Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2010

Chemistry

CHY3H

Unit Chemistry C3

H

Written Paper

Monday 18 January 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. 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 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 Read the following information and then answer the questions.

Chlorine – for better, for worse?

Chlorine is used to make bleaches, plastics and medicines. Swimming pool water is often treated with chlorine.

Chlorine is used to make water safe to drink. It is relatively cheap and easy to use. People who drink untreated water risk dying from typhoid and cholera.

However, chlorine is a poisonous chemical. It causes breathing difficulties and can kill people. Some people are also allergic to chlorine.

1 (a) How does chlorine make water safe to drink?

.....

.....

(1 mark)

1 (b) The amount of chlorine in swimming pool water should be carefully monitored and controlled.

Explain why.

.....

.....

.....

.....

(2 marks)

1 (c) Developing countries are likely to choose chlorination as their method of making water safe to drink.

Suggest why.

.....

.....

.....

(1 mark)

1 (d) A government is setting up an enquiry into the safety of using chlorine.

1 (d) (i) Suggest why people from all political parties should be represented.

.....

.....

.....

(1 mark)

1 (d) (ii) Suggest why the opinion of a well-respected scientist might change the outcome of any discussion.

.....

.....

.....

(1 mark)

1 (d) (iii) The decision taken about the safety of using chlorine should be based on evidence and data rather than on hearsay and opinion.

Suggest why.

.....

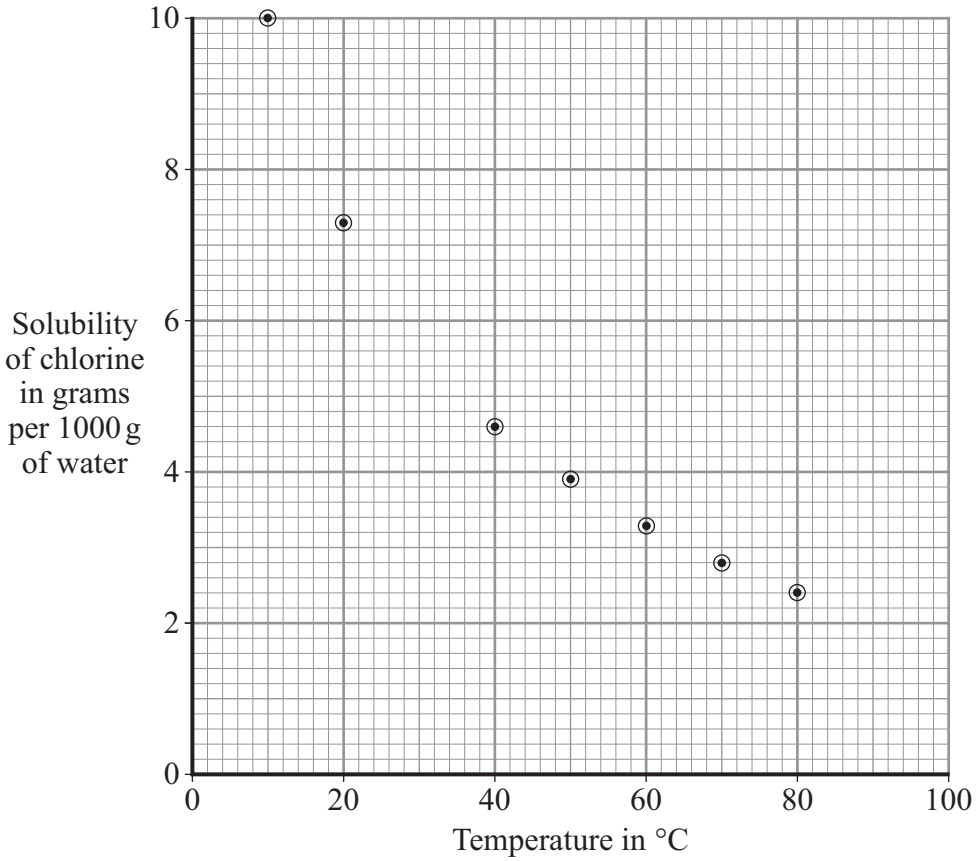
.....

.....

(1 mark)

7

2 The points on the graph show the mass of chlorine that dissolves in 1000 g of water at different temperatures.



Use the graph to answer the following questions.

2 (a) Draw a smooth curve through all the points.

(1 mark)

2 (b) What is the mass of chlorine that dissolves in 1000 g of water at 30 °C?

Mass = ... g

(1 mark)

2 (c) Calculate the mass of chlorine that bubbles out of 1000 g of water when the temperature increases from 10 °C to 80 °C.

.....

.....

Mass = ... g

(2 marks)

4

3 Go Grease is a drain and oven cleaner.

The active ingredient in Go Grease is the alkali sodium hydroxide (NaOH).

3 (a) Name or give the formula of the ion that makes solutions alkaline.

.....

(1 mark)

3 (b) Sodium hydroxide is a *strong* alkali.

In terms of ionisation, what is meant by the word *strong*?

.....

.....

(1 mark)

3 (c) You are given solutions of sodium hydroxide and ammonia of the same concentration.

Describe and give the results of a test to show that sodium hydroxide is a stronger alkali than ammonia solution.

.....

.....

.....

.....

.....

(2 marks)

4

4 Alums are salts. They have been used since ancient times in dyeing and medicine and still have many uses today.

Three alums are shown in the table:

Name	Ions present		
Ammonium alum	NH_4^+	Al^{3+}	SO_4^{2-}
Potassium alum	K^+	Al^{3+}	SO_4^{2-}
Sodium alum	Na^+	Al^{3+}	SO_4^{2-}

4 (a) These alums contain sulfate ions (SO_4^{2-}).

