UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4700162322

BIOLOGY **9700/04**

Paper 4 A2 Structured Questions **May/June 2008**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Answer Paper available on request.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions in Section A and **one** question from Section B.
Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
Section B	
9 or 10	
Total	

This document consists of **20** printed pages, **4** lined pages and **4** blank pages.

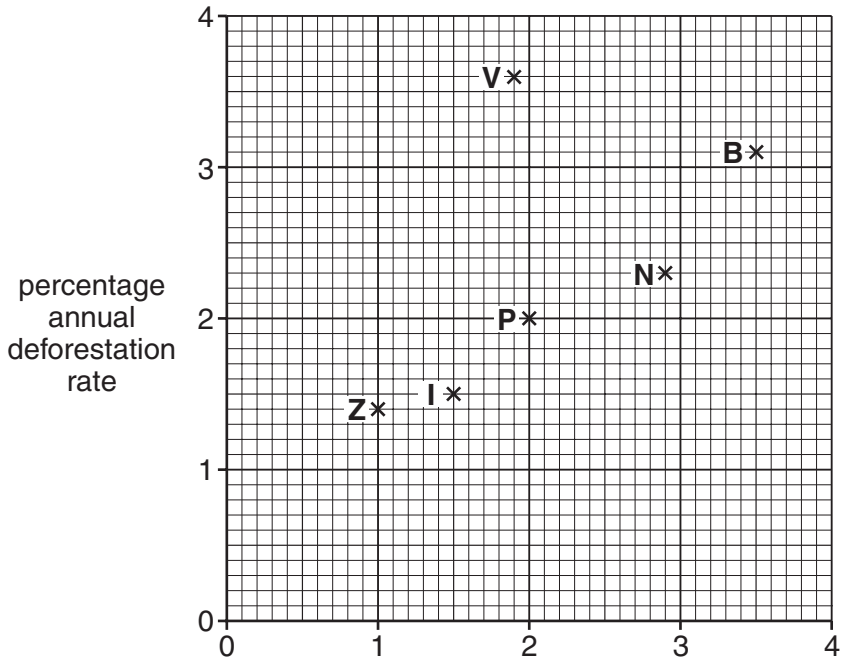
© UCLES 2008

Section A

Answer **all** the questions.

For Examiner's Use

1 **(a)** Fig. 1.1 shows the relationship between annual deforestation rates and annual human population growth for six countries.



B – Burundi
I – Indonesia
N – Nigeria
P – Philippines
V – Vietnam
Z – Zimbabwe

Fig. 1.1

Describe the relationship shown in Fig. 1.1.

.....

.....

.....

.....[2]

© UCLES 2008

(b) Over half of the species of plants and animals comprising the biodiversity of the Earth are thought to exist in tropical rainforests.

For Examiner's Use

(i) Explain the meaning of the term *biodiversity*.

.....

.....

.....[2]

(ii) Explain the economic reasons for maintaining biodiversity.

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 8]

