AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.2.2

# Ways of reducing the use of resources

## Past-paper questions

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **46** |
| 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.

**4.10.2.2 Ways of reducing the use of resources**

**Question 01**

January 2007 | CHY1H | Original Q3 | Legacy

**3** Many everyday items are made from iron.

(a) Haematite is an *ore* of iron. Haematite contains iron oxide, $Fe_2O_3$.

(i) What is the meaning of the term *ore*?

.....

.....

*(1 mark)*

(ii) Iron can be produced by reacting iron oxide with carbon in a blast furnace.

What type of reaction produces the iron?

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*(1 mark)*

(iii) The word equation for this reaction is:

iron oxide + carbon → iron + carbon dioxide

Complete and balance the symbol equation for this reaction.

.....$Fe_2O_3$ + .....C → ..... + .....

*(2 marks)*

**Question 3 continues on the next page**

**4.10.2.2 Ways of reducing the use of resources**

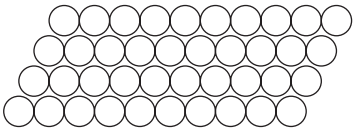
**Question 01 · continued**



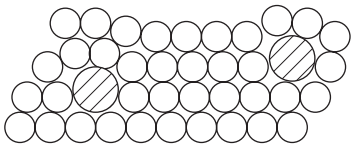
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(b) Pure iron is relatively soft and not very strong.

The iron from the blast furnace is very hard and brittle. It contains about 4 % carbon and is used as cast iron.



Pure iron



Cast iron

Explain the differences in the properties of pure iron and cast iron by referring to the diagrams.

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*(3 marks)*

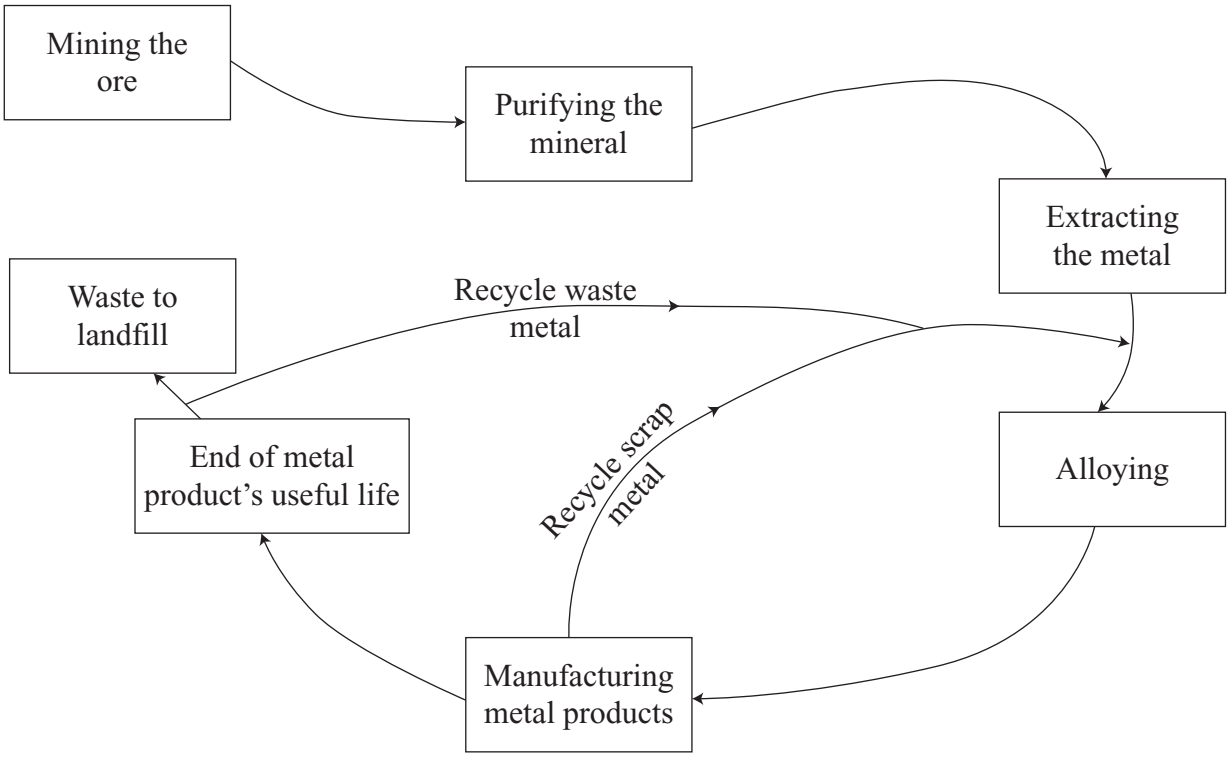
**4.10.2.2 Ways of reducing the use of resources**

**Question 01 · continued**



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(c) The diagram shows the way in which iron is extracted, used and recycled.




Explain why the recycling of iron is necessary for sustainable development.

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*(3 marks)*

10

**4.10.2.2 Ways of reducing the use of resources**

**Question 02**

March 2007 | CHY1A | Original Q4 | Legacy

## QUESTION FOUR

Aluminium can be obtained by extracting it from aluminium ore, and by recycling used objects made from aluminium.

**4A** One disadvantage of extracting aluminium from aluminium ore is that . . .

**1** aluminium ore contains very small amounts of aluminium.

**2** aluminium ore is a limited resource.

**3** the aluminium obtained corrodes easily.

**4** the aluminium obtained has a high density.

**4B** It is better to recycle aluminium than to extract it from aluminium ore because . . .

**1** aluminium ore contains few impurities.

**2** aluminium ore produces low grade aluminium.

**3** digging up aluminium ore destroys the local environment.

**4** recycling produces ‘smart’ aluminium alloys.

**4C** It makes economic sense to recycle aluminium because extracting it from its ore . . .

**1** is a cheap process.

**2** takes too long.

**3** employs more people.

**4** uses large amounts of energy.

**4D** If aluminium cans are not recycled, they can affect the environment by . . .

**1** causing acid rain.

**2** filling up landfill rubbish tips.

**3** producing poisonous gases.

**4** rapidly corroding in lakes and rivers.

**4.10.2.2 Ways of reducing the use of resources**

**Question 03**

June 2007 | CHY1A | Original Q7 | Legacy

## QUESTION SEVEN

In the United Kingdom, about 40 % of all the aluminium used is recycled.
To produce aluminium from recycling uses just 5 % of the energy needed for extraction of the metal from its ores.

Recycling 1 kilogram of aluminium saves about:

- 8 kilograms of aluminium ore
- 4 kilograms of raw materials used in extracting the metal from its ores
- 14 kilowatt-hours of electricity.

**7A** To make metal recycling worthwhile, there must be a steady supply of scrap and the necessary technology to separate the required metal from scrap materials.

Another factor that may increase the amount of metal that is recycled is . . .

**1** that new deposits of the ore are discovered.

**2** that the price of the metal falls.

**3** that the recycling process is much cheaper than extraction from the ore.

**4** that the cost of raw materials used in extraction falls.

**7B** One benefit of more recycling is that . . .

**1** the aluminium metal produced is of higher quality.

**2** there will be less destruction of the landscape by mining.

**3** recycled aluminium is a softer metal.

**4** landfill sites can be redeveloped more quickly.

**7C** Reducing the amount of energy required to produce the aluminium could also . . .

**1** increase the amount of gases which cause acid rain.

**2** increase the cost of producing the metal.

**3** reduce carbon dioxide emissions.

**4** increase the number of stages needed in the process.

**4.10.2.2 Ways of reducing the use of resources**



**7D** How many kilowatt-hours of electricity are needed to produce 1 kg of aluminium from its ore?

**1** 0.7 kWh

**2** 14.0 kWh

**3** 14.7 kWh

**4** 28.0 kWh

**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

**Question 04**

June 2007 | CHY1H | Original Q2 | Legacy

**2** Copper is a widely used metal. The main ore of copper contains copper sulfide. Copper can be extracted from copper sulfide in a three stage process.

(a) In the first stage of extraction the copper sulfide is heated in air.

(i) Balance the symbol equation for the reaction.

$$Cu_2S + .....O_2 \rightarrow .....CuO + SO_2$$

*(1 mark)*

(ii) Explain why there would be an environmental problem if the gas from this reaction were allowed to escape into the atmosphere.

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*(2 marks)*

(b) In the second stage copper oxide, CuO, is reduced using carbon.

Describe and explain what happens during this reaction.

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*(2 marks)*

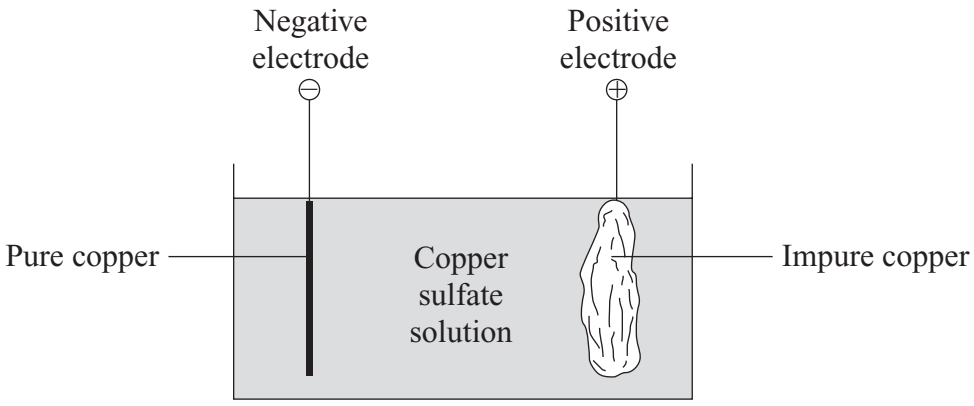
**4.10.2.2 Ways of reducing the use of resources**

**Question 04 · continued**



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(c) During the third stage the copper can be purified as shown in the diagram.




(i) What is the name of the type of process used for this purification?

.....

*(1 mark)*

(ii) Give **one** use of purified copper.

.....

*(1 mark)*

(d) Copper-rich ores are running out.

New ways of extracting copper from low grade ores are being researched.

Recycling of copper may be better than extracting copper from its ores.

Explain why.

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*(3 marks)*

10

**4.10.2.2 Ways of reducing the use of resources**

**Question 05**

November 2007 | CHY1A | Original Q7 | Legacy

## QUESTION SEVEN

Aluminium (7.85%) and iron (4.12%) are the two most abundant metals in the Earth's crust.

Iron is extracted from iron oxide in a blast furnace.

The equations show two reactions that occur in the furnace.

$$FeO + C \rightarrow Fe + CO$$

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

**7A** Which substances are reduced and which substances cause the reduction in these two reactions?

| | Substances reduced | Substances causing the reduction |
|---|---|---|
| **1** | iron | carbon and carbon monoxide |
| **2** | iron oxides | carbon monoxide and carbon dioxide |
| **3** | carbon and carbon dioxide | iron oxides |
| **4** | iron oxides | carbon and carbon monoxide |

**7B** Aluminium **cannot** be extracted from its ores in a blast furnace because . . .

**1** it is more reactive than iron.

**2** too many stages are needed in the process.

**3** too much energy is required.

**4** it is more reactive than carbon.

**4.10.2.2 Ways of reducing the use of resources**

**Question 05 · continued** November 2007 | CHY1A | Original Q7 | Legacy

**7C** Which two of the following statements could explain why aluminium is preferred to iron for making cans for drinks?

**W** Aluminium has a lower density than iron.

**X** Aluminium is a better conductor than iron.

**Y** Aluminium corrodes less easily than iron.

**Z** Aluminium is not as strong as iron.

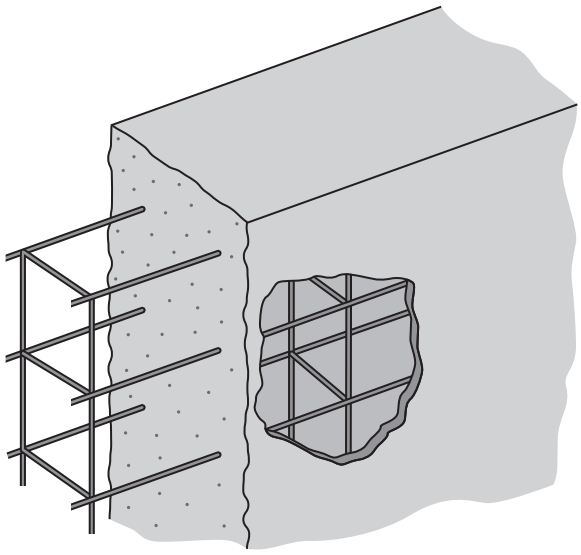
**1** **W** and **X**

**2** **W** and **Y**

**3** **X** and **Y**

**4** **Y** and **Z**

**7D** The diagram shows some reinforced concrete.



Which one of the following is the best material to use to reinforce concrete?

**1** cast iron

**2** low carbon steel

**3** high carbon steel

**4** stainless steel

**4.10.2.2 Ways of reducing the use of resources**

**Question 06**

November 2007 | CHY1A | Original Q9 | Legacy

## QUESTION NINE

In the 1980s, environmentalist Paul Ehrlich predicted that there would be a massive worldwide shortage of various natural resources. At the same time, economist Julian Simon said that natural resources were effectively infinite.

In 1988, the known resources of tin were estimated to last for 18 years. In 2006, there is still not a serious shortage of tin.

**9A** Which of the following is **not** a reason why Ehrlich's prediction of massive shortages has been proved wrong?

**1** Existing materials have been recycled.

**2** Existing resources have been used more efficiently.

**3** More material has been imported.

**4** New sources have been discovered.

**9B** The Coca-Cola company is a commercial organisation. Coke cans are now made from 80% less aluminium than 40 years ago.

