

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
November 2007

SCIENCE A
Unit Chemistry C1a (Products from Rocks)

CHY1A



CHEMISTRY
Unit Chemistry C1a (Products from Rocks)

Thursday 22 November 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

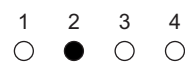
Instructions

- 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

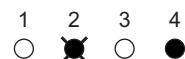
- Use a **black ball-point pen**.

- For each answer **completely fill in the circle** as shown:

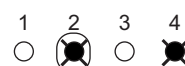


- Do **not** extend beyond the circles.

- 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**.

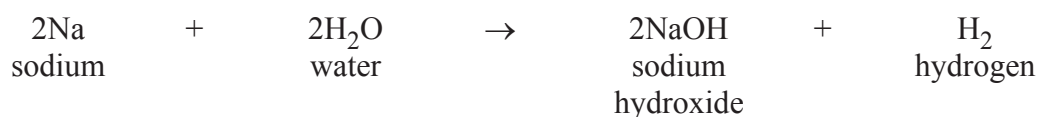
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The equation shows how sodium reacts with water.



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

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

In the equation:

2Na represents two . . . **1** . . . of sodium.

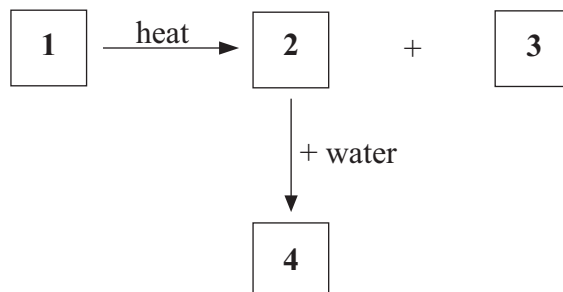
$2\text{H}_2\text{O}$ represents two . . . **2** . . . of water.

Water and sodium hydroxide are . . . **3**

Sodium and hydrogen are . . . **4**

QUESTION TWO

The flow diagram shows what happens when a sample of limestone is strongly heated, and water is then added to the solid product.



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

- A** calcium carbonate
- B** calcium hydroxide
- C** calcium oxide
- D** carbon dioxide

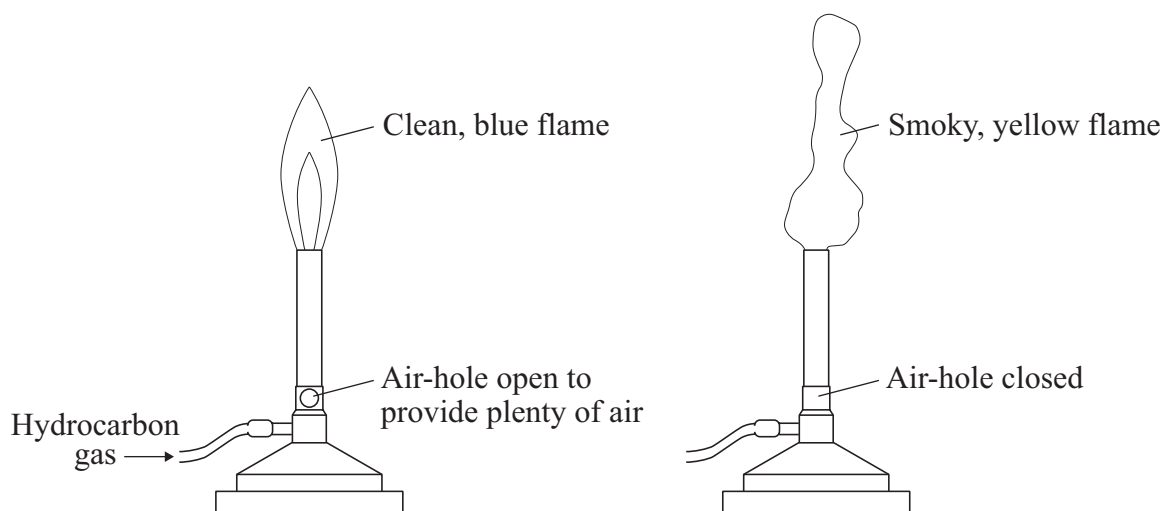
Turn over for the next question

Turn over ►

QUESTION THREE

The diagram shows a hydrocarbon gas burning in a Bunsen burner.

The flame is different when the air-hole is open compared with when it is closed.



