

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

SCIENCE

2844

Science and Environmental Management

Tuesday

20 JUNE 2006

Morning

1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Candidate Name	Centre Number	Candidate Number												
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TIME 1 hour 30 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 an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	13	
3	17	
4	15	
5	14	
6	17	
TOTAL	90	

This question paper consists of 14 printed pages and 2 blank pages.

Answer **all** the questions.

- 1 Fig. 1.1 shows the concentration of nitrate ions in a stream flowing through an area of farmland in England, in the year 2000. It also shows how the stream flow varied throughout the year.

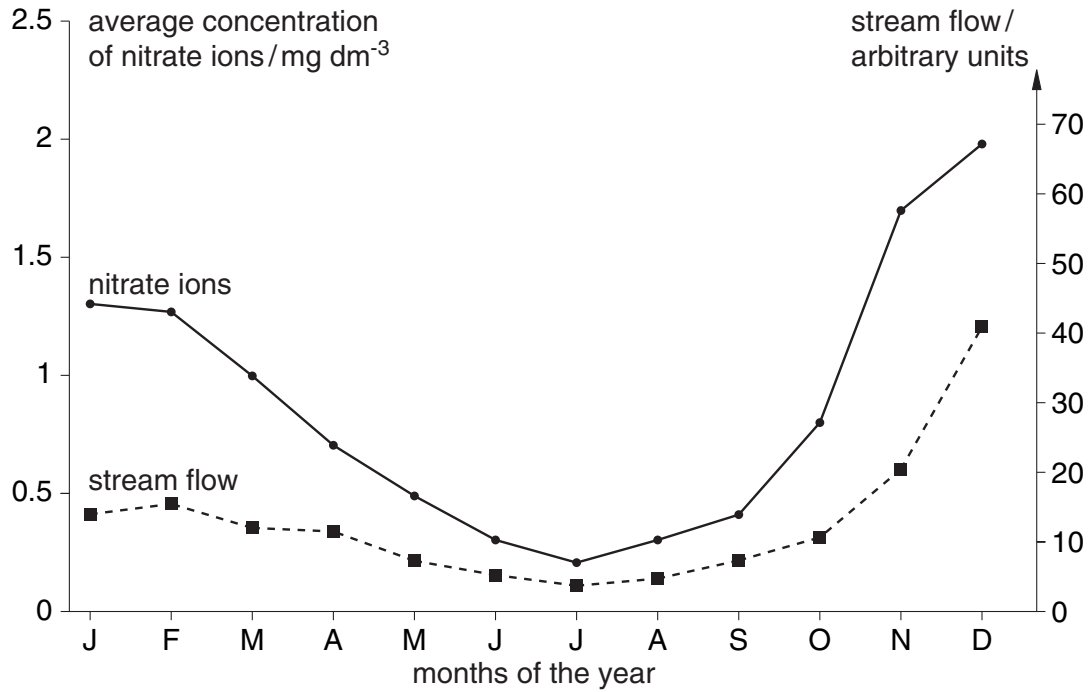


Fig. 1.1

- (a) Suggest **two** sources of the nitrate ions in the stream.
- 1
- 2 [2]
- (b) Suggest why the nitrate ion concentration and stream flow vary as shown throughout the year.
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- [3]
- (c) A high concentration of nitrate ions in water can cause environmental problems. Suggest **two** strategies for decreasing the concentration of nitrate ions entering the stream.
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- [2]

- (d) In order to collect data on the concentration of nitrates in a stream throughout the year, samples of the stream water must be taken and analysed.

Suggest what factors need to be controlled in the sampling so that comparisons can be made, on a month by month basis, of the concentration of nitrates in the stream.

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..... [3]

- (e) High concentrations of nitrate and phosphate ions in stream water may lead to an increase in the populations of algae in the stream.

- (i) Suggest a reason for this.

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..... [1]

- (ii) Describe the effect that increased populations of algae could have on fish living in the stream.

