Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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5010797224

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2023**

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.

[Turn over

1 The malarial pathogen, *Plasmodium falciparum*, enters red blood cells after a person becomes infected. After some time, each cell of *P. falciparum* divides to form daughter cells.

Fig. 1.1 shows a cell of *P. falciparum* that is forming many daughter cells.

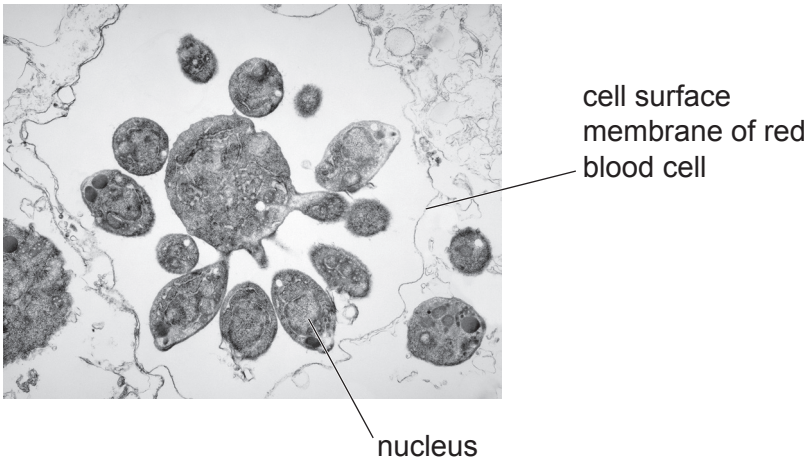

Fig. 1.1

(a) With reference to Fig. 1.1, suggest how the presence of *P. falciparum* affects a red blood cell.

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..... [3]

(b) When *P. falciparum* divides there is unequal division of the cytoplasm to form small, genetically identical daughter cells.

Outline the events that occur in the cell of *P. falciparum* to form the daughter cells shown in Fig. 1.1.

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..... [3]

In 2013, the World Health Organization (WHO) set a target for researchers to create a vaccine for malaria. WHO required the vaccine to show 75% efficacy and be ready for use by 2030.

Efficacy is a measure of the effectiveness of a vaccine in reducing the number of new cases of malaria.

A trial of the R21/Matrix-M^{TM} vaccine in Burkina Faso in 2020 achieved a 77% efficacy over a 12-month period. A control group received a vaccine for rabies.

Vaccines stimulate an immune response with the production of antibodies.

(c) Explain how antibodies will reduce the spread of the malarial pathogen through the bloodstream.

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(d) Some vaccination programmes have been more successful than others.

Discuss the factors that contribute to the success of a vaccination programme.

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..... [5]

[Total: 14]

2 Glucose is used in the synthesis of amylose. Glucose is first converted to glucose 1-phosphate (G 1-P).

Starch phosphorylase is an intracellular enzyme that can catalyse the synthesis of amylose from G 1-P, which is the substrate for the reaction:

(glucose 1-phosphate)n ⟶ amylose + (phosphate ions)n

n = a large number

Students used a colorimeter to investigate the progress of the reaction.

The students made a reaction mixture containing 0.01 mol dm^{-3} G 1-P in a buffer solution at pH 6.0. A very small quantity of amylose was added to initiate the reaction.

A solution of starch phosphorylase was added to the reaction mixture and samples were taken at 1-minute intervals. Each sample was added to a dilute iodine solution, stirred and then poured into a cuvette. The absorbance of each solution was recorded.

The results of the investigation are shown in Fig. 2.1.

