

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2009

Science A
Unit Chemistry C1a (Products from Rocks)
Chemistry
Unit Chemistry C1a (Products from Rocks)

CHY1AP
F&H

Thursday 19 November 2009 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

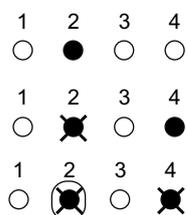
- 30 minutes

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**.

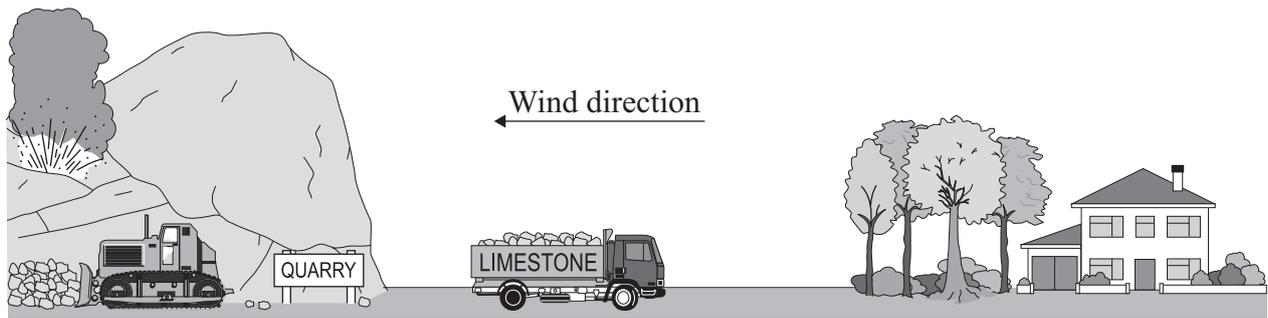
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The drawing shows a house near a limestone quarry.



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

- A** trees
- B** vehicle exhaust gases
- C** vehicle movements
- D** wind

Visual pollution for the people in the house is reduced by the . . . **1**

Noise pollution is caused by the . . . **2**

Dust is carried away from the house by the . . . **3**

Global warming might be increased by the . . . **4**

QUESTION TWO

This question is about metals.

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

- A** metal ore
- B** reactive metal
- C** transition metal
- D** metal alloy

1	a substance that contains enough metal to make it worth extracting
2	a mixture of metals
3	a metal that is found in the central block of the periodic table
4	a metal that cannot be extracted by reduction using carbon

QUESTION THREE

The formula of hydrogen sulfide is H_2S .

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

- A** atoms
- B** electrons
- C** compounds
- D** elements

Hydrogen and sulfur are in the periodic table because they are . . . **1**

Hydrogen and sulfur are combined together in hydrogen sulfide, which is one of many known . . . **2**

The bonds in hydrogen sulfide are formed by shared pairs of . . . **3**

The formula of hydrogen sulfide contains a total of three . . . **4**

Turn over ►

QUESTION FOUR

Exhaust gases from petrol and diesel vehicles were measured under different driving conditions.

The table shows the results in parts per million (ppm).

	Driving conditions					
	Accelerating		Steady speed		Slowing down	
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel
Hydrocarbons in ppm	2000	200	1000	100	10 000	300
Carbon monoxide in ppm	25 000	1000	18 000	15	20 000	46
Nitrogen oxides in ppm	1020	856	650	240	20	30

Match the type of fuel and the driving conditions, **A**, **B**, **C** and **D**, with the exhaust gas descriptions **1–4** in the table below.

- A** diesel, steady speed
- B** diesel, slowing down
- C** petrol, accelerating
- D** petrol, slowing down

Exhaust gas description	
1	a total of 76 ppm of carbon monoxide and nitrogen oxides
2	the smallest amount of hydrocarbons
3	the highest total of carbon monoxide and nitrogen oxides
4	the most unburnt fuel

QUESTION FIVE

The diagram shows part of the periodic table.

Li															
Na															
	Ca						Fe								
										Au					

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

- A** Calcium (Ca)
- B** Lithium (Li)
- C** Gold (Au)
- D** Iron (Fe)

1	It will not react with oxygen or water even at high temperatures.
2	It forms the oxide known as quicklime.
3	It has properties most similar to those of sodium (Na).
4	It is a transition element found in the Earth as an oxide.

