

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced GCE**

**CHEMISTRY**

**2815/03**

Environmental Chemistry

Monday

**26 JUNE 2006**

Morning

50 minutes

Candidates answer on the question paper.

Additional materials:

*Data Sheet for Chemistry*

Scientific calculator

Candidate Name	Centre Number	Candidate Number												
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**TIME** 50 minutes

**INSTRUCTIONS TO CANDIDATES**

- Write your name in the space above.
- Write your Centre Number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	8	
2	14	
3	12	
4	11	
<b>TOTAL</b>	<b>45</b>	

**This question paper consists of 9 printed pages and 3 blank pages.**



Answer **all** the questions.

1 Solid waste can be disposed of by incineration or landfill. Three possible gaseous products of solid waste disposal are carbon dioxide, dioxin, and methane.

(a) For each gas, suggest **one** way that the gas is formed.

carbon dioxide .....

.....

dioxin .....

.....

methane .....

..... [3]

(b) Carbon dioxide and methane contribute to the Greenhouse Effect.

State **two** factors that determine the contribution of a gas to the Greenhouse Effect.

.....

.....

..... [2]

(c) Landfill gas is mainly methane and carbon monoxide, with impurities such as hydrogen sulphide and hydrogen chloride. Landfill gas has been used to make electricity by means of fuel cells.

Before use, the gas must be purified. In one process, this is achieved with liquid carbon dioxide under pressure. The carbon dioxide dissolves compounds such as hydrogen sulphide and hydrogen chloride.

(i) Why is hydrogen sulphide considered dangerous?

..... [1]

(ii) Suggest the type of intermolecular force that causes hydrogen chloride to dissolve in liquid carbon dioxide.

..... [1]

(iii) Some of the clean liquid carbon dioxide is sold to commercial tomato growers for use in greenhouses. Suggest how the plants use the carbon dioxide.

.....

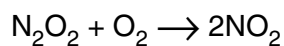
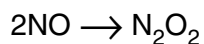
..... [1]

[Total: 8]



- (b) Another pollutant in the atmosphere is nitrogen monoxide. It is readily converted to nitrogen dioxide.

The mechanism for the oxidation of NO to NO<sub>2</sub> in polluted air can be summarised in two equations.



- (i) State **one** way in which NO is formed in the troposphere.

..... [1]

- (ii) Write an overall equation for the two reactions shown above.

..... [1]

- (iii) Deduce the oxidation state of nitrogen in N<sub>2</sub>O<sub>2</sub>.

..... [1]

- (c) State **two** environmental consequences of the presence of **nitrogen monoxide** in the atmosphere, other than acid rain. You should specify the region of the atmosphere for each of your examples.

.....  
.....  
.....  
..... [2]

[Total: 14]

**3** Calcium carbonate can be formed by precipitation from natural waters containing calcium and carbonate ions. It can also be formed by the evaporation of temporary hard water, which contains calcium hydrogencarbonate.

**(a) (i)** Write an ionic equation for the formation of solid calcium carbonate from natural water by precipitation.

..... [1]

**(ii)** Write an equation for the formation of solid calcium carbonate from temporary hard water by evaporation.

..... [1]

