Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Secondary Education
June 2003

SCIENCE: DOUBLE AWARD (CO-ORDINATED) 3462/2H
HIGHER TIER
Paper 2

Monday 9 June 2003 9.00 am to 10.30 am

H

In addition to this paper you will require:
a ruler;
the Data Sheet (enclosed).
You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

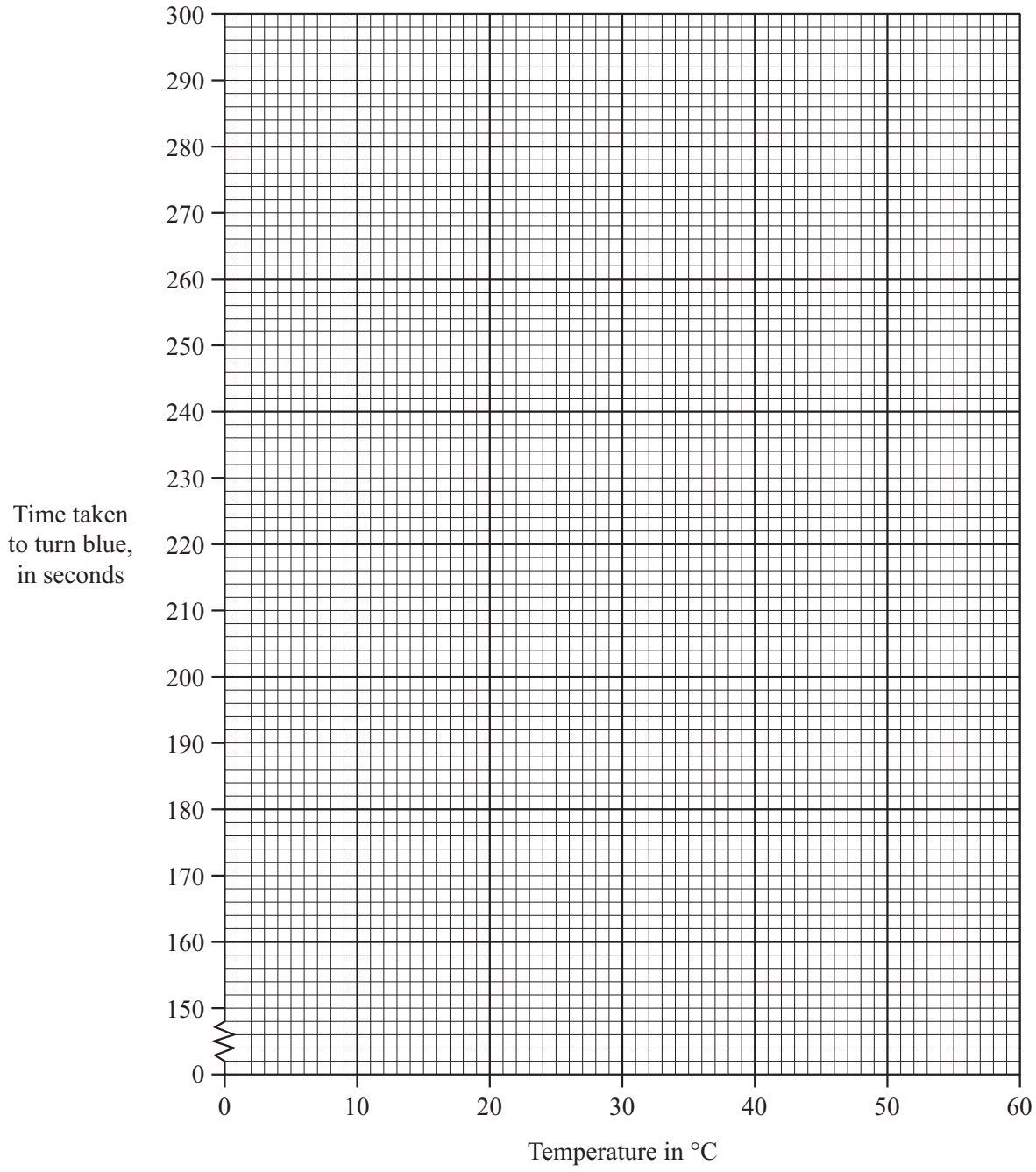
For Examiner's Use			
Number	Mark	Number	Mark
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	
		13	
		14	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

