Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
June 2007

SCIENCE A **CHY1A**
Unit Chemistry C1a (Products from Rocks)

CHEMISTRY
Unit Chemistry C1a (Products from Rocks)

Monday 25 June 2007 Morning Session

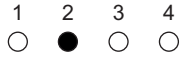
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

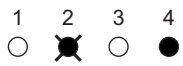
Time allowed: 30 minutes

Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Products from Rocks' printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

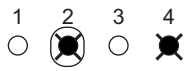
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown:



- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown:



Information
- The maximum mark for this paper is 36.

Advice
- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 of this booklet.

FOUNDATION TIER

SECTION ONE

Questions **ONE** to **SIX**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

The balanced, symbol equation shows the atoms involved in a chemical reaction.

$Fe_2O_3(s)$	+	$3CO(g)$	→	$2Fe(s)$	+	$3CO_2(g)$
iron oxide		carbon monoxide		iron		carbon dioxide

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

A atom

B compound

C element

D symbol

O is the . . . **1** . . . for oxygen.

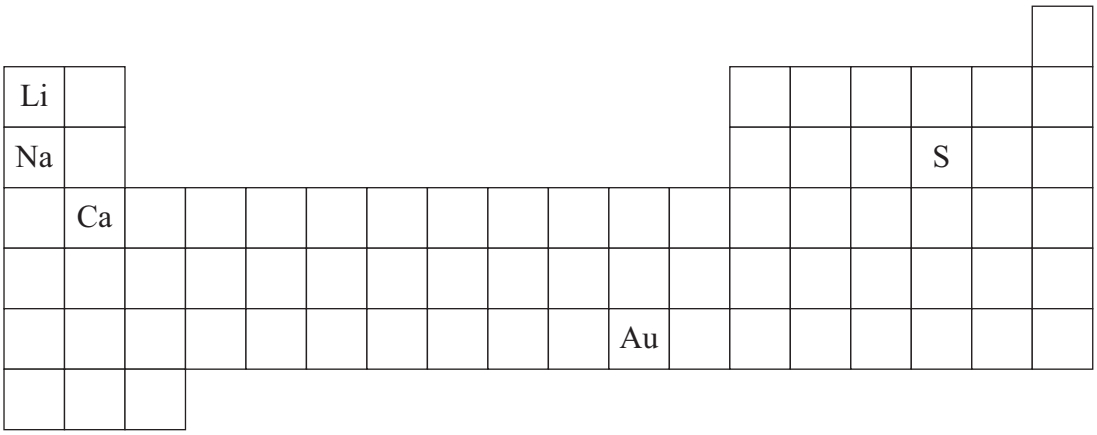
Fe_2O_3 is the formula for the . . . **2** . . . , iron oxide.

Fe represents one . . . **3** . . . of iron.

Carbon is a soft, black, non-metal . . . **4** . . . .

QUESTION TWO

The diagram shows the position of some elements in the periodic table.



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

A gold (Au)

B lithium (Li)

C calcium (Ca)

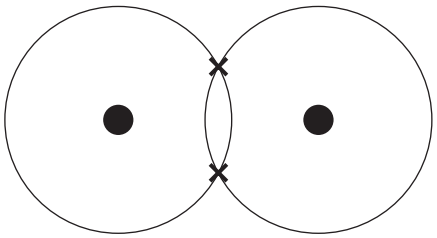
D sulfur (S)

	What we can say about the element
1	It is combined with the element oxygen in quicklime.
2	It is in a compound that produces acid rain.
3	It is an unreactive transition metal.
4	It has similar chemical properties to sodium.

Turn over for the next question

QUESTION THREE

The diagram shows how two atoms of hydrogen are joined.



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

A a bond

B an electron

C a molecule

D a nucleus

In the diagram, ● represents . . . **1** . . . and ✕ represents . . . **2** . . . .

The two atoms are held together by . . . **3** . . . to form . . . **4** . . . of hydrogen.

QUESTION FOUR

These are some of the properties of four metals.