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..... [3]

[Total: 14]

2 Many algae can reproduce both sexually and asexually. A mature *Chlamydomonas* alga is a single haploid cell. During asexual reproduction, the cell undergoes mitosis. Haploid daughter cells are created that emerge from the enclosing parent cell as spores.

(a) State the meaning of the term *haploid*, as used in the passage above.

..... [1]

(b) Describe how a cell undergoes mitosis to produce daughter cells.

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(c) Under certain environmental conditions, such as lack of nutrients or moisture, the haploid daughter cells undergo sexual reproduction. Instead of forming spores, the haploid daughter cells fuse to form a diploid zygote. The zygote undergoes meiosis, to produce four haploid cells that eventually grow into mature cells.

(i) Explain the different effects that the two types of reproduction, sexual and asexual, may have on variation in algal cells.

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..... [4]

(ii) State the meaning of the term *diploid*.

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..... [1]

(d) Explain **one** possible advantage to a species of reproducing sexually rather than asexually.

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..... [2]

[Total: 13]

3 (a) Deoxyribonucleic acid (DNA) is made from a long chain of nucleotides, each of which consists of

- deoxyribose (sugar)
- phosphate group
- base (adenine, guanine, cytosine or thymine).

Using the key in Fig. 3.1, draw a diagram to show how these components are arranged in a short section of double stranded DNA.



Fig. 3.1

[4]

(b) Name the type of bond that holds the two strands of DNA together.

..... [1]

(c) Explain how just four different bases in DNA are sufficient to code for all the different amino acids in proteins.

.....

 [3]

(d) Ribonucleic acid (RNA) is another molecule composed of nucleotides. In RNA, the sugar is ribose instead of deoxyribose.

(i) State **two** ways, other than the type of sugar, in which RNA is different from DNA.

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 [2]

(ii) Two different kinds of RNA are found in a cell: transfer RNA (tRNA) and messenger RNA (mRNA). Describe how they are both involved in the synthesis of proteins.

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(e) Explain how damage to a single base in DNA can cause a mutation which results in a protein that is completely non-functional.

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[Total: 17]

4 The aim of genetic modification of plants is to remove a desired gene from one organism and transfer it to another organism where it can be expressed. This means that a required protein can be synthesised within the receiving organism. One important application of this process is to produce plants that are resistant to certain insect pests.

(a) Give **two** possible benefits, other than to gain pest resistance, of genetic modification in plants.

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..... [2]

(b) In order to carry out gene transfer, passenger DNA must be isolated and removed from the DNA of a plant which shows the desired characteristics.

Describe how restriction enzymes are used to achieve this.

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(c) The passenger DNA may then be inserted into a section of vector DNA to produce recombinant DNA.

(i) Describe how this is done.

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(ii) Suggest **one** possible vector.

..... [1]

(d) The vector carries the desired gene into the cell of a new organism. This is often a bacterium, and eventually the bacterium may carry the new gene into a new plant by infection.

(i) Not all bacterial cells will take up the new gene. Describe a method for identifying those bacterial cells containing recombinant DNA.

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..... [3]

(ii) It may not be possible to carry the recombinant DNA into the plant cell by infection. Describe **one** other method that may be used to insert the recombinant DNA into the receiving plant cell.

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..... [2]

(e) There are possible dangers associated with genetic modification of plants.

(i) Describe **one** possible danger.

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..... [2]

(ii) State **one** way of minimising this danger.

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..... [1]

[Total: 15]

- 5 Modern pesticides are designed to be broken down in the soil to prevent their build-up and resultant damage to animal life. The breakdown process normally takes around two months.

Extracts from the soil are analysed at intervals to check that these pesticides are breaking down. Thin layer chromatography (t.l.c.) can be used for this analysis.

Some results are shown in Fig. 5.1.

