Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/24**

Paper 2 AS Level Structured Questions **May/June 2025**

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.

DC (SL/SG) 357397

[Turn over

1 In the roots of plants, specialised tissues are formed from a region in the root tip known as the root apical meristem.

Fig. 1.1 shows the different regions of a root tip.

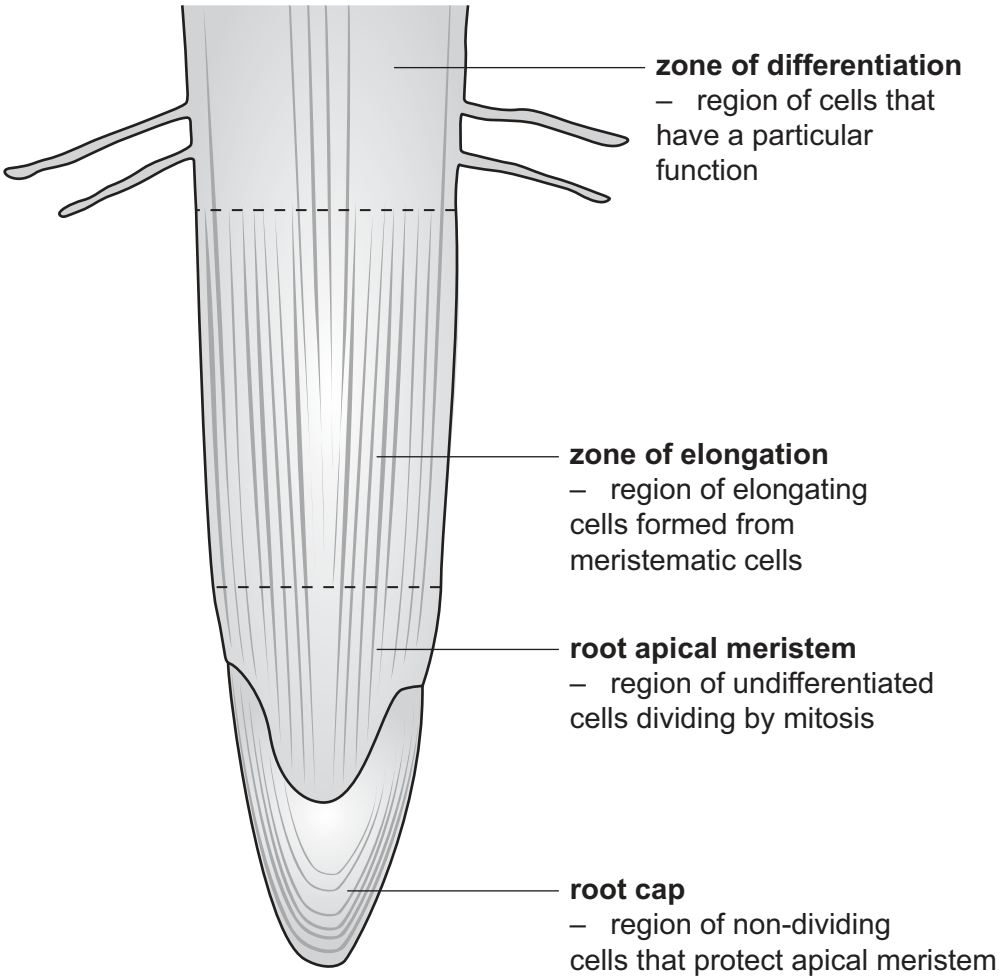

Fig. 1.1

(a) Cells in all stages of mitosis will be visible in the root apical meristem by using the high power of a light microscope.

(i) Name the stage of mitosis during which the chromosomes are arranged at the spindle equator of the cell.

..... [1]

(ii) Early in mitosis, the nuclear envelope breaks up into vesicles and so will not be seen in some cells in the root apical meristem.

Name the stage of mitosis during which the vesicles fuse to form new nuclear envelopes.