What is the most probable reason for this?

**1** The company sells more Coca-Cola than 40 years ago.

**2** The price of aluminium has decreased.

**3** There is a serious shortage of aluminium.

**4** Thinner cans cut costs and increase profits.

**9C** The availability of metals has not decreased as fast as predicted 20 years ago. One reason for this is a reduction in the use of some metals.

Which of the following has **not** contributed to a reduction in the overall use of metals?

**1** Environmental concerns have caused more people to use energy saving lamps which has reduced the demand for tungsten.

**2** To reduce costs, 'tin' cans are now coated with plastic instead of tin.

**3** To reduce corrosion, aluminium has replaced iron in some of the body parts of cars.

**4** New technology has resulted in the use of more fibre optic cables and a reduced use of copper wire.

**4.10.2.2 Ways of reducing the use of resources**

**Question 06 · continued**



**9D** The main source of tin is the ore tin sulfide. This is used to make tin oxide. The tin oxide is then heated with carbon to obtain the metal.

Why does it normally take less energy to obtain tin from scrap tin than to extract the tin from its ore?

**1** There are more impurities in scrap tin than in the tin ore.

**2** More waste materials are left from scrap tin than from tin ore.

**3** Scrap tin does not need to be reduced to tin.

**4** Tin sulfide contains the element sulfur.

**END OF TEST**

**4.10.2.2 Ways of reducing the use of resources**

**Question 07**

November 2007 | CHY1B | Original Q3 | Legacy

## QUESTION THREE

Plastic waste in the United Kingdom has reached 3 million tonnes per year.
About 56 % of this waste is from packaging.
60 % of the litter on United Kingdom beaches is plastic.
Under European law, at least 55 % of packaging must be recycled by 2008.

Most plastic waste does not break down at all.
Three improved types of plastic used for bags and packaging are:

- degradable – breaks down over a long period of time, but only into smaller pieces
- biodegradable – undergoes decomposition by microorganisms; produces some solid waste which may be toxic
- compostable – biodegrades and disintegrates in a compost-making system at home; produces no toxic waste

**3A** One reason that plastics are often used for bags and packaging is that they are cheap to produce.

Which of these properties of plastics is the **least** important when they are used for making waste-bin liners?

**1** lightweight

**2** resist wear and tear

**3** resist chemicals and water

**4** transparent

**3B** Which of these is **not** an advantage of recycling plastics?

**1** conservation of non-renewable fuels

**2** reduced energy consumption

**3** less waste to landfill

**4** reduced use of plastic bags

**4.10.2.2 Ways of reducing the use of resources**

**Question 07 · continued** November 2007 | CHY1B | Original Q3 | Legacy

**3C** A supermarket chain has introduced compostable food containers. Which of the following may **not** happen because of the increased use of compost-making systems at home?

**1** It will save council transport and labour costs.

**2** It will save space in landfill sites.

**3** It will reduce costs to supermarkets.

**4** It will help to conserve non-renewable fuels.

**3D** Some supermarkets are using more environmentally-friendly packaging.

The most likely commercial reason for this is that the supermarkets are concerned about . . .

**1** decreasing the amount of litter.

**2** the damaging effects of acid rain.

**3** the increasing cost of plastics.

**4** attracting more customers.

**4.10.2.2 Ways of reducing the use of resources**

**Question 08**

January 2008 | CHY1H | Original Q2 | Legacy

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

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

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

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*(1 mark)*

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

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*(2 marks)*

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

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

..... → ..... + .....

*(2 marks)*

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

.....

*(1 mark)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 08 · continued**



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

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

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*(1 mark)*

7

**Turn over for the next question**

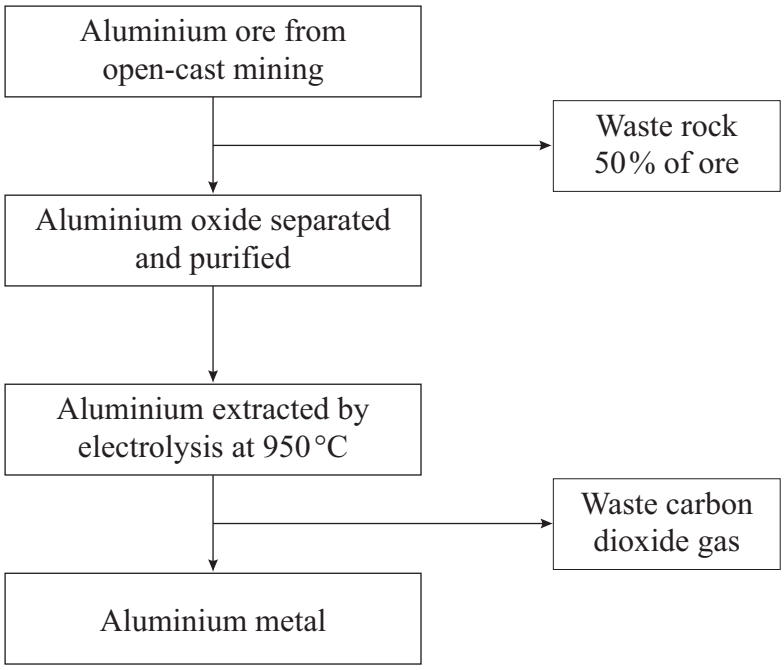
**4.10.2.2 Ways of reducing the use of resources**

**Question 09**

January 2008 | CHY1H | Original Q4 | Legacy

**4** Aluminium has many uses because of its low density, good electrical conductivity, flexibility and resistance to corrosion.

The main steps in the extraction of aluminium are shown in the flow chart.




(a) Use the information in the flow chart to suggest the benefits of recycling aluminium.

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*(3 marks)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 09 · continued**



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(b) Pure aluminium is rarely used for the construction of large objects. Small amounts of other metals are usually mixed with aluminium.

Explain why.

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*(2 marks)*

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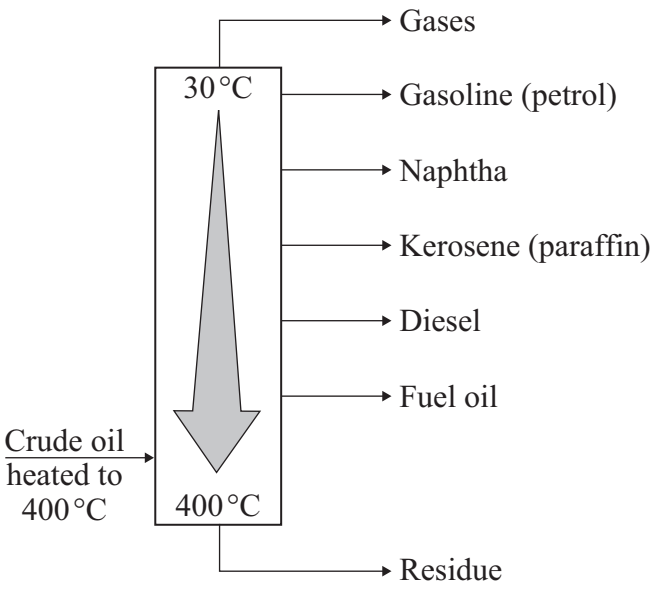
**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

**Question 10**

January 2008 | CHY1H | Original Q6 | Legacy

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




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

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*(2 marks)*

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

For example:

decane → hexane + ethene

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

(i) Balance the symbol equation given above.

*(1 mark)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 10 · continued**



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(ii) Describe how cracking is carried out.

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*(2 marks)*

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

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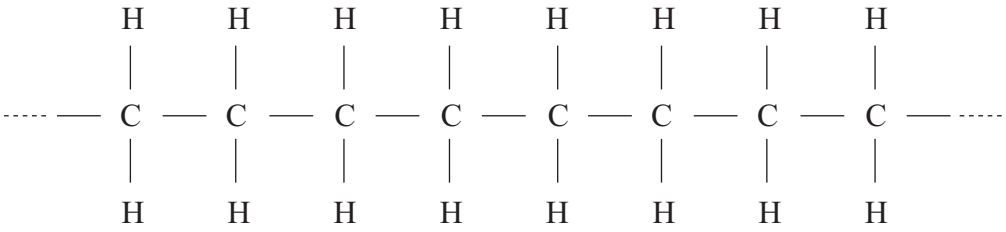
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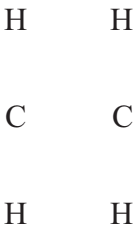
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*(2 marks)*

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



Complete the diagram to show the bonds in ethene.



*(1 mark)*

**Question 6 continues on the next page**

**4.10.2.2 Ways of reducing the use of resources**

**Question 10 · continued**



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(d) Read the following information.

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

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

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

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

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

**4.10.2.2 Ways of reducing the use of resources**

**Question 10 · continued**



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

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

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

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*(4 marks)*

12

**4.10.2.2 Ways of reducing the use of resources**

**Question 11**

June 2008 | CHY1AP | Original Q3 | Legacy

## QUESTION THREE

- Iron is obtained by reducing its oxide ore with carbon.
- Aluminium **cannot** be obtained by reducing its oxide ore with carbon.
- Gold occurs as the metal itself.

**3A** From the information above, which row in the table shows the order of reactivity of the four elements?

| | most reactive → | | | least reactive |
|---|---|---|---|---|
| **1** | aluminium | carbon | iron | gold |
| **2** | iron | aluminium | carbon | gold |
| **3** | iron | aluminium | gold | carbon |
| **4** | aluminium | iron | gold | carbon |

**3B** Iron obtained directly from the blast furnace was used to build the Iron Bridge in Shropshire.

This bridge is unsuitable for use by modern lorries because . . .

**1** it **cannot** be stopped from rusting.

**2** it will easily bend out of shape.

**3** it is too heavy to support its own weight.

**4** it is too brittle and so it will break.

**4.10.2.2 Ways of reducing the use of resources**

**Question 11 · continued** June 2008 | CHY1AP | Original Q3 | Legacy

- Aluminium waste of high purity can be recycled.
- Any iron and other impurities are removed.
- The aluminium is then melted and processed in the same way as aluminium that has been extracted from its ore.
- Recycling aluminium in this way creates only 5% of the carbon dioxide produced by extracting aluminium from its ore.

**3C** Which of the following benefits an aluminium recycling company financially?

**1** a fall in the price of aluminium

**2** the high melting point of aluminium

**3** the high purity of the aluminium waste arriving at the recycling plant

**4** the metal can be purified by electrolysis

**3D** An environmental disadvantage of recycling aluminium is that . . .

**1** the aluminium waste has to be transported for recycling.

**2** land fill sites would **not** be filled so quickly.

**3** the process creates only 5% of the carbon dioxide produced by extracting aluminium from its ore.

**4** the price of aluminium will fall.

**4.10.2.2 Ways of reducing the use of resources**

**Question 12**

June 2008 | CHY1AP | Original Q7 | Legacy

**QUESTION SEVEN**

Copper is found in the Earth's crust, both as the metal itself and as a variety of compounds.

**7A** This suggests that copper . . .

**1** is a very reactive metal.

**2** reacts with only a small number of other elements.

**3** is **not** very reactive but more reactive than gold.

**4** reacts rapidly with oxygen and sulfur at low temperatures.

A naturally occurring compound of copper is malachite, $CuCO_3.Cu(OH)_2$

**7B** Which row in the table shows the number of elements and the number of atoms of oxygen in the formula for malachite?

| | Elements | Atoms of oxygen |
|---|---|---|
| **1** | 4 | 5 |
| **2** | 4 | 4 |
| **3** | 5 | 3 |
| **4** | 6 | 2 |

Copper is extracted from high grade ores by first smelting the mined ore, then purification by electrolysis.

Copper salts can be extracted from some low grade ores by leaching. Sulfuric acid runs through the ore to produce a solution of copper sulfate. The copper can then be obtained from the solution by electrolysis.

**7C** An advantage of leaching over smelting is that . . .

**1** leaching produces large amounts of copper sulfate.

**2** there is no chance of environmental damage during leaching.

**3** leaching does **not** require large quantities of energy.

**4** there are no waste products left after leaching.

**4.10.2.2 Ways of reducing the use of resources**

**Question 12 · continued** June 2008 | CHY1AP | Original Q7 | Legacy

**7D** There is plenty of scrap copper and copper alloys that could be recycled.

One factor that could bring an increase in the amount that is recycled would be . . .

**1** the opening of new large mines with high grade ores.

**2** a reduction in the price of copper on the world markets.

**3** that recycling became much more economic than extraction from the ore.

**4** other metals being used instead of copper.

**Turn over for the next question**

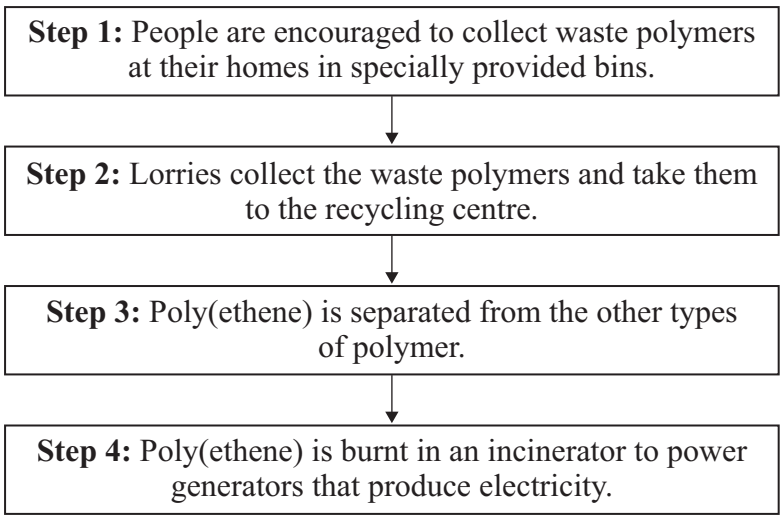
**4.10.2.2 Ways of reducing the use of resources**

**Question 13**

June 2008 | CHY1BP | Original Q3 | Legacy

## QUESTION THREE

The flow chart shows how the waste poly(ethene) from our homes can be used.




