Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
January 2009

CHEMISTRY **CHY3H**
Unit Chemistry C3 **H**

Higher Tier

Thursday 15 January 2009 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 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. Answers written in margins or on blank pages will not be marked.
- 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.

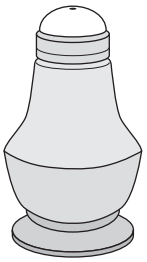
Advice
- In all calculations, show clearly how you work out your answer.

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

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

1 The label is from a packet of Low Sodium Salt.

LOW SODIUM SALT



INGREDIENTS

potassium chloride
sodium chloride

Anti-caking agent: magnesium carbonate

1 (a) A student tested some Low Sodium Salt to show that it contains carbonate ions and chloride ions.

1 (a) (i) Describe and give the result of a test for carbonate ions.

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(2 marks)

1 (a) (ii) A student identified chloride ions using acidified silver nitrate solution.

State what you would **see** when acidified silver nitrate solution is added to a solution of Low Sodium Salt.

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(1 mark)

1 (a) (iii) Flame tests can be used to identify potassium ions and sodium ions.

Suggest why it is difficult to identify **both** of these ions in Low Sodium Salt using a flame test.

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(1 mark)

1 (b) Read the following information and then answer the questions.

Salt – friend or foe?

Sodium chloride (salt) is an essential mineral for our health. It is used to flavour and preserve foods. Too much sodium in our diet may increase the risk of high blood pressure and heart disease. Heart disease is the biggest cause of death in the United Kingdom. Some people claim that excess sodium is a poison that can cause cancer, while others say that more evidence is needed.

Many processed foods contain salt, so it is easy to exceed the recommended daily upper limit of about 5 g of salt per person. A 'healthier' amount should be about 3 g. In the United Kingdom many people consume over 10 g of salt each day.

One way to reduce sodium in our diet is to use Low Sodium Salt. This has two thirds of the sodium chloride replaced by potassium chloride.

A national newspaper asked readers for their views on two options.

Option **1**: Ban the use of sodium chloride in foods.

Option **2**: Reduce the amount of sodium chloride in **all** foods to a 'healthier' level.

1 (b) (i) Suggest why Option **1** was rejected.

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(1 mark)

Question 1 continues on the next page

1 (b) (ii) Suggest **two** advantages and **one** disadvantage of Option **2**.

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(3 marks)

8

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

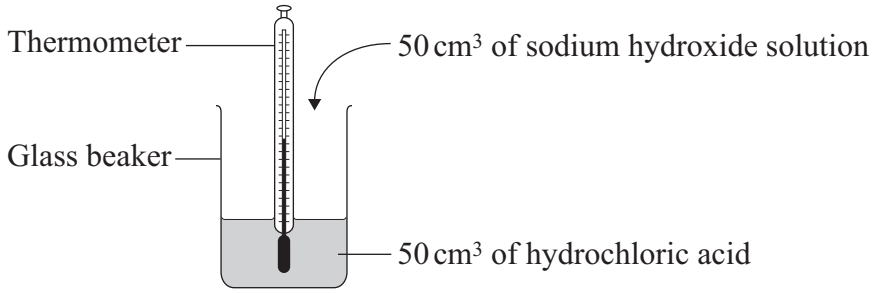
2 Read the information about energy changes and then answer the questions.

A student did an experiment to find the energy change when hydrochloric acid reacts with sodium hydroxide.

The equation which represents the reaction is:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

The student used the apparatus shown in the diagram.



The student placed 50 cm^3 of hydrochloric acid in a glass beaker and measured the temperature.

The student then quickly added 50 cm^3 of sodium hydroxide solution and stirred the mixture with the thermometer. The highest temperature was recorded.

The student repeated the experiment, and calculated the temperature change each time.

	Experiment 1	**Experiment 2**	**Experiment 3**	**Experiment 4**
Initial temperature in °C	19.0	22.0	19.2	19.0
Highest temperature in °C	26.2	29.0	26.0	23.5
Temperature change in °C	7.2	7.0	6.8	4.5

2 (a) The biggest error in this experiment is heat loss.

Suggest how the apparatus could be modified to reduce heat loss.

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(1 mark)

2 (b) Suggest why it is important to stir the chemicals thoroughly.

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(1 mark)

2 (c) Which **one** of these experiments was probably carried out on a different day to the others?

Explain your answer.

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(1 mark)

2 (d) Suggest why experiment 4 should **not** be used to calculate the average temperature change.

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(1 mark)

2 (e) Calculate the average temperature change from the first three experiments.

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Answer = ... °C

(1 mark)

2 (f) Use the following equation to calculate the energy change for this reaction.

energy change in joules = 100 × 4.2 × average temperature change

.....

Answer = ... J

(1 mark)

Question 2 continues on the next page

2 (g) Which **one** of these energy level diagrams, **A** or **B**, represents the energy change for this reaction?

Explain why.

