AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.9.2.4

The carbon footprint and its reduction

Past-paper questions

Tier	**Higher**
Question groups	**15**
Available paper years	**2007–2013**

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.

4.9.2.4 The carbon footprint and its reduction

Question 01

June 2007 | CHY1B | Original Q9 | Legacy

QUESTION NINE

This passage is about biodiesel.

- Petroleum diesel is made from crude oil.
- Biodiesel is made from a variety of vegetable oils, eg soybean, palm and rapeseed.
- Biodiesel can be used in diesel cars without modification to the engine.

The use of biodiesel will reduce a country's dependency on crude oil, particularly if the technology involved in the production of biodiesel is improved.
However, large areas of agricultural land will be needed to grow the crops from which to extract the vegetable oils.

Palm oil produces better yields of fuel per hectare of land than other crops. Indonesia plans to increase the amount of land used to produce palm oil by 50%. 1.8 million hectares of rainforest in Borneo would be cut down to produce the world's largest palm oil plantation.

9A One reason why there is research and development into the use of biodiesel is that . . .

1 biodiesel does not produce any harmful waste gases when it burns.

2 there are large areas of unused agricultural land.

3 in some countries, manufacturers do not know how to make petroleum diesel.

4 crude oil is non-renewable.

9B On what basis can those who support the increased use of biodiesel claim that, when compared with petroleum diesel, it reduces the **net** greenhouse gas emissions?

1 Plants used to make biodiesel take up carbon dioxide for photosynthesis.

2 Biodiesel does not produce greenhouse gases when it burns.

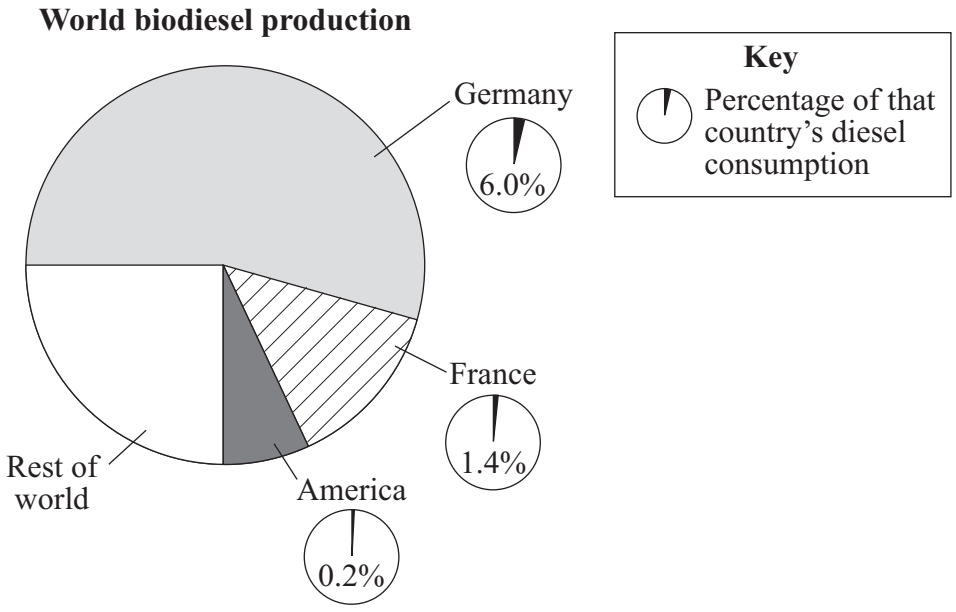
3 Biodiesel produces more carbon dioxide when it burns.

4 Biodiesel does not produce water vapour when it burns.

4.9.2.4 The carbon footprint and its reduction

Question 01 · continued June 2007 | CHY1B | Original Q9 | Legacy

9C The pie chart shows information on the world biodiesel production and percentage of diesel consumption in 2005.



The pie chart shows that in 2005, . . .

1 France used seven times more biodiesel than America.

2 America produced less biodiesel than any other country in the world.

3 three countries produced about 75 % of the world's biodiesel.

4 Germany was the largest user of biodiesel.

9D Some pressure groups argue against the increased use of biodiesel.

Which of the following is **not** an argument that they could reasonably use?

