Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
January 2008

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

Higher Tier

Friday 18 January 2008 1.30 pm to 2.15 pm

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

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.

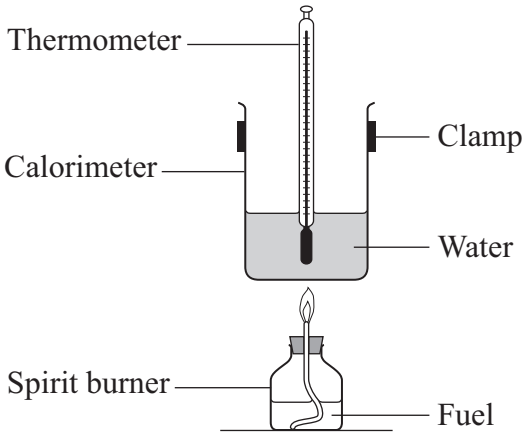
Advice
- In all calculations, show clearly how you work out your answer.

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

Answer **all** questions in the spaces provided

1 A student burned four fuels and compared the amounts of energy they produced.

The student set up the apparatus as shown in the diagram.



The heat produced when each fuel was burned was used to raise the temperature of 100 g of water. The student noted the mass of fuel burned, the increase in temperature and whether the flame was smoky.

The results are shown in the table.

Fuel	Mass of fuel burned (g)	Temperature increase (°C)	Type of flame
Ethanol	4	24	Not smoky
Methanol	3	9	Not smoky
Peanut oil	2	20	Smoky
Vegetable oil	1	15	Smoky

(a) The student suggested that the vegetable oil was the best fuel for producing heat.

Explain why.

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(2 marks)

(b) Suggest an environmental problem that could be caused when large amounts of vegetable oil are burned. Suggest how the problem could be overcome.

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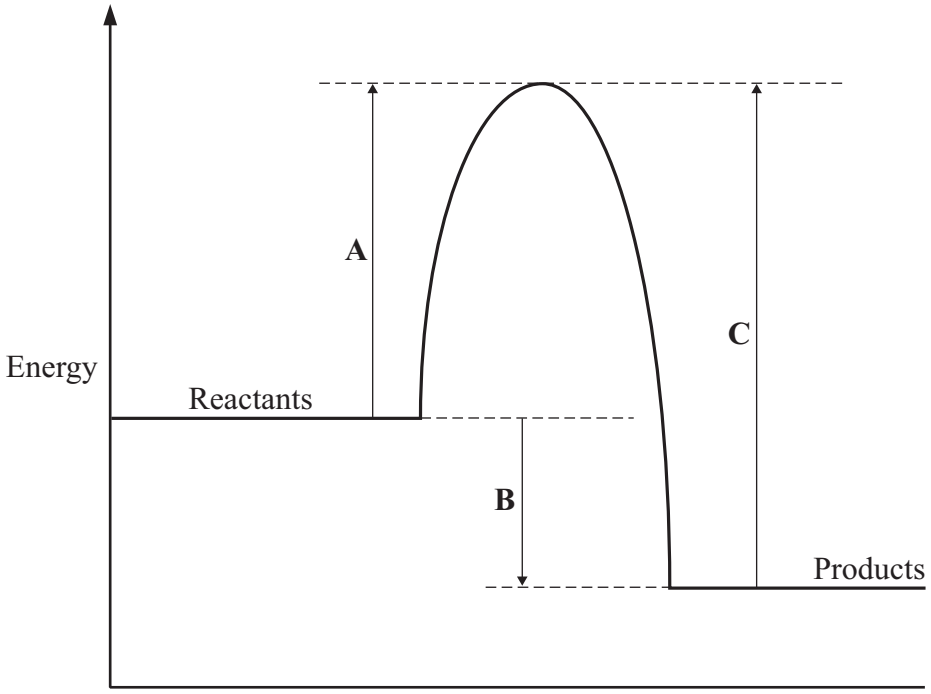
(2 marks)

(c) An energy level diagram for the burning of vegetable oil is shown below.



