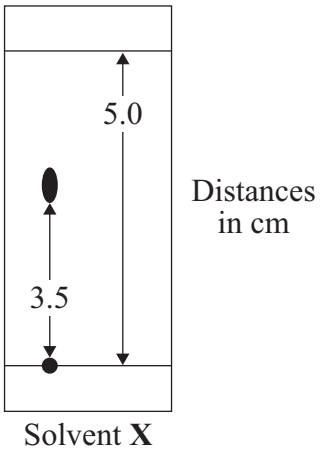
1 Chromatography works only on added artificial colouring.

2 Chromatography works only on added natural colouring.

3 Chromatography works only on natural colouring already in the food.

4 Chromatography works on any soluble colouring.

3D A red substance was tested. The chromatography strip using solvent **X** is shown.



The R_f value in solvent **Y** is 0.2.

Which statement is true?

1 The red substance could be **A**.

2 The red substance could be **B**.

3 The red substance could be **C**.

4 The red substance could be **D**.

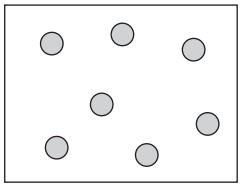
4.1.1.2 Mixtures

Question 06

June 2007 | CHY1A | Original Q2 | Legacy

QUESTION TWO

The diagrams show the atoms in four different substances.



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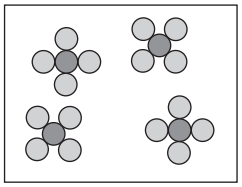

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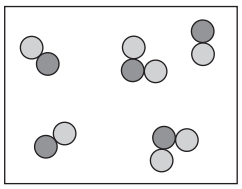

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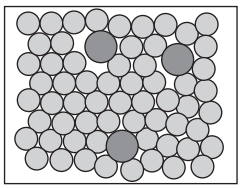


4

Match the substances, **A**, **B**, **C** and **D**, with the diagrams **1–4**.

A an alloy

B an element

C a hydrocarbon

D a mixture of compounds

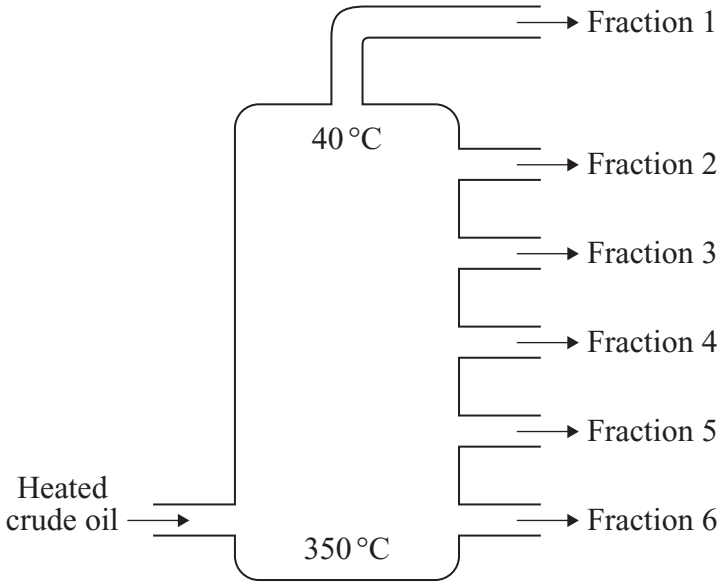
4.1.1.2 Mixtures

Question 07

June 2007 | CHY1A | Original Q6 | Legacy

QUESTION SIX

In a fractionating column, crude oil is separated into a number of fractions.



6A Crude oil can be separated into fractions in this way because . . .

1 it contains liquid and gaseous hydrocarbons.

2 it vaporises at about 350 °C.

3 it is a mixture of only two elements.

4 it is a mixture of hydrocarbons.

6B Each fraction has a range of boiling points because . . .

1 a hydrocarbon does not have a fixed boiling point.

2 not all fractions contain the same number of hydrocarbons.

3 not all fractions contain solid hydrocarbons.

4 each fraction is a mixture of hydrocarbons.

4.1.1.2 Mixtures

6C Which row in the table correctly describes the hydrocarbons in Fraction 1?

1	molecules are large	ignite with difficulty
2	liquids at room temperature	ignite easily
3	molecules are small	ignite easily
4	molecules are small	ignite with difficulty

6D Which of these compounds will make up the largest percentage of Fraction 1?

1 C_2H_4

2 C_3H_6

3 C_3H_8

4 $C_{12}H_{26}$

Turn over for the next question

4.1.1.2 Mixtures

Question 08

June 2007 | CHY1A | Original Q8 | Legacy

QUESTION EIGHT

Exhaust fumes from petrol-driven cars contain harmful gases, particularly acidic nitrogen oxide, poisonous carbon monoxide and unburned hydrocarbons.

Catalytic converters are fitted to these cars to help to reduce the quantities of these gases released into the atmosphere. The reaction in the converter can be summarised by this equation:

carbon monoxide + nitrogen oxide → carbon dioxide + nitrogen

The catalysts in the converters usually contain a mixture of two transition metals, platinum and rhodium.

These metals occur in the Earth's crust mainly with copper and nickel sulfide ores.
To extract the metals, the ores are roasted in air which produces sulfur dioxide.

8A The balanced, symbol equation for the reaction between carbon monoxide and nitrogen oxide is . . .

1 $2CO + 2NO \rightarrow 2CO_2 + N_2$

2 $CO + NO \rightarrow CO_2 + N_2$

3 $2CO + 2NO \rightarrow CO_2 + N_2$

4 $2CO + 2NO \rightarrow CO_2 + 2N_2$

8B Which substance is reduced in this reaction?

1 carbon monoxide

2 carbon dioxide

3 nitrogen oxide

4 nitrogen

8C Why do some environmental organisations question the benefits of catalytic converters?

1 They are expensive to manufacture and make cars more expensive.

2 Polluting gases are released both in producing them and in using them.

3 They do not remove any of the harmful gases from the exhaust fumes.

4 Nitrogen is a poisonous gas.

4.1.1.2 Mixtures

8D What conclusion about the use of catalytic converters can safely be made from the information in this question?

1 Transition metals are good conductors of heat and electricity.

2 There are no harmful gases in the exhaust fumes from a car fitted with a catalytic converter.

3 A catalytic converter reduces the amount of carbon monoxide in the exhaust fumes from a petrol-driven car.

4 Catalytic converters work equally well in both diesel-driven and petrol-driven cars.

Turn over for the next question

4.1.1.2 Mixtures

Question 09

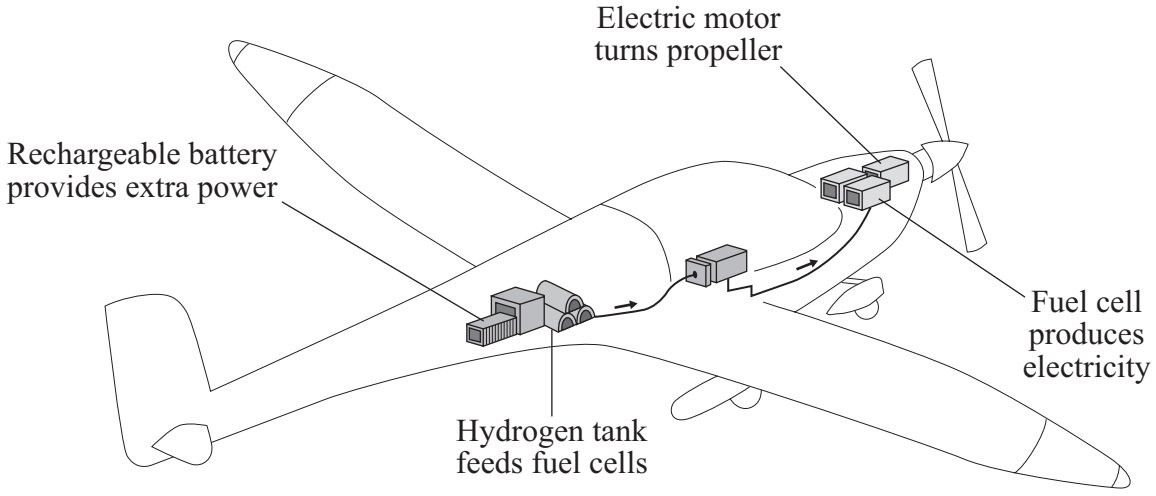
June 2007 | CHY1A | Original Q9 | Legacy

QUESTION NINE

This information is an edited newspaper article about aircraft research.

Greening the skies

'Emission-free aircraft'



Conventional aircraft use very large volumes of kerosene fuel which is a mixture of hydrocarbons. Research is being carried out into the use of hydrogen as a fuel.

In the fuel cell, hydrogen is chemically combined with oxygen to produce electricity, to drive a motor which turns the propeller. Fuel cells are bulky and expensive but have no moving parts and run silently.

Most commercially produced hydrogen is obtained from natural gas, and carbon dioxide is generated as a by-product. It has been called 'black hydrogen' by some groups.

As an aircraft fuel, mass for mass, hydrogen will deliver about three times as much energy as kerosene; however, the volume of the hydrogen is much greater.

One problem with kerosene fuel is that aircraft sometimes have to dump large volumes of fuel, if, for example, they are turned back to the take-off airport.

4.1.1.2 Mixtures

9A There are several reasons why this research is being carried out.

Which of the following is **not** one of those reasons?

1 There could be a shortage of kerosene in the future.

2 There is political pressure to reduce air travel.

3 Kerosene is obtained from a non-renewable source.

4 There is political pressure to reduce emission of gases which may cause global warming.

9B In this article, 'emission free' means . . .

1 there are no waste products when hydrogen is used in a fuel cell.

2 the fuel cell only produces carbon dioxide and water as waste.

3 there are no harmful gases produced by the fuel cell.

4 the fuel cell reduces noise pollution from aircraft.

9C One reason why some groups refer to the commercially produced hydrogen as 'black hydrogen' is that . . .

1 the hydrogen is impure.

2 the hydrogen is made from a fossil fuel.

3 the hydrogen burns to produce more carbon dioxide.

4 sulfur dioxide is a by-product of the process.

9D Even if hydrogen-powered aircraft are used commercially in the future, there will probably still be pressure groups against increased air travel.

One reason for objection to increased air travel could be that . . .

1 hydrogen-powered aircraft are too noisy.

2 hydrogen is a dangerous fuel to use in an aircraft.

3 agricultural land will be lost to the building of new runways.

4 dumping large volumes of hydrogen is dangerous.

END OF TEST

4.1.1.2 Mixtures

Question 10

June 2007 | CHY1B | Original Q7 | Legacy

QUESTION SEVEN

A compound, C_4H_{10}, was decomposed by passing it over a hot catalyst.

Analysis showed the product to be a mixture of two different hydrocarbons, hydrocarbon **A** (an alkane) and hydrocarbon **B**.
Both hydrocarbon **A** and hydrocarbon **B** had two carbon atoms in each molecule.

7A Which row in the table shows the correct formulae for these two hydrocarbons?

	Hydrocarbon A	Hydrocarbon B
1	C_2H_6	C_2H_4
2	C_2H_2	C_2H_8
3	C_2H_4	C_2H_6
4	C_2H_5	C_2H_5

7B The boiling point of hydrocarbon **A** is –89 °C and that of hydrocarbon **B** is –104 °C.

They could probably be separated and collected by . . .

1 thermal decomposition.

2 cracking.

3 condensation.

4 polymerisation.

7C Each of the two hydrocarbons was tested with bromine water.

Which row in the table correctly shows what happens to the bromine water?

	With hydrocarbon A	With hydrocarbon B
1	turns green	turns colourless
2	turns colourless	stays yellow-brown
3	stays yellow-brown	turns colourless
4	stays yellow-brown	turns green

4.1.1.2 Mixtures

7D Of these two hydrocarbons, only hydrocarbon **B** can form polymers.

This is because . . .

1 it has a higher boiling point.

2 its molecule has a double carbon carbon bond.

3 its molecule is saturated.

4 it has smaller molecules.

Turn over for the next question

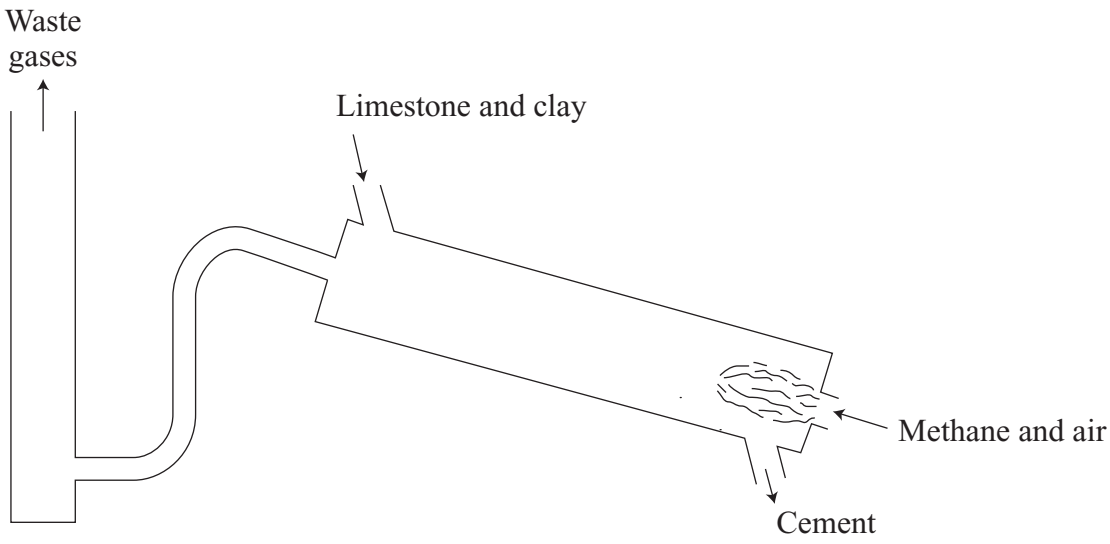
4.1.1.2 Mixtures

Question 11

June 2007 | CHY1H | Original Q1 | Legacy

1 Limestone contains the compound calcium carbonate, $CaCO_3$.

(a) Limestone is used to make cement in a rotary kiln.



Use the information in the diagram to name the **two** main waste gases from this rotary kiln.

1 .....

2 .....

(2 marks)

4.1.1.2 Mixtures

Question 11 · continued

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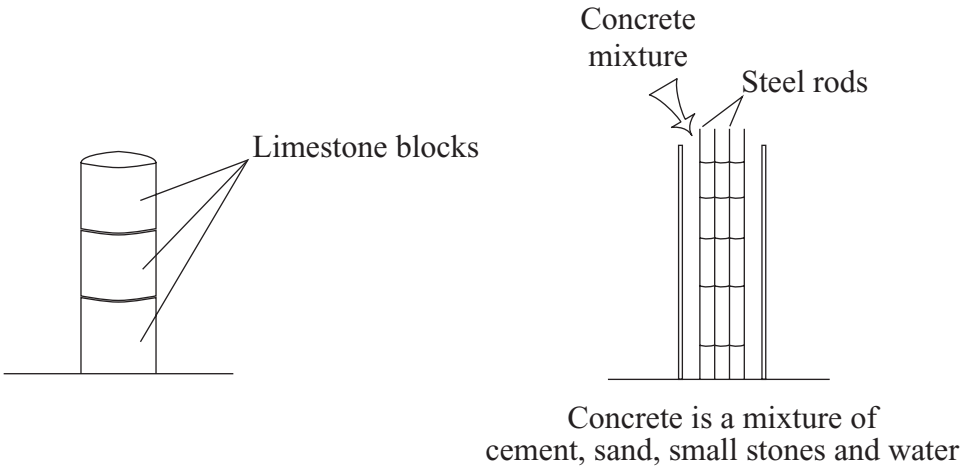
(b) Columns used as supports for buildings can be made from materials such as limestone blocks or concrete.



Concrete is a mixture of cement, sand, small stones and water

From the diagrams, name which you think is the better material for making a column.

.....

Give **three** advantages for your choice of material.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5

4.1.1.2 Mixtures

Question 12

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)

4.1.1.2 Mixtures

Question 12 · 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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.....

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.....

.....

(4 marks)

10

4.1.1.2 Mixtures

Question 13

November 2007 | CHY1A | Original Q1 | Legacy

QUESTION ONE

This question is about fractional distillation of crude oil.

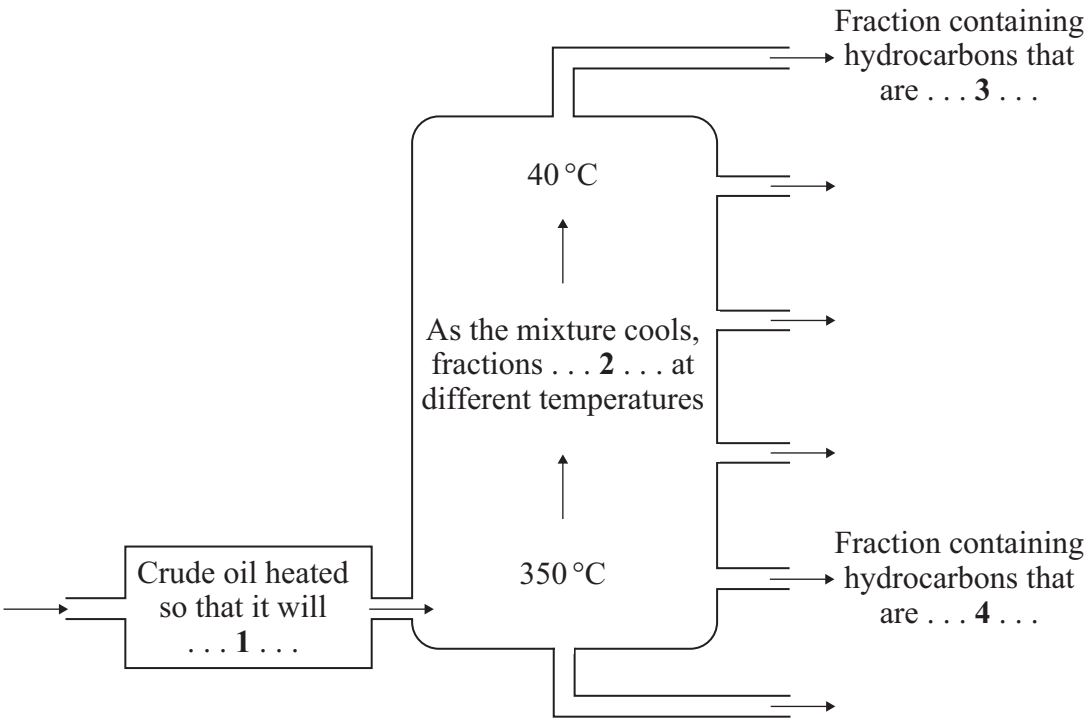
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences on the diagram.

A condense

B vaporise

C viscous

D volatile



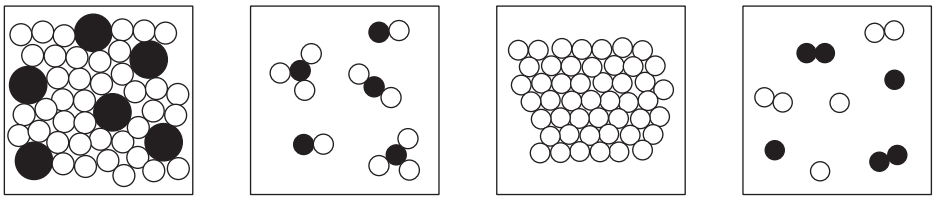
4.1.1.2 Mixtures

Question 14

November 2007 | CHY1A | Original Q2 | Legacy

QUESTION TWO

The diagrams show the atoms in four substances.



1 2 3 4

Match words, **A**, **B**, **C** and **D**, with the diagrams **1–4**.

A pure iron

B an alloy

C a mixture of compounds

D a mixture of elements

4.1.1.2 Mixtures

Question 15

November 2007 | CHY1B | Original Q1 | Legacy

QUESTION ONE

This question is about the manufacture of margarine spreads from sunflower oil.

Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart on the opposite page.

A Oil hardens and additives are mixed in.

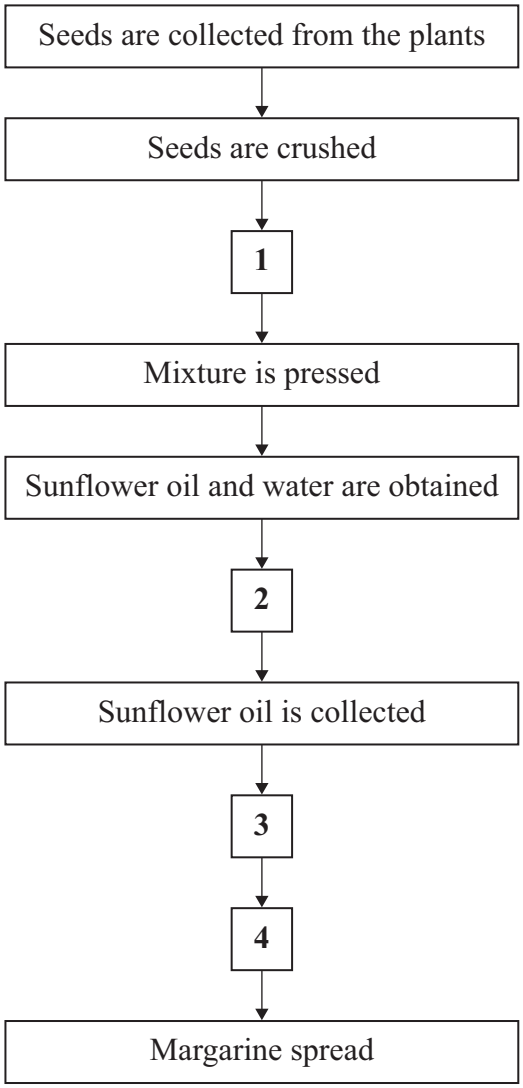
B Sunflower oil separates from the water.

C Water is added and the mixture is stirred.

D Sunflower oil is reacted with hydrogen.

4.1.1.2 Mixtures

Question 15 · continued



4.1.1.2 Mixtures

Question 16

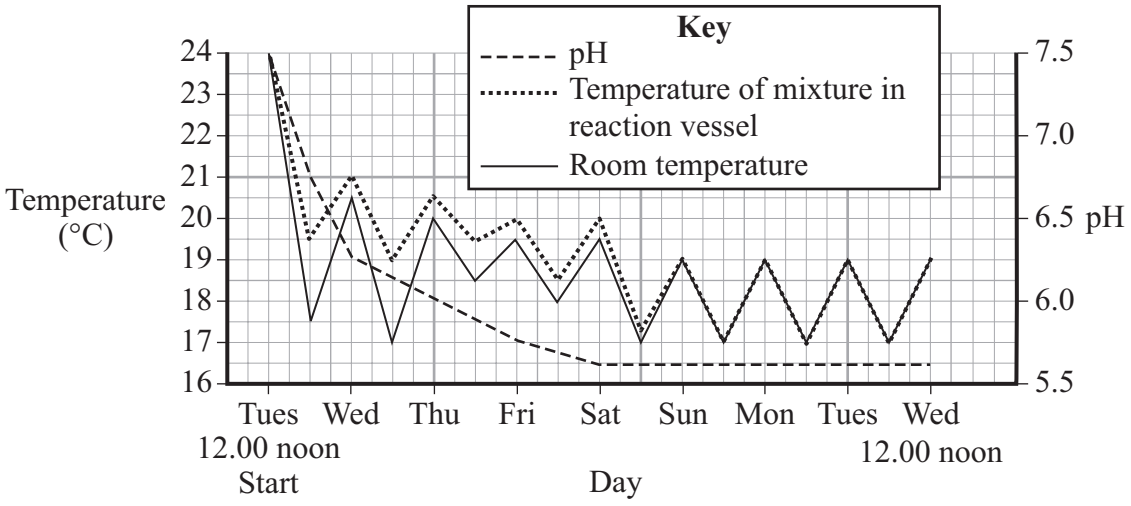
November 2007 | CHY1B | Original Q8 | Legacy

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.

4.1.1.2 Mixtures

Question 16 · continued

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.

4.1.1.2 Mixtures

Question 17

January 2008 | CHY1H | Original Q2 | Legacy

2 Soda-lime glass is made by heating, to above 1500 °C, a mixture of:

soda (sodium carbonate), Na_2CO_3
limestone (calcium carbonate), $CaCO_3$
sand (silicon dioxide), SiO_2

(a) (i) Which element do all of these compounds contain?

.....

(1 mark)

(ii) Explain what the formula Na_2CO_3 shows about the compound.

.....

.....

.....

.....

(2 marks)

(b) Calcium carbonate breaks down when heated to above 1500 °C.

(i) Write a word equation to show what happens.

..... → ..... + ...

(2 marks)

(ii) What is the name of this type of chemical reaction?

.....

(1 mark)

4.1.1.2 Mixtures

Question 17 · continued

BLANK

(c) The melting point of soda-lime glass is about 750 °C.
The raw materials for making soda are limestone and common salt (sodium chloride).
There are almost unlimited amounts of the raw materials available to manufacture soda-lime glass.

From the information given, what is the most important reason for recycling soda-lime glass?

.....

.....

(1 mark)

7

Turn over for the next question

4.1.1.2 Mixtures

Question 18

3 The nutrition label is from a pack of smoked salmon.

Typical values	Per 100 g	Per 50 g portion
Energy kJ kcal	695 165	350 85
Protein g Carbohydrate g of which sugars g	22.3 3.2 0.1	11.2 1.6 0.05
Fat g of which saturates g monounsaturates g polyunsaturates g	7.1 1.7 2.5 2.4	3.6 0.9 1.3 1.2
Fibre g Sodium g	0.5 1.30	0.3 0.70
Equivalent as salt g	3.2	1.6

Guideline Daily Amounts Recommended by nutrition professionals for average adults			
	Per 50 g portion	Woman	Man
Calories	85	2000	2500
Fat g	3.6	70	95
Salt g	1.6	6	6

(a) Smoked salmon is said to be a healthy food because it contains Omega 3 and other *unsaturated* fats.

(i) What does *unsaturated* mean?

.....

(1 mark)

(ii) To detect unsaturated fats, a small amount of bromine or iodine solution can be added.

What happens to show that an unsaturated fat is present?

.....

(1 mark)

(b) The amount of salt in this smoked salmon may be considered unhealthy.

Explain why it is advisable to consume only one portion of the smoked salmon per day.

.....

.....

.....

.....

(2 marks)

4.1.1.2 Mixtures

Question 18 · continued

BLANK

(c) Some farmed salmon have a coloured additive in the food that they are given. This is a permitted additive that improves the colour of the fish meat.

A sample of the colour is extracted from a salmon.

Explain how paper chromatography could be used to confirm that this is the permitted additive.

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(3 marks)

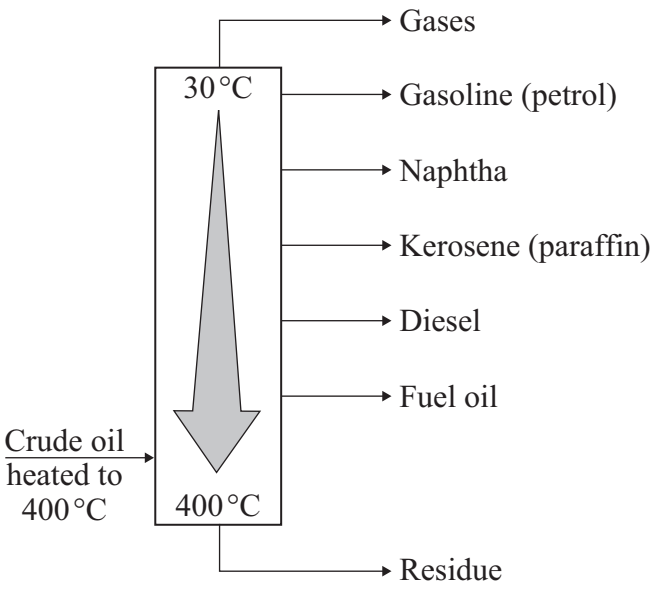
7

4.1.1.2 Mixtures

Question 19

January 2008 | CHY1H | Original Q6 | Legacy

6 Crude oil is the source of many useful materials. Crude oil is separated into fractions by fractional distillation.



(a) Describe how the naphtha fraction separates from the other fractions.

.....

.....

.....

.....

(2 marks)

(b) The naphtha fraction is often used to make other useful materials.
This involves the cracking of hydrocarbons in the naphtha fraction.

For example:

decane → hexane + ethene

$C_{10}H_{22} \rightarrow C_6H_{14} + C_2H_4$

(i) Balance the symbol equation given above.

(1 mark)

4.1.1.2 Mixtures

Question 19 · continued

BLANK

(ii) Describe how cracking is carried out.

.....

.....

.....

(2 marks)

(iii) Why does ethene have different chemical properties from decane and hexane?

.....

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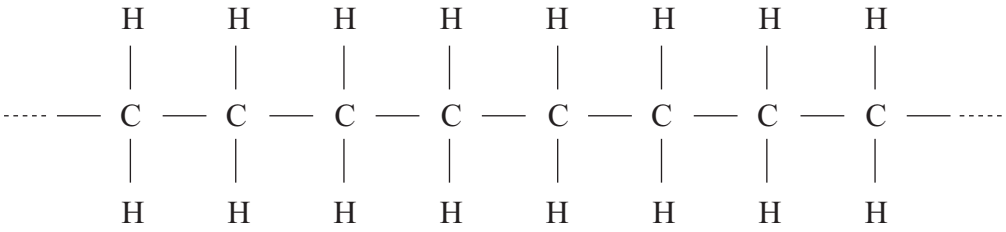
.....

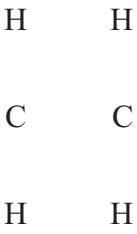
.....

(2 marks)

(c) Ethene is used as the starting material for many polymers. The most common polymer is poly(ethene). One hydrocarbon molecule in poly(ethene) will contain thousands of carbon atoms.



Complete the diagram to show the bonds in ethene.



(1 mark)

Question 6 continues on the next page

4.1.1.2 Mixtures

Question 19 · continued

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(d) Read the following information.

Landfill, Incineration, Recycling and Re-use of Poly(ethene)

People could be encouraged to re-use their poly(ethene) bags and containers.

Recycling poly(ethene) saves raw materials and energy needed to make new plastic. When polymers are recycled the plastics must be collected, transported, sorted into different types by hand and washed. This requires the use of fossil fuels and is expensive.

Poly(ethene) can be burnt in an incinerator with other household waste. The heat released could be used to make steam to drive an electric generator. Surplus heat could be used to heat greenhouses used for growing vegetables. Incineration at too low a temperature can produce harmful substances. The residue (ash) has to go to landfill.

Landfill is probably the easiest way to dispose of polymers and it is cheap. Polymers are often mixed in with other household rubbish. Household waste does not get sorted into different materials because it is disposed of in the same hole in the ground. When the hole is eventually full, the waste is covered by a layer of soil to stop it smelling. The waste gets compressed under its own weight. Most polymers, such as poly(ethene), are not biodegradable so will remain in the ground forever.

4.1.1.2 Mixtures

Question 19 · continued

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You are asked to decide which option for the disposal of poly(ethene) will be put forward in your area. You decide that recycling is the best option.

Suggest **one** economic argument and **one** environmental argument that will be made against recycling.

For each argument made, how will you persuade those making the argument to accept your option?
(You must use only one sentence for each argument made against your decision and only one sentence for your response to it.)

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(4 marks)

12

4.1.1.2 Mixtures

Question 20

January 2008 | CHY2H | Original Q6 | Legacy

6 Photographic film often contains silver bromide. Silver bromide is changed by light to form silver which appears as a black solid. This darkens the photographic film.

A photographic film can be made by coating thin transparent plastic with a gel containing silver bromide.

The main steps in making this photographic film are as follows:

Step 1 Gelatine is dissolved in warm water to make a solution.

Step 2 Compound **A**, a soluble compound which contains bromide ions, is dissolved into this solution.

Step 3 The lights are turned out in the darkroom.

Step 4 Compound **B**, a soluble compound which contains silver ions, is dissolved in water.

Step 5 The solution of compound **B** is added to the solution containing compound **A** and gelatine. Solid silver bromide is formed.

Step 6 The warm mixture is poured onto thin, transparent plastic film.

Step 7 The mixture sets to form a gel containing solid silver bromide.

(a) The table below gives information about the solubility of some compounds.

SOLUBLE	INSOLUBLE
All sodium and potassium salts	
All nitrates	
Most chlorides, bromides and iodides	Silver and lead chlorides, bromides and iodides
Most sulfates	Lead sulfate and barium sulfate
Sodium, potassium and ammonium carbonates	Most other carbonates

Use the table to help you to name suitable compounds for **A** and **B**.

Compound **A** .....

Compound **B** .....

(2 marks)

4.1.1.2 Mixtures

Question 20 · continued

BLANK

(b) Suggest why the lights are turned out at **step 3** in this method of making a photographic film.

.....

.....

(1 mark)

(c) What type of chemical reaction takes place when the compounds are mixed in **step 5**?

.....

(1 mark)

(d) The photographic film is placed in a camera and a picture is taken. Where light hits the photographic film the silver ions (Ag^+) are changed into silver metal (Ag).

Explain why this reaction is a reduction.

.....

.....

.....

.....

(2 marks)

6

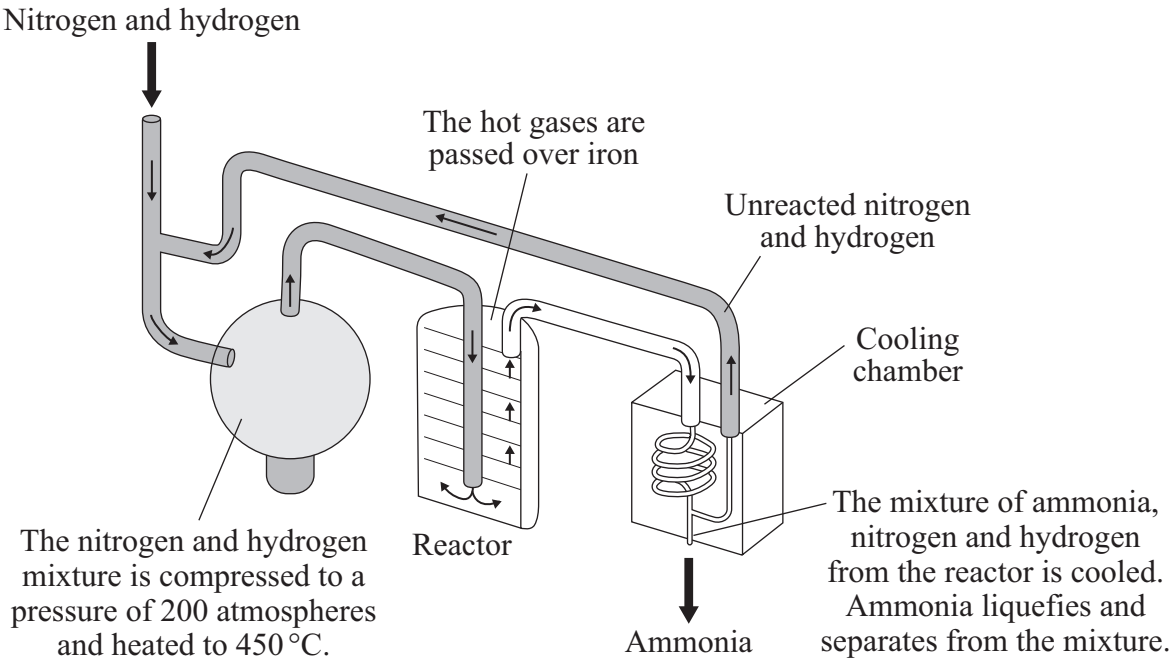
4.1.1.2 Mixtures

Question 21

January 2008 | CHY2H | Original Q7 | Legacy

7 The Haber process is named after the German chemist, Fritz Haber.

The diagram shows the main stages in the Haber process.



An exothermic reaction takes place when nitrogen reacts with hydrogen to make ammonia. The reaction can be represented by this equation.

$$N_2\,(g) \quad + \quad 3H_2\,(g) \quad \rightleftharpoons \quad 2NH_3\,(g)$$

(a) Calculate the maximum mass of ammonia that could be made from 1000 g of nitrogen.

Relative atomic masses: H = 1; N = 14

.....

.....

.....

.....

Mass .....g

(3 marks)

4.1.1.2 Mixtures

Question 21 · continued

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(b) At a temperature of 450 °C and 200 atmospheres the actual mass of ammonia produced when 1000 g of nitrogen is passed through the reactor is 304 g.

Calculate the percentage yield of ammonia produced in the reactor.

(If you did not answer part (a), then assume that the maximum mass of ammonia that can be made from 1000 g of nitrogen is 1100 g. This is **not** the correct answer to part (a).)

.....

.....

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.....

.....

Percentage yield of ammonia = ... %

(2 marks)

(c) State **and** explain:

(i) how a **decrease** in temperature would affect the yield of ammonia

.....

.....

.....

.....

(2 marks)

(ii) how an **increase** in pressure would affect the yield of ammonia.

.....

.....

.....

.....

(2 marks)

Question 7 continues on the next page

4.1.1.2 Mixtures

Question 21 · continued

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(d) Factories that make ammonia are often near to large towns.

Discuss the economic, safety and environmental factors to be considered when there is an ammonia factory near a town.

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(3 marks)

12

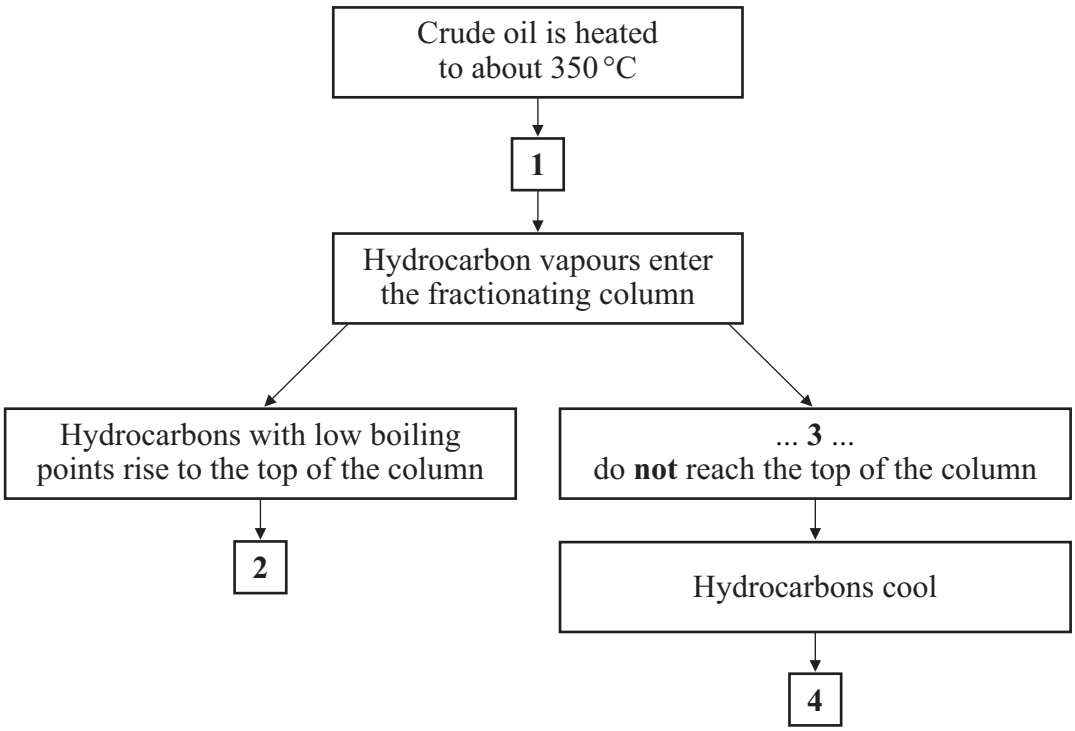
4.1.1.2 Mixtures

Question 22

March 2008 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

The flow chart shows stages in the fractional distillation of crude oil.



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

A Hydrocarbons in the crude oil turn to vapour

B Hydrocarbons collected as gases

C Hydrocarbons with high boiling points

D Hydrocarbons condense to form liquids

4.1.1.2 Mixtures

Question 23

March 2008 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The table gives some information about the boiling points and combustion products of the first six alkanes.

			When one molecule of the alkane is completely burned	
Name	**Formula**	**Boiling point in °C**	**Number of molecules of CO_2 formed**	**Number of molecules of H_2O formed**
Methane	CH_4	–168	1	2
Ethane	C_2H_6	– 89	2	3
Propane	C_3H_8	– 42	3	4
Butane	C_4H_{10}	– 0.5		
Pentane	C_5H_{12}	+ 36		
Hexane	C_6H_{14}	+ 69		

8A Which one of the following statements is true about the fractional distillation of a mixture of the alkanes in the table?

1 Each of the fractions collected would contain just **one** alkane.

2 Hexane would be in the fraction selected at the highest temperature.

3 The hottest part of the column would be at the top.

4 Methane would be separated out at the bottom of the column.

8B Which one of the following is true about burning the alkanes?

1 As the size of the alkane molecules increases, the ratio of $CO_2 : H_2O$ molecules formed will eventually be 1:1

2 As the size of the alkane molecules increases, more and more oxygen molecules will be required to completely burn one molecule of the alkane.

3 The amount of water and carbon dioxide formed suggests that the alkanes with larger molecules will ignite more easily.

4 Since only water and carbon dioxide are formed on burning, the alkanes are environmentally-friendly fuels.

4.1.1.2 Mixtures

Question 23 · continued

8C Burning the alkanes that have larger molecules tends to produce carbon monoxide along with carbon dioxide and water.

This suggests that these alkanes . . .

1 do **not** undergo complete combustion.

2 would make better fuels.

3 contain dissolved carbon monoxide gas.

4 can never be made totally pure.

8D To estimate the boiling point of heptane (C_7H_{16}) it would be best to use the boiling points from the table to plot . . .

1 a line graph with the number of carbon atoms as the independent, discrete variable.

2 a line graph with the number of carbon atoms as the categoric variable.

3 a bar chart with the number of carbon atoms as the independent, discrete variable.

4 a bar chart with the number of carbon atoms as the categoric variable.

4.1.1.2 Mixtures

Question 24

June 2008 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Crude oil contains a large number of alkanes, which have the general formula C_nH_{2n+2}

Crude oil can be separated into a number of fractions by fractional distillation.

6A Crude oil can be separated into fractions in this way because . . .

1 the alkanes it contains have different boiling points.

2 the alkanes it contains have different densities.

3 alkanes are compounds which are made up of more than one element.

4 all alkanes vaporise easily when they are heated.

6B Each fraction from the crude oil will contain . . .

1 a single alkane.

2 a mixture of several alkanes.

3 alkanes that have the same boiling point.

4 alkanes that have the same density.

The alkanes are a series of compounds.

The first ten alkanes in the series range from methane, CH_4 to decane, $C_{10}H_{22}$

6C The difference between the formulae of successive alkanes is . . .

1 C

2 H_2

3 CH

4 CH_2

4.1.1.2 Mixtures

6D Which of the following changes in the alkane series, from methane to decane?

1 the general formula

2 the number of bonds on each carbon atom

3 the ratio of carbon atoms to hydrogen atoms

4 the number of elements present

Turn over for the next question

4.1.1.2 Mixtures

Question 25

June 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Green plant cells contain many different coloured pigments.

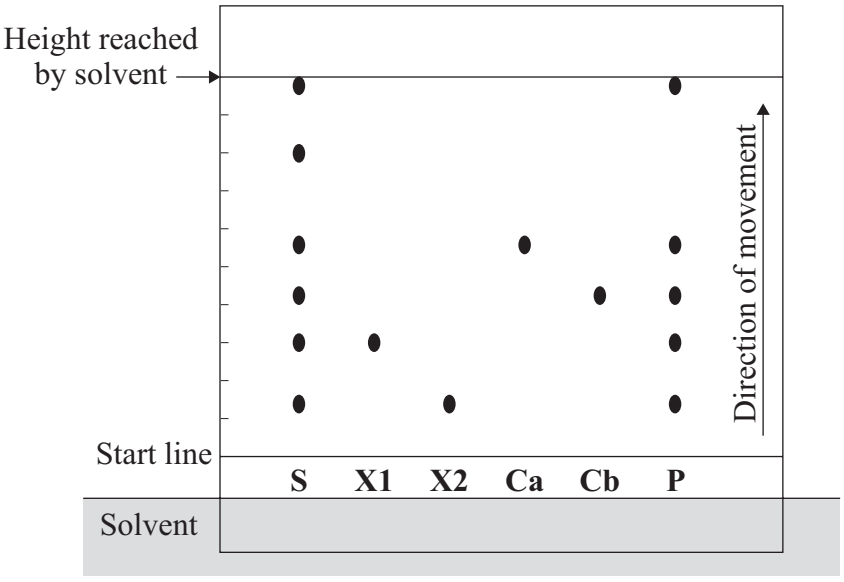
Examples are:

- two types of chlorophyll, **Ca** and **Cb**
- two types of xanthophyll, **X1** and **X2**.

