

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY

2806/01

Unifying Concepts in Biology

Tuesday

21 JUNE 2005

Morning

1 hour 15 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number										
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TIME 1 hour 15 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 blue or black ink, in the spaces provided on the question paper.
- Read each question carefully 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	9	
2	10	
3	16	
4	12	
5	13	
TOTAL	60	

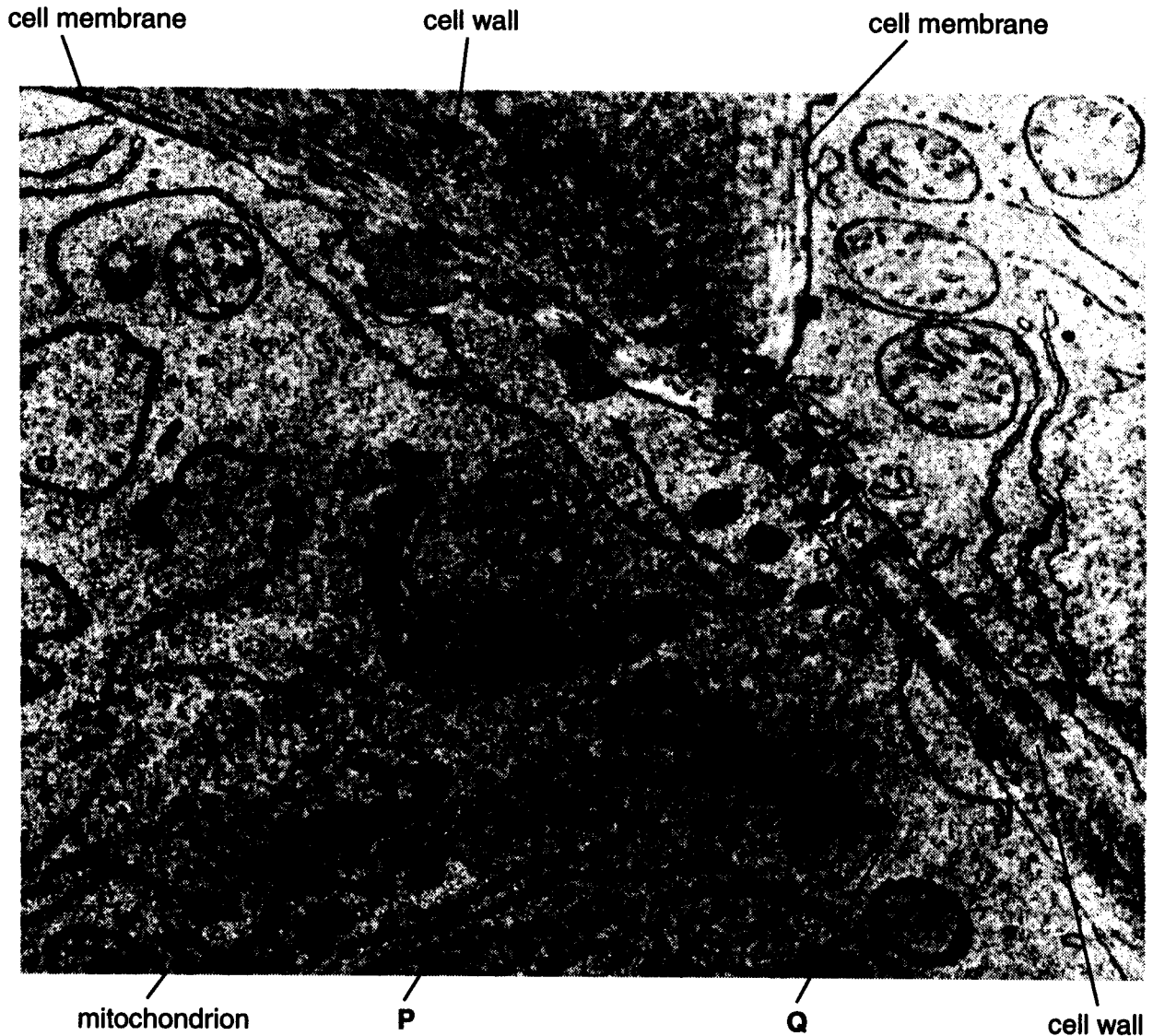
This question paper consists of 14 printed pages and 2 blank pages and an insert.

