Surname		Other Names	
Centre Number			Candidate Number								
Candidate Signature											

Leave blank

General Certificate of Secondary Education
June 2003

CHEMISTRY **3421/F**
FOUNDATION TIER

F

Monday 9 June 2003 9.00 am to 11.15 am

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

Time allowed: 2 hours 15 minutes

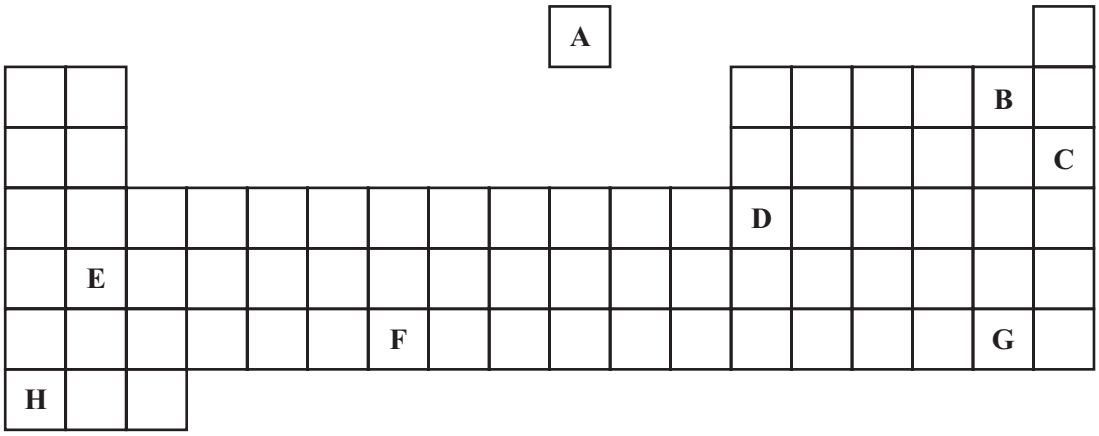
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 135.
- 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		16	
2		17	
3		18	
4		19	
5		20	
6		21	
7		22	
8		23	
9		24	
10			
11			
12			
13			
14			
15			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

1 The periodic table on the Data Sheet may help you to answer this question.

The diagram shows an outline of the periodic table.



Choose your answers **only** from the letters shown on this outline table.

Which letter, **A** to **H**, represents an element which:

(a) is in Group 3, Letter .....
(1 mark)

(b) is in Period 2, Letter .....
(1 mark)

(c) is a transition element, Letter .....
(1 mark)

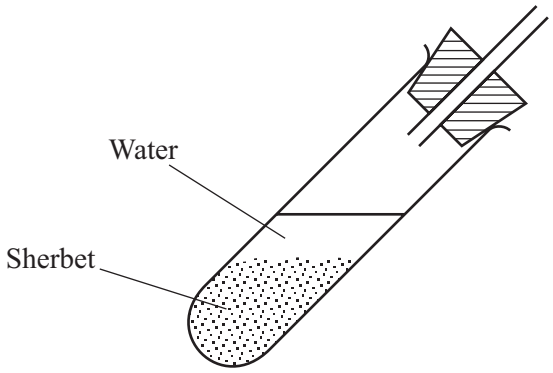
(d) is the least reactive element in Group 7, Letter .....
(1 mark)

(e) is the most reactive metal? Letter .....
(1 mark)

5

2 A student added water to some sherbet and noticed that it bubbled.

(a) Complete the diagram to show how the student could collect some of the gas produced.



(1 mark)

(b) The student tested the gas to see if it was carbon dioxide.

(i) Name the solution used to test for carbon dioxide.

.....

(1 mark)

(ii) What effect does carbon dioxide have on this solution?

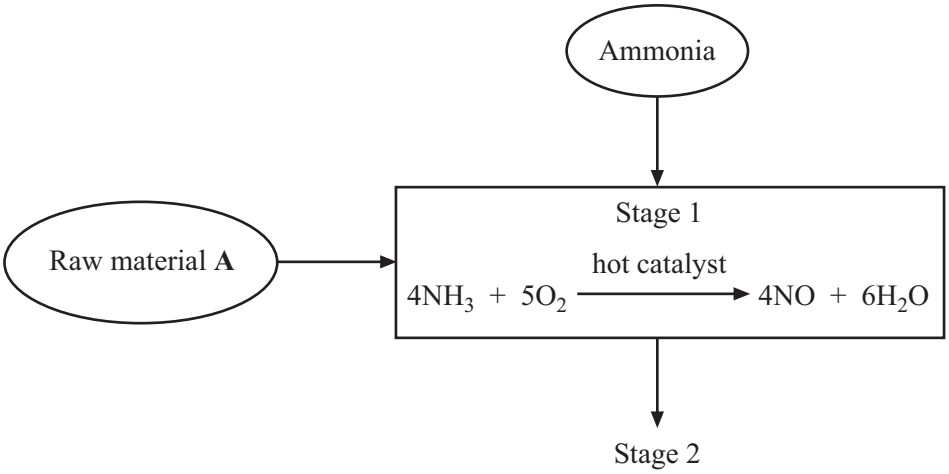
.....

(1 mark)

3

3 Nitric acid is made from ammonia, NH_3.

The first stage in this process can be shown in a flow diagram.
Look at the flow diagram below.



(a) Name raw material **A**.

.....

