Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
January 2012

Additional Science CHY2F
Unit Chemistry C2

Chemistry F
Unit Chemistry C2

Written Paper

Thursday 26 January 2012 9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

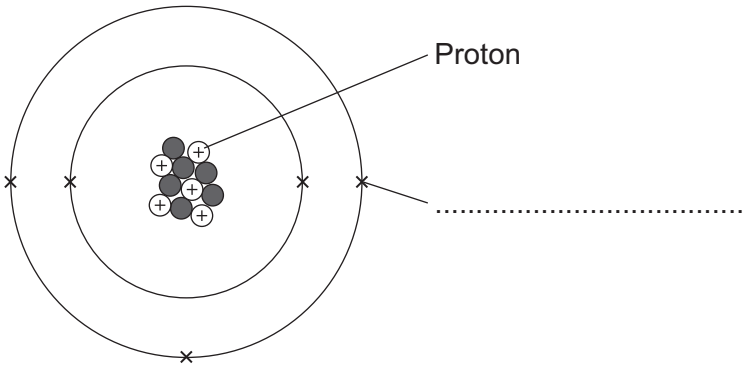
Advice
- In all calculations, show clearly how you work out your answer.

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

1 The diagram represents an atom of an element.

1 (a) Choose **one** word from the box to complete the label on the diagram.

electron	**neutron**	**nucleus**



(1 mark)

1 (b) (i) What is the atomic (proton) number of this atom? .....

(1 mark)

1 (b) (ii) Name the element.

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

The name of the element is ..... .

(1 mark)

1 (c) (i) Draw a ring around the mass number of this atom.

5 **11** **16**

(1 mark)

1 (c) (ii) Another atom of this element has a different mass number.

Draw a ring around the correct word in the box to complete the sentence.

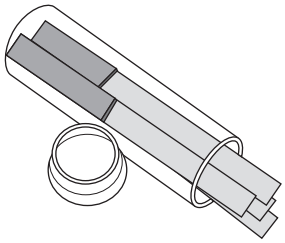
Atoms of the same element with different numbers of | electrons / neutrons / protons | are called isotopes.

(1 mark)

5

Turn over for the next question

2 Read the information and then answer the questions.



COBALT CHLORIDE PAPER

Cobalt chloride paper can be used to test for water.

The paper contains anhydrous cobalt chloride.

The jar containing the papers must be kept closed when not being used.

The equation shows the reaction between anhydrous cobalt chloride and water.

$$CoCl_2 + 6\,H_2O \rightleftharpoons CoCl_2.6H_2O$$

anhydrous cobalt chloride (blue) — hydrated cobalt chloride (pink)

2 (a) Choose **one** word from the box to complete the sentence.

endothermic	**exothermic**	**reversible**

The symbol $\rightleftharpoons$ means that the reaction is ..... .

(1 mark)

2 (b) Describe the colour change when water is added to the cobalt chloride paper.

.....

.....

(1 mark)

2 (c) Suggest why the jar containing the unused cobalt chloride papers must be kept closed.

.....

.....

(1 mark)

3

Turn over for the next question

3 (a) Ammonia solution is used in cleaning products to remove grease from kitchen surfaces.

Ammonia solution is alkaline.

3 (a) (i) Draw a ring around the number most likely to be the pH of ammonia solution.

1 **3** **7** **10**

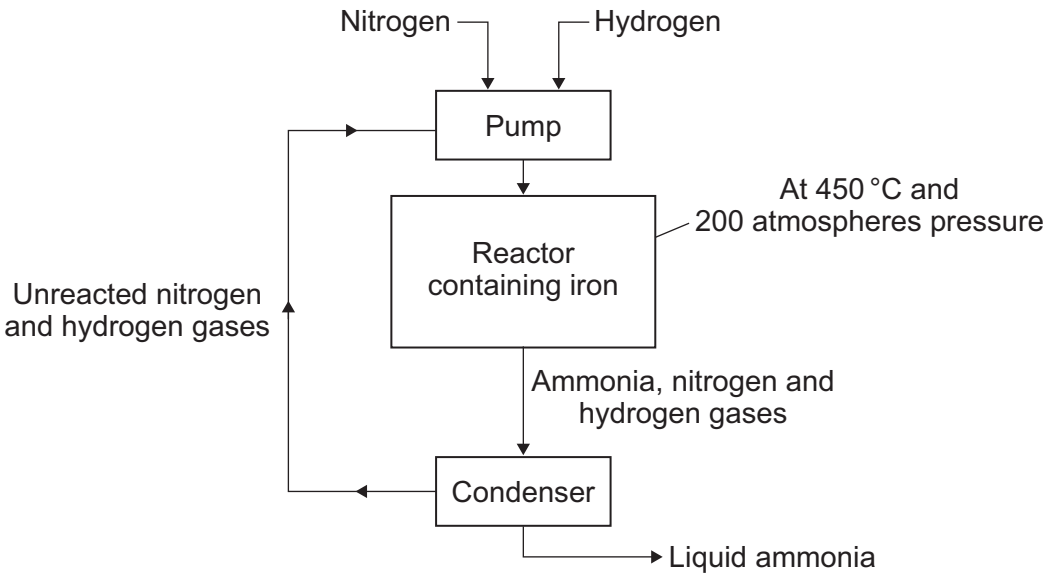
(1 mark)

3 (a) (ii) Draw a ring around the ion in ammonia solution which makes it alkaline.

