

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
June 2005



CHEMISTRY (MODULAR) SPECIFICATION A 3423/F
Written Paper
Foundation Tier

F

Thursday 16 June 2005 9.00 am to 10.30 am

In addition to this paper you will require:

- the Data Sheet (enclosed);
- a ruler.

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10			
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

Instructions

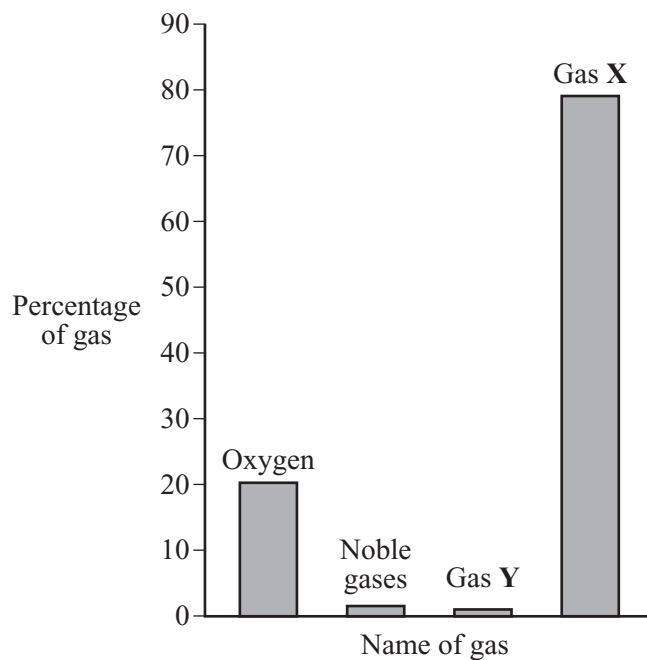
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show all your working in calculations.

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.

PATTERNS OF CHEMICAL CHANGE

- 1 (a) Air is a mixture of gases.
The chart below shows the percentages of gases in dry air.



- (i) Name gas **X**.

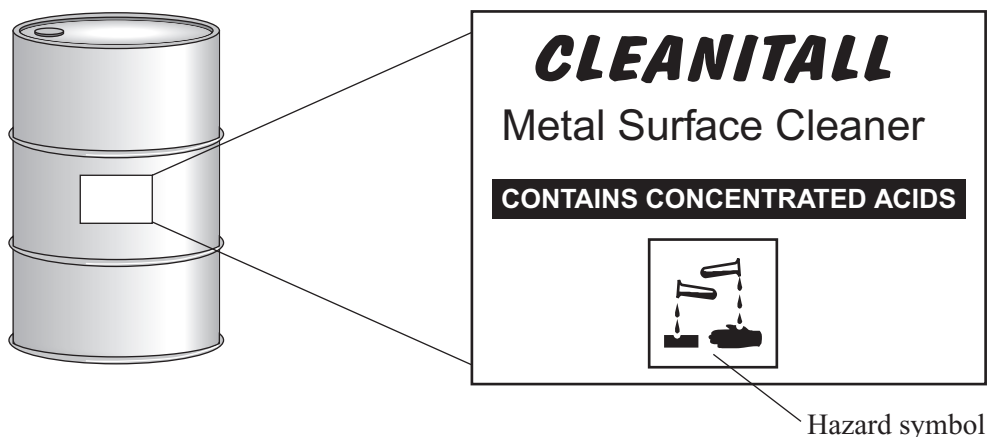
.....
(1 mark)

- (ii) When gas **Y** is bubbled through limewater solution, the solution goes milky.

Name gas **Y**.

.....
(1 mark)

- (b) The label on a drum of concentrated acid is shown below.



- (i) What does the hazard symbol on the label mean?
Draw a ring around the correct answer.

corrosive **harmful** **highly flammable** **toxic**

(1 mark)

- (ii) The acid can be used to clean the surface of metals.
When the acid is added to the metal surface, an *exothermic reaction* often takes place.

What happens to the temperature during an *exothermic reaction*?

.....
.....