1 It could result in the loss of some animal and plant species.

2 It could create food shortages in some parts of the world.

3 It could cause water shortages in some countries.

4 It could cause petroleum diesel prices to rise sharply.

END OF TEST

4.9.2.4 The carbon footprint and its reduction

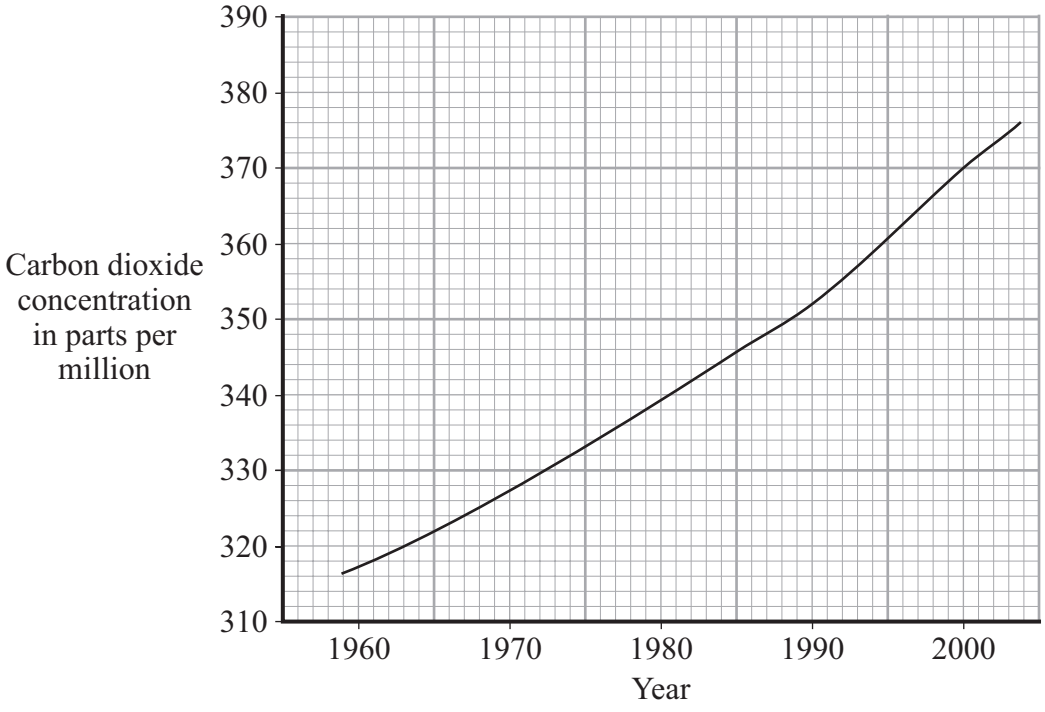
Question 02

November 2007 | CHY1B | Original Q4 | Legacy

QUESTION FOUR

Measurements of carbon dioxide in the atmosphere have been made continuously for almost 50 years at the Mauna Loa Observatory, 4000 metres up a mountain in Hawaii.
This site is far enough away from any large carbon dioxide source to be a reliable measuring point.

Atmospheric carbon dioxide levels measured at Mauna Loa, Hawaii



4A What is the mean (average) rate of increase per year of carbon dioxide (in parts per million) in the atmosphere at Mauna Loa between 1990 and 2000?

1 1.8

2 18.0

3 352.0

4 370.0

4B The change in carbon dioxide concentration over the past 50 years is thought to be a result of . . .

1 increased volcanic activity.

2 an increase in the use of fossil fuels.

3 variations in the Sun's energy output.

4 an increase in ocean temperatures.

4.9.2.4 The carbon footprint and its reduction

Question 02 · continued

4C Many scientists think that there is a close link between atmospheric carbon dioxide levels and global warming.
Some political leaders have taken no action to reduce carbon dioxide emissions.

One possible reason is that . . .

1 restrictions on industrial development might result.

2 their countries have few oil reserves.

3 they do not think that scientists are qualified to make important judgements.

4 they do not think that global warming will affect their country.

4D Concerns about carbon dioxide levels and global warming have increased research and technical development in some areas.

Which of these has **not** been part of this development?

1 the use of ethanol as a fuel in cars

2 the use of diesel oil instead of petrol in cars

3 the use of vegetable oils as a fuel in cars

4 the development of electric cars

4.9.2.4 The carbon footprint and its reduction

Question 03

January 2008 | CHY1H | Original Q5 | Legacy

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)

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(1 mark)

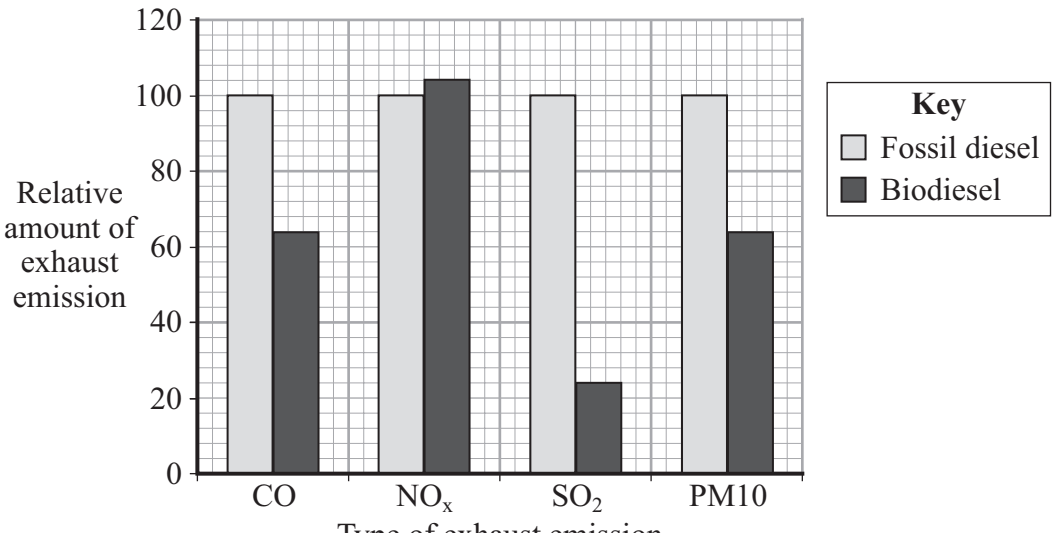
(ii) the increased level of particulates (PM10).

.....

(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.



4.9.2.4 The carbon footprint and its reduction

Question 03 · 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.

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(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.

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(3 marks)

8

4.9.2.4 The carbon footprint and its reduction

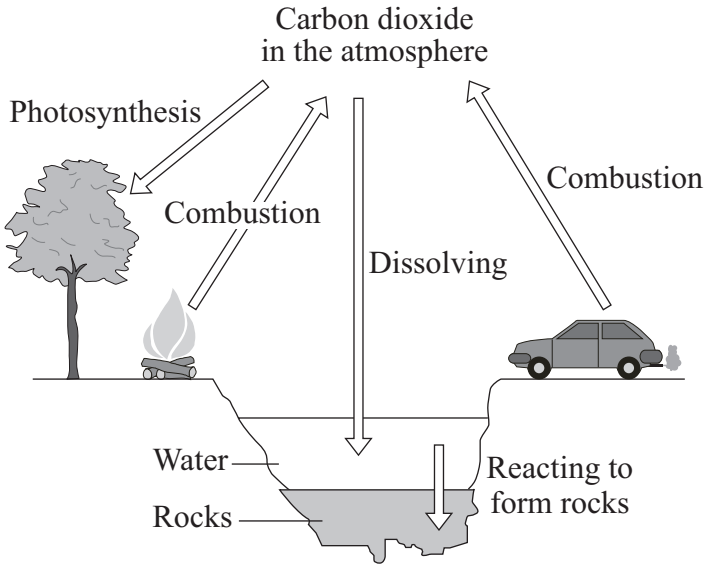
Question 04

March 2008 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

This question is about the balance of carbon dioxide in the atmosphere.