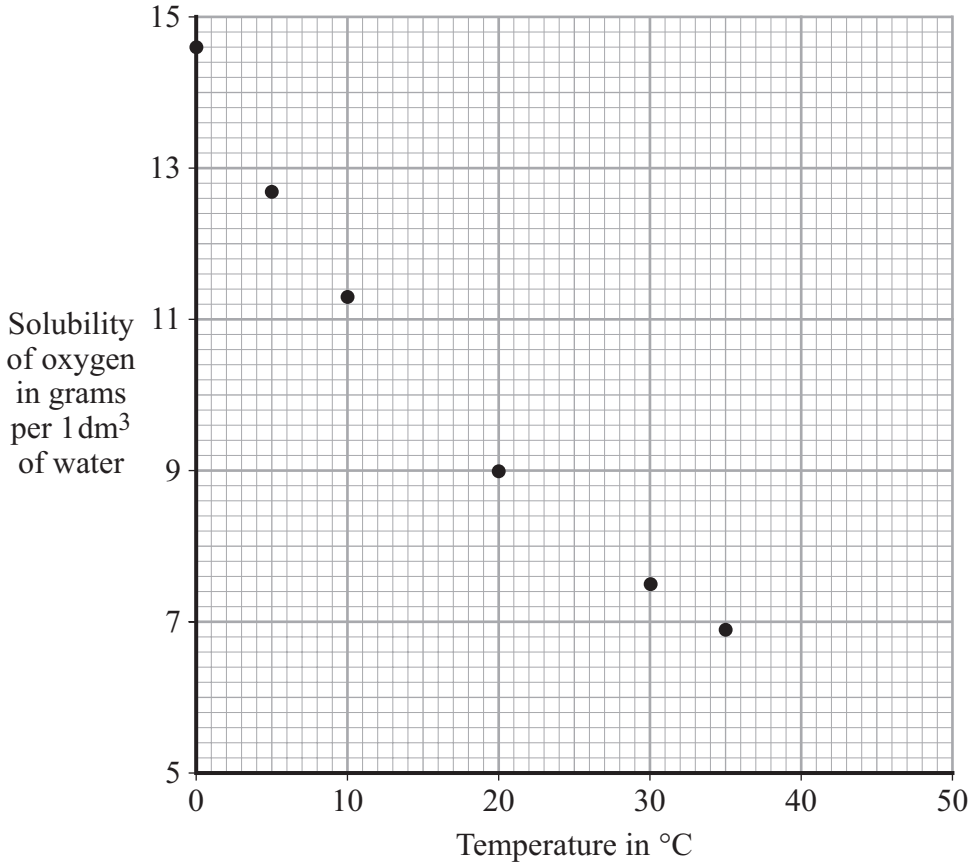
Which of the energy changes **A**, **B** or **C**:

(i) represents the activation energy .....
(1 mark)

(ii) shows the amount of energy given out during the reaction? .....
(1 mark)

6

2 The points on the graph show the mass of oxygen that dissolves in 1 dm^3 of water at different temperatures.



Use the graph to answer the following questions.

(a) (i) Draw a smooth curve through the points, extending your curve to 50 °C.

(1 mark)

(ii) Use your curve to estimate the mass of oxygen that dissolves in 1 dm^3 of water at 50 °C.

Mass = ... g

(1 mark)

(iii) What mass of oxygen gas comes out of 1 dm^3 of water when the temperature increases from 15 °C to 50 °C?

.....

.....

Mass = ... g

(2 marks)

(iv) A student claimed that they were more sure of the value at 15 °C than the value at 50 °C.

Do you agree? Explain the reason for your answer.

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(1 mark)

Question 2 continues on the next page

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

> Dissolved oxygen is essential for aquatic life. For example, trout need about 7 g/dm^3 of dissolved oxygen. They can live in concentrations down to about 5 g/dm^3 for short periods but are likely to die if the water temperature is above 26 °C.
>
> The amount of oxygen dissolved in water depends on many factors, including whether it is summer or winter, day or night. Factors such as photosynthesis and the action of wind add oxygen to water. Respiration of aquatic plants at night, decomposition of organic matter and higher temperatures remove oxygen.
>
> The management of a factory wants to put small amounts of waste hot water at 50 °C directly into a lake that contains trout. The local council has objected to this proposal and there is to be an Independent Public Enquiry.

(i) Suggest why it is important to have an Independent Public Enquiry into adding hot water to this lake.

.....

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(1 mark)

(ii) Suggest how the experience and status of the people giving evidence at the Public Enquiry could influence the final decision.

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(1 mark)

(iii) At the Public Enquiry, the factory management and the council gave their opinions. Suggest what these opinions were by completing the sentences.

The factory management said that there was **no** risk to the trout because .....

.....

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.....

The council said that there **was** a risk to the trout because .....

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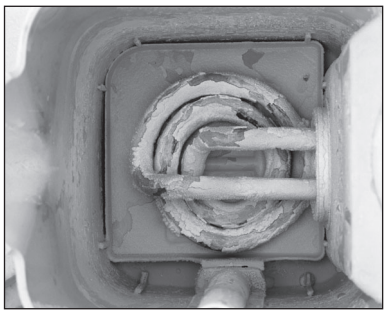
(2 marks)

9

Turn over for the next question

3 Two problems of hard water are *scale* and *scum*, as shown in the pictures of a heating element and a wash basin.



(a) Explain the difference between *scale* and *scum*.

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(2 marks)

(b) Explain how hard water can be made soft using an ion-exchange column.

