

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY

2804

Central Concepts

Tuesday

28 JANUARY 2003

Morning

1 hour 30 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 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 blue or black ink, in the spaces 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 calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	17	
2	13	
3	14	
4	9	
5	12	
6	15	
7	10	
TOTAL	90	

This question paper consists of 18 printed pages and 2 blank pages.

Answer **all** the questions.

- 1 The rate of photosynthesis at different wavelengths of light can be measured and plotted on a graph. This is called an action spectrum and is shown on Fig. 1.1.

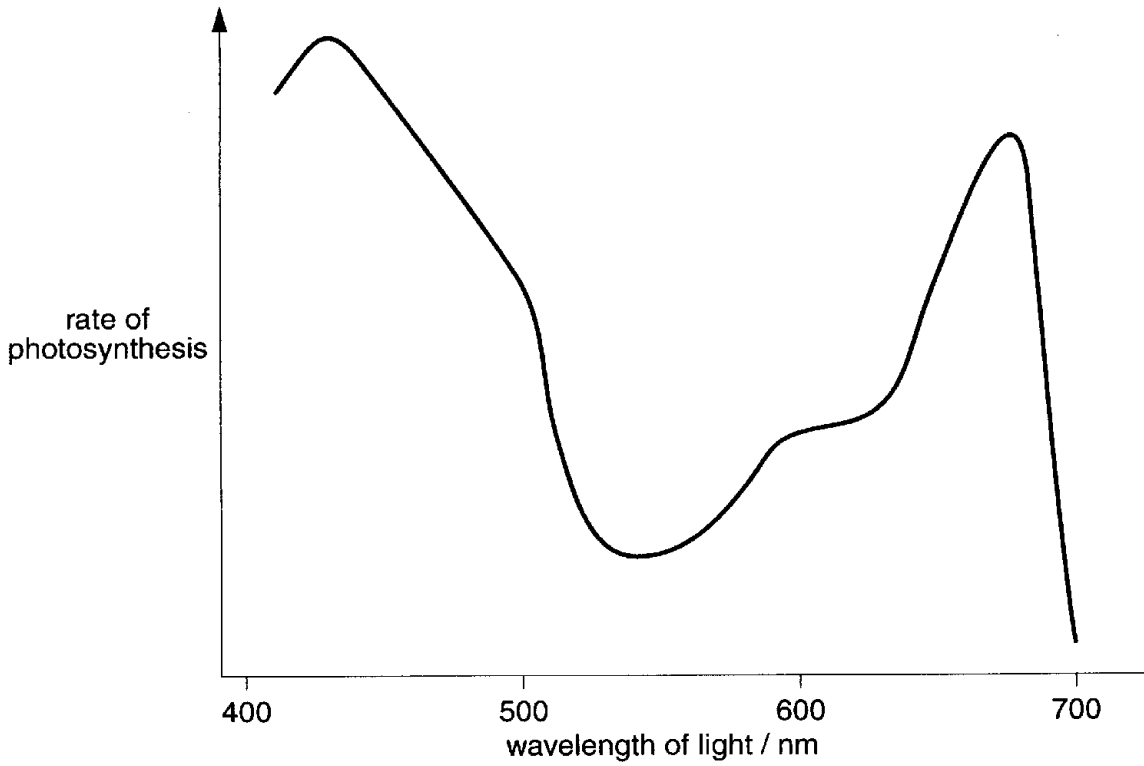


Fig. 1.1

- (a) Describe the effects of different wavelengths of light on the rate of photosynthesis.

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.....[3]

- (b) In the chloroplasts of green plants, pigment molecules are organised into photosynthetic units called photosystems.

Fig. 1.2 shows the generalised structure of a photosystem.