The diagram below shows some of the processes involved in the atmosphere.



The total UK carbon dioxide emissions (million tonnes) from transport between 1990 and 2002 are listed in the table below.

Year	1990	1995	1996	1997	1998	1999	2000	2001	2002
Carbon dioxide emissions in million tonnes	58.5	68.9	75.2	79.7	84.3	84.5	88.3	86.3	86.0

Source: National Statistics website: *www.statistics.gov.uk*
Greenhouse gas emissions from the UK transport industry.
Reproduced under the terms of the Click-Use Licence.

4A The data for total UK carbon dioxide emissions from vehicles could be obtained by . . .

1 measuring the carbon dioxide in the atmosphere.

2 calculating the amount of carbon dioxide produced from the amount of fuel used by vehicles.

3 counting the number of vehicles on the road.

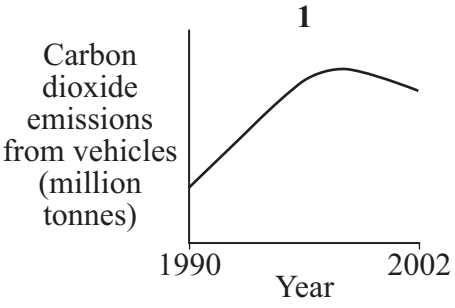
4 measuring the amount of carbon dioxide in the air near a busy motorway.

4.9.2.4 The carbon footprint and its reduction

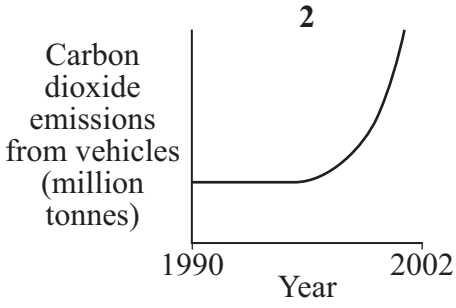
Question 04 · continued March 2008 | CHY1BP | Original Q4 | Legacy

4B A graph plotted using the data 'Year' (x-axis) against 'Carbon dioxide emissions from vehicles' (y-axis) would look like which one of the following?

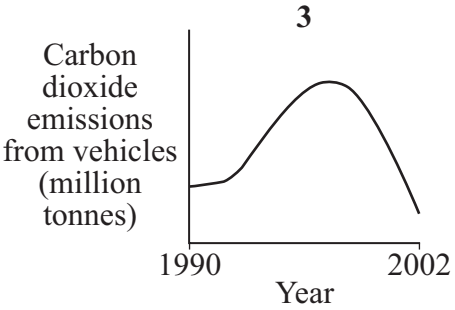
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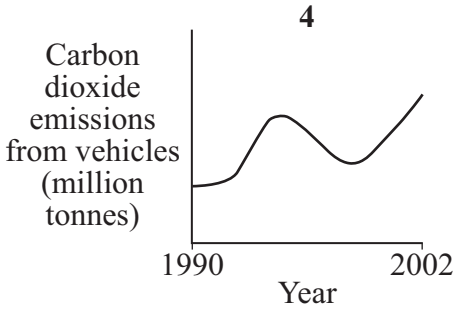
2



3



4



4C The increase in the amount of carbon dioxide in the air over the past 40 years is thought to be due mainly to . . .

1 increased growth of plants.

2 increased burning of fossil fuels.

3 the formation of carbonate rocks.

4 the release of carbon dioxide from oceans due to global warming.

4D The amount of carbon dioxide in the atmosphere could be reduced by . . .

1 taking more flights in aeroplanes.

2 cutting down trees in your garden.

3 walking to work instead of using a car.

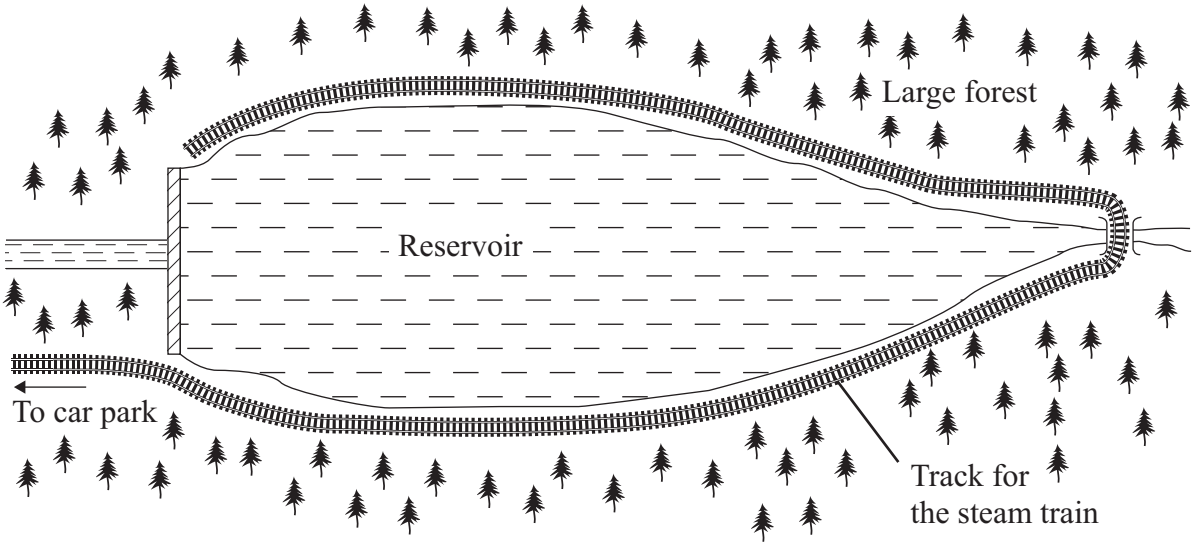
4 driving a car with a larger engine.

