

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
June 2013

Additional Science

Unit Chemistry C2

Chemistry

Unit Chemistry C2

CH2HP

H

Monday 20 May 2013 1.30 pm to 2.30 pm

For this paper you must have:

- the Chemistry Data Sheet (enclosed).
- You may use a calculator.

Time allowed

- 1 hour

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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(b) should be answered in continuous prose.
In this question you will be marked on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

Advice

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

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



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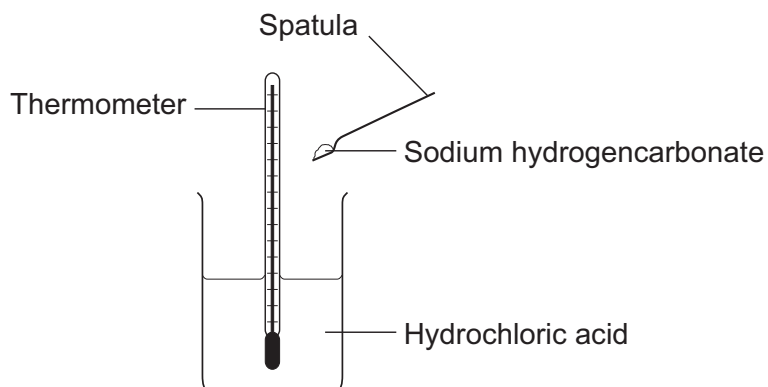
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CH2HP

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

- 1 (a)** Some students did an experiment to find the temperature change when hydrochloric acid reacts with sodium hydrogencarbonate.



The results are in the table.

Number of spatula measures of sodium hydrogencarbonate	Start temperature in °C	Final temperature in °C	Change in temperature in °C
2	20	16	4
4	20	14	6
6	19	11	8
8	20	10	10
10	19	9	10
12	20	10	10



1 (a) (i) Describe, as fully as you can, the trends shown in the students' results.

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(3 marks)

1 (a) (ii) State the type of energy transfer for this reaction.

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(1 mark)

Question 1 continues on the next page

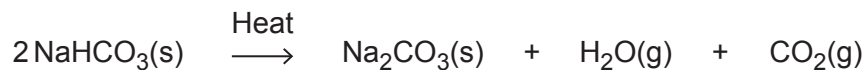
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- 1 (b)** Sodium hydrogencarbonate is used as baking powder for making cakes.

When the cake mixture is baked the sodium hydrogencarbonate decomposes.

The equation for the reaction is:



- 1 (b) (i)** The cake mixture rises when baked.



Use the equation to suggest why.

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(1 mark)

- 1 (b) (ii)** The same reaction can be reversed to produce sodium hydrogencarbonate from sodium carbonate.



Do the reactants need to be heated?

Give a reason for your answer.

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(1 mark)



- 1 (c) (i)** Calculate the relative formula mass of sodium hydrogencarbonate (NaHCO_3).

Relative atomic masses (A_r): H=1; C=12; O=16; Na=23

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Relative formula mass (M_r) =
(2 marks)

- 1 (c) (ii)** Calculate the percentage by mass of carbon in sodium hydrogencarbonate.

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Percentage of carbon = %
(1 mark)

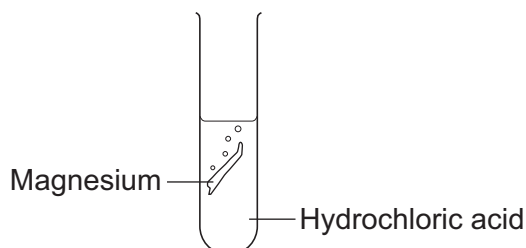
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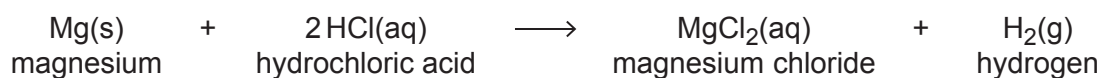
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- 2 A student investigated the reaction between magnesium and hydrochloric acid.



The equation for the reaction is:



- 2 (a) Give **two** observations the student could make during the reaction.

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(2 marks)

- 2 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

- describe how you would carry out the investigation and make it a fair test
- describe the measurements you would make.

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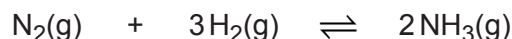
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8



3 Ammonia is produced from nitrogen and hydrogen.

The equation for this reaction is:



3 (a) (i) A company wants to make 6.8 tonnes of ammonia.

Calculate the mass of nitrogen needed.

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

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Mass of nitrogen = tonnes
(3 marks)

3 (a) (ii) The company expected to make 6.8 tonnes of ammonia.

The yield of ammonia was only 4.2 tonnes.

Calculate the percentage yield of ammonia.

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Percentage yield of ammonia = %
(2 marks)

3 (a) (iii) Use the equation above to explain why the percentage yield of ammonia was less than expected.