Metal		Electrical conductivity	Density in grams per cm^3	Melting point in °C	Boiling point in °C
A	Aluminium	very good	2.7	660	2470
B	Iron	good	7.8	1535	2750
C	Mercury	very good	13.6	–39	357
D	Potassium	good	0.9	64	774

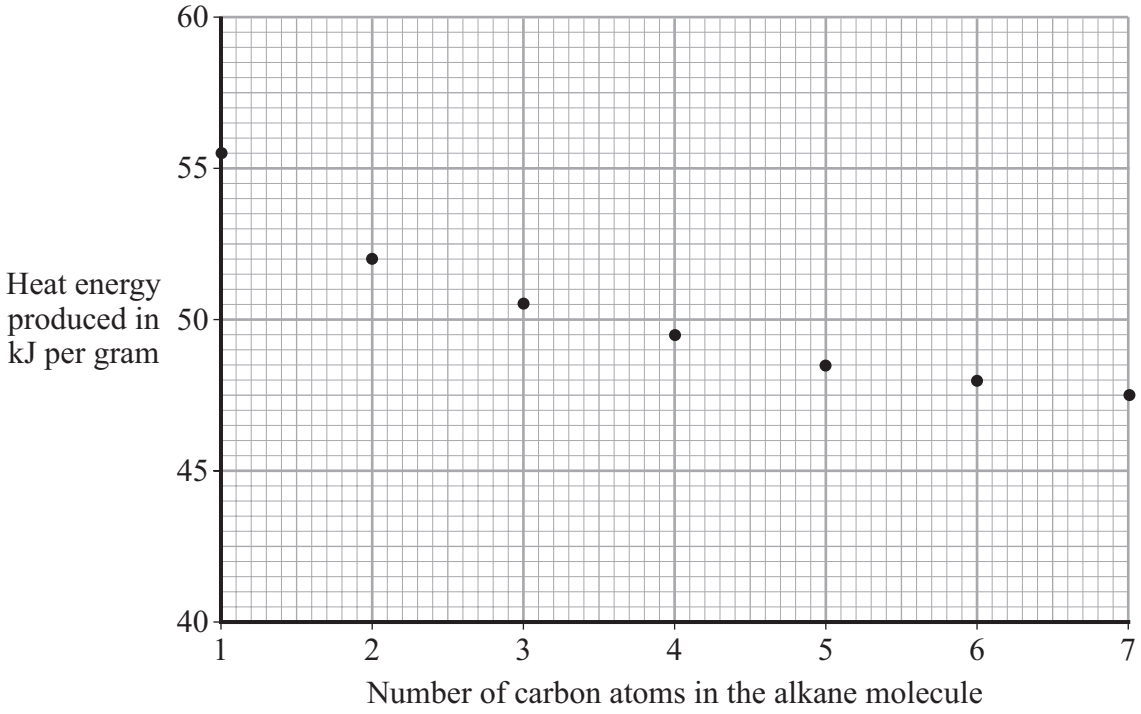
Match metals, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the table.

	What we can say about the metal
1	It is a liquid at room temperature (20 °C).
2	It is used in making overhead electricity cables because it is a very good conductor and has a low density.
3	It has the highest melting and boiling points.
4	It will float on a liquid which has a density of 1.0 grams per cm^3.

Turn over for the next question

QUESTION FIVE

The graph shows how much heat energy is produced when 1 gram of each of seven alkanes is burned.



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

A one

B four

C five

D seven

The alkane that burns to give out 48.5 kJ of heat per gram has a molecule with . . . **1** . . . carbon atom(s).

The alkane that burns to give out most heat per gram has a molecule with . . . **2** . . . carbon atom(s) and . . . **3** . . . hydrogen atom(s).

The alkane with six carbon atoms in each molecule will have a lower boiling point than the alkane with . . . **4** . . . carbon atom(s) in each molecule.

QUESTION SIX

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** . . . .

Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SEVEN

The table shows what happens to some metal carbonates when they are heated in a Bunsen burner flame.