The pigments can be separated by chromatography.

In an experiment, extracts from two plants, **P** and **S**, were compared with pure **Ca**, **Cb**, **X1** and **X2** using chromatography.

The diagram shows the results of the experiment.



Key	
X1 and **X2**	Pure xanthophyll
Ca and **Cb**	Pure chlorophyll
S	Extract from plant **S**
P	Extract from plant **P**

8A From this experiment it is possible to deduce that plant **S** contains . . .

1 coloured substances **not** identified by this experiment.

2 four coloured substances.

3 seven coloured substances.

4 the same mixture of coloured substances as plant **P**.

4.1.1.2 Mixtures

Question 25 · continued

8B From this experiment it is possible to deduce that plant **P** . . .

1 contains coloured substances that are soluble in the solvent.

2 contains substances that could be safely used for colouring food.

3 is unhealthy.

4 would look identical to plant **S**.

In chromatography, the R_f value = $\frac{\text{distance moved by the substance}}{\text{distance moved by the solvent}}$

8C What is the R_f value for **X1**?

1 0.03

2 0.16

3 0.30

4 3.33

8D Two other coloured substances found in plants are:

- carotene R_f value 0.98
- phaeophytin R_f value 0.80

From this information we can deduce that the leaves on plant **S** contain . . .

1 both carotene and phaeophytin.

2 carotene but **not** phaeophytin.

3 phaeophytin but **not** carotene.

4 neither carotene nor phaeophytin.

4.1.1.2 Mixtures

Question 26

June 2008 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

9A There was little or no nitrogen in Earth's early atmosphere, but a gaseous compound of nitrogen was present in small amounts.

This gaseous compound is . . .

1 ammonia.

2 carbon dioxide.

3 methane.

4 sulfur dioxide.

In 1892, Lord Rayleigh compared nitrogen from the air with very pure nitrogen obtained from nitrogen compounds. The density of the nitrogen was:

nitrogen from the air	= 1.2572 grams per litre
nitrogen from nitrogen compounds	= 1.2511 grams per litre.

Rayleigh and Sir William Ramsay proved that atmospheric nitrogen was not pure but contained five other gases, which together made up about 1% of the Earth's atmosphere. The gases were argon (0.94%) and traces of helium, neon, krypton and xenon.

The five gases are similar in that they show no chemical reactions but have different physical properties, eg density, melting point, boiling point.

9B The main reason why scientists did **not** find these five gases in the atmosphere at an earlier date was that . . .

1 they have a very low density.

2 they are present in only small quantities.

3 they are unreactive.

4 they are colourless.

9C One way of separating the five gases from each other is by . . .

1 passing a mixture of the gases over heated carbon.

2 allowing them to settle, according to density, in a glass vessel.

3 fractional distillation of the mixture.

4 passing a mixture of the gases over a nickel catalyst.

4.1.1.2 Mixtures

9D From the information given in the question, it is safe to predict that . . .

1 nitrogen makes up about 78% of the atmosphere.

2 argon has a density greater than the density of nitrogen.

3 neon, krypton and xenon have a density lower than the density of nitrogen.

4 nitrogen from nitrogen compounds must contain a very light gas such as hydrogen.

END OF TEST

4.1.1.2 Mixtures

Question 27

June 2008 | CHY1H | Original Q3 | Legacy

3

Why blue sweets are turning white

A recent study identified a possible harmful effect on children's nervous systems by some artificial colours. Two of these colours are Brilliant Blue (E133) and Quinoline Yellow (E104). Both are artificial colours because they are made from coal. The company is to stop producing the blue sweets because it is removing all artificial colours and there is no natural blue alternative.

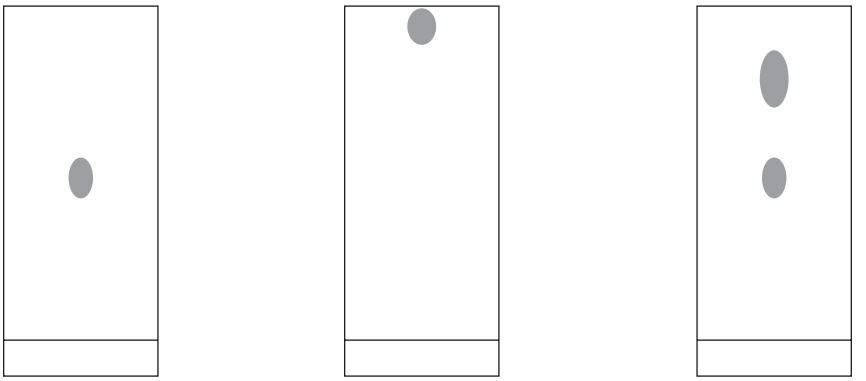
3 (a) Suggest why it is important to be able to identify the colour additives in food.

.....

.....

(1 mark)

3 (b) A brown colour used in sweets was analysed using chromatography. The results were compared with those from E104 and E133.



What do the results tell you about the brown colour and its suitability for use in sweets?

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.....

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(3 marks)

4.1.1.2 Mixtures

Question 27 · continued

for mark

3 (c) Once all the unsuitable colours are removed, the company claims that its sweets are now 'free from artificial colours'.

Does this mean that the sweets contain no additives? Explain your answer.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

4.1.1.2 Mixtures

Question 28

November 2008 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

The extraction of iron involves heating a mixture of iron ore, limestone and coke (carbon) at high temperatures in a blast furnace.

The limestone and iron ore are extracted from large quarries, some of which are found in areas of outstanding natural beauty.

4A Some people are against the development of these large quarries.

One reason is that the quarries . . .

1 attract large numbers of tourists to visit the area.

2 make unsightly scars on the landscape.

3 are unnecessary because there are few uses for limestone.

4 create a dangerous habitat for wildlife.

4B Some people support the development of these quarries.

One reason is that the working quarries . . .

1 are always placed where the public cannot see them.

2 conserve resources.

3 provide employment for people who live in the area.

4 provide an area for leisure activities.

4C Iron is produced continuously, sometimes for several years without shutting down the blast furnace.

This is done . . .

1 because it is difficult to obtain large supplies of limestone.

2 because it takes several years to reach the required temperature in the furnace.

3 to minimise the energy costs.

4 to ensure that the iron is of the highest quality.

4.1.1.2 Mixtures

4D Some iron is obtained by recycling scrap iron.

Why does it take less energy to make iron from scrap iron than to extract the iron from its ore?

1 Scrap iron is an alloy.

2 Scrap iron contains the element sulfur.

3 Scrap iron does **not** have to be reduced using carbon.

4 Corrosion of the scrap iron makes it easier to melt.

Turn over for the next question

4.1.1.2 Mixtures

Question 29

November 2008 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Large hydrocarbon molecules can be broken down to produce smaller molecules.

An example is shown in the equation below:

$$\underset{\text{Hexane}}{C_6H_{14}} \longrightarrow \underset{\text{Substance } \mathbf{K}}{C_3H_8} + \underset{\text{Substance } \mathbf{L}}{C_3H_6}$$

7A What are the conditions needed for this breakdown of hexane?

1 heat at 60 °C

2 heat the vapour with hydrogen

3 heat with hydrogen in the presence of a nickel catalyst

4 heat and pass the vapour over a hot catalyst

7B The mixture of substances **K** and **L** could be separated by condensation if they . . .

1 were of different density.

2 ignited at different temperatures.

3 had different boiling points.

4 were both gases.

7C Substance **L** is . . .

1 a saturated hydrocarbon.

2 an alkane.

3 an alkene.

4 a polymer.

4.1.1.2 Mixtures

7D One difference between the molecules of substances **K** and **L** is that . . .

1 in **K** there is a higher ratio of carbon to hydrogen atoms.

2 in **L** the carbon atoms have fewer bonds.

3 in **K** there are fewer single bonds.

4 in **L** there is a double bond.

Turn over for the next question

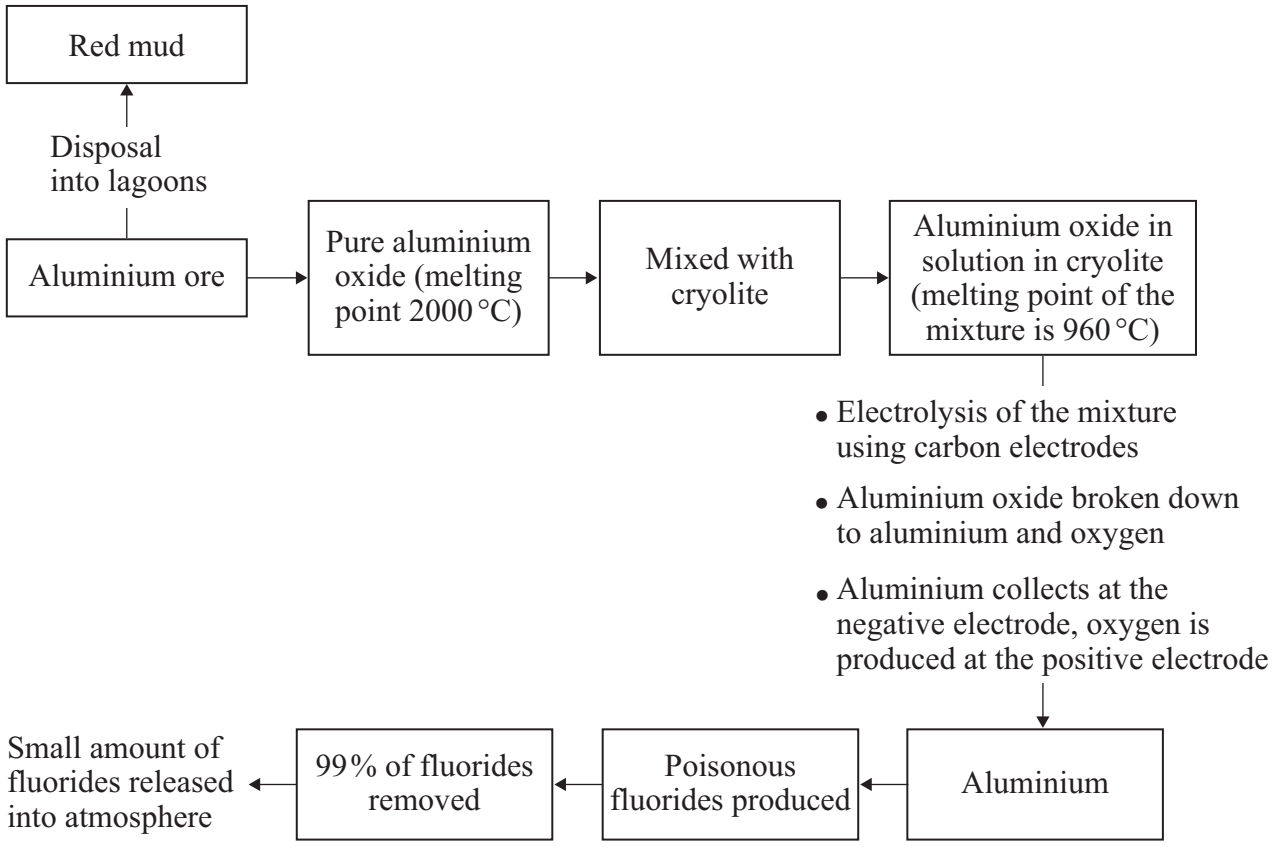
4.1.1.2 Mixtures

Question 30

June 2009 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

The flow chart shows the stages in the extraction of aluminium.



9A The red mud from the aluminium ore is disposed of by dumping in lagoons. The red mud contains iron oxide.

The most likely reason why iron is **not** extracted from the red mud is that . . .

1 the iron oxide evaporates too quickly.

2 there is no transportation system nearby.

3 it is **not** economic compared to other sources of iron.

4 iron oxide from the lagoons cannot be reduced by carbon.

4.1.1.2 Mixtures

9B Why is pure aluminium oxide mixed with cryolite before electrolysis?

1 to produce an aluminium alloy

2 to reduce the breakdown of aluminium oxide

3 to lower the melting point so less energy is used during electrolysis

4 to react with impurities in the aluminium oxide

9C During electrolysis, the positive carbon electrode is rapidly used up causing emissions.

The main component of these emissions contributes to . . .

1 global dimming.

2 global warming.

3 acid rain.

4 red mud lagoons.

9D It is important to monitor the amount of poisonous fluorides released into the atmosphere.

Plants absorb these fluorides. The amounts of fluorides in plants can be found by chemical analysis.

The best information would be found by chemical analysis of plants that are growing . . .

1 in all the workers' homes.

2 at exactly one kilometre in all directions from the factory.

3 at various distances in all directions from the factory.

4 at various distances in an easterly direction from the factory.

END OF TEST

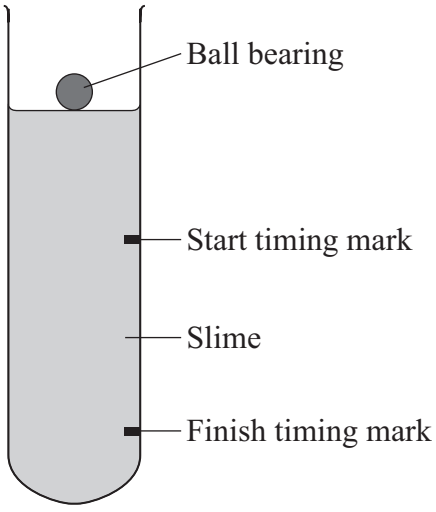
4.1.1.2 Mixtures

Question 31

June 2009 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

Some students made a slime by mixing a solution of PVA with a solution of borax.



They decided to investigate how the viscosity (thickness) of the slime depended on the amount of borax solution added to the PVA solution. They used various mixtures and timed how long a ball bearing took to fall between two timing marks, as shown in the diagram.
The same person took the time readings throughout the experiment. The temperature of the room did not change.

The students' results are shown in the table.

Volume of PVA solution in cm^3	Volume of borax solution in cm^3	Volume of water in cm^3	Time 1 in seconds	Time 2 in seconds	Time 3 in seconds	Average time in seconds
40	1	9	1.6	1.6	1.6	1.6
40	2	8	3.6	4.0	–	3.8
40	3	7	4.8	5.2	5.6	5.2
40	4	6	7.2	7.4	7.4	7.3
40	5	5	10.0	10.2	9.8	10.0
40	6	4	10.2	10.4	10.0	10.2
40	7	3	11.0	9.0	10.6	10.2
40	8	2	10.0	9.8	9.6	9.8
40	9	1	9.0	9.2	8.8	9.0
40	10	0	8.8	8.8	–	8.8

4.1.1.2 Mixtures

Question 31 · continued

6A Which row in the table shows the correct independent and dependent variables in this experiment?

	Independent variable	Dependent variable
1	Volume of PVA solution	Time for ball to drop between the marks
2	Time for ball to drop between the marks	Volume of borax solution
3	Volume of borax solution	Volume of PVA solution
4	Volume of borax solution	Time for ball to drop between the marks

6B In the experiment, one variable that is **not** controlled is . . .

1 the total volume of PVA, borax and water.

2 the person taking the time readings.

3 the temperature of the room.

4 the total volume of water.

6C Which of the following actions will **not** improve the reliability of the results?

1 Measuring the time taken three times instead of two for the tests with 2 cm^3 and 10 cm^3 of borax solution.

2 Using a timer able to read to 0.1 seconds instead of 0.2 seconds.

3 Repeating the set of readings for 7 cm^3 of borax solution.

4 Repeating the whole experiment on another day.

6D What is the **best** conclusion that can be made from the results?

1 There is a consistent error in the method of timing.

2 The viscosity of slime depends directly on the volume of borax solution.

3 There is **not** enough evidence to relate the volume of borax solution to the viscosity of slime.

4 There is a clear relationship between the volume of borax solution and the viscosity of slime.

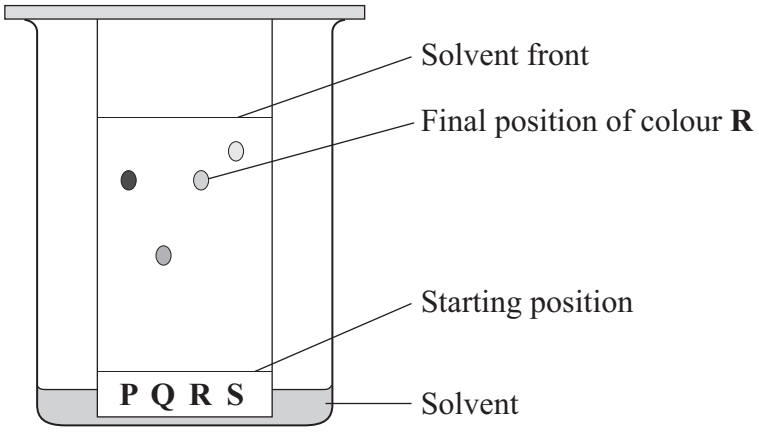
4.1.1.2 Mixtures

Question 32

June 2009 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows an investigation of four colours, **P**, **Q**, **R** and **S**, using paper chromatography.



As the solvent rises up the paper it moves the colours depending on their attraction for the solvent and the paper.
The greater the attraction of a colour for the solvent and the less the attraction for the paper, the further the colour moves.

The R_f value is defined as:

$$R_f = \frac{\text{distance travelled by the colour}}{\text{distance travelled by the solvent}}$$

9A In the investigation shown in the diagram, what was the R_f value of colour **Q**?

1 0.0

2 0.5

3 0.7

4 0.9

4.1.1.2 Mixtures

Question 32 · continued

The R_f values for the colours, **P**, **Q**, **R** and **S**, in four different solvents are shown in the table.

	Solvent			
	Water	**Ethanol**	**Propanone**	**Tetrachloromethane**
Colour P	0.5	0.9	0.7	0.5
Colour Q	0.0	0.8	0.6	0.2
Colour R	0.5	0.7	0.6	0.1
Colour S	0.2	0.6	0.4	0.2

9B Which colour is **not** soluble in water?

1 **P**

2 **Q**

3 **R**

4 **S**

9C Using the data in the table above, which solvent could be used to separate a mixture of all four colours, **P**, **Q**, **R** and **S**?

1 water

2 ethanol

3 propanone

4 tetrachloromethane

Question 9 continues on the next page

4.1.1.2 Mixtures

Question 32 · continued

9D R_f values are not very reliable because other factors can affect how the colours move. These factors include the temperature and the amount of solvent vapour in the atmosphere around the chromatography paper. For this reason, R_f values are not normally quoted in textbooks.

Which of the following statements is true?

1 Chromatography is useless for identifying unknown substances.

2 Chromatography can only be used if the temperature is carefully controlled to a constant value.

3 Chromatography can only be used if there is always the same amount of solvent in the beaker.

4 Chromatography can be used if known colours are used, with the unknown colour as a comparison.

END OF TEST

4.1.1.2 Mixtures

Question 33

June 2009 | CHY1H | Original Q2 | Legacy

2 (a) Limestone is a hard rock that is used as a building material.
Limestone was used by the Egyptians to make plaster.

Reaction 1 – calcium carbonate, $CaCO_3$, was decomposed by heating limestone

$$CaCO_3 \rightarrow CaO + CO_2$$

Reaction 2 – water was added to the solid produced to make slaked lime

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Reaction 3 – a mixture of slaked lime and water was used as plaster. After the plaster had set it became even harder with age

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

2 (a) (i) Name the solid formed when calcium carbonate decomposed.

.....

(1 mark)

2 (a) (ii) Use the reactions to explain how the plaster became even harder with age.

.....

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(3 marks)

4.1.1.2 Mixtures

Question 33 · continued

for mark

2 (b) A gardener wanted to make a step up to his greenhouse door. He decided to use a mixture of cement and sand to make mortar.

He experimented using mixtures with different cement to sand ratios.

- The mortar mixtures were put in the same sized mould.
- Each mortar mixture was allowed to set hard.
- He then dropped a metal ball from increasing heights until the set mortar cracked.
- He recorded his results in a table.

Volume of sand in cm^3	Volume of cement in cm^3	Height the metal ball dropped to crack the set mortar in cm
800	100	17
700	100	24
600	100	30
500	100	36
400	100	37
300	100	48
200	100	54

2 (b) (i) What is the relationship between the volume of sand and the strength of the mortar?

.....

.....

(1 mark)

2 (b) (ii) The gardener was not sure about some of his results.

Use the results to explain why.

.....

.....

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(2 marks)

7

4.1.1.2 Mixtures

Question 34

June 2009 | CHY1H | Original Q6 | Legacy

6 (a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

6 (a) (i) Describe how ethene forms poly(ethene).

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(2 marks)

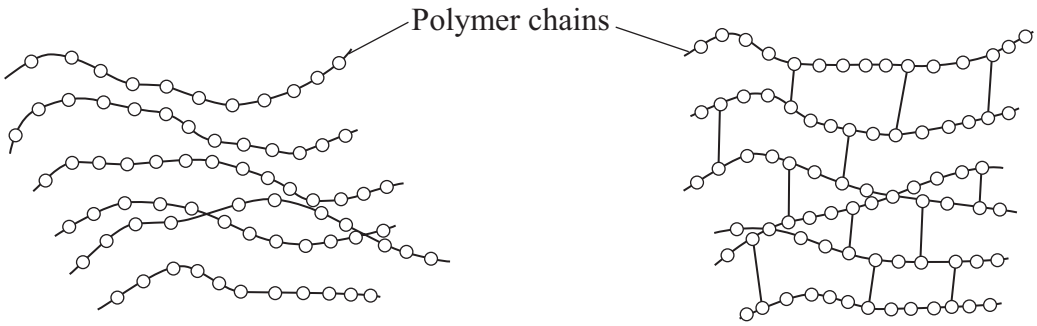
6 (a) (ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

.....

.....

(1 mark)

6 (a) (iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) **PEX**

Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

.....

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.....

.....

.....

(3 marks)

4.1.1.2 Mixtures

Question 34 · continued

for mark

6 (b) Copper was considered to be the most suitable material to use for hot water pipes. PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

1 The low-grade ore is powdered and concentrated.
2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
3 Oxygen is blown into the impure, molten copper to remove any sulfur. The copper is cast into rectangular slabs.
4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes.

1 Fractional distillation
2 Cracking
3 Polymerisation
4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

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(4 marks)

10

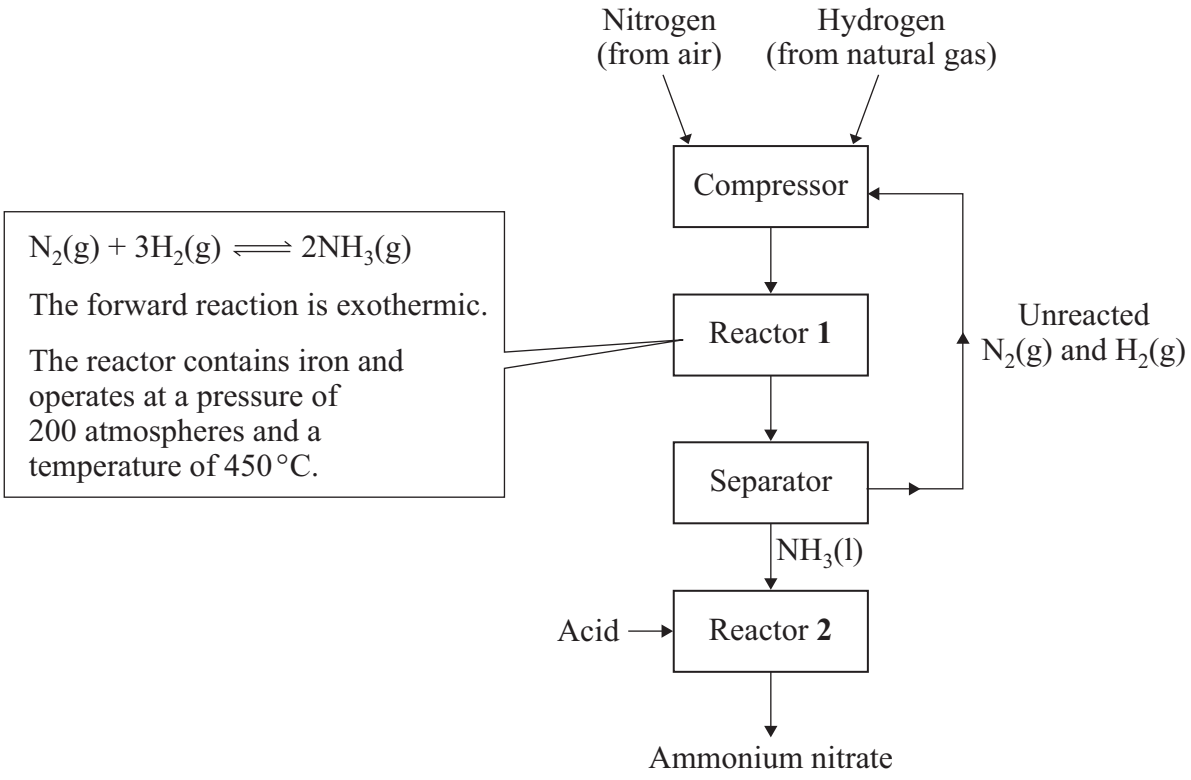
4.1.1.2 Mixtures

Question 35

June 2009 | CHY2H | Original Q3 | Legacy

3 Ammonium nitrate is an important chemical. The diagram shows the main stages in the manufacture of ammonium nitrate.

Study the diagram and then answer the question.



3 (a) What is the purpose of the iron in reactor **1**?

.....

.....

(1 mark)

4.1.1.2 Mixtures

Question 35 · continued

for mark

3 (b) Explain why the best yield of ammonia at equilibrium is obtained:

3 (b) (i) at low temperature

.....

.....

(1 mark)

3 (b) (ii) at high pressure.

.....

.....

(1 mark)

3 (c) The temperature used in reactor **1** is 450 °C.

Explain why a much lower temperature is **not** used.

.....

.....

(1 mark)

3 (d) A mixture of ammonia, nitrogen and hydrogen leaves reactor **1**.

In the separator, what is done to the mixture to separate the ammonia from the other gases?

.....

.....

(1 mark)

3 (e) Name the acid that reacts with ammonia in reactor **2** to make ammonium nitrate.

.....

.....

(1 mark)

6

4.1.1.2 Mixtures

Question 36

June 2009 | CHY2H | Original Q6 | Legacy

6 Perfumes contain a mixture of chemicals.



The main ingredients of perfumes are a solvent and a mixture of fragrances.

6 (a) A sample of the solvent used in one perfume contained 0.60 g of carbon, 0.15 g of hydrogen and 0.40 g of oxygen.

Relative atomic masses: H = l; C = 12; O = 16.

Calculate the empirical (simplest) formula of the solvent.

You must show all of your working to gain full marks for this question.

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(4 marks)

4.1.1.2 Mixtures

Question 36 · continued

for mark

6 (b) Solvent molecules evaporate easily.

Explain why substances made of simple molecules evaporate easily.

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(2 marks)

6 (c) Most companies claim that their perfumes have been tested on skin. A study was made of the tests they used. The study found that each company used different tests. The perfumes were tested in the companies' own laboratories and **not** by independent scientists.

Some companies did not give any information about the tests that they had used.

6 (c) (i) Suggest why companies test their perfumes on skin.

.....

.....

.....

(1 mark)

6 (c) (ii) Did the study show that the tests made by the different companies were valid and reliable?

Explain your answer.

.....

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.....

(2 marks)

9

4.1.1.2 Mixtures

Question 37

November 2009 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

Duralumin is an alloy which contains copper and magnesium mixed with aluminium.

Aluminium is a low density metal but duralumin is used more often in making aeroplanes.

4A Aluminium, copper and magnesium are extracted from their naturally occurring compounds.

The method used for the extraction depends on . . .

1 the density of the metal.

2 the abundance of the metal compound in the Earth's crust.

3 the melting point of the metal compound.

4 the reactivity of the metal.

4B Copper can be extracted by strongly heating a mixture of the copper compound and carbon.

In this reaction, the copper compound is . . .

1 oxidised.

2 electrolysed.

3 reduced.

4 distilled.

4C Aluminium and magnesium are extracted by electrolysis.

One reason why this method is expensive is that . . .

1 the metals are resistant to corrosion.

2 the process requires a large amount of energy.

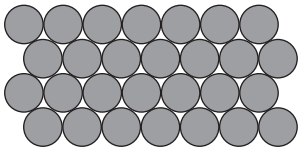
3 the metals are less reactive than carbon.

4 the metal ores are very abundant.

4.1.1.2 Mixtures

Question 37 · continued

4D The diagram shows the arrangement of the atoms in pure aluminium.



Which row in the table correctly shows how the structure and properties are different in duralumin?

	Structure	Properties
1	The layers of atoms are distorted.	The alloy is harder.
2	The copper atoms attach strongly to the aluminium atoms.	The alloy is softer.
3	The layers of atoms are distorted.	The alloy is softer.
4	The magnesium atoms attach strongly to the aluminium atoms.	The alloy is harder.

4.1.1.2 Mixtures

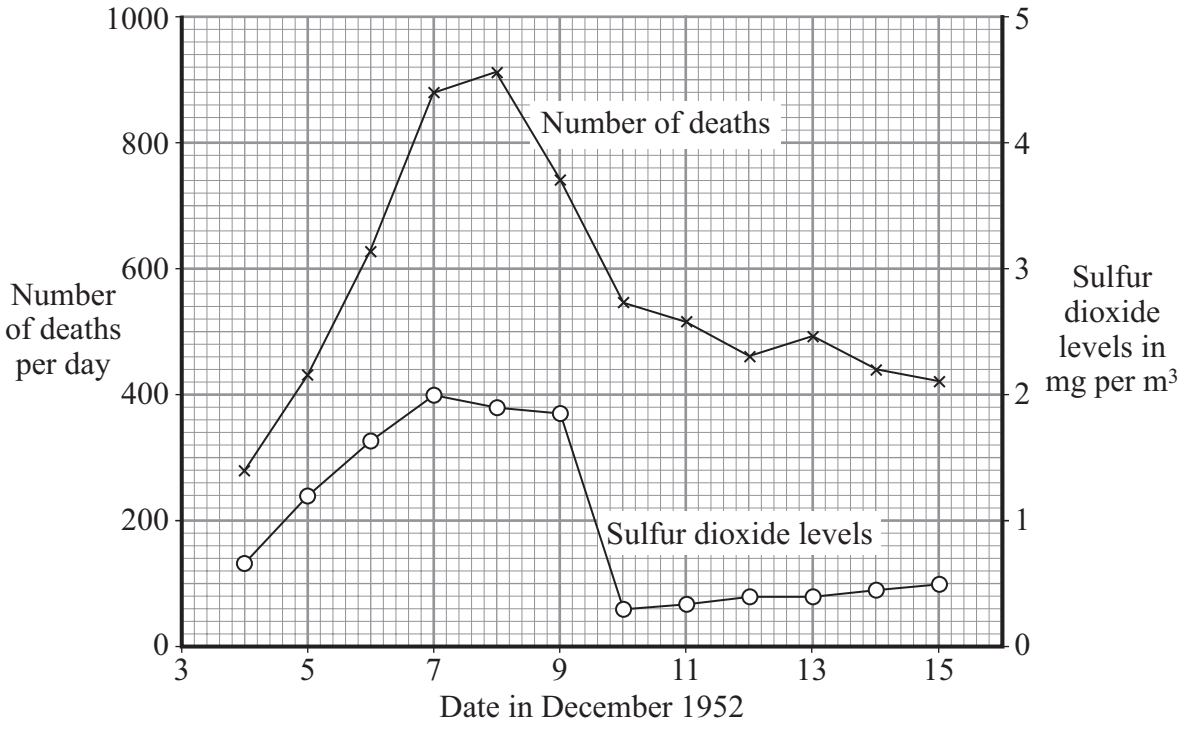
Question 38

November 2009 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Smog is a mixture containing sulfur dioxide and smoke particles.

The graph below shows how the number of deaths due to sulfur dioxide varied during the Great Smog in London during December 1952.



7A It is generally agreed that sulfur dioxide caused the increase in the number of deaths in London in December 1952.

Which of the following would be the best argument **against** this conclusion?

1 The level of sulfur dioxide does **not** go as high as the number of deaths.

2 After a period of time, the sulfur dioxide levels increase but the number of deaths decreases.

3 The graphs show a similar pattern of increase and decrease.

4 The number of deaths increases faster than the sulfur dioxide levels increase.

Question 38 · continued November 2009 | CHY1AP | Original Q7 | Legacy

7B A group of students studying the Great Smog of London in 1952 wrote four statements after looking at the data.

Which one of their statements is correct?

1 The number of deaths peaks on the same day as sulfur dioxide levels peak.

2 The number of deaths always increases when sulfur dioxide levels increase.

3 On the day that sulfur dioxide levels reached 2 mg per m^3, there were 880 deaths.

4 If sulfur dioxide levels double, the number of deaths doubles.

7C Many cars now use low-sulfur fuels that were introduced in 2000. However, the amount of sulfur dioxide emissions from vehicles in the UK has increased since 2000.

This increase is because . . .

1 early versions of low-sulfur fuels did not burn correctly.

2 there is an increasing number of vehicles on UK roads.

3 there is now 5 % ethanol (C_2H_5OH) in petrol.

4 sulfur dioxide is producing acid rain.

7D Sulfur dioxide can be removed from the waste gases from power stations using a process called flue gas desulfurisation. This is done by reacting the sulfur dioxide [SO_2] with calcium carbonate [$CaCO_3$], calcium oxide [CaO], calcium hydroxide [$Ca(OH)_2$] or magnesium oxide [MgO].

Which one of the following is **not** a correctly balanced equation for a reaction taking place during *flue gas desulfurisation*?

1 $SO_2 + MgO \rightarrow MgSO_3$

2 $SO_2 + CaO \rightarrow CaSO_3$

3 $SO_2 + CaCO_3 \rightarrow CaSO_3 + CO_2$

4 $SO_2 + Ca(OH)_2 \rightarrow CaSO_3 + 2H_2O$

4.1.1.2 Mixtures

Question 39

November 2009 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about extracting lavender oil from lavender plants.

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

A condenses

B boils

C evaporates

D floats

The crushed lavender plants are mixed with water in a distillation flask and heated until the mixture . . . **1** . . . .

The lavender oil and some water . . . **2** . . . .

The vapour is allowed to cool and it . . . **3** . . . .

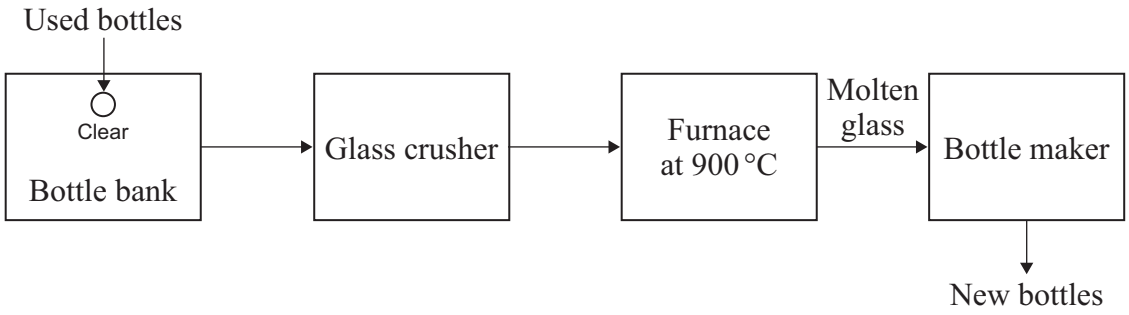
The lavender oil rises to the surface of the water where it . . . **4** . . . .
The lavender oil is separated from the water and collected.

4.1.1.2 Mixtures

Question 40

2 In recent years we have become more aware of the need to recycle glass.

2 (a) Used glass bottles can be recycled if they are put into bottle banks.



2 (a) (i) Suggest **one** reason why light bulbs should **not** be put into bottle banks.

.....

.....

(1 mark)

2 (a) (ii) Very few glass bottles are reused (used more than once).

Suggest **one** reason why.

.....

.....

(1 mark)

2 (a) (iii) New glass bottles can also be produced by heating, at 1700 °C, a mixture of the following raw materials:

sand (silicon dioxide), SiO_2
soda ash (sodium carbonate), Na_2CO_3
limestone (calcium carbonate), $CaCO_3$

Explain why the use of recycled glass to make glass bottles produces less carbon dioxide than making glass bottles from these raw materials.

.....

.....

.....

.....

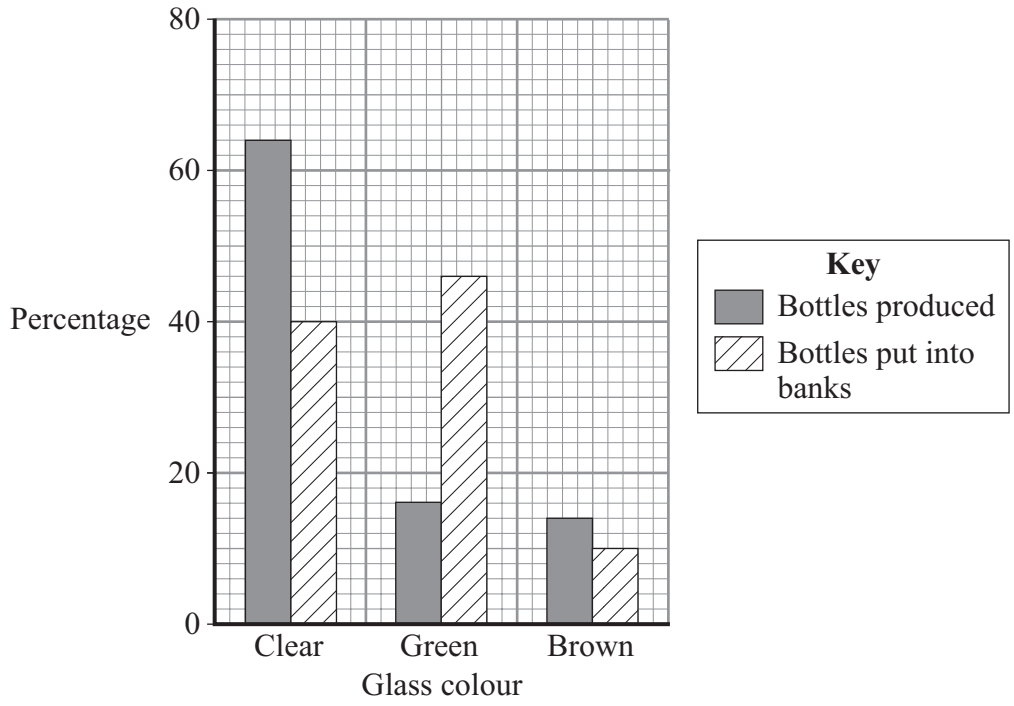
(2 marks)

4.1.1.2 Mixtures

Question 40 · continued

for mark

2 (b) The bar chart shows the percentages of glass bottles produced and the percentages of glass bottles put into bottle banks in the UK.



2 (b) (i) The percentage of green glass bottles produced is 16%.
What is the percentage of green glass bottles put into bottle banks?

Percentage = ... %

(1 mark)

2 (b) (ii) More green glass bottles are put into bottle banks than are made in the UK.
Suggest **one** reason why.

.....

.....

(1 mark)

2 (b) (iii) Suggest and explain **one** problem resulting from the percentage of clear glass bottles produced in the UK.

.....

.....

.....

.....

(2 marks)

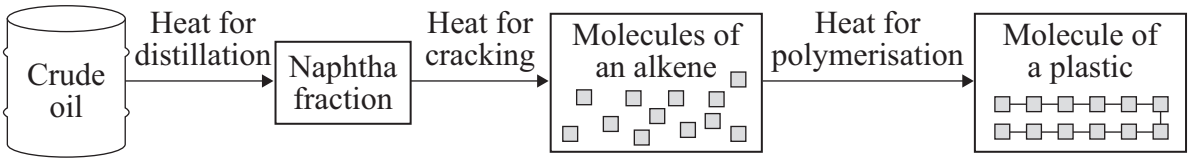
8

4.1.1.2 Mixtures

Question 41

January 2010 | CHY1H | Original Q6 | Legacy

6 To make a plastic, such as poly(ethene), from crude oil involves many processes.



6 (a) Describe how crude oil is separated into fractions.

.....

.....

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.....

.....

(2 marks)

6 (b) Ethene is produced by cracking the hydrocarbons in the naphtha fraction.

6 (b) (i) Balance the symbol equation for this reaction.

$$\underset{\text{decane}}{C_{10}H_{22}} \rightarrow \underset{\text{butane}}{C_4H_{10}} + \underset{\text{ethene}}{C_2H_4}$$

(1 mark)

6 (b) (ii) Describe how cracking is carried out.

.....

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.....

.....

(2 marks)

4.1.1.2 Mixtures

Question 41 · continued

for mark

6 (c) Alkanes, such as butane (C_4H_{10}), do **not** form polymers.

Alkenes, such as ethene (C_2H_4), do form polymers.

Explain these statements.

.....

.....

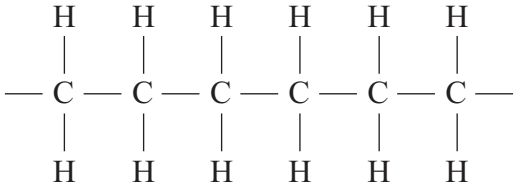
.....

.....

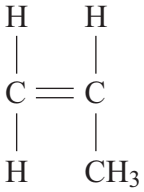
.....

(2 marks)

6 (d) Ethene molecules form the polymer poly(ethene). One molecule in poly(ethene) will contain thousands of carbon atoms. The diagram represents part of a poly(ethene) molecule.



Propene molecules form the polymer poly(propene).



Propene molecule

Draw a diagram to represent part of a poly(propene) molecule.

(2 marks)

9

4.1.1.2 Mixtures

Question 42

2 Read the article.

In the late eighteenth century the French scientist Nicolas Leblanc invented a process to change sodium chloride into sodium carbonate.

The main steps in the original process were:

Step 1. Sodium chloride was reacted with sulfuric acid to make sodium sulfate. Hydrogen chloride was formed and escaped into the atmosphere. The hydrogen chloride damaged plants over a wide area around the factory.

Step 2. The sodium sulfate was heated with limestone and coal. A solid mixture was formed which contained sodium carbonate, calcium sulfide and unreacted coal. The calcium sulfide gave off a very unpleasant smell.

Step 3. The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

Step 4. Crystals of sodium carbonate were obtained from the solution of sodium carbonate.

The process was later improved.

- The hydrogen chloride produced in **Step 1** was changed into chlorine which was used to make bleach.
- The calcium sulfide produced in **Step 2** was converted into sulfur. This sulfur was used to make sulfuric acid.

2 (a) The symbol equation for the reaction in **Step 1** is shown below.

$$2NaCl(s) + H_2SO_4(l) \rightarrow Na_2SO_4(s) + 2HCl(g)$$

What property of hydrogen chloride allowed it to escape into the atmosphere?

.....

(1 mark)

2 (b) The insoluble solids, calcium sulfide and unreacted coal were separated from the sodium carbonate solution in **Step 3**.

Suggest how this was done.

.....

.....

(1 mark)

4.1.1.2 Mixtures

Question 42 · continued

for mark

2 (c) Sodium carbonate crystals were obtained from sodium carbonate solution in **Step 4**.

Suggest how this was done.

.....

.....

(1 mark)

2 (d) It has been stated that: 'the Chemical Industry can turn problems into profit'.

State **two** problems with the original process and explain how they were turned into profit.

1 .....

.....

.....

.....

2 .....

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.....

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(4 marks)

7

4.1.1.2 Mixtures

Question 43

March 2010 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

Fuel oil is a mixture of compounds, mainly hydrocarbons.

Fuel oil is obtained from crude oil by fractional distillation.

5A Which of the following hydrocarbons is an alkane?

1 CH_6

2 C_3H_6

3 C_2H_6

4 C_2H_4

5B Which of the following describes how fuel oil is obtained from crude oil during fractional distillation?

1 boiling followed by evaporation

2 evaporation followed by boiling

3 evaporation followed by condensation

4 condensation followed by evaporation

5C Which of the following is a correct list of gases that might be produced by burning fuel oil?

1 carbon dioxide, water vapour, sulfur dioxide, carbon monoxide

2 hydrogen, carbon dioxide, sulfur dioxide, carbon monoxide

3 sulfur dioxide, carbon dioxide, water vapour, hydrogen

4 carbon, water vapour, sulfur dioxide, carbon monoxide

4.1.1.2 Mixtures

Question 43 · continued

5D Which row in the table correctly describes the type of combustion **and** a substance produced when fuel oil is burned?

	Type of combustion	Substance produced
1	Incomplete	Hydrogen
2	Complete	Carbon particles
3	Incomplete	Carbon particles
4	Complete	Carbon monoxide

Turn over for the next question

4.1.1.2 Mixtures

Question 44

March 2010 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about the extraction and uses of soybean oil.