Turn over for the next question

Turn over ►

SECTION TWO

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

Each of these questions has four parts.

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

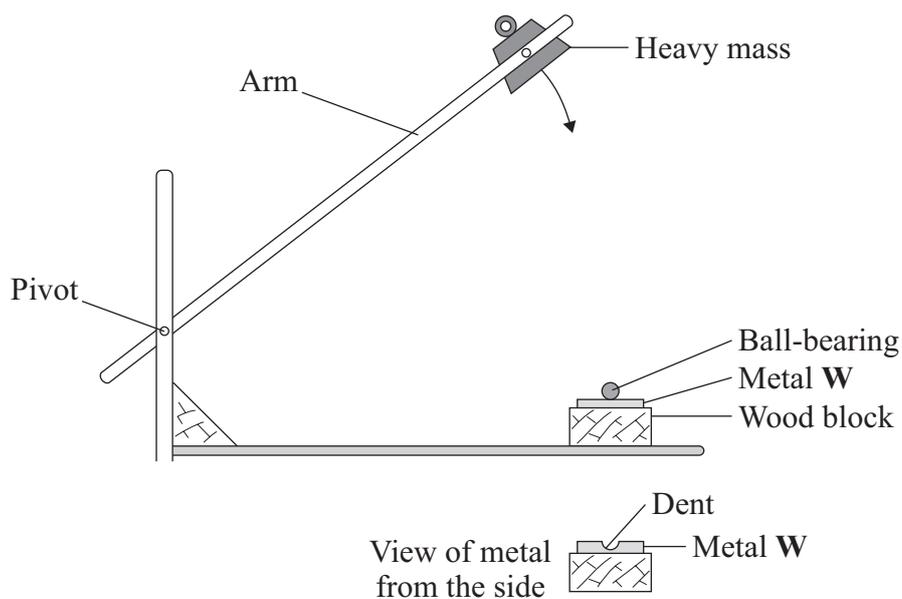
Mark your choices on the answer sheet.

QUESTION SIX

A student was asked to investigate the hardness of four metals, **W**, **X**, **Y** and **Z**. He used the apparatus shown in the diagram.

The student allowed the heavy mass to drop onto the ball-bearing resting on metal **W**. This made a dent in metal **W**. He measured the diameter of the dent.

The student repeated the experiment using metals **X**, **Y** and **Z**. He attempted to drop the heavy mass from the same height each time.



The results of the experiment are shown in the table.

Metal	Diameter of dent in mm
W	3.5
X	1.0
Y	2.5
Z	0.0

6A The order of hardness of the metals, starting with the softest, is . . .

- 1 W, X, Y, Z.
- 2 W, Y, X, Z.
- 3 Y, X, W, Z.
- 4 Z, X, Y, W.

6B The student could make his results more precise by . . .

- 1 dropping a smaller mass onto the ball-bearing.
- 2 dropping the mass from different heights.
- 3 repeating the test on each metal and calculating the average diameter of the dent.
- 4 using an instrument with smaller divisions to measure the diameters of the dents.

6C Metal **W** is pure copper.

If a copper alloy was used instead, the diameter of the dent would be . . .

- 1 the same.
- 2 smaller.
- 3 larger.
- 4 deeper.

6D The student was asked to suggest some improvements to his experimental procedure.

Which of the following suggestions would be most likely to improve his results?

- 1 measure the time for the mass to fall from the point of release onto the ball-bearing
- 2 use a different ball-bearing for every test
- 3 use a screen around the apparatus to reduce the effects of draughts
- 4 use a ruler to make sure that the mass is always dropped from the same height

Turn over ►

QUESTION SEVEN

Test tubes used in school laboratories can be made from soda-lime glass or from boro-silicate glass.

Typical compositions of these two types of glass are shown in **Table 1**.

Table 1

	Percentage (%) composition					
	Silicon oxide	Aluminium oxide	Calcium oxide	Magnesium oxide	Sodium oxide	Boron oxide
Soda-lime glass	60–75	1	5–12	4	12–18	0
Boro-silicate glass	70–81	2–7	0.1	0	4–8	7–13

7A For boro-silicate glass, which of the following oxides shows the smallest range of percentage composition?

