Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

Science A

Unit Chemistry C1a (Products from Rocks)

Chemistry

Unit Chemistry C1a (Products from Rocks)

CHY1AP

F&H

Monday 28 June 2010 Morning Session

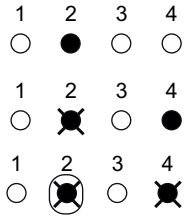
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

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 12 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**.

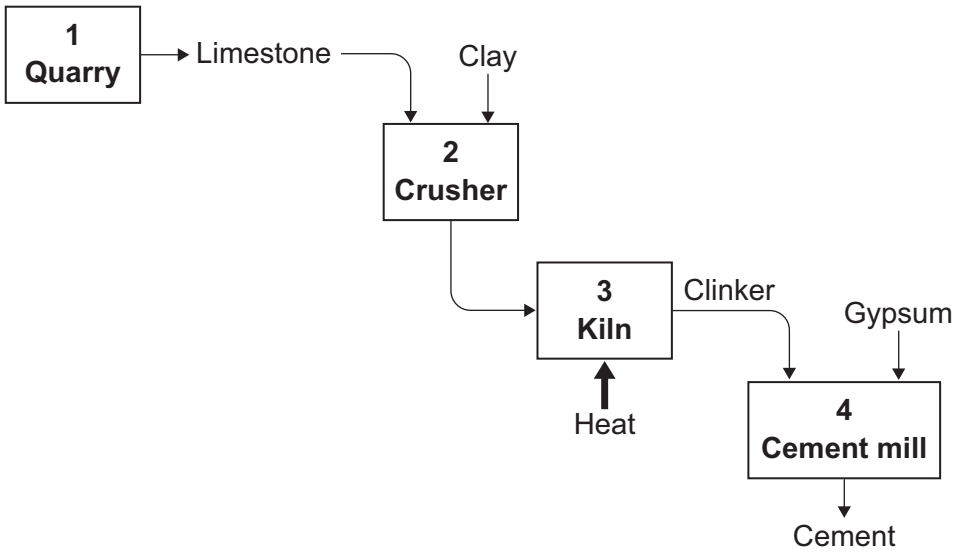
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

Limestone, clay and gypsum are natural substances that can be quarried.

The flow chart shows how they are used to make cement.



Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** on the flow chart.

A It is where thermal decomposition takes place.

B It is where only natural substances are mixed.

C It is where a natural substance is mixed with a man-made substance.

D It is where limestone is obtained.

QUESTION TWO

The table shows the composition and melting points of four alloys, **A**, **B**, **C** and **D**.

Alloy	Melting point in °C	Percentage composition (%)				
		Tin	Indium	Bismuth*	Lead*	Cadmium*
A	100	24.0	0	49.0	27.0	0
B	62	16.5	51.0	32.5	0	0
C	70	13.0	0	50.0	27.0	10.0
D	47	8.3	19.1	44.7	22.6	5.3

Toxic substances are marked with *.

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

1 It has the highest melting point.

2 It is made up from the largest number of substances.

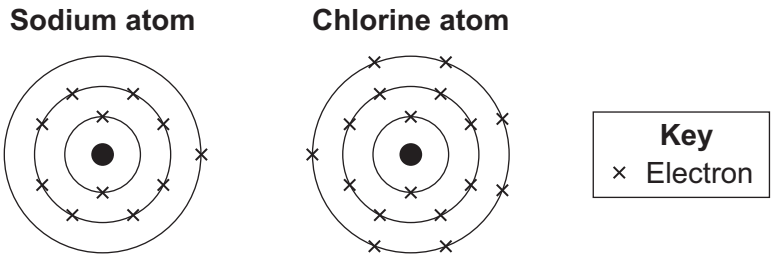
3 It contains the least bismuth.

4 It contains the largest percentage of toxic substances.

Turn over for the next question

QUESTION THREE

This question is about a sodium atom and a chlorine atom.



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

A bonds

B electrons

C elements

D nuclei

In the diagrams, ● represents . . . **1** . . . .

