Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2010

Additional Science
Unit Chemistry C2

CHY2H

H

Chemistry
Unit Chemistry C2

Wednesday 26 May 2010 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

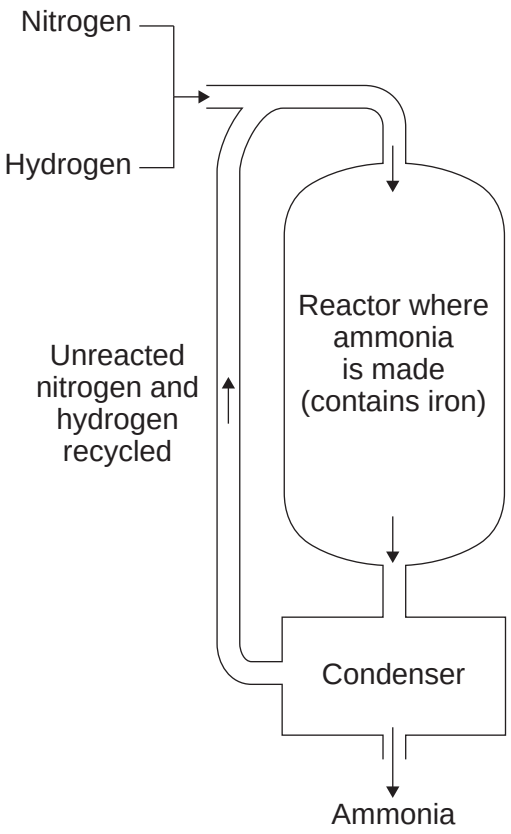
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work 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 (a) The diagram shows how ammonia is made.



1 (a) (i) Complete the word equation for the reaction that takes place in the reactor.

nitrogen + ... → .....

(1 mark)

1 (a) (ii) Ammonia is made by passing nitrogen and hydrogen over hot iron.
Why is iron used in the reactor?

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(1 mark)

1 (a) (iii) Explain how ammonia is separated from the unreacted nitrogen and hydrogen.

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(2 marks)

1 (b) Ammonia is used to make the fertiliser ammonium nitrate.

Calculate the relative formula mass (M_r) of ammonium nitrate, NH_4NO_3

Relative atomic masses (A_r): H = 1; N = 14; O = 16

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Relative formula mass = ...

(2 marks)

1 (c) Another fertiliser is potassium nitrate, KNO_3

The relative formula mass (M_r) of potassium nitrate is 101.

Relative atomic masses (A_r): N = 14; O = 16; K = 39

The table shows the percentage by mass of potassium and nitrogen in four fertilisers, **A**, **B**, **C** and **D**.

Fertiliser	Percentage by mass of potassium (%)	Percentage by mass of nitrogen (%)
A	12.45	25.21
B	19.91	24.12
C	38.61	13.86
D	24.89	9.25

Which fertiliser, **A**, **B**, **C** or **D**, is potassium nitrate?

You **must** show your working to gain full marks.

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Potassium nitrate is fertiliser ☐

(2 marks)

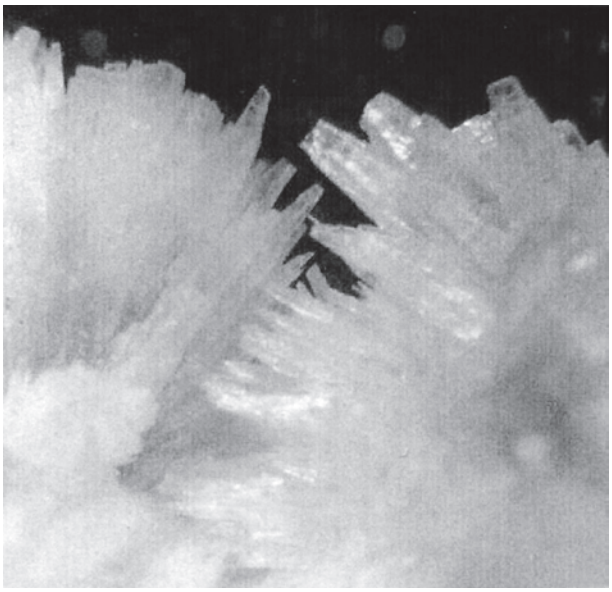
8

Turn over ▶

2 (a) Read the article about the mineral strontianite.

Strontianite is a mineral that was discovered near the village of Strontian in Scotland. At first some scientists thought that strontianite was barium carbonate.

Strontianite



In 1790, Professor Adair Crawford and William Cruikshank were both lecturers in chemistry and doctors of medicine. They investigated the properties of strontianite. They found that strontianite had different properties from barium carbonate. They concluded that strontianite contained a new element.

