Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
March 2009

SCIENCE A **CHY1AP**
Unit Chemistry C1a (Products from Rocks)

CHEMISTRY
Unit Chemistry C1a (Products from Rocks)

Wednesday 4 March 2009 Morning Session

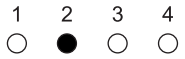
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

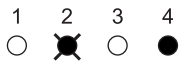
Time allowed: 30 minutes

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.

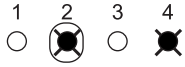
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 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 molecules of ammonia.

The formula for ammonia is NH_3

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

A elements

B electrons

C atoms

D bonds

The formula tells us that one molecule of ammonia contains three . . . **1** . . . of hydrogen.

In ammonia, the particles of nitrogen and hydrogen are joined together by . . . **2** . . . which are formed by sharing . . . **3** . . . between the nitrogen and hydrogen.

Nitrogen and hydrogen are both . . . **4** . . . .

QUESTION TWO

Impure iron is produced in a blast furnace by reducing the iron compound found in one of its ores.

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

A carbon

B cast iron

C iron

D iron oxide

The main ore from which iron is extracted contains the compound . . . **1** . . . .

This is reduced in the blast furnace by reacting it with . . . **2** . . . .

The metal produced from the blast furnace contains about 96% . . . **3** . . . .

The product is brittle and is known as . . . **4** . . . .

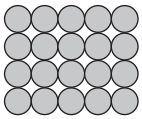
Turn over for the next question

QUESTION THREE

The diagrams show the arrangement of atoms in each of four substances, **A**, **B**, **C** and **D**, at room temperature (20 °C).

Substance **A**

Substance **B**



Substance **C**

Substance **D**

Key

- An atom of oxygen
- An atom of carbon
- An atom of iron
- An atom of hydrogen

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

	Description of the substance
1	It is an element that is a gas.
2	It is an element that is a solid.
3	It is a compound that is a gas.
4	It is a compound that is a liquid.

QUESTION FOUR

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

	Melting point in °C	Boiling point in °C	Density in g per cm^3	Electrical conductivity
A	64	774	0.9	good
B	–218	–183	0.00014	very poor
C	–39	357	13.6	very good
D	115	444	2.1	very poor

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

	Property of the element
1	It is the element with the highest melting point.
2	It is a gas at room temperature (20 °C).
3	It is the metal with the lowest density.
4	It is the metal that is liquid at room temperature (20 °C).

Turn over for the next question

QUESTION FIVE

Fuels burn in air to form oxides of the elements they contain.
When fuel molecules contain a large number of carbon atoms, combustion is not always complete.
With incomplete combustion, carbon particles may be produced.

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

A H_2

B CO

C C_4H_{10}

D $C_{14}H_{28}$

1	It will burn to form carbon dioxide only.
2	It will burn to form water only.
3	It is an alkane.
4	It will probably contribute to global dimming when burned.