Sodium and chlorine are . . . **2** . . . .

When sodium and chlorine react, the chlorine atoms take . . . **3** . . . from the sodium atoms.

The sodium and chlorine atoms are then held together by . . . **4** . . . .

QUESTION FOUR

The table shows information about four fuels, **A**, **B**, **C** and **D**.

	Fuel	Type of substance	Number of carbon atoms per molecule	Energy per g of fuel	Mass of carbon dioxide per g of fuel
A	LPG	Alkanes	3 or 4	50 kJ	3.0 g
B	Diesel	Alkanes	16–20	53 kJ	3.1 g
C	Ethanol	Alcohol	2	30 kJ	1.9 g
D	Hydrogen	Element	0	118 kJ	0.0 g

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

1 This fuel has the lowest boiling point of the fuels that are alkanes.

2 This fuel does not produce carbon dioxide when burned.

3 This fuel gives the least amount of energy per gram when burned.

4 This fuel has the most carbon atoms in its molecules.

QUESTION FIVE

Petrol is a hydrocarbon fuel that burns in air. Air is mainly nitrogen.

In a car engine:

- not all of the petrol burns completely
- after burning, the products pass into the exhaust pipe.

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

A nitrogen dioxide

B carbon monoxide

C carbon dioxide

D soot (carbon)

The black solid seen inside the exhaust pipe is . . . **1** . . . .

The gas in the exhaust fumes formed by the complete combustion of petrol is . . . **2** . . . .

The poisonous gas in the exhaust fumes formed by incomplete combustion of petrol is . . . **3** . . . .

The gas in the exhaust fumes formed by combining two gases from the air is . . . **4** . . . .

Section Two

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

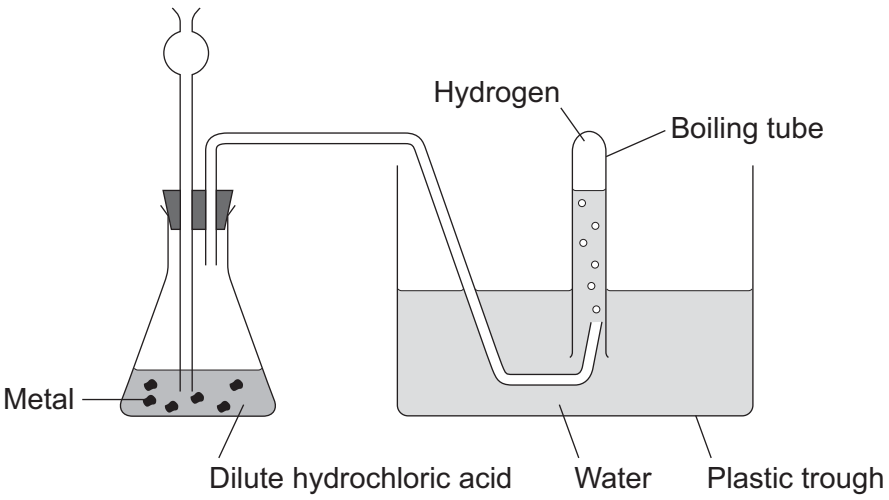
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

Some students were trying to decide which one of the metals, **K**, **L**, **M** or **N**, was the most reactive. They set up the apparatus shown in the diagram.



Dilute hydrochloric acid was added to the metal **K**. Hydrogen was given off. The students recorded how long it took to fill the boiling tube with the hydrogen. They did the experiment twice more under exactly the same conditions.

They repeated the experiment, using equal-sized pieces of metals **L**, **M** and **N**.

The results are shown in the table.

	Time taken to fill the boiling tube with hydrogen in seconds		
Metal	**Experiment 1**	**Experiment 2**	**Experiment 3**
K	600	479	649
L	189	220	178
M	81	82	78
N	125	132	143

6A To make it a fair test, the students made sure that the boiling tube was always completely filled with hydrogen before they recorded the time.

What else should they do to make it a fair test?

