Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
March 2007

SCIENCE A **CHY1A**
Unit C1a (Products from Rocks)

CHEMISTRY
Unit C1a (Products from Rocks)

Monday 12 March 2007 Morning Session

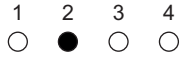
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

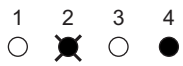
Time allowed: 30 minutes

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 'Products from Rocks' 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.

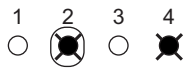
Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 **SIX**.

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 crude oil.

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

A an alkane

B carbon

C crude oil

D sulfur dioxide

An example of a mixture is . . . **1** . . . .

An example of an element is . . . **2** . . . .

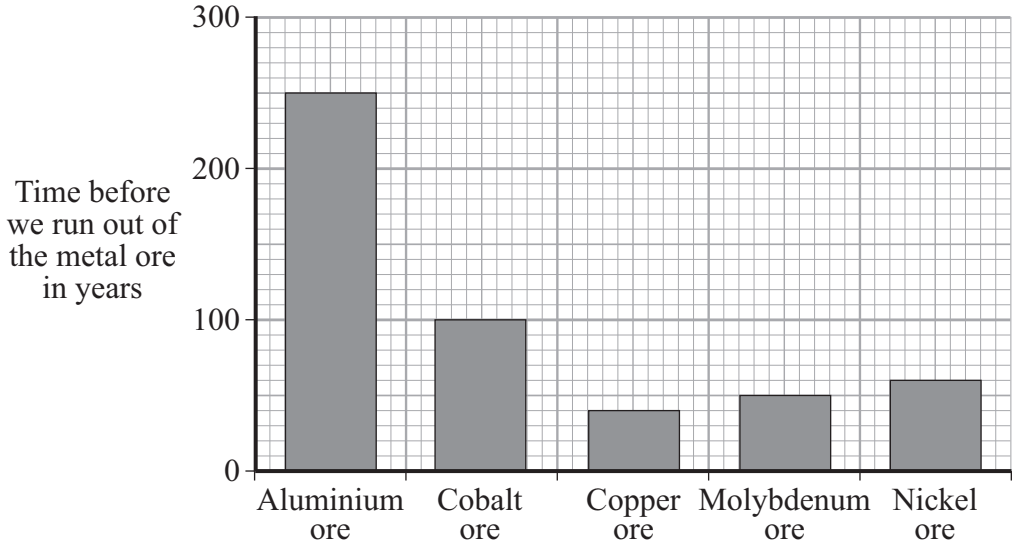
An example of a hydrocarbon is . . . **3** . . . .

An example of an acidic gas often made when a fuel burns is . . . **4** . . . .

QUESTION TWO

Metal ores are found in the Earth's crust.

The graph shows approximately how long it will be before we run out of some of these metal ores, if we continue to use them at the present rate.