**3A** One problem associated with **Step 1** is that . . .

**1** some people do **not** put their waste polymers in the special bins.

**2** people prefer to burn their waste polymers.

**3** poly(ethene) is toxic.

**4** waste polymers rot and begin to smell.

**3B** One problem associated with **Step 2** is that . . .

**1** burning diesel fuel in lorries can increase global warming.

**2** people do **not** know where the recycling centres are.

**3** the bins of waste polymers are very heavy.

**4** the lorries are hard to recognise.

**4.10.2.2 Ways of reducing the use of resources**

**Question 13 · continued**



**3C** One problem associated with **Step 3** is that . . .

**1** all polymers are the same colour.

**2** polymers **cannot** be melted down.

**3** polymers are magnetic.

**4** separating polymers costs money.

**3D** One reason why all waste polymers are **not** burned in **Step 4** is that . . .

**1** burning polymers can produce toxic gases.

**2** polymers are poor conductors of electricity.

**3** some polymers melt before burning.

**4** burning polymers produces too much heat.

**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

**Question 14**

June 2008 | CHY1H | Original Q1 | Legacy

**1** Limestone is mainly calcium carbonate.

**1** (a) Quicklime is produced by heating limestone.

**1** (a) (i) Complete the word equation for this reaction by writing the chemical name of the solid and the gas produced.

calcium carbonate → ..... + ..... .

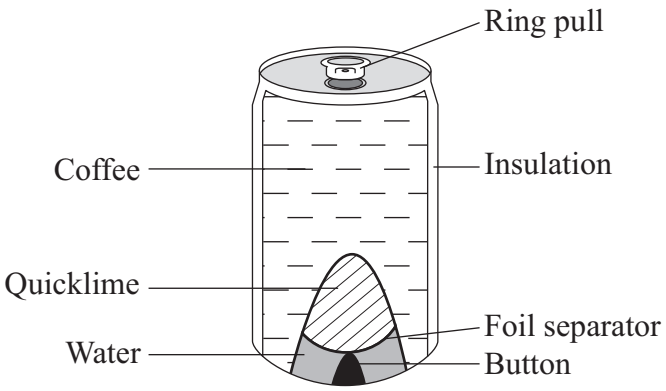
*(2 marks)*

**1** (a) (ii) What is the name for this type of chemical reaction?

.....

*(1 mark)*

**1** (b) Quicklime is used in self-heating cans.
The diagram shows a self-heating can designed to raise the temperature of coffee to 60 °C.




The button on the base of the can is pushed. The foil separator breaks, allowing water to mix with the quicklime. After about 3 minutes, the can is opened by the ring pull. Insulating materials are used inside the walls of the can to prevent either the lips or the fingers from being burned.

**1** (b) (i) Explain why the coffee becomes hot.

.....

.....

.....

.....

*(2 marks)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 14 · continued**



*for mark*

**1** (b) (ii) Suggest **two** reasons why it is **not** possible to re-use this self-heating can.

1 .....

.....

2 .....

.....

*(2 marks)*

7

**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

**Question 15**

November 2008 | CHY1AP | Original Q4 | Legacy

## QUESTION FOUR

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

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

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

One reason is that the quarries . . .

**1** attract large numbers of tourists to visit the area.

**2** make unsightly scars on the landscape.

**3** are unnecessary because there are few uses for limestone.

**4** create a dangerous habitat for wildlife.

**4B** Some people support the development of these quarries.

One reason is that the working quarries . . .

**1** are always placed where the public cannot see them.

**2** conserve resources.

**3** provide employment for people who live in the area.

**4** provide an area for leisure activities.

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

This is done . . .

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

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

**3** to minimise the energy costs.

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

**4.10.2.2 Ways of reducing the use of resources**

**Question 15 · continued**



**4D** Some iron is obtained by recycling scrap iron.

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

**1** Scrap iron is an alloy.

**2** Scrap iron contains the element sulfur.

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

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

**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

**Question 16**

November 2008 | CHY1AP | Original Q8 | Legacy

## QUESTION EIGHT

Most titanium is extracted from titanium oxide ore. The oxide is first converted to titanium chloride. The titanium chloride is then reacted with sodium as shown in the word equation.

$$\text{titanium chloride} + \text{sodium} \xrightarrow{500\,^{\circ}\text{C}} \text{titanium} + \text{sodium chloride}$$

**8A** Titanium metal is produced in this reaction because . . .

**1** titanium is more reactive than sodium.

**2** titanium chloride decomposes at 500 °C.

**3** sodium is more reactive than titanium.

**4** sodium chloride is a catalyst for this reaction.

**8B** This method of extracting titanium is expensive.

The amount of titanium that is recycled would probably be increased if . . .

**1** the cost of sodium were to fall.

**2** the cost of titanium were to fall.

**3** new high-grade deposits of titanium oxide were discovered.

**4** more uses for titanium were found.

**8C** Nitinol is a smart alloy made from titanium (55%) and nickel (45%).

Making 50 g of the alloy will require . . .

**1** 5 g of titanium and 45 g of nickel.

**2** 5 g of titanium and 22.5 g of nickel.

**3** 27.5 g of titanium and 22.5 g of nickel.

**4** 55 g of titanium and 45 g of nickel.

**4.10.2.2 Ways of reducing the use of resources**

**Question 16 · continued**



**8D** At room temperature (20 °C), nitinol can be stretched. If nitinol is then warmed, it contracts back to its original length.

Two possible uses of nitinol are in . . .

**1** dental braces and spectacle frames.

**2** dental braces and screwdrivers.

**3** screwdrivers and jewellery.

**4** jewellery and spectacle frames.

**Turn over for the next question**

**4.10.2.2 Ways of reducing the use of resources**

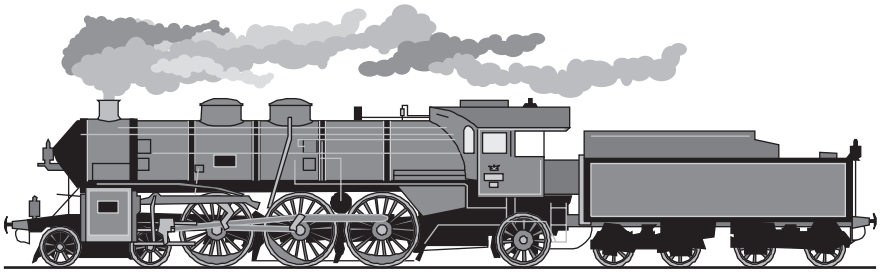
**Question 17**

June 2009 | CHY1AP | Original Q4 | Legacy

## QUESTION FOUR

Read the following newspaper extract.

### Copper shortage puts the brakes on Flying Scotsman renovation



A major overhaul of the steam locomotive Flying Scotsman has been delayed by more than a year because of the lack of copper for the engine's firebox.

Copper is at a record high price because of huge demand from China's rapidly growing economy. The price had been falling over the previous 30 years, which had discouraged exploration for new supplies.

Other users have been forced to switch to cheaper materials, with plumbers using plastic rather than copper pipes, and telecoms firms using fibre-optic cables rather than copper wire.

**4A** The firebox of a steam locomotive is where coal is burned to boil water.

Which of these properties is **not** important when using copper in the firebox of a steam locomotive?

**1** Copper is a good conductor of heat.

**2** Copper has a high melting point.

**3** Copper is a good conductor of electricity.

**4** Copper is easily hammered and bent into shape.

**4.10.2.2 Ways of reducing the use of resources**

**Question 17 · continued** June 2009 | CHY1AP | Original Q4 | Legacy

**4B** Which row in the table explains why copper was important to plumbers and telecoms firms?

| | Plumbers | Telecoms firms |
|---|---|---|
| **1** | High melting point | Good heat conductor |
| **2** | Good electrical conductor | High melting point |
| **3** | Resistant to corrosion | Good electrical conductor |
| **4** | High boiling point | Good electrical conductor |

**4C** Which of the following would make the copper shortage in China and other countries worse?

**1** recycling scrap copper rather than burying it in landfill sites

**2** developing alternative materials to do the same job as copper

**3** extraction of copper from low-grade ores

**4** forcing suppliers to reduce the price of copper

**4D** Why is it environmentally important to recycle copper rather than mine fresh copper ore?

**1** Copper ores are non-renewable, and a lot of energy is needed to extract copper from its ore.

**2** There are enormous reserves of copper ore which are not expected to run out for hundreds of years.

**3** Copper ores are cheap, and scrap copper is easy to dispose of in landfill sites.

**4** Copper recycling is difficult and uses more energy when compared with processing new ores.

**4.10.2.2 Ways of reducing the use of resources**

**Question 18**

June 2009 | CHY1H | Original Q4 | Legacy

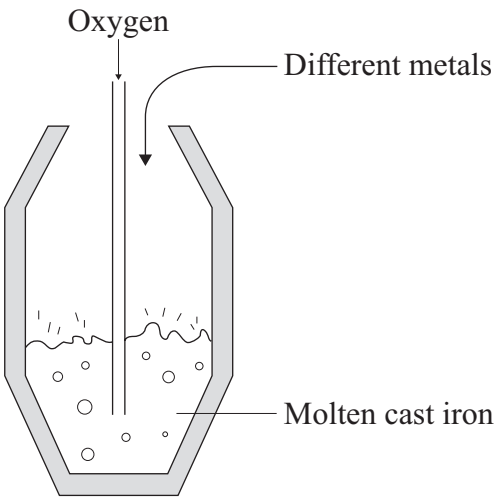
**4** The demand for iron and steel is high.

**4** (a) Iron that is extracted from its oxide by carbon reduction in a blast furnace is called cast iron. Cast iron contains about 4% carbon. This carbon makes cast iron very brittle.

Carbon steels can be made by the following processes.

- Blowing oxygen into molten cast iron to remove most of the carbon.
- Adding a calculated amount of carbon.

Sometimes different metals may also be added to the molten carbon steels.




**4** (a) (i) Suggest how blowing oxygen into molten cast iron removes most of the carbon.

.....

.....

.....

.....

*(2 marks)*

**4** (a) (ii) Why are different metals sometimes added to molten carbon steels?

.....

.....

*(1 mark)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 18 · continued**



*for mark*

**4** (b) The percentage of iron and steel recycled in the UK has been increasing.

| Year | % iron and steel recycled |
|---|---|
| 1998 | 25 |
| 2000 | 35 |
| 2002 | 42 |
| 2004 | 46 |
| 2006 | 57 |

The UK government has set targets for the percentage of iron and steel to be recycled. In 2006 the target was exceeded.

Suggest **two** reasons why the UK government wants to encourage recycling of iron and steel.

1 .....

.....

2 .....

.....

*(2 marks)*

**5**

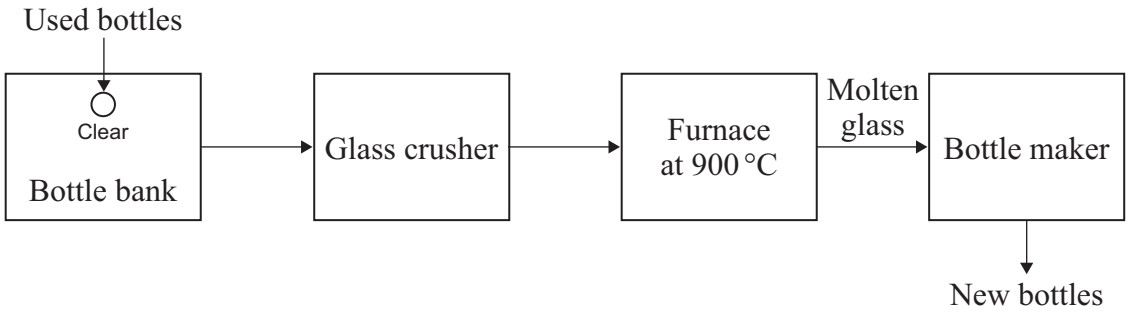
**4.10.2.2 Ways of reducing the use of resources**

**Question 19**

January 2010 | CHY1H | Original Q2 | Legacy

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

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




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

.....

.....

*(1 mark)*

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

Suggest **one** reason why.

.....

.....

*(1 mark)*

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

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

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

.....

.....

.....

.....

*(2 marks)*

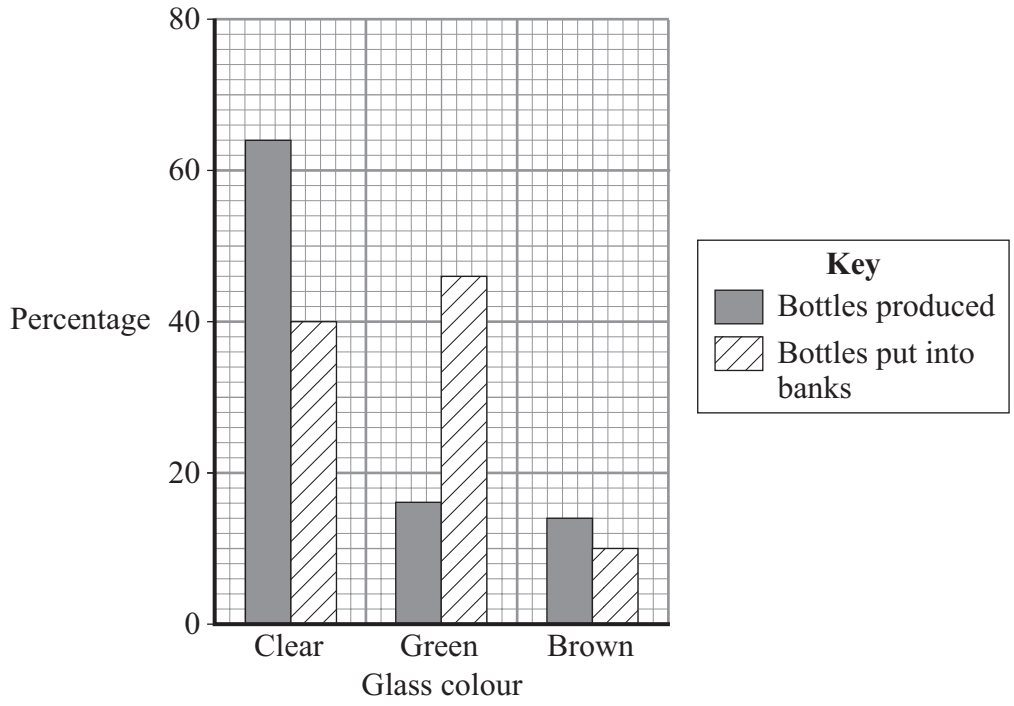
**4.10.2.2 Ways of reducing the use of resources**

**Question 19 · continued**



*for mark*

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




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

Percentage = ..... %

*(1 mark)*

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

.....

