



INTERNATIONAL BACCALAUREATE

BIOLOGY

Subsidiary Level

Monday 13 May 1996 (afternoon)

Paper 2

45 minutes

This examination paper consists of 2 questions.

The maximum mark for each question is 10.

The maximum mark for this paper is 20.

This examination paper consists of 7 pages.

INSTRUCTIONS TO CANDIDATES

Write your candidate reference
number in this box

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DO NOT open this examination paper until instructed to do so.

Answer **BOTH** questions in the spaces provided in this answer book.

EXAMINATION MATERIALS

Required/Essential:

Electronic Calculator (neither programmable nor graphic display calculators are allowed)

Allowed/Optional:

A simple translating dictionary for candidates not working in their own language

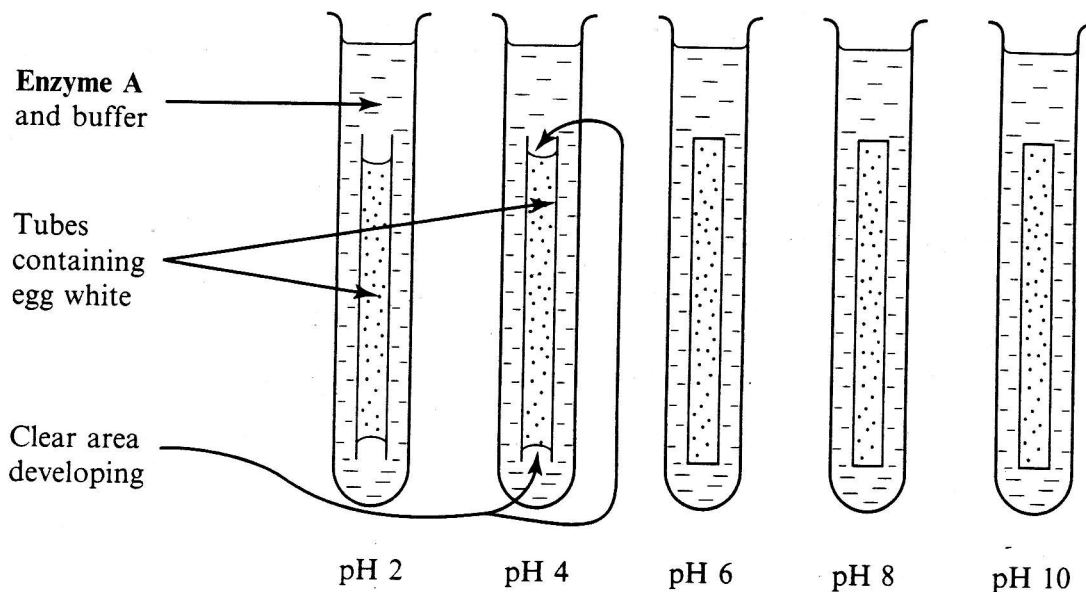
Question 1

Enzyme A is an enzyme found in the human digestive system. An investigation was carried out into the activity of this enzyme on the protein in egg white.

Five test tubes were set up, each one with the same quantity and concentration of **enzyme A**. Each tube was maintained at a different pH using buffers. The test tubes were then placed in a water bath which was maintained at a constant temperature of 20 °C.

Raw egg white was then drawn into narrow glass tubes. The tubes were plunged into boiling water which 'fixed' the egg white in position. It also made the egg white opaque (non-transparent), so that it could be easily seen.

The experiment was started by placing one tube, containing egg white, into each test tube and, at the same time starting a stop watch. **Enzyme A** then began to digest the opaque egg white making it once again transparent (clear). Every two minutes the length of the clear part was measured and from these data the percentage digestion of egg white was calculated. The experiment is summarised below and shows the situation two minutes after the start.



(This question continues on the following page)

(Question 1 continued)

Table showing percentage digestion of egg white at intervals of 2 minutes.

Time from start (min)	Percentage digestion of egg white				
	pH 2	pH 4	pH 6	pH 8	pH 10
0	0	0	0	0	0
2	12	8	0	0	0
4	28	12	0	0	0
6	39	20	0	0	0
8	55	29	0	0	0
10	68	38	3	0	0
12	94	53	10	3	0

(a) What was the purpose of this experiment?

[1 mark]

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(b) Why is it necessary to use a water bath in this experiment?

[1 mark]

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(c) Why do the contents of the small tubes turn clear on digestion?

[1 mark]

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(d) From this experiment, what conclusions can be drawn about the activity of enzyme A?

[2 marks]

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(This question continues on the following page)

(Question 1 continued)

(e) What result would you have expected if saliva had been used instead of enzyme A?

[1 mark]

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(f) What result would you have expected if the experiment had been carried out at (i) 40 °C and (ii) 80 °C?

[2 marks]

(i)

(ii)

(g) Where in the human digestive system would you expect to find this enzyme? Give a reason for your answer.

