Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
March 2010

Science A
Unit Chemistry C1a (Products from Rocks)

Chemistry
Unit Chemistry C1a (Products from Rocks)

CHY1AP

F&H

Wednesday 3 March 2010 Morning Session

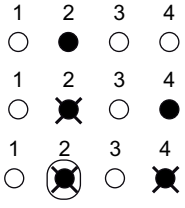
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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 14 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

New substances are formed when fuels are burned. Some of these substances affect the environment.

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

A carbon dioxide

B particles

C sulfur dioxide

D water vapour

	Environmental effect
1	acid rain
2	global dimming
3	global warming
4	non-polluting

QUESTION TWO

This question is about metals.

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

A iron

B aluminium

C gold

D stainless steel

1	It is found in the Earth as the metal itself.
2	It is an alloy which is resistant to corrosion.
3	It is extracted by reduction of its oxide in a blast furnace.
4	It is extracted from its oxide by electrolysis.

QUESTION THREE

This question is about the substances involved in the thermal decomposition of calcium carbonate, $CaCO_3$

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

A atoms

B compounds

C non-metal elements

D elements

Calcium carbonate contains three . . . **1** . . . .

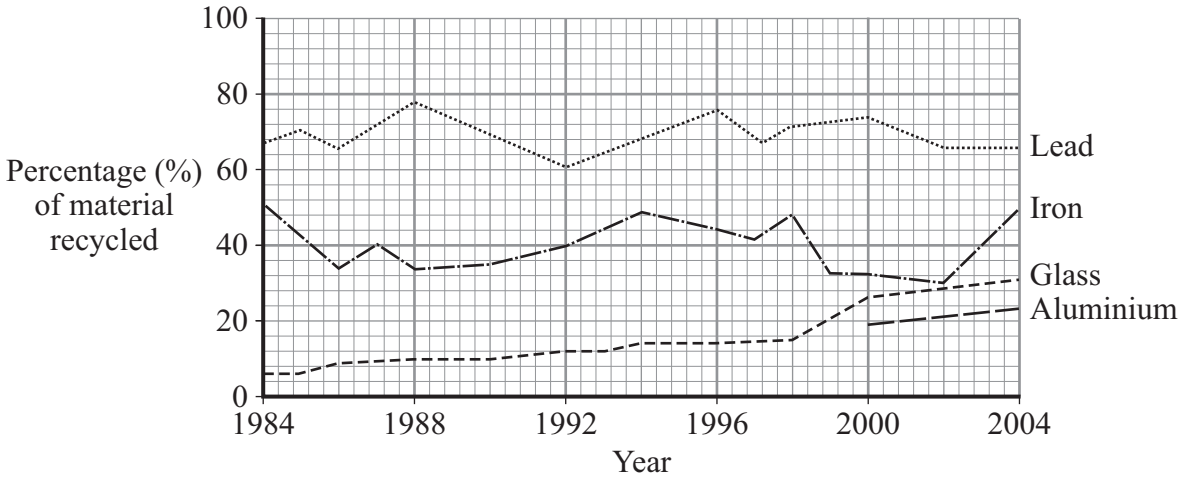
The formula for calcium carbonate contains a total of five . . . **2** . . . .

Calcium carbonate contains two . . . **3** . . . .

On heating, calcium carbonate decomposes into two new . . . **4** . . . .

QUESTION FOUR

The graph shows the percentages of aluminium, glass, iron and lead that have been recycled in the UK between 1984 and 2004.



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

A aluminium

B glass

C iron

D lead

The material that has the highest percentage recycled is . . . **1** . . . .

Before 2000, there is no data for . . . **2** . . . .

Since 1984, there has been an increase in the percentage of . . . **3** . . . recycled.

Since 2002, there has been a steep increase in the percentage of . . . **4** . . . recycled.

QUESTION FIVE

Anaesthetics are used to put patients to sleep before an operation.

