

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
Spring 2003



SCIENCE: SINGLE AWARD (MODULAR)
Materials and Reactions (Module 15)

346015

Wednesday 5 March 2003 Morning Session

In addition to this paper you will require:

- an HB pencil and a rubber;
- an answer sheet.

Time allowed: 30 minutes

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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 “Materials and Reactions” printed on it.
- Attempt **one Tier only, either** the Foundation Tier **or** the Higher Tier.
- Answer **all** the questions for the Tier you are attempting.
- 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.
- Mark your responses on the separate answer sheet only. Rough work may be done on the question paper.
- Mark the best responses by using a thick pencil stroke to fill in the box. Use an HB pencil. Make sure the pencil stroke does **not** extend beyond the box. Do **not** use ink or ball-point pen. If you wish to change your answer, rub out your first answer completely. See below.

Examples:

	1	2	3	4
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	QUESTION XXX			
xxx.1	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
xxx.2	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
xxx.3	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
xxx.4	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

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 rub 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 A

Questions **ONE** to **FIVE**.

In these questions match the words in the list with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

This question is about gases.

Match words from the list with each of the numbers **1–4** in the table.

carbon dioxide

oxygen

sulphur dioxide

water vapour

Gas	What we can say about the gas
1	it is an oxide of hydrogen
2	it is formed when sulphur burns in air
3	it reacts with carbon to form carbon dioxide
4	it is produced in the thermal decomposition of copper carbonate

QUESTION TWO

This question is about chemical processes.

Match words from the list with each of the numbers 1–4 in the table.

decomposition

displacement

neutralisation

oxidation

Process	Example of the process
1	magnesium reacts with copper sulphate solution to give copper and magnesium sulphate
2	carbon monoxide reacts with oxygen to form carbon dioxide
3	sodium hydroxide reacts with hydrochloric acid to form sodium chloride and water
4	zinc carbonate breaks down into zinc oxide and carbon dioxide

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION THREE

The diagram shows stages in the cracking of hydrocarbons.

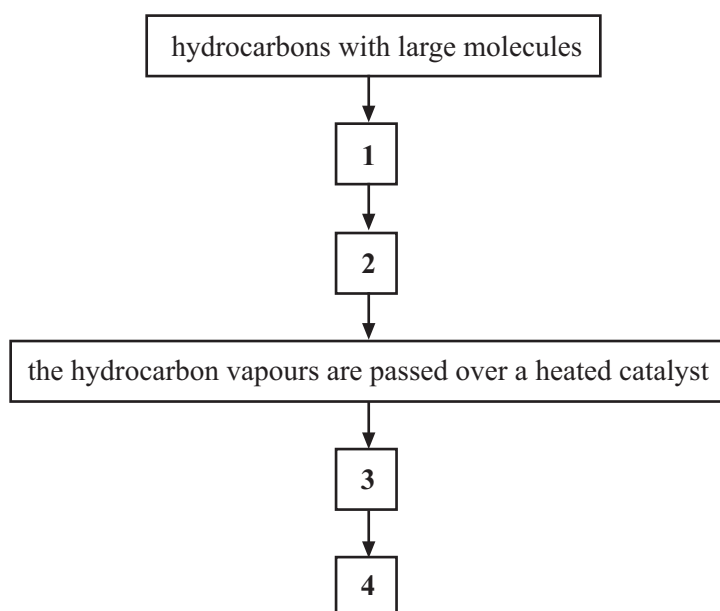
Match words from the list with each of the spaces 1–4, to describe what happens in this process.

