Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

1695804370

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2021**

1 hour 15 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 60.
- The number of marks for each question or part question is shown in brackets [ ].

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

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Answer **all** questions.

1 Fig. 1.1 is a diagram showing a stage in protein synthesis.

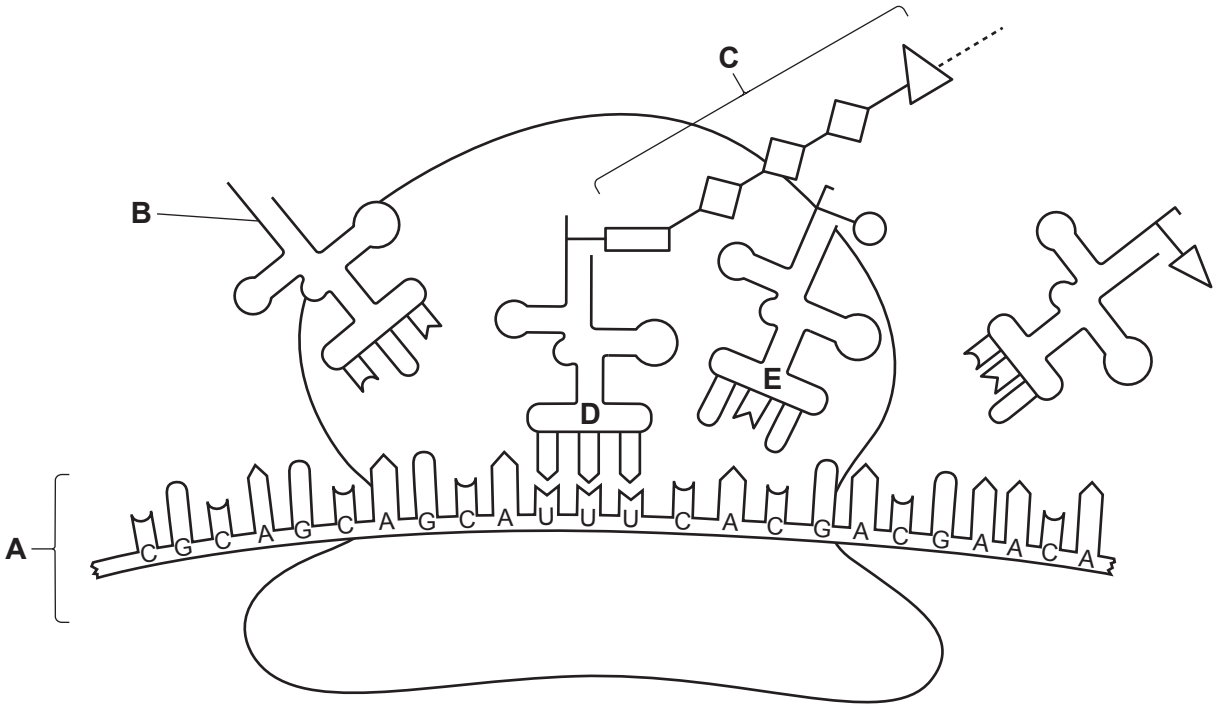


Fig. 1.1

(a) (i) Name the stage of protein synthesis that is shown in Fig. 1.1.

..... [1]

(ii) Identify **A**, **B** and **C** in Fig. 1.1.

A .....

B .....

C .....
[3]

(iii) State the base sequences at **D** and **E**.

D .....

E .....
[1]

(b) Mutagenesis is a process that leads to a change in the amino acid sequences of proteins. Scientists carry out mutagenesis to investigate the importance of particular amino acids in protein structure and function.

Outline how changing one amino acid in the β-globin polypeptide of haemoglobin may change the structure and function of a molecule of haemoglobin.

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..... [4]

[Total: 9]

2 Pepsin is an enzyme that hydrolyses proteins (protease). Some students used pepsin from the stomach of a mammal.

The activity of the pepsin was investigated by placing a small quantity of the enzyme with a known concentration of the protein albumen.