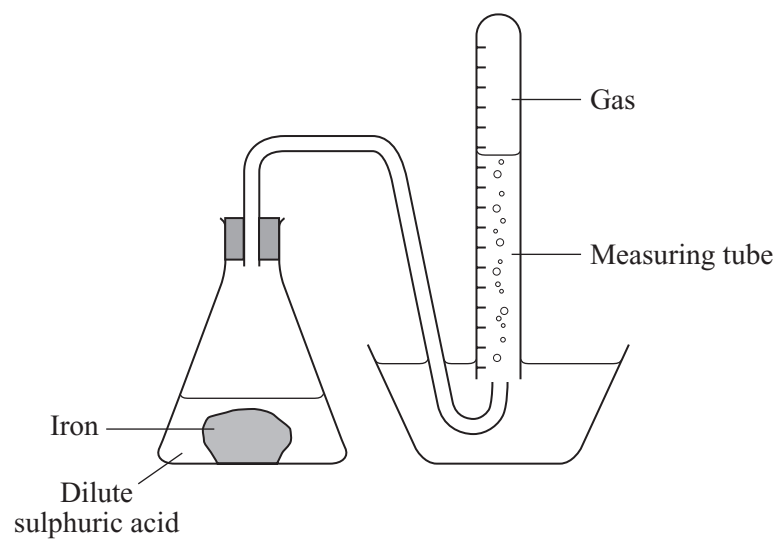
(1 mark)

4

TURN OVER FOR THE NEXT QUESTION

Turn over ►

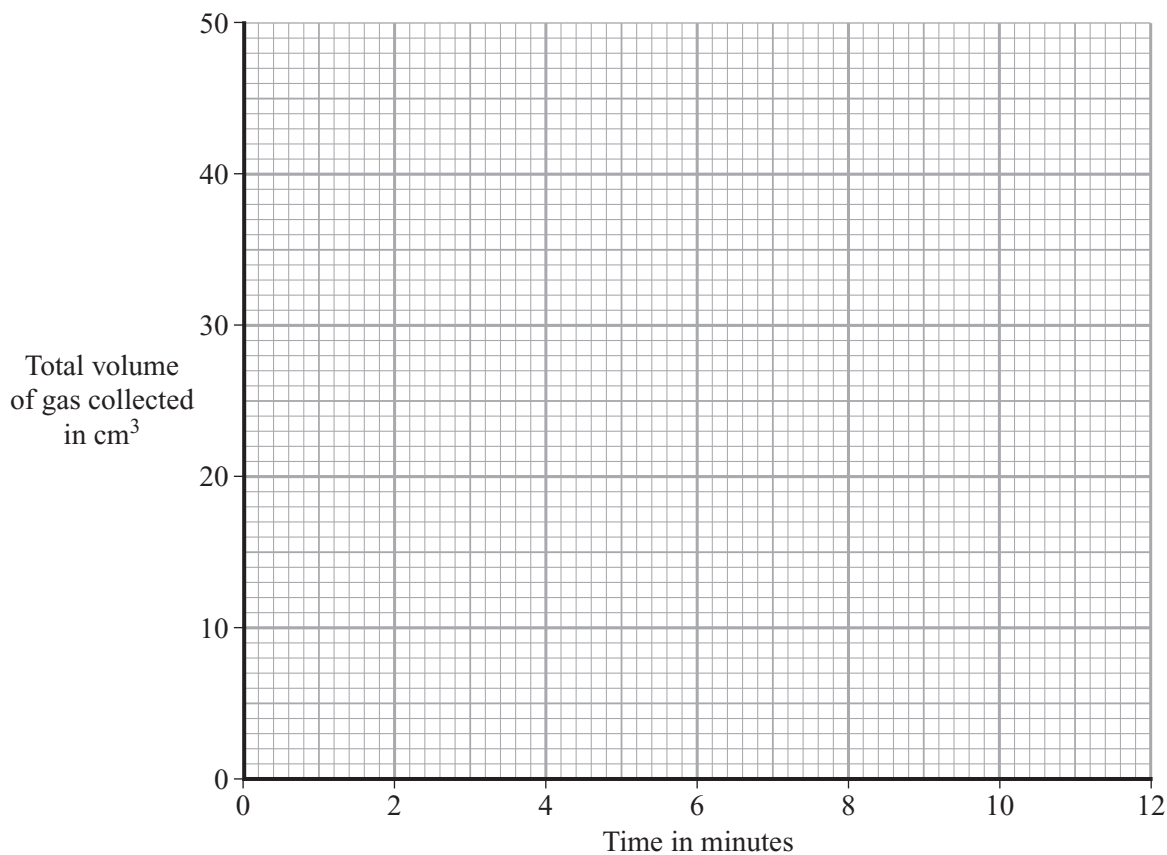
- 2 Iron reacts with dilute sulphuric acid to make a gas.
This apparatus can be used for the reaction.