.....

*(1 mark)*

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

.....

.....

.....

.....

*(2 marks)*

8

**4.10.2.2 Ways of reducing the use of resources**

**Question 20**

March 2010 | CHY1BP | Original Q6 | Legacy

## QUESTION SIX

Recycling of plastic bottles increased between 1994 and 2005.

| Year | Tonnes of plastic bottles recycled |
|---|---|
| 1994 | 2 000 |
| 1995 | 4 000 |
| 1996 | 5 000 |
| 1997 | 6 000 |
| 1998 | 9 000 |
| 1999 | 10 000 |
| 2000 | 11 000 |
| 2001 | 13 000 |
| 2002 | 18 000 |
| 2003 | 25 000 |
| 2004 | 38 000 |
| 2005 | 63 000 |

**6A** If the rate of recycling plastic bottles continued to follow this trend, the quantity recycled in 2006 would have been . . .

**1** 70 000 tonnes.

**2** 99 000 tonnes.

**3** 200 000 tonnes.

**4** 350 000 tonnes.

**Question 20 · continued** March 2010 | CHY1BP | Original Q6 | Legacy

**6B** Between which two years was there the greatest percentage growth in recycling plastic bottles?

**1** 1994 to 1995

**2** 1999 to 2000

**3** 2002 to 2003

**4** 2004 to 2005

**6C** The data in the table on page 24, could be presented as a bar chart.

Which row of the table below gives the correct data types for tonnes of plastic bottles and the year?

| | Tonnes of plastic bottles | Year |
|---|---|---|
| **1** | Continuous | Categoric |
| **2** | Discrete | Continuous |
| **3** | Categoric | Continuous |
| **4** | Continuous | Discrete |

**6D** The government should encourage the recycling of plastic bottles because . . .

**1** there is an unlimited supply of the raw material.

**2** landfill sites cannot take plastic bottles.

**3** plastic bottles are made from a non-renewable raw material.

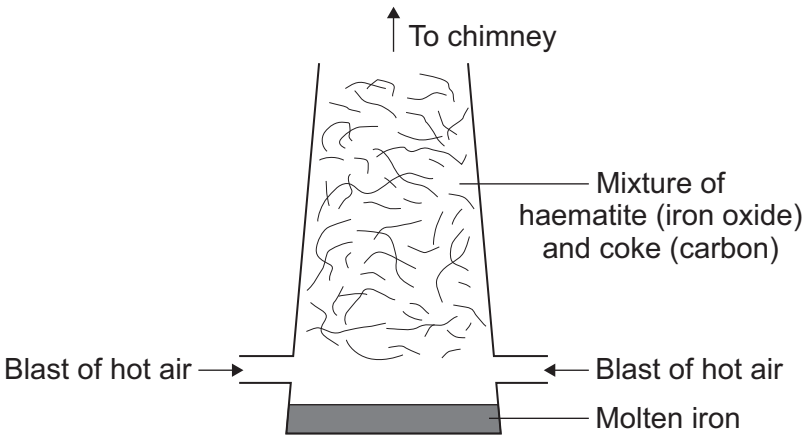
**4** plastic bottles may decompose after use.

### 4.10.2.2 Ways of reducing the use of resources

**Question 21**

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.

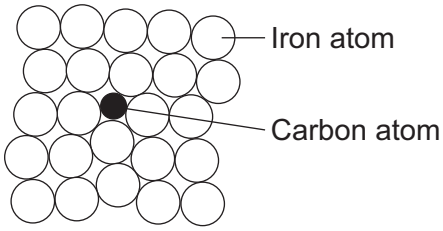
$Fe_2O_3$ + 3CO → ..... + .....

*(2 marks)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 21 · 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)*

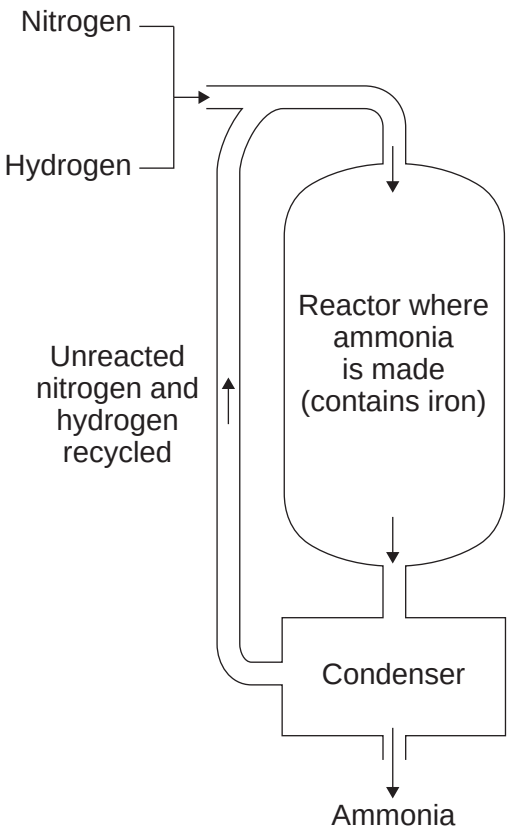
7

### 4.10.2.2 Ways of reducing the use of resources

**Question 22**

June 2010 | CHY2H | Original Q1 | Legacy

**1 (a)** The diagram shows how ammonia is made.




**1 (a) (i)** Complete the word equation for the reaction that takes place in the reactor.

nitrogen + ..... → .....

*(1 mark)*

**1 (a) (ii)** Ammonia is made by passing nitrogen and hydrogen over hot iron.
Why is iron used in the reactor?

.....

.....

*(1 mark)*

**1 (a) (iii)** Explain how ammonia is separated from the unreacted nitrogen and hydrogen.

.....

.....

.....

.....

*(2 marks)*

4.10.2.2 Ways of reducing the use of resources

Question 22 · continued



**1 (b)** Ammonia is used to make the fertiliser ammonium nitrate.

Calculate the relative formula mass ($M_r$) of ammonium nitrate, $NH_4NO_3$

Relative atomic masses ($A_r$): H = 1; N = 14; O = 16

.....

.....

.....

.....

Relative formula mass = .....

*(2 marks)*

**1 (c)** Another fertiliser is potassium nitrate, $KNO_3$

The relative formula mass ($M_r$) of potassium nitrate is 101.

Relative atomic masses ($A_r$): N = 14; O = 16; K = 39

The table shows the percentage by mass of potassium and nitrogen in four fertilisers, **A**, **B**, **C** and **D**.

| Fertiliser | Percentage by mass of potassium (%) | Percentage by mass of nitrogen (%) |
|---|---|---|
| **A** | 12.45 | 25.21 |
| **B** | 19.91 | 24.12 |
| **C** | 38.61 | 13.86 |
| **D** | 24.89 | 9.25 |

Which fertiliser, **A**, **B**, **C** or **D**, is potassium nitrate?

You **must** show your working to gain full marks.

.....

.....

.....

.....

Potassium nitrate is fertiliser ☐

*(2 marks)*

8

4.10.2.2 Ways of reducing the use of resources

Question 23

November 2010 | CHY1AP | Original Q4 | Legacy

**QUESTION FOUR**

Aluminium is extracted from a substance called bauxite. Bauxite contains aluminium oxide and impurities such as sand. Bauxite is first purified to make pure aluminium oxide. Then electricity is passed through the molten aluminium oxide. The molten aluminium oxide splits to make aluminium and oxygen.

**4A** Bauxite is an example of . . .

**1** an element.

**2** a compound.

**3** an ore.

**4** a solution.

**4B** The process used to extract aluminium is . . .

**1** thermal decomposition.

**2** reduction.

**3** corrosion.

**4** distillation.

**4C** Aluminium **cannot** be extracted from aluminium oxide using carbon because . . .

**1** aluminium is more reactive than carbon.

**2** the density of aluminium is too low.

**3** carbon is higher in the reactivity series than aluminium.

**4** aluminium is covered in a layer of aluminium oxide.

**4D** Aluminium is often recycled.

Which one of the following is **not** a good reason to recycle aluminium?

**1** Recycling is cheaper than extracting aluminium from bauxite.

**2** Drinks cans must be made from aluminium.

**3** Recycling reduces the amount of energy used to make aluminium.

**4** Bauxite reserves will last longer.

### 4.10.2.2 Ways of reducing the use of resources

**Question 24**

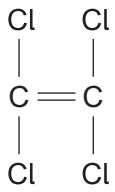
November 2010 | CHY1BP | Original Q2 | Legacy

**QUESTION TWO**

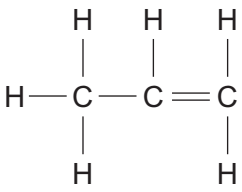
Plastic waste was taken to a recycling centre. At the recycling centre, the plastic was sorted and treated chemically. The chemical treatment broke down the plastic.

Breaking down the plastic produced new substances. The formulae for some of the substances produced are shown below.

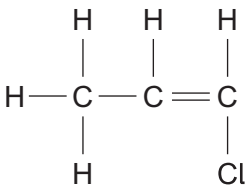
**A**



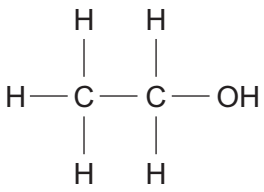
**B**



**C**



**D**



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

| | |
|---|---|
| **1** | It is a hydrocarbon. |
| **2** | It could be made from propene, $C_3H_6$ |
| **3** | It is formed by reacting ethene with steam, $H_2O$ |
| **4** | It would not produce water vapour if burnt in air. |

4.10.2.2 Ways of reducing the use of resources

Question 25

November 2010 | CHY1BP | Original Q5 | Legacy

## QUESTION FIVE

This question is about recycling plastic.

**5A** Many people think that plastic products should be recycled because . . .

**1** plastics are made from non-renewable resources.

**2** recycling will encourage more people to use paper bags.

**3** all plastics can be easily melted.

**4** all plastics give off toxic chemicals if buried in the ground.

**5B** To decide if recycling plastic is the best way to dispose of plastic waste, we should . . .

**1** ask people shopping at a local supermarket that sells products wrapped in plastic packaging.

**2** ask a company that recycles plastics.

**3** compare the environmental and cost implications of recycling with the use of new plastic.

**4** read articles in an environmental magazine.

**5C** Many plastic products, such as computer keyboards, are sent to China for recycling. Workers separate valuable components from the plastics. The plastics are used to make toys.

The plastic products are sent to China because . . .

**1** British workers do not have the correct equipment to remove the valuable components.

**2** wages are generally lower in China than in Britain.

**3** there are social issues concerning the recycling of plastic in Britain.

**4** Britain has enough plastic reserves.

**5D** Some environmentalists are concerned about British waste plastic being recycled in China to make toys because . . .

**1** we make better quality toys in Britain.

**2** the recycling will take much longer.

**3** China makes large quantities of plastic toys.

**4** transporting plastic waste to China will increase carbon dioxide emissions.

### 4.10.2.2 Ways of reducing the use of resources

**Question 26**



**1** The flow diagram shows the main stages used to extract a metal from its ore.

mining the ore → purifying the ore → extracting the metal

The table shows some information about three metals.

| Metal | Metal ore | Purified ore | % of metal in the ore | % of metal in the Earth's crust |
|---|---|---|---|---|
| aluminium | bauxite | aluminium oxide, $Al_2O_3$ | 28.0 | 8.0 |
| copper | chalcocite | copper sulfide, $Cu_2S$ | 0.5 | 0.001 |
| iron | haematite | iron oxide, $Fe_2O_3$ | 29.0 | 5.0 |

**1 (a)** Use the information in the table and your knowledge and understanding to help you to answer the questions.

**1 (a) (i)** Suggest why purifying the copper ore produces large quantities of waste.

.....

.....

.....

*(1 mark)*

**1 (a) (ii)** Suggest why the annual world production of iron is forty times greater than that of aluminium.

.....

.....

.....

