Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **5090/21**

Paper 2 Theory **May/June 2025**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

Answer **all** questions.

Write your answers in the spaces provided.

1 **(a)** Large molecules in cells are made from smaller molecules.

Complete Table 1.1 to show which small molecules make up each large molecule.

Choose the small molecules from this list.

amino acids **fatty acids** **glucose** **glycerol** **nucleotides**

Table 1.1

large molecule	small molecules
protein	
cellulose	
lipid	

[3]

(b) DNA is found in the nucleus of each cell.

Put a tick (✓) next to any statements that correctly describe the structure of DNA.

A DNA molecule has four strands coiled together to form a helix.	
Each strand is made up of a chain of nucleotides.	
Each nucleotide contains a base, a sugar and an amino acid.	
The bases always pair up in the same way, A with T, and C with G.	
Bonds between sugar molecules hold the strands together.	

[2]

(c) Explain how the sequence of bases in a DNA molecule controls how a cell functions.

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..... [3]

[Total: 8]

2 **(a)** Fig. 2.1 shows a food web from a pond.

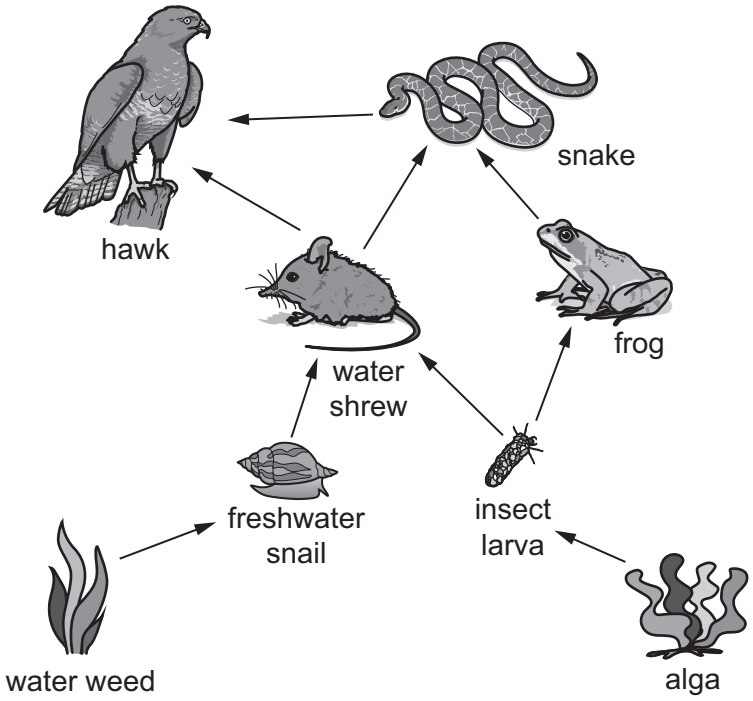

Fig. 2.1

(i) State the source of energy for this food web.

..... [1]

(ii) Complete Table 2.1 by writing the number of different organisms in this food web that fit each description.

The first one has been done for you.

Table 2.1

description	number of different organisms
producers	2
secondary consumers	
carnivores	

[2]

(iii) The hawk feeds at two different trophic levels.
Use Fig. 2.1 to explain this statement.

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..... [2]

(b) Scientists have studied how water shrews feed on freshwater snails and insect larvae. The shrews dive under water to collect food.

(i) Explain why shrews need more oxygen when they dive under water which is very cold.

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..... [2]

(ii) Scientists have found that shrews contain high levels of a special protein that can store oxygen. This allows the shrews to stay under water for longer to collect food.

Explain how the ability of shrews to store oxygen may have developed by natural selection.