(1 mark)

(b) Draw a ring around:

(i) the name of the catalyst used in stage 1;

gold **iron** **mercury** **platinum**

(1 mark)

(ii) the word which best describes this reaction.

decomposition **displacement** **neutralisation** **oxidation**

(1 mark)

(c) Nitric acid can be neutralised by alkalis to make salts.

(i) The salt called potassium nitrate can be made from nitric acid.

Complete the word equation for this neutralisation reaction.
Choose the correct substances from the box.

hydrogen	**oxygen**	**potassium chloride**
potassium hydroxide		**water**

nitric acid + ... → potassium nitrate + ...

(2 marks)

(ii) Ammonium nitrate is another salt made from nitric acid.

Which **one** of the following is the main use of ammonium nitrate?
Draw a ring around your answer.

dye **fertiliser** **plastic** **fuel**

(1 mark)

(iii) Complete this sentence by choosing the correct ion from the box.

H^+	NH_4^+	NO_3^-	O^{2-}	OH^-

The ion that makes solutions acidic is ..... .

(1 mark)

7

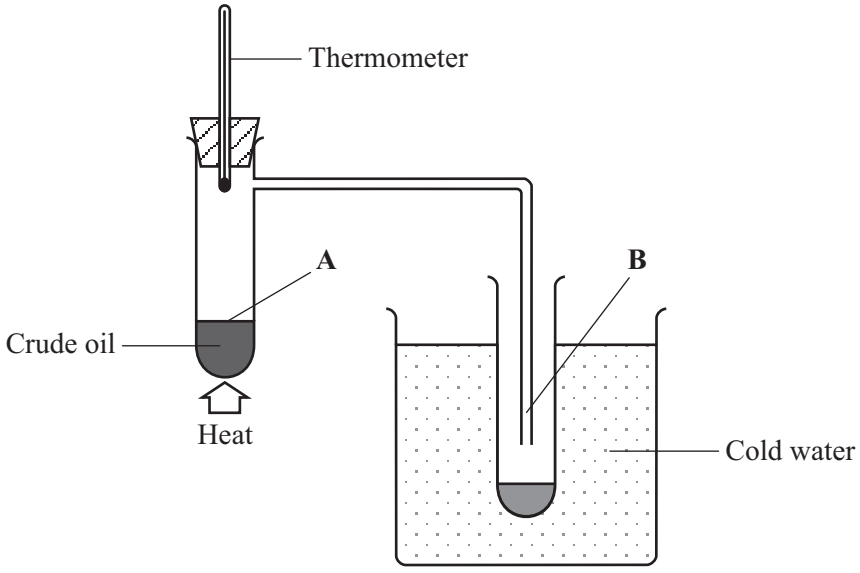
TURN OVER FOR THE NEXT QUESTION

4 (a) Complete this sentence about crude oil.

Crude oil is mainly a mixture of compounds called ..... which contain carbon and hydrogen only.

(1 mark)

(b) The diagram shows a laboratory experiment used to separate crude oil.



Complete each sentence by choosing the correct words from the box.

condensation	**distillation**	**evaporation**
melting	**sublimation**	

The main process taking place at **A** is .....

The main process taking place at **B** is .....

This method of separating crude oil is called .....

(3 marks)

(c) Complete this sentence by crossing out the word in each box that is wrong. The first one has been done for you.

This method of separating crude oil works because the [smaller / ~~larger~~] the molecules are, the [higher / lower] their boiling point and the [more / less] volatile they are.

(1 mark)

(d) Poly(ethene) is a plastic made from crude oil. It is a useful plastic but it can cause problems because it is **not** *biodegradable*.

(i) Give **one** use of poly(ethene).

.....

(1 mark)

(ii) Explain the meaning of *biodegradable*.

.....

.....

(1 mark)

(iii) Suggest reasons why the disposal of poly(ethene) may cause environmental problems.

.....

.....

.....

.....

(2 marks)

9

TURN OVER FOR THE NEXT QUESTION

5 Bags of readi-to-mix concrete contain three ingredients.

Readi-to-mix Concrete

contains

cement
crushed rock
sand

Complete each sentence by choosing the correct words from the box.

clay	**limestone**	**salt**	**slaked lime**	**water**

Cement is made by heating ..... and ..... in a rotary kiln.

To make concrete, the contents of the bag of readi-to-mix concrete must be mixed with

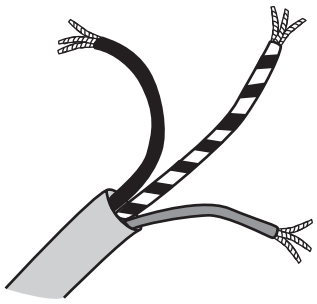
..... .

(3 marks)

3

6 The properties of transition metals make them useful elements.

(a) Why is copper used for electrical wiring?

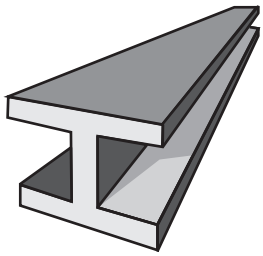


.....

.....

(1 mark)

(b) Why is iron used for girders in buildings?



.....

.....

(1 mark)

(c) Why are transition metal compounds added to glazes for pottery?