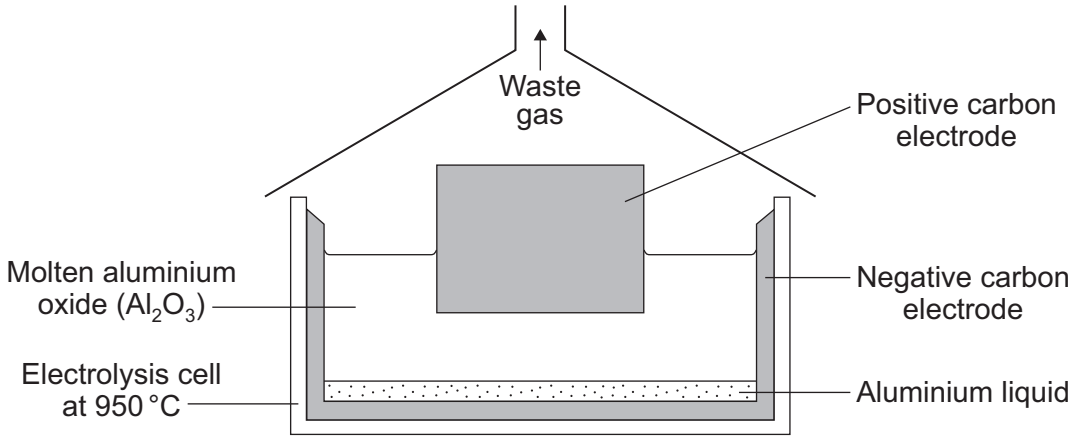
*(1 mark)*

4.10.2.2 Ways of reducing the use of resources

Question 26 · continued



**1 (b)** Aluminium is used for drinks cans.
Aluminium is extracted from its purified ore by electrolysis.




**1 (b) (i)** Suggest why the aluminium produced in the electrolysis cell is a liquid.

.....

.....

*(1 mark)*

**1 (b) (ii)** In this electrolysis, aluminium and oxygen gas are produced from the aluminium oxide.

Use the information in the diagram to suggest why most of the waste gas is carbon dioxide and not oxygen.

.....

.....

.....

.....

*(2 marks)*

**1 (b) (iii)** Aluminium is the most abundant metal in the Earth's crust.

Suggest **two** reasons why we should recycle aluminium drinks cans.

1 .....

.....

2 .....

.....

*(2 marks)*

7

### 4.10.2.2 Ways of reducing the use of resources

**Question 27**

January 2011 | CHY1H | Original Q5 | Legacy

**5** Supermarkets in the UK have been advised by the Government to stop giving plastic bags to customers. The Government states that this is because plastic bags use up resources that are not renewable and that the manufacture of plastic bags produces carbon dioxide.
Most of these plastic bags are made from poly(ethene). The table shows methods to deal with large numbers of used plastic bags.

| **Method** | **Description of what happens to the plastic bag** |
|---|---|
| Reused | used again by the customer |
| Recycled | collected, transported, washed and melted to make new plastic items |
| Burned | collected, transported and burnt to release heat energy |
| Dumped | mixed with other household waste, collected, transported and disposed of at a landfill site |

Use the information and your knowledge and understanding to briefly give **one advantage and one disadvantage** for each of these methods.

Reused .....

.....

.....

Recycled .....

.....

.....

Burned .....

.....

.....

Dumped .....

.....

.....

*(4 marks)*

4

### 4.10.2.2 Ways of reducing the use of resources

**Question 28**

March 2011 | CHY1AP | Original Q4 | Legacy

## QUESTION FOUR

This question is about the extraction and recycling of copper.

Copper is used in its pure form or mixed with other metals.
Large amounts of scrap copper metal from a variety of sources can easily be recycled by re-melting.

**4A** Pure copper can be extracted directly by . . .

**1** thermal decomposition of copper carbonate.

**2** thermal decomposition of copper oxide.

**3** carbon reduction of copper oxide in a blast furnace.

**4** electrolysis of copper compounds dissolved in water.

**4B** Small amounts of other metals are sometimes added to copper to produce . . .

**1** compounds that conduct electricity better.

**2** compounds that are softer.

**3** alloys that are harder.

**4** new elements that are harder.

**4C** The price of copper would increase if there was . . .

**1** a decrease in the demand for copper.

**2** an increase in energy costs.

**3** an increase in the amount of copper being recycled.

**4** a discovery of a low grade copper ore in a remote area of the world.

**4D** One **disadvantage** of recycling copper is that it . . .

**1** prevents heaps of scrap metal from building up.

**2** still requires the use of energy resources.

**3** will increase the price of copper.

**4** will contaminate the world's supplies of copper.

4.10.2.2 Ways of reducing the use of resources

Question 29

March 2011 | CHY1BP | Original Q7 | Legacy

## QUESTION SEVEN

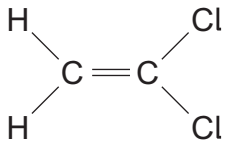
Worldwide, about 20 billion wine bottle stoppers are produced each year.

In recent years, the traditional cork stoppers have been gradually replaced by screw-top stoppers.

Cork is the bark from the cork-oak tree, which is cut off about every ten years. Tens of thousands of people in rural Portugal depend on cork for their livelihoods. Used cork can be recycled.

A screw-top stopper can be made of aluminium, inside which is a polymer sealant. The sealant is usually made of poly(ethene) or poly(vinylidene chloride). Extraction of aluminium from its ores is expensive and a lot of energy is required. It is difficult to separate the polymer from the aluminium cap to allow aluminium to be recycled.

Vinylidene chloride has the structure:




**7A** One difference between ethene and vinylidene chloride is that . . .

**1** only ethene is an unsaturated compound.

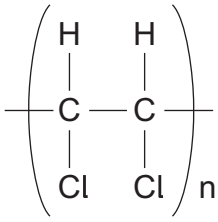
**2** only vinylidene chloride will react with iodine.

**3** only vinylidene chloride is obtained from crude oil.

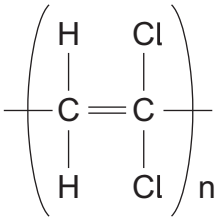
**4** only ethene is a hydrocarbon.

**7B** The formula for poly(vinylidene chloride) is . . .

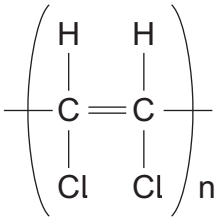
**1**



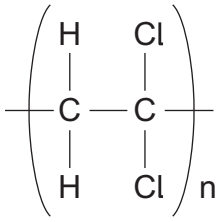

**2**




**3**




**4**



### 4.10.2.2 Ways of reducing the use of resources

**Question 29 · continued** March 2011 | CHY1BP | Original Q7 | Legacy

**7C** There are two likely consequences of wine companies using metal screw-top stoppers with polymer sealants instead of cork.

Which row in the table correctly shows the two likely consequences?

| | | |
|---|---|---|
| **1** | increased use of crude oil | loss of employment in rural Portugal |
| **2** | reduction in carbon dioxide emissions | loss of employment in rural Portugal |
| **3** | reduction in carbon dioxide emissions | loss of important forest habitat |
| **4** | increased use of crude oil | reduced amount of material to landfill |

**7D** Scientists are researching the consequences of using screw-top stoppers with polymer sealants instead of cork.

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

| | Issue | Impact |
|---|---|---|
| **1** | ethical | effect on the price of wine |
| **2** | social | effect on the rural communities |
| **3** | environmental | effect on the quality of wine |
| **4** | economic | effect on cork forest habitat |

### 4.10.2.2 Ways of reducing the use of resources

**Question 30** June 2011 | CHY1AP | Original Q5 | Legacy

**QUESTION FIVE**

Iron and copper can be extracted from their oxides by reduction with carbon.
Aluminium cannot be extracted from its oxide in this way.

Copper can be found in the Earth's crust as the metal itself.
Iron and aluminium are found only as compounds in the Earth's crust.

**5A** Which row in the table shows the order of reactivity of the four elements in the passage above?

| | **Most reactive → Least reactive** | | | |
|---|---|---|---|---|
| **1** | copper | iron | aluminium | carbon |
| **2** | aluminium | carbon | iron | copper |
| **3** | carbon | copper | iron | aluminium |
| **4** | iron | aluminium | copper | carbon |

**5B** Iron can be extracted from iron oxide, $Fe_2O_3$, by mixing the oxide with carbon and heating strongly in air.

Which row in the table below shows the name of the process and the products of the reaction?

| | **Name of the process** | **Products of the reaction** |
|---|---|---|
| **1** | electrolysis | Fe, $O_2$ and $CO_2$ |
| **2** | reduction | Fe and $CO_2$ |
| **3** | electrolysis | Fe and $CO_2$ |
| **4** | reduction | Fe, $O_2$ and $CO_2$ |

4.10.2.2 Ways of reducing the use of resources

**Question 30 · continued**



**5C** Copper is extracted from high grade ores by first heating them strongly in a furnace to obtain impure copper. This is called smelting. Pure copper is then obtained by electrolysis.

Copper is extracted from low grade ores by leaching. A solution of sulfuric acid is run through the ores to produce a solution of copper sulfate. Electrolysis of this solution gives pure copper.

An advantage of leaching over smelting is that . . .

**1** leaching uses less energy.

**2** leaching causes no environmental damage.

**3** leaching leaves no waste.

**4** leaching produces purer copper.

**5D** Extraction of aluminium from its ores requires a lot of energy. Aluminium obtained by recycling scrap aluminium saves about 95% of this energy.

Another advantage of recycling scrap aluminium is that . . .

**1** large, new aluminium ore mines will be developed.

**2** alternative metals will replace aluminium in making drinks cans.

**3** deposits of aluminium ore will last longer.

**4** recycled aluminium contains other metals.

### 4.10.2.2 Ways of reducing the use of resources

**Question 31**

November 2011 | CHY1AP | Original Q4 | Legacy

## QUESTION FOUR

Iron oxide can be reduced to iron by mixing the oxide with carbon and heating strongly.

Aluminium oxide cannot be reduced to aluminium in this way. Aluminium is obtained from aluminium oxide by electrolysis.

**4A** Why is it possible to obtain iron but not aluminium by carbon reduction?

**1** Iron is more reactive than aluminium.

**2** Carbon is more reactive than aluminium but less reactive than iron.

**3** Carbon is more reactive than iron but less reactive than aluminium.

**4** Aluminium and iron are both more reactive than carbon.

**4B** The extraction of aluminium by electrolysis is an expensive process because . . .

**1** aluminium easily corrodes in air.

**2** a large amount of energy is needed.

**3** aluminium oxide is difficult to mine.

**4** aluminium reacts with carbon.

**4C** As electrolysis is expensive, an increasing amount of aluminium is being recycled.

Another important reason to recycle aluminium is that . . .

**1** it saves limited aluminium oxide reserves.

**2** the recycled aluminium is purer.

**3** aluminium scrap does not corrode easily.

**4** recycling aluminium does not use energy.

4.10.2.2 Ways of reducing the use of resources

Question 31 · continued



**4D** Which two of the following statements could explain why aluminium is preferred to iron for making cans for drinks?

**W** Aluminium has a lower density than iron.

**X** Aluminium is a better conductor than iron.

**Y** Aluminium corrodes less easily than iron.

**Z** Aluminium is not as strong as iron.

**1** **W** and **X**

**2** **W** and **Y**

**3** **X** and **Y**

**4** **Y** and **Z**

**Turn over for the next question**

### 4.10.2.2 Ways of reducing the use of resources

**Question 32**

January 2012 | CH1HP | Original Q4 | Legacy

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



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

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

.....

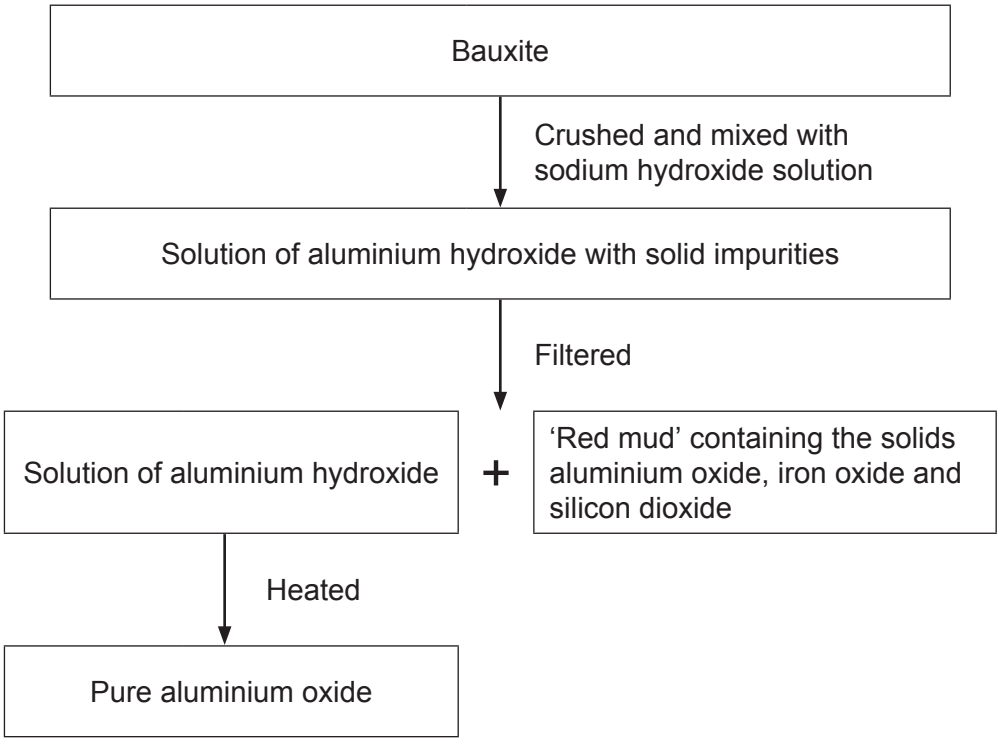
*(1 mark)*

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

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

*(1 mark)*

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



4.10.2.2 Ways of reducing the use of resources

Question 32 · continued



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

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

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

What percentage of aluminium oxide did the bauxite contain?

.....

Answer = ..... %

*(1 mark)*

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

.....

*(1 mark)*

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

Suggest **one** reason why.

.....

*(1 mark)*

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

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

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

Environmental .....

.....

Ethical or social .....

.....

