AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.9.3.2

Properties and effects of atmospheric pollutants

Past-paper questions

Tier	**Higher**
Question groups	**53**
Available paper years	**2007–2024**

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:** _____

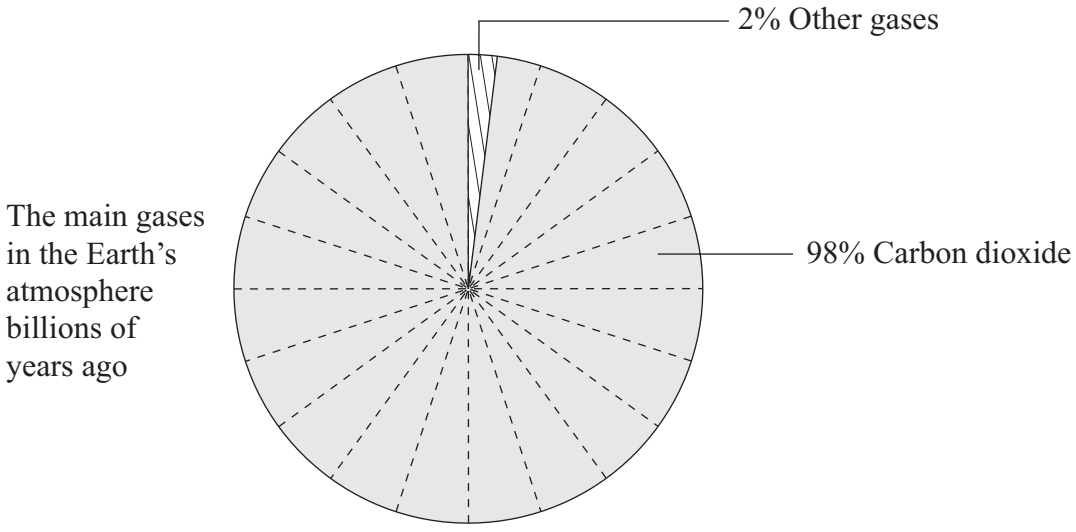
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.9.3.2 Properties and effects of atmospheric pollutants

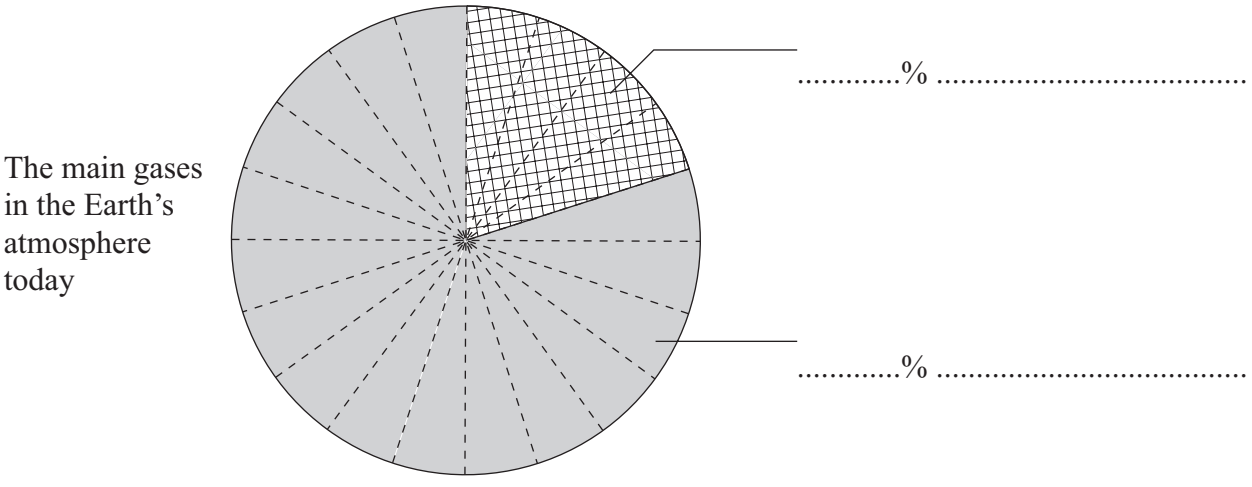
Question 01

January 2007 | CHY1H | Original Q2 | Legacy

2 Life on Earth would not exist without the atmosphere.
Billions of years ago the composition of the Earth's atmosphere was very different from the composition today.



(a) Label the pie chart below to show the percentages and names of the two main gases in the Earth's atmosphere today.



(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 01 · continued

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(b) There is evidence that the composition of the Earth's atmosphere is still changing. One possible reason is that many power stations generate electricity by burning fossil fuels such as coal, oil or natural gas. Sulfur dioxide, SO_2, is produced when coal burns in air.

(i) What environmental problem does sulfur dioxide cause?

.....

.....

(1 mark)

(ii) How could this environmental problem be reduced in coal-fired power stations?

.....

.....

(1 mark)

(iii) Gas-fired power stations burn methane, CH_4, in air.

Complete the word equation for this reaction.

methane + ... → carbon dioxide + ...

(2 marks)

(c) Excess carbon dioxide should be prevented from entering the atmosphere.

Explain why.

.....

.....

.....

.....

(2 marks)

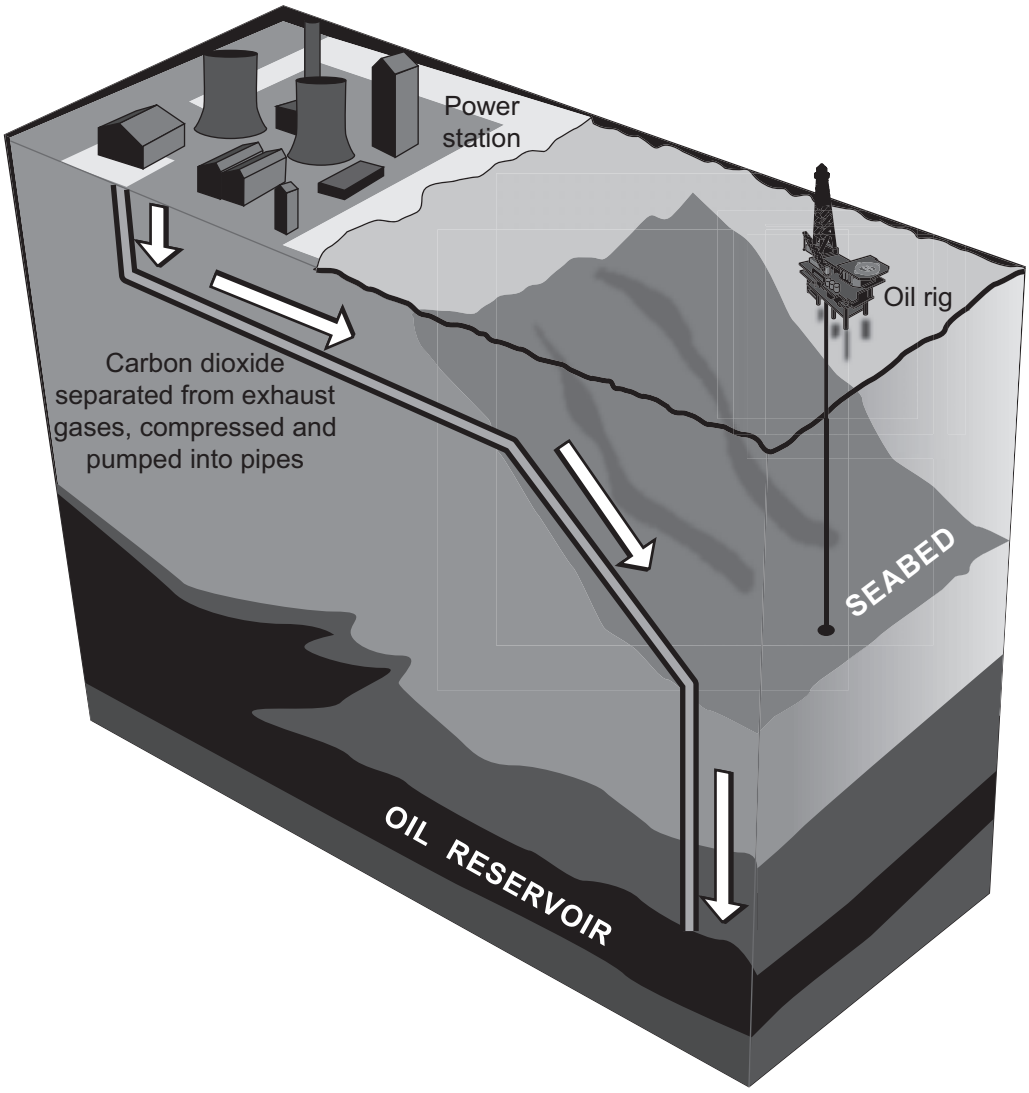
Question 2 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 01 · continued

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(d) Carbon dioxide is produced when fossil fuels burn in power stations. The diagram represents one idea to prevent excess carbon dioxide from entering the atmosphere.



Use the diagram to explain how carbon dioxide can be prevented from entering the atmosphere.

.....

.....

.....

.....

(2 marks)

10

4.9.3.2 Properties and effects of atmospheric pollutants

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 02 · continued March 2007 | CHY1A | Original Q3 | Legacy

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.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 03

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 03 · continued March 2007 | CHY1A | Original Q7 | Legacy

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.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 04

March 2007 | CHY1B | Original Q9 | Legacy

QUESTION NINE

Read this extract from a magazine article.

BIODIESEL

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

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

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

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

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

1 it does not cause any damage to engines.

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

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

4 it is a renewable fuel.

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

1 a decrease in acid rain formation.

2 an increase in fog formation.

3 a decrease in soap production.

4 a reduction in global warming.

4.9.3.2 Properties and effects of atmospheric pollutants

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

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

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

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

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

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

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

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

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

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

END OF TEST

4.9.3.2 Properties and effects of atmospheric pollutants

Question 05

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.

4.9.3.2 Properties and effects of atmospheric pollutants

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 06

November 2007 | CHY1A | Original Q3 | Legacy

QUESTION THREE

The table shows the emissions of sulfur dioxide, in the United Kingdom (UK), by different fuels in 1990 and in 2004.

	Emissions of sulfur dioxide by different fuels in thousands of tonnes		
Fuel type	**1990**	**2004**	**Percentage change between 1990 and 2004**
Coal	2707	578	–79
Other solid fuels	66	20	–70
Petroleum fuel oil	605	78	–87
Other petroleum products (including petrol and diesel)	193	83	–57
Gaseous fuels	9	11	+22
Other emissions of sulfur dioxide	118	58	–51
TOTAL	**3698**	**828**	**–78**

- Since 1990, the amount of coal used in the generation of electricity at power stations has reduced by more than 60%.
- Since 1990, gaseous fuels have gradually been replacing fuel oil for electricity generation and in industry.
- The small amount of sulfur dioxide emitted from petrol and diesel fuel used in vehicles has decreased. It should decrease further with the increased use of low-sulfur petrol and diesel.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 06 · continued

3A Which fuel had the largest reduction in sulfur dioxide emissions, **in thousands of tonnes**, between 1990 and 2004?

1 coal

2 fuel oil

3 other petroleum products

4 gaseous fuels

3B This data suggests that emissions of sulfur dioxide between 1990 and 2004 . . .

1 decreased for all fuels.

2 decreased by more than 50% for all fuels.

3 decreased by 78% for all fuels except gaseous fuels.

4 decreased by more than 50% for all fuels except gaseous fuels.

3C Which reasonable prediction can be made from the evidence given at the beginning of this question?

1 Sulfur dioxide emissions will begin to increase in the future as the number of vehicles on our roads increases.

2 Overall, sulfur dioxide emissions are likely to continue to decrease.

3 Supplies of fuel oil will be used up in another twenty years.

4 Sulfur dioxide emissions from gaseous fuels will be greater than those from coal in the near future.

3D The data in the table was obtained by estimating the sulfur dioxide emissions from power stations, industrial plants, vehicles, etc.

Sulfur dioxide emissions in the UK could also be monitored by . . .

1 providing each vehicle with a digital readout of sulfur dioxide emitted.

2 measuring the sulfur dioxide concentrations in the air above the largest power stations and industrial plants.

3 measuring the sulfur dioxide concentrations in the air at a large number of sites spread across the UK.

4 measuring the sulfur content of all fuels before they are used.

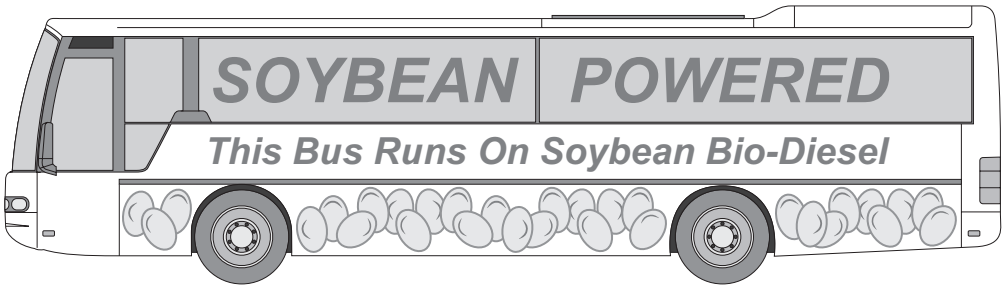
4.9.3.2 Properties and effects of atmospheric pollutants

Question 07

November 2007 | CHY1B | Original Q9 | Legacy

QUESTION NINE

Petroleum diesel fuel is made from crude oil.
Biodiesel fuel is made from vegetable oils. In America, soybean and rapeseed oil are used.



Biodiesel biodegrades in about a quarter of the time required for petroleum diesel to do so.
Biodiesel, when burned, emits more acidic nitrogen oxides but fewer particulates than petroleum diesel.

Three types of fuel containing biodiesel are available in America:

- B100 (100% biodiesel)
- B20 (20% biodiesel)
- B2 (2% biodiesel).

In a diesel engine, the fuel flows from the fuel tank, along fuel pipes, to the combustion chamber where it is ignited by glow plugs.
There are some operating problems with B100. Biodiesel is much thicker than petroleum diesel and is more difficult to ignite (has a lower cetane number than petroleum diesel). In most engines, the biodiesel needs to be pre-heated.
Biodiesel also has a higher melting point than petroleum diesel and so, in winter, can solidify in pipes and filters.
Using B20 gives few problems, and little or no modification to engines is required.