In an experiment, a large lump of iron was added to 50 cm³ of dilute sulphuric acid.
A student measured the total volume of gas produced at 2 minute intervals.
Here are the student's results.

Time in minutes	0	2	4	6	8	10	12
Total volume of gas collected in cm ³	0	18	30	38	42	45	46

- (a) Plot the student's results on the graph paper. Use the points to draw a smooth line graph.



(3 marks)

- (b) The student repeated the experiment three times and each time a change was made.

Complete the table to show whether there would be an **increase**, a **decrease** or **no change** in the rate of reaction.

Change made	How the rate of reaction would change
The concentration of the sulphuric acid was increased.	
The temperature of the dilute sulphuric acid was decreased.	
A catalyst was added.	

(3 marks)

- (c) Besides the changes in part (b), what could the student do to the lump of iron to make it react faster with the dilute sulphuric acid?

.....

(1 mark)

Turn over ►

STRUCTURES AND BONDING

- 3 An atom has a small central part called the nucleus.
Atoms contain protons, neutrons and electrons.

- (a) Complete the table to show where the protons, neutrons and electrons are found in an atom.
Tick (✓) the correct boxes.

Particles	In the nucleus	Outside the nucleus
Protons		
Neutrons		
Electrons		

(3 marks)

- (b) Atoms have no overall electrical charge – they are electrically neutral.

Why do atoms have no overall electrical charge?

.....

.....

(1 mark)

- (c) An atom of lithium can be shown as ${}^7_3\text{Li}$.

How many protons, neutrons and electrons are present in one atom of ${}^7_3\text{Li}$?

Number of protons	
Number of neutrons	
Number of electrons	

(3 marks)

(7)

4 You may find the periodic table on the Data Sheet useful when answering this question.

Lithium, sodium and potassium are all in Group 1 of the periodic table.

(a) The boxes below show the three metals and how they react with water.

Match each metal to the correct description by drawing lines between the boxes.

Lithium

The metal fizzes, floats and moves across the water surface. It does not melt.

Sodium

A very vigorous reaction takes place. The metal melts and moves quickly across the water surface. A pale purple (lilac) coloured flame appears.

Potassium

A vigorous reaction takes place. The metal melts and moves quickly across the water surface. A bright yellow flame might be produced.

(2 marks)

(b) Each metal reacts with water to form a gas which burns with a “pop”.

Name this gas.

.....
(1 mark)

(c) Each metal reacts with water to produce a solution. These solutions all give the same colour with red litmus.

(i) What is this colour?

.....
(1 mark)

(ii) What type of substance makes the red litmus change in this way?

.....
(1 mark)

5

Turn over ►

5 Complete each sentence by choosing the correct word from the box.

alkalis	bottom	halogens	ions
molecules	three	top	two

- (a) The elements in Group 7 are called
- (b) Each molecule of a Group 7 element contains atoms.
- (c) When atoms of Group 7 elements react with metals, they form particles called, which have a charge of -1 .
- (d) The most reactive element in Group 7 is found at the of the Group.

(4 marks)

4

CHEMISTRY IN ACTION

6 Sulphuric acid, H_2SO_4 , is made by the Contact Process. There are four stages in the process. The first three stages are shown below but they are **not** in the correct order.

(a) Arrange them in the correct order by putting a 1, 2 or 3 in the boxes.

Process taking place	Stage Number
Dissolve sulphur trioxide, SO_3 , in concentrated sulphuric acid to make oleum, $\text{H}_2\text{S}_2\text{O}_7$.	
Burn sulphur in air to make sulphur dioxide, SO_2 .	
Mix sulphur dioxide, SO_2 , with more air and pass the mixture over hot vanadium oxide, V_2O_5 .	

