Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1254127717

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **February/March 2017**

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 on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

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Section A

Answer **all** the questions.

1 **(a)** Fig. 1.1 shows diagrams of nephrons from the kidneys of three different mammals, **P**, **Q** and **R**. These are all drawn to the same scale.

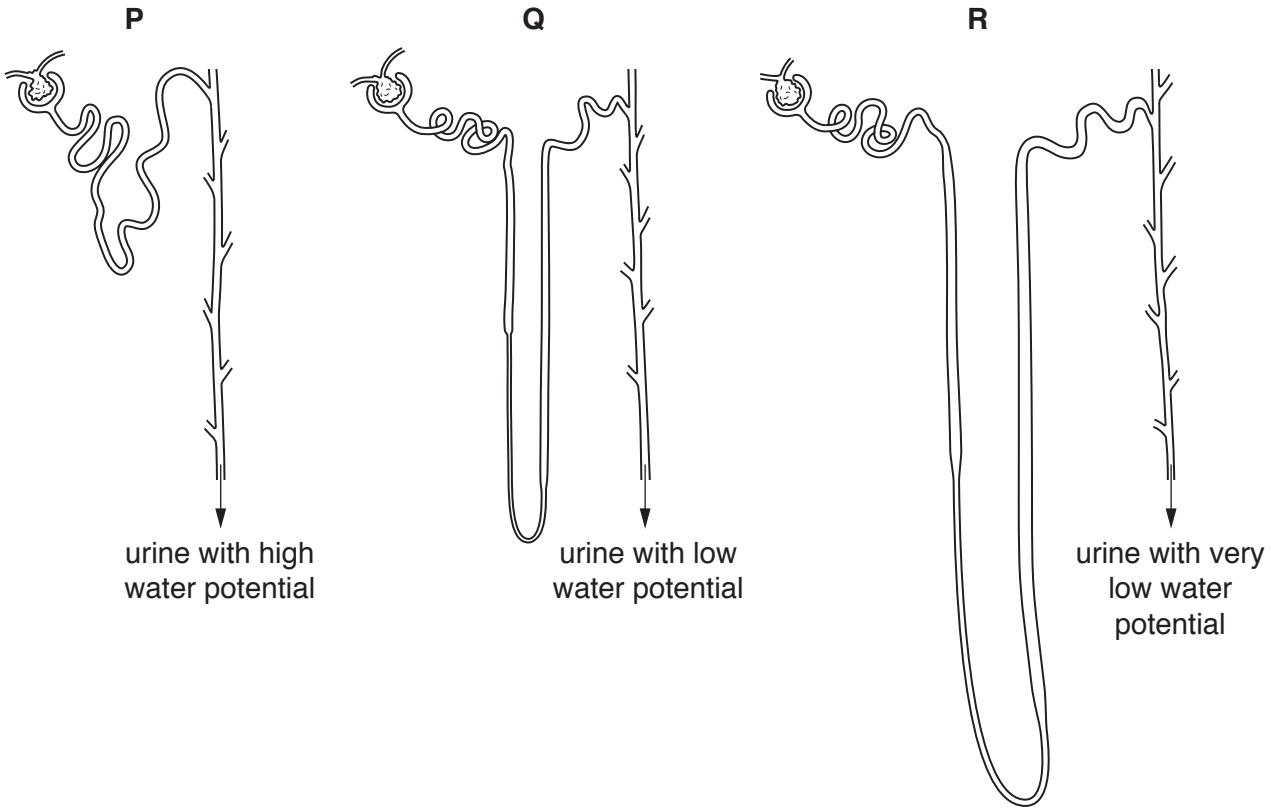

Fig. 1.1

(i) State the relationship between the length of the loop of Henle and the water potential of the urine of the three mammals.

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..... [1]

(ii) The nephron of a camel is similar to that of mammal **R**.

Suggest why it is important that the camel produces urine with a very low water potential.

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..... [2]

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(b) The epithelial cells of the proximal convoluted tubule are adapted to carry out selective reabsorption.

Table 1.1 lists three features of epithelial cells of the proximal convoluted tubule.

For each feature, explain how it helps the process of selective reabsorption.