After this, other scientists also showed that strontianite and barium carbonate had different properties. Strontianite is now known to be strontium carbonate.

2 (a) (i) What evidence did Crawford and Cruikshank use to prove that strontianite was **not** barium carbonate?

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(1 mark)

2 (a) (ii) Crawford and Cruikshank's conclusion was immediately accepted by other scientists. Suggest why.

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(1 mark)

2 (a) (iii) How was the reliability of the work of Crawford and Cruikshank confirmed?

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(1 mark)

2 (b) One of Crawford and Cruikshank's experiments was repeated in a school laboratory. Samples of strontianite and barium carbonate were reacted with hydrochloric acid to produce strontium chloride and barium chloride.

Solid strontium chloride and solid barium chloride were separately added to water. The change in temperature of the water was measured.

The results of the experiments are shown below.

	Experiment 1 Strontium chloride dissolved in water	**Experiment 2** Barium chloride dissolved in water
Temperature of water before adding the chloride in ºC	19.5	19.6
Temperature of water after adding the chloride in ºC	21.2	17.5

2 (b) (i) State **one** variable that should be controlled to make it a fair test.

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(1 mark)

2 (b) (ii) Which experiment, **1** or **2**, is endothermic?

Explain how you know.

Experiment ☐ because .....

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(1 mark)

2 (b) (iii) The results prove that strontium chloride and barium chloride must be different even if all of the variables had not been controlled when they were dissolved. Explain why.

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(1 mark)

2 (c) In 1808, Humphry Davy was the first person to extract strontium. He did this by the electrolysis of molten strontium chloride. Strontium formed at the negative electrode.

Suggest why strontium ions are attracted to the negative electrode.

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(1 mark)

7

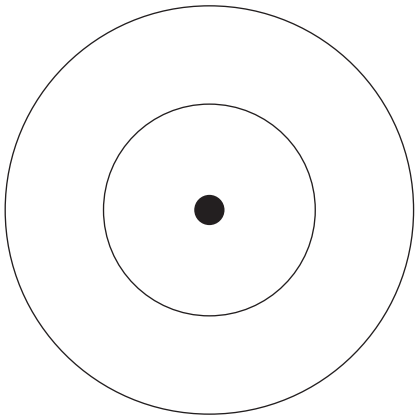
Turn over ▶

3 Pure carbon can exist in two forms, diamond and graphite.

3 (a) Complete the diagram to show the electronic structure of a carbon atom.

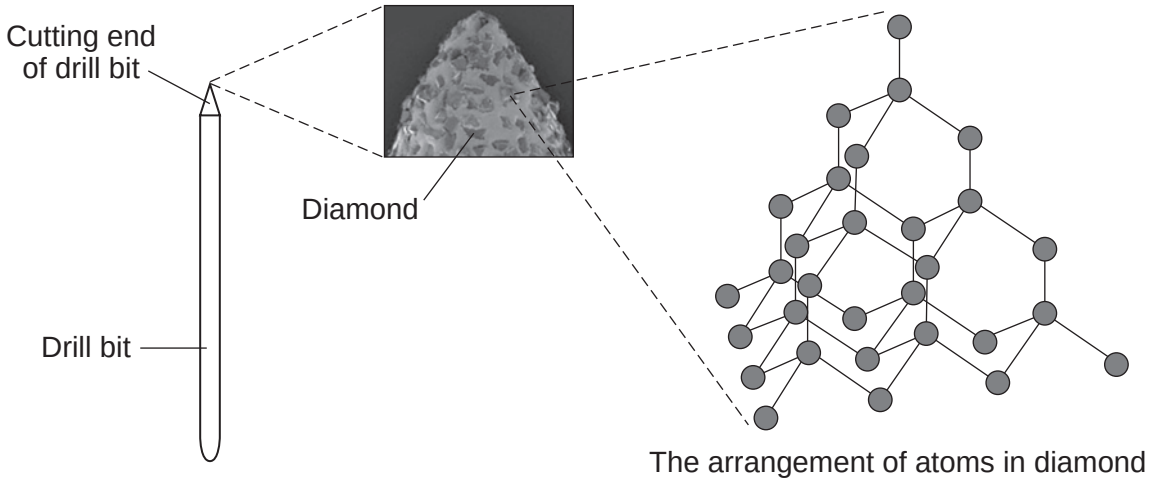
A carbon atom has 6 electrons.

Show the electrons as crosses (x).



(1 mark)

3 (b) A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



The arrangement of atoms in diamond

3 (b) (i) What property of diamond makes it suitable for use on the cutting end of a drill bit?