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

A aluminium ore

B cobalt ore

C copper ore

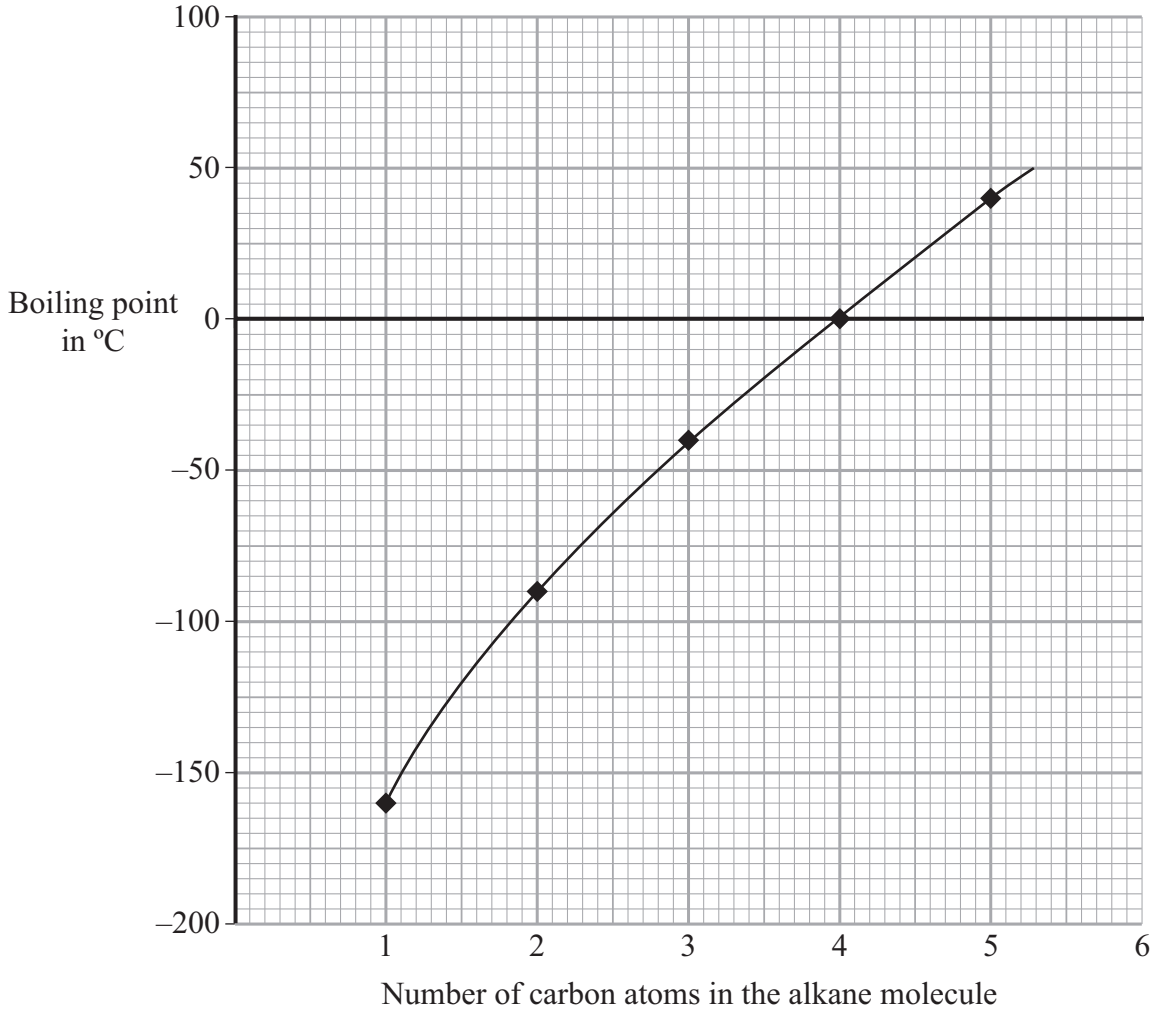
D nickel ore

	What we can say about the metal ore
1	It will run out after about 60 years.
2	It will run out about 50 years after the molybdenum ore.
3	The metal from this ore is used in plumbing.
4	The main compound in this ore has the formula Al_2O_3

QUESTION THREE

The graph shows the boiling points of five alkanes.

The general formula for the alkanes is C_nH_{2n+2}



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

A 0

B 5

C 8

D 70

The alkane plotted on the graph which is a liquid at 10 °C has . . . **1** . . . carbon atoms in each molecule.

Propane has three carbon atoms and . . . **2** . . . hydrogen atoms in each molecule.

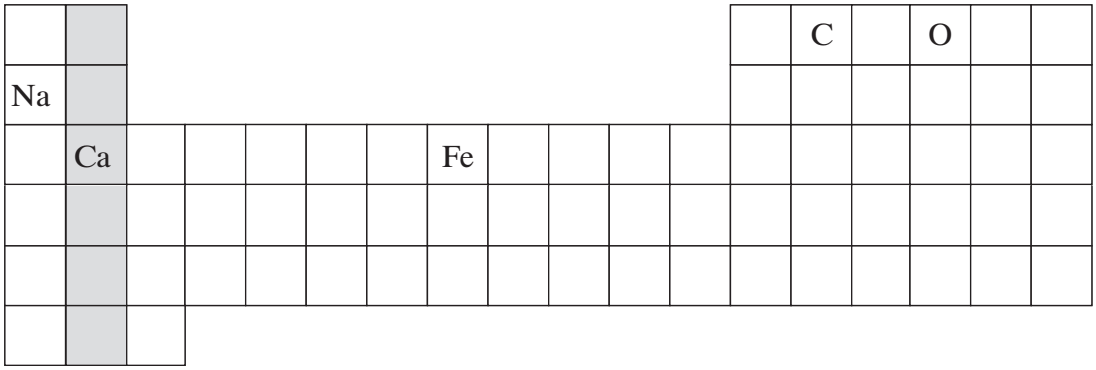
The boiling point of the alkane with four carbon atoms in each molecule is . . . **3** . . . °C.