Cl^- **H^+** **Na^+** **OH^-**

(1 mark)

3 (b) Ammonia is made using the Haber process.



3 (b) (i) Where does the nitrogen used in the Haber process come from?

Draw a ring around your answer.

air **natural gas** **water**

(1 mark)

3 (b) (ii) A high temperature of 450 °C is used in the reactor.

Tick (✓) **two** reasons in the table which explain why high temperatures make reactions faster.

Reasons	Tick (✓)
Particles move faster	
Particles are closer together	
Particles collide more often	
Particles have less energy	

(2 marks)

3 (b) (iii) The iron in the reactor speeds up the reaction but is not used up.

What is the name given to substances that speed up the chemical reaction but which are not used up during the reaction?

.....

(1 mark)

3 (c) Complete the sentence.

The condenser separates the ammonia from the unreacted nitrogen and hydrogen by

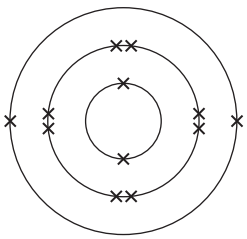
turning the ammonia into a ..... .

(1 mark)

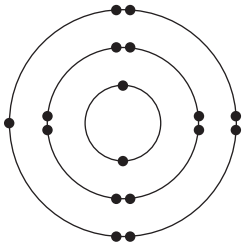
7

Turn over for the next question

4 The diagrams represent the electronic structure of a magnesium atom and a chlorine atom.



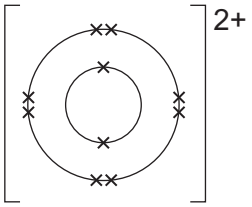
Magnesium atom



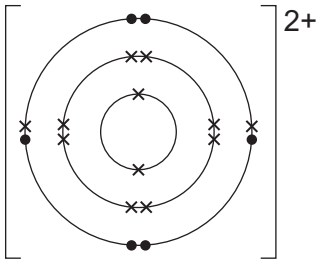
Chlorine atom

Magnesium reacts with chlorine to make the ionic compound called magnesium chloride. This contains magnesium ions, Mg^{2+}, and chloride ions, Cl^{-}

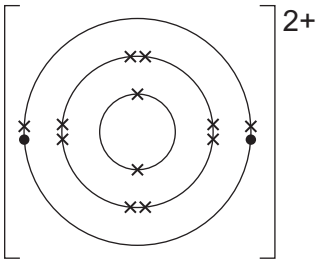
4 (a) (i) Which structure, **A**, **B** or **C**, represents a magnesium ion?



Structure **A**



Structure **B**

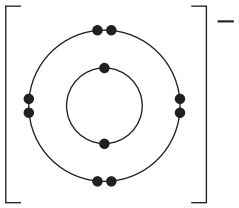


Structure **C**

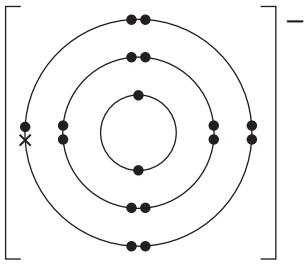
The magnesium ion is Structure ☐

(1 mark)

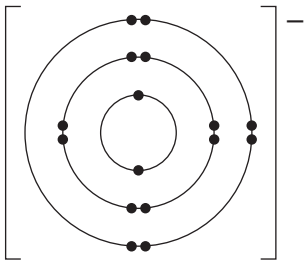
4 (a) (ii) Which structure, **D**, **E** or **F**, represents a chloride ion?



Structure **D**



Structure **E**



Structure **F**

The chloride ion is Structure ☐

(1 mark)

4 (b) Magnesium metal can be extracted from sea water.
Sea water contains magnesium chloride, $MgCl_2$

4 (b) (i) Calcium hydroxide, $Ca(OH)_2$, is added to the sea water.
Magnesium hydroxide, $Mg(OH)_2$, is produced as a solid.

This is the equation for the reaction:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

Draw a ring around the correct answer to complete each sentence.

Magnesium hydroxide forms as a solid because it is [soluble / insoluble / dissolved] in water.