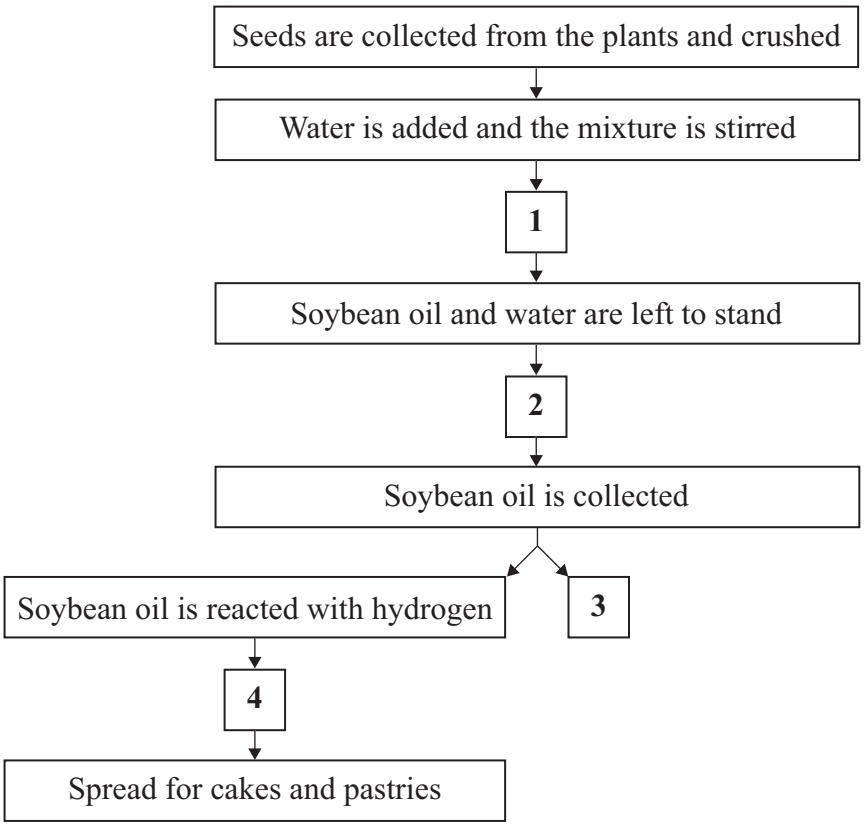
Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A The modified oil solidifies and additives are mixed in

B Soybean oil is used as biofuel in vehicles

C Soybean oil separates from the water

D Mixture of soybean seeds and water is pressed



4.1.1.2 Mixtures

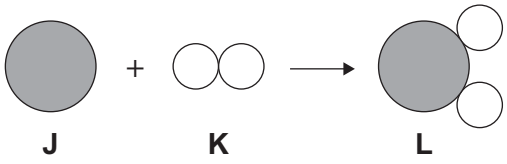
Question 45

June 2010 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram represents the reaction between substance **J** and substance **K** to create a new substance, **L**.

In the diagram, each circle represents an atom.



4A Which substance or substances are elements?

1 **J** only

2 both **K** and **L**

3 both **J** and **K**

4 **L** only

4B Substance **L** . . .

1 is an impure substance.

2 is a mixture.

3 will have the same chemical properties as substances **J** and **K**.

4 is a compound of **J** and **K**.

4C When substance **L** is formed from substances **J** and **K** . . .

1 there is an overall increase in mass.

2 there is an overall decrease in mass.

3 there is no overall change in mass.

4 the total number of atoms changes.

4D A molecule of substance **K** will . . .

1 have two separate nuclei.

2 share a nucleus.

3 not have any chemical bonds.

4 not contain any electrons.

4.1.1.2 Mixtures

Question 46 June 2010 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Mortar is made by mixing cement, sand and water, and then leaving it to set hard.

A student investigated the effect of changing the cement content on the strength of mortar.

- She made 8 blocks of mortar, one for each of the mixtures of cement and sand shown in the table.
- After 48 hours, she measured the force needed to break each solid block.

The results are shown in the table below.

Mass of cement in g	Mass of sand in g	Breaking force in N
17.5	50.0	11.7
20.0	50.0	15.2
22.5	50.0	18.7
25.0	50.0	22.2
27.5	50.0	25.7
30.0	50.0	29.2
32.5	50.0	31.7
35.0	50.0	33.2

6A The student tried to make the experiment a fair test.

Which row in the table below explains what she did, and what else she should have done?

	Steps taken by student	Extra steps needed
1	Equal volumes of water and equal setting time	Repeat the experiments several times and work out averages
2	Equal mass of cement and equal setting time	Equal size blocks and equal volumes of water
3	Equal mass of sand and equal setting time	Equal size blocks and equal volumes of water
4	Repeat the experiment several times for each mixture and work out averages	Equal size blocks and equal setting time

4.1.1.2 Mixtures

Question 46 · continued

6B Which row in the table below gives a correct description of the breaking force and the best way to show the results of the experiment?

	Breaking force	Best way to show results
1	A dependent, categoric variable	Bar chart
2	An independent, continuous variable	Line graph
3	An independent, categoric variable	Scattergram
4	A dependent, continuous variable	Line graph

6C A correct conclusion that can be made from the results is that the strength of the mortar . . .

1 is directly proportional to the mass of cement used.

2 is greater if the amount of cement used is increased.

3 could be increased by using fibres in the mixture.

4 would be reduced by using more water.

6D What conclusion might the student have made if she had stopped after her first six measurements?

1 The breaking force halves when the mass of cement doubles.

2 The breaking force decreases as the mass of cement increases.

3 Bars containing no sand would be the strongest.

4 The breaking force increases linearly with the mass of cement.

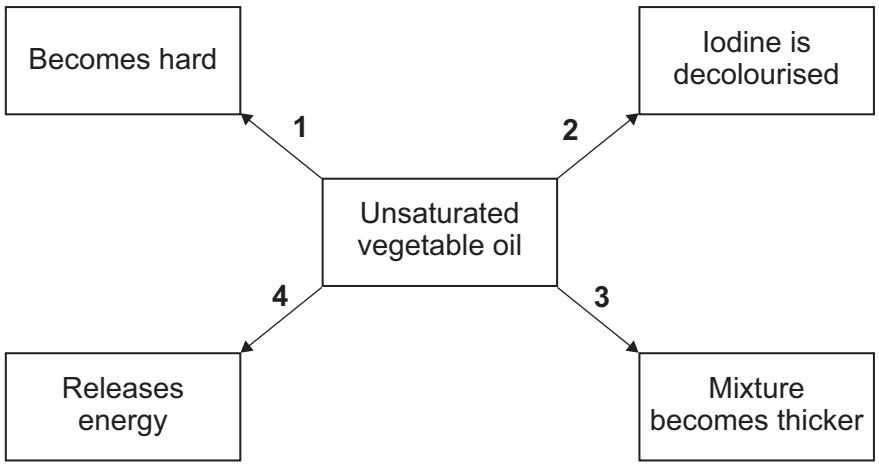
4.1.1.2 Mixtures

Question 47

June 2010 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

The diagram shows what happens to an unsaturated vegetable oil when it is treated in different ways.



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

A Burn in oxygen

B Test for unsaturation

C Add water and shake vigorously

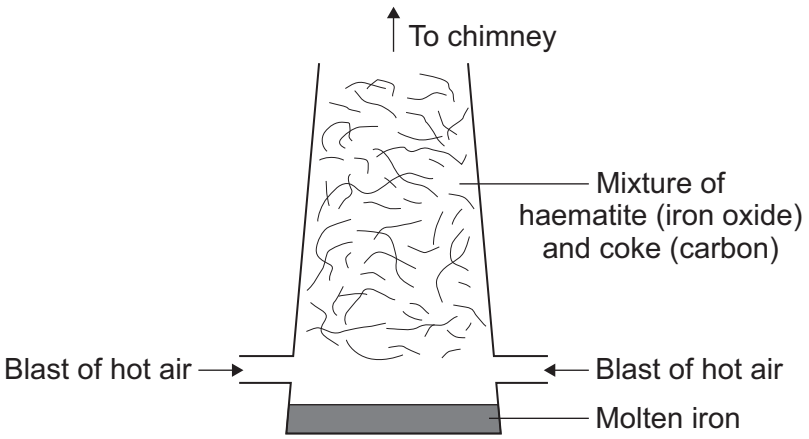
D React with hydrogen

4.1.1.2 Mixtures

Question 48

June 2010 | CHY1H | Original Q3 | Legacy

3 Iron is produced by reacting a mixture of haematite and coke in a blast furnace.
Haematite is an ore of iron containing iron oxide (Fe_2O_3).
Coke is made from coal and is almost pure carbon.



3 (a) (i) The coke burns in air. This reaction heats the furnace to above 1300 °C.

Complete the chemical equation for carbon reacting with oxygen to form carbon dioxide.

..... + O_2 → CO_2

(1 mark)

3 (a) (ii) Carbon monoxide is also formed in the furnace. Carbon monoxide reacts with iron oxide to produce iron and carbon dioxide.

iron oxide + carbon monoxide → iron + carbon dioxide

Complete and balance the chemical equation for the production of iron.

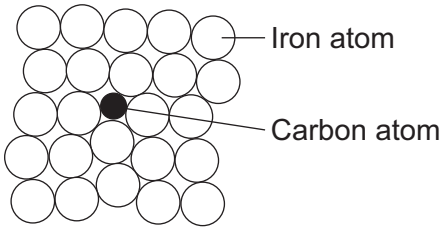
Fe_2O_3 + 3CO → ..... + ...

(2 marks)

4.1.1.2 Mixtures

Question 48 · continued

3 (a) (iii) Iron from a blast furnace is called cast iron and contains about 4% carbon.



Why is pure iron softer than cast iron?

.....

.....

.....

(1 mark)

3 (b) Steel is made by reducing the percentage of carbon in cast iron and then adding different metals to form the type of steel required.

In the UK we use about 1.8 billion steel cans every year but only 30% of these are recycled. Recycling reduces waste. Producing steel from recycled cans requires only 25% of the energy needed to make steel from iron ore.

Give **three** environmental benefits of recycling a higher percentage of used steel cans.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

7

4.1.1.2 Mixtures

Question 49

June 2010 | CHY1H | Original Q4 | Legacy

4 Medical evidence suggests that eating saturated fats, compared with unsaturated fats, is associated with a higher risk of circulatory and heart problems.

Each of the oils listed in the table contains a mixture of saturated and unsaturated fats.

Oil	Melting point in °C	Iodine number
palm	24	54
olive	–6	85
rapeseed	–10	98
sunflower	–17	127

The iodine number is the mass of iodine in grams that reacts with 100 cm^3 of the oil. The iodine number shows the amount of unsaturated fat in each oil.

4 (a) (i) What would be seen if a solution containing 1 g of iodine was added to 100 cm^3 of any of these oils?

.....

.....

(1 mark)

4 (a) (ii) What does the word *unsaturated* mean?

.....

.....

(1 mark)

4 (a) (iii) Which oil in the table would **probably** cause the highest risk of circulatory and heart problems?

Use the information in the table to give a reason for your answer.

Oil .....

Reason .....

.....

.....

.....

(2 marks)

4.1.1.2 Mixtures

Question 49 · continued

4 (b) Sunflower oil can be hardened so that it can be used to make margarine.

Explain how sunflower oil can be hardened.

.....

.....

.....

.....

.....

.....

(3 marks)

7

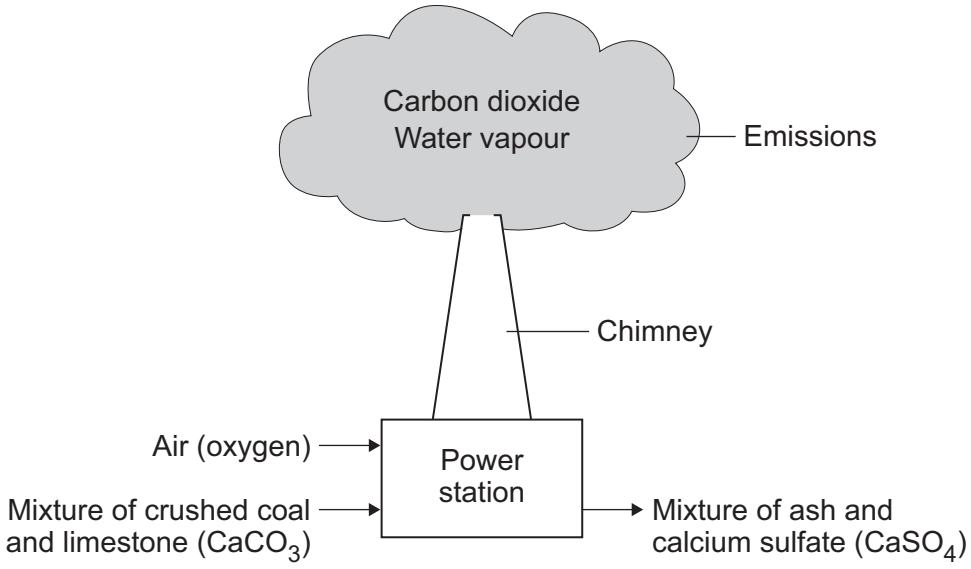
Turn over for the next question

4.1.1.2 Mixtures

Question 50

June 2010 | CHY1H | Original Q5 | Legacy

5 Most power stations burn coal to generate electricity. Burning coal gives off sulfur dioxide gas which can be removed from the waste gases by using limestone. This prevents sulfur dioxide from entering the atmosphere and causing acid rain. One disadvantage of using limestone in a power station is that it releases 'locked up carbon dioxide' into the atmosphere.



5 (a) How does the limestone used in a power station:

5 (a) (i) release carbon dioxide

.....

.....

(1 mark)

5 (a) (ii) remove sulfur dioxide?

.....

.....

(1 mark)

4.1.1.2 Mixtures

Question 50 · continued

5 (b) The waste gases from the chimney are monitored. One toxic gas that should not be released is carbon monoxide.

Explain how carbon monoxide would be formed.

.....

.....

.....

.....

(2 marks)

5 (c) The use of limestone in a power station releases 'locked up carbon dioxide' into the atmosphere.

5 (c) (i) Explain the meaning of 'locked up carbon dioxide'.

.....

.....

.....

.....

(2 marks)

5 (c) (ii) Why does the release of this carbon dioxide cause an environmental problem?

.....

.....

.....

(1 mark)

7

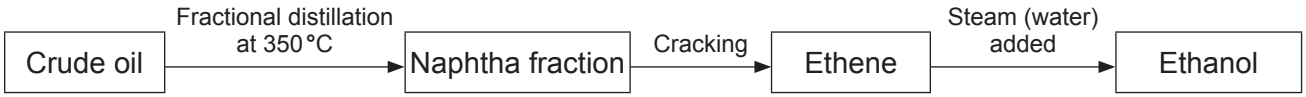
4.1.1.2 Mixtures

Question 51

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?

.....

.....

(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.

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

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

.....

.....

.....

.....

(2 marks)

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

H H

C C

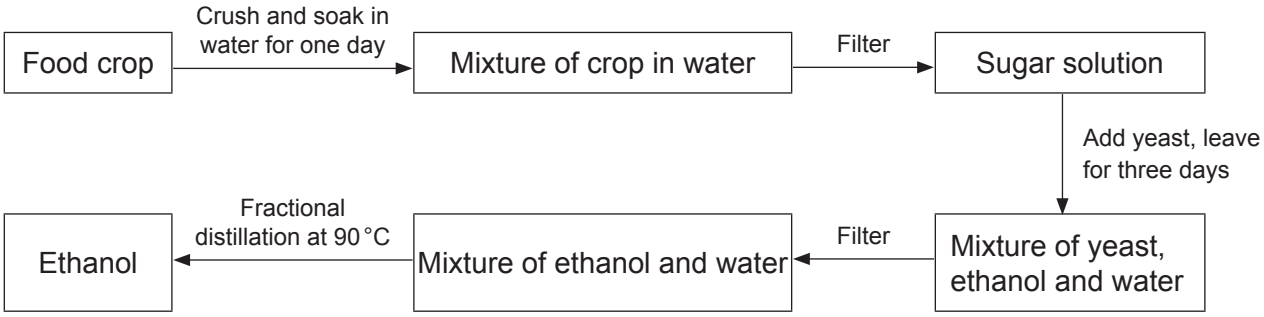
H H

(1 mark)

4.1.1.2 Mixtures

Question 51 · 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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

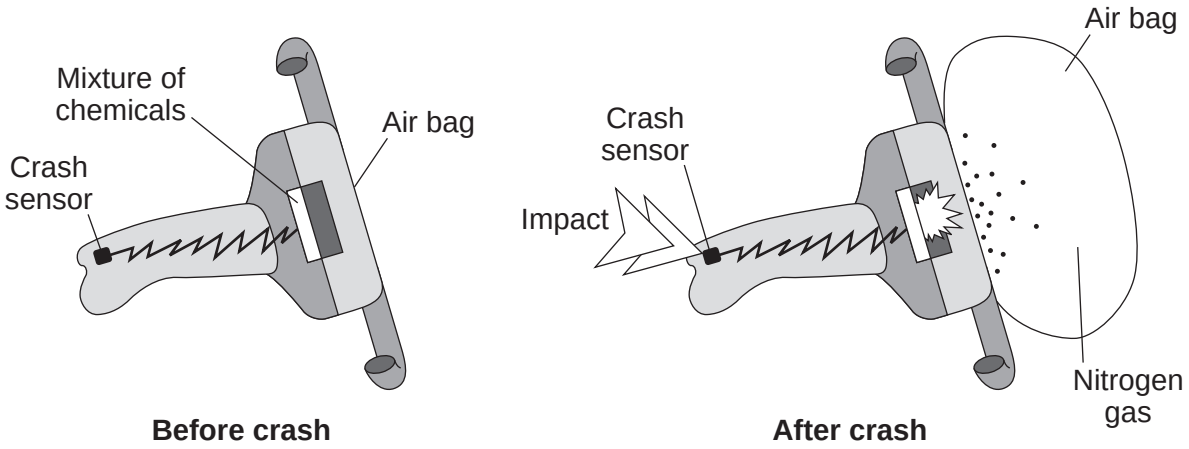
9

4.1.1.2 Mixtures

Question 52

June 2010 | CHY2H | Original Q4 | Legacy

4 Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



Before crash **After crash**

4 (a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

4 (a) (i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

.....

.....

.....

.....

Mass of nitrogen = ... g

(3 marks)

4.1.1.2 Mixtures

Question 52 · continued

4 (a) (ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

.....

Volume = ... litres

(1 mark)

4 (b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

4 (b) (i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$$10Na + ...KNO_3 \rightarrow .....Na_2O + K_2O + N_2$$

(1 mark)

4 (b) (ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

.....

.....

(1 mark)

6

4.1.1.2 Mixtures

Question 53

November 2010 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about how we obtain some metals.

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

A uses another metal

B does **not** use a chemical reaction

C could be done in a blast furnace

D is called electrolysis

1	Aluminium is made when an electric current passes through a molten aluminium compound.
2	Gold can be found at the bottom of some streams.
3	Titanium is made by reacting titanium chloride with magnesium.
4	Zinc is made when a mixture of zinc oxide and carbon is heated.

4.1.1.2 Mixtures

Question 54

November 2010 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

Concrete is made when cement, sand, gravel and water are mixed together. The strength of concrete depends on how much cement is used in the mixture. Large buildings should be made of strong concrete. It is important that the concrete used for buildings has the correct strength.

In an experiment, different concrete mixtures were made up and allowed to set in a mould. The amount of cement added was varied, but the mix of sand, gravel and water was kept constant. The size of the mould was also kept the same.

The results of a series of tests are shown in the table.

		Strength in Newtons				
Concrete sample	**Percentage (%) of cement**	**Test 1**	**Test 2**	**Test 3**	**Test 4**	**Average**
1	5	100	110	105	105	105
2	10	120	130	125	125	125
3	15	160	160	120	160	160
4	20	180	180	180	165	
5	25	170	165	175	170	170
6	30	150	145	145	140	145

5A Which row in the table below is correct?

	The percentage (%) of cement is . . .	**The pattern in the results is best shown using a . . .**
1	an independent categoric variable	line graph
2	a dependent continuous variable	bar chart
3	an independent continuous variable	line graph
4	a dependent categoric variable	bar chart

4.1.1.2 Mixtures

Question 54 · continued

5B The average result for Concrete sample 4 is . . .

1 165 N.

2 176 N.

3 177 N.

4 180 N.

5C What is the best conclusion that can be made from the results in the table?

1 The strength of the concrete is directly proportioned to the percentage of cement.

2 The percentage of cement affects the strength of the concrete.

3 The concrete could be made stronger if steel rods were used for reinforcement.

4 Earthquakes cause weak buildings to fall down.

5D What is the best way to improve the reliability of the results of this experiment?

1 Use a range of sizes of moulds, and take an average of all the results.

2 Repeat the series of tests with different mixes of sand and gravel.

3 Repeat the same tests and compare the results.

4 Use equipment that can measure strength more accurately.

4.1.1.2 Mixtures

Question 55

November 2010 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about crude oil and some of the alkanes that it contains.

The table shows information about four of the fractions obtained from the distillation of crude oil.

Fraction	Boiling point in °C	Number of carbon atoms in the molecules of the alkanes in the fraction
Gases	Lower than 25	1–4
Petrol	25–60	4–11
Naphtha	60–180	7–14
Kerosene	180–222	11–15

7A Which of the following is the likely boiling point for the alkane with twelve **hydrogen** atoms?

1 −16 °C

2 36 °C

3 76 °C

4 186 °C

7B Which of the following statements about the distillation of crude oil is correct?

1 It produces more alkanes than were in the original mixture.

2 It will not use up the world's fuel supplies.

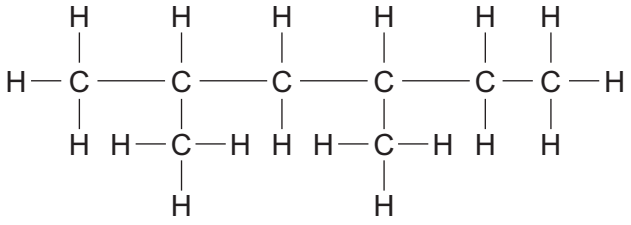
3 It will contribute to global warming.

4 It is a continuous process that could go on for ever.

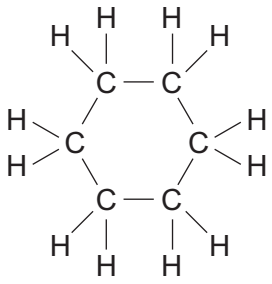
Question 55 · continued

7C Which of the following hydrocarbons would give the same number of molecules of carbon dioxide on complete combustion as octane C_8H_{18}?

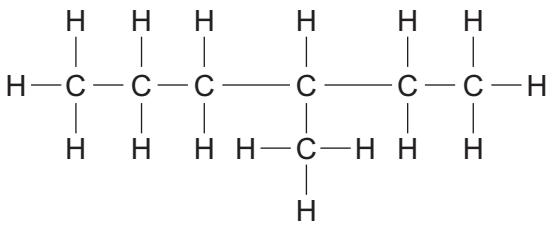
1



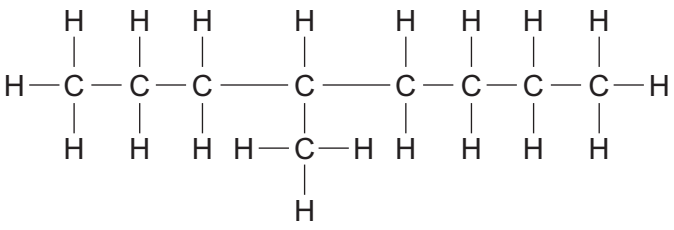
2



3



4



7D Hexane is the **sixth** member of the alkanes.

Which of the following could **not** be calculated from this information about its position in the alkane series?

1 its chemical formula

2 the number of water molecules produced by burning one molecule of hexane

3 the number of bonds in one molecule of hexane

4 the number of carbon monoxide molecules produced by the incomplete combustion of one molecule of hexane

4.1.1.2 Mixtures

Question 56

November 2010 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about vegetable oils.

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

A chromatography

B combustion

C hydrogenation

D unsaturation

Vegetable oils are important foods and fuels.

Artificial colours in foods are usually detected by . . . **1** . . . .

Reacting oils with bromine will show the degree of . . . **2** . . . in the oil.

The melting points of vegetable oils can be increased by . . . **3** . . . .

Oils release energy by the process of . . . **4** . . . .

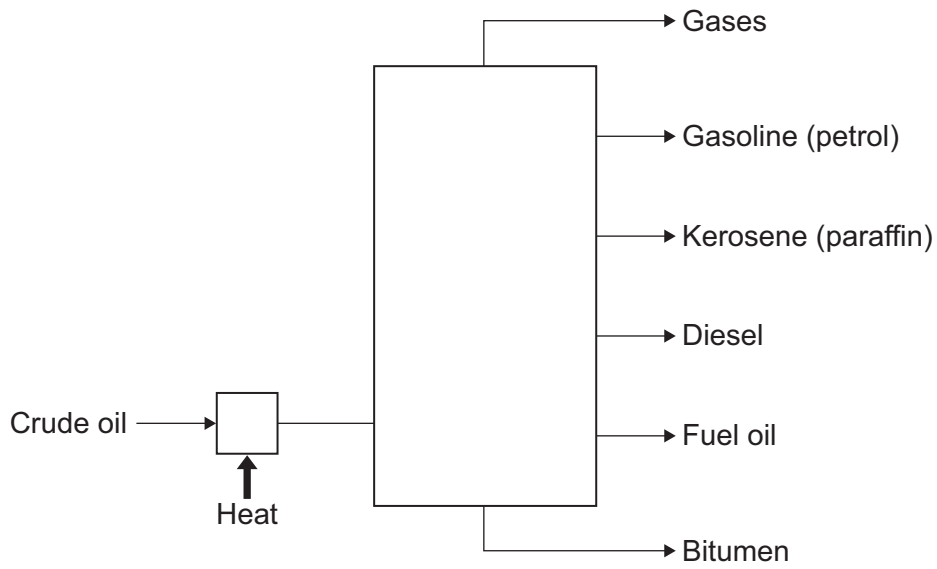
4.1.1.2 Mixtures

Question 57

January 2011 | CHY1H | Original Q2 | Legacy

2 Crude oil is used to produce many useful materials.

2 (a) The diagram shows some of the fractions produced from crude oil by fractional distillation.



Use the diagram to help you to explain how crude oil is separated into fractions.

You should use the words evaporated and condensed in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

4.1.1.2 Mixtures

Question 57 · continued

2 (b) The table shows some information about four of the fractions from crude oil that are used as fuels.

Fraction	Boiling point in °C	Number of carbon atoms found in the molecules
Gasoline (petrol)	20 – 200	5 – 10
Kerosene (paraffin)	180 – 260	10 – 16
Diesel	260 – 340	14 – 20
Fuel oil	370 – 600	20 – 70

Use the information in the table to help you to answer these questions.

2 (b) (i) How can you tell that each of the fractions is a mixture?

.....

.....

(1 mark)

2 (b) (ii) How does the number of carbon atoms in a molecule affect its boiling point?

.....

.....

(1 mark)

2 (c) Fuels are substances that release energy.

2 (c) (i) Name the reaction that releases energy from a fuel such as gasoline (petrol).

.....

(1 mark)

2 (c) (ii) Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).

.....

.....

.....

.....

(2 marks)

8

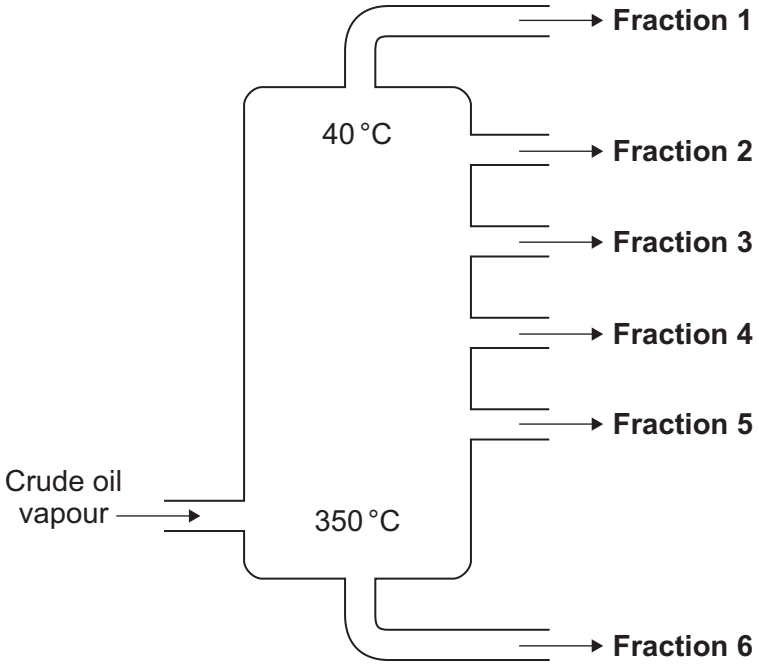
4.1.1.2 Mixtures

Question 58

March 2011 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

Crude oil can be separated into fractions by fractional distillation.



5A The fractions can be separated in this way because the hydrocarbons in the crude oil . . .

1 have different chemical properties.

2 are compounds containing only two elements.

3 are gases, liquids and solids.

4 have different boiling points.

5B Each fraction will contain . . .

1 a single alkane.

2 alkanes with the same chemical formula.

3 a mixture of alkanes.

4 alkanes with the same number of carbon atoms in each molecule.

4.1.1.2 Mixtures

Question 58 · continued

5C When compared with **Fraction 5**, **Fraction 3** . . .

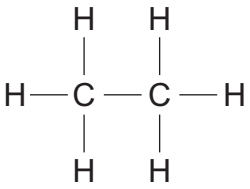
1 will be more difficult to ignite.

2 will be more volatile.

3 will be more viscous.

4 will have boiling points in a higher range.

5D The diagram shows a molecule of an alkane.



In which fraction will most of this alkane be found?

1 **Fraction 1**

2 **Fraction 2**

3 **Fraction 4**

4 **Fraction 6**

4.1.1.2 Mixtures

Question 59

March 2011 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Some vehicles which normally use petroleum diesel fuel can also use a mixture of biodiesel and petroleum diesel.

Petroleum diesel is made from crude oil.
Biodiesel is made from a variety of vegetable oils: for example, soybean, palm and rapeseed.
This means that large areas of land are needed to grow crops from which to extract the vegetable oils for the production of biodiesel.

8A Research into the production and use of biodiesel continues.

The main reason for this is that . . .

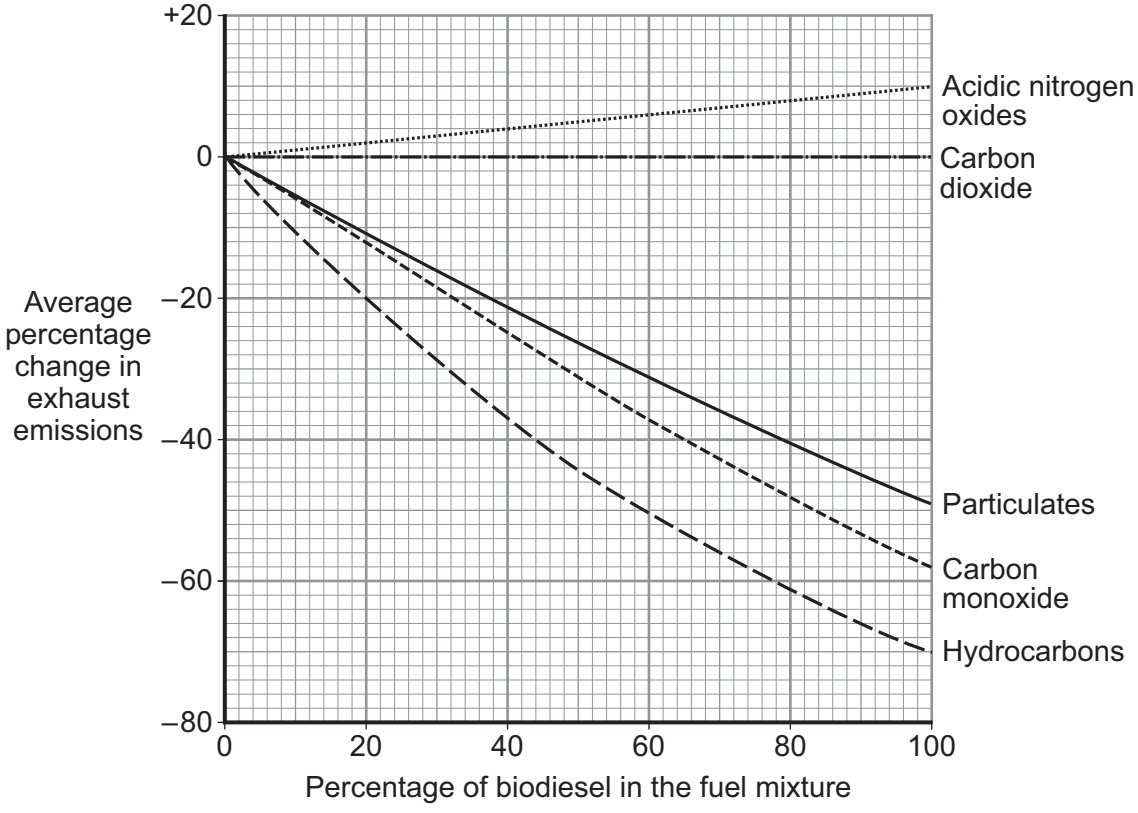
1 unused food crops are being wasted in some developing countries.

2 large, new oilfields have been discovered in Europe.

3 crude oil is a non-renewable energy source.

4 car manufacturers are making cars that run only on biodiesel.

The graph shows the average percentage change in exhaust emissions from vehicles using different mixtures of petroleum diesel and biodiesel.



4.1.1.2 Mixtures

Question 59 · continued

8B Some scientists claim that net carbon dioxide emissions are lower for biodiesel than for petroleum diesel.

What is the basis for this argument?

1 Biodiesel produces less carbon dioxide when it burns.

2 Plants take up carbon dioxide as they grow.

3 Biodiesel is not a carbon compound.

4 Plants release carbon dioxide in respiration.

8C The graph indicates that when compared with 100 % petroleum diesel, a fuel mixture of equal volumes of petroleum diesel and biodiesel will . . .

1 reduce nitrogen oxides by about 5 %.

2 increase both particulates and carbon monoxide by about 25 %.

3 reduce hydrocarbons by about 45 %.

4 reduce carbon dioxide by about 5 %.

8D One possible disadvantage of using fuel with a high percentage of biodiesel is that . . .

1 it is non-biodegradable.

2 it could increase the amount of acid rain.

3 it is non-renewable.

4 it could increase global dimming.

4.1.1.2 Mixtures

Question 60

June 2011 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Symbols	
Fe	Iron
O	Oxygen
Al	Aluminium

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

A electrons

B bonds

C products

D elements

Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the . . . **1** . . . .

Aluminium atoms and oxygen atoms combine by transferring . . . **2** . . . .

The particles (ions) in aluminium oxide are held together by . . . **3** . . . .

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the . . . **4** . . . .

4.1.1.2 Mixtures

Question 61

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.

4.1.1.2 Mixtures

Question 62

June 2011 | CHY1AP | Original Q9 | Legacy

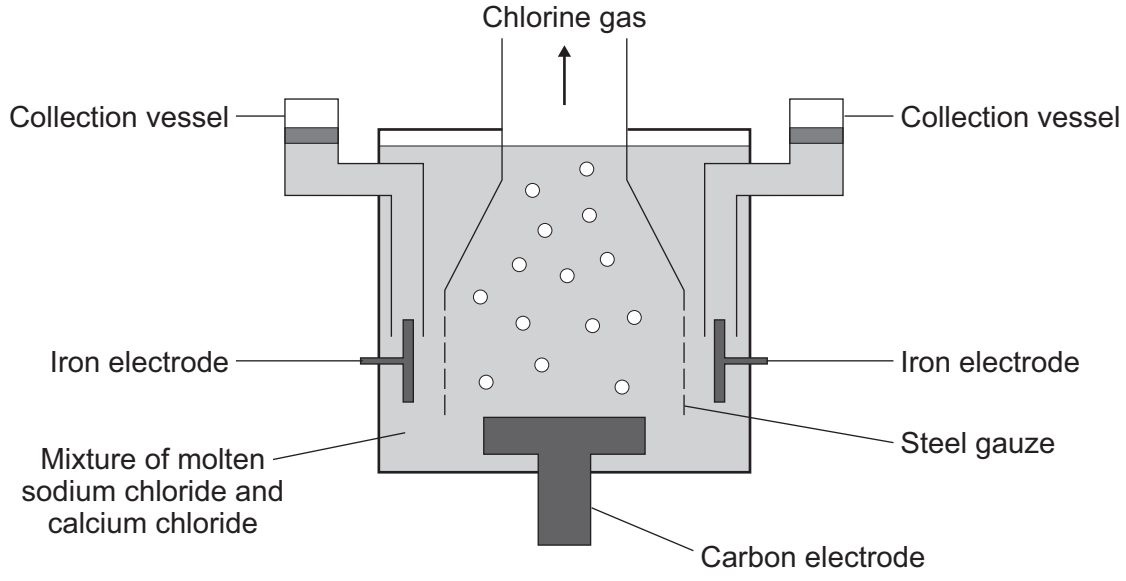
QUESTION NINE

Sodium cannot be extracted from its oxide by reduction with carbon.

Sodium metal is extracted by electrolysis of molten sodium chloride. The melting point of sodium chloride is very high (800°C), so calcium chloride is added to reduce the melting point of the mixture to about 550°C.

During electrolysis, both sodium and calcium are obtained at the iron electrodes, and chlorine at the carbon electrode.

The diagram shows the electrolysis cell used for the extraction of sodium.



The table shows some properties of sodium and calcium.

	Melting point in °C	Density in g per cm^3	Reactivity
Sodium	97	0.97	Very reactive
Calcium	839	1.55	Reactive

9A In the extraction of sodium, a mixture of sodium chloride and calcium chloride is used to . . .

1 reduce the amount of energy required to melt the mixture.

2 obtain a pure sample of sodium.

3 absorb the chlorine gas.

4 increase the temperature of the mixture.

4.1.1.2 Mixtures

Question 62 · continued

9B The purpose of the steel gauze is to prevent the reaction of . . .

1 sodium with calcium.

2 sodium with chlorine.

3 iron electrodes with sodium chloride.

4 sodium chloride with calcium chloride.

9C In the collection vessel there is . . .

1 solid sodium below a layer of liquid calcium.

2 solid calcium below a layer of liquid sodium.

3 a mixture of liquid sodium and liquid calcium.

4 a mixture of solid calcium and solid sodium.

9D The information in the diagram suggests that the element carbon . . .

1 has a melting point lower than 550 °C.

2 reacts rapidly with chlorine gas.

3 is an electrical conductor.

4 is more reactive than iron.

END OF TEST

4.1.1.2 Mixtures

Question 63

June 2011 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about sunflower oil.

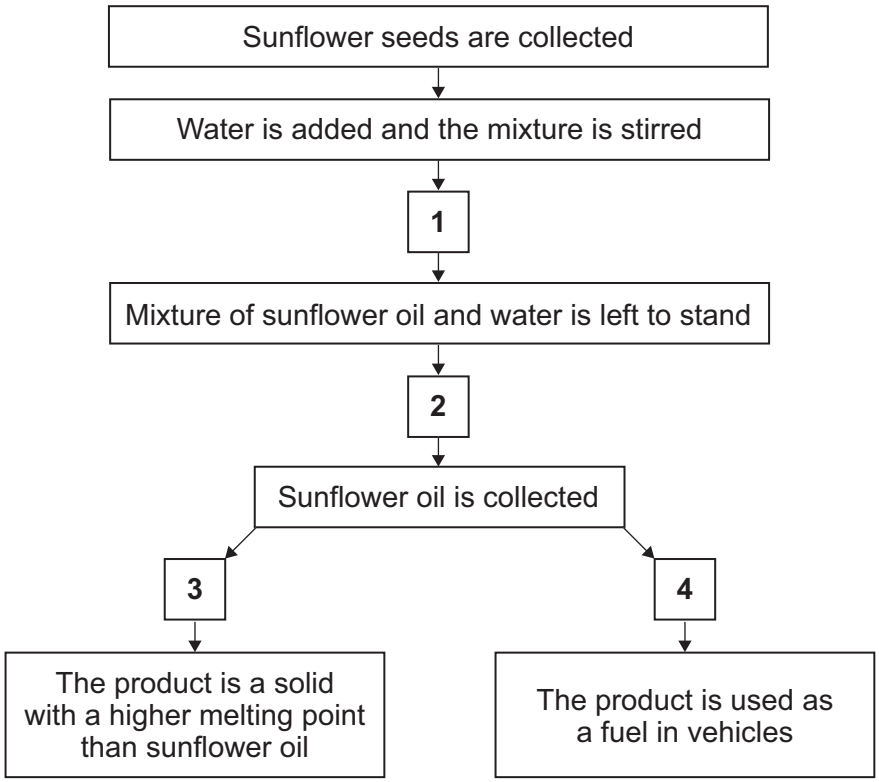
Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A Sunflower oil separates as a layer above the water.

B Sunflower oil is reacted with hydrogen at 60 °C.

C Sunflower oil is mixed with petroleum diesel.

D Mixture of sunflower seeds and water is pressed.



4.1.1.2 Mixtures

Question 64

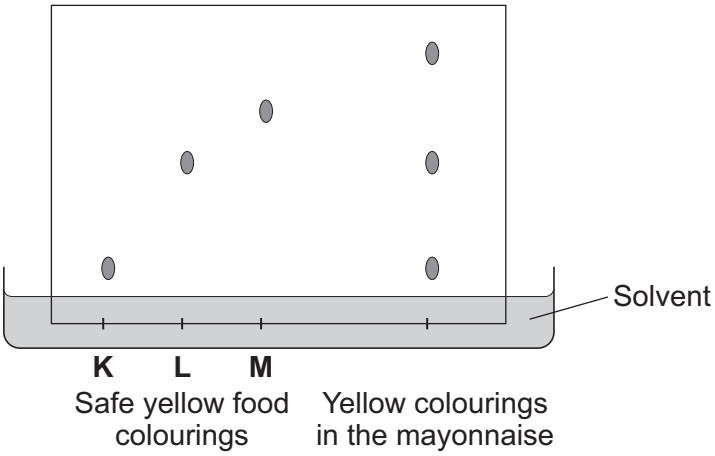
June 2011 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

This ingredients list was on a jar of mayonnaise.

Ingredients
Water
Rapeseed oil
Sugar
Egg yolk
Cornflower
Vinegar
Colourings
Preservative E202

A test was used to find out if the yellow colourings in the mayonnaise were safe to eat.
The result of the test is shown below.



4A The test to detect and identify the colours is called . . .

1 distillation.

2 extraction.

3 vaporisation.

4 chromatography.

4B The test results show that in the mayonnaise . . .

1 none of the colourings is safe.

2 only one of the colourings is safe.

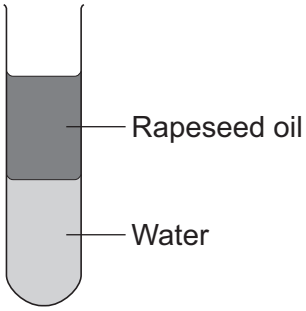
3 two of the colourings are safe.

4 all of the colourings are safe.

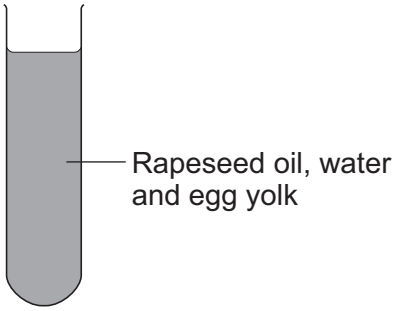
4.1.1.2 Mixtures

Question 64 · continued

4C The diagrams show an experiment using some of the ingredients in the mayonnaise.



Mixture of rapeseed oil and water, shaken then left to stand



Mixture of rapeseed oil, water and egg yolk, shaken then left to stand

The results of the experiment suggest that . . .

1 rapeseed oil dissolves in water.

2 rapeseed oil is unsuitable for use in mayonnaise.

3 egg yolk is an emulsifier.

4 egg yolk improves the colour of the mayonnaise.

4D The preservative in the mayonnaise has an E-number.

This means that this preservative . . .

1 is a natural ingredient.

2 adds to the flavour of the mayonnaise.

3 is a permitted additive.

