



ADVANCED GCE
CHEMISTRY
 Environmental Chemistry

2815/03

Candidates answer on the question paper

OCR Supplied Materials:

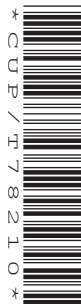
- *Data Sheet for Chemistry* (Inserted)

Other Materials Required:

- Scientific calculator

Thursday 18 June 2009
Morning

Duration: 50 minutes



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

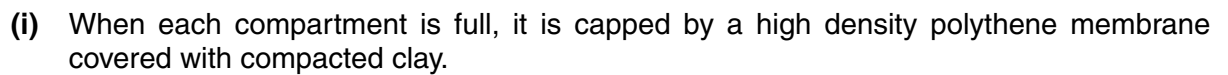
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	11	
2	11	
3	13	
4	10	
TOTAL	45	

(a) The landfill is divided into a number of compartments which are filled in turn. The diagram shows a compartment from a modern landfill system.

[illegible]

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- (ii) The landfill gas is a mixture of gases.

Name **two** gases present in *landfill gas*. Explain why each gas needs to be piped away.

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..... [4]

- (b) Flue gases from incinerators contain compounds such as sulphur dioxide, SO_2 , and nitrogen monoxide, NO . These must be removed before the flue gas is released to the atmosphere.

- (i) State **two** reasons, apart from the greenhouse effect, why sulphur dioxide should **not** be released into the atmosphere.

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..... [2]

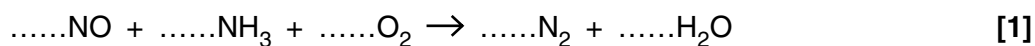
- (ii) The sulphur dioxide is removed by reacting it with sodium hydroxide solution in the presence of oxygen, forming sodium sulphate, Na_2SO_4 .

Write an equation for this reaction.

..... [1]

- (iii) Nitrogen monoxide is removed by heating with ammonia and oxygen in the presence of a catalyst to form nitrogen and steam.

Complete the equation for this reaction.



[Total: 11]

- 2 (a) Hard water, $\text{Ca}(\text{HCO}_3)_2$ solution, is formed when rainwater slowly dissolves the rock in limestone areas. Limestone caves can be formed at the same time.

Stalagmites and stalactites, made of calcium carbonate, are formed in limestone caves when temporary hard water drips slowly from the roof and evaporates.



- (i) Use the equilibrium above to explain the formation of the solid calcium carbonate in the caves.

.....

 [3]

- (ii) $100\,000\text{ dm}^3$ of $\text{Ca}(\text{HCO}_3)_2(\text{aq})$, with a concentration of 0.096 mol dm^{-3} is slowly converted to calcium carbonate over thousands of years.

Calculate the maximum mass, in g, of calcium carbonate that could be formed.

maximum mass of calcium carbonate = g [3]

- (b) Aluminium ions and chlorine gas are used at various stages in the treatment of natural water for domestic water supplies.

Explain the chemistry underlying the use of these two substances.

aluminium ions:

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chlorine gas:

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..... [5]

[Total: 11]

3 This question is about ozone in the stratosphere and troposphere.

- (a) (i) The ozone concentration in the stratosphere should remain fairly constant from year to year. This can be explained by the 'oxygen only' model.

Outline the chemical reactions involved.

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..... [4]

- (ii) Draw a 'dot-and-cross' diagram for ozone, O_3 .

[1]

(b) CFCs damage the ozone layer by acting as a source of chlorine free radicals.

- (i) State **one** disadvantage of damaging the ozone layer.

..... [1]

- (ii) A number of less damaging alternatives to CFCs have been developed. These alternatives are volatile and non-toxic.

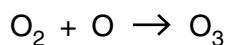
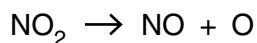
Suggest **two other** factors that should be considered when choosing these alternatives.

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..... [2]

- (c) Ozone is involved in the formation of photochemical smog in the troposphere.

It is formed from nitrogen dioxides by the following reactions.



- (i) The first step involves homolytic fission.

Explain the meaning of the term *homolytic fission*.

.....
 [1]

- (ii) Ozone reacts with rubber, a naturally occurring polymer. Rubber is an unsaturated hydrocarbon.

State and explain the damaging effect of the ozone in photochemical smog on rubber.

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 [2]

- (iii) Suggest and explain **one** way in which the level of nitrogen oxides from motor vehicles can be reduced. Your answer should include an equation.

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 [2]

[Total: 13]

- 4 In this question, one mark is available for the quality of use and organisation of scientific terms.

Both 1:1 and 2:1 clays contain layers of aluminate and silicate sheets.

The two types of clay have differing tendencies to absorb water. They also differ in their abilities to undergo ion exchange reactions with aqueous cations in the soil water.

Explain these differing properties of 1:1 and 2:1 clays in terms of the differences in their structures. You may find it helpful to use diagrams in your answer.

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[Total: 10]

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