Name of carbonate	What happens when heated
Sodium carbonate	melts at 851°C but decomposes only at much higher temperatures
Calcium carbonate	decomposes at 825 °C
Magnesium carbonate	decomposes at 350 °C
Zinc carbonate	decomposes at 300 °C
Silver carbonate	decomposes at 220 °C

The information below may help you to answer some parts of this question.

	Reactivity series for some metals	
Non-transition metals	Sodium Calcium Magnesium Aluminium	Most reactive
Transition metals	Zinc Iron Copper Silver	Least reactive

7A What pattern, if any, can be seen in these results for the action of heat on metal carbonates?

1 All metal carbonates decompose when they are heated in a Bunsen burner flame.

2 Carbonates of the more reactive metals decompose at higher temperatures.

3 Carbonates of the transition metals decompose at higher temperatures.

4 There is no pattern to the results.

7B Potassium carbonate melts at 891°C but does not decompose.

What is the probable position of potassium in the reactivity series?

1 below silver

2 between silver and copper

3 between calcium and sodium

4 above sodium

7C What is produced by all metal carbonates when they decompose?

1 oxygen

2 hydrogen

3 a metal oxide

4 a hydrocarbon

7D 3.10 grams of copper carbonate are heated in a test tube until completely decomposed.
1.10 grams of carbon dioxide are collected and a black compound is left in the test tube.

What is the mass of the black compound?