1 Solutions **A** and **B** are colourless. When they are mixed, they react and turn blue after a period of time. A student investigated how temperature affected the rate of reaction between solutions **A** and **B**. The rate was measured by timing how long the mixture took to turn blue.

The results are shown in the table.

Temperature in °C	22	25	34	45	51
Time taken to turn blue, in seconds	290	250	200	170	160

(a) (i) Draw a graph for these results.



(3 marks)

(ii) Use your graph to find how long it takes the solution to turn blue at 40 °C.

Time = ... s

(1 mark)

(b) (i) How does the rate of reaction change as the temperature is increased?

.....

.....

(1 mark)

(ii) Explain, in terms of particles, why temperature has this effect on the rate of reaction.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(3 marks)

(c) State **one** variable that must be kept constant to make this experiment a fair test.

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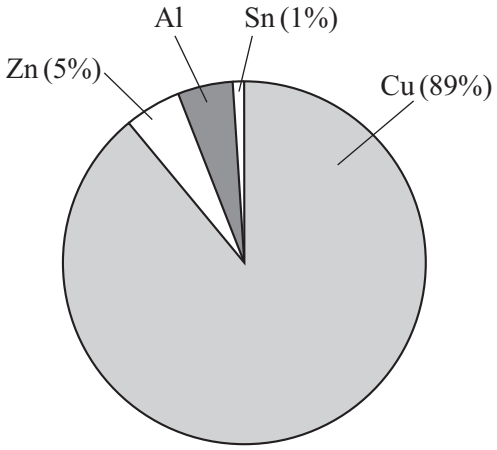
(1 mark)

9

TURN OVER FOR THE NEXT QUESTION

2 The 50 Eurocent coin is made from an alloy called 'Nordic Gold'.

The pie chart shows the percentage by mass of each metal in 'Nordic Gold'.



(a) (i) Calculate the percentage of aluminium, Al, in the coin.

.....

(1 mark)

(ii) The 50 Eurocent coin has a mass of 7 grams.
Calculate the mass of zinc, Zn, in this coin.

.....

.....

Mass of zinc = ... g

(2 marks)

(b) Zinc is extracted by removing oxygen from zinc oxide.

(i) What name is given to a reaction in which oxygen is removed from a substance?

.....

(1 mark)

(ii) Explain how oxygen can be removed from zinc oxide to make zinc. Use the reactivity series on the Data Sheet to help you.

.....

.....

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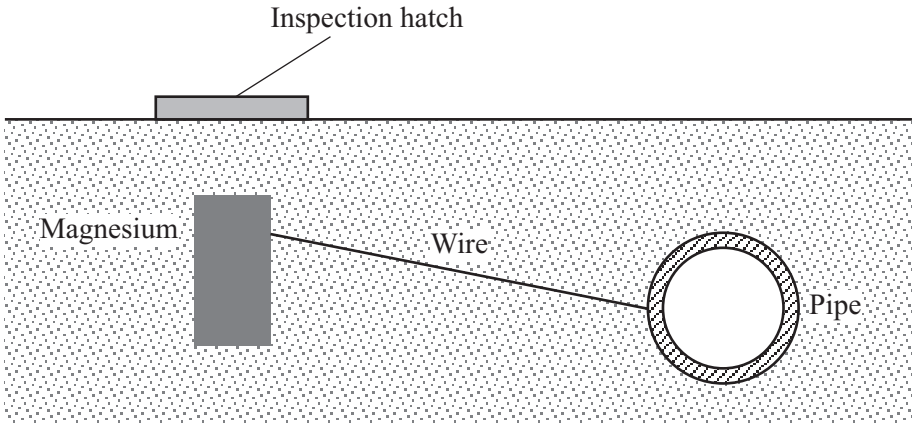
(2 marks)

6

3 Underground pipes are often made of iron. The diagram shows a method of preventing the pipes from corroding.
Pieces of magnesium are connected to the pipes at intervals.



