AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.3.1

Corrosion and its prevention

Past-paper questions

Tier	**Higher**
Question groups	**28**
Available paper years	**2007–2025**

Using this booklet

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

Name: _____ **Date:** _____

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

4.10.3.1 Corrosion and its prevention

Question 01

January 2007 | CHY1H | Original Q1 | Legacy

1 (a) Two hundred years ago, scientists thought that the Earth was about 400 million years old. This estimate came from the idea that the centre of the Earth was still molten. More recently, measurement of radioactivity in rocks has shown that the Earth is much older than 400 million years.

Suggest **one** reason why scientists now know that the Earth is much older than 400 million years.

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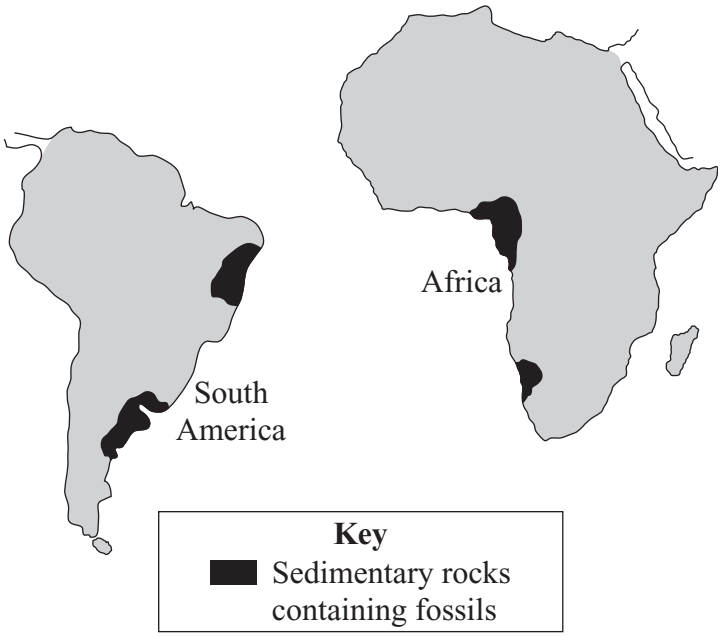
(1 mark)

(b) About one hundred years ago there was a scientist called Alfred Wegener. He found evidence that the continents, such as South America and Africa, had once been joined and then drifted apart.



Use the diagram to suggest **two** pieces of evidence that could be used to show that the continents had once been joined.

1 .....

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2 .....

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(2 marks)

4.10.3.1 Corrosion and its prevention

Question 01 · continued

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(c) About fifty years ago, new evidence convinced scientists that the Earth's crust is made up of tectonic plates that are moving very slowly.

Give **two** pieces of evidence that have helped to convince these scientists that the tectonic plates are moving.

1 .....

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2 .....

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(2 marks)

5

Turn over for the next question

4.10.3.1 Corrosion and its prevention

Question 02

March 2007 | CHY1A | Original Q5 | Legacy

QUESTION FIVE

Iron is about twice as strong as aluminium.

Some other properties of aluminium and iron are shown in the table.

	Electrical conductivity	Density in grams per cm^3	Resistance to corrosion
Aluminium	very good	2.7	good
Iron	good	7.8	poor

5A Iron is better than aluminium for making bridges.

This is because iron . . .

1 is a better insulator.

2 is more easily painted.

3 is stronger.

4 has a higher density.

5B Aluminium is better than iron for making cans for fizzy drinks.

The main reason is that . . .

1 aluminium conducts electricity better.

2 aluminium is harder.

3 iron cannot be recycled.

4 aluminium is more resistant to corrosion.

5C Aluminium has a low density and good electrical conductivity.

Which use for aluminium depends on **both** of these properties?

1 for cooking pans

2 for aeroplanes

3 for overhead power cables

4 for racing cars

4.10.3.1 Corrosion and its prevention

5D Most of the iron that is made is converted into steel.

Compared with low carbon steel, high carbon steel . . .

1 corrodes more quickly.

2 is a better electrical conductor.

3 is harder.

4 is more easily shaped.

Turn over for the next question

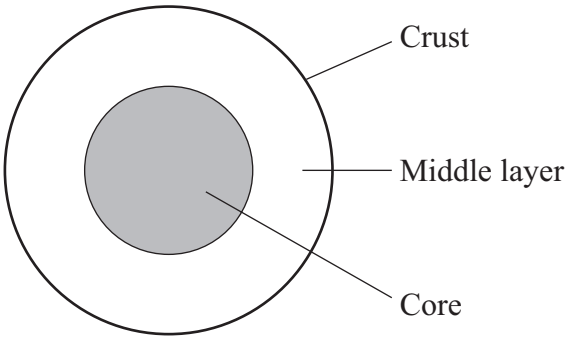
4.10.3.1 Corrosion and its prevention

Question 03

March 2007 | CHY1B | Original Q5 | Legacy

QUESTION FIVE

The diagram shows the layered structure of the Earth.



5A The middle layer is called the . . .

1 atmosphere.

2 lava.

3 magma.

4 mantle.

5B The material in the middle layer is moving slowly.

The movement is caused by . . .

1 the rotation of the Earth.

2 the drifting tectonic plates.

3 the cooling of the Earth.

4 heat from natural radioactive processes.

5C Mountains on the Earth's surface are caused by large-scale movements of the Earth's crust but scientists used to believe that they were caused by . . .

1 the movement of low density rocks above those that were more dense.

2 the activity of volcanoes.

3 shrinking of the crust after it was formed.

4 weathering and erosion.

4.10.3.1 Corrosion and its prevention

5D Much of the carbon dioxide that was present in Earth's early atmosphere is now locked up in . . .

1 fossil fuels and sedimentary carbonate rocks.

2 volcanic rocks and fossil fuels.

3 metal ores and sedimentary carbonate rocks.

4 landfill sites and volcanic rocks.

Turn over for the next question

4.10.3.1 Corrosion and its prevention

Question 04

June 2007 | CHY1A | Original Q1 | Legacy

QUESTION ONE

This question is about iron and steel.

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

A hard

B resistant to corrosion

C easily shaped

D brittle

Iron from the blast furnace has few uses because it is . . . **1** . . . .

A low carbon steel is used to make wire because it is . . . **2** . . . .

A high carbon steel is used to make hammers and chisels because it is . . . **3** . . . .

A stainless steel is used to make cutlery because it is . . . **4** . . . .