1 use a different acid for each metal

2 use the same volume of the acid for each test

3 replace the water in the plastic trough for each test

4 use different temperatures for each metal

6B Which metal was the most reactive?

1 metal **K**

2 metal **L**

3 metal **M**

4 metal **N**

6C Why did the students take more than one reading for each metal?

1 to make an error less likely

2 so that they could plot a graph

3 to make it easier to see the relationship between the two variables

4 to make it a fair test

6D Some of their results were anomalous.

Which of the following experiments should the students repeat?

1 metal **K**, experiment 2

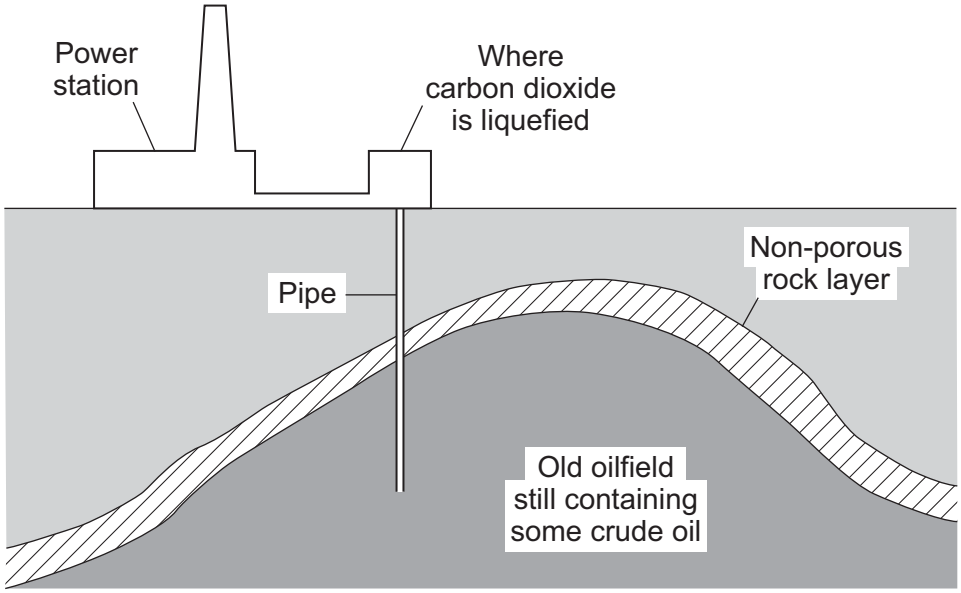
2 metal **L**, experiment 3

3 metal **M**, experiment 3

4 metal **N**, experiment 1

QUESTION SEVEN

Carbon capture and storage (CCS) is being developed to reduce the amount of carbon dioxide released into the atmosphere by power stations. Carbon dioxide is separated from the waste gases. It is liquefied and then pumped into a storage area underground. There are many old oilfields that could be used as storage areas.



7A The main reason why CCS is being developed is . . .

1 to reduce global warming.

2 because old oilfields need filling up.

3 because carbon dioxide is toxic.

4 to store carbon dioxide for future use.

7B A possible additional benefit from CCS is that it . . .

1 stops crude oil from rising to the surface.

2 could help to extract any remaining crude oil.

3 prevents the formation of new crude oil.

4 stops the old oilfield from being used as a landfill site.

7C The carbon dioxide does not re-enter the atmosphere from the old oilfield . . .

1 because of plants that grow deep underground.

2 because the pipe to the old oilfield is too narrow.

3 because of the non-porous rock layer.

4 because it turns into a fossil fuel.

7D Which of the following might be a problem for CCS?

1 The carbon dioxide is needed in the atmosphere.

2 There are no old oilfields left.

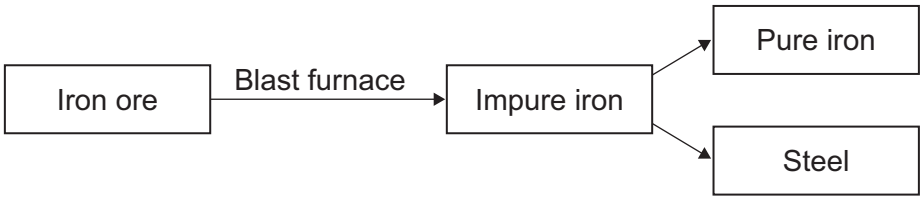
3 Nobody will be burning fossil fuels in the near future.