Fig. 2.1 shows the progress of the enzyme-catalysed reaction that was carried out at 20 °C.

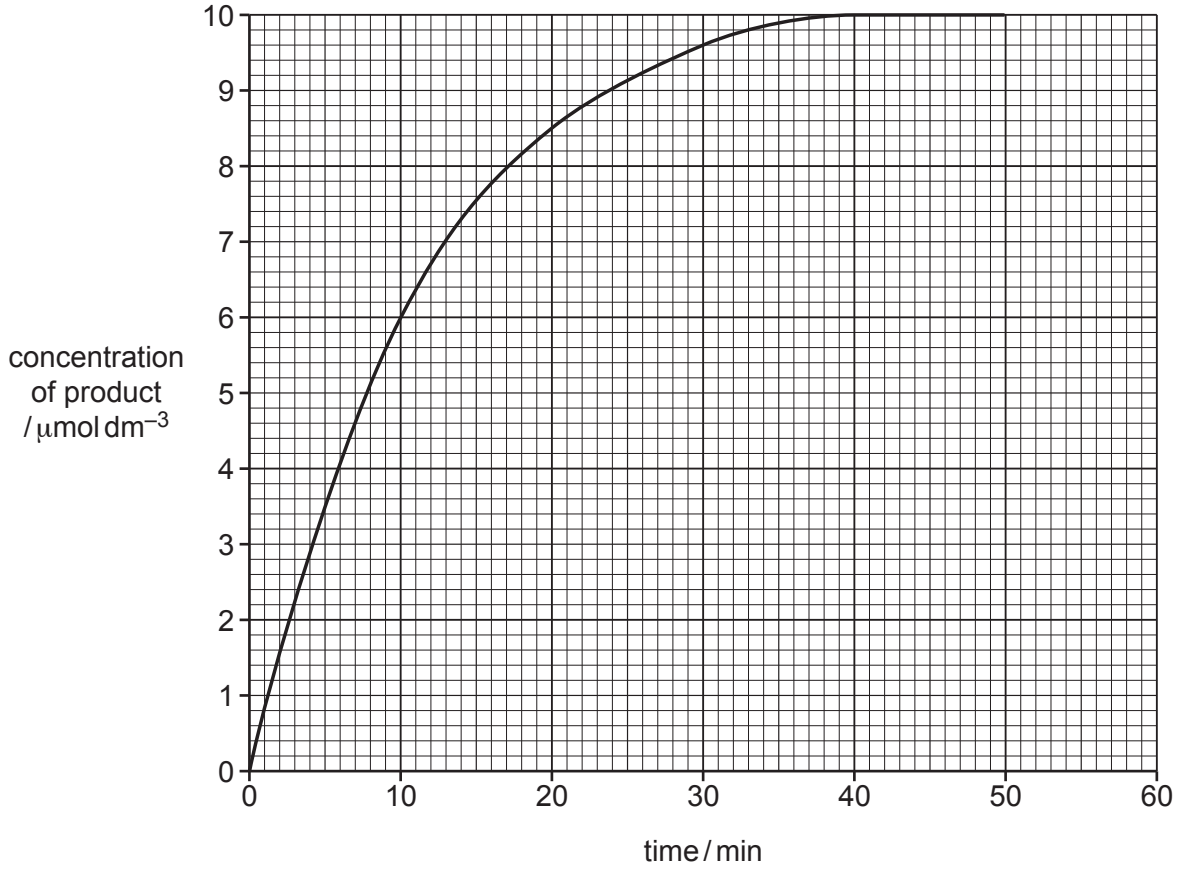


Fig. 2.1

(a) Calculate the initial rate of the reaction.

initial rate of reaction = ... [2]

(b) (i) The procedure was repeated to find the effects on the activity of the pepsin using a competitive inhibitor at the same temperature, 20 °C.