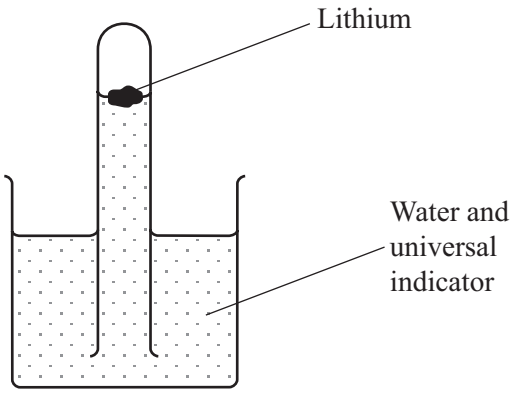
.....

.....

(1 mark)

3

7 The diagram shows an experiment to study the reaction of lithium with water.



(a) Describe, as fully as you can, what you would see as the lithium reacts with the water in this experiment.

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.

.....

.....

.....

.....

.....

.....

(3 marks)

(b) The reaction has two products. Complete the word equation for this reaction by choosing the correct substances from the box.

hydrogen	**lithium hydride**	**lithium hydroxide**
lithium oxide		**oxygen**

lithium + water → ..... + ...

(2 marks)

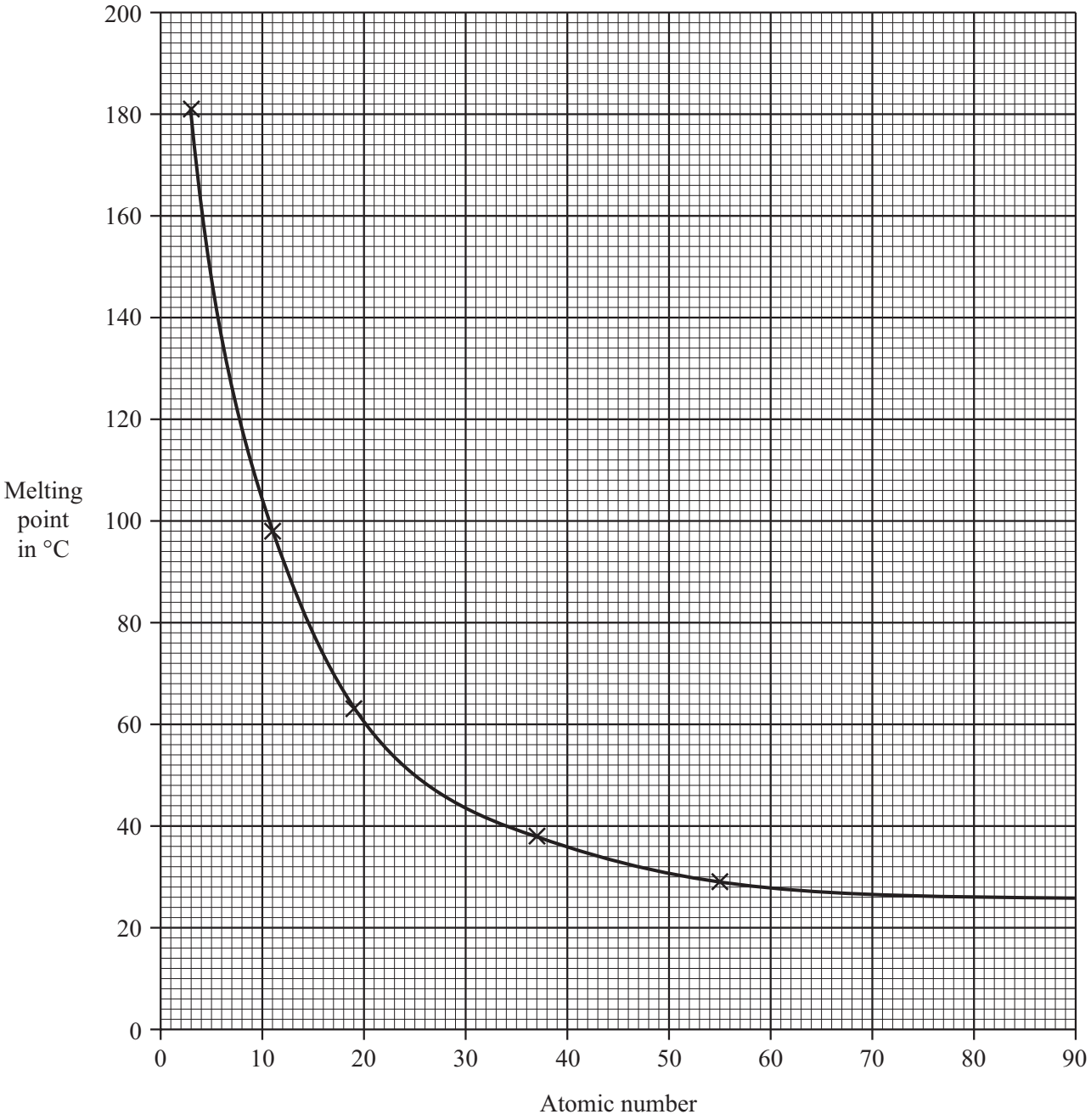
(c) Caesium is lower down in Group 1 of the periodic table than lithium.
Suggest how the reaction of caesium with water might be different from lithium's reaction.

.....

.....

(1 mark)

(d) The graph shows the melting points of the Group 1 metals plotted against their atomic numbers.



(i) Describe fully how the melting points change as the atomic number increases.

.....

.....

.....