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

A carbon

B carbon monoxide

C carbon dioxide

D oxygen

With the air-hole open, the two main products of combustion are water and ... **1**

Water is formed when hydrogen in the hydrocarbon gas reacts with ... **2**

With the air-hole closed, another gas that is produced during combustion is ... **3**

The yellow flame contains black specks of ... **4**

QUESTION FOUR

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

	Melting point in °C	Boiling point in °C	Density in grams per cm³	Electrical conductivity
Element A	115	444	2.10	very poor
Element B	-101	-35	0.003	very poor
Element C	1083	2600	8.90	very good
Element D	98	890	0.97	good

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

Element	Property of the element
1	It is the metal with the lowest density.
2	It is the non-metal that is a gas at 20 °C.
3	It is the metal with the highest melting point.
4	It is the non-metal with the highest boiling point.

Turn over for the next question

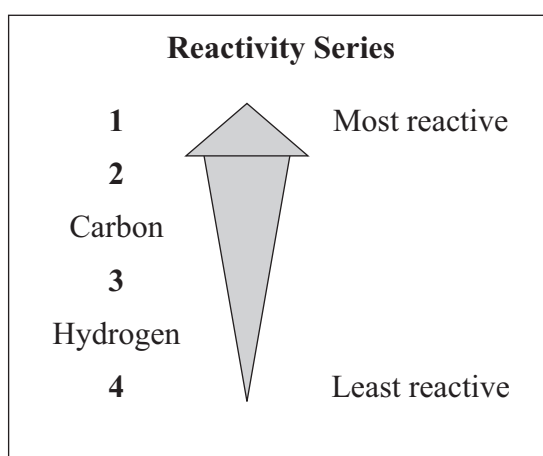
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QUESTION FIVE

This question is about the positions of four metals, **A**, **B**, **C** and **D**, in the reactivity series.

- Only metals **A** and **C** can be extracted from their oxides by strongly heating their oxides mixed with carbon.
- Metal **C**, but not metal **A**, can be extracted from its oxide by heating the oxide in a stream of hydrogen.
- Metal **D** is more reactive than metal **B**.

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

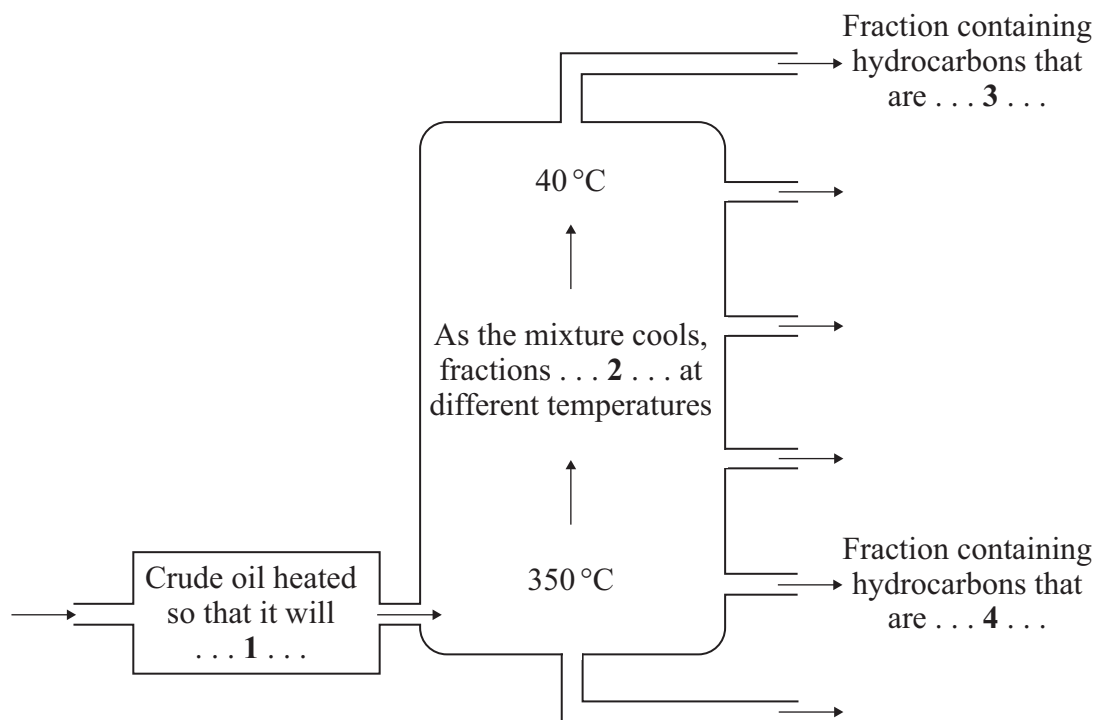


QUESTION SIX

This question is about fractional distillation of crude oil.