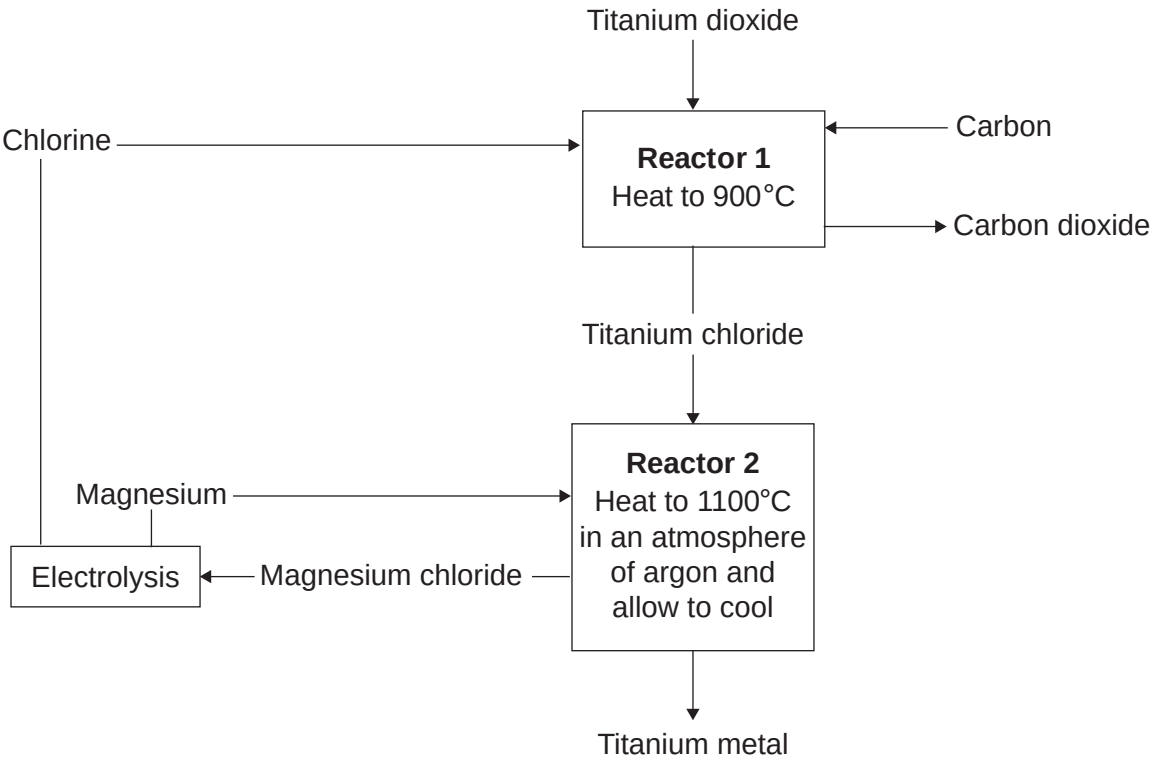
*(2 marks)*

### 4.10.2.2 Ways of reducing the use of resources

**Question 33**

June 2012 | CH1HP | Original Q2 | Legacy

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




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

Give **one** reason why.

.....

.....

*(1 mark)*

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

.....

*(1 mark)*

4.10.2.2 Ways of reducing the use of resources

Question 33 · continued



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

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*(2 marks)*

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

Explain why.

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*(2 marks)*

**Question 2 continues on the next page**

4.10.2.2 Ways of reducing the use of resources

Question 33 · continued



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

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

Calculate the mass of titanium metal produced.

.....

Mass = ..... kg

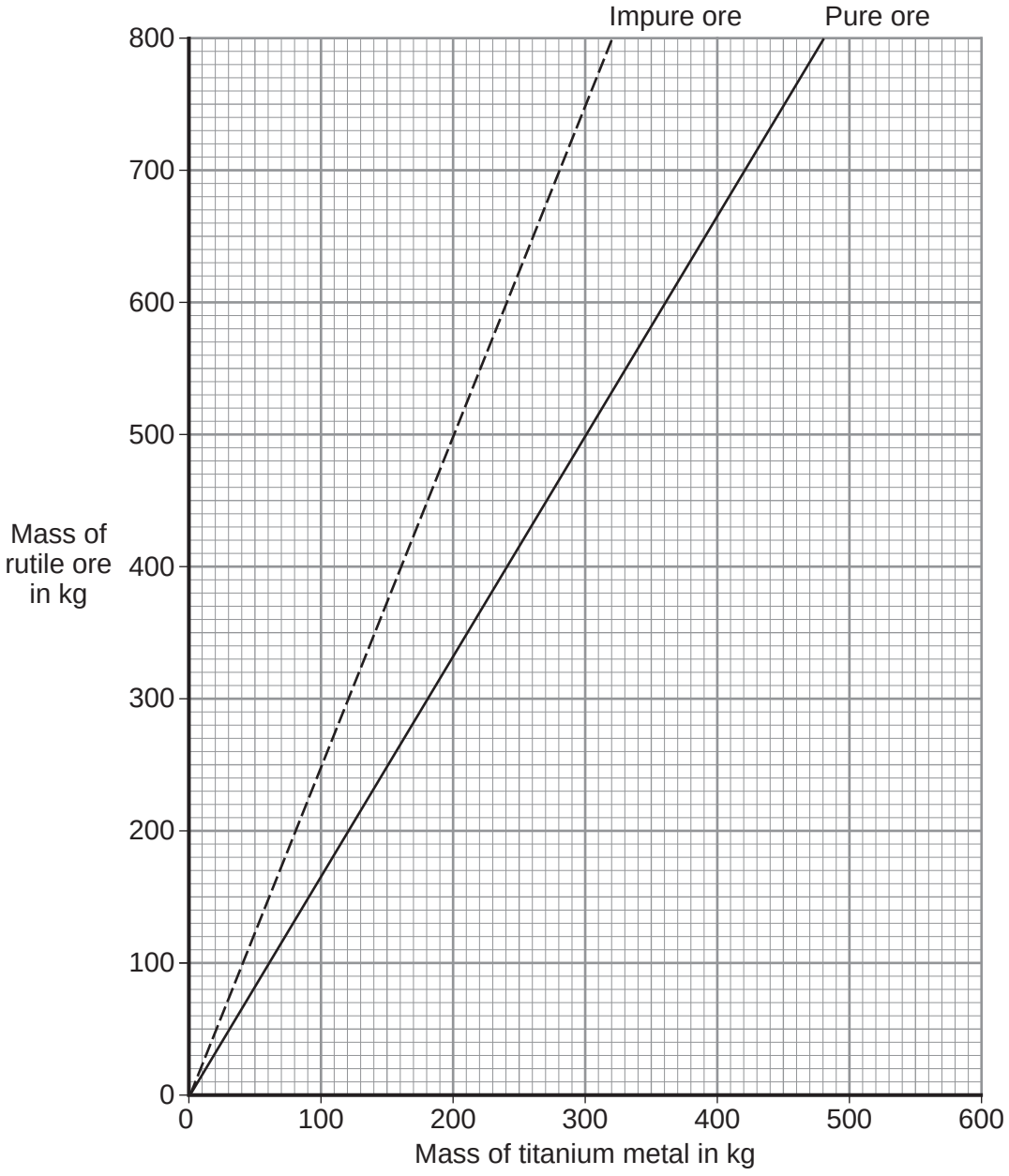
*(1 mark)*

4.10.2.2 Ways of reducing the use of resources

Question 33 · continued



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




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

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

Calculate the mass of waste rock in the impure ore.

.....

Mass = ..... kg

*(1 mark)*

8

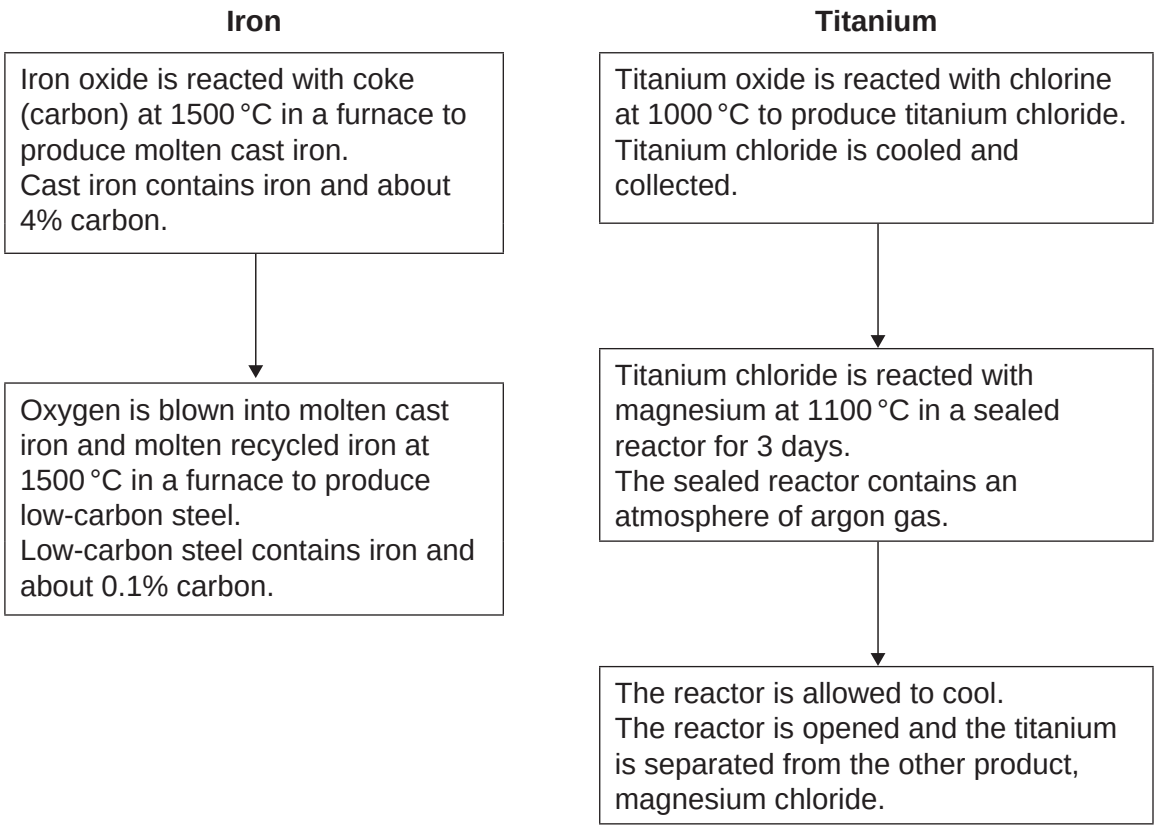
### 4.10.2.2 Ways of reducing the use of resources

**Question 34**

January 2013 | CH1HP | Original Q7 | Legacy

**7** Iron is produced from the ore haematite (iron oxide).

Titanium is produced from the ore rutile (titanium oxide).




**7 (a)** The production of low-carbon steel uses oxygen but the production of titanium uses argon.

Explain why.

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*(3 marks)*

**4.10.2.2 Ways of reducing the use of resources**

**Question 34 · continued**



**7 (b)** There is less titanium than iron in the Earth's crust.

Apart from titanium's scarcity, explain why titanium costs much more than iron.

Use the two flow diagrams on page 16 to help you to answer this question.

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*(3 marks)*

**7 (c)** Many chemical reactions take place in the production of both metals.

A chemical reaction in the production of iron is:

$$2\,Fe_2O_3 + 3\,C \rightarrow 4\,Fe + 3\,CO_2$$

A chemical reaction in the production of titanium is:

$$TiCl_4 + 2\,Mg \rightarrow Ti + 2\,MgCl_2$$

Titanium can be used to produce iron from iron oxide. The chemical reaction is:

$$2\,Fe_2O_3 + 3\,Ti \rightarrow 4\,Fe + 3\,TiO_2$$

Use these three reactions and the Chemistry Data Sheet to answer this question.

Suggest the position of titanium in the Reactivity Series of Metals.

Explain your answer.

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*(2 marks)*

8

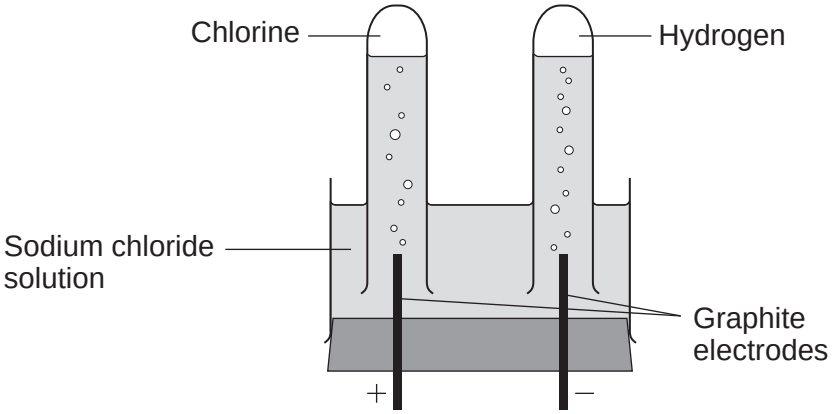
### 4.10.2.2 Ways of reducing the use of resources

**Question 35**

January 2013 | CH2HP | Original Q2 | Legacy

**2** The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.




**2 (a)** One of the products of the electrolysis of sodium chloride solution is hydrogen.

**2 (a) (i)** Why do hydrogen ions move to the negative electrode?

.....

.....

*(1 mark)*

**2 (a) (ii)** How does a hydrogen ion change into a hydrogen atom?

.....

