UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3216215542

BIOLOGY **9700/41**

Paper 4 Structured Questions A2 Core **October/November 2010**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question
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.

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Section A

For Examiner's Use

Answer **all** the questions.

1 The Great Lakes, in North America, lie between the USA and Canada. A survey of birds of the Lake Ontario area has shown the relative abundance of birds between 1995 and 2005.

Table 1.1 shows the feeding habits and the relative change in numbers of some of the birds in the survey.

Table 1.1

name	feeding habit	percentage change in numbers between 1995 and 2005
mallard *Anas platyrhynchos*	amphibia, plants	+10.0
tree swallow *Tachycineta bicolor*	flying insects	–6.2
blue-winged teal *Anas discors*	aquatic insects, molluscs, plants	–12.3
pied-billed grebe *Podilymbus podiceps*	amphibia, aquatic insects, fish	–15.9
black tern *Chlidonias niger*	aquatic insects, fish, flying insects	–18.7

(a) Using the information in Table 1.1 suggest reasons for the changes in numbers of these birds.

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(b) An ecosystem that has a wide range of species has a high biodiversity.

Explain the benefits of maintaining biodiversity.

For Examiner's Use

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..... [4]

[Total: 8]

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[Turn over

For Examiner's Use

2 The disease-causing bacterium, *Pseudomonas aeruginosa*, may occur in the form of a 'biofilm'. A biofilm consists of a layer of bacteria, growing on a surface and attached to one another. Such biofilms are difficult to control by antibiotics.

A mutant strain of *P. aeruginosa* has been found which produces biofilms that are indistinguishable from those of the wild-type bacteria. However, the mutant strain differs from the wild-type in its resistance to an antibiotic, **A**.

(a) Antibiotic **A** belongs to a group of antibiotics known as anti-pseudomonal penicillins.

(i) Describe the mode of action of penicillin on bacteria.

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(ii) Explain why penicillin does not affect viruses.

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..... [2]

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(b) Wild-type and mutant bacteria were grown on solid culture media both with antibiotic **A** and without antibiotic **A**.

For Examiner's Use

The subsequent change in numbers of living bacteria is shown in Fig. 2.1.