4 Earthquakes might occur in the old oilfields.

Turn over for the next question

QUESTION EIGHT

The flow chart shows how iron ore can be changed into useful materials.



8A Iron ore is the starting material for making iron because . . .

1 iron ore is magnetic.

2 iron ore contains a reasonable amount of iron oxide.

3 a lot of energy is needed to convert iron ore into iron.

4 mining iron ore does not cause any environmental problems.

8B In the blast furnace, iron oxide is converted to iron using carbon. This is because . . .

1 iron is less reactive than carbon.

2 iron is more reactive than carbon.

3 carbon is a cheap material to use.

4 carbon combines with the metal impurities in the iron ore, leaving iron.

8C Impure iron is hard and brittle. This is because in impure iron . . .

1 the impurities distort the layers of atoms so they cannot slide over each other.

2 the carbon breaks up the iron structure, allowing it to bend easily.

3 its structure has been destroyed by heating to a very high temperature.

4 all the atoms are the same and so remain in a regular arrangement.

8D When impure iron is converted into steel, . . .

1 all the carbon is removed and not replaced.

2 the amount of carbon is carefully controlled.

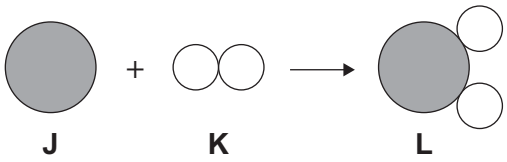
3 all the metal impurities are removed and not replaced.

4 chromium is always added to the iron.

QUESTION NINE

The diagram represents the reaction between substance **J** and substance **K** to create a new substance, **L**.

In the diagram, each circle represents an atom.



9A Which substance or substances are elements?

1 **J** only

2 both **K** and **L**

3 both **J** and **K**

4 **L** only

9B Substance **L** . . .

1 is an impure substance.

2 is a mixture.

3 will have the same chemical properties as substances **J** and **K**.

4 is a compound of **J** and **K**.

9C When substance **L** is formed from substances **J** and **K** . . .

1 there is an overall increase in mass.

2 there is an overall decrease in mass.

3 there is no overall change in mass.

4 the total number of atoms changes.

9D A molecule of substance **K** will . . .

1 have two separate nuclei.

2 share a nucleus.

3 not have any chemical bonds.

4 not contain any electrons.

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

Petrol is a hydrocarbon fuel that burns in air. Air is mainly nitrogen.

In a car engine:

- not all of the petrol burns completely
- after burning, the products pass into the exhaust pipe.

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

A nitrogen dioxide

B carbon monoxide

C carbon dioxide

D soot (carbon)

The black solid seen inside the exhaust pipe is . . . **1** . . . .

The gas in the exhaust fumes formed by the complete combustion of petrol is . . . **2** . . . .

The poisonous gas in the exhaust fumes formed by incomplete combustion of petrol is . . . **3** . . . .

The gas in the exhaust fumes formed by combining two gases from the air is . . . **4** . . . .

QUESTION TWO

This question is about the substances in this reaction:

$$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$

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

A C

B Fe

C CO

D Fe_2O_3

1	In the reaction, it is reduced.
2	It is a transition element.
3	In the reaction, it is oxidised.
4	It is formed by oxidation of a non-metal element.

Turn over for the next question

Section Two

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

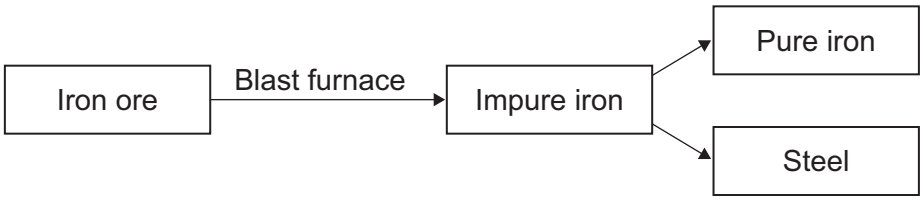
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION THREE

The flow chart shows how iron ore can be changed into useful materials.