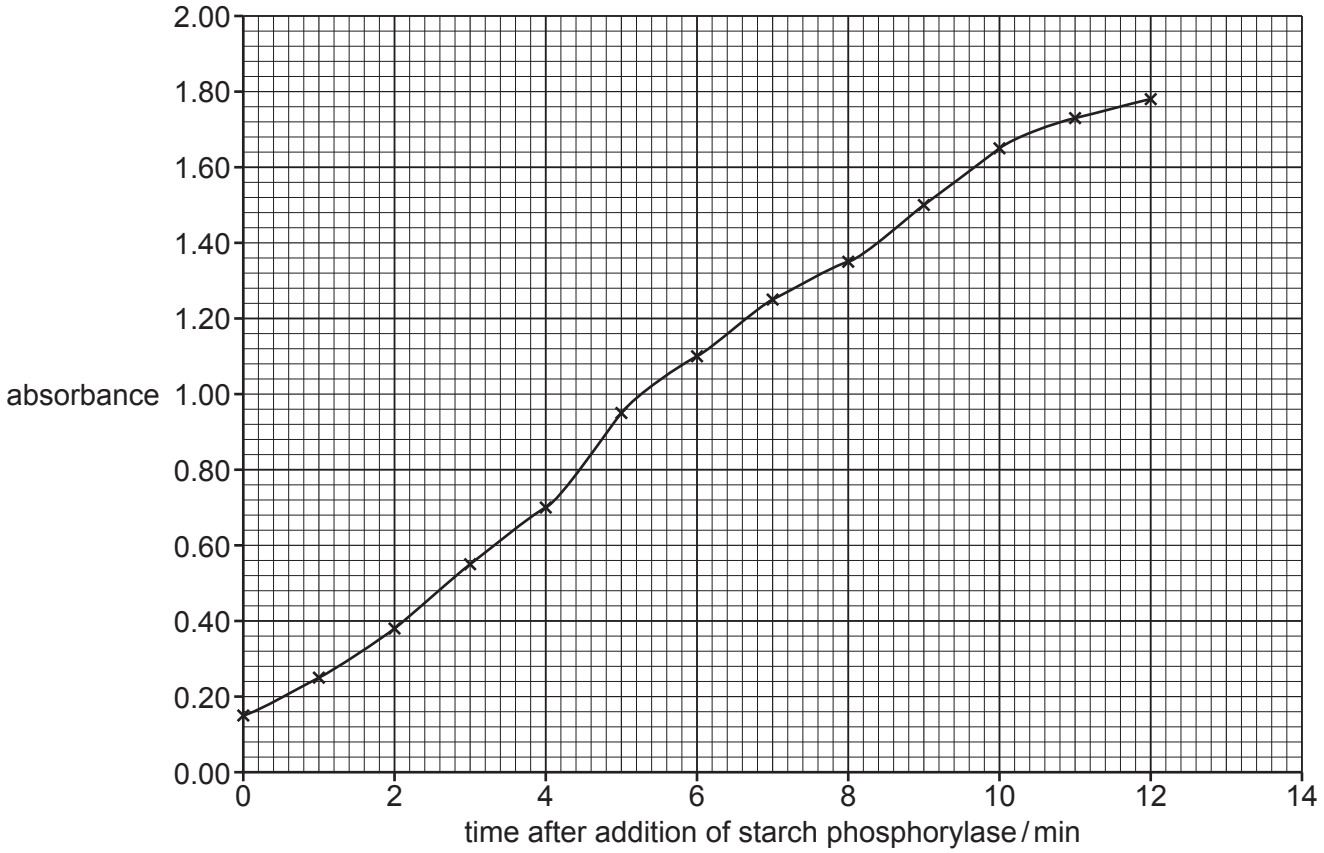

Fig. 2.1

(a) (i) Explain why the absorbance increases, as shown in Fig. 2.1.

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..... [1]

(ii) The students took their final sample at 12 minutes.

Predict the results for absorbance if the students had continued to take samples for a further 10 minutes. Explain your answer.

prediction .....

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explanation .....

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[2]

(iii) State an advantage of using a colorimeter in determining the progress of the reaction.

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..... [1]

(b) The reaction catalysed by starch phosphorylase occurs at the ends of amylose molecules.

Describe the sequence of events that occurs when starch phosphorylase catalyses the addition of a molecule of glucose to the end of an amylose molecule.

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..... [4]

[Total: 8]

