Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
June 2005

ASSESSMENT and QUALIFICATIONS ALLIANCE

SCIENCE: DOUBLE AWARD (CO-ORDINATED) 3462/2F
FOUNDATION TIER
PAPER 2

Thursday 16 June 2005 9.00 am to 10.30 am

F

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** 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.

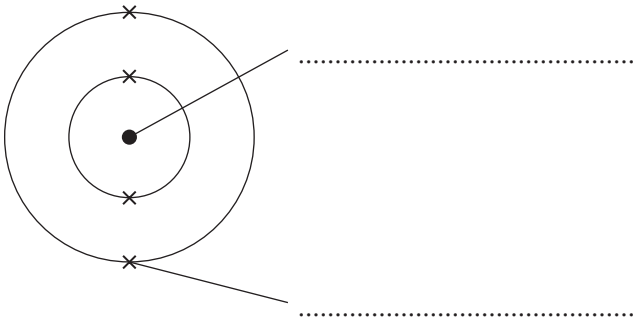
For Examiner's Use			
Number	Mark	Number	Mark
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 (a) The diagram represents an atom of beryllium.

Use words from the box to label the diagram.

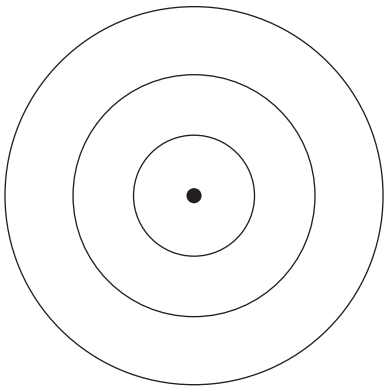
electron	**ion**	**isotope**	**molecule**	**nucleus**



(2 marks)

(b) Use crosses (×) to complete the diagram to show the electronic structure of a magnesium atom.

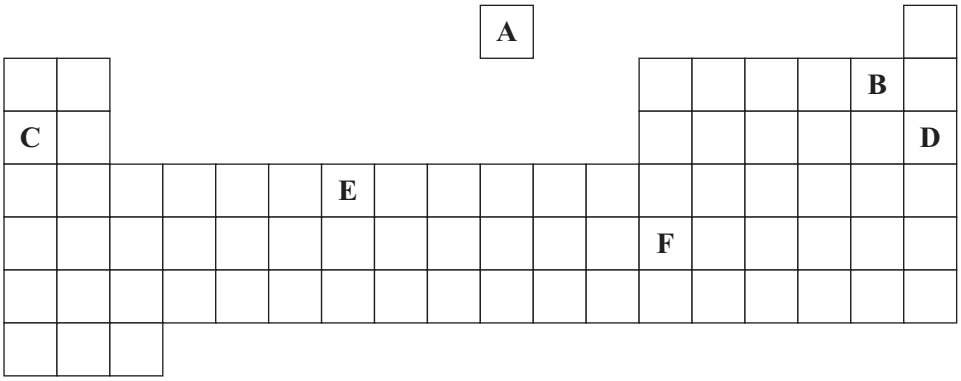
The atomic (proton) number of magnesium is 12.



(2 marks)

4

2 The diagram shows an outline of the periodic table.



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

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

Which element, **A** to **F**:

(a) is in Group 3; .....
(1 mark)

(b) is a metal which floats on water and reacts violently to make an alkaline solution and hydrogen gas;

.....
(1 mark)

(c) is a gas which burns with a squeaky pop? .....
(1 mark)

3

TURN OVER FOR THE NEXT QUESTION

3 Salts can be prepared by the reaction of acids with alkalis.

(a) (i) The reactions of acids with alkalis can be represented by the equation below.

Choose a substance from the box to complete the equation.

carbon dioxide	**hydrogen**	**oxygen**	**water**

acid + alkali → salt + ...

(1 mark)

(ii) Draw a ring around the word which best describes the reaction.

displacement **neutralisation** **oxidation** **reduction**

(1 mark)

(b) Sodium sulphate is an important salt.

The table gives a list of some substances.