3A Iron ore is the starting material for making iron because . . .

1 iron ore is magnetic.

2 iron ore contains a reasonable amount of iron oxide.

3 a lot of energy is needed to convert iron ore into iron.

4 mining iron ore does not cause any environmental problems.

3B In the blast furnace, iron oxide is converted to iron using carbon. This is because . . .

1 iron is less reactive than carbon.

2 iron is more reactive than carbon.

3 carbon is a cheap material to use.

4 carbon combines with the metal impurities in the iron ore, leaving iron.

3C Impure iron is hard and brittle. This is because in impure iron . . .

1 the impurities distort the layers of atoms so they cannot slide over each other.

2 the carbon breaks up the iron structure, allowing it to bend easily.

3 its structure has been destroyed by heating to a very high temperature.

4 all the atoms are the same and so remain in a regular arrangement.

3D When impure iron is converted into steel, . . .

1 all the carbon is removed and not replaced.

2 the amount of carbon is carefully controlled.

3 all the metal impurities are removed and not replaced.

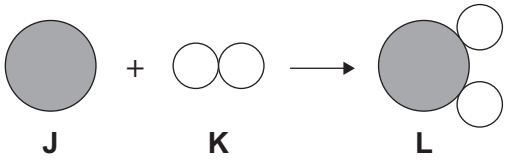
4 chromium is always added to the iron.

Turn over for the next question

QUESTION FOUR

The diagram represents the reaction between substance **J** and substance **K** to create a new substance, **L**.

In the diagram, each circle represents an atom.



4A Which substance or substances are elements?

1 **J** only

2 both **K** and **L**

3 both **J** and **K**

4 **L** only

4B Substance **L** . . .

1 is an impure substance.

2 is a mixture.

3 will have the same chemical properties as substances **J** and **K**.

4 is a compound of **J** and **K**.

4C When substance **L** is formed from substances **J** and **K** . . .

1 there is an overall increase in mass.

2 there is an overall decrease in mass.

3 there is no overall change in mass.

4 the total number of atoms changes.

4D A molecule of substance **K** will . . .

1 have two separate nuclei.

2 share a nucleus.

3 not have any chemical bonds.

4 not contain any electrons.

Turn over for the next question

QUESTION FIVE

Limestone varies in its composition. Most limestone from Derbyshire is almost pure calcium carbonate, but dolomitic limestone contains both calcium carbonate and magnesium carbonate.

Limestone is quarried because it can be:

- cut into blocks and used for buildings
- thermally decomposed to make other materials.

5A One possible way of conserving the world's supply of limestone is to . . .

1 use more dolomitic limestone instead of limestone from Derbyshire.

2 allow quarry workers to work more hours per day.

3 recycle the limestone used in buildings.

4 re-open old limestone quarries.

5B The mineral dolomite has the formula $CaCO_3.MgCO_3$

This means that the formula contains . . .

1 as many metallic elements as non-metallic elements.

2 a total of eight atoms.

3 a total of four metal atoms.

4 six different elements.

Metal carbonates decompose at different temperatures.

- Calcium carbonate decomposes at 900 °C.
- Magnesium carbonate decomposes at 540 °C.

5C Which substances would be formed if dolomitic limestone was heated at 700 °C?

1 magnesium oxide and carbon dioxide

2 calcium oxide and carbon dioxide

3 magnesium oxide, calcium oxide and carbon dioxide

4 magnesium oxide, calcium oxide and carbon monoxide

5D An advantage of using dolomitic limestone instead of limestone from Derbyshire is that dolomitic limestone . . .

1 is completely decomposed at lower temperatures.

2 produces more products on decomposition.

3 is more easily quarried.