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

- A** condense
- B** vaporise
- C** viscous
- D** volatile



Turn over for the next question

Turn over ►

SECTION TWOQuestions **SEVEN** to **NINE**.

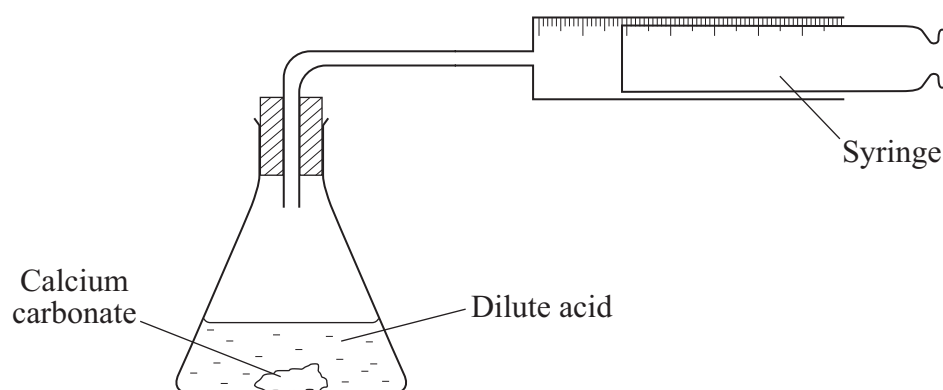
Each of these questions has four parts.

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

QUESTION SEVEN

Calcium carbonate reacts with acids to produce carbon dioxide gas.

A student investigated the reaction when a 10 g piece of calcium carbonate reacted with a dilute acid in this apparatus.



The student recorded the total volume of carbon dioxide collected in the syringe every two minutes.

When the reaction finished, there was still some unreacted calcium carbonate left in the conical flask.

Results

Time in minutes	0	2	4	6	8	10	12	14	16	18
Total volume of carbon dioxide in cm³	0	40.1	55.6	66.4	74.5	80.7	82.2	82.5	82.5	82.5

7A The reaction finishes just before . . .

- 1 12 minutes.
- 2 14 minutes.
- 3 16 minutes.
- 4 18 minutes.

7B To find a more accurate time for the end of the reaction, the student could . . .

- 1 use a larger volume of acid.
- 2 use a larger piece of calcium carbonate.
- 3 measure the volume of the carbon dioxide every 30 seconds.
- 4 use a digital clock.

7C To improve the reliability of the data, the student should . . .

- 1 take readings for more than 18 minutes.
- 2 use a more accurate syringe.
- 3 measure the strength of the acid.
- 4 repeat the investigation at least one more time.

7D These results are best displayed as a . . .

- 1 line graph.
- 2 bar chart.
- 3 scattergram.
- 4 table.

Turn over ►

QUESTION EIGHT

The table shows the emissions of sulfur dioxide, in the United Kingdom (UK), by different fuels in 1990 and in 2004.

Fuel type	Emissions of sulfur dioxide by different fuels in thousands of tonnes		Percentage change between 1990 and 2004
	1990	2004	
Coal	2707	578	-79
Other solid fuels	66	20	-70
Petroleum fuel oil	605	78	-87
Other petroleum products (including petrol and diesel)	193	83	-57
Gaseous fuels	9	11	+22
Other emissions of sulfur dioxide	118	58	-51
TOTAL	3698	828	-78

- Since 1990, the amount of coal used in the generation of electricity at power stations has reduced by more than 60%.
- Since 1990, gaseous fuels have gradually been replacing fuel oil for electricity generation and in industry.
- The small amount of sulfur dioxide emitted from petrol and diesel fuel used in vehicles has decreased. It should decrease further with the increased use of low-sulfur petrol and diesel.

8A Which fuel had the largest reduction in sulfur dioxide emissions, **in thousands of tonnes**, between 1990 and 2004?