9A The availability of B2 and B20 may persuade motorists to use biodiesel instead of petroleum diesel.

This could be important because . . .

1 crude oil is non-renewable.

2 biodiesel emissions are less likely to cause acid rain.

3 B100 does not ignite as easily as petroleum diesel.

4 biodiesel does not produce any waste gases when it burns.

Question 07 · continued

9B Ideally, the vegetable oil used for biodiesel should have all these properties **except** . . .

1 a low viscosity.

2 a high melting point.

3 a high cetane number.

4 a good flow rate.

9C Why are **net** carbon dioxide emissions lower for biodiesel than for petroleum diesel?

1 The carbon dioxide is reused to make fossil fuels.

2 Some vegetable oils produce very little carbon dioxide when they burn.

3 The carbon dioxide is recycled as it is used by plants for photosynthesis.

4 The carbon dioxide formed from burning biodiesel is very soluble in water.

9D Spills of fuels from oil tankers cause considerable damage to the marine environment. Spills of biodiesel could be less harmful than those of petroleum diesel.

This is because biodiesel . . .

1 will float more easily on the water.

2 could be burned more easily on the surface of the water.

3 would not spread over the water as easily.

4 would break down into less harmful substances more quickly.

END OF TEST

4.9.3.2 Properties and effects of atmospheric pollutants

Question 08

5 Since 2000 there has been a lot more research into alternative, environmentally-friendly fuels for road transport.
Several pollutants are found in the exhaust emissions produced when fossil fuels are used for road transport.

Carbon monoxide (CO) interferes with the way that red blood cells carry oxygen.
Carbon dioxide (CO_2) increases the level of carbon dioxide in the atmosphere and causes global warming.

Oxides of nitrogen (NO_x) are produced at high temperatures when nitrogen and oxygen from the atmosphere combine.

Sulfur dioxide (SO_2) is produced when sulfur impurities in the fuel combine with oxygen in the atmosphere.

Tiny particles of solids are produced when the fuel does not burn completely.
This increases the level of particulates (PM10) in the atmosphere.

(a) Name the environmental effect caused by:

(i) oxides of nitrogen (NO_x) and sulfur dioxide (SO_2)

.....

(1 mark)

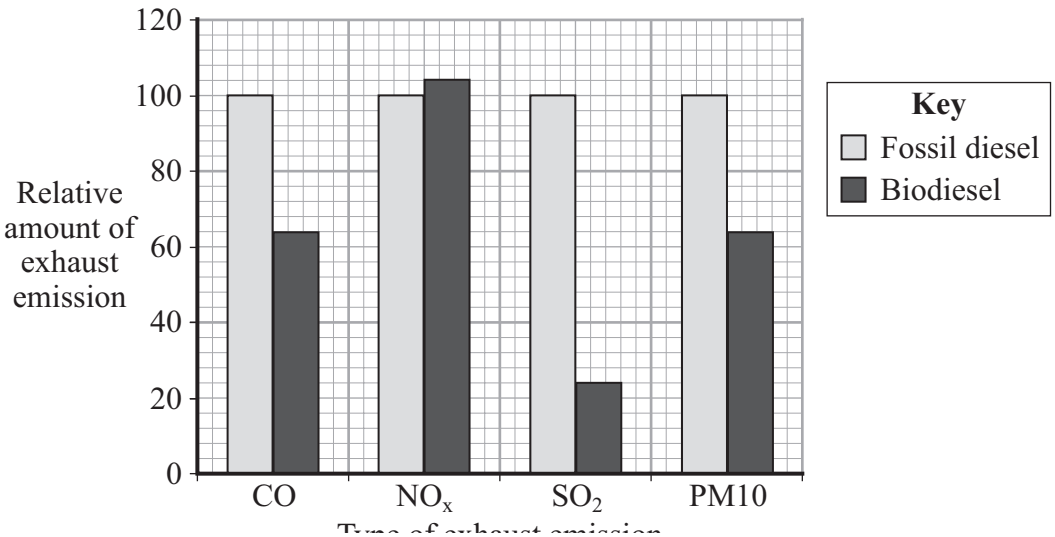
(ii) the increased level of particulates (PM10).

.....

(1 mark)

(b) Diesel obtained from crude oil is often called fossil diesel.
Biodiesel can be made from many vegetable oils.
One research project compared the exhaust emissions when fossil diesel or biodiesel were used as fuels.

Some of the relative amounts of these exhaust emissions are shown in the bar chart.



4.9.3.2 Properties and effects of atmospheric pollutants

Question 08 · continued

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(i) Use your knowledge and the information opposite to explain the environmental benefits of using biodiesel as a sustainable, low pollution fuel.

.....

.....

.....

.....

.....

.....

(3 marks)

(ii) Biodiesel is called a green fuel.

This is because the life-cycle emission of carbon dioxide from biodiesel is less than that from fossil diesel.

Use your knowledge and the information opposite to explain why biodiesel's contribution to global warming is considered to be much less than that of fossil diesel.

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.9.3.2 Properties and effects of atmospheric pollutants

Question 09

March 2008 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

Scientists have been concerned for some time about the effects of releasing large amounts of sulfur dioxide into the atmosphere. Much of the sulfur dioxide is formed from burning fuels that contain sulfur. The equation for this reaction is:

$$S + O_2 \rightarrow SO_2$$

4A The equation given above for the burning of sulfur is balanced because . . .

1 there are the same number of atoms on each side of the equation.

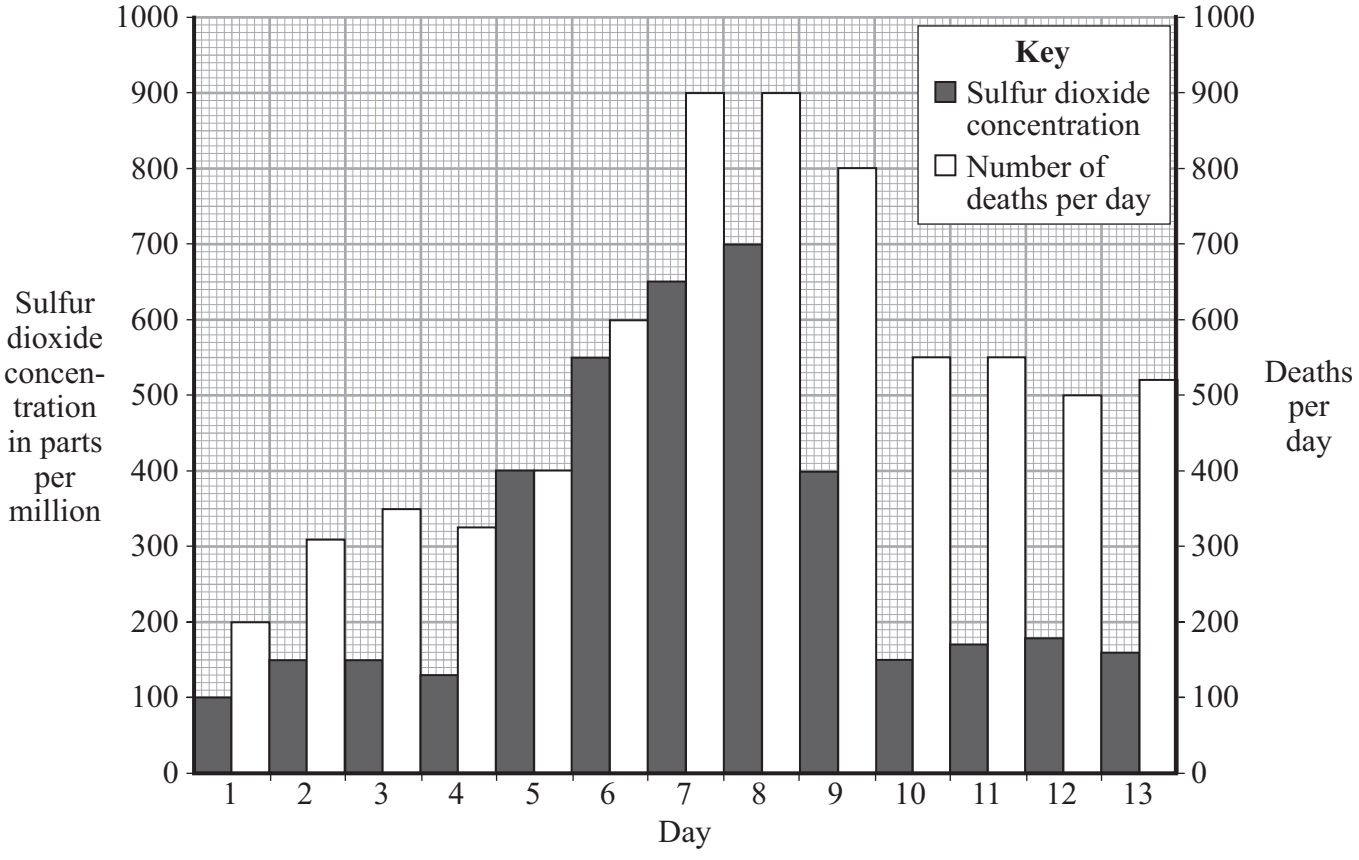
2 there are the same number of each type of atom on each side of the equation.

3 the amount of sulfur dioxide in the air stays about the same.

4 only two elements are involved in the equation.

Some scientists believe that sulfur dioxide is responsible for human deaths. To support this idea, they looked at the death rates during the smogs that occurred in London in the 1950s. The smogs contained sulfur dioxide and smoke particles.

The data the scientists used is shown below.



4.9.3.2 Properties and effects of atmospheric pollutants

Question 09 · continued March 2008 | CHY1AP | Original Q4 | Legacy

4B The average number of deaths per day from day 5 to day 8 was . . .

1 475

2 700

3 900

4 2800

4C The suggestion that sulfur dioxide in the smog was responsible for human deaths was . . .

1 a conclusion.

2 a hypothesis.

3 a piece of research.

4 a piece of evidence.

4D Which one of the following is a valid statement from the graph?

1 Sulfur dioxide was responsible for the deaths.

2 Smog was responsible for the deaths.

3 Sulfur dioxide could **not** be responsible for the deaths since the graphs do **not** match exactly.

4 Sulfur dioxide was probably responsible for the deaths but other factors may have been responsible.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 10

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.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 10 · continued March 2008 | CHY1AP | Original Q8 | Legacy

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.

4.9.3.2 Properties and effects of atmospheric pollutants

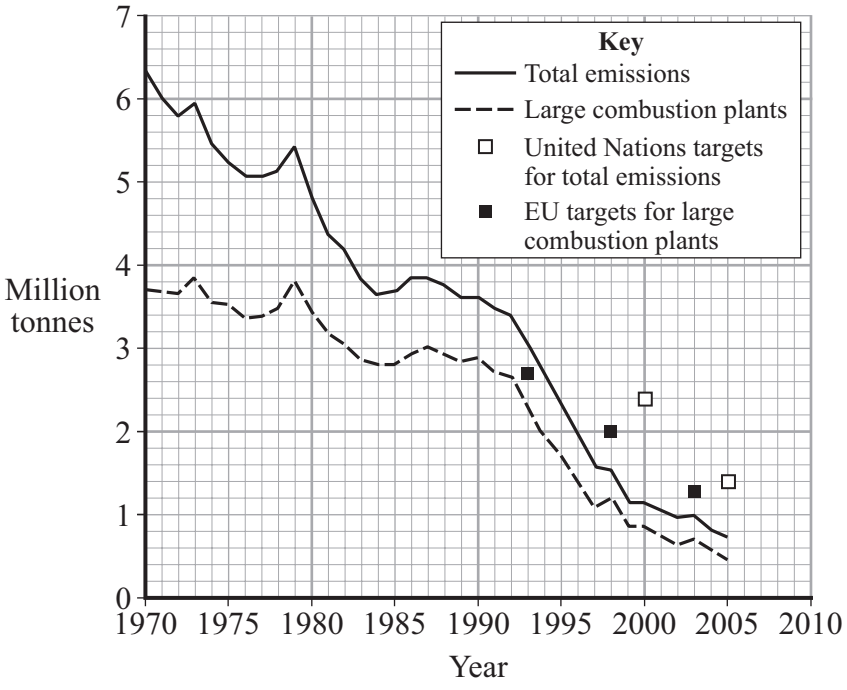
Question 11

March 2008 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

This passage is about sulfur dioxide gas released into the atmosphere in the United Kingdom.

The graph shows sulfur dioxide emissions and also targets set by the European Union and the United Nations.



Large combustion plants are:

- power stations
- oil refineries
- metal refineries
- some manufacturing industries.

Transport, domestic use and services contribute most of the other emissions.

Between 1990 and 2004, the amount of coal used in power stations fell by about 60%; sulfur dioxide emissions from power stations fell by about 82%.

The combustion of petroleum products contributed to 19% of all emissions in 2004, down 77% since 1990. This is mainly due to industry's use of gas rather than oil.

The already small amount of sulfur dioxide emitted from cars and lorries has fallen due to the introduction of ultra-low sulfur petrol and diesel fuels.

Question 11 · continued March 2008 | CHY1AP | Original Q9 | Legacy

9A A general conclusion that can be made from the data is that . . .

1 total emissions of sulfur dioxide have fallen every year since 1970.

2 emissions of sulfur dioxide from large combustion plants fell more quickly than total emissions between 1970 and 1990.

3 from 1970 to 1980, total emissions fell by about 1.5 million tonnes.

4 total emissions were greater in 1990 than in 1980.

9B Sulfur dioxide emissions fell quickly from 1990 onwards.

One of the main reasons for this was . . .

1 the use of ultra-low sulfur petrol and diesel fuels.

2 the use of gas instead of oil in industry.

3 the reduction in the use of coal in power stations.

4 the reduction in the use of coal to heat houses.

9C The graph indicates that, of the emission targets set for the United Kingdom . . .

1 all the targets have been reached.

2 only the targets for total emissions have been reached.

3 all except **one** of the targets for emissions from large combustion plants have been reached.

4 none of the targets has been reached.