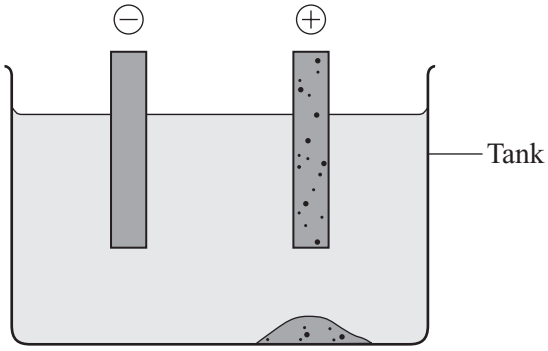
Put a tick (✓) next to the names of the acid **and** the alkali that would react to make sodium sulphate.

Substances	**(✓)**
Hydrochloric acid	
Nitric acid	
Potassium sulphate	
Sodium hydroxide	
Sodium nitrate	
Sulphuric acid	

(2 marks)

4

4 The diagram shows a method used to purify copper.



Choose words or phrases from the box to complete the sentences below.

bottom of the tank	**cracking**	**displacement**	**electrolysis**
negative electrode	**positive electrode**	**surface of the solution**	

This method of purifying copper is called ..... .

The impure copper is made the ..... and the pure copper collects at the ..... .

The impurities collect at the ..... .

(4 marks)

4

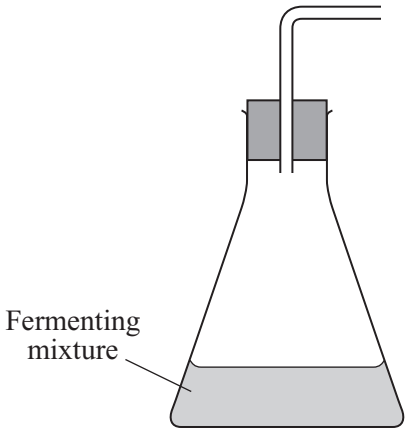
TURN OVER FOR THE NEXT QUESTION

5 Sugar can be fermented. The reaction can be represented by this equation.

sugar → alcohol + carbon dioxide

(a) A student set up this apparatus to show that fermentation produces carbon dioxide. The student wanted to use limewater to test the carbon dioxide.

(i) **Complete** the diagram to show how the carbon dioxide can be bubbled through limewater.



(2 marks)

(ii) What change would you see in the limewater when carbon dioxide is bubbled through it?

.....

(1 mark)

(b) This label was on a loaf of bread.

Farmhouse Bread

Ingredients
Flour
Water
Yeast
Salt
Sugar
Preservative
Ascorbic acid

The fermentation reaction is used when bread is made.

(i) State **two** ingredients in the bread which are essential for the fermentation reaction to occur.

..... and .....

(2 marks)

(ii) Explain why fermentation is used when bread is made.

.....

.....

.....