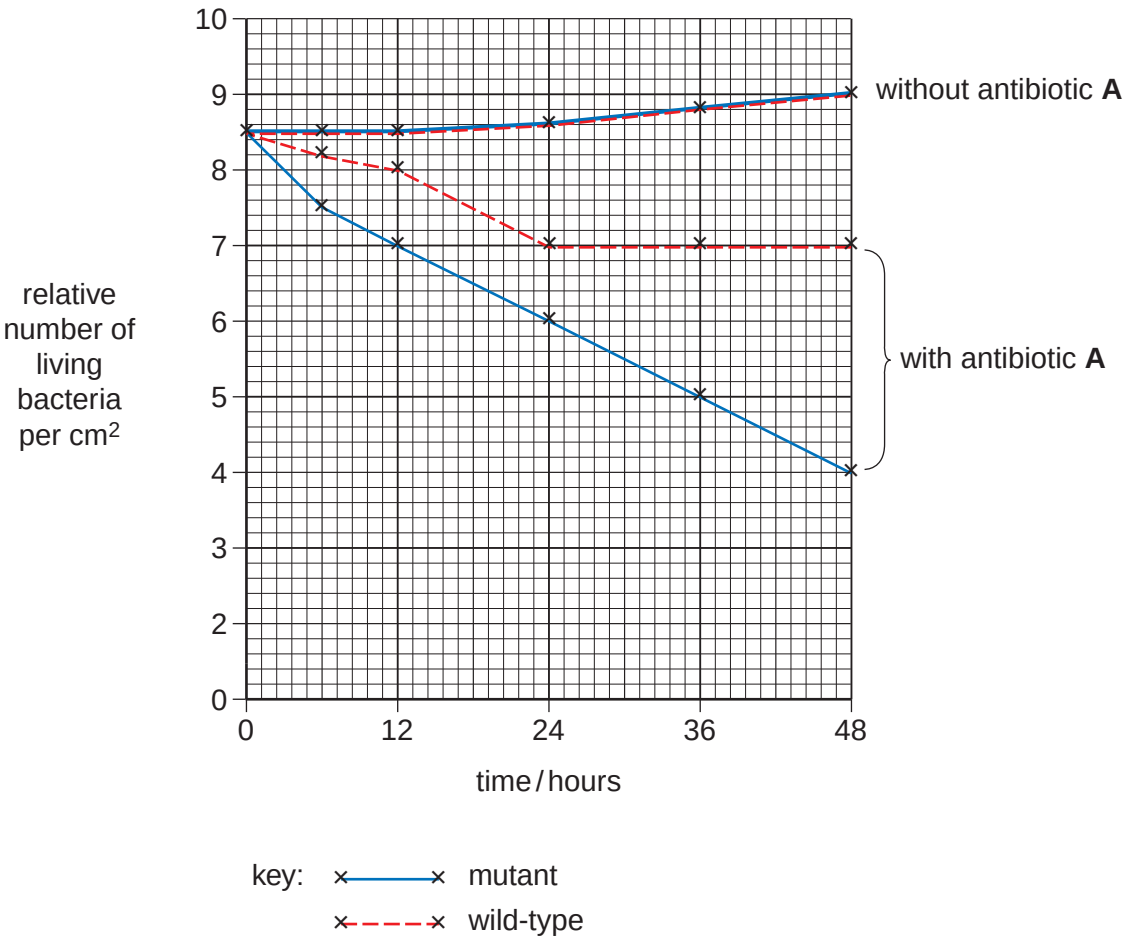


Fig. 2.1

With reference to Fig. 2.1, describe the changes in numbers of the wild-type and mutant bacteria on culture media with antibiotic **A and** without antibiotic **A**.

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For Examiner's Use

(c) The wild-type and mutant strains of this bacterium have different DNA sequences in part of a gene coding for an enzyme which is needed to produce polymers of glucose, called glucans. Glucans are secreted by bacteria and can bind to various molecules, including those of antibiotic **A**.

Explain

(i) how a mutation of a gene coding for an enzyme may result in an enzyme with reduced activity,

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..... [2]

(ii) the different effects of antibiotic **A**, shown in Fig. 2.1, on the wild-type and mutant strains of bacteria.

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(d) Explain the role of natural selection in the evolution of antibiotic resistance in bacteria.

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[Total: 16]

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3 A recent development in fertility treatment is called in-vitro maturation (IVM). This is both cheaper and safer than the standard procedure used in in-vitro fertilisation (IVF), especially for women with polycystic ovaries. Hormone treatment can be dangerous for women with this condition, in which a number of ovarian follicles mature at the same time.

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IVF and IVM are compared in Fig. 3.1.