4.10.3.1 Corrosion and its prevention

Question 05 June 2007 | CHY1A | Original Q8 | Legacy

QUESTION EIGHT

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

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

carbon monoxide + nitrogen oxide → carbon dioxide + nitrogen

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

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

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

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

2 $CO + NO \rightarrow CO_2 + N_2$

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

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

8B Which substance is reduced in this reaction?

1 carbon monoxide

2 carbon dioxide

3 nitrogen oxide

4 nitrogen

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

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

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

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

4 Nitrogen is a poisonous gas.

4.10.3.1 Corrosion and its prevention

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

1 Transition metals are good conductors of heat and electricity.

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

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

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

Turn over for the next question

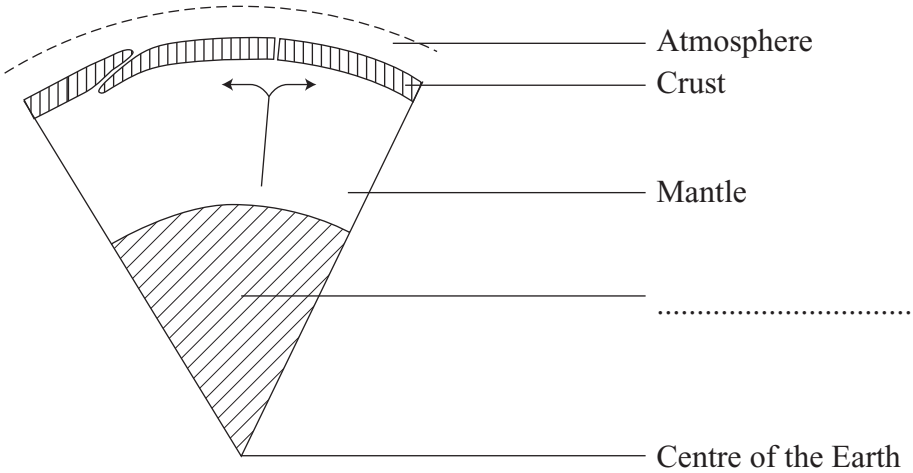
4.10.3.1 Corrosion and its prevention

Question 06

June 2007 | CHY1H | Original Q3 | Legacy

3 The Earth is shaped like a sphere and is surrounded by an atmosphere.

(a) The diagram shows a section of the layered structure of the Earth.



Not to scale

(i) Complete the diagram by writing in the missing label. *(1 mark)*

(ii) Earthquakes within the Earth's crust can be sudden and disastrous. Scientists cannot accurately predict when earthquakes will occur.

Explain why.

To obtain full marks you must support your answer with a description of what causes earthquakes.

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(4 marks)

4.10.3.1 Corrosion and its prevention

Question 06 · continued

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(b) Some theories suggest that the Earth's early atmosphere was like the atmosphere of Mars today.

Gases	The atmosphere of Mars today	The atmosphere of Earth today
Carbon dioxide %	95	0.03
Nitrogen %	3	
Argon %	1.5	0.97
Oxygen %	0.5	21

(i) Complete the table by writing in the percentage of nitrogen in the atmosphere of Earth today. *(1 mark)*

(ii) Use the information in the table to describe the changes that have happened to **two** of the gases in the Earth's atmosphere.

Explain what has caused these changes.

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(4 marks)

10

4.10.3.1 Corrosion and its prevention

Question 07

November 2007 | CHY1A | Original Q4 | Legacy

QUESTION FOUR

Jobs for bacteria – metal miners

Copper is found in the Earth's crust as the ore copper sulfide.

Traditionally, copper-rich ores are roasted and smelted to extract the metal.

Copper compounds can now be extracted from low-grade ores by bioleaching. In one type of bioleaching, the copper compounds are extracted from heaps of the crushed ore using bacteria.

- The bacteria live in the ore and gain their energy by slowly breaking down the copper compounds.
- The bacteria produce acidic solutions in which the copper compounds dissolve from the rocks and can be collected.
- The bacteria usually live at 35 °C to 40 °C. This means that breakdown of the compounds takes place only very slowly in the heaps of crushed ore.
- If these bacteria could work at a temperature 10 °C higher, then it is estimated that the rate of breakdown of the compounds would be twice as fast.

4A Which of the following is a disadvantage of extracting copper by bioleaching rather than by the traditional method?

1 Bioleaching allows us to use low-grade ores.

2 Bioleaching is more economical.

3 Bioleaching is slower.

4 Bioleaching uses less energy.

4B Copper compounds can be extracted more quickly from the ore in tanks at a temperature of 75 °C.

Where might bacteria able to work at this temperature be found?

1 in rivers running through rainforests

2 in polluted rivers

3 in streams on the sides of active volcanoes

4 in tropical seas

4.10.3.1 Corrosion and its prevention

Question 07 · continued

4C About 20% of the world's copper is now extracted from low-grade ores by bioleaching.

Some scientists think that this figure will steadily increase in the next few years.

An increase in the use of bioleaching may **not** happen if . . .

1 the price of copper increases dramatically.

2 large new deposits of high-grade ore are discovered.

3 the cost of energy rises quickly.

4 sulfur dioxide levels in the atmosphere reach dangerous levels.

4D Copper can be obtained from solutions containing copper compounds by . . .

1 electrolysis.

2 oxidation.

3 fractionation.

4 combustion.

4.10.3.1 Corrosion and its prevention

Question 08

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.

4.10.3.1 Corrosion and its prevention

Question 08 · continued

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.