1 1.10 grams

2 2.00 grams

3 3.41 grams

4 4.20 grams

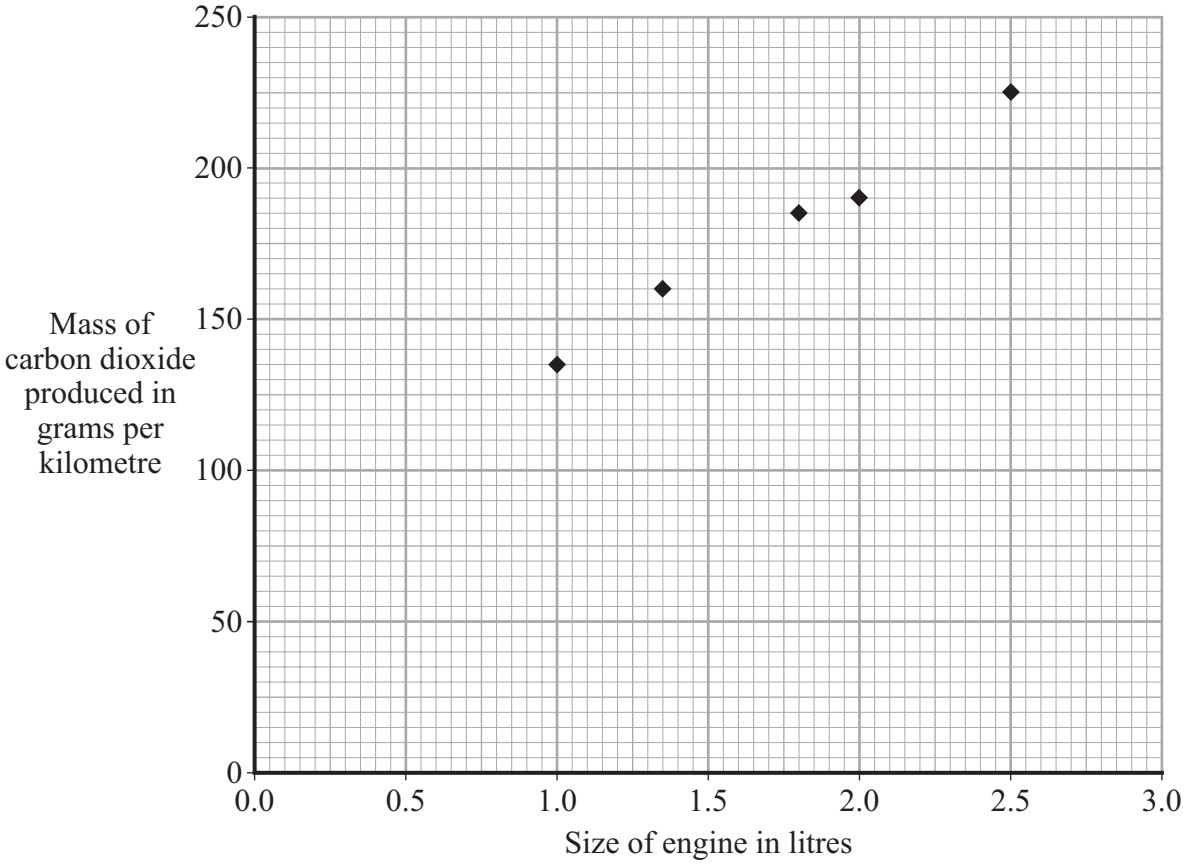
Turn over for the next question

QUESTION EIGHT

Technicians at a car manufacturing company carried out tests on carbon dioxide emissions from their new range of cars.

First, they tested a small, lightweight, four-seater car with a 1.0 litre petrol engine.
They repeated the tests on similar cars, under similar conditions but with different engine sizes.

The results of their tests are shown on the graph.



8A What relationship is supported by these data?

1 Large engines produce more carbon dioxide per kilometre than small engines.

2 Small engines are more economical than large engines.

3 The mass of carbon dioxide produced per kilometre is directly proportional to the engine size.

4 A 2.0 litre engine produces twice as much carbon dioxide per kilometre as a 1.0 litre engine.

8B What could the technicians do to improve the reliability of the data in this investigation?

1 repeat the tests with different numbers of passengers in the cars

2 repeat the tests and calculate the mean (average) mass of carbon dioxide produced

3 repeat the tests and use the lowest mass of carbon dioxide produced

4 repeat the tests and use the highest mass of carbon dioxide produced

8C A car salesman claimed that a large, heavy, eight-seater car with the same 2.5 litre petrol engine would produce only 225 grams of carbon dioxide per kilometre.

Was this a fair claim from the data?

1 No, because the reading on the graph is 230 grams of carbon dioxide per kilometre.

2 No, because the result may be different for a heavier vehicle.

3 Yes, because that is the value shown on the graph.

4 Yes, because a 2.5 litre engine will always give the same results.

8D In another series of tests under the same conditions, the small, lightweight, four-seater car with a 2.0 litre diesel engine produced 150 grams of carbon dioxide per kilometre.

What is the best conclusion about petrol and diesel engines that can be drawn from these data?

1 Diesel engines are more efficient than petrol engines.

2 Diesel engines always produce less carbon dioxide than petrol engines.

3 The type of fuel used in a car engine may affect the amount of carbon dioxide produced.

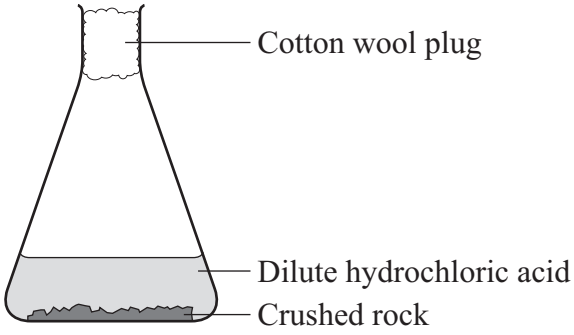
4 The type of fuel used in a car engine does not affect the amount of carbon dioxide produced.

Turn over for the next question

QUESTION NINE

A student wanted to find the percentage (%) of calcium carbonate in a rock sample that she had collected.

She used a small piece of the sample, crushed it, weighed it, and then set up her experiment as shown.



Bubbles of carbon dioxide were given off as the calcium carbonate in the crushed rock reacted with the acid.
She allowed the reaction to continue until no more bubbles were seen.

9A The student assumed that all the calcium carbonate in the samples had reacted when the bubbles stopped.

What else should she do to be sure that it had all reacted?

1 test to see whether there is any acid left in the mixture

2 allow the contents of the flask to cool to room temperature

3 add alkali to neutralise the solution in the flask

4 test to see whether there is any carbon dioxide in the flask

9B The student did the experiment four times and calculated the following results for the percentage of calcium carbonate in the rock.

67 %, **50 %**, **39 %**, **56 %**

What is the mean of her results?