Predict the results that will be obtained using the competitive inhibitor.

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..... [2]

(ii) The procedure was repeated **without** the competitive inhibitor but at the higher temperature of 30 °C.

Predict the results that will be obtained at 30 °C.

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..... [2]

(c) The students extended their investigation by using pepsin from a different species of mammal. The experiments were carried out at 20 °C and **without** a competitive inhibitor.

With reference to Fig. 2.1, explain the advantage of calculating the initial rate of reaction in each experiment.

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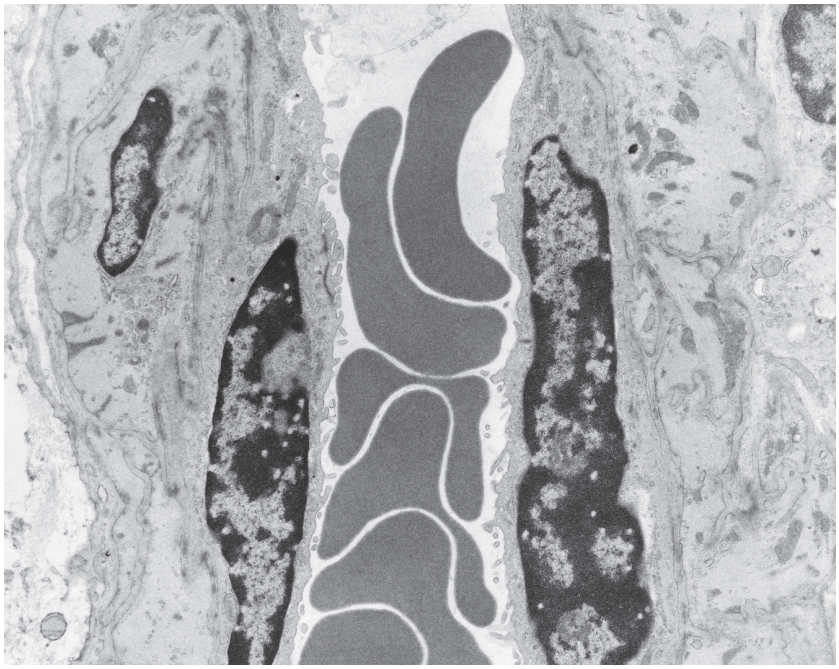
.....

..... [2]

[Total: 8]

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3 Fig. 3.1 is a transmission electron micrograph showing red blood cells in a capillary of a healthy adult.



magnification = ×4000

Fig. 3.1

(a) (i) Explain how the cells in the capillary shown in Fig. 3.1 can be identified as red blood cells.

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..... [3]

(ii) Capillaries are surrounded by tissue fluid.

Outline the ways in which the composition of tissue fluid differs from blood.

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..... [2]

(b) Scientists compared features of the physiology of three groups of people who live at different altitudes. These people were selected from populations that have lived at these altitudes for many thousands of years.

The scientists took blood samples from people in each location and measured:

- the concentration of haemoglobin in the blood
- the percentage saturation of haemoglobin with oxygen in blood leaving the lungs
- the oxygen concentration in the blood leaving the lungs.

The results are shown in Table 3.1.

Table 3.1

altitude / m	**location of group of people**	**mean haemoglobin concentration in blood / g 100 cm^{-3}**	**mean percentage saturation of haemoglobin with oxygen in blood leaving the lungs**	**mean oxygen concentration in blood leaving the lungs / cm^3 100 cm^{-3}**
100 (near sea level)	Peru	15.3	97.0	21.1
3500	East Africa mountains	15.6	95.5	21.1
3750 – 4000	Andes mountains	19.1	92.0	22.0

(i) Describe the changes in mean percentage saturation of haemoglobin with oxygen and the mean haemoglobin concentration in blood as altitude increases.