Turn over for the next question

SECTION TWO

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

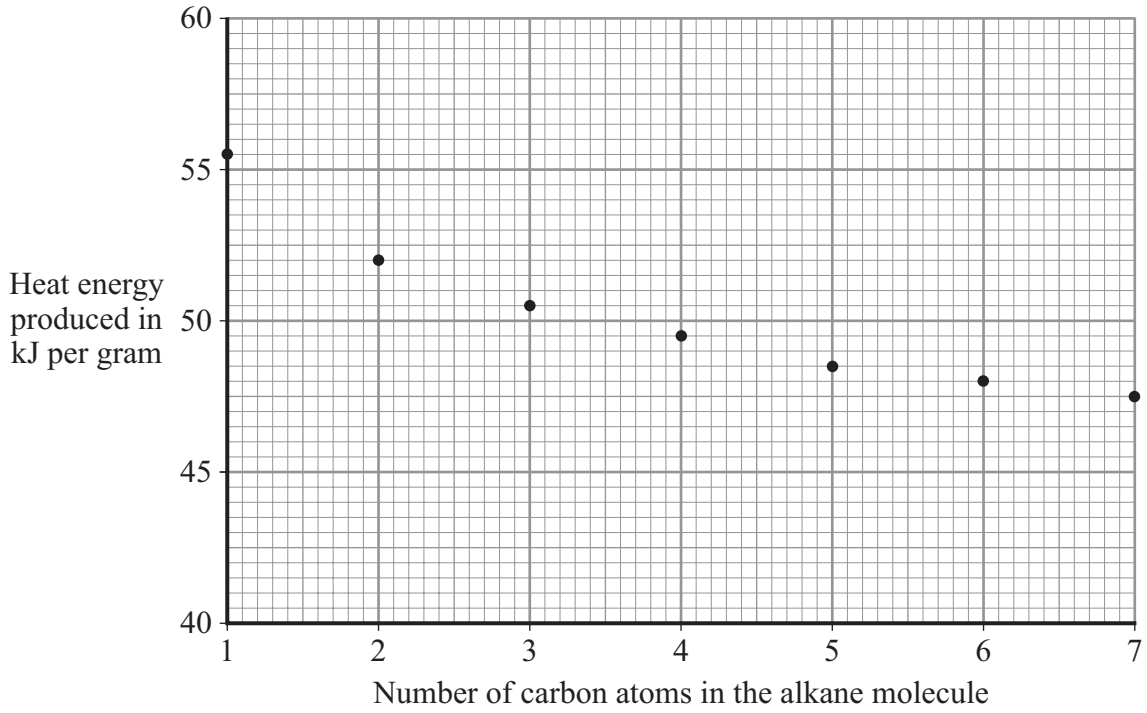
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

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



6A How much heat energy is produced by burning one gram of the alkane with two carbon atoms in its molecule?

1 51 kJ

2 52 kJ

3 53 kJ

4 54 kJ

6B The alkane that produces the most heat energy per gram, when burned, is the alkane with . . .

1 one carbon atom in its molecule.

2 three carbon atoms in its molecule.

3 five carbon atoms in its molecule.

4 seven carbon atoms in its molecule.

6C Carbon dioxide is produced when hydrocarbon fuels burn.

This is a problem because carbon dioxide . . .

1 dissolves in rainwater.

2 reacts with oxygen to form carbon monoxide.

3 may cause global warming.

4 may cause global dimming.

6D Petrol companies have reduced the amount of sulfur in petrol and diesel fuels.

The main reason is . . .

1 to reduce their production costs.

2 to reduce the amount of carbon dioxide released into the atmosphere.

3 to reduce the acidity of rain.

4 to reduce the amount of fuel used in vehicles.

Turn over for the next question

QUESTION SEVEN

A student designed an experiment to find the mass of calcium oxide that could be obtained from 5.00 g of calcium carbonate.

He heated 5.00 g of calcium carbonate in a test tube with a Bunsen burner. The mass of the contents remaining in the test tube was recorded every minute.

He repeated the experiment with another 5.00 g of calcium carbonate.

The results are shown in the table.

	Time in minutes	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Mass of the contents of the test tube in g	Test 1	5.00	4.81	4.23	3.85	3.43	3.08	2.96
	Test 2	5.00	4.55	3.97	3.36	2.92	2.80	2.80

7A To improve the reliability of the results, the student should . . .

1 use a more precise balance.

2 repeat the investigation at least one more time.

3 use a greater mass of calcium carbonate.

4 measure the mass of carbon dioxide released during heating.

7B One variable that is difficult to control in this experiment is . . .

1 the mass of the calcium carbonate.

2 the mass of the test tube.

3 the time for which the calcium carbonate is heated.

4 the temperature of the Bunsen burner flame.

7C The student wants an accurate result for the mass of calcium oxide that forms from 5.00 g of calcium carbonate.

He should . . .

1 take readings at shorter time intervals.

2 remove the calcium oxide from the tube to find the mass.

3 use a larger test tube so that the carbon dioxide given off does not escape.

4 heat the calcium carbonate until there is no further loss in mass.

7D This is the word equation for the decomposition of calcium carbonate:

$$\text{calcium carbonate} \rightarrow \text{calcium oxide} + \text{carbon dioxide}$$

When 5.00 g of calcium carbonate is heated, 2.80 g of calcium oxide is left.

How much carbon dioxide has been given off?