hydrocarbons with small molecules

the hydrocarbons are heated

the hydrocarbons are in a vapour state

thermal decomposition of hydrocarbons

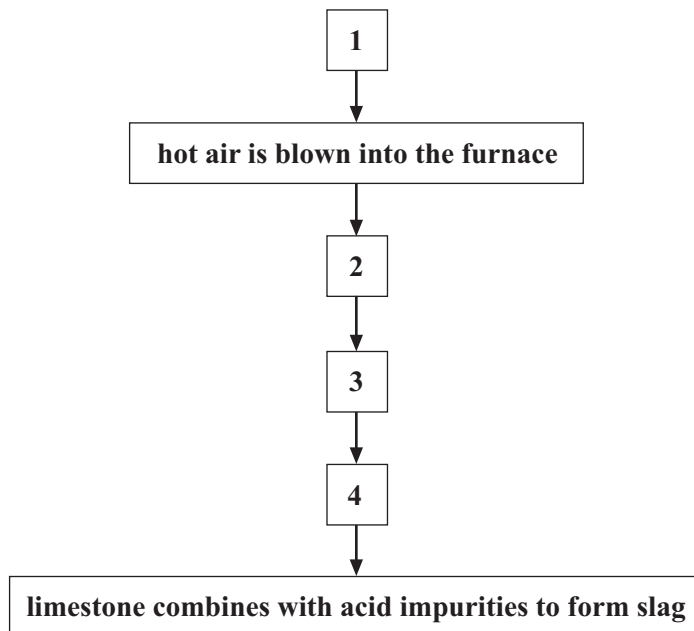


QUESTION FOUR

The diagram shows stages in the manufacture of iron in the blast furnace.

Match statements **P**, **Q**, **R** and **S** with each of the spaces **1–4**, to explain what happens in this process.

- P** carbon dioxide reacts with coke to produce carbon monoxide
- Q** carbon monoxide reacts with iron oxide to produce iron
- R** coke burns to form carbon dioxide
- S** iron ore, coke and limestone are put into the furnace



TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION FIVE

This question is about the reactivity series.

Carbon will displace metal **K** and metal **L** from their oxides.

Hydrogen will displace metal **K** from its oxide but cannot displace metal **L** from its oxide.

Carbon will not displace metals **M** and **N** from their oxides.

Metal **M** will displace metal **N** from its oxide.

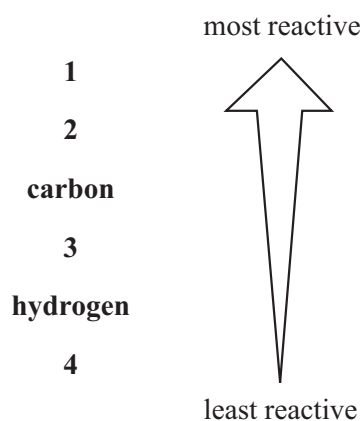
Match metals from the list with each of the numbers **1–4** in the reactivity series.

metal K

metal L

metal M

metal N



SECTION BQuestions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION SIX

This question is about plastics (polymers).

Choose from the list the **two** statements that are correct.**all hydrocarbons with large molecules are polymers****microorganisms break down waste polythene****most plastics (polymers) are biodegradable****poly(propene) is a plastic used for making crates and ropes****some small hydrocarbon molecules can be used to make plastics (polymers)****QUESTION SEVEN**

This question is about iron.

Choose from the list the **two** statements that are correct.**a non-rusting alloy of iron is stainless steel****iron can be protected by connecting it to a more reactive metal****iron can be protected by connecting it to copper****iron corrodes much more slowly than other transition metals****stainless steel is made by mixing iron with carbon****Turn over ►**

SECTION CQuestions **EIGHT** to **TEN**.

Each of these questions has four parts.

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

QUESTION EIGHT**8.1** The word equation shows the breakdown of limestone when it is heated in a lime kiln.

Which substance completes the word equation?

- A** Calcium chloride
 - B** Calcium hydrogencarbonate
 - C** Calcium hydroxide
 - D** Calcium oxide
- 8.2** Powdered limestone can be mixed with powdered clay and heated in a rotary kiln.
- The main useful product is
- A** cement.
 - B** concrete.
 - C** glass.
 - D** quicklime.
- 8.3** The chemical name for slaked lime is
- A** calcium chloride.
 - B** calcium hydroxide.
 - C** calcium oxide.
 - D** calcium sulphate.
- 8.4** One use of slaked lime is to
- A** make concrete.
 - B** make quicklime.
 - C** make soil less acid.
 - D** neutralise alkaline lake water.

QUESTION NINE

The diagram shows a part of the periodic table.

The symbols for some of the elements are given in their correct position in the table.

Group 1		Group 2												Group 3						Group 0
Li	Be																	He		
Na	Mg											Al						Ar		
K	Ca				Cr		Fe		Ni	Cu	Zn									

9.1 In the periodic table, the chemical elements are arranged in order of their

- A density.
- B molecular size.
- C reactivity.
- D relative atomic mass.

9.2 Elements within a Group have

- A a similar colour.
- B a similar density.
- C similar chemical properties.
- D similar melting points.