4.9.2.4 The carbon footprint and its reduction

Question 05

June 2008 | CHY1H | Original Q6 | Legacy

6 A large reservoir is surrounded by trees. Planners need to protect the environment. The distance around the reservoir is many kilometres. There will be only one road access to a car park a few kilometres from the reservoir. From the car park people would be transported to accommodation, activities or places of interest by steam train.



6 (a) Coal contains carbon and small amounts of sulfur. The steam train would cause environmental problems if coal were used as the fuel.

Explain why.

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(4 marks)

4.9.2.4 The carbon footprint and its reduction

Question 05 · continued

for mark

6 (b) The planners have stated that, as a result of using the steam train, there must be no overall increase of carbon dioxide added to the atmosphere. The steam train would be considered as 'carbon neutral' if wood, from the surrounding forest, were used as the fuel.

Suggest why.

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(3 marks)

7

Turn over for the next question

4.9.2.4 The carbon footprint and its reduction

Question 06

November 2008 | CHY1BP | Original Q6 | Legacy

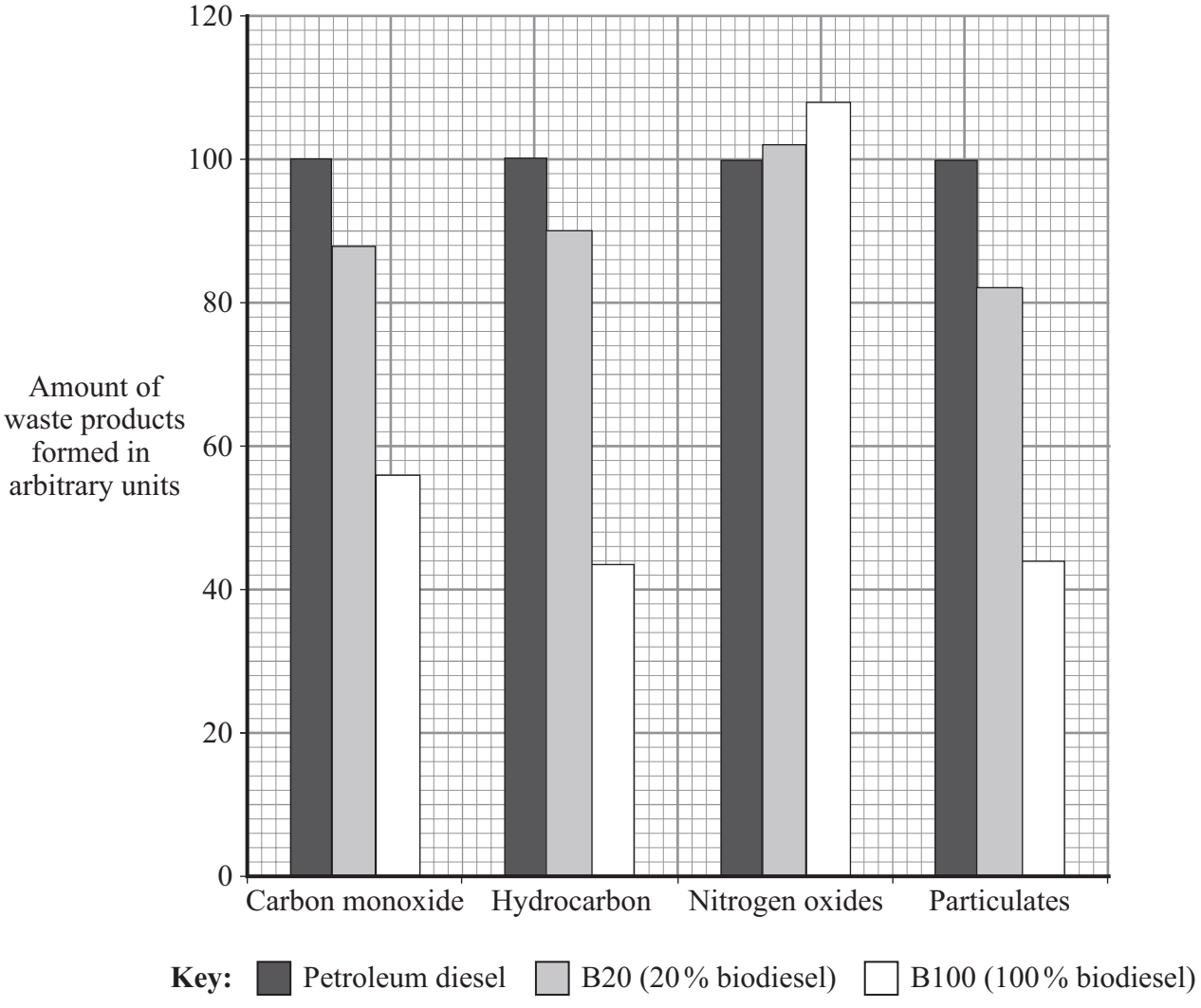
QUESTION SIX

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.



4.9.2.4 The carbon footprint and its reduction

Question 06 · 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.

4.9.2.4 The carbon footprint and its reduction

Question 07

June 2009 | CHY1BP | Original Q3 | Legacy

QUESTION THREE

This question is about vegetable oils.

3A When food is cooked, it is heated up and chemical changes take place in the food. Food that is cooked in vegetable oil (fried) is completely different from food cooked in water (boiled). Food cooked in oil reaches a much higher temperature than food cooked in water.