Diagram A

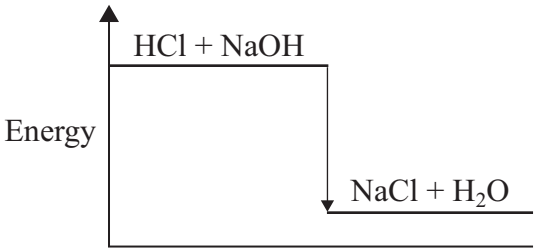
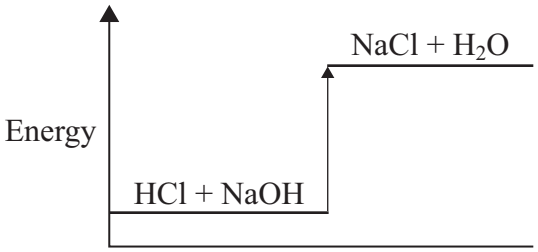


Diagram B



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(1 mark)

7

3 Water is a natural resource.

3 (a) Describe the processes involved in the water cycle.

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(3 marks)

3 (b) In some parts of the world the water is hard, but in other parts the water is soft.

3 (b) (i) Name an ion that causes water to be hard.

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(1 mark)

3 (b) (ii) Describe how these ions get into the water.

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(2 marks)

3 (b) (iii) Sodium carbonate makes hard water soft.

Explain how.

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(2 marks)

8

4 Read the information about the development of the periodic table and answer the questions that follow:

Johann Döbereiner was a chemist who realised there was a link between atomic weight and chemical properties. Although it was difficult to measure atomic weights accurately, by 1829 Döbereiner had arranged many elements with similar chemical reactions in groups of three. He noticed that the middle element had an atomic weight that was approximately the average of the other two. These groupings were known as triads. Three of these triads are shown below:

Li	7	S	32	Cl	35.5
Na	23	Se	79	Br	80
K	39	Te	128	I	127

As new elements were discovered, it became difficult to group them in triads, and it was left to others to build on Döbereiner's work. The result was the first periodic table, suggested by Dimitri Mendeleev in 1869.

Our modern periodic table has evolved from Mendeleev's Table. Lithium, sodium and potassium are still together in Group 1, and chlorine, bromine and iodine are in Group 7.

It was many years before chemists understood the nature of the transition elements.

The modern periodic table on the Data Sheet may help you to answer these questions.

4 (a) Döbereiner suggested that calcium (Ca), strontium (Sr) and barium (Ba) were also a triad.

Use relative atomic masses to explain why.

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(1 mark)

4 (b) Suggest why Döbereiner's ideas were replaced by those of Mendeleev.

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(1 mark)

4 (c) Lithium, sodium and potassium are in Group 1. All these elements react with water.

Describe what you **see** when potassium is added to water.

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(2 marks)

4 (d) In terms of electronic structure, explain why:

4 (d) (i) elements in the same group of the periodic table have similar chemical properties

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(1 mark)

4 (d) (ii) transition elements have similar properties even though they are not in the same group

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(2 marks)

4 (d) (iii) in Group 1, lithium is **less** reactive than potassium.

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(2 marks)

9

5 In 1884 Svante Arrhenius, a Swedish chemist, put forward ideas to explain acid-base behaviour.

It was known that chemicals such as hydrochloric acid, sodium hydroxide and water were all compounds containing hydrogen. Arrhenius suggested why they had different acid-base properties.

5 (a) Using the ideas of Arrhenius, explain why:

5 (a) (i) hydrochloric acid, HCl, is an acid

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(1 mark)

5 (a) (ii) sodium hydroxide, NaOH, is a base

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(1 mark)

5 (a) (iii) water, H_2O, is neutral.

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(1 mark)

5 (b) In 1923, Johannes Brønsted and Thomas Lowry extended Arrhenius' ideas on acids and bases.

Complete this sentence: Brønsted and Lowry defined an acid as

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(1 mark)

5 (c) Why did Arrhenius' ideas take longer to be accepted than those of Brønsted and Lowry?

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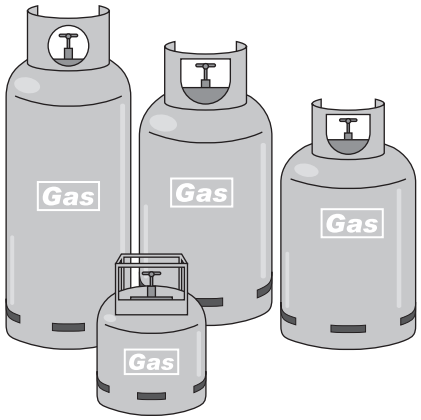
(1 mark)

5

Turn over for the next question

6 Liquefied petroleum gases such as propane and butane are used as heating fuels for caravans, boats and barbecues.



6 (a) These gases often contain small amounts of unsaturated hydrocarbons.

Describe and give the result of a chemical test for unsaturated hydrocarbons.

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(2 marks)

6 (b) Propane and butane have no smell, so for safety reasons a very small amount of thioethanol – the smelliest substance known – is added, even though it is toxic in large concentrations.

Suggest **one** safety reason why thioethanol is added to propane and butane.

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(1 mark)

6 (c) Suggest how mass spectrometry could be used to distinguish between propane (C_3H_8) and butane (C_4H_{10}).

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(1 mark)

6 (d) When 0.4 g of a hydrocarbon gas was completely burned in oxygen, 1.1 g of carbon dioxide and 0.9 g of water were the only products.

Relative formula masses: $CO_2 = 44$; $H_2O = 18$.

Use this information to calculate the number of moles of carbon dioxide and of water produced in this reaction. Use your answers to calculate the empirical formula of this hydrocarbon.

You must show all your working to gain full marks.

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Empirical formula is .....

(4 marks)

8

END OF QUESTIONS

There are no questions printed on this page

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