The boiling point of the alkane with six carbon atoms in each molecule is likely to be about . . . **4** . . . °C.

QUESTION FOUR

The diagram shows part of the periodic table.

One vertical column has been shaded in.



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

A compounds

B elements

C groups

D properties

Some of the substances shown in the periodic table can react together to form . . . **1** . . . .

The substances in the periodic table are . . . **2** . . . .

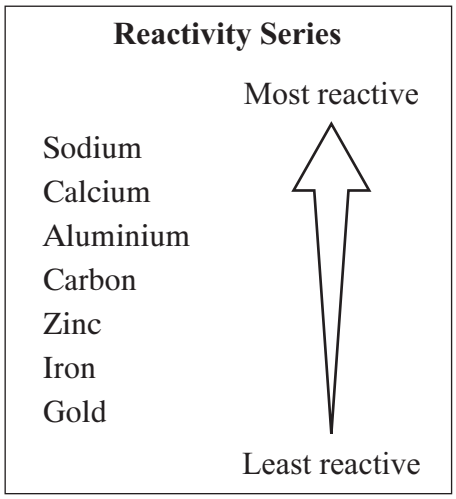
Substances in the same vertical column have similar chemical . . . **3** . . . .

The vertical columns are called . . . **4** . . . .

Turn over for the next question

QUESTION FIVE

This question is about metals.



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

A aluminium

B calcium

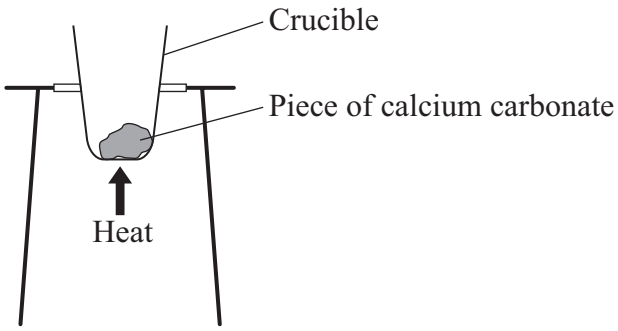
C sodium

D zinc

	What we can say about the metal
1	It has the symbol Na
2	Its oxide is called quicklime.
3	It is more reactive than iron but can be extracted from its oxide by heating with carbon.
4	It is less reactive than calcium but cannot be extracted from its oxide by reduction with carbon.

QUESTION SIX

A student heated a piece of calcium carbonate very strongly 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
Mass of crucible and contents in grams	22.00	21.44	21.12	21.12

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

A calcium carbonate only

B calcium oxide only

C calcium carbonate and calcium oxide

D carbon dioxide only

At the start, the crucible contained . . . **1** . . . .

After two minutes of heating, the crucible contained . . . **2** . . . .

After six minutes of heating, the crucible contained . . . **3** . . . .

The loss in mass was because . . . **4** . . . escaped from the crucible.

Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

Each of these questions has four parts.

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

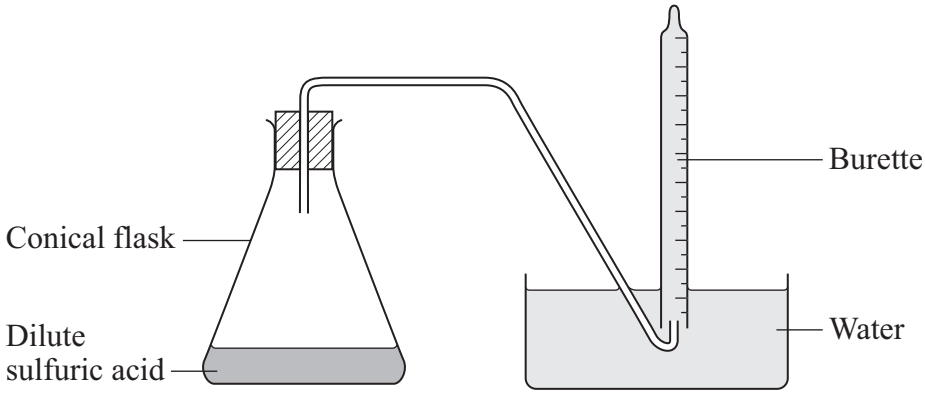
Mark your choices on the answer sheet.