(a) Explain why magnesium can be used to protect pipes from corroding.
Information on the Data Sheet may help you to answer this question.

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(2 marks)

(b) Suggest why this method has to be used to protect underground pipes.

.....

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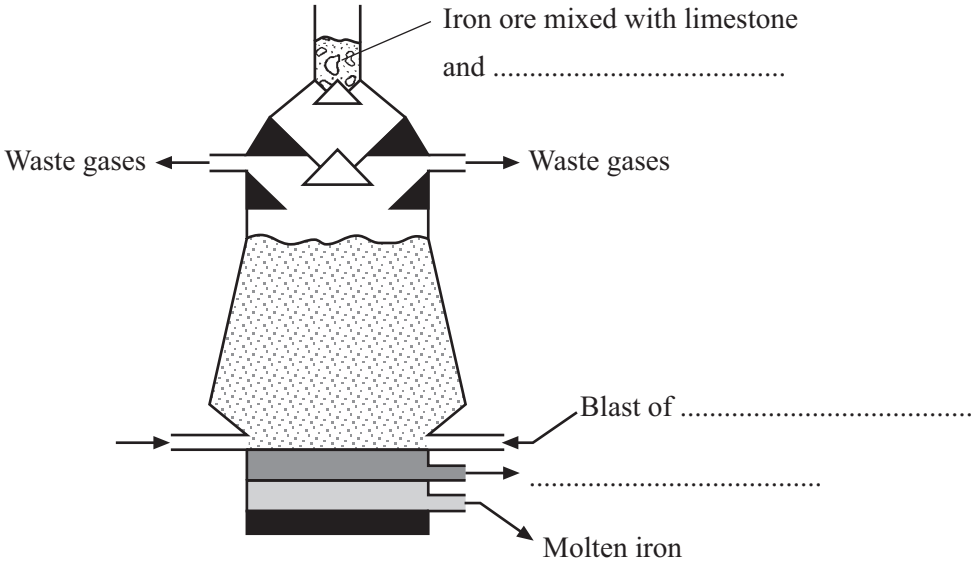
(1 mark)

3

TURN OVER FOR THE NEXT QUESTION

4 (a) The diagram shows a blast furnace used to extract iron from iron ore.

Complete the diagram by adding the **three** missing labels.



(3 marks)

(b) An important reaction in this process is represented by this equation.

(i) Balance the equation.

$$Fe_2O_3 \quad + \quad 3CO \quad \rightarrow \quad .....Fe \quad + \quad .....CO_2$$

(1 mark)

(ii) Which substance has been reduced in this reaction?

.....

(1 mark)

(c) Iron ore contains iron oxide.

(i) Calculate the relative formula mass of iron oxide, Fe_2O_3.

Relative atomic masses: O = 16; Fe = 56.

.....

.....

Answer = ...

(2 marks)

(ii) Calculate the percentage by mass of iron in iron oxide.

.....

Percentage of iron = ...%

(2 marks)

(iii) Calculate the mass of iron that could be extracted from 1000 kg of iron oxide.

Use your answer to part (c) (ii) to help you with this calculation.

.....