9D The European Union target for total emissions for the United Kingdom in 2010 is 585 thousand tonnes.

From the evidence in this question, . . .

1 it is probable that this target will be reached.

2 the increasing number of cars will make it difficult to reach this target.

3 it is unlikely that the target will be reached.

4 the target has already been reached.

END OF TEST

4.9.3.2 Properties and effects of atmospheric pollutants

Question 12

March 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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

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

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

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

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

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

1 hydrogen

2 ethanol

3 syngas

4 petrol

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

1 hydrogen obtained by the electrolysis of water.

2 ethanol obtained from plants.

3 syngas obtained from coal.

4 petrol obtained from crude oil.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 12 · continued

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

1 temperatures accurate to 1 °C over 5 years.

2 temperatures accurate to 1 °C over 50 years.

3 temperatures accurate to 0.1 °C over 5 years.

4 temperatures accurate to 0.1 °C over 50 years.

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

1 employed by car manufacturers.

2 employed by farmers.

3 employed by oil companies.

4 employed by universities.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 13

June 2008 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

The flow chart below gives information about some of the substances involved in the combustion of a hydrocarbon fuel.

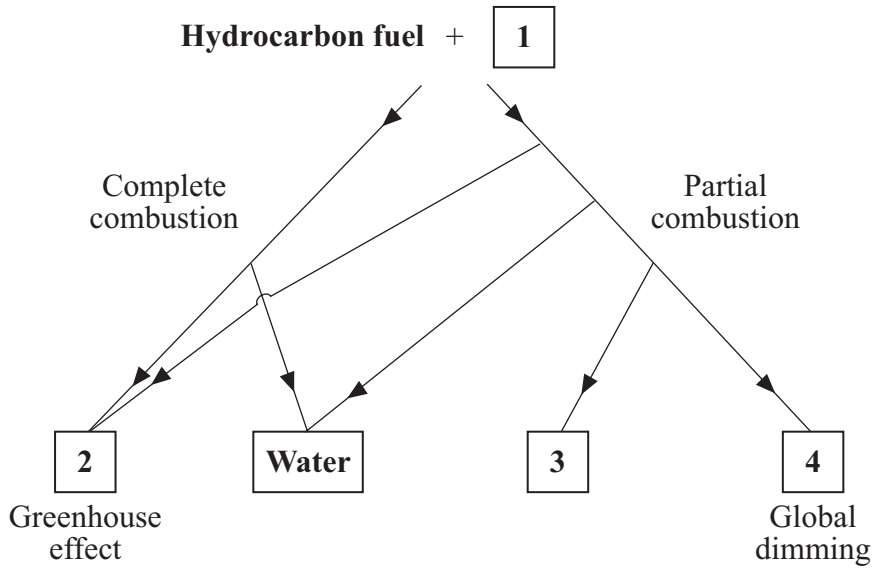
Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A carbon monoxide

B carbon particles

C oxygen

D carbon dioxide



4.9.3.2 Properties and effects of atmospheric pollutants

Question 14

June 2008 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

Environmentalists say that the introduction of low-sulfur fuels is essential because it gives cleaner emissions from vehicles.

Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels.
Some claim that low-sulfur fuels give higher emissions of carbon dioxide.
Other scientists suggest that the improved fuel consumption from these fuels means that less carbon dioxide is released.

5A Vehicle emissions would be cleaner using low-sulfur fuels because they would **definitely** produce less . . .

1 carbon dioxide.

2 carbon monoxide.

3 nitrogen oxides.

4 sulfur dioxide.

5B Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels because . . .

1 they **cannot** repeat the results of their investigation.

2 simple experiments do **not** give accurate results.

3 there are **not** enough variables in their investigations.

4 the data they are using is too simple for a complex problem.

Oil companies are concerned about the cost of removing more sulfur from fuels. They claim that more dinitrogen oxide (N_2O) is produced by these fuels when catalytic converters are running at low temperatures. Dinitrogen oxide is 310 times more powerful than carbon dioxide as a greenhouse gas.

5C Oil companies do **not** want to remove more sulfur from fuels because . . .

1 increased production costs would put up the price of their fuels.

2 they would sell less fuel because of improved fuel consumption.

3 they do **not** agree that the emissions from low-sulfur fuels are cleaner.

4 customers do **not** believe that the fuels are any better for the environment.

5D The oil companies claim that more dinitrogen oxide is produced when low-sulfur fuels are used.

How could this be verified?

1 The oil companies should repeat their investigations.

2 Independent scientists should carry out further investigations.

3 Government scientists should measure the levels of dinitrogen oxide near motorways.

4 University students should research the effects of dinitrogen oxide when it is released into the atmosphere.

Turn over for the next question

4.9.3.2 Properties and effects of atmospheric pollutants

Question 15

November 2008 | CHY1AP | Original Q3 | Legacy

QUESTION THREE

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

The results are shown in the table below.

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

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

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

1 hydrocarbon fuel **K**.

2 hydrocarbon fuel **L**.

3 hydrocarbon fuel **M**.

4 hydrocarbon fuel **N**.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 15 · continued

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

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

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

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

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

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

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

1 Sulfur dioxide in the air causes heavier rainfall.

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

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

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

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

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

1 no carbon dioxide is produced.

2 carbon dioxide and water are produced.

3 no sulfur dioxide is produced.

4 only water is produced.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 16

November 2008 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

Environmentalists say that the use of low-sulfur fuels is essential.
It is claimed that high sulfur dioxide levels in the air cause health problems such as asthma.

The table shows the number of deaths from asthma in five age groups from 1960 to 1995.

Year	Number of deaths from asthma for each age group				
	0–14	15–44	45–64	65–84	85 and above
1960	50	250	750	1230	1240
1965	100	700	1500	2030	2040
1970	50	250	700	1210	1230
1975	40	200	600	1180	1200
1980	40	200	660	1400	1450
1985	40	250	900	1770	1900
1990	30	200	650	1650	1800
1995	30	150	520	1200	1370
2000					

Sources:
ONS: *www.statistics.gov.uk* Reproduced under the terms of the Click-Use Licence.
Lung and Asthma Information Agency, St. Georges University of London: *www.laia.co.uk*

5A Which one of the following statements is true about deaths from asthma?

1 Values for all age groups increased and then decreased without a further increase.

2 The largest range of deaths occurred in the 0–14 age group.

3 Values for each age group peaked in 1965.

4 The values for each year always increased for any given age group.

5B Which row in the table most accurately shows the expected deaths in Year 2000 if the trend from 1985 to 1995 continued?

	0–14	15–44	45–64	65–84	85 and above
1	30	100	460	950	1000
2	50	100	310	1250	1500
3	70	180	720	950	1000
4	30	150	520	1300	1400

5C A doctor has noticed an increase in cases of asthma in his patients. He thinks it may be linked to the release of sulfur dioxide into the atmosphere from cars following the recent building of a new road near his surgery. He decides to carry out a survey to test his hypothesis.

The best people to survey would be all his patients who . . .

1 drive and have breathing problems.

2 live near the new road.

3 are over 65 years old.

4 drive to work.

5D An improvement that the use of low-sulfur fuels should bring is . . .

1 less acid gas entering the atmosphere.

2 a reduction in carbon emissions.

3 a reduction in carbon monoxide emissions.

4 less nitrogen entering the atmosphere.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 17

November 2008 | CHY1BP | Original Q6 | Legacy

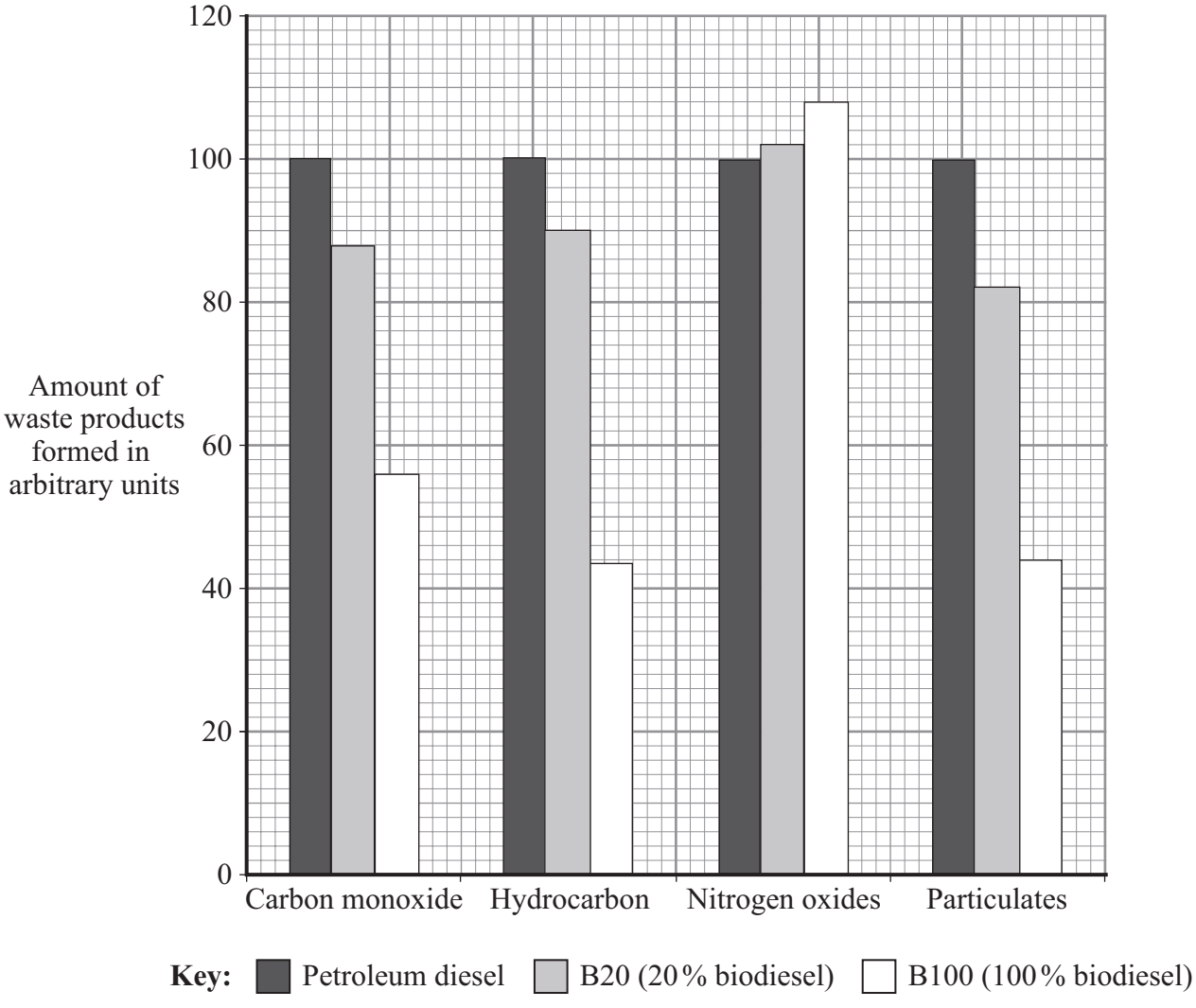
QUESTION SIX

Biodiesel is a fuel made from vegetable oils. It can be mixed with or it can entirely replace petroleum diesel fuel in vehicles.
B20 is petroleum diesel with 20 % biodiesel.
B100 is 100 % biodiesel.

Petroleum diesel is made from crude oil.

In a car engine, the fuel ignites and burns in air. The waste products formed leave the engine through the exhaust system.

The bar graph compares the quantities of four different waste products formed by burning B20 and B100 with the quantities formed by burning petroleum diesel.



4.9.3.2 Properties and effects of atmospheric pollutants

Question 17 · continued

6A From the information on the chart, the use of B100 instead of B20 will reduce particulates by about . . .

1 5 times.

2 half.

3 20%

4 35%

6B Which of the following is a correct statement about the waste products formed by burning these fuels?

1 They are all oxides.

2 They are all reduced when B20 is used instead of petroleum diesel.

3 Water vapour is also produced.

4 No carbon dioxide is produced with B100.

6C The main advantage of B100 over petroleum diesel is that B100 . . .

1 is non-biodegradable.

2 is renewable.

3 is unsaturated.

4 is hydrogenated.

6D Why are net carbon dioxide emissions lower for biodiesel than for petroleum diesel?

1 Plants use carbon dioxide for photosynthesis.

2 There are fewer alkanes in biodiesel.

3 Biodiesel does **not** contain any hydrocarbons.

4 Plants produce carbon dioxide in respiration.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 18

June 2009 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about substances that can be burned in air.

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

A C_2H_5SH

B C_2H_6

C C_2H_2

D C

1	It would contribute to the formation of acid rain when burned.
2	It is an alkane.
3	It corresponds to the general formula C_nH_{2n-2}
4	It forms only carbon dioxide when burned in air.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 19

June 2009 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Two problems caused by the gases released when fossil fuels are burned are:

- acid rain, caused by sulfur dioxide and oxides of nitrogen
- global warming, caused by carbon dioxide.

Fuel manufacturers have introduced low-sulfur fuels to try to reduce the sulfur dioxide emissions.

6A Low-sulfur fuels were introduced in the UK in 2000. The amount of acid rain gases from transport increased from 2000 to 2004.

This increase could be due to . . .

1 the partial combustion of low-sulfur fuels.

2 an increasing number of vehicles on the UK's roads.

3 increasing emissions of carbon monoxide.

4 some sulfur dioxide not dissolving in rain water.

6B Carbon monoxide and oxides of nitrogen can be removed by a catalytic converter in the exhaust system of vehicles. The two gases, carbon monoxide (CO) and nitrogen dioxide (NO_2), react to produce carbon dioxide (CO_2) and nitrogen (N_2).

The balanced equation that correctly describes this reaction is . . .

1 $CO + NO_2 \rightarrow CO_2 + N_2$

2 $2CO + NO_2 \rightarrow 2CO_2 + N_2$

3 $3CO + 2NO_2 \rightarrow 3CO_2 + N_2$

4 $4CO + 2NO_2 \rightarrow 4CO_2 + N_2$

6C The conversion of carbon monoxide and nitrogen dioxide to carbon dioxide and nitrogen will . . .

1 decrease acid rain and decrease global warming.