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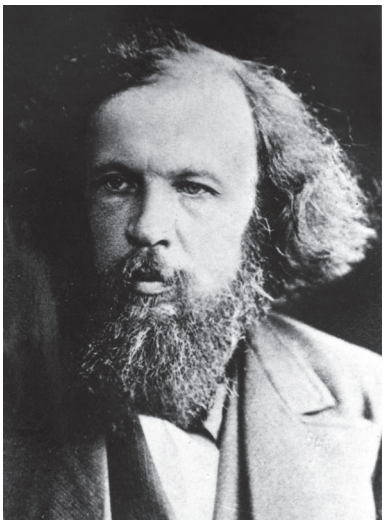
(2 marks)

4

Turn over for the next question

4 Read the information about the periodic table.



When the Russian chemist Dimitri Mendeleev put forward his periodic table in 1869, the atomic structure of elements was unknown.

Mendeleev tried to arrange the elements in a meaningful way based on their chemical reactions. First he put the elements in order of their increasing atomic weight. He then put elements with similar properties in the same column.

However, he left gaps, and sometimes did not follow the order of increasing atomic weight – for example, he placed iodine (atomic weight 127) after tellurium (atomic weight 128).

Within a few years there was sufficient evidence to prove that Mendeleev was correct.

Our modern periodic table has evolved from Mendeleev's table.

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

(a) (i) State why Mendeleev left gaps.

.....

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(1 mark)

(ii) State why some elements were **not** placed in order of increasing atomic weight.

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(1 mark)

(b) (i) The periodic table is now based on atomic structure.

Explain how.

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(3 marks)

(ii) Suggest why it is impossible to have an undiscovered element that would fit between sodium and magnesium.

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(1 mark)

(c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

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(3 marks)

9

5 In 1916, during the First World War, a German U-boat sank a Swedish ship which was carrying a cargo of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

(a) 25.0 cm^3 of the champagne were placed in a conical flask.

Describe how the volume of sodium hydroxide solution needed to react completely with the weak acids in 25.0 cm^3 of this champagne can be found by titration, using phenolphthalein indicator.

Name any other apparatus used.

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(4 marks)

(b) The acid in 25.0 cm^3 of the champagne reacted completely with 13.5 cm^3 of sodium hydroxide of concentration 0.10 moles per cubic decimetre.

Calculate the concentration in moles per cubic decimetre of acid in the champagne.

Assume that 1 mole of sodium hydroxide reacts completely with 1 mole of acid.

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Concentration = ... moles per cubic decimetre

(2 marks)

(c) Is analysis by titration enough to decide whether this champagne is safe to drink?

Explain your answer.

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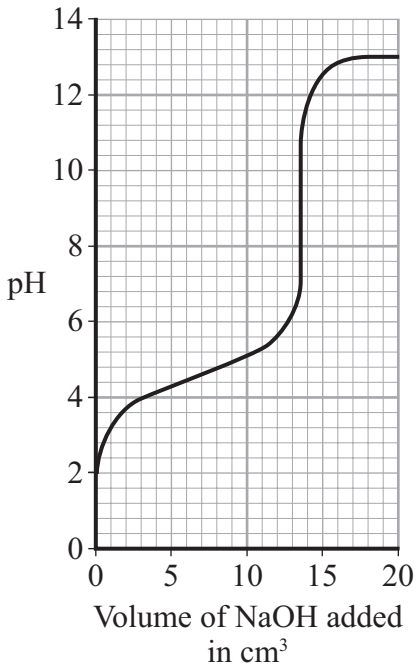
(1 mark)

(d) The graph shows how the pH of the solution changes during this titration.



Phenolphthalein is the indicator used in this titration. It changes colour between pH 8.2 and pH 10.0.

Methyl orange is another indicator. It changes colour between pH 3.2 and pH 4.4.

Suggest why methyl orange is **not** a suitable indicator for this titration.

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(2 marks)

9

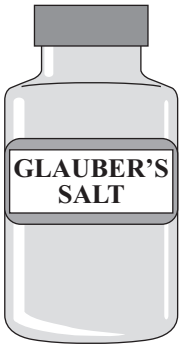
Turn over ▶

6 (a) Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.

Sodium carbonate

Sodium chloride

Sodium nitrate



Sodium sulfate

The chemicals are correctly named.

You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.

(i) Describe tests to show that these chemicals are correctly named.

In each case give the reagent(s) you would use and state what you would see.

Test and result for carbonate ions:

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Test and result for chloride ions:

.....

.....

Test and result for nitrate ions:

.....

.....

Test and result for sulfate ions:

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(5 marks)

(ii) Suggest why a flame test would **not** distinguish between these four chemicals.

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(1 mark)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals.

Describe **two** advantages of using instrumental methods of analysis.

.....

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(2 marks)

8

END OF QUESTIONS

There are no questions printed on this page

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