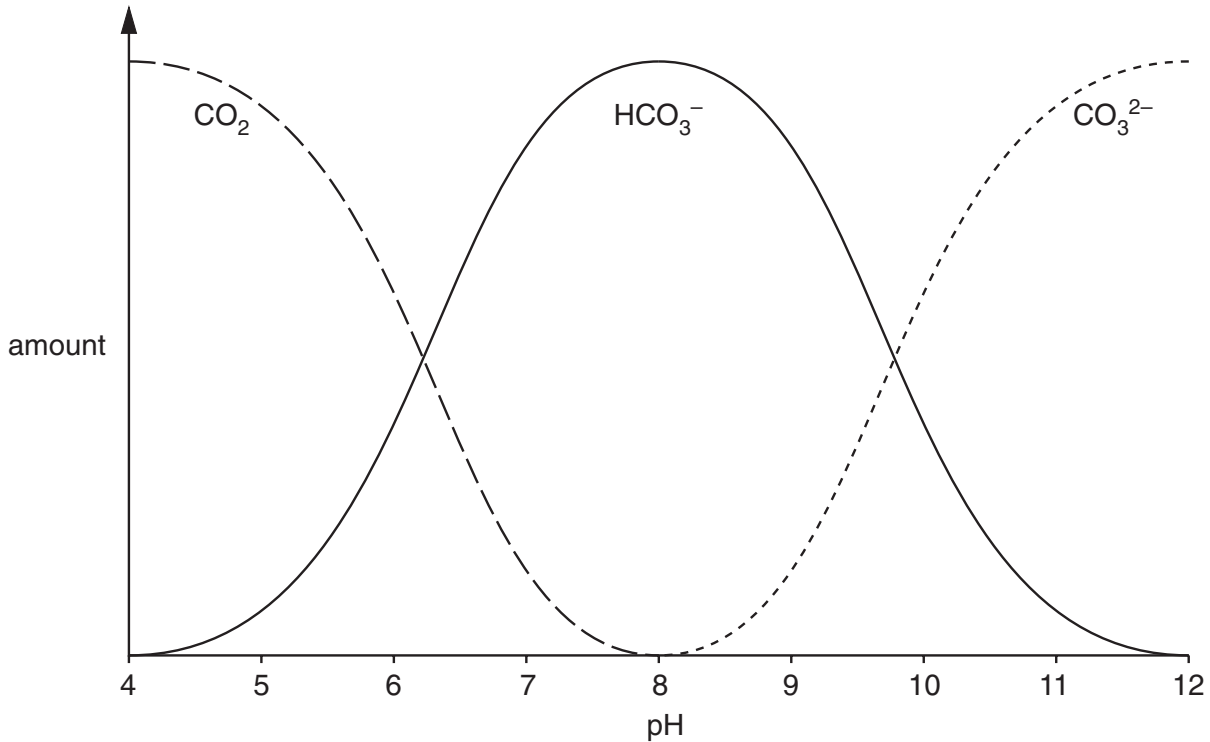
**(b)** Describe and explain the removal of hardness from water using an ion exchange resin.

.....  
.....  
.....  
.....  
..... [3]

**(c)** Explain the use of aluminium ions and chlorine in the production of drinking (potable) water.

.....  
.....  
.....  
..... [3]

- (d) The diagram shows the different amounts of  $\text{CO}_2$ ,  $\text{HCO}_3^-$  and  $\text{CO}_3^{2-}$  present in natural water as the pH changes.



- Use the diagram to explain the effect of acid rain on the concentration of hydrogencarbonate ions in natural waters.

.....

.....

.....

- Use the diagram to explain why the pH of natural water determines whether or not calcium carbonate will precipitate.

.....

.....

..... [4]

[Total: 12]

4 Kaolinite,  $Al_2Si_2O_5(OH)_4$ , is a 1:1 clay in which silicate and aluminate sheets are arranged in layers.

(a) Draw a diagram of a silicate sheet.

[2]

(b) Suggest how the silicate and aluminate sheets are linked within a single layer of kaolinite.

.....  
.....  
..... [2]

(c) Explain why the 1:1 layer structure of kaolinite makes it difficult for water and cations to penetrate the clay.

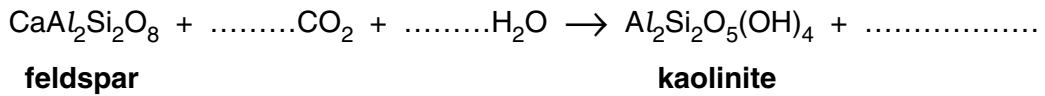
.....  
.....  
.....  
..... [3]



- (d) Explain how cation exchange can occur at the surface of kaolinite.

.....  
 .....  
 ..... [2]

- (e) Kaolinite, together with temporary hard water, is formed by the weathering action of dissolved carbon dioxide on the feldspar mineral,  $\text{CaAl}_2\text{Si}_2\text{O}_8$ . Complete a balanced equation for this reaction.



[2]

[Total: 11]

**END OF QUESTION PAPER**





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