2 decrease acid rain and increase global warming.

3 increase acid rain and increase global warming.

4 increase acid rain and decrease global warming.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 19 · continued June 2009 | CHY1AP | Original Q6 | Legacy

6D Environmentalists have encouraged the use of hydrogen as a fuel instead of petrol because . . .

1 hydrogen is a renewable fuel obtained from sugar.

2 carbon monoxide is the main product of combustion.

3 no carbon dioxide is produced when hydrogen is burned.

4 hydrogen produces only low levels of sulfur dioxide when burned.

Turn over for the next question

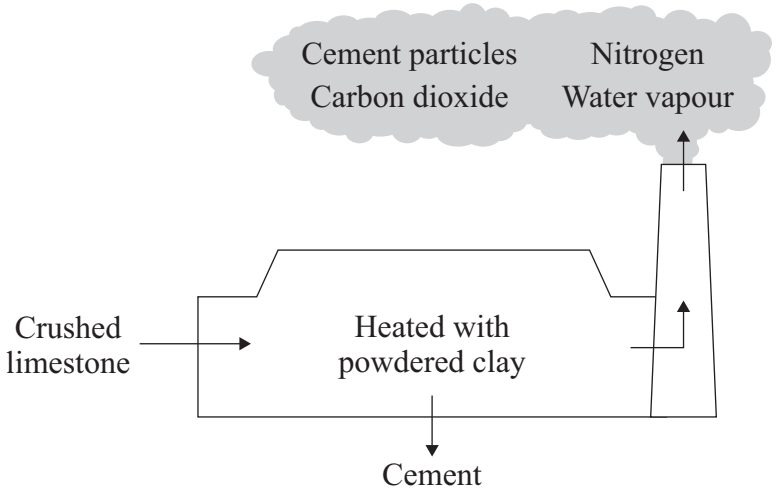
4.9.3.2 Properties and effects of atmospheric pollutants

Question 20

June 2009 | CHY1H | Original Q1 | Legacy

1 A limestone quarry is in an area of natural beauty and near several villages.
The company operating the quarry wants planning permission to build a new cement works in the quarry.

The diagram shows some of the substances used and produced at a cement works.



1 (a) Limestone is mainly calcium carbonate, $CaCO_3$.
Write the correct number in the box to complete each sentence.

1 (a) (i) The formula shows that calcium carbonate, $CaCO_3$,

contains ☐ different elements.

(1 mark)

1 (a) (ii) Calcium carbonate, $CaCO_3$, contains a total number of ☐ atoms.

(1 mark)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 20 · continued

for mark

1 (b) The company wants the new cement works because the nearest cement works is 100 km from the quarry. The company argues that a new cement works sited inside the quarry would reduce carbon dioxide emissions.

Suggest why the new cement works might reduce carbon dioxide emissions.

.....

.....

.....

(1 mark)

1 (c) Residents from the villages near the quarry are concerned that there will be atmospheric pollution from the new cement works.

1 (c) (i) Name and explain how **one** of the emissions from the chimney causes atmospheric pollution.

Name of emission: .....

Explanation: .....

.....

(2 marks)

1 (c) (ii) Suggest what the company could do to reduce this atmospheric pollution.

.....

.....

(1 mark)

6

4.9.3.2 Properties and effects of atmospheric pollutants

Question 21

November 2009 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about four chemical substances involved in the two chemical reactions below.

$$ZnCO_3 \rightarrow ZnO + \text{Substance } \mathbf{X}$$

$$2ZnO + C \rightarrow 2Zn + \text{Substance } \mathbf{X}$$

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

A $ZnCO_3$

B C

C CO_2

D ZnO

1	It is the metal oxide produced by thermal decomposition.
2	It has a formula made up of five atoms of three different elements.
3	It is the compound produced in both reactions.
4	It will burn in a limited supply of air to produce carbon monoxide and carbon dioxide.

4.9.3.2 Properties and effects of atmospheric pollutants

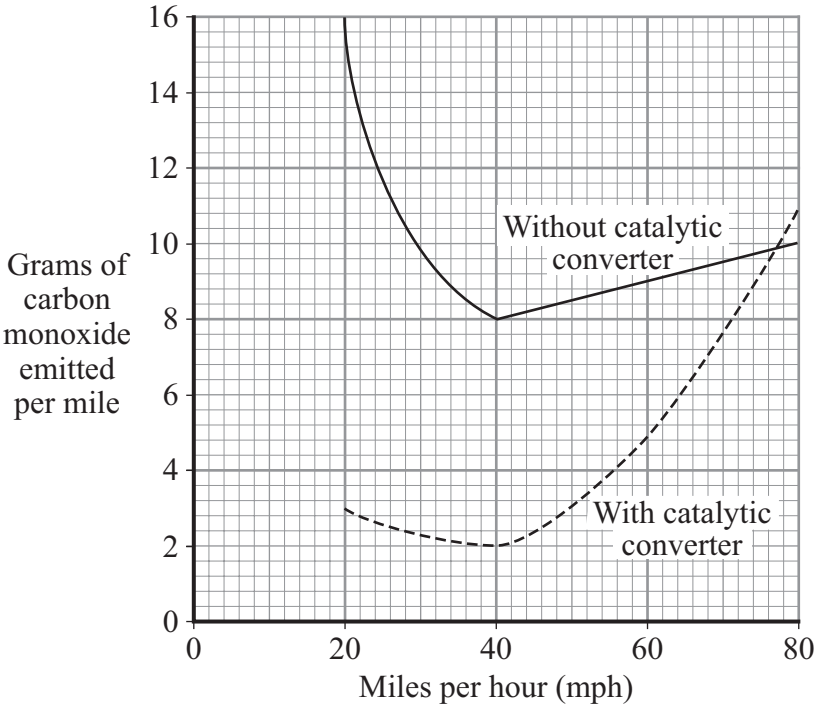
Question 22

November 2009 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

Catalytic converters are fitted to car exhausts to reduce harmful emissions from the car.
In a catalytic converter, carbon monoxide is converted into carbon dioxide. However, catalytic converters are not 100% efficient.

The graph shows the effect of a catalytic converter.



6A At 40 mph, a catalytic converter reduces carbon monoxide emissions by . . .

1 2 g per mile.

2 4 g per mile.

3 6 g per mile.

4 8 g per mile.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 22 · continued November 2009 | CHY1AP | Original Q6 | Legacy

6B At what speed does a car with a catalytic converter emit the same amount of carbon monoxide as a car without a catalytic converter?

1 40 mph

2 70 mph

3 77 mph

4 80 mph

6C Which statement about the graph is true?

1 Catalytic converters work best at speeds above 40 mph.

2 The higher the speed, the higher the carbon monoxide emissions.

3 There is no connection between speed and the amount of carbon monoxide emitted.

4 Catalytic converters are more effective at lower speeds.

6D All the carbon monoxide emitted into the atmosphere eventually forms carbon dioxide.

Which of the following statements is true?

1 Using catalytic converters reduces the amount of carbon dioxide put into the atmosphere by cars.

2 The effect that car emissions have on global warming is not changed by using catalytic converters.

3 Carbon dioxide levels are not affected by the use of cars.

4 A car without a catalytic converter produces more carbon dioxide than a car fitted with one.

4.9.3.2 Properties and effects of atmospheric pollutants

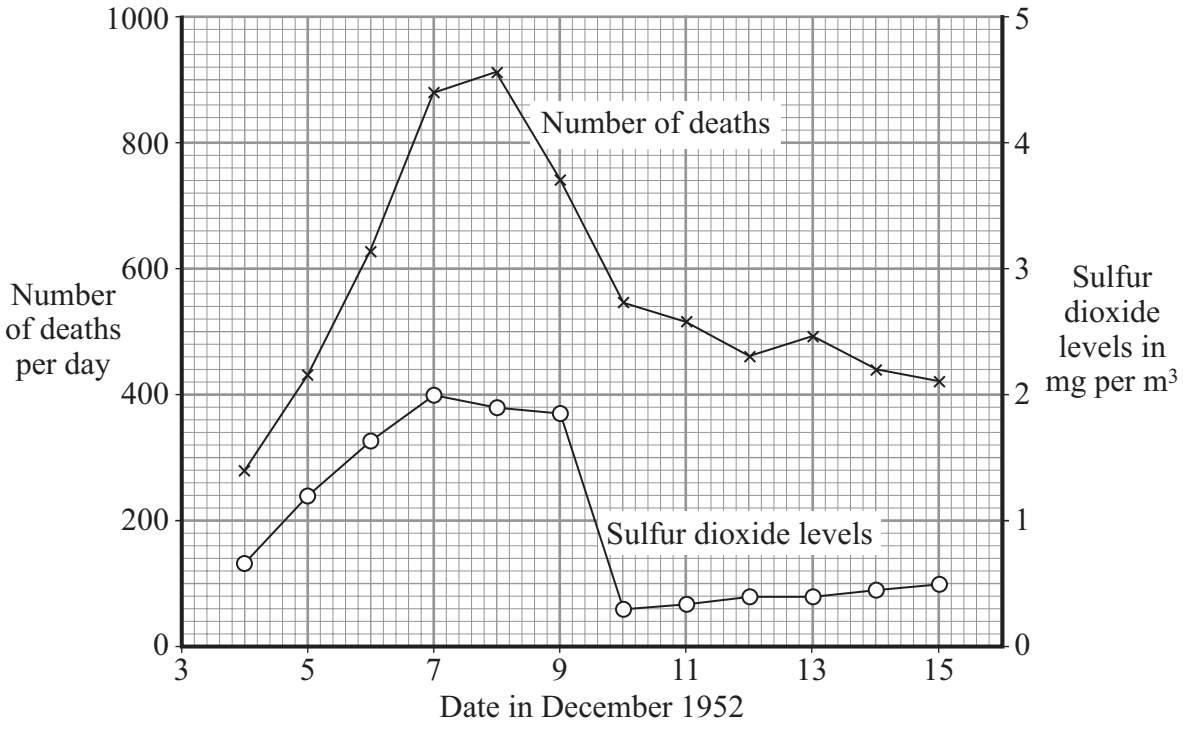
Question 23

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 24

November 2009 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

Some scientists think that the Earth's early atmosphere was mainly carbon dioxide, water vapour and nitrogen, with no oxygen.

Some scientists think that the early atmosphere also contained carbon monoxide, hydrogen, methane and ammonia.

Other scientists think that the atmosphere has always contained some oxygen.

Evidence comes from geological records starting over 4 billion years ago, the composition of gases from volcanoes, observations of conditions on other planets, and the composition of the atmosphere today.

The table shows some information about the atmospheres of the planets, Venus, Earth and Mars today.

	Venus	Earth	Mars
Carbon dioxide, % by mass	98.0	0.036	95.0
Oxygen, % by mass	0.0	21.0	0.25
Nitrogen, % by mass	2.0	78.0	2.4
Water vapour, % by mass	0.05	0.20	0.10
Mass of atmosphere in tonnes	5.2×10^{17}	5.2×10^{15}	2.4×10^{10}

9A Scientists do **not** agree about the Earth's early atmosphere because . . .

1 there is too much evidence available.

2 the information can be interpreted in different ways.

3 the data is inaccurate.

4 geological records do not go back far enough.

9B Which of the following supports the idea that there was oxygen in the Earth's early atmosphere?

1 Calcium sulfate ($CaSO_4$) is found in rocks formed 3.5 billion years ago.

2 Many of the oldest rocks contain iron sulfide, FeS.

3 The atmosphere now contains more than 20% oxygen.

4 Some of the gases in the early atmosphere came from volcanoes.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 24 · continued

9C Which one of these is an **incorrect** reason for the small percentage of carbon dioxide in the Earth's atmosphere today?

1 Some carbon dioxide has dissolved in the oceans.

2 Carbon dioxide has been used in chemical reactions to form sedimentary rocks.

3 Some carbon dioxide has been locked up in fossil fuels.

4 There has always been only a small amount of carbon dioxide in the atmosphere.

9D Which one of the following statements is true?

1 Venus has the smallest mass of water vapour in its atmosphere.

2 Earth has a greater mass of water vapour in its atmosphere than Venus or Mars.

3 Venus has a greater mass of nitrogen in its atmosphere than Earth or Mars.

4 Mars has a greater mass of carbon dioxide in its atmosphere than the Earth.

END OF TEST

4.9.3.2 Properties and effects of atmospheric pollutants

Question 25

January 2010 | CHY3H | Original Q6 | Legacy

6 During a thunderstorm lightning strikes the Eiffel Tower.

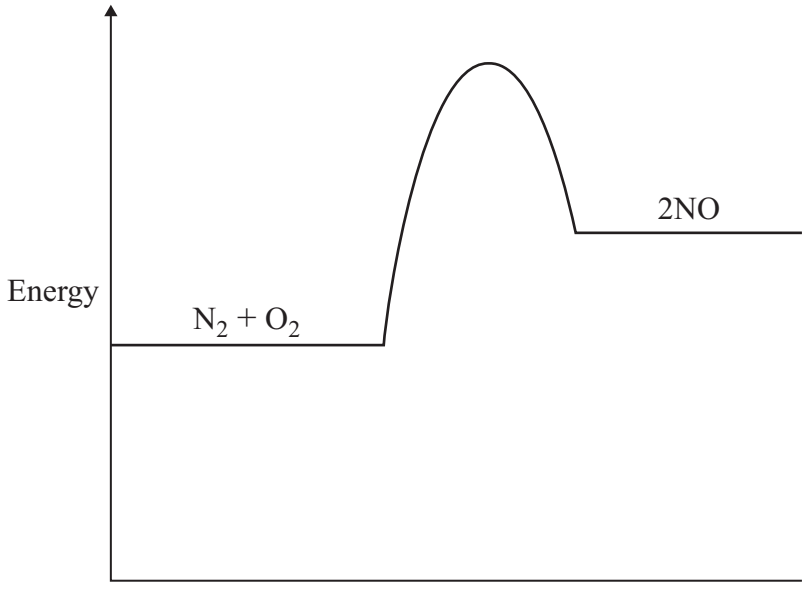


In lightning the temperature can reach 30 000 °C. This causes nitrogen and oxygen in the air to react, producing nitrogen oxide. This reaction has a high *activation energy* and is *endothermic*.