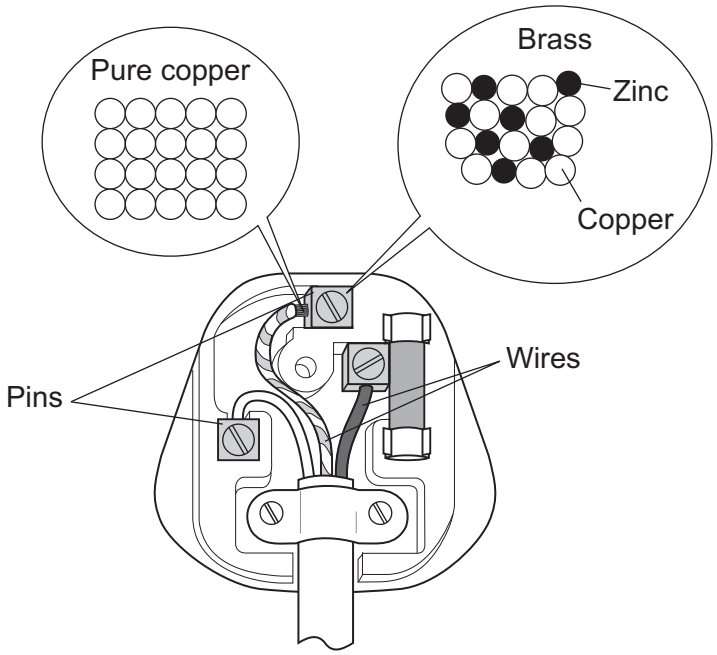
4 improves the appearance of the mayonnaise.

4.1.1.2 Mixtures

Question 65

June 2011 | CHY1H | Original Q3 | Legacy

3 The diagram shows an electric plug.



3 (a) Brass is used for the pins because it is harder than pure copper. Use the particle diagrams to help you to explain why.

.....

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(2 marks)

Question 3 continues on the next page

4.1.1.2 Mixtures

Question 65 · continued

3 (b) An ore contains a mixture of zinc carbonate and lead carbonate. Zinc and lead are produced from this ore by two reactions.

3 (b) (i) **Reaction 1**: The carbonates in the ore are converted into a mixture of zinc oxide and lead oxide.

Name this type of reaction. .....

How is this reaction done? .....

.....

(2 marks)

3 (b) (ii) **Reaction 2**: The metal oxides are mixed with carbon and heated in a furnace to produce zinc and lead.

Explain why zinc and lead are produced.

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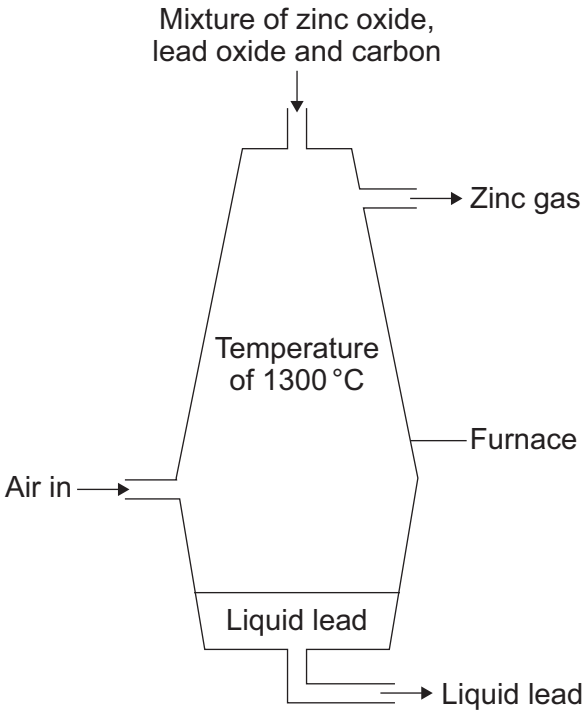
(2 marks)

4.1.1.2 Mixtures

Question 65 · continued

3 (b) (iii) The diagram represents a furnace used to produce zinc and lead from their oxides.



Metal	Melting point in °C	Boiling point in °C	Density in g per cm^3
Lead	328	1751	11.3
Zinc	420	908	7.1

Use the diagram and the information in the table to explain how zinc and lead are separated in the furnace.

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(2 marks)

8

4.1.1.2 Mixtures

Question 66

June 2011 | CHY1H | Original Q4 | Legacy

4 This is part of an article about food additives.

THE PERIL OF FOOD ADDITIVES

Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow).
These three additives are thought to cause hyperactivity in children.

4 (a) State **two** reasons why a manufacturer could justify the use of these additives.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) Some scientists asked 4000 twelve year-old children to help them to investigate if there is a link between these three additives and hyperactivity.
How would the scientists use these 4000 children to investigate if there is a link between these three additives and hyperactivity in children?

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(4 marks)

4.1.1.2 Mixtures

Question 66 · continued

4 (c) A manufacturer used an independent scientist to show that their orange drink did not contain these three additives.

4 (c) (i) Suggest why the manufacturer would use a scientist who was independent instead of using their own scientist.

.....

.....

(1 mark)

4 (c) (ii) The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.

Describe how the scientist could use the results to show that the orange drink did not contain any of these three additives. (You may include a diagram of the paper chromatography results.)

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(2 marks)

9

4.1.1.2 Mixtures

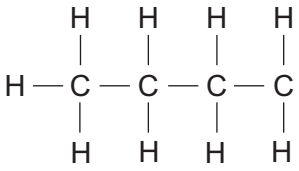
Question 67

June 2011 | CHY1H | Original Q5 | Legacy

5 Crude oil is a mixture of hydrocarbons. Most of these hydrocarbons are alkanes.

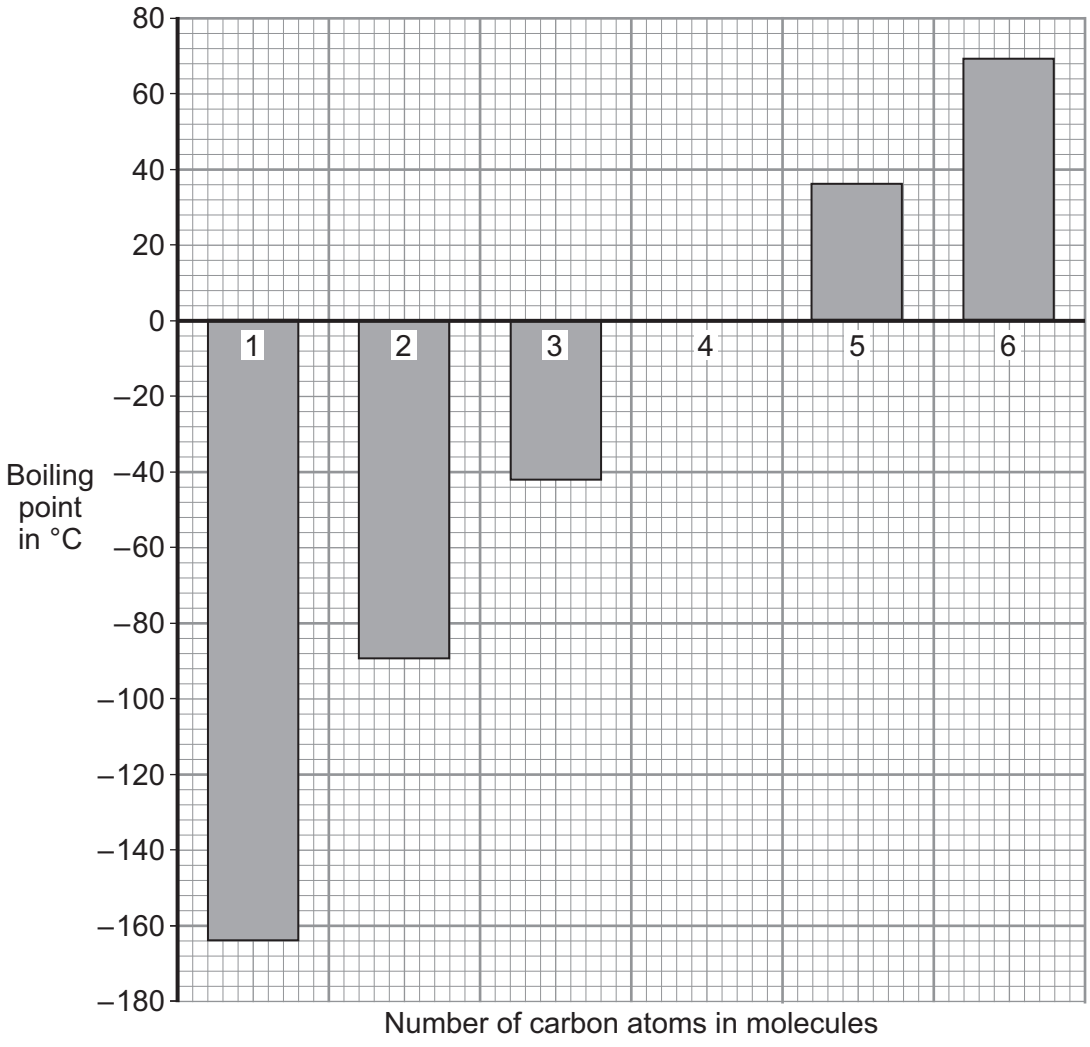
5 (a) The general formula of an alkane is C_nH_{2n+2}

Complete the structural formula for the alkane that has **six** carbon atoms in its molecules.



(1 mark)

5 (b) The boiling points of alkanes are linked to the number of carbon atoms in their molecules.



5 (b) (i) Describe the link between the number of carbon atoms in an alkane molecule and its boiling point.

.....

.....

(1 mark)

4.1.1.2 Mixtures

Question 67 · continued

5 (b) (ii) Suggest **two** reasons why all of the alkanes in the bar chart are better fuels than the alkane with the formula $C_{30}H_{62}$

1 .....

.....

2 .....

.....

(2 marks)

5 (c) During the last 200 million years the carbon cycle has maintained the percentage of carbon dioxide in the atmosphere at about 0.03 %.
Over the last 100 years the percentage of carbon dioxide in the atmosphere has increased to about 0.04 %.
Most of this increase is caused by burning fossil fuels to heat buildings, to generate electricity and to power our transport.
Fossil fuels contain carbon that has been locked up for millions of years.

5 (c) (i) Burning fossil fuels, such as petrol, releases this locked up carbon. Balance the chemical equation for the combustion of one of the alkanes in petrol.

$$2\,C_8H_{18} + 25\,O_2 \longrightarrow \text{.....}\ CO_2 + \text{.....}\ H_2O$$

(1 mark)

5 (c) (ii) Where did the carbon that is locked up in fossil fuels come from?

.....

.....

(1 mark)

5 (c) (iii) The burning of fossil fuels has caused the percentage of carbon dioxide in the atmosphere to increase to above 0.03 %.
Explain why.

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(2 marks)

8

4.1.1.2 Mixtures

Question 68

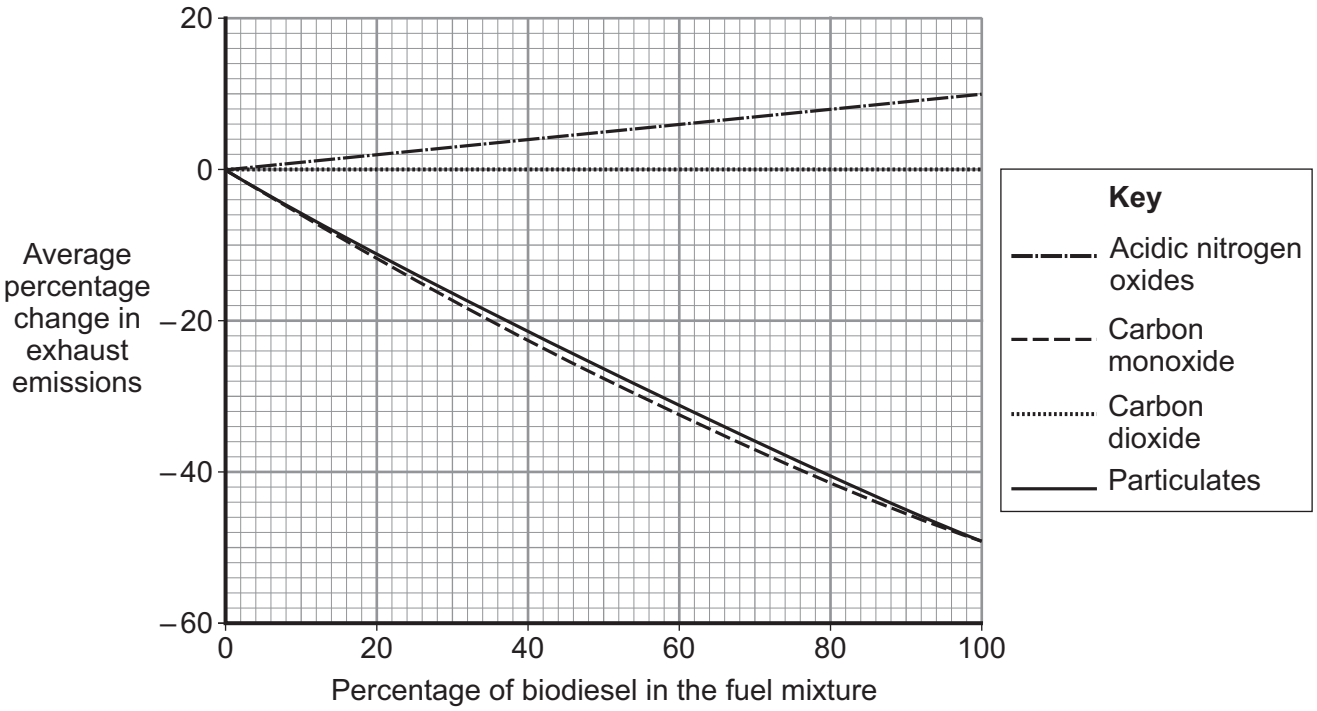
June 2011 | CHY1H | Original Q6 | Legacy

6 Petroleum diesel is produced from crude oil.

Most vehicles that use petroleum diesel as fuel can also use biodiesel or a mixture of these two fuels. In the UK (in 2010) there must be 5% biodiesel in all petroleum diesel fuel.

Biodiesel is produced from plant oils such as soya. The crops used to produce biodiesel can also be used to feed humans. The benefit that biodiesel is 'carbon neutral' is outweighed by the increasing demand for crops. This increasing demand is causing forests to be burnt to provide land for crops to produce biodiesel. Only a huge fall in the price of petroleum diesel would halt the increasing use of biodiesel.

The graph shows the average percentage change in exhaust emissions from vehicles using different mixtures of petroleum diesel and biodiesel.



4.1.1.2 Mixtures

Question 68 · continued

There is no difference in carbon dioxide emissions for all mixtures of petroleum diesel and biodiesel.

Use the information and your knowledge and understanding to evaluate the use of plant oils to produce biodiesel.

Remember to give a conclusion to your evaluation.

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(5 marks)

5

4.1.1.2 Mixtures

Question 69

June 2011 | CHY2H | Original Q3 | Legacy

3 The picture shows lumps of phosphate rock.



Phosphoric acid is made by adding sulfuric acid to phosphate rock.

3 (a) The rate of reaction between sulfuric acid and phosphate rock can be increased if the mixture is heated to a higher temperature.

Explain, in terms of particles, why an increase in temperature increases the rate of reaction.

.....

.....

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.....

(2 marks)

3 (b) State **one** other way in which the rate of reaction between sulfuric acid and phosphate rock can be increased.

.....

.....

(1 mark)

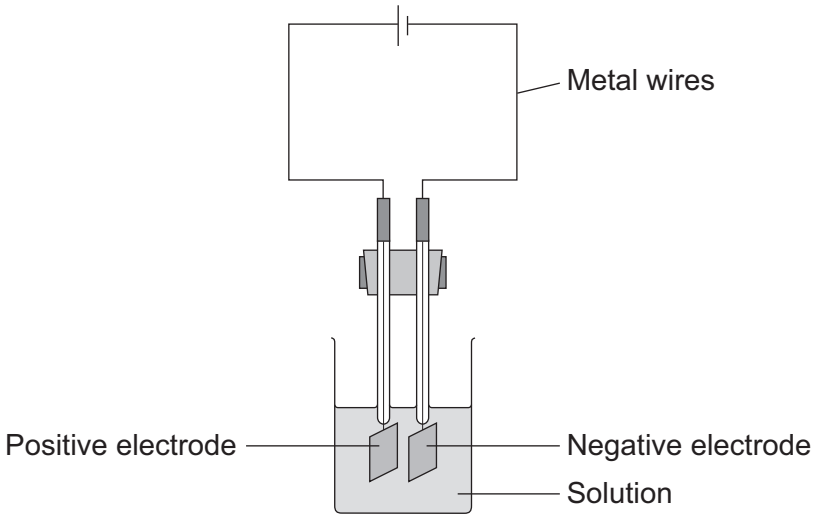
3

4.1.1.2 Mixtures

Question 70

June 2011 | CHY2H | Original Q5 | Legacy

5 The diagram shows apparatus used by a student to investigate electrolysis.



The student was given a solution by the teacher. The solution contained a mixture of ionic compounds.

5 (a) Name the particles which carry the electric current through:

5 (a) (i) the metal wires.....

(1 mark)

5 (a) (ii) the solution. .....

(1 mark)

5 (b) The table shows the ions in the solution.

Positive ions in the solution	Negative ions in the solution
Zinc ion (Zn^{2+})	Chloride ion (Cl^-)
Iron(III) ion (Fe^{3+})	Hydroxide ion (OH^-)
Hydrogen ion (H^+)	Nitrate ion (NO_3^-)
Copper(II) ion (Cu^{2+})	Sulfate ion (SO_4^{2-})

The reactivity series on the Data Sheet may help you to answer this question.

5 (b) (i) Which element is most likely to be formed at the negative electrode?

.....

(1 mark)

4.1.1.2 Mixtures

Question 70 · continued

5 (b) (ii) Explain, as fully as you can, why you have chosen this element.

.....

.....

.....

.....

(2 marks)

5 (c) The electrolysis of sodium chloride solution is an industrial process.

5 (c) (i) The reaction at one of the electrodes can be represented by the equation shown below.

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

The chloride ions (Cl^-) are oxidised.

Explain why.

.....

.....

(1 mark)

5 (c) (ii) The reaction at the other electrode can be represented by an equation.

Complete and balance the equation for the reaction at the other electrode.

$$H^+ \rightarrow H_2$$

(1 mark)

7

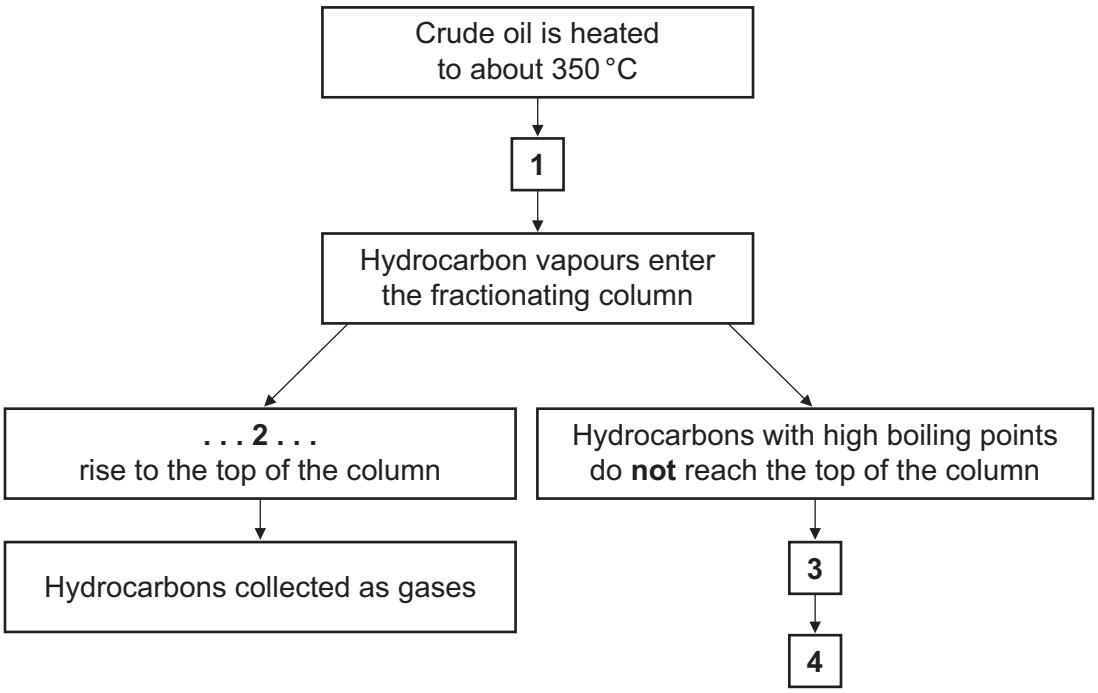
4.1.1.2 Mixtures

Question 71

November 2011 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

The flow chart shows stages in the fractional distillation of crude oil.



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

A Hydrocarbons turn to vapour

B Hydrocarbons cool

C Hydrocarbons with low boiling points

D Hydrocarbons condense to form liquids

4.1.1.2 Mixtures

Question 72

November 2011 | CHY1AP | Original Q5 | Legacy

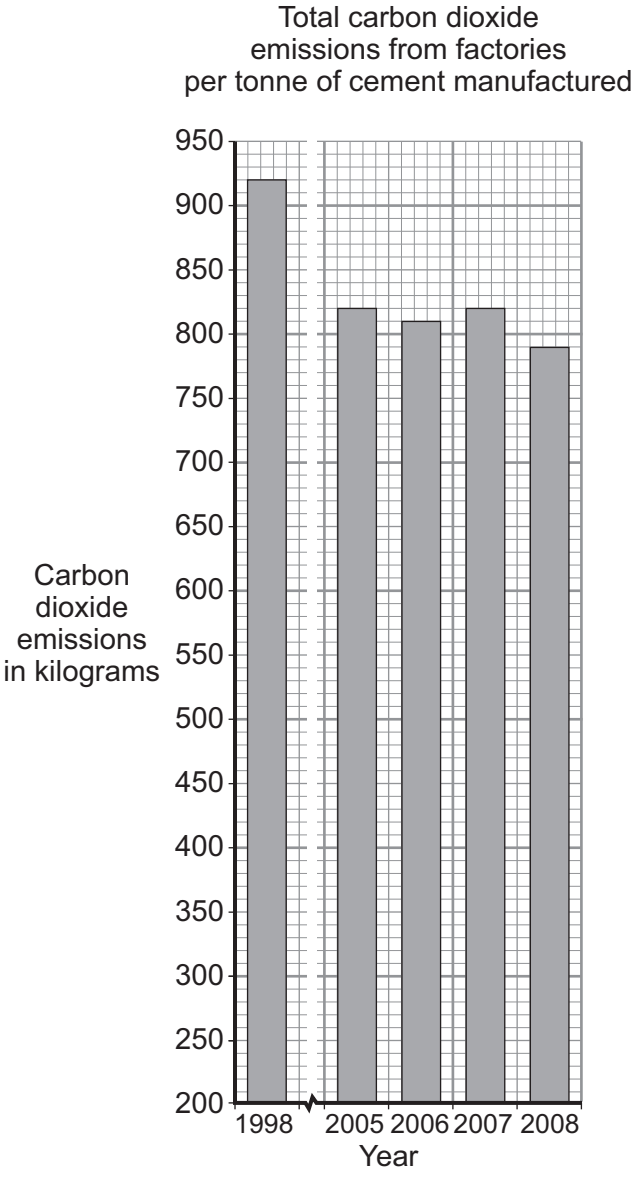
QUESTION FIVE

Cement is made in a rotary kiln, from a mixture of limestone and clay. The kiln is heated by burning a hydrocarbon fuel in air.

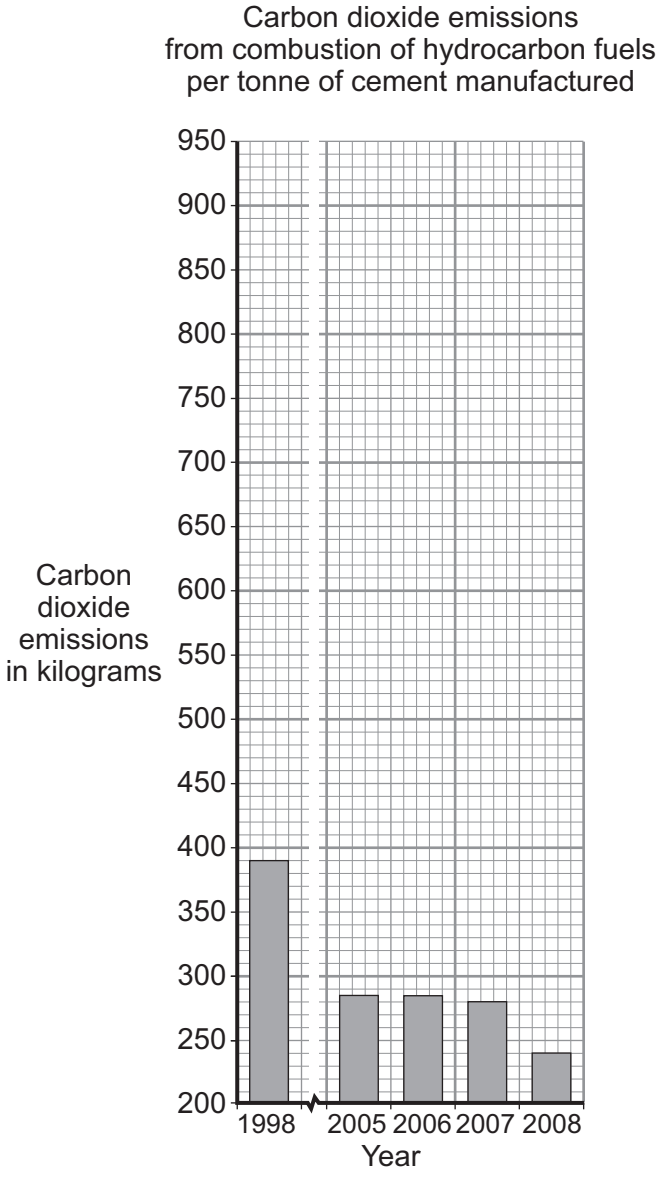
The cement industry needs to reduce carbon dioxide emissions.

Graphs 1 and **2** show carbon dioxide emissions from cement manufacture in Britain, between 1998 and 2008.

Graph 1



Graph 2



4.1.1.2 Mixtures

Question 72 · continued

5A A correct conclusion from the information in the graphs is that . . .

1 the largest reduction in total emissions of carbon dioxide was from 1998 to 1999.

2 the largest reduction in emissions of carbon dioxide from combustion of hydrocarbon fuels was from 2007 to 2008.

3 from 2007 to 2008, total emissions of carbon dioxide, per tonne of cement manufactured, reduced by 40 kilograms.

4 from 2007 to 2008, emissions of carbon dioxide from combustion of hydrocarbon fuels, per tonne of cement manufactured, reduced by 40 kilograms.

5B What was the percentage reduction in emissions of carbon dioxide from combustion of hydrocarbon fuels at cement factories between 1998 and 2008?

1 16.2 %

2 38.5 %

3 61.5 %

4 84.4 %

5C What proportion of the carbon dioxide released during cement manufacture in 2006 came from combustion of hydrocarbon fuels?

1 0.23

2 0.35

3 0.61

4 0.85

5D Most of the carbon dioxide released during cement manufacture comes from . . .

1 hydrocarbons.

2 limestone.

3 quicklime.

4 slaked lime.

4.1.1.2 Mixtures

Question 73

November 2011 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Titanium (Ti) is extracted from the ore called rutile. Rutile is mainly made up of titanium oxide (TiO_2). Titanium is not very reactive so it should be possible to displace titanium from its oxide with carbon. But carbon reacts with titanium, making it very brittle.

Therefore, titanium is extracted by reacting titanium chloride ($TiCl_4$) with sodium. Titanium chloride is produced by reacting titanium oxide with chlorine. The sodium used for the reaction is obtained by electrolysis.

The titanium chloride is added to a reactor in which sodium has been heated to about 550 °C in an inert argon atmosphere. During the reaction, the temperature increases to about 1000 °C.
After the reaction is complete, and everything has cooled, which can take several days, the mixture is crushed and washed with water to remove the sodium chloride (NaCl).

7A Which row in the table is the correct order of reactivity for carbon, sodium and titanium?

	Most reactive ⟶		**Least reactive**
1	sodium	carbon	titanium
2	carbon	titanium	sodium
3	titanium	carbon	sodium
4	sodium	titanium	carbon

7B The equation for the reaction of titanium chloride with sodium is shown below.

$$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$$

When 190 g of titanium chloride were reacted with sodium, 48 g of titanium and 234 g of sodium chloride were produced.

How much sodium is required to produce 48 g of titanium?

1 23 g

2 92 g

3 190 g

4 234 g

4.1.1.2 Mixtures

Question 73 · continued

7C A student suggested that there are four possible reasons why titanium is expensive.

J the cost of the process used to remove the sodium chloride
K large amounts of energy are needed to produce the sodium
L it takes several days to complete the process of separating the mixture
M the reacting mixture needs to be cooled to a low temperature

Which two of these reasons are correct?

1 **J** and **M**

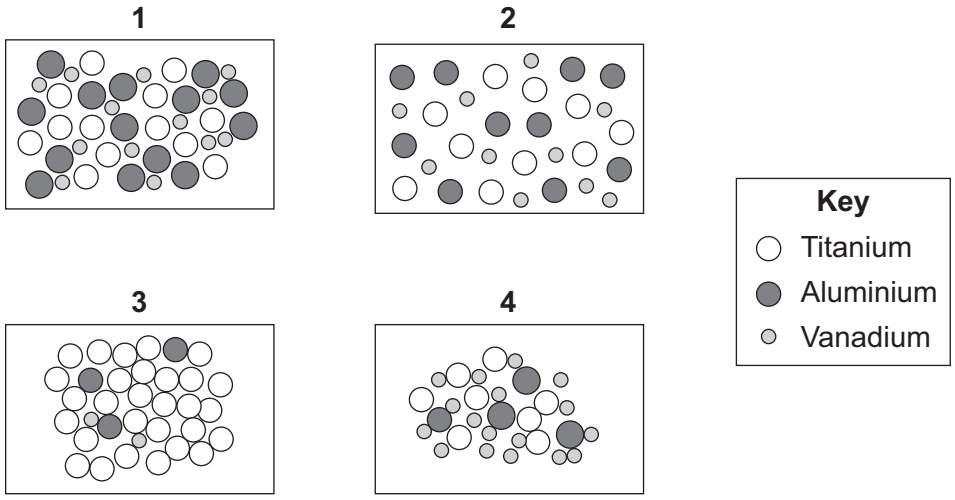
2 **K** and **L**

3 **J** and **K**

4 **L** and **M**

7D Titanium is often alloyed with small amounts of vanadium (4 %) and aluminium (6 %). This makes the titanium harder and stronger.

Which of the diagrams below shows the atoms in a sample of this titanium alloy?



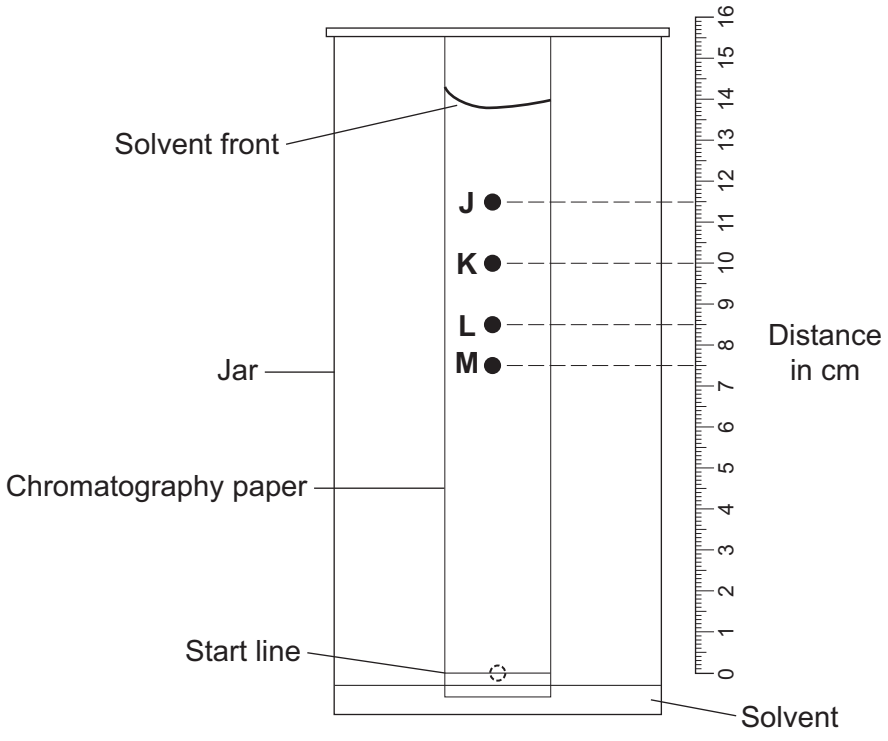
4.1.1.2 Mixtures

Question 74

November 2011 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The colours from a sweet were dissolved in a solvent. A spot of the solution was put onto some chromatography paper. The paper was then placed in a jar. After a period of time, the colours were separated as shown in the diagram.



$$\text{the } R_f \text{ value for a colour} = \frac{\text{distance moved by the colour}}{\text{distance moved by the solvent}}$$

The substance responsible for a colour can be identified by using its R_f value. This tells you where to look on the chromatogram for this colour.

9A Amaranth has an R_f value of 0.54.

Which of the colours is possibly amaranth?

1 **J**

2 **K**

3 **L**

4 **M**

4.1.1.2 Mixtures

Question 74 · continued

Indigo carmine has an R_f value of 0.58 and amaranth has an R_f value of 0.54.

9B There must be some doubt about whether a particular spot is indigo carmine or amaranth because . . .

1 the solvent front is not straight.

2 the length of time the chromatography paper was in the solvent is not known.

3 the scale is marked in 10 mm divisions.

4 only colours from one sweet were used.

9C The test was done four times for one particular colour.
R_f values of 0.51, 0.53, 0.58 and 0.61 were obtained.

This data tells us that . . .

1 the colour is amaranth.

2 the colour is indigo carmine.

3 the colour could be indigo carmine or amaranth.

4 the method cannot detect different colours.

9D It is recommended that indigo carmine should not be eaten by children.

The evidence from this investigation should lead to . . .

1 these sweets being banned.

2 further investigation with additional chemical tests.

3 these sweets being banned for children only.

4 this test being repeated more times.

END OF TEST

4.1.1.2 Mixtures

Question 75

January 2012 | CH1HP | Original Q2 | Legacy

2 A mixture of petrol and air is burned in a car engine.
Petrol is a mixture of alkanes. Air is a mixture of gases.

The tables give information about the composition of petrol and the composition of air.

Petrol	
Alkane	**Formula**
hexane	C_6H_{14}
heptane	
octane	C_8H_{18}
nonane	C_9H_{20}
decane	$C_{10}H_{22}$

Air	
Gas	**Percentage (%)**
nitrogen	78
oxygen	21
carbon dioxide	0.035
Small amounts of other gases and water vapour	

2 (a) Use the information above to answer these questions.

2 (a) (i) Give the formula for heptane.

.....

(1 mark)

2 (a) (ii) Complete the general formula of alkanes.
n = number of carbon atoms

$$C_nH$$

(1 mark)

2 (b) Alkanes in petrol burn in air.
The equations represent two reactions of hexane burning in air.

Reaction 1 $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

Reaction 2 $2C_6H_{14} + 13O_2 \rightarrow 12CO + 14H_2O$

Reaction 2 produces a different carbon compound to **Reaction 1**.

2 (b) (i) Name the carbon compound produced in **Reaction 2**.

.....

(1 mark)

2 (b) (ii) Give a reason why the carbon compounds produced are different.

.....

.....

(1 mark)

Question 2 continues on the next page

4.1.1.2 Mixtures

Question 75 · continued

2 (c) The table shows the percentages of some gases in the exhaust from a petrol engine.

Name of gas	Percentage (%)
nitrogen	68
carbon dioxide	15
carbon monoxide	1.0
oxygen	0.75
nitrogen oxides	0.24
hydrocarbons	0.005
sulfur dioxide	0.005
other gases	

2 (c) (i) What is the percentage of the other gases in the table?

.....

(1 mark)

2 (c) (ii) What is the name of the compound that makes up most of the other gases?

.....

(1 mark)

2 (c) (iii) Give a reason why sulfur dioxide is produced in a petrol engine.

.....

.....

(1 mark)

2 (c) (iv) State how nitrogen oxides are produced in a petrol engine.

.....

.....

.....

.....

(2 marks)

4.1.1.2 Mixtures

Question 75 · continued

2 (d) Many scientists are concerned about the carbon dioxide released from burning fossil fuels such as petrol.

Explain why.

.....

.....

.....

.....

(2 marks)

11

Turn over for the next question

4.1.1.2 Mixtures

Question 76

January 2012 | CH1HP | Original Q4 | Legacy

4 Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.



4 (a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

4 (a) (i) Name this type of reaction.

.....

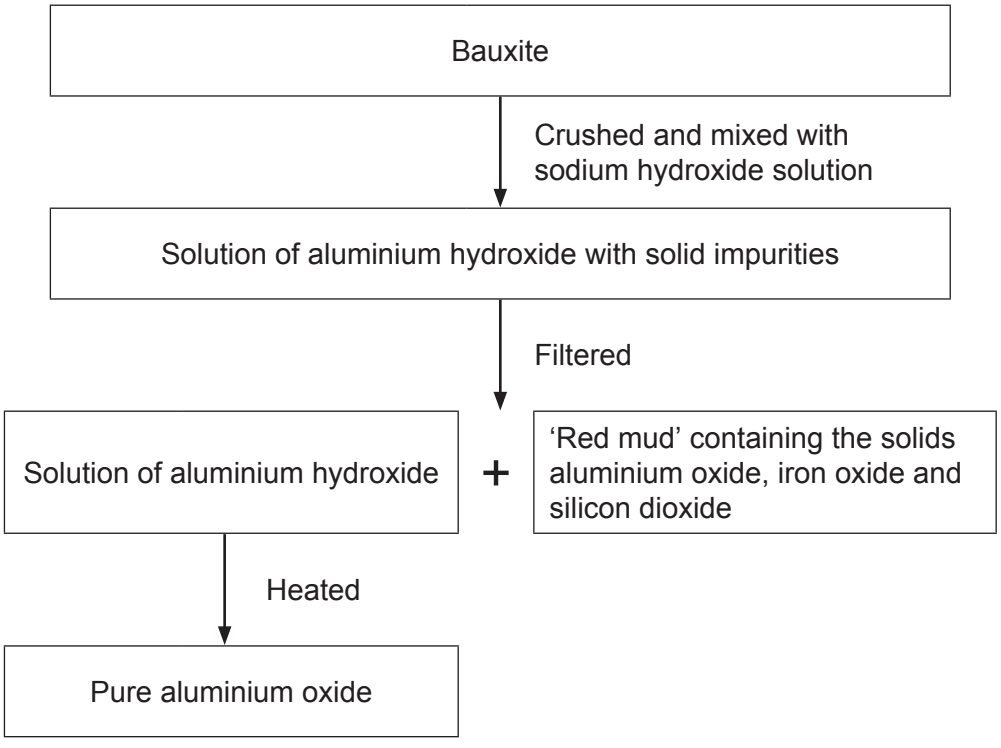
(1 mark)

4 (a) (ii) Balance the symbol equation for this reaction.

$2Fe_2O_3$ + ... C → ..... Fe + ... CO_2

(1 mark)

4 (b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide.
Aluminium is extracted by electrolysis of aluminium oxide.



4.1.1.2 Mixtures

Question 76 · continued

The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

4 (b) (i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

.....

Answer = ... %

(1 mark)

4 (b) (ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

.....

(1 mark)

4 (b) (iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

.....

(1 mark)

4 (c) Aluminium is used to make many things including cans.

During one year in the USA:
- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental .....

.....

Ethical or social .....

.....

(2 marks)

7

4.1.1.2 Mixtures

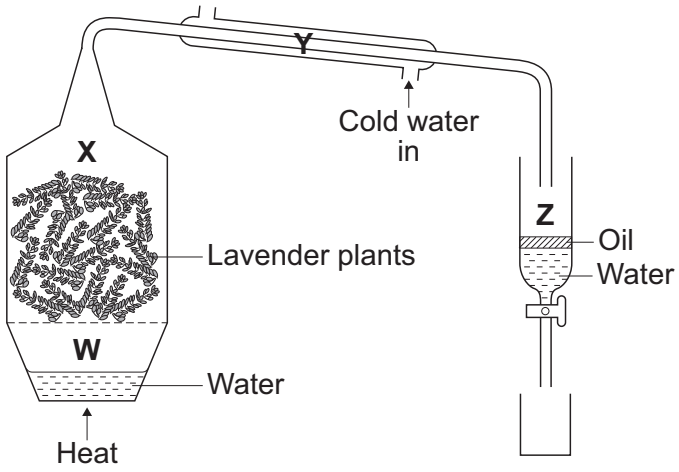
Question 77

January 2012 | CH1HP | Original Q5 | Legacy

5 This question is about plant oils.

5 (a) Steam distillation is used to separate oils from plants.

The diagram shows some apparatus that can be used to separate oil from lavender plants.
Four parts of the apparatus are labelled **W**, **X**, **Y** and **Z**.



Describe how lavender oil is separated from the plant material.

You need to describe what happens in each of the parts, **W**, **X**, **Y** and **Z**, of the apparatus.

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(4 marks)

4.1.1.2 Mixtures

Question 77 · continued

5 (b) Olive oil can be used in the manufacture of margarine.
Olive oil has a melting point of –6 °C and contains about 11 % saturated fat and 89 % unsaturated fat.

5 (b) (i) Describe a test to show that olive oil contains unsaturated compounds.

Give the result of the test.

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(2 marks)

5 (b) (ii) To make margarine from olive oil the percentage of unsaturated fat needs to be decreased.

Give **one** reason why.

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(1 mark)

5 (b) (iii) Describe how to decrease the percentage of unsaturated fat in olive oil.

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(3 marks)

10

4.1.1.2 Mixtures

Question 78

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

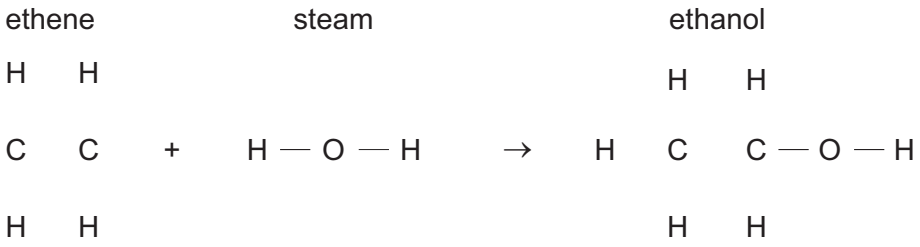
.....

.....

(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.

4.1.1.2 Mixtures

Question 78 · 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)

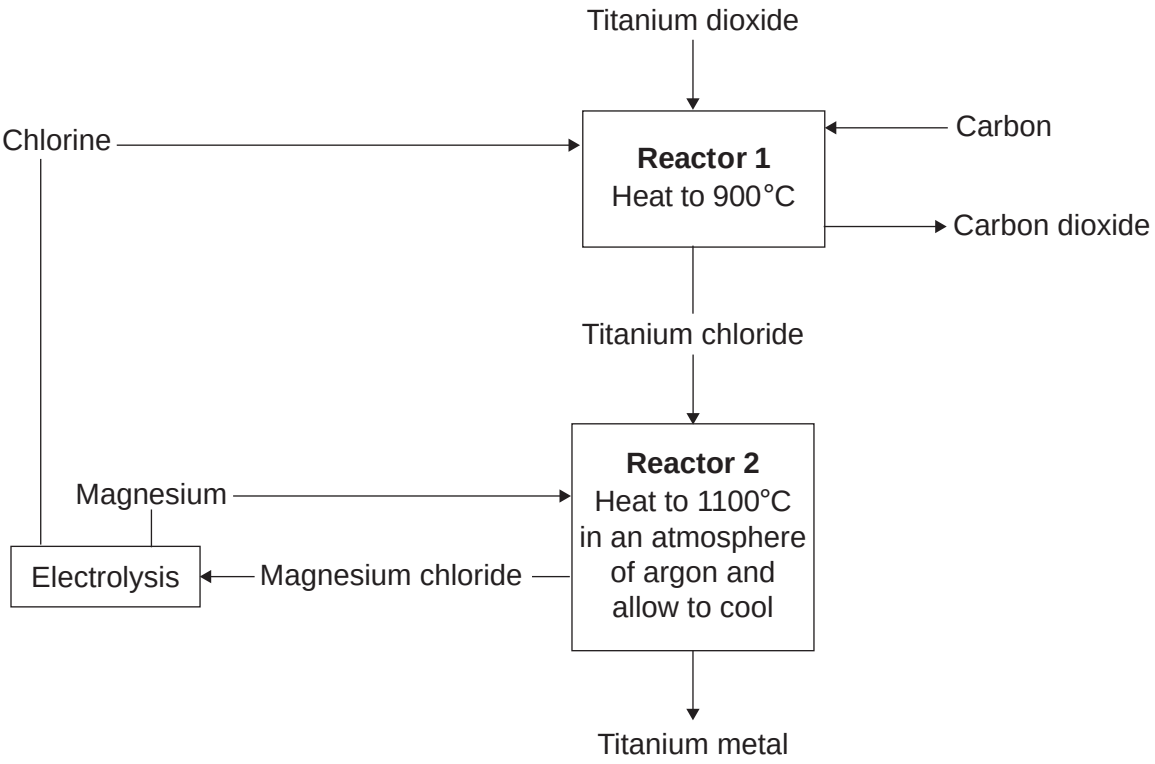
10

4.1.1.2 Mixtures

Question 79

June 2012 | CH1HP | Original Q2 | Legacy

2 Rutile is an ore of titanium. Rutile contains titanium dioxide.
The flow chart shows how titanium metal is extracted from titanium dioxide.



