



**BIOLOGY**  
**HIGHER LEVEL**  
**PAPER 2**

Monday 21 May 2001 (afternoon)

2 hours 15 minutes

Name

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Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: Answer all of Section A in the spaces provided.
- Section B: Answer two questions from Section B. Write your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the numbers of the Section B questions answered in the boxes below.

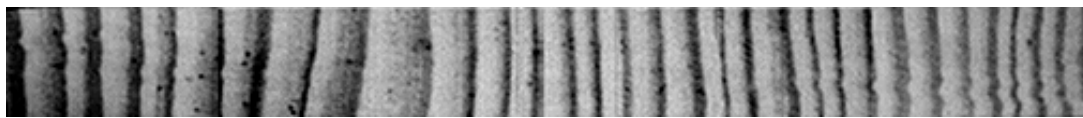
QUESTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
SECTION A	ALL	/32	/32	/32
SECTION B				
QUESTION	.....	/20	/20	/20
QUESTION	.....	/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	.....	TOTAL /72	TOTAL /72	TOTAL /72

SECTION A

Candidates must answer **all** questions in the spaces provided.

- 1. Many trees grow rapidly for part of each year. A ring of growth, called a tree-ring, is produced in the wood of the tree. The thickness of the tree-ring gives an indication of how quickly the tree grew in a particular year.

The photograph below shows a 30 year sequence of tree-rings from a pine tree (*Pinus nigra*). The start of each annual ring is light and the end is dark. Three of the rings are dated.



~  
1970

~  
1980

~  
1990

- (a) Identify in which of the 30 years the growth of the tree was:
  - (i) greatest: ..... [1]
  - (ii) least: ..... [1]

The pine tree grew in Shropshire, England. In this area the rainfall, during the growing season, was lowest in the years 1976, 1984, 1990, 1995 and 1996.

- (b) Using the tree-ring data in the photograph, evaluate the hypothesis that low rainfall, during the growing season, reduced the growth of the tree. [2]

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*Pinus nigra* is not native to Shropshire and is adapted to a warmer climate.

- (c) Suggest, using the tree-ring data, which of the 30 years was the warmest in Shropshire. [1]

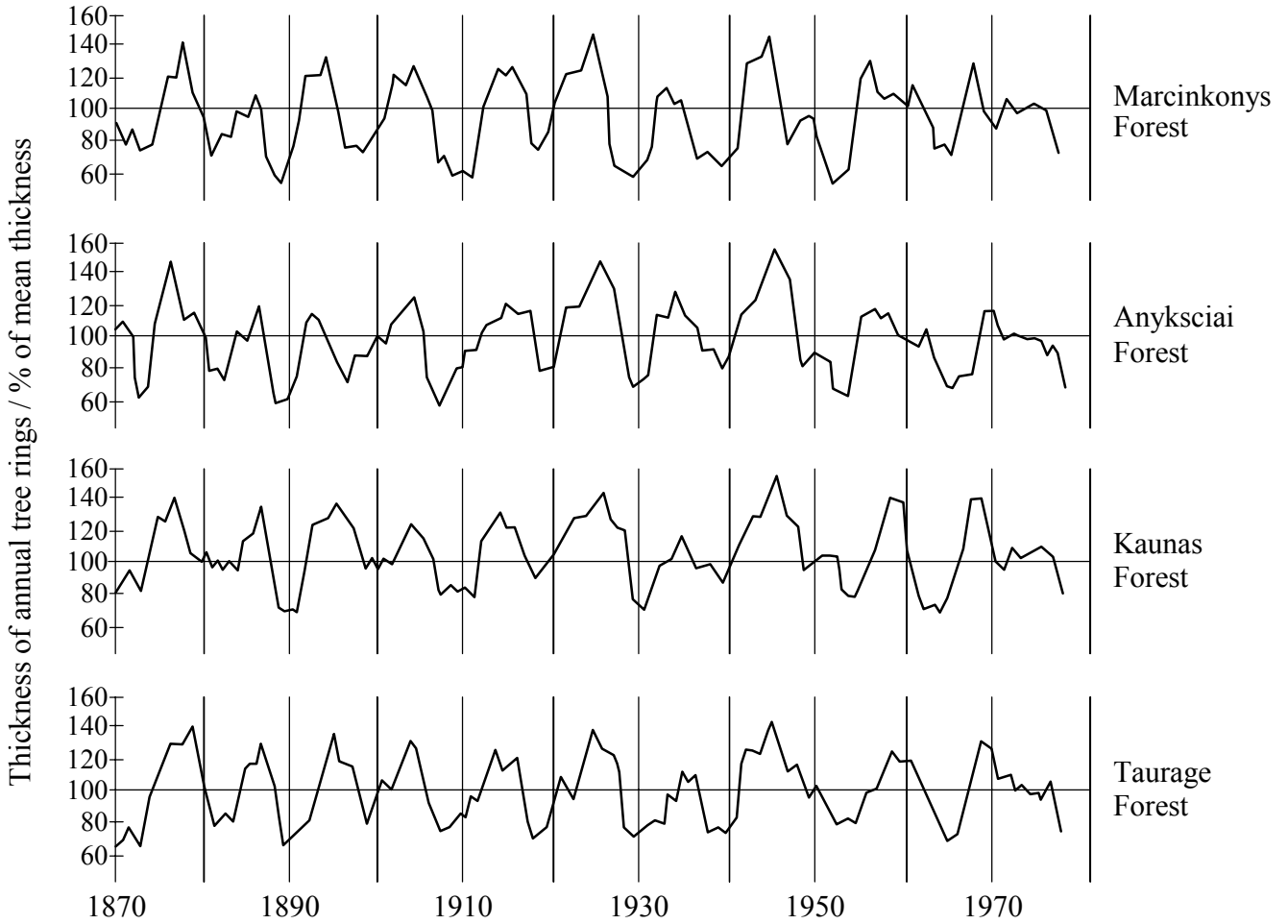
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(Question 1 continued)