(2 marks)

(b) Describe the final stage of the Contact Process.

.....

.....

.....

(2 marks)

4

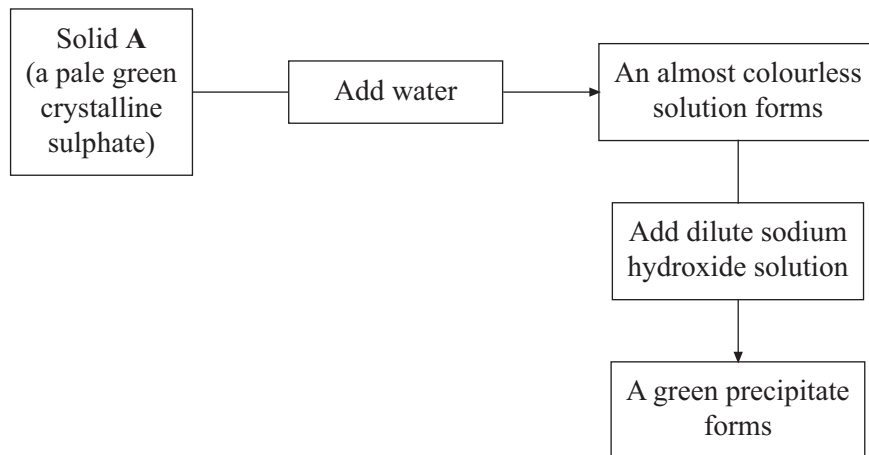
TURN OVER FOR THE NEXT QUESTION

Turn over ►

7 This question is about the changes that take place when substances are mixed together.

(a) Use the information to identify the solids **A**, **B** and **C**.

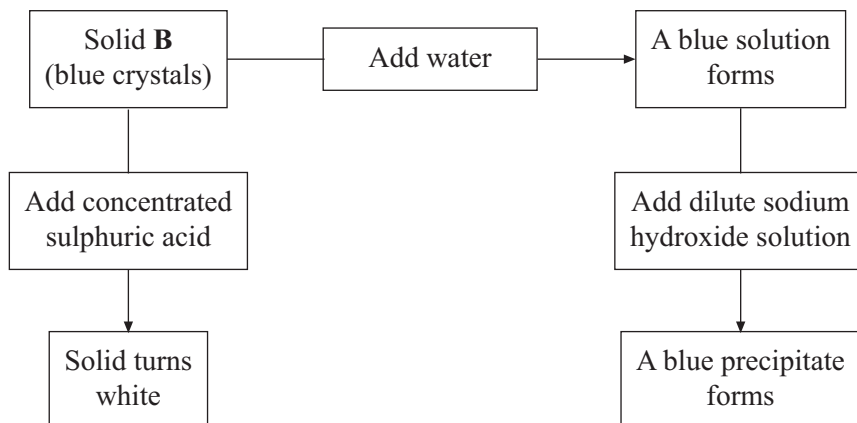
(i)



Solid **A** is sulphate

(1 mark)

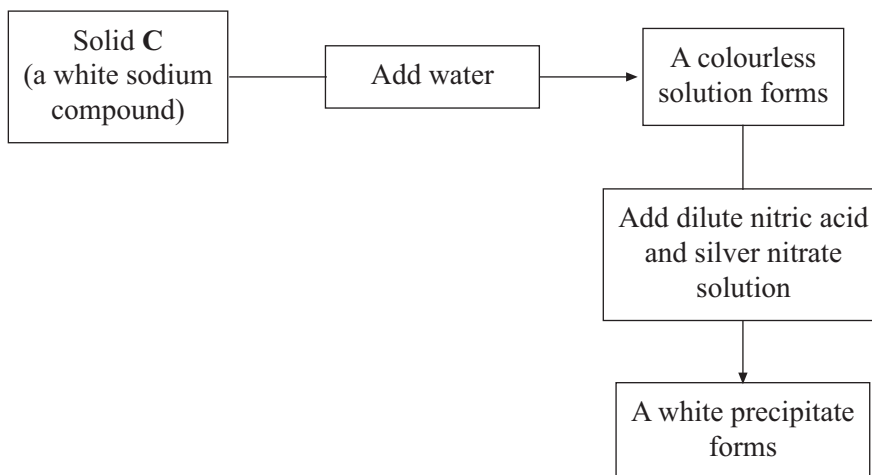
(ii)



Solid **B** is

(2 marks)

(iii)



Solid C is sodium

(1 mark)

(b) Describe a simple test to prove that a solution contains sulphate ions, SO_4^{2-} .
Give the result of the test if sulphate ions are in solution.