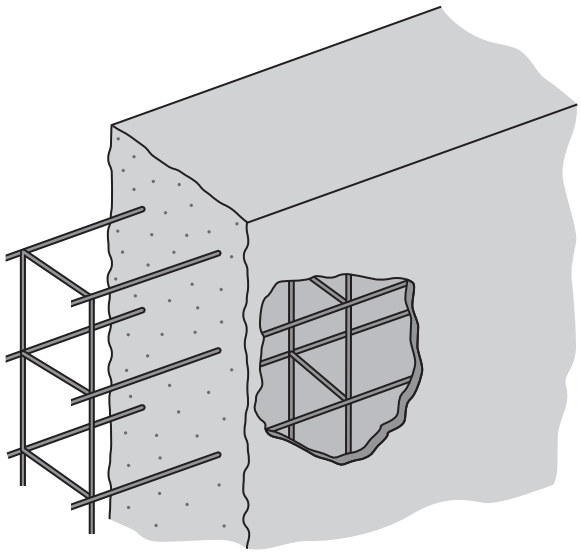
1 **W** and **X**

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

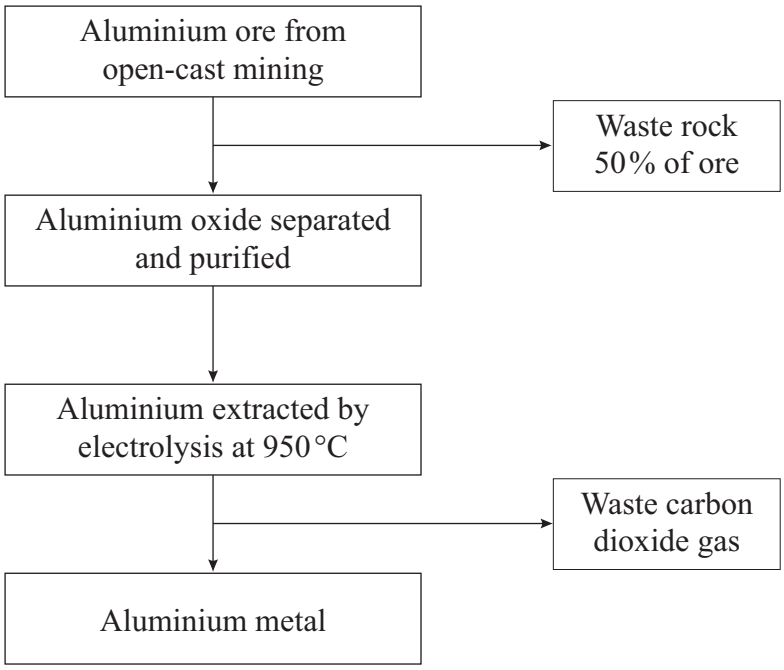
4.10.3.1 Corrosion and its prevention

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)

4.10.3.1 Corrosion and its prevention

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)

5

Turn over for the next question

4.10.3.1 Corrosion and its prevention

Question 10

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.

4.10.3.1 Corrosion and its prevention

Question 10 · 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

4.10.3.1 Corrosion and its prevention

Question 11

March 2009 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Movements in the Earth's crust can cause dramatic events such as volcanic eruptions.

8A Which of the following does **not** happen at plate boundaries?

1 Volcanoes form and lava is released.

2 Heat is produced by radioactive processes.

3 Subduction occurs and rocks melt.

4 Sea-floor spreading occurs and ridges form.

8B Scientists can predict with reasonable accuracy . . .

1 the areas in which volcanoes are likely to occur from data about previous eruptions.

2 the position of a volcanic eruption from movements of convection currents in the mantle.

3 the size of a volcanic eruption from the frequency of previous eruptions in the area.

4 the number of volcanic eruptions from slight movements of the Earth's crust.

Scientists measure the temperature of the gases coming out of a volcano. Raised temperatures are an indication of increased volcanic activity.

8C Which row in the table shows:

- the most appropriate method to present the data
- the expected trend which might predict an eruption?

	Method of presenting the data	Expected trend
1	line graph	direct proportionality
2	scattergram	positive correlation
3	bar chart	increasing volume of bars
4	pie chart	increase in the area of the sectors representing higher temperatures

4.10.3.1 Corrosion and its prevention

Question 11 · continued

8D The temperatures recorded by the scientists were found to be reproducible but consistently lower than the accurate value.

This was probably due to . . .

1 their readings being invalid.

2 their readings being taken with thermometers that were **not** sensitive enough.

3 their readings being averages that included anomalous results.

4 their thermometers being incorrectly calibrated.

Turn over for the next question

4.10.3.1 Corrosion and its prevention

Question 12

June 2009 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about three metals, copper, lead and zinc.

7A Copper is found in the Earth's crust as the metal itself.

Lead and zinc are also found in the Earth's crust, but only as compounds such as oxides and sulfides.

These facts suggest that . . .

1 copper is a very reactive metal.

2 lead and zinc are transition metals, but copper is not.

3 lead and zinc react rapidly with oxygen and sulfur, but copper does not.

4 lead and zinc are more reactive than copper.

7B A naturally occurring compound of zinc is hydrozincite, $2ZnCO_3.3Zn(OH)_2$

Which row in the table correctly shows the number of elements, and the number of atoms of oxygen in the formula for hydrozincite?

	Number of elements	Number of atoms of oxygen
1	4	12
2	4	8
3	5	5
4	6	4

Question 12 · continued

7C Zinc is also found as zincite, ZnO.

The metal can be extracted from zincite by mixing it with carbon and heating strongly.

Which row in the table correctly shows the name for this process and the products?

	Name of process	Products
1	electrolysis	zinc and carbon dioxide
2	leaching	zinc and oxygen
3	reduction	zinc and oxygen
4	reduction	zinc and carbon dioxide

Lead and zinc compounds are often found together in the same ore.

The metals can be extracted by mixing the ore with carbon and heating strongly in a furnace. They can then be separated.

The table shows the melting points and boiling points of lead and zinc.

	Lead	Zinc
Melting point in °C	328	420
Boiling point in °C	1740	907

The furnace operates at a temperature of 1200 °C.

7D How will the lead and zinc be separated?

1 Molten lead remains in the furnace and the zinc evaporates.

2 Molten lead and molten zinc form two separate layers in the furnace.

3 Molten zinc remains in the furnace and the lead evaporates.

4 Zinc and lead vapours leave the furnace and are separated in a condenser.

4.10.3.1 Corrosion and its prevention

Question 13

June 2009 | CHY1H | Original Q3 | Legacy

3 There are many ideas about the formation of the Earth and its atmosphere from a molten ball of rock and minerals.

3 (a) One idea is that the Earth's early atmosphere and average surface temperature were probably like that of Venus today.

The table shows information about the Earth and Venus today.

	Percentage composition of atmosphere	
Name of gas	**Earth today**	**Venus today**
Nitrogen	78	3.5
Oxygen	21	a trace
Argon	0.97	a trace
Carbon dioxide	0.03	96.5
Average surface temperature	20 °C	460 °C

There is a variable amount of water vapour in both atmospheres.

3 (a) (i) How was the Earth's early atmosphere formed?

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(1 mark)

3 (a) (ii) The Earth's average surface temperature decreased over time. At what temperature would oceans have started to form?

Temperature = ... °C

(1 mark)

3 (a) (iii) Describe how the evolution of plants changed the Earth's atmosphere.