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..... [4]

[Total: 11]

3 Fig. 3.1 shows the human digestive system.

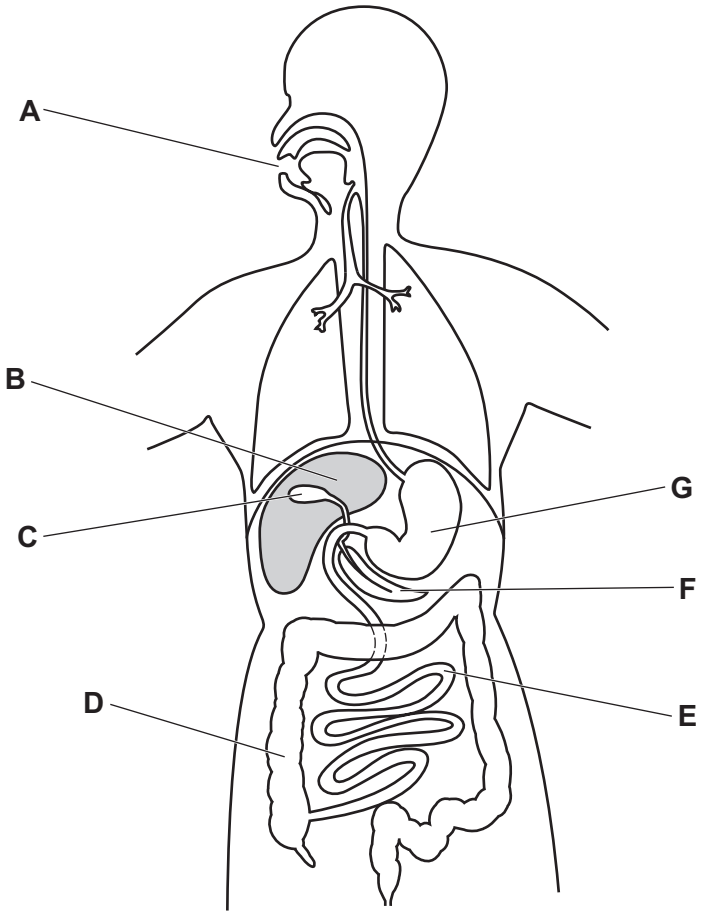

Fig 3.1

(a) (i) In each box write the letter that has been used to label these parts of the digestive system.

The part where starch digestion starts. ☐

The part where protein digestion starts. ☐

[2]

(ii) Describe the roles of organs **B** and **C** in lipid digestion.

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..... [3]

(b) Coeliac disease affects several million people in the world. It is linked to a substance called gluten that is found in some foods.

Fig. 3.2 shows a section through organ **E** in a healthy person and in a person with coeliac disease.

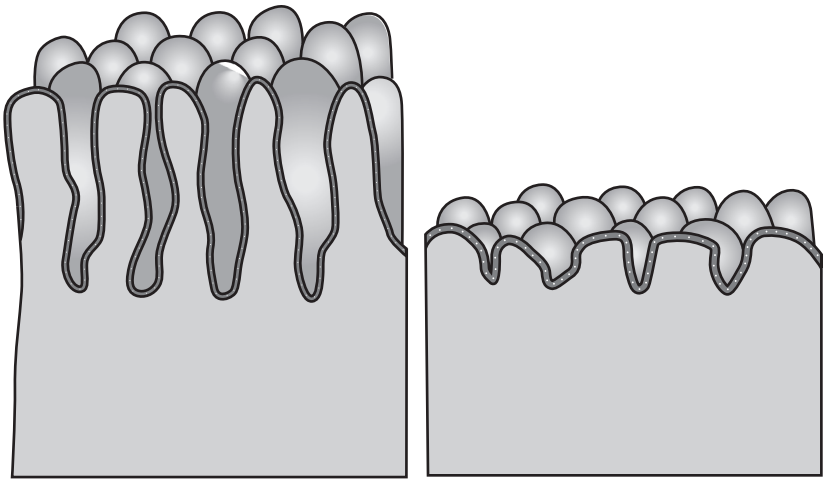

Fig. 3.2

(i) If a child with coeliac disease is **not** treated, their growth may be reduced.
Use Fig. 3.2 to explain why.

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..... [3]

(ii) Scientists are investigating a new treatment for coeliac disease. They have produced an enzyme that will digest gluten when it reaches organ **E**. They plan to put the enzyme into a tablet which can be swallowed.

To make this treatment work, the tablet must have a coating that will dissolve in alkaline conditions but **not** in acid conditions.
Explain why.

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..... [3]

[Total: 11]

4 Transmissible diseases are caused by pathogens.

(a) Draw a line from each transmissible disease to the type of pathogen that causes the disease.

transmissible disease	type of pathogen
AIDS	bacterium
cholera	virus
malaria	protoctist

[2]

(b) (i) Complete these sentences about cholera by writing words in the gaps.

