Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
January 2008

ADDITIONAL SCIENCE
Unit Chemistry C2

CHY2H

H

CHEMISTRY
Unit Chemistry C2

Higher Tier

Friday 18 January 2008 1.30 pm to 2.15 pm

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

You may use a calculator.

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- 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.

For Examiner's Use			
Question	Mark	Question	Mark
1		4	
2		5	
3		6	
		7	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

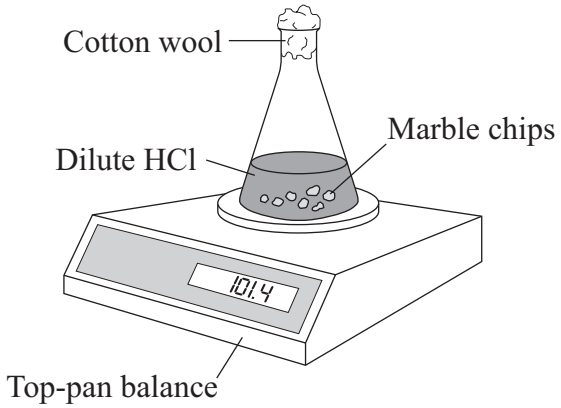
1 A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation.

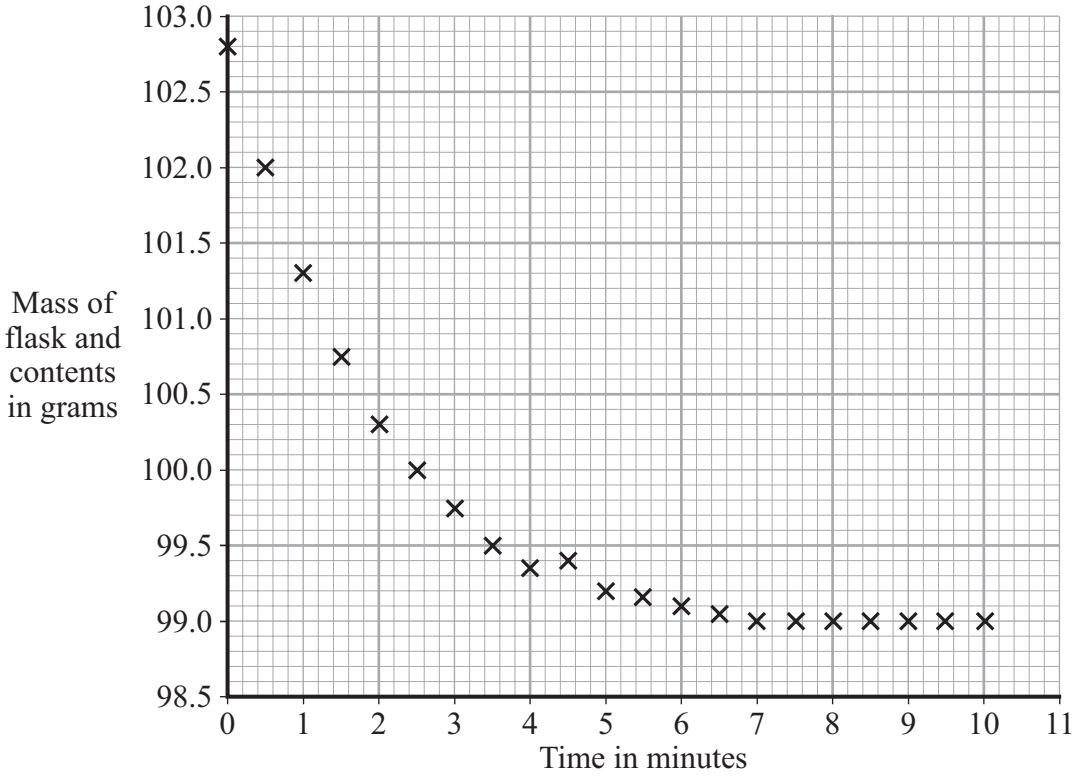
$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + H_2O (l) + CO_2 (g)

The student used the apparatus shown in the diagram.



The student measured the mass of the flask and contents every half minute for ten minutes.

The results are shown on the graph. Use the graph to answer the questions.



(a) **Complete the graph** opposite by drawing a line of best fit.

(1 mark)

(b) Why did the mass of the flask and contents decrease with time?

.....

.....

(1 mark)

(c) After how many minutes had all the acid been used up?

..... minutes

(1 mark)

(d) The student repeated the experiment at a higher temperature. All other variables were kept the same as in the first experiment. The rate of reaction was much faster.

(i) Draw a line **on the graph** opposite to show what the results for this second experiment might look like.