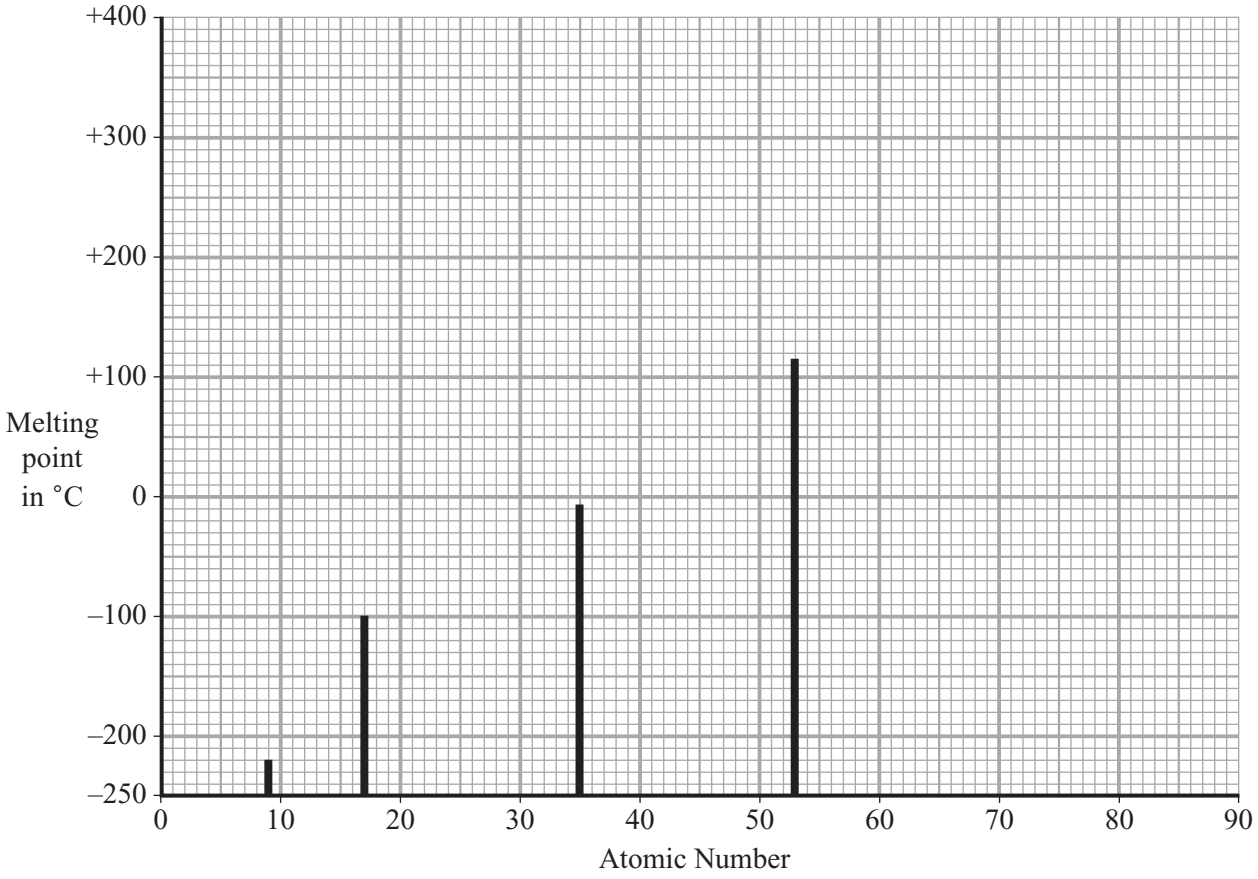
.....

(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

6 (a) The bar graph shows the melting points of the elements in Group 7 plotted against their atomic numbers.



(i) How do the melting points of the Group 7 elements change as the atomic number increases?

.....

.....

(1 mark)

(ii) The melting point of astatine (atomic number = 85) is not shown on the bar graph.

Estimate the melting point of astatine. ..... ºC

(1 mark)

Draw a bar for this value on the bar graph. *(1 mark)*

(b) The water from wells in Japan contains bromide ions.

Bromine is extracted from this water. The bromine is displaced by adding another Group 7 element.

(i) Place a tick (✓) next to the name of **one** Group 7 element that could be used to displace bromine from this water.

Most reactive ↑ Least reactive

Group 7	(✓)
Fluorine	
Chlorine	
Bromine	
Iodine	
Astatine	

(1 mark)

(ii) State why you have chosen this element.

.....

.....

(1 mark)

(iii) One sample of this water contained 2 g of bromine per litre of water.

How many litres of this water would be needed to make 1 kg of bromine?
(1 kg = 1000 g)

.....

..... litres

(1 mark)

6

7 A student investigated some instant soup.

(a) Instant soup contains a food additive which has the formula:

$$NaH_2PO_4$$

Give the names of all the elements in this compound.

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

.....

.....

(2 marks)

(b) The student investigated the reaction which takes place when soup powder is added to cold water.
The student thought that the reaction might be *exothermic*.

(i) What is meant by the term *exothermic* reaction?

.....

.....

(2 marks)

(ii) Describe an experiment that the student could do to prove that this reaction is exothermic.