Test

.....

Result.....

.....

(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

- 8 (a) Crude oil is a mixture of hydrocarbons. It is split into fractions by a process called *fractional distillation*.

Describe the **two** main steps that occur in *fractional distillation*.

.....

.....

.....

.....

(2 marks)

- (b) Many of the fractions produced are used as fuels. Some of these fuels contain sulphur as an impurity.

- (i) Name the acidic gas formed when the sulphur impurity in a fuel burns.

.....

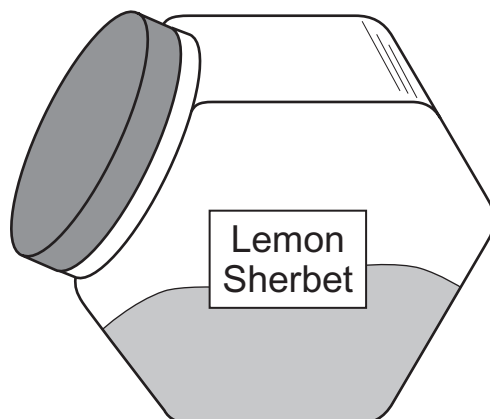
(1 mark)

- (ii) A pure hydrocarbon fuel is burned completely in a good supply of oxygen.

Complete the word equation to show the two substances formed.

hydrocarbon fuel + oxygen → +
(2 marks)

- 9 Lemon sherbet crystals are a mixture of substances.
These include sodium hydrogencarbonate, tartaric acid, sugar and lemon flavouring.



When water is added to sherbet crystals, they fizz. This is because the sodium hydrogencarbonate and tartaric acid react together to make carbon dioxide gas.

- (a) Why do the sodium hydrogencarbonate and tartaric acid start to react only when water is added?

.....
.....

(1 mark)

- (b) Tartaric acid is a *weak* acid.

Suggest a pH value for a dilute solution of tartaric acid.
Draw a ring around the correct answer.

1 4 7 9 11 14

(1 mark)

- (c) Tartaric acid reacts with the alkali sodium hydroxide to form a salt and water only.

What name is given to this type of reaction?

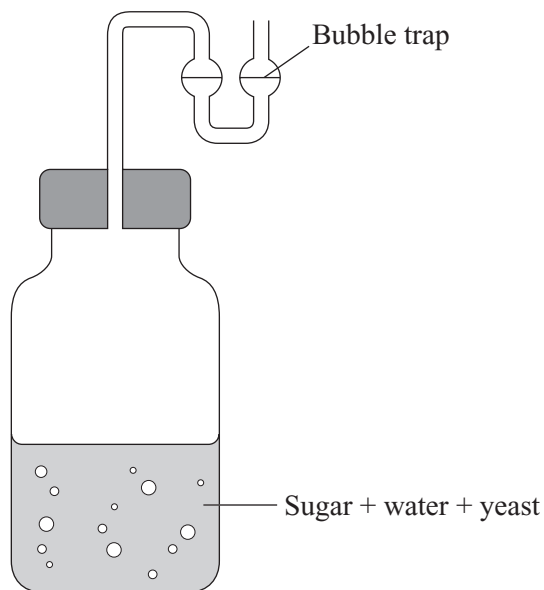
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(1 mark)

3

Turn over ►

10 Ethanol can be made from sugars using the apparatus shown below.



The bubble trap allows the gases to escape from the jar but stops air getting in.

(a) Name the process by which sugars are changed into ethanol.

.....
(1 mark)

(b) Name the gas, made during the reaction, that escapes through the bubble trap.

.....
(1 mark)

(c) Why is yeast used in this process?

.....
.....
.....
(2 marks)

(d) State **one** use for ethanol.