An equation that represents this endothermic reaction is:

$$N_2 + O_2 \rightarrow 2NO$$

The energy level diagram for this reaction is given below.



6 (a) The energy level diagram shows that this reaction is *endothermic*.

Explain how.

.....

.....

(1 mark)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 25 · continued

for mark

6 (b) What is meant by the term *activation energy*?

.....

.....

(1 mark)

6 (c) The equation showing the structural formulae of the reactants and products is

$$N \equiv N \quad + \quad O = O \quad \rightarrow \quad 2\ N = O$$

Bond	Bond energy in kJ
N ≡ N	945
O = O	498
N = O	630

6 (c) (i) Use the bond energies in the table to calculate the energy change for this reaction.

.....

.....

.....

.....

Energy change = ... kJ

(3 marks)

6 (c) (ii) In terms of bond energies, explain why this reaction is endothermic.

.....

.....

.....

(1 mark)

6

4.9.3.2 Properties and effects of atmospheric pollutants

Question 26

June 2010 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

Petrol is a hydrocarbon fuel that burns in air. Air is mainly nitrogen.

In a car engine:

- not all of the petrol burns completely
- after burning, the products pass into the exhaust pipe.

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

A nitrogen dioxide

B carbon monoxide

C carbon dioxide

D soot (carbon)

The black solid seen inside the exhaust pipe is . . . **1** . . . .

The gas in the exhaust fumes formed by the complete combustion of petrol is . . . **2** . . . .

The poisonous gas in the exhaust fumes formed by incomplete combustion of petrol is . . . **3** . . . .

The gas in the exhaust fumes formed by combining two gases from the air is . . . **4** . . . .

4.9.3.2 Properties and effects of atmospheric pollutants

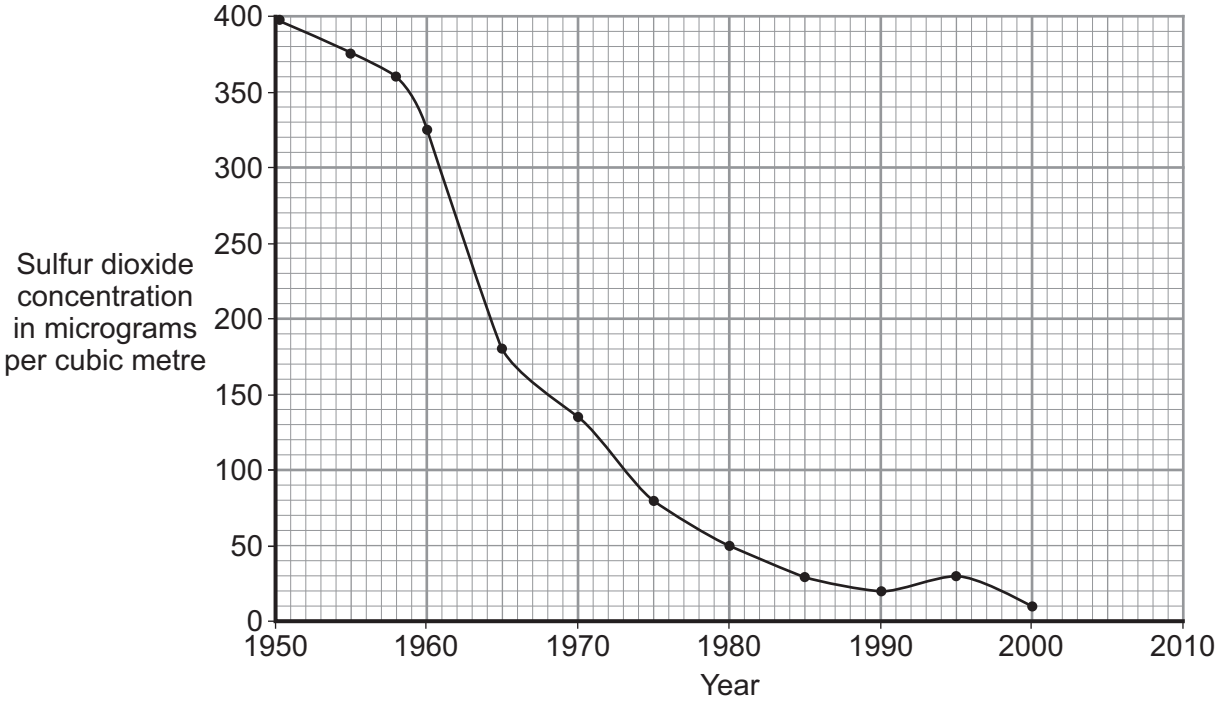
Question 27

June 2010 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The graph shows how sulfur dioxide concentrations in the atmosphere above London changed between 1950 and 2000.

The table shows the energy used in London in 1950 and in 2000.



Year	Energy used in arbitrary units							
	Petrol	Diesel	Electricity	Oil	House coal	Other solid fuels	Gas	Total
1950	10	5	20	25	100	110	60	330
2000	60	20	130	10	0	10	310	540

7A The information in the graph and table suggests that sulfur dioxide levels have decreased due to . . .

1 an increase in the use of petrol.

2 a decrease in the use of coal and other solid fuels.

3 an increase in the use of electricity that is generated at coal-burning power stations.

4 an increase in the use of diesel.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 27 · continued June 2010 | CHY1AP | Original Q7 | Legacy

7B Which one of the following is a reason why a prediction for sulfur dioxide concentration in 2010 might be unreliable?

1 Sulfur dioxide has a natural cycle in London of increasing and decreasing.

2 Sulfur dioxide dissolves in water to produce acid rain.

3 The concentration of sulfur dioxide has, in previous years, both increased and decreased.

4 Sulfur dioxide is very difficult to measure in such small concentrations.

7C It was found that the amount of sulfur dioxide from transport increased during years 2000 to 2004, even though many more cars were using low-sulfur fuels.

The reason for this could be . . .

1 a decrease in the use of transport.

2 the introduction of more efficient cars that burn less fuel.

3 an increase in the number of cars used in London.

4 an increase in the price of crude oil.

7D A newspaper published an article about sulfur dioxide concentrations in the atmosphere above London. It stated that in one five-year period, sulfur dioxide levels had fallen by about 44 %.

The five-year period was . . .

1 1960–1965.

2 1965–1970.

3 1985–1990.

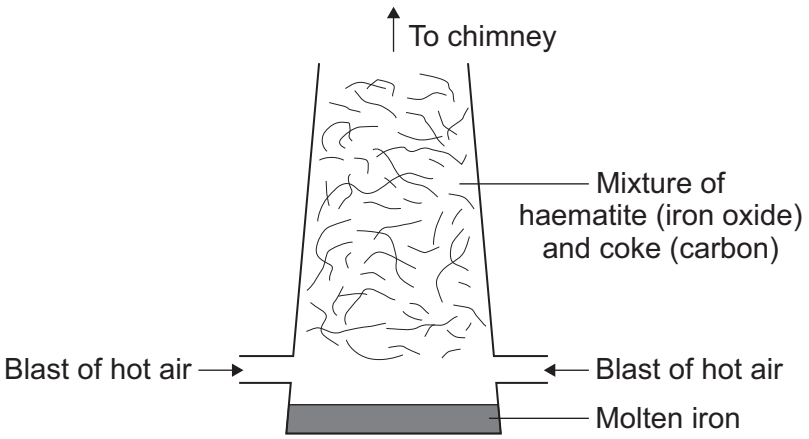
4 1995–2000.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 28

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.

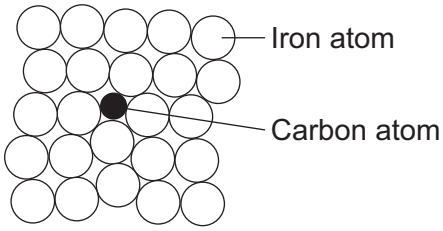
Fe_2O_3 + 3CO → ..... + ...

(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 28 · continued June 2010 | CHY1H | Original Q3 | Legacy

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)

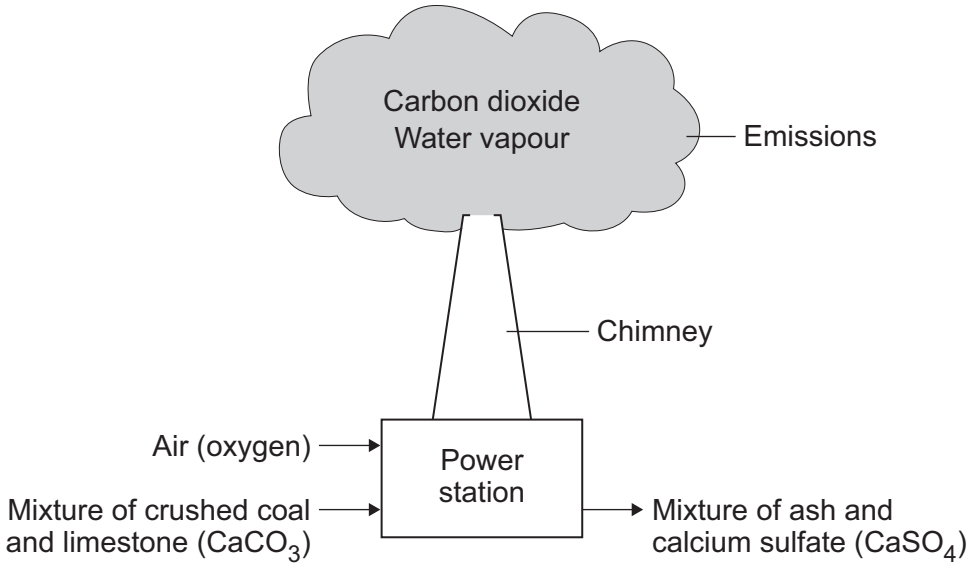
7

4.9.3.2 Properties and effects of atmospheric pollutants

Question 29

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)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 29 · 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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 30

November 2010 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

The table shows the quantity of acidic gases produced in Britain, from different sources, between 1990 and 2004.

	Acidic gases produced in millions of tonnes			
Year	**Domestic**	**Transport and communications**	**Other industries**	**Total**
1990	0.75	0.75	5.40	6.90
1992	0.75	0.80	5.00	6.55
1994	0.70	0.80	4.10	5.60
1996	0.60	0.80	3.40	4.80
1998	0.50	0.85	2.90	4.25
2000	0.45	0.70	2.50	3.65
2002	0.40	0.85	2.15	3.40
2004	0.35	0.90	2.05	3.30

6A The decrease in the total amount of acidic gases produced between 1990 and 2004 is about . . .

1 5%.

2 25%.

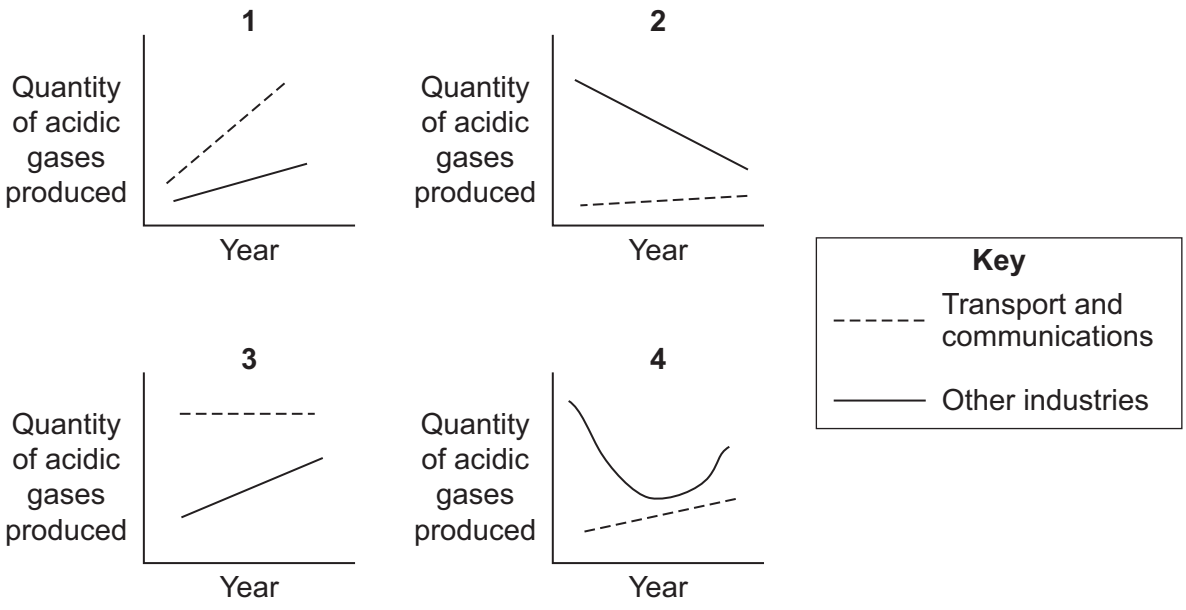
3 50%.

4 75%.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 30 · continued

6B Which graph correctly shows the data in the table for 'Transport and communications' and for 'Other industries'?



6C In 2000, 'Transport and communications' produced an unexpected amount of acidic gases, when compared to the trend in values.

Which one of the following could help to explain the unexpected amount of acidic gases produced?

1 a decrease in the number of aircraft flights

2 a decrease in the cost of crude oil

3 more traffic on the roads because of an increase in car production

4 more homes being built in the countryside

6D A catalytic converter in the exhaust system of vehicles can remove carbon monoxide and nitrogen dioxide. The two gases, carbon monoxide (CO) and nitrogen dioxide (NO_2), react to produce carbon dioxide (CO_2) and nitrogen (N_2).