Many new anaesthetics are based on alkanes in which some of the hydrogen atoms are replaced by fluorine (F), chlorine (Cl) and bromine (Br).

The temperature in an operating theatre is usually above 30 °C.

	Formula of the anaesthetic	Boiling point in °C	Additional information
A	$CF_3CHClBr$	50	Unstable in light
B	$CHF_2OCHClCF_3$	49	Very few side-effects
C	$(CF_3)_2CHOCH_2F$	59	High cost
D	$CF_3CHFOCHF_2$	24	Large amount needed to put patients to sleep

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

1 It does **not** require warming in the operating theatre to turn it into a gas.

2 It has to be stored in a dark bottle.

3 It contains the most fluorine atoms in its formula.

4 It would cause least harm to patients.

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

A company extracts limestone from a quarry. The company uses explosives to make thousands of tonnes of limestone fall to the floor of the quarry. The limestone is then removed by large lorries and taken to a factory for processing.

6A People live close to the quarry.

They find this unpleasant because . . .

1 they do not use limestone.

2 it is sometimes very noisy.

3 the quarry provides jobs.

4 there would be more places for parking.

6B The company wants to start limestone quarrying at weekends.

Some local people welcome this decision because . . .

1 the company will make more profit.

2 less limestone will be produced.

3 it will provide more jobs.

4 new technologies will be used.

6C The company wants to find the opinions of local people.

The company would use . . .

1 a calculation.

2 an evaluation.

3 an experiment.

4 a survey.

6D The company stated that it's limestone is 'the best in the world'.

A second company says that this is **not** true. The reason for saying this is that . . .

1 the second company may sell less limestone.

2 all limestones are pure calcium carbonate.

3 all limestones have the same properties.

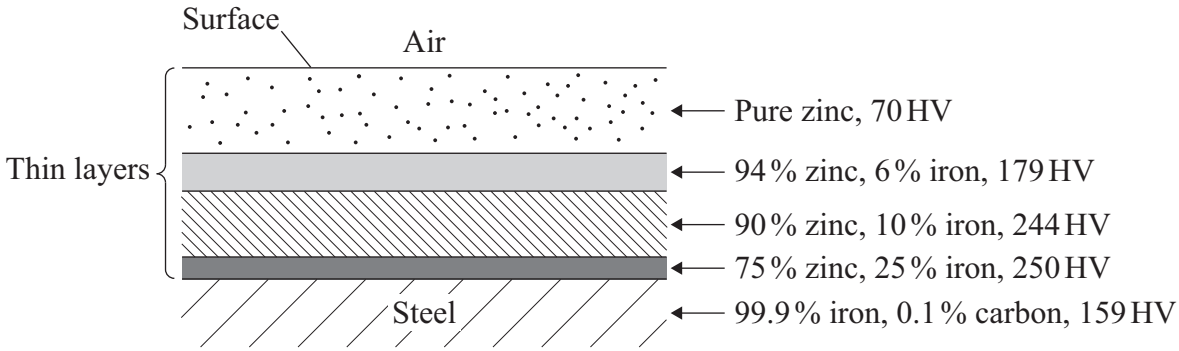
4 the second company produces the best limestone.

Turn over for the next question

QUESTION SEVEN

Steel is dipped into molten zinc to prevent it from rusting. The zinc combines with the iron in the steel to form layers of zinc-iron alloys.

The diagram shows a cross-section through the layers.



HV is a unit of hardness. The higher the HV number, the harder the metal.

7A The diagram shows that . . .

1 the alloy layers are all of equal thickness.

2 all the layers are pure substances.

3 the steel is in contact with the air.

4 steel is harder than pure zinc.

7B The diagram shows that . . .

1 the amount of iron increases nearer the surface.

2 the percentage of zinc increases nearer the steel.

3 there is no pattern.

4 the percentage of zinc decreases nearer the steel.

7C The diagram also shows that . . .