This is because . . .

1 water has a higher melting point than vegetable oil.

2 vegetable oil has a higher melting point than water.

3 water has a higher boiling point than vegetable oil.

4 vegetable oil has a higher boiling point than water.

3B Many vegetable oils contain unsaturated compounds.

This means that . . .

1 they do **not** dissolve in water.

2 they contain double carbon carbon bonds.

3 they react with an emulsifier.

4 they are hydrocarbons.

3C The amount of unsaturation in a vegetable oil is found by measuring . . .

1 how much steam it reacts with.

2 how much hydrogen it reacts with.

3 how much iodine it reacts with.

4 how much nickel it reacts with.

4.9.2.4 The carbon footprint and its reduction

Question 07 · continued

3D Biodiesel is a fuel made from vegetable oils.

Biodiesel is almost ‘carbon neutral’.

This is because . . .

1 it is a renewable energy source.

2 it will never run out.

3 carbon dioxide is absorbed by the plants from which vegetable oils are obtained.

4 the carbon dioxide produced when it burns is not acidic.

Turn over for the next question

4.9.2.4 The carbon footprint and its reduction

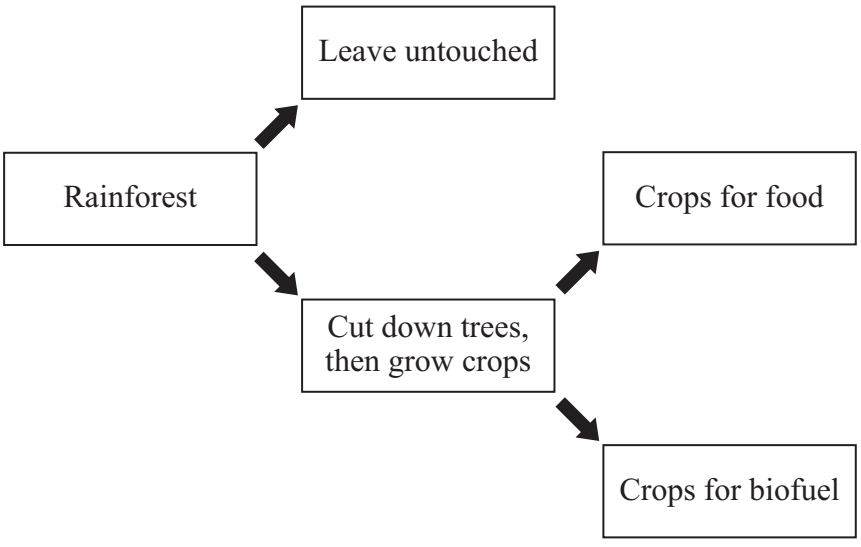
Question 08

June 2009 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

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

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



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

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

2 They are a renewable source of energy.

3 Their use is always sustained.

4 No greenhouse gases are produced.

4.9.2.4 The carbon footprint and its reduction

Question 08 · continued June 2009 | CHY1BP | Original Q7 | Legacy

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

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

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

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

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

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

The purpose of this process is to . . .

1 remove single carbon carbon bonds in the oil.

2 add double carbon carbon bonds to the oil.

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

4 make the chemicals in the oil detectable with bromine.

4.9.2.4 The carbon footprint and its reduction

Question 09

3 Many human activities result in carbon dioxide emissions.
Our carbon footprint is a measure of how much carbon dioxide we each cause to be produced.

3 (a) Why should we be concerned about our carbon footprint?

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(1 mark)

3 (b) Most power stations in the UK burn coal.
Coal was formed from tree-like plants over millions of years.

Suggest why burning wood instead of coal would help to reduce our carbon footprint.

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(3 marks)

4

4.9.2.4 The carbon footprint and its reduction

Question 10

June 2010 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

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

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

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

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

It is because . . .

1 ethanol is not a fossil fuel.

2 crops take in carbon dioxide as they grow.

3 fermentation uses very little energy.

4 when ethanol burns it does not produce carbon dioxide.

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

Which of the following is a correct statement?

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

2 Both food and fuel provide a lot of energy.

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

4 The debate is only about economics.

4.9.2.4 The carbon footprint and its reduction

Question 10 · continued

7C The claims on the website could be criticised.

Which is a valid criticism?

1 The use of biofuels increases global warming.

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

3 Ethanol can be made from maize.

4 Ethanol production can be from crops or from ethene.

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

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

4.9.2.4 The carbon footprint and its reduction

Question 11

March 2011 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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

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

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

The main reason for this is that . . .