Table 1.1

feature	explanation
microvilli	....
many mitochondria	....
tight junctions between cells	....

[6]

[Total: 9]

2 **(a)** During a sporting event, an athlete carries out respiration in aerobic conditions.

(i) Complete Table 2.1 to state the precise locations within a muscle cell of glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation.

Table 2.1

process	precise location
glycolysis	
link reaction	
Krebs cycle	
oxidative phosphorylation	

[2]

(ii) In a muscle cell, molecules of glucose are phosphorylated at the start of glycolysis.

Suggest why the phosphorylated glucose molecules cannot diffuse out of the cell.

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..... [2]

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(b) Sometimes an athlete will need to carry out respiration in anaerobic conditions to produce ATP.

Explain why the respiration of glucose in anaerobic conditions produces less ATP than in aerobic conditions.

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..... [5]

(c) For a short time after exercise, a person continues to breathe more heavily than at rest to take in more oxygen than normal.

Explain the use of this **extra** oxygen.

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..... [3]

[Total: 12]

3 One example of chemical control and co-ordination in plants is in the breakdown of food reserves during the germination of cereal grains, such as wheat.

(a) Fig. 3.1 is a diagram of a grain of wheat.

The numbered arrows indicate the sequence of events that occurs after the uptake of water by the grain of wheat.

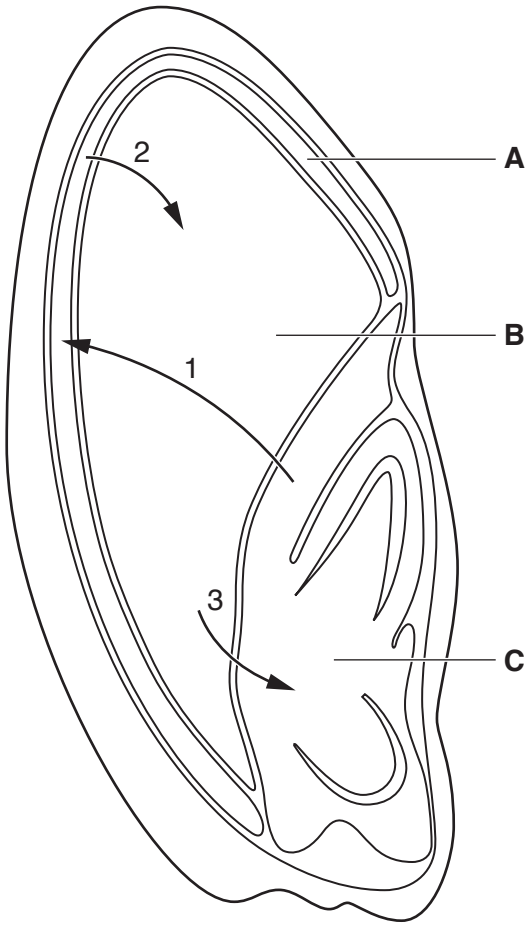

Fig. 3.1

(i) Name structures **A**, **B** and **C**, shown in Fig. 3.1.

A .....

B .....

C .....

[3]

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(ii) With reference to the three numbered arrows in Fig. 3.1, describe the sequence of events that follows the uptake of water by the grain of wheat.

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..... [6]

(b) Growth in plants occurs in areas such as shoot and root tips. Growth occurs by cell division and cell elongation.

Fig. 3.2 shows the effect of the plant growth regulator auxin on mean cell length in the shoot tips of wheat seedlings.