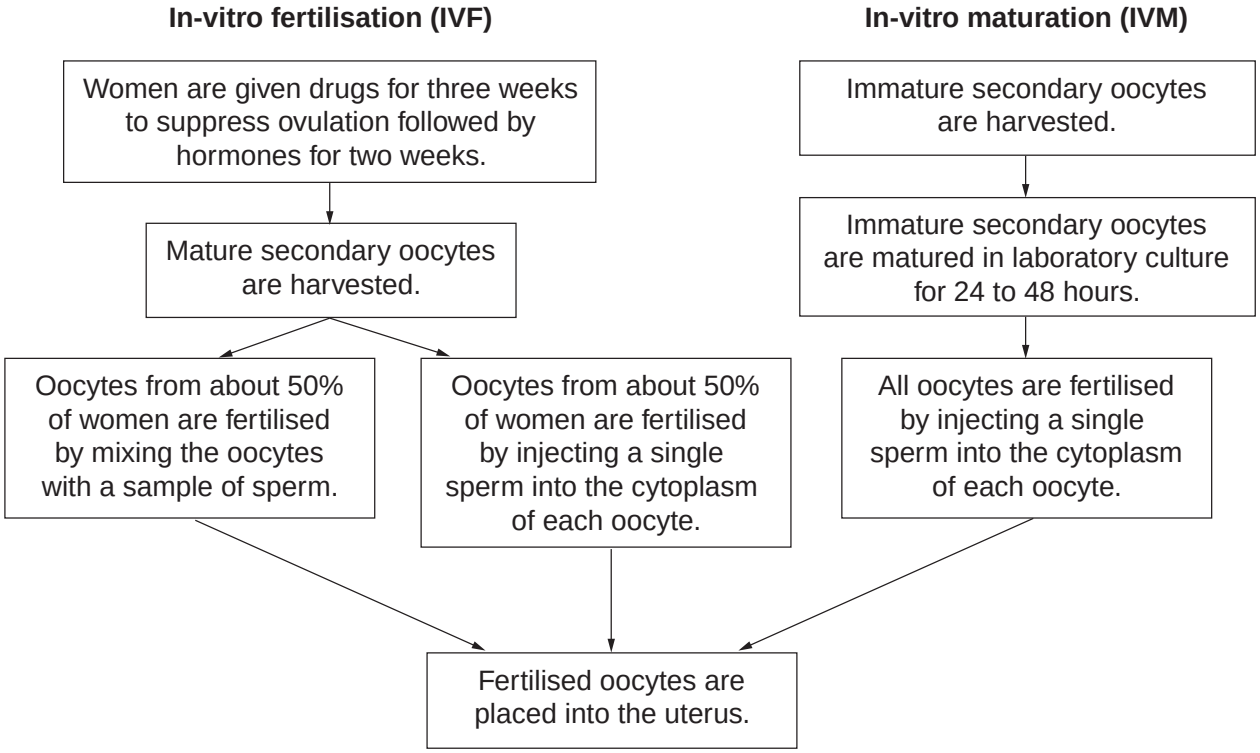


Fig. 3.1

(a) With reference to Fig. 3.1, explain why women are treated with hormones for two weeks after being given drugs to suppress ovulation at the beginning of IVF treatment.

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(b) State the roles of mitosis and meiosis in producing an immature secondary oocyte.

For Examiner's Use

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..... [3]

(c) Suggest one advantage and one possible disadvantage of fertilising an oocyte by injecting a sperm into its cytoplasm instead of mixing the oocyte with a sample of sperm.

advantage .....

.....

disadvantage .....

..... [2]

[Total: 7]

For Examiner's Use

4 The secretion of insulin by the islets of Langerhans in the pancreas stimulates the liver to reduce the blood glucose concentration.

(a) Describe how the **liver** reduces blood glucose concentration, when insulin is secreted.

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(b) Almost all insulin used to treat type I diabetes is produced by genetically engineered bacteria or yeast. A summary of this procedure is shown in Fig. 4.1.