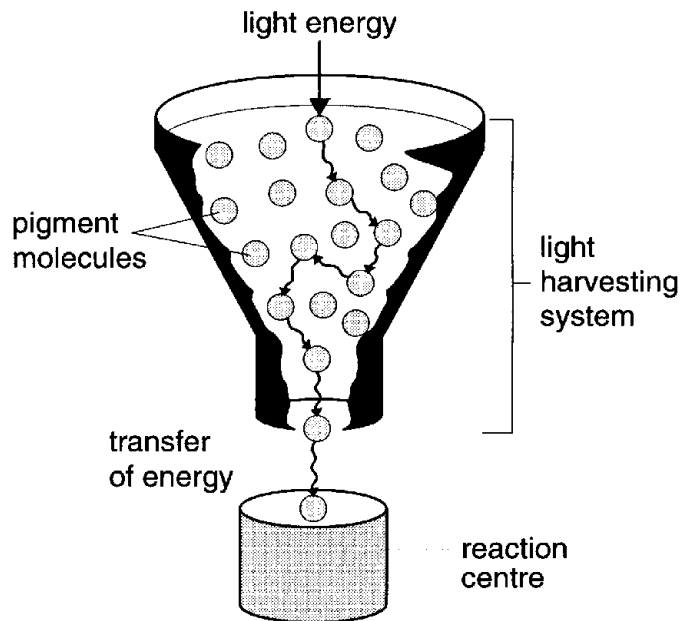


Fig. 1.2

- (i) Name **two** pigment molecules found in chloroplasts.

1

2 [2]

- (ii) State **one** role of pigment molecules in a photosystem.

.....

..... [1]

- (iii) State the location of photosystems within the chloroplast.

..... [1]

(c) The production of ATP in chloroplasts is known as photophosphorylation. There are two types of photophosphorylation, cyclic and non-cyclic.

(i) Complete the following table comparing the two types of photophosphorylation.

	cyclic	non-cyclic
photosystem(s) involved		
end product(s)		

[4]

(ii) Explain the role of ATP in the light **independent** stage of photosynthesis.

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[3]

(d) Some chloroplasts have been shown to possess photosystem 1 only.

Explain why these chloroplasts are unable to form sugars.

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[3]

[Total: 17]

- 2 Table 2.1 shows the diploid chromosome number in different organisms.

Table 2.1

name of organism	diploid chromosome number (2n)
yeast	34
broad bean	12
fruit fly	8
domestic cat	72
human	46

- (a) State the number of chromosomes present in the following:

domestic cat sperm cell

human white blood cell

broad bean companion cell

fruit fly zygote

[4]

(b) In diploid organisms, haploid cells or gametes are produced by meiosis.

Fig. 2.1 shows diagrams of an animal cell at various points in the first division of meiosis. The diagrams are **not** in the correct sequence.