This type of reaction is called [precipitation. / neutralisation. / thermal decomposition.]

(2 marks)

4 (b) (ii) How is the solid magnesium hydroxide separated from the solution?

.....

(1 mark)

4 (b) (iii) An acid is then added to the solid magnesium hydroxide to make magnesium chloride.

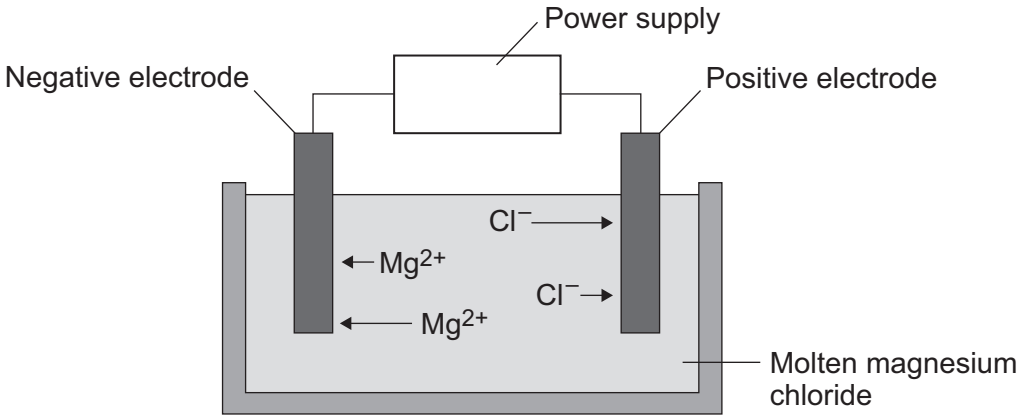
Draw a ring around the name of this acid.

nitric acid **hydrochloric acid** **sulfuric acid**

(1 mark)

Question 4 continues on the next page

4 (c) Electrolysis is used to extract magnesium metal from magnesium chloride.



4 (c) (i) What must be done to solid magnesium chloride to allow it to conduct electricity?

.....

(1 mark)

4 (c) (ii) Why do the magnesium ions move to the negative electrode?

.....

.....

(1 mark)

4 (c) (iii) Name the product formed at the positive electrode.

.....

(1 mark)

9

Turn over for the next question

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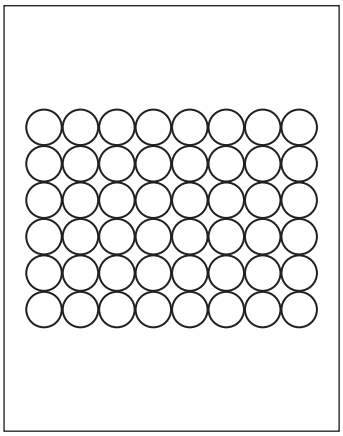
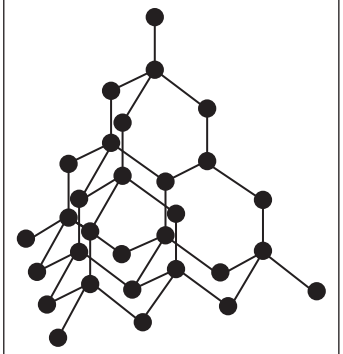
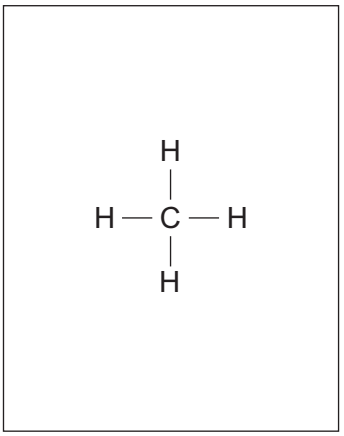
5 The diagrams represent the structures of five substances, **A**, **B**, **C**, **D** and **E**.



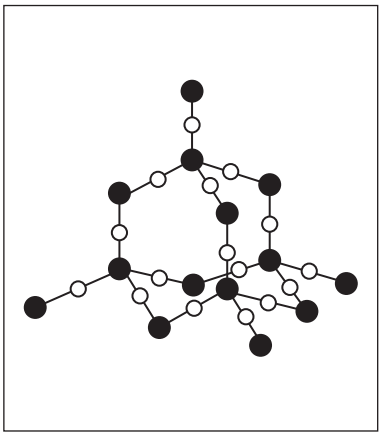
A



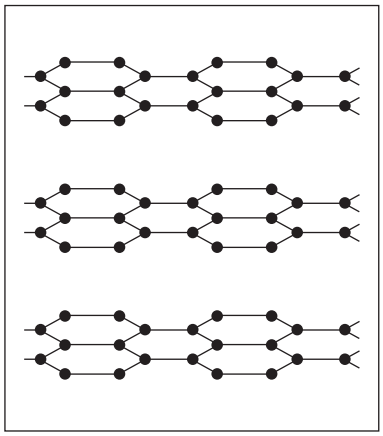
B



C



D



E

5 (a) Give **one** substance, **A**, **B**, **C**, **D** or **E**, that:

5 (a) (i) has a very low boiling point

(1 mark)

5 (a) (ii) is a compound

(1 mark)

5 (a) (iii) is a metal.