4 produces fewer gases on decomposition.

Turn over for the next question

QUESTION SIX

Mortar is made by mixing cement, sand and water, and then leaving it to set hard.

A student investigated the effect of changing the cement content on the strength of mortar.

- She made 8 blocks of mortar, one for each of the mixtures of cement and sand shown in the table.
- After 48 hours, she measured the force needed to break each solid block.

The results are shown in the table below.

Mass of cement in g	Mass of sand in g	Breaking force in N
17.5	50.0	11.7
20.0	50.0	15.2
22.5	50.0	18.7
25.0	50.0	22.2
27.5	50.0	25.7
30.0	50.0	29.2
32.5	50.0	31.7
35.0	50.0	33.2

6A The student tried to make the experiment a fair test.

Which row in the table below explains what she did, and what else she should have done?

	Steps taken by student	Extra steps needed
1	Equal volumes of water and equal setting time	Repeat the experiments several times and work out averages
2	Equal mass of cement and equal setting time	Equal size blocks and equal volumes of water
3	Equal mass of sand and equal setting time	Equal size blocks and equal volumes of water
4	Repeat the experiment several times for each mixture and work out averages	Equal size blocks and equal setting time

6B Which row in the table below gives a correct description of the breaking force and the best way to show the results of the experiment?

	Breaking force	Best way to show results
1	A dependent, categoric variable	Bar chart
2	An independent, continuous variable	Line graph
3	An independent, categoric variable	Scattergram
4	A dependent, continuous variable	Line graph

6C A correct conclusion that can be made from the results is that the strength of the mortar . . .

1 is directly proportional to the mass of cement used.

2 is greater if the amount of cement used is increased.

3 could be increased by using fibres in the mixture.

4 would be reduced by using more water.

6D What conclusion might the student have made if she had stopped after her first six measurements?

1 The breaking force halves when the mass of cement doubles.

2 The breaking force decreases as the mass of cement increases.

3 Bars containing no sand would be the strongest.

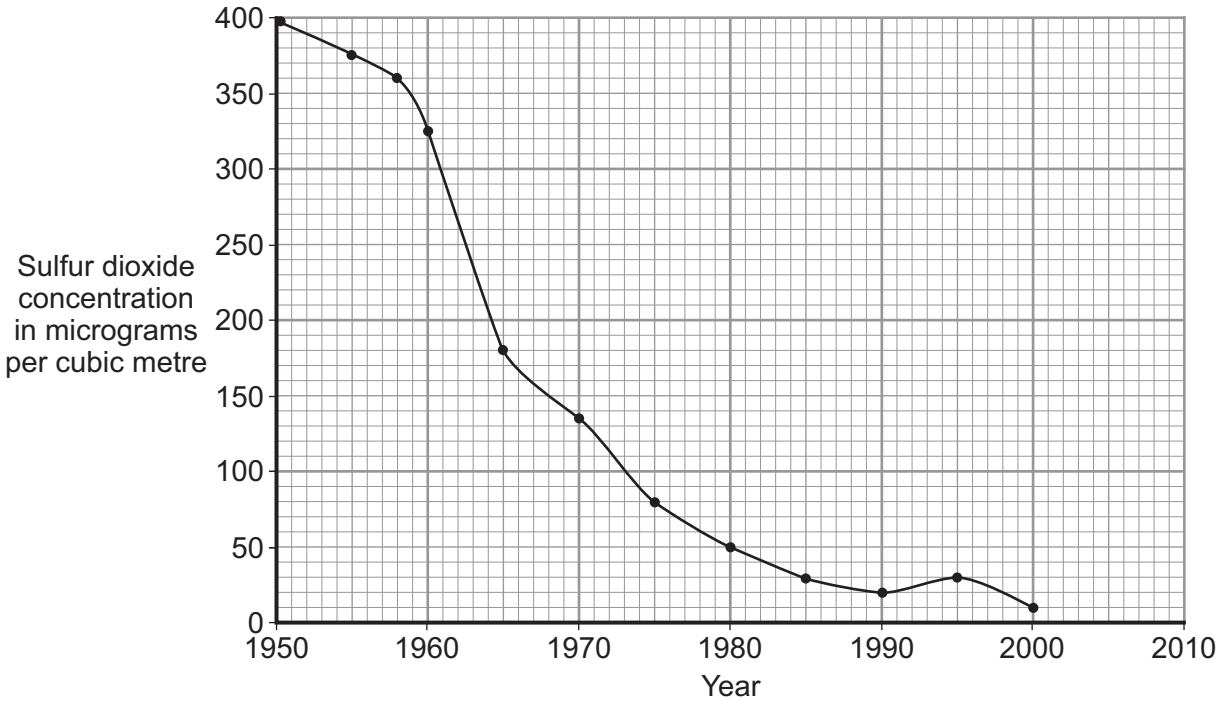
4 The breaking force increases linearly with the mass of cement.

