Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTER NUMBER	
CANDIDATE NUMBER	

5616478492

BIOLOGY (US) **0438/41**

Paper 4 Theory (Extended) **October/November 2016**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Center 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.

Answer **all** questions.

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.

This document consists of **18** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

BLANK PAGE

1 Penicillin is an antibiotic.

(a) (i) Explain why doctors give antibiotics to people who are ill.

.....

.....

.....

.....[2]

(ii) Explain why it is important to complete a full treatment of antibiotics.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Penicillin was discovered in 1928 by Alexander Fleming.

Name the type of microorganism that produces the antibiotic penicillin.

.....[1]

(c) Penicillin is produced commercially in fermenters as shown in Fig. 1.1.

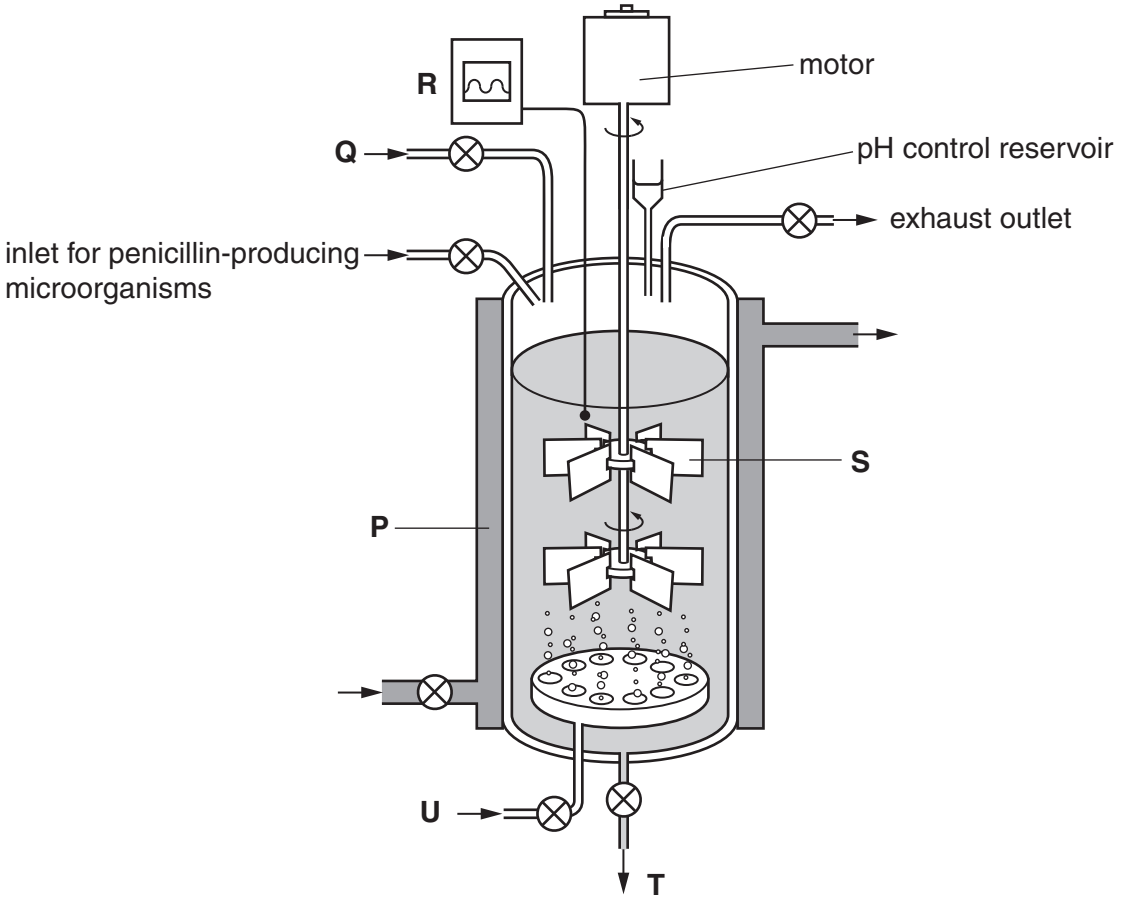

Fig. 1.1

(i) Describe how a fermenter can be sterilized.