The results of a study of tree-rings in four forests of *Pinus sylvestris* trees, in a small area of Lithuania, are shown in the graph below. The thickness of the tree-rings is shown as a percentage of the mean tree-ring thickness in each forest.



[Source: Kairiukstis and Duinskaite (1990) in *Methods of Dendrochronology*, page 309, published by Kluwer]

(d) (i) Compare the growth of the trees in the forests by giving **two** similarities in the data. [2]

- 1: .....
- .....
- 2: .....
- .....

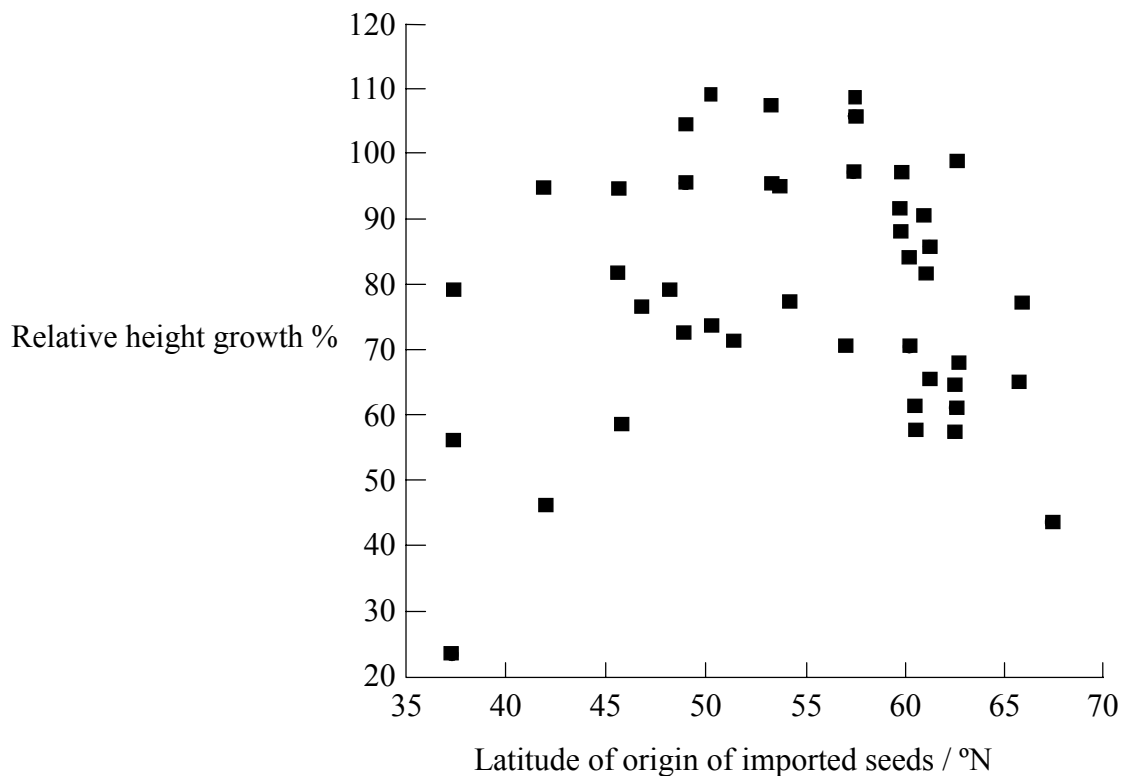
(ii) Suggest **two** reasons for the similarities. [2]