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(1 mark)

3 (b) (ii) Explain, as fully as you can, why diamond has this property. Use your knowledge of the structure and bonding of diamond and the information shown opposite to help you to answer this question.

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(3 marks)

3 (c) Explain why graphite is a good conductor of electricity and why diamond does **not** conduct electricity.

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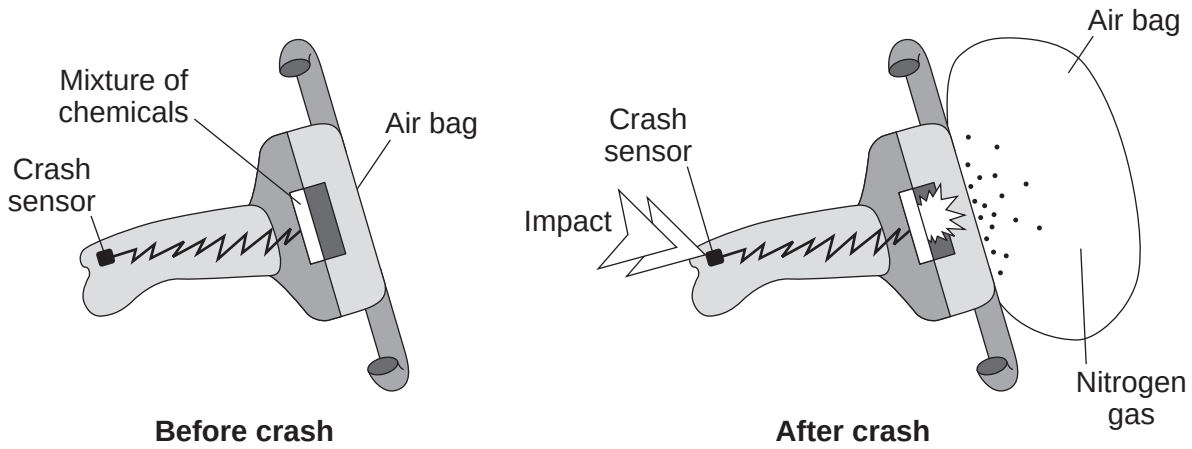
(3 marks)

8

4 Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



Before crash **After crash**

4 (a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

4 (a) (i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

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Mass of nitrogen = ... g

(3 marks)

4 (a) (ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

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Volume = ... litres

(1 mark)

4 (b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

4 (b) (i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$$10Na + ...KNO_3 \rightarrow .....Na_2O + K_2O + N_2$$

(1 mark)

4 (b) (ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

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(1 mark)

6

Turn over for the next question

5 This question is about some compounds of iodine.

5 (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a precipitate.

$$Pb^{2+}(aq) + 2I^{-}(aq) \rightarrow PbI_2(s)$$

5 (a) (i) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you name:

a soluble compound which contains lead ions .....

a soluble compound which contains iodide ions .....

(2 marks)

5 (a) (ii) Suggest a method of separating the lead iodide from the solution.

.....

(1 mark)

5 (b) Magnesium iodide can be made by reacting magnesium with iodine.

$$Mg + I_2 \rightarrow MgI_2$$

Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^{-}).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

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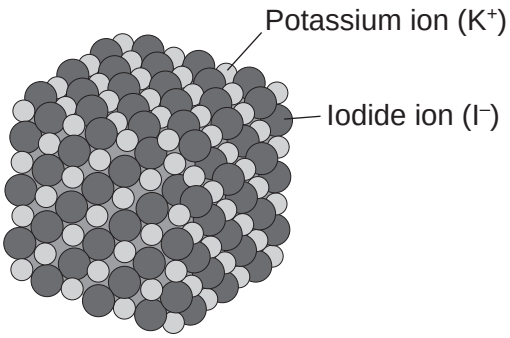
(4 marks)

5 (c) The diagram shows the structure of potassium iodide.



Explain why a high temperature is needed to melt potassium iodide.

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(2 marks)

9

Turn over for the next question

6 The equation for a reaction to produce hydrogen is:

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

6 (a) Explain why changing the pressure does **not** affect the yield of hydrogen at equilibrium.

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(1 mark)

6 (b) Suggest why the best yield of hydrogen at equilibrium is obtained at **low** temperatures.

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(1 mark)

6 (c) The temperature used in industry needs to be high enough for the reaction to take place quickly. Explain, in terms of particles, why the rate of reaction increases when the temperature is increased.

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(3 marks)

6 (d) Scientists have developed catalysts which allow the reaction to take place quickly at lower temperatures. How could this be good for the manufacturer and for the environment?

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(2 marks)

7

END OF QUESTIONS

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