Answer **all** the questions.

- 1 The tip of a growing root is covered by a layer of tissue that allows the root to be pushed through the soil as it elongates. This tissue is called the root cap and it consists of secretory cells, which produce glycoproteins.

Mucus is a solution of glycoproteins that allows roots to slip through the soil without being damaged by friction. It is not only produced by root caps but also by some cells in several types of mammalian epithelium.

Fig. 1.1 shows an electron micrograph of part of two root cap cells.



× 20 000

Fig. 1.1

- (a) Calculate the width in micrometres (μm) of the organelle between the points labelled **P** and **Q** on Fig. 1.1. Show your working. Give your answer to the nearest micrometre.

Answer = μm [2]

- (b) (i) Name the organelle between **P** and **Q** on Fig. 1.1. Describe the function of this organelle in cells, such as root cap cells and mucus-secreting cells in mammals.

name.....

function

.....

.....

..... [3]

- (ii) Describe how glycoprotein would be secreted from a root cap cell into the cell wall.

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..... [2]

- (iii) Explain why secretory cells contain large numbers of mitochondria.

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..... [2]

[Total: 9]

2 Sections of young, growing stems were cut from just below the terminal buds of several similar plants of the same species. Each section was 5 mm long.

The stem sections were placed in Petri dishes containing different solutions of auxin, with ten sections in each dish.

After 12 hours, the sections were removed from the Petri dishes and measured.

Fig. 2.1 shows the mean increase in length of the sections in each dish, plotted against the concentration of auxin in the solution in the dish.

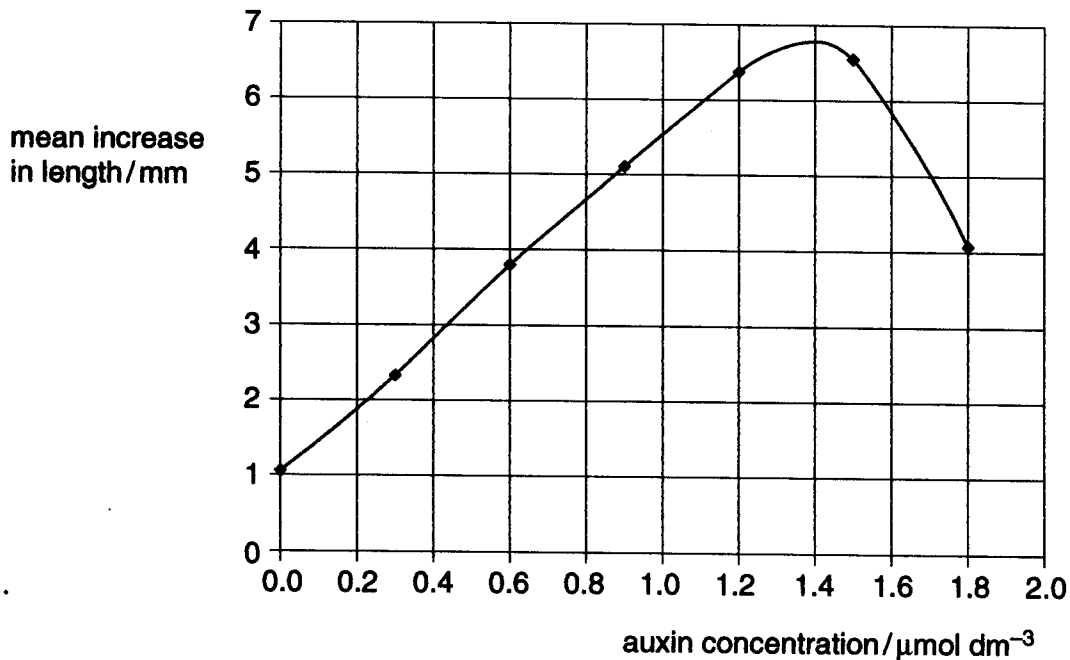


Fig. 2.1

(a) (i) Using Fig. 2.1, describe the relationship between the concentration of auxin in the solutions in the Petri dishes and the mean increase in length of the stem sections.