Describe and give the result of a chemical test to show this.

Test .....

.....

Result .....

.....

(2 marks)

4 (b) These alums contain aluminium ions (Al^{3+}).

Describe how sodium hydroxide solution can be used to show this.

.....

.....

.....

.....

.....

(2 marks)

4 (c) Aluminium ions do not give a colour in flame tests. However, flame tests can be used to distinguish between these three alums.

Explain how these three alums could be identified from the results of flame tests.

.....

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

5 (a) Dimitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

The photograph of Dimitri Mendeleev is not reproduced here due to third-party copyright constraints.

How did Mendeleev know that there must be undiscovered elements and how did he take this into account when he designed his periodic table?

.....

.....

.....

.....

.....

(2 marks)

5 (b) By the early 20th century protons and electrons had been discovered.

Describe how this discovery allowed chemists to place elements in their correct order and correct group.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

5 (c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

5 (c) (i) Transition elements have similar properties.

Explain why in terms of electronic structure.

.....

.....

.....

.....

.....

(2 marks)

5 (c) (ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Explain why in terms of electronic structure.

.....

.....

.....

(1 mark)

8

Turn over for the next question

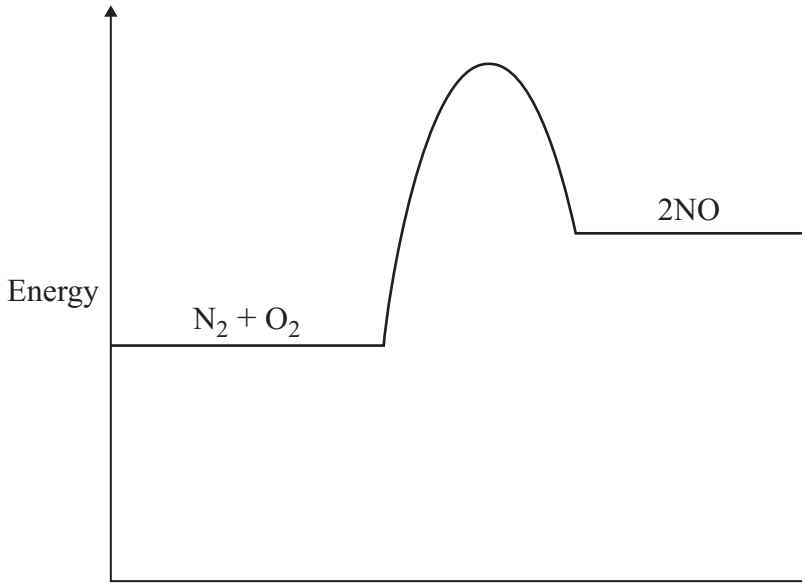
6 During a thunderstorm lightning strikes the Eiffel Tower.

In lightning the temperature can reach 30 000 °C. This causes nitrogen and oxygen in the air to react, producing nitrogen oxide. This reaction has a high *activation energy* and is *endothermic*.

An equation that represents this endothermic reaction is:

$$N_2 + O_2 \rightarrow 2NO$$

The energy level diagram for this reaction is given below.



6 (a) The energy level diagram shows that this reaction is *endothermic*.

Explain how.

.....

.....

(1 mark)

6 (b) What is meant by the term *activation energy*?

.....

.....

(1 mark)

6 (c) The equation showing the structural formulae of the reactants and products is

$$N \equiv N \quad + \quad O = O \quad \rightarrow \quad 2\ N = O$$

Bond	Bond energy in kJ
N ≡ N	945
O = O	498
N = O	630

6 (c) (i) Use the bond energies in the table to calculate the energy change for this reaction.

.....

.....

.....

.....

Energy change = ... kJ

(3 marks)

6 (c) (ii) In terms of bond energies, explain why this reaction is endothermic.

.....

.....

.....

(1 mark)

6

7 Aminoethanoic acid (glycine), NH_2CH_2COOH, is an amino acid. It is found in fish, meat, beans and dairy produce. It can behave both as an acid and as a base.

7 (a) Explain, in terms of Brønsted and Lowry's ideas, why aminoethanoic acid behaves as:

an acid when it reacts with sodium hydroxide

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

.....

.....

.....

a base when it reacts with hydrochloric acid.

$$NH_2CH_2COOH + H^+Cl^- \rightarrow NH_3^+CH_2COOH + Cl^-$$

.....

.....

.....

(3 marks)

7 (b) In a titration, 25.00 cm^3 of a solution of aminoethanoic acid reacted with 18.40 cm^3 of sodium hydroxide solution of concentration 0.15 moles per cubic decimetre.

The equation which represents the reaction is:

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

7 (b) (i) Calculate the concentration of aminoethanoic acid in moles per cubic decimetre.

.....

.....

.....

.....

Concentration = ... moles per cubic decimetre

(2 marks)

7 (b) (ii) Name an indicator used for weak acid-strong alkali titrations.

.....

(1 mark)

6

Turn over for the next question

8 In the United Kingdom, water companies supply drinking water to our homes. However, some people are concerned about the taste and quality of the water that is supplied.

Describe one method that people can use at home to improve the taste and quality of the tap water supplied. Explain how this method works.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

4

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

ACKNOWLEDGEMENT OF COPYRIGHT-HOLDERS AND PUBLISHERS

Question 6: Photograph © Jean-Loup Charmet / Science Photo Library