1 zinc is the hardest metal.

2 the zinc alloys are softer than steel.

3 increasing the iron content of the zinc alloys softens them.

4 for the zinc alloys, hardness increases with decreasing zinc content.

7D Steel car bodies are coated with zinc before painting.

This is to make them . . .

1 easier to recycle.

2 last longer.

3 weigh less.

4 more dense.

Turn over for the next question

QUESTION EIGHT

This is part of the periodic table.

															O		
Na	Mg											Al					
K			Ti				Fe										

8A What do the metals Fe (iron) and Ti (titanium) have in common?

1 They belong to the same group in the periodic table.

2 They are transition metals.

3 They do **not** conduct electricity.

4 They are resistant to corrosion.

8B When Fe (iron) and O (oxygen) react, iron atoms join with oxygen atoms to form iron oxide, Fe_2O_3

When this happens, . . .

1 the nuclei from iron and oxygen atoms join together.

2 electrons are lost and new atoms form.

3 electrons are transferred and chemical bonds hold the atoms together.

4 the nuclei are transferred and new atoms form.

8C Fe (iron) and O (oxygen) are in the periodic table but Fe_2O_3 (iron oxide) is not.

This is because iron oxide is . . .

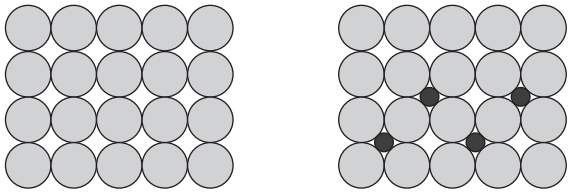
1 an alloy.

2 a compound.

3 an ore.

4 a gas.

8D The diagram shows the arrangement of atoms in pure iron and in steel.



Pure iron **Steel**

Which row in the table shows the metal that is harder **and** correctly explains why it is harder?

	Harder metal	**Explanation**
1	Pure iron	It contains only one type of atom.
2	Steel	The atoms cannot easily slide over each other.
3	Pure iron	The atoms cannot easily slide over each other.
4	Steel	It contains only one type of atom.

Turn over for the next question

QUESTION NINE

The alkanes are a series of hydrocarbons.

9A What is the general formula for the alkane series?

1 C_nH_n

2 C_nH_{2n}

3 C_nH_{2n+2}

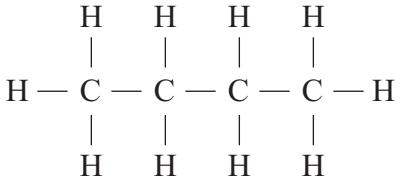
4 $C_{2n}H_{2n-2}$

The table shows information about four alkanes.

Alkane	Number of carbon atoms in each molecule
Methane	1
Butane	4
Octane	8
Dodecane	12

9B The structural formula for butane is . . .

1



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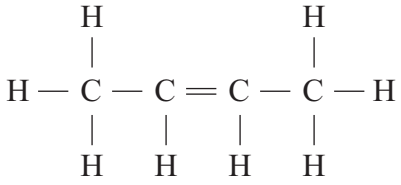

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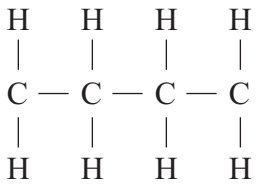

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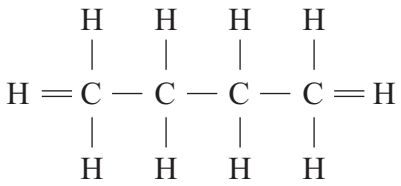

9C When compared with octane, dodecane . . .

1 has a lower boiling point.

2 is easier to ignite.

3 evaporates less easily.

4 is less viscous.

9D When pure methane burns in plenty of oxygen, the only products are . . .

1 carbon dioxide and hydrogen.

2 carbon, carbon dioxide and water.

3 carbon dioxide, sulfur dioxide and water.

