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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	0	5	/	0	1	Signature	

Paper Reference(s)

6105/01

Edexcel GCE

Biology

Advanced

Unit 5B

Monday 24 January 2005 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

Materials required for examination
Ruler

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your signature, surname and initials. The paper reference is shown above.
Check that you have the correct question paper.
Answer ALL SEVEN questions in the spaces provided in this booklet.
If you need to use additional answer sheets, attach them loosely but securely inside this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and parts of questions are shown in round brackets: e.g. **(2)**.
The total mark for this question paper is 70.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.
The Synoptic section (Questions 4 to 7) is designed to give you the opportunity to make connections between different areas of biology and to use skills and ideas developed throughout the course in new contexts. You should include in your answers any relevant information from the whole of your course.

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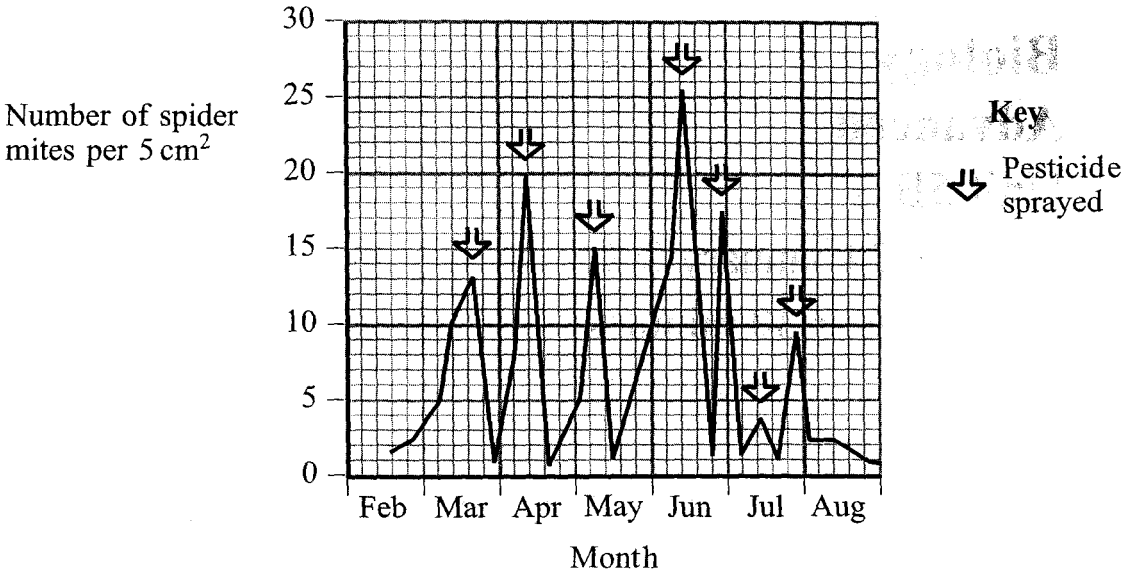
Answer ALL questions in the spaces provided.

1. Spider mites are pests of many glasshouse crops, such as salad vegetables. These pests can be controlled either by using pesticides or by the introduction of a predator. The graph below shows how the number of spider mites per cm^2 of leaf surface in a glasshouse fluctuated during the growing season when controlled using pesticides. The arrows indicate the times at which the pesticide was sprayed.



(a) Explain why the numbers of spider mites decreased immediately after the spraying of the pesticide, and then rose again.

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(3)

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(b) Explain the meaning of the term **integrated pest management** (IPM).

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(2)

(c) Spider mites can be controlled biologically using a natural predator.

Describe **two** advantages of using biological control compared with chemical control.

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(2)

(Total 7 marks)

Q1

Leave blank

2. The inheritance of the ABO blood-group system in humans is an example of multiple allele inheritance.

(a) Distinguish between the terms **multiple allele inheritance** and **polygenic inheritance**.