1 28 %

2 53 %

3 56 %

4 67 %

9C One possible reason why there is so much variation in the four results is that . . .

1 there was an increase in the laboratory temperature.

2 there was a decrease in the laboratory temperature.

3 the hydrochloric acid was too strong.

4 calcium carbonate is not spread evenly through the rock sample.

9D A systematic error in the student's technique that could produce incorrect results is that . . .

1 other substances in the rock may react with hydrochloric acid.

2 the same mass of crushed rock was not used in each experiment.

3 the balance was not zeroed before each weighing.

4 a mistake was made in a calculation.

END OF TEST

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

SECTION ONE

Questions **ONE** and **TWO**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

Use **each** answer only **once**.

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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

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

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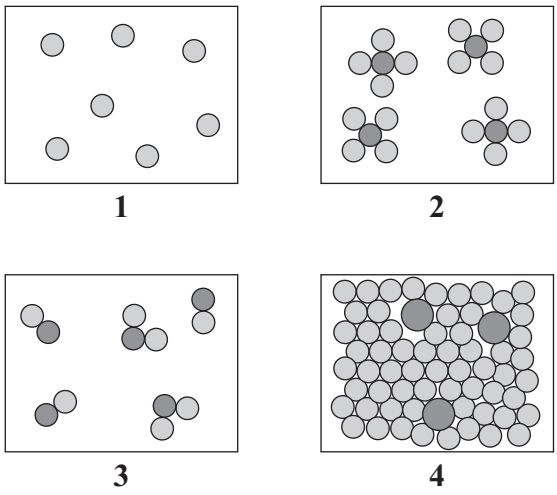
A high carbon steel is used to make hammers and chisels because it is . . . **3** . . . .

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

QUESTION TWO

The diagrams show the atoms in four different substances.



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

A an alloy

B an element

C a hydrocarbon

D a mixture of compounds

Turn over for the next question

SECTION TWO

Questions **THREE** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

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QUESTION THREE

Technicians at a car manufacturing company carried out tests on carbon dioxide emissions from their new range of cars.

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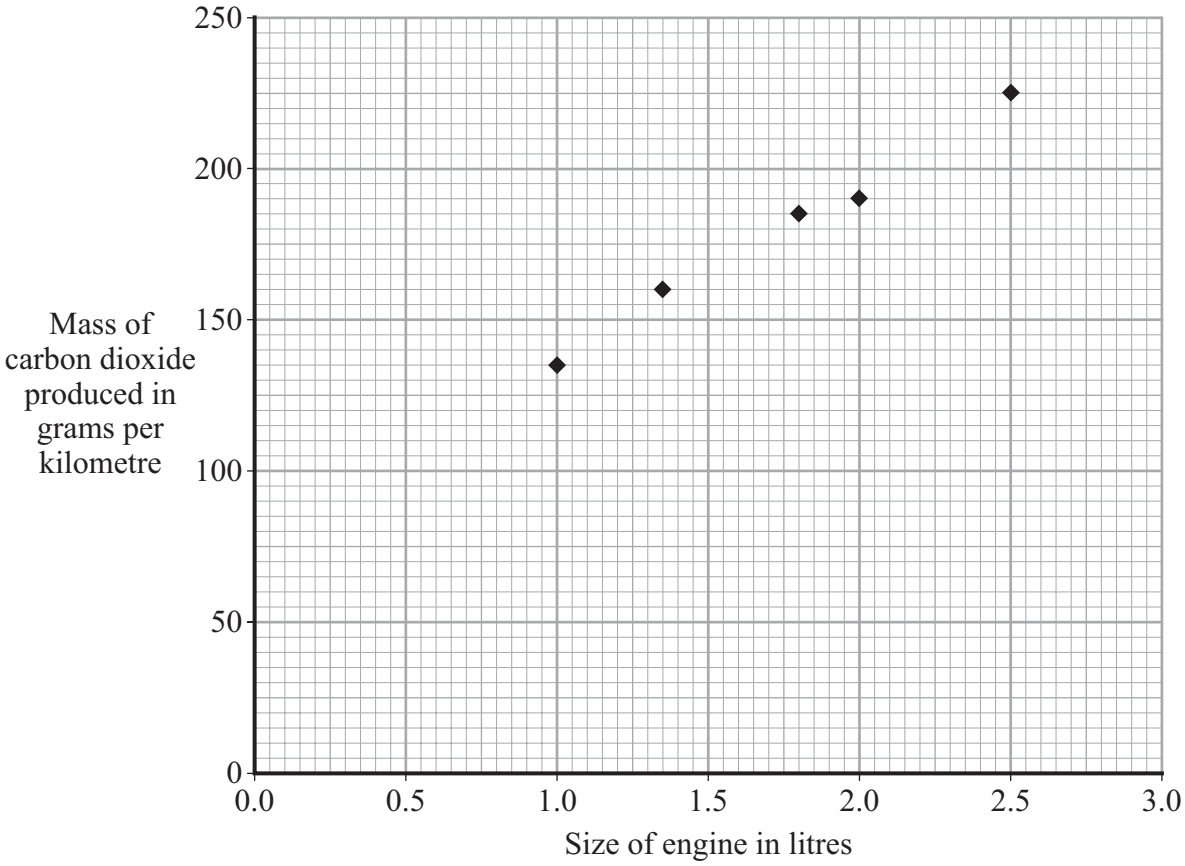