1 2.20 g

2 2.80 g

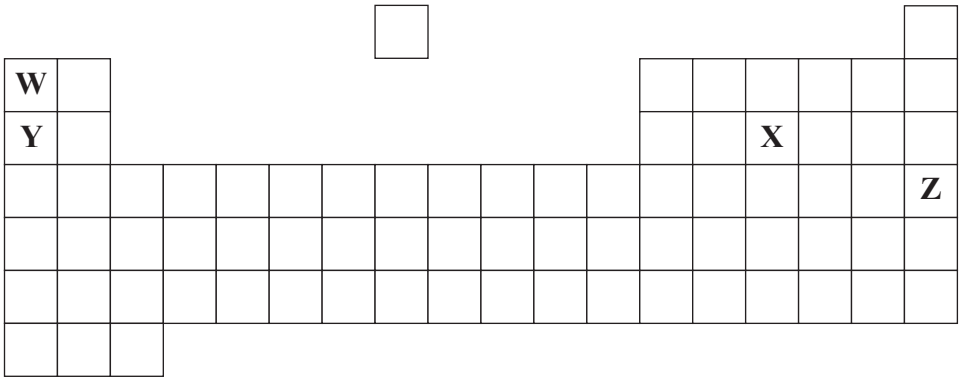
3 5.00 g

4 7.80 g

Turn over for the next question

QUESTION EIGHT

The diagram represents the periodic table.



Four elements, **W**, **X**, **Y** and **Z**, are shown. The letters representing these elements are **not** their chemical symbols.

8A Which elements have chemical properties similar to element **W**?

1 both elements **X** and **Y**

2 only element **X**

3 only element **Y**

4 only element **Z**

8B What are the vertical columns called in the periodic table?

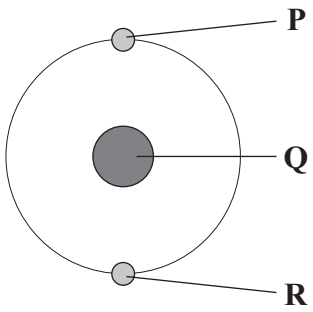
1 compounds

2 groups

3 periods

4 tables

8C The diagram shows an atom.



Which row in the table is correct?

	P	Q	R
1	electron	nucleus	electron
2	electron	nucleus	nucleus
3	nucleus	electron	electron
4	nucleus	nucleus	electron

8D In a chemical reaction, . . .

1 new types of atom are produced.

2 more atoms are produced.

3 the atoms rearrange themselves.

4 some atoms are lost.

Turn over for the next question

QUESTION NINE

Solder is an alloy of lead and tin. The table shows how the percentage of tin affects some of the properties of solder.

Percentage of tin	Tensile strength in MPa	Melting point in °C	Density in g per cm^3
0	12	347	11.35
10	30	297	10.50
20	33	257	10.40
30	34	217	9.66
40	37	187	9.28
50	41	147	8.90
60	52	153	8.52
70	54	167	8.17

9A What is the density of lead in g per cm^3?

1 8.17

2 8.90

3 11.35

4 12.00

9B Increasing the percentage of tin in solder . . .

1 decreases the tensile strength of the solder.

2 decreases the density of the solder.

3 increases the flexibility of the solder.

4 increases the melting point of the solder.

9C How could the lowest melting point of solder be found accurately?

1 by using a more accurate type of thermometer

2 by repeating the measurements between 30 % and 50 % tin

3 by increasing the number of measurements between 40 % and 60 % tin

4 by increasing the number of measurements between 50 % and 70 % tin

9D How might the relationship between the percentage of tin in solder and the melting point of solder best be described?

1 The relationship is directly proportional.

2 There is no relationship.

3 As the percentage of tin increases, the melting point decreases steadily.

4 As the percentage of tin increases, the melting point decreases, and then starts to rise.

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

Fuels burn in air to form oxides of the elements they contain.
When fuel molecules contain a large number of carbon atoms, combustion is not always complete.
With incomplete combustion, carbon particles may be produced.

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

A H_2

B CO

C C_4H_{10}

D $C_{14}H_{28}$

1	It will burn to form carbon dioxide only.
2	It will burn to form water only.
3	It is an alkane.
4	It will probably contribute to global dimming when burned.

QUESTION TWO

This question is about the production of metals.

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

A decomposed

B acidified

C reduced

D extracted

Some metals are produced from their carbonate ores.