When the cholera pathogen is inside the small intestine it produces a

..... .

This results in the secretion of ..... ions into the small intestine.

The water potential inside the small intestine will ..... , causing water to move into the intestine.

[3]

(ii) In 2017 the World Health Organization estimated that 95 000 people die from cholera each year.

The World Health Organization set up a project to reduce this number of deaths by 95% by 2030.

If the project is successful, calculate the maximum number of cholera deaths in 2030.

Space for working.

maximum number of cholera deaths = ... [2]

(iii) The World Health Organization recommends vaccines to protect people from cholera.

Describe how vaccination can make people immune to a disease.

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..... [4]

(iv) Table 4.1 shows details of a vaccine used by the World Health Organization to protect people from cholera.

Table 4.1

doses needed	how taken	storage temperature for vaccine
two doses, one to six weeks apart	vaccine added to a glass of water	2–8 °C

Discuss the practical problems of using this vaccine in different parts of the world.

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..... [3]

[Total: 14]

5 Air pollution by carbon dioxide is contributing to global warming.

(a) Explain how the increasing concentration of carbon dioxide in the atmosphere is causing global warming.

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..... [3]

(b) Scientists are planning to reduce the concentration of carbon dioxide in the atmosphere.

They plan to grow large areas of seaweed that float in the ocean.

The seaweed will take in carbon dioxide for photosynthesis and grow larger.

(i) Complete the balanced symbol equation for photosynthesis.

$6CO_2$ + ... → ..... + ...

[2]

(ii) The scientists estimate that the seaweed will double in biomass every 10 days.

If they start with 2 tonnes of seaweed, calculate the biomass expected after 40 days of growth.

Space for working.

biomass = ... tonnes [2]

(c) The scientists need to supply the seaweed with the minerals needed for growth.

(i) Nitrates are one of the minerals that will be supplied to the seaweed.

Explain the importance of nitrates to plants.

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..... [2]

As the seaweed grows, the scientists plan to send bundles of it to the bottom of the ocean. The seaweed in the bundles dies on the ocean floor.

Fig. 5.1 shows the process.

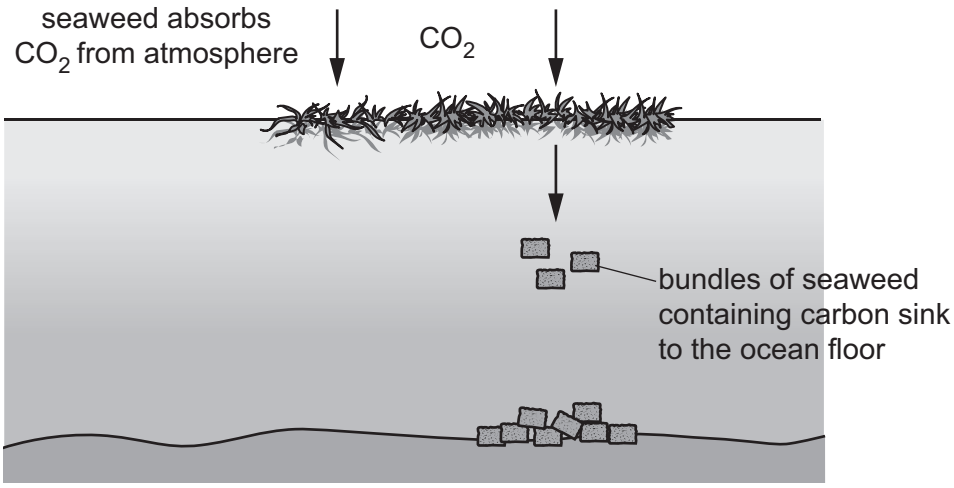

Fig. 5.1

(ii) There is very little oxygen in the water at the bottom of the ocean.

Explain how this will help the carbon to stay trapped in the dead seaweed.

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..... [2]

[Total: 11]

6 Sycamore trees (*Acer pseudoplatanus*) grow throughout most of Europe.

(a) (i) Sycamore trees produce flowers in the spring.
The flowers have these characteristics:

- small and green coloured
- produce large quantities of small, light pollen grains
- contain nectar.

Explain why scientists think that the flowers can be pollinated by wind and by insects.

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..... [2]

(ii) The flowers of the sycamore tree are cross-pollinated.