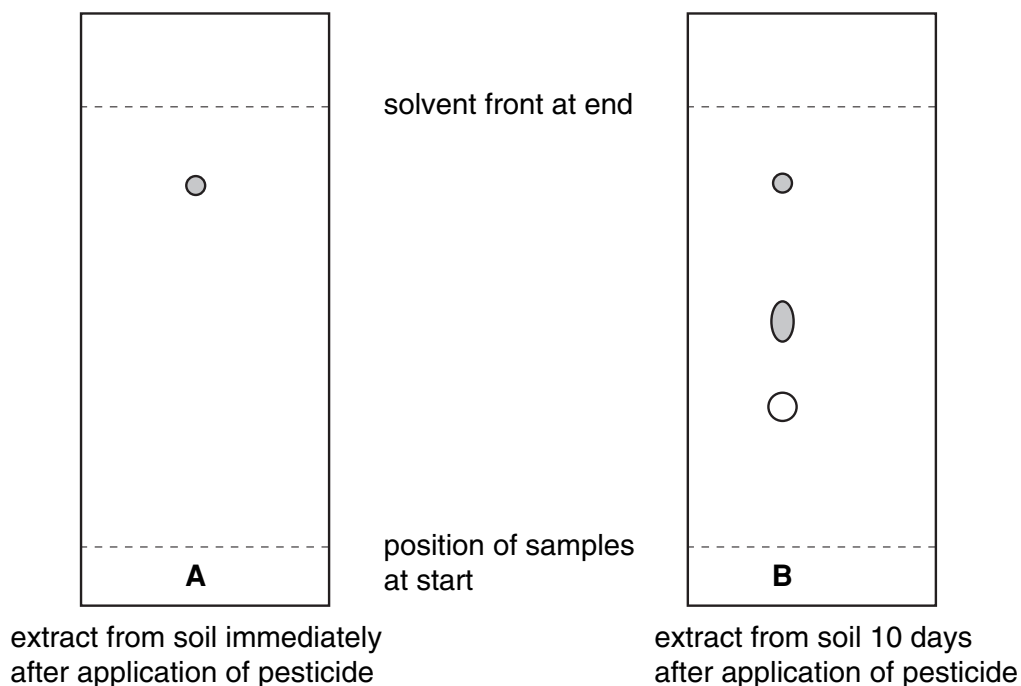


Fig. 5.1

- (a) Explain why there are 3 spots visible on the chromatogram from extract **B**.

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 [2]

- (b) What would you expect to see on a chromatogram from an extract taken after 2 months? Explain your answer.

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 [2]

(c) A t.l.c. plate is made from a thin layer of aluminium oxide or silica powder, coated onto a sheet of glass. The bottom of the plate is placed in a suitable non-polar solvent.

(i) T.l.c. works because different types of molecule in the sample bind more or less strongly to the grains of powder on the plate. Explain why.

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..... [3]

(ii) Components of a sample become separated as they travel up the t.l.c. plate. Explain why.

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(d) Sometimes the spots on a t.l.c. plate may be so close together that it is not possible to see how many spots there are. What can be done to separate spots which are very close together?

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..... [1]

(e) Gas liquid chromatography (g.l.c.) is another form of chromatography. State **two** differences between t.l.c. and g.l.c.

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..... [2]

[Total: 14]

6 In this question, four marks are available for the quality of written communication.

When substances are dissolved in water, the dissolving may be accompanied by a temperature change. Fig. 6.1 shows the temperature changes observed when three ionic compounds are dissolved in water.

compound	temperature change
NaCl	none
CaCl_2	increase
NH_4Cl	decrease

Fig. 6.1

(a) Explain, in terms of bonds breaking and forming, the reasons for the temperature changes which are observed in the three cases above.

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Quality of Written Communication [4]

(b) Volume changes may also be observed when substances dissolve in water.

Explain how dissolving a substance in water can result in a reduction in total volume.

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(c) Explain, in terms of the overall entropy change, why dissolving occurs in all three of the cases shown in Fig. 6.1.

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..... [4]

[Total: 17]

END OF QUESTION PAPER

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