9.3 Most of the metal elements are found in the central block and

- A in Groups 1 and 2.
- B in Groups 1 and 0.
- C in Groups 2 and 3.
- D in Groups 2 and 0.

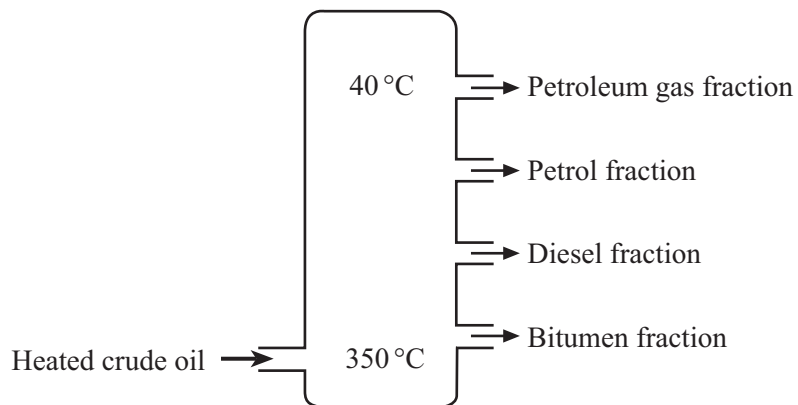
9.4 Which of the following is a transition element?

- A Aluminium
- B Argon
- C Iron
- D Potassium

Turn over ►

QUESTION TEN

In a fractionating column, crude oil is separated into a number of fractions, some of which are shown in the diagram.



10.1 Crude oil is

- A** a compound of carbon and hydrogen only.
- B** a mixture of elements.
- C** a mixture of hydrocarbons.
- D** an element.

10.2 The hydrocarbon molecules in each fraction contain

- A** a similar number of carbon atoms.
- B** a similar number of oxygen atoms.
- C** carbon, hydrogen and oxygen atoms.
- D** exactly the same number of carbon atoms.

10.3 Hydrocarbon molecules vary in size.

The fraction containing hydrocarbons with the smallest molecules is

- A** the bitumen fraction.
- B** the diesel fraction.
- C** the petrol fraction.
- D** the petroleum gas fraction.

10.4 When compared with other hydrocarbons, those with the smallest molecules

- A** will be easier to ignite.
- B** will be less volatile.
- C** will be more viscous.
- D** will have higher boiling points.

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 A

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

In these questions match the words in the list with the numbers.

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Mark your choices on the answer sheet.

QUESTION ONE

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Carbon will displace metal **K** and metal **L** from their oxides.

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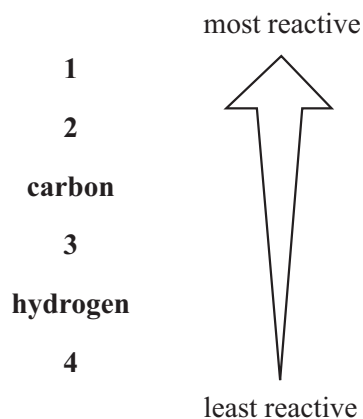
Match metals from the list with each of the numbers **1–4** in the reactivity series.

metal K

metal L

metal M

metal N



QUESTION TWO

Chemical reactions can be represented by word equations.

Choose words from the list for each of the spaces **1–4** in the equations.

calcium hydroxide

carbon dioxide

lead

potassium nitrate

iron oxide + carbon monoxide \longrightarrow iron + **1**

lead oxide + carbon \longrightarrow carbon dioxide + **2**

potassium hydroxide + nitric acid \longrightarrow **3** + water

calcium oxide + water \longrightarrow **4**

TURN OVER FOR THE NEXT QUESTION

Turn over ►

SECTION BQuestions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION THREE

This question is about iron.

Choose from the list the **two** statements that are correct.**a non-rusting alloy of iron is stainless steel****iron can be protected by connecting it to a more reactive metal****iron can be protected by connecting it to copper****iron corrodes much more slowly than other transition metals****stainless steel is made by mixing iron with carbon****QUESTION FOUR**

This question is about carbon dioxide gas.

Which **two** statements about the gas are correct?**it is produced during the cracking of large hydrocarbon molecules****it is produced when polymers burn****it is produced when quicklime reacts with water****it is produced when unsaturated hydrocarbons burn****it is released in the polymerisation of alkenes**

SECTION CQuestions **FIVE** to **TEN**.

Each of these questions has four parts.