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Turn over for the next question

QUESTION FOUR

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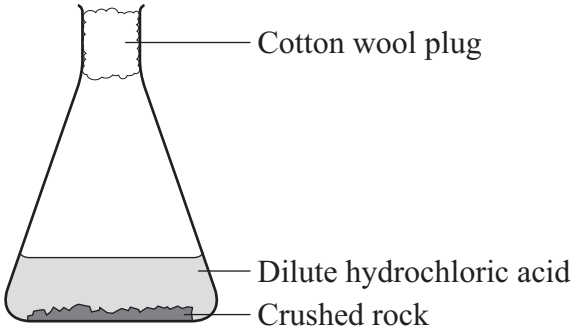

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4D A systematic error in the student's technique that could produce incorrect results is that . . .

1 other substances in the rock may react with hydrochloric acid.

2 the same mass of crushed rock was not used in each experiment.

3 the balance was not zeroed before each weighing.

4 a mistake was made in a calculation.

Turn over for the next question

QUESTION FIVE

This question is about the metals copper and zinc.

5A Copper and zinc can be extracted from their oxides by strongly heating the oxides with carbon.

In these reactions, the oxides are . . .

1 oxidised.

2 distilled.

3 reduced.

4 combined.

5B Copper can also be extracted by passing an electric current through . . .

1 solid copper oxide.

2 a solution of a copper compound.

3 a copper-rich ore.

4 impure copper.

5C There is a lot of research into new ways of extracting copper from low-grade ores.

One reason for this is . . .

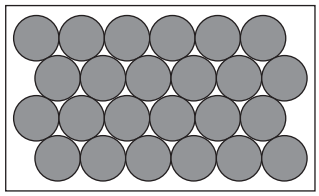
1 a significant rise in the price of copper.

2 more copper ore is being found.

3 a reduction in the use of copper.

4 low-grade ores contain more copper.

5D The diagram shows the arrangement of the atoms in pure copper.



Pure copper is quite soft. It can be made harder by mixing it with zinc.

This is because . . .

1 the copper atoms cannot now easily slide over each other.

2 the zinc atoms attach themselves strongly to the copper atoms.