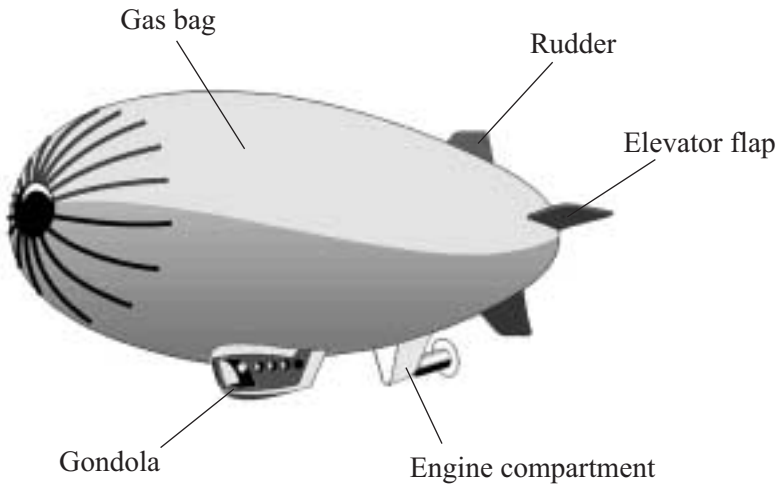
(2 marks)

(ii) Francium has an atomic number of 87.
Use the graph to estimate the melting point of francium.

Estimate of melting point ..... °C
(1 mark)

9

8 The drawing shows an airship that was used about 80 years ago.



(a) The gas bag was filled with hydrogen. A leak from the gas bag could be very dangerous. Use your knowledge of the reactions of hydrogen to explain why.

.....

.....

.....

.....

(2 marks)

(b) Modern airships are filled with helium.

(i) What property makes both hydrogen and helium suitable for use in airships?

.....

.....

(1 mark)

(ii) Helium is safer than hydrogen for use in airships. Explain why.
You should use the position of helium in the periodic table in your answer.

.....

.....

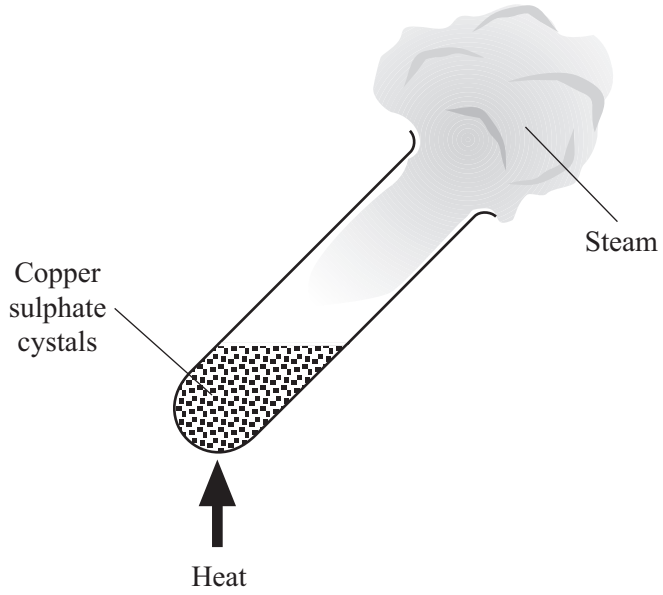
.....

.....

(2 marks)

5

9 A student heated some blue copper sulphate crystals. The crystals turned into white copper sulphate.



(a) The blue copper sulphate had to be heated to change it into white copper sulphate.

State whether the reaction was exothermic or endothermic. .....

Explain your answer.

.....

.....

(1 mark)

(b) The word equation for this reaction is shown below.

hydrated copper sulphate (blue)	[+ heat energy]	$\rightleftharpoons$	anhydrous copper sulphate (white)	+	water

(i) What does the symbol $\rightleftharpoons$ tell you about this reaction?

.....

(1 mark)

(ii) How could the student turn the white powder back to blue?

.....

(1 mark)

3

10 John Dalton wrote these statements in 1808.

- "All substances are made of a vast number of extremely small particles called atoms."
- "Every particle of water is like every other particle of water, every particle of hydrogen is like every other particle of hydrogen, etc."

(a) "Every particle of water is like every other particle of water."
Use Dalton's ideas and your knowledge of water to explain why.

.....

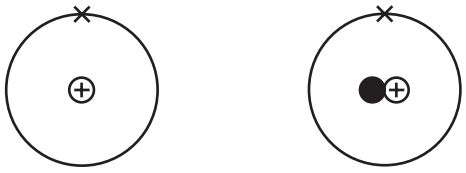
.....

.....

.....

(2 marks)

(b) Dalton thought that all atoms of an element are exactly the same. We now know that it is possible to have atoms of the same element but with different mass numbers.
The diagrams represent two atoms of hydrogen.



Atom **A** Atom **B**

(i) State, in terms of particles, how these two atoms are different.

.....

.....

(1 mark)

(ii) Complete this sentence by choosing the correct word from the box.

ions	**isotopes**	**molecules**	**protons**

Atoms of the same element which have different mass numbers are called

..... .

(1 mark)

4

11 (a) Coal, crude oil, natural gas and wood contain organic compounds.

Name the element present in all organic compounds.

.....

(1 mark)

(b) Most organic compounds burn in air.