- 1 coal
- 2 fuel oil
- 3 other petroleum products
- 4 gaseous fuels

-
- 8B** This data suggests that emissions of sulfur dioxide between 1990 and 2004 . . .
- 1 decreased for all fuels.
 - 2 decreased by more than 50% for all fuels.
 - 3 decreased by 78% for all fuels except gaseous fuels.
 - 4 decreased by more than 50% for all fuels except gaseous fuels.
- 8C** Which reasonable prediction can be made from the evidence given at the beginning of this question?
- 1 Sulfur dioxide emissions will begin to increase in the future as the number of vehicles on our roads increases.
 - 2 Overall, sulfur dioxide emissions are likely to continue to decrease.
 - 3 Supplies of fuel oil will be used up in another twenty years.
 - 4 Sulfur dioxide emissions from gaseous fuels will be greater than those from coal in the near future.
- 8D** The data in the table was obtained by estimating the sulfur dioxide emissions from power stations, industrial plants, vehicles, etc.
- Sulfur dioxide emissions in the UK could also be monitored by . . .
- 1 providing each vehicle with a digital readout of sulfur dioxide emitted.
 - 2 measuring the sulfur dioxide concentrations in the air above the largest power stations and industrial plants.
 - 3 measuring the sulfur dioxide concentrations in the air at a large number of sites spread across the UK.
 - 4 measuring the sulfur content of all fuels before they are used.

Turn over for the next question

Turn over ►

QUESTION NINE**Jobs for bacteria – metal miners**

Copper is found in the Earth's crust as the ore copper sulfide.

Traditionally, copper-rich ores are roasted and smelted to extract the metal.

Copper compounds can now be extracted from low-grade ores by bioleaching. In one type of bioleaching, the copper compounds are extracted from heaps of the crushed ore using bacteria.

- The bacteria live in the ore and gain their energy by slowly breaking down the copper compounds.
- The bacteria produce acidic solutions in which the copper compounds dissolve from the rocks and can be collected.
- The bacteria usually live at 35 °C to 40 °C. This means that breakdown of the compounds takes place only very slowly in the heaps of crushed ore.
- If these bacteria could work at a temperature 10 °C higher, then it is estimated that the rate of breakdown of the compounds would be twice as fast.

9A Which of the following is a disadvantage of extracting copper by bioleaching rather than by the traditional method?

- 1 Bioleaching allows us to use low-grade ores.
- 2 Bioleaching is more economical.
- 3 Bioleaching is slower.
- 4 Bioleaching uses less energy.

9B Copper compounds can be extracted more quickly from the ore in tanks at a temperature of 75 °C.

Where might bacteria able to work at this temperature be found?

- 1 in rivers running through rainforests
- 2 in polluted rivers
- 3 in streams on the sides of active volcanoes
- 4 in tropical seas

9C About 20% of the world's copper is now extracted from low-grade ores by bioleaching.

Some scientists think that this figure will steadily increase in the next few years.

An increase in the use of bioleaching may **not** happen if . . .

- 1 the price of copper increases dramatically.
- 2 large new deposits of high-grade ore are discovered.
- 3 the cost of energy rises quickly.
- 4 sulfur dioxide levels in the atmosphere reach dangerous levels.

9D Copper can be obtained from solutions containing copper compounds by . . .

- 1 electrolysis.
- 2 oxidation.
- 3 fractionation.
- 4 combustion.

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**.

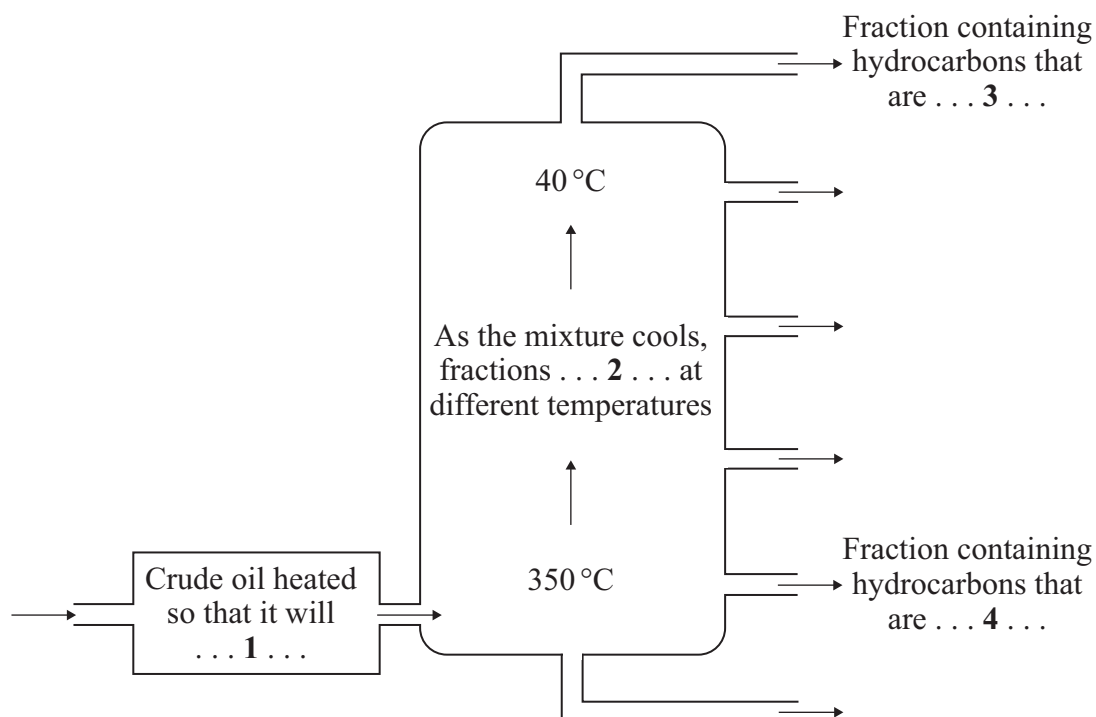
Mark your choices on the answer sheet.