2 Fig. 2.1 is a light micrograph of a small part of the pancreas.

For Examiner's Use

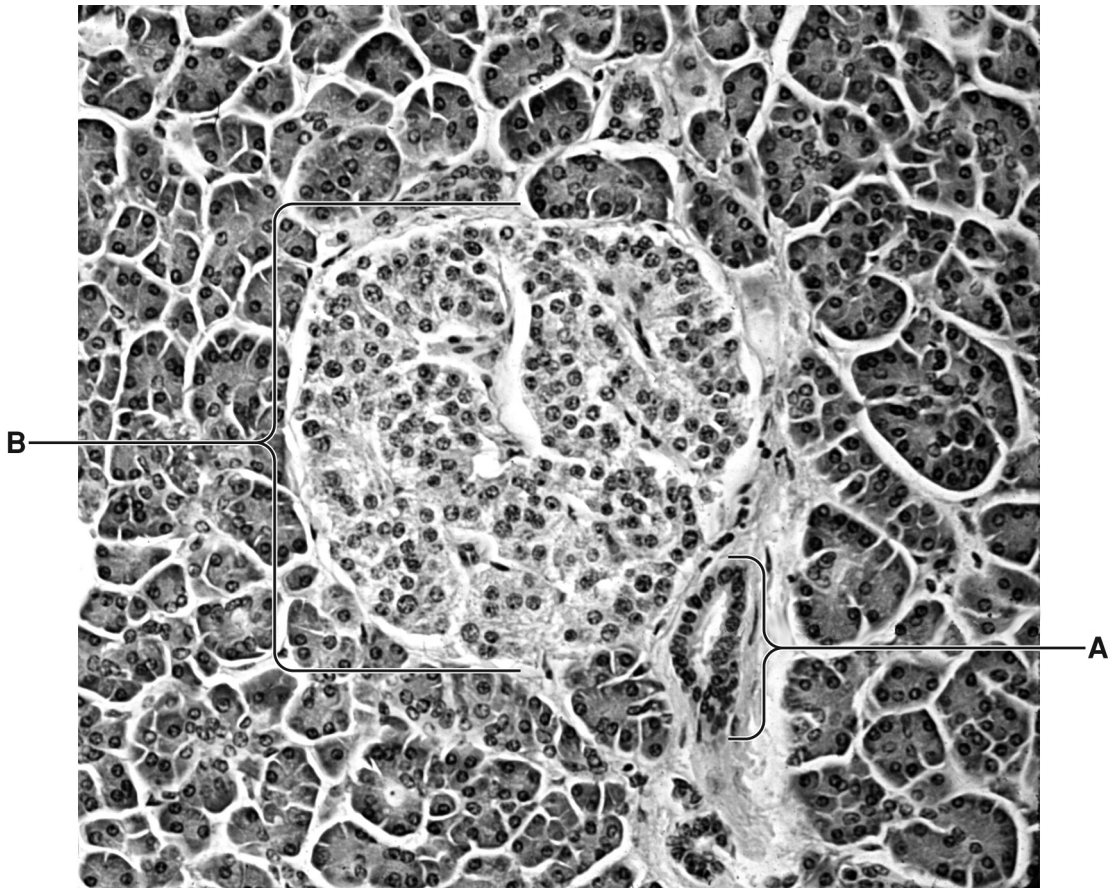


Fig. 2.1

(a) Name structures **A** and **B**.

A .....

B .....[2]

(b) With reference to Fig. 2.1, explain why the pancreas is an *endocrine gland*.

.....

.....

.....[2]

(c) Insulin and glucagon are involved in the control of blood glucose concentration. When blood glucose concentration rises, secretion of insulin increases.

For Examiner's Use

Outline two ways in which insulin affects the activity of cells in the liver.

1. .....

.....

2. .....

.....[2]

(d) Some forms of diabetes are caused by an inability to secrete insulin and can be controlled by regular injections of insulin. Most of this insulin is now produced using genetically modified *Escherichia coli.*

Explain the advantages of using this type of insulin, rather than insulin obtained from animal sources.

.....

.....

.....

.....[2]

[Total: 8]

BLANK PAGE

© UCLES 2008

3 **(a)** Fig. 3.1 shows the male and female flowers of maize.

For Examiner's Use



Fig. 3.1

(i) With reference to Fig. 3.1, describe how the flowering habit of maize encourages wind-pollination.

.....

.....

.....

.....

.....[3]

(ii) In a maize plant, the anthers normally ripen before the stigmas are mature and ready to receive pollen. This encourages cross-pollination.

Explain the potential advantages of cross-pollination to a plant species.

.....

.....

.....

.....[3]

© UCLES 2008

(b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

For Examiner's Use

Archaeological excavations have found that maize in its edible form dates back at least 4000 years. It has been argued that the structural differences between teosinte and maize grains are so great that it is unlikely that maize could have been bred from teosinte so long ago.

Investigations have been carried out into the genetic differences between teosinte and maize. A gene on chromosome 4, *tga 1*, containing 1042 base pairs, was found to be responsible for all of the structural differences between teosinte and maize.

Fig. 3.2 shows the DNA base sequence of the only part of *tga 1* that always differs between teosinte and maize.

teosinte	GAT	TGG	GAT	CTC	AAG	GCG	GCG	GGC	GCG	TGG
maize	GAT	TGG	GAT	CTC	AAC	GCG	GCG	GGC	GCG	TGG

Fig. 3.2

(i) Outline the principles of electrophoresis as used in sequencing this DNA.

.....

.....

.....

.....

.....

.....

.....[4]

© UCLES 2008

(ii) Suggest how the difference in the base sequence of the *tga 1* gene shown in Fig. 3.2 could cause large differences in phenotype between teosinte and maize.

For Examiner's Use

.....

.....