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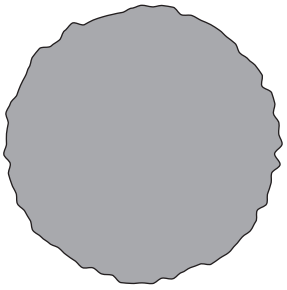
(2 marks)

4.10.3.1 Corrosion and its prevention

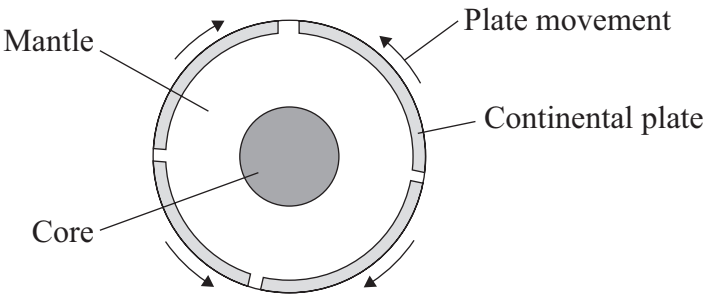
Question 13 · continued

for mark

3 (b) Another idea was that the Earth's mountains and continents formed in fixed positions as the molten ball of rock and minerals cooled and wrinkled.



Wegener, in 1915, had the idea that the Earth's crust and the upper part of the mantle had cracked into plates that were able to move. His idea meant that the mountains and continents were not in fixed positions.



3 (b) (i) Give **one** piece of evidence that led to Wegener's idea being accepted.

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(1 mark)

3 (b) (ii) Describe what causes the Earth's tectonic plates to move.

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(3 marks)

8

4.10.3.1 Corrosion and its prevention

Question 14

March 2010 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about types of reactions.

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

A reduction

B combustion

C thermal decomposition

D corrosion

	Example of the type of reaction
1	Copper carbonate forms copper oxide and carbon dioxide when heated.
2	Hydrogen reacts with oxygen to produce water.
3	Carbon steels react when exposed to air and water.
4	Zinc is obtained from zinc oxide by removal of the oxygen.

4.10.3.1 Corrosion and its prevention

Question 15

March 2010 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

This question is about the Earth.

7A The density of the Earth's crust is about 2800 kg per m^3, but the overall density of the Earth is about 5500 kg per m^3.

A valid conclusion from this information is that . . .

1 the mantle is denser than the crust.

2 the core is denser than the crust.

3 the average density of the core and mantle is greater than the density of the crust.

4 the average density of the core and mantle is less than the density of the crust.

7B The rocks of the mantle are semi-molten because of . . .

1 the heat retained from when the Earth was first formed from the Sun.

2 the frictional forces between the core and the mantle.

3 the decay of radioactive substances in the mantle.

4 the atmosphere absorbing radiation from the Sun.

7C Earthquakes occur at plate boundaries because . . .

1 the plates expand against each other due to the heat of the magma.

2 the plates move past each other due to convection currents in the mantle.

3 the plates slowly contract away from each other as the Earth cools.

4 the plates push past each other due to the expansion of the core.

4.10.3.1 Corrosion and its prevention

Question 15 · continued

7D Scientists can predict the regions where earthquakes will occur, but not when they will occur.

This is because . . .

1 earthquakes occur at random intervals.

2 earthquakes usually occur deep in the oceans.

3 earthquakes occur in ten-year or twenty-year cycles.

4 earthquakes occur infrequently and vary in strength.

Turn over for the next question

4.10.3.1 Corrosion and its prevention

Question 16

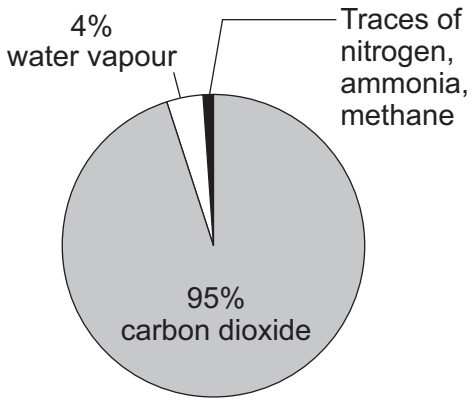
June 2010 | CHY1H | Original Q2 | Legacy

2 (a) Scientists have suggested that:

- the Earth formed as a molten ball of rock and minerals
- the rock and minerals cooled slowly
- the surface of the Earth was covered by volcanoes
- the volcanoes released gases that formed the Earth's early atmosphere.

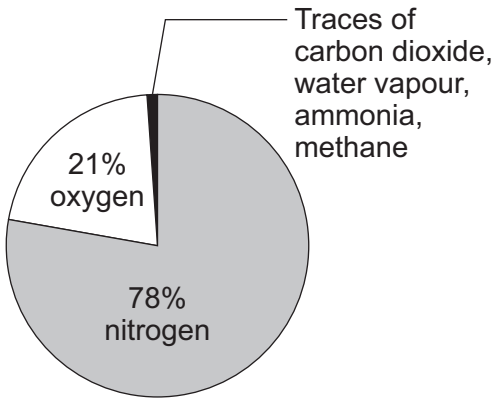
The pie charts show the approximate percentages of gases in the Earth's early atmosphere and in the Earth's atmosphere today.

Earth's early atmosphere



Average surface temperature above 400 °C

Earth's atmosphere today



Average surface temperature 20 °C

2 (a) (i) Explain what has happened to most of the water vapour in the Earth's early atmosphere.

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(2 marks)

2 (a) (ii) Give **two** reasons why the percentage of carbon dioxide in the Earth's early atmosphere decreased.

1 .....

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2 .....

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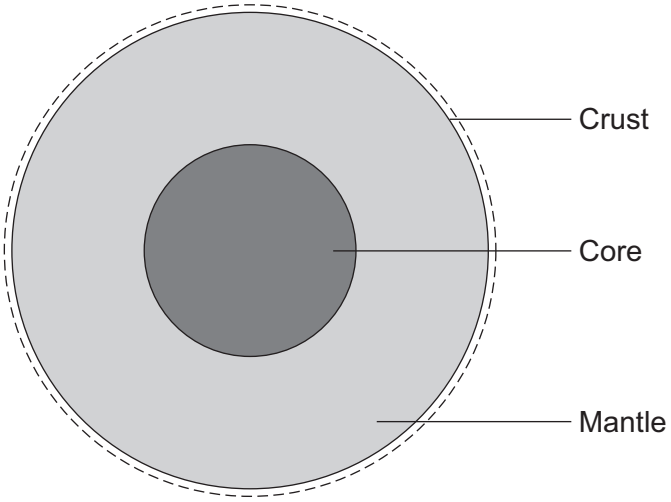
(2 marks)

4.10.3.1 Corrosion and its prevention

Question 16 · continued

2 (b) Scientists have suggested that the Earth consists of a core, mantle and crust.