- 1 silicon oxide
- 2 aluminium oxide
- 3 sodium oxide
- 4 boron oxide

7B Boro-silicate glass has a higher melting point than soda-lime glass.

From the information given in **Table 1**, it is valid to conclude that this is because boro-silicate glass . . .

- 1 does **not** contain any magnesium oxide.
- 2 contains less silicon oxide.
- 3 has a different composition.
- 4 contains more oxides.

Table 2 shows information about soda-lime and boro-silicate glass test tubes.

Table 2

	Cost of one test tube in pence	Density in g per cm³	Average number of times it can be used	Melting point in °C
Soda-lime glass test tube	8	2.52	4	500
Boro-silicate glass test tube	18	2.23	12	1200

7C Schools use large numbers of test tubes.

The decision to buy soda-lime or boro-silicate glass test tubes for use in schools depends on . . .

- 1 the density and melting point.
- 2 the cost and how many times the test tube can be used.
- 3 the composition and density.
- 4 the melting point and quantities of impurities.

7D In an experiment, a student needs to heat a substance in a test tube to 700 °C.

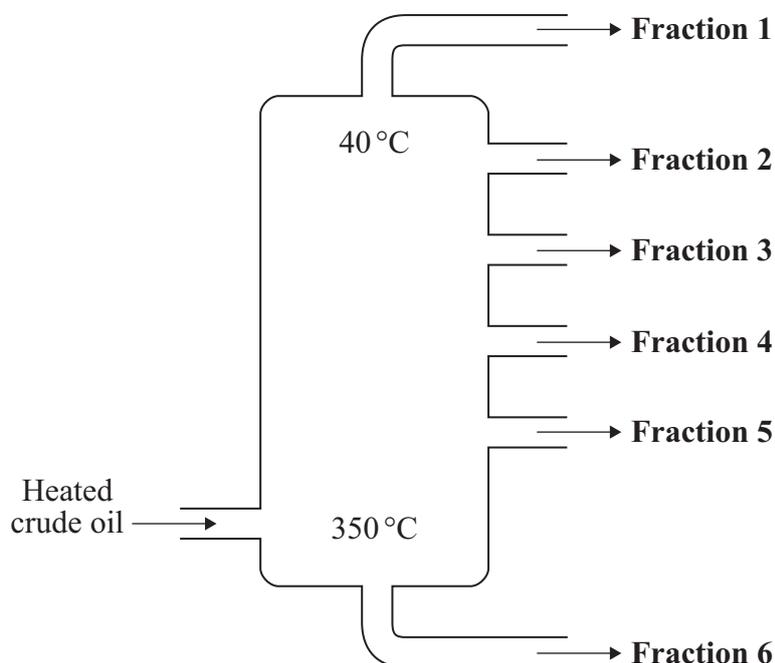
She selects a boro-silicate glass test tube rather than a soda-lime glass test tube because the boro-silicate glass test tube . . .

- 1 contains less silicon oxide.
- 2 is more expensive.
- 3 has a higher density.
- 4 has a melting point above 700 °C.

Turn over ►

QUESTION EIGHT

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



8A Each fraction contains . . .

- 1 only alkanes that are liquids.
- 2 only alkanes that condense at temperatures above 40 °C.
- 3 alkanes with similar boiling points.
- 4 alkanes with the same chemical formula.

8B Which statement is true for the alkanes in **Fraction 1**?

- 1 They burn to produce carbon dioxide and sulfur dioxide only.
- 2 They have the general formula C_nH_{2n-2}
- 3 They are saturated compounds.
- 4 They are compounds of carbon, hydrogen and oxygen.

8C When compared with the alkanes in **Fraction 6**, the alkanes in **Fraction 1** . . .

- 1 will ignite more easily.
- 2 will be more viscous.
- 3 will have higher boiling points.
- 4 will have larger molecules.

8D In a molecule of the alkane called propane, there are eight hydrogen atoms.

The formula for propane is . . .

- 1 C_2H_8
- 2 C_3H_8
- 3 C_4H_8
- 4 C_3H_8O

Turn over for the next question

Turn over ►

QUESTION NINE

Duralumin is an alloy which contains copper and magnesium mixed with aluminium.