.....

.....

.....[2]

(ii) Table 1.1 shows some names of the parts of the fermenter and their functions.

Complete Table 1.1.

One row has been done for you.

Table 1.1

letter from Fig. 1.1	name	function
	water jacket	
S		
	nutrient inlet	
R		
	air supply	
T	outlet	allows collection of the liquid containing penicillin after fermentation

[5]

(d) Describe what happens to the liquid containing penicillin after it is collected from the fermenter.

.....

.....[1]

[Total: 14]

[Turn over

2 Carp are a type of fish. Researchers in Brazil measured the body lengths of a population of carp in a river in **1998** and again in **2008**.

Histograms of their results are shown in Fig. 2.1.

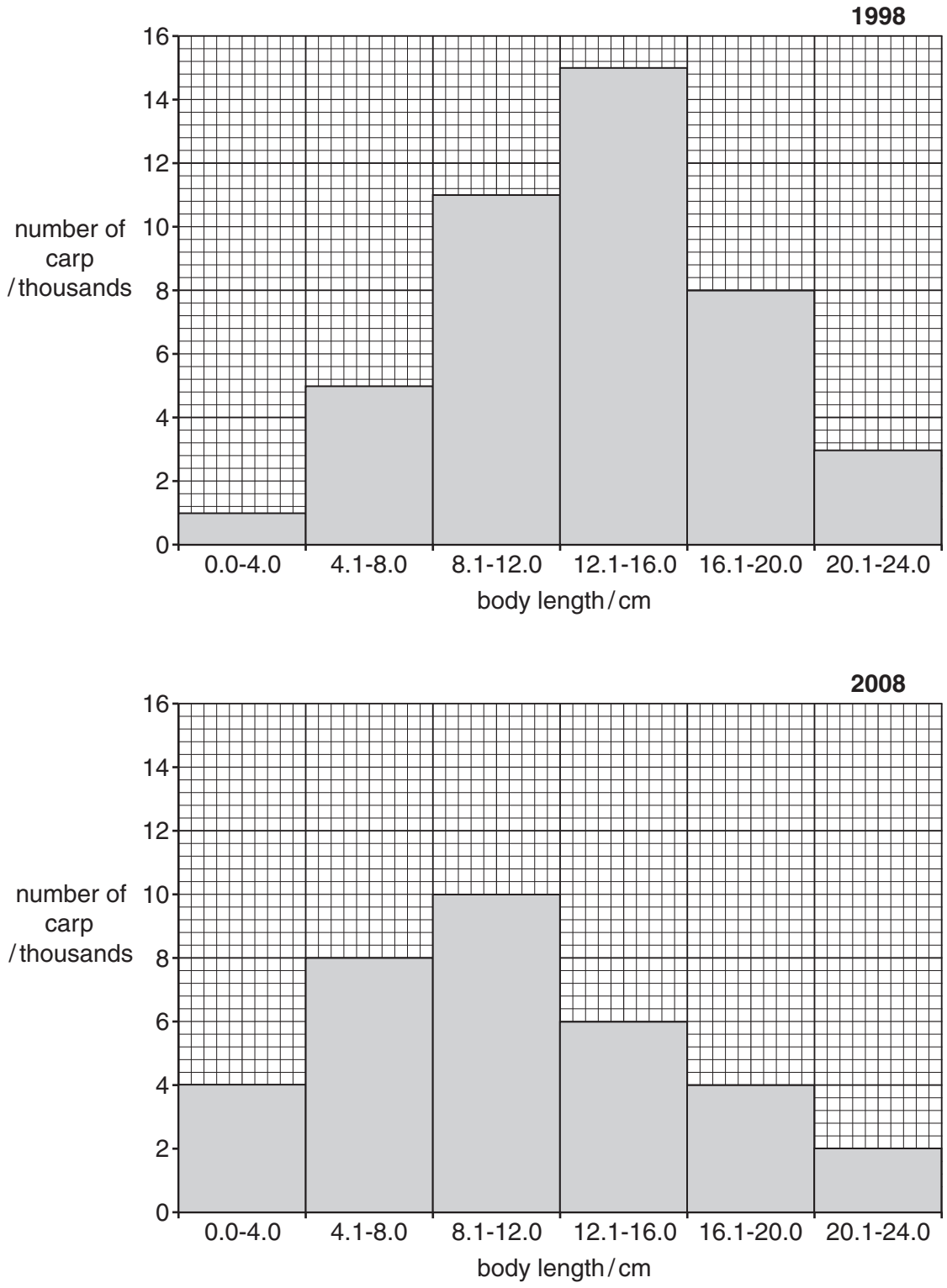

Fig. 2.1

(a) Define the term *population*.

.....

.....

.....

.....

.....[2]

(b) Describe the variation in body length of the carp population in **1998**. Use the data in Fig. 2.1 to support your answer.

.....

.....

.....

.....

.....

.....

.....[3]

(c) The total population of carp in 1998 was 43 000 fish.

(i) Calculate the total population of carp in **2008**.

Show your working.

.....[2]

(ii) The decrease in the carp population by 2008 was caused by overfishing.

Explain how fish stocks can be sustained.

.....

.....

.....

.....

.....

.....

.....[4]

(d) Body length is an example of continuous variation.

(i) Suggest what causes the variation in body length in a population of fish.

.....

.....

.....

.....

.....

.....

.....[2]

(ii) Continuous variation is shown with a histogram.