3 Haemoglobin is a complex protein molecule made of four separate subunits, as shown in Fig. 3.1.

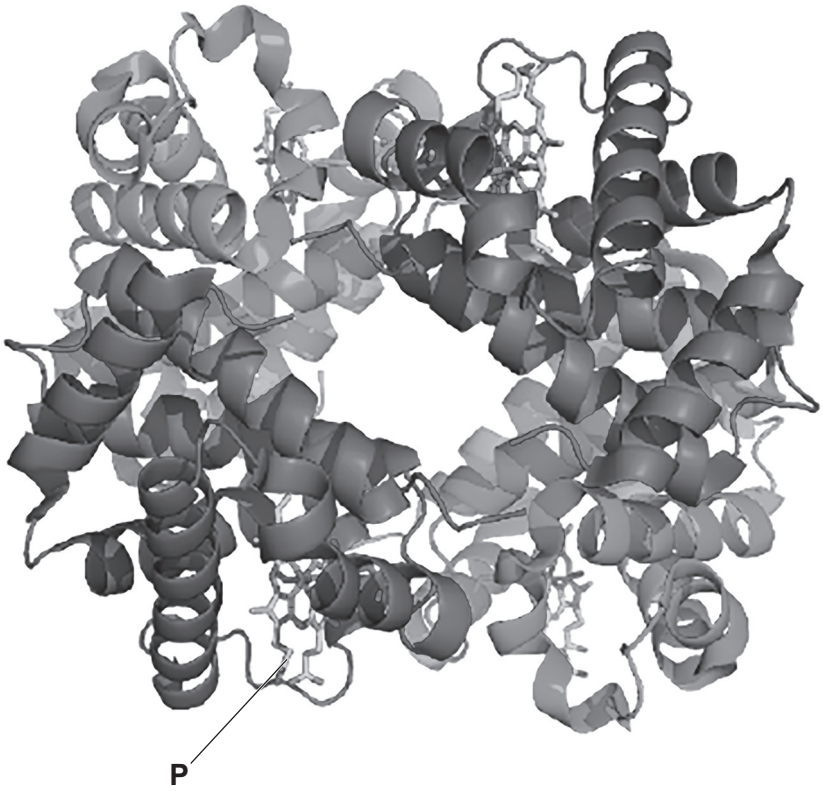

Fig. 3.1

(a) (i) The shading represents the two different polypeptides that form a molecule of haemoglobin.

State the names of the **two** different polypeptides.

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..... [1]

(ii) Identify the structure labelled **P** in Fig. 3.1.

..... [1]

(iii) Fig. 3.1 shows some of the levels of protein structure.

State the level of protein structure that is **not** shown in Fig. 3.1.

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..... [1]

(b) Haemoglobin is involved in the transport of carbon dioxide.

Molecules of carbon dioxide enter red blood cells as the cells travel in capillaries through muscle tissue. Some of these molecules are converted to carbonic acid.

Explain how haemoglobin is involved in the transport of carbon dioxide molecules that are **not** converted to carbonic acid.

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..... [3]

(c) When haemoglobin associates (binds) with oxygen it forms oxyhaemoglobin.

State the precise site in the mammalian body where haemoglobin molecules bind with oxygen.

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..... [1]

[Turn over

(d) The compound 2,3-diphosphoglycerate (2,3-DPG) is produced in red blood cells. 2,3-DPG binds to haemoglobin and stabilises it.

Fig. 3.2 shows oxygen dissociation curves when red blood cells have high and low concentrations of 2,3-DPG.