QUESTION ONE

This question is about fractional distillation of crude oil.

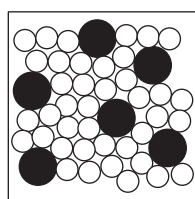
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences on the diagram.

- A** condense
- B** vaporise
- C** viscous
- D** volatile

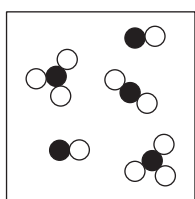


QUESTION TWO

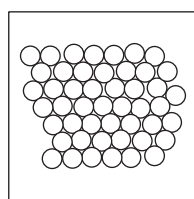
The diagrams show the atoms in four substances.



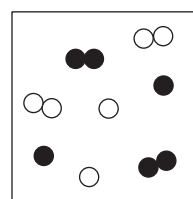
1



2



3



4

Match words, **A**, **B**, **C** and **D**, with the diagrams 1–4.

- A** pure iron
- B** an alloy
- C** a mixture of compounds
- D** a mixture of elements

Turn over for the next question

Turn over ►

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 table shows the emissions of sulfur dioxide, in the United Kingdom (UK), by different fuels in 1990 and in 2004.

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3A Which fuel had the largest reduction in sulfur dioxide emissions, **in thousands of tonnes**, between 1990 and 2004?

- 1 coal
- 2 fuel oil
- 3 other petroleum products
- 4 gaseous fuels

3B This data suggests that emissions of sulfur dioxide between 1990 and 2004 . . .

- 1 decreased for all fuels.
- 2 decreased by more than 50% for all fuels.
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3C Which reasonable prediction can be made from the evidence given at the beginning of this question?

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3D The data in the table was obtained by estimating the sulfur dioxide emissions from power stations, industrial plants, vehicles, etc.

Sulfur dioxide emissions in the UK could also be monitored by . . .

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Turn over ►

QUESTION FOUR**Jobs for bacteria – metal miners**

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Traditionally, copper-rich ores are roasted and smelted to extract the metal.

Copper compounds can now be extracted from low-grade ores by bioleaching. In one type of bioleaching, the copper compounds are extracted from heaps of the crushed ore using bacteria.

- The bacteria live in the ore and gain their energy by slowly breaking down the copper compounds.
- The bacteria produce acidic solutions in which the copper compounds dissolve from the rocks and can be collected.
- The bacteria usually live at 35 °C to 40 °C. This means that breakdown of the compounds takes place only very slowly in the heaps of crushed ore.
- If these bacteria could work at a temperature 10 °C higher, then it is estimated that the rate of breakdown of the compounds would be twice as fast.

4A Which of the following is a disadvantage of extracting copper by bioleaching rather than by the traditional method?

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- 3 Bioleaching is slower.
- 4 Bioleaching uses less energy.

4B Copper compounds can be extracted more quickly from the ore in tanks at a temperature of 75 °C.

Where might bacteria able to work at this temperature be found?

- 1 in rivers running through rainforests
- 2 in polluted rivers
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4C About 20% of the world's copper is now extracted from low-grade ores by bioleaching.

Some scientists think that this figure will steadily increase in the next few years.

An increase in the use of bioleaching may **not** happen if . . .

- 1 the price of copper increases dramatically.
- 2 large new deposits of high-grade ore are discovered.
- 3 the cost of energy rises quickly.
- 4 sulfur dioxide levels in the atmosphere reach dangerous levels.

4D Copper can be obtained from solutions containing copper compounds by . . .