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

QUESTION FIVE**5.1** The word equation shows the breakdown of limestone when it is heated in a lime kiln.

Which substance completes the word equation?

- A** Calcium chloride
 - B** Calcium hydrogencarbonate
 - C** Calcium hydroxide
 - D** Calcium oxide
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Turn over ►

QUESTION SIX

The diagram shows a part of the periodic table.

The symbols for some of the elements are given in their correct position in the table.

																			Group 0
Group 1	Group 2									Group 3									He
Li	Be																		
Na	Mg									Al									Ar
K	Ca				Cr		Fe		Ni	Cu	Zn								

6.1 In the periodic table, the chemical elements are arranged in order of their

- A density.
- B molecular size.
- C reactivity.
- D relative atomic mass.

6.2 Elements within a Group have

- A a similar colour.
- B a similar density.
- C similar chemical properties.
- D similar melting points.

6.3 Most of the metal elements are found in the central block and

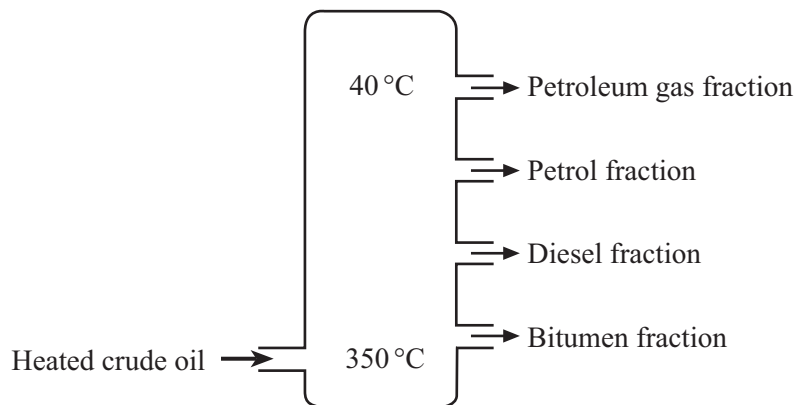
- A in Groups 1 and 2.
- B in Groups 1 and 0.
- C in Groups 2 and 3.
- D in Groups 2 and 0.

6.4 Which of the following is a transition element?

- A Aluminium
- B Argon
- C Iron
- D Potassium

QUESTION SEVEN

In a fractionating column, crude oil is separated into a number of fractions, some of which are shown in the diagram.



7.1 Crude oil is

- A** a compound of carbon and hydrogen only.
- B** a mixture of elements.
- C** a mixture of hydrocarbons.
- D** an element.

7.2 The hydrocarbon molecules in each fraction contain

- A** a similar number of carbon atoms.
- B** a similar number of oxygen atoms.
- C** carbon, hydrogen and oxygen atoms.
- D** exactly the same number of carbon atoms.

7.3 Hydrocarbon molecules vary in size.

The fraction containing hydrocarbons with the smallest molecules is

- A** the bitumen fraction.
- B** the diesel fraction.
- C** the petrol fraction.
- D** the petroleum gas fraction.

7.4 When compared with other hydrocarbons, those with the smallest molecules

- A will be easier to ignite.
- B will be less volatile.
- C will be more viscous.
- D will have higher boiling points.

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION EIGHT

Hydrocarbons are compounds of carbon and hydrogen.

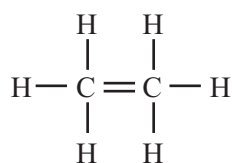
The formulas for two hydrocarbons, **X** and **Y**, are shown below.

Hydrocarbon X	Formula C₂H₆
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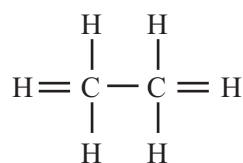
Hydrocarbon Y	Formula C₃H₆
----------------------	---

8.1 The structural formula for hydrocarbon **X** is

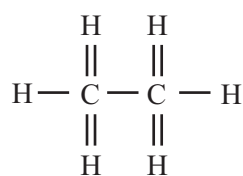
A



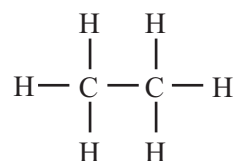
B



C



D



8.2 In both compounds, carbon atoms form the spine of the molecule.

How are the carbon atoms joined?