..... [1]

(b) In the zone of elongation, shown in Fig. 1.1, the newly formed cells expand and elongate.

Two main events that occur in these cells are:

- the entry of water into the cells
- the formation of the large vacuole.

(i) Outline the process by which water enters the cells.

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..... [3]

(ii) Outline the structure of a fully mature plant vacuole.

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..... [2]

(c) In the zone of differentiation, shown in Fig. 1.1, two types of vascular (transport) tissue form: xylem and phloem.

Draw a diagram showing the distribution of the vascular tissue as seen in a transverse section of a root in the zone of differentiation.

[2]

(d) Starch can be stored in the roots of plants. This can be converted to sucrose, which is loaded into phloem sieve tubes for transport within the phloem sap to growing areas in the stem.

After loading of sucrose into phloem sieve tubes, the transport of phloem sap occurs by mass flow.

Explain how the phloem sap is moved within the sieve tubes by mass flow from the root storage areas to the growing areas of the stem.

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..... [4]

[Total: 13]

2 The human pancreas synthesises and secretes a number of different digestive enzymes. These enzymes have their effect in the small intestine.

Pancreatic lipase acts by breaking the bond between glycerol and fatty acids in triglycerides.

(a) State the term used to describe any enzyme that is secreted to the outside of the cell where it has its effect.

..... [1]

(b) One of the triglycerides found in olive oil is shown in Fig. 2.1.

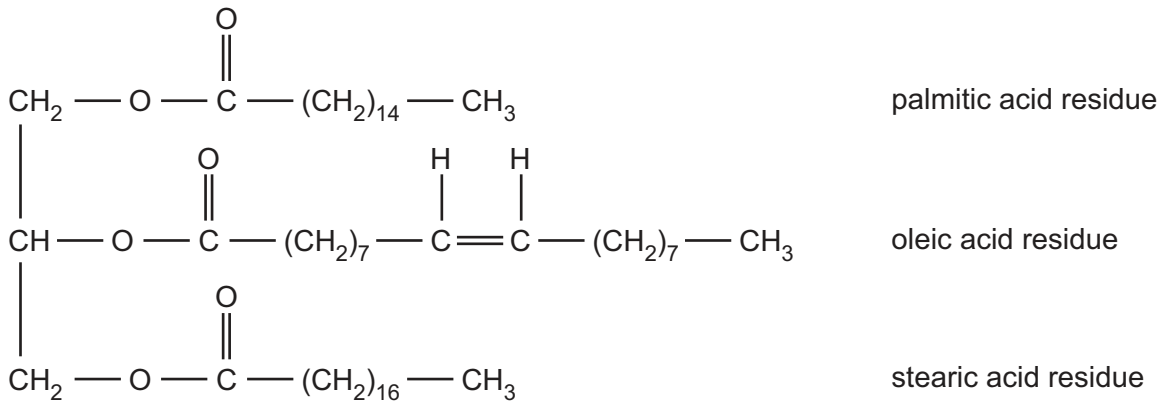

Fig. 2.1

(i) Draw an arrow on Fig. 2.1 to show where the bond between the glycerol residue and the stearic acid residue is broken by lipase digestion. [1]

(ii) State the type of reaction that occurs to produce stearic acid from this triglyceride **and** name the type of bond that is broken.

type of reaction .....

type of bond .....
[2]

Investigations were carried out into the activity of a lipase extracted from a strain of bacterium that lives in hot springs.

(c) The activity of the bacterial lipase was measured at 37 °C using different concentrations of olive oil as the substrate.

The results were used to derive a Michaelis–Menten constant (K_m) of 91.76 mmol dm^{-3}.

Explain what is meant by a K_m of 91.76 mmol dm^{-3}.

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..... [2]

(d) Fig. 2.2 shows the results of an investigation into the effect of temperature on the activity of the bacterial lipase.