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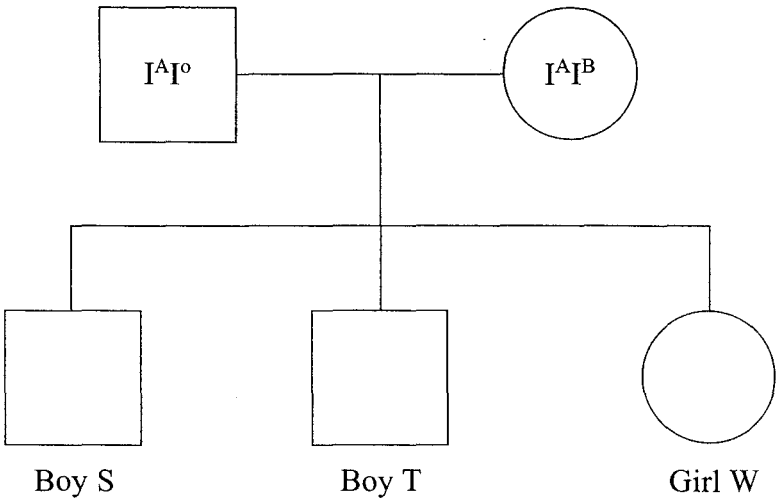
(2)

(b) The diagram below shows the genotypes of a man and a woman for the ABO blood group system. It also shows their three children, S, T and W.



(i) Complete the table to show all the possible genotypes of each of the children.

Child	Blood group of child	Possible genotypes
Boy S	A	
Boy T	B	
Girl W	AB	

(2)

Leave blank

(ii) Explain, with the use of a genetic diagram, why girl W could not have any children with blood group O, even if their father has blood group O.

(3)

(c) The ABO blood-group system has been used in tests where the fatherhood of a child was in doubt.

Give an example of another technique that could be used to indicate the fatherhood of a child. State **one** advantage of this technique compared with using ABO blood groups.

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(2)

Q2

(Total 9 marks)

Leave blank

3. In most plants, the enzyme ribulose bisphosphate carboxylase (rubisco) catalyses the fixation of carbon dioxide. This fixation occurs during the light-independent stage of photosynthesis, as shown in the equation below.

$$\textbf{carbon dioxide + 5C compound X} \xrightarrow{\textbf{rubisco}} \textbf{2 × 3C compound Y}$$

Since the product of this reaction is a 3-carbon compound, plants which fix carbon dioxide in this way are called C3 plants.

However, oxygen produced by photosynthesis competes with carbon dioxide for the active site of rubisco. If oxygen occupies the active site, photosynthesis is inhibited and less carbon dioxide is fixed.

Some plants, such as maize and sugar cane, fix carbon dioxide using a 3-carbon compound. This is catalysed by a different enzyme and the product is a 4-carbon compound. These plants are known as C4 plants. Oxygen does not compete with carbon dioxide for the active site of this enzyme.

(a) Name compounds X and Y shown in the equation above.

X .....

Y .....

(2)

(b) State where the fixation of carbon dioxide takes place in the chloroplast of a C3 plant.