Hydrocarbon X

Hydrocarbon Y

A by a single bond

by single bonds

B by a double bond

by single bonds

C by a single bond

by single or double bonds

D by a single or double bond

by double bonds

8.3 To which group of hydrocarbons do these compounds belong?

	Hydrocarbon X	Hydrocarbon Y
A	saturated	saturated
B	saturated	unsaturated
C	unsaturated	saturated
D	unsaturated	unsaturated

8.4 Which of these hydrocarbons belongs to the same group as hydrocarbon X?

- A** C_3H_8
- B** C_4H_8
- C** C_5H_{10}
- D** C_6H_{12}

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION NINE

You can make a solution of a salt by reacting an acid with an alkali.

9.1 Which salt is produced in this reaction?

ammonia solution + nitric acid \longrightarrow ? + water

- A** ammonia
- B** ammonium chloride
- C** ammonium nitrate
- D** ammonium sulphate

9.2 When the ammonia solution is completely neutralised by the nitric acid solution, the reaction can be written

- A** $\text{H}^{\text{-(aq)}} + \text{OH}^{\text{+(aq)}} \longrightarrow \text{H}_2\text{O(1)}$
- B** $\text{H}^{\text{+(aq)}} + \text{OH}^{\text{-(aq)}} \longrightarrow \text{H}_2\text{O(1)}$
- C** $\text{H}^{\text{+(aq)}} - \text{OH}^{\text{-(aq)}} \longrightarrow \text{H}_2\text{O(1)}$
- D** $\text{H}^{\text{(aq)}} - \text{OH}^{\text{(aq)}} \longrightarrow \text{H}_2\text{O(1)}$

9.3 A molecule of nitric acid (HNO_3) has one hydrogen atom which can be replaced by a metal to form a normal salt. When the acid molecule has two or more replaceable hydrogen atoms, normal or acid salts may be formed.

Which one of these acids will form acid salts?

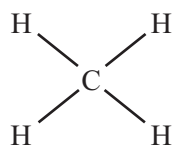
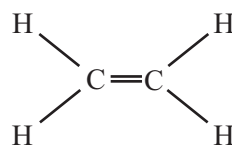
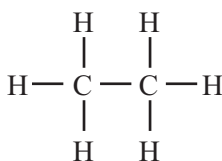
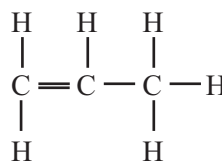
- A** Carbonic acid, H_2CO_3
- B** Hydriodic acid, HI
- C** Hydrobromic acid, HBr
- D** Hydrochloric acid, HCl

9.4 Which of these substances will react with nitric acid to produce the salt, copper nitrate?

- A** Copper bromide
- B** Copper chloride
- C** Copper oxide
- D** Copper sulphate

QUESTION TEN

The diagrams show the structural formulas of the molecules of four hydrocarbon compounds, **J**, **K**, **L** and **M**.

**Hydrocarbon J****Hydrocarbon K****Hydrocarbon L****Hydrocarbon M**

10.1 Which of these compounds can undergo polymerisation?

- A** Hydrocarbons **J** and **K**
- B** Hydrocarbons **K** and **M**
- C** Hydrocarbons **L** and **M**
- D** Hydrocarbon **K** only

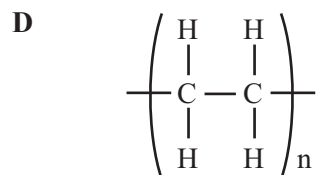
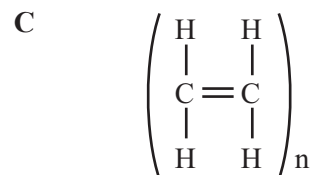
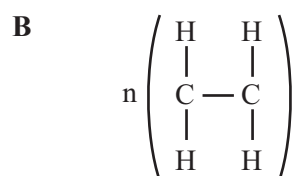
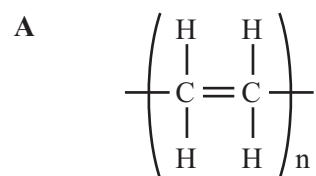
10.2 Each small hydrocarbon molecule from which a polymer is produced is called

- A** a monomer.
- B** an alkane.
- C** an ester.
- D** an oxide.

10.3 From which of the four hydrocarbons can poly(ethene) be made?

- A** Hydrocarbon **J**
- B** Hydrocarbon **K**
- C** Hydrocarbon **L**
- D** Hydrocarbon **M**

10.4 Poly(ethene) can be represented by the formula



END OF TEST