- 1 electrolysis.
- 2 oxidation.
- 3 fractionation.
- 4 combustion.

Turn over for the next question

Turn over ►

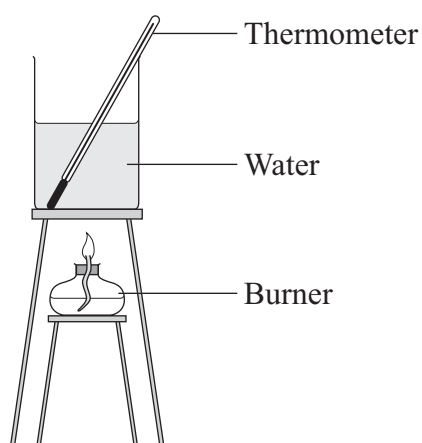
QUESTION FIVE

A student carried out an experiment to find out how much energy is given off when one gram of the alkane called pentane is burned.

The student heated some water with the burning pentane. The temperature rise was recorded.

The student repeated the experiment with pentane two more times.

The student then repeated the whole experiment using three other alkanes, hexane, heptane and octane.



The results are shown in the table.

Name of alkane	Number of carbon atoms in a molecule	Test number	Temperature rise (°C)	Average temperature rise (°C)	Energy given off in kJ per g	
					From experiment	Correct value
Pentane	5	1	8.5	8.8	2.8	48.6
		2	9.0			
		3	9.0			
Hexane	6	1	8.5			48.3
		2	8.9			
		3	14.0			
Heptane	7	1	9.0	9.2	3.6	
		2	9.5			
		3	9.0			
Octane	8	1	8.5	9.0	3.5	47.9
		2	9.0			
		3	9.5			

-
- 5A** Which one of the following values is the most sensible to use for the average temperature rise for hexane?
- 1 8.5
 - 2 8.7
 - 3 8.9
 - 4 10.5
- 5B** Which is the best estimate for the correct value for the energy given off when heptane is burned?
- 1 47.9 kJ/g
 - 2 48.1 kJ/g
 - 3 48.4 kJ/g
 - 4 48.5 kJ/g
- 5C** Which one of the following changes will **not** improve the accuracy of the results?
- 1 burning the fuel for longer to get a large temperature rise
 - 2 enclosing the apparatus in a tube to exclude draughts
 - 3 using a thermometer that measures to the nearest degree
 - 4 weighing the burner on a more sensitive balance
- 5D** When the fuel is burning, the flame is yellow. This is because the fuel is not completely burned. What effect does this have on the accuracy of the results of the experiment?
- 1 It makes no difference to the results.
 - 2 Some results are too high and some are too low.
 - 3 The results are all too high.
 - 4 The results are all too low.

QUESTION SIX

The diagram shows part of the periodic table.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
	Be						
Na	Mg	Al	Si	P	S	Cl	Ar
	Ca						
	Sr						

The row of substances from sodium (Na) to argon (Ar) is called a period.

6A Magnesium (Mg) and calcium (Ca) are placed in the same group of the periodic table because they . . .

- 1 have a similar colour.
- 2 have similar boiling points.
- 3 have similar chemical properties.
- 4 are next to each other in the reactivity series.

6B Magnesium (Mg) and sulfur (S) are in the same period.

Which row in the table below correctly shows one similarity and one difference between magnesium and sulfur?

	Similarity	Difference
1	Both are solids.	Magnesium is a non-metal; sulfur is a metal.
2	Both conduct electricity.	Magnesium is a solid; sulfur is a gas.
3	Both are solids.	Magnesium conducts electricity; sulfur does not.
4	Both conduct electricity.	Magnesium is a metal; sulfur is a non-metal.

6C Calcium (Ca) is in the periodic table but quicklime is not.

This is because . . .

- 1 calcium is a metal but quicklime is a non-metal.
- 2 calcium is an element but quicklime is a compound.
- 3 calcium is an element but quicklime is an alloy.
- 4 calcium is a metal but quicklime is a carbonate.

6D The balanced equation which shows the reaction between sodium and chlorine is . . .

- 1 $\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}_2$
- 2 $2\text{Na} + \text{Cl}_2 \rightarrow \text{Na}_2\text{Cl}_2$
- 3 $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$
- 4 $2\text{Na} + 2\text{Cl}_2 \rightarrow 2\text{NaCl}_2$

Turn over for the next question

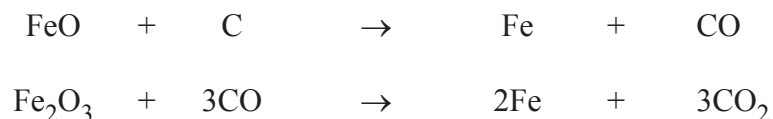
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QUESTION SEVEN

Aluminium (7.85 %) and iron (4.12 %) are the two most abundant metals in the Earth's crust.