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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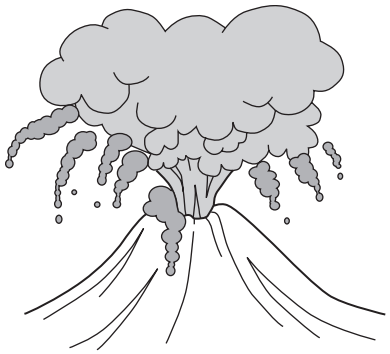
(4 marks)

8

8 (a) During the first billion years of the Earth's existence, there were many active volcanoes. The volcanoes released the gases that formed the early atmosphere.



(i) Describe how volcanoes caused the oceans to be formed.

.....

.....

.....

.....

(2 marks)

(ii) Most of the early atmosphere was carbon dioxide.

Give **one** way in which carbon dioxide is removed from the atmosphere.

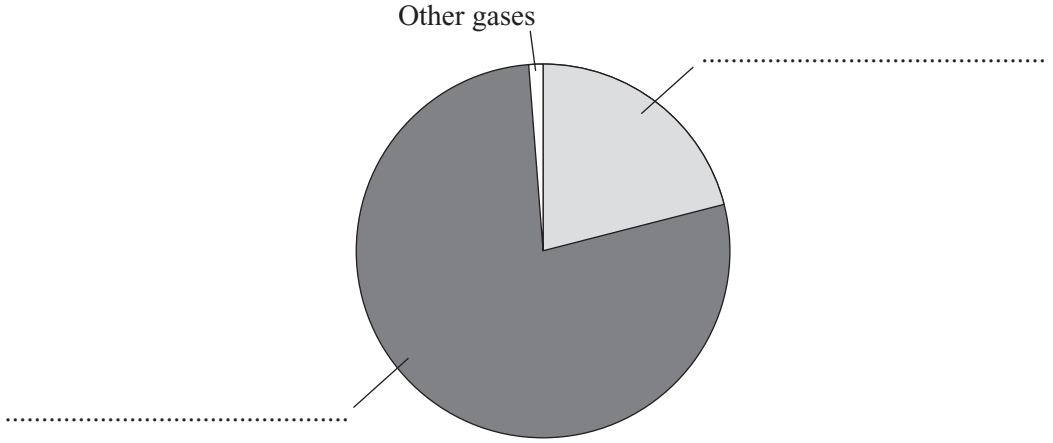
.....

(1 mark)

(b) The atmosphere on Earth today is very different from the early atmosphere.

The pie chart shows the amounts of different gases in the air today. Choose gases from the box to label the pie chart.

argon	**carbon dioxide**	**hydrogen**	**nitrogen**	**oxygen**

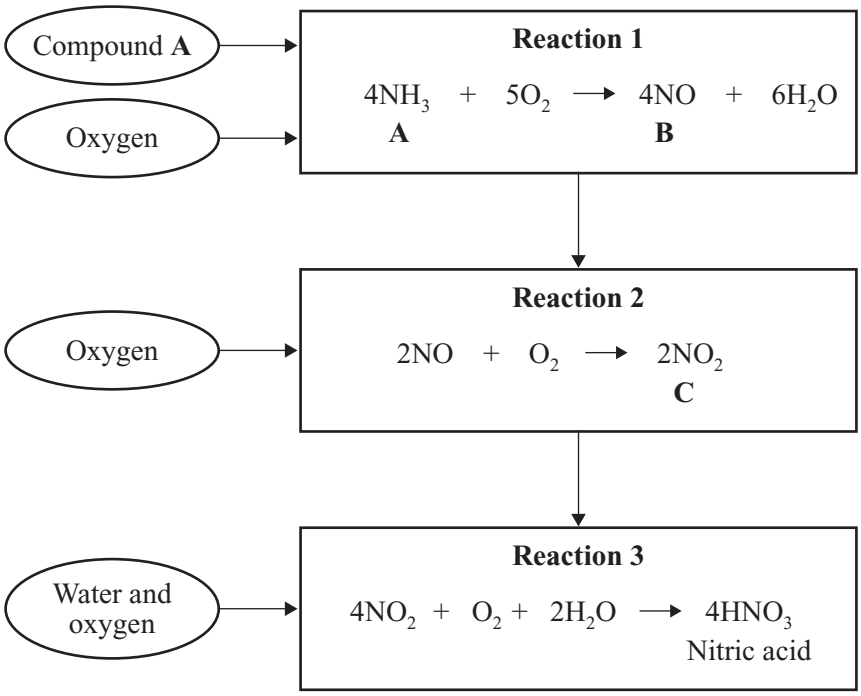


(2 marks)

Turn over ▶

5

9 (a) The flow diagram shows the stages in the production of nitric acid.



