UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/04**

Paper 4 A2 Structured Questions **May/June 2007**

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, **2** lined pages and **2** blank pages.

For Examiner's Use

Section A

Answer **all** the questions.

1 The western lowland gorilla, *Gorilla gorilla*, has become an endangered species although it has no known enemies, except humans. Gorillas are herbivorous, feeding on fruit, shoots, tree bark and leaves. Fig. 1.1 shows a western lowland gorilla.

Fig. 1.1

(a) Suggest three reasons why the western lowland gorilla has become an endangered species.

1. .....

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2. .....

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3. .....

.....[3]

(b) **(i)** Explain how captive breeding programmes in zoos may help in the protection of endangered species, such as the western lowland gorilla.

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.....[3]

(ii) State two disadvantages of captive breeding programmes.

1. .....

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2. .....

.....[2]

[Total: 8]

2 Aerobic respiration consists of three main processes.

Fill in the table to show the major products of each process.

process	major products
glycolysis	....
Krebs cycle	....
oxidative phosphorylation	....

[8]

[Total: 8]

3 (a) Three different strains, **A**, **B** and **C**, of a species of bacterium were grown on nutrient agar in a divided petri dish until they formed 'lawns' covering the agar.

Three discs of filter paper were soaked in a solution of a penicillin antibiotic and one disc placed in contact with each of the bacterial strains for 10 minutes.

After 24 hours, zones of clearance, indicating bacterial cell death, were seen in the 'lawns' of strains **A** and **B**.

The appearance of the petri dish 24 hours after addition of antibiotic is shown in Fig. 3.1.

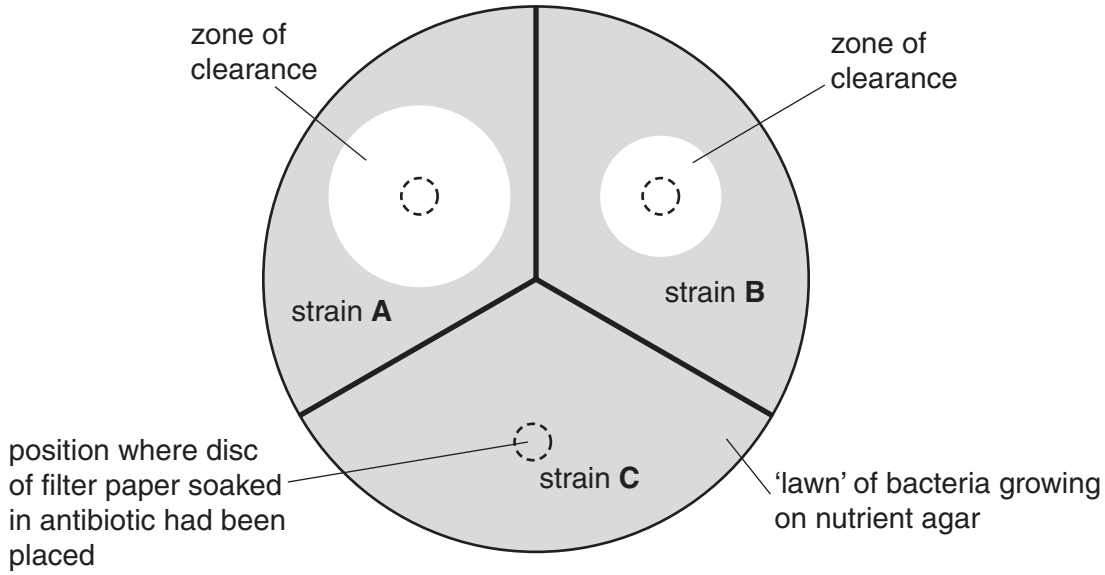

Fig. 3.1

(i) The effectiveness of the antibiotic is proportional to the area of the zone of clearance.

Measure the diameters (**d**) of each of the zones of clearance of bacterial strains A and B and record them to the nearest mm in Table 3.1.

Using πr^2, calculate the **area** in mm^2 of the zone of clearance for each strain of bacterium and record them in Table 3.1.