.....
(1 mark)

PATTERNS OF CHEMICAL CHANGE

11 The enzyme isomerase is used in industry to convert glucose syrup into fructose syrup.

- (a) State **one** advantage of using enzymes in industrial processes.

.....
.....
(1 mark)

- (b) Fructose syrup is sweeter than glucose syrup and is used to sweeten fruit drinks.

Suggest **one** other reason for using fructose syrup instead of glucose syrup.

.....
.....
(1 mark)

- (c) Glucose can also be changed into ethanoic acid, CH_3COOH .

- (i) How many different elements are present in ethanoic acid?

.....
(1 mark)

- (ii) Calculate the relative formula mass of ethanoic acid.

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

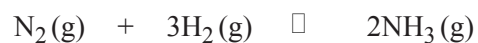
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(2 marks)

5

Turn over ►

12 Ammonia is manufactured from nitrogen and hydrogen.

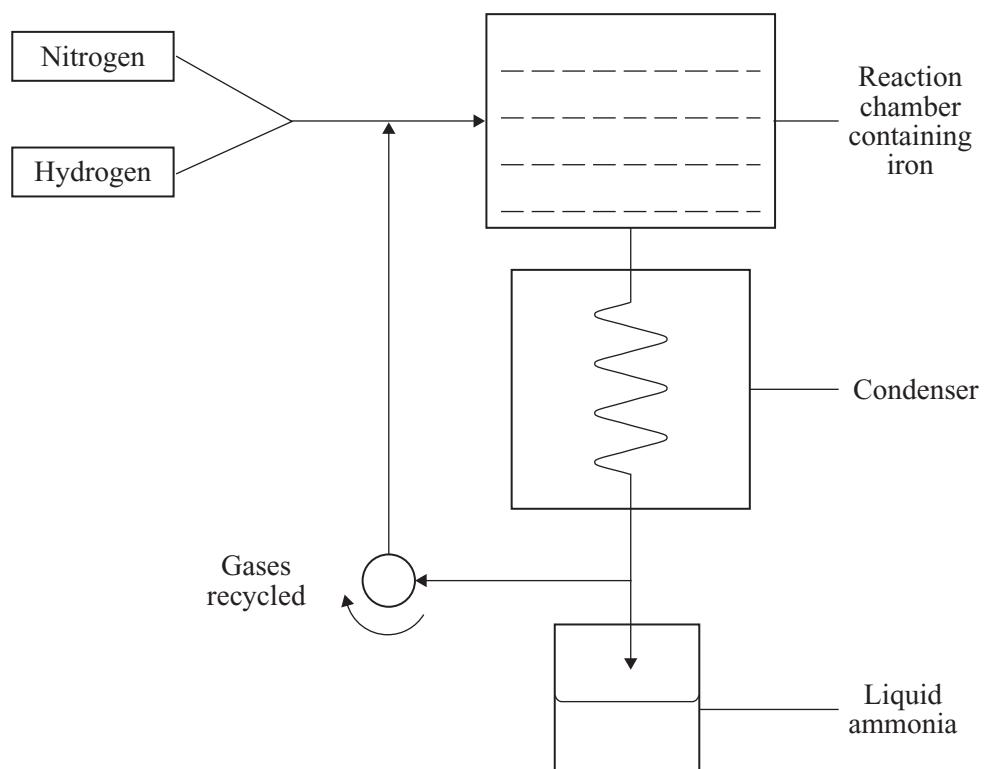
The equation for the reaction is:



(a) Name the industrial process by which ammonia is manufactured.

.....
(1 mark)

(b) Here is a flow diagram of the industrial process for making ammonia.



Use the diagram to help you to explain the main stages in the manufacture of ammonia.

Your answer should include:

- details of the reaction conditions inside the reaction chamber;
- why iron is present in the reaction chamber;
- why it is necessary to recycle some of the gases.