Give the names of the compounds labelled as **A**, **B** and **C** on the flow diagram.
Choose names from the box.

ammonia	**nitrogen**	**nitrogen dioxide**	**nitrogen monoxide**

A ..... **B** .....

C ..... *(3 marks)*

(b) Use the flow diagram to help you name **two** raw materials used to make nitric acid.

..... and .....

(2 marks)

(c) Reaction **1** uses a catalyst.

(i) How does a catalyst help this reaction?

.....

(1 mark)

(ii) Draw a ring around the name of the catalyst used in reaction **1**.

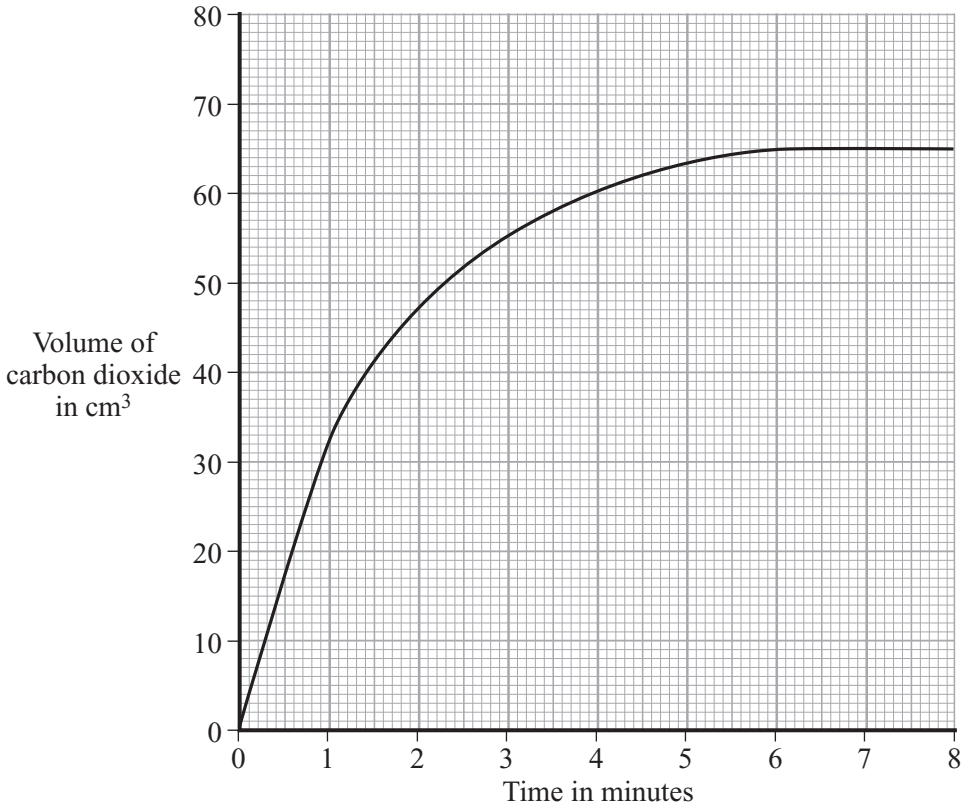
copper **iron** **platinum** **vanadium**

(1 mark)

10 A student studied the reaction between dilute hydrochloric acid and an **excess** of calcium carbonate.

calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

The student measured the volume of carbon dioxide produced in the experiment. The results are shown on the graph.



(a) After how many minutes had all the acid been used up? ..... minutes
(1 mark)

(b) The student wrote this conclusion for the experiment:

'The reaction gets slower and slower as the time increases.'

