OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY 2815/03

Environmental Chemistry

Tuesday **29 JUNE 2004** Morning 50 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name	Centre Number	Candidate Number

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 the 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	11	
2	12	
3	12	
4	10	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Registered Charity Number 1066969
[Turn over

For Examiner's Use

Answer **all** the questions.

1 This question is about atmospheric pollution by nitrogen oxides.

(a) Explain, with the aid of an equation, how nitrogen monoxide is produced in petrol engines.

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.....[2]

(b) The pavements in many Japanese cities are paved with concrete blocks covered in a thin layer of titanium(IV) oxide. This is a photocatalyst for the formation of oxygen free radicals, which can then oxidise pollutant NO or NO_2 in the air to nitrate ions.

(i) Suggest the meaning of the term *photocatalyst*.

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.....[2]

(ii) Draw a '*dot-and-cross*' diagram to show the electron arrangement in an NO molecule. Show outer electrons only.

[2]

(iii) Why are both NO and NO_2 called free radicals?

.....[1]

(iv) Suggest **one** way in which the nitrate ions might be removed from the pavement.

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.....[1]

(v) State **one** effect of nitrogen oxides in the troposphere.

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.....[1]

For Examiner's Use

(c) (i) The following reactions are involved in ozone depletion in the stratosphere.

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO_2 + O \rightarrow NO + O_2$$

Explain how it is possible for one molecule of nitrogen monoxide to remove many molecules of ozone.

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.....[1]

(ii) Construct the overall equation for the process.

.....[1]

[Total: 11]

[Turn over

For Examiner's Use

2 **(a)** In this question, one mark is available for the quality of written communication.

River water contains dissolved oxygen, carbon dioxide and sulphur dioxide.

- Outline the origin of these dissolved gases.
- Describe their importance in river water.

You should include equations in your answer, where appropriate.

For Examiner's Use

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Quality of Written Communication [1]

(b) Explain why rainwater does **not** require treatment with chlorine and aluminium sulphate to make it potable.

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.....[2]

[Total: 12]

[Turn over

For Examiner's Use

3 **(a)** Rocks containing gypsum, $CaSO_4$, are weathered by water because the $CaSO_4$ is slightly soluble.

(i) Draw a diagram, in terms of the ions and molecules involved, to show the dissolving of calcium sulphate in water.

[2]

(ii) Explain, in energy terms, how the crystal lattice breaks down.

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.....[2]

(b) Water containing dissolved calcium sulphate is described as hard water. Explain the meaning of the term *hard water* and suggest why this type of hardness cannot be removed by boiling.

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.....[2]

(c) Bentonite is a 2:1 clay.

(i) What is meant by the term *2:1 clay*?

.....[1]

For Examiner's Use

(ii) Describe, with the aid of a diagram, the structure of the **silicate sheets** found in 2:1 clays.

[2]

(iii) Explain the origin of negative charge on the surface of the layers in 2:1 clays.

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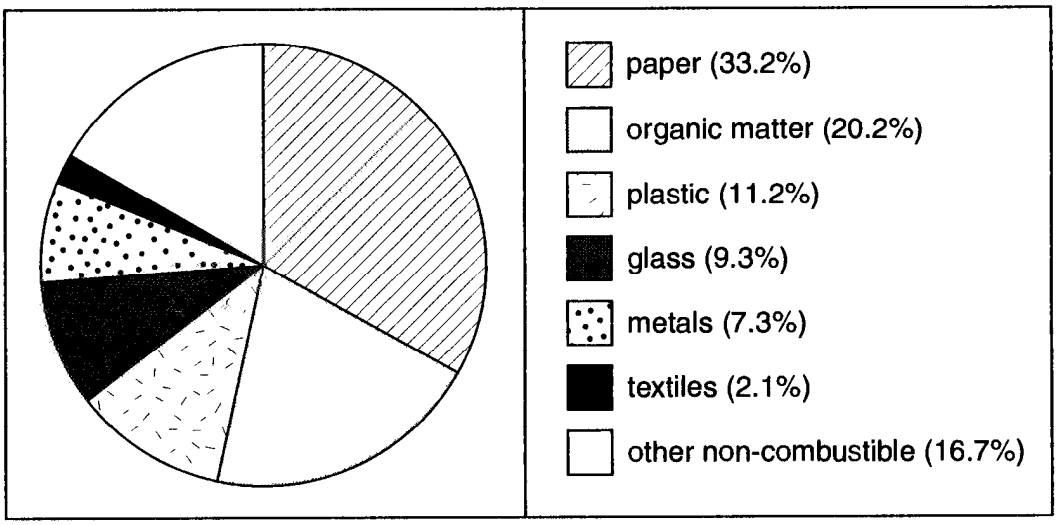
[Total: 12]

[Turn over

For Examiner's Use

4 The pie chart shows the average composition of solid domestic waste at the Fresh Kills landfill site on Staten Island, USA.



