Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
June 2011

Science A

Unit Chemistry C1a (Products from Rocks)

Chemistry

Unit Chemistry C1a (Products from Rocks)

CHY1AP

F&H

Tuesday 28 June 2011 Morning Session

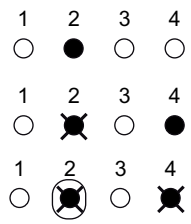
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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 'Chemistry Unit 1a' 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 16 of this booklet.

FOUNDATION TIER

Section One

Questions **ONE** to **FIVE**.

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

This question is about gases produced when a fuel burns.

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

A carbon dioxide

B carbon monoxide

C sulfur dioxide

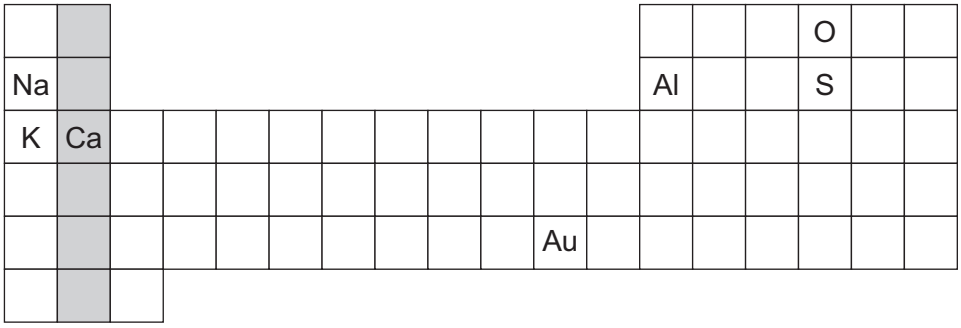
D water vapour

1	It is the main cause of acid rain.
2	It is only produced by incomplete combustion of the fuel.
3	It is a cause of global warming.
4	It is produced from hydrogen in the fuel.

QUESTION TWO

The diagram shows part of the periodic table.

One vertical column has been shaded.



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

A compounds

B groups

C properties

D symbols

The elements in the periodic table are represented by . . . **1** . . . .

The vertical columns in the periodic table are called . . . **2** . . . .

Na (sodium) and K (potassium) have similar chemical . . . **3** . . . .

Some of the elements react together to form . . . **4** . . . .

Turn over for the next question

QUESTION THREE

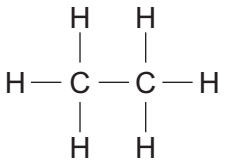
This question is about four alkanes, **A**, **B**, **C** and **D**.

	Alkane	Formula	Boiling point in °C
A	Methane	CH_4	−162
B	Ethane	C_2H_6	−89
C	Butane	C_4H_{10}	0
D	Nonane	C_9H_{20}	+150

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

The alkane with the lowest boiling point is . . . **1** . . . .

The alkane with 14 atoms in each molecule is . . . **2** . . . .

The alkane with the structural formula  is . . . **3** . . . .

The alkane which is least flammable is . . . **4** . . . .

QUESTION FOUR

The table gives some information about four metals, **A**, **B**, **C** and **D**.

	Metal	Main ore	Price in £ per tonne	Percentage abundance of the metal in the Earth's crust
A	Aluminium	Bauxite, Al_2O_3	1800	7
B	Copper	Chalcopyrite, $CuFeS_2$	3300	0.005
C	Tin	Cassiterite, SnO_2	8000	0.0002
D	Iron	Haematite, Fe_2O_3	30	4

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

1	It is the least expensive metal.
2	It is the least abundant metal.
3	The main ore of this metal is not an oxide.
4	This metal cannot be obtained from its main ore by reduction with carbon.

Turn over for the next question

QUESTION FIVE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Symbols	
Fe	Iron
O	Oxygen
Al	Aluminium

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

A electrons

B bonds

C products

D elements

Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the . . . **1** . . . .

Aluminium atoms and oxygen atoms combine by transferring . . . **2** . . . .

The particles (ions) in aluminium oxide are held together by . . . **3** . . . .

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the . . . **4** . . . .

Turn over for the next question

Section Two

Questions **SIX** to **NINE**.

Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

Copper is in high demand. Copper is extracted from ores containing copper sulfide. Most of these ores contain only low percentages of copper sulfide.

The copper sulfide is heated in a furnace. Oxygen is blown through the molten copper sulfide. Copper and sulfur dioxide are produced.

6A A company uses copper sulfide ores to produce copper.

The company will make more profit if . . .

1 the cost of the fuel to heat the furnace increases.

2 the ores contain a higher percentage of copper sulfide.

3 their workers are paid more.

4 there is a reduced demand for copper.

6B The company wants to know the amount of sulfur dioxide released into the atmosphere from the chemical works.

It would be best to measure the amount of sulfur dioxide . . .

1 in the nearest town.

2 in the area around the chemical works.

3 in the gases coming out of the chimneys at the chemical works.

4 in the country as a whole.

6C The company wants to know the total amount of sulfur dioxide given off by the chemical works in a 24-hour period.

The best way to calculate this would be from measurements taken . . .

1 at midday.

2 at 10.00 am and 10.00 pm.

3 at 9.00 am, midday and 4.00 pm.

4 every hour.

6D Ores containing very low percentages of copper sulfide are being used to produce copper.

One factor that would increase the use of these ores is . . .

1 the discovery of large deposits of high grade copper ore.

2 an increase in the use of plastics instead of copper for water pipes.

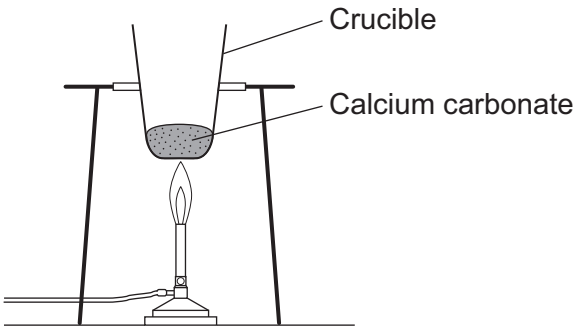
3 a large increase in the price of copper.

4 an increase in the amount of copper that is recycled.

Turn over for the next question

QUESTION SEVEN

A student investigated the change in mass when two metal carbonates were heated.
He heated 4.00 g of calcium carbonate in an open crucible. He measured the mass of crucible and contents every minute for 6 minutes.



He then repeated the whole experiment in the same way but used 4.00 g of copper carbonate in the same crucible.

The student's results are shown in the table.

	Time in minutes	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Calcium carbonate	Mass of crucible and contents in g	24.00	23.02	22.50	22.35	22.31	22.24	22.24
Copper carbonate	Mass of crucible and contents in g	24.00	23.32	22.82	22.58	22.58	22.58	22.58

7A The results show that . . .

1 both carbonates were fully decomposed after 3 minutes.

2 copper carbonate showed the larger loss in mass after 6 minutes.

3 copper carbonate was the first to be fully decomposed.

4 neither carbonate was fully decomposed after 6 minutes.

7B The change in mass in both experiments is because carbon dioxide gas is lost from the crucible.

During which period of time was most carbon dioxide lost?

1 0 – 1 minutes

2 1 – 2 minutes

3 2 – 3 minutes

4 5 – 6 minutes

7C The student could find a more precise time for the end of each reaction by . . .

1 heating larger masses of the calcium and copper carbonates.

2 measuring the mass of the crucible and contents every 30 seconds.

3 heating the carbonates in a larger crucible.

4 measuring the mass of the crucible and contents for another 3 minutes.

7D One variable that is difficult to control in the experiment is . . .

1 the mass of the crucible.

2 the masses of the calcium carbonate and copper carbonate.

3 the times for which the calcium carbonate and copper carbonate are heated.

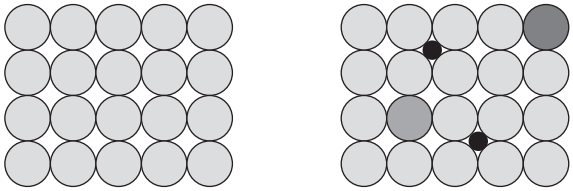
4 the temperature of the crucible.

Turn over for the next question

QUESTION EIGHT

This question is about iron and different types of steel.

8A The diagrams show the arrangement of atoms in pure iron and in stainless steel.