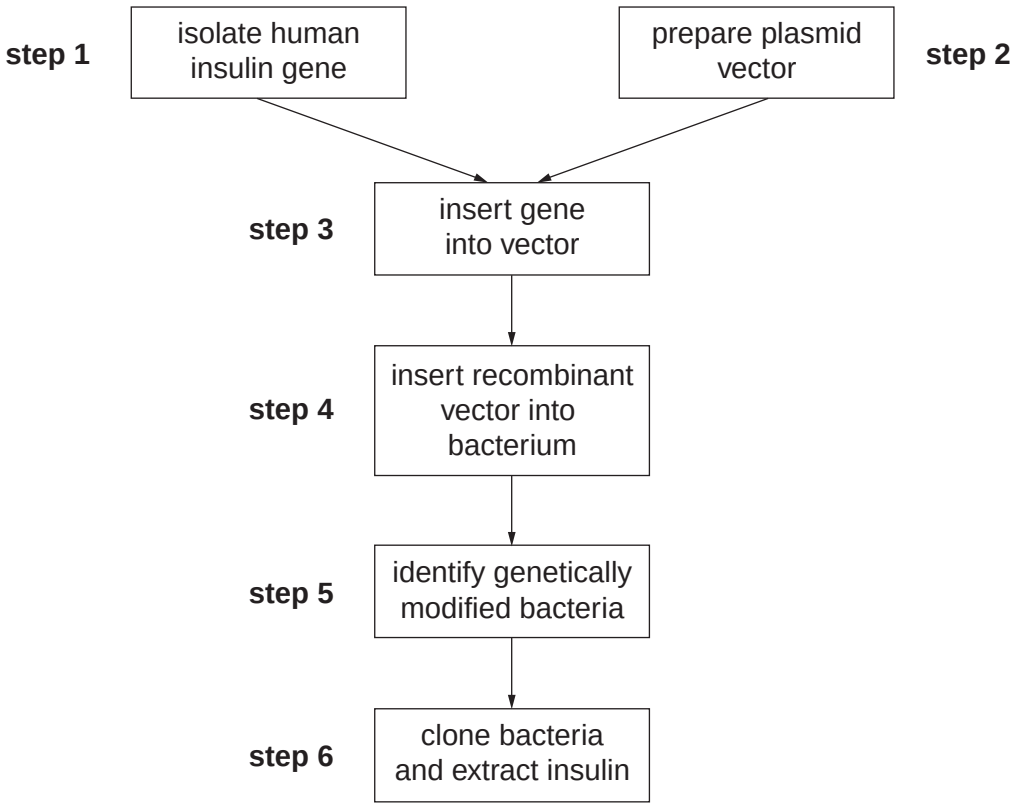


Fig. 4.1

For Examiner's Use

(i) One way of carrying out **step 1** is to collect mRNA from β cells from the pancreas. The relevant mRNA is then isolated and used to make DNA.

Suggest why isolating the mRNA coding for insulin in a β cell is easier than isolating the DNA for insulin in a β cell.

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..... [2]

(ii) Outline the use of restriction enzymes in **step 2**.

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(c) Most people with type I diabetes inject insulin. A recent product contains insulin that can be administered using a nasal spray. The spray is inhaled and the insulin is taken up through the lungs.

For Examiner's Use

Fig. 4.2 shows the concentration of insulin in the blood plasma in the 480 minutes after injecting or inhaling insulin. In both cases, the insulin was of the same type, obtained from genetically engineered *Escherichia coli*.