.....[2]

(iii) With reference to Fig. 3.2, explain how these results support the suggestion that it would have been relatively easy for early farmers in Mexico to have bred maize from teosinte.

.....

.....

.....

.....

.....[3]

[Total: 15]

© UCLES 2008

4 **(a)** Outline the role of calcium ions in the transmission of nerve impulses.

For Examiner's Use

.....

.....

.....

.....

.....[3]

(b) It has been suggested that during maturation of a sperm, the uptake of calcium ions is necessary to produce the vigorous movements of the sperm's flagellum that allow it to penetrate the zona pellucida of an oocyte.

Uptake of calcium ions can be measured by staining the sperm with a non-toxic fluorescent stain. Fluorescence increases as the concentration of calcium ions inside the sperm increases.

Sperm from two types of mice were investigated:

- wild-type mice, whose sperm have a particular protein, **P**. **P** is an ion channel found in the plasma (cell surface) membrane.
- mutant mice whose sperm did not have protein **P**.

The results of the investigation are shown in Fig. 4.1.

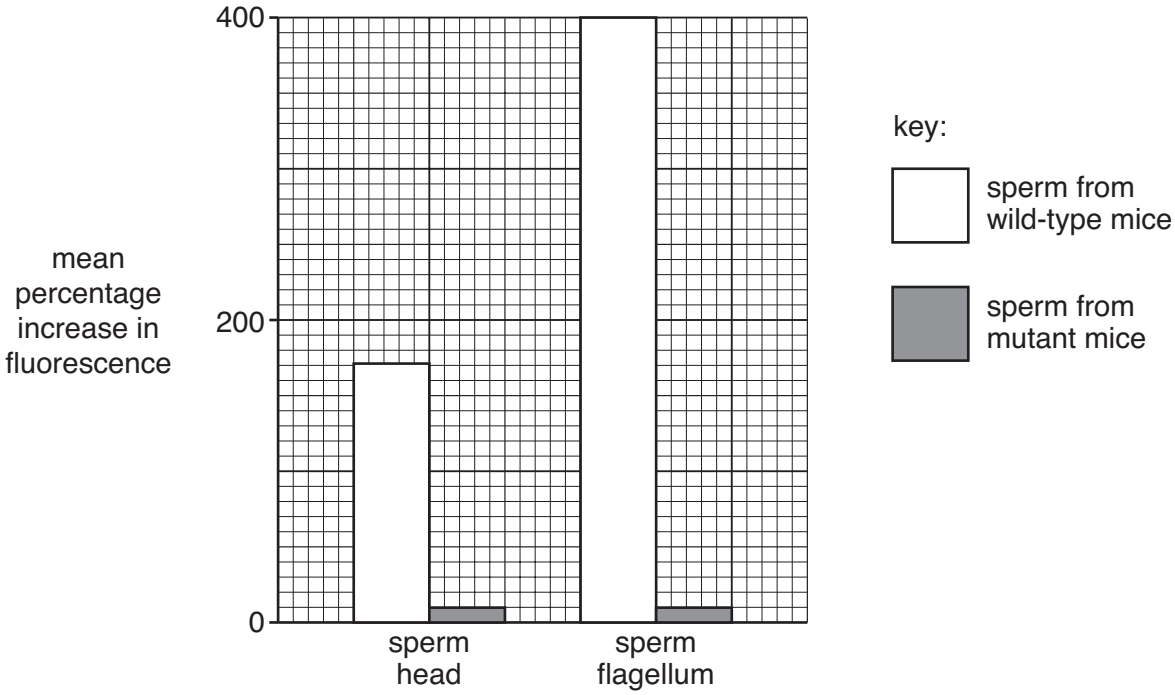


Fig. 4.1

With reference to Fig. 4.1, describe and explain the different mean percentage increases in fluorescence of

For Examiner's Use

(i) sperm from wild-type and mutant mice,

.....

.....

.....

.....

.....[3]

(ii) sperm heads and flagella.

.....

.....

.....

.....

.....[3]

(c) The ability of sperm from wild-type and mutant mice to penetrate oocytes was tested using in-vitro fertilisation (IVF) of oocytes with and without a zona pellucida. The results are shown in Fig. 4.2.