(i) Fill in the gaps in this sentence about **complete** combustion by choosing the correct words from the box. Each word may be used once or not at all.

carbon	**carbon monoxide**	**oxidised**
oxygen	**reduced**	**water**

When organic compounds are burned in a plentiful supply of air, the

..... is ..... to form

carbon dioxide and the hydrogen is oxidised to form ..... .

(3 marks)

(ii) Fill in the gaps in these sentences about **incomplete** combustion of organic compounds by choosing the correct words from the box. Each word may be used once or not at all.

carbon	**carbon monoxide**	**flammable**
oxygen	**poisonous**	**sulphur**

Incomplete combustion occurs when there is a limited supply of air. Two other substances can be formed in this reaction. One substance is the gas

..... , and the other substance is a black solid named

..... . The gas is .....

because it lowers the capacity of blood to carry ..... .

(4 marks)

8

12 (a) Titanium is an important transition metal.

Complete these sentences about the extraction of titanium by crossing out the **two** answers in each box that are wrong.

Titanium can be extracted from its ore called

bauxite
haematite
rutile

which contains titanium dioxide.

The titanium dioxide is first converted to

titanium chloride
titanium nitrate
titanium sulphate

.

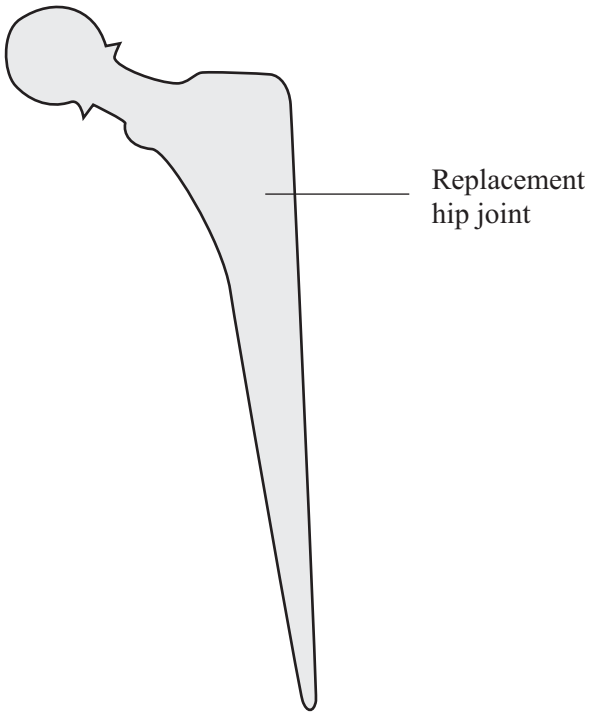
This compound is then reacted with

copper
gold
sodium

to form titanium.

(3 marks)

(b) Titanium is used to make replacement hip joints.



Some properties of elements are given in the table below.

Three of these are properties of titanium which make it a good material for replacement hip joints.

One of these properties has been ticked for you. Place a tick next to the other **two** properties.

Property	Tick box
Conducts electricity	
Easily breaks	
Not toxic	
Unreactive	✓
Very corrosive	
Very strong	

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

13 Chemical tests are used to identify compounds.

(a) What colour is produced by sodium compounds in flame tests?

.....

(1 mark)

(b) Chemical tests are carried out on these substances.

ammonium chloride	**copper bromide**	**magnesium sulphate**
potassium nitrate	**sodium nitrate**	**zinc carbonate**

Complete each sentence by choosing the correct substance from the box. You may use each substance once or not at all.

The substance which

(i) reacts with dilute hydrochloric acid to produce carbon dioxide gas is

.....

(1 mark)

(ii) in solution reacts with sodium hydroxide solution to form a blue precipitate is

.....

(1 mark)

(iii) in solution reacts with barium chloride solution, in the presence of dilute hydrochloric acid, to form a white precipitate is

.....

(1 mark)

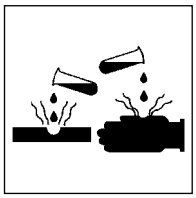
(c) State what you **see** when sodium chloride solution reacts with silver nitrate solution in the presence of dilute nitric acid.

.....

(1 mark)

5

14 (a) The following hazard symbol was on a bottle containing concentrated sulphuric acid.



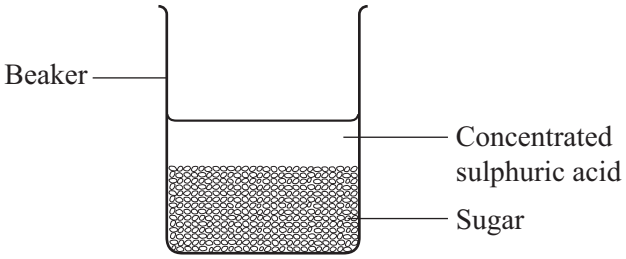
Which **one** of the following words best describes the meaning of this hazard symbol?

Draw a ring around your answer.

corrosive **harmful** **irritant** **oxidising** **toxic**

(1 mark)

(b) Some concentrated sulphuric acid was poured onto some sugar, $C_6H_{12}O_6$.



(i) The equation which represents the reaction is

$$C_6H_{12}O_6\,(s) \rightarrow 6C(s) + 6H_2O(g)$$

Describe, as fully as you can, what you would **see** happening.

.....

.....

.....

.....

(3 marks)

(ii) In this reaction, concentrated sulphuric acid removes the elements of water from the sugar.