The ores are first . . . **1** . . . from the ground.

They are then heated until the metal carbonate is . . . **2** . . . .

When the ore is heated, sulfur impurities may react with air and eventually cause rainwater to be . . . **3** . . . .

Finally, the metal oxide can be reacted with carbon and so be . . . **4** . . . to the metal.

Turn over for the next question

SECTION TWO

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

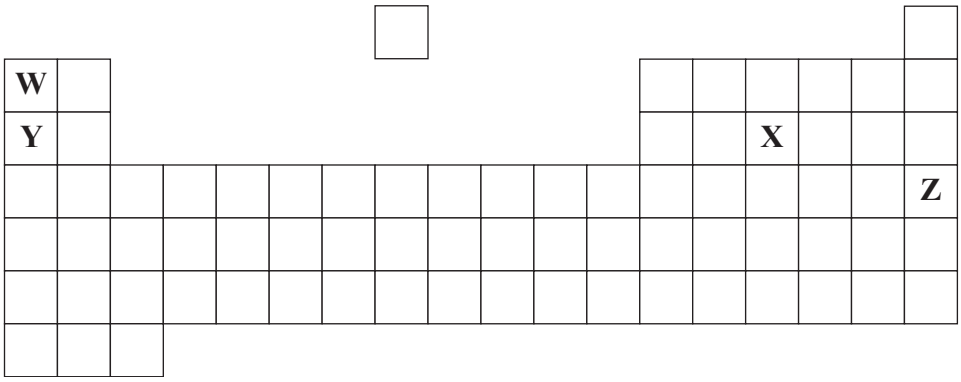
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

The diagram represents the periodic table.



Four elements, **W**, **X**, **Y** and **Z**, are shown. The letters representing these elements are **not** their chemical symbols.

3A Which elements have chemical properties similar to element **W**?

1 both elements **X** and **Y**

2 only element **X**

3 only element **Y**

4 only element **Z**

3B What are the vertical columns called in the periodic table?

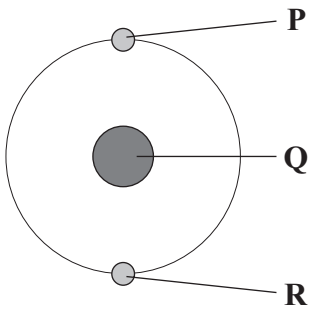
1 compounds

2 groups

3 periods

4 tables

3C The diagram shows an atom.



Which row in the table is correct?

	P	Q	R
1	electron	nucleus	electron
2	electron	nucleus	nucleus
3	nucleus	electron	electron
4	nucleus	nucleus	electron

3D In a chemical reaction, . . .

1 new types of atom are produced.

2 more atoms are produced.

3 the atoms rearrange themselves.

4 some atoms are lost.

Turn over for the next question

QUESTION FOUR

Solder is an alloy of lead and tin. The table shows how the percentage of tin affects some of the properties of solder.

Percentage of tin	Tensile strength in MPa	Melting point in °C	Density in g per cm^3
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30	34	217	9.66
40	37	187	9.28
50	41	147	8.90
60	52	153	8.52
70	54	167	8.17

4A What is the density of lead in g per cm^3?

1 8.17

2 8.90

3 11.35

4 12.00

4B Increasing the percentage of tin in solder . . .

1 decreases the tensile strength of the solder.

2 decreases the density of the solder.

3 increases the flexibility of the solder.

4 increases the melting point of the solder.

4C How could the lowest melting point of solder be found accurately?

1 by using a more accurate type of thermometer

2 by repeating the measurements between 30 % and 50 % tin

3 by increasing the number of measurements between 40 % and 60 % tin

4 by increasing the number of measurements between 50 % and 70 % tin

4D How might the relationship between the percentage of tin in solder and the melting point of solder best be described?

1 The relationship is directly proportional.

2 There is no relationship.

3 As the percentage of tin increases, the melting point decreases steadily.

4 As the percentage of tin increases, the melting point decreases, and then starts to rise.

Turn over for the next question

QUESTION FIVE

This question is about heating some metal carbonates.

A student heated exactly 1.00 g of four different metal carbonates. He heated them strongly for exactly the same amount of time. He used the same balance for each measurement.