- 1: .....
- .....
- 2: .....
- .....

(This question continues on the following page)

(Question 1 continued)

Pine trees are widely grown to produce timber. Young trees are raised by collecting seeds from mature trees and germinating them. A growth study was carried out on a site at a latitude of 57° in the Highlands of Scotland. Trees were grown using local seeds collected from *Pinus sylvestris* trees near the trial site and from seeds collected from trees of the same species in other parts of Europe. The growth in height of the trees per year was measured. The scattergraph below shows the latitude of each seed source and the growth, in height, of trees raised from it. The growth in height of trees grown from imported seeds is shown as a percentage of the growth in height of the trees raised from local seeds.



[Source: Worrell R., *Tree News*, Autumn 1998, p 12]

(e) Identify the relationship between latitude of origin and growth

[1]

(i) between 35° and 57°.

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(ii) between 57° and 70°.

[1]

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(This question continues on the following page)

*(Question 1 continued)*

- (f) Suggest reasons for the relationships between latitude of origin of imported seeds and the growth of the trees. [2]

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- (g) Suggest **one** recommendation, based on the results of the growth study, which should be given to a person anywhere in the world intending to raise trees from seed. [1]

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2. Health in humans depends upon the efficient functioning of all parts of the body, including the lungs and defence against disease.

- (a) (i) State the role of alveoli. [1]

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- (ii) State **one** health problem that could affect the functioning of the alveoli. [1]

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- (b) Outline the role of fibrinogen. [2]

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- (c) Describe the role of helper T-cells. [3]

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3. *Nephrogenic diabetes insipidus* is a rare genetic disease. In one family affected by the disease, geneticists found a mutation in the gene coding for the ADH receptor protein. In the mutant allele there is a stop codon instead of a codon for the amino acid tryptophan at position 284.

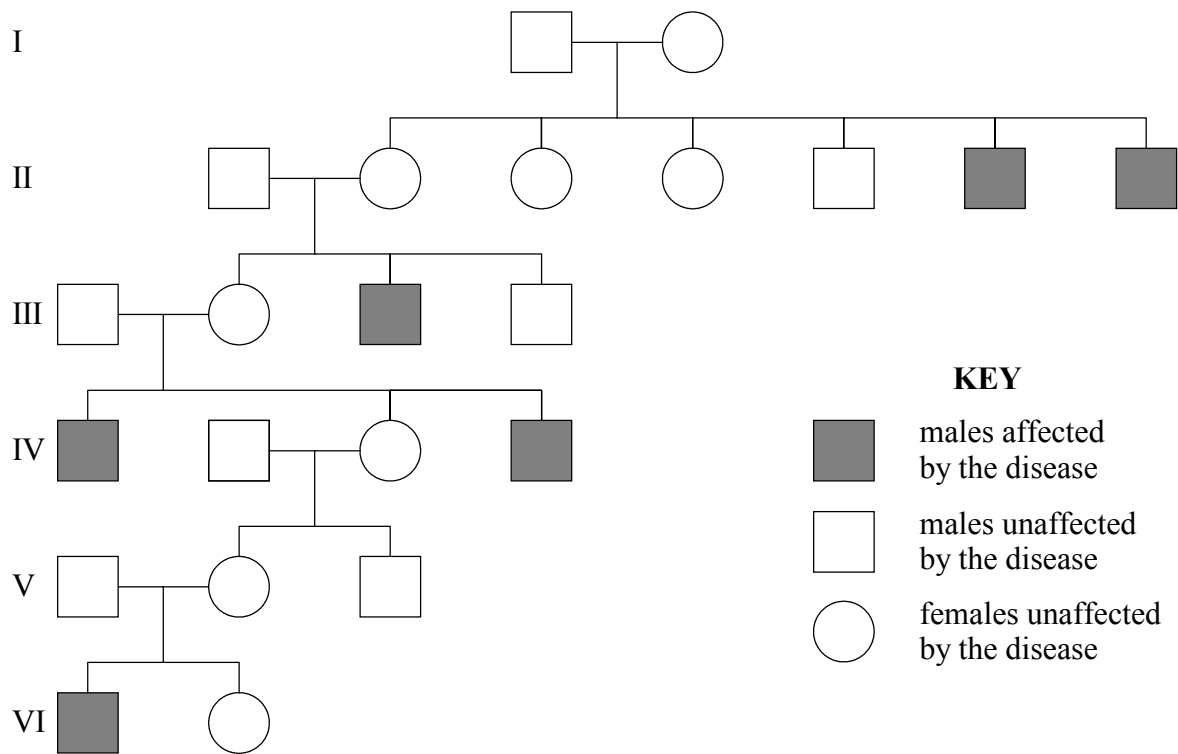
(a) (i) State the type of mutation that converts one codon into another. [1]