Calculate the ratio of the **area** for strain **A** to the **area** for strain **B** and record the ratio in Table 3.1.

Table 3.1

bacterial strain	**A**	**B**
diameter (**d**) of zone of clearance / mm	.....	.....
area of the zone of clearance / mm^2	.....	.....
area for strain **A** : **area** for strain **B**	.....	

[3]

(ii) Explain the different effects of the antibiotic on bacterial strains **A**, **B** and **C**.

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.....[4]

(iii) Describe the role of natural selection in the spread of bacterial strains, such as **A** and **B**, when an antibiotic is used.

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.....[4]

(b) The β-lactam antibiotics, such as penicillin, are similar shaped molecules to the substrate of a bacterial enzyme, transpeptidase.

Explain the mode of action of β-lactam antibiotics on susceptible bacteria.

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.....[4]

[Total: 15]

4 **(a)** Describe the role of insulin in the regulation of blood glucose concentration.

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Question 4 continues on page 8

[Turn over

(b) Fig. 4.1 shows some of the steps involved in the production of bacteria capable of synthesising human insulin.

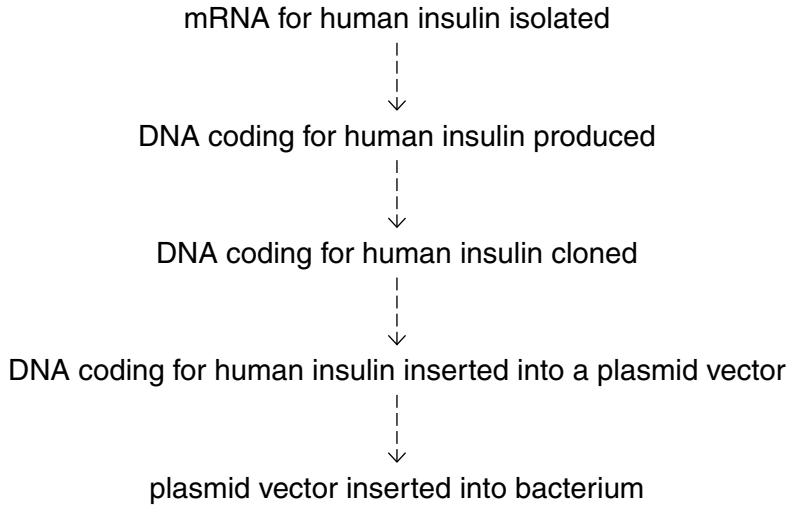

Fig. 4.1

State the role of each of the following enzymes in the production of bacteria capable of synthesising human insulin,

reverse transcriptase .....

.....

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DNA polymerase .....

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restriction enzymes (restriction endonucleases) .....

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.....

DNA ligase. .....

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.....[6]

[Total: 10]

5 Rice, *Oryza sativa*, is a grass that is grown as a cereal crop in many parts of the world. In most rice-growing regimes, the rice fields are flooded with water while the rice is actively growing. Fig. 5.1 shows cultivation of rice.

Fig. 5.1

(a) (i) Describe **one** structural feature of the tissues in the submerged stems and leaves of rice that is an adaptation for growth in water.

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.....[2]

(ii) Explain the importance of the adaptation you have described in **(i)**.

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.....[2]

(b) An investigation was carried out into the effect of flooding on the growth of the submerged stems of rice plants.

Young rice plants were grown in a container in which the level of water was increased in 10 cm steps, over a period of seven days. The mean length of the submerged internodes (lengths of stem between two leaves) and the concentration of ethene in the rice stems was measured each day. As a control, rice plants were grown in identical conditions but the water level was kept constant throughout the seven days. The results are shown in Fig. 5.2.