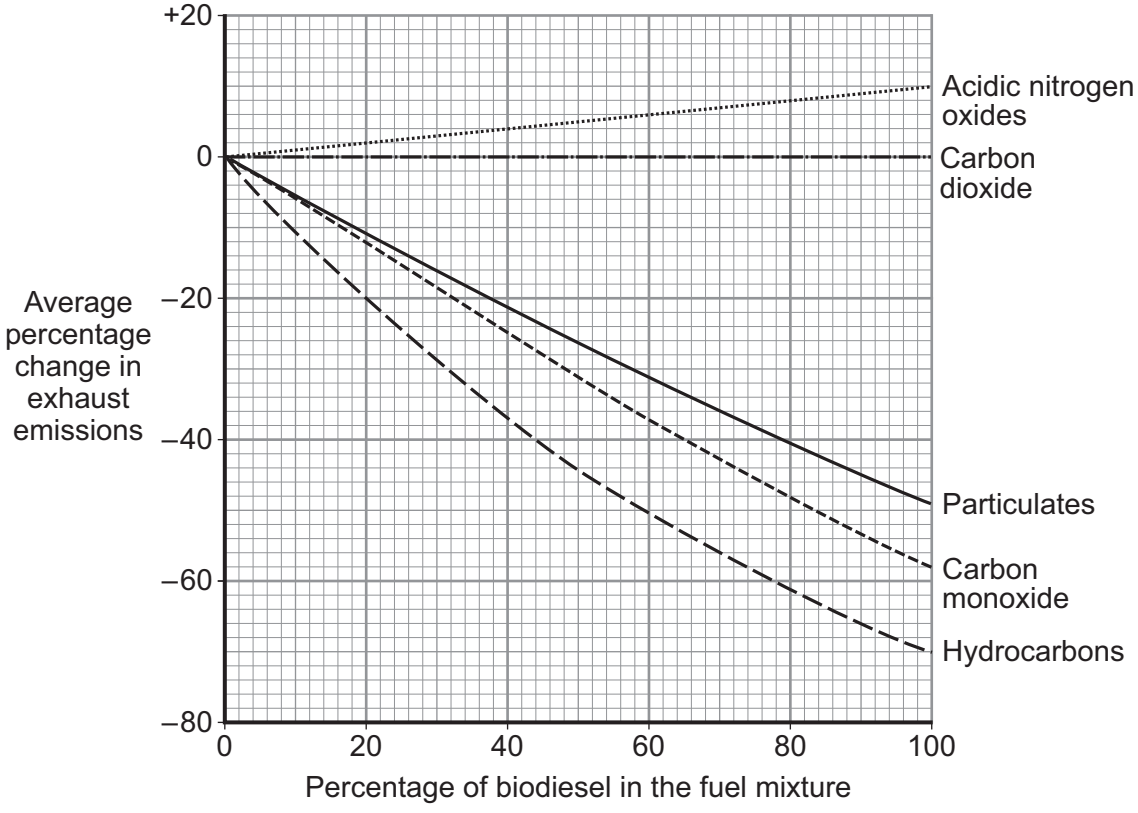
1 unused food crops are being wasted in some developing countries.

2 large, new oilfields have been discovered in Europe.

3 crude oil is a non-renewable energy source.

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

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



4.9.2.4 The carbon footprint and its reduction

Question 11 · continued

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

What is the basis for this argument?

1 Biodiesel produces less carbon dioxide when it burns.

2 Plants take up carbon dioxide as they grow.

3 Biodiesel is not a carbon compound.

4 Plants release carbon dioxide in respiration.

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

1 reduce nitrogen oxides by about 5 %.

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

3 reduce hydrocarbons by about 45 %.

4 reduce carbon dioxide by about 5 %.

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

1 it is non-biodegradable.

2 it could increase the amount of acid rain.

3 it is non-renewable.

4 it could increase global dimming.

4.9.2.4 The carbon footprint and its reduction

Question 12

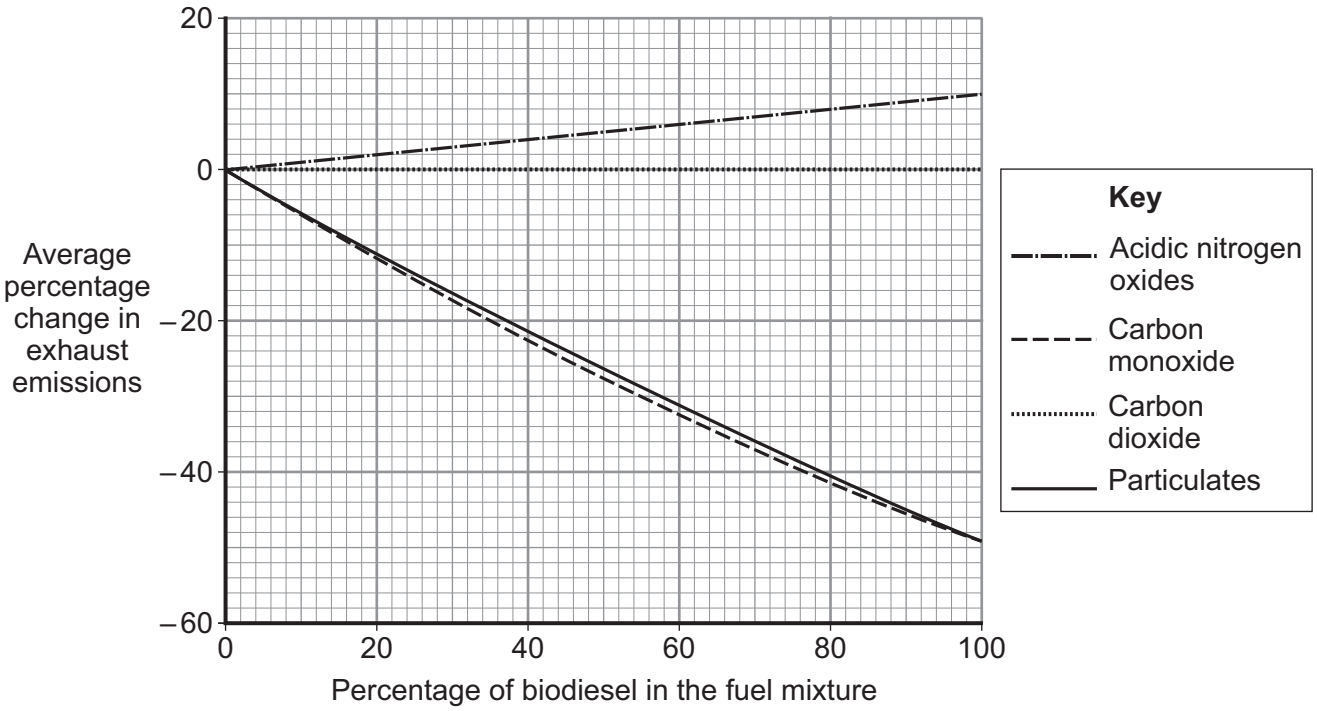
June 2011 | CHY1H | Original Q6 | Legacy

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.



