Rewarding Learning

71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Chemistry

Paper 2
Higher Tier

G1404

[G1404]

TUESDAY 7 JUNE, AFTERNOON

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 160.
Quality of written communication will be assessed in question **6(c)(ii)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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1 Two of the most important compounds of nitrogen are ammonia and nitric acid.

(a) Complete the table below giving the physical properties of ammonia.

Name	Ammonia
State at room temperature and pressure	
Colour	
Odour	
pH of aqueous ammonia	

[4]

(b) The presence of ammonia can be detected chemically by reacting it with hydrogen chloride gas. The hydrogen chloride gas is released from concentrated hydrochloric acid.

The information given below describes how the test is carried out.

1. Wear safety glasses.

2. Dip a glass rod into concentrated hydrochloric acid.

3. Apply the glass rod to ammonia.

(i) What observations would you make for a positive test?

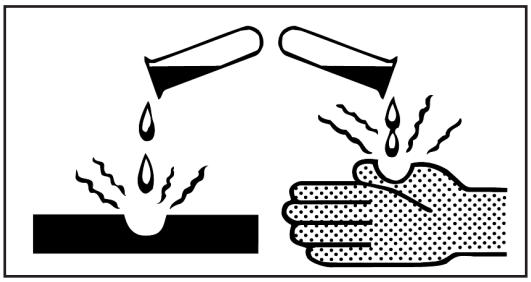
_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(ii) The hazard symbol below is found on the bottle of concentrated hydrochloric acid.



Name this hazard symbol.

_____ [1]

(iii) Apart from wearing safety glasses, state one safety precaution you should take when carrying out this test.

_____ [1]

(c) Ammonia reacts with dilute nitric acid forming ammonium nitrate which is used as a fertiliser. Excessive use of ammonium nitrate can lead to an increased growth of algae in lakes and rivers.

Due to copyright an image of a lake has been removed which is not essential to answer this question.

(i) Write a balanced symbol equation for the reaction of ammonia with nitric acid.

_____ [2]

(ii) What name is given to the process of increased growth of algae in rivers and lakes?

_____ [1]

(iii) Explain how the increased growth of algae can lead to the death of fish in these lakes and rivers.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

(d) In November 2004 the Churchill House office block in Belfast was demolished to make way for the new Victoria Square building. 90 kg of explosive were used. The explosive used was manufactured using nitric acid.

© Paul Faith/PA Archive/Press Association Images

Explain in detail the industrial manufacture of nitric acid.
Your answer should include:

- names of reactants for all reactions
- conditions required
- balanced symbol equations for all reactions

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Marks	Remark

_____

_____

_____

_____ [15]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 In the United States of America, magnesium chloride is used as a de-icer on roads and pavements. It is much less toxic to plant life and less corrosive to concrete and steel than other de-icers.

© Snowplowing-Contactors.com 12 April 2007

(a) Name one other compound which can be used as a road de-icer.

_____ [1]

(b) Magnesium chloride can be prepared by the reaction of magnesium metal with hydrochloric acid.

To determine the effect of temperature on the rate of reaction between magnesium and hydrochloric acid, two experiments were set up, and the time taken for the reaction to be completed was recorded. The table shows the results.

Temperature (°C)	**Concentration of acid (mol/dm^3)**	**Volume of acid (cm^3)**	**Mass of magnesium (g)**	**Form of magnesium**	**Time (s)**	**Rate (s^{-1}) $\left(\frac{1}{\text{time}}\right)$**
20	1.0	20	0.1	ribbon	100	0.01
30	1.0	20	0.1	ribbon	50	

(i) Calculate the rate of reaction at 30 °C and enter the value into the table.

[1]

(ii) State and explain fully, **in terms of particles**, the effect of a change in temperature on the rate of the reaction between magnesium and hydrochloric acid.

Effect of temperature: _____

_____

Explanation: _____

_____

_____

_____

_____ [4]

(iii) Explain why this set of experiments can be considered to be a fair test.

_____

_____ [1]

(iv) How could this experiment be changed to determine the effect of the surface area of magnesium on the rate of the reaction between magnesium and hydrochloric acid?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(c) To determine the effect of the concentration of hydrochloric acid on the rate of the reaction, the experiment detailed below was carried out.