Aluminium is a low density metal but duralumin is used more often in making aeroplanes.

9A Aluminium, copper and magnesium are extracted from their naturally occurring compounds.

The method used for the extraction depends on . . .

- 1 the density of the metal.
- 2 the abundance of the metal compound in the Earth's crust.
- 3 the melting point of the metal compound.
- 4 the reactivity of the metal.

9B Copper can be extracted by strongly heating a mixture of the copper compound and carbon.

In this reaction, the copper compound is . . .

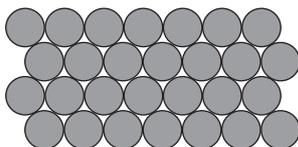
- 1 oxidised.
- 2 electrolysed.
- 3 reduced.
- 4 distilled.

9C Aluminium and magnesium are extracted by electrolysis.

One reason why this method is expensive is that . . .

- 1 the metals are resistant to corrosion.
- 2 the process requires a large amount of energy.
- 3 the metals are less reactive than carbon.
- 4 the metal ores are very abundant.

9D The diagram shows the arrangement of the atoms in pure aluminium.



Which row in the table correctly shows how the structure and properties are different in duralumin?

	Structure	Properties
1	The layers of atoms are distorted.	The alloy is harder.
2	The copper atoms attach strongly to the aluminium atoms.	The alloy is softer.
3	The layers of atoms are distorted.	The alloy is softer.
4	The magnesium atoms attach strongly to the aluminium atoms.	The alloy is harder.

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

The diagram shows part of the periodic table.

Li																	
Na																	
	Ca						Fe										
										Au							

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

- A** Calcium (Ca)
- B** Lithium (Li)
- C** Gold (Au)
- D** Iron (Fe)

1	It will not react with oxygen or water even at high temperatures.
2	It forms the oxide known as quicklime.
3	It has properties most similar to those of sodium (Na).
4	It is a transition element found in the Earth as an oxide.

QUESTION TWO

This question is about four chemical substances involved in the two chemical reactions below.



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

A ZnCO_3

B C

C CO_2

D ZnO

1	It is the metal oxide produced by thermal decomposition.
2	It has a formula made up of five atoms of three different elements.
3	It is the compound produced in both reactions.
4	It will burn in a limited supply of air to produce carbon monoxide and carbon dioxide.

Turn over for the next question

Turn over ►

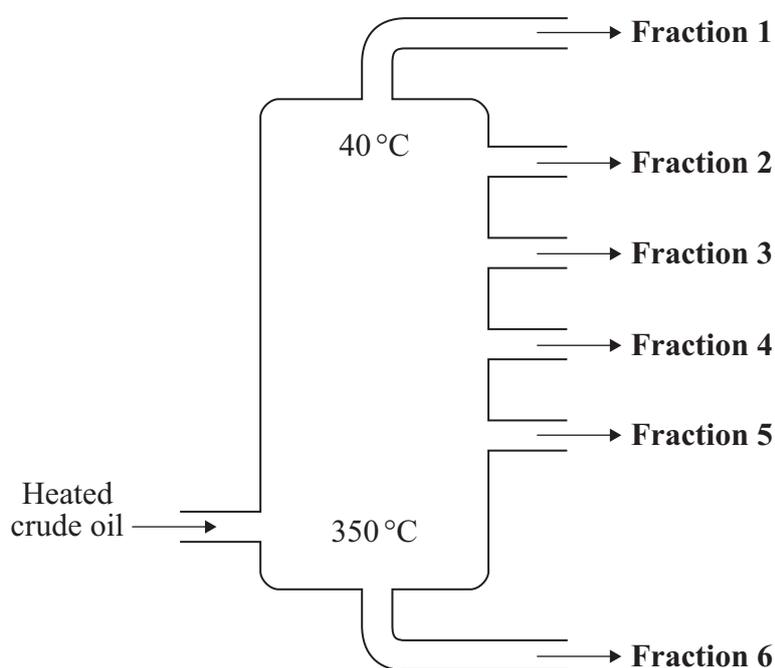
SECTION TWOQuestions **THREE** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.Mark your choices on the answer sheet.