Iron is extracted from iron oxide in a blast furnace.

The equations show two reactions that occur in the furnace.



7A Which substances are reduced and which substances cause the reduction in these two reactions?

	Substances reduced	Substances causing the reduction
1	iron	carbon and carbon monoxide
2	iron oxides	carbon monoxide and carbon dioxide
3	carbon and carbon dioxide	iron oxides
4	iron oxides	carbon and carbon monoxide

7B Aluminium **cannot** be extracted from its ores in a blast furnace because . . .

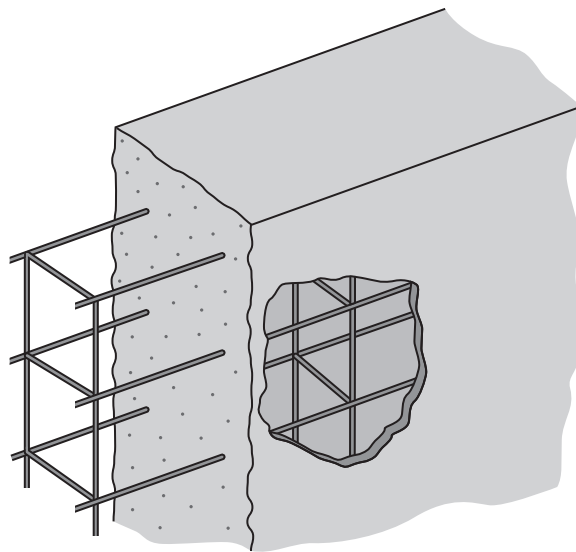
- 1** it is more reactive than iron.
- 2** too many stages are needed in the process.
- 3** too much energy is required.
- 4** it is more reactive than carbon.

7C Which two of the following statements could explain why aluminium is preferred to iron for making cans for drinks?

- W Aluminium has a lower density than iron.
- X Aluminium is a better conductor than iron.
- Y Aluminium corrodes less easily than iron.
- Z Aluminium is not as strong as iron.

- 1 W and X
- 2 W and Y
- 3 X and Y
- 4 Y and Z

7D The diagram shows some reinforced concrete.



Which one of the following is the best material to use to reinforce concrete?

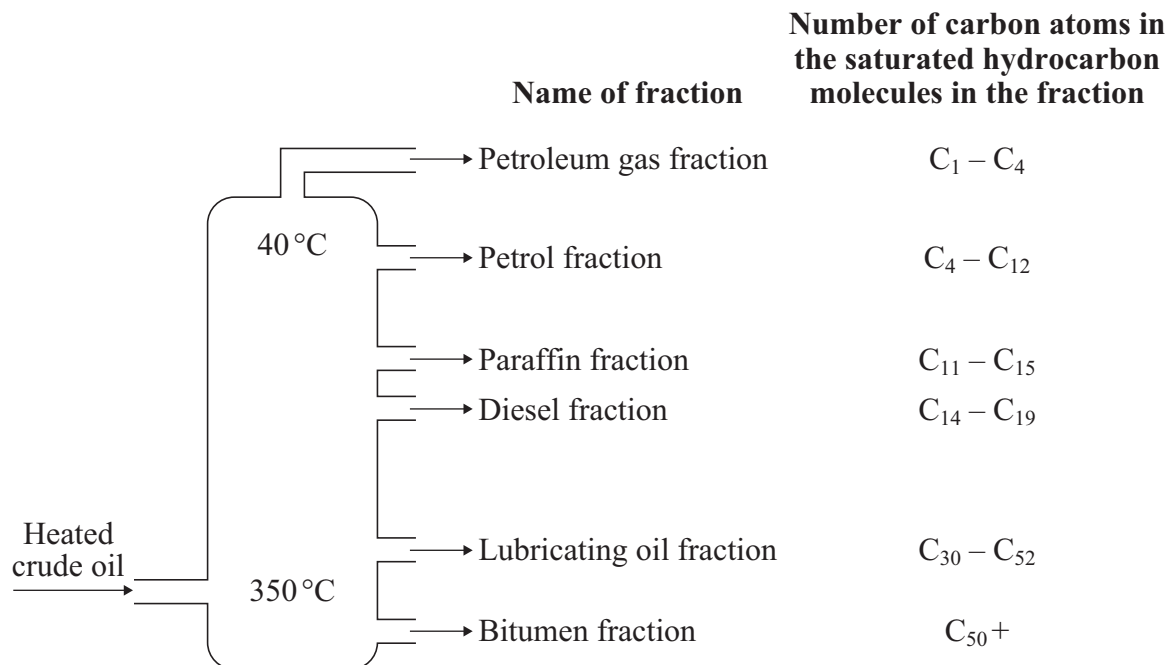
- 1 cast iron
- 2 low carbon steel
- 3 high carbon steel
- 4 stainless steel