State an advantage of cross-pollination rather than self-pollination.

.....

..... [1]

(b) The sentences describe the processes that occur in a sycamore flower after pollination.

Complete the sentences by writing words in the gaps.

The pollen grain grows a ..... which allows the male gamete to reach the female gamete.

After fertilisation, the ovule becomes a ..... and the ..... will develop into a fruit.

[3]

(c) Fig. 6.1 shows two sycamore fruits.

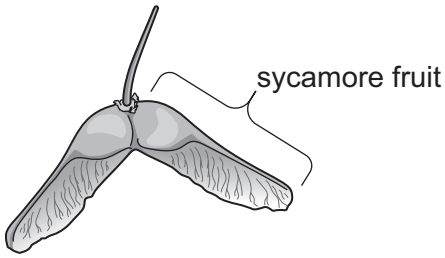

Fig. 6.1

The wings on the fruits cause them to spin as they fall to the ground. This slows their fall so that they can be blown away by the wind.

Explain why this is an advantage to the parent tree and any young trees that are produced from these fruits.

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..... [3]

[Total: 9]

7 The inheritance of ABO blood groups in humans is an example of codominance.
The blood groups are controlled by three different alleles, I^A, I^B, and I^O.

(a) (i) State the blood group of a person who has the genotype $I^A I^O$.

..... [1]

(ii) State the genotype of a person who is blood group O.

..... [1]

(b) Fig. 7.1 is a family tree showing the ABO blood groups of eight different people, numbered (1) to (8).

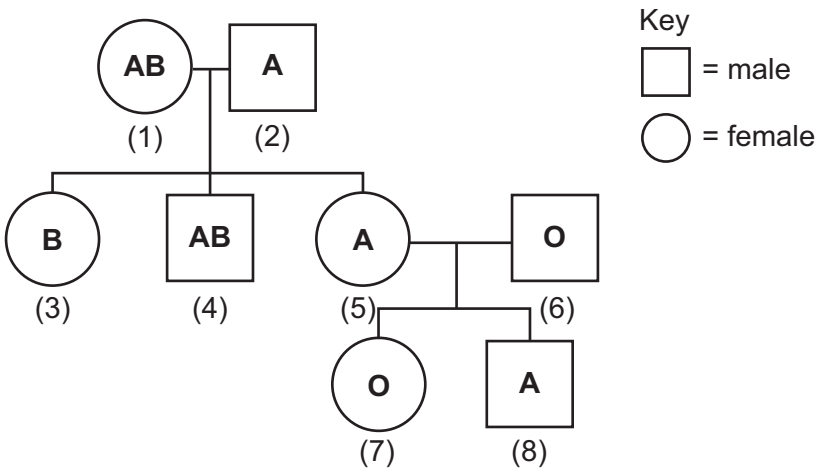

Fig. 7.1

(i) The parents (5) and (6) in Fig. 7.1 are expecting another child.

Complete this Punnett square to show the possible genotypes of the child.

parent 5 \ parent 6		
I^A		
I^O		

[2]

(ii) What is the probability that this child is male with blood group A?

probability = ... [1]

(iii) How many people in the family tree in Fig. 7.1 are homozygous for the ABO blood group alleles?

..... [1]

[Total: 6]

8 Pectinase is an enzyme that is produced by fungi.

In the large-scale industrial production of pectinase, fungi are grown in fermenters.

Fig. 8.1 shows a fermenter.