4 carbon dioxide and water.

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**.

Mark your choices on the answer sheet.

QUESTION ONE

Anaesthetics are used to put patients to sleep before an operation.

Many new anaesthetics are based on alkanes in which some of the hydrogen atoms are replaced by fluorine (F), chlorine (Cl) and bromine (Br).

The temperature in an operating theatre is usually above 30 °C.

	Formula of the anaesthetic	Boiling point in °C	Additional information
A	$CF_3CHClBr$	50	Unstable in light
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Match anaesthetics, **A**, **B**, **C** and **D**, with the numbers **1–4** below.

1 It does **not** require warming in the operating theatre to turn it into a gas.

2 It has to be stored in a dark bottle.

3 It contains the most fluorine atoms in its formula.

4 It would cause least harm to patients.

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.

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 is part of the periodic table.

															O		
Na	Mg											Al					
K			Ti				Fe										

3A What do the metals Fe (iron) and Ti (titanium) have in common?

1 They belong to the same group in the periodic table.

2 They are transition metals.

3 They do **not** conduct electricity.

4 They are resistant to corrosion.

3B When Fe (iron) and O (oxygen) react, iron atoms join with oxygen atoms to form iron oxide, Fe_2O_3

When this happens, . . .

1 the nuclei from iron and oxygen atoms join together.

2 electrons are lost and new atoms form.

3 electrons are transferred and chemical bonds hold the atoms together.

4 the nuclei are transferred and new atoms form.

3C Fe (iron) and O (oxygen) are in the periodic table but Fe_2O_3 (iron oxide) is not.

This is because iron oxide is . . .

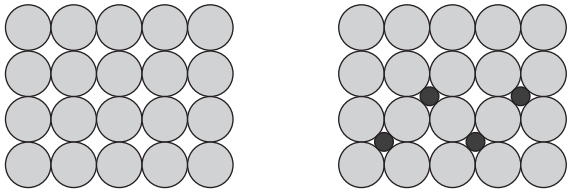
1 an alloy.

2 a compound.

3 an ore.

4 a gas.

3D The diagram shows the arrangement of atoms in pure iron and in steel.



Pure iron **Steel**

Which row in the table shows the metal that is harder **and** correctly explains why it is harder?

	Harder metal	**Explanation**
1	Pure iron	It contains only one type of atom.
2	Steel	The atoms cannot easily slide over each other.
3	Pure iron	The atoms cannot easily slide over each other.
4	Steel	It contains only one type of atom.

QUESTION FOUR

The alkanes are a series of hydrocarbons.

4A What is the general formula for the alkane series?

1 C_nH_n

2 C_nH_{2n}

3 C_nH_{2n+2}

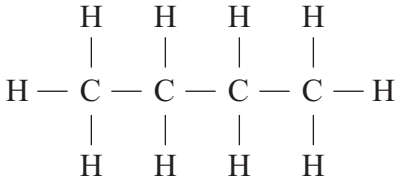
4 $C_{2n}H_{2n-2}$

The table shows information about four alkanes.

Alkane	Number of carbon atoms in each molecule
Methane	1
Butane	4
Octane	8
Dodecane	12

4B The structural formula for butane is . . .

1



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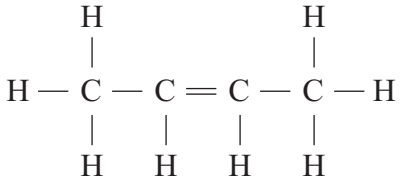

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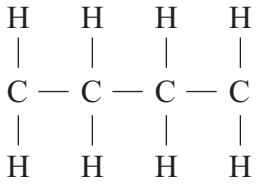

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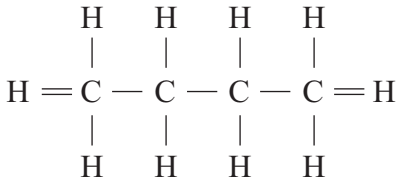


4C When compared with octane, dodecane . . .

