

OXFORD CAMBRIDGE AND RSA EXAMINATIONS**Advanced GCE****CHEMISTRY****2815/03**

Environmental Chemistry

Friday

23 JANUARY 2004

Afternoon

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

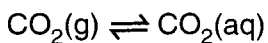
- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised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

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	11	
2	11	
3	11	
4	12	
TOTAL	45	

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

Answer **all** the questions.

- 1 Carbon dioxide in the troposphere is in equilibrium with dissolved carbon dioxide in oceans, lakes and rivers.



Some of the carbon dioxide released into the troposphere is removed by dissolving in this way.

- (a) (i) What is the *troposphere*?

.....
.....[1]

- (ii) State **one** other way in which carbon dioxide leaves the troposphere.

.....[1]

- (iii) Dissolved carbon dioxide can weather carbonate rocks such as limestone. Write an equation for the reaction involved.

.....[1]

- (b) Over the last two hundred years, there has been a significant increase in the concentration of carbon dioxide in the troposphere. This may contribute to global warming.

- (i) Suggest a reason for the increase.

.....
.....[1]

- (ii) Explain the possible connection between carbon dioxide concentration and global warming.

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.....
.....[4]

- (c) Incineration of waste plastic also puts carbon dioxide into the atmosphere.
State **two** advantages and **one** disadvantage, other than global warming, of the disposal of plastic waste by incineration, rather than by landfill.

advantages

.....

.....

disadvantage

.....[3]

[Total: 11]

2 Clays are aluminosilicate minerals with a layered structure.

(a) A basic building block of clays is the silicate ion, SiO_4^{4-} .

(i) Draw the three dimensional structure of this ion, stating its shape.

[2]

(ii) Suggest the formula and charge of the ion formed when two SiO_4^{4-} units link by sharing one oxygen.

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

(b) The table shows the cation exchange capacity and the pH at which the overall charge is zero for two clays.

clay (type)	cation exchange capacity/mol kg ⁻¹	pH for zero charge
kaolinite (1:1)	0.3	4.6
montmorillonite (2:1)	1.0	2.5

(i) Explain, in terms of structure, why montmorillonite has a higher cation exchange capacity than kaolinite.

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.....[3]

- (ii) When the pH of montmorillonite is lowered to 2.5, the charge becomes zero. Suggest why.

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..... [2]

- (iii) What is the effect of lowering pH on the supply of nutrient cations to plants?

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..... [2]

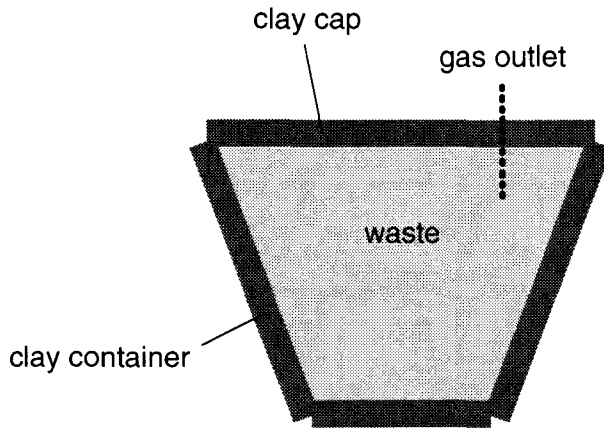
[Total: 11]

.....[10]

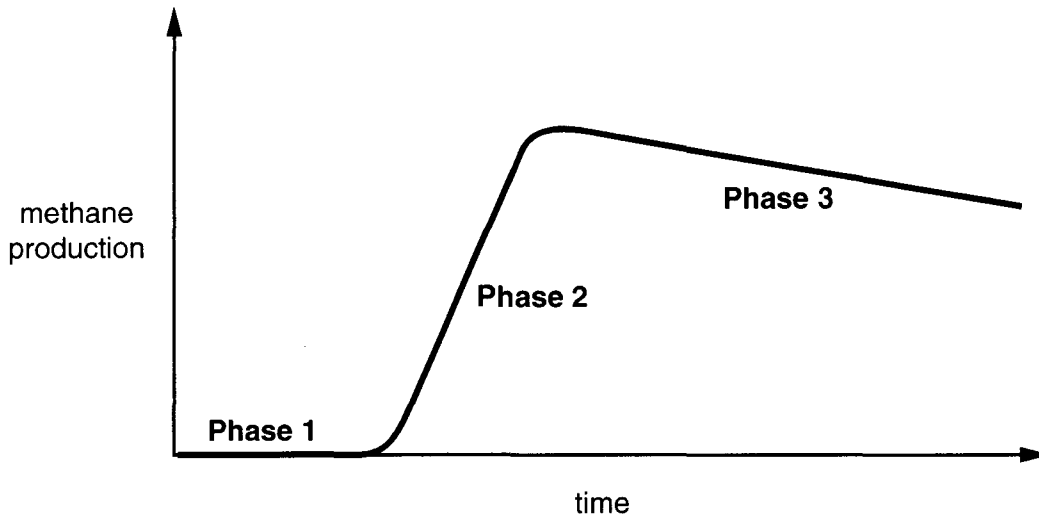
Quality of Written Communication [1]

[Total: 11]

- 4 (a) Waste in landfill is sometimes packed into cells, which are sealed with clay.



As the waste decays, landfill gas is produced; this contains methane. The graph below shows how the production of methane varies with time.



- (i) Suggest why methane is **not** a decomposition product in **Phase 1**.

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.....[2]

- (ii) Explain the sharp increase in methane production in **Phase 2**.

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.....[2]

(iii) Suggest why methane production gradually tails off in **Phase 3**.

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.....[1]

(iv) Explain why landfill gas containing methane can be dangerous.

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.....[1]

(b) The gas produced by some sewage treatment plants contains hydrogen sulphide. This is removed by passing the gas with air through biofilters that contain microorganisms. The emerging gas contains only water vapour and carbon dioxide.

(i) State **one** reason why hydrogen sulphide is undesirable.

.....[1]

(ii) Suggest **one** sulphur-containing substance into which the hydrogen sulphide might be converted by the microorganisms.

.....[1]

(c) Water from treatment plants can still be hard, due to dissolved calcium and magnesium compounds.

(i) What is meant by *hard water*?

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.....[1]

(ii) State and explain **one** method for removing the hardness.

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.....[3]

[Total: 12]

END OF QUESTION PAPER