QUESTION SEVEN

Metals can react with acids to produce hydrogen gas.

Iron reacts with sulfuric acid to produce hydrogen gas.

Five students, **A**, **B**, **C**, **D** and **E**, reacted iron with dilute sulfuric acid in the apparatus shown below.



- In the first experiment, each student weighed out 0.04 grams of iron.
- The students then dropped the iron into the acid in the conical flask.
- The students replaced the bung in the flask as quickly as possible.
- They recorded the volume of hydrogen collected when all the iron had reacted.
- They repeated the experiment using 0.08, 0.12, 0.16 and 0.20 grams of iron.

Results

Mass of iron in grams	**Volume of hydrogen in cm^3**					
	Student **A**	Student **B**	Student **C**	Student **D**	Student **E**	Mean
0.04	14	10	11	12	13	12
0.08	32	23	30	33	29	31
0.12	53	49	49	48	46	49
0.16	66	69	65	68	67	67
0.20	86	85	87	86	86	86

7A The expected volume of hydrogen produced from 0.04 grams of iron and this volume of sulfuric acid is 17 cm^3.
All five students collected less hydrogen than this.

The most likely reason for this similar error is that . . .

1 the conical flask was too big.

2 the burette was not accurate enough.

3 some of the hydrogen gas escaped.

4 the acid was too dilute.

7B Student **B**'s result was not used to calculate the mean for 0.08 grams of iron.
This was because it was . . .

1 a systematic error.

2 an anomalous result.

3 a categoric error.

4 a negative result.

7C 86 cm^3 is the true value for the volume of hydrogen produced from 0.20 grams of iron.
All the students carried out the tests with greater accuracy by the time they reached the last of the five experiments.
Their results, using 0.20 grams of iron, are more accurate because they . . .

1 are much higher than their first results.

2 are close to 100 cm^3.

3 are about five times higher than their first results.

4 are all close to the true value.

7D Each student's results would be best shown as . . .

1 a pie chart.

2 a line graph.

3 a bar chart.

4 a scattergram.

QUESTION EIGHT

Crude oil is a non-renewable energy source. Petrol is a fuel obtained from the fractional distillation of crude oil.

Gasohol is also a fuel. It is a mixture of 90 % petrol and 10 % ethanol. The ethanol can be produced from the waste stems and leaves when crops have been harvested. So ethanol is a renewable energy source.

	Mass in grams of gas produced by completely burning 10 cm^3 of fuel		
Fuel	Carbon dioxide from petrol	Carbon dioxide from ethanol	Water vapour
Petrol	26.4	0	12.6
Gasohol	23.8	1.5	12.2

8A What is the total mass of carbon dioxide produced when 10 cm^3 of gasohol is burned?

1 22.3 g

2 23.8 g

3 25.3 g

4 26.4 g

8B How much more carbon dioxide is produced when 10 cm^3 of petrol is burned than when 10 cm^3 of gasohol is burned?

1 0.4 g

2 1.1 g

3 1.6 g

4 24.9 g

8C Why is the water vapour produced by burning fuels not a problem?

1 It condenses to a liquid.

2 It does not cause corrosion.

3 It is not a pollutant.

4 Very little is produced.

8D Carbon dioxide causes environmental problems.

Why is carbon dioxide from burning ethanol thought to be less of a problem than carbon dioxide from burning petrol?

1 Not as much carbon dioxide is produced.

2 The carbon dioxide produced has different chemical properties.

3 It is just recycling carbon dioxide removed from the air by plants.

4 The ethanol is not produced from crude oil.

Turn over for the next question

QUESTION NINE

Aluminium can be obtained by extracting it from aluminium ore, and by recycling used objects made from aluminium.

9A One disadvantage of extracting aluminium from aluminium ore is that . . .

1 aluminium ore contains very small amounts of aluminium.

2 aluminium ore is a limited resource.

3 the aluminium obtained corrodes easily.

4 the aluminium obtained has a high density.

9B It is better to recycle aluminium than to extract it from aluminium ore because . . .

1 aluminium ore contains few impurities.

2 aluminium ore produces low grade aluminium.

3 digging up aluminium ore destroys the local environment.

4 recycling produces ‘smart’ aluminium alloys.