Name the type of graph that should be used to show **discontinuous** variation.

.....[1]

[Total: 14]

3 Pepsin is a protease enzyme found in the alimentary canal.

(a) (i) Name the product formed from the digestion of proteins by protease enzymes.

.....[1]

(ii) State the organ in the alimentary canal where pepsin is secreted.

.....[1]

(b) A biologist performed an experiment to find the optimum pH for the activity of pepsin.

The enzyme activity was measured in four test-tubes. Each test-tube contained a 1 cm^3 cube of cooked egg white which contains protein.

Fig. 3.1 shows the four test-tubes.

The biologist measured the time taken for the complete digestion of the cubes of cooked egg white.

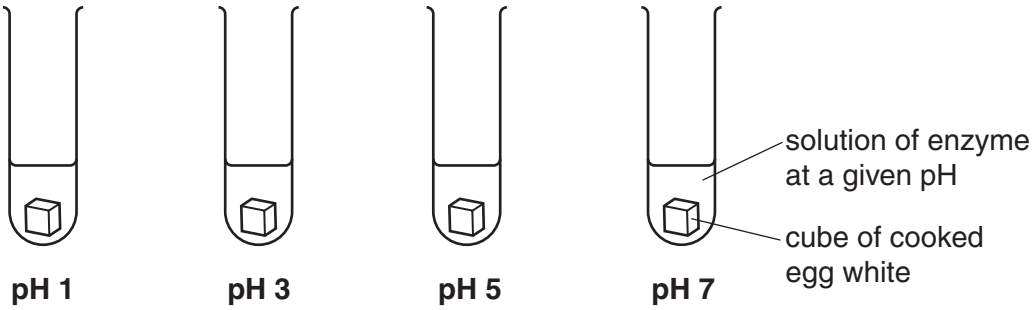

Fig. 3.1

(i) The biologist ensured all the cubes of cooked egg white were exactly the same size.

Suggest why.

.....

.....

.....

.....

.....[2]

(ii) Temperature must be controlled in this experiment.

Describe how temperature could be controlled.

.....

.....[2]

(c) The same experiment was performed with trypsin, another protease enzyme.

Predict the optimum pH for trypsin.

.....[1]

(d) Enzymes, such as proteases, are important in digestion.

Describe in detail how enzymes function, using other digestive enzymes as examples.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[6]

[Total: 13]

4 Type 1 diabetes is caused by the immune system destroying body cells.

(a) (i) Suggest which organ in the body is attacked by the immune system to cause Type 1 diabetes.