For Examiner's Use

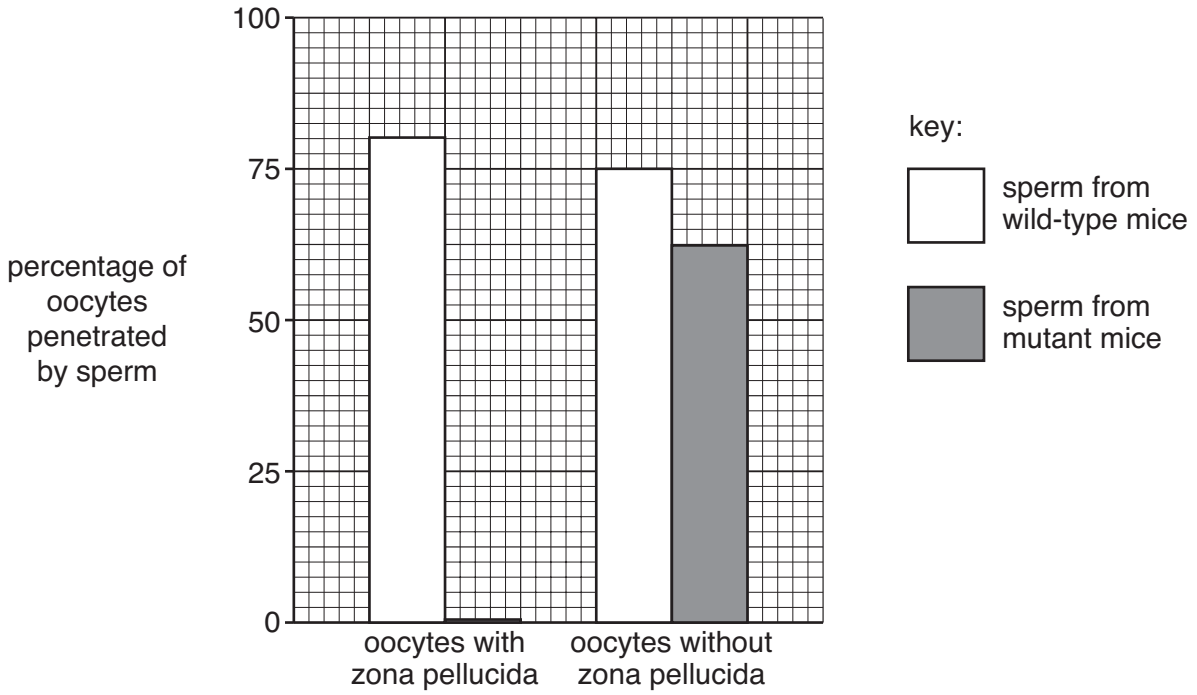


Fig. 4.2

(i) Explain what is meant by *in-vitro fertilisation*.

.....

.....

.....[2]

(ii) With reference to Fig. 4.2, explain the differences in the ability of sperm from wild-type and mutant mice to penetrate oocytes in IVF.

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 15]

© UCLES 2008

BLANK PAGE

Question 5 starts on page 14

5 A significant quantity of the metallic copper produced in some countries is obtained using the chemoautotrophic bacterium, *Thiobacillus ferro-oxidans*, which is present in rocks in many countries.

For Examiner's Use

The process, known as bioleaching, is shown in Fig. 5.1.