The balanced equation that correctly describes this reaction is:

1 $CO + NO_2 \rightarrow CO_2 + N_2$

2 $2CO + NO_2 \rightarrow 2CO_2 + N_2$

3 $3CO + 2NO_2 \rightarrow 3CO_2 + N_2$

4 $4CO + 2NO_2 \rightarrow 4CO_2 + N_2$

4.9.3.2 Properties and effects of atmospheric pollutants

Question 31

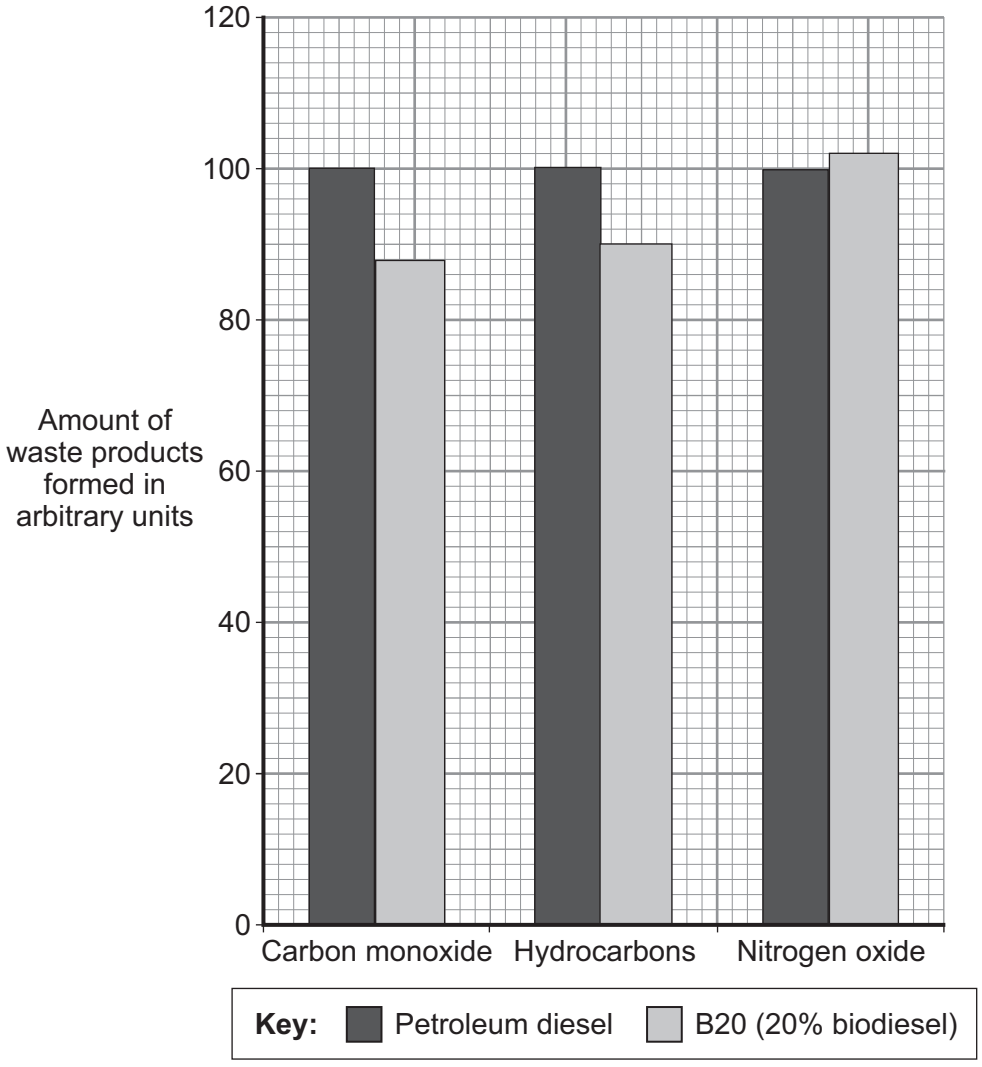
November 2010 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

Petroleum diesel fuel is made from crude oil. Biodiesel fuel is made from vegetable oils.

Some diesel cars can use petroleum diesel mixed with different amounts of biodiesel.
For example, B20 is 20 % biodiesel and 80 % petroleum diesel.

The bar chart shows the waste products from burning petroleum diesel and B20. The amounts of the three waste products are shown for each fuel.



6A Which of the following is a correct statement about these waste products?

1 They are all oxides.

2 They all contain carbon.

3 They are all elements.

4 They are all compounds.

4.9.3.2 Properties and effects of atmospheric pollutants

6B When B20 burns in a diesel engine, the other waste products are likely to be . . .

1 carbon dioxide, oxygen and water vapour.

2 nitrogen, water vapour and sulfur dioxide.

3 carbon dioxide, water vapour and sulfur dioxide.

4 oxygen, water vapour and sulfur dioxide.

6C Which row in the table shows a correct advantage and a correct disadvantage of using B20 instead of petroleum diesel?

	Advantage of using B20	Disadvantage of using B20
1	It is partly renewable.	It produces a greater amount of all harmful waste products.
2	It is unsaturated.	It is non-biodegradable.
3	It is partly renewable.	It produces an increased amount of nitrogen oxide.
4	It is hydrogenated.	It produces more carbon monoxide.

6D B100 is 100 % biodiesel. Net carbon dioxide emissions are lower for B100 than for petroleum diesel.

This is because . . .

1 the carbon dioxide is used by plants for photosynthesis.

2 vegetable oils produce very little carbon dioxide when they burn.

3 biodiesel does not contain any hydrocarbons.

4 carbon dioxide dissolves in the oceans.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 32

January 2011 | CHY1H | Original Q6 | Legacy

6 This information about diesel was printed in a magazine.

Almost all of the crops that we eat can be converted into fuel for cars.
Vegetable oils can be used as biodiesel. Diesel from crude oil is called fossil diesel.
When either biodiesel or fossil diesel burn they both produce similar amounts of carbon dioxide.
Both types of diesel produce carbon monoxide. However, biodiesel produces fewer carbon particles and less sulfur dioxide.

6 (a) Carbon monoxide can be produced when diesel burns in a car engine. Explain how.

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 32 · continued

6 (b) Use the information at the start of this question and your knowledge and understanding to evaluate the use of biodiesel compared with fossil diesel as a fuel for cars.

Remember to give a conclusion to your evaluation.

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(5 marks)

7

4.9.3.2 Properties and effects of atmospheric pollutants

Question 33

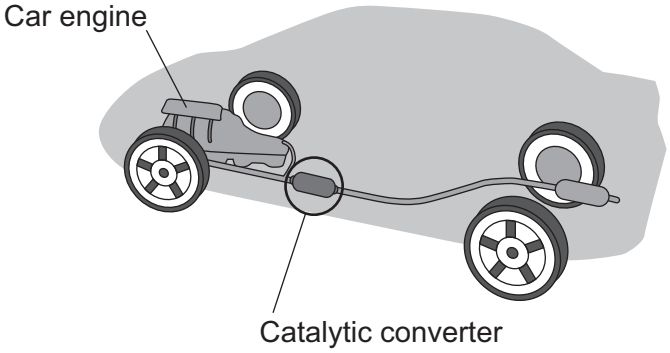
January 2011 | CHY2H | Original Q4 | Legacy

4 Read the information about car engines.

Burning petrol in air is an *exothermic* reaction. This reaction is used in car engines.

When petrol burns it produces harmful substances such as nitrogen oxides and carbon monoxide.

A catalytic converter stops these harmful substances being released into the air.



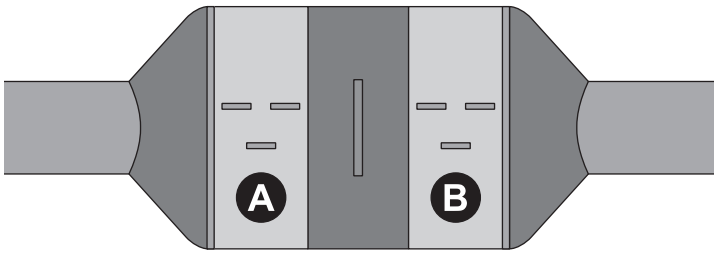
4 (a) The reaction is *exothermic*. What is the meaning of *exothermic*?

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(1 mark)

4 (b) The catalytic converter has two parts shown as **A** and **B** in the diagram.



Part **A** contains a catalyst made from platinum and rhodium.

Part **B** contains a catalyst made from platinum and palladium.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 33 · continued January 2011 | CHY2H | Original Q4 | Legacy

4 (b) (i) Why are catalysts used in chemical reactions?

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.....

(1 mark)

4 (b) (ii) One reaction in part **A** is shown by this equation.

$$2NO \rightarrow N_2 + O_2$$

Suggest why this reaction helps the environment.

.....

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(1 mark)

4 (b) (iii) The equation for one of the reactions in part **B** is shown below.

Balance this equation.

..... CO + O_2 → ..... CO_2

(1 mark)

4 (b) (iv) The catalytic converter works for many years without replacing the catalyst.

Explain why the catalyst does not need to be replaced.

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(1 mark)

4 (b) (v) Suggest why different catalysts are used in parts **A** and **B**.

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(1 mark)

Question 4 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 33 · continued

4 (c) Modern catalytic converters contain nanosized particles of catalyst. Using nanosized particles reduces the cost of the catalytic converter.

Suggest and explain why the use of nanosized catalyst particles reduces the cost of the catalytic converter.

Your answer should include information about the size and surface area of the particles.

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(3 marks)

9

4.9.3.2 Properties and effects of atmospheric pollutants

Question 34

January 2011 | CHY2H | Original Q6 | Legacy

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



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

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

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

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(1 mark)

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

Explain why methanol has a low boiling point.

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 34 · continued

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

The equation for this reaction is:

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

The forward reaction is exothermic.

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

Explain why the best equilibrium yield is obtained:

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

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(1 mark)

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

.....

.....

(1 mark)

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

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

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(2 marks)

Question 6 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 34 · continued January 2011 | CHY2H | Original Q6 | Legacy

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

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

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

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

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

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

.....

.....

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

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

.....

.....
(1 mark)

12

4.9.3.2 Properties and effects of atmospheric pollutants

Question 35

March 2011 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about substances that burn in air and the gases they produce.

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

A Carbon monoxide (CO)

B Hydrogen (H_2)

C Methane (CH_4)

D Hydrogen sulfide (H_2S)

	Gases produced when the substance burns in air
1	carbon dioxide (CO_2) and water vapour (H_2O)
2	water vapour (H_2O) only
3	water vapour (H_2O) and sulfur dioxide (SO_2)
4	carbon dioxide (CO_2) only

4.9.3.2 Properties and effects of atmospheric pollutants

Question 36

March 2011 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

Zinc is a reactive metal that will react with oxygen at high temperatures. Its two main ores are zinc sulfide (ZnS) and zinc carbonate ($ZnCO_3$). The relative abundance of each ore is about the same throughout the world.

To extract zinc, the ores are first heated to produce zinc oxide:

$$2ZnS + 3O_2 \xrightarrow{\text{heat}} 2ZnO + 2SO_2$$

$$ZnCO_3 \xrightarrow{\text{heat}} ZnO + CO_2$$

The zinc oxide is mixed with carbon (C) and heated in a furnace.

In the furnace, these reactions occur:

$$C + O_2(air) \xrightarrow{\text{heat}} CO_2$$

$$CO_2 + C \longrightarrow 2CO$$

Zinc is extracted by the following reaction:

$$ZnO + CO \longrightarrow Zn + CO_2$$

8A An advantage of using zinc carbonate instead of zinc sulfide is that. . .

1 zinc carbonate is more common and therefore cheaper.

2 only one waste product is formed.

3 less zinc is lost during the reaction.

4 zinc is formed directly without another chemical being used.

8B The atmosphere inside the furnace is kept rich in carbon monoxide (CO).

This is to . . .

1 prevent zinc oxide from reacting with carbon (C).

2 stop the zinc from re-forming zinc oxide.

3 remove carbon (C) from the furnace.

4 make carbon dioxide (CO_2).

4.9.3.2 Properties and effects of atmospheric pollutants

Question 36 · continued

8C Zinc ores also contain lead compounds. Lead is produced with the zinc in the furnace. The temperature inside the furnace is about 1500 °C.

	Boiling point in °C	Density in g per cm^3	Reactivity
Lead	1749	11.3	Low
Zinc	907	7.1	High

Pure zinc is obtained from the furnace because . . .

1 zinc leaves the furnace as vapour, and liquid lead remains in the furnace.

2 liquid zinc floats on liquid lead in the furnace.

3 lead leaves the furnace as vapour, and liquid zinc remains in the furnace.

4 lead is more reactive than zinc and reacts with oxygen to form lead oxide.

8D Limestone is added to the furnace because . . .

1 it provides energy for the reaction.

2 it removes any acidic impurities.

3 it is the only source of the carbon dioxide in the furnace.

4 it is thermally stable.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 37

June 2011 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about four carbon compounds that burn in air.

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

A CO

B CS_2

C C_2H_4

D C_3H_8

1	It burns to form carbon dioxide only.
2	It is a hydrocarbon but it is not an alkane.
3	It is in the series with the general formula C_nH_{2n+2}
4	It burns to form carbon dioxide and sulfur dioxide.