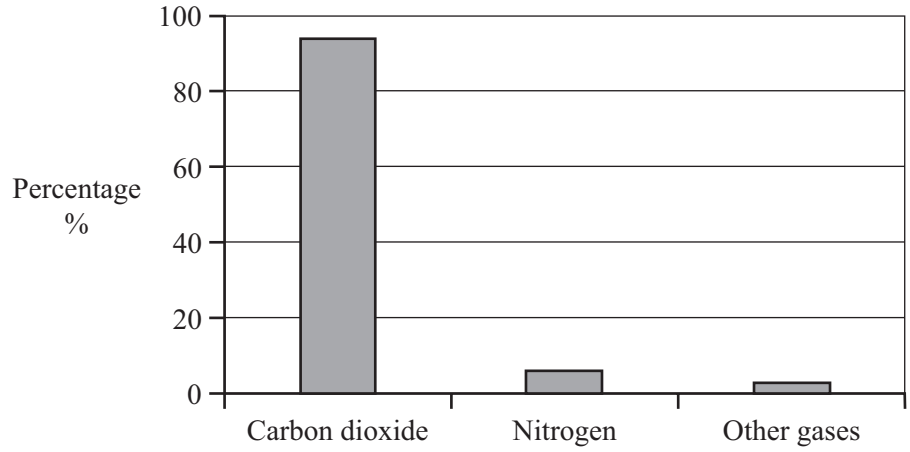
Mass of iron = ...kg

(1 mark)

10

TURN OVER FOR THE NEXT QUESTION

5 The bar chart shows the percentage composition of the atmosphere on Mars.



(a) State **three** ways in which the atmosphere on Earth today is different from that on Mars.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

(b) The atmosphere on Earth may once have been like that on Mars. The evolution of green plants has changed the atmosphere on Earth.

Explain why.

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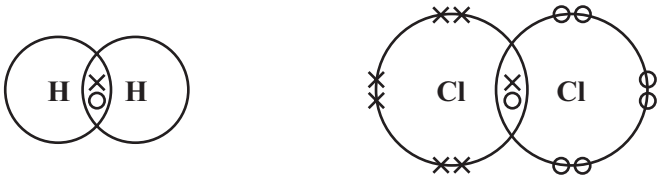
(2 marks)

5

6 Hydrogen chloride (HCl) can be made by the reaction of hydrogen (H_2) with chlorine (Cl_2).

(a) The diagrams represent molecules of hydrogen and chlorine.



Draw a similar diagram to represent a molecule of hydrogen chloride (HCl).
You need show only the outer energy level (shell) electrons.

(1 mark)

(b) The word equation for the reaction of hydrogen with chlorine is shown below.

hydrogen + chlorine → hydrogen chloride

Write a balanced symbol equation for this reaction.

.....

(2 marks)

(c) Hydrogen chloride gas reacts with magnesium to form the ionic compound called magnesium chloride. Use the table of ions on the Data Sheet to help you to write the formula of magnesium chloride.

.....

(1 mark)

(d) Why does magnesium chloride have a much higher melting point than hydrogen chloride?

.....

.....

.....

.....

(2 marks)

6

LEAVE MARGIN BLANK

7 Modern window frames are often made from uPVC which contains the plastic poly(chloroethene).

WONDERFUL WINDOWS

Replace your old wooden windows with our super high quality uPVC windows!

NO PAINTING - MAINTENANCE FREE

(a) State why plastic window frames need no painting or maintenance.

.....

.....

(1 mark)

(b) Poly(chloroethene) is a polymer formed by the *addition polymerisation* of chloroethene.

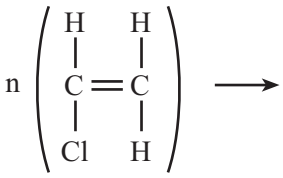
(i) Chloroethene is an unsaturated molecule. Why is this molecule said to be unsaturated?

.....

.....

(1 mark)

(ii) Complete the diagram to represent how poly(chloroethene) is formed from chloroethene.



(3 marks)

(iii) Explain what is meant by the term *polymerisation*.

.....

.....

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.....

(2 marks)

(iv) Why is this an *addition polymerisation*?

.....