(2 marks)

(ii) Why does an increase in temperature increase the rate of reaction?

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(3 marks)

8

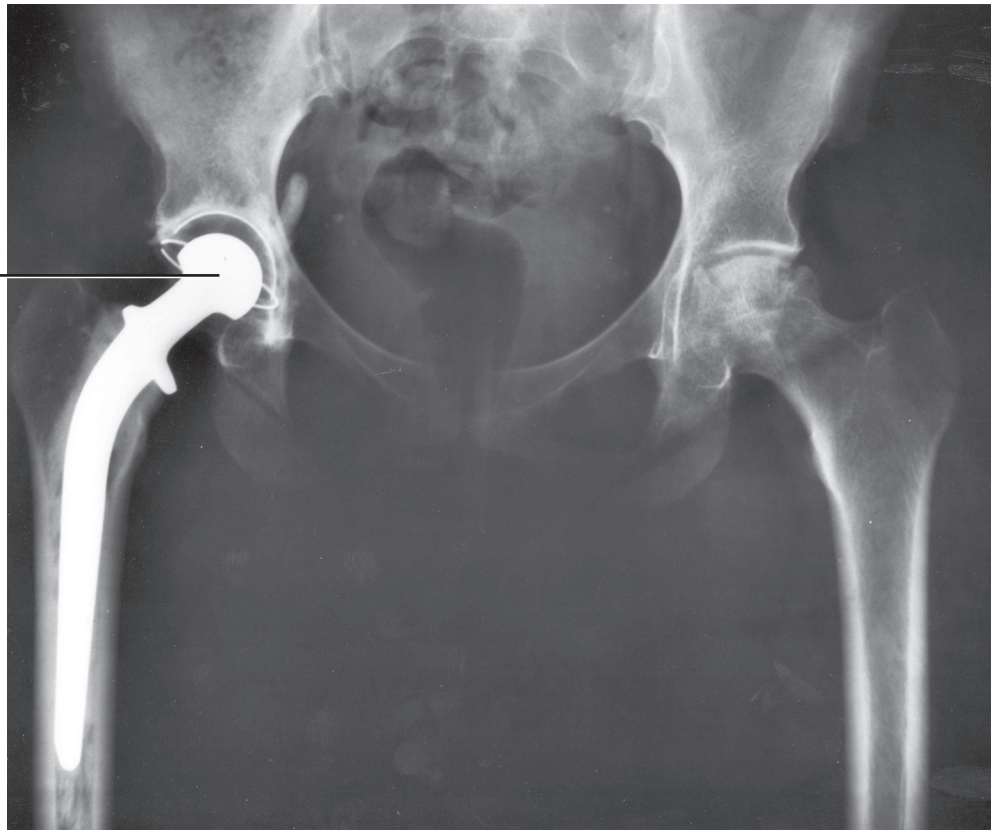
Turn over for the next question

2 Read this passage about metals.

Metals are crystalline materials. The metal crystals are normally about 20 000 nm (nanometres) in diameter. The atoms inside these crystals are arranged in layers.

A new nanoscience process produces nanocrystalline metals. Nanocrystalline metals are stronger and harder than normal metals.

It is hoped that nanocrystalline metals can be used in hip replacements.



The use of nanocrystalline metals should give people better hip replacements which last longer.

(a) State why metals can be bent and hammered into different shapes.

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(1 mark)

(b) How is the size of the crystals in nanocrystalline metals different from the size of the crystals in normal metals?

.....

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(1 mark)

(c) Hip joints are constantly moving when people walk.

Suggest and explain why the hip replacement made of nanocrystalline metal should last longer than one made of normal metals.

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(2 marks)

4

Turn over for the next question

3 (a) A chemist was asked to identify a nitrogen compound. The chemist carried out an experiment to find the relative formula mass (M_r) of the compound.

The M_r of the compound was **44**.

Relative atomic masses: N = 14, O = 16

Draw a ring around the formula of the compound.

NO **NO_2** **N_2O_4** **N_2O**

(1 mark)

(b) Potassium nitrate is another nitrogen compound. It is used in fertilisers. It has the formula **KNO_3**.

The M_r of potassium nitrate is **101**.

Calculate the percentage of **nitrogen** by mass in potassium nitrate.

Relative atomic mass: N = 14.

.....

.....

Percentage of nitrogen = ... %

(2 marks)

3

4 The *electrolysis* of sodium chloride solution produces useful substances.

(a) Explain the meaning of *electrolysis*.