After heating with a Bunsen burner, the masses remaining were:

calcium carbonate	0.56 g
copper carbonate	0.64 g
magnesium carbonate	0.48 g
sodium carbonate	1.00 g

5A What is the most likely reason why sodium carbonate had the same mass after heating?

1 The balance was not working properly.

2 Sodium carbonate does not decompose at Bunsen burner temperatures.

3 The student did not heat the sodium carbonate long enough.

4 The student used too much sodium carbonate so it was not all heated.

5B When copper carbonate is heated, it changes from a green powder to a black powder.

What is the black powder?

1 carbon

2 copper

3 copper hydroxide

4 copper oxide

Four students, **A**, **B**, **C** and **D**, heated copper carbonate. The table shows their results.

Student	Mass of copper carbonate used in g	Mass after heating in g
A	0.50	0.32
B	0.60	0.38
C	0.70	0.40
D	0.80	0.51

5C Which student obtained an anomalous result?

1 Student **A**

2 Student **B**

3 Student **C**

4 Student **D**

5D The student with the anomalous result thought that he had not heated the copper carbonate long enough for the reaction to finish. He repeated the experiment.

What is the best method he could use to make sure that the reaction had finished?

1 heat the copper carbonate for twice as long

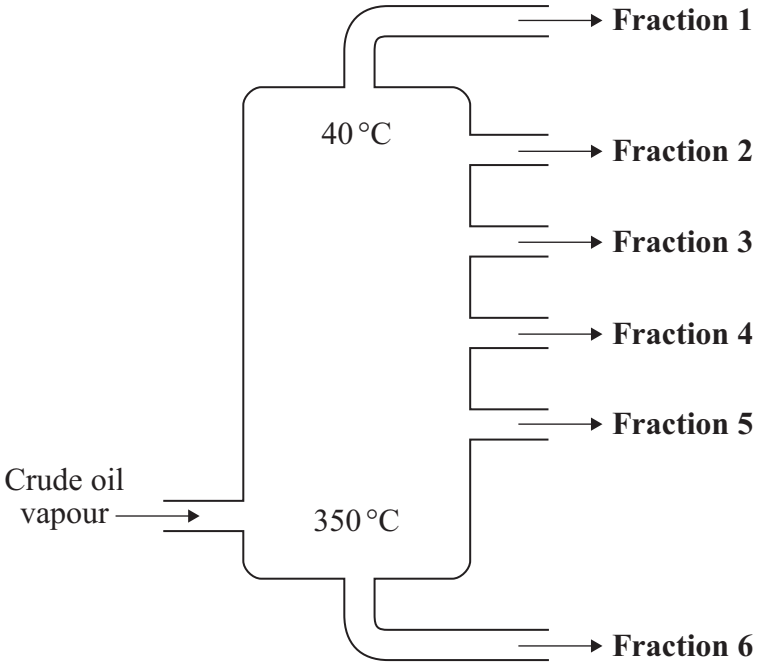
2 heat the copper carbonate until he could not see any more green colour

3 heat the copper carbonate until it did not lose any more mass

4 heat the copper carbonate until carbon dioxide is detected coming from the tube

QUESTION SIX

Crude oil vapour can be separated into a number of fractions.



6A Crude oil vapour enters the fractionating column.

What happens as the vapour cools?

1 The fractions separate because they have different densities.

2 The fractions condense at 40 °C.

3 The fractions condense at different temperatures.

4 The fractions condense at 350 °C.

6B **Fraction 6** will contain . . .

1 alkanes with high boiling points.

2 alkanes with a small number of carbon atoms in each molecule.

3 only hydrocarbons that are unsaturated.

4 only hydrocarbons with low boiling points.

6C **Fraction 1** contains the alkanes called methane, ethane, propane and butane.

By what process could pure methane be obtained from this fraction?

1 evaporation

2 electrolysis

3 thermal decomposition

4 fractional distillation

6D Which of these statements is correct for the alkanes?

1 They are a series of compounds with the general formula C_nH_{2n+1}

2 They are saturated compounds.

3 Most are gases at room temperature (20 °C), some are liquids, none are solids.

4 Their molecules have a carbon : hydrogen ratio of 1 : 4

Turn over for the next question

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 56 g of calcium oxide.