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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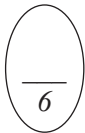
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(5 marks)

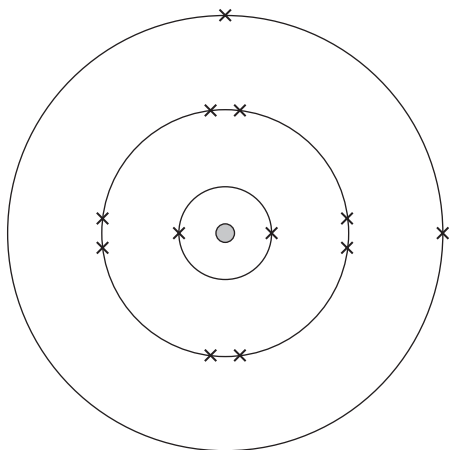


TURN OVER FOR THE NEXT QUESTION

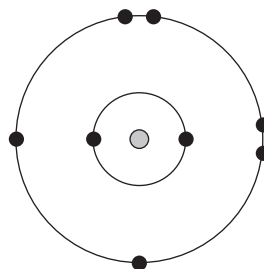
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STRUCTURES AND BONDING

- 13 Magnesium and oxygen react to make the compound magnesium oxide.
The electronic structures of magnesium and oxygen atoms are shown below.



A magnesium atom



An oxygen atom

- (a) Explain what happens to magnesium and oxygen atoms when they make magnesium oxide.
(You may draw diagrams to help with your explanation.)

.....

.....

.....

.....

.....

.....

(2 marks)

- (b) Name the type of bond in magnesium oxide.

.....

(1 mark)

- (c) What forces hold the particles together in magnesium oxide?

.....

(1 mark)

- 14 During the 19th century, the Russian chemist, Dmitri Mendeleev, produced a periodic table of the elements.

	Group 1		Group 2		Group 3		Group 4		Group 5		Group 6		Group 7	
Period 1	H (1)													
Period 2	Li (7)		Be (9)		B (11)		C (12)		N (14)		O (16)		F (19)	
Period 3	Na (23)		Mg (24)		Al (27)		Si (28)		P (31)		S (32)		Cl (35.5)	
Period 4	K (39)	Cu (63)	Ca (40)	Zn (65)	?	?	Ti (48)	?	V (51)	As (75)	Cr (52)	Se (78)	Mn (55)	Br (80)
Period 5	Rb (85)	Ag (108)	Sr (87)	Cd (112)	Y (88)	In (113)	Zr (90)	Sn (118)	Nb (94)	Sb (122)	Mo (96)	Te (125)	?	I (127)

There were some gaps in Mendeleev's periodic table. These are shown as ? in the table. Mendeleev suggested that his periodic table allowed scientists to predict the properties of some elements.

Use the information above and the periodic table on the Data Sheet to help you answer these questions.

- (a) Why were there gaps in Mendeleev's periodic table?

.....

 (1 mark)

- (b) Which important Group of elements was missing from Mendeleev's periodic table?

.....
 (1 mark)

- (c) Mendeleev used "atomic weights" (now called relative atomic masses) to arrange the elements in his periodic table. "Atomic weights" are shown in brackets in the table above.

Use Mendeleev's "atomic weight" values to predict a value for the "atomic weight" of the element missing from Group 4 of his table.

.....

 (2 marks)

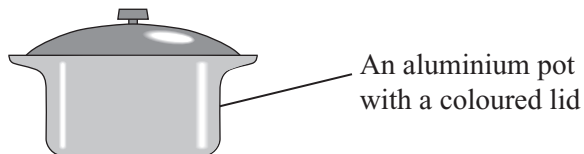
- (d) Use the periodic table on the Data Sheet to identify the missing element in Group 4.

.....
 (1 mark)

Turn over ►

CHEMISTRY IN ACTION

15 Aluminium can be treated so that its surface can be coloured with a dye.



(a) Name the substance on the surface of aluminium that protects it from corrosion.

..... (1 mark)

(b) When aluminium objects are to be coloured, the protective layer needs to be made thicker. The process used is summarised below.

Stage 1	The aluminium object is placed in sodium hydroxide solution.
Stage 2	The object is rinsed with water.
Stage 3	<p>The object is placed in the following apparatus for 30 minutes.</p>
Stage 4	The object is rinsed in water and placed in a container of dye for 10 minutes.
Stage 5	The object is put into boiling water for a few minutes to seal the dye in place.

- (i) Name this process for increasing the thickness of the protective surface layer on aluminium objects.

.....
(1 mark)

- (ii) What happens during **Stage 1**?