9C It makes economic sense to recycle aluminium because extracting it from its ore . . .

1 is a cheap process.

2 takes too long.

3 employs more people.

4 uses large amounts of energy.

9D If aluminium cans are not recycled, they can affect the environment by . . .

1 causing acid rain.

2 filling up landfill rubbish tips.

3 producing poisonous gases.

4 rapidly corroding in lakes and rivers.

END OF TEST

There are no questions printed on this page

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

SECTION ONE

Questions **ONE** and **TWO**.

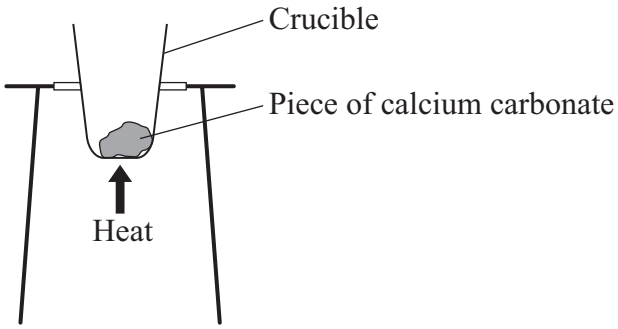
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

A student heated a piece of calcium carbonate very strongly in an open crucible.



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

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

A calcium carbonate only

B calcium oxide only

C calcium carbonate and calcium oxide

D carbon dioxide only

At the start, the crucible contained . . . **1** . . . .

After two minutes of heating, the crucible contained . . . **2** . . . .

After six minutes of heating, the crucible contained . . . **3** . . . .

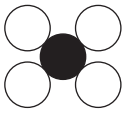
The loss in mass was because . . . **4** . . . escaped from the crucible.

QUESTION TWO

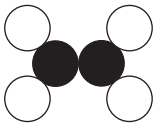
The diagrams show the numbers and different types of atoms in four compounds.

A

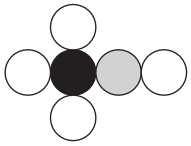
B



C



D



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

	Formula for the compound
1	CH_4
2	CO_2
3	CH_3OH
4	C_2H_4

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

Crude oil is a non-renewable energy source. Petrol is a fuel obtained from the fractional distillation of crude oil.

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Fuel	Carbon dioxide from petrol	Carbon dioxide from ethanol	Water vapour
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Gasohol	23.8	1.5	12.2

3A What is the total mass of carbon dioxide produced when 10 cm^3 of gasohol is burned?

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2 23.8 g

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4 26.4 g

3B How much more carbon dioxide is produced when 10 cm^3 of petrol is burned than when 10 cm^3 of gasohol is burned?

1 0.4 g

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4 24.9 g

3C Why is the water vapour produced by burning fuels not a problem?

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2 It does not cause corrosion.

3 It is not a pollutant.

4 Very little is produced.

3D Carbon dioxide causes environmental problems.

Why is carbon dioxide from burning ethanol thought to be less of a problem than carbon dioxide from burning petrol?

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2 The carbon dioxide produced has different chemical properties.

3 It is just recycling carbon dioxide removed from the air by plants.

4 The ethanol is not produced from crude oil.

Turn over for the next question

QUESTION FOUR

Aluminium can be obtained by extracting it from aluminium ore, and by recycling used objects made from aluminium.

4A One disadvantage of extracting aluminium from aluminium ore is that . . .

1 aluminium ore contains very small amounts of aluminium.

2 aluminium ore is a limited resource.

3 the aluminium obtained corrodes easily.

4 the aluminium obtained has a high density.

4B It is better to recycle aluminium than to extract it from aluminium ore because . . .

1 aluminium ore contains few impurities.

2 aluminium ore produces low grade aluminium.

3 digging up aluminium ore destroys the local environment.

4 recycling produces ‘smart’ aluminium alloys.

4C It makes economic sense to recycle aluminium because extracting it from its ore . . .

1 is a cheap process.

2 takes too long.

3 employs more people.

4 uses large amounts of energy.

4D If aluminium cans are not recycled, they can affect the environment by . . .

1 causing acid rain.

2 filling up landfill rubbish tips.

3 producing poisonous gases.

4 rapidly corroding in lakes and rivers.

Turn over for the next question

QUESTION FIVE

Iron is about twice as strong as aluminium.

Some other properties of aluminium and iron are shown in the table.