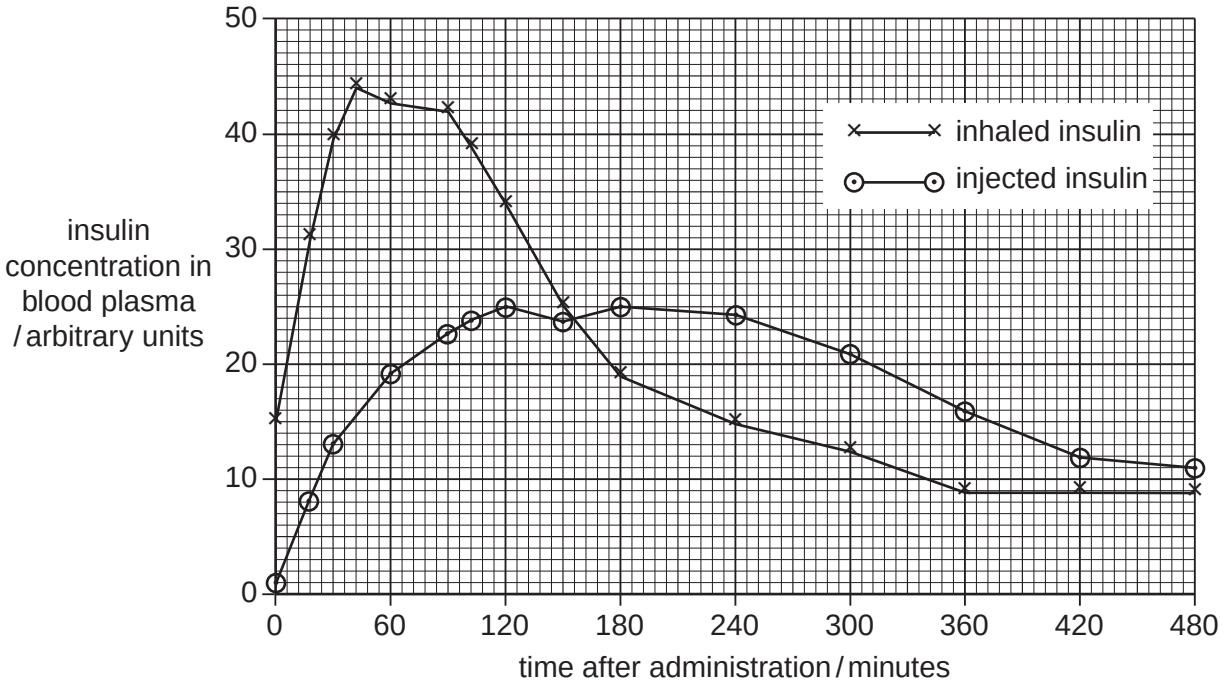


Fig. 4.2

Fig. 4.3 shows the concentration of glucose in the blood plasma in the 480 minutes after injecting or inhaling insulin.

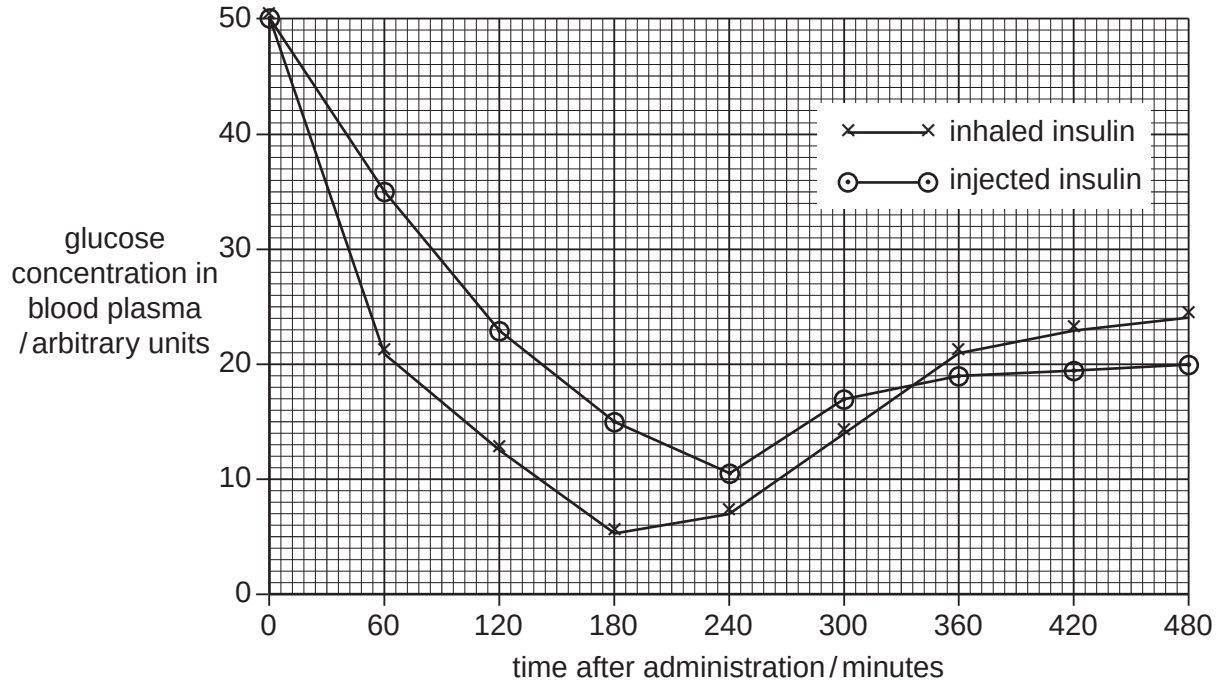


Fig. 4.3

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For Examiner's Use

(i) Compare the results for injected insulin and inhaled insulin shown in Fig. 4.2.