Complete this sentence by choosing the correct word from the box.

dehydrates	**dissolves**	**dries**	**neutralises**

The word which best describes what the concentrated sulphuric acid does to the sugar is

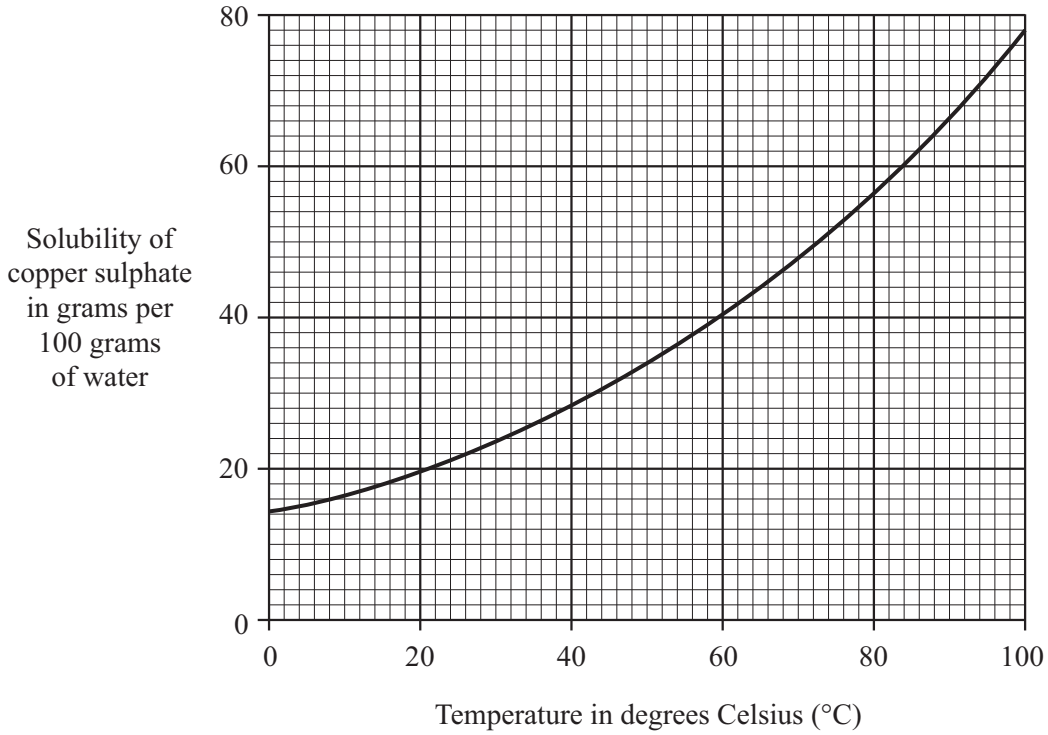
..... .

(1 mark)

5

Turn over ▶

15 The graph shows the mass of copper sulphate which dissolves in 100 g of water at different temperatures.



(a) A saturated solution of copper sulphate was made using 100 g of water at 60 °C.

Use the graph to answer the following questions.

(i) What mass of copper sulphate dissolves at 60 °C?

Mass = ... g

(1 mark)

(ii) What mass of copper sulphate would come out of this solution if the temperature goes down from 60 °C to 30 °C?

.....

.....

Mass = ... g

(2 marks)

(b) Suggest why it is **not** possible to measure the solubility of substances in water at temperatures above 100 °C or below 0 °C.

.....

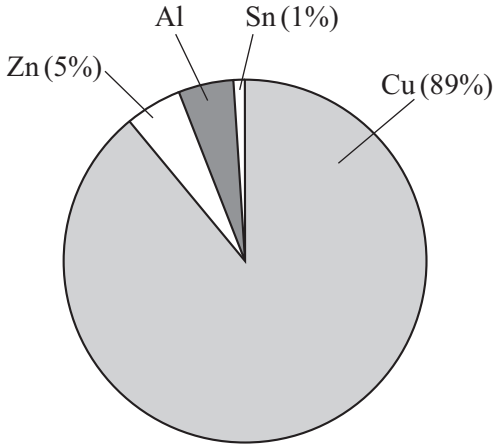
.....

(1 mark)

4

16 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.

.....

.....

.....

(2 marks)