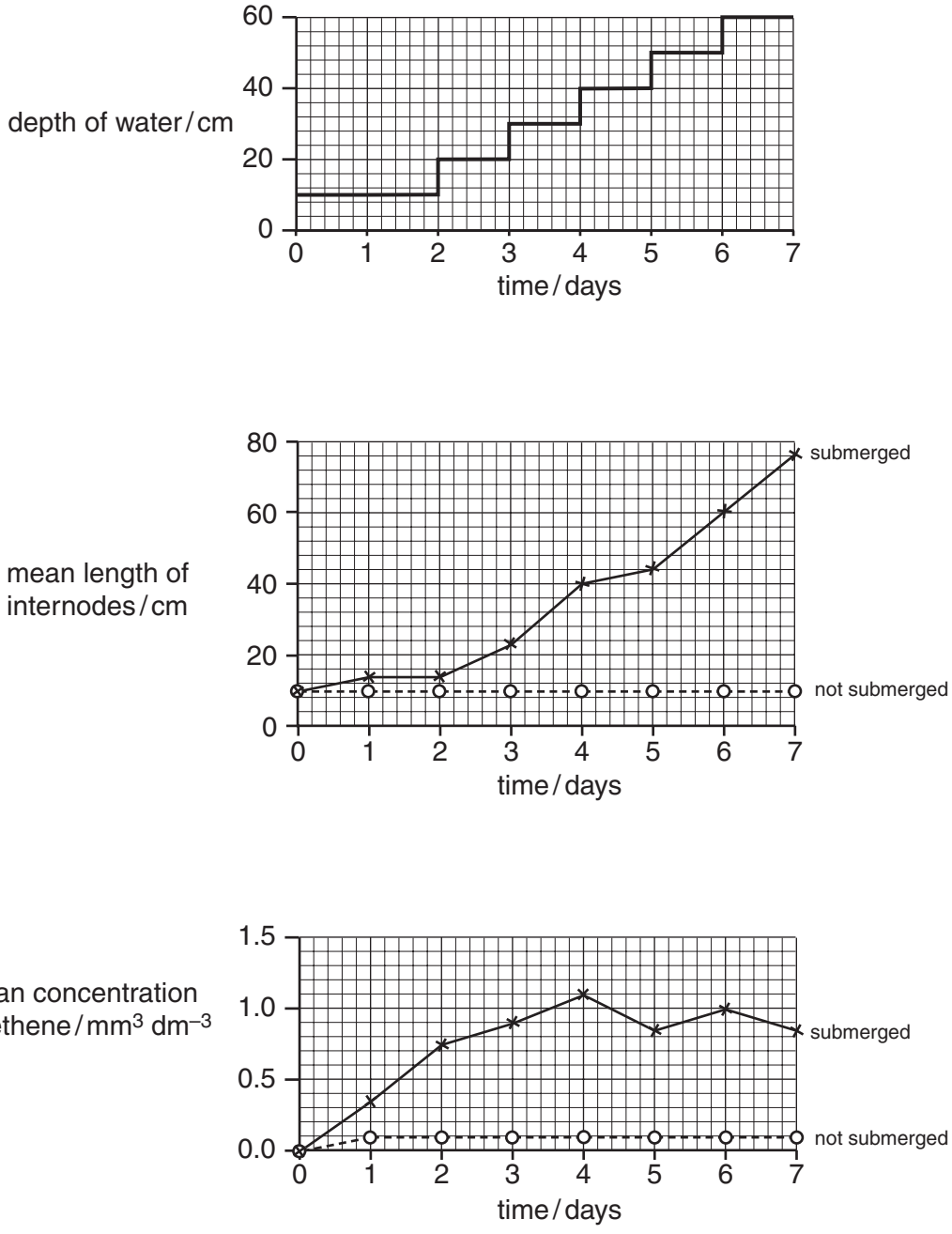

Fig. 5.2

(i) With reference to Fig. 5.2, describe the effect of increasing water level on the length of the submerged internodes.

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.....[2]

(ii) Suggest advantages to the rice plants of the effect that you have described in **(i)**.

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.....[2]

(iii) With reference to Fig. 5.2, describe the effect of increasing water level on the concentration of ethene in the rice stems.

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.....[2]

(c) Application of gibberellin can also affect the growth of rice plants. In a further investigation, various concentrations of gibberellin were applied to submerged rice stems. The stems were placed, for three days in closed containers, in which the air supply either contained pure air or contained ethene. Ethene is a gas that is secreted by plant tissues and acts as a plant growth regulator.