1 has a lower boiling point.

2 is easier to ignite.

3 evaporates less easily.

4 is less viscous.

4D When pure methane burns in plenty of oxygen, the only products are . . .

1 carbon dioxide and hydrogen.

2 carbon, carbon dioxide and water.

3 carbon dioxide, sulfur dioxide and water.

4 carbon dioxide and water.

Turn over for the next question

QUESTION FIVE

Fuel oil is a mixture of compounds, mainly hydrocarbons.

Fuel oil is obtained from crude oil by fractional distillation.

5A Which of the following hydrocarbons is an alkane?

1 CH_6

2 C_3H_6

3 C_2H_6

4 C_2H_4

5B Which of the following describes how fuel oil is obtained from crude oil during fractional distillation?

1 boiling followed by evaporation

2 evaporation followed by boiling

3 evaporation followed by condensation

4 condensation followed by evaporation

5C Which of the following is a correct list of gases that might be produced by burning fuel oil?

1 carbon dioxide, water vapour, sulfur dioxide, carbon monoxide

2 hydrogen, carbon dioxide, sulfur dioxide, carbon monoxide

3 sulfur dioxide, carbon dioxide, water vapour, hydrogen

4 carbon, water vapour, sulfur dioxide, carbon monoxide

5D Which row in the table correctly describes the type of combustion **and** a substance produced when fuel oil is burned?

	Type of combustion	**Substance produced**
1	Incomplete	Hydrogen
2	Complete	Carbon particles
3	Incomplete	Carbon particles
4	Complete	Carbon monoxide

Turn over for the next question

QUESTION SIX

Titanium cannot be extracted by carbon reduction of its ore, which contains titanium dioxide, TiO_2

Titanium is obtained from titanium dioxide in two stages.

In **Stage 1**, the titanium dioxide is converted to titanium chloride ($TiCl_4$).

titanium dioxide + chlorine + carbon → titanium chloride + carbon dioxide

The possible escape of carbon dioxide and chlorine (a poisonous gas) can cause damage to the environment.

In **Stage 2**, the titanium chloride formed is reacted with sodium.

titanium chloride + sodium → titanium + sodium chloride

The sodium chloride formed is removed by washing the titanium with hydrochloric acid but the disposal of the acidic sodium chloride solution causes another environmental problem.

6A Which of the following is a correctly balanced equation for **Stage 2**?

1 $TiCl_4 + Na \rightarrow 4Ti + NaCl$

2 $TiCl_4 + Na \rightarrow Ti + 4NaCl$

3 $TiCl_4 + 4Na \rightarrow 4Ti + 4NaCl$

4 $TiC1_4 + 4Na \rightarrow Ti + 4NaCl$

6B Sodium, not carbon, is used to extract titanium from its compounds.

Which row in the table does this information suggest to be the order of reactivity for carbon, sodium and titanium?

	Most reactive ⟶		**Least reactive**
1	Sodium	Titanium	Carbon
2	Sodium	Carbon	Titanium
3	Titanium	Sodium	Carbon
4	Carbon	Titanium	Sodium

6C In **Stage 1**, the gases carbon dioxide and chlorine should **not** be allowed to escape into the air because . . .

1 both add to global dimming.

2 both are poisonous gases.

3 carbon dioxide adds to global warming and chlorine is toxic.

4 carbon dioxide adds to global dimming and chlorine is expensive.

6D In **Stage 2**, the best way to dispose of the acidic sodium chloride solution is . . .

1 to pump it into the ocean.

2 to pump it into landfill sites.

3 to boil the solution until all the acid has evaporated.

4 to separate the acid from the salt so that both can be used in other chemical processes.

Turn over for the next question

QUESTION SEVEN

Glass is made by heating limestone with silicon dioxide at 1700 °C. Sodium carbonate and potassium carbonate are also added.