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..... [3]

(ii) List three variables which should have been controlled in the investigation.

1

2

3 [3]

(b) Suggest **two** ways in which auxin might have caused the change in growth of the stems as shown in Fig. 2.1.

1

.....

2

..... [2]

(c) State **two** ways in which the control of plant growth by growth substances differs from the control of blood sugar concentration by mammalian hormones.

1

.....

2

..... [2]

[Total: 10]

- 3 Vancouver Island, off the west coast of Canada, was covered by cool temperate rain forest until timber extraction began about one hundred years ago. A large area of this climatic climax community has been cut or burned, though much remains.

When timber is extracted from an area of forest, all trees, including those not required for timber, are usually cut down. The land is then left so that seeds of tree species can germinate and new forest can develop. It takes many decades for a complete canopy of mature trees to develop in an area which has been treated in this way.

Small soil animals of two arthropod orders – **mites** and **springtails** – were studied in several areas of forest on Vancouver Island. Each of the areas was similar in slope and soil type.

The study areas had different stages of tree growth. In each area, mites and springtails were extracted from soil samples and counted. The species of springtail in each sample were identified. The species of mite were not identified.

Some of the data from the investigation are shown in Table 3.1.

Table 3.1

stage of tree growth	numbers per 100 g of soil		
	mean number of individuals of all types of mite	mean number of individuals of all types of springtail	mean number of species of springtail
tree seedlings	1375	125	9
young trees	2564	300	13
mature trees	1981	312	11
climax forest, not cut or burned since records began	2890	715	16

- (a) State **three** conclusions that you can draw from the data in Table 3.1.

1

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2

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3

..... [3]

- (b) What ecological process was being investigated by the researchers?

.....[1]

- (c) Springtails and some species of mite are decomposers, feeding on decaying plant material in the soil. Other mite species occupy different trophic levels in forest ecosystems. The mites and springtails are part of an extremely complex food web.

Explain why a food web is essential for the stability of an ecosystem.

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..... [3]

- (d) Many investigations have shown that when an area of forest is cleared of trees, there is a dramatic rise in the concentration of nitrate ions in the streams that flow through the area that has been cleared.

Explain this finding.

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..... [2]

- 4 In an investigation of photosynthesis, the rate of carbon dioxide absorption by leaves of two plants, barley and sugar cane, was measured. The leaves were provided with air, moving at a constant rate, through an apparatus that is illustrated by Fig. 4.1.