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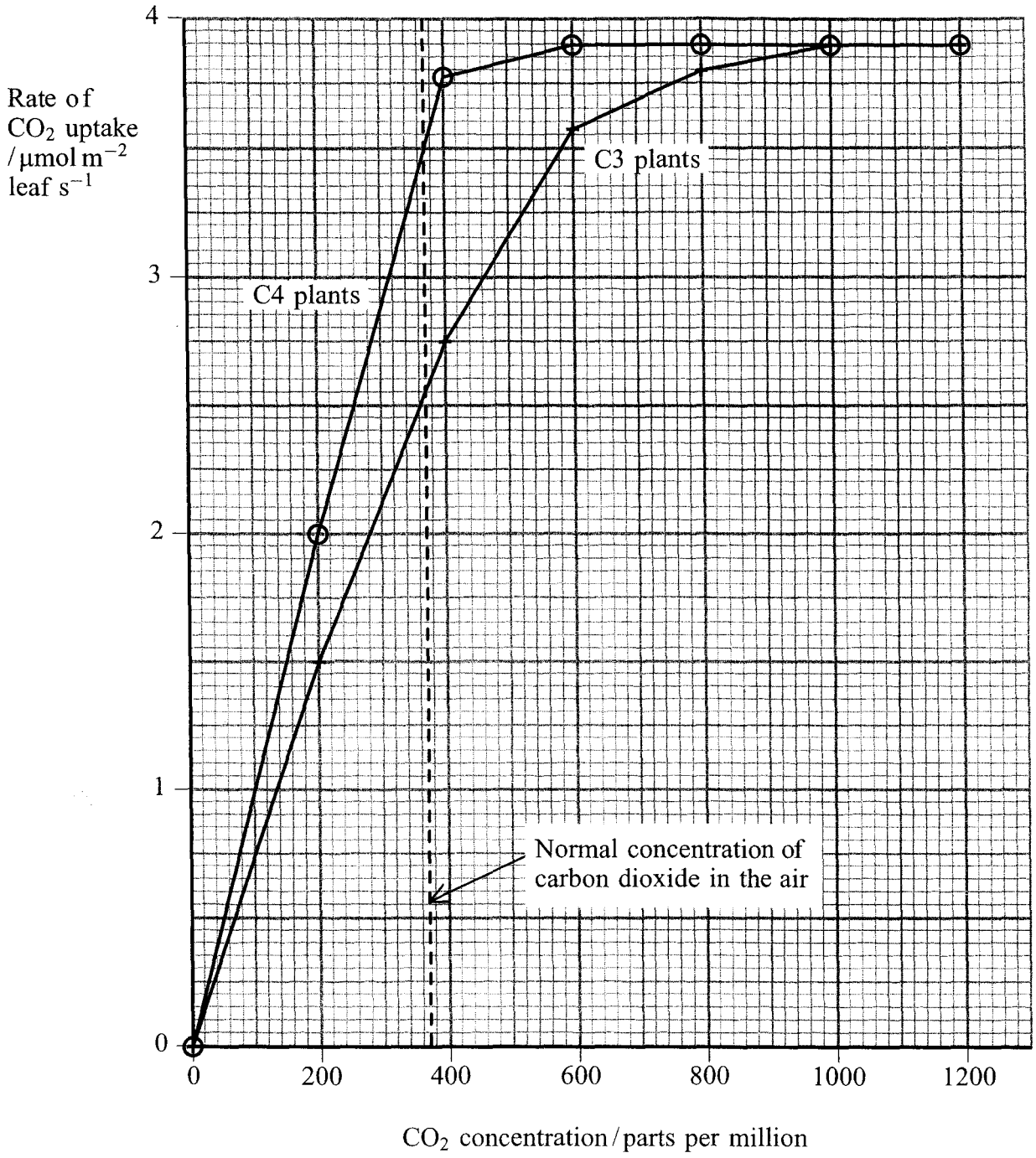
(1)

Leave blank

(c) The graph below shows the rate of carbon dioxide uptake in C3 and C4 plants at different carbon dioxide concentrations, at a constant high light intensity.



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(i) Compare the rate of carbon dioxide uptake in C3 plants with that of C4 plants as the carbon dioxide concentration increases.

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(3)

(ii) With reference to the data shown by the graph and the information in the passage, suggest why C4 crop plants such as maize are grown in tropical regions which have long periods of high light intensity.

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(2)

(Total 8 marks)

Q3

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Synoptic Section

The questions in this section are designed to give you the opportunity to make connections between different areas of biology and to use skills and ideas developed throughout the course in new contexts. You should include in your answers any relevant information from the whole of your course.