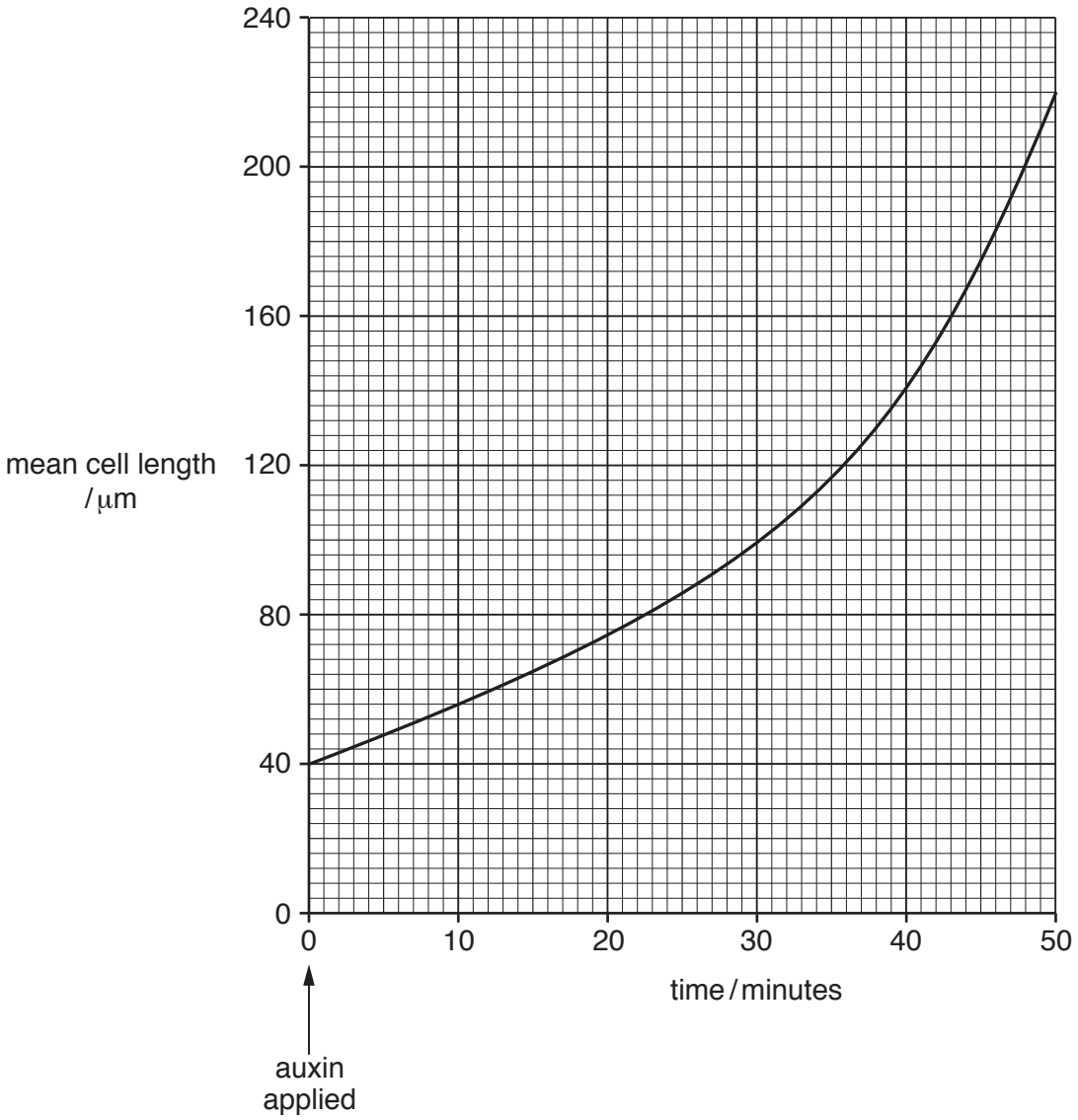

Fig. 3.2

(i) With reference to Fig. 3.2, calculate the overall rate of increase in mean cell length over the time period shown.

overall rate of increase .....

[2]

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(ii) The pH of the cell walls decreased after the application of auxin.

Outline the events that occurred to cause this decrease in pH.

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..... [2]

(iii) Explain the increase in the length of the cells following the decrease in pH of the cell walls.

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..... [3]

[Total: 16]

4 **(a)** An investigation was carried out to measure the rate of photosynthesis at different concentrations of carbon dioxide. Two different plants, barley and sugar cane, were tested at two different temperatures, 10 °C and 25 °C.

The results are shown in Fig. 4.1.