A 3 cm piece of magnesium ribbon was placed in 50 cm^3 of hydrochloric acid of concentration 0.5 mol/dm^3 in a conical flask and the time taken for the reaction to be completed was recorded.

The experiment was repeated using 50 cm^3 portions of different concentrations of hydrochloric acid and the results recorded in the table below. There was an excess of acid in all the experiments.

Concentration of hydrochloric acid (mol/dm^3)	0.5	0.6	0.8	1.0	1.4	2.0
Time (s)	225	150	75	50	30	20

(i) Draw a labelled diagram of the assembled apparatus used to carry out this experiment.

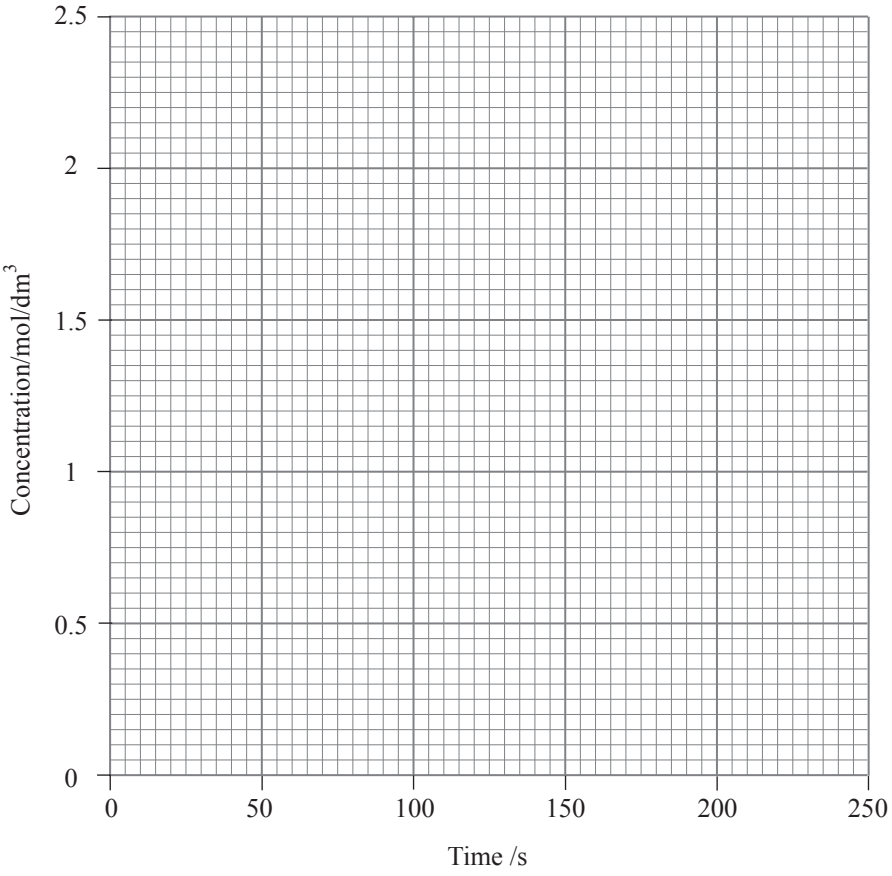
[3]

(ii) How could you tell when the reaction is complete?

_____

_____ [1]

(iii) Use the results in the table to plot a graph of concentration against time. [3]



(iv) How long did it take for the reaction to complete when 50 cm^3 of 1.5 mol/dm^3 of hydrochloric acid was used?

_____ [1]

(v) State the effect of decreasing the concentration of hydrochloric acid on the rate of the reaction between magnesium and hydrochloric acid.

_____

_____ [1]

(d) Magnesium chloride is used as a catalyst for the polymerisation of ethene. What is meant by the term **catalyst**?

_____

_____

_____ [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 Some substances, for example molten lead(II) bromide and molten sodium chloride, are electrolytes. Other substances, for example copper metal, are conductors.

(a) Explain how the following substances conduct electricity:

- copper metal and
- molten lead(II) bromide

and state any effect the passage of electricity has on each substance.