7A Limestone contains calcium carbonate. The reaction between calcium carbonate and silicon dioxide produces calcium silicate. The equation for this reaction is:

$$CaCO_3 + SiO_2 \rightarrow \mathbf{X} + CO_2$$

X represents the formula for calcium silicate.

The equation will be balanced if the formula for calcium silicate is . . .

1 $CaSiO_2$

2 $CaSi_2O$

3 $CaSiO_3$

4 Ca_2SiO_2

Glass sheets are produced by pouring hot liquid glass onto molten tin. The glass floats on top of the molten tin and is allowed to cool. The viscosity of the hot liquid glass needs to be just right when poured onto the molten tin.

The viscosity of hot liquid glass depends partly on its temperature. The viscosity also depends on the composition of the glass.

The table shows how the lowest pouring temperature depends on the amounts of sodium and potassium in the glass.

Sodium percentage (%)	Potassium percentage (%)	Lowest pouring temperature in °C
0	20	450
4	16	400
10	10	390
16	4	395
18	2	410
20	0	440

7B The manufacturer wants to use the lowest pouring temperature for the glass.

In what range of sodium content should further work be done to determine the lowest pouring temperature?

1 0% to 10%

2 4% to 16%

3 10% to 18%

4 16% to 20%

7C Listed below are four possible reasons why the manufacturer wants to use the lowest pouring temperature.

Reason **K** – It uses less energy
Reason **L** – It reduces the loss of glass by evaporation
Reason **M** – It makes the process cheaper
Reason **N** – It increases carbon emissions

Which of these are the most likely reasons for using the lowest pouring temperature?

1 Reasons **K** and **L**

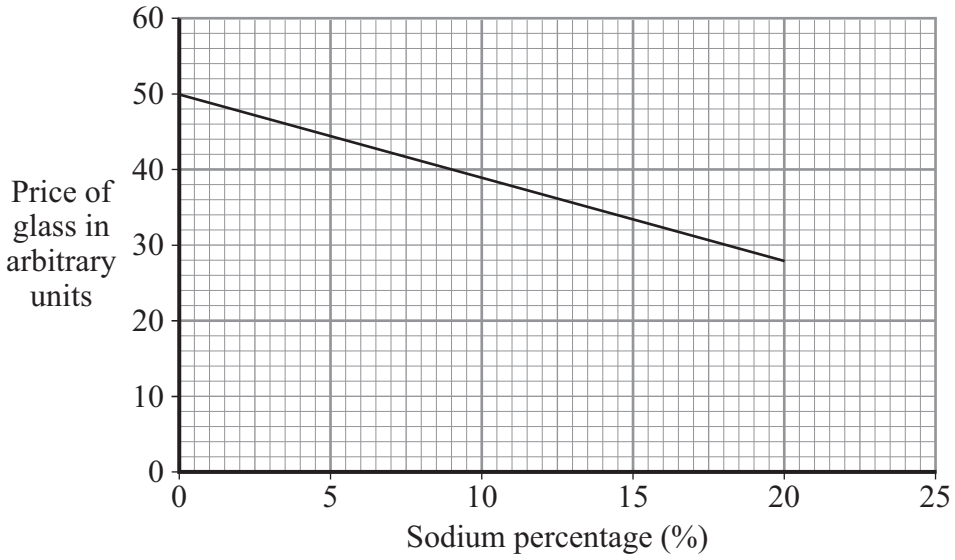
2 Reasons **K** and **M**

3 Reasons **L** and **N**

4 Reasons **M** and **N**

Question 7 continues on the next page

7D The graph shows how the price of glass depends on the sodium percentage (%).



Use the information from the table on page 24 and the graph above.

What will be the effects of increasing the sodium percentage in the glass from 10% to 20%?