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*(1 mark)*

4.10.2.2 Ways of reducing the use of resources

Question 35 · continued

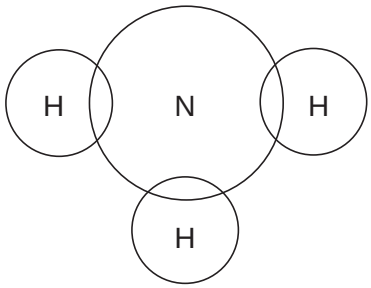


**2 (b)** Hydrogen is used to make ammonia ($NH_3$).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.




*(2 marks)*

**2 (c)** The table shows the ions in sodium chloride solution.

| Positive ions | Negative ions |
|---|---|
| hydrogen | chloride |
| sodium | hydroxide |

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

**2 (c) (i)** Which ion makes the waste alkaline?

.....

*(1 mark)*

**2 (c) (ii)** This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

*(1 mark)*

**Question 2 continues on the next page**

4.10.2.2 Ways of reducing the use of resources

Question 35 · continued



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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

| | **Mercury cell** | **Membrane cell** |
|---|---|---|
| **Cost of construction** | Expensive | Relatively cheap |
| **Additional substances used** | Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste. | Membrane, which is made of a polymer. The membrane must be replaced every 3 years. |
| **Amount of electricity used for each tonne of chlorine produced in kWh** | 3400 | 2950 |
| **Quality of chlorine produced** | Pure | Needs to be liquefied and distilled to make it pure. |
| **Quality of sodium hydroxide solution produced** | 50% concentration. Steam is used to concentrate the sodium hydroxide solution produced. | 30% concentration. Steam is used to concentrate the sodium hydroxide solution produced. |

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

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### 4.10.2.2 Ways of reducing the use of resources

**Question 36**

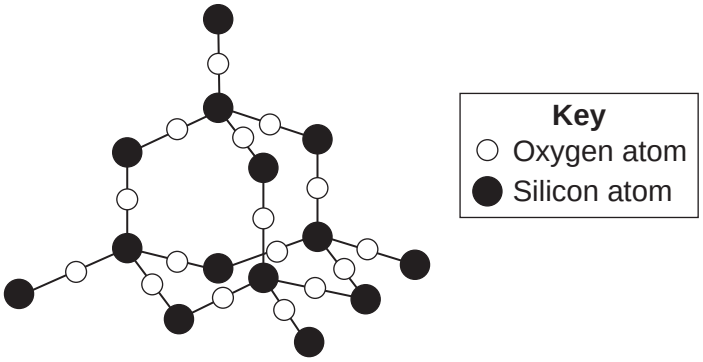
January 2013 | CH2HP | Original Q6 | Legacy

**6** Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.



The diagram shows a small part of the structure of silicon dioxide.




Explain why silicon dioxide is a suitable material for lining furnaces.

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*(4 marks)*

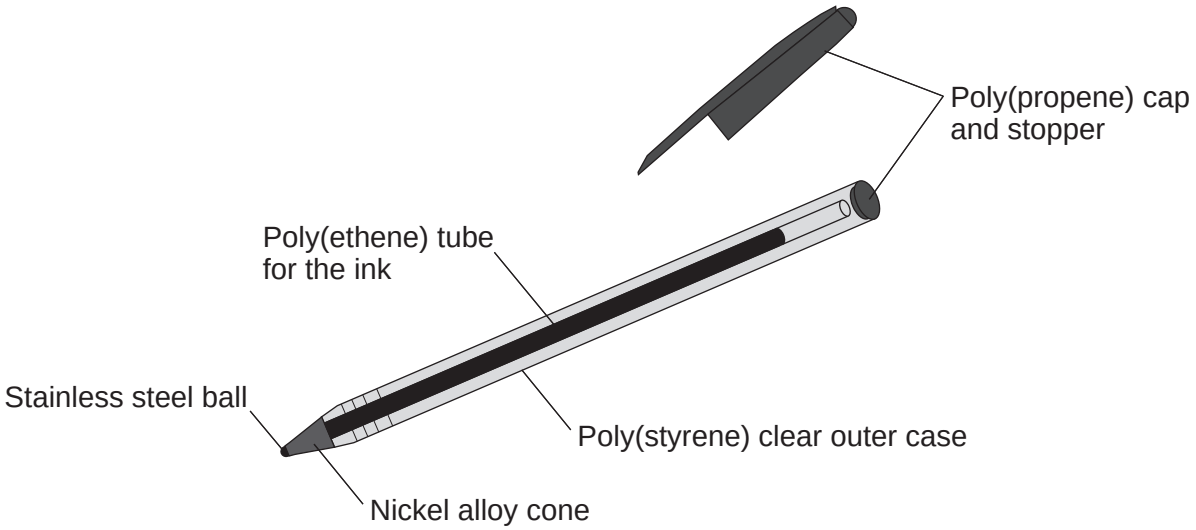
4

### 4.10.2.2 Ways of reducing the use of resources

**Question 37**

June 2013 | CH1HP | Original Q4 | Legacy

**4** The diagram shows a ballpoint pen.




**4 (a)** Give **one** advantage and **one** disadvantage of recycling the materials from this type of ballpoint pen.

.....

.....

.....

.....

*(2 marks)*

**4 (b)** Alloys are used to make the ballpoint pen.

Give **two** reasons why alloys are used in the ballpoint pen.

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.....

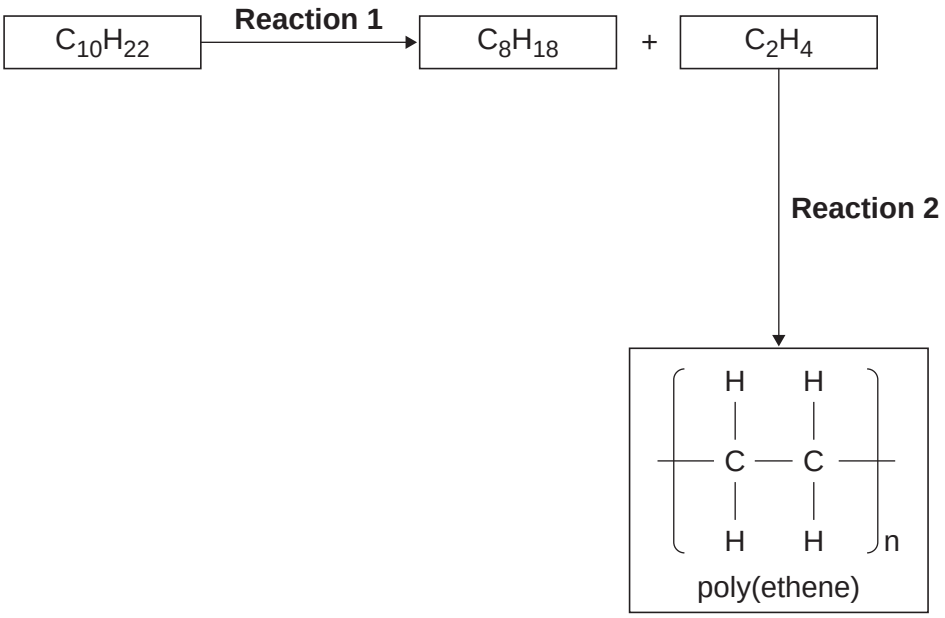
*(2 marks)*

4.10.2.2 Ways of reducing the use of resources

Question 37 · continued



**4 (c)** Decane ($C_{10}H_{22}$) can be used to produce poly(ethene).




**4 (c) (i)** Describe the conditions needed for **Reaction 1**.

.....

.....

.....

.....

*(2 marks)*

**4 (c) (ii)** Describe, in terms of molecules, how poly(ethene) is produced in **Reaction 2.**

.....

.....

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.....

.....

*(2 marks)*

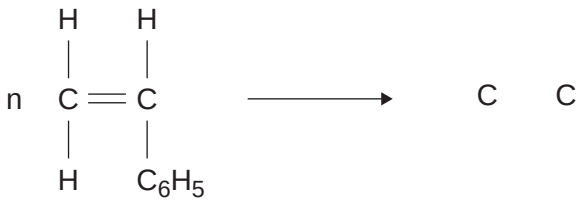
**Question 4 continues on the next page**

### 4.10.2.2 Ways of reducing the use of resources

**Question 37 · continued**



**4 (d)** Complete the displayed structure of the product in the equation.




styrene poly(styrene)

*(2 marks)*

10

4.10.2.2 Ways of reducing the use of resources

Question 38

June 2016 | CH1HP | Original Q3 | Legacy

**3** Metals are extracted from ores in the Earth's crust.

Some ores contain metal carbonates and some ores contain metal oxides.

**3 (a) (i)** Name the type of reaction that happens when a metal carbonate is heated.

**[1 mark]**

_____

**3 (a) (ii)** Which solid product is formed when copper carbonate is heated?

**[1 mark]**

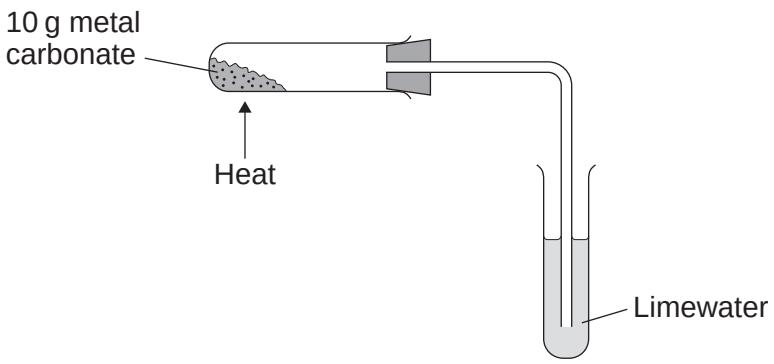
Tick (✓) **one** box.

- copper ☐
- copper nitrate ☐
- copper oxide ☐
- copper sulfide ☐

**3 (b)** A student investigated heating four metal carbonates.

**Figure 4** shows the apparatus used.

**Figure 4**



4.10.2.2 Ways of reducing the use of resources

Question 38 · continued



The student heated each metal carbonate for five minutes.

**Table 3** shows the results.

**Table 3**

| Metal carbonate | Mass of metal carbonate at start in g | Mass of solid after heating for 5 minutes in g | Observations |
|---|---|---|---|
| Copper carbonate | 10.0 | 6.9 | Limewater turns cloudy |
| Magnesium carbonate | 10.0 | 9.1 | Limewater turns cloudy |
| Potassium carbonate | 10.0 | 10.0 | Limewater does not turn cloudy |
| Zinc carbonate | 10.0 | 8.3 | Limewater turns cloudy |

**3 (b) (i)** Explain the results for potassium carbonate.

**[3 marks]**

**3 (b) (ii)** Suggest how the reactivity series can be used to predict which metal carbonate reacts most easily when heated.

**[2 marks]**

**Question 3 continues on the next page**

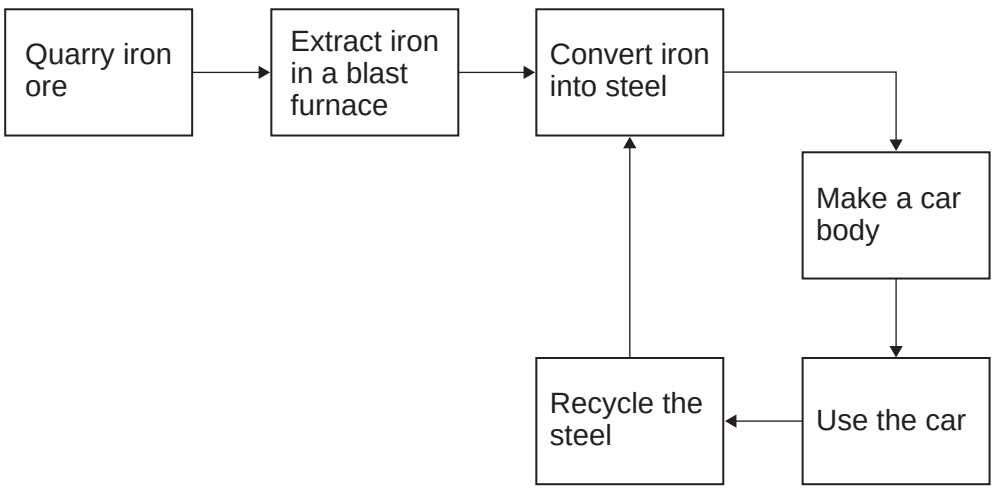
4.10.2.2 Ways of reducing the use of resources

Question 38 · continued



**3 (c)** **Figure 5** shows a simple life cycle of a car body.

**Figure 5**




**3 (c) (i)** Complete the sentence.

**[1 mark]**

Iron ores must contain enough iron to _____

_____

**3 (c) (ii)** Some iron ores contain iron oxide ($Fe_2O_3$).

Complete and balance the equation for a reaction to produce iron from iron oxide.

**[2 marks]**

_____ $Fe_2O_3$ + _____ C ⟶ _____ + _____ $CO_2$

**3 (c) (iii)** Give **two** reasons why iron produced in a blast furnace is converted into steel.

**[2 marks]**

_____

_____

_____

_____

### 4.10.2.2 Ways of reducing the use of resources

**Question 38 · continued**



**3 (c) (iv)** When a car reaches the end of its useful life, the car body can be:

- recycled
- reused
- sent to landfill.

Give **three** reasons why a steel car body should be recycled and **not** reused or sent to landfill.

**[3 marks]**

15

**4.10.2.2 Ways of reducing the use of resources**

**Question 39**

June 2017 | CH1HP | Original Q4 | Legacy

**4** A polymer is used to make supermarket carrier bags.

**4 (a)** **Table 3** shows data about polymer bags used by customers of UK supermarkets.

**Table 3**

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| Number of bags used in millions | 12 419 | 11 346 | 9004 | 7570 | 7974 | 8392 | 8487 | 8759 | 8959 |
| Mass of bags used in thousands of tonnes | 109.8 | 104.7 | 83.4 | 65.6 | 68.3 | 72.3 | 70.4 | 67.3 | 66.1 |

**4 (a) (i)** Describe what happens in a polymerisation reaction.

**[1 mark]**

**4 (a) (ii)** Describe the trend in the number of bags used per year between 2006 and 2014.

**[2 marks]**

**4 (a) (iii)** The trend in the number of bags used does **not** match the trend of the mass of bags used between 2012 and 2014.