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..... [3]

(ii) With reference to Fig. 4.2, explain the differences in the blood glucose levels after injecting or inhaling insulin shown in Fig. 4.3.

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..... [3]

(iii) With reference to Figs. 4.2 and 4.3, suggest one advantage and one disadvantage of inhaling insulin rather than injecting it.

advantage .....

.....

disadvantage .....

..... [2]

[Total: 15]

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[Turn over

5 Rice, *Oryza sativa*, is a staple food in many parts of the world. Rice is often grown in fields that are flooded with water for part of the growing season.

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(a) The roots of young rice plants are highly tolerant of ethanol. Explain how this helps them to survive when the fields are flooded.

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..... [2]

(b) Rice grains have a similar structure to those of maize. The endosperm makes up most of the rice grain. The endosperm is surrounded by an aleurone layer, which contains hydrolytic enzymes. Outside the aleurone layer is the fused pericarp and testa, containing large amounts of cellulose.

(i) Describe the function of the endosperm.

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..... [2]

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Brown rice includes the pericarp and testa, whereas in white rice these have been removed during milling, along with most of the aleurone layer.

For Examiner's Use

Table 5.1 shows the nutrient content of samples of white and brown rice.

Table 5.1

	nutrient content per 100 g	
	white rice	brown rice
lipid / g	0.8	2.4
dietary fibre / g	0.6	2.8
calcium / mg	8	12
vitamin B_1 / mg	0.07	0.26
protein / g	6.0	7.4
carbohydrate / g	82.0	77.7

(ii) With reference to the structure of rice grains, suggest why brown rice contains more protein than white rice.

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..... [2]

(iii) Explain why brown rice contains less carbohydrate per gram than white rice.

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..... [1]

(iv) Explain why the grains of cereals such as rice are staple foods in many parts of the world.

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..... [2]

[Total: 9]

6 In sickle cell anaemia the recessive allele Hb^S replaces the normal allele Hb^A.

For Examiner's Use

- The frequency of Hb^S is much higher in West Africa than in most parts of the world.
- The frequency of Hb^S corresponds with the distribution of malaria.

(a) Explain what is meant by the term *allele.*

.....

..... [1]

(b) State whether the likely life expectancy is high or low in West Africa for individuals with the following genotypes. In each case give a reason for your answer.

Hb^AHb^A .....

.....

Hb^AHb^S .....

.....

Hb^SHb^S .....

..... [4]

(c) Explain why populations of West African descent living in the USA have a decreased frequency of the Hb^S allele compared to West African populations.

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..... [2]

[Total: 7]

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7 An investigation was carried out into the effects of a plant growth regulator, auxin (IAA), on apical dominance.

- The apical buds of 20 pea plants were cut off and discarded.
- The cut surfaces of 10 pea plants were coated with an inert paste containing auxin.
- The cut surfaces of the other group of 10 pea plants were coated with the inert paste alone.
- A further group of 10 pea plants did not have their apical buds removed and were not coated with paste. This was a control group.

The lengths of the side shoots of plants in each of the three groups were measured at regular time intervals and mean values calculated.

The results are shown in Fig. 7.1.