4.9.2.4 The carbon footprint and its reduction

Question 12 · 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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4.9.2.4 The carbon footprint and its reduction

Question 13

November 2011 | CHY1AP | Original Q5 | Legacy

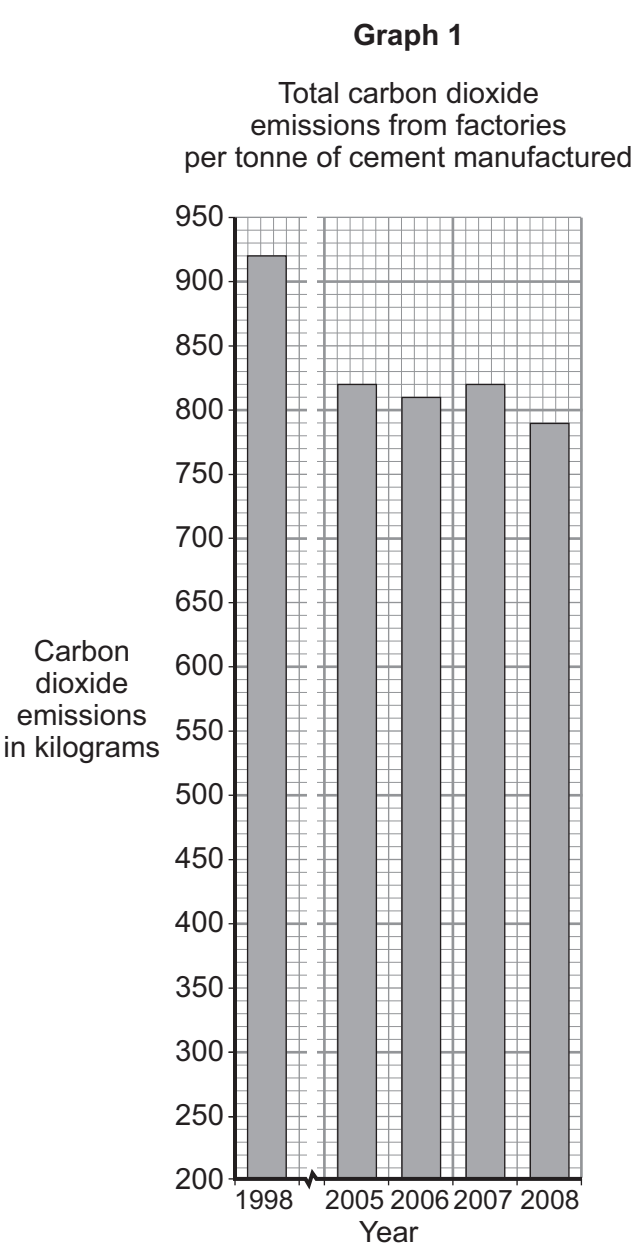
QUESTION FIVE

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

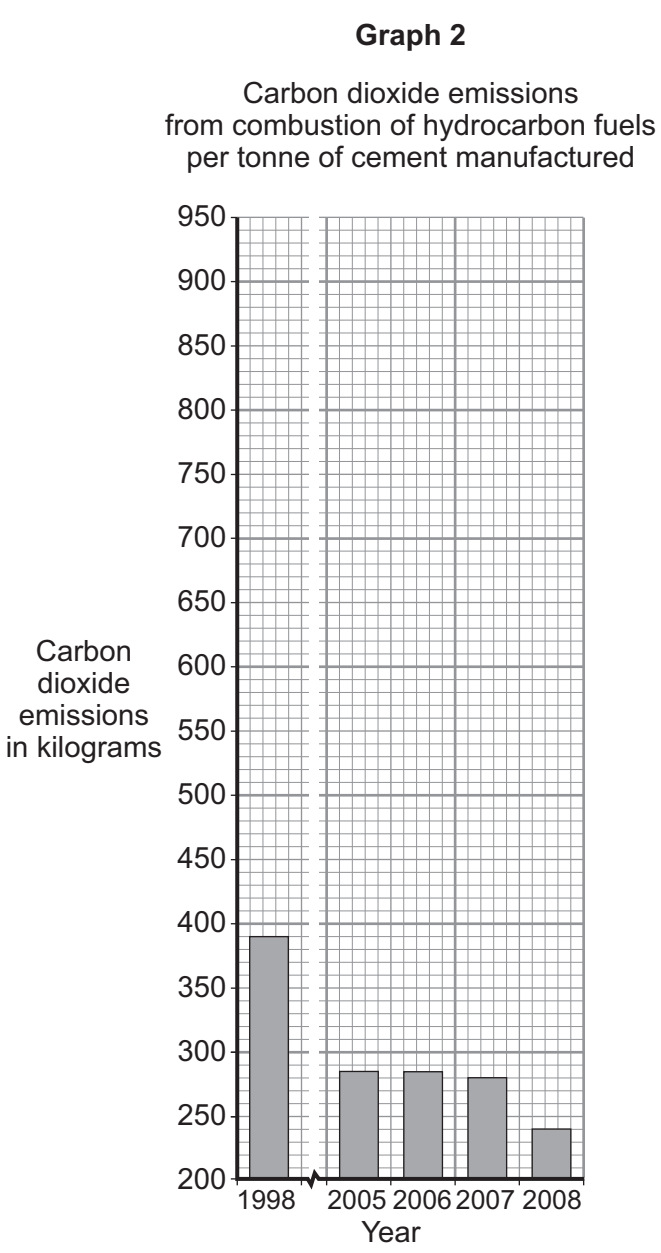
The cement industry needs to reduce carbon dioxide emissions.

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

Graph 1



Graph 2



4.9.2.4 The carbon footprint and its reduction

Question 13 · continued

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

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

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

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

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

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

1 16.2 %

2 38.5 %

3 61.5 %

4 84.4 %

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

1 0.23

2 0.35

3 0.61

4 0.85

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

1 hydrocarbons.