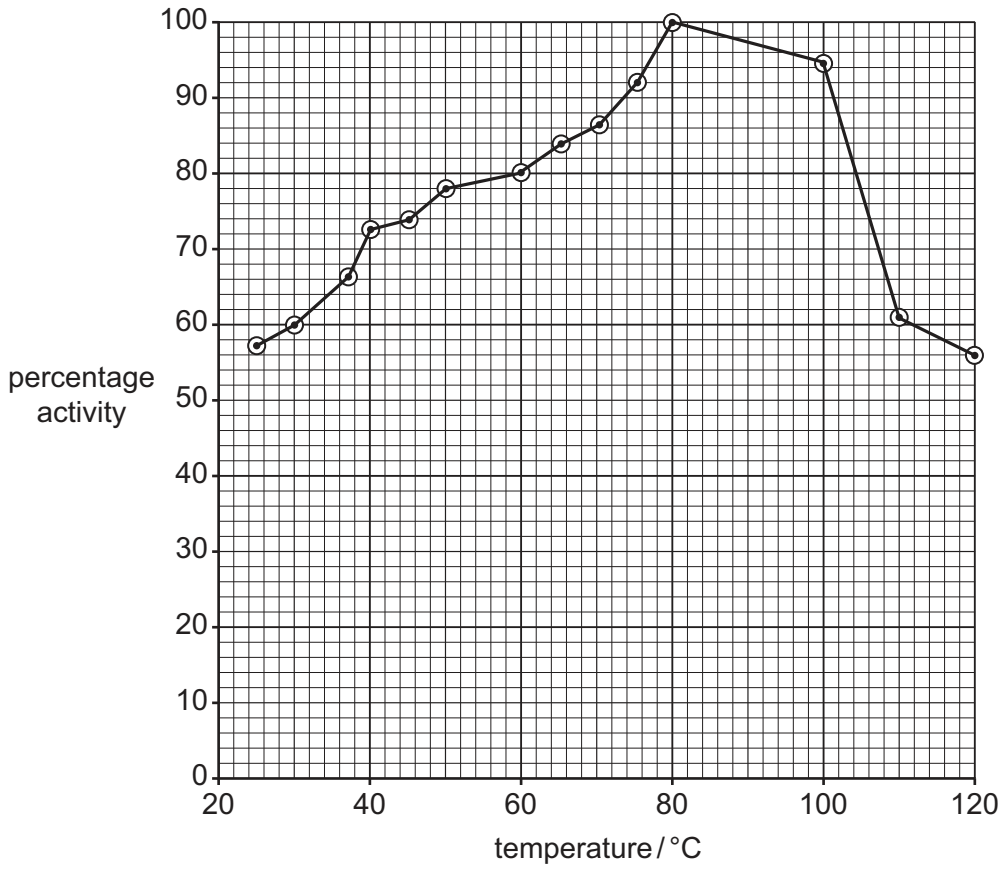

Fig. 2.2

(i) Describe **and** explain the results shown in Fig. 2.2.

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(ii) An investigation using human pancreatic lipase at the same range of temperature will produce different results from those shown in Fig. 2.2.

Predict how the trend will be different from that shown in Fig. 2.2.

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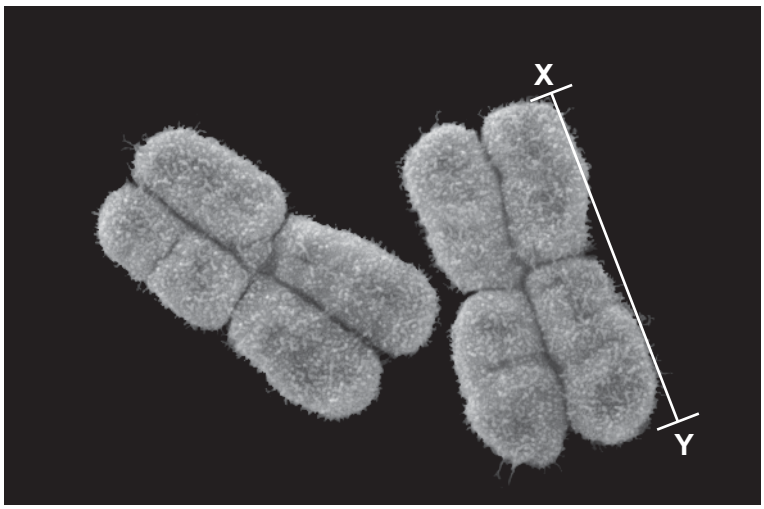
..... [2]