The results are shown in Fig. 5.3.

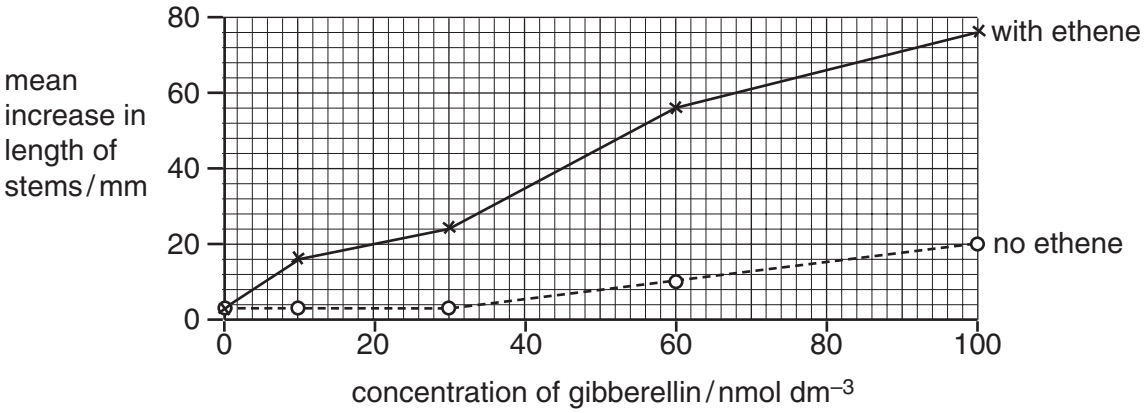

Fig. 5.3

(i) State the meaning of the term *plant growth regulator*.

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.....[1]

(ii) Using your knowledge of the effects of gibberellin, and the results shown in Fig. 5.2, suggest an explanation for the results shown in Fig. 5.3.

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.....[3]

[Total: 14]

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6 Fig. 6.1 is a photomicrograph of a section through the ovary of a mammal.

Fig. 6.1

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

A .....

B .....[2]

Fig. 6.2 shows part of the sequence of processes by which female gametes are produced.

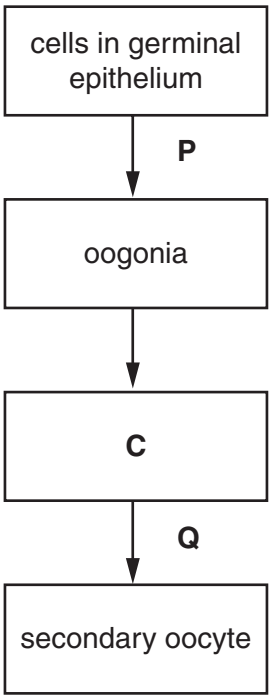

Fig. 6.2

(b) With reference to Fig. 6.2,

(i) name the cell at stage **C**;

..... [1]

(ii) draw a label line **on Fig. 6.1** to a cell at stage **C**; [1]

(iii) name the types of cell division that take place at **P** and **Q**.

P .....

Q ..... [1]

(c) Describe **one** way in which genetic variation between secondary oocytes is achieved during meiosis.

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.....[3]

[Total: 8]

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7 **(a)** Sometimes a gene has more than two alleles, termed *multiple alleles*.
The ABO blood group system in humans is controlled by a gene with three alleles, I^A, I^B and I^o. Alleles I^A and I^B are codominant and I^o is recessive to both.

The blood group **AB** is the result of codominance.

Explain what is meant by *codominance*.

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.....[3]

(b) In humans, a gene that codes for the production of a protein, called factor VIII, is located on the X chromosome. The dominant allele for this gene produces factor VIII, but the recessive allele does not produce factor VIII.

A person who is unable to make factor VIII has haemophilia in which the blood fails to clot properly.

Explain why a man with haemophilia cannot pass haemophilia to his son but may pass haemophilia to his grandson.