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

The carbon dioxide formed could be:

- used by oil companies
- used by ice-cream companies
- reacted with sodium hydroxide to make sodium carbonate for glass-making.

7A Calculate the mass of carbon dioxide that would be released by completely decomposing 400 tonnes of calcium carbonate.

(1 tonne = 1 000 000 g)

1 17.6 tonnes

2 22.4 tonnes

3 176.0 tonnes

4 224.0 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 reverting back to calcium carbonate.

7C A company makes calcium oxide from calcium carbonate.

The best way for this company to benefit economically, and at the same time reduce environmental damage, is to . . .

1 store the carbon dioxide in holes in the ground made by oil companies.

2 offer the carbon dioxide to oil companies so that they can use it to flush 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 glass-making companies for conversion into sodium carbonate.

7D Graphs of global temperatures compared with the amount of carbon dioxide in the atmosphere over the past 50 years follow each other very closely.

The best conclusion that can be drawn from this is that . . .

1 burning fossil fuels causes global warming.

2 decomposing limestone causes global warming.

3 the heat from processing limestone causes global warming.

4 rising levels of carbon dioxide probably add to global warming.

Turn over for the next question

QUESTION EIGHT

This question is about cyclic alkanes. Cyclic alkanes have similar chemical properties to straight chain alkanes.

The table below gives the energy released by burning the first four cyclic alkanes.

Cyclic alkane	Formula	Energy released by burning 1 g of the cyclic alkane
Cyclopropane	C_3H_6	46.6 kJ
Cyclobutane	C_4H_8	45.9 kJ
Cyclopentane	C_5H_{10}	44.3 kJ
Cyclohexane	C_6H_{12}	43.9 kJ

8A The cyclic alkanes listed in the table all fit the general formula . . .

1 CH_2

2 C_nH_{2n}

3 C_nH_{2n+2}

4 C_nH_{n+2}

8B Burning cyclic alkanes could **not** produce . . .

1 carbon.

2 hydrogen.

3 carbon dioxide.

4 water.

8C A graph of the energy released by burning cyclic alkanes (y-axis) against the number of carbon atoms they contain (x-axis), would involve plotting . . .

1 an independent variable against a discrete variable.

2 a continuous variable against a continuous variable.

3 a discrete variable against a control variable.

4 a continuous variable against a discrete variable.

8D A graph of the energy released by burning cyclic alkanes (y-axis) against the number of carbon atoms they contain (x-axis), would show . . .

1 negative correlation.

2 no clear pattern.

3 positive correlation.

4 direct proportionality.

Turn over for the next question

QUESTION NINE

A scientist investigated the chemistry of four metals, **W**, **X**, **Y** and **Z**.

These are the results.

- The oxides of **W** and **Y** were reduced to the metal when mixed with carbon and heated.
- The oxide of **Z** could not be reduced by heating with carbon.
- The oxide of **X** decomposed to the metal on heating alone.
- **Y** gave off hydrogen gas with dilute acid but **W** and **X** did not.

9A Starting with the most reactive, what is the order of reactivity for the four metals?

1 **X**, **W**, **Y**, **Z**

2 **Z**, **Y**, **W**, **X**

3 **X**, **W**, **Z**, **Y**

4 **Z**, **W**, **Y**, **X**

9B Which metal is most likely to be found in the ground as the pure metal?

1 **W**

2 **X**

3 **Y**

4 **Z**

9C How would metal **Z** be produced?

1 by mixing the oxide of **Z** with carbon and heating

2 by mixing an oxide of **Z** with the metal **W** and heating

3 by electrolysis of a molten oxide of **Z**

4 by heating the oxide of **Z** in a stream of hydrogen gas

9D The equation for the reduction of the oxide of **W** to the metal **W** can be represented by the following equation:

$$2\mathbf{W}_2O_3 \quad + \quad \boldsymbol{q}C \quad = \quad 3CO_2 \quad + \quad \boldsymbol{r}\mathbf{W}$$

What values of ***q*** and ***r*** are needed to balance the equation?

1 ***q*** = 3 and ***r*** = 4

2 ***q*** = 2 and ***r*** = 2

3 ***q*** = 4 and ***r*** = 2

4 ***q*** = 3 and ***r*** = 2

END OF TEST

There are no questions printed on this page