Pure iron Stainless steel

Pure iron is soft and easily shaped because the atoms . . .

1 are not arranged in a regular pattern.

2 are small and spherical.

3 are in layers that can slide over each other.

4 are of different sizes.

8B Stainless steel rather than pure iron is used for making cutlery.

Which row in the table gives two reasons why stainless steel is used?

Stainless steel . . .		
1	is harder.	is a better heat conductor.
2	is more resistant to corrosion.	is harder.
3	is a better heat conductor.	can be more easily shaped.
4	can be more easily shaped.	is more resistant to corrosion.

8C Which type of iron or steel is used to make hammer heads and chisels?

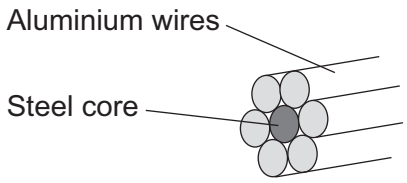
1 cast iron (iron from a blast furnace)

2 pure iron

3 low carbon steel

4 high carbon steel

8D The diagram shows the structure of an overhead power cable. The steel core gives strength to the cable.



Aluminium is used because it is a good conductor of electricity and . . .

1 it has a low density.

2 it is a good conductor of heat.

3 it can be hammered into shape.

4 it is a hard metal.

Turn over for the next question

QUESTION NINE

Crude oil is a mixture made up mainly of alkanes.

9A The alkanes are a series of hydrocarbons . . .

1 all of which are gases at room temperature (20 °C).

2 that have the general formula $C_nH_{2n.}$

3 in which the molecules have a carbon : hydrogen ratio of 1 : 4.

4 that are saturated.

Crude oil can be separated into fractions by fractional distillation.

9B In the fractionating column, the crude oil separates into fractions because . . .

1 the crude oil changes from a liquid into a vapour.

2 the alkanes condense at different temperatures.

3 the crude oil decomposes when it is heated.

4 the alkanes have different densities.

9C The petrol fraction has a boiling range from 40 °C to 70 °C.

The fraction does not have a fixed boiling point because it . . .

1 contains only one alkane.

2 contains several alkanes.

3 collects near the top of the column.

4 decomposes at 40 °C.

9D The petrol fraction is used as a fuel. Ethanol (C_2H_5OH), made from plant material, can be used as a fuel instead of petrol.

One advantage of ethanol over petrol is that ethanol . . .

1 does not produce carbon dioxide when it burns.

2 is a renewable fuel.

3 produces only water when it burns.

4 is a compound, not a mixture.

END OF TEST

There are no questions printed on this page

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**.

Mark your choices on the answer sheet.

QUESTION ONE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Symbols	
Fe	Iron
O	Oxygen
Al	Aluminium

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

A electrons

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Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the . . . **1** . . . .

Aluminium atoms and oxygen atoms combine by transferring . . . **2** . . . .

The particles (ions) in aluminium oxide are held together by . . . **3** . . . .

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the . . . **4** . . . .

QUESTION TWO

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

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

A CO

B CS_2

C C_2H_4

D C_3H_8

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

Turn over for the next question

Section Two

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

Each of these questions has four parts.

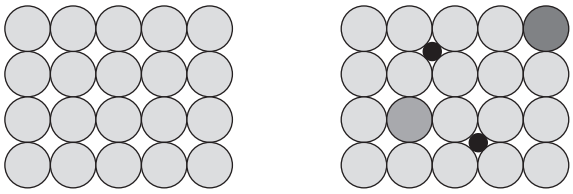
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

This question is about iron and different types of steel.

3A The diagrams show the arrangement of atoms in pure iron and in stainless steel.



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Which row in the table gives two reasons why stainless steel is used?

Stainless steel . . .		
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3	is a better heat conductor.	can be more easily shaped.
4	can be more easily shaped.	is more resistant to corrosion.

3C Which type of iron or steel is used to make hammer heads and chisels?

1 cast iron (iron from a blast furnace)

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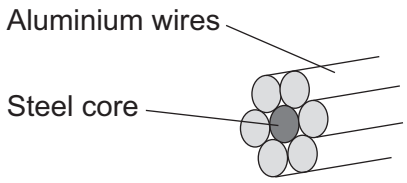
4 high carbon steel

3D The diagram shows the structure of an overhead power cable. The steel core gives strength to the cable.