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..... [3]

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(ii) With reference to Table 3.1, suggest how the people living at high altitude can have an oxygen concentration in blood leaving the lungs similar to that of the people living at sea level.

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..... [3]

[Total: 11]

4 In thale cress, *Arabidopsis thaliana*, most of the stomata are on the lower surface of the leaves.

Fig. 4.1 is a diagram of an open stoma and two guard cells. Some of the cellulose fibres in the cell wall of the guard cells are shown.

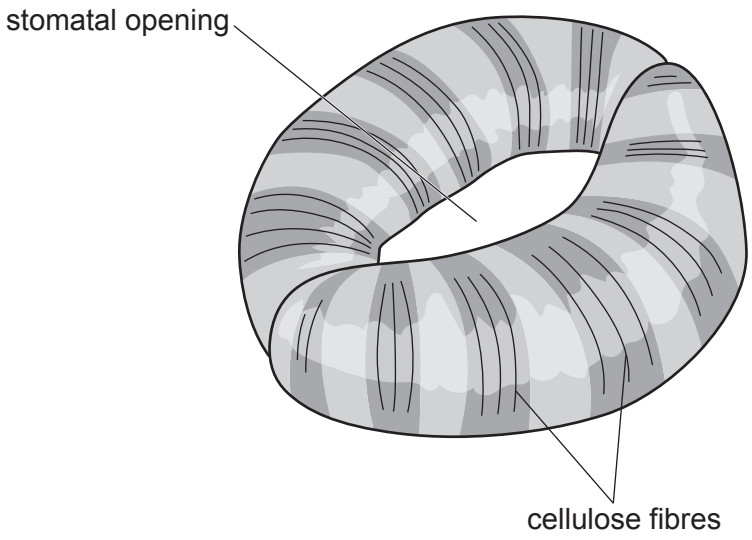


Fig. 4.1

(a) The cellulose fibres shown in Fig. 4.1 are composed of bundles of cellulose microfibrils.

Explain how molecules of cellulose are arranged into a microfibril.

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..... [2]

(b) The width of stomatal openings in *A. thaliana* is regulated by movement of ions. These ions move through channel proteins in the cell surface membranes of the guard cells.

(i) Draw a diagram to show part of a cell surface membrane with a channel protein.

Label your diagram.

[3]

(ii) Explain why channel proteins are needed for the movement of ions into and out of cells.

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..... [2]

(c) The outward movement of ions from guard cells causes stomata to close.

A variety of *A. thaliana* does **not** have channel proteins for the outward movement of ions in the cell surface membranes of the guard cells.

Suggest **and** explain the effect of **not** having these channel proteins on transpiration.

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..... [3]

[Total: 10]

5 Measles is a highly infectious disease. The World Health Organization (WHO) has coordinated a programme for controlling this disease by using vaccination.

(a) (i) Name the pathogen that causes measles.

..... [1]

(ii) Explain how the measles pathogen is transmitted.

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..... [3]

(b) Fig. 5.1 shows the number of cases of measles globally each month between January 2015 and March 2019.