_____

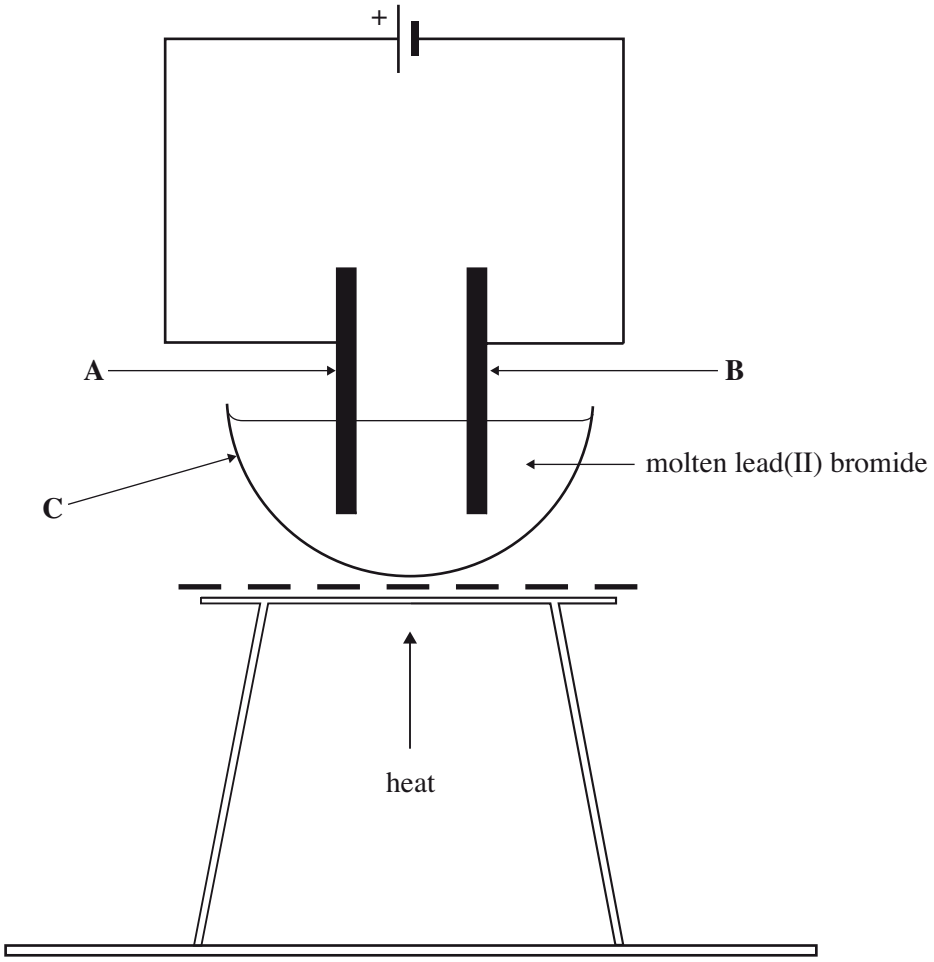
_____

_____

_____

_____ [4]

(b) An experiment to investigate the electrolysis of molten lead(II) bromide was set up as shown in the diagram below.



(i) Some pieces of apparatus in the diagram are labelled A–C. Complete the table by stating the correct name for each piece of apparatus.

Label	Name of apparatus
A	
B	
C	

[3]

(ii) Name a piece of apparatus which could be connected in the circuit to show that an electric current is flowing through the molten lead(II) bromide.

_____ [1]

(iii) Complete the table to state the observations at electrode **A**, the name of the product at electrode **B** and the half equations for the reactions at both electrodes.

Electrode	Observations	Name of Product	Half equation
A		bromine	
B	silvery grey bead		

[7]

(iv) Why does this electrolysis need to be carried out in a fume cupboard?