A 'traditional' theory is that the core is made of iron and nickel.

A 'controversial' theory is that the core is like a nuclear reactor made of the radioactive elements uranium and plutonium.

2 (b) (i) Why can scientists **not** prove which theory about the core is correct?

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(1 mark)

2 (b) (ii) How can the 'controversial' theory be used to explain why the Earth's tectonic plates move?

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(3 marks)

8

4.10.3.1 Corrosion and its prevention

Question 17

January 2011 | CHY1H | Original Q1 | Legacy

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.

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(1 mark)

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

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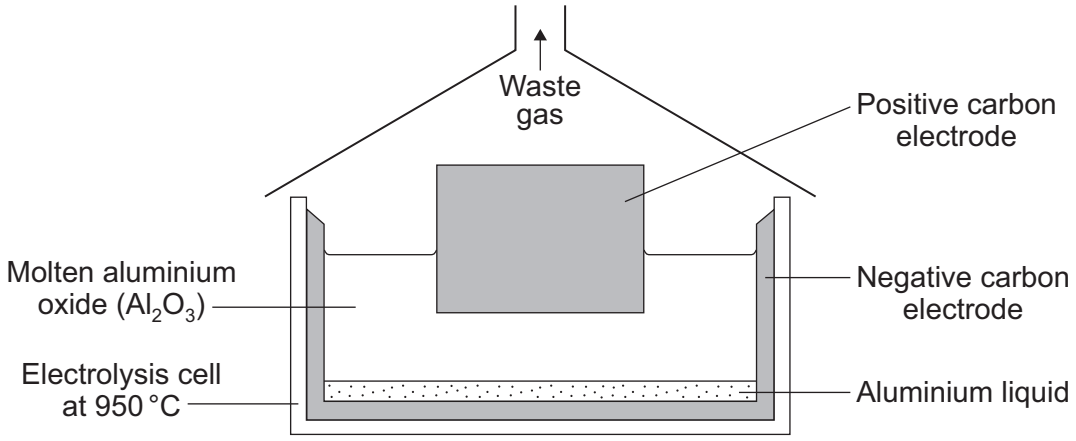
(1 mark)

4.10.3.1 Corrosion and its prevention

Question 17 · 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.

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(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.

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(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 .....

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2 .....

.....

(2 marks)

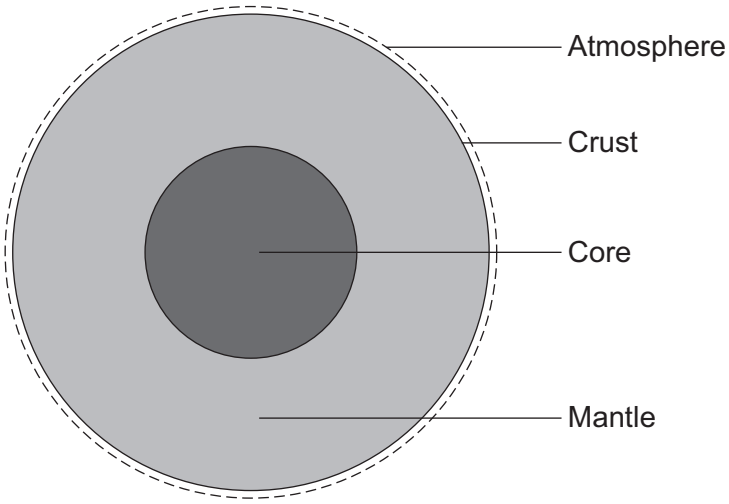
7

4.10.3.1 Corrosion and its prevention

Question 18

January 2011 | CHY1H | Original Q3 | Legacy

3 The Earth has a layered structure and is surrounded by an atmosphere.



3 (a) Scientists believe that the Earth's atmosphere was formed by volcanoes releasing gases.
This early atmosphere was about 95 % carbon dioxide.
The composition of the Earth's atmosphere is always changing.

3 (a) (i) The Earth's atmosphere today contains about 0.035 % carbon dioxide.

What happened to most of the carbon dioxide that was in the Earth's early atmosphere?

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(2 marks)

3 (a) (ii) About 60 million years ago a large meteorite hit the Earth.
This meteorite heated limestone in the Earth's crust causing the release of large amounts of carbon dioxide.

Explain how carbon dioxide is released from limestone.

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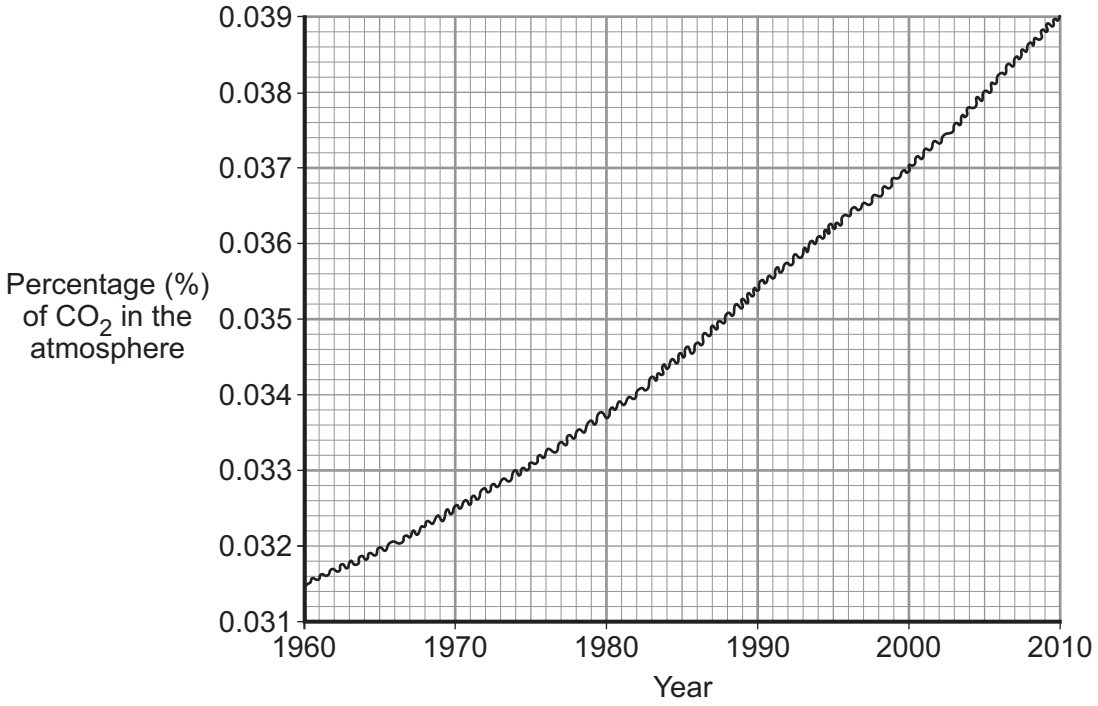
(2 marks)

4.10.3.1 Corrosion and its prevention

Question 18 · continued

3 (b) The graph shows the percentage of carbon dioxide in the Earth's atmosphere over the last 50 years.