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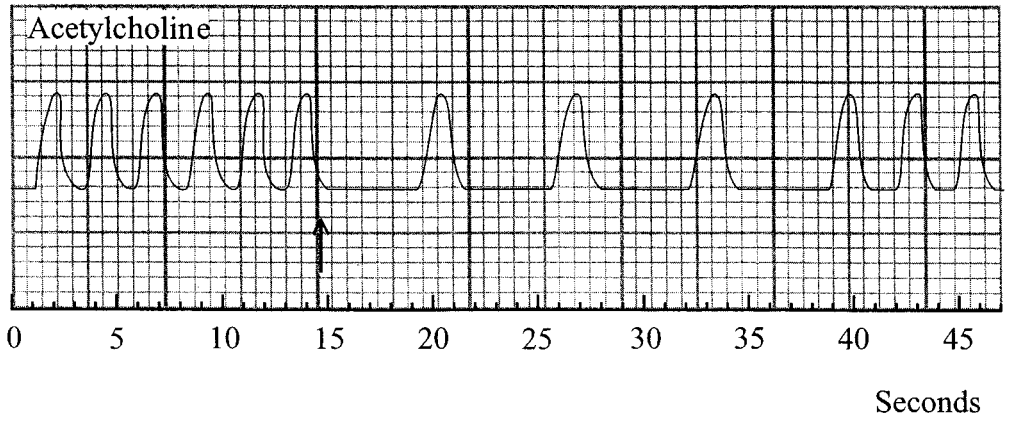
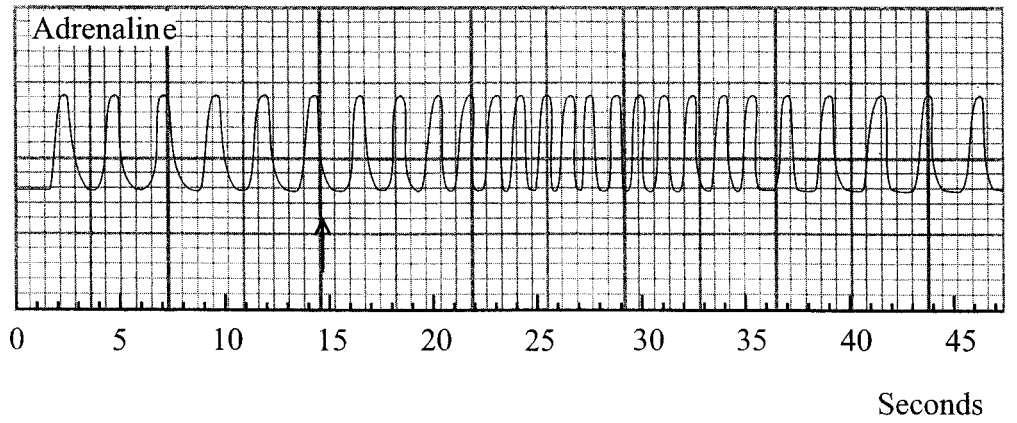
4. Adrenaline is a hormone that is secreted by the adrenal gland. Acetylcholine is a neurotransmitter. An investigation was carried out to determine the effect of these two chemicals on heart rate.

The results are shown in the diagram below. Each peak indicates one heart beat. The arrows indicate when the acetylcholine or adrenaline was added.





(a) (i) Calculate the heart rate shown in the first diagram before the acetylcholine was added.

Answer = ...

(2)

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(ii) Compare the effects of acetylcholine and adrenaline on heart rate.

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(3)

(b) Describe the role of adrenaline in the control of blood glucose.

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(c) 'Transmitter substances such as acetylcholine are essential to the functioning of the nervous system.' Explain this statement.