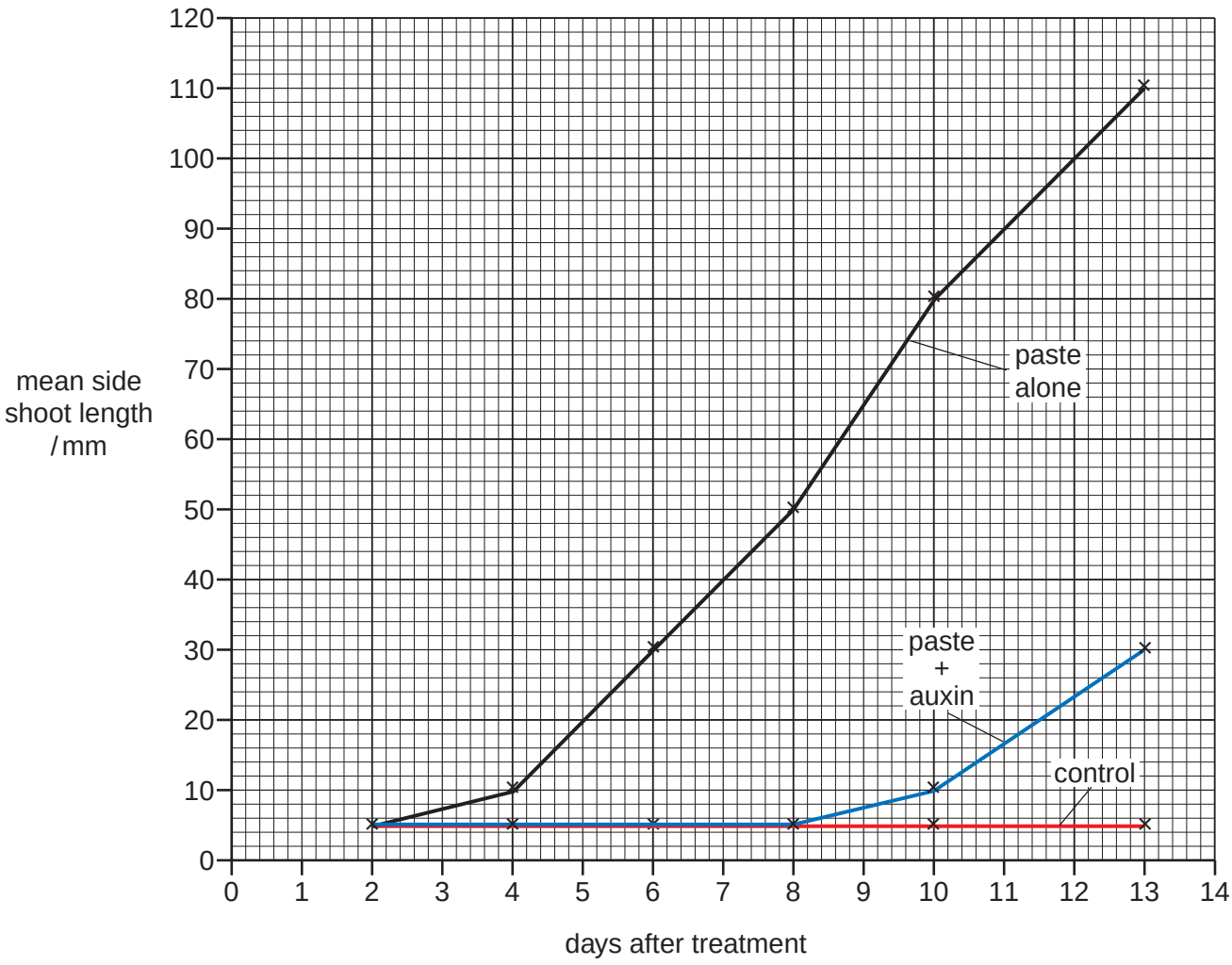


Fig. 7.1

(a) Explain why the side shoots increase in length when the terminal buds are removed.

For Examiner's Use

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..... [3]

(b) Calculate the percentage difference, at 13 days, in the mean length of side shoots of plants treated with paste alone compared with the plants treated with paste and auxin.

Give your answer to the nearest whole number.

Show your working.

Answer .....% [2]

(c) Using data from Fig. 7.1, describe **and** explain the effect of auxin on the growth of side shoots.

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..... [3]

[Total: 8]

For Examiner's Use

8 **(a)** In flowering plants, the light-dependent reactions are carried out by photosynthetic pigments which fall into two categories: primary pigments and accessory pigments.