2 (a) Titanium is much more expensive than iron.

Give **one** reason why.

.....

.....

(1 mark)

2 (b) Name the only waste product shown on the flow chart.

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(1 mark)

4.1.1.2 Mixtures

Question 79 · continued

2 (c) Describe the example of recycling shown on the flow chart.

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(2 marks)

2 (d) The air is removed from **Reactor 2**. An atmosphere of argon is used for the reaction between titanium chloride and magnesium metal.

Explain why.

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(2 marks)

Question 2 continues on the next page

4.1.1.2 Mixtures

Question 79 · continued

2 (e) Titanium metal is produced by reacting titanium chloride with magnesium.

950 kg of titanium chloride was mixed with 240 kg of magnesium metal. The mixture was heated and produced 950 kg of magnesium chloride.

Calculate the mass of titanium metal produced.

.....

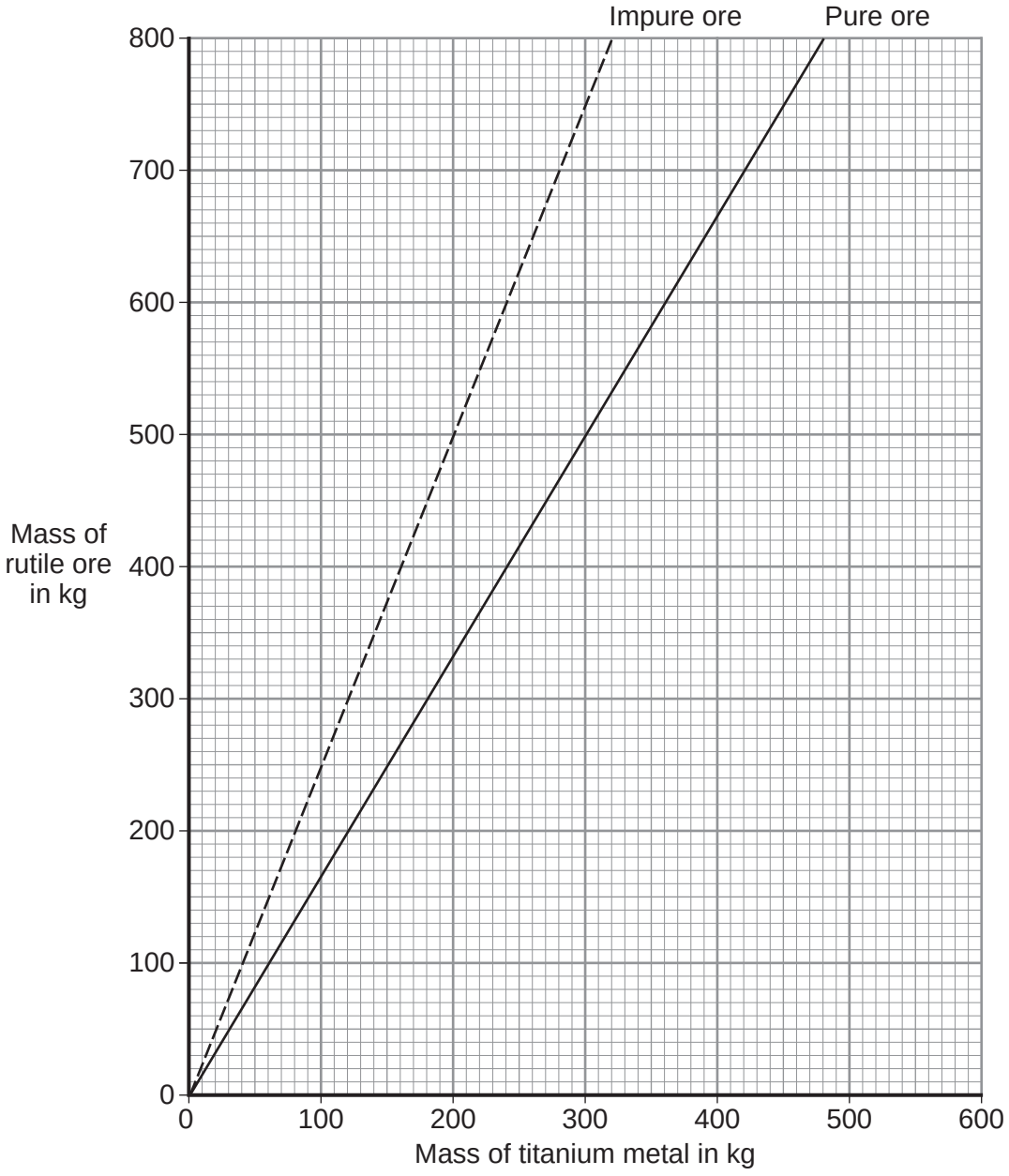
Mass = ... kg

(1 mark)

4.1.1.2 Mixtures

Question 79 · continued

2 (f) The graph shows the mass of titanium metal produced from a pure rutile ore and from an impure rutile ore.



The difference between the two lines represents the amount of waste rock in the impure ore.

300 kg of titanium metal was produced from the impure ore.

Calculate the mass of waste rock in the impure ore.

.....

Mass = ... kg

(1 mark)

8

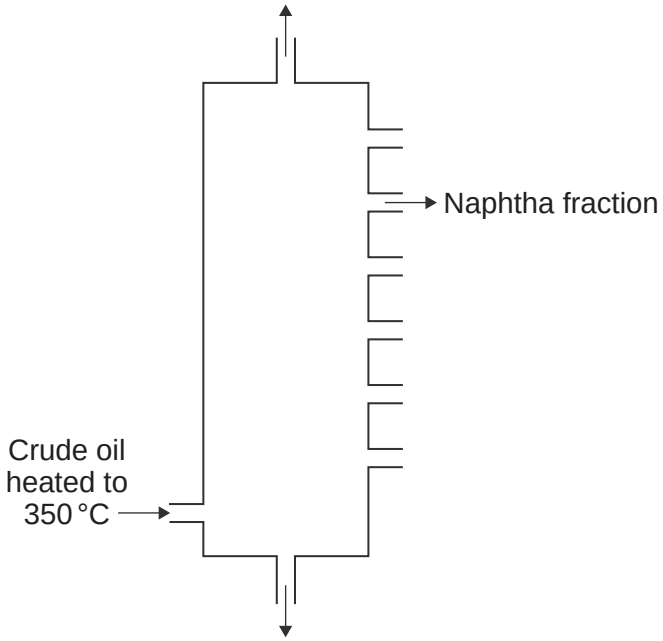
4.1.1.2 Mixtures

Question 80

June 2012 | CH1HP | Original Q3 | Legacy

3 Crude oil is used to produce poly(ethene).

3 (a) Fractional distillation is used to separate crude oil into fractions.



3 (a) (i) Write a number, **2**, **3**, **4** or **5**, next to each stage so that the description of fractional distillation is in the correct order. Numbers **1** and **6** have been done for you.

Number	Stage
1	The crude oil is heated to 350 °C.
	When a fraction in the vapours cools to its boiling point, the fraction condenses.
	Any liquids flow down to the bottom of the column and the hot vapours rise up the column.
6	The condensed fraction is separated and flows out through a pipe.
	When the hot vapours rise up the column, the vapours cool.
	Most of the compounds in the crude oil evaporate.

(2 marks)

3 (a) (ii) The naphtha fraction is cracked to produce ethene (C_2H_4).
Ethene is used to make the polymer called poly(ethene).

Name **two** substances produced when poly(ethene) burns in air.

1 .....

2 .....

(2 marks)

4.1.1.2 Mixtures

Question 80 · continued

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

Each year in the UK, billions of plastic bags are given free to shoppers. These bags are made from poly(ethene) and are often used only once.
After being used many of these plastic bags are either thrown away as litter or buried in landfill sites.

In 2006 over 10 billion of these plastic bags were given free to shoppers.
In 2009 the number of plastic bags given to shoppers had decreased to 6.1 billion.
One reason for the decrease was because some supermarkets made people pay for their plastic bags.

From 2011 a new type of plastic shopping bag made mainly from poly(ethene) had a use-by date of only one year printed on the bag.

Use the information above and your knowledge and understanding to describe advantages and disadvantages of using plastic shopping bags made from poly(ethene).

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(6 marks)

10

4.1.1.2 Mixtures

Question 81

June 2012 | CH1HP | Original Q5 | Legacy

5 Calcium carbonate is found in limestone.
Limestone is used as a building material.
Limestone is also used to make calcium oxide and calcium hydroxide.

5 (a) Limestone is heated to make calcium oxide.

5 (a) (i) Calcium oxide reacts with a substance to produce calcium hydroxide.
Name the substance.

.....

(1 mark)

5 (a) (ii) Calcium hydroxide reacts with a substance to produce calcium carbonate.
Name the substance.

.....

(1 mark)

5 (b) Limestone reacts with acids.

5 (b) (i) Balance the chemical equation for the reaction of calcium carbonate with hydrochloric acid.

$$CaCO_3 + HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

(1 mark)

5 (b) (ii) Buildings made from limestone are affected by the products from burning fossil fuels containing sulfur.

Explain why.

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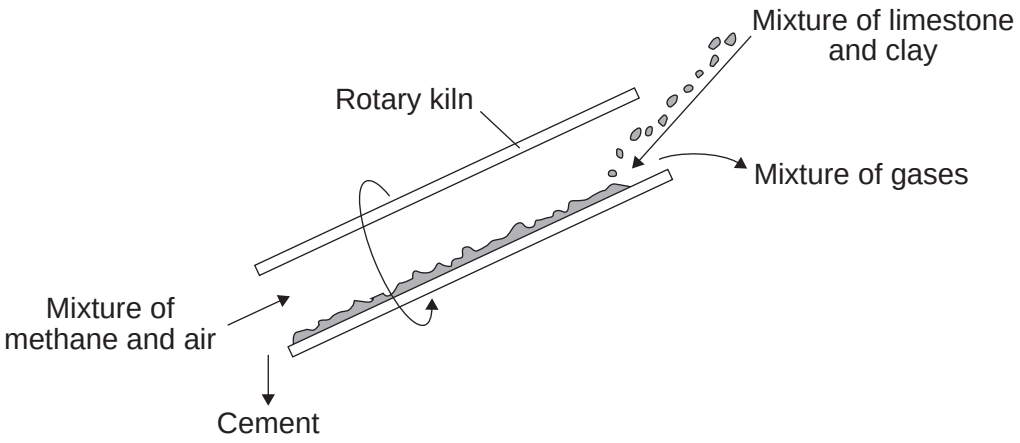
(2 marks)

4.1.1.2 Mixtures

Question 81 · continued

5 (c) When a mixture of limestone and clay is heated in a rotary kiln cement is produced.
Burning a mixture of methane and air heats the kiln.
Clay does not decompose in the kiln.



5 (c) (i) Carbon dioxide is one of the main gases in the mixture of gases coming out of the kiln.

Give **two** reasons why.

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(2 marks)

5 (c) (ii) Name the other main gas in the mixture of gases coming out of the kiln.

Give a reason why there is a high percentage of this gas in the mixture of gases coming out of the kiln.

Name of gas .....

Reason .....

.....

.....

(2 marks)

9

4.1.1.2 Mixtures

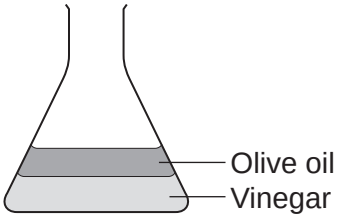
Question 82

June 2012 | CH1HP | Original Q6 | Legacy

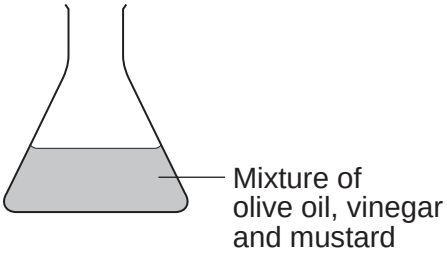
6 Olive oil is used to make salad dressings and margarine.

6 (a) Vinegar is often used to make salad dressings.
Vinegar contains 95% water and 5% ethanoic acid.

Simple salad dressing



French salad dressing



To make a simple salad dressing add olive oil to vinegar and shake. After a few minutes the mixture separates.
To make a French salad dressing add mustard to the olive oil and vinegar and shake. After several minutes the mixture does **not** separate.

6 (a) (i) Why does the mixture in the simple salad dressing separate?

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(1 mark)

6 (a) (ii) Mustard in the French salad dressing has molecules with hydrophilic properties and hydrophobic properties.

Explain why the French salad dressing does **not** separate.
You may include a diagram to help you to answer this question.

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(3 marks)

4.1.1.2 Mixtures

Question 82 · continued

6 (b) Olive oil contains 89% unsaturated fats and 11% saturated fats.

What is the test and the result for unsaturated fats?

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(2 marks)

6 (c) Olive oil is hardened to make margarine.

Describe the reaction and conditions needed to harden a vegetable oil.

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(3 marks)

9

4.1.1.2 Mixtures

Question 83

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?

.....

.....

(1 mark)

4.1.1.2 Mixtures

Question 83 · 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

4.1.1.2 Mixtures

Question 84

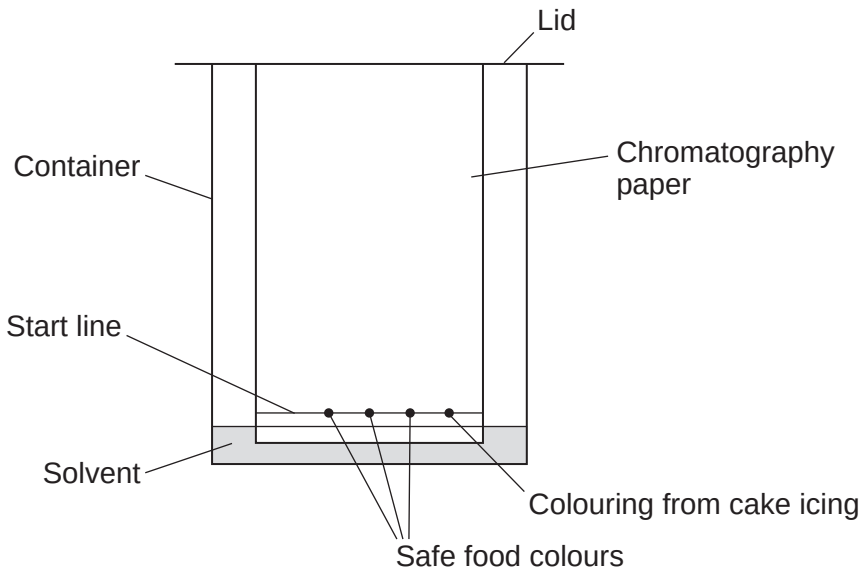
June 2012 | CH2HP | Original Q1 | Legacy

1 Icing on cakes is tested to check that safe colours were used when they were made.



Paper chromatography is one method of testing which colours are in cake icing.

1 (a) The diagram shows an experiment a student did.



1 (a) (i) Suggest why there is a lid on the container.

.....

.....

(1 mark)

1 (a) (ii) The start line should be drawn in pencil **not** in ink.
Suggest why.

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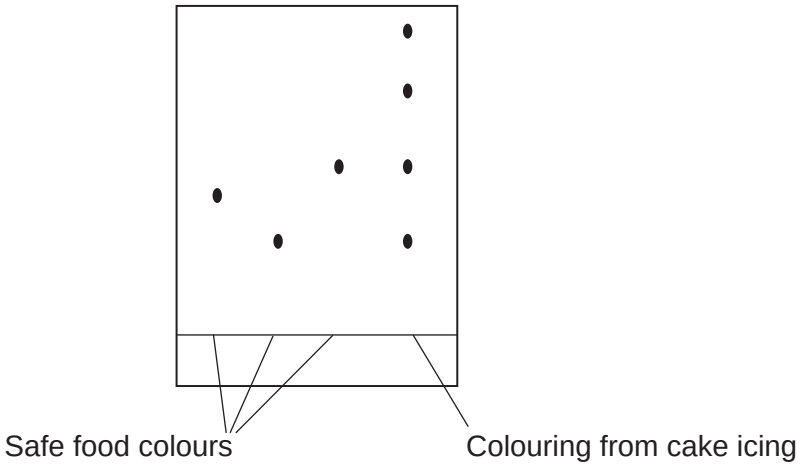
(1 mark)

4.1.1.2 Mixtures

Question 84 · continued

1 (b) The diagram shows the results of the paper chromatography experiment.



1 (b) (i) How many different food colours were used in the colouring from the cake icing?

.....

(1 mark)

1 (b) (ii) Is the cake icing safe to eat?

Give a reason for your answer.

.....

.....

(1 mark)

Question 1 continues on the next page

4.1.1.2 Mixtures

Question 84 · continued

1 (c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

1 (c) (i) Give **two** advantages of gas chromatography compared with paper chromatography.

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(2 marks)

1 (c) (ii) What does gas chromatography do to the mixture of solvents?

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(1 mark)

1 (c) (iii) What information does mass spectroscopy give?

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(1 mark)

8

4.1.1.2 Mixtures

Question 85

January 2013 | CH1HP | Original Q3 | Legacy

3 This question is about oil reserves.

3 (a) Diesel is separated from crude oil by fractional distillation.

Describe the steps involved in the fractional distillation of crude oil.

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(3 marks)

3 (b) Diesel is a mixture of lots of different *alkanes.*

What are *alkanes*?

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(2 marks)

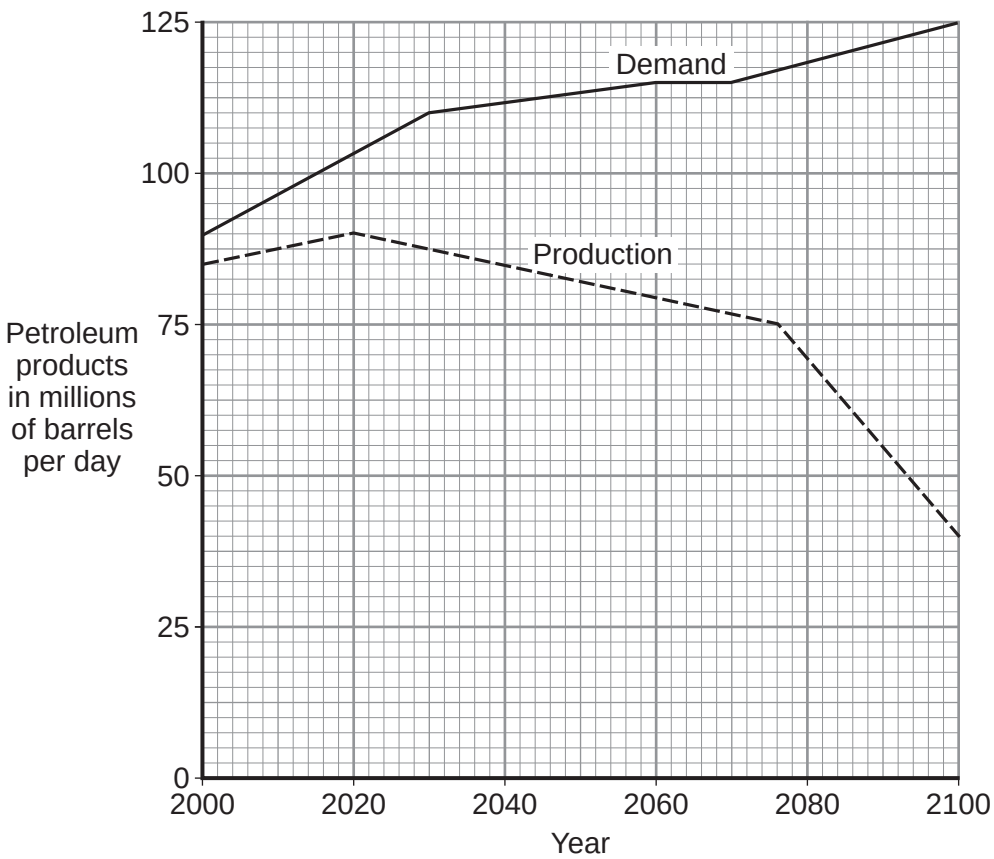
Question 3 continues on the next page

4.1.1.2 Mixtures

Question 85 · continued

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

Petroleum products, such as petrol, are produced from crude oil.
The graph shows the possible future production of petroleum products from crude oil and the expected demand for petroleum products.



Canada's oil sands hold about 20% of the world's known crude oil reserves.

The oil sands contain between 10 to 15% of crude oil. This crude oil is mainly bitumen.

In Canada the oil sands are found in the ground underneath a very large area of forest. The trees are removed. Then large diggers and trucks remove 30 metres depth of soil and rock to reach the oil sands. The oil sands are quarried. Boiling water is mixed with the quarried oil sands to separate the bitumen from the sand. Methane (natural gas) is burned to heat the water.

The mixture can be separated because bitumen floats on water and the sand sinks to the bottom of the water. The bitumen is cracked and the products are separated by fractional distillation.

4.1.1.2 Mixtures

Question 85 · continued

Use the information on page 8 and your knowledge and understanding to suggest the advantages and disadvantages of extracting petroleum products from oil sands.

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(6 marks)

11

4.1.1.2 Mixtures

Question 86

January 2013 | CH1HP | Original Q5 | Legacy

5 Olive oil has a melting point of –6 °C and a boiling point of 300 °C.
Olive oil has a high content of healthy, unsaturated fats.

5 (a) Olive oil can be hardened by reacting it with hydrogen.

5 (a) (i) State the conditions needed for this reaction.

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(2 marks)

5 (a) (ii) A student said that hardening would make olive oil healthier.

Is this student's hypothesis correct?

Explain your answer in terms of what happens in the hardening process.

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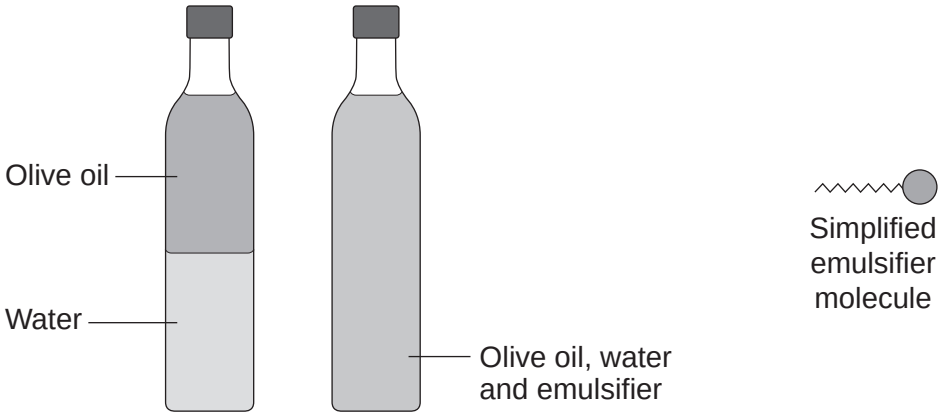
(2 marks)

4.1.1.2 Mixtures

Question 86 · continued

5 (b) Olive oil and water do not mix.
A salad dressing is made by shaking olive oil and water with an emulsifier.



Explain how these emulsifier molecules are able to produce a stable mixture after shaking olive oil and water.

Use the diagram of the simplified emulsifier molecule to help you to answer this question.

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(3 marks)

7

4.1.1.2 Mixtures

Question 87

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)

4.1.1.2 Mixtures

Question 87 · 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

4.1.1.2 Mixtures

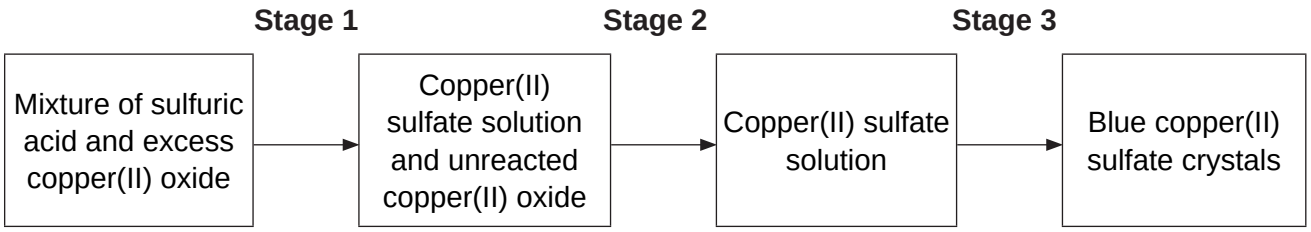
Question 88

January 2013 | CH2HP | Original Q3 | Legacy

3 This question is about compounds of copper.

3 (a) A student made some copper(II) sulfate crystals.

The flow diagram shows the stages of the preparation of copper(II) sulfate crystals.



3 (a) (i) The reaction mixture is heated in **Stage 1**.

Suggest why.

.....

.....

(1 mark)

3 (a) (ii) Complete the equation for this reaction.

CuO + ... → $CuSO_4$ + ...

(2 marks)

3 (a) (iii) How would the student remove the unreacted copper(II) oxide in **Stage 2**?

.....

.....

(1 mark)

3 (a) (iv) How would the student obtain copper(II) sulfate crystals from the copper(II) sulfate solution in **Stage 3**?

.....

(1 mark)

3 (a) (v) The mass of crystals obtained was less than the student had calculated.

Suggest **one** reason why.

.....

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(1 mark)

4.1.1.2 Mixtures

Question 88 · continued

3 (b) The student heated the blue copper(II) sulfate crystals.

The word equation for the reaction is shown below.

hydrated copper(II) sulfate ⇌ anhydrous copper(II) sulfate + water

blue white

3 (b) (i) What does the symbol ⇌ mean ?

.....

(1 mark)

3 (b) (ii) 300 J of energy are taken in when some blue copper(II) sulfate crystals are heated.

What is the energy change when an excess of water is added to the anhydrous copper(II) sulfate produced?

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(2 marks)

3 (c) A sample of copper nitride contains 3.81 g of copper and 0.28 g of nitrogen.

Calculate the empirical formula.

You **must** show all your working to get full marks.

Relative atomic masses (A_r): N = 14; Cu = 63.5.

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Empirical formula = ...

(4 marks)

13

4.1.1.2 Mixtures

Question 89

January 2013 | CH2HP | Original Q4 | Legacy

4 Thermosoftening polymers can be used to make plastic bottles and food packaging.

4 (a) The reaction to produce polymers uses a catalyst.

Why does the catalyst work for a long time before it needs replacing?

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(1 mark)

4 (b) Thermosoftening polymers would **not** be suitable for packaging very hot food.

Explain why in terms of their properties and structure.

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(2 marks)

4.1.1.2 Mixtures

Question 89 · continued

4 (c) Compounds from food packaging must not contaminate the food.

Food can be tested for contamination using gas chromatography linked to mass spectroscopy (GC-MS).

4 (c) (i) Gas chromatography can separate substances in a mixture of compounds.

Describe how, as fully as you can.

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(3 marks)

4 (c) (ii) What information does the molecular ion peak give about the molecule?

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(1 mark)

7

4.1.1.2 Mixtures

Question 90

June 2013 | CH1HP | Original Q3 | Legacy

3 Crude oil is a mixture of many different chemical compounds.

3 (a) Fuels, such as petrol (gasoline), can be produced from crude oil.

3 (a) (i) Fuels react with oxygen to release energy.

Name the type of reaction that releases energy from a fuel.

.....

(1 mark)

3 (a) (ii) Fuels react with oxygen to produce carbon dioxide.
The reaction of a fuel with oxygen can produce a different oxide of carbon.

Name this different oxide of carbon and explain why it is produced.

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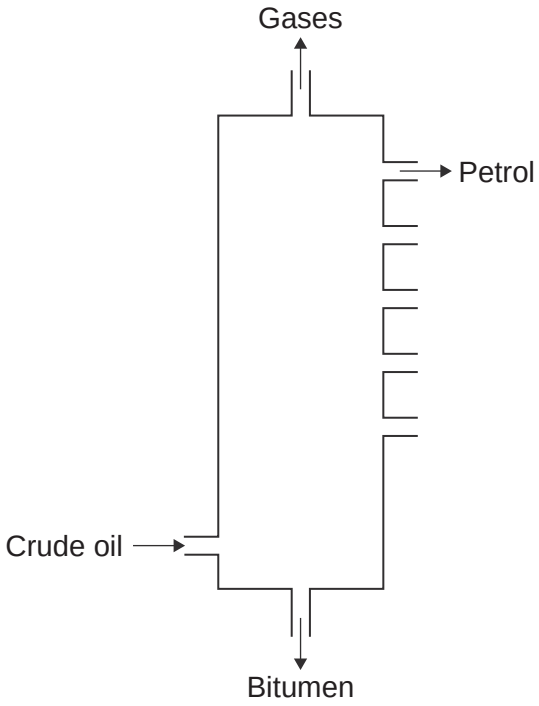
(2 marks)

3 (b) Most of the compounds in crude oil are hydrocarbons.
Hydrocarbons with the smallest molecules are very volatile.



4.1.1.2 Mixtures

Question 90 · continued

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

Describe and explain how **petrol** is separated from the mixture of hydrocarbons in crude oil.

Use the diagram and your knowledge to answer this question.

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(6 marks)

9

4.1.1.2 Mixtures

Question 91

June 2013 | CH1HP | Original Q5 | Legacy

5 The amount of carbon dioxide in the Earth's atmosphere has changed since the Earth was formed.
The amount of carbon dioxide continues to change because of human activities.

5 (a) Cement is produced when a mixture of calcium carbonate and clay is heated in a rotary kiln. The fuel mixture is a hydrocarbon and air.

Hydrocarbons react with oxygen to produce carbon dioxide.
Calcium carbonate decomposes to produce carbon dioxide.

5 (a) (i) Complete each chemical equation by writing the formula of the other product.

$$CH_4 + 2O_2 \longrightarrow 2 \text{ .....} + CO_2$$

$$CaCO_3 \longrightarrow \text{.....} + CO_2$$

(2 marks)

5 (a) (ii) Hydrocarbons and calcium carbonate contain *locked up* carbon dioxide.

What is *locked up* carbon dioxide?

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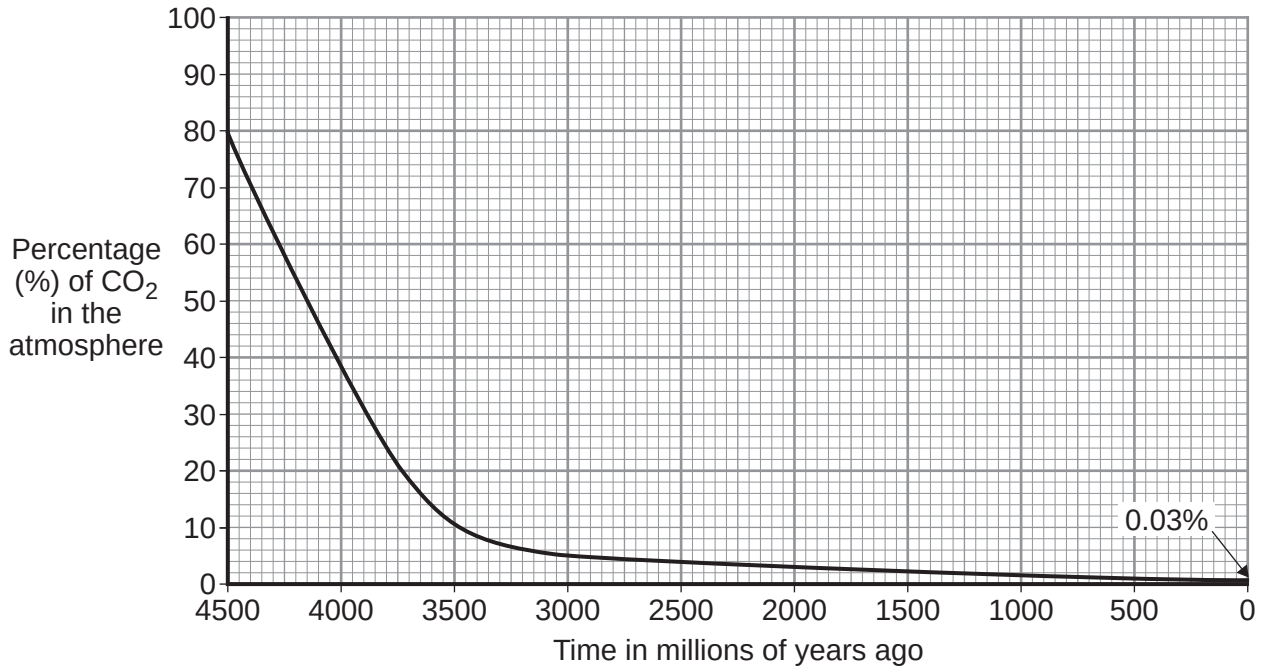
(2 marks)

4.1.1.2 Mixtures

Question 91 · continued

5 (b) **Graph 1** shows how the percentage of carbon dioxide in the atmosphere changed in the last 4500 million years.

Graph 1



Use information from **Graph 1** to answer these questions.

5 (b) (i) Describe how the percentage of carbon dioxide has changed in the last 4500 million years.

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(2 marks)

5 (b) (ii) Give **two** reasons why the percentage of carbon dioxide has changed.

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(2 marks)

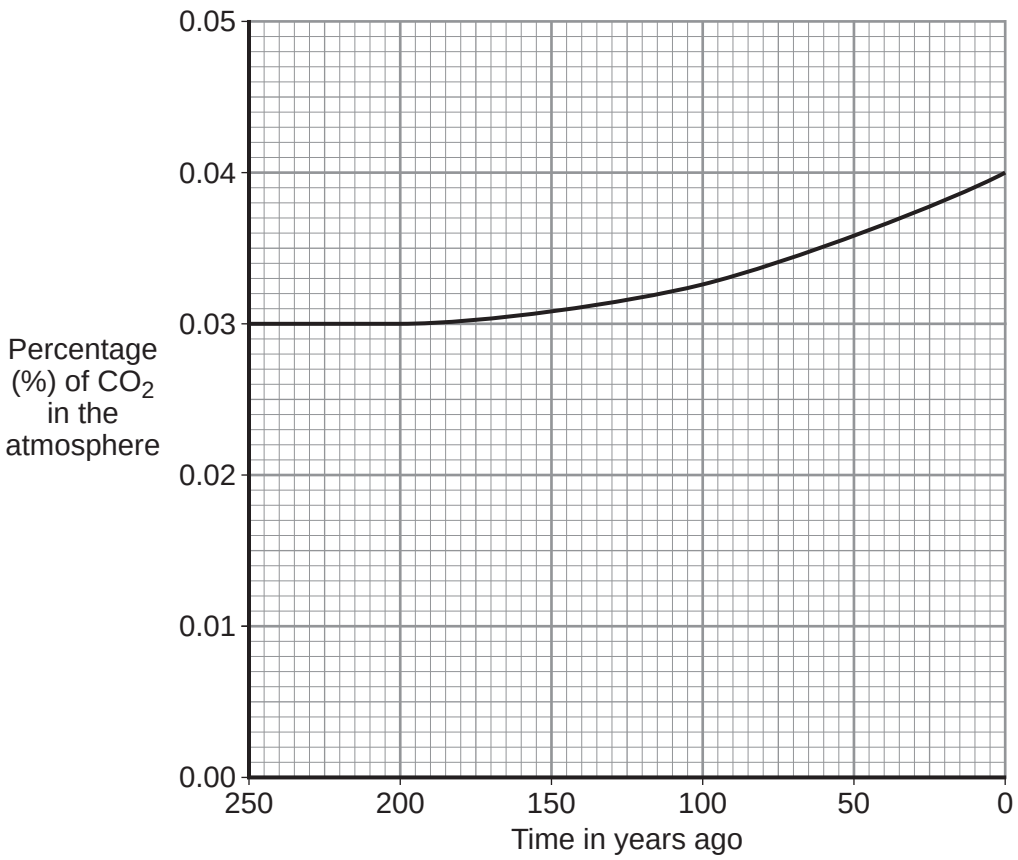
Question 5 continues on the next page

4.1.1.2 Mixtures

Question 91 · continued

5 (c) **Graph 2** shows how the percentage of carbon dioxide in the atmosphere changed in the last 250 years.

Graph 2



Should we be concerned about this change in the percentage of carbon dioxide?

Explain your answer.

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(2 marks)

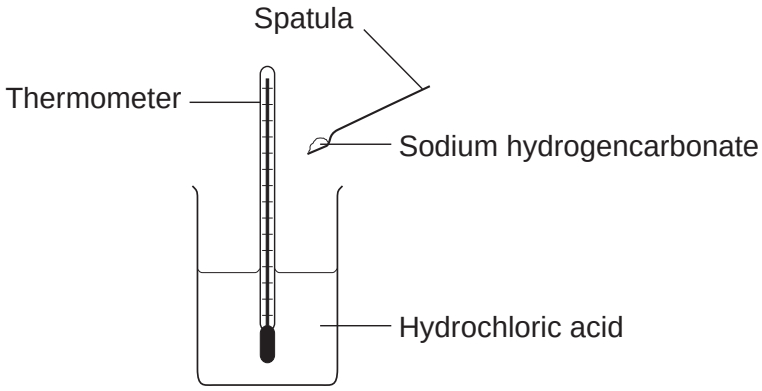
10

4.1.1.2 Mixtures

Question 92

June 2013 | CH2HP | Original Q1 | Legacy

1 (a) Some students did an experiment to find the temperature change when hydrochloric acid reacts with sodium hydrogencarbonate.



The results are in the table.

Number of spatula measures of sodium hydrogencarbonate	Start temperature in °C	Final temperature in °C	Change in temperature in °C
2	20	16	4
4	20	14	6
6	19	11	8
8	20	10	10
10	19	9	10
12	20	10	10

4.1.1.2 Mixtures

Question 92 · continued

1 (a) (i) Describe, as fully as you can, the trends shown in the students' results.

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(3 marks)

1 (a) (ii) State the type of energy transfer for this reaction.

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(1 mark)

Question 1 continues on the next page

4.1.1.2 Mixtures

Question 92 · continued

1 (b) Sodium hydrogencarbonate is used as baking powder for making cakes.

When the cake mixture is baked the sodium hydrogencarbonate decomposes.

The equation for the reaction is:

$$2\,NaHCO_3(s) \xrightarrow{\text{Heat}} Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

1 (b) (i) The cake mixture rises when baked.



Use the equation to suggest why.

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.....

(1 mark)

1 (b) (ii) The same reaction can be reversed to produce sodium hydrogencarbonate from sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2\,NaHCO_3$$

Do the reactants need to be heated?

Give a reason for your answer.

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(1 mark)

4.1.1.2 Mixtures

Question 92 · continued

1 (c) (i) Calculate the relative formula mass of sodium hydrogencarbonate ($NaHCO_3$).

Relative atomic masses (A_r): H=1; C=12; O=16; Na=23

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Relative formula mass (M_r) = ...

(2 marks)

1 (c) (ii) Calculate the percentage by mass of carbon in sodium hydrogencarbonate.

.....

.....

Percentage of carbon = ... %

(1 mark)

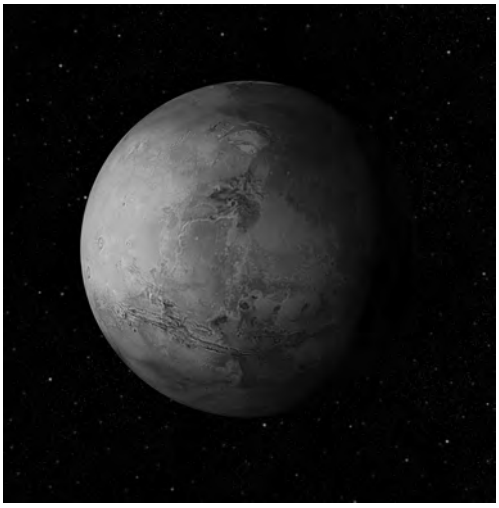
9

4.1.1.2 Mixtures

Question 93

June 2013 | CH2HP | Original Q6 | Legacy

6 Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



6 (a) The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

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(3 marks)

4.1.1.2 Mixtures

Question 93 · continued

6 (b) Gas chromatography linked to a mass spectrometer (GC-MS) is used to identify substances found on Mars.

6 (b) (i) What is the purpose of gas chromatography?

.....

.....

(1 mark)

6 (b) (ii) What information do the molecular ion peaks from the mass spectrometer give about the substances?

.....

(1 mark)

6 (c) The atmosphere on Venus contains droplets of sulfuric acid solution.

6 (c) (i) Suggest a pH value for sulfuric acid solution.

pH = ...

(1 mark)

6 (c) (ii) Name the ion which makes sulfuric acid solution acidic.

.....

(1 mark)

6 (d) The atmosphere of Venus contains the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

Describe the similarities and the differences in the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

You should refer to the sub-atomic particles in each isotope.

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(3 marks)

10

4.1.1.2 Mixtures

Question 94

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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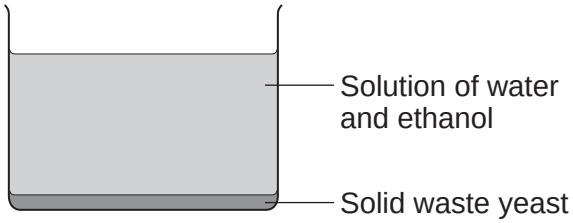
.....

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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4.1.1.2 Mixtures

Question 94 · 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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4.1.1.2 Mixtures

Question 95

June 2014 | CH2HP | Original Q1 | Legacy

1 The label shows the ingredients in a drink called Cola.

Cola

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

1 (a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

[1 mark]

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1 (a) (ii) Which ion causes the pH to be 2.9?

[1 mark]

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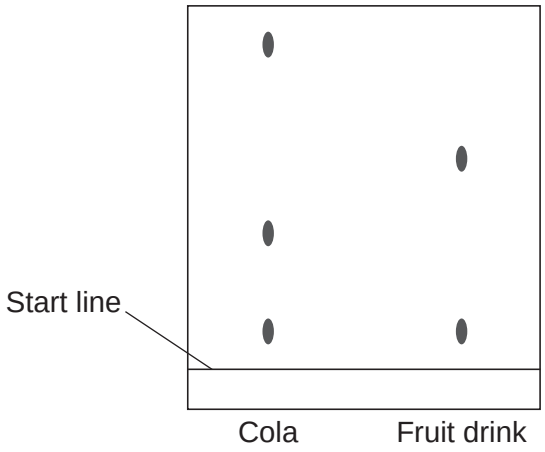
4.1.1.2 Mixtures

Question 95 · continued

1 (b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in **Figure 1** shows the student's results.

Figure 1



1 (b) (i) Complete the sentence.

The start line should be drawn with a ruler and ..... .

Give a reason for your answer.

[2 marks]

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1 (b) (ii) Suggest **three** conclusions you can make from the student's results.

[3 marks]

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4.1.1.2 Mixtures

Question 95 · continued

1 (c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

[1 mark]

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1 (d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

1 (d) (i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

[1 mark]

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

1 (d) (ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

[2 marks]

Reason 1 .....

.....

Reason 2 .....

.....

11

4.1.1.2 Mixtures

Question 96

June 2014 | CH3HP | Original Q1 | Legacy

1 Water in Britain is taken from reservoirs to use as drinking water.

Figure 1



1 (a) What are the **two** main steps used to treat water from reservoirs?

Give **one** reason for each step.

[4 marks]

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4.1.1.2 Mixtures

Question 96 · continued

1 (b) Some people use water filters to treat water before drinking it.

1 (b) (i) Water filters remove hardness from hard water.

What is in water filters that removes hardness from water?

[1 mark]

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1 (b) (ii) Suggest why water filters used in the home contain particles of silver.

[1 mark]

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1 (c) Pure water can be produced by distillation.

Why is distillation **not** usually an economic method of treating water for drinking?

[1 mark]

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1 (d) Drinking hard water has health benefits.

State **one** health benefit of drinking hard water.

[1 mark]

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8

4.1.1.2 Mixtures

Question 97

June 2015 | CH1HP | Original Q2 | Legacy

2 Limestone is used to make many different materials.

2 (a) Heating limestone produces calcium oxide and carbon dioxide.