QUESTION THREE

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

**3A** Each fraction contains . . .

- 1 only alkanes that are liquids.
- 2 only alkanes that condense at temperatures above 40 °C.
- 3 alkanes with similar boiling points.
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3B Which statement is true for the alkanes in **Fraction 1**?

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3C When compared with the alkanes in **Fraction 6**, the alkanes in **Fraction 1** . . .

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The formula for propane is . . .

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- 2 C_3H_8
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- 4 C_3H_8O

Turn over for the next question

Turn over ►

QUESTION FOUR

Duralumin is an alloy which contains copper and magnesium mixed with aluminium.

Aluminium is a low density metal but duralumin is used more often in making aeroplanes.

4A Aluminium, copper and magnesium are extracted from their naturally occurring compounds.

The method used for the extraction depends on . . .

- 1 the density of the metal.
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- 3 the melting point of the metal compound.
- 4 the reactivity of the metal.

4B Copper can be extracted by strongly heating a mixture of the copper compound and carbon.

In this reaction, the copper compound is . . .

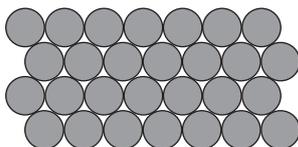
- 1 oxidised.
- 2 electrolysed.
- 3 reduced.
- 4 distilled.

4C Aluminium and magnesium are extracted by electrolysis.

One reason why this method is expensive is that . . .

- 1 the metals are resistant to corrosion.
- 2 the process requires a large amount of energy.
- 3 the metals are less reactive than carbon.
- 4 the metal ores are very abundant.

4D The diagram shows the arrangement of the atoms in pure aluminium.



Which row in the table correctly shows how the structure and properties are different in duralumin?

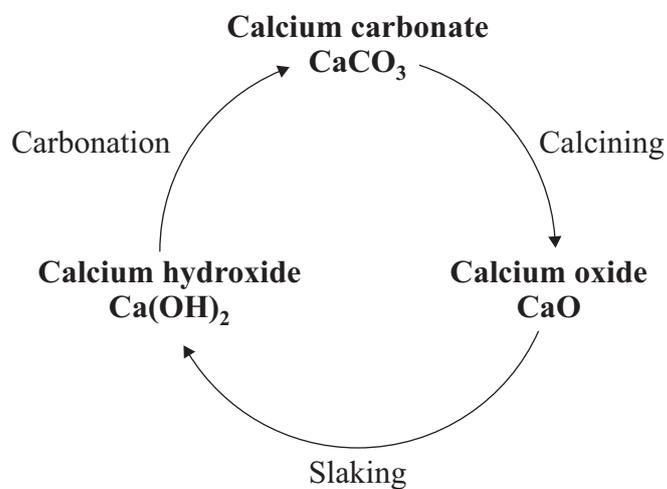
	Structure	Properties
1	The layers of atoms are distorted.	The alloy is harder.
2	The copper atoms attach strongly to the aluminium atoms.	The alloy is softer.
3	The layers of atoms are distorted.	The alloy is softer.
4	The magnesium atoms attach strongly to the aluminium atoms.	The alloy is harder.

Turn over for the next question

Turn over ►

QUESTION FIVE

The diagram shows substances and processes in the lime cycle.



The words calcining, slaking and carbonation are used in the lime industry to name the processes involved.

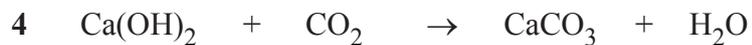
5A What type of reaction is described as *calcining* in the diagram?

- 1 neutralisation
- 2 thermal decomposition
- 3 combustion
- 4 hydration

5B What substance reacts with calcium oxide during *slaking*?

- 1 carbon dioxide
- 2 calcium hydroxide
- 3 hydrogen
- 4 water

5C Which of the following is the correct equation for *carbonation*?



5D Which of the following parts of the lime cycle contributes to global warming?