Explain, as fully as you can, why we should be concerned about the information displayed on this graph.

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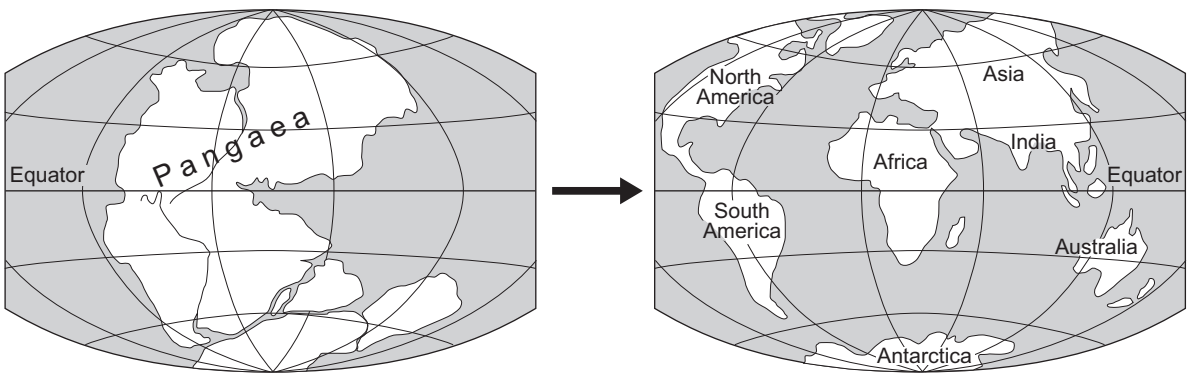
(3 marks)

Question 3 continues on the next page

Question 18 · continued

3 (c) Scientists believe that all the continents of the Earth were once joined together. The huge 'supercontinent' was called Pangaea.



200 million years ago **Today**

In 1915, Alfred Wegener had an idea that the change shown in the diagram was caused by *continental drift*. Most scientists could not accept his idea.

3 (c) (i) Suggest why most scientists in 1915 could not accept Wegener's idea of *continental drift*.

.....

.....

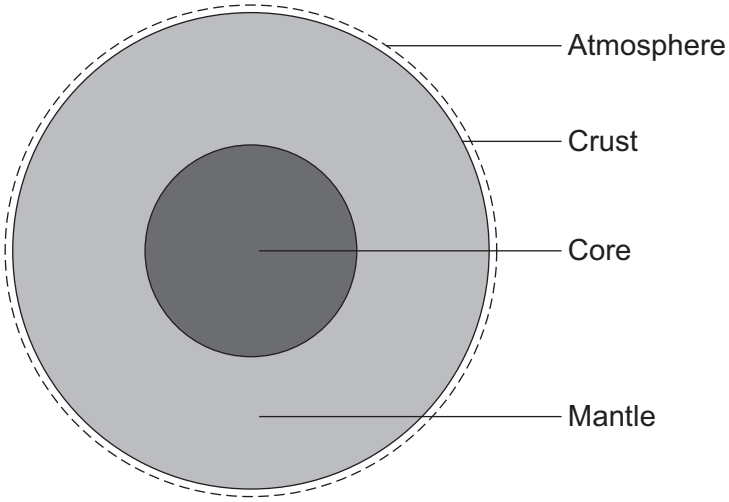
(1 mark)

4.10.3.1 Corrosion and its prevention

Question 18 · continued

To help you with this question, the information and diagram from the beginning of the question are reprinted here.

The Earth has a layered structure and is surrounded by an atmosphere.



3 (c) (ii) Use this information and your knowledge and understanding to explain how continents move.

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(3 marks)

11

4.10.3.1 Corrosion and its prevention

Question 19

January 2011 | CHY1H | Original Q4 | Legacy

4 Titanium is used for replacement hip joints because it has a low density, is strong and does not corrode.
Titanium is extracted from titanium dioxide (TiO_2) in three stages.

4 (a) **Stage 1**
Titanium dioxide is converted into titanium chloride ($TiCl_4$) because the metal cannot be extracted from its oxide by *reduction* with carbon.

4 (a) (i) What does *reduction* mean?

.....

.....

(1 mark)

4 (a) (ii) Balance the chemical equation for the conversion of titanium dioxide to titanium chloride.

TiO_2 + Cl_2 + C → $TiCl_4$ + CO_2

(1 mark)

4 (a) (iii) Chemical equations are always balanced. Explain why.

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.....

.....

(1 mark)

4 (b) **Stage 2**
Titanium is extracted from the titanium chloride by reacting it with sodium at 1000 °C in a reactor.
The only other substance in the reactor is argon gas.

$TiCl_4$ + 4Na → Ti + 4NaCl

4 (b) (i) What does this tell you about the reactivity of sodium compared with titanium?

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.....

(1 mark)

4 (b) (ii) Suggest why the reactor contains argon and **not** air.

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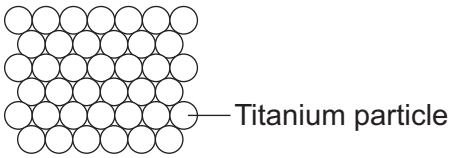
(1 mark)

4.10.3.1 Corrosion and its prevention

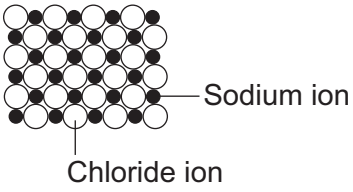
Question 19 · continued

4 (c) **Stage 3**
After **Stage 2** the titanium is separated from the products by washing out the sodium chloride with water.
The diagrams show sections through the lattice of titanium metal and the lattice of sodium chloride.