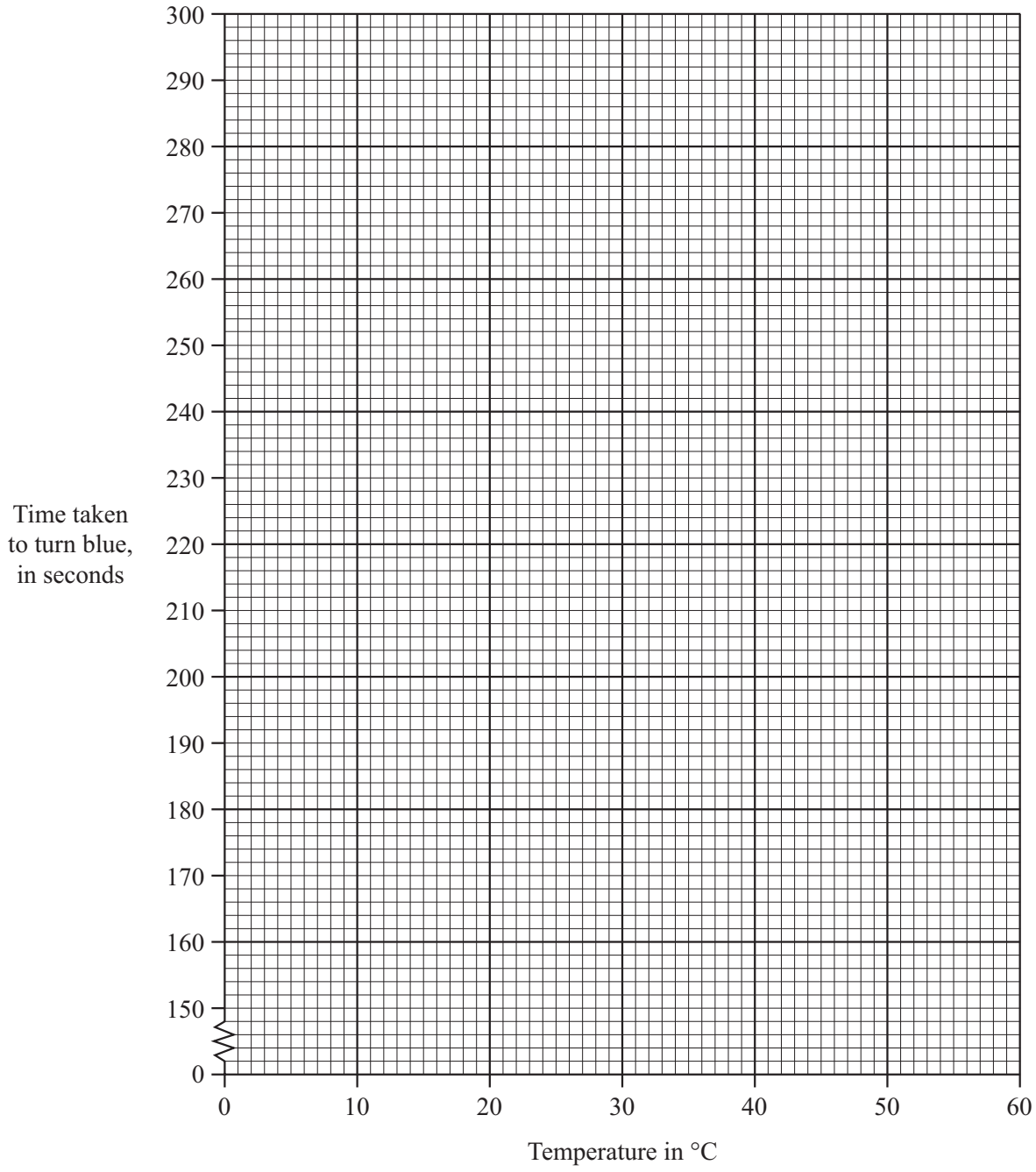
6

17 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.

.....

.....

.....

.....

.....

.....

(3 marks)

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

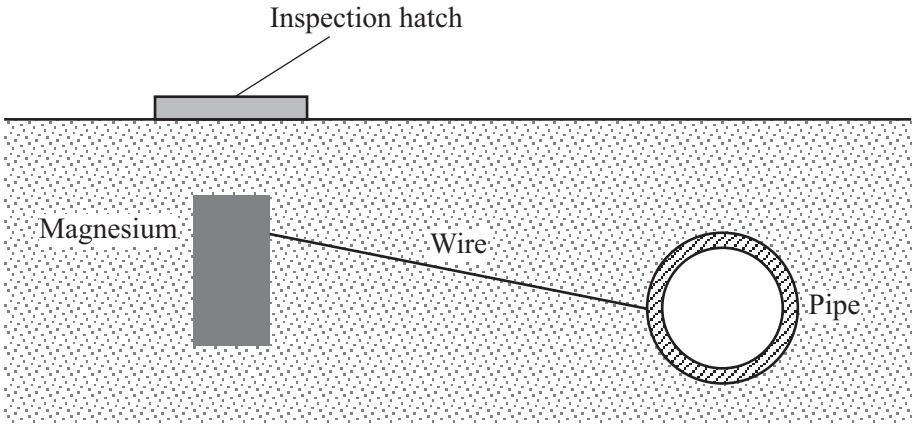
.....

(1 mark)

9

TURN OVER FOR THE NEXT QUESTION

18 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.

.....

.....

.....

.....

(2 marks)

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

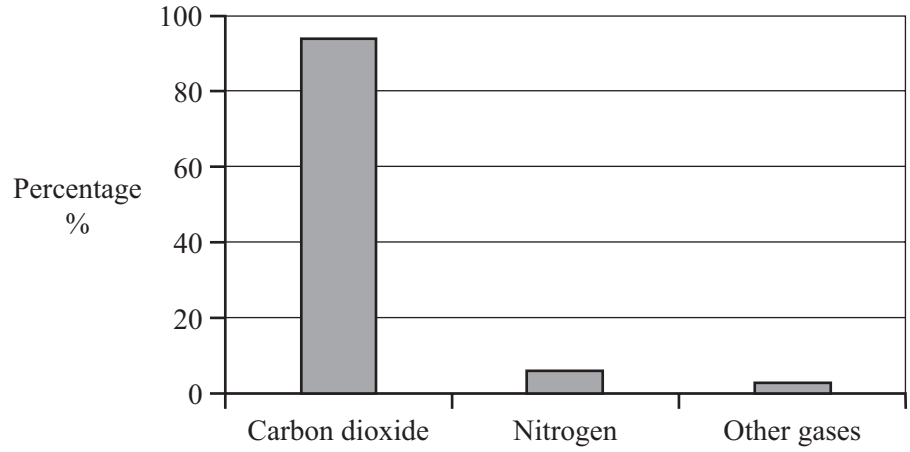
.....