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(1 mark)

8

8 (a) This hazard symbol was on a cylinder of chlorine gas.

Suggest and explain a suitable safety precaution when using chlorine in the laboratory.

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.....

.....

.....

(2 marks)

(b) Bromine can be extracted from sea water. The bromide ions in the sea water are *oxidised* by chlorine to form bromine.

$$Cl_2 \quad + \quad 2Br^- \quad \rightarrow \quad 2Cl^- \quad + \quad Br_2$$

(i) Why are the bromide ions said to be *oxidised*?

.....

.....

(2 marks)

(ii) Why is this reaction called a redox reaction?

.....

.....

(1 mark)

(iii) This reaction takes place because chlorine is more reactive than bromine. Explain, in terms of the electron arrangements of the atoms, why chlorine is more reactive than bromine.

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(3 marks)

8

9 Neutralisation reactions can be used to make salts.

(a) Write an ionic equation for a neutralisation reaction, including state symbols.

.....

(2 marks)

(b) Ammonium nitrate is a salt used as a fertiliser.

(i) Ammonium nitrate is made by mixing two solutions. Name these solutions.

..... and .....

(1 mark)

(ii) Hazard information about ammonium nitrate states:

- it is not itself a fire hazard (does not burn);
- it must not be allowed to come into contact with combustible materials such as fuels because it can cause these to catch fire.

Suggest why ammonium nitrate helps other substances to burn.

.....

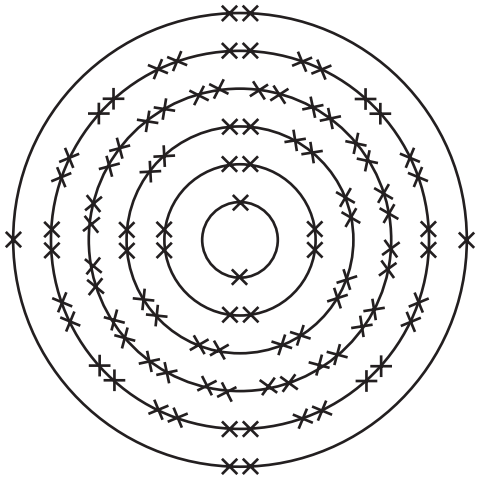
.....

(1 mark)

4

10 In 1999 scientists at the University of Berkeley claimed to have discovered the element Ununhexium.

The electron arrangement of this element is thought to be as shown in the diagram below.



(a) Which group of the periodic table should this element be placed in?

Group .....

(1 mark)

(b) Give a reason for your answer.

.....

.....

(1 mark)

2

TURN OVER FOR THE NEXT QUESTION

11 The table shown below was devised by John Newlands in 1864. He arranged the elements in order of their relative atomic masses. He found a repeating pattern, with elements having similar properties in the vertical columns (Groups). He called this pattern the 'Law of Octaves', because elements with similar properties seemed to be repeated every eighth element.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co/Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce/La	Zr	Di/Mo	Ro/Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba/V	Ta	W	Nb	Au
Pt/Ir	Tl	Pb	Th	Hg	Bi	Os

(a) Many scientists were critical of Newlands' Law of Octaves.
Suggest why other scientists were critical of the Law of Octaves.
You should give examples from the table and use your knowledge of the chemistry of the elements.

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(3 marks)

(b) The diagram below shows a version of Mendeleev's Periodic Table of 1871. Mendeleev placed most of the elements in order of relative atomic mass.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

This table became accepted by other scientists.

Give **two** ways in which Mendeleev's table improved on Newlands' table.

1 .....

.....

2 .....

.....

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

12 The reaction of methane with steam is used in industry to make hydrogen.

(a) One of the reactions in this process is represented by this equation.

$$CH_4\,(g) + H_2O\,(g) \rightleftharpoons CO\,(g) + 3H_2\,(g)$$

The forward reaction is endothermic.

State the conditions of temperature and pressure that would give the maximum yield of hydrogen.