Suggest **two** reasons why.

**[2 marks]**

4.10.2.2 Ways of reducing the use of resources

Question 39 · continued



**4 (b)** There has been an increase in the amount of recycled polymer used to make supermarket carrier bags.

This reduces the amount of polymer put into landfill.

**4 (b) (i)** Give **two** reasons why the amount of polymer put into landfill **should** be reduced.

**[2 marks]**

**4 (b) (ii)** Apart from reducing the use of landfill, give **two** reasons why more recycled polymer, instead of newly manufactured polymer, should be used to make supermarket carrier bags.

**[2 marks]**

9

4.10.2.2 Ways of reducing the use of resources

Question 40

June 2018 | 8462/2H | Original Q10

**1 0** Disposable cups are made from coated paper or poly(styrene).

**Table 6** shows information on the life cycle assessments (LCAs) of disposable cups.

**Table 6**

| | Coated paper cups | Poly(styrene) cups |
|---|---|---|
| Raw materials | Wood | Crude oil |
| Mass of 1 cup in g | 8.3 | 1.9 |
| Energy to produce 1 cup in kJ | 550 | 200 |
| Energy released when 1 cup is burned in kJ | 166 | 76 |
| Biodegradable | Yes | No |
| Recyclable | No | Yes |

**1 0 . 1** Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use **Table 6** and your knowledge and understanding of LCAs.

**[6 marks]**

4.10.2.2 Ways of reducing the use of resources

Question 40 · continued



**10.2** Calculate the energy needed to produce 1.00 kg of coated paper cups.

Use **Table 6**.

Give your answer in standard form.

**[2 marks]**

Energy = _____ kJ

**10.3** Melamine is a polymer used to make non-disposable cups.

Melamine does **not** melt when it is heated.

Explain why.

**[2 marks]**

10

4.10.2.2 Ways of reducing the use of resources

Question 41

November 2020 | 8462/2H | Original Q5

**0 5** This question is about materials used to make food plates.

Food plates are made from paper, polymers or ceramics.

**Table 2** shows information about plates of the same diameter made from each of these materials.

**Table 2**

| | Food plate material | | |
|---|---|---|---|
| | **Paper** | **Polymers** | **Ceramics** |
| Raw material | Wood | Crude oil | Mined clay |
| Number packaged in 10 $dm^3$ cardboard box | 500 | 100 | 50 |
| Average number of times used | 1 | 400 | 1000 |
| Biodegradable? | Yes | No | No |
| Recyclable? | Yes | Yes | No |

**0 5 . 1** **Table 2** does **not** show information about energy usage.

Suggest **two** pieces of information about energy usage which would help to produce a complete life cycle assessment (LCA) for the three food plate materials.

**[2 marks]**

1 _____

_____

2 _____

_____

4.10.2.2 Ways of reducing the use of resources

Question 41 · continued



**0 5 . 2** Evaluate the use of these materials for making food plates.

You should use features of life cycle assessments (LCAs).

Use **Table 2**.

**[4 marks]**

**0 5 . 3** Describe how ceramic food plates are produced from clay.

**[2 marks]**

8

4.10.2.2 Ways of reducing the use of resources

Question 42

November 2021 | 8462/2H | Original Q4

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

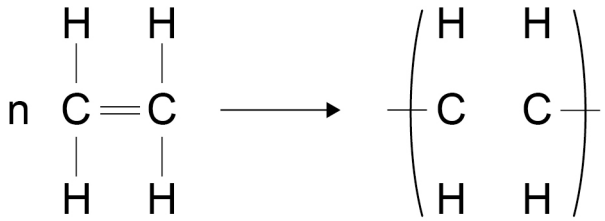
**0 4 . 1** Poly(ethene) is produced from ethene.

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

Complete **Figure 3**.

**[2 marks]**

**Figure 3**




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

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

**[2 marks]**

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

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

**[1 mark]**

4.10.2.2 Ways of reducing the use of resources

Question 42 · continued



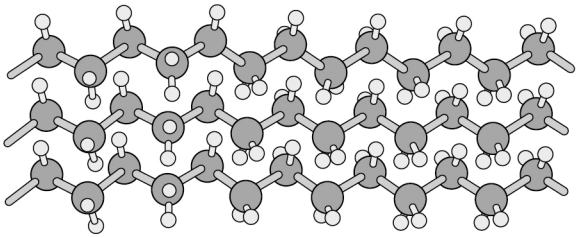
**0 4 . 4** Two different forms of poly(ethene) are:

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

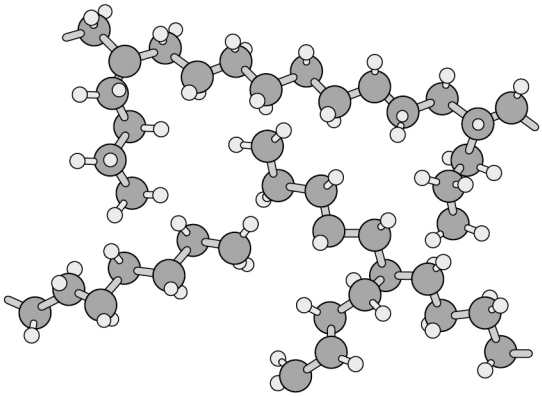
**Figure 4** represents part of the structures of HDPE and LDPE.

**Figure 4**

**HDPE**



**LDPE**



Explain why HDPE has a higher density than LDPE.

**[2 marks]**

**Question 4 continues on the next page.**

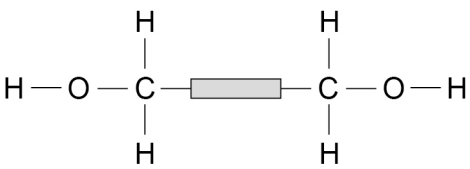
Question 42 · continued



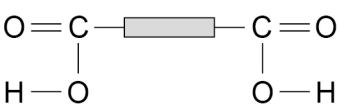
**Figure 5** shows three monomers, **A**, **B** and **C**.

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

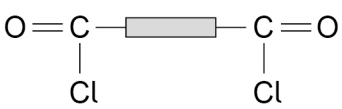
**Figure 5**



Monomer **A**



Monomer **B**



Monomer **C**

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

**[1 mark]**

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

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

**[1 mark]**

**Table 2**

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

9

4.10.2.2 Ways of reducing the use of resources

Question 43

November 2021 | 8462/2H | Original Q8

**0 8** This question is about copper and alloys of copper.

Solders are alloys used to join metals together.

Some solders contain copper.

**Table 4** shows information about three solders, **A**, **B** and **C**.

**Table 4**

| Solder | Melting point in °C | Metals in solder |
|---|---|---|
| **A** | 183 | tin, copper, lead |
| **B** | 228 | tin, copper, silver |
| **C** | 217 | tin, copper, silver |

**0 8 . 1** Solder **B** and solder **C** are now used more frequently than solder **A** for health reasons.

Suggest **one** reason why.

Use **Table 4**.

**[1 mark]**

**0 8 . 2** Suggest **one** reason why solders **B** and **C** have different melting points.

Use **Table 4.**

**[1 mark]**

4.10.2.2 Ways of reducing the use of resources

Question 43 · continued



Copper can be obtained by:

- processing copper ores
- recycling scrap copper.

**0 8 . 3** Suggest **three** reasons why recycling scrap copper is a more sustainable way of obtaining copper than processing copper ores.

**[3 marks]**

1 _____

_____

2 _____

_____

3 _____

_____

**Question 8 continues on the next page**

4.10.2.2 Ways of reducing the use of resources

Question 43 · continued



Copper is extracted from low-grade ores by phytomining.

**0 8 . 4** Describe how copper is extracted from low-grade ores by phytomining.

**[4 marks]**

**0 8 . 5** Phytomining has **not** been widely used to extract copper.

Suggest **two** reasons why.

**[2 marks]**

1

2

**11**

4.10.2.2 Ways of reducing the use of resources

Question 44

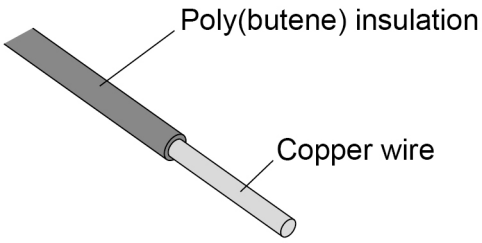
June 2022 | 8462/2H | Original Q1

**0 1** This question is about copper wire and copper compounds.

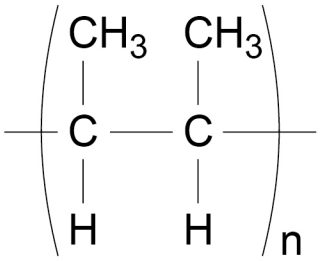
Copper is used to make electrical wires.

**Figure 1** shows how copper electrical wire is insulated using an addition polymer called poly(butene).

**Figure 1**




**0 1 . 1** The addition polymer poly(butene) has the displayed structural formula:

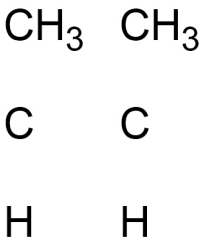



Poly(butene) is produced from the monomer butene.

Complete **Figure 2** to show the displayed structural formula of butene.

**[2 marks]**

**Figure 2**



4.10.2.2 Ways of reducing the use of resources

Question 44 · continued



Copper can be obtained by recycling scrap copper wire.

**0 1 . 2** Suggest why poly(butene) insulation must be removed from scrap copper wire before the copper is recycled.

**[1 mark]**

**0 1 . 3** Describe how scrap copper wire can be recycled to make new copper water pipes.

**[2 marks]**

**0 1 . 4** Suggest **two** reasons why recycling scrap copper is more sustainable than extracting copper from copper ores.

**[2 marks]**

1

2

**Question 1 continues on the next page**

4.10.2.2 Ways of reducing the use of resources

**Question 44 · continued**



Copper sulfate is a compound of copper.

Copper sulfate solution contains copper(II) ions and sulfate ions.

**0 1 . 5** A solution can be added to copper sulfate solution to show the presence of copper(II) ions.

Name the solution added.

Give the result of the test.

**[2 marks]**

Name of solution added _____

_____

Result _____

_____

**0 1 . 6** Describe **one** test to show the presence of sulfate ions in copper sulfate solution.

Give the result of the test.

**[2 marks]**

Test _____

_____

Result _____

_____

**11**

4.10.2.2 Ways of reducing the use of resources

Question 45

June 2022 | 8462/2H | Original Q3

**0 3** This question is about life cycle assessments (LCAs).

**0 3 . 1** Milk bottles can be made from glass or from a polymer.

**Table 2** shows information about milk bottles of equal volume.

**Table 2**

| | Glass | Polymer |
|---|---|---|
| Raw materials | Limestone<br>Sand<br>Sodium carbonate | Crude oil |
| Energy needed to process raw materials in kilojoules | 6750 | 1710 |
| Energy needed to manufacture bottle in kilojoules | 750 | 90 |
| Mass of bottle in grams | 200 | 20 |
| Mean number of times used during lifetime of bottle | 25 | 1 |
| One disposal method at end of useful life | Recycled to make different glass products | Recycled to make different polymer products |

Evaluate the use of glass for milk bottles compared with the use of a polymer for milk bottles.

Use features of life cycle assessments (LCAs) in your answer.

Use **Table 2**.

**[6 marks]**

4.10.2.2 Ways of reducing the use of resources

Question 45 · continued



**0 3 . 2** Milk is also sold in cardboard cartons.

A carton is made using 40 $cm^3$ of cardboard.

The density of the cardboard is 0.40 $g/cm^3$.

Calculate the mass of the carton.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

**[3 marks]**

Mass = _____ g

9

4.10.2.2 Ways of reducing the use of resources

Question 46

June 2024 | 8462/2H | Original Q6

**0 6** This question is about materials used to make bicycles.

**Figure 6** shows a bicycle.

**Figure 6**




**Table 3** shows information about two materials used to make bicycle frames.

**Table 3**

| | **Material** | |
|---|---|---|
| | **Aluminium alloy** | **Bamboo** |
| Raw material | aluminium ore | bamboo plant |
| Cost of frame in £ | 250 | 1500 |
| Strength in arbitrary units | 290 | 193 |
| Mass in kilograms | 1.6 | 2.4 |
| Lifespan in years | 6–10 | 10–15 |
| One method of disposal at end of life | recycled to make new products | burned to produce heat energy |

4.10.2.2 Ways of reducing the use of resources

Question 46 · continued



**0 6 . 1** Evaluate the use of aluminium alloy and of bamboo for making bicycle frames.

Use **Table 3**.

**[6 marks]**

**0 6 . 2** Explain why aluminium alloy bicycle frames do **not** need protection from corrosion.

**[2 marks]**

**Question 6 continues on the next page**

4.10.2.2 Ways of reducing the use of resources

Question 46 · continued



**0 6 . 3** Bicycle chains are made from an alloy of iron.

Bicycle chains rust without protection.

Paint is **not** used to protect bicycle chains from rusting.

Suggest how bicycle chains can be protected from rusting.

**[1 mark]**

**0 6 . 4** Bicycle frames can also be made from a composite of carbon fibres embedded in a polymer resin.

What description is given in this composite to:

- the carbon fibre component
- the polymer resin component?

**[2 marks]**

Carbon fibre _____

Polymer resin _____

**11**