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.....[3]

(c) A gene for feather colour in chickens is carried on an autosome. This gene has two alleles, black (C^B) and splashed-white (C^W). When a male chicken with black feathers is mated with a female chicken with splashed-white feathers, all the offspring have blue feathers. This also occurs when a male chicken with splashed-white feathers is crossed with a female with black feathers.

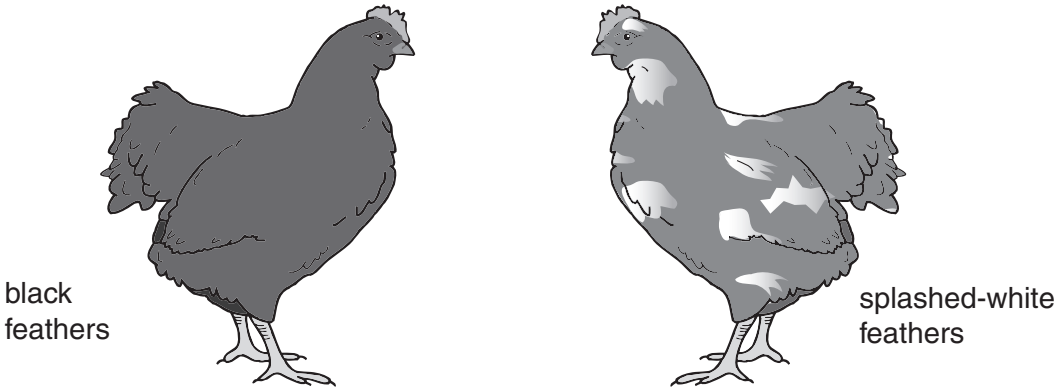

Fig. 7.1

Another gene may cause stripes on feathers (barred feathers). This gene is carried on the X chromosome. The allele for barred feathers (X^A) is dominant to the allele for non-barred feathers (X^a).

In chickens the male is homogametic and has two X chromosomes while the female is heterogametic and has one X chromosome and one Y chromosome.

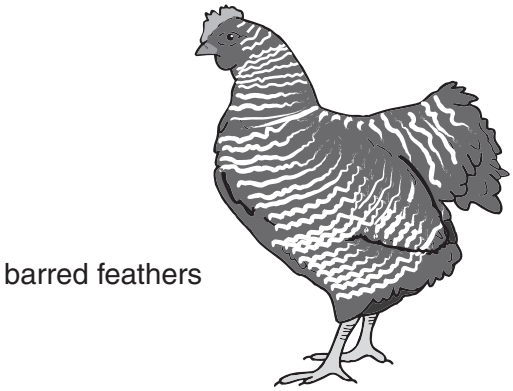

Fig. 7.2

(i) A male chicken with black, non-barred feathers was crossed with a female chicken with splashed-white, barred feathers. All the offspring had blue feathers, but the males were barred and the females were non-barred.

Using the symbols given above draw a genetic diagram to show this cross.

parents' phenotype	male, black, non-barred feathers.	female, splashed-white, barred feathers.
genotype		
gametes		
offspring genotypes		
phenotypes	male, blue, barred feathers.	female, blue, non-barred feathers.

[5]

(ii) Explain how a farmer could use a breeding programme to find out the genotype of a male chicken with blue, barred feathers.

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.....[3]

[Total: 14]

8 **(a)** Explain what is meant by *artificial selection.*

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(b) In a plant breeding programme, corn, *Zea mays*, was bred in an attempt to produce a high yield of protein in the grain.

The results of this programme are shown in Fig. 8.1.