[2 marks]

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Question 2

Tulips are perennial plants that have an active growth period. The parts above ground then 'die back' leaving only underground storage organs known as bulbs. These bulbs can be removed from the soil, stored and then replanted. Leaves, and sometimes a flower, develop from the bulb in the following growth period. Experiments have been done to find out how many bulbs should be planted per square metre to get the largest number that are suitable for sale.

In such an experiment bulbs were planted at three different densities. When the plants had grown, the stem height and leaf area of each plant were measured and at the end of the growth period the mass of bulbs formed per plant was found. The mean results are shown in the table below. (Ref. Journal of Applied Ecology.)

Density of bulbs /number planted per square metre	Mean height of stem / mm	Mean total leaf area / cm ²	Mean mass of bulbs formed / g
48	395	312	55
125	445	317	27
258	465	314	20

(a) Using only the information in the table, state the effect of the number of bulbs planted per square metre on:

[3 marks]

(i) stem height

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.....

(ii) leaf area

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.....

(iii) mass of bulbs formed

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(This question continues on the following page)

(Question 2 continued)

- (b) Give **one** possible reason why the number of bulbs planted per square metre affects the growth of tulips.

[1 mark]

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The table below shows the mass of bulbs planted and the mass of bulbs formed per square metre. This is shown for the same three densities of planting.

Density of bulbs /number planted per square metre	Total mass of bulbs planted / kg m ⁻²	Total mass of bulbs formed / kg m ⁻²
48	0.84	2.59
125	2.52	4.11
258	4.20	4.94

- (c) Using these data calculate the number of bulbs per square metre that gives the largest increase in mass of bulbs. Show your working.

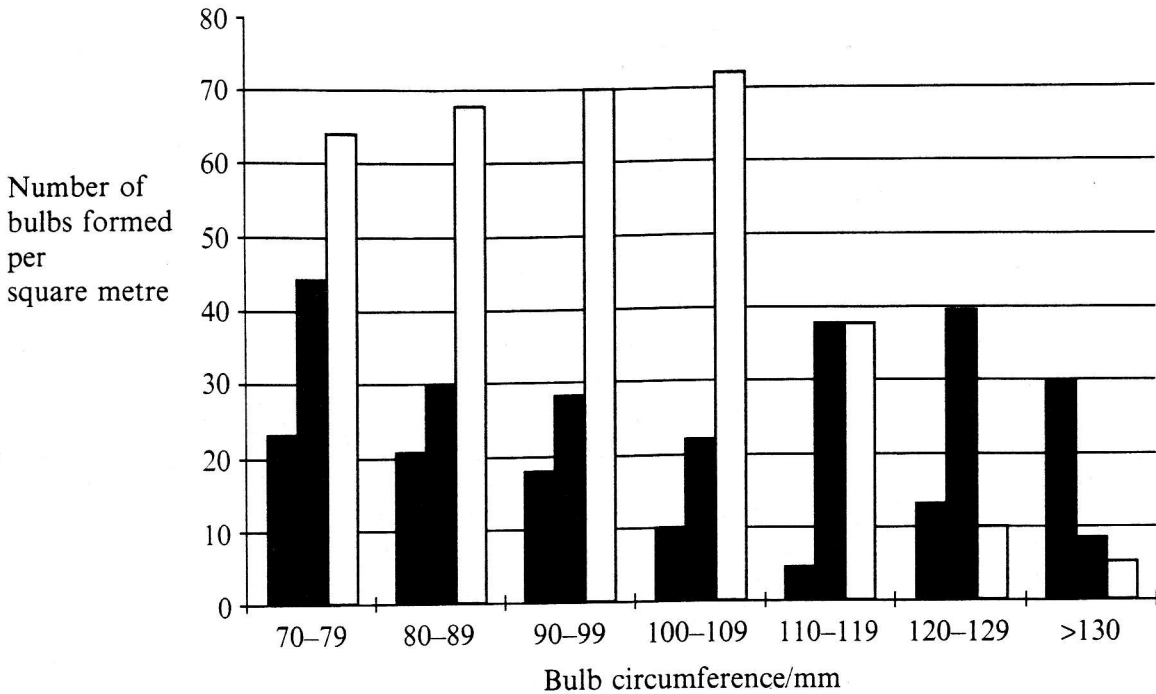
[2 marks]

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(Question 2 continued)

Only tulip bulbs with a circumference of 110 mm or more are mature enough to produce a flower and can therefore be sold to gardeners. The histograms below show the numbers of bulbs, in each of 7 classes, formed per square metre when planted at the same three densities.



Planting density
(Number per square metre): ■ 48 ■ 125 □ 258

- (d) Using the data in the histograms, find which density of planting would give the greatest number of bulbs large enough to produce a flower. [2 marks]

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- (e) Explain which of the three densities of planting would be best for a commercial grower. [2 marks]

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