Explain why the reaction gets slower. Your answer should be in terms of particles.

.....

.....

.....

.....
(2 marks)

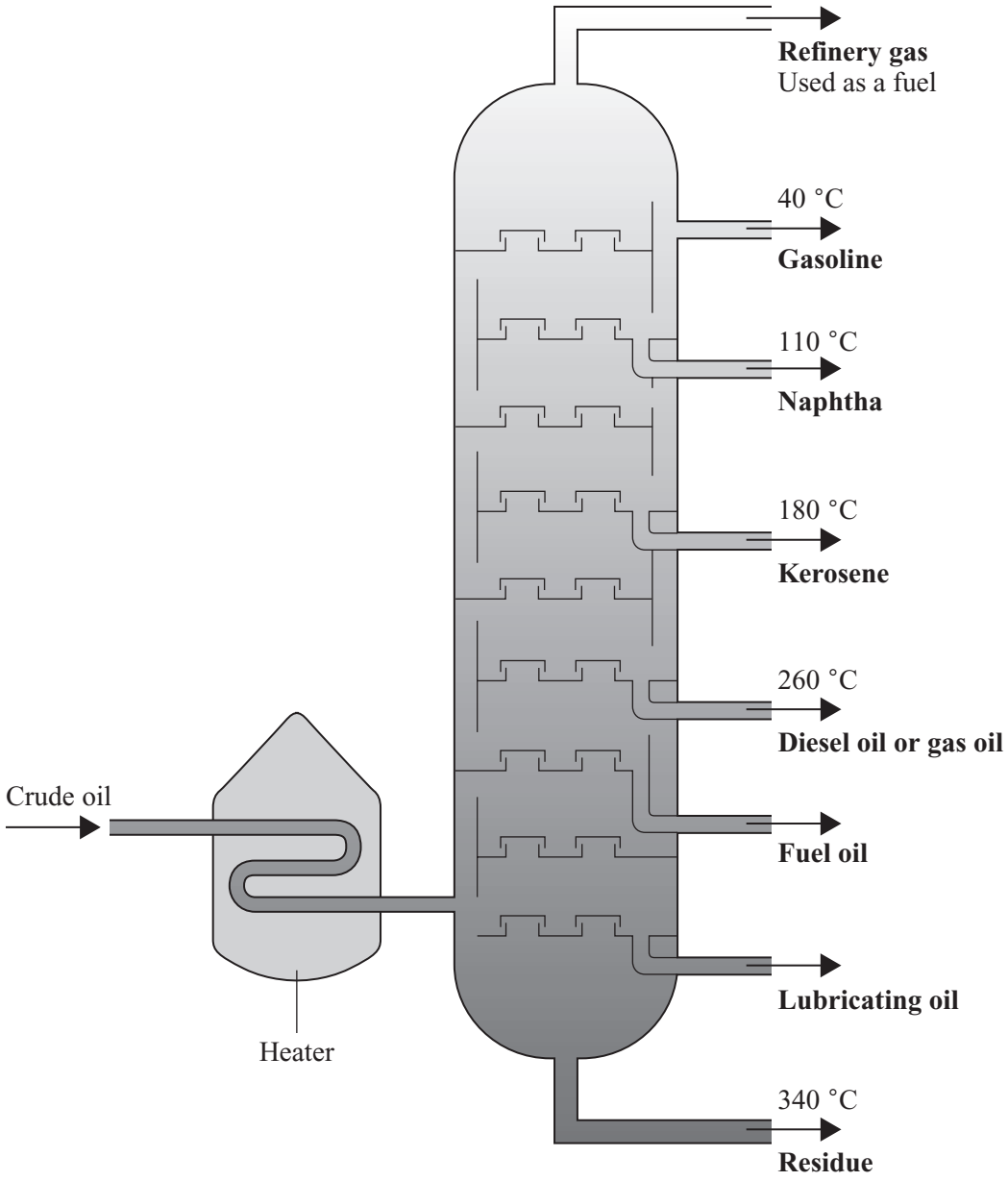
(c) A second experiment was carried out at a higher temperature. All other factors were the same.