Complete the sentences.

2 (a) (i) The main compound in limestone is calcium ..... .
[1 mark]

2 (a) (ii) The reaction to produce calcium oxide from limestone is thermal ..... .
[1 mark]

2 (a) (iii) Calcium hydroxide is produced when calcium oxide reacts with ..... .
[1 mark]

2 (a) (iv) Calcium hydroxide is used to neutralise acids because it is an ..... .
[1 mark]

Question 2 continues on the next page

4.1.1.2 Mixtures

Question 97 · continued

2 (b) Cement is made from limestone and clay.

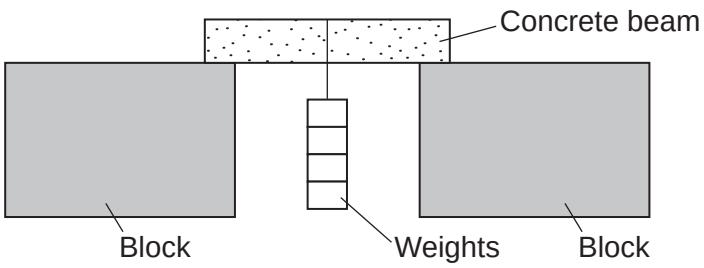
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

A group of students did an investigation on the amount of aggregate needed to make the strongest concrete beam.

The students used this method:

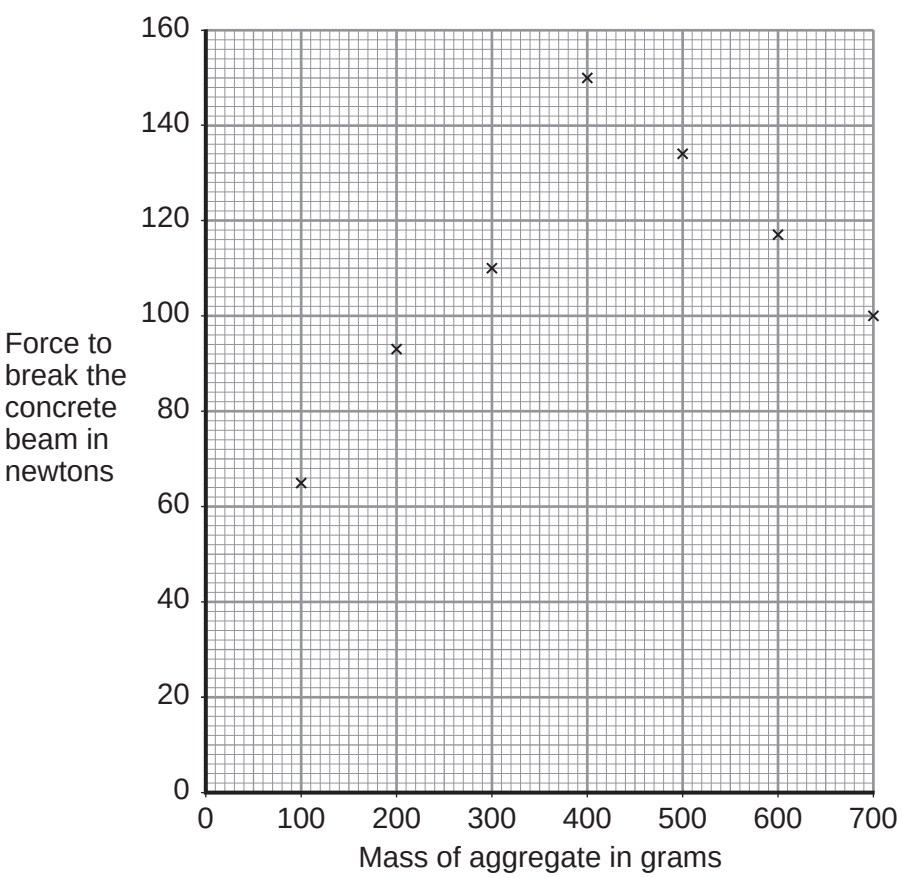
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 2**, until the concrete beam breaks.

Figure 2



The students' results are plotted on the graph in **Figure 3**.

Figure 3



4.1.1.2 Mixtures

Question 97 · continued

2 (b) (i) One of the points is anomalous.

Complete the graph in **Figure 3** by drawing **two** straight lines of best fit.

[2 marks]

2 (b) (ii) Describe **one** way the students could improve the method so that their results are more accurate for each graph point.

[2 marks]

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2 (b) (iii) What force is needed to break a concrete beam containing no aggregate?

Show your working on the graph.

[2 marks]

Force = ... newtons

2 (b) (iv) One of the students concluded that:

'The force needed to break a concrete beam increases as the mass of aggregate increases.'

The student's conclusion is **not completely** correct. Use values from the graph to explain why.

[3 marks]

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13

4.1.1.2 Mixtures

Question 98

June 2015 | CH1HP | Original Q6 | Legacy

6 Useful materials, including foods and fuels, are produced from plants.

6 (a) Some plants have seeds that contain vegetable oils.

6 (a) (i) Give **one** reason why vegetable oils are important foods and fuels.

[1 mark]

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6 (a) (ii) State the **two** main stages used to extract a sample of vegetable oil from seeds.

[2 marks]

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6 (b) One property of a vegetable oil gives the oil an advantage over water for cooking foods.

Explain how.

[2 marks]

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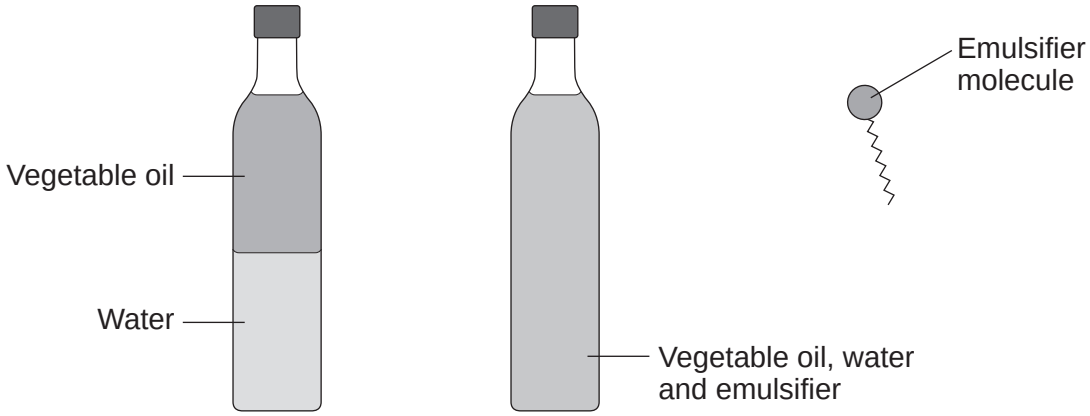
4.1.1.2 Mixtures

Question 98 · continued

6 (c) Vegetable oils and water do not mix.

An emulsion is made by shaking a vegetable oil and water with an emulsifier, as shown in **Figure 7**.

Figure 7



Explain how the emulsifier molecules are able to produce an emulsion that is a stable mixture containing the vegetable oil and water.

Use the diagram of the emulsifier molecule to help you to answer this question.

[4 marks]

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4.1.1.2 Mixtures

Question 99

June 2015 | CH2HP | Original Q3 | Legacy

3 This question is about metals and alloys.

3 (a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

[4 marks]

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3 (b) Describe how the structure of an alloy is different from the structure of a pure metal.

[2 marks]

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3 (c) Alloys are used to make dental braces and coins.

3 (c) (i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

[1 mark]

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.....

4.1.1.2 Mixtures

Question 99 · continued

3 (c) (ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

[1 mark]

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.....

3 (c) (iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

[1 mark]

Aluminium is manufactured by the electrolysis of a molten mixture of

cryolite and ..... .

3 (c) (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

[1 mark]

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3 (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

[1 mark]

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11

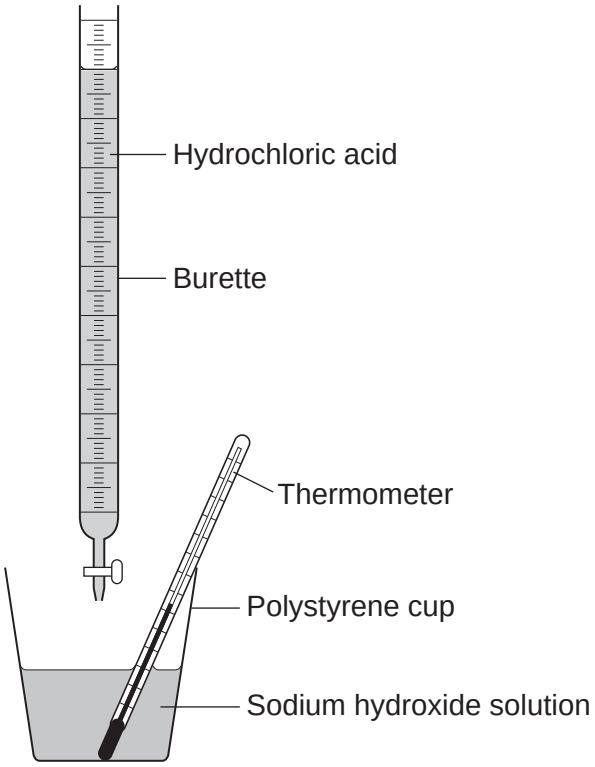
4.1.1.2 Mixtures

Question 100

June 2015 | CH3HP | Original Q8 | Legacy

8 A student investigates the energy released when hydrochloric acid completely neutralises sodium hydroxide solution.
The student uses the apparatus shown in **Figure 4**.

Figure 4



The student:

- measures 25 cm^3 sodium hydroxide solution into a polystyrene cup
- fills a burette with hydrochloric acid
- measures the temperature of the sodium hydroxide solution
- adds 5 cm^3 hydrochloric acid to the sodium hydroxide solution in the polystyrene cup
- stirs the mixture and measures the highest temperature of the mixture
- continues to add 5 cm^3 portions of hydrochloric acid, stirring and measuring the highest temperature of the mixture after each addition.

Question 8 continues on the next page

4.1.1.2 Mixtures

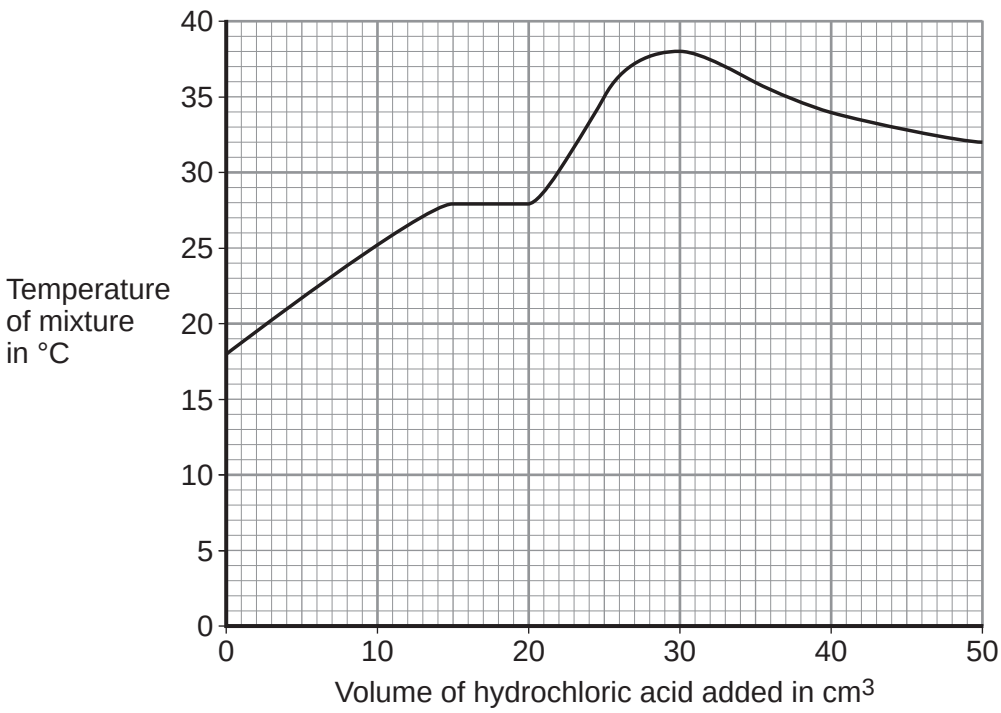
Question 100 · continued

8 (a) The student has plotted a graph of the results.

The graph line has been incorrectly drawn by including an anomalous result.

The graph is shown in **Figure 5**.

Figure 5



8 (a) (i) Suggest a cause for the anomalous result when 20 cm^3 of hydrochloric acid is added.

[1 mark]

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8 (a) (ii) Suggest the true value of the temperature of the anomalous point.

[1 mark]

Temperature = ... °C

8 (a) (iii) What was the **total** volume of the mixture when the maximum temperature was reached?

[1 mark]

.....

Total volume of the mixture = ... cm^3

4.1.1.2 Mixtures

Question 100 · continued

8 (a) (iv) Calculate the overall temperature increase in this experiment.

[1 mark]

.....

Overall temperature increase = ... °C

8 (a) (v) Use your answers to **8(a)(iii)** and **8(a)(iv)** and the equation to calculate the energy released in the reaction. Give the unit.

[2 marks]

Assume the volume in cm^3 is equivalent to the mass of solution in grams.

Equation: $Q = mc\Delta T$

where:
Q = energy released
m = mass of solution (g)
c = 4.2 (J per g per °C)
ΔT = change in temperature (°C)

.....

.....

Energy released = ... Unit = ...

8 (b) The student did the experiment on page 19 again, starting with 50 cm^3 of sodium hydroxide solution instead of 25 cm^3.

Explain why this would make no difference to the overall temperature increase.

[2 marks]

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8

4.1.1.2 Mixtures

Question 101

June 2016 | CH1HP | Original Q2 | Legacy

2 This question is about hydrocarbons.

2 (a) Most of the hydrocarbons in crude oil are alkanes.

2 (a) (i) Large alkane molecules can be cracked to produce more useful molecules.

The equation shows the cracking of dodecane.

$$\underset{\text{dodecane}}{C_{12}H_{26}} \longrightarrow \underset{\text{butane}}{C_4H_{10}} + \underset{\text{hexene}}{C_6H_{12}} + \underset{\text{ethene}}{C_2H_4}$$

Give **two** conditions used to crack large alkane molecules.

[2 marks]

1 _____

2 _____

2 (a) (ii) The products hexene and ethene are alkenes.

Complete the sentence.

[1 mark]

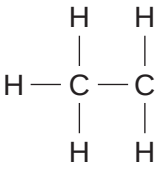
When alkenes react with bromine water the colour changes

from orange to _____ .

2 (a) (iii) Butane (C_4H_{10}) is an alkane.

Complete the displayed structure of butane.

[1 mark]



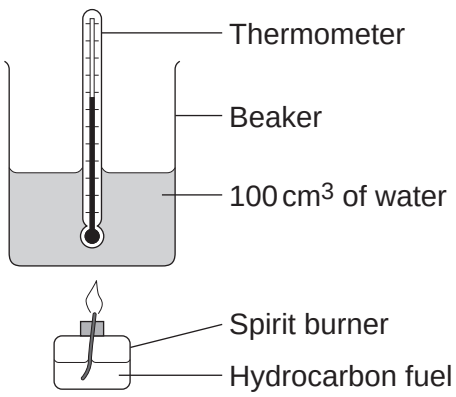
Question 2 continues on the next page

Question 101 · continued

2 (b) A group of students investigated the energy released by the combustion of four hydrocarbon fuels.

Figure 3 shows the apparatus used.

Figure 3



Each hydrocarbon fuel was burned for two minutes.

Table 1 shows the students' results.

Table 1

	After two minutes				
Name and formula of hydrocarbon fuel	**Mass of fuel used in g**	**Temperature increase of water in °C**	**Energy released by fuel in kJ**	**Energy released by 1.0 g of fuel in kJ**	**Relative amount of smoke in the flame**
Hexane, C_6H_{14}	0.81	40	16.80	20.74	very little smoke
Octane, C_8H_{18}	1.10	54	22.68	20.62	some smoke
Decane, $C_{10}H_{22}$	1.20	58	24.36		smoky
Dodecane, $C_{12}H_{26}$	1.41	67	28.14	19.96	very smoky

4.1.1.2 Mixtures

Question 101 · continued

2 (b) (i) Calculate the energy released by 1.0 g of decane in kJ.

[2 marks]

Energy released = _____ kJ

2 (b) (ii) Suggest **one** improvement to the apparatus, or the use of the apparatus, that would make the temperature increase of the water for each fuel more accurate.

Give a reason why this is an improvement.

[2 marks]

2 (b) (iii) The students noticed that the bottom of the beaker became covered in a black substance when burning these fuels.

Name this black substance.

Suggest why it is produced.

[2 marks]

2 (b) (iv) A student concluded that hexane is the best of the four fuels.

Give **two** reasons why the results in **Table 1** support this conclusion.

[2 marks]

1 _____

2 _____

Question 2 continues on the next page

4.1.1.2 Mixtures

Question 101 · continued

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

Most car engines use petrol as a fuel.

- Petrol is produced from the fractional distillation of crude oil.
- Crude oil is a mixture of hydrocarbons.
- Sulfur is an impurity in crude oil.

Car engines could be developed to burn hydrogen as a fuel.

- Hydrogen is produced from natural gas.
- Natural gas is mainly methane.

Table 2 shows information about petrol and hydrogen.

Table 2

	Petrol	**Hydrogen**
State of fuel at room temperature	Liquid	Gas
Word equation for combustion of the fuel	petrol + oxygen ⟶ carbon dioxide + water	hydrogen + oxygen ⟶ water
Energy released from combustion of 1 g of the fuel	47 kJ	142 kJ

Describe the **advantages** and **disadvantages** of using hydrogen instead of petrol in car engines.

Use the information given and your knowledge and understanding to answer this question.

[6 marks]

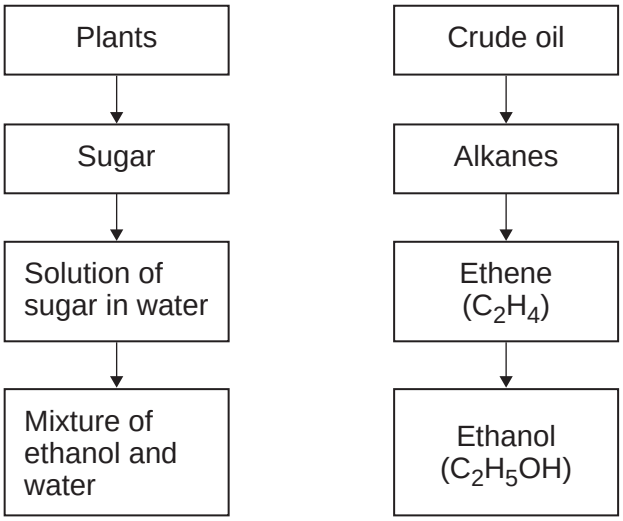
4.1.1.2 Mixtures

Question 102

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]

4.1.1.2 Mixtures

Question 102 · 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

4.1.1.2 Mixtures

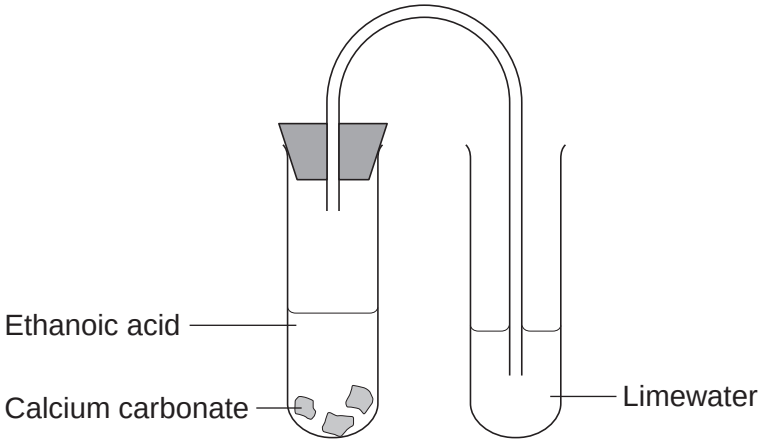
Question 103

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 _____

_____

_____

_____

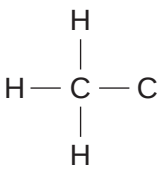
Question 1 continues on the next page

4.1.1.2 Mixtures

Question 103 · continued

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

[1 mark]



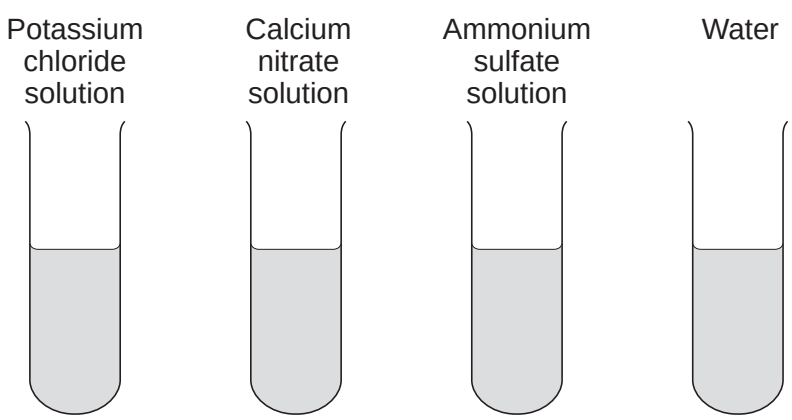
1 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

[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.

4.1.1.2 Mixtures

Question 103 · 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

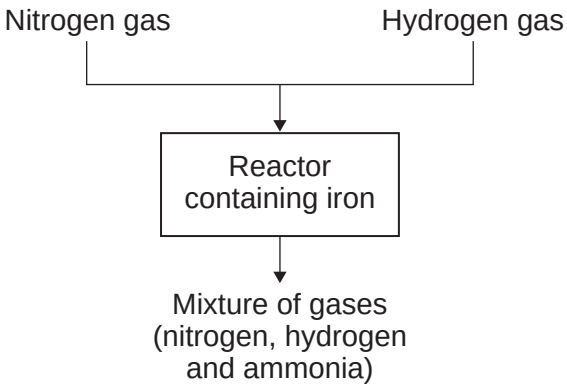
4.1.1.2 Mixtures

Question 104

June 2016 | CH3HP | Original Q6 | Legacy

6 **Figure 6** shows a flow diagram for the Haber process.

Figure 6



6 (a) (i) Hydrogen gas is obtained from methane.
Name **one** source of methane.

[1 mark]

_____

6 (a) (ii) Air is the source used to produce nitrogen for the Haber process.
Suggest why air must **not** get into the reactor.

[2 marks]

_____

_____

_____

6 (a) (iii) Describe what happens to the mixture of gases from the reactor.

[3 marks]

_____

_____

_____

_____

_____

_____

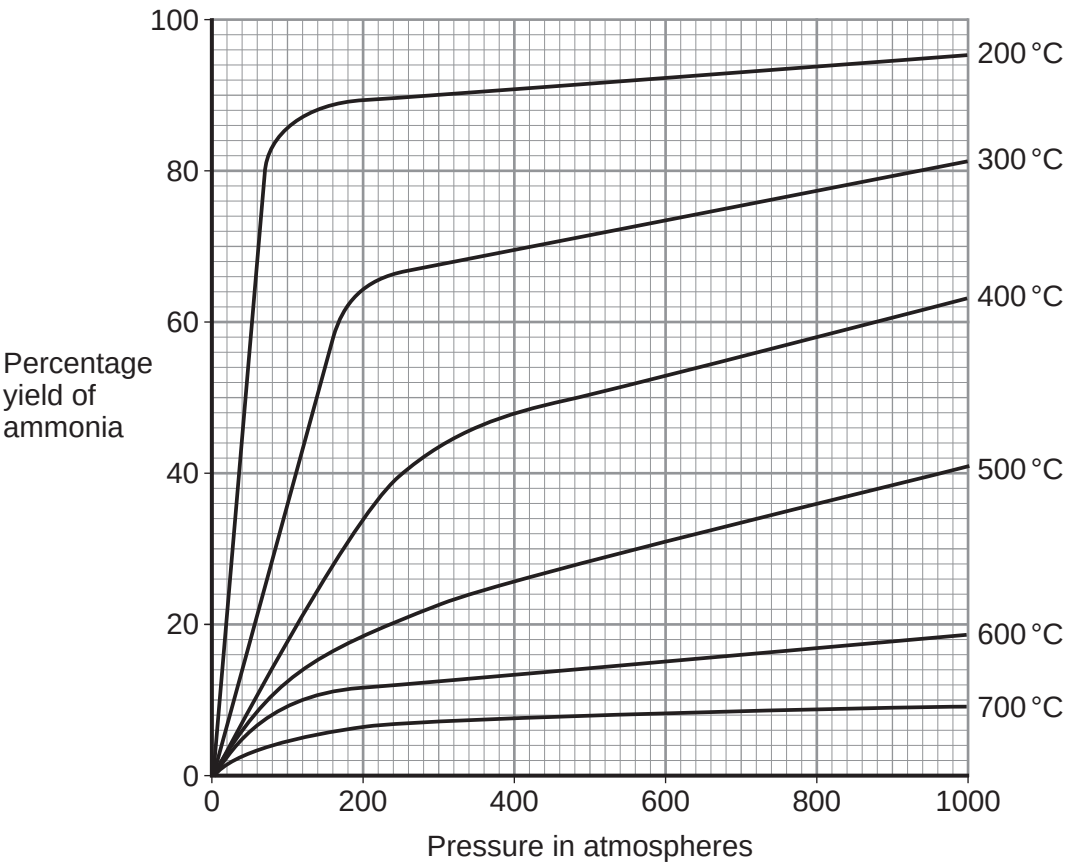
Question 6 continues on the next page

4.1.1.2 Mixtures

Question 104 · continued

6 (b) The graph in **Figure 7** shows the percentage yield of ammonia using different conditions.

Figure 7



6 (b) (i) Use **Figure 7** to suggest the conditions that produce the greatest yield of ammonia.

[1 mark]

4.1.1.2 Mixtures

Question 104 · continued

6 (b) (ii) Use **Figure 7** to suggest and explain why the conditions used to produce ammonia in the Haber process are a temperature of 450 °C and a pressure of 200 atmospheres.

[5 marks]

12

4.1.1.2 Mixtures

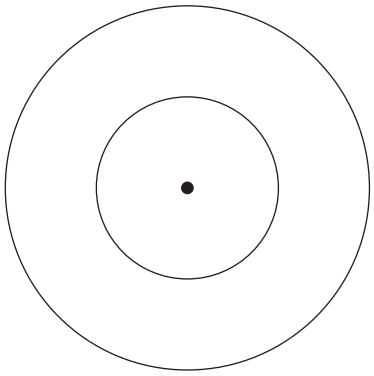
Question 105

June 2017 | CH1HP | Original Q2 | Legacy

2 This question is about compounds of carbon.

2 (a) **Figure 2** shows an atom with two energy levels (shells).

Figure 2



2 (a) (i) A carbon atom has six electrons.

Complete **Figure 2** to show the electronic structure of a carbon atom.

Use **x** to represent an electron.

[1 mark]

2 (a) (ii) Complete the following description about the central part of this carbon atom.

[3 marks]

The central part is made up of six neutrons that have no electrical charge and _____

_____

_____

_____

_____

2 (b) Crude oil is a mixture of compounds. These compounds are mainly hydrocarbons.

What does the term hydrocarbon mean?

[1 mark]

_____

_____

Question 105 · continued

2 (c) Alkanes and alkenes are hydrocarbons.

Table 2 shows the boiling points of some alkanes and alkenes.

Table 2

Alkanes

Name	Formula	Boiling point in °C
Ethane	C_2H_6	−88
Propane	C_3H_8	−42
Butane	C_4H_{10}	0
Pentane	C_5H_{12}	+36
Hexane	C_6H_{14}	+69

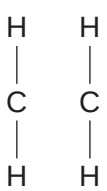
Alkenes

Name	Formula	Boiling point in °C
Ethene	C_2H_4	–104
Propene	C_3H_6	−48
Butene	C_4H_8	−6
Pentene	C_5H_{10}	+30
Hexene	C_6H_{12}	+64

2 (c) (i) Complete the displayed structure of ethane and the displayed structure of ethene.

[2 marks]

Ethane



Ethene



2 (c) (ii) Describe the relationship between the number of carbon atoms in an alkane molecule and the boiling point of the alkane molecule.

[1 mark]

4.1.1.2 Mixtures

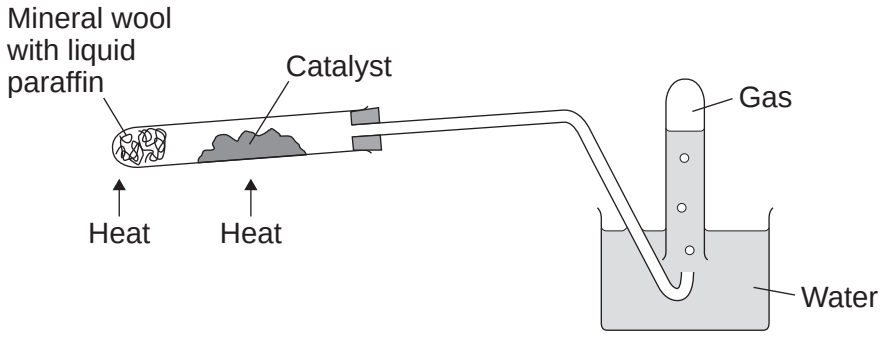
Question 105 · continued

2 (c) (iii) Use the information in **Table 2** to compare the boiling points of alkanes with the boiling points of alkenes.

[2 marks]

2 (d) A student used the apparatus in **Figure 3** to investigate what happens when liquid paraffin is heated to a high temperature.

Figure 3



Liquid paraffin contains alkanes.

Describe what happens to the alkane molecules in this investigation.

[3 marks]

13

4.1.1.2 Mixtures

Question 106

June 2017 | CH1HP | Original Q5 | Legacy

5 This question is about the Earth's atmosphere.

5 (a) The Earth's early atmosphere was a mixture of gases.

One theory is that the Earth's early atmosphere had the composition shown in **Table 4**.

Table 4

Gas	Percentage in Earth's early atmosphere (%)
Carbon dioxide	96
Nitrogen	3.5
Oxygen	a trace
Other gases including methane, ammonia, hydrogen and water vapour	0.5

5 (a) (i) Amino acids are at the basis of all life processes.
The simplest amino acid is glycine, NH_2CH_2COOH

Two scientists, Miller and Urey, showed that they could produce glycine from a mixture of methane, ammonia, hydrogen and water.
Miller and Urey concluded that this is how life was formed on Earth.

Suggest **one** reason why this conclusion may **not** be correct.

[1 mark]

5 (a) (ii) Give **three** reasons why the percentage of carbon dioxide in the Earth's atmosphere today is less than the percentage of carbon dioxide in the Earth's early atmosphere.

[3 marks]

4.1.1.2 Mixtures

Question 106 · continued

5 (b) **Table 5** shows the boiling points of some gases in the air.

Table 5

Gas	Boiling point in °C
Nitrogen	–196
Oxygen	–183
Carbon dioxide	–79*
Helium	–269
Neon	–246
Argon	–186

*freezes at this temperature

Oxygen from the air is separated by fractional distillation. To do this separation the air is cooled to –200 °C. Most of the gases condense.

5 (b) (i) Name the two gases that would **not** condense at –200 °C.

[1 mark]

_____ and _____

5 (b) (ii) Suggest why carbon dioxide is removed before the air is cooled.

[1 mark]

_____

_____

5 (b) (iii) The liquid at –200 °C is passed into a fractionating column.

Explain why one of the fractions is a mixture of oxygen and one other gas.

[2 marks]

_____

_____

_____

_____

4.1.1.2 Mixtures

Question 106 · continued

5 (c) Oxygen is used in the production of steel.

Cast iron from a blast furnace contains 96% iron and 4% carbon.

The stages for the production of steel from cast iron are:

Stage 1 pass oxygen into molten cast iron

Stage 2 add small amounts of other metals.

Explain why each stage is needed in the production of steel.

[4 marks]

12

4.1.1.2 Mixtures

Question 107

June 2017 | CH2HP | Original Q5 | Legacy

5 This question is about methods of analysis.

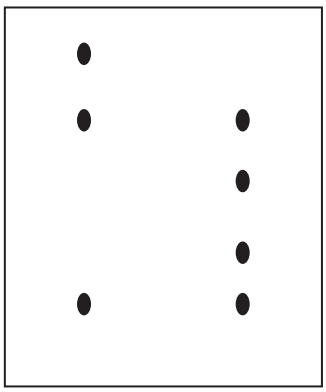
5 (a) A student wanted to compare the colours in two inks, **A** and **B**, using paper chromatography.

5 (a) (i) Describe a method the student could use.

[4 marks]

5 (a) (ii) **Figure 6** shows the student's results.

Figure 6



Compare the colours in the inks **A** and **B**.

[2 marks]

4.1.1.2 Mixtures

Question 107 · continued

5 (b) A method of instrumental analysis is gas chromatography linked to mass spectrometry (GC-MS).

5 (b) (i) Describe how gas chromatography separates substances in a mixture of compounds.

[3 marks]

5 (b) (ii) A mass spectrometer is used to identify the substances.

What information about each substance is given by the mass spectrometer?

[1 mark]

10

4.1.1.2 Mixtures

Question 108

June 2017 | CH2HP | Original Q6 | Legacy

6 This question is about sodium chloride.

6 (a) A student reacted hydrochloric acid and sodium hydroxide solution to produce sodium chloride solution.

The student:

- measured 50 cm^3 of hydrochloric acid into a glass beaker
- measured the initial temperature of the hydrochloric acid
- added 50 cm^3 of sodium hydroxide solution
- stirred the mixture and measured the highest temperature of the solution.

6 (a) (i) The hydrochloric acid and sodium hydroxide solution were the same concentration.

Suggest **one** reason why the temperature change could be greater than expected.

[1 mark]

Tick (✓) **one** box.

The volume of the sodium hydroxide solution was more than 50 cm^3. ☐

The volume of the hydrochloric acid was more than 50 cm^3. ☐

The initial temperature reading was too low. ☐

The highest temperature reading was too low. ☐

6 (a) (ii) The student did the investigation three times.

Table 2 shows the results.

Table 2

Experiment number	Initial temperature of the acid in °C	Highest temperature of solution in °C
1	20	33
2	19	30
3	20	32

4.1.1.2 Mixtures

Question 108 · continued

What conclusion can you make about the reaction from the results in **Table 2**?

[1 mark]

6 (b) The student electrolysed sodium chloride solution.

6 (b) (i) Explain what happens at the negative electrode and why sodium is **not** produced.

[3 marks]

6 (b) (ii) Chlorine gas is produced at the positive electrode.
Complete the half equation.

[1 mark]

$$____\ Cl^- \longrightarrow _____ + _____$$

6 (b) (iii) Explain why the pH of the solution after electrolysis was 14

[2 marks]

8

4.1.1.2 Mixtures

Question 109

June 2017 | CH3HP | Original Q3 | Legacy

3 This question is about elements and compounds.

3 (a) In 1869 Mendeleev produced an early version of the periodic table.

Figure 4 shows part of Mendeleev's periodic table.

Figure 4

H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn

3 (a) (i) Why did Mendeleev leave gaps in his periodic table?

[1 mark]

3 (a) (ii) Give **one** reason why the elements Ti, V, Cr and Mn should **not** be where Mendeleev placed them.

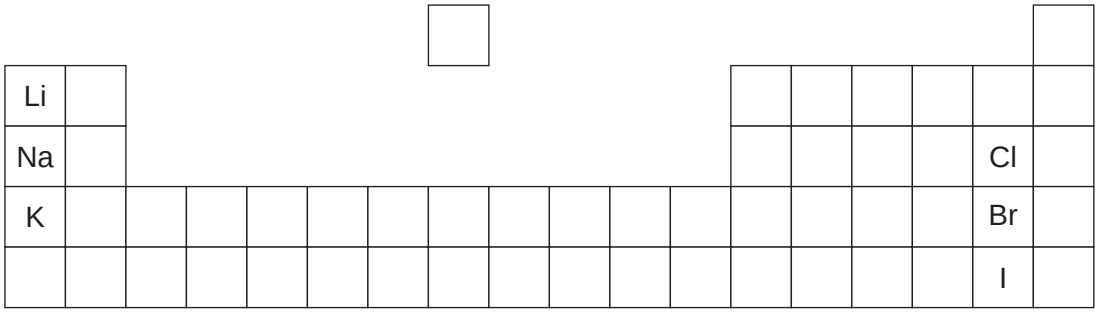
[1 mark]

4.1.1.2 Mixtures

Question 109 · continued

3 (b) **Figure 5** shows an outline of the modern periodic table.

Figure 5



3 (b) (i) Why, in terms of electrons, is bromine in Group 7?

[1 mark]

3 (b) (ii) Bromine reacts with sodium iodide.

The word equation for the reaction is:

bromine + sodium iodide ⟶ sodium bromide + iodine

This reaction shows that bromine is more reactive than iodine.

Explain why, in terms of electrons.

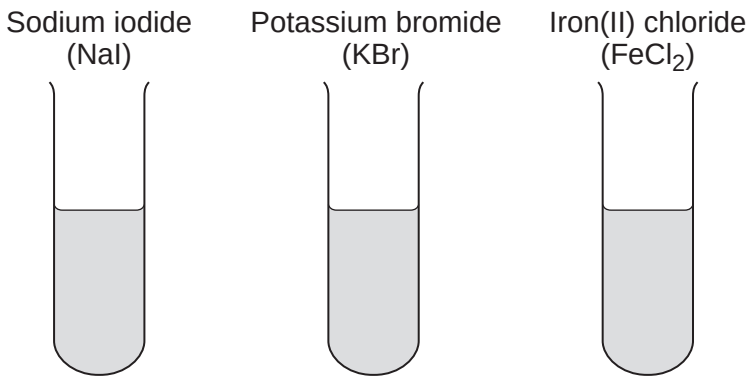
[3 marks]

Question 3 continues on the next page

Question 109 · continued

3 (c) **Figure 6** shows test tubes containing solutions of sodium iodide, potassium bromide and iron(II) chloride.

Figure 6



3 (c) (i) A student tested each solution with silver nitrate in the presence of dilute nitric acid.

Write the result for sodium iodide solution in **Table 1**.

[1 mark]

Table 1

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding silver nitrate		Cream precipitate	White precipitate

3 (c) (ii) The student tested new samples of each solution with sodium hydroxide solution.

Write the result for iron(II) chloride solution in **Table 2**.

[1 mark]

Table 2

	Sodium iodide solution	**Potassium bromide solution**	**Iron(II) chloride solution**
Result of adding sodium hydroxide solution	No precipitate	No precipitate	

4.1.1.2 Mixtures

Question 109 · continued

3 (d) A flame test is done on a mixture of sodium iodide and potassium bromide.

Why would a flame test **not** show the presence of both sodium ions and potassium ions in the mixture?

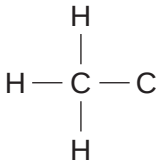
[1 mark]

3 (e) Carboxylic acids are compounds containing carbon.

3 (e) (i) Complete **Figure 7** to show the displayed structure of ethanoic acid.

[1 mark]

Figure 7



3 (e) (ii) Explain why ethanoic acid has a higher pH value than hydrochloric acid of the same concentration.

[2 marks]

12

4.1.1.2 Mixtures

Question 110

June 2017 | CH3HP | Original Q6 | Legacy

6 This question is about ammonia and a compound produced from ammonia.

6 (a) Ammonia is produced by the Haber process.

6 (a) (i) The reactants in the Haber process are nitrogen and hydrogen.

Give the source of the hydrogen used for the Haber process.

[1 mark]

_____

6 (a) (ii) The Haber process produces a mixture of the gases ammonia, hydrogen and nitrogen.

Table 3 shows boiling points for ammonia, hydrogen and nitrogen.

Table 3

	Boiling point in °C
Ammonia	–33
Hydrogen	–260
Nitrogen	–196

Explain how to separate ammonia from the mixture of gases.

Use the information in **Table 3** to help you.

[2 marks]

_____

_____

_____

_____

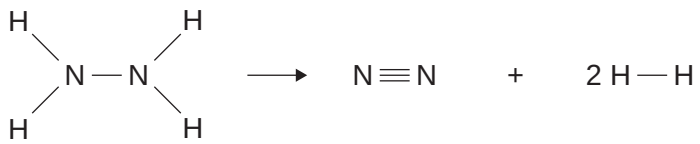
Question 6 continues on the next page

4.1.1.2 Mixtures

Question 110 · continued

6 (b) Ammonia is used to produce hydrazine (N_2H_4).

6 (b) (i) The equation for the decomposition of hydrazine is:



Bond energies are given in **Table 4**.

Table 4

Bond	Bond energy in kJ
N — N	160
N — H	391
N ≡ N	941
H — H	432

Calculate the energy change for the decomposition of hydrazine.

[3 marks]

Energy change = _____ kJ

4.1.1.2 Mixtures

Question 110 · continued

6 (b) (ii) The decomposition of hydrazine is exothermic.

Explain why, in terms of bond making and bond breaking.

[2 marks]

8

4.1.1.2 Mixtures

Question 111

June 2018 | 8462/2H | Original Q1

0 1 This question is about chemicals in fireworks.

Coloured flames are produced because of the metal ions present in fireworks.

0 1 . 1 What colour flame would sodium ions produce?

[1 mark]

0 1 . 2 Name a metal ion that would produce a green flame.

[1 mark]

0 1 . 3 Some fireworks contain a mixture of metal ions.

Why is it difficult to identify the metal ions from the colour of the flame?

[1 mark]

4.1.1.2 Mixtures

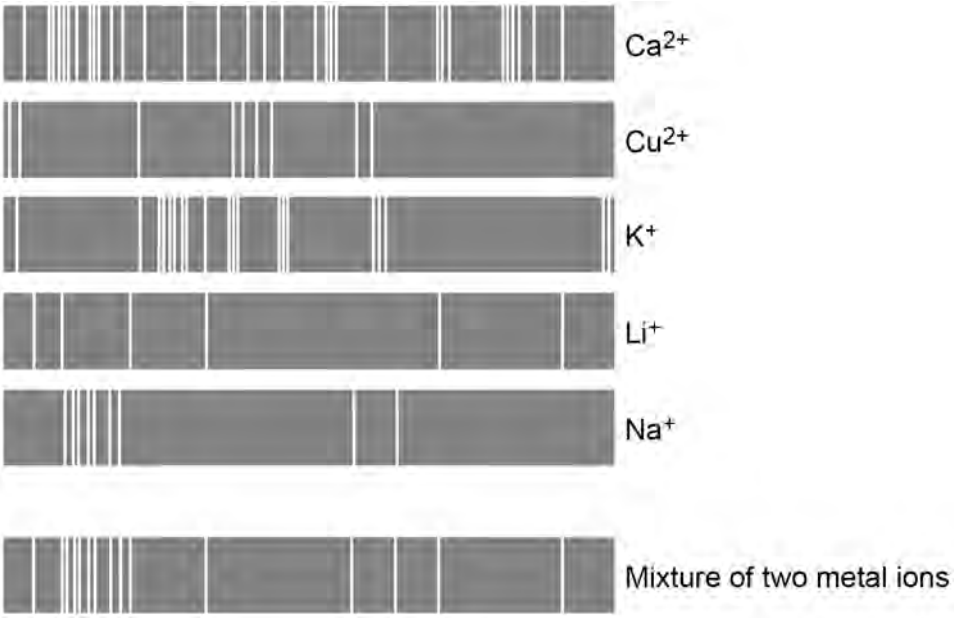
Question 111 · continued

0 1 . 4 Flame emission spectroscopy is used to identify metal ions in a firework.

Figure 1 shows:

- the flame emission spectra of five individual metal ions
- a flame emission spectrum for a mixture of two metal ions.

Figure 1



Which **two** metal ions are in the mixture?

[2 marks]

Tick **two** boxes.

Ca^{2+} ☐

Cu^{2+} ☐

K^+ ☐

Li^+ ☐

Na^+ ☐

4.1.1.2 Mixtures

Question 111 · continued

The compounds in fireworks also contain non-metal ions.

A scientist tests a solution of the chemicals used in a firework.

0 1 . 5 Silver nitrate solution and dilute nitric acid are added to the solution.

A cream precipitate forms.

Which ion is shown to be present by the cream precipitate?

[1 mark]

0 1 . 6 Describe a test to show the presence of sulfate ions in the solution.

Give the result of the test if there are sulfate ions in the solution.