[Total: 12]

3 Fig. 3.1 is a scanning electron micrograph of a pair of human chromosomes in a stage of the mitotic cell cycle.



magnification ×8625

Fig. 3.1

(a) Calculate the actual length, to the nearest 0.1 μm, of the chromosome in Fig. 3.1 indicated by the line **X**–**Y**.

Write the formula you used to make your calculation.

formula

actual length = ... μm [2]

(b) Outline **one** feature of Fig. 3.1 that confirms the microscope used to obtain the image is a scanning electron microscope and **not** a transmission electron microscope.

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..... [1]

(c) With reference to Fig. 3.1, explain how it is possible to deduce that DNA replication has already occurred.

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..... [1]

[Total: 4]

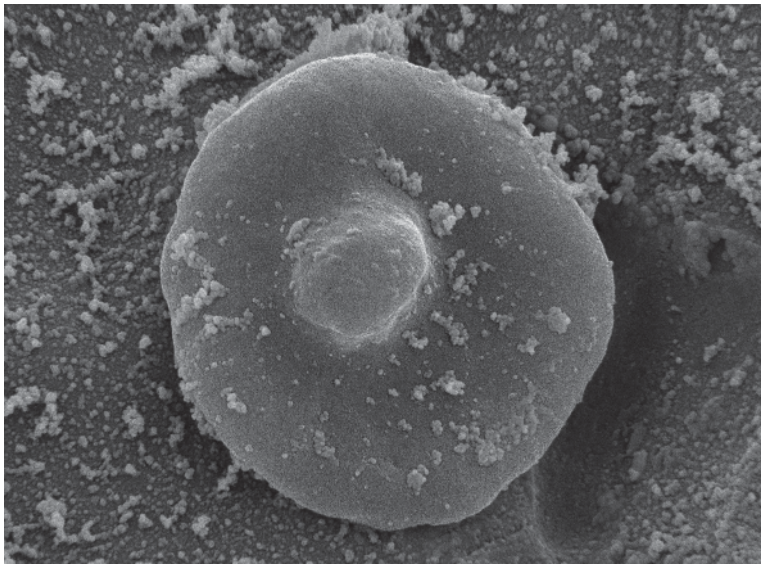
4 A number of species in the genus *Plasmodium* are known to cause malaria in humans.

Plasmodium has a complex life cycle with a number of different structural forms. The merozoite is one form of the pathogen that is present in human hosts.

(a) State the type of organism that causes malaria.

..... [1]

Fig. 4.1 is a scanning electron micrograph of a red blood cell infected with merozoites. Debris (waste particles) from the preparation of the electron micrograph is also shown.



magnification ×23 000

Fig. 4.1

(b) State the difference between the appearance of the red blood cell shown in Fig. 4.1 and a healthy red blood cell.

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..... [1]

(c) When *Plasmodium* is present within mature red blood cells there is a decrease in concentration of haemoglobin in these infected cells.

Suggest why the concentration of haemoglobin within the infected red blood cells decreases.

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..... [1]

A protein known as merozoite surface protein 1 (MSP1) is found as part of the cell surface membrane of merozoites. All species of *Plasmodium* that cause malaria have MSP1. The protein is used to help *Plasmodium* enter human red blood cells.

(d) MSP1 is composed of a single polypeptide, which is coded for by gene *MSP1*.

Some of the steps occurring in the synthesis of MSP1 by *Plasmodium* are described in Table 4.1. They are **not** listed in the correct sequence.