Explain your answers.

(i) Temperature

.....

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.....

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(2 marks)

(ii) Pressure

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(2 marks)

(iii) Which one of the following metals is most likely to be a catalyst for this process?
Draw a ring around your answer.

aluminium **lead** **magnesium** **nickel** **sodium**

Give a reason for your choice.

.....

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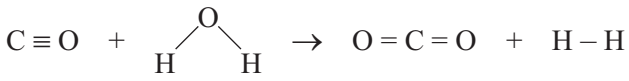
(1 mark)

(b) A second stage in this process is represented by this equation.



(i) Use the bond energies given in the table to help you to calculate the nett energy transfer (energy change) for this reaction.

Bond	Bond energy in kJ/mol
C ≡ O	1077
C = O	805
H – H	436
O – H	464

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Nett energy transfer = ... kJ/mol

(3 marks)

(ii) State whether this reaction is exothermic or endothermic. .....

Explain, by reference to your calculation, how you know.

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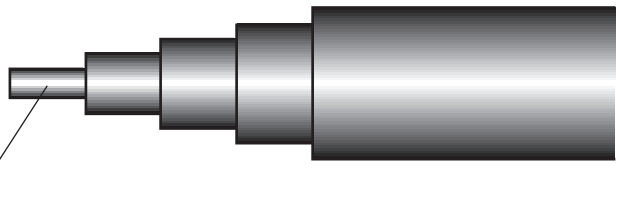
(2 marks)

10

13 The drawing shows a high quality wire used to make electrical connections on a hi-fi system.



Multi-strand "OFC" copper
to maintain high signal purity

(a) Copper is used because it is a very good conductor of electricity. Copper is a typical metal.

(i) Describe the structure and bonding in a metal. You may wish to draw a diagram to help you to answer this question.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(3 marks)

(ii) Explain, by reference to your answer to part (a)(i), why copper conducts electricity.

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(1 mark)

(iii) Explain, by reference to your answer to part (a)(i), why copper can be drawn into wires.

.....

.....

(1 mark)

(b) The copper used to make this wire is "OFC" copper. This stands for 'oxygen free copper'.

(i) It is thought that when molten copper is cooled and solidified it can take in some oxygen from the air. This may slightly decrease the conductivity of the copper.

Suggest why the conductivity might be decreased.

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(2 marks)

(ii) To make it oxygen free, the copper is heated in an atmosphere of hydrogen.

Explain how this will remove the oxygen.

.....

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(1 mark)

8

TURN OVER FOR THE NEXT QUESTION

14 This cake recipe is taken from a cookery book.

Soda Cake

- Mix the flour and butter and add the sugar, currants and flavouring.
- Then add the beaten egg.
- Add a little milk with a teaspoonful of **baking soda (sodium hydrogencarbonate)** and mix it in well.
- Bake in a moderate oven for about 30 minutes.

When sodium hydrogencarbonate is heated in an oven, it forms carbon dioxide gas.

$$2\ NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

(a) A teaspoonful of baking soda contains a mass of 11 g of sodium hydrogencarbonate. Calculate the mass of carbon dioxide that could be made from 11 g of sodium hydrogencarbonate. Show clearly how you work out your final answer.

Relative atomic masses: H = 1; C = 12; O = 16; Na = 23.

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.....

Mass of carbon dioxide = ... g

(3 marks)

(b) Use your answer from part (a) to help you to calculate the volume of carbon dioxide produced, at room temperature and pressure, from 11 g of sodium hydrogencarbonate. Show clearly how you work out your final answer.

The volume of the relative formula mass (M_r) in grams, of a gas, is 24 000 cm^3 at room temperature and pressure.

.....

.....

Volume of carbon dioxide = ... cm^3

(2 marks)

(c) Suggest why sodium hydrogencarbonate is added to the cake mixture.

.....

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(1 mark)

6

END OF QUESTIONS