(a) (i) The percentage of plastic waste on Staten Island 25 years ago was around 1%. What is the reason for the large increase over this time?

.....[1]

(ii) What percentage of the solid waste could be incinerated?

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.....[1]

(iii) Explain **two** possible disadvantages of incineration, compared with landfill.

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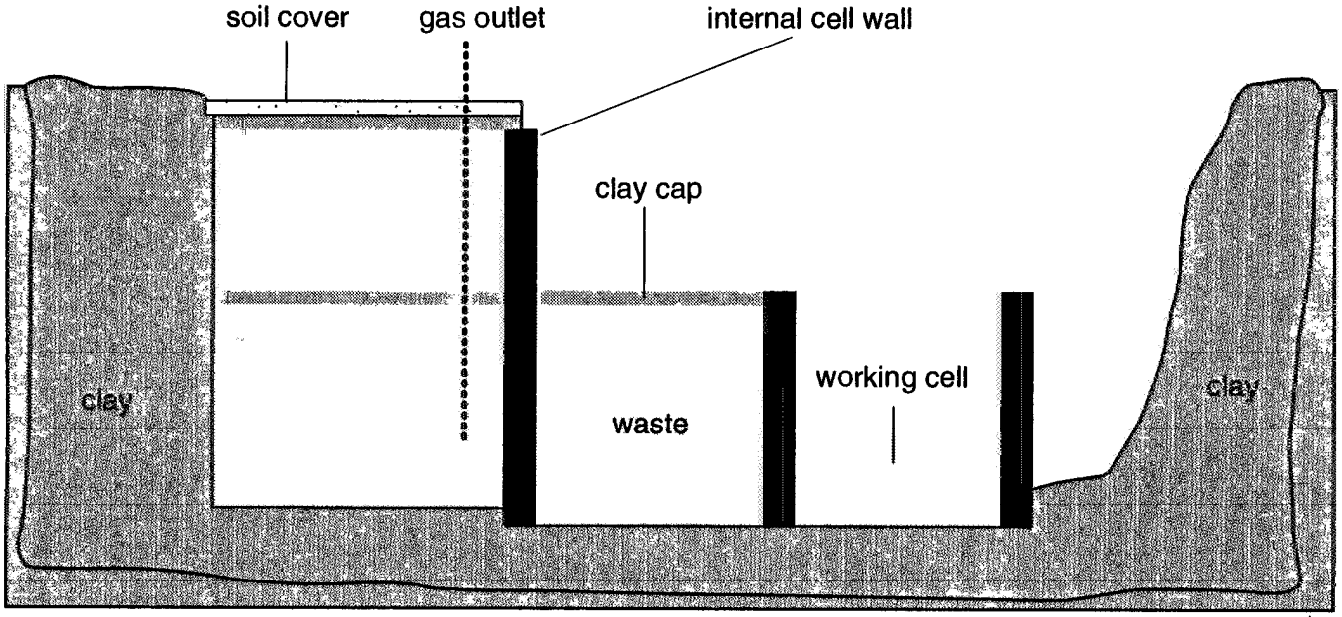
.....[3]

For Examiner's Use

(b) The diagram shows the cell method of landfill. Waste is compacted before it is put in the cell, and full cells are sealed at the top with clay. Landfill gas is piped off.



(i) Explain why compacting the waste will encourage anaerobic decay.

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.....[1]

(ii) Suggest **one** other advantage of compacting the waste.

.....[1]

(iii) Suggest **two** reasons why a 2:1 clay such as bentonite would be preferred for the clay cells, rather than a 1:1 clay.

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.....[2]

(iv) Landfill produces methane. What use can be made of this?

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[Total: 10]

END OF QUESTION PAPER