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(ii) Predict the effect of converting a codon in the middle of a gene into a stop codon. [2]

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The pedigree chart below shows which members of the family were affected by *nephrogenic diabetes insipidus* and which were unaffected.



[Source: unpublished Extended Essay]

(b) Explain, using information from the pedigree chart, whether the allele causing the disease is dominant or recessive. [2]

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(Question 3 continued)

- (c) The pattern of inheritance shown in the pedigree chart suggests that *nephrogenic diabetes insipidus* is a sex-linked condition. Evaluate the evidence provided by the pedigree chart for sex-linkage. [2]

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- (d) The hypothesis that the disease is sex-linked can be tested using the chi-squared test. If the disease was not sex-linked, one quarter of both male and female offspring would, on average, be affected. The numbers of affected and unaffected children are shown in the table below:

	Affected	Unaffected
Sons	6	3
Daughters	0	7

- (i) Calculate  $\frac{(O - E)^2}{E}$ , where *O* is the observed number of sons affected by the disease and *E* the expected number of sons affected by the disease. [2]

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(Question 3 (d) continued)

- (ii) The same calculation was done for unaffected sons, for affected daughters and for unaffected daughters. When all four results are added together the total is 10.66. This is the statistic chi-squared.

$$\sum \frac{(O - E)^2}{E} = 10.66 \text{ (with three degrees of freedom)}$$

Using the table below, deduce whether the observed and the expected results are significantly different and whether the hypothesis that the disease is sex-linked is supported or not.

[2]

Degrees of freedom	Probability						
	99 %	95 %	50 %	20 %	10 %	5 %	1 %
1	0.0002	0.0039	0.45	1.64	2.71	3.84	6.63
2	0.020	0.103	1.39	3.22	4.61	5.99	9.21
3	0.115	0.352	2.37	4.64	6.25	7.81	11.34
4	0.30	0.71	3.36	5.99	7.78	9.49	13.28

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**SECTION B**

Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers in a continuation answer booklet. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.

4. (a) Describe the process of fertilisation in humans. [6]
- (b) Outline the way in which a pregnancy can be detected at a very early stage. [4]
- (c) Explain the factors that cause a population to follow the sigmoid (S-shaped) growth curve. [8]
5. (a) Draw a diagram of a prokaryotic cell. [6]
- (b) Outline the structure of the nucleosomes in eukaryotic chromosomes. [4]
- (c) Explain how DNA replication is carried out by eukaryotes. [8]
6. (a) Draw a diagram to show the structure of a cell membrane. [5]
- (b) Outline the ways in which substances move passively across membranes. [5]
- (c) Explain how ATP is produced by photophosphorylation in chloroplasts. [8]
7. (a) Compare the way in which autotrophic, heterotrophic and saprotrophic organisms obtain energy. [6]
- (b) Outline the international system used for naming species of living organism. [4]
- (c) Discuss the definition of the term *species*. [8]
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