[3 marks]

Test

Result

9

4.1.1.2 Mixtures

Question 112

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

4.1.1.2 Mixtures

Question 112 · 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]

4.1.1.2 Mixtures

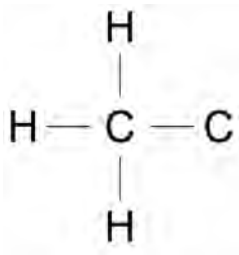
Question 112 · continued

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]

4.1.1.2 Mixtures

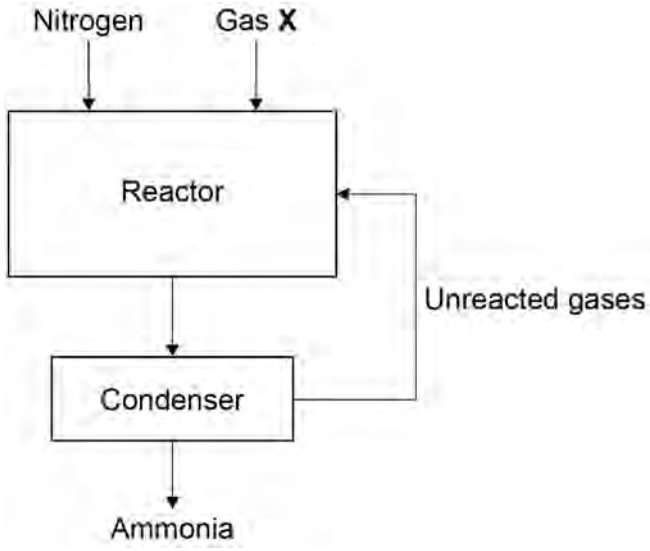
Question 113

June 2018 | 8462/2H | Original Q3

0 3 This question is about gases.

Figure 3 shows how nitrogen is used in the Haber Process to produce ammonia.

Figure 3



0 3 . 1 Gas **X** in **Figure 3** is obtained from methane.

Name gas **X**.

[1 mark]

_____

0 3 . 2 Give the approximate temperature and pressure used in the reactor.

[2 marks]

Temperature _____

Pressure _____

0 3 . 3 The mixture of gases from the reactor cools in the condenser.

Suggest why ammonia condenses but the other gases do not.

[1 mark]

_____

_____

4.1.1.2 Mixtures

Question 113 · continued

The Earth's early atmosphere was different to Earth's atmosphere today.

Scientists think that the Earth's early atmosphere was like the atmosphere found on Venus today.

Table 2 shows the amounts of carbon dioxide and oxygen in the atmospheres of Venus and Earth today.

Table 2

Gas	Percentage (%) in Venus' atmosphere today	Percentage (%) in Earth's atmosphere today
Carbon dioxide	96.50	0.04
Oxygen	0.00	20.95

0 3 . 4 The percentages of carbon dioxide and oxygen have changed from Earth's early atmosphere to Earth's atmosphere today.

Explain the processes that led to these changes.

[6 marks]

4.1.1.2 Mixtures

Question 113 · continued

0 3 . 5 Why are scientists **not** certain about the percentage of each gas in the Earth's early atmosphere?

[1 mark]

11

Turn over for the next question

4.1.1.2 Mixtures

Question 114

June 2018 | 8462/2H | Original Q4

0 4 A student investigated the colours in three different flowers, **A**, **B** and **C**.

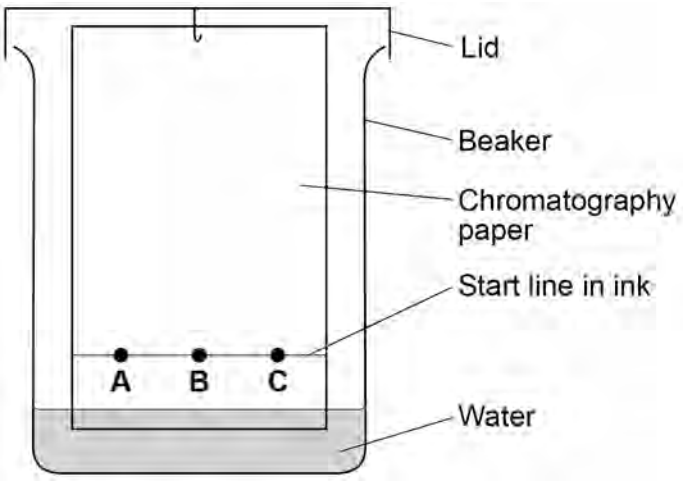
The colours are soluble in ethanol but are insoluble in water.

This is the method used.

1. Crush flower **A**.
2. Add ethanol to flower **A**.
3. Filter the mixture.
4. Put spots of the coloured filtrate on to the chromatography paper.
5. Repeat steps 1-4 with flowers **B** and **C**.

Figure 4 shows the apparatus used.

Figure 4



0 4 . 1 The student made **two** mistakes in setting up the apparatus.

Give **one** problem caused by each mistake.

[4 marks]

Mistake 1 _____

Problem caused _____

_____

Mistake 2 _____

Problem caused _____

_____

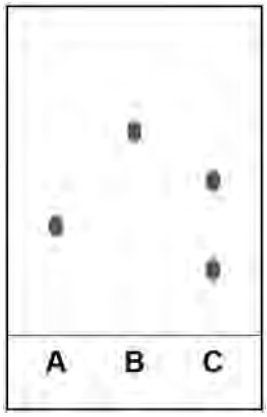
4.1.1.2 Mixtures

Question 114 · continued

0 4 . 2 Another student set up the apparatus correctly.

Figure 5 represents the student's results.

Figure 5



Give **two** conclusions you can make from **Figure 5**.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 3 Colour **A** has an R_f value of 0.65

Colour **A** moves 3.2 cm

Calculate the distance moved by the solvent.

[2 marks]

_____

_____

Distance moved by solvent = _____ cm

8

4.1.1.2 Mixtures

Question 115

June 2018 | 8462/2H | Original Q6

0 6 This question is about polymers.

0 6 . 1 Polyesters are produced when monomers join together and lose a small molecule.

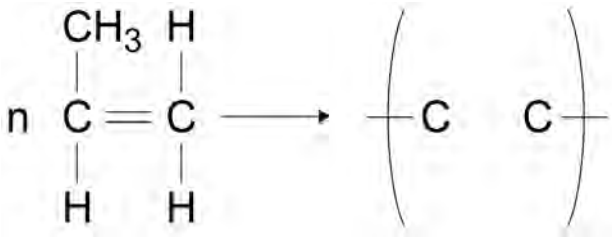
Name the small molecule lost.

[1 mark]

0 6 . 2 Poly(propene) is produced from propene.

Complete the structure of poly(propene) in the equation.

[3 marks]



0 6 . 3 Carpets are made from:

- poly(propene)
- wool
- a mixture of poly(propene) and wool.

Poly(propene) wears out more slowly than wool.

A mixture of poly(propene) and wool to make carpets is more sustainable than using just poly(propene) or just wool.

Suggest why.

[2 marks]

4.1.1.2 Mixtures

Question 115 · continued

Polymer fibres are used to make firefighter uniforms.

Table 3 shows some properties of two polymer fibres.

Table 3

	Polymer fibres	
Property	**Poly(propene)**	**Polyester**
Density in g/cm^3	0.90	1.38
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 6 . 4 Evaluate the suitability of poly(propene) and polyester for firefighter uniforms.

[4 marks]

10

4.1.1.2 Mixtures

Question 116

June 2018 | 8462/2H | Original Q7

0 7 Older cars are tested each year to measure the amount of pollutants contained in exhaust fumes.

Table 4 shows the maximum allowed percentages of exhaust pollutants for petrol cars.

Table 4

Age of car in years	Maximum allowed percentage (%) of exhaust pollutant	
	Carbon monoxide	Unburned hydrocarbons
16–24	0.30	0.02
3–16	0.20	0.02

0 7 . 1 Explain how carbon monoxide is produced when petrol is burned in car engines.

[2 marks]

0 7 . 2 Suggest **two** reasons why the maximum allowed percentage of carbon monoxide has been decreased for newer cars.

[2 marks]

1

2

4.1.1.2 Mixtures

Question 116 · continued

0 7 . 3 Give **one** reason for having a maximum allowed percentage of unburned hydrocarbons in exhaust fumes.

[1 mark]

Oxides of nitrogen are also pollutants contained in exhaust fumes.

0 7 . 4 Describe how oxides of nitrogen are produced when petrol is burned in car engines.

[2 marks]

Catalytic converters are fitted to car exhausts to reduce the amount of pollutants released into the atmosphere.

0 7 . 5 Nitrogen dioxide is an oxide of nitrogen.

Nitrogen dioxide reacts to produce nitrogen and oxygen in catalytic converters.

Complete the equation for this reaction.

The equation should be balanced.

[2 marks]

$$___\ NO_2\ (g) \rightarrow _____ + ___\ O_2\ (g)$$

4.1.1.2 Mixtures

Question 116 · continued

0 7 . 6 Give **two** effects of atmospheric pollution which are reduced by using catalytic converters.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 7 The catalyst in catalytic converters is a mixture of three elements.

Where in the periodic table are these elements most likely to be found?

[1 mark]

Tick **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐
- Transition metals ☐

12

4.1.1.2 Mixtures

Question 117

June 2019 | 8462/1H | Original Q7

0 7 This question is about electrolysis.

Aluminium is produced by electrolysing a molten mixture of aluminium oxide and cryolite.

0 7 . 1 Explain why a mixture is used as the electrolyte instead of using only aluminium oxide.

[2 marks]

0 7 . 2 What happens at the negative electrode during the production of aluminium?

[1 mark]

Tick (✓) **one** box.

- Aluminium atoms gain electrons. ☐
- Aluminium atoms lose electrons. ☐
- Aluminium ions gain electrons. ☐
- Aluminium ions lose electrons. ☐

0 7 . 3 Oxygen is produced at the positive electrode.

Complete the balanced half-equation for the process at the positive electrode.

[2 marks]

→ O_2 +

4.1.1.2 Mixtures

Question 117 · continued

0 7 . 4 Explain why the positive electrode must be continually replaced.

[3 marks]

0 7 . 5 The overall equation for the electrolysis of aluminium oxide is:

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

Calculate the mass of oxygen produced when 2000 kg of aluminium oxide is completely electrolysed.

Relative atomic masses (A_r): O = 16 Al = 27

[4 marks]

Mass of oxygen = _____ kg

4.1.1.2 Mixtures

Question 117 · continued

Sodium metal and chlorine gas are produced by the electrolysis of molten sodium chloride.

0 7 . 6 Explain why sodium chloride solution **cannot** be used as the electrolyte to produce sodium metal.

[2 marks]

0 7 . 7 Calculate the volume of 150 kg of chlorine gas at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Relative formula mass (M_r): Cl_2 = 71

[2 marks]

Volume = _____ dm^3

16

4.1.1.2 Mixtures

Question 118

June 2019 | 8462/2H | Original Q2

0 2 This question is about lithium carbonate.

Lithium carbonate is used in medicines.

Figure 2 shows a tablet containing lithium carbonate.

Figure 2



0 2 . 1 Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire
- dilute hydrochloric acid
- limewater.

Plan an investigation to show the presence of lithium ions **and** of carbonate ions in the tablet.

You should include the results of the tests for the ions.

[6 marks]

4.1.1.2 Mixtures

Question 118 · continued

0 2 . 2 The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

[1 mark]

0 2 . 3 The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.

Calculate the percentage by mass of lithium carbonate in this tablet.

[3 marks]

Percentage by mass of lithium carbonate = _____ %

10

4.1.1.2 Mixtures

Question 119

November 2020 | 8462/1H | Original Q3

0 3 This question is about silver iodide.

Silver iodide is produced in the reaction between silver nitrate solution and sodium iodide solution.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

0 3 . 1 A student investigated the law of conservation of mass.

This is the method used.

1. Pour silver nitrate solution into a beaker labelled **A**.
2. Pour sodium iodide solution into a beaker labelled **B**.
3. Measure the masses of both beakers and their contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the masses of both beakers and their contents again.

Table 3 shows the student's results.

Table 3

	Mass before mixing in g	**Mass after mixing in g**
Beaker **A** and contents	78.26	108.22
Beaker **B** and contents	78.50	48.54

Explain how the results demonstrate the law of conservation of mass.

You should use data from **Table 3** in your answer.

[2 marks]

4.1.1.2 Mixtures

Question 119 · continued

0 3 . 2 Suggest how the student could separate the insoluble silver iodide from the mixture at the end of the reaction.

[1 mark]

The student purified the separated silver iodide.

This is the method used.

1. Rinse the silver iodide with distilled water.

2. Warm the silver iodide.

0 3 . 3 Suggest **one** impurity that was removed by rinsing with water.

[1 mark]

0 3 . 4 Suggest why the student warmed the silver iodide.

[1 mark]

Question 3 continues on the next page

4.1.1.2 Mixtures

Question 119 · continued

0 3 . 5 Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

Give your answer to 3 significant figures.

Relative formula masses (M_r): $AgNO_3 = 170$ NaI = 150 AgI = 235 $NaNO_3 = 85$

[4 marks]

Percentage atom economy (3 significant figures) = _____ %

0 3 . 6 Give **one** reason why reactions with a high atom economy are used in industry.

[1 mark]

10

4.1.1.2 Mixtures

Question 120

November 2020 | 8462/1H | Original Q6

0 6 This question is about displacement reactions.

0 6 . 1 The displacement reaction between aluminium and iron oxide has a high activation energy.

What is meant by 'activation energy'?

[1 mark]

0 6 . 2 A mixture contains 1.00 kg of aluminium and 3.00 kg of iron oxide.

The equation for the reaction is:

$$2\,Al + Fe_2O_3 \rightarrow 2\,Fe + Al_2O_3$$

Show that aluminium is the limiting reactant.

Relative atomic masses (A_r): O = 16 Al = 27 Fe = 56

[4 marks]

4.1.1.2 Mixtures

Question 120 · continued

Magnesium displaces zinc from zinc sulfate solution.

0 6 . 3 Complete the ionic equation for the reaction.

You should include state symbols.

[2 marks]

$$Mg(s) + Zn^{2+}(aq) \rightarrow _____ + _____$$

0 6 . 4 Explain why the reaction between magnesium atoms and zinc ions is both oxidation and reduction.

[2 marks]

9

4.1.1.2 Mixtures

Question 121

November 2020 | 8462/2H | Original Q1

0 1 This question is about chemical analysis.

A student tested copper sulfate solution and calcium iodide solution using flame tests.

This is the method used.

1. Dip a metal wire in copper sulfate solution.

2. Put the metal wire in a blue Bunsen burner flame.

3. Record the flame colour produced.

4. Repeat steps 1 to 3 using the same metal wire but using calcium iodide solution.

0 1 . 1 What flame colour is produced by copper sulfate solution?

[1 mark]

0 1 . 2 Calcium compounds produce an orange-red flame colour.

The student left out an important step before reusing the metal wire.

The student's method did **not** produce a distinct orange-red flame colour using calcium iodide solution.

Explain why.

[2 marks]

4.1.1.2 Mixtures

Question 121 · continued

0 1 . 3 The student added sodium hydroxide solution to:

- copper sulfate solution
- calcium iodide solution.

Give the results of the tests.

[2 marks]

Copper sulfate solution _____

_____

Calcium iodide solution _____

_____

0 1 . 4 To test for sulfate ions the student added dilute hydrochloric acid to copper sulfate solution.

Name the solution that would show the presence of sulfate ions when added to this mixture.

[1 mark]

_____

0 1 . 5 To test for iodide ions the student added dilute nitric acid to calcium iodide solution.

Name the solution that would show the presence of iodide ions when added to this mixture.

Give the result of the test.

[2 marks]

Solution _____

Result _____

_____

8

4.1.1.2 Mixtures

Question 122

November 2020 | 8462/2H | Original Q4

0 4 This question is about ink.

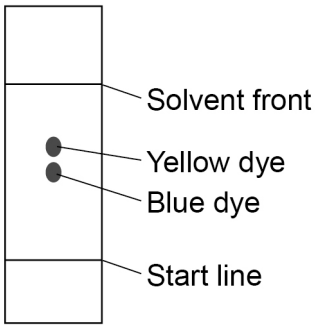
A student investigated green ink using paper chromatography in a beaker.

The student used water as the solvent.

Figure 2 shows the chromatogram obtained.

Figure 2

Diagram not to scale



0 4 . 1 The R_f value of the yellow dye = 0.60

The distance moved by the yellow dye = 5.7 cm

Calculate the distance moved by the solvent.

[3 marks]

Distance moved by the solvent = _____ cm

4.1.1.2 Mixtures

Question 122 · continued

0 4 . 2 The green ink contains more than two compounds.

Suggest **one** reason why only two spots are seen on **Figure 2**.

[1 mark]

0 4 . 3 On the student's chromatogram, the yellow and blue spots are very close together.

Which **two** ways could increase the distance between the spots?

[2 marks]

Tick (✓) **two** boxes.

- Allow the solvent front to travel further. ☐
- Dry the chromatogram more slowly. ☐
- Use a different solvent. ☐
- Use a larger beaker. ☐
- Use a larger spot of green ink. ☐

0 4 . 4 The manufacturers of the green ink always use the same proportions of yellow dye and blue dye.

Suggest **one** reason why.

[1 mark]

4.1.1.2 Mixtures

Question 122 · continued

0 4 . 5 The R_f value of a dye depends on:

- the solubility of the dye in the solvent
- the attraction of the dye to the paper.

Which will **definitely** produce a smaller R_f value if the solvent and paper are both changed?

[1 mark]

Tick (✓) **one** box.

The dye is less soluble in the new solvent and less attracted to the new paper. ☐

The dye is less soluble in the new solvent and more attracted to the new paper. ☐

The dye is more soluble in the new solvent and less attracted to the new paper. ☐

The dye is more soluble in the new solvent and more attracted to the new paper. ☐

8

4.1.1.2 Mixtures

Question 123

November 2020 | 8462/2H | Original Q10

1 0 This question is about a reversible reaction.

The reaction between solutions of iron(III) ions (Fe^{3+}) and thiocyanate ions (SCN^-) is reversible.

The ionic equation for the reaction is:

	$Fe^{3+}(aq)$	+	$SCN^-(aq)$	$\rightleftharpoons$	$FeSCN^{2+}(aq)$
Colour of solution:	yellow		colourless		red

The colour of the equilibrium mixture is orange at room temperature.

1 0 . 1 Give the name of the solvent used to dissolve the ions in this reaction.

[1 mark]

1 0 . 2 A few drops of a colourless solution containing a high concentration of thiocyanate ions (SCN^-) are added to the orange equilibrium mixture.

Explain the colour change observed.

[3 marks]

4.1.1.2 Mixtures

Question 123 · continued

1 0 . 3 A water bath is set up at a temperature above room temperature.

When a test tube containing the orange equilibrium mixture is placed in the water bath, the mixture becomes more yellow.

Explain what this shows about the energy change for the forward reaction.

[3 marks]

1 0 . 4 Explain why a change in pressure does **not** affect the colour of the equilibrium mixture.

[2 marks]

1 0 . 5 Other metal ions form coloured equilibrium mixtures with thiocyanate ions.

Which metal ion could form a coloured equilibrium mixture with thiocyanate ions?

[1 mark]

Tick (✓) **one** box.

Al^{3+} ☐

Co^{2+} ☐

Mg^{2+} ☐

Na^{+} ☐

10

4.1.1.2 Mixtures

Question 124

November 2021 | 8462/2H | Original Q2

0 2 This question is about alkanes.

Table 1 shows information about some alkanes.

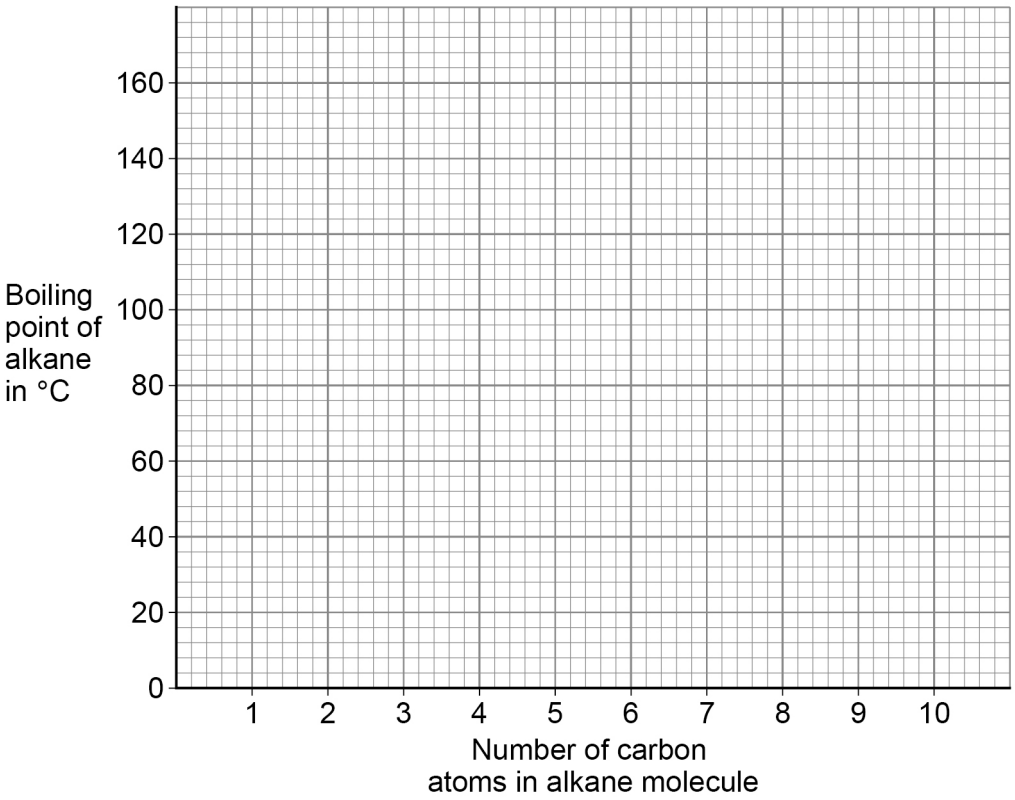
Table 1

Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	**X**
8	126
9	151

0 2 . 1 Plot the data from **Table 1** on **Figure 2**.

[2 marks]

Figure 2



4.1.1.2 Mixtures

Question 124 · continued

0 2 . 2 Predict the boiling point **X** of the alkane with seven carbon atoms in a molecule.

Use **Table 1** and **Figure 2**.

[1 mark]

X = _____ °C

0 2 . 3 **Figure 2** is **not** suitable to show the boiling point of the alkane with three carbon atoms in a molecule.

Suggest **one** reason why.

[1 mark]

_____

_____

0 2 . 4 What is the state at 20 °C of the alkane with four carbon atoms in a molecule?

Use **Table 1**.

[1 mark]

_____

Question 2 continues on the next page

4.1.1.2 Mixtures

Table 1 is repeated below.

Table 1

Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	**X**
8	126
9	151

The alkane with nine carbon atoms in a molecule is called nonane.

0 2 . 5 Complete the formula of nonane.

[1 mark]

C_9H____

0 2 . 6 Nonane will condense lower in a fractionating column during fractional distillation than the other alkanes in **Table 1**.

Explain why.

You should refer to the temperature gradient in the fractionating column.

[2 marks]

8

4.1.1.2 Mixtures

Question 125

November 2021 | 8462/2H | Original Q3

0 3 This question is about paper chromatography.

A food colouring contains a dye.

0 3 . 1 Plan an investigation to determine the R_f value for the dye in this food colouring.

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

Your plan should include the use of:

- a beaker
- a solvent
- chromatography paper.

[6 marks]

4.1.1.2 Mixtures

Question 125 · continued

0 3 . 2 Two students investigated a dye in a food colouring using paper chromatography.

Each student did the investigation differently.

The R_f values they determined for the **same** dye were different.

How did the students' investigations differ?

[1 mark]

Tick (✓) **one** box.

- Different length of paper used ☐
- Different period of time used ☐
- Different size of beaker used ☐
- Different solvent used ☐

0 3 . 3 Paper chromatography involves a stationary phase.

What is the stationary phase in paper chromatography?

[1 mark]

Tick (✓) **one** box.

- Beaker ☐
- Dye ☐
- Paper ☐
- Solvent ☐

8

4.1.1.2 Mixtures

Question 126

November 2021 | 8462/2H | Original Q5

0 5 This question is about fertilisers.

Some fertilisers are described as NPK fertilisers because they contain three elements needed for healthy plant growth.

0 5 . 1 Which **two** compounds each contain **two** of these elements?

[2 marks]

Tick (✓) **two** boxes.

- Ammonium nitrate ☐
- Ammonium phosphate ☐
- Calcium chloride ☐
- Calcium phosphate ☐
- Potassium chloride ☐
- Potassium nitrate ☐

0 5 . 2 Rocks containing calcium phosphate are treated with acid to produce soluble salts that can be used as fertilisers.

Name the soluble salts produced when calcium phosphate reacts with:

- nitric acid
- phosphoric acid.

[2 marks]

Nitric acid _____

Phosphoric acid _____

4.1.1.2 Mixtures

Question 126 · continued

0 5 . 3 Ammonium sulfate is a compound in fertilisers.

Ammonium sulfate can be made using an industrial process or in the laboratory.

In the industrial process, the following steps are used.

1. React streams of ammonia solution and sulfuric acid together.
2. Evaporate the water by passing the solution down a warm column.
3. Collect dry crystals continuously at the bottom of the column.

In the laboratory, the following steps are used.

1. React ammonia solution and sulfuric acid in a conical flask.
2. Evaporate water from the solution until crystals start to form.
3. Leave to cool and crystallise further.
4. Separate the crystals using filtration.
5. Dry the crystals between pieces of filter paper.

Evaluate the two methods for producing a large mass of ammonium sulfate.

[4 marks]

8

4.1.1.2 Mixtures

Question 127

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]

4.1.1.2 Mixtures

Question 127 · 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]

4.1.1.2 Mixtures

Question 127 · 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]

4.1.1.2 Mixtures

Question 127 · 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

4.1.1.2 Mixtures

Question 128

June 2022 | 8462/1H | Original Q2

0 2 Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.

The equation for the reaction is:

$$Na_2CO_3(s) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + CO_2(g) + H_2O(l)$$

A student investigated the effect of changing the mass of sodium carbonate powder on the highest temperature reached by the reaction mixture.

0 2 . 1 Plan a method to investigate the effect of changing the mass of sodium carbonate powder on the highest temperature reached.

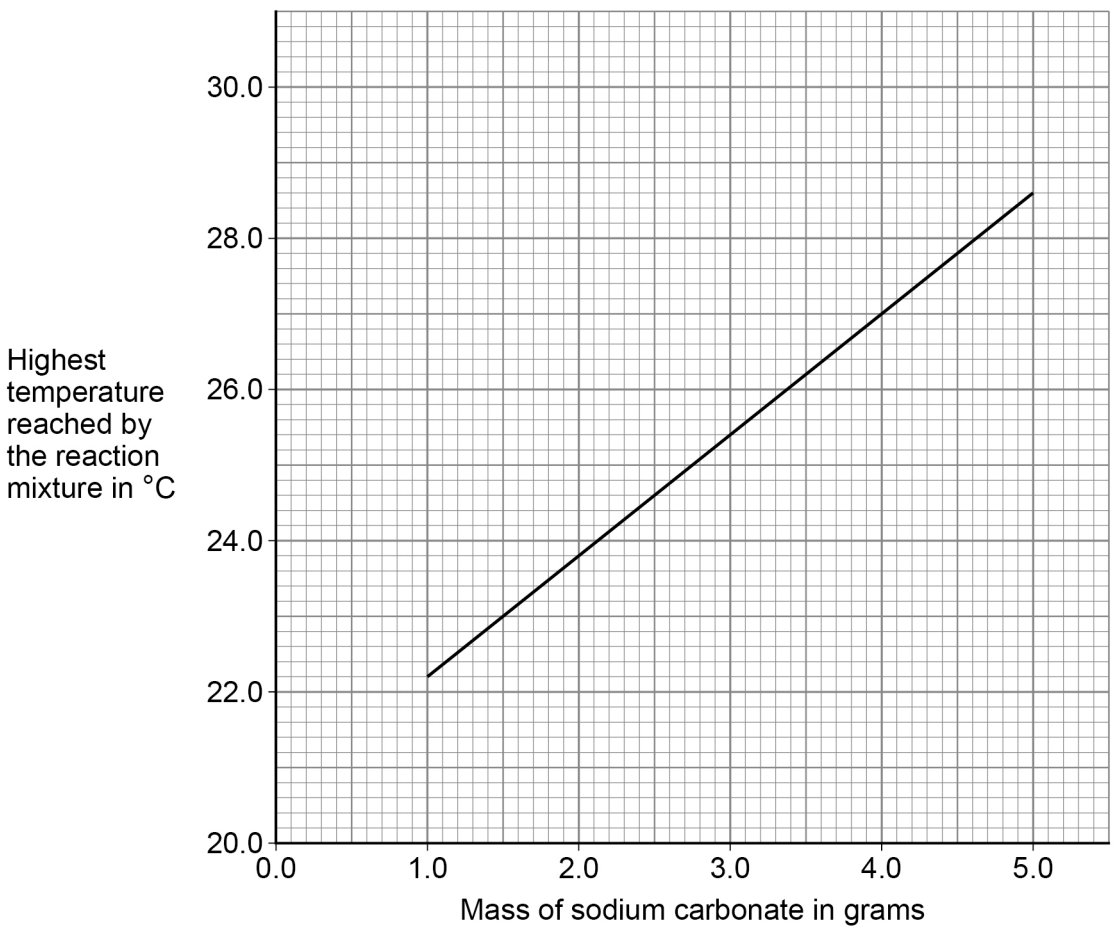
[6 marks]

4.1.1.2 Mixtures

Question 128 · continued

Figure 3 shows a line of best fit drawn through the student's results.

Figure 3



4.1.1.2 Mixtures

Question 128 · continued

0 2 . 2 Determine the gradient of the line of best fit in **Figure 3**.

Use the equation:

$$\text{Gradient} = \frac{\text{Change in highest temperature}}{\text{Change in mass}}$$

Give the unit.

[5 marks]

Gradient = _____ Unit _____

0 2 . 3 The initial temperature of the reaction mixture is where the line of best fit would meet the *y*-axis.

Determine the initial temperature of the reaction mixture.

Show your working on **Figure 3**.

[2 marks]

Initial temperature of the reaction mixture = _____ °C

4.1.1.2 Mixtures

Question 128 · continued

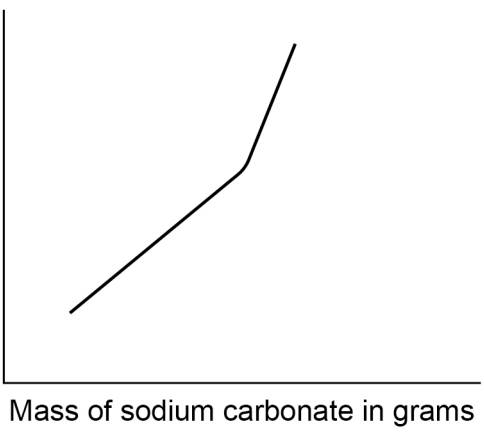
0 2 . 4 Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

Which sketch graph shows the results obtained when sodium carbonate was added until in excess?

[1 mark]

Tick (✓) **one** box.

A



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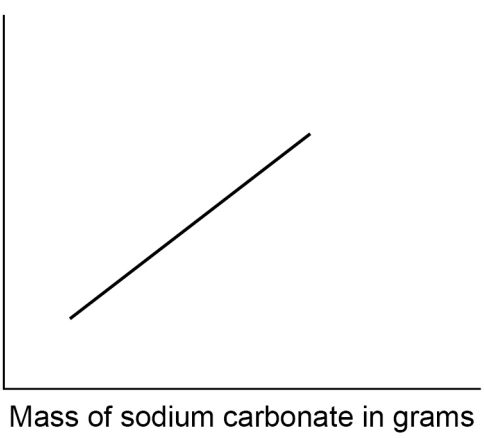
B



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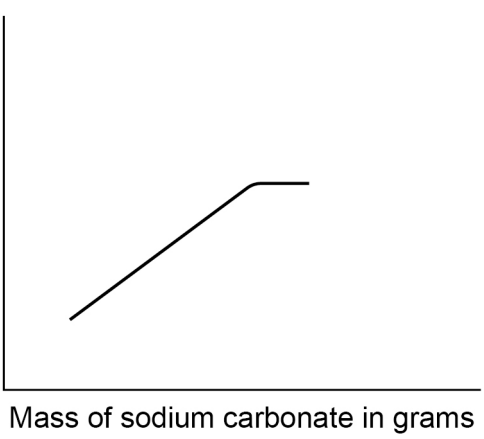

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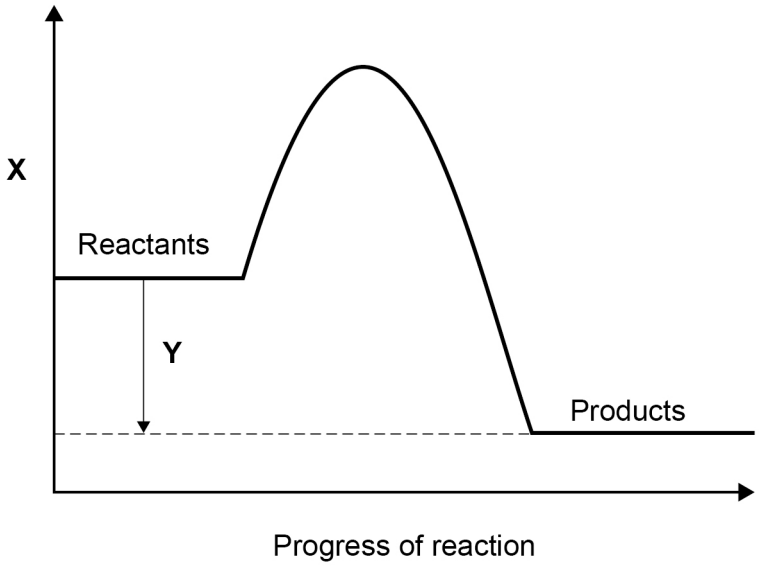
4.1.1.2 Mixtures

Question 128 · continued

Figure 4 shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

Figure 4



0 2 . 5 What do labels **X** and **Y** represent on **Figure 4**?

[2 marks]

X _____

Y _____

0 2 . 6 How does the reaction profile show that the reaction is exothermic?

Use **Figure 4**.

[1 mark]

_____

_____

17

4.1.1.2 Mixtures

Question 129

June 2022 | 8462/1H | Original Q8

0 8 This question is about acids and alkalis.

0 8 . 1 Explain why the pH of an acid depends on:

- the strength of the acid
- the concentration of the acid.

[4 marks]

0 8 . 2 A student titrated 25.00 cm^3 of hydrochloric acid with 0.100 mol/dm^3 barium hydroxide solution.

Table 2 shows the results.

Table 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm^3	23.90	23.45	23.55	23.55	23.45

The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm^3.

Explain why the student used a volume of 23.50 cm^3 of barium hydroxide solution in the titration calculation.

[2 marks]

4.1.1.2 Mixtures

Question 129 · continued

0 8 . 3 25.00 cm^3 of the hydrochloric acid reacted with 23.50 cm^3 of the 0.100 mol/dm^3 barium hydroxide solution.

The equation for the reaction is:

$$2\,HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2\,H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol/dm^3.

[4 marks]

Concentration of the hydrochloric acid = _____ mol/dm^3

Question 8 continues on the next page

Question 129 · continued

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

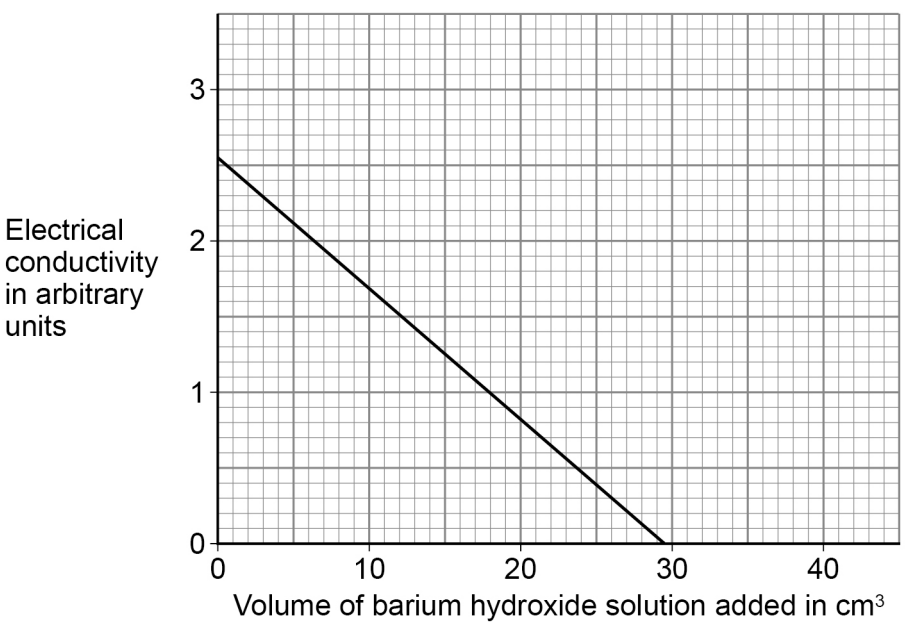
$$H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

Figure 10 shows the results.

Figure 10



0 8 . 4 Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

[3 marks]

4.1.1.2 Mixtures

Question 129 · continued

0 8 . 5 The student then added a further 10 cm^3 of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give **one** reason why.

[1 mark]

14

4.1.1.2 Mixtures

Question 130

June 2022 | 8462/2H | Original Q4

0 4 This question is about the fractions obtained from crude oil.

0 4 . 1 Crude oil is separated into fractions by fractional distillation.

The fractions obtained from crude oil include:

- lubricating oil
- naphtha
- petroleum gases.

Table 3 shows the boiling point range of these fractions.

Table 3

Fraction	Boiling point range in °C
Lubricating oil	300–350
Naphtha	90–200
Petroleum gases	< 25

Explain how these fractions are obtained from crude oil by fractional distillation.

[4 marks]

4.1.1.2 Mixtures

Question 130 · continued

0 4 . 2 Fractions from crude oil can be processed to produce feedstock for the petrochemical industry.

Which **two** are useful materials produced from this feedstock?

[2 marks]

Tick (✓) **two** boxes.

- Alloys ☐
- Ceramics ☐
- Detergents ☐
- Fertilisers ☐
- Solvents ☐

Another fraction obtained from crude oil is petrol.

0 4 . 3 Petrol contains a hydrocarbon with the formula C_9H_{20}

Complete the equation for the complete combustion of C_9H_{20}

You should balance the equation.

[2 marks]

C_9H_{20} + _____ → _____ + _____

0 4 . 4 Petrol obtained from crude oil contains sulfur impurities.

Explain why sulfur impurities are removed before petrol is burned in car engines.

[2 marks]

4.1.1.2 Mixtures

Question 130 · continued

0 4 . 5 **Table 4** shows information about two more fractions obtained from crude oil.

Table 4

Fraction	Range of number of carbon atoms in each molecule
Kerosene	11–15
Heavy fuel oil	20–40

A student predicted that heavy fuel oil is more viscous than kerosene.

The student's prediction was correct.

Justify the student's prediction.

[2 marks]

4.1.1.2 Mixtures

Question 130 · continued

The heavy fuel oil fraction can be processed to produce smaller hydrocarbon molecules.

0 4 . 6 Name the process which produces smaller hydrocarbon molecules from heavy fuel oil.

Give the conditions used in this process.

[3 marks]

Name of process _____

Conditions _____

_____

_____

0 4 . 7 Hydrocarbon molecules containing seven and eight carbon atoms can be produced when heavy fuel oil is processed.

Which pair of hydrocarbon molecules would **both** turn bromine water colourless?

[1 mark]

Tick (✓) **one** box.

C_7H_{14} and C_8H_{16} ☐

C_7H_{14} and C_8H_{18} ☐

C_7H_{16} and C_8H_{16} ☐

C_7H_{16} and C_8H_{18} ☐

16

4.1.1.2 Mixtures

Question 131

June 2022 | 8462/2H | Original Q5

0 5 This question is about water.

0 5 . 1 Sewage is waste water.

Sewage contains organic matter.

Describe how sewage is treated to remove organic matter.

[4 marks]

Question 5 continues on the next page

Question 131 · continued

Sea water and ground water are treated to make them potable.

Table 5 shows information about the composition and treatment of sea water and of ground water.

Table 5

	Sea water	Ground water
Concentration of sodium ions and chloride ions before **Process 1**	Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 1	Reverse osmosis	Filtration
Concentration of sodium ions and chloride ions after **Process 1**	**X**	Na^+ : 0.001 mol/dm^3 Cl^- : 0.001 mol/dm^3
Process 2	Add ozone	Expose to ultraviolet light

0 5 . 2 Sea water is desalinated during **Process 1**.

Which pair of concentrations could represent **X** in **Table 5**?

[1 mark]

Tick (✓) **one** box.

Na^+ : 0.003 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.003 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.003 mol/dm^3 ☐

Na^+ : 0.5 mol/dm^3 Cl^- : 0.5 mol/dm^3 ☐

0 5 . 3 Explain why the concentrations of sodium ions and of chloride ions in the ground water in **Table 5** are unchanged by **Process 1**.

[2 marks]

4.1.1.2 Mixtures

Question 131 · continued

0 5 . 4 Explain why the ground water in **Table 5** requires **Process 2** before the water is safe to drink.

[2 marks]

0 5 . 5 After treatment the ground water in **Table 5** is sold by a company as pure water.

The ground water in **Table 5** is not chemically pure because the water contains sodium ions and chloride ions.

Suggest what the company means by 'pure'.

[1 mark]

0 5 . 6 Chlorine is also used to treat some ground water.

Describe the test for chlorine gas.

Give the result of the test.

[2 marks]

Test

Result

12

4.1.1.2 Mixtures

Question 132

June 2022 | 8462/2H | Original Q8

0 8 This question is about the reaction between sodium thiosulfate solution and hydrochloric acid.

When hydrochloric acid is added to sodium thiosulfate solution, the mixture gradually becomes cloudy.

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

0 8 . 1 Sulfur is produced in the reaction.

Why does the mixture become cloudy?

[1 mark]

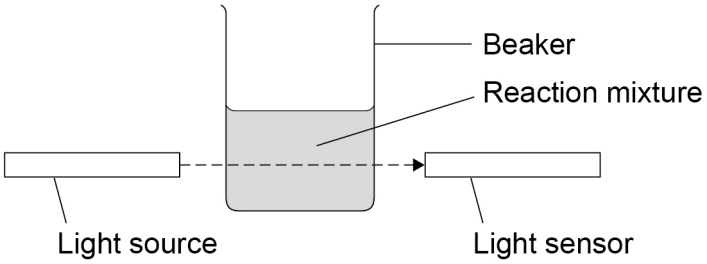
4.1.1.2 Mixtures

Question 132 · continued

A student investigated the effect of changing the concentration of sodium thiosulfate solution on the rate of the reaction.

Figure 6 shows the apparatus used.

Figure 6



A smaller percentage of light from the light source reaches the light sensor as the mixture becomes more cloudy.

This is the method used.

1. Measure 50 cm^3 of 0.10 mol/dm^3 sodium thiosulfate solution into the beaker.
2. Add 10 cm^3 of hydrochloric acid to the sodium thiosulfate solution.
3. Immediately start a timer.
4. Record the percentage of light from the light source that reaches the light sensor every 20 seconds for 120 seconds.
5. Repeat steps 1 to 4 using 0.20 mol/dm^3 sodium thiosulfate solution.