(1 mark)

5 (b) Draw a ring around the type of bonding holding the atoms together in substance **C**.

covalent **ionic** **metallic**

(1 mark)

5 (c) Explain why substance **E** is soft and slippery.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

6 Read the information.

Alumina is a white solid. In 1800, scientists thought that alumina contained an undiscovered metal. We now call this metal aluminium. At that time, scientists could not extract the aluminium from alumina.

In 1825, Christian Oersted, a Danish scientist, did experiments with alumina.

Step 1 He reacted a mixture of hot alumina and carbon with chlorine to form aluminium chloride. The reaction is very endothermic.

Step 2 The aluminium chloride was reacted with potassium. He was left with potassium chloride and tiny particles of aluminium metal.

Other scientists were **not** able to obtain the same results using his experiment and his work was not accepted at that time.

In 1827, Friedrich Wöhler, a German chemist, made some changes to Oersted's experiment. He obtained a lump of aluminium. He tested the aluminium and recorded its properties.

6 (a) Suggest why scientists in 1800 could not extract aluminium from alumina.

.....

.....

(1 mark)

6 (b) Oersted's experiment in 1825 was **not** thought to be reliable.

Explain why.

.....

.....

(1 mark)

6 (c) Why must the reaction in **Step 1** be heated to make it work?

.....

.....

(1 mark)

6 (d) Complete the word equation for the reaction in **Step 2**.

aluminium chloride + potassium → ..... + ...

(1 mark)

6 (e) Suggest how Wöhler was able to prove that he had made a new metal.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

7 Some students investigated magnesium oxide.

7 (a) Magnesium oxide has the formula MgO.

7 (a) (i) Calculate the relative formula mass (M_r) of magnesium oxide.

Relative atomic masses: O = 16; Mg = 24.

.....

.....

Relative formula mass = ...

(2 marks)

7 (a) (ii) Calculate the percentage by mass of magnesium in magnesium oxide.

.....

.....

Percentage by mass of magnesium in magnesium oxide = ...%

(2 marks)

7 (a) (iii) Calculate the mass of magnesium needed to make 25 g of magnesium oxide.

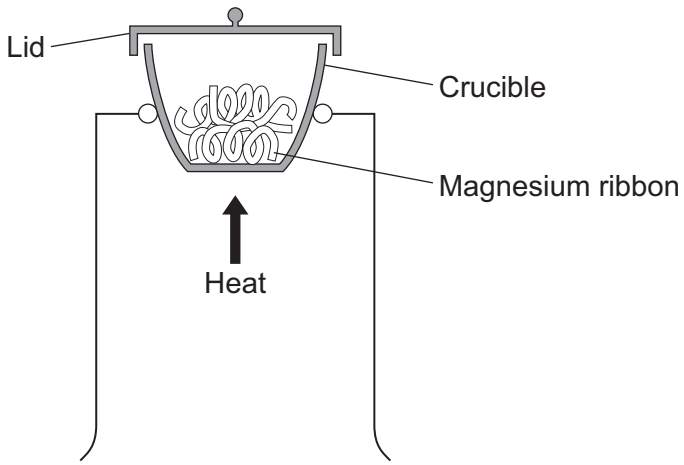
.....

Mass of magnesium = ... g

(1 mark)

7 (b) The students calculated that if they used 0.12 g of magnesium they should make 0.20 g of magnesium oxide.

They did this experiment to find out if this was correct.



- The students weighed 0.12 g of magnesium ribbon into a crucible.
- They heated the magnesium ribbon.
- They lifted the lid of the crucible slightly from time to time to allow air into the crucible.
- The students tried to avoid lifting the lid too much in case some of the magnesium oxide escaped.
- When all of the magnesium appeared to have reacted, the students weighed the magnesium oxide produced.

The results of the experiment are shown below.

Mass of magnesium used in grams	0.12
Mass of magnesium oxide produced in grams	0.18

7 (b) (i) The mass of magnesium oxide produced was lower than the students had calculated. They thought that this was caused by experimental error.

Suggest **two** experimental errors that the students had made.

.....

.....

.....

.....

(2 marks)

7 (b) (ii) The students only did the experiment once.

Give **two** reasons why they should have repeated the experiment.

.....

.....

.....

.....

(2 marks)

9

END OF QUESTIONS

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