Outline the role played by accessory pigments in the light-dependent reactions.

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..... [2]

(b) Photosynthetic pigments are arranged in photosystems. There are two photosystems, PS I and PS II. PS I takes part in cyclic photophosphorylation but PS II does not.

Outline the differences between cyclic and non-cyclic photophosphorylation.

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..... [4]

(c) The rate of photosynthesis is affected by several environmental factors. Fig. 8.1 shows the effect of temperature on the rate of photosynthesis.

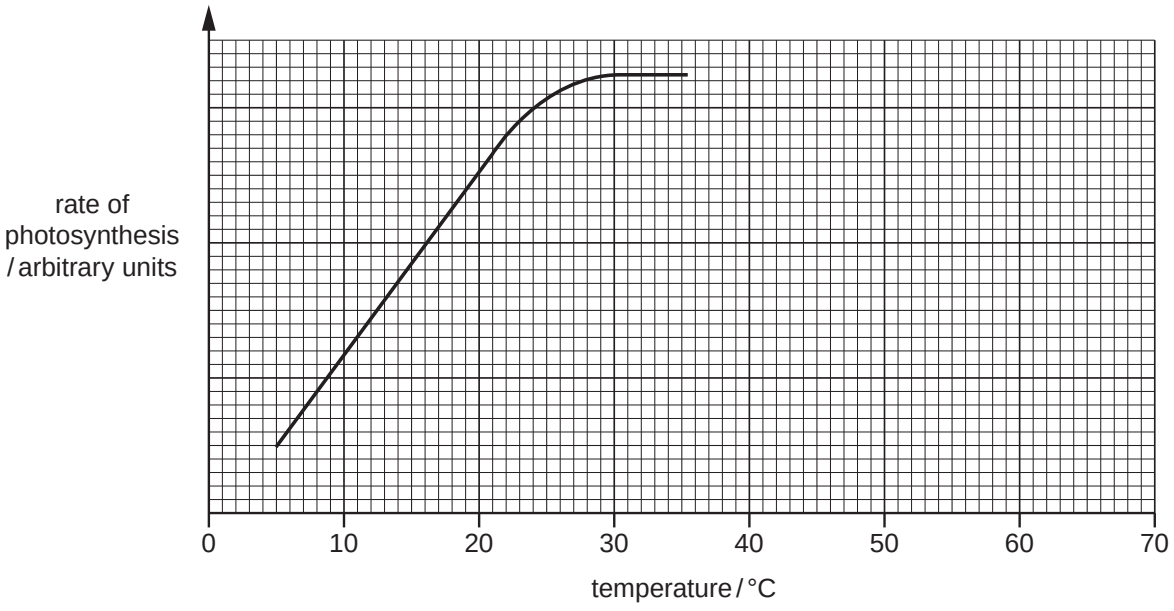


Fig. 8.1

For Examiner's Use

(i) Explain why the rate of photosynthesis levels out at 30 °C.

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..... [2]

(ii) On Fig. 8.1 continue the curve to indicate what would happen to the rate of photosynthesis if the temperature was increased to 70 °C. [1]

(iii) Explain why you have continued the curve in this way.

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..... [2]

(d) A palisade mesophyll cell is adapted to carry out photosynthesis. The table below lists some of the adaptations of a palisade mesophyll cell.

Complete the table to show how these adaptations help the cell to carry out photosynthesis.

adaptation	how the adaptation helps photosynthesis
thin cell wall	....
cylindrical shape	....
large vacuole	....
chloroplasts can be moved within the cell	....

[4]

[Total: 15]

Section B

Answer **one** question.

For Examiner's Use

9 **(a)** Outline the behaviour of **chromosomes** during meiosis. [9]

(b) Describe the ways by which **gene** mutations can occur. [6]

[Total: 15]

10 **(a)** Outline the need for energy in living organisms using named examples. [9]

(b) Explain the different energy values of carbohydrate, lipid and protein as respiratory substrates. [6]

[Total: 15]

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