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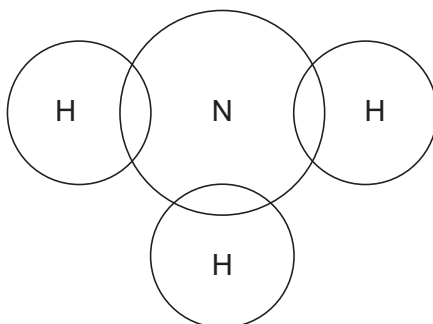
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(1 mark)



- 3 (b)** Complete the diagram to show the arrangement of the outer shell electrons of the nitrogen and hydrogen atoms in ammonia.

Use dots (•) and crosses (x) to represent the electrons.



(2 marks)

- 3 (c)** Ammonia dissolves in water to produce an alkaline solution.

- 3 (c) (i)** Which ion makes ammonia solution alkaline?

.....
(1 mark)

- 3 (c) (ii)** Name the type of reaction between aqueous ammonia solution and an acid.

.....
(1 mark)

- 3 (c) (iii)** Name the acid needed to produce ammonium nitrate.

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(1 mark)

- 3 (c) (iv)** The reaction of ammonia with sulfuric acid produces ammonium sulfate.

Use the formulae of the ions on the Chemistry Data Sheet.

Write the formula of ammonium sulfate.

.....
(1 mark)



4 This question is about potassium.

4 (a) Humphrey Davy was a professor of chemistry.

In 1807 Davy did an electrolysis experiment to produce potassium.

4 (a) (i) Davy first tried to electrolyse a solid potassium salt to produce potassium.

Explain why this electrolysis did **not** work.

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(2 marks)

4 (a) (ii) Humphrey Davy was the first person to produce potassium.

Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

Suggest why.

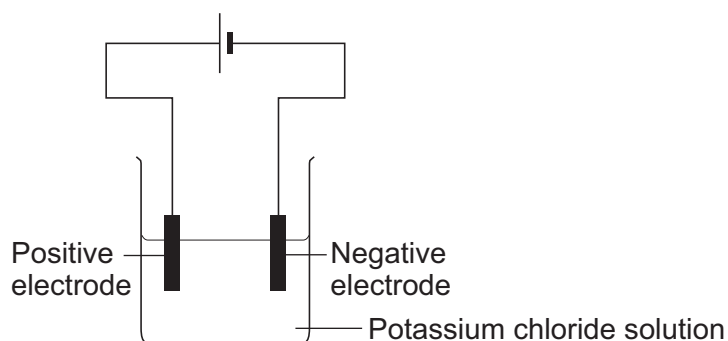
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(1 mark)

4 (b) A student dissolved some potassium chloride in water.
The student tried to electrolyse the potassium chloride solution to produce potassium.

The apparatus the student used is shown in the diagram.



The student expected to see potassium metal at the negative electrode, but instead saw bubbles of a gas.

- Name the gas produced at the negative electrode.
- Explain why this gas was produced at the negative electrode **and** why potassium was not produced.

The reactivity series of metals on the Chemistry Data Sheet may help you to answer this question.

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(3 marks)

4 (c) The student tried to electrolyse molten potassium chloride to produce potassium.

4 (c) (i) Potassium metal was produced at the negative electrode.

Describe how potassium atoms are formed from potassium ions.

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(2 marks)

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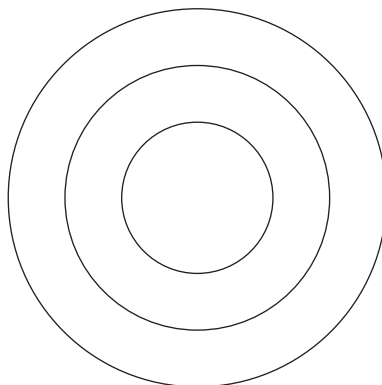


4 (c) (ii) Complete and balance the equation for the reaction at the positive electrode.



(1 mark)

4 (c) (iii) Complete the diagram to show the electronic structure of a chloride ion (Cl^-).



(1 mark)

10

5 Oil rigs are used to drill for crude oil.



5 (a) Drill heads are made from steel. Steel is an alloy.

Explain why alloys are harder than pure metals.

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(3 marks)



5 (b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

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(4 marks)

5 (c) Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

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(4 marks)

11

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- 6** Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



- 6 (a)** The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

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(3 marks)



6 (b) Gas chromatography linked to a mass spectrometer (GC-MS) is used to identify substances found on Mars.

6 (b) (i) What is the purpose of gas chromatography?

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(1 mark)

6 (b) (ii) What information do the molecular ion peaks from the mass spectrometer give about the substances?

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(1 mark)

6 (c) The atmosphere on Venus contains droplets of sulfuric acid solution.

6 (c) (i) Suggest a pH value for sulfuric acid solution.

pH =
(1 mark)

6 (c) (ii) Name the ion which makes sulfuric acid solution acidic.

.....
(1 mark)

6 (d) The atmosphere of Venus contains the isotopes ${}^2_1\text{H}$ and ${}^1_1\text{H}$

Describe the similarities and the differences in the isotopes ${}^2_1\text{H}$ and ${}^1_1\text{H}$

You should refer to the sub-atomic particles in each isotope.

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(3 marks)

END OF QUESTIONS



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