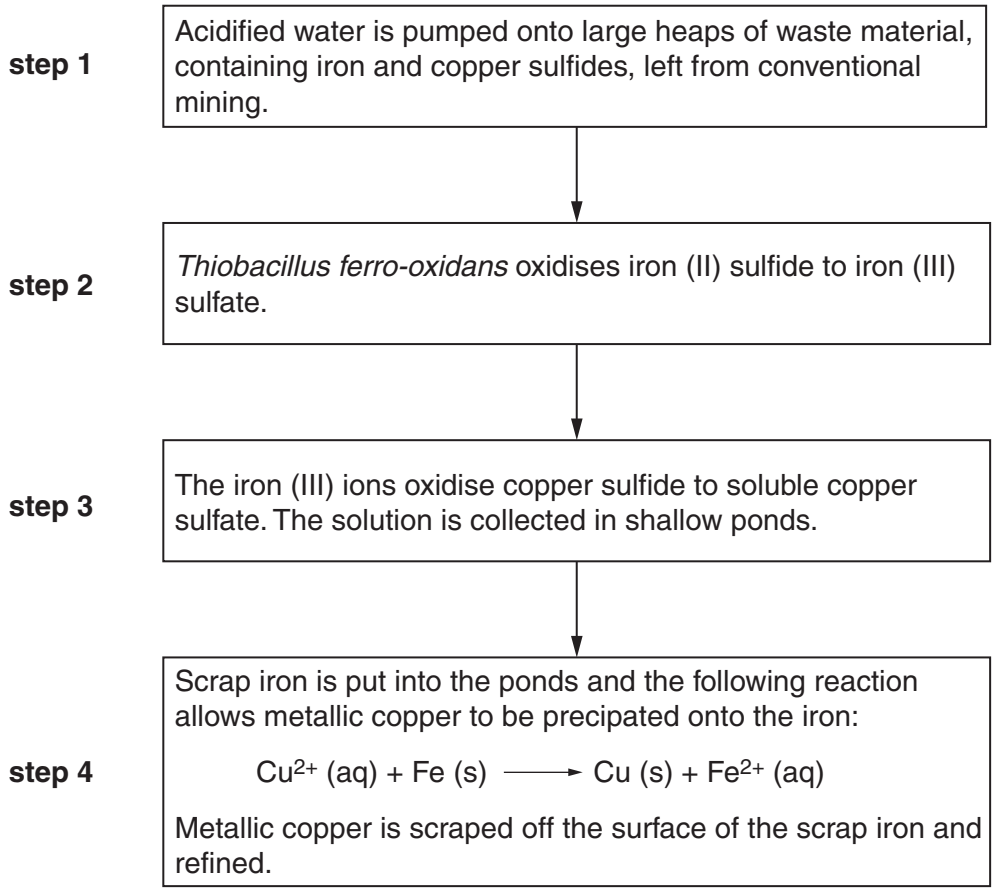


Fig. 5.1

(a) Suggest the benefit to the bacterium of **step 2**.

.....

.....

.....[2]

(b) State two environmental disadvantages of extracting metals by bioleaching.

For Examiner's Use

1. .....

.....

2. .....

.....[2]

(c) Explain why the production of metallic copper by bioleaching can be cheaper than using conventional mining methods.

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 8]

For Examiner's Use

6 Colour blindness is a condition characterised by the inability of the brain to perceive certain colours accurately.

- The most common form is termed red-green colour blindness (RGC).
- RGC results from a recessive allele.
- 0.6% of females worldwide have RGC.
- 8.0% of males worldwide have RGC.

Fig. 6.1 shows the occurrence of RGC in one family.

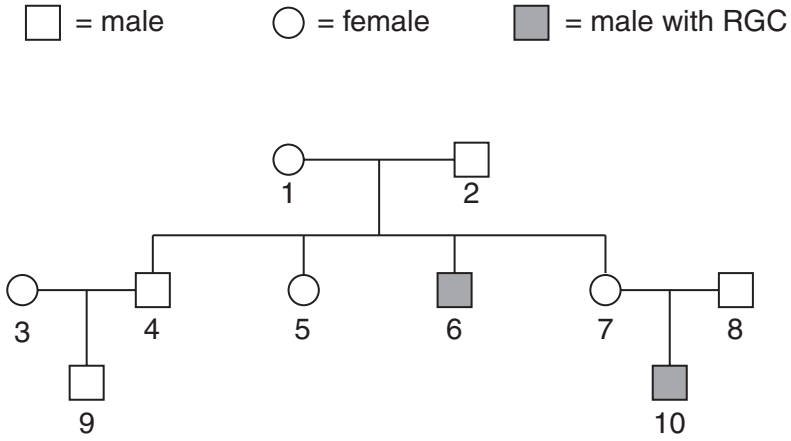


Fig. 6.1

(a) Explain the meaning of the terms *allele* and *recessive*.

allele .....

.....[1]

recessive .....

.....[1]

(b) Explain why females are less likely than males to have RGC.

.....

.....

.....[2]

(c) With reference to Fig. 6.1, and using the symbols **R** for the dominant allele and **r** for the recessive allele, state the genotypes of the individuals **1**, **4**, **6** and **7**.

1 .....

4 .....

6 .....

7 ..... [4]

[Total: 8]

© UCLES 2008

BLANK PAGE

Question 7 begins on page 18

For Examiner's Use

7 **(a)** An **absorption** spectrum is a graph of the absorption of different wavelengths of light by a photosynthetic pigment.

An **action** spectrum is a graph of the rate of photosynthesis at different wavelengths of light.

Fig. 7.1 shows the absorption spectra of chlorophyll a and chlorophyll b as well as an action spectrum.