	Electrical conductivity	**Density in grams per cm^3**	**Resistance to corrosion**
Aluminium	very good	2.7	good
Iron	good	7.8	poor

5A Iron is better than aluminium for making bridges.

This is because iron . . .

1 is a better insulator.

2 is more easily painted.

3 is stronger.

4 has a higher density.

5B Aluminium is better than iron for making cans for fizzy drinks.

The main reason is that . . .

1 aluminium conducts electricity better.

2 aluminium is harder.

3 iron cannot be recycled.

4 aluminium is more resistant to corrosion.

5C Aluminium has a low density and good electrical conductivity.

Which use for aluminium depends on **both** of these properties?

1 for cooking pans

2 for aeroplanes

3 for overhead power cables

4 for racing cars

5D Most of the iron that is made is converted into steel.

Compared with low carbon steel, high carbon steel . . .

1 corrodes more quickly.

2 is a better electrical conductor.

3 is harder.

4 is more easily shaped.

Turn over for the next question

QUESTION SIX

Titanium is extracted from titanium oxide in this two-stage process.

Stage 1: titanium oxide + carbon + chlorine → titanium chloride + carbon dioxide

Stage 2: titanium chloride + sodium → titanium + sodium chloride

Stage 2 takes place inside a furnace where the temperature needed is greater than 500 °C.
This procedure is a batch process which means that the furnace does not operate continuously but is cooled after each operation so that the titanium can be removed.

6A Titanium is not extracted in a blast furnace because . . .

1 carbon is too dangerous to use.

2 titanium cannot be extracted by reduction with carbon.

3 titanium oxide is highly reactive.

4 titanium is too valuable.

6B One of the products of **Stage 1** may increase . . .

1 acid rain.

2 global dimming.

3 global warming.

4 the ozone layer.

6C Titanium metal is produced in **Stage 2** because . . .

1 chlorine is more reactive than titanium.

2 sodium is more reactive than oxygen.

3 sodium is more reactive than titanium.

4 titanium is more reactive than carbon.

6D Extraction of iron in the blast furnace is a continuous process.
One reason why the continuous process requires less energy than the batch process is that . . .

1 iron ore is more plentiful than titanium ore.

2 the furnace is maintained at a high temperature.

3 iron ore contains fewer impurities than titanium ore.

4 the continuous process is completed more quickly.

Turn over for the next question

QUESTION SEVEN

In the engine cylinders of petrol-driven cars, a mixture of petrol and air is ignited.

- Petrol consists mainly of alkanes in the $C_5 - C_{10}$ range.
- Air consists of nitrogen (79 %), oxygen (20 %) and small amounts of other gases.

The petrol/air mixture is ignited by an electrical spark causing an explosive reaction to drive the pistons in the cylinders.

Some of the elements in the petrol/air mixture combine with oxygen at the very high temperatures reached.

Modern engines are very efficient but are still not capable of complete combustion. The gases produced during combustion are released as exhaust gases.

The table shows some of the exhaust gases from a typical petrol engine.

Gas	**Percentage**
carbon dioxide	15.0
carbon monoxide	1.0
oxygen	0.7
hydrocarbons	0.05
nitrogen oxides	0.2
sulfur dioxide	0.007

7A The gases in the table make up less than 20 % of the exhaust gases.

Which substance will make up most of the remainder of the exhaust gases?

1 hydrogen

2 methane

3 nitrogen

4 water vapour

7B One piece of evidence that suggests there is incomplete combustion is . . .

1 the high percentage of carbon dioxide.

2 the presence of carbon monoxide.

3 the presence of nitrogen oxides.

4 the low percentage of sulfur dioxide.

Nitrogen oxides are acidic oxides.
The equation shows how nitrogen monoxide is formed in the cylinders.

$$N_2 + O_2 \rightarrow 2NO$$

7C Nitrogen monoxide reacts with more oxygen to produce nitrogen dioxide.

Which is the correct equation for this reaction?

1 $N_2 + O_2 \rightarrow NO_2$

2 $NO + O_2 \rightarrow NO_2$

3 $2NO + O_2 \rightarrow 2NO_2$

4 $2NO + 2O_2 \rightarrow 2NO_2$

7D Why is it important to remove nitrogen oxides from the exhaust gases?