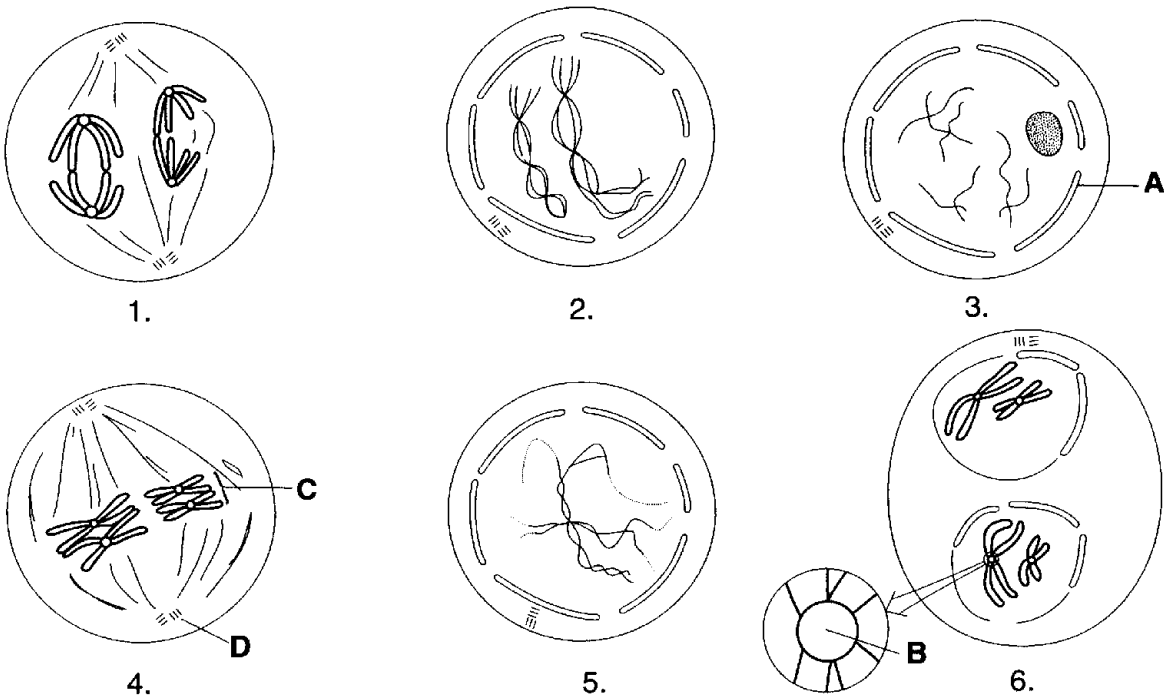


Fig. 2.1

(i) Write the numbers of the diagrams to show the correct meiotic sequence.

..... [1]

(ii) Identify the structures labelled A to D.

A

B

C

D [4]

(c) Explain how meiosis **and** fertilisation produce variation within a population.

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..... [4]
 [Total: 13]

- 3 The collared dove, *Streptopelia decaocto*, is a recent addition to the British list of breeding birds. At the start of the 20th century, this bird was a rare visitor. It spread across northern Europe and breeding pairs were first seen in Britain in the early 1950s. The collared dove is now widespread throughout Britain.

Fig. 3.1 is a record of its population growth.

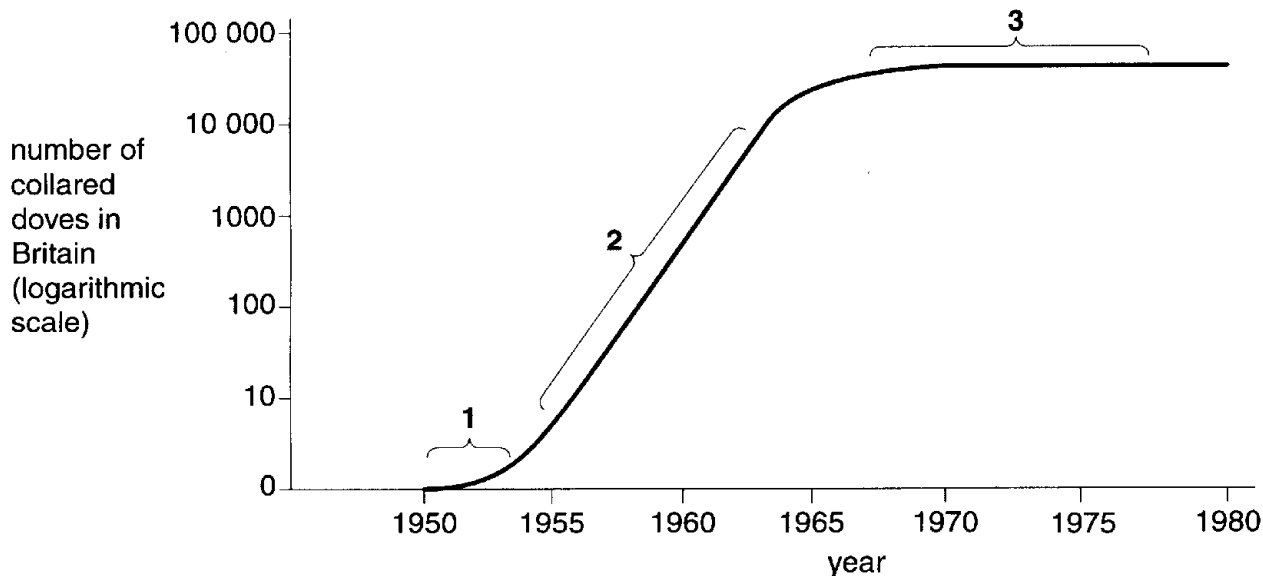


Fig. 3.1

- (a) Name the stages labelled 1 to 3 on Fig. 3.1.

1

2

3 [3]

- (b) Suggest why the number of collared doves in Britain remained constant between 1970 and 1980.

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..... [3]

(c) In this question, one mark is available for the quality of written communication.

Fig. 3.2 shows the population curve of unicellular photosynthetic organisms (algae) in a freshwater lake in southern England.