Turn over for the next question

QUESTION SEVEN

The graph shows how sulfur dioxide concentrations in the atmosphere above London changed between 1950 and 2000.

The table shows the energy used in London in 1950 and in 2000.



Year	Energy used in arbitrary units							
	Petrol	**Diesel**	**Electricity**	**Oil**	**House coal**	**Other solid fuels**	**Gas**	**Total**
1950	10	5	20	25	100	110	60	330
2000	60	20	130	10	0	10	310	540

7A The information in the graph and table suggests that sulfur dioxide levels have decreased due to . . .

1 an increase in the use of petrol.

2 a decrease in the use of coal and other solid fuels.

3 an increase in the use of electricity that is generated at coal-burning power stations.

4 an increase in the use of diesel.

7B Which one of the following is a reason why a prediction for sulfur dioxide concentration in 2010 might be unreliable?

1 Sulfur dioxide has a natural cycle in London of increasing and decreasing.

2 Sulfur dioxide dissolves in water to produce acid rain.

3 The concentration of sulfur dioxide has, in previous years, both increased and decreased.

4 Sulfur dioxide is very difficult to measure in such small concentrations.

7C It was found that the amount of sulfur dioxide from transport increased during years 2000 to 2004, even though many more cars were using low-sulfur fuels.

The reason for this could be . . .

1 a decrease in the use of transport.

2 the introduction of more efficient cars that burn less fuel.

3 an increase in the number of cars used in London.

4 an increase in the price of crude oil.

7D A newspaper published an article about sulfur dioxide concentrations in the atmosphere above London. It stated that in one five-year period, sulfur dioxide levels had fallen by about 44 %.

The five-year period was . . .

1 1960 – 1965.

2 1965 – 1970.

3 1985 – 1990.

4 1995 – 2000.

QUESTION EIGHT

The table gives some data on four alkanes.

Name of alkane	Formula of alkane	Melting point in °C	Boiling point in °C	Amount of oxygen in cm^3 needed to completely burn 100 cm^3 of the alkane	Amount of air in cm^3 needed to completely burn 100 cm^3 of the alkane
Methane	CH_4	−182	−164	200	1000
Ethane	C_2H_6	−183	−89	350	1750
Propane	C_3H_8	−190	−42	500	2500
Butane	C_4H_{10}	−138	−1	650	3250

8A Petroleum gas contains the four alkanes in the table.

Which statement correctly describes what happens if petroleum gas is cooled?

1 By cooling to –150 °C, only methane would turn to liquid.

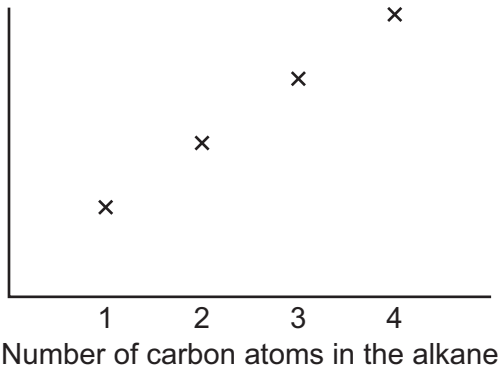
2 By cooling to –170 °C and then warming, it is possible to separate methane from petroleum gas.