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(5)

(Total 12 marks)

Q4

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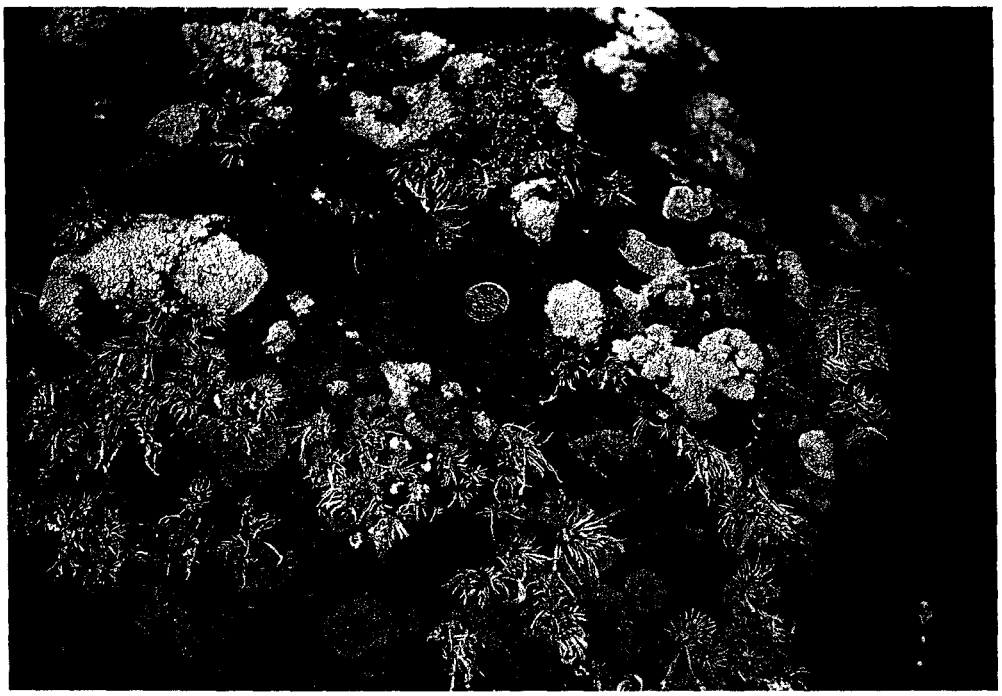
5. Lichens are often found growing on the bark of trees and other surfaces. A lichen consists of an alga and fungus living together in a close relationship in which both organisms benefit.



(a) Name the type of relationship shown by the alga and the fungus in a lichen. Give another example of this type of relationship between two organisms.