Turn over ►

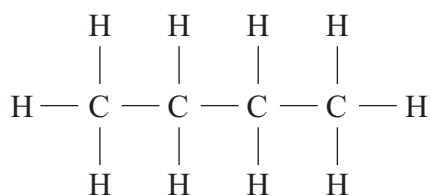
QUESTION EIGHT

Crude oil can be separated into fractions.

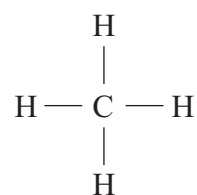
Each fraction contains several different saturated hydrocarbons.



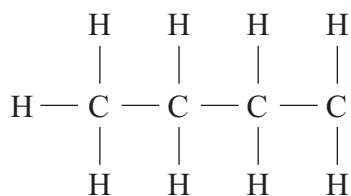
8A One of the hydrocarbons in the petrol fraction can be represented by . . .



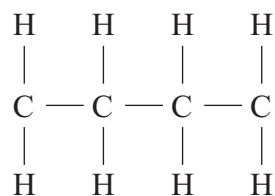
1



2



3



4

8B Which statement is **not** true of saturated hydrocarbons?

- 1 When burned completely, they produce carbon dioxide and water.
- 2 They have the general formula C_nH_{2n+1}
- 3 They can be solids, liquids or gases.
- 4 Those with a small number of carbon atoms in each molecule are useful as fuels.

8C When compared with diesel, petrol . . .

- 1 is more difficult to ignite.
- 2 is more volatile.
- 3 has a higher boiling point.
- 4 is more viscous.

8D Which one of these statements about ethanol is **false**?

- 1 Ethanol is a renewable resource.
- 2 Ethanol does not release carbon dioxide when it burns.
- 3 Ethanol, produced from plant material, can be carbon-neutral.
- 4 Ethanol does not release sulfur dioxide when it burns.

Turn over for the next question

Turn over ►

QUESTION NINE

In the 1980s, environmentalist Paul Ehrlich predicted that there would be a massive worldwide shortage of various natural resources. At the same time, economist Julian Simon said that natural resources were effectively infinite.

In 1988, the known resources of tin were estimated to last for 18 years. In 2006, there is still not a serious shortage of tin.

9A Which of the following is **not** a reason why Ehrlich's prediction of massive shortages has been proved wrong?

- 1 Existing materials have been recycled.
- 2 Existing resources have been used more efficiently.
- 3 More material has been imported.
- 4 New sources have been discovered.

9B The Coca-Cola company is a commercial organisation. Coke cans are now made from 80% less aluminium than 40 years ago.

What is the most probable reason for this?

- 1 The company sells more Coca-Cola than 40 years ago.
- 2 The price of aluminium has decreased.
- 3 There is a serious shortage of aluminium.
- 4 Thinner cans cut costs and increase profits.

9C The availability of metals has not decreased as fast as predicted 20 years ago. One reason for this is a reduction in the use of some metals.

Which of the following has **not** contributed to a reduction in the overall use of metals?

- 1 Environmental concerns have caused more people to use energy saving lamps which has reduced the demand for tungsten.
- 2 To reduce costs, 'tin' cans are now coated with plastic instead of tin.
- 3 To reduce corrosion, aluminium has replaced iron in some of the body parts of cars.
- 4 New technology has resulted in the use of more fibre optic cables and a reduced use of copper wire.

9D The main source of tin is the ore tin sulfide. This is used to make tin oxide. The tin oxide is then heated with carbon to obtain the metal.

Why does it normally take less energy to obtain tin from scrap tin than to extract the tin from its ore?

- 1 There are more impurities in scrap tin than in the tin ore.
- 2 More waste materials are left from scrap tin than from tin ore.
- 3 Scrap tin does not need to be reduced to tin.
- 4 Tin sulfide contains the element sulfur.

END OF TEST

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