.....[1]

(ii) Antibodies are part of the immune system.

Describe how antibodies function.

.....

.....

.....

.....

.....[2]

(b) Humans need vitamin D as part of their diet.

(i) Describe a cause of vitamin D deficiency in humans.

.....

.....[1]

(ii) Describe the effects of vitamin D deficiency in humans.

.....

.....

.....

.....

.....[2]

[Turn over

Scientists have found that mice can suffer from Type 1 diabetes. They also found that vitamin D affects the development of Type 1 diabetes in mice.

Two groups of mice were studied. One group were normal and the other group were vitamin D-deficient. The percentage of mice in each group that developed Type 1 diabetes was recorded every fifty days.

Table 4.1 shows their results.

Table 4.1

age / days	percentage of mice with Type 1 diabetes	
	normal mice	vitamin D-deficient mice
0	0	0
50	1	1
100	8	35
150	34	62
200	45	65
250	46	65

(c) Describe the effect of vitamin D deficiency on the development of Type 1 diabetes in mice. Use the data in Table 4.1 to support your answer.

.....

.....

.....

.....

.....

.....

.....[3]

(d) Suggest the symptoms that mice with Type 1 diabetes would have.

.....

.....

.....

.....

.....

.....

.....[4]

(e) Describe the treatment for human patients with Type 1 diabetes.

.....

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 16]

5 Fig. 5.1 is an image of a germinating seed showing the growing root.

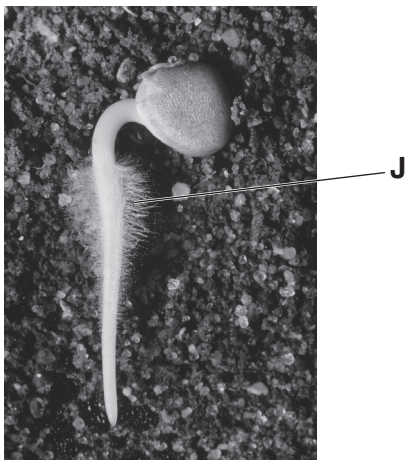

Fig. 5.1

(a) Describe **and** explain how the structures seen at **J** are adapted for their function.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

(b) (i) The root shown in Fig. 5.1 is growing downward into the soil.

Name this response seen in roots.

.....[1]

(ii) Name the chemical that controls this response.

.....[1]

(iii) There are situations, either in wild plants or in laboratory experiments, where roots do not grow downwards.

Suggest and explain **one** situation.

.....

.....

.....

.....

.....[2]

[Total: 9]

[Turn over

BLANK PAGE

6 A DNA molecule has two strands as shown in Fig. 6.1.

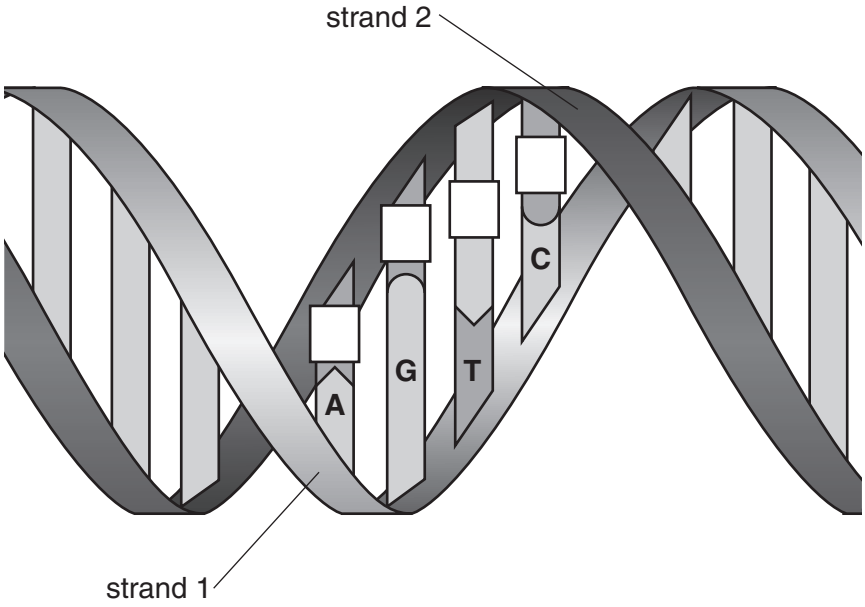

Fig. 6.1

(a) (i) Fill in the boxes on Fig. 6.1 to show the letter of the bases on strand 2 that will pair with the corresponding bases on strand 1. [2]

(ii) State the name for the structure of a DNA molecule as shown in Fig. 6.1.