1 to decrease the price of the glass and decrease the pouring temperature

2 to decrease the price of the glass and increase the pouring temperature

3 to increase the price of the glass and decrease the pouring temperature

4 to increase the price of the glass and increase the pouring temperature

Turn over for the next question

QUESTION EIGHT

The table below gives the temperatures at which some metal carbonates decompose.

Name of metal carbonate	Position of metal in periodic table	Temperature at which it decomposes
Sodium carbonate	Group 1	Decomposes only above its melting point of 851 °C
Calcium carbonate	Third in Group 2	825 °C
Magnesium carbonate	Second in Group 2	350 °C
Zinc carbonate	In the transition metal block	300 °C

8A Which of the following pairs of carbonates would decompose at 750 °C?

1 sodium carbonate and calcium carbonate

2 calcium carbonate and magnesium carbonate

3 sodium carbonate and zinc carbonate

4 magnesium carbonate and zinc carbonate

8B A valid conclusion that can be drawn from the temperatures in the table is that . . .

1 transition metal carbonates are the most thermally stable.

2 Group 2 metal carbonates become less thermally stable down the group.

3 zinc carbonate is the least thermally stable.

4 Group 1 metal carbonates melt before they decompose.

8C Extracting metal carbonates, such as limestone, from the ground can cause environmental damage.

A mining company issued this statement:

> Our research shows that our method of mining for limestone causes very little environmental damage.

This statement is . . .

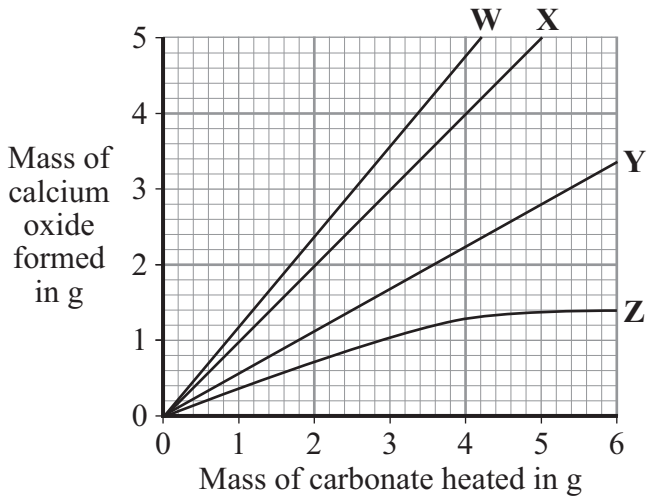
1 given on invalid evidence.

2 an invalid hypothesis.

3 a biased conclusion.

4 based on hearsay.

8D Assuming complete reaction, which of the following lines on the graph represents the mass of calcium oxide formed by heating different masses of calcium carbonate?