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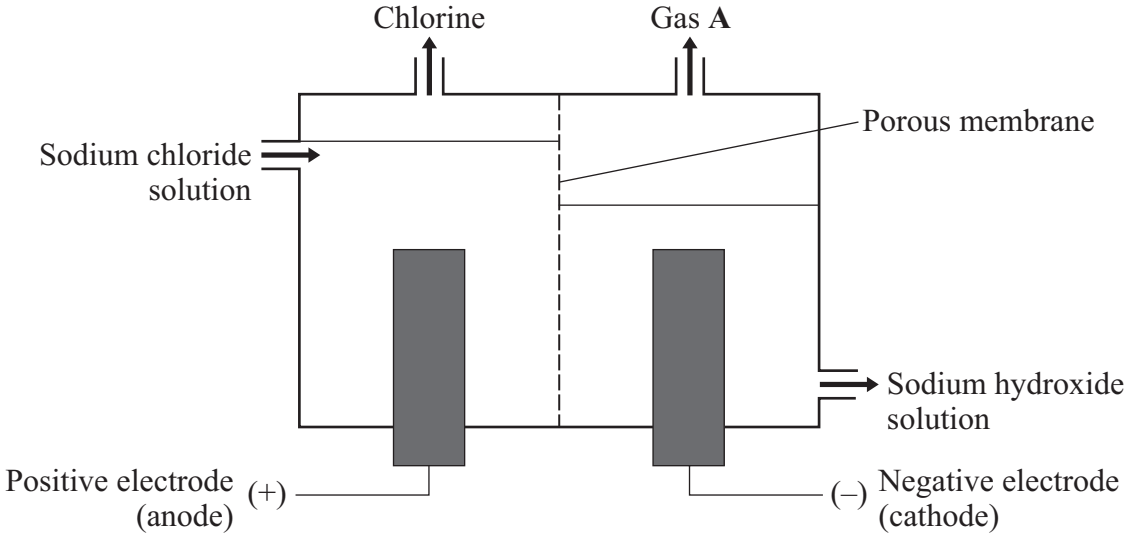
(2 marks)

(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



The electrolysis produces two gases, chlorine and Gas **A**.

Name Gas **A** .....

(1 mark)

(c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

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(2 marks)

5

Turn over ▶

5 Distress flares are used to attract attention in an emergency.

Flares often contain the element magnesium. Magnesium burns to form magnesium oxide.

(a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

State the meaning of *exothermic*.

.....

.....

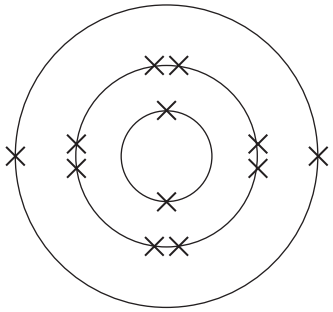
(1 mark)

(b) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O_2) to form magnesium oxide (MgO).

.....

(1 mark)

(c) The diagram shows the electronic structure of a magnesium atom.
The atomic (proton) number of magnesium is 12.



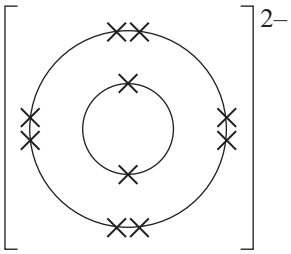
Magnesium atom

Draw a similar diagram to show the electronic structure of an oxygen atom.
The atomic (proton) number of oxygen is 8.

(1 mark)

(d) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

The diagram shows the electronic structure of an oxide ion.



Oxide ion

Draw a similar diagram to show the electronic structure of a magnesium ion.

(1 mark)

(e) Magnesium oxide is a white solid with a high melting point.

Explain how the ions are held together in solid magnesium oxide.

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(2 marks)

(f) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Complete the word equation for the reaction between magnesium oxide and hydrochloric acid.

hydrochloric acid + magnesium oxide → ..... + water.

(1 mark)

7

6 Photographic film often contains silver bromide. Silver bromide is changed by light to form silver which appears as a black solid. This darkens the photographic film.

A photographic film can be made by coating thin transparent plastic with a gel containing silver bromide.

The main steps in making this photographic film are as follows:

Step 1 Gelatine is dissolved in warm water to make a solution.

Step 2 Compound **A**, a soluble compound which contains bromide ions, is dissolved into this solution.

Step 3 The lights are turned out in the darkroom.

Step 4 Compound **B**, a soluble compound which contains silver ions, is dissolved in water.

Step 5 The solution of compound **B** is added to the solution containing compound **A** and gelatine. Solid silver bromide is formed.

Step 6 The warm mixture is poured onto thin, transparent plastic film.

Step 7 The mixture sets to form a gel containing solid silver bromide.