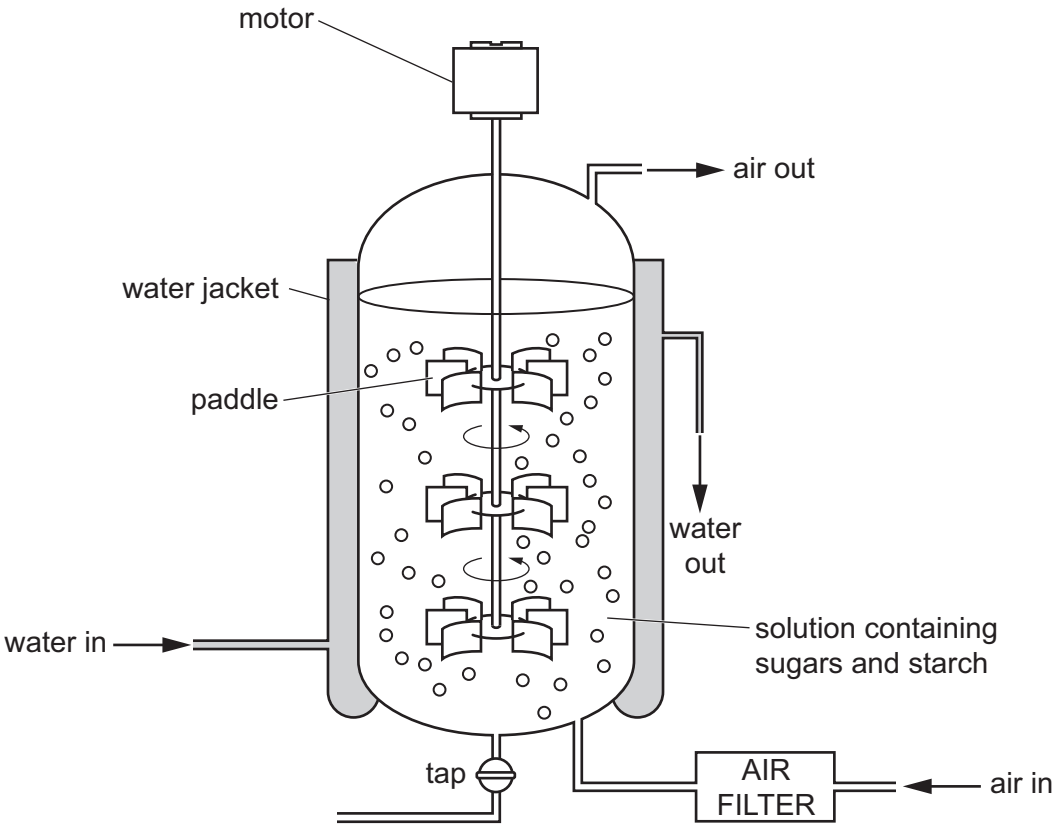

Fig. 8.1

(a) Explain how the features of the fermenter shown in Fig. 8.1 provide suitable conditions for the growth of fungi.

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..... [6]

(b) In an experiment, scientists added pectinase made by the fungi to a sample of crushed fruit.

They measured changes in:

- the sugar content of the sample of crushed fruit
- the thickness of the sample of crushed fruit.

The scientists' results are shown in Fig. 8.2.

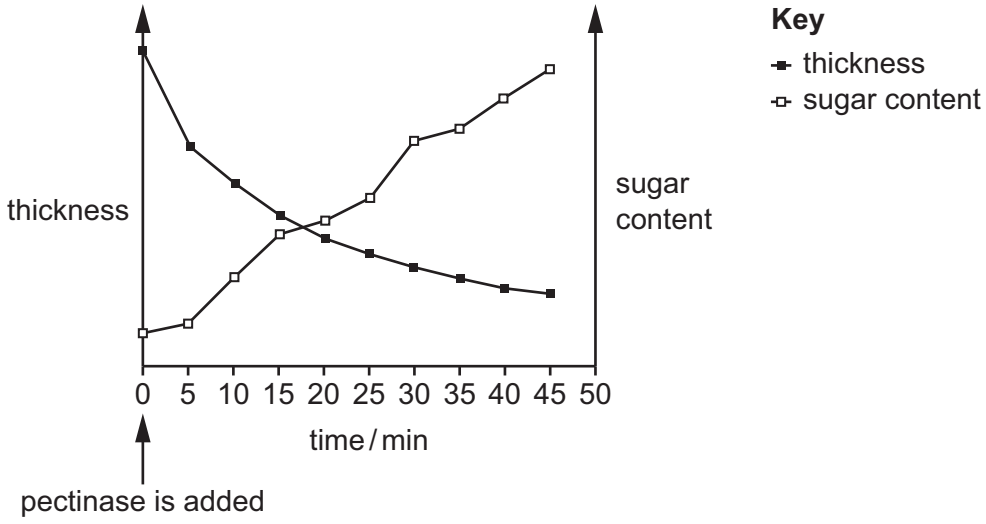

Fig. 8.2

Use your knowledge of the action of pectinase to explain the scientists' results.

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..... [4]

[Total: 10]

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