1 **W**

2 **X**

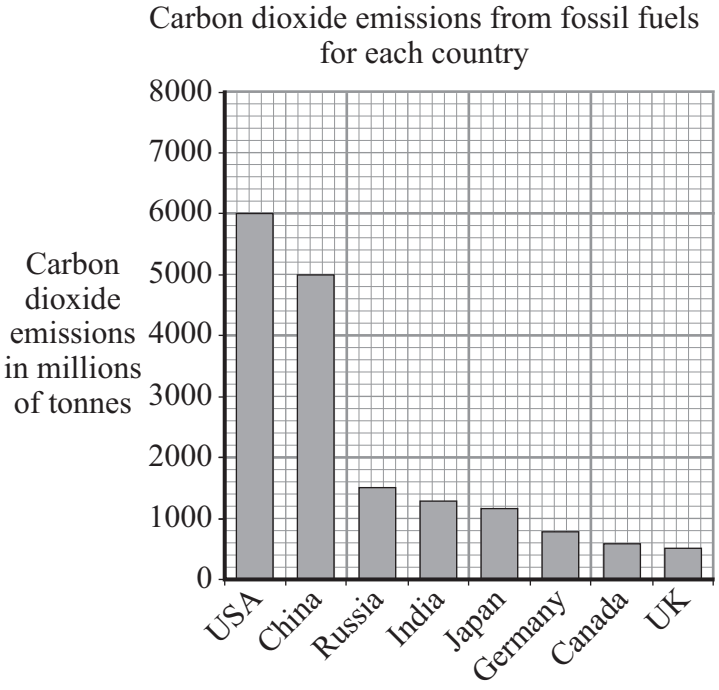
3 **Y**

4 **Z**

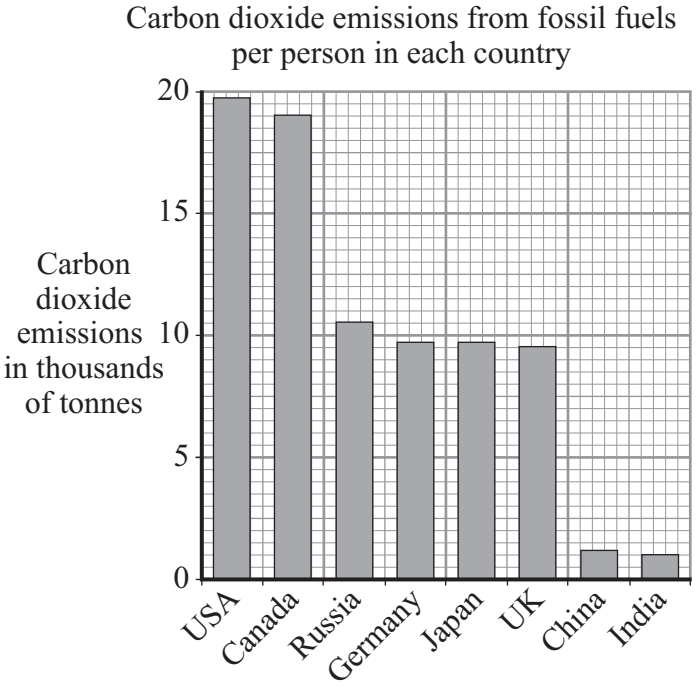
QUESTION NINE

The bar charts show the carbon dioxide emissions from burning fossil fuels only, for several countries, during 2004.
Bar chart **X** shows the carbon dioxide emissions for each country.
Bar chart **Y** shows the carbon dioxide emissions per person in each country.

Bar chart **X**



Bar chart **Y**



9A In the two bar charts, the countries are ranked in a different order.

Which statement explains the difference?

1 The units for carbon dioxide emissions are different and so the bar charts cannot be compared.

2 India's population is less than Japan's.

3 China and the USA have similar populations.

4 China has a very large population but very few people drive vehicles.

9B There has been rapid economic expansion in China and India. New industry is being developed in these countries and this increases the use of fossil fuels.

Which of the following statements is correct if the economic expansion continues and the population in each country stays the same?

1 The bar for China will be higher in chart **X**, but will be lower in chart **Y**.

2 The bars for China and India will be lower in both charts **X** and **Y**.

3 The bars for China and India will be higher in both charts **X** and **Y**.

4 The bar for India will be higher in chart **X**, but will be lower in chart **Y**.

9C The data in the bar charts could be displayed in a different way.

Which one of the following gives a suitable display method with an appropriate explanation?

1 A straight line graph could be used because the dependent variable is continuous.

2 A pie chart could be used because the independent variable is categoric.

3 A smooth curve graph could be used because the independent variable is continuous.

4 A scattergraph could be used because there is a gradual change in carbon dioxide emissions.

9D Which one of the following would reduce the height of the bars in both bar charts?

1 compulsory use of catalytic converters that convert carbon monoxide to carbon dioxide

2 changing the vertical axis on bar chart **X** to measure in thousands of tonnes

3 planting more trees, which will absorb carbon dioxide

4 using more efficient engines that burn less fossil fuel per mile

END OF TEST

There are no questions printed on this page