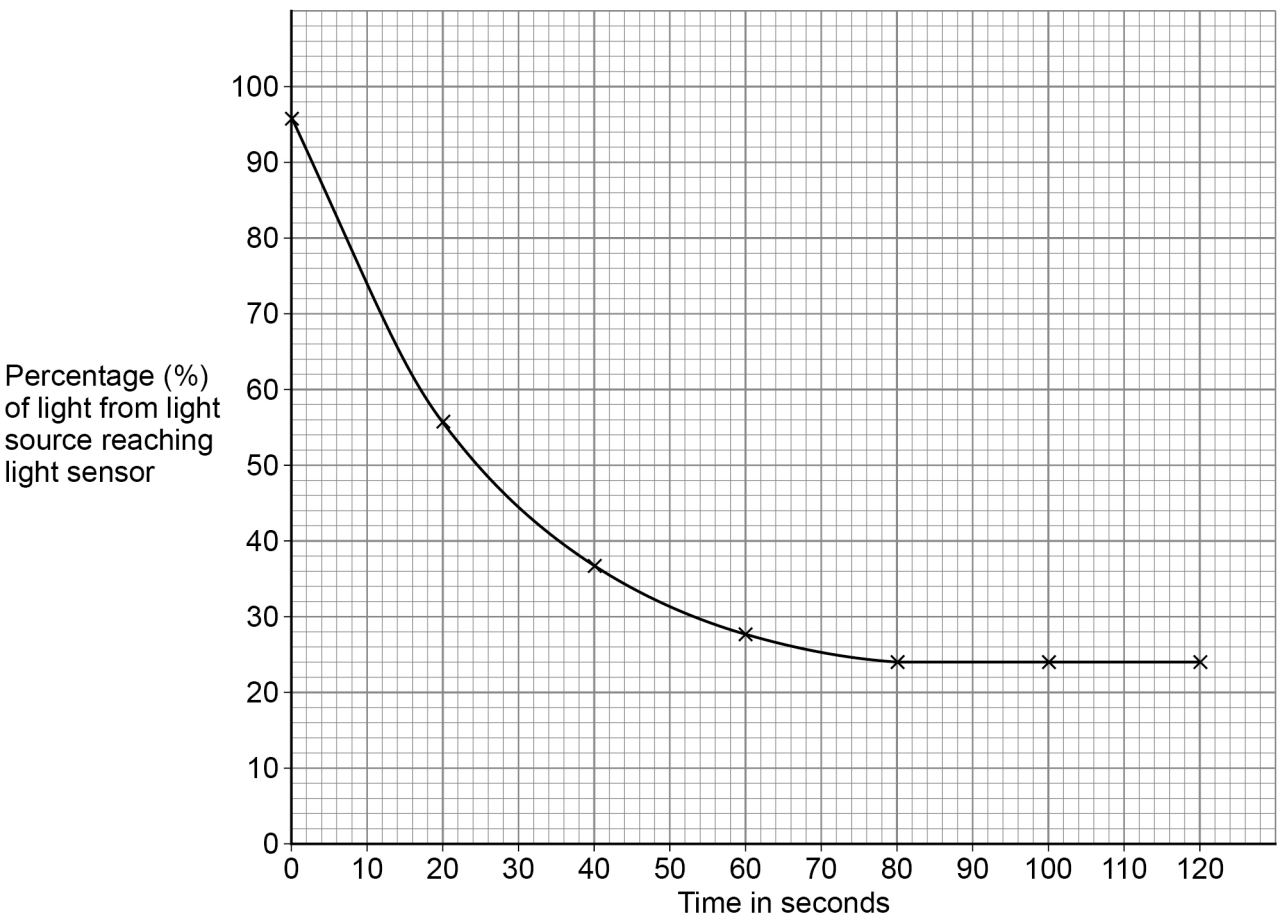
Question 8 continues on the next page

4.1.1.2 Mixtures

Question 132 · continued

Figure 7 shows the results for 0.10 mol/dm^3 sodium thiosulfate solution.

Figure 7



4.1.1.2 Mixtures

Question 132 · continued

0 8 . 2 The percentage of light reaching the light sensor decreases by 1% when 7.1×10^{-5} moles of sulfur is produced.

Determine the rate of reaction in mol/s for the production of sulfur at 30 seconds.

You should draw a tangent on **Figure 7**.

[5 marks]

Rate = _____ mol/s

0 8 . 3 Explain why the rate of reaction changes between 0 and 60 seconds.

Answer in terms of concentration.

Use **Figure 7**.

[2 marks]

4.1.1.2 Mixtures

Question 132 · continued

Figure 8 is a repeat of **Figure 7**.

Figure 8

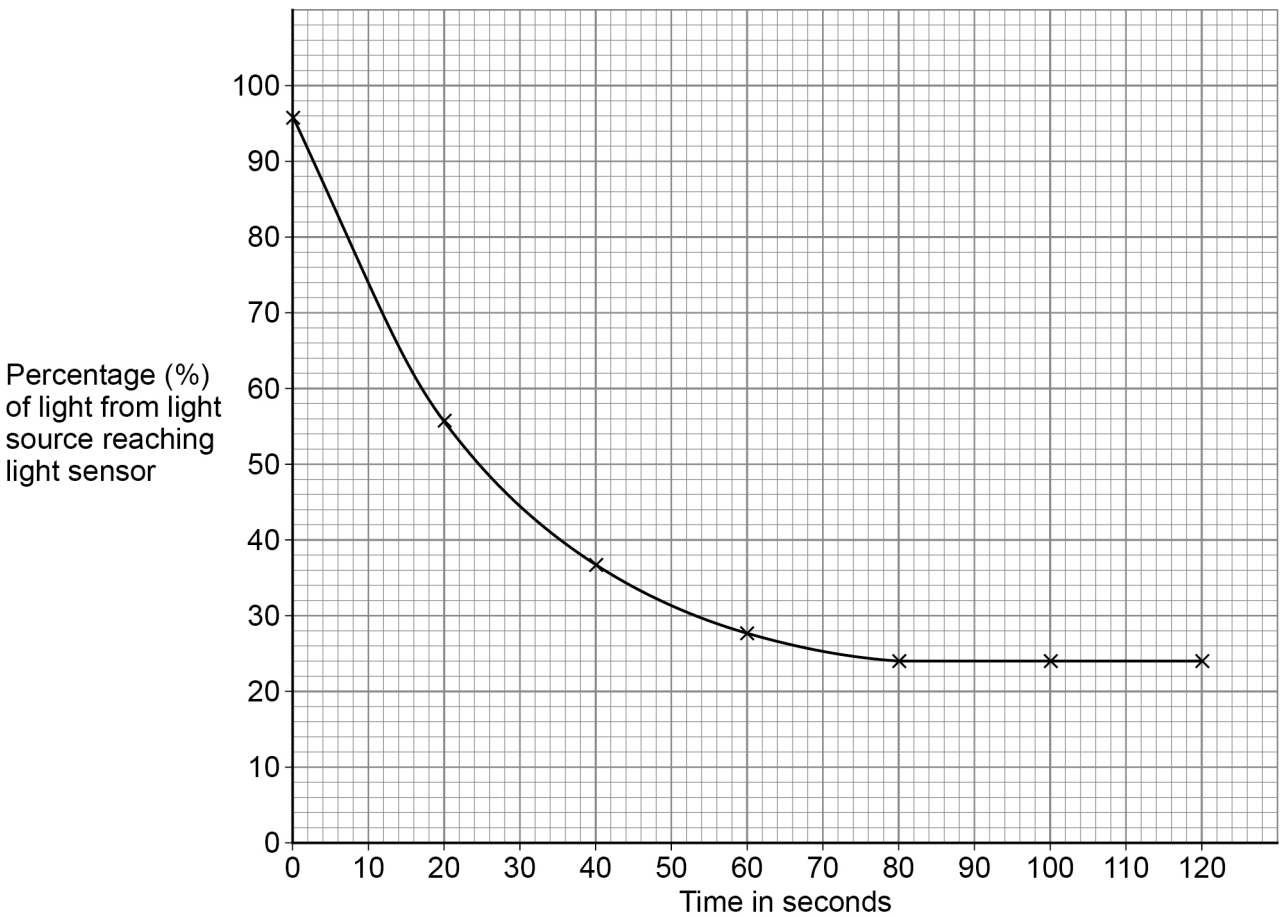


Figure 8 shows the results for 0.10 mol/dm^3 sodium thiosulfate solution.

Sodium thiosulfate solution was in excess in the investigation.

0 8 . 4 The line of best fit on **Figure 8** is horizontal between 80 and 120 seconds because the reaction stopped.

Why did the reaction stop?

[1 mark]

0 8 . 5 Sketch a line on **Figure 8** to show the results you would predict for 0.20 mol/dm^3 sodium thiosulfate solution.

[2 marks]

4.1.1.2 Mixtures

Question 132 · continued

The same student did the investigation again the next day.

The student found that the same method produced different results for the percentage of light reaching the light sensor.

0 8 . 6 How could the student improve the method so that the same percentages of light reached the light sensor?

[1 mark]

Tick (✓) **one** box.

- Record the percentage of light every 10 seconds. ☐
- Stop light from other sources reaching the light sensor. ☐
- Use a larger volume of sodium thiosulfate solution. ☐
- Use a more sensitive light sensor. ☐

0 8 . 7 The student improved the method so that similar results were obtained on different days.

What name is given to similar results obtained on different days under the same conditions by the same student?

[1 mark]

Tick (✓) **one** box.

- Anomalous ☐
- Precise ☐
- Repeatable ☐
- Reproducible ☐

4.1.1.2 Mixtures

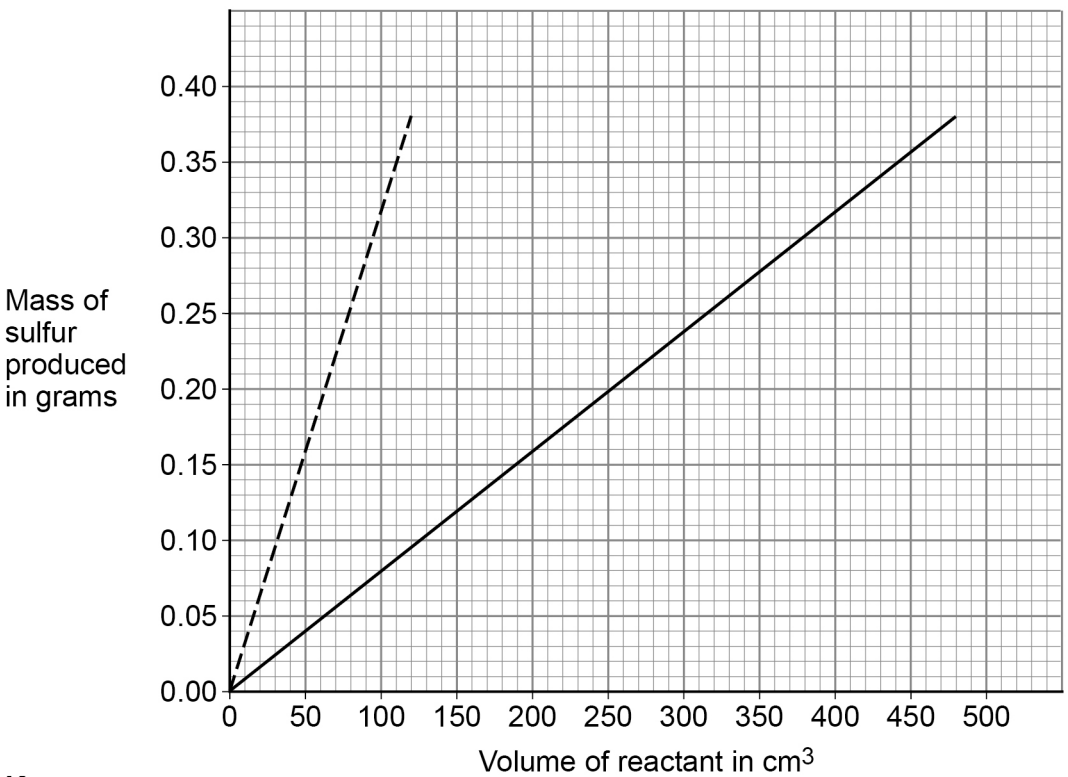
Question 132 · continued

Figure 9 shows the volumes of:

- sodium thiosulfate solution of concentration 0.10 mol/dm^3
- hydrochloric acid of concentration 0.05 mol/dm^3

which completely react to produce different masses of sulfur.

Figure 9



Key

– – – 0.10 mol/dm^3 sodium thiosulfate solution

—— 0.05 mol/dm^3 hydrochloric acid

4.1.1.2 Mixtures

Question 132 · continued

0 8 . 8 Which expression represents the relationship between the volume (V) of sodium thiosulfate solution used and the mass (m) of sulfur produced?

Use **Figure 9**.

[1 mark]

Tick (✓) **one** box.

V ∝ m ☐

V ~ m ☐

V << m ☐

V = m ☐

0 8 . 9 Determine the simplest whole number ratio of the volumes of

sodium thiosulfate solution : hydrochloric acid

which completely react with each other.

Use **Figure 9**.

[3 marks]

Simplest whole number ratio = _____ : _____

17

4.1.1.2 Mixtures

Question 133

June 2023 | 8462/1H | Original Q7

0 7 This question is about electrolysis.

Aluminium is manufactured by electrolysing a molten mixture of aluminium oxide (Al_2O_3) and cryolite (Na_3AlF_6).

0 7 . 1 Complete the half equation for the reaction occurring at the negative electrode.

[1 mark]

$$Al^{3+} + ____ e^- \rightarrow Al$$

0 7 . 2 Cryolite contains Na^+ ions as well as Al^{3+} ions.

Suggest **one** reason why sodium is **not** a product of the electrolysis.

[1 mark]

Question 7 continues on the next page

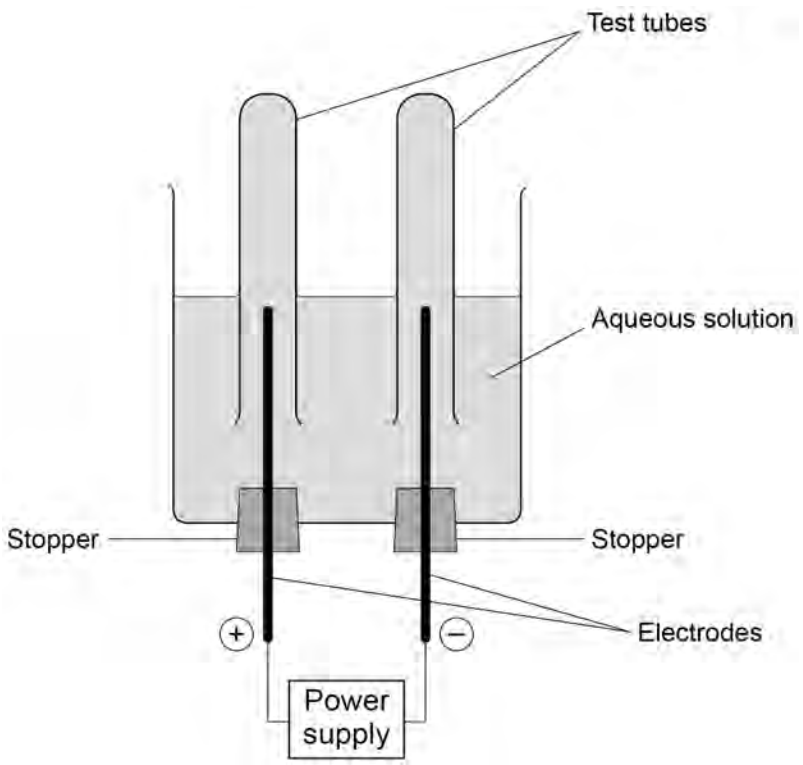
4.1.1.2 Mixtures

Question 133 · continued

A student investigated the electrolysis of an aqueous solution of a different compound.

Figure 7 shows the apparatus.

Figure 7



4.1.1.2 Mixtures

Question 133 · continued

Hydrogen was produced at the negative electrode and oxygen was produced at the positive electrode.

0 7 . 3 Explain how oxygen was produced from water during the electrolysis of this aqueous solution.

[4 marks]

0 7 . 4 The student compared the volumes of the two gases collected.

How can the student change the apparatus in **Figure 7** to compare the volumes of the two gases produced more accurately?

Give **one** reason for your answer.

[2 marks]

Change _____

Reason _____

0 7 . 5 The overall equation for the reaction is:

$$2\,H_2O(l) \rightarrow 2\,H_2(g) + O_2(g)$$

What is the volume of oxygen produced when 20 cm^3 of hydrogen has been produced?

[1 mark]

Tick (✓) **one** box.

10 cm^3 ☐ 20 cm^3 ☐ 30 cm^3 ☐ 40 cm^3 ☐

9

4.1.1.2 Mixtures

Question 134

June 2023 | 8462/1H | Original Q9

0 9 This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

The equation for the reaction is:

$$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$

0 9 . 1 Which substance in the equation is reduced?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

_____

0 9 . 2 Which expression shows how to calculate the mass of carbon needed to produce 1 mole of iron from iron oxide?

Relative atomic mass (A_r): C = 12

[1 mark]

Tick (✓) **one** box.

$\frac{1}{3} \times 12$ g ☐

$\frac{3}{2} \times 12$ g ☐

1×12 g ☐

3×12 g ☐

Question 9 continues on the next page

Question 134 · continued

A student investigated displacement reactions of four different metals represented by **A**, **B**, **C** and **D**.

A, **B**, **C** and **D** are **not** the actual chemical symbols for the metals.

The student:

- added each metal to aqueous solutions of the metal nitrates
- observed whether a reaction took place.

Table 6 shows information about three of the reaction mixtures.

Table 6

Reaction	Metal	Metal nitrate solution	Equation
1	**A**	**B**NO_3	**A** + 2**B**NO_3 → 2**B** + **A**$(NO_3)_2$
2	**C**	**A**$(NO_3)_2$	2**C** + 3**A**$(NO_3)_2$ → 3**A** + 2**C**$(NO_3)_3$
3	**C**	**D**$(NO_3)_2$	no reaction

0 9 . 3 The ionic equation for **Reaction 1** is:

$$\mathbf{A} + 2\mathbf{B}^{+} \rightarrow 2\mathbf{B} + \mathbf{A}^{2+}$$

Why is this a redox reaction?

[1 mark]

Tick (✓) **one** box.

A gains electrons and $\mathbf{B}^{+}$ loses electrons. ☐

A loses electrons and $\mathbf{B}^{+}$ gains electrons. ☐

Both **A** and $\mathbf{B}^{+}$ gain electrons. ☐

Both **A** and $\mathbf{B}^{+}$ lose electrons. ☐

4.1.1.2 Mixtures

Question 134 · continued

0 9 . 4 Which of the four metals has the greatest tendency to form positive ions?

Use **Table 6**.

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 9 . 5 The nitrate ion has the formula NO_3^-

Which of the four metals could be aluminium?

Explain your answer.

Use **Table 6**.

[3 marks]

Metal _____

Explanation _____

_____

_____

_____

Question 9 continues on the next page

4.1.1.2 Mixtures

Question 134 · continued

0 9 . 6 Metal **X** is extracted from an oxide of metal **X** by reaction with hydrogen.

The equation for the reaction is:

$$\mathbf{X}O_3 + 3H_2 \rightarrow \mathbf{X} + 3H_2O$$

The percentage atom economy for obtaining metal **X** by this method is 77.3%.

Calculate the relative atomic mass (A_r) of metal **X**.

Relative atomic masses (A_r): H = 1 O = 16

[4 marks]

Relative atomic mass (A_r) = _____

12

4.1.1.2 Mixtures

Question 135

June 2023 | 8462/2H | Original Q6

0 6 This question is about chromatography.

A student investigated an orange food colouring using two different types of chromatography paper.

The food colouring:

- contained a mixture of red and yellow dyes
- was soluble in water.

This is the method used.

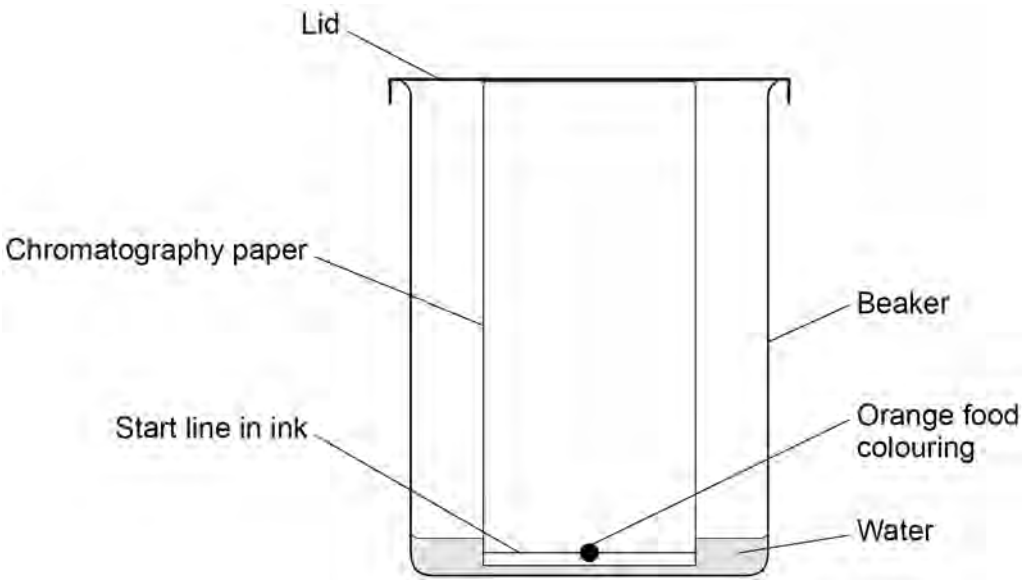
1. Draw a start line on a piece of type **A** chromatography paper.
2. Put a spot of orange food colouring on the line.
3. Put the paper into a beaker containing water as a solvent.
4. Wait for the water to travel up the paper.
5. Measure the distance above the start line moved by the red and yellow dyes and the water.
6. Repeat steps 1 to 5 using type **B** chromatography paper.

4.1.1.2 Mixtures

Question 135 · continued

Figure 3 shows how the student set up the apparatus.

Figure 3



0 6 . 1 The student made **two** mistakes when setting up the apparatus.

Give **two** mistakes the student made.

[2 marks]

1 _____

_____

2 _____

_____

Question 6 continues on the next page

4.1.1.2 Mixtures

Question 135 · continued

Another student set up the apparatus correctly.

Table 3 shows the results.

Table 3

	Type A chromatography paper		Type B chromatography paper	
	Red dye	**Yellow dye**	**Red dye**	**Yellow dye**
Distance moved by dye in cm	4.8	6.6	5.4	**X**
Distance moved by water in cm	12.0	12.0	12.0	12.0
R_f value	0.40	0.55	0.45	0.60

0 6 . 2 Determine value **X** in **Table 3**.

[3 marks]

X = _____ cm

4.1.1.2 Mixtures

Question 135 · continued

Changing the type of chromatography paper resulted in different R_f values for the red dye.

0 6 . 3 Explain why the R_f values for the red dye are different using the two types of chromatography paper.

Use **Table 3**.

[3 marks]

0 6 . 4 What other change to the investigation could result in a different R_f value for the red dye?

[1 mark]

9

4.1.1.2 Mixtures

Question 136

June 2023 | 8462/2H | Original Q9

0 9 This question is about reversible reactions.

When 4.68 g of hydrated copper sulfate changes into anhydrous copper sulfate:

- 2.99 g of anhydrous copper sulfate is produced
- 1.47 kJ of energy is taken in from the surroundings.

The equation for the reversible reaction is:

$$\text{hydrated copper sulfate} \rightleftharpoons \text{anhydrous copper sulfate} + \text{water}$$

0 9 . 1 Calculate the maximum mass of water that can be produced from 11.7 g of hydrated copper sulfate.

[3 marks]

Mass = _____ g

0 9 . 2 15.0 g of anhydrous copper sulfate completely changes into hydrated copper sulfate when water is added.

Calculate the amount of energy transferred to the surroundings.

[2 marks]

Energy = _____ kJ

4.1.1.2 Mixtures

Question 136 · continued June 2023 | 8462/2H | Original Q9

The gases nitrogen dioxide and dinitrogen tetroxide reach dynamic equilibrium in a sealed container.

The equation for the reaction is:

$$2\ NO_2(g) \rightleftharpoons N_2O_4(g)$$

nitrogen dioxide (brown) — dinitrogen tetroxide (colourless)

The forward reaction is exothermic.

0 9 . 3 What happens to the position of the equilibrium in this reaction if the temperature is increased?

[1 mark]

Tick (✓) **one** box.

- Shifts to the left ☐
- Stays the same ☐
- Shifts to the right ☐

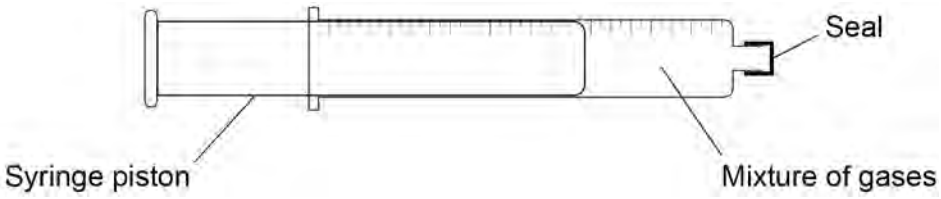
4.1.1.2 Mixtures

Question 136 · continued

0 9 . 4 A teacher seals a brown-coloured mixture of nitrogen dioxide and dinitrogen tetroxide in a gas syringe.

Figure 8 shows the sealed gas syringe.

Figure 8



The teacher pushes the syringe piston in.

This increases the pressure in the gas syringe.

What is the colour of the mixture when a new equilibrium position is reached?

[1 mark]

Tick (✓) **one** box.

The mixture is a darker shade of brown. ☐

The mixture is the same shade of brown. ☐

The mixture is a lighter shade of brown. ☐

Question 9 continues on the next page

4.1.1.2 Mixtures

Question 136 · continued June 2023 | 8462/2H | Original Q9

Hydrogen iodide gas decomposes into hydrogen gas and iodine gas at high temperatures.

The equation for the reaction is:

$$2\,HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

0 9 . 5 Explain the effect of increasing the pressure on the equilibrium position of this reaction.

[2 marks]

0 9 . 6 Suggest the effect of adding a catalyst on the equilibrium position of this reaction.

[1 mark]

4.1.1.2 Mixtures

Question 136 · continued

Copper forms coloured compounds.

Hydrochloric acid is added to an aqueous solution of copper compound **A**.

The word equation for the reaction is:

copper compound **A** (blue) + hydrochloric acid ⇌ copper compound **B** (yellow) + water

0 9 . 7 The reaction mixture is green when both copper compounds are present in a solution at equilibrium.

How can the equilibrium position be shifted to make the reaction mixture more yellow?

[1 mark]

Tick (✓) **one** box.

- Add more hydrochloric acid ☐
- Add more water ☐
- Leave the reaction mixture for 30 minutes ☐

0 9 . 8 The concentrations of the substances in this reaction do **not** change at dynamic equilibrium.

Explain why.

[2 marks]

13

4.1.1.2 Mixtures

Question 137

June 2024 | 8462/1H | Original Q1

0 1 A student produced a salt by reacting copper carbonate with sulfuric acid.

This is the method used.

1. Measure 50 cm^3 of sulfuric acid into a beaker.
2. Add copper carbonate powder.
3. Stir the mixture.
4. Repeat steps 2 and 3 until copper carbonate is in excess.
5. Filter the mixture.
6. Warm the filtrate gently until crystals start to appear.
7. Leave the solution to cool and crystallise.

0 1 . 1 Complete the word equation for the reaction.

[2 marks]

copper carbonate + sulfuric acid → _____ + _____ + carbon dioxide

0 1 . 2 Give **one** observation the student could make during **Step 4** which shows that the copper carbonate is in excess.

[1 mark]

_____

_____

0 1 . 3 Give **one** reason for filtering the mixture in **Step 5**.

[1 mark]

_____

_____

4.1.1.2 Mixtures

Question 137 · continued

0 1 . 4 Name the equipment that can be used to warm the filtrate **gently** in **Step 6**.

[1 mark]

0 1 . 5 The maximum theoretical mass of the salt that could be produced using 50 cm^3 of the sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

Use the equation:

$$\% \text{ yield} = \frac{\text{mass of salt actually produced}}{\text{maximum theoretical mass of salt that could be produced}} \times 100$$

[3 marks]

Mass of salt actually produced = _____ g

Question 1 continues on the next page

4.1.1.2 Mixtures

Question 137 · continued

0 1 . 6 Some salts can be produced by reacting sulfuric acid with a metal.

Neither copper nor sodium is used to produce a salt with sulfuric acid.

Give **one** reason why each metal is **not** used.

[2 marks]

Copper _____

_____

Sodium _____

_____

1(

4.1.1.2 Mixtures

Question 138

June 2024 | 8462/1H | Original Q4

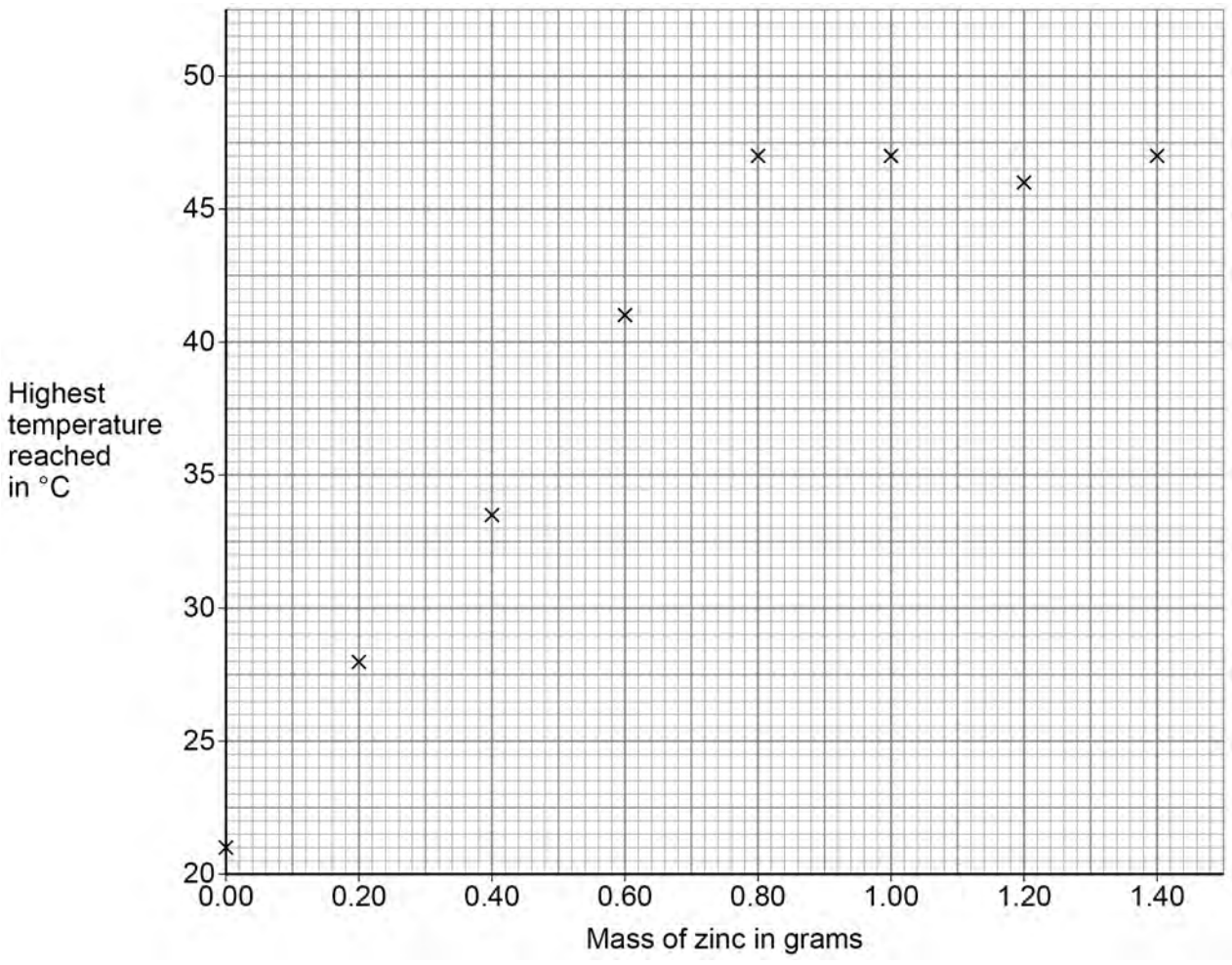
0 4 A student investigated the energy change of the reaction between zinc and copper sulfate solution.

This is the method used.

1. Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.
2. Measure the temperature of the copper sulfate solution.
3. Add 0.20 g of zinc powder to the copper sulfate solution.
4. Stir the reaction mixture.
5. Record the highest temperature reached.
6. Repeat steps 1 to 5 with different masses of zinc powder.

Figure 3 shows the results.

Figure 3



4.1.1.2 Mixtures

Question 138 · continued

0 4 . 1 Draw **two** lines of best fit on **Figure 3**.

The lines should cross.

[2 marks]

0 4 . 2 Explain the results shown in **Figure 3**.

Do **not** refer to anomalous points.

Use data from **Figure 3**.

[4 marks]

0 4 . 3 Explain why using a polystyrene cup gives more accurate results than using a glass beaker.

[2 marks]

0 4 . 4 Complete the ionic equation for the reaction between zinc and copper sulfate solution.

Include state symbols.

[2 marks]

$$Zn(s) + Cu^{2+}(aq) \rightarrow ____(__) + ____(__)$$

Question 138 · continued

A different student repeated steps 1 to 5 of the method four times using 0.50 g of zinc powder.

Table 2 shows the results.

Table 2

	Trial 1	Trial 2	Trial 3	Trial 4
Highest temperature reached in °C	37.6	37.2	37.8	37.4

0 4 . 5 Calculate the mean highest temperature reached.

Include the uncertainty in your answer.

[3 marks]

Mean highest temperature reached = _____ ± _____ °C

0 4 . 6 The results show random errors.

The student did not make any measuring errors.

Suggest **one** reason for the random errors in this experiment.

[1 mark]

14

4.1.1.2 Mixtures

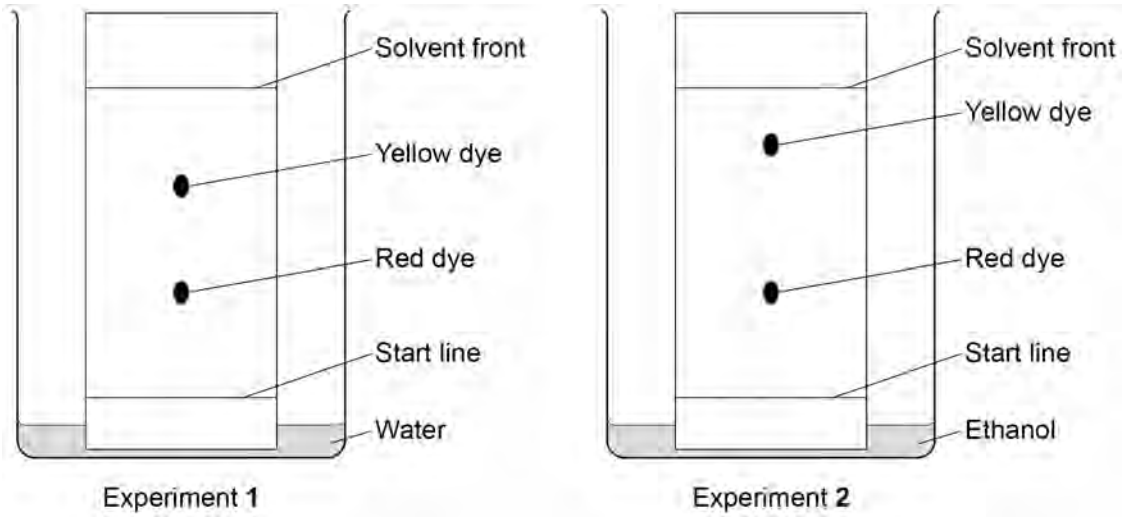
Question 139

June 2024 | 8462/2H | Original Q4

0 4 A student investigated an orange dye (**A**) using paper chromatography.

Figure 4 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

Figure 4



0 4 . 1 Explain why the yellow dye and red dye travel different distances in Experiment **1**.

Refer to forces of attraction between the dyes and the chromatography paper in your answer.

[2 marks]

4.1.1.2 Mixtures

Question 139 · continued

0 4 . 2 The student used the same type of chromatography paper in Experiment **1** and in Experiment **2**.

Explain why the yellow dye is in different positions in Experiment **1** and in Experiment **2**.

Use **Figure 4**.

[3 marks]

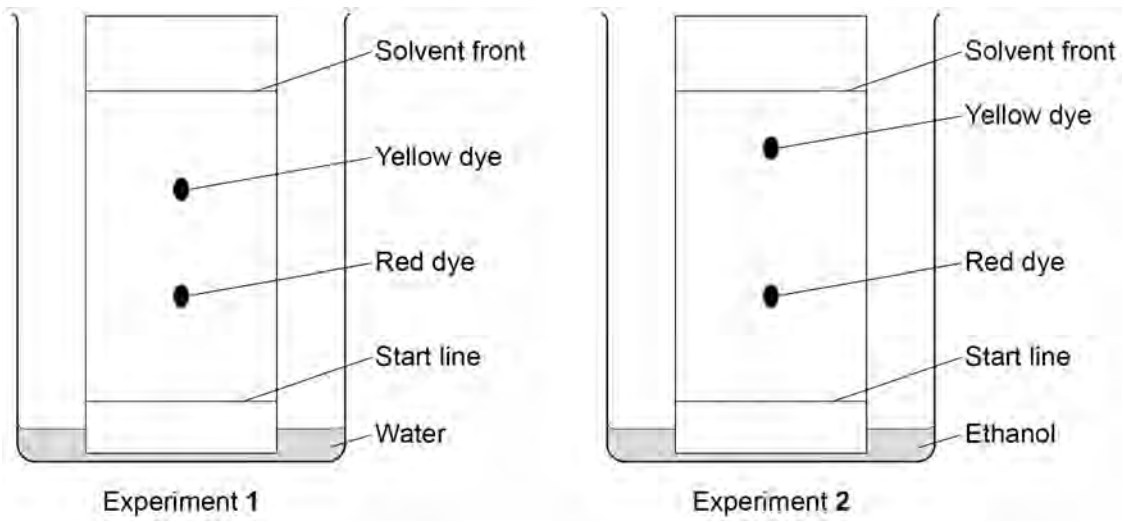
Question 4 continues on the next page

Question 139 · continued

Figure 4 is repeated below.

Figure 4 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

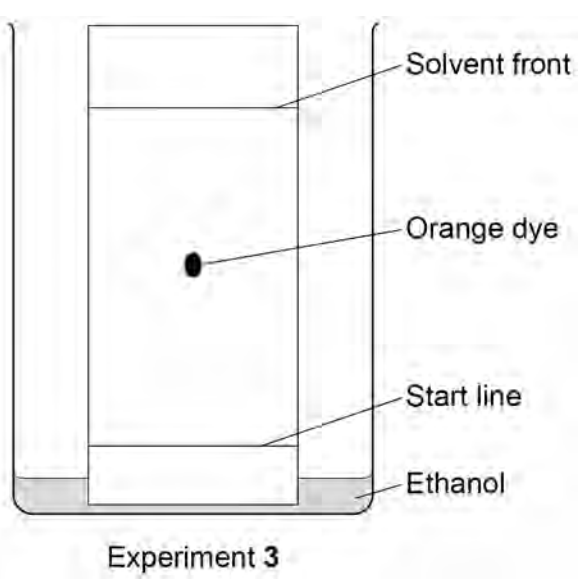
Figure 4



The student investigated a different orange dye (**B**).

Figure 5 shows the results of Experiment **3** using orange dye **B**.

Figure 5



4.1.1.2 Mixtures

Question 139 · continued

0 4 . 3 Compare the purity of the orange dyes **A** and **B**.

Give reasons for your answer.

Use **Figure 4** and **Figure 5**.

[2 marks]

0 4 . 4 The student calculated that the R_f value of the orange dye in the experiment shown in **Figure 5** was 0.48

Calculate the distance moved by the solvent front when the orange dye had moved 5.4 cm.

[3 marks]

Distance moved by solvent front = _____ cm

0 4 . 5 Why is the R_f value of a dye **not** affected by how far the solvent front is allowed to travel?

[1 mark]

4.1.1.2 Mixtures

Question 139 · continued

0 4 . 6 Another type of chromatography is called gas chromatography.

Gas chromatography is an instrumental method of chemical analysis.

Scientists tested the orange dyes using gas chromatography.

Suggest **two** advantages of using the instrumental method of gas chromatography rather than paper chromatography.

[2 marks]

1 _____

_____

2 _____

_____

13

4.1.1.2 Mixtures

Question 140

June 2024 | 8462/2H | Original Q5

0 5 This question is about burning fuels in central heating boilers.

In the future, gas central heating boilers may burn hydrogen rather than natural gas.

Table 2 shows information about these fuels when 1 dm^3 of the fuel is burned in a central heating boiler.

Table 2

	Fuel	
	Hydrogen	**Natural gas**
Energy released in kJ	11.9	37.1
Mass of carbon dioxide produced in grams	0.00	1.83
Mass of water vapour produced in grams	0.75	1.50
Mass of oxides of nitrogen produced in grams	6.6×10^{-4}	4.9×10^{-4}

0 5 . 1 Explain how oxides of nitrogen are produced when burning fuels.

[2 marks]

4.1.1.2 Mixtures

Question 140 · continued

0 5 . 2 Explain **one** positive impact on the environment of burning hydrogen rather than natural gas as a fuel.

Use **Table 2**.

[2 marks]

0 5 . 3 Explain **one** negative impact on the environment of burning hydrogen rather than natural gas as a fuel.

Use **Table 2**.

[2 marks]

Question 5 continues on the next page

4.1.1.2 Mixtures

Question 140 · continued

0 5 . 4 Air is 20% oxygen.

Calculate the volume of air needed to provide enough oxygen to react with 3.50 dm^3 of hydrogen gas.

The equation for the reaction is

$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

[3 marks]

Volume of air = _____ dm^3

0 5 . 5 Central heating boilers can also burn kerosene.

Kerosene is produced from crude oil in a fractionating column using fractional distillation.

In the first step, crude oil is heated and hydrocarbon vapours are formed.

Explain how kerosene is produced from these hydrocarbon vapours.

[3 marks]

12

4.1.1.2 Mixtures

Question 141

June 2025 | 8462/1H | Original Q6

0 6 Aluminium is extracted by the electrolysis of a molten mixture.

The mixture contains aluminium oxide and one other substance.

0 6 . 1 Aluminium oxide is an ionic compound.

Explain why aluminium oxide has a very high melting point.

[4 marks]

Extra space

0 6 . 2 Name the substance added to aluminium oxide to form the mixture.

[1 mark]

0 6 . 3 Give **one** reason why a mixture is used as the electrolyte.

[1 mark]

4.1.1.2 Mixtures

Question 141 · continued

Oxygen is produced at the positive electrode.

0 6 . 4 Write the half equation for the reaction that produces oxygen at the positive electrode.

[2 marks]

_____ → _____ + _____

0 6 . 5 The positive electrode must be continually replaced.

Explain why.

[3 marks]

_____

_____

_____

_____

_____

_____

11

4.1.1.2 Mixtures

Question 142

June 2025 | 8462/2H | Original Q9

0 9 This question is about ammonia.

Ammonia is produced from nitrogen and hydrogen in the Haber process.

Hydrogen is produced from methane and steam.

The equation for one of the reactions in the production of hydrogen is:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\,H_2(g)$$

The forward reaction absorbs energy from the surroundings.

0 9 . 1 Explain why a high temperature is used in this reaction.

[3 marks]

0 9 . 2 Explain why as low a pressure as possible is used in this reaction.

[2 marks]

4.1.1.2 Mixtures

Question 142 · continued

0 9 . 3 A nickel catalyst is used in this reaction.

What is the effect of the nickel catalyst on the position of equilibrium?

[1 mark]

Tick (✓) **one** box.

Equilibrium position shifts to the left. ☐

No effect on equilibrium position. ☐

Equilibrium position shifts to the right. ☐

0 9 . 4 The nitrogen needed in the Haber process is obtained from air.

Calculate the approximate volume of air required to obtain 50 dm^3 of nitrogen.

[2 marks]

Volume ~ _____ dm^3

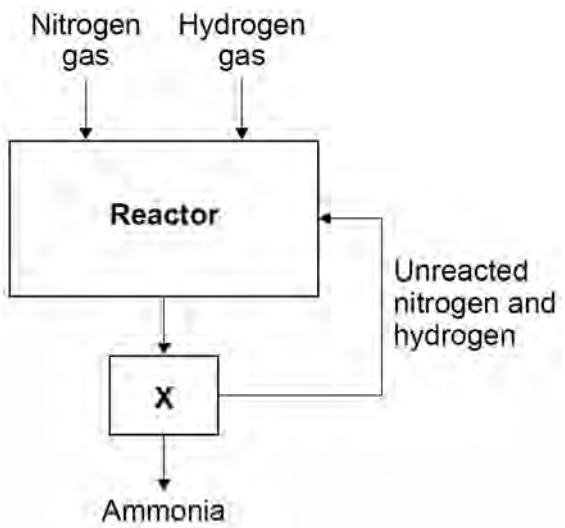
Question 9 continues on the next page

4.1.1.2 Mixtures

Question 142 · continued

0 9 . 5 **Figure 9** shows how ammonia is produced from nitrogen and hydrogen.

Figure 9



Explain how the mixture of ammonia, nitrogen and hydrogen is separated at **X**.

[3 marks]

4.1.1.2 Mixtures

Question 142 · continued

0 9 . 6 Ammonia is used to produce fertilisers.

Nitrogen is released into the air when bacteria break down fertilisers and dead plant matter.

One of the reactions during the production of hydrogen from methane (natural gas) releases carbon dioxide into the air.

The use of nitrogen to produce ammonia is more sustainable than the use of hydrogen to produce ammonia.

Give **three** reasons why.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

14