1 They are brown gases.

2 They can cause global dimming.

3 They can cause acid rain.

4 They cause carbon deposits in the exhaust pipe.

Turn over for the next question

QUESTION EIGHT

This question is about crude oil.
Crude oil is separated into fractions by fractional distillation.

8A In the fractionating column, the crude oil separates into fractions because . . .

1 it evaporates.

2 the vapour condenses at 100 °C.

3 the vapour condenses at different temperatures.

4 thermal decomposition occurs.

8B Fractional distillation is possible because the hydrocarbons in the crude oil have . . .

1 different boiling points.

2 different chemical properties.

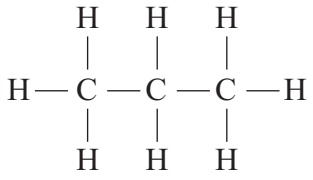
3 exactly the same boiling points.

4 the same ignition temperature.

The simplest alkane in crude oil is methane, CH_4
Another alkane is propane, C_3H_8

8C A molecule of propane can be represented by . . .

1



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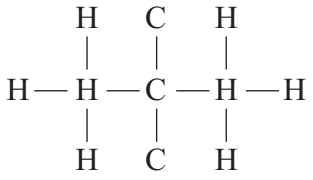

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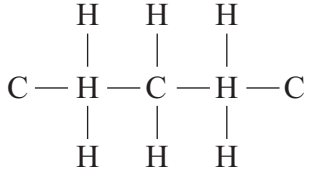

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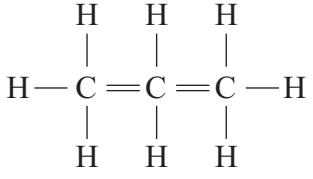


8D Compared with methane, propane will . . .

1 ignite more easily.

2 boil at a lower temperature.

3 have a higher boiling point.

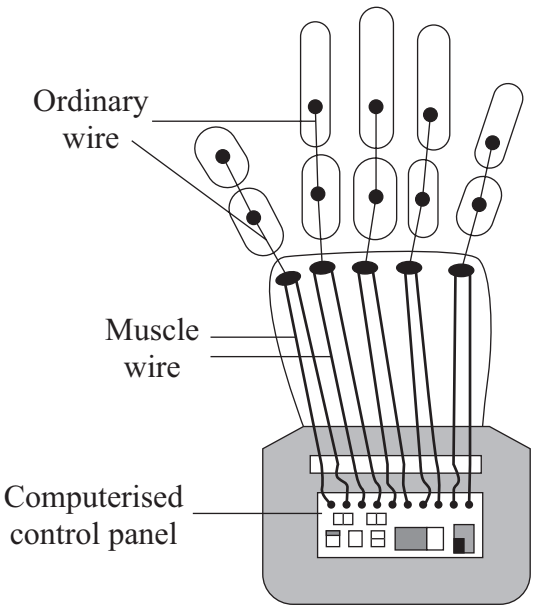
4 be less saturated.

Turn over for the next question

QUESTION NINE

Muscle wire is an alloy made from nickel and titanium (Nitinol).
At room temperature, it can be stretched fairly easily.
If a small electric current is passed through the stretched wire, this causes a heating effect. As it heats up, the wire contracts back to its original length with a reasonably strong force.
If the amount of stretching is limited to less than 5 %, the alloy will go through the stretching and recovery cycle millions of times.

The diagram shows a simplified version of a robotic hand operated by muscle wire.



9A The hand will close in a gripping movement when the tension in the wires is increased by . . .

1 passing an electric current through the muscle wires.

2 putting the hand in a refrigerator.

3 there being **no** current in the muscle wire.

4 wrapping the hand in a thermal insulator, eg bubble wrap.

9B Nitinol is an alloy.

It can be described as a **smart** alloy because . . .

1 it is a flexible alloy.

2 it expands when it is heated.

3 it is made from a mixture of two metals.

4 when stretched it returns to its original length on heating.

9C A disadvantage of using smart alloys as muscle wire is that they . . .

1 are made from metals which are rare and very difficult to extract.

2 can control only a limited amount of movement.

3 cannot be permanently reshaped for a particular task.

4 corrode very easily.

9D Scientists are looking for new applications for muscle wires. All except one of the following are feasible possibilities.

Which **one** is **not** feasible?

1 making electrical wiring for houses

2 making miniature forceps that can open and close

3 making the wired braces (at low temperature) for straightening teeth

4 making bimetallic thermostats

END OF TEST

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