_____

_____ [1]

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Marks	Remark

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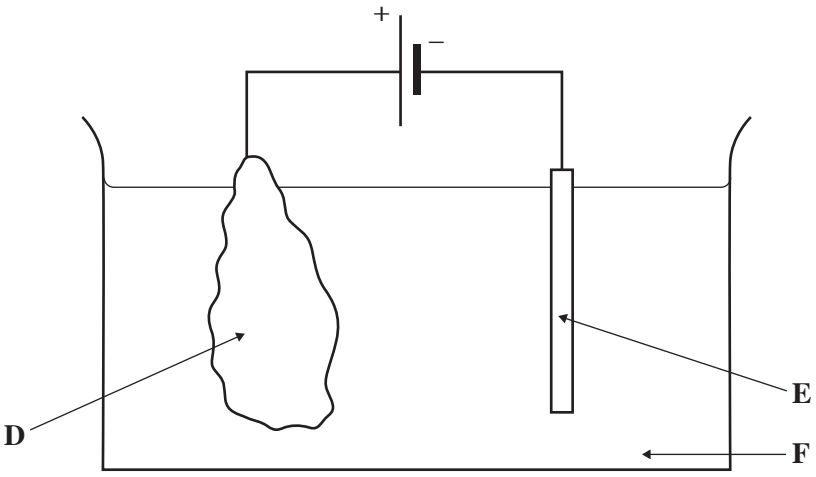
Marks	Remark

(c) Copper metal is a good conductor of electricity and is often used in electrical wires. Impure copper is not used to make wires because the impurities greatly reduce the conductivity. Impure copper is refined by electrolysis as shown in the diagram below.



(i) State the name of the materials which are used to make electrodes **D** and **E**.

D _____

E _____ [2]

(ii) Name the electrolyte **F** which is used in this electrolysis.

_____ [1]

(iii) Write a half equation for the reaction occurring at electrode **E**.

_____ [2]

(iv) Apart from electrical conductivity, state one other physical property of copper which makes it suitable for use in electrical wiring.

_____ [1]

Examiner Only	
Marks	Remark

4 **(a)** Five solutions were tested to find their pH. The results are recorded in the table below.

Solution	pH value
Soap solution	10
Sulphuric acid	1
Water	7
Sodium hydroxide	14
Lemon juice	5

(i) Describe the method the student should use to determine the pH of each solution.

_____

_____

_____ [2]

(ii) Using only the solutions given in the table above, state an example of each of the following:

A weak acid _____

A strong alkali _____

Neutral _____ [3]

(iii) Hydrogen ions are found in all acidic solutions. Write the symbol for a hydrogen ion including its charge.

_____ [1]

(iv) The ion found in all alkalis is OH^-. Name this ion.

_____ [1]

(v) **Name** the salt produced when sulphuric acid reacts with sodium hydroxide solution.

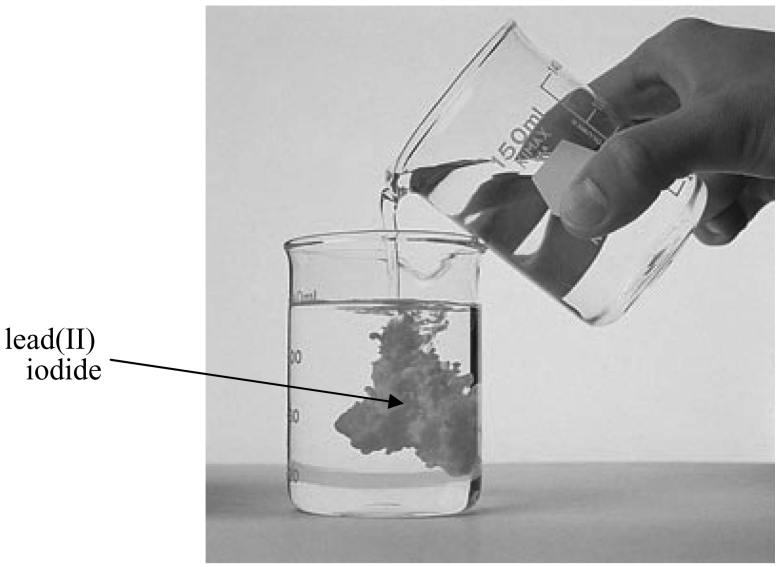
_____ [1]

(vi) Write a balanced symbol equation for the reaction between sulphuric acid and sodium hydroxide solution.