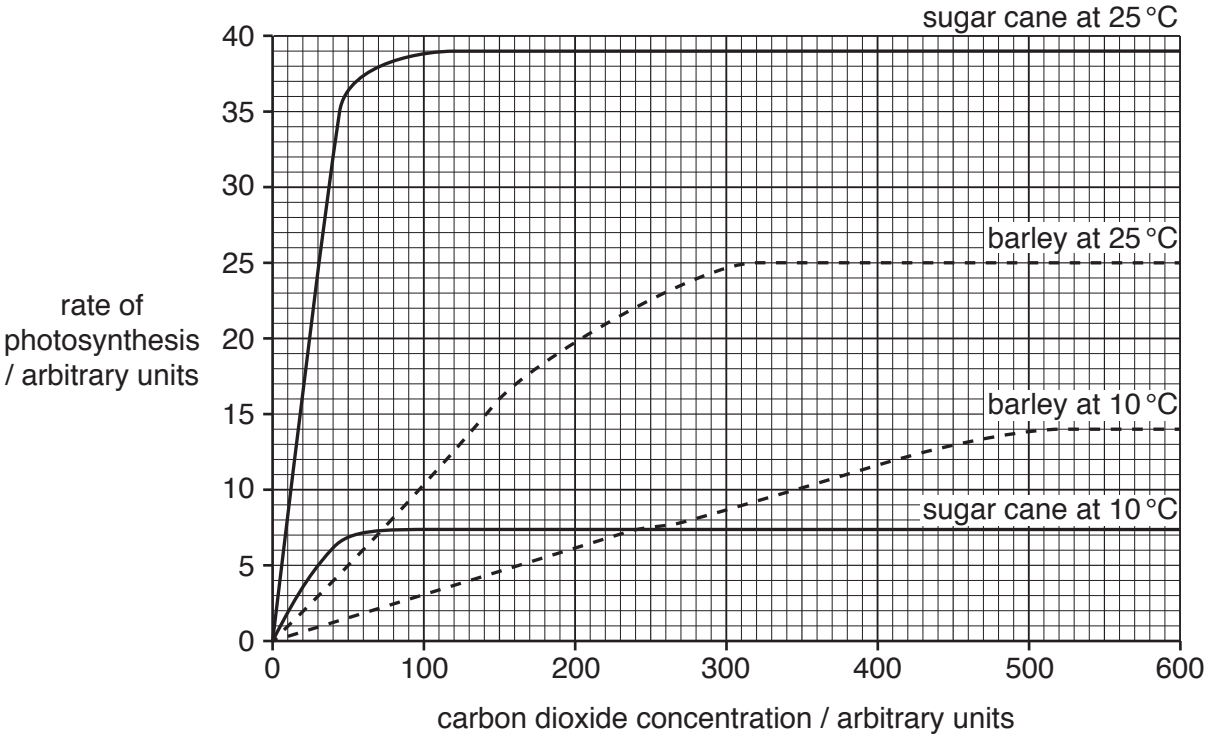

Fig. 4.1

(i) Suggest why, in all four experiments, the rate of photosynthesis became constant as the carbon dioxide concentration increased.

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..... [2]

(ii) With reference to Fig. 4.1, describe the difference in the rate of photosynthesis, **at 10 °C**, between barley and sugar cane.

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..... [3]

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(iii) Sugar cane is a C4 plant. Barley is **not** a C4 plant.

Explain why, **at 25 °C**, sugar cane had a higher rate of photosynthesis than barley.

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..... [4]

(b) Carbon dioxide for photosynthesis enters the leaves through open stomata. Stomata do not stay open all the time.

Changes in environmental conditions can cause stomata to close. Describe these conditions and explain how stomatal closure benefits the plant.

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..... [4]

[Total: 13]

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[Turn over

5 The foxglove, *Digitalis purpurea*, is a common plant in many parts of the world.

Fig. 5.1 shows a foxglove.

Fig. 5.1

Flower colour in foxgloves is controlled by two genes that interact with each other.

- Dominant allele **M** codes for an enzyme involved in the production of a purple pigment.
- Recessive allele **m** codes for a non-functioning enzyme so no purple pigment is produced, resulting in a white colour.
- Dominant allele **D** interacts with allele **M** to produce dark purple flowers.
- Recessive allele **d** does not interact with allele **M**.
- Neither allele **D** nor allele **d** interact with allele **m**.

A double homozygous foxglove with dark purple flowers was crossed with a double homozygous recessive foxglove with white flowers. All the offspring had dark purple flowers.