.....

(1 mark)

3

19 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.

.....

.....

.....

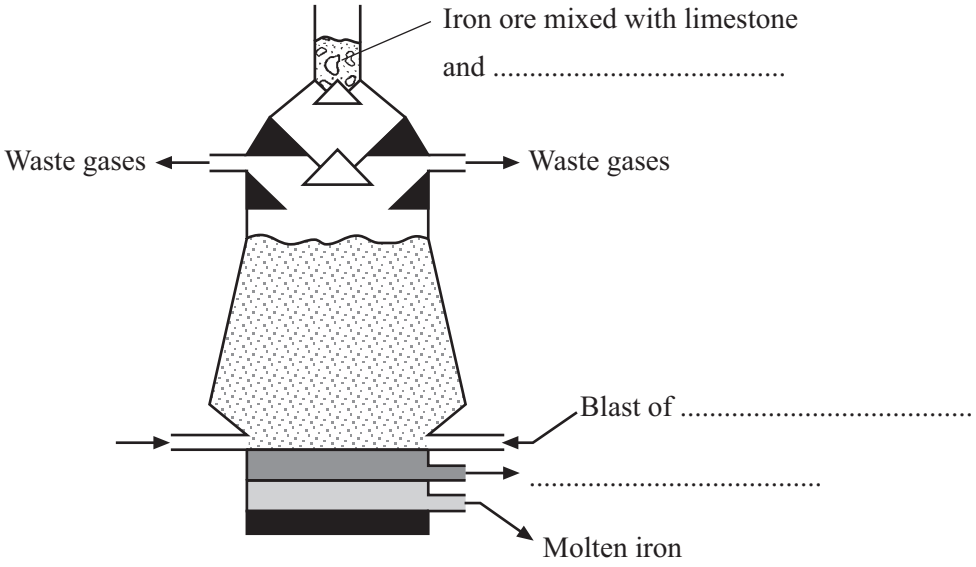
.....

(2 marks)

5

20 (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

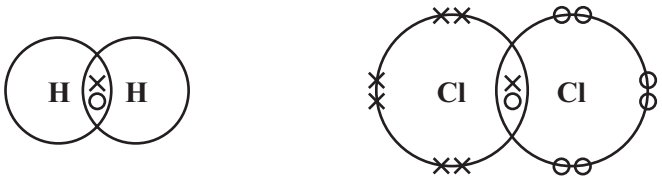
(1 mark)

10

TURN OVER FOR THE NEXT QUESTION

21 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

22 Many soft drinks contain citric acid.

(a) Citric acid is a *weak acid*.

(i) What is meant by a *weak acid* in terms of its ionisation in water?

.....

.....

(1 mark)

(ii) Describe and give the results of an experiment which would show that citric acid is a weaker acid than hydrochloric acid of the same concentration.

.....

.....

.....

.....

(2 marks)

(b) Citric acid behaves as an acid. Explain why, using the ideas of Arrhenius **and** of Bronsted-Lowry.

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.

.....

.....

.....

.....

.....

.....

(3 marks)

6

23 This information has been taken from two bottles of Australian spring water.

Ridgway Spring Water comes from a natural source deep under the Central Highlands of Victoria.

TYPICAL ANALYSIS
(mg per litre)

hydrogencarbonate	158
chloride	33
sodium	33
calcium	30
magnesium	23
potassium	9

Homeland Spring Water originates from a high mountainous source in the Central Highlands of Victoria.

TYPICAL ANALYSIS
(mg per litre)

hydrogencarbonate	158
chloride	27
sodium	24
magnesium	15
calcium	12
potassium	5

(a) The labels show the names of the ions present in Ridgway and Homeland spring waters.

Describe how these ions got into the water.

.....

.....

.....

.....

(2 marks)

(b) Both Ridgway and Homeland spring waters are hard.

(i) There are two ions shown on the labels which make these spring waters hard.

Name **one** of these ions.

.....

(1 mark)

(ii) Ridgway spring water is about **twice** as hard as Homeland spring water.

Use the information on the labels to explain why.

.....

.....

.....

.....

(2 marks)

(iii) Describe how you could use soap solution to show that Ridgway spring water is about **twice** as hard as Homeland spring water. You should state how the experiment is made fair.

.....

.....

.....

.....

.....

.....

(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

24 The following passage is about aluminium.

> Aluminium resists corrosion because it reacts with the air to form a thin layer of aluminium oxide.
>
> The thickness of this layer can be increased artificially.
>
> This involves removing the oxide layer using solution **X**.
>
> The aluminium is then made the positive electrode in the electrolysis of solution **Y**.
>
> Oxygen forms on the surface of the aluminium and reacts with the metal to form a thicker oxide layer.

(a) Use information from the Data Sheet to suggest why aluminium should **not** resist corrosion.

.....

.....

(1 mark)

(b) Name solution **X**.

.....

(1 mark)

(c) Name solution **Y**.

.....

(1 mark)

(d) Balance the symbol equation which represents the reaction taking place on the surface of the aluminium.

..... Al + ... O_2 → ..... Al_2O_3

(1 mark)

4

END OF QUESTIONS