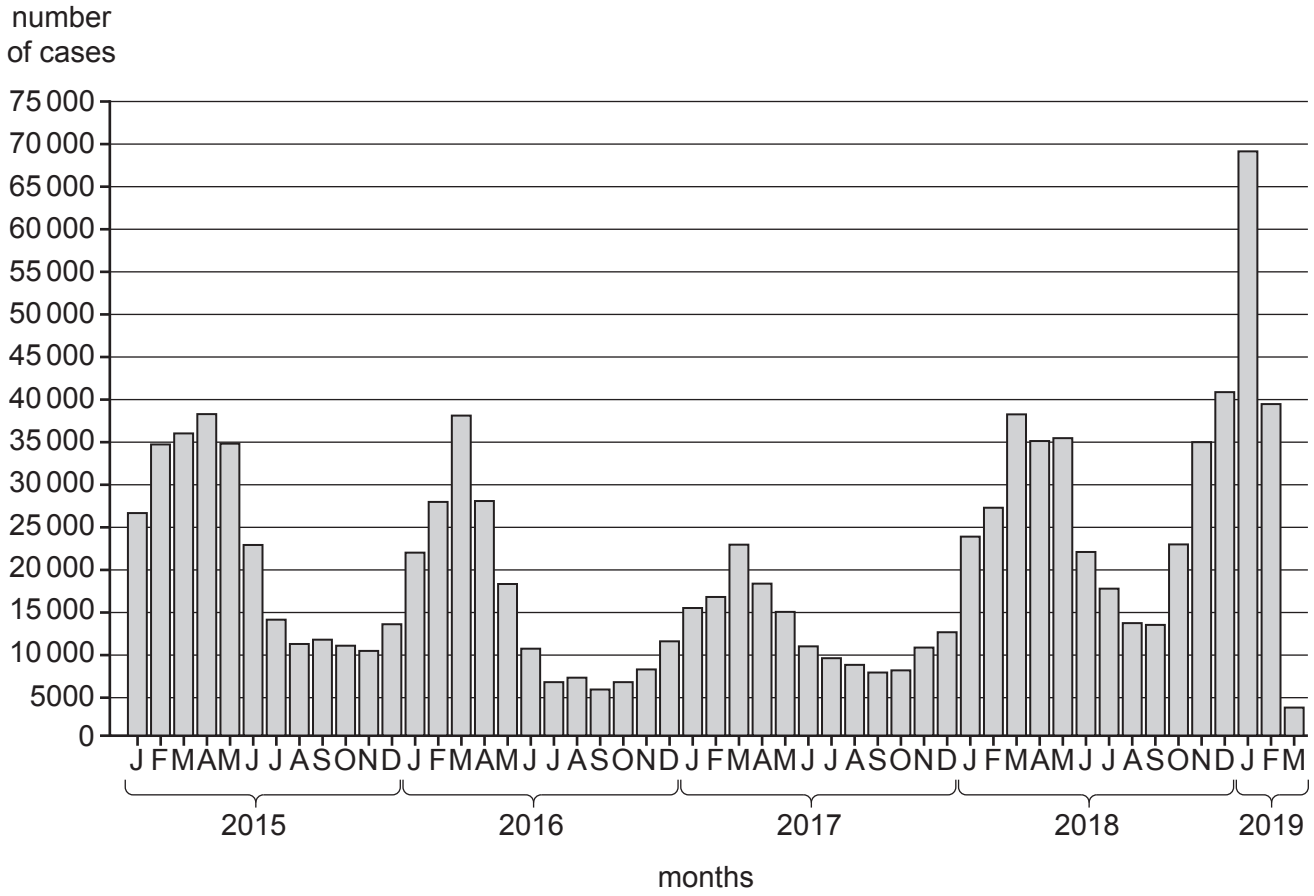


Fig. 5.1

Describe the pattern of measles cases as shown in Fig. 5.1.

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..... [3]

(c) Explain why measles has **not** yet been eradicated even though a vaccine has been available since the 1960s.

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..... [4]

[Total: 11]

6 **(a)** Table 6.1 compares some of the features of DNA with the protein collagen.

Complete Table 6.1.

Table 6.1

feature	DNA	collagen
elements		C H O N
monomers		
bond between monomers		
site of production in eukaryotic cells	nucleus	

[6]

(b) Most of the DNA in a eukaryotic cell is located in the nucleus.

State how the structure of a nucleus is suited to its function of containing DNA.

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..... [2]

(c) Fibroblast cells produce elastic fibres and collagen fibres in lung tissue.

Describe the function of elastic fibres in lung tissue.

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..... [2]

(d) Name the stage of the cell cycle during which DNA **and** proteins are synthesised.

..... [1]

[Total: 11]

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