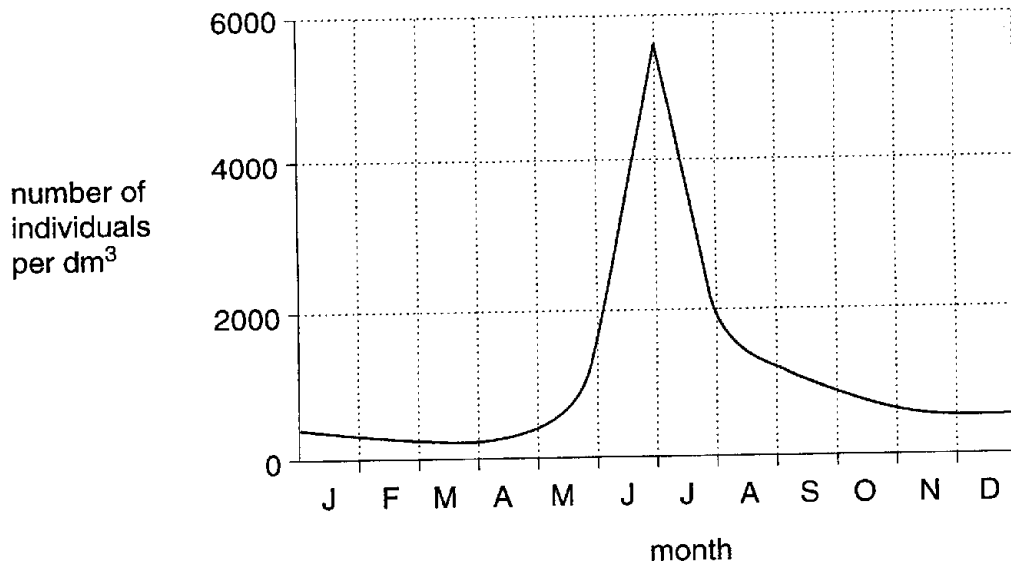


Fig. 3.2

Explain how a change in environmental factors could account for the sudden rise and fall of this population between May and September.

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Quality of Written Communication [1]

[Total: 14]

- 4 Plant growth substances are important in controlling the life cycles of flowering plants. Changes in the concentration of plant growth substances in cells can regulate the expression of specific genes. One such substance is abscisic acid, ABA.

The concentration of ABA was measured during development of cotton fruits.

Fig. 4.1 shows the change in concentration of ABA as cotton fruits develop. Fig. 4.2 shows a mature cotton fruit.