.....[1]

[Turn over

When molecules of DNA are used to classify species, only one of the two DNA strands is sequenced.

First the DNA sequence from one strand of a DNA molecule from each species is lined up against one strand from another species.

The bases of the DNA sequences from the same strand can then be compared with each other.

Fig. 6.2 shows a short section from the DNA sequences of eight plant species. There are ten differences between species **A** and species **B**. These differences are shown in Fig. 6.2.

Species **A**: CTCCTCGGGT GACGGCCTAG CCCGTTGACG AATCCCATTC CTAAACTTT

Species **B**: CTCCTAGGGT GCAGGACTAG CCCGTTGACG AATCCCATTC CCAAGA

Species **C**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCACATTC CGATT

Species **D**: CTCATAGGGT GCAGGCCTAG CCCCTTGACG AATCCAATTC CGCTT

Species **E**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCCAATTC CGCTT

Species **F**: CTCCTAGGTT GCAGGCCTAG CCCTTTGAAG AATCACATTC CCCAA

Species **G**: CTCCTCGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CGAAA

Species **H**: CTCCTAGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CAAAAT

Fig. 6.2

(b) The number of differences between the DNA sequences of the eight species shown in Fig. 6.2 are recorded in Table 6.1.

Count the number of differences between the DNA sequences shown in Fig. 6.2 for:

- species **C** and species **D**
- species **G** and species **H**

Write your answers in Table 6.1. [2]

Table 6.1

	species **A**	species **B**	species **C**	species **D**	species **E**	species **F**	species **G**	species **H**
species **A**		10	10	13	12	11	10	9
species **B**			7	8	7	7	7	6
species **C**					3	7	8	8
species **D**					1	9	9	8
species **E**						9	8	10
species **F**							6	7
species **G**								
species **H**								

(c) The most closely related species have the fewest differences between their DNA sequences.

State which **two** plant species shown in Table 6.1 are most **distantly related** to each other.

.....[1]

(d) The most closely related species have the shortest distance from a branching point on a classification tree.

Use the information in Table 6.1 to complete the classification tree in Fig. 6.3. Write the letter corresponding to species **B**, **C**, **D** and **G** in the box next to the correct branch of the classification tree. [3]

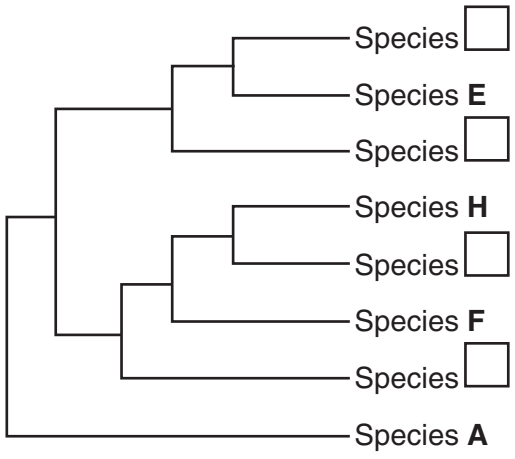

Fig. 6.3

(e) A modern method for improving crop productivity is to cut out sections of DNA carrying a useful gene from one organism and place them into another organism.

(i) Name the technique of inserting genes from one organism into another.

.....[1]

(ii) A gene for producing a vaccine has been inserted into banana plants.

Give **two** other examples in which crop plants have been changed by inserting genes. State one advantage for each example.

example 1 .....

advantage .....

.....

example 2 .....

advantage .....

.....
[4]

[Total: 14]