1 calcining

2 slaking

3 carbonation

4 slaking and carbonation

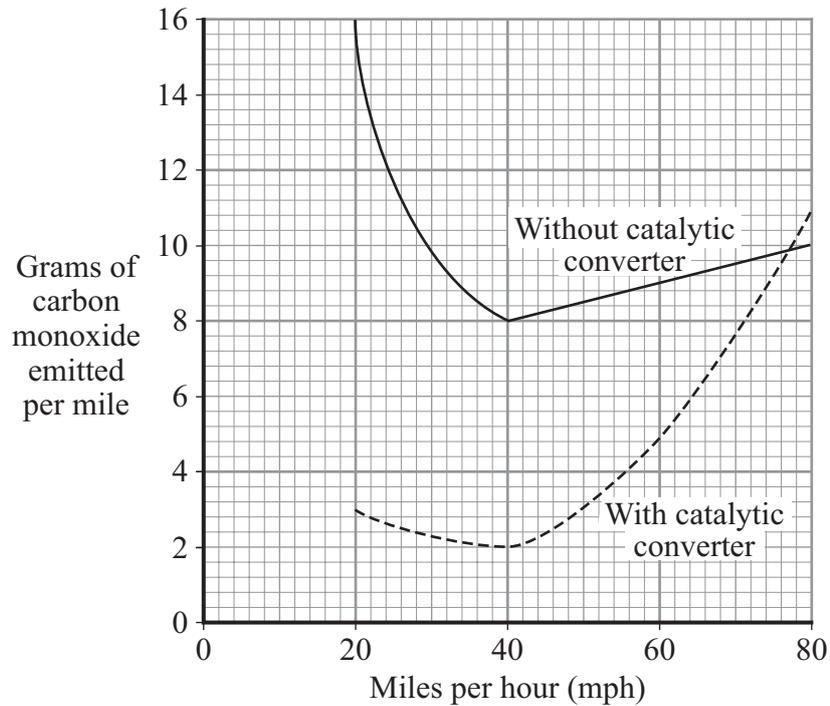
Turn over for the next question

Turn over ►

QUESTION SIX

Catalytic converters are fitted to car exhausts to reduce harmful emissions from the car. In a catalytic converter, carbon monoxide is converted into carbon dioxide. However, catalytic converters are not 100% efficient.

The graph shows the effect of a catalytic converter.



- 6A** At 40 mph, a catalytic converter reduces carbon monoxide emissions by . . .
- 1 2 g per mile.
 - 2 4 g per mile.
 - 3 6 g per mile.
 - 4 8 g per mile.

6B At what speed does a car with a catalytic converter emit the same amount of carbon monoxide as a car without a catalytic converter?

- 1 40 mph
- 2 70 mph
- 3 77 mph
- 4 80 mph

6C Which statement about the graph is true?

- 1 Catalytic converters work best at speeds above 40 mph.
- 2 The higher the speed, the higher the carbon monoxide emissions.
- 3 There is no connection between speed and the amount of carbon monoxide emitted.
- 4 Catalytic converters are more effective at lower speeds.

6D All the carbon monoxide emitted into the atmosphere eventually forms carbon dioxide.