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2 it is a good conductor of heat.

3 it can be hammered into shape.

4 it is a hard metal.

Turn over for the next question

QUESTION FOUR

Crude oil is a mixture made up mainly of alkanes.

4A The alkanes are a series of hydrocarbons . . .

1 all of which are gases at room temperature (20 °C).

2 that have the general formula $C_nH_{2n.}$

3 in which the molecules have a carbon : hydrogen ratio of 1 : 4.

4 that are saturated.

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One advantage of ethanol over petrol is that ethanol . . .

1 does not produce carbon dioxide when it burns.

2 is a renewable fuel.

3 produces only water when it burns.

4 is a compound, not a mixture.

Turn over for the next question

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

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.

Turn over for the next question

QUESTION SIX

In 1774, a Frenchman called Antoine Lavoisier put forward this theory:

> "*Matter can neither be created nor destroyed, and in every chemical reaction there is just as much matter present before, as after the reaction has taken place*."

6A This theory is now an accepted law of chemistry.

This law means that in any chemical reaction . . .

1 the mass of the products is equal to the mass of the reactants.

2 new atoms are produced from the atoms which make up the reactants.

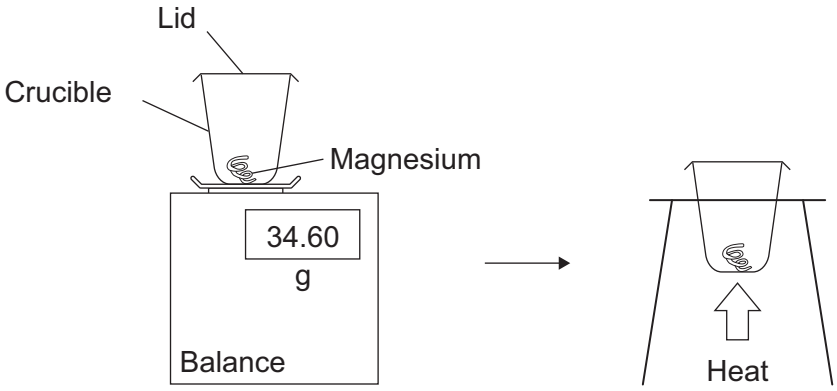
3 the number of molecules of reactants is equal to the number of molecules of products.

4 atoms of elements react by giving, taking or sharing electrons.

A student investigated the reaction when some magnesium burned completely in oxygen.

magnesium + oxygen → magnesium oxide

The student weighed a crucible, its lid and a piece of magnesium.



The student then:

- heated the crucible for one minute, raising the lid occasionally
- allowed the crucible, lid and contents to cool, and then reweighed them
- repeated the heating, cooling and reweighing several times.

The results are shown in the table.

Total time of heating in minutes	0	1	2	3	4	5	6
Mass of crucible, lid and contents in grams	34.60	34.92	35.00	35.07	35.10	35.10	35.10

6B Which row in the table below correctly explains the procedures in the experiment?

	Reason for:	
	raising the crucible lid occasionally	**repeating the heating, cooling and reweighing**
1	so the crucible would not get too hot	to check the accuracy of the balance
2	to allow air to enter the crucible	to make sure that all the magnesium had reacted
3	to allow air to enter the crucible	to check the accuracy of the balance
4	so the crucible would not get too hot	to make sure that all the magnesium had reacted

6C Why do the results in this experiment appear to contradict Lavoisier's theory?

1 The mass of reacting oxygen was not included in the weighings.

2 Magnesium oxide is a compound but magnesium and oxygen are elements.

3 There was not enough oxygen for all of the magnesium to react.

4 The mass of magnesium used was too small.

6D From calculations done before the experiment, the student expected the final mass of the crucible, lid and contents to be 35.32 grams rather than 35.10 grams.

The best explanation for this difference is that . . .

1 the student did not heat the crucible to a high enough temperature.

2 some magnesium oxide escaped from the crucible.

3 magnesium oxide begins to decompose at the temperature of the Bunsen burner.

4 the student did not allow the crucible to completely cool each time.