Draw a line on the graph above to show the results that you would expect. *(2 marks)*

Turn over ▶

5

11 Crude oil is a mixture of many hydrocarbons. The diagram shows the method used to separate crude oil.



(a) Name this method of separating crude oil.

.....

(1 mark)

(b) Explain, as fully as you can, the way in which this method of separation works.

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.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

5

TURN OVER FOR THE NEXT QUESTION

12 The table gives information about some metals.

Name of the metal	Cost of one tonne of the metal in December 2003 (£)	Percentage of the metal in the crust of the earth (%)
Aluminium	883	8.2
Platinum	16720000	0.0000001
Iron	216	4.1
Gold	8236800	0.0000001

(a) Use information in the table to suggest why gold and platinum are very expensive metals.

.....

.....

(1 mark)

(b) Aluminium and iron are made by *reduction* of their ores.

(i) Name the element that is removed from the ores when they are *reduced*.

.....

(1 mark)

(ii) Use the reactivity series on the Data Sheet to suggest a metal that would reduce aluminium ore.

.....

(1 mark)

(c) Aluminium is made by the reduction of molten aluminium ore, using a very large amount of electricity.

(i) How is iron ore reduced in a blast furnace to make iron?

.....

.....

.....

.....

(2 marks)

(ii) Suggest why aluminium is more expensive than iron.

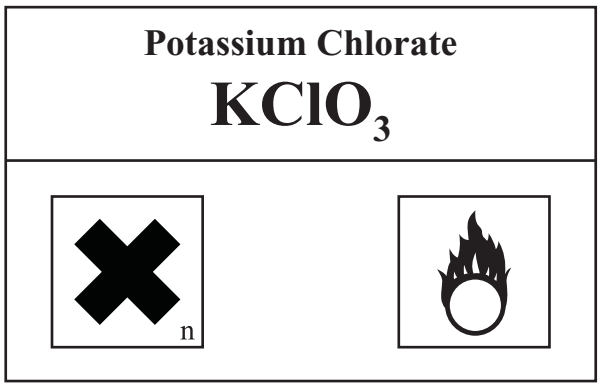
.....

.....

(1 mark)

6

13 This label was on a bottle of potassium chlorate.



(a) What does the hazard symbol on the bottom left of the label tell you about potassium chlorate?

.....

(1 mark)

(b) A mixture of chemicals is used to make the head of a match.

The mixture contains potassium chlorate and some substances that burn easily.

Suggest why potassium chlorate is used.

.....

.....

.....

(2 marks)

(c) (i) Calculate the relative formula mass (M_r) of potassium chlorate, $KClO_3$

(Relative atomic masses: O = 16 ; Cl = 35.5 ; K = 39)

.....

.....

Relative formula mass .....

(2 marks)

(ii) Calculate the percentage of **oxygen** in potassium chlorate.

.....

.....

Oxygen ..... %

(2 marks)

7

14 Mendeleev constructed a periodic table in 1869.

In his periodic table:

- most of the elements were put in order of increasing relative atomic mass;
- elements with similar properties were put into groups;
- Mendeleev changed the order of some elements to put them with similar elements;
- spaces were left for elements that Mendeleev thought would be discovered in the future.

One space was in Group 3 between the elements aluminium and indium.

Group 3
Boron
Aluminium
?
Indium
Thallium

Mendeleev called this undiscovered element 'eka-aluminium'. This element is now known as gallium.

In 1871, he also predicted some of the properties of gallium.

The table shows the properties of aluminium and indium, along with some of the predictions made by Mendeleev for gallium.

	Appearance	Metal or non-metal	Boiling point in ^{o}C	Density in g per cm^3	Relative atomic mass
Aluminium	silvery white	metal	2467	2.7	27
Predicted properties of gallium	silvery white	metal	?	?	68
Indium	silvery white	metal	2080	7.31	115

(a) Suggest values for:

(i) the boiling point of gallium;

..... ºC
(1 mark)

(ii) the density of gallium.

..... g per cm^3
(1 mark)

(b) (i) Suggest **two** reasons why other scientists in 1871 did not accept Mendeleev's periodic table.