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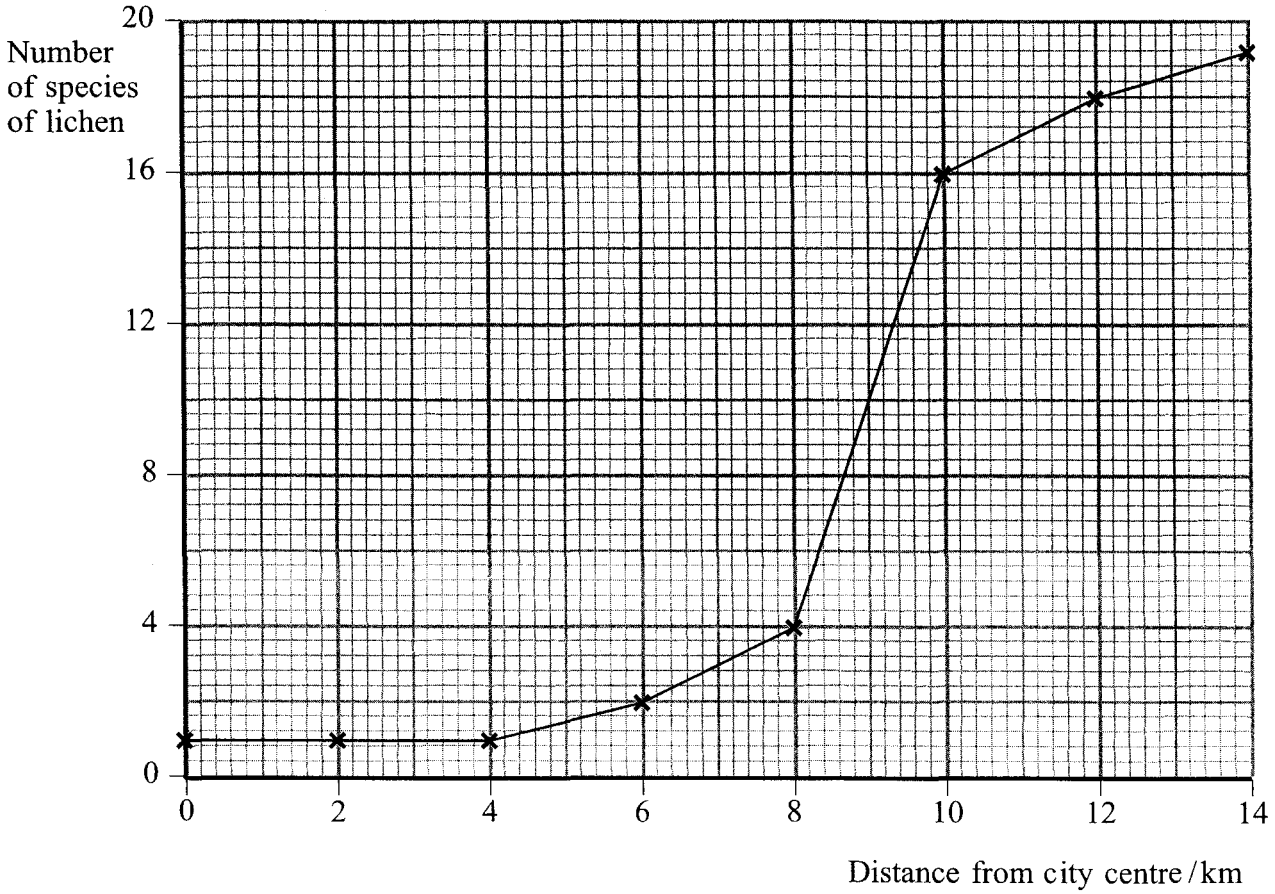
(2)

(b) A survey of the lichens growing at different distances from the centre of a large city was carried out. At intervals of 2 kilometres, the number of different species of lichen on the trees within a 10 × 10 metre square was counted. This technique of sampling is known as a line transect.

The results of this survey are shown in the graph below.



The mean winter sulphur dioxide concentration at some of the sites along the line transect was also assessed. The results of this assessment are shown in the table below.

Distance from city centre /km	Mean winter SO_2 concentration /μg m^{-3}
0	18
6	17
10	6
14	3

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(i) Compare the trend shown by the lichen survey with that shown by the sulphur dioxide assessment.

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(3)

(ii) Suggest an explanation for the changes in sulphur dioxide concentration with increasing distance from the city centre.

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(c) Describe **one** technique, other than a line transect, that you could use to investigate the distribution of a named organism in a named habitat.

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(4)

Q5

(Total 11 marks)