Titanium



Sodium chloride



How do the diagrams show that:

4 (c) (i) titanium is an element

.....

.....

(1 mark)

4 (c) (ii) sodium chloride is a compound?

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(2 marks)

8

4.10.3.1 Corrosion and its prevention

Question 20

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

4.10.3.1 Corrosion and its prevention

Question 20 · 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.

4.10.3.1 Corrosion and its prevention

Question 21

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.

4.10.3.1 Corrosion and its prevention

Question 21 · 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

4.10.3.1 Corrosion and its prevention

Question 22

January 2012 | CH1HP | Original Q3 | Legacy

3 There are about 500 000 earthquakes every year. On 12 January 2010 there was an earthquake near Port-au-Prince in Haiti. Many buildings were destroyed causing the deaths of thousands of people. The earthquake did not come as a surprise to scientists who predicted the earthquake a week earlier. The Government and people ignored the prediction.



The Richter scale is used to compare the size of earthquakes.

Richter scale value	Effect of earthquake
Less than 2	People do not feel the earthquake.
2 – 4	People feel the earthquake but the earthquake rarely causes damage to buildings.
4 – 5	People feel the earthquake and the earthquake causes minor damage to a few buildings.
5 – 6	Shaking of the ground and major damage to some buildings.
6 – 8	Violent shaking of the ground and many buildings destroyed.
8 – 10	Very violent shaking of the ground and most buildings destroyed.

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

3 (a) (i) Suggest the Richter scale value for the earthquake that happened near Port-au-Prince in Haiti.

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(1 mark)

3 (a) (ii) Governments and people often ignore scientists' predictions of an earthquake.

Suggest **three** reasons why.

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4.10.3.1 Corrosion and its prevention

Question 22 · continued

2 .....

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3 .....

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(3 marks)

3 (b) During the twentieth century many scientists proposed ideas about the cause of earthquakes and about the Earth's crust.
In 1912 Alfred Wegener proposed his idea of '*continental drift*'.
In 1930 Arthur Holmes suggested his idea of '*mantle dynamics*'.

3 (b) (i) What did Wegener mean by *'continental drift'*?

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(2 marks)

3 (b) (ii) Holmes' idea of '*mantle dynamics*' provided an explanation for Wegener's idea of *'continental drift'*.

Suggest what *'mantle dynamics'* is and state what causes *'mantle dynamics'*.

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(2 marks)

8

4.10.3.1 Corrosion and its prevention

Question 23

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).

Iron	Titanium
Iron oxide is reacted with coke (carbon) at 1500 °C in a furnace to produce molten cast iron. Cast iron contains iron and about 4% carbon.	Titanium oxide is reacted with chlorine at 1000 °C to produce titanium chloride. Titanium chloride is cooled and collected.
↓	↓
Oxygen is blown into molten cast iron and molten recycled iron at 1500 °C in a furnace to produce low-carbon steel. Low-carbon steel contains iron and about 0.1% carbon.	Titanium chloride is reacted with magnesium at 1100 °C in a sealed reactor for 3 days. The sealed reactor contains an atmosphere of argon gas.
	↓
	The reactor is allowed to cool. The reactor is opened and the titanium is separated from the other product, magnesium chloride.

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)

4.10.3.1 Corrosion and its prevention

Question 23 · 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

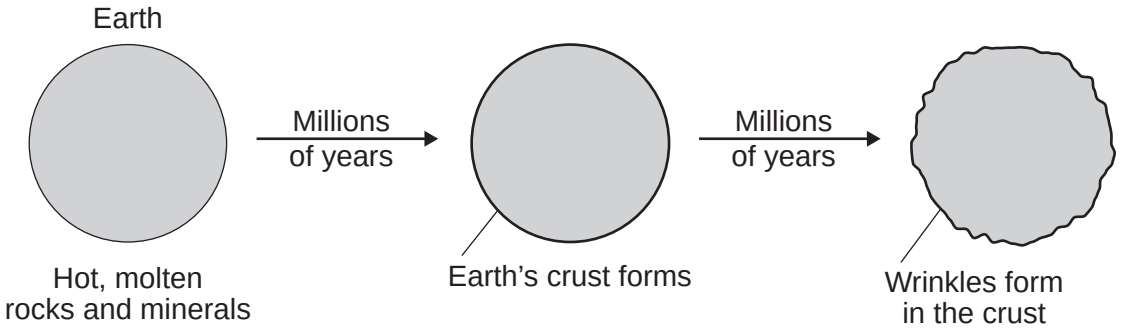
4.10.3.1 Corrosion and its prevention

Question 24

June 2013 | CH1HP | Original Q6 | Legacy

6 There were many ideas about how the Earth was formed from a molten ball of rock and minerals.

At one time scientists thought the features of the Earth were caused when the molten ball of rock and minerals cooled and wrinkled.



6 (a) Scientists now have evidence that the Earth has a layered structure.

Describe the layered structure of the Earth. You should indicate the relative sizes of the layers.

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(3 marks)

6 (b) At one time scientists thought the Earth's continents were formed in fixed positions when the molten ball of rock and minerals cooled and wrinkled.

In 1912, the scientist Alfred Wegener suggested his idea about how Earth's continents formed.

Describe Wegener's idea of how Earth's continents formed.

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(2 marks)

5

4.10.3.1 Corrosion and its prevention

Question 25

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 ☐

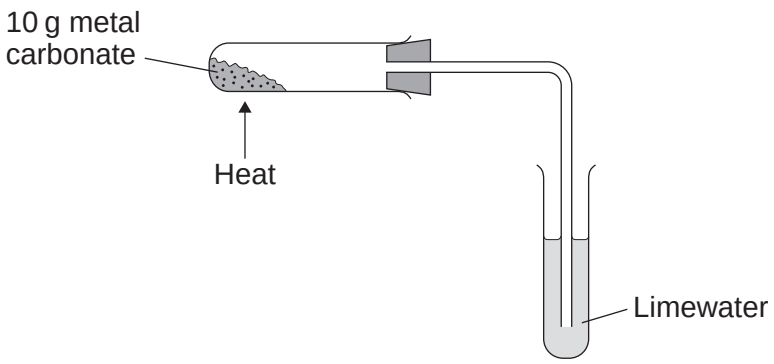
copper oxide ☐

copper sulfide ☐

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

Figure 4 shows the apparatus used.