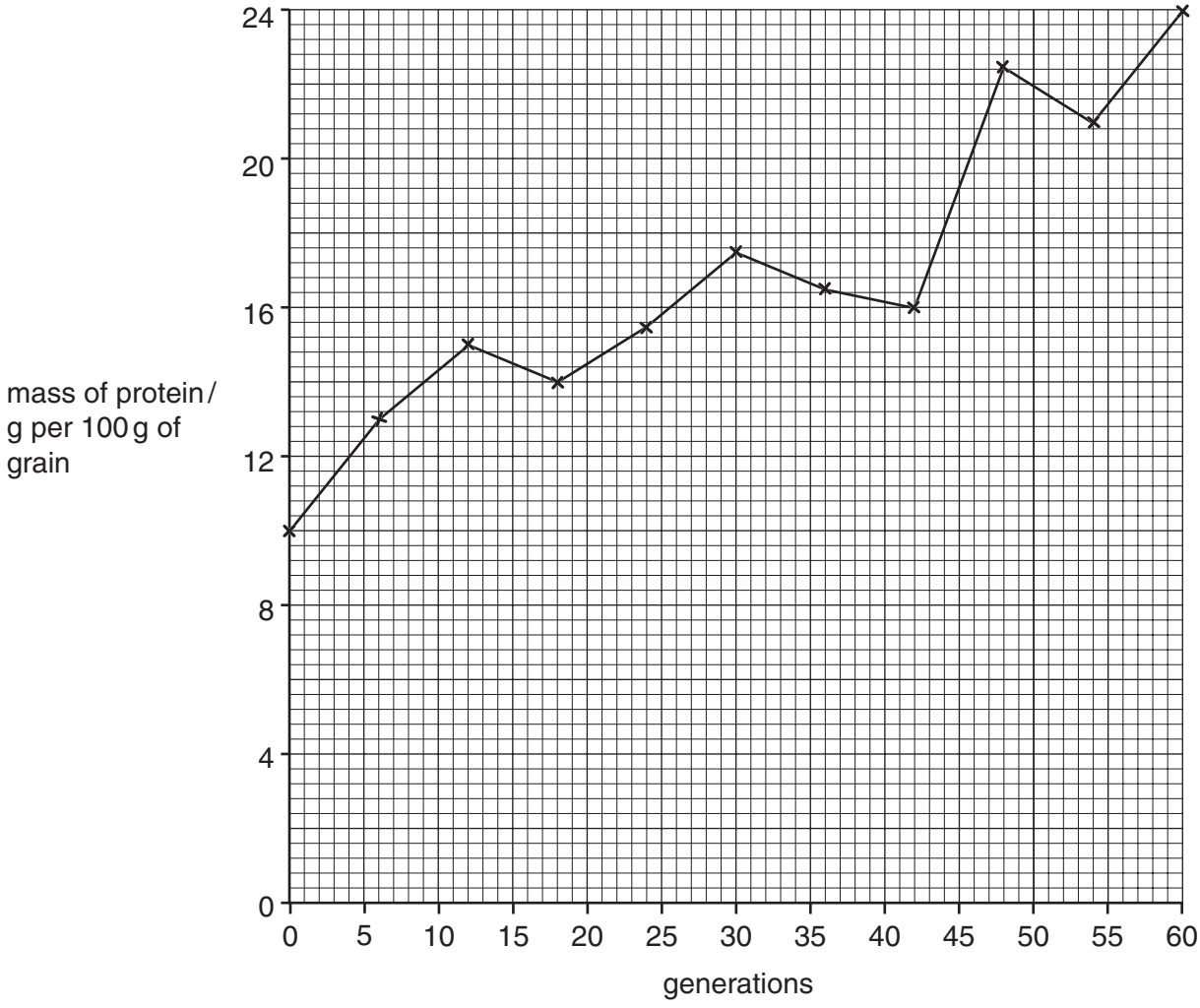

Fig. 8.1

(i) With reference to Fig. 8.1, calculate the percentage increase in grain protein by the end of the experiment.

Show your working.

Answer .....% [2]

(ii) Suggest why the protein yield does not increase steadily in each generation.

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.....[2]

[Total: 8]

Section B starts on page 22

Section B

Answer **one** question.

9 **(a)** Describe how a nerve impulse crosses a cholinergic synapse. [9]

(b) Explain the roles of synapses in the nervous system. [6]

[Total: 15]

10 **(a)** Describe the structure of a chloroplast. [9]

(b) Explain how the palisade mesophyll cells of a leaf are adapted for photosynthesis. [6]

[Total: 15]