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

SOLUBLE	INSOLUBLE
All sodium and potassium salts	
All nitrates	
Most chlorides, bromides and iodides	Silver and lead chlorides, bromides and iodides
Most sulfates	Lead sulfate and barium sulfate
Sodium, potassium and ammonium carbonates	Most other carbonates

Use the table to help you to name suitable compounds for **A** and **B**.

Compound **A** .....

Compound **B** .....

(2 marks)

(b) Suggest why the lights are turned out at **step 3** in this method of making a photographic film.

.....

.....

(1 mark)

(c) What type of chemical reaction takes place when the compounds are mixed in **step 5**?

.....

(1 mark)

(d) The photographic film is placed in a camera and a picture is taken. Where light hits the photographic film the silver ions (Ag^+) are changed into silver metal (Ag).

Explain why this reaction is a reduction.

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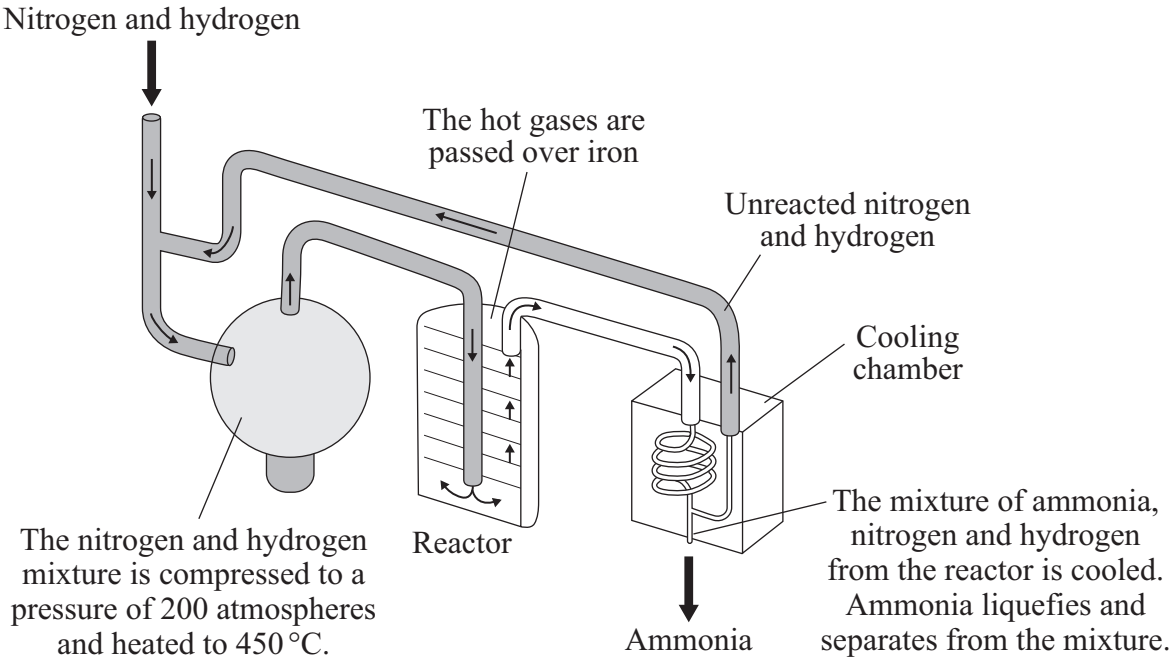
(2 marks)

6

Turn over for the next question

7 The Haber process is named after the German chemist, Fritz Haber.

The diagram shows the main stages in the Haber process.



An exothermic reaction takes place when nitrogen reacts with hydrogen to make ammonia. The reaction can be represented by this equation.

$$N_2\,(g) \quad + \quad 3H_2\,(g) \quad \rightleftharpoons \quad 2NH_3\,(g)$$

(a) Calculate the maximum mass of ammonia that could be made from 1000 g of nitrogen.

Relative atomic masses: H = 1; N = 14

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Mass .....g

(3 marks)

(b) At a temperature of 450 ºC and 200 atmospheres the actual mass of ammonia produced when 1000 g of nitrogen is passed through the reactor is 304 g.

Calculate the percentage yield of ammonia produced in the reactor.

(If you did not answer part (a), then assume that the maximum mass of ammonia that can be made from 1000 g of nitrogen is 1100 g. This is **not** the correct answer to part (a).)

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Percentage yield of ammonia = ... %

(2 marks)

(c) State **and** explain:

(i) how a **decrease** in temperature would affect the yield of ammonia

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(2 marks)

(ii) how an **increase** in pressure would affect the yield of ammonia.

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(2 marks)

Question 7 continues on the next page

(d) Factories that make ammonia are often near to large towns.

Discuss the economic, safety and environmental factors to be considered when there is an ammonia factory near a town.

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(3 marks)

12

END OF QUESTIONS

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