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

.....

..... [1]

(b) Using the symbols above, state the genotype of the offspring with dark purple flowers.

..... [1]

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(c) Two of these offspring with dark purple flowers were crossed.

This cross produced a mixture of plants with three different flower colours:

- dark purple
- purple
- white.

Draw a Punnett square to show the possible genotypes **and** phenotypes of the mixture of plants from this cross.

Write down the expected ratio of plants with each flower colour.

ratio .....

[6]

[Total: 8]

6 The Hardy-Weinberg principle may be used to calculate allele and genotype frequencies for a gene, within a population.

The Hardy-Weinberg principle uses these equations:

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

(a) Within a population of butterflies, the allele for brown wing colour, **B**, is dominant to the allele for white wing colour, **b**.

40% of the butterflies in this population are white.

Use the Hardy-Weinberg principle to calculate the percentage of butterflies in the population that are heterozygous for the gene controlling wing colour.

Show your working.

answer ..... %
[3]

(b) Describe **four** situations where the Hardy-Weinberg principle does **not** apply.

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..... [4]

[Total: 7]

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Question 7 starts on page 16

7 **(a)** Most reflex arcs pass through the spinal cord and involve different types of neurones.

Name **and** state the functions of the three types of neurone in a spinal reflex arc.

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..... [3]

(b) Some poisons affect the functioning of synapses between neurones. Listed below are four organisms, **A**, **B**, **C** and **D**, each of which produces a different poison that affects the functioning of synapses.

A *Hapalochlaena lunulata*, the blue-ringed octopus

B *Conus textile*, the textile cone sea snail

C *Clostridium botulinum*, a bacterium

D *Physostigma venenosum*, the calabar bean plant

Table 7.1 summarises the action of the poisons from organisms **A**, **B**, **C** and **D**.

Table 7.1

source of poison	action of poison at synapse
A	blocks sodium channels
B	blocks calcium channels
C	prevents exocytosis
D	inhibits acetylcholinesterase

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Suggest **and** explain how poison from each of these organisms affects the functioning of synapses.

A .....

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B .....

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C .....

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D .....

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[6]

[Total: 9]

8 Palm oil is an edible vegetable oil that comes from the fruit of oil palm trees.

- Palm oil is cheap.
- It is the world's most widely used vegetable oil.
- The yield of oil per hectare from oil palm trees is thirty times more than that of oil from maize.
- Around 85% of the world's palm oil is now produced in Indonesia.

Table 8.1 shows the change in forest cover on the three main Indonesian islands between 2000 and 2010.

Table 8.1

	island		
	Sumatra	**Borneo**	**Java**
area of island /million hectares	42	72	12
forest cover in 2000 /million hectares	15	33	3
forest cover in 2010 /million hectares	12	27	1
loss of forest cover between 2000 and 2010 /million hectares	3	.....	2
percentage loss of forest cover between 2000 and 2010	20	.....	67

(a) Complete Table 8.1 to show the loss of forest cover **and** the percentage loss of forest cover for Borneo between 2000 and 2010. [2]

(b) The Sumatran forest is the natural habitat for the Sumatran orangutan, *Pongo abelii*.

Fig. 8.1 shows a Sumatran orangutan.

Fig. 8.1

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The Sumatran orangutan is classified as critically endangered on the IUCN Red List of Threatened Species. Loss of forest cover can separate family groups from other groups.

(i) Suggest the genetic consequences of the separation of family groups.

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..... [3]

(ii) Suggest ways in which the Sumatran orangutan can be protected in its **natural** environment.

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..... [3]

(iii) Describe the role of zoos in the protection of endangered species such as the Sumatran orangutan.

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..... [3]

[Total: 11]

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[Turn over

Section B

Answer **one** question.

9 **(a)** Explain what is meant by the terms *ecosystem* and *niche*. [7]

(b) Describe the sampling techniques that could be used to measure the distribution and abundance of organisms in a habitat. [8]

[Total: 15]

10 **(a)** Describe the principles of the polymerase chain reaction (PCR). [9]

(b) Explain why plasmids are frequently used in gene technology. [6]

[Total: 15]

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