3 By cooling to –100 °C, two liquid alkanes would be formed.

4 By cooling to –170 °C, all the alkanes would be solids.

8B The graph makes use of some of the data in the table.

The label on the vertical (*y*) axis has been omitted.



Which of the following could be the correct label for the *y*-axis?

1 either melting point or boiling point

2 either boiling point or the amount of oxygen required to burn the alkane

3 either boiling point or the amount of air required to burn the alkane

4 either the amount of oxygen or the amount of air required to burn the alkane

8C The graph in part **B** shows points plotted. This is not the best way to represent this data.

Which type of graph or chart should be used?

1 a bar chart because the number of carbon atoms is a continuous variable

2 a bar chart because the number of carbon atoms is a discrete variable

3 a line graph because the number of carbon atoms is a continuous variable

4 a line graph because the number of carbon atoms is a discrete variable

8D The equation below shows the reaction when methane burns completely in oxygen.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Which row in the table below shows how many molecules of carbon dioxide and molecules of water will be produced when a molecule of **propane** (C_3H_8) burns completely?

	Molecules of carbon dioxide	**Molecules of water**
1	2	4
2	3	4
3	4	8
4	3	6

Turn over for the next question

QUESTION NINE

This question is about metals.

9A A scientist investigated some reactions of three metals, **K**, **L** and **M**.

- Metal **L** can be extracted by mixing its oxide with carbon and heating.
- Metal **M** cannot be extracted by mixing its oxide with carbon and heating.
- Hydrogen will displace metal **K** from its oxide but will not displace metal **L** from its oxide.
- The oxide of metal **K** is decomposed to the metal on heating alone.

The order of reactivity for the three metals, with the most reactive first, is . . .

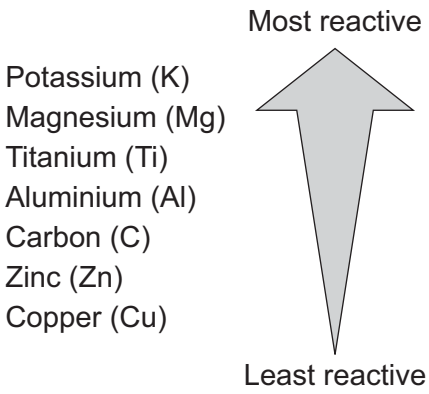
1 **K, L, M.**

2 **M, L, K.**

3 **L, K, M.**

4 **K, M, L.**

9B The order of reactivity for several metals and carbon is shown below.



Which of the following shows a correctly balanced equation for a possible reaction?

1 $ZnO + C \rightarrow Zn + CO_2$

2 $Cu + MgO \rightarrow CuO + Mg$

3 $2Mg + K_2O \rightarrow 2MgO + 2K$

4 $2Al + 3ZnO \rightarrow 3Zn + Al_2O_3$

Titanium is extracted from titanium chloride by mixing the titanium chloride with sodium and heating the mixture. The reaction is carried out in a furnace above 500 °C.

It is a batch process; this means that the furnace does not operate continuously but is cooled after each operation so that the titanium can be removed.

9C Which row in the table correctly describes the reaction for the extraction of titanium?

	Why the reaction occurs	**Products of the reaction**
1	Sodium is more reactive than titanium	Titanium, sodium and chlorine
2	Titanium is more reactive than sodium	Titanium and chlorine
3	Titanium is more reactive than sodium	Titanium and sodium chloride
4	Sodium is more reactive than titanium	Titanium and sodium chloride

9D The extraction of iron in a blast furnace is a continuous process.

Over a period of 12 months, the batch method for extraction of titanium requires much more energy per tonne of metal than the continuous method for the extraction of iron.

This is because . . .

1 the batch process is completed more quickly.

2 iron is less reactive than titanium.

3 the furnace is not maintained at a high temperature.

4 titanium chloride is not as pure as iron oxide.

END OF TEST

There are no questions printed on this page