QUESTION SEVEN

Calcium carbonate decomposes on heating to give calcium oxide and carbon dioxide.

$$CaCO_3 \rightarrow CaO + CO_2$$

100 g of calcium carbonate, on complete decomposition, produces 44 g of carbon dioxide.

If the carbon dioxide is not allowed to escape, it will recombine with the calcium oxide. This can happen at any temperature.

7A Calculate the mass of calcium oxide that would be produced by completely decomposing 400 tonnes of calcium carbonate.

(1 tonne = 1 000 000 g)

1 17.6 tonnes

2 22.4 tonnes

3 176 tonnes

4 224 tonnes

7B If calcium oxide is left exposed to the air, it will increase in mass.

Which of the following could **not** be the reason for this?

1 The calcium oxide is recombining with carbon dioxide from the air.

2 The calcium oxide is reacting with water from the air.

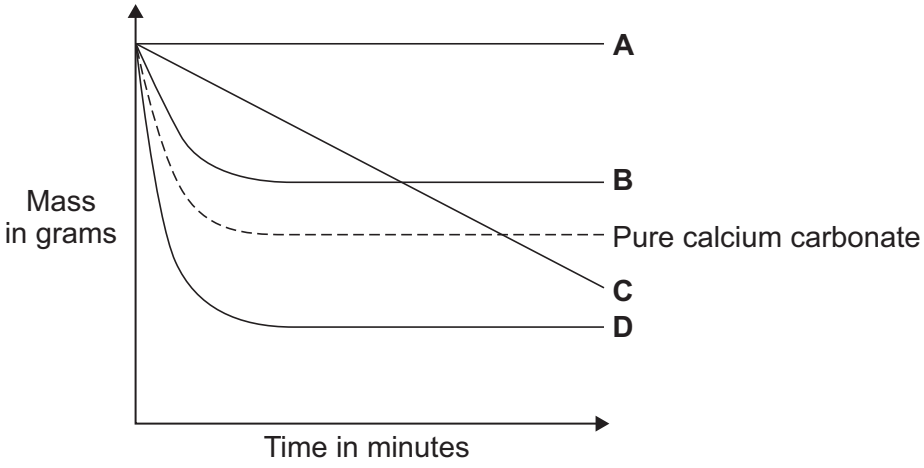
3 The calcium oxide is still thermally decomposing.

4 The calcium oxide is changing back to calcium carbonate.

7C Limestone usually contains impurities.

The diagram below shows the change in mass when pure calcium carbonate is heated.

Which of the lines, **A**, **B**, **C** or **D,** shows a sample of limestone containing impurities that do not thermally decompose?



1 **A**

2 **B**

3 **C**

4 **D**

7D A company makes calcium oxide from calcium carbonate.

The best way for this company to benefit economically, **and** also to limit environmental damage, is to . . .

1 store the carbon dioxide in spaces underground which are left when coal has been extracted.

2 sell the carbon dioxide to oil companies so that they can use it to force oil out of the ground.

3 sell solid carbon dioxide to ice-cream companies for keeping ice-cream cold.

4 sell the carbon dioxide to companies that make fizzy drinks.

QUESTION EIGHT

This question is about alkanes.

Alkane	Melting point in °C	Boiling point in °C
Methane, CH_4	−183	−164
Ethane, C_2H_6	−183	−89
Propane, C_3H_8	−190	−42
Butane, C_4H_{10}	−138	−0.5
Pentane, C_5H_{12}	−130	+36

8A Which of the following is correct?

1 Butane is liquid at room temperature (20 °C).

2 These alkanes will be collected separately during the fractional distillation of crude oil.

3 The boiling points of the alkanes decrease as the size of their molecules increases.

4 Pentane is liquid over the greatest range of temperature.

8B In the alkane series, which one of the following changes from one alkane to the next?

1 the general formula

2 the number of bonds on each carbon atom

3 the ratio of carbon atoms to hydrogen atoms in each molecule

4 the number of double carbon carbon bonds in each molecule

8C The general equation below represents the burning of an alkane in excess of oxygen.

$$C_wH_x + (w + \tfrac{x}{y})O_2 \rightarrow wCO_2 + (\tfrac{x}{2})H_2O$$

The value of y is . . .