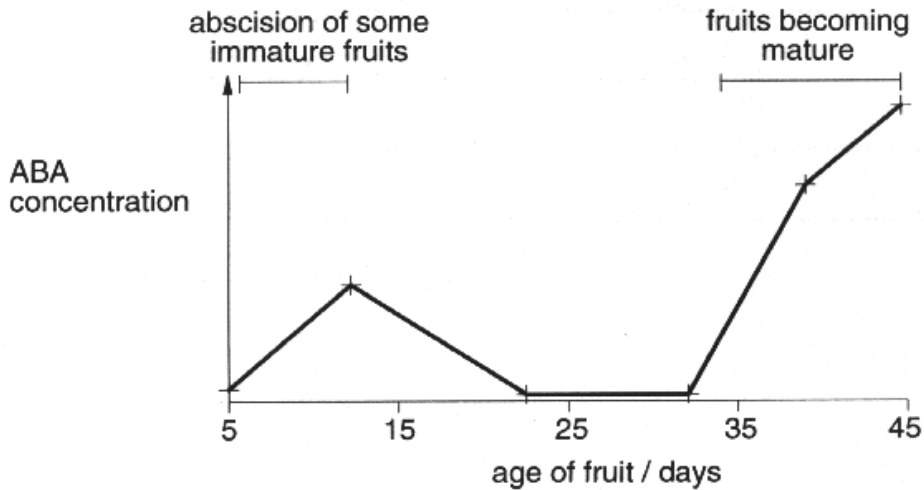


Fig.4.1

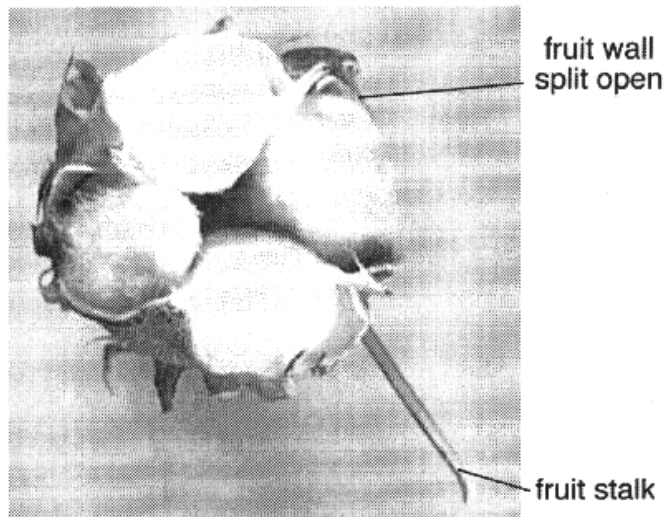


Fig. 4.2

(a) With reference to Fig. 4.1, describe the relationship between fruit development and ABA concentration.

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..... [3]

(b) Suggest a way in which ABA acts within plant cells to bring about changes.

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..... [2]

(c) ABA concentrations have also been measured in the leaves of broad bean seedlings grown in outdoor experimental plots. It has been observed that the concentration of ABA increases on hot, dry and breezy summer days.

Explain

(i) why these environmental conditions lead to an increase in the concentration of ABA;

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..... [2]

(ii) the effect of raised ABA concentrations on the leaf.

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..... [2]

[Total: 9]

5 Between 1976 and 1978, a study of the relationship between beak size and diet was carried out on a population of a single species of ground finch, *Geospiza fortis*, living on one of the Galapagos Islands.

- In 1976 the beak depth of 751 birds was measured.
- In 1977 there was a severe drought that reduced the mass of seeds available. The seeds that were produced that year were larger than in 1976.
- In 1978 the beak depth of 90 birds was measured.

Ground finches with smaller beaks are better at opening small seeds, whereas ground finches with larger beaks are better at opening large seeds.

Data from this study are shown in Fig. 5.1 as follows:

- A** – number of *G. fortis* between 1976 and 1978
- B** – total mass of seeds available between 1976 and 1978
- C** – beak depth of *G. fortis* in 1976 and 1978.