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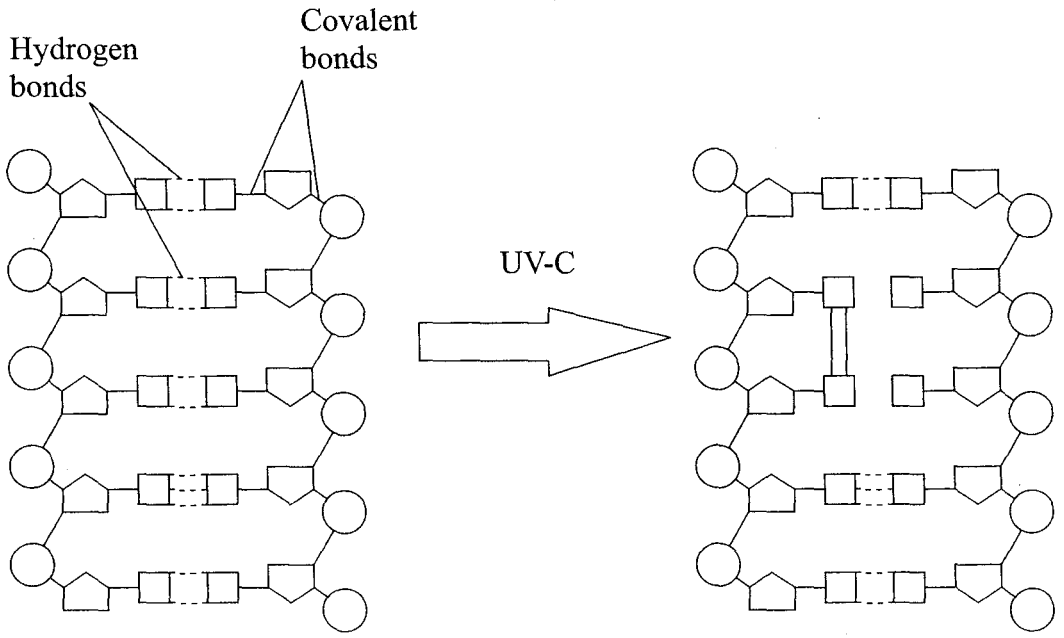
6. Ultraviolet radiation with wavelengths from 200 nm to 280 nm is known as UV-C and has strong mutagenic effects. One of the effects of UV-C is to damage pyrimidine bases within DNA.

(a) The diagram below shows the effect of UV-C upon DNA.



(i) On the diagram above, draw a circle around one nucleotide.

(1)

(ii) Describe the changes in the structure of the DNA that have been caused by exposure to UV-C.

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(2)

(iii) Suggest how the changes shown above might affect the replication of DNA.

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(b) Many organisms are able to synthesise an enzyme, photolyase, that repairs DNA damaged by UV-C. This repair system is called photoreactivation.

The table below shows the effect of UV-C upon the survival rate of two groups of fruit flies, A and B.

UV-C dosage / arbitrary units	Percentage survival rate	
	Group A	Group B
0	100	100
100	55	65
200	40	25
300	30	0
400	15	0
500	15	0
600	5	0
700	0	0

(i) Compare the survival rates of the flies in group A and group B as the dosage of UV-C increases.

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(ii) Suggest which group of flies was able to synthesise photolyase. Explain your answer.

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(2)

(Total 11 marks)

Q6

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7. The banana is the world's fourth most important crop after rice, wheat and maize. Surprisingly, most varieties of banana in cultivation have been derived from just two species, *Musa acuminata* and *Musa balbisiana*. Unlike other staple crops, the banana has not been improved and yields have only increased slowly through the use of agricultural chemicals.

Ecoscene/Paul Thompson

Improving the banana has proved difficult as most of the bananas grown commercially are infertile and the fruits are seedless. Researchers are hoping to find suitable genes in wild varieties of banana that could be used to improve fungal resistance.

This question continues on the next page.

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(a) The table below shows some features of three varieties of banana.

Feature	Banana variety		
	A	B	C
Volume of fruit/cm^3	19.0	9.5	19.0
Growth rate of fruit/cm^3 $week^{-1}$	7.2	2.9	6.8
Force required to break leaf/N	90.0	100.0	80.0
Number of chromosomes	33	22	44

(i) If you were selecting a variety of banana to grow commercially, which variety would you select? Explain your selection.

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(2)

(ii) The three banana varieties differ in their number of chromosomes. Suggest why variety A is infertile.

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(2)

(b) Bananas can reproduce asexually. This means that the daughter plants are clones. Explain the term **clone**.

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(2)

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(c) Recently commercial banana plantations around the world have been infected by the black sigatoka fungus. This destroys the leaves and reduces the yield by as much as 50 per cent. Researchers are looking for a wild banana with a gene for resistance to this disease.

Suggest how you would use the techniques of gene technology to produce a new variety of banana with resistance to black sigatoka fungus.

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(6)

Q7

(Total 12 marks)

TOTAL FOR PAPER: 70 MARKS

END