1 1

2 2

3 4

4 8

8D The complete combustion of a molecule of propane . . .

1 produces less carbon dioxide than the complete combustion of a molecule of butane.

2 requires more oxygen than the complete combustion of a molecule of pentane.

3 produces the same ratio of carbon dioxide molecules to water molecules as pentane.

4 requires less oxygen than the complete combustion of a molecule of methane.

Turn over for the next question

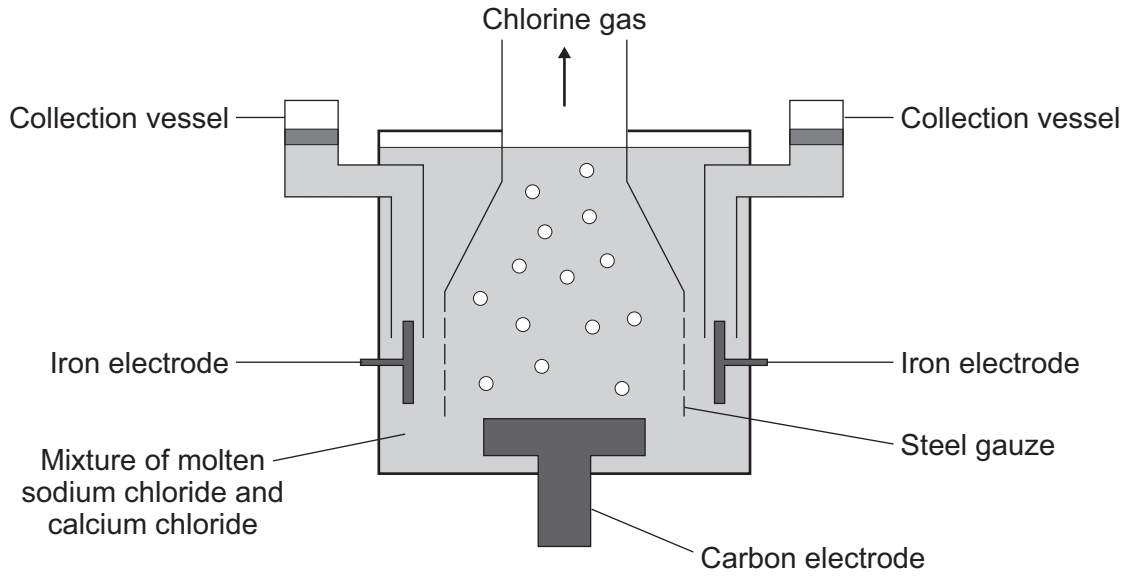
QUESTION NINE

Sodium cannot be extracted from its oxide by reduction with carbon.

Sodium metal is extracted by electrolysis of molten sodium chloride. The melting point of sodium chloride is very high (800°C), so calcium chloride is added to reduce the melting point of the mixture to about 550°C.

During electrolysis, both sodium and calcium are obtained at the iron electrodes, and chlorine at the carbon electrode.

The diagram shows the electrolysis cell used for the extraction of sodium.



The table shows some properties of sodium and calcium.

	Melting point in °C	**Density in g per cm^3**	**Reactivity**
Sodium	97	0.97	Very reactive
Calcium	839	1.55	Reactive

9A In the extraction of sodium, a mixture of sodium chloride and calcium chloride is used to . . .

1 reduce the amount of energy required to melt the mixture.

2 obtain a pure sample of sodium.

3 absorb the chlorine gas.

4 increase the temperature of the mixture.

9B The purpose of the steel gauze is to prevent the reaction of . . .

1 sodium with calcium.

2 sodium with chlorine.

3 iron electrodes with sodium chloride.

4 sodium chloride with calcium chloride.

9C In the collection vessel there is . . .

1 solid sodium below a layer of liquid calcium.

2 solid calcium below a layer of liquid sodium.

3 a mixture of liquid sodium and liquid calcium.

4 a mixture of solid calcium and solid sodium.

9D The information in the diagram suggests that the element carbon . . .

1 has a melting point lower than 550 °C.

2 reacts rapidly with chlorine gas.

3 is an electrical conductor.

4 is more reactive than iron.

END OF TEST

There are no questions printed on this page