Figure 4



4.10.3.1 Corrosion and its prevention

Question 25 · 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]

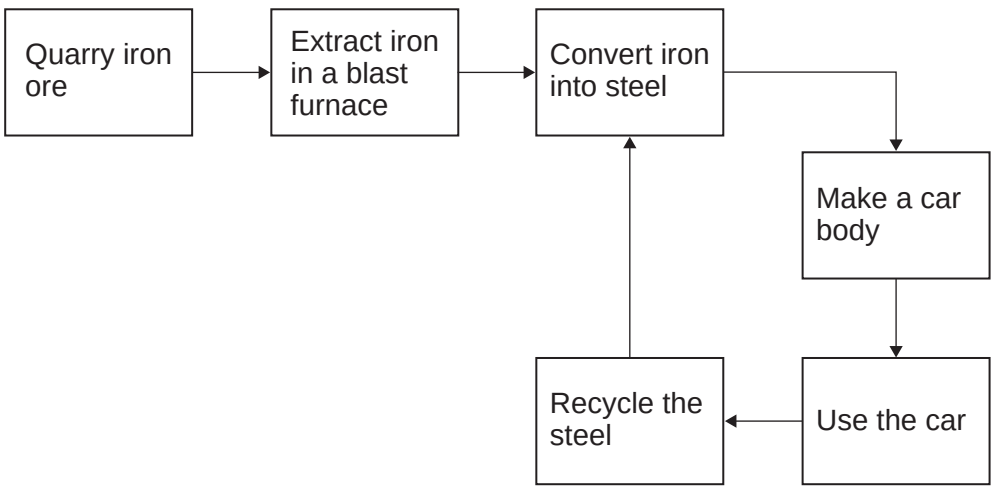
Question 3 continues on the next page

4.10.3.1 Corrosion and its prevention

Question 25 · 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]

_____

_____

_____

_____

4.10.3.1 Corrosion and its prevention

Question 25 · 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

4.10.3.1 Corrosion and its prevention

Question 26

June 2019 | 8462/2H | Original Q4

0 4 This question is about the corrosion of metals.

The corrosion of iron is called rusting.

0 4 . 1 A student investigated the rusting of iron.

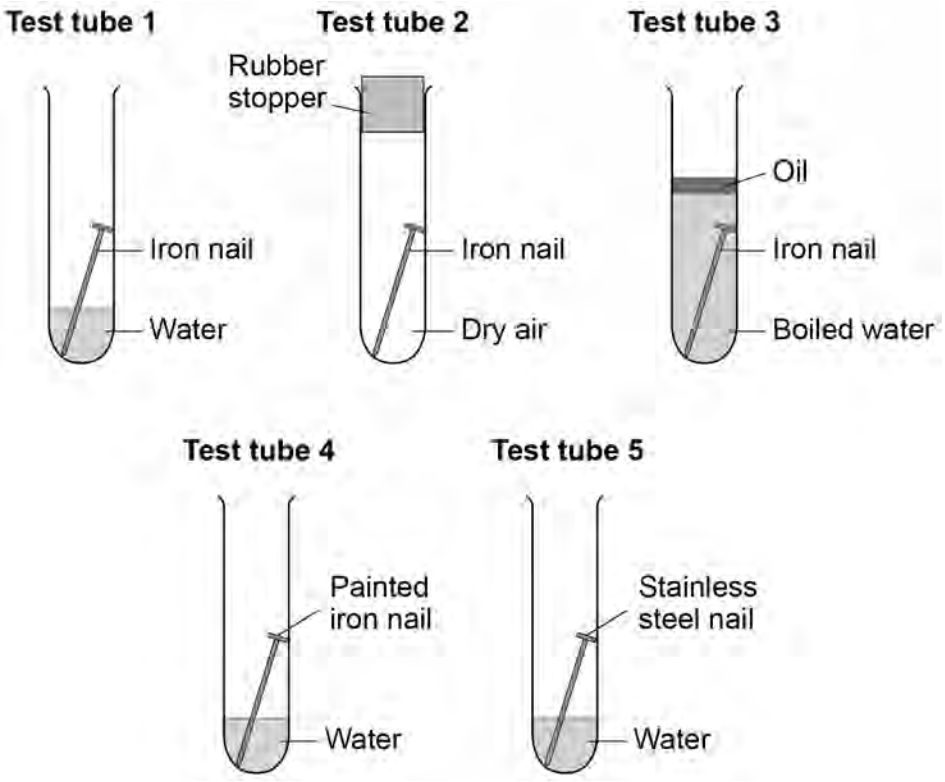
This is the method used.

1. Set up the test tubes as shown in **Figure 4**.

2. Leave the test tubes for 1 week.

3. Examine the nails for signs of rust.

Figure 4



Explain what would happen to the nails in each of the test tubes.

[5 marks]

4.10.3.1 Corrosion and its prevention

Question 26 · continued

0 4 . 2 Magnesium is fixed to some steel ships.

Explain how this prevents the steel from rusting.

[2 marks]

0 4 . 3 Explain why aluminium window frames do **not** corrode after they are made.

[2 marks]

9

4.10.3.1 Corrosion and its prevention

Question 27

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

4.10.3.1 Corrosion and its prevention

Question 27 · 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

4.10.3.1 Corrosion and its prevention

Question 27 · 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

4.10.3.1 Corrosion and its prevention

Question 28

June 2025 | 8462/2H | Original Q3

0 3 Doors can be made from aluminium or wood.

0 3 . 1 **Table 3** gives information about aluminium and wood.

Table 3

	Aluminium	**Wood**
Raw material	Metal ore from rock	Trees
Relative cost of 1 kilogram of material	87	1
Relative strength	1.3	1.0
Protection	No protection needed to prevent corrosion	Painted to prevent rotting
Disposal	Melted to form new products	Shredded into wood chips for fuel

Evaluate the use of aluminium and of wood for making doors.

[6 marks]

Extra space

4.10.3.1 Corrosion and its prevention

Question 28 · continued

0 3 . 2 Aluminium has an oxide coating that protects the metal from corrosion.

Explain how the oxide coating protects aluminium from corrosion.

[2 marks]

0 3 . 3 Doors made from wood need painting to prevent rotting.

Paints are **formulations** made by mixing a solid pigment and a liquid.

Which statement describes the composition of a paint?

[1 mark]

Tick (✓) **one** box.

- A fixed mass of pigment and a fixed mass of liquid ☐
- A fixed mass of pigment and a variable mass of liquid ☐
- A variable mass of pigment and a fixed mass of liquid ☐
- A variable mass of pigment and a variable mass of liquid ☐

9