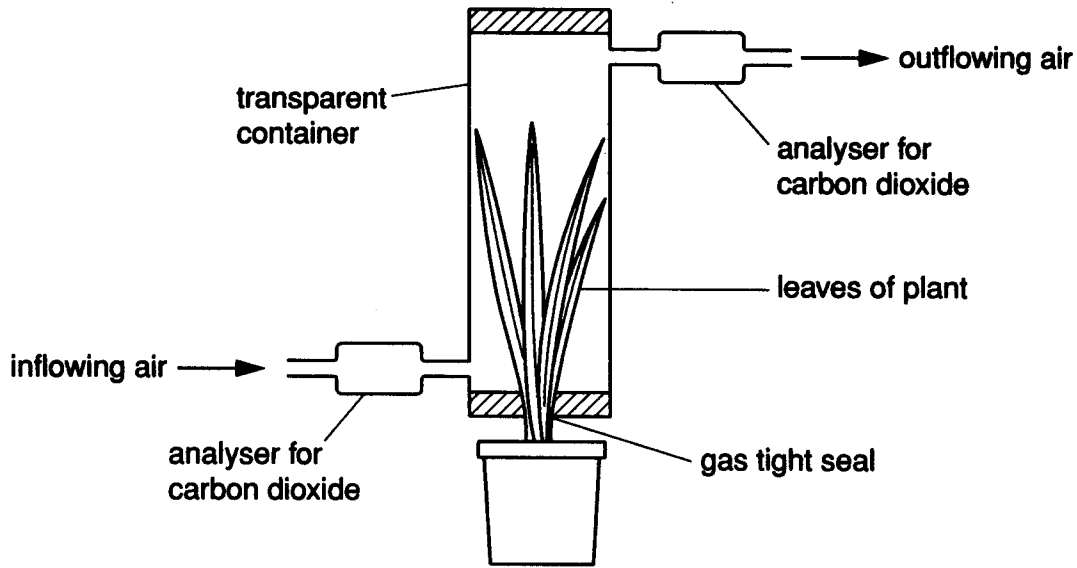


Fig. 4.1

- The light intensity was kept constant and high, equivalent to full sunlight.
- The concentration of carbon dioxide in the air entering the apparatus could be varied.
- The carbon dioxide taken up or given out by the leaves was determined by calculating the **difference** between the concentration in the inflowing and outflowing air.
- The leaves remained attached to the plants during the investigation.
- Two different temperatures, 10 °C and 25 °C, were used for each type of plant.

The results of the investigation are shown in Fig. 4.2 on an insert.

- (a) In all four experiments, the rate of carbon dioxide uptake reached a maximum and became constant.

Suggest why.

.....

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..... [2]

(b) Explain why carbon dioxide was released when the carbon dioxide concentrations were low.

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..... [2]

(c) Explain why all the measurements were made at the same light intensity.

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..... [1]

(d) Suggest why it was important that the leaves remained attached to the plants while the measurements were made.

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..... [2]

(e) Comment on the similarities and differences in response of the two species, sugar cane and barley, to differences in carbon dioxide concentration and temperature.

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..... [5]

[Total: 12]

- 5 Telomeres are the lengths of DNA double helix at the **ends** of all eukaryotic chromosomes. They have a nucleotide sequence in which the order of the bases in one of the single strands is:

Thymine Thymine Adenine Guanine Guanine Guanine.

This sequence is repeated as many as 2000 times. This repetition is shown in Fig. 5.1.

Attached to the DNA of the telomere are protein units that protect the DNA and enable homologous chromosomes to pair during meiosis.

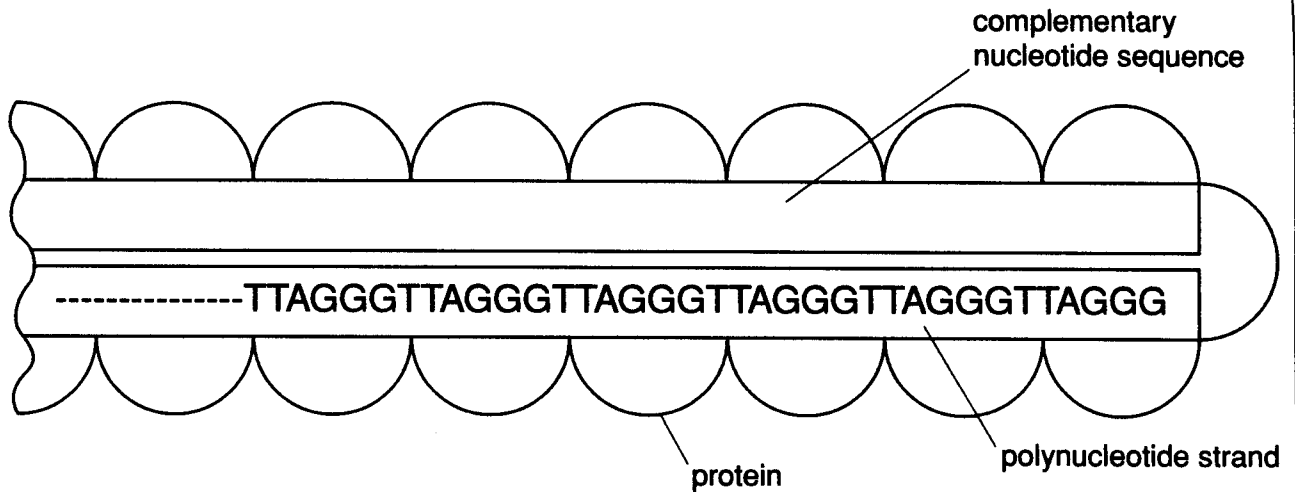


Fig. 5.1

- (a) What sequence of bases is **repeated** in the complementary polynucleotide shown in Fig. 5.1?