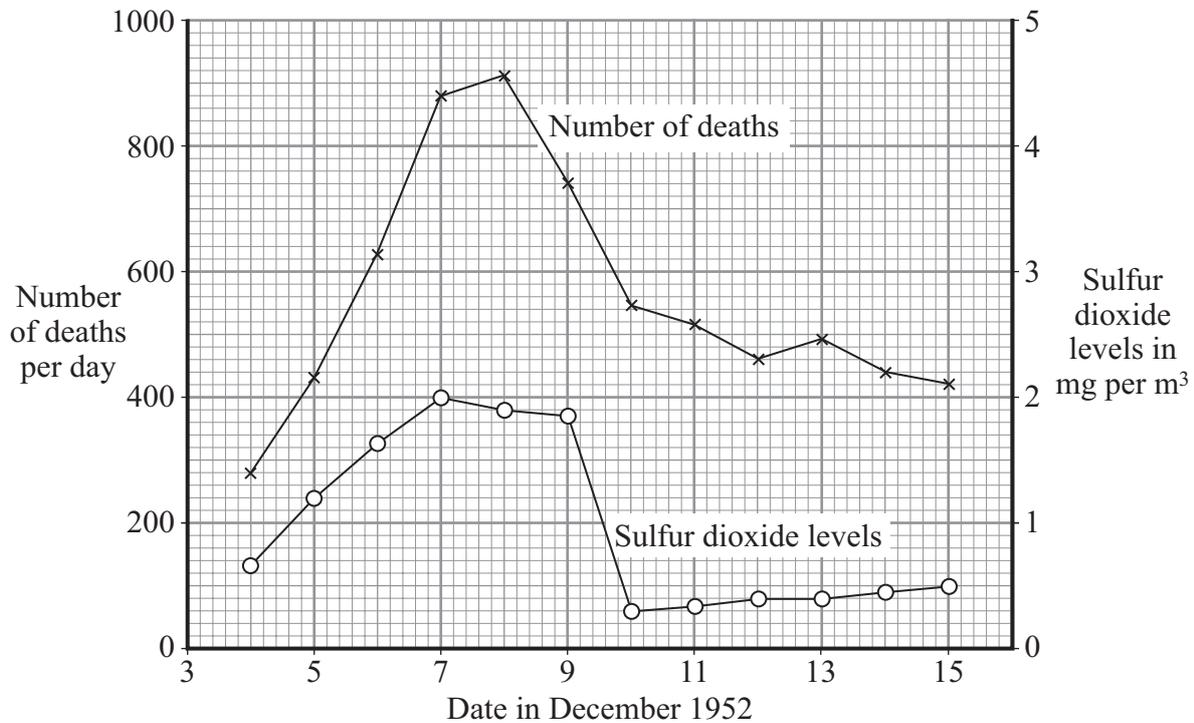
Which of the following statements is true?

- 1 Using catalytic converters reduces the amount of carbon dioxide put into the atmosphere by cars.
- 2 The effect that car emissions have on global warming is not changed by using catalytic converters.
- 3 Carbon dioxide levels are not affected by the use of cars.
- 4 A car without a catalytic converter produces more carbon dioxide than a car fitted with one.

QUESTION SEVEN

Smog is a mixture containing sulfur dioxide and smoke particles.

The graph below shows how the number of deaths due to sulfur dioxide varied during the Great Smog in London during December 1952.



7A It is generally agreed that sulfur dioxide caused the increase in the number of deaths in London in December 1952.

Which of the following would be the best argument **against** this conclusion?

- 1 The level of sulfur dioxide does **not** go as high as the number of deaths.
- 2 After a period of time, the sulfur dioxide levels increase but the number of deaths decreases.
- 3 The graphs show a similar pattern of increase and decrease.
- 4 The number of deaths increases faster than the sulfur dioxide levels increase.

7B A group of students studying the Great Smog of London in 1952 wrote four statements after looking at the data.

Which one of their statements is correct?

- 1 The number of deaths peaks on the same day as sulfur dioxide levels peak.
- 2 The number of deaths always increases when sulfur dioxide levels increase.
- 3 On the day that sulfur dioxide levels reached 2 mg per m^3 , there were 880 deaths.
- 4 If sulfur dioxide levels double, the number of deaths doubles.

7C Many cars now use low-sulfur fuels that were introduced in 2000. However, the amount of sulfur dioxide emissions from vehicles in the UK has increased since 2000.

This increase is because . . .

- 1 early versions of low-sulfur fuels did not burn correctly.
- 2 there is an increasing number of vehicles on UK roads.
- 3 there is now 5% ethanol ($\text{C}_2\text{H}_5\text{OH}$) in petrol.
- 4 sulfur dioxide is producing acid rain.

7D Sulfur dioxide can be removed from the waste gases from power stations using a process called flue gas desulfurisation. This is done by reacting the sulfur dioxide [SO_2] with calcium carbonate [CaCO_3], calcium oxide [CaO], calcium hydroxide [$\text{Ca}(\text{OH})_2$] or magnesium oxide [MgO].

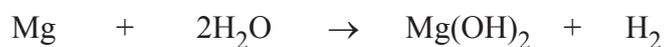
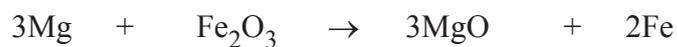
Which one of the following is **not** a correctly balanced equation for a reaction taking place during *flue gas desulfurisation*?