4.9.3.2 Properties and effects of atmospheric pollutants

Question 38

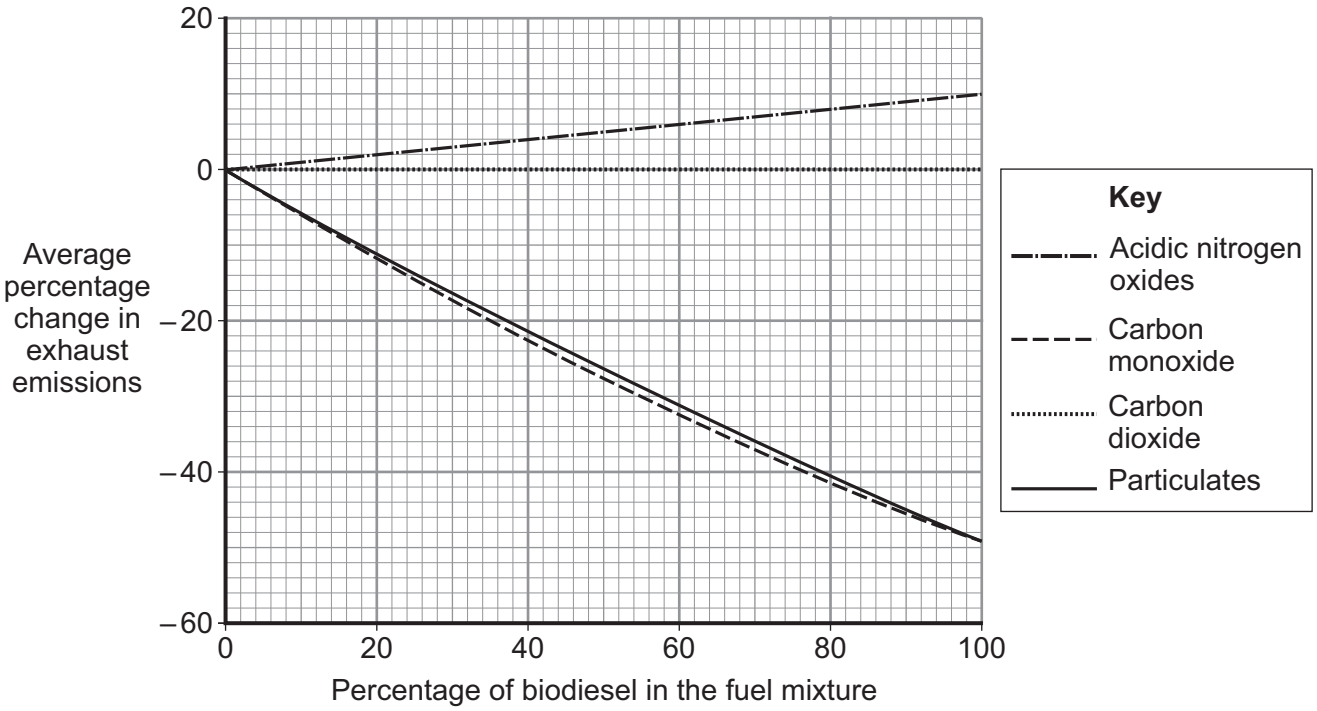
June 2011 | CHY1H | Original Q6 | Legacy

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.



4.9.3.2 Properties and effects of atmospheric pollutants

Question 38 · 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)

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4.9.3.2 Properties and effects of atmospheric pollutants

Question 39

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.

.....

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(1 mark)

Question 2 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 39 · 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.

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(1 mark)

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

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 39 · continued

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

Explain why.

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(2 marks)

11

Turn over for the next question

4.9.3.2 Properties and effects of atmospheric pollutants

Question 40

January 2012 | CH1HP | Original Q6 | Legacy

6 Limestone is used as a building material. Acid rain erodes limestone.

6 (a) Limestone contains calcium carbonate.
The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

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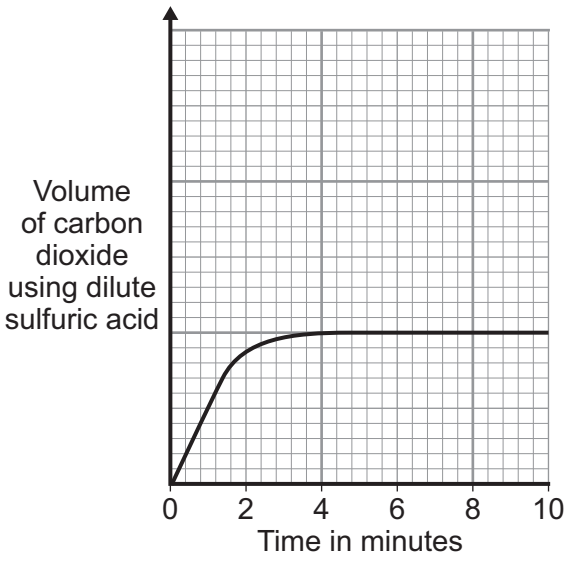
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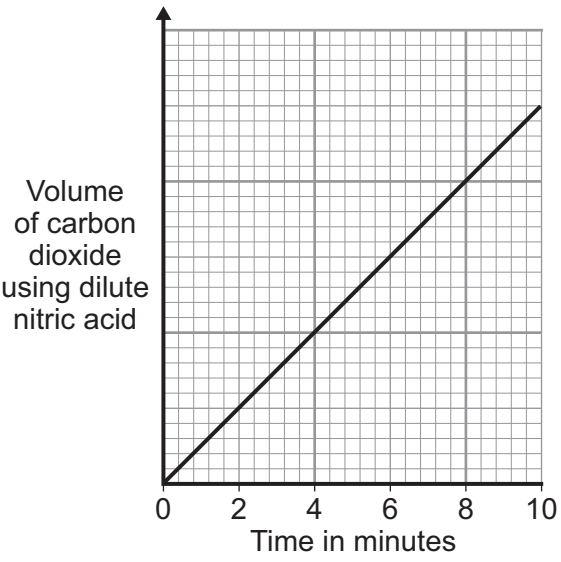
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(2 marks)

6 (b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone).
The type of acid was changed but all other variables were kept the same.
The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).
The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.
The results are shown below.





4.9.3.2 Properties and effects of atmospheric pollutants

Question 40 · continued

6 (b) (i) State **two** variables that must be kept the same for this investigation.

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(2 marks)

6 (b) (ii) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.

$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + H_2O(l) + CO_2(g)$

$CaCO_3(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$

Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

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(3 marks)

7

4.9.3.2 Properties and effects of atmospheric pollutants

Question 41

June 2012 | CH2HP | Original Q4 | Legacy

4 This question is about gold (Au).

4 (a) An atom of gold is represented as:

$$^{197}_{79}Au$$

How many neutrons are in this atom of gold? .....

(1 mark)

4 (b) Gold ions are used as a catalyst.

How does a gold atom (Au) become a gold ion (Au^{3+})?

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 41 · continued

4 (c) A gold catalyst can be used when carbon monoxide reacts with oxygen to make carbon dioxide.

4 (c) (i) Complete and balance the equation for this reaction.

..... CO + ... → ..... CO_2

(2 marks)

4 (c) (ii) Carbon dioxide has a very low boiling point.

Explain why.

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(3 marks)

4 (d) Gold is used as a catalyst in industrial processes. Gold is rare and increasingly expensive.

Suggest **three** reasons why gold is still used in industrial processes.

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(3 marks)

11

4.9.3.2 Properties and effects of atmospheric pollutants

Question 42

June 2012 | CH2HP | Original Q6 | Legacy

6 This question is about calcium hydroxide.

Ancient artworks and monuments can be protected from acid rain if the surface is sprayed with calcium hydroxide nanoparticles.



6 (a) Calcium hydroxide has the formula $Ca(OH)_2$

Why are there two hydroxide ions for each calcium ion in the formula?

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(1 mark)

6 (b) The calcium hydroxide is used in the form of *nanoparticles*.

What are *nanoparticles*?

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(1 mark)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 42 · continued

6 (c) A student added water to calcium oxide to make calcium hydroxide.

The equation for the reaction is shown below.

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

Calculate the maximum mass of calcium hydroxide which could be made from 2.00 g of calcium oxide.

Relative atomic masses (A_r): H = 1; O = 16; Ca = 40.

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Maximum mass of calcium hydroxide = ... g

(3 marks)

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4.9.3.2 Properties and effects of atmospheric pollutants

Question 43

8 Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere may have evolved.

Titan is the largest moon of Saturn.

The table shows data about some substances in the atmosphere of Titan.

Substance	Melting point in °C	Boiling point in °C
Nitrogen	–210	–196
Methane	–183	–164
Argon	–189	–186
Hydrogen	–259	–253
Carbon monoxide	–205	–192

8 (a) There is no water on Titan. The average surface temperature on Titan is –179 °C.

Which of the substances in the table would form oceans on Titan?

Explain your answer.

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 43 · continued

8 (b) Amino acids are essential to life.

In the 1950s the Miller-Urey experiment showed that simple amino acids, such as glycine (NH_2CH_2COOH), could have been produced from the Earth's early atmosphere.

The Miller-Urey experiment showed that simple amino acids could be produced by reactions between hydrocarbons, ammonia and water.

Explain how the Miller-Urey experiment suggests that reactions between the substances in Titan's atmosphere could also produce simple amino acids.

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(4 marks)

6

4.9.3.2 Properties and effects of atmospheric pollutants

Question 44

June 2013 | CH1HP | Original Q7 | Legacy

7 There has been research into fuels for car engines.

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

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

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

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(2 marks)

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

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

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(2 marks)

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

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

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(2 marks)

4.9.3.2 Properties and effects of atmospheric pollutants

Question 44 · continued

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

Explain why.

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(2 marks)

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

To gain full marks you should give a justified conclusion.

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

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(4 marks)

12

4.9.3.2 Properties and effects of atmospheric pollutants

Question 45

2 Ethanol and vegetable oil are used as fuels.

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

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

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

What is **hydration**?

[1 mark]

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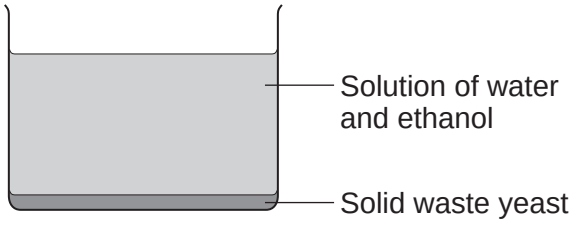
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2 (a) (ii) Fermentation is used to produce ethanol from sugar by:

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

Figure 2 shows the substances after three days.

Figure 2



Suggest:

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

[2 marks]

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4.9.3.2 Properties and effects of atmospheric pollutants

Question 45 · 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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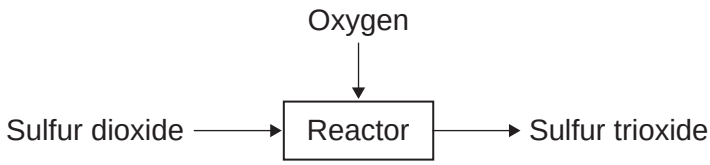
4.9.3.2 Properties and effects of atmospheric pollutants

Question 46

June 2014 | CH2HP | Original Q3 | Legacy

3 **Figure 2** represents a reaction in the production of sulfuric acid.

Figure 2



3 (a) Complete and balance the equation for the reaction.

[2 marks]

..... $SO_2(g)$ + ... (g) $\rightleftharpoons$ ..... $SO_3(g)$

3 (b) The conditions can affect the rate of the reaction.

3 (b) (i) The pressure of the reacting gases was increased.

State the effect of increasing the pressure on the rate of reaction.

Explain your answer in terms of particles.

[3 marks]

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4.9.3.2 Properties and effects of atmospheric pollutants

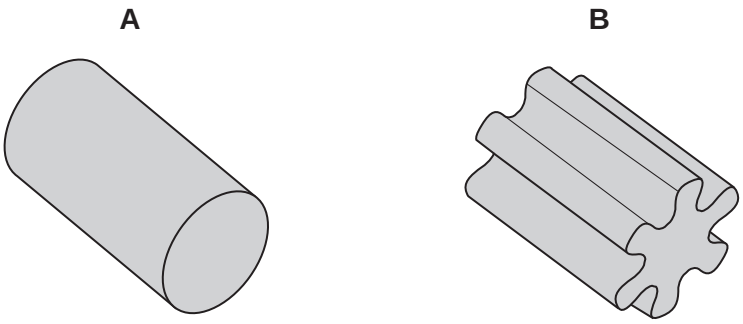
Question 46 · continued

3 (b) (ii) A catalyst is used for the reaction.

The gases pass through a layer containing pieces of the catalyst.

Figure 3 shows the shapes of pieces of catalyst.

Figure 3



Suggest and explain why shape **B** is more effective as a catalyst than shape **A**.

[2 marks]

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3 (c) The reaction is carried out at a high temperature to provide the reactants with the **activation energy**.

What is meant by the **activation energy**?

[1 mark]

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4.9.3.2 Properties and effects of atmospheric pollutants

Question 46 · continued

3 (d) Sulfuric acid reacts with metals to produce salts.

3 (d) (i) A student concluded that potassium would **not** be a suitable metal to react with sulfuric acid.

Explain why.

[2 marks]

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3 (d) (ii) A student reacted zinc metal with sulfuric acid to produce a salt and another product.

Complete the equation for this reaction.

[2 marks]

$Zn + H_2SO_4 \longrightarrow$ ..... + ...

3 (d) (iii) The student wanted to increase the rate of the reaction between the zinc and sulfuric acid.

State **one** way, other than using a catalyst, that the student could increase the rate of the reaction.

[1 mark]

.....

.....

13

4.9.3.2 Properties and effects of atmospheric pollutants

Question 47

June 2015 | CH1HP | Original Q5 | Legacy

5 Crude oil is a fossil fuel.

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

[4 marks]

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5 (b) Fuel oil is one of the fractions from crude oil.

Power stations burn fuel oil to generate electricity. The waste gases from the combustion of fuel oil contain carbon dioxide, water vapour, sulfur dioxide and oxides of nitrogen.

The waste gases are passed through a suspension of limestone in water. Limestone is mainly calcium carbonate.

Suggest how the use of a suspension of limestone decreases one of the environmental impacts that the waste gases would cause.

[3 marks]

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4.9.3.2 Properties and effects of atmospheric pollutants

Question 47 · continued

5 (c) Some fractions from crude oil contain large hydrocarbon molecules.

5 (c) (i) Hydrocarbon molecules, such as decane, can be cracked to produce smaller, more useful molecules.

Write the correct formula of the third product to complete the chemical equation.

You do not need to give the name of this product.

[1 mark]

$C_{10}H_{22} \longrightarrow C_5H_{10} + C_3H_8 +$ .....

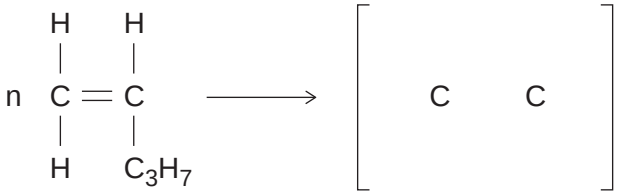
decane pentene propane

5 (c) (ii) Pentene is used to produce poly(pentene).

Complete the equation and the displayed structure of poly(pentene).

[3 marks]

Pentene **Poly(pentene)**



5 (c) (iii) Some polymers are described as smart polymers.

Suggest **one** property of a smart polymer that is different to that of an ordinary polymer.

[1 mark]

.....

.....