.....
.....
(1 mark)

- (iii) To which terminal of the battery should the aluminium object be attached?

.....
(1 mark)

- (iv) Which gas is produced around the aluminium object during **Stage 3**?

.....
(1 mark)

- 16** (a) Steel is an *alloy*.

What is meant by the term *alloy*?

.....
.....
(1 mark)

- (b) Steel contains up to 2 % carbon.

How does the amount of carbon present in a steel affect the hardness of the steel?

.....
.....
(1 mark)

- (c) Steel can be changed into stainless steel by adding small amounts of transition metals.

Name a transition metal that is added to steel to make stainless steel.

.....
(1 mark)

- (d) The elements present in steels can be identified using instrumental methods.

Name **one** instrumental method used to identify elements.

.....
(1 mark)

Turn over ►

5

4

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

17 Explain what is meant by *hard* water.

Your answer should include:

- how the water becomes *hard*;
- the name of one substance that causes the hardness;
- one method for removing hardness.

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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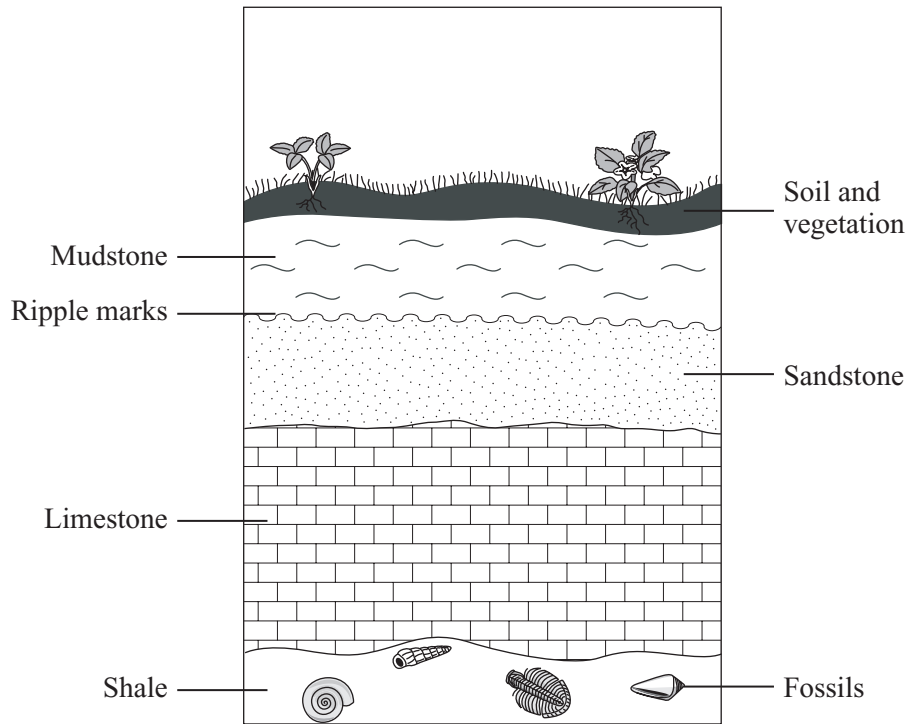
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(4 marks)

○
—
4

18 The diagram shows part of a rock face.



(a) Which is most likely to be the oldest rock in the diagram?

.....
(1 mark)

(b) There are ripple marks in the sandstone.

How have these ripple marks been formed?

.....
.....
(1 mark)

(c) All the rocks shown are of the same type.

Name the type of rock.

.....
(1 mark)

- 19 Iron railway lines may be joined together using molten iron. This is made by reacting aluminium powder and iron(III) oxide.

Use the information from the Data Sheet to help you to answer these questions.

- (a) Why can aluminium powder convert iron(III) oxide into iron?

.....
.....

(1 mark)

- (b) It is not possible to produce calcium metal by heating zinc powder and calcium oxide.

Explain why.

.....
.....
.....

(2 marks)

- (c) Transition metals are found in the centre of the periodic table.

Mark with a cross (×) the statement that is **not** true for transition metals.

They usually have high melting points.	
They react very vigorously with water.	
They are often used as catalysts in chemical reactions.	
Their compounds are often coloured.	

(1 mark)

END OF QUESTIONS

4