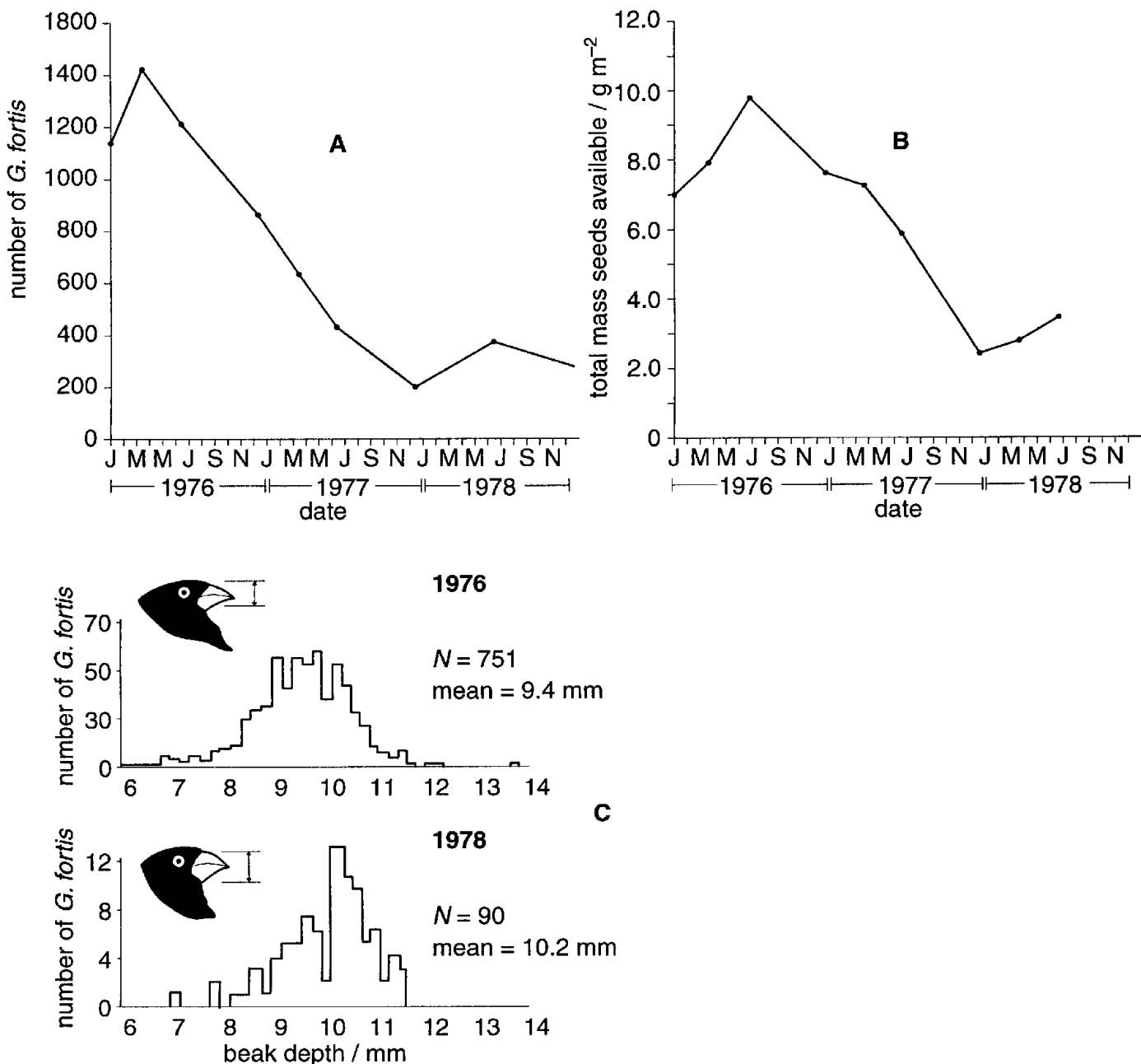


Fig. 5.1

- (a) Using Fig. 5.1 C, calculate the % increase in mean beak depth of *G. fortis* between 1976 and 1978. Show your working.

Answer % [2]

- (b) In this question, one mark is available for the quality of written communication.

Using the information and the data in Fig. 5.1 A, B and C, describe the changes in the numbers of the population of *G. fortis* and the size of beaks. Explain the reasons for the changes.

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Quality of Written Communication [1]

[Total: 12]

6 The pancreas contains endocrine tissue. Fig. 6.1 shows an electronmicrograph of a section of pancreatic endocrine tissue.