Table 4.1

step	description
A	tRNA, following amino acid activation, attaches to ribosome
B	mRNA passes through nuclear pores
C	a stop codon is reached and the polypeptide is released
D	DNA double helix unwinds
E	codon–anticodon binding occurs
F	RNA polymerase forms phosphodiester bonds
G	peptide bond formation occurs
H	mRNA attaches to ribosome

Use the steps described in Table 4.1 to complete Table 4.2 to show the correct sequence of events as they would occur in the synthesis of MSP1.

Two of the steps have been added to Table 4.2 for you.

Table 4.2

correct sequence	step
1	
2	
3	
4	**H**
5	
6	
7	
8	**C**

[4]

(e) The MSP1 protein has three levels of protein structure: primary, secondary and tertiary.

Outline the changes that occur after translation to a polypeptide, such as the MSP1 polypeptide, that result in a protein showing secondary and tertiary structure.

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..... [4]

(f) Subunit vaccines are vaccines that contain non-self antigens, but do **not** contain whole organisms. The aim is to stimulate a primary immune response after the vaccine is given so that the person gains artificial active immunity.

One trial that has been carried out on human volunteers has used MSP1 from *Plasmodium falciparum* in a subunit vaccine against malaria.

Explain why a vaccine containing MSP1 provides artificial active immunity to malaria.

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..... [4]

(g) The female *Anopheles* mosquito is the vector of *Plasmodium*.

Discuss the ways in which the vector is controlled to help prevent the transmission of malaria.

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..... [3]

[Total: 18]

5 The human gas exchange system is responsible for the efficient uptake of oxygen into the blood and for the excretion of carbon dioxide.

The different tissues of the human gas exchange system are each adapted to their specific function.

(a) Ciliated epithelium is a lining tissue found in the human gas exchange system. The tissue is composed of ciliated epithelial cells and goblet cells.

Squamous epithelium is a lining tissue found in the walls of the alveoli.

(i) Squamous epithelial cells do **not** have cilia, unlike ciliated epithelial cells.

Suggest why ciliated epithelial cells are **not suitable** as the lining tissue in the walls of alveoli.

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..... [2]

(ii) Goblet cells and mucous glands function to maintain the health of the gas exchange system. They produce mucus that traps pathogens and other particles, such as dust.

Explain why ciliated epithelial cells are also important in maintaining the health of the gas exchange system.

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..... [2]

(b) The statements in Fig. 5.1 refer to the saturation of haemoglobin with oxygen in blood leaving the alveolar capillaries.

For a healthy person who inhales air in areas with **no air pollution**, the saturation of haemoglobin with oxygen can be as high as 99%. For the same healthy person who inhales air in areas with **high air pollution**, the saturation of haemoglobin with oxygen is often lower than 99%.

Fig. 5.1

Suggest explanations for the differences stated in Fig. 5.1.

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..... [4]

[Total: 8]

6 The sinoatrial node (SAN), the atrioventricular node (AVN) and the Purkyne fibres have a role in the initiation and control of heart action.

(a) The sinoatrial nodal artery (SN artery) is a branch of one of the main arteries serving the cardiac muscle. Partial blockage of the SN artery as a result of cardiovascular disease can cause the SAN to malfunction.

(i) Name the main artery serving the cardiac muscle from which the SN artery branches.

..... [1]

(ii) With reference to the role of the SAN, suggest how a slow rate of ventricular contraction could indicate that the SAN is **not** functioning correctly.

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..... [2]

(b) In people with Wolff–Parkinson–White syndrome, there is a bundle of fibres known as the bundle of Kent. These fibres can conduct impulses from the atria to the ventricles. This means that impulses do **not** always take the normal route through the AVN to the ventricles.

With reference to the role of the AVN, suggest **and** explain the change that occurs in the heart rate when impulses pass down the bundle of Kent to the ventricles instead of passing through the AVN.

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..... [2]

[Total: 5]

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