2 limestone.

3 quicklime.

4 slaked lime.

4.9.2.4 The carbon footprint and its reduction

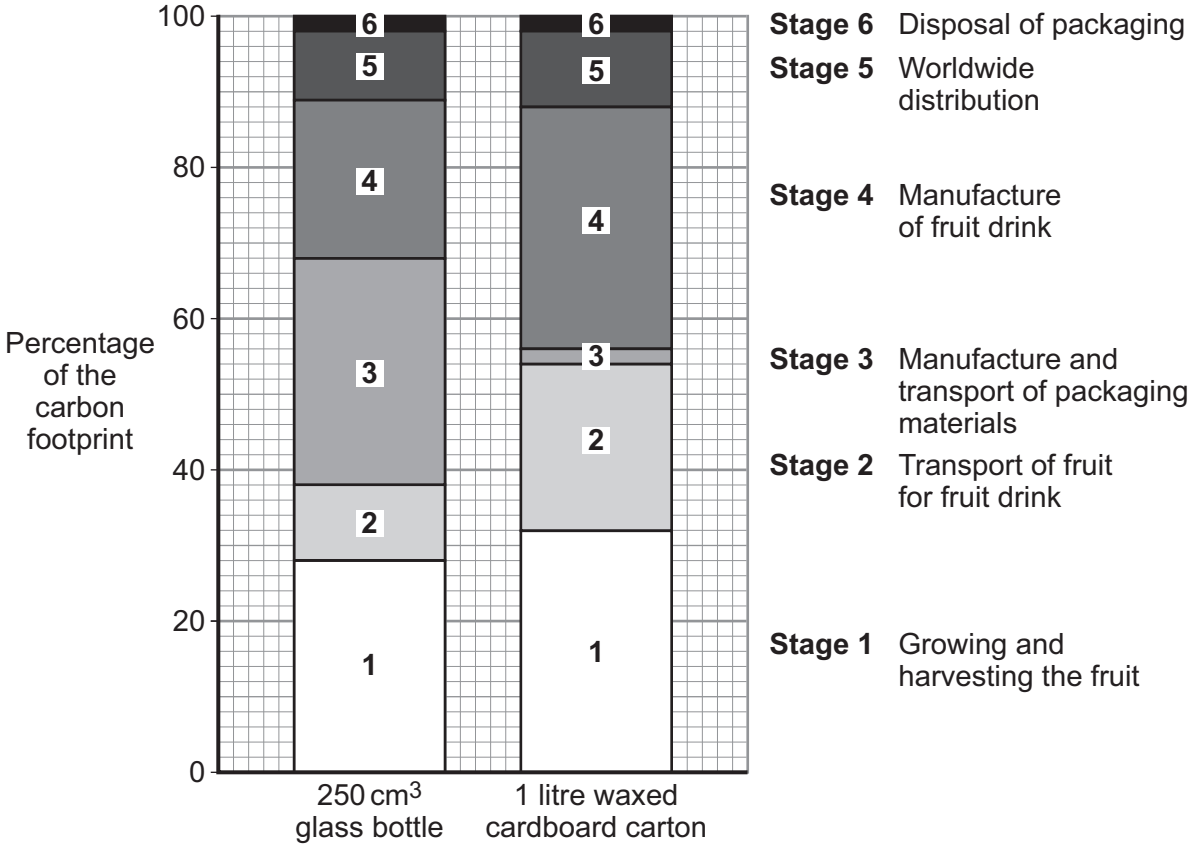
Question 14

November 2011 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

The carbon footprint of a food product is the total amount of carbon dioxide that is produced in its preparation, distribution and disposal.

The bar chart shows the percentage (%) of the carbon footprint for each stage of the overall process for a natural fruit drink. The fruit drink is packaged either in a 250 cm^3 glass bottle or in a 1 litre waxed cardboard carton.



6A Most of the carbon dioxide produced at **Stage 5** will be . . .

1 by electric trolleys at the supermarket storage depot.

2 by lorries delivering bottles and cartons of the fruit drink.

3 by refrigerators at the supermarket storage depot.

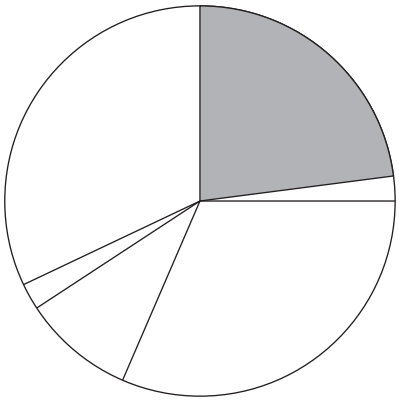
4 by the large workforce at the distribution centre.

4.9.2.4 The carbon footprint and its reduction

Question 14 · continued

6B Which stage on the bar chart for a 1 litre carton corresponds to the shaded area on the pie chart?

Percentage (%) of carbon footprint for a 1 litre carton of natural fruit drink



1 **Stage 1**

2 **Stage 2**

3 **Stage 3**

4 **Stage 4**

6C One reason why, at **Stage 2**, the carbon footprint percentage is much smaller for a 250 cm^3 glass bottle than for a 1 litre carton is that . . .

1 a bottle contains a larger volume of liquid than a carton.

2 a bottle is heavier than a carton.

3 more fruit is needed to make the juice in a carton than in a bottle.

4 the fruit for the juice in the bottles is transported further than that for the juice in the cartons.

6D There is a large difference in the percentages at **Stage 3**.

One possible reason for this is that . . .

1 cartons are made of renewable materials.

2 making glass bottles needs a lot of energy.

3 cartons need more protective packaging than bottles.

4 glass bottles can be recycled but cartons cannot.

4.9.2.4 The carbon footprint and its reduction

Question 15

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)

4.9.2.4 The carbon footprint and its reduction

Question 15 · 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