12

4.9.3.2 Properties and effects of atmospheric pollutants

Question 48

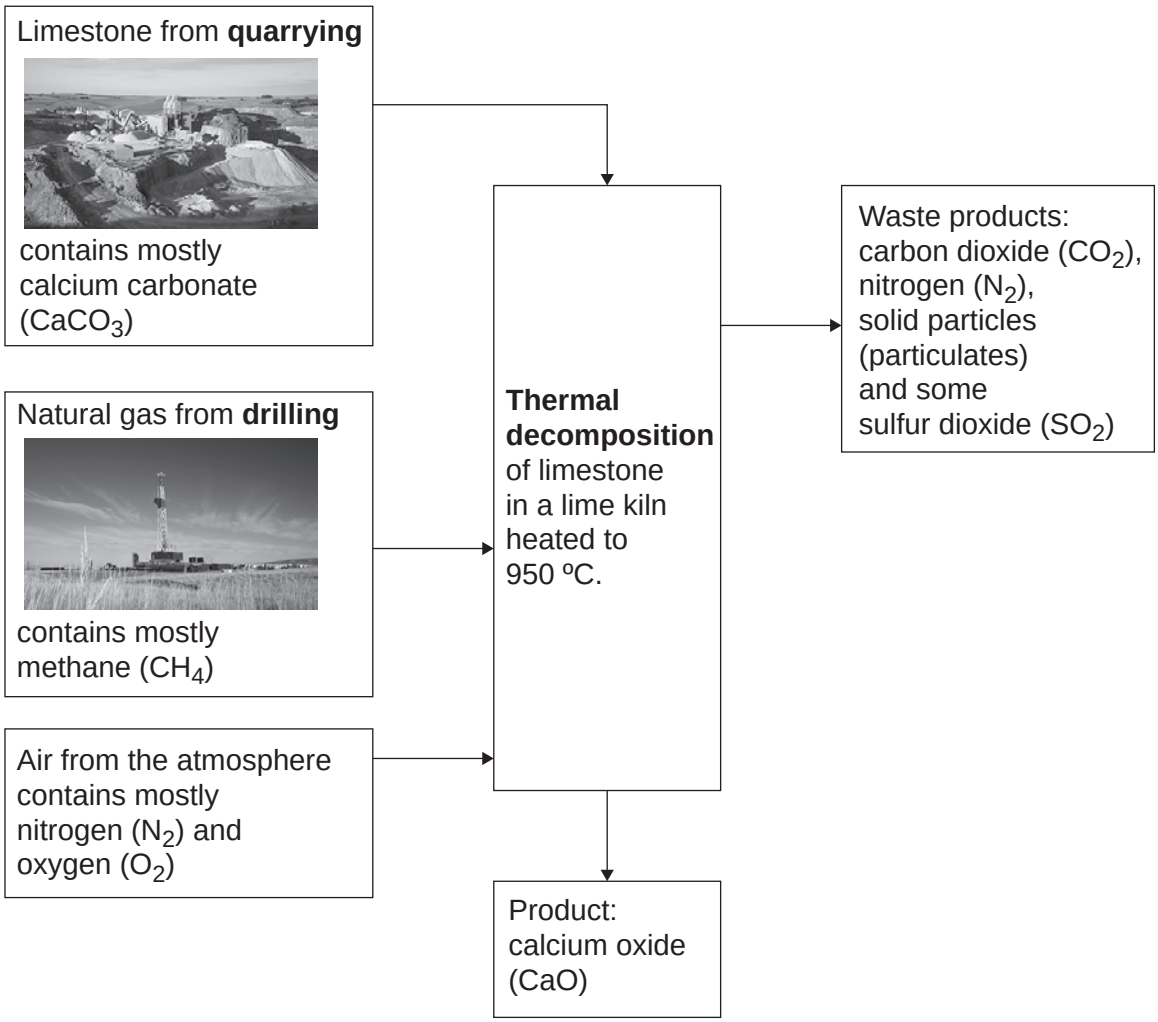
June 2017 | CH1HP | Original Q3 | Legacy

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

Limestone is heated in a lime kiln to produce calcium oxide.

Figure 4 shows the reactants used and the products made in a lime kiln.

Figure 4



Use information from **Figure 4** to explain the potential environmental impacts of quarrying, drilling and the thermal decomposition of limestone used in the production of calcium oxide.

[6 marks]

4.9.3.2 Properties and effects of atmospheric pollutants

Question 49

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 49 · 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]

$$__\ NO_2\ (g) \rightarrow _____ + __\ O_2\ (g)$$

4.9.3.2 Properties and effects of atmospheric pollutants

Question 49 · 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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 50

June 2018 | 8462/2H | Original Q9

0 9 This question is about methanol.

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

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

[1 mark]

Tick **one** box.

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

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

The equation for the reaction is:

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

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

[1 mark]

Tick **one** box.

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

4.9.3.2 Properties and effects of atmospheric pollutants

Question 50 · continued

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

The forward reaction is exothermic.

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

[2 marks]

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

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

Explain why.

[4 marks]

Question 9 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 50 · continued

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

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

[2 marks]

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

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

[1 mark]

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

[1 mark]

12

4.9.3.2 Properties and effects of atmospheric pollutants

Question 51

June 2019 | 8462/2H | Original Q5

0 5 This question is about combustion of fuels.

0 5 . 1 Some central heating boilers use wood as a fuel.

Suggest **two** reasons why wood is more sustainable than natural gas as a fuel for central heating boilers.

[2 marks]

1 _____

_____

2 _____

_____

Natural gas is mainly methane.

When methane burns it can produce both carbon monoxide and carbon dioxide.

0 5 . 2 Explain the process by which carbon monoxide can be produced when methane is burned.

[2 marks]

_____

_____

_____

_____

0 5 . 3 Balance the equation for the combustion of methane to produce carbon monoxide.

[1 mark]

$$___\ CH_4(g) + ___\ O_2(g) \rightarrow ___\ CO(g) + ___\ H_2O(l)$$

4.9.3.2 Properties and effects of atmospheric pollutants

Question 51 · continued

0 5 . 4 Propane burns to form carbon dioxide and water.

The equation for the reaction is:

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

3.60 dm^3 carbon dioxide is produced when a sample of propane is burned in 7.25 dm^3 oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm^3

[4 marks]

Volume of unreacted oxygen = _____ cm^3

9

4.9.3.2 Properties and effects of atmospheric pollutants

Question 52

June 2019 | 8462/2H | Original Q10

1 0 This question is about reversible reactions and equilibrium.

Hydrogen is used to produce ammonia in the Haber process.

The hydrogen is made in two stages.

Stage 1 is the reaction of methane and steam to produce carbon monoxide and hydrogen.

The equation for the reaction is:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

1 0 . 1 Calculate the atom economy for the formation of hydrogen in **stage 1**.

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

[2 marks]

Atom economy = _____ %

4.9.3.2 Properties and effects of atmospheric pollutants

Question 52 · continued

1 0 . 2 Explain why a low pressure is used in **stage 1**.

Give your answer in terms of equilibrium.

[2 marks]

1 0 . 3 **Stage 2** uses the carbon monoxide produced in **stage 1**.

The carbon monoxide is reacted with more steam to produce carbon dioxide and more hydrogen.

The equation for the reaction in **stage 2** is:

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

What is the effect of increasing the pressure on the equilibrium yield of hydrogen in **stage 2**?

[1 mark]

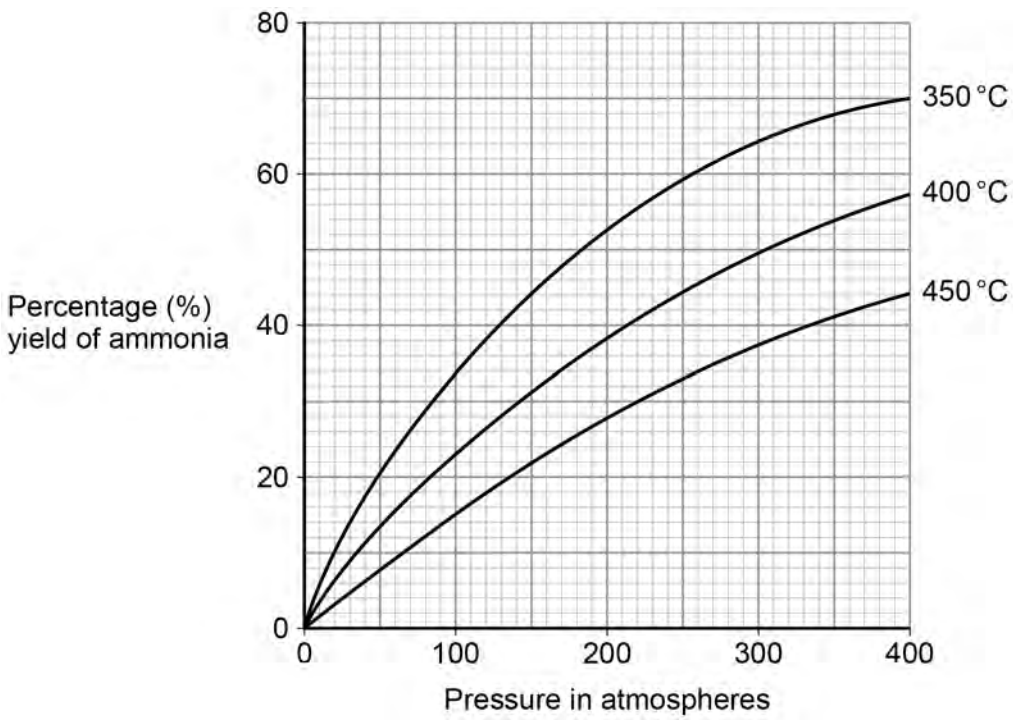
Question 10 continues on the next page

4.9.3.2 Properties and effects of atmospheric pollutants

Question 52 · continued

Figure 10 shows the percentage yield of ammonia produced at different temperatures and pressures in the Haber process.

Figure 10



A temperature of 450 °C and a pressure of 200 atmospheres are used in the Haber process.

1 0 . 4 A student suggested that a temperature of 350 °C and a pressure of 285 atmospheres could be used instead of those used in the Haber process.

Determine how many times greater the percentage yield of ammonia obtained would be.

Use **Figure 10**.

[3 marks]

Percentage yield = _____ times greater

4.9.3.2 Properties and effects of atmospheric pollutants

Question 52 · continued

10.5 A pressure of 285 atmospheres is **not** used in the Haber process instead of 200 atmospheres.

Give **one** reason why.

[1 mark]

10.6 How does **Figure 10** show that the forward reaction in the Haber process is exothermic?

[1 mark]

10.7 World production of ammonia is now about 30 times greater than it was in 1950.

Suggest why the demand for ammonia has increased.

[2 marks]

12

4.9.3.2 Properties and effects of atmospheric pollutants

Question 53

June 2024 | 8462/2H | Original Q7

0 7 This question is about sulfuric acid.

0 7 . 1 Sulfuric acid contains sulfate ions.

Describe the test for the presence of sulfate ions in sulfuric acid.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

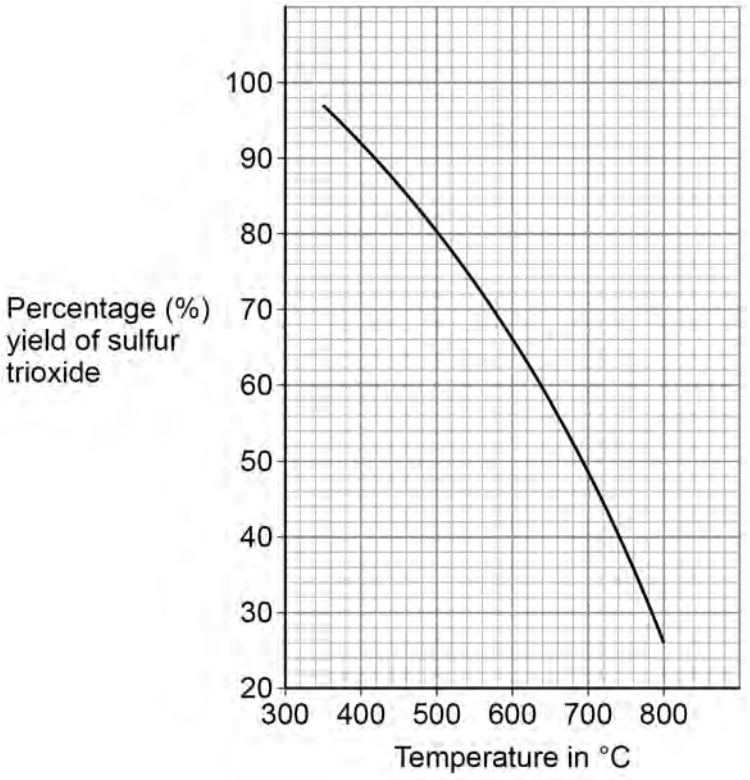
_____

One stage in the industrial production of sulfuric acid is the reaction of sulfur dioxide with oxygen to produce sulfur trioxide.

This reversible reaction reaches dynamic equilibrium.

Figure 7 shows the percentage yield of sulfur trioxide in this reaction at different temperatures.

Figure 7



4.9.3.2 Properties and effects of atmospheric pollutants

Question 53 · continued

0 7 . 2 Which statement about the forward reaction is correct?

Use **Figure 7**.

[1 mark]

Tick (✓) **one** box.

- The yield is greater at higher temperatures because the reaction is exothermic. ☐
- The yield is greater at higher temperatures because the reaction is endothermic. ☐
- The yield is smaller at higher temperatures because the reaction is exothermic. ☐
- The yield is smaller at higher temperatures because the reaction is endothermic. ☐

The equation for the reaction is:

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

0 7 . 3 Explain why the percentage yield of sulfur trioxide in this reaction is greater if the pressure is higher.

[2 marks]

0 7 . 4 In industry, the reaction is done at 450 °C and atmospheric pressure.

Under these conditions the yield of sulfur trioxide is 86%.

Suggest **two** reasons why a higher pressure is **not** used.

[2 marks]

1

2

4.9.3.2 Properties and effects of atmospheric pollutants

Question 53 · continued

0 7 . 5 This reaction uses a catalyst to increase the rate of the reaction.

The catalyst is a metal oxide.

Which is the most likely metal in the metal oxide catalyst?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

- Aluminium (Al) ☐
- Barium (Ba) ☐
- Potassium (K) ☐
- Vanadium (V) ☐

8