_____ [3]

Examiner Only	
Marks	Remark

(b) Lead(II) iodide, PbI_2, is a toxic yellow solid used as a pigment by painters in the nineteenth century. It is insoluble in water. The picture below shows two solutions mixing and lead(II) iodide forming.



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(i) Name two solutions which would react together to form insoluble lead(II) iodide.

Solution 1: _____

Solution 2: _____ [2]

(ii) Draw a labelled diagram of the assembled apparatus used to recover the insoluble lead(II) iodide when the reaction is finished.

[3]

(iii) Write a balanced ionic equation to show the formation of lead(II) iodide.

_____ [3]

(c) Barium sulphate is another insoluble salt. It may be prepared by mixing solutions of barium chloride and sodium sulphate. The barium sulphate is dried after it is prepared.

(i) Write a balanced symbol equation for the reaction of barium chloride with sodium sulphate to form barium sulphate.

_____ [3]

(ii) How would you dry the sample of barium sulphate?

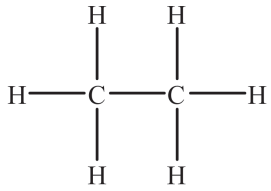
_____ [1]

Examiner Only	
Marks	Remark

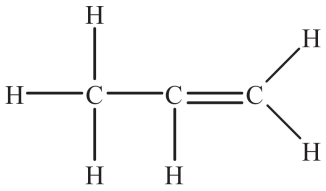
Examiner Only	
Marks	Remark

5 **(a)** Alkanes and alkenes are two homologous series of organic compounds. The four structural formulae given below labelled **A**, **B**, **C** and **D** represent some alkanes and alkenes.

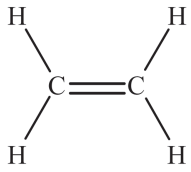
A



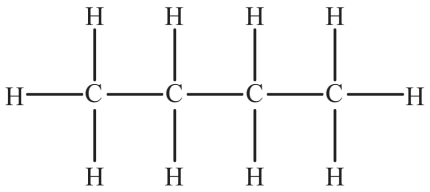
B



C



D



(i) Name **A**, **B**, **C** and **D**.

A _____

B _____

C _____

D _____ [4]

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Marks	Remark

(ii) Write the molecular formula for substance **D**.

_____ [1]

(iii) Which one of the substances (**A**, **B**, **C** or **D**) has the empirical formula CH_3?

_____ [1]

(iv) Write a balanced symbol equation for the complete combustion of substance **B**.

_____ [3]

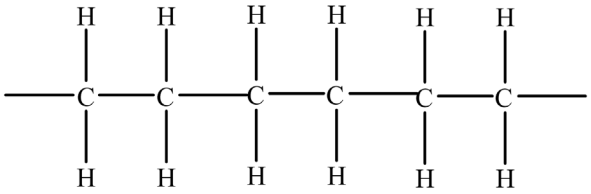
(v) What is meant by the term homologous series?

_____

_____

_____ [3]

(b) Polythene is described as a hydrocarbon polymer whereas polyvinylchloride (PVC) is not. Part of the structure of polythene is shown below.



(i) What is meant by the term hydrocarbon?

_____

_____ [2]

(ii) What type of polymerisation is used to form polythene?

_____ [1]

(iii) Explain what you understand by the term polymer.

_____

_____

_____ [2]

(iv) Name the monomer from which polythene is formed.

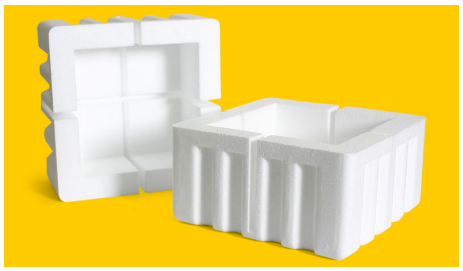
_____ [1]

(v) Write a structural equation to show the polymerisation of vinyl chloride to form polyvinylchloride (PVC).

[4]

Examiner Only	
Marks	Remark

(c) The three items below are all made from polymers. Write the name of the polymer used to make these items in the table.