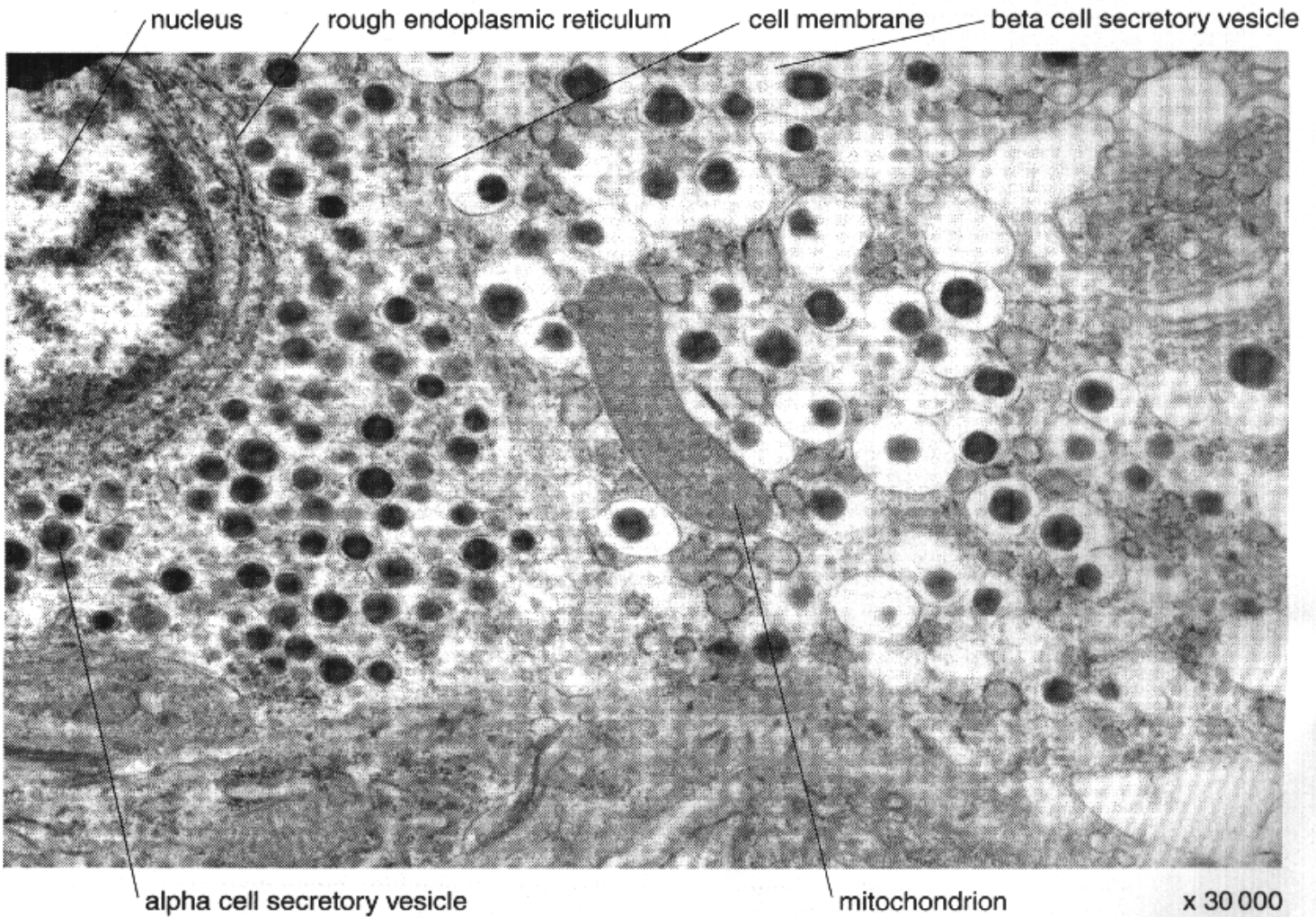


Fig. 6.1

(a) Name the endocrine tissue shown in Fig. 6.1.
[1]

(b) This tissue produces two hormones. State the type of macromolecule these hormones are made of.
[1]

(c) Name the hormone present in the secretory vesicles of
 alpha cells
 beta cells.[2]

(d) The electronmicrograph has a magnification of 30 000. Calculate the actual length of the labelled mitochondrion in micrometres (μm). Show your working.

length = μm [2]

(e) During vigorous exercise the blood glucose concentration falls.
 Describe the changes that take place to ensure that the blood glucose concentration does not fall to a dangerous level.

 [6]

- (f) Until the 1980s, all insulin used to treat diabetes was obtained from animals such as pigs and cattle. In the 1980s, the human insulin gene was introduced into bacteria and insulin is now produced by genetically engineered bacteria.

Describe the advantages of using genetically engineered insulin.

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..... [3]

[Total: 15]

7 (a) State what is meant by the term *respiratory quotient (RQ)*.

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 [1]

(b) Complete the following equation for the aerobic respiration of **compound A**.



(c) Calculate the RQ for this reaction.

Answer = [2]

(d) Identify **compound A** from the RQ value calculated.

.....
 [1]

(e) After surface sterilisation, some seeds were soaked in water for four hours before being left in moist air to germinate. The RQ values of these seeds are shown in Table 7.1.

Table 7.1

time	RQ
immediately after soaking	6.34
after 12 hours in air	2.22
after 36 hours in air, radicles appearing	1.02

Explain the changes in RQ values of these germinating seeds.

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 [4]

[Total: 10]

Copyright Acknowledgements:

Question 3 Fig. 3.1 and 3.2 from 'Advanced Biology' by C. Clegg and D. MacKean, published by John Murray (ISBN 0-7195-5078-5).

Question 6 Electronmicrograph reproduced by permission of Electron Microscope Unit, Dept. of Histopathology, Manchester Royal Infirmary.

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