

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

Environmental Chemistry

Tuesday

**25 JANUARY 2005**

Afternoon

50 minutes

Candidates answer on the question paper.

Additional materials:

*Data Sheet for Chemistry*

Scientific calculator

Candidate Name	Centre Number	Candidate Number										
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td></tr> </table>						<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td><td style="width: 15px; height: 15px;"></td></tr> </table>					

**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 the questions 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.

<b>FOR EXAMINER'S USE</b>		
<b>Qu.</b>	<b>Max.</b>	<b>Mark</b>
<b>1</b>	<b>9</b>	
<b>2</b>	<b>12</b>	
<b>3</b>	<b>10</b>	
<b>4</b>	<b>14</b>	
<b>TOTAL</b>	<b>45</b>	

---

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



Answer **all** the questions.

1 Sulphur dioxide emissions from ship exhausts worldwide total  $1.20 \times 10^7$  tonnes per year. In confined waterways, such as the English Channel, these emissions can make a significant contribution to acid rain in nearby countries.

(a) (i) Explain how sulphur dioxide is converted to  $H_2SO_4$  in the formation of acid rain. Your answer should include at least **one** equation.

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

(ii) Calculate the maximum mass of  $H_2SO_4$  that could be produced from  $1.20 \times 10^7$  tonnes of sulphur dioxide from ship exhausts. Give your answer to an appropriate number of significant figures.  
(1 tonne =  $10^6$  g)

[2]

(b) Acid rain, containing dilute sulphuric acid, reacts with limestone buildings. Explain this reaction. Your answer should include an equation.

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

(c) Rain containing dissolved carbon dioxide can also slowly react with limestone.

(i) Write a balanced equation for the reaction.

.....[2]

(ii) Explain why this reaction can be classified as acid-base.

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

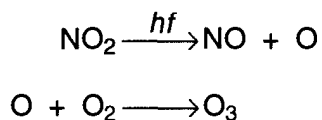
[Total: 9]

2 Ozone is a component of photochemical smog in the troposphere.

(a) What do you understand by the term *troposphere*?

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

(b) Ozone concentration in the troposphere is increased by the following pair of reactions, involving free radicals.



(i) What does the term *hf* represent?

.....[1]

(ii) Draw a 'dot-and-cross' diagram for a molecule of NO.

[1]

(iii) Explain why NO is described as a free radical.

.....[1]

(c) Most of the ozone in the troposphere comes from the stratosphere, by atmospheric mixing.

Describe the *oxygen only* model for the formation of ozone in the stratosphere.

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

(d) Ozone reacts with rubber, a naturally occurring polymer. Rubber is an unsaturated compound.

(i) Suggest how ozone reacts with rubber. An equation is **not** required.

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

(ii) Suggest how the appearance of the rubber is changed by the reaction.

.....[1]

(e) Ozone can contribute to the **greenhouse effect** in the troposphere.

(i) Suggest **one** reason for this.

.....[1]

(ii) Suggest why the contribution of ozone to the greenhouse effect is relatively small.

.....[1]

(f) Why is ozone sometimes preferred to chlorine for treatment of water supplies?

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

[Total: 12]



.....[9]

Quality of Written Communication [1]

[Total: 10]

4 Houses built on clay are particularly at risk from subsidence, and more so in times of drought. Tree roots remove water from the ground, which causes the clay supporting the houses to dry out and contract. Subsidence can then occur.

(a) Explain, in terms of structure, why this problem is worse for homes built on 2:1 clays than on 1:1 clays.

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

(b) Colloidal clay particles in natural waters often carry a negative charge.

(i) What do you understand by the term *colloidal*?

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

(ii) Explain how these colloidal particles are removed from untreated water to make it potable.

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



(c) Clay particles can act as cation exchangers.

(i) Aqueous potassium ions in soil water are used up by plants. Explain the role of clay particles in replacing these ions.

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

(ii) Explain how acid rain can cause cations to be released from clays. Why may this be damaging to the environment?

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

[Total: 14]

**END OF QUESTION PAPER**