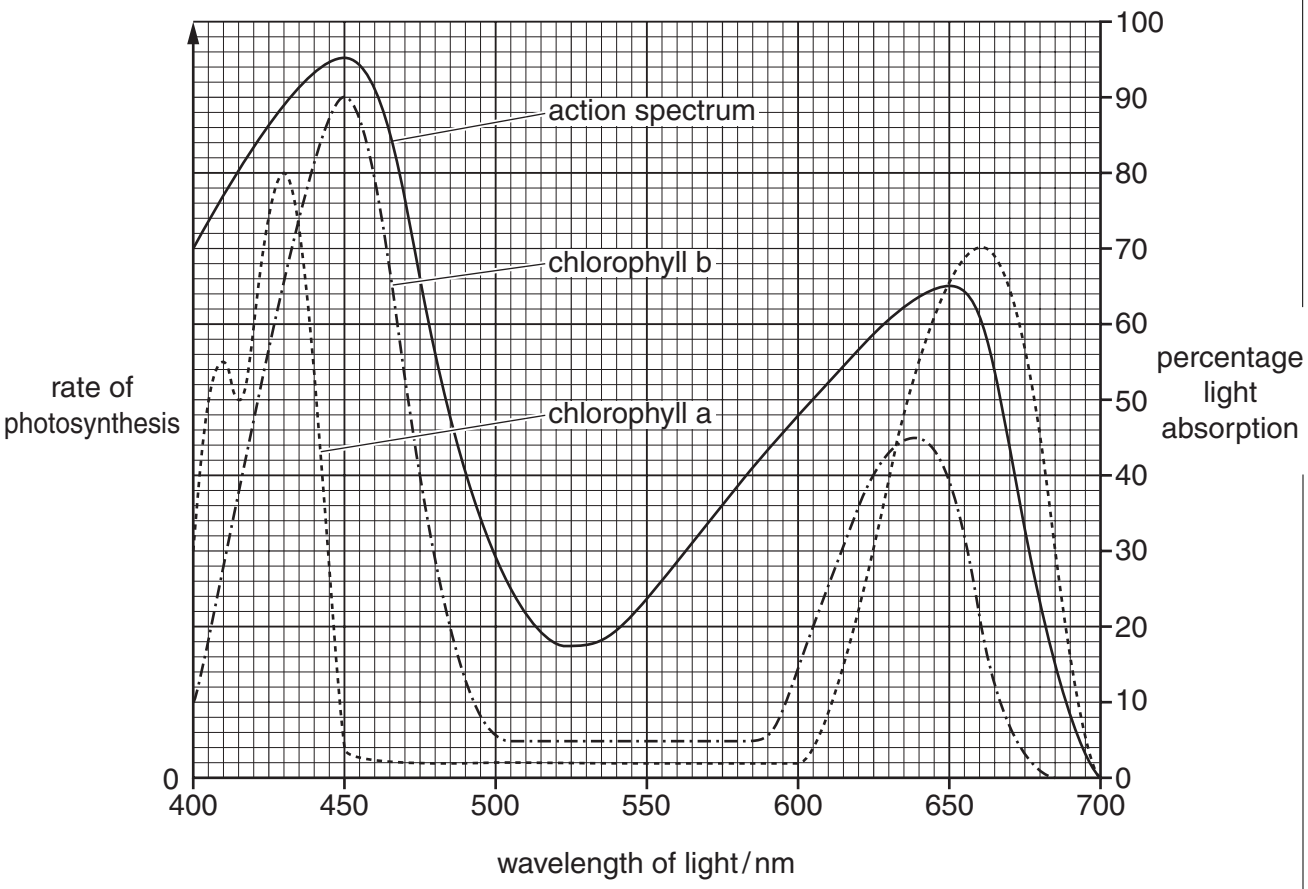


Fig. 7.1

With reference to Fig. 7.1,

(i) compare the **absorption** spectra of chlorophyll a and chlorophyll b,

.....

.....

.....

.....

.....

.....

.....[3]

(ii) explain the shape of the **action** spectrum,

.....

.....

.....

.....

.....[3]

(iii) explain why plants appear green .

.....

.....

.....

.....[2]

(b) Fig. 7.2 is an electron micrograph showing a section through part of a chloroplast.