- 1 $\text{SO}_2 + \text{MgO} \rightarrow \text{MgSO}_3$
- 2 $\text{SO}_2 + \text{CaO} \rightarrow \text{CaSO}_3$
- 3 $\text{SO}_2 + \text{CaCO}_3 \rightarrow \text{CaSO}_3 + \text{CO}_2$
- 4 $\text{SO}_2 + \text{Ca}(\text{OH})_2 \rightarrow \text{CaSO}_3 + 2\text{H}_2\text{O}$

Turn over ►

QUESTION EIGHT

The equations show three reactions of the metal magnesium.



8A Magnesium **cannot** be produced by heating magnesium oxide with carbon.

Which row in the table correctly shows the order of reactivity for iron, magnesium and carbon?

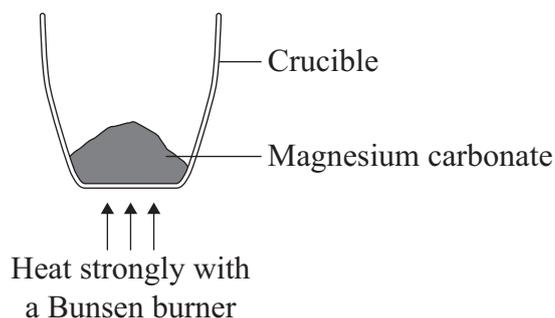
	Most reactive	—————→	Least reactive
1	magnesium	carbon	iron
2	magnesium	iron	carbon
3	iron	carbon	magnesium
4	carbon	iron	magnesium

8B When magnesium reacts with hydrochloric acid, hydrogen is given off.
When excess magnesium is used and all the acid has reacted, hydrogen continues to be given off from the remaining magnesium.

The probable reason is that . . .

- 1 magnesium reacts with water to form hydrogen and magnesium hydroxide.
- 2 magnesium reacts with water to form hydrogen and oxygen.
- 3 magnesium reacts with oxygen from the air to form hydrogen and magnesium oxide.
- 4 magnesium oxide decomposes to form magnesium, oxygen and hydrogen.

A student heated some magnesium carbonate in an open crucible.



The table shows the mass of the crucible and its contents at two-minute intervals.

Time in minutes	0	2	4	6	8
Mass of crucible and contents in grams	20.80	20.55	20.25	19.85	19.85

8C Which solid substances will the crucible contain after heating for two minutes?

- 1 magnesium carbonate only
- 2 magnesium oxide only
- 3 magnesium carbonate and magnesium oxide
- 4 magnesium and magnesium oxide

8D The student found that when the experiment was repeated using sodium carbonate instead of magnesium carbonate, there was no loss in mass.

The best conclusion that the student could make is that sodium carbonate . . .

- 1 does **not** decompose when heated.
- 2 only decomposes when heated gently.
- 3 only decomposes when heated to a very high temperature.
- 4 does **not** decompose at Bunsen burner temperatures.

Turn over ►

QUESTION NINE

Hydrogen is used as a fuel. Some of its properties are listed below.

- K** – There is a plentiful supply in water and natural gas.
- L** – On combustion, it forms water only.
- M** – It requires a lot of energy to make.
- N** – It is highly flammable.
- P** – Because of its very low density, large volumes are needed.
- Q** – It is difficult to liquefy because its boiling point is -253°C .

9A Which pair of properties shows that hydrogen is a useful fuel?

- 1 **K and M**
- 2 **K and L**
- 3 **N and P**
- 4 **M and Q**

9B Which pair of properties might hold back the use of hydrogen as a fuel?

- 1 **M and P**
- 2 **K and Q**
- 3 **L and P**
- 4 **N and K**

9C Which of the following events would delay the development of hydrogen as a fuel?

- 1 the discovery of large deposits of crude oil
- 2 global warming becoming much worse
- 3 the cost of hydrogen manufacture decreasing
- 4 a safe way of storing hydrogen being discovered

9D The very rare and expensive metal palladium is capable of storing many hundreds of times its own volume of hydrogen.

Which statement would be true if palladium was used in hydrogen-powered cars?

- 1 The increased demand for palladium will cause its price to fall.
- 2 Hydrogen that has been stored in palladium will have a lower density.
- 3 Hydrogen that has been stored in palladium is hard to burn.
- 4 The cars would be safer than those that store hydrogen in pressurised cylinders.

END OF TEST