Reason 1 .....

.....

Reason 2 .....

.....
(2 marks)

(ii) Suggest why the discovery of gallium in 1875 convinced other scientists that Mendeleev's table was correct.

.....

.....

.....
(1 mark)

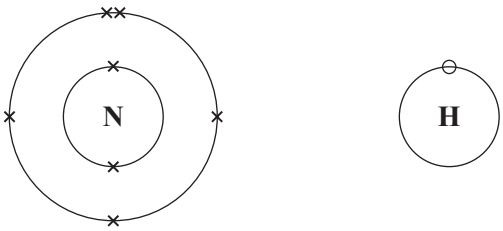
5

TURN OVER FOR THE NEXT QUESTION

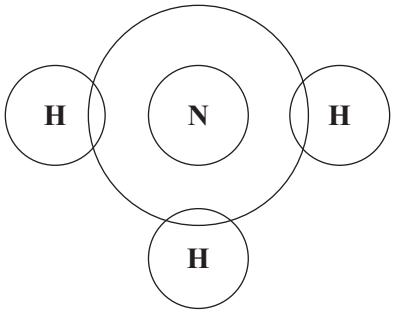
15 Ammonia (NH_3) is an important chemical which is used to make fertilisers.

Ammonia is made from nitrogen and hydrogen.

(a) The diagrams represent the electron arrangements in atoms of nitrogen and hydrogen.



Complete the diagram showing the arrangement of electrons in a molecule of ammonia.



(1 mark)

(b) Name the type of bonding which holds the nitrogen and hydrogen atoms together in an ammonia molecule.

.....

(1 mark)

(c) This word equation represents the reaction between nitrogen and hydrogen.

nitrogen + hydrogen □ ammonia

What does the sign □ mean?

.....

(1 mark)

(d) Read this article about coffee production in Costa Rica, a country in Central America. Answer the questions that follow.

> Coffee is one of the most valuable crops of Costa Rica. Coffee production accounts for nearly a fifth of the country's exports.
> The coffee plantations are found mainly in the Central Valley of Costa Rica. Large amounts of nitrate fertilisers are used throughout the year in the production of the coffee.
> Scientists have shown that coffee plants take up about 40 % of the nitrate fertiliser during the main growing season. Towards the end of the growing season the plants only take up about 6 % of the nitrate fertiliser.
> Underneath the Central Valley, there are natural underground reservoirs in the rock which hold large volumes of fresh water. These reservoirs supply water to more than one million people, about a quarter of the population.
> Scientists have found that nitrates have contaminated the underground water. They have also shown that a large amount of this nitrate contamination has come from fertilisers used in coffee production.

(i) Why do farmers use nitrate fertilisers?

.....

(1 mark)

(ii) How does the use of nitrate fertilisers help the people of Costa Rica?

.....

.....

(1 mark)

(iii) Suggest how the nitrates got into the underground water.

.....

.....

(1 mark)

(iv) Why are scientists concerned about pollution of the underground water?

.....

(1 mark)

(v) Suggest how the problem of nitrate pollution could be reduced in Costa Rica.

.....

.....

.....

(2 marks)

9

16 Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.

(a) State why transition metal oxides are added to pottery glazes.

.....

(1 mark)

(b) Use the table of ions on the Data Sheet to help you work out the formula of iron(III) oxide.

.....

(1 mark)

(c) Cobalt oxide is reacted with hydrogen to form cobalt.

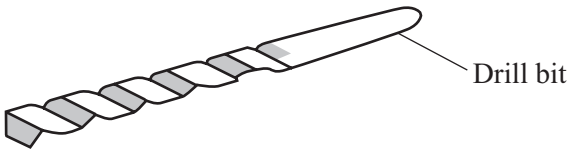
(i) Balance the equation for this reaction.

$$Co_3O_4 + \text{.....}\ H_2 \rightarrow 3\ Co + \text{.....}\ H_2O$$

(1 mark)

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.



Suggest **two** properties of transition metals that make them suitable for making cutting tools.

1 .....

.....

2 .....

.....

(2 marks)

END OF QUESTIONS

5

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