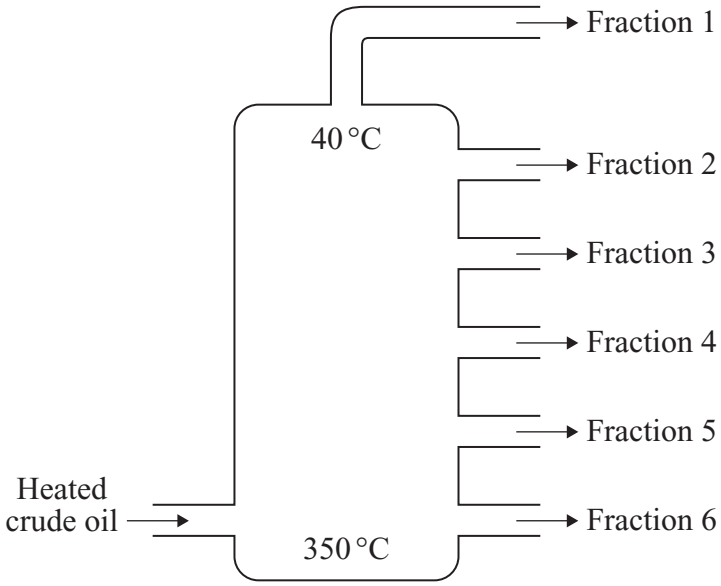
3 the zinc atoms form strong bonds with the copper atoms.

4 zinc is harder than copper.

Turn over for the next question

QUESTION SIX

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



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

1 it contains liquid and gaseous hydrocarbons.

2 it vaporises at about 350 °C.

3 it is a mixture of only two elements.

4 it is a mixture of hydrocarbons.

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

1 a hydrocarbon does not have a fixed boiling point.

2 not all fractions contain the same number of hydrocarbons.

3 not all fractions contain solid hydrocarbons.

4 each fraction is a mixture of hydrocarbons.

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

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

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

1 C_2H_4

2 C_3H_6

3 C_3H_8

4 $C_{12}H_{26}$

Turn over for the next question

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.

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

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.

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.

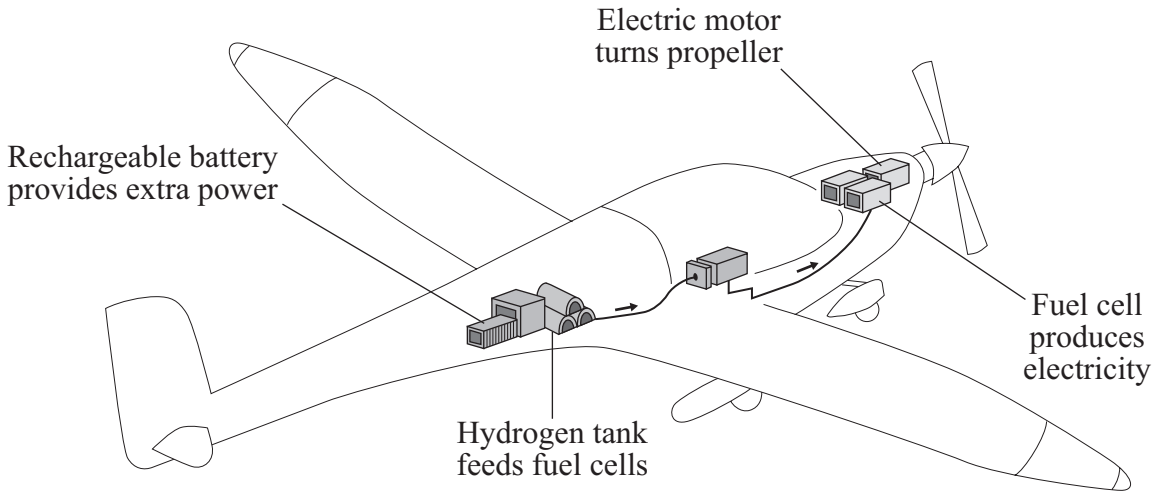
Turn over for the next question

QUESTION NINE

This information is an edited newspaper article about aircraft research.

Greening the skies

'Emission-free aircraft'



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

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

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

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

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

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

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

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

2 There is political pressure to reduce air travel.

3 Kerosene is obtained from a non-renewable source.

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

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

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

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

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

4 the fuel cell reduces noise pollution from aircraft.

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

1 the hydrogen is impure.

2 the hydrogen is made from a fossil fuel.

3 the hydrogen burns to produce more carbon dioxide.

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

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

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

1 hydrogen-powered aircraft are too noisy.

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

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

4 dumping large volumes of hydrogen is dangerous.

END OF TEST

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