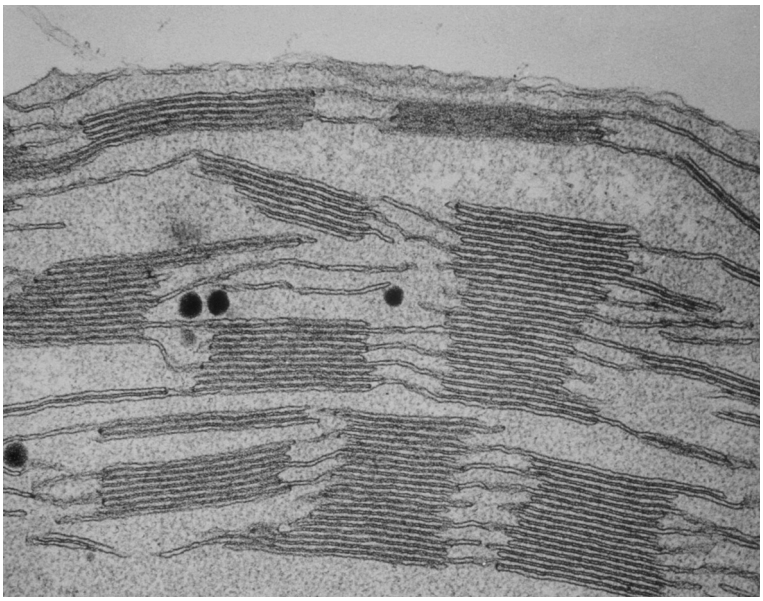


Fig. 7.2

On Fig. 7.2, draw label lines and use the letters **W** and **Y** to identify the following structures:

- **W** where the light-independent reactions occur
- **Y** where chlorophyll is found [2]

(c) Explain why increasing the concentration of carbon dioxide may increase the rate of production of carbohydrates at high light intensities.

For Examiner's Use

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 15]

BLANK PAGE

Question 8 begins on page 22

For Examiner's Use

8 The Atlantic herring, *Clupea harengus*, lives in large populations called shoals and may grow up to 40 cm long.

Fig. 8.1 shows the appearance of *C. harengus*.

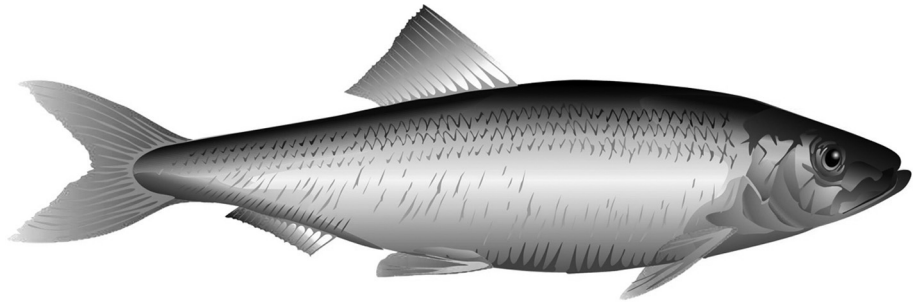


Fig. 8.1

The length of *C. harengus* shows wide variation.

Fig. 8.2 shows the numbers of fish of different lengths in a population of *C. harengus*.

The arrows show the selection pressures, **P** and **S**.

