

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

Environmental Chemistry

Wednesday

**29 JANUARY 2003**

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 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	12	
2	7	
3	11	
4	7	
5	8	
<b>TOTAL</b>	<b>45</b>	

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**This question paper consists of 8 printed pages.**

Answer **all** the questions.

1 (a) Temporary hardness can arise in water which has trickled through rocks containing magnesium carbonate.

(i) Outline how this temporary hardness arises. Your answer should include an equation, with state symbols.

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

(ii) Suggest **two** factors that might affect the amount of hardness in the water in (i).

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

(b) (i) How does a deposit form on the element of an electric kettle in hard water areas?

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

(ii) Suggest why the formation of this deposit is a problem in the operation of the kettle.

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

(c) Explain the chemistry involved in the removal of temporary hardness from water by the process of cation exchange.

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

[Total: 12]

2 The diagram, Fig. 2.1, shows the layout of a typical treatment plant for the production of potable water.

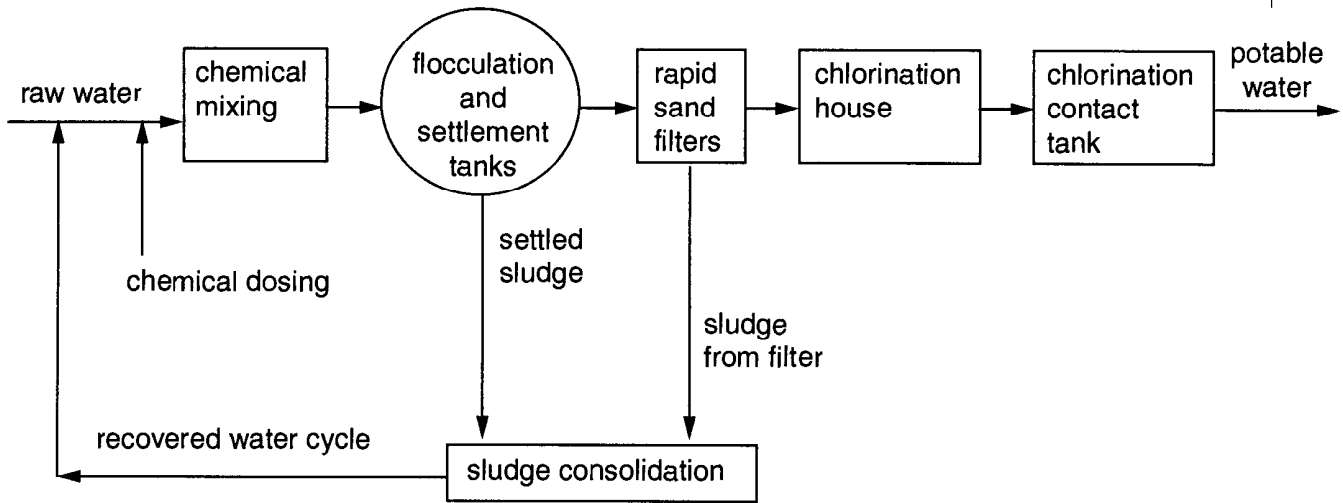


Fig. 2.1

(a) In the flocculation and settlement tanks, very fine suspended solids are removed. Explain, in chemical terms, how this is achieved.

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

(b) Suggest how the sludge is removed from the rapid sand filters.

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

(c) Chlorine reacts with water to produce hydrochloric acid and chloric(I)acid,  $\text{HClO}$ .

What **changes** in oxidation number of chlorine have taken place during the reaction?

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

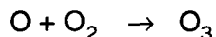
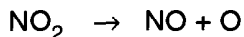
[Total: 7]

3 Ozone is a harmful constituent of photochemical smog, which can form in the troposphere. Ozone is produced photochemically from nitrogen dioxide and oxygen.

(a) What is meant by the term *photochemically*?

.....[1]

(b) The following equations show the formation of ozone from nitrogen dioxide and oxygen in the troposphere.



(i) Which of these reactions requires light energy? Explain your answer.

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

(ii) Draw a *dot-and-cross* diagram of nitrogen monoxide, NO, showing outer electrons only. Explain why it can be called a *free radical*.

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

(iii) One source of nitrogen oxides in the troposphere is the emissions from car exhausts. Describe how catalytic convertors in car exhaust systems are effective in decreasing the emission of nitrogen oxides.

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

(c) State **one** way in which ozone is damaging to human health.

.....[1]

(d) Ozone reacts with rubber, a naturally occurring unsaturated polymer.

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

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

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

.....[1]

[Total: 11]

4 The Foot and Mouth crisis in the UK during 2001 left authorities with the problem of disposing of large numbers of animal carcasses. They achieved this by burning and by mass burials.

(a) What environmental and health concerns need to be taken into account when planning the burning of carcasses?

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

(b) Burials of carcasses were carried out in large pits, each with a capacity for 25 000 sheep or equivalent.

(i) Name **two** of the gases which could have been produced by decomposition of the animal matter, and outline the possible hazard to the local community associated with **one** of them.

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

(ii) A problem with mass burials is the possible contamination of ground water. Suggest how the ground water might have become contaminated, and how this problem could be minimised.

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

[Total: 7]