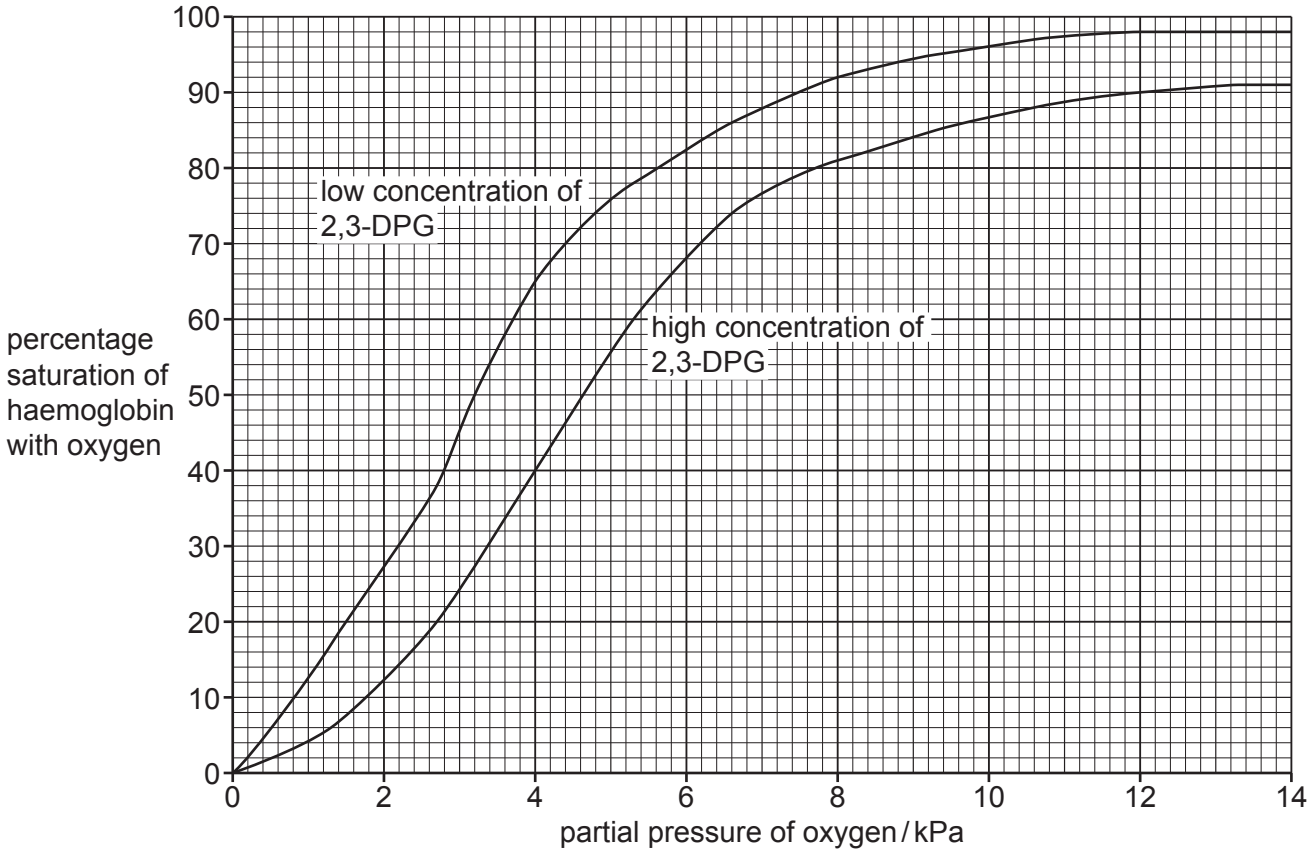

Fig. 3.2

P_{50} is the partial pressure of oxygen when haemoglobin is 50% saturated. The P_{50} is used to compare the affinity of haemoglobin for oxygen under different conditions.

(i) Use the information in Fig. 3.2 to describe the effect of an increase in the concentration of 2,3-DPG on the oxygen dissociation curve.

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..... [2]

(ii) Blood is stored in blood banks for use in hospitals during operations.

The concentration of 2,3-DPG in red blood cells decreases when blood is stored in a blood bank.

State **and** explain the effect that the use of blood taken from a blood bank has on the supply of oxygen to the tissues of a person during an operation.

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..... [2]

[Total: 11]

4 Fig. 4.1 is a diagram showing the transcription of part of the *COL1A2* gene that codes for a collagen polypeptide. The part of the *COL1A2* gene shown is a section of exon. Structure **A** represents an enzyme involved in transcription.

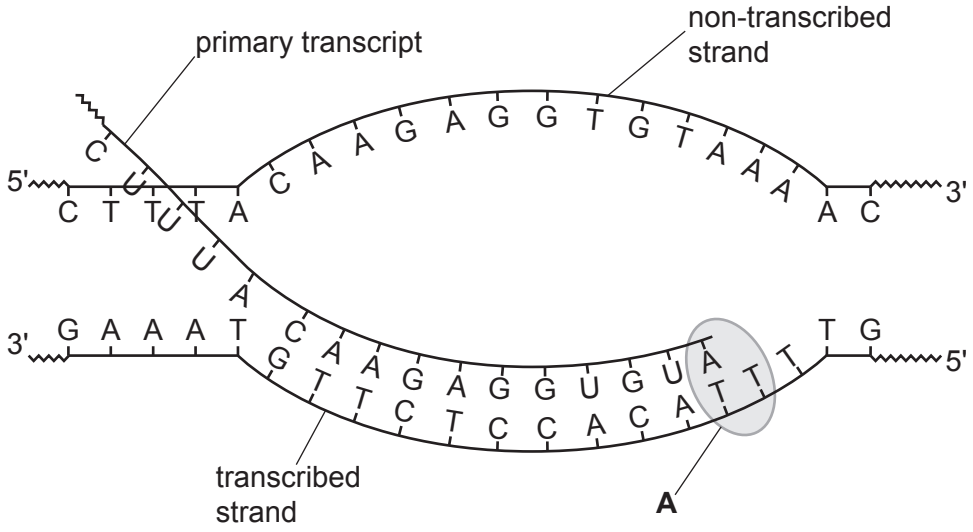

Fig. 4.1

(a) (i) Name the enzyme labelled **A** in Fig. 4.1.

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(ii) Name the bond that forms between the nucleotides in the primary transcript.

..... [1]

(b) (i) State the number of amino acids that are coded for by the sequence of nucleotides on the primary transcript shown in Fig. 4.1.