..... [1]

- (b) The TTAGGG repetitive base sequence of telomere DNA is an example of a non-coding base sequence.

Explain what is meant by **non-coding**.

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..... [2]

- (c) When a chromosome replicates, DNA polymerase cannot attach to the extreme end of a telomere. This means that one of the two daughter chromosomes has a slightly shorter telomere than the original chromosome.

Why do many of the tissues of old animals have telomeres that are much shorter than those of young animals?

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..... [1]

(d) State why prokaryotic cells, such as bacteria, do not have telomeres.

.....
 [1]

(e) Repeating nucleotide sequences are common in the genomes of eukaryotes, for example in the centromeres and in the regions, called introns, which appear to interrupt the genes. Repeating sequences have been referred to as 'junk DNA'.

Suggest why the term 'junk DNA' is misleading.

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 [2]

(f) Some species of plant are able to grow on soils that contain very little phosphate, while other species, for example stinging nettles, can only grow well in soils that are rich in phosphate. Each nucleotide in a DNA molecule includes a phosphate group.

If much of the non-coding DNA can be correctly regarded as functionless 'junk', there may be a correlation between the percentage of DNA that is non-coding and the minimum concentration of phosphate ions needed for healthy growth.

Draw a straight line graph, using the axes in Fig. 5.2, to show the correlation that you would predict.

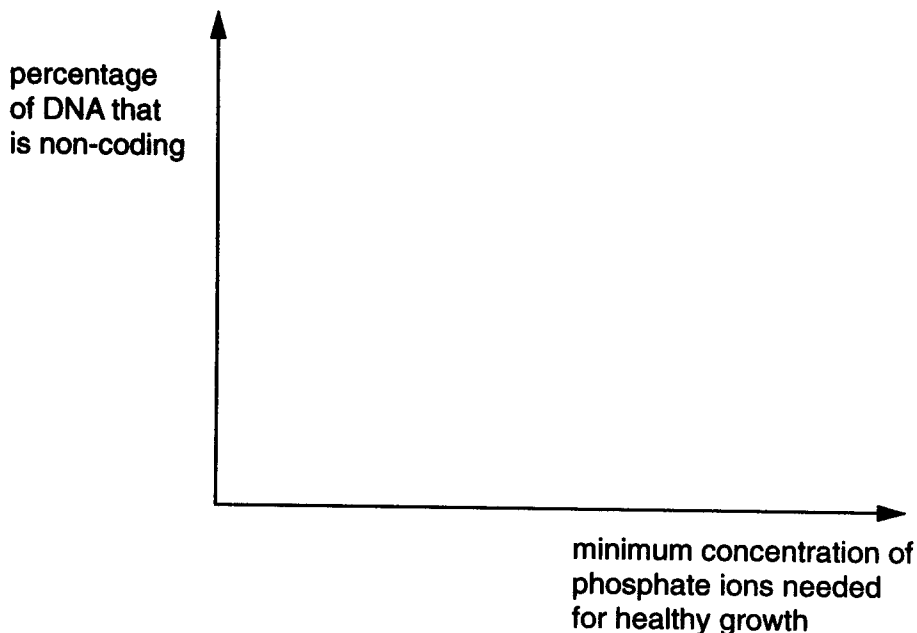


Fig. 5.2

[1]

(g) Name a substance **other than DNA** that is found in cells and has one or more phosphate groups as part of its chemical structure.

..... [1]

(h) Washing powders usually contain phosphate. Water that has been used for washing often passes through the sewage system into rivers. The concentration of phosphate ions dissolved in river water is often higher than it was before washing powders came into use.

Suggest possible impacts of an increase in the phosphate concentration of the water on a river community.

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..... [4]

[Total: 13]

END OF QUESTION PAPER