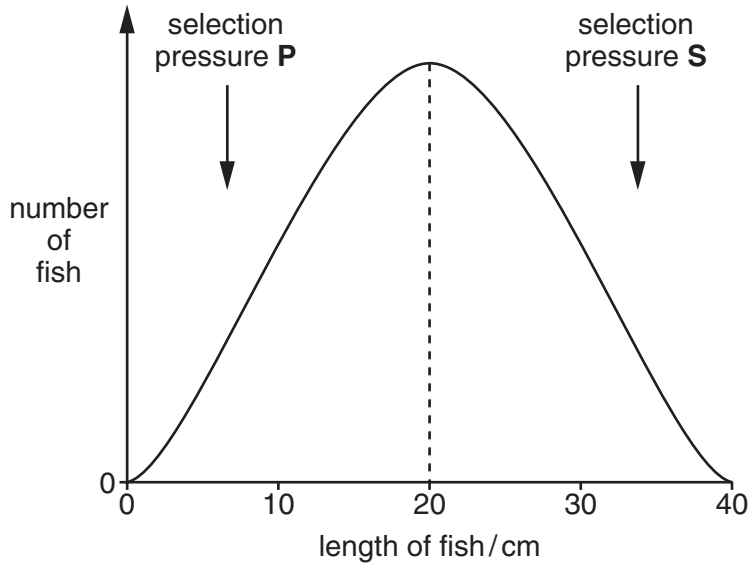
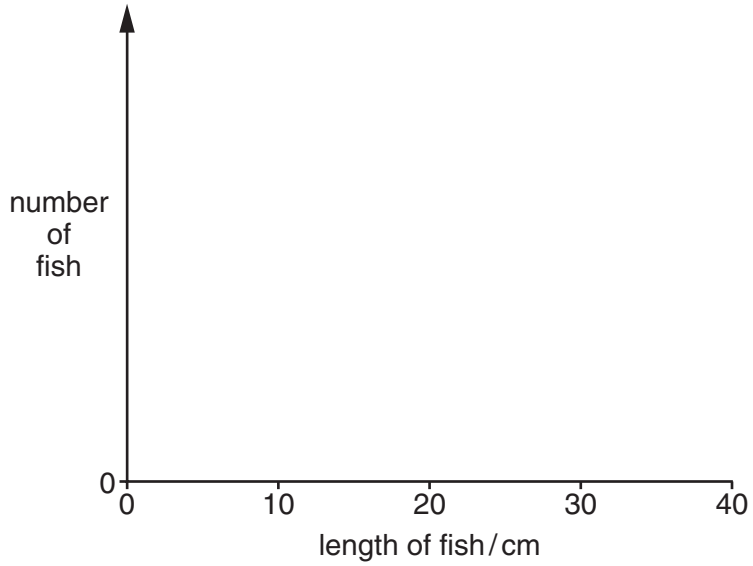


Fig. 8.2

© UCLES 2008

For Examiner's Use

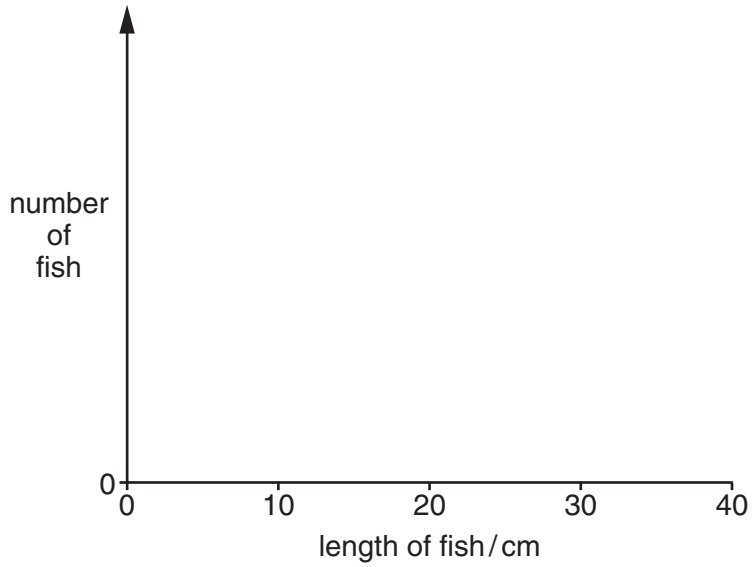
(a) (i) Sketch a graph on the axes below to show the distribution of length of *C. harengus*, when selection pressures **P** and **S** operate for a few years.



[2]

(ii) Name this type of natural selection .....[1]

(b) (i) Sketch a graph on the axes below to show the distribution of length of *C. harengus*, when selection pressure **S** alone operates for a few years.



[2]

(ii) Name this type of natural selection .....[1]

(iii) Suggest two examples of selection pressure **S**.

1. .....

2. .....[2]

[Total: 8]

Section B

Answer **one** question.

For Examiner's Use

9 **(a)** Describe the process of oxidative phosphorylation in the mitochondrion. [9]

(b) Explain the roles of NAD in anaerobic respiration in **both** plants and animals. [6]

[Total: 15]

10 **(a)** Compare the roles of the endocrine **and** nervous systems in control and coordination in animals. [8]

(b) Describe the part played by auxins in apical dominance in a plant shoot. [7]

[Total: 15]

For Examiner's Use

For Examiner's Use

For Examiner's Use

For Examiner's Use

Copyright Acknowledgements:

Question 7 Fig. 7.2 © DR KENETH R. MILLER / SCIENCE PHOTO LIBRARY.
Question 8 Fig. 8.1 © Gulf of Maine Research Institute www.gmri.org

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© UCLES 2008