Item	Polymer
 *É Custompac Ltd* packaging	
shopping bags	
window frames	

[3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

6 Chemical reactions are either exothermic or endothermic.

(a) What do you understand by the term exothermic?

_____

_____ [1]

(b) The table below gives the word equations for several exothermic reactions.

Reaction	Word Equation
A	hydrogen + oxygen → water
B	sodium hydroxide + hydrochloric acid → sodium chloride + water
C	copper(II) sulphate + magnesium → magnesium sulphate + copper
D	magnesium + carbon dioxide → magnesium oxide + carbon

(i) Name the type of reaction represented by **A** and **B**.

A _____ [1]

B _____ [1]

(ii) Write a balanced symbol equation for Reaction **B**.

_____ [2]

(iii) Write a balanced symbol equation for reaction **D**

_____ [3]

(iv) Describe what would be observed during reaction **D**.

_____

_____

_____ [3]

(c) Reaction **C** is a redox reaction.

(i) Describe what would be observed when a piece of magnesium ribbon is added to copper(II) sulphate solution.

_____

_____

_____ [3]

(ii) Explain, in terms of electrons, why reaction **C** is described as a redox reaction. You may use half equations to help answer this question.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [7]

Quality of Written Communication [2]

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Marks	Remark

Examiner Only	
Marks	Remark

7 In the United Kingdom 45 million mobile phone users discard about 15 million handsets every year. Only about 2% of these handsets are recycled, with the remainder going to landfill dumps. Recycling mobile phones means an overall reduction in carbon dioxide emissions as well as saving precious metals such as gold, silver and copper.

Due to copyright an image of a pile of discarded mobile phones has been removed which is not essential to answer this question.

(a) (i) State two environmental disadvantages of landfill dumps.

_____

_____

_____ [2]

(ii) Name the environmental problem caused by carbon dioxide emissions.

_____ [1]

(iii) Suggest why it is important to recycle phones to recover metals such as gold, silver and copper.

_____

_____ [1]

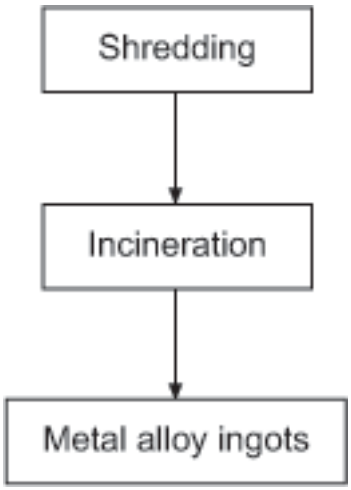
(iv) Suggest why metals such as gold are used in the circuit boards and wiring of mobile phones.

_____

_____ [1]

Examiner Only	
Marks	Remark

(b) In the recycling process the phones are first placed in a shredder, and then the shredded material is heated in ovens to incinerate the plastic. The remains from this process enter a melting furnace to produce a metal alloy covered with slag, which consists mainly of silicates. The metal alloy bars from one tonne of mobile phones can contain 2.3 kg of silver and 227 g of gold.



(i) State one advantage and one disadvantage of incineration as a method of disposal of plastics.

Advantage: _____

_____

Disadvantage:_____

_____ [2]

(ii) What is meant by the term alloy?

_____ [1]

(iii) The silicate ion found in slag has the formula SiO_3^{2-}. Write the formula for aluminium silicate.

_____ [1]

Examiner Only	
Marks	Remark

(c) Slag is also produced in the Blast Furnace during the extraction of iron from haematite. Limestone and haematite are two of the solid raw materials added to the Blast Furnace. Both haematite and limestone are mined.

(i) Complete the table which gives details of the two raw materials.

Raw material	Formula	Name of chemical
Haematite		iron(III) oxide
Limestone	$CaCO_3$	

[2]

(ii) Name the other solid raw material added to the Blast Furnace.

_____ [1]

(iii) State two advantages to a local community of a limestone mine.

_____

_____ [2]

(iv) Name the reducing agent in the Blast Furnace.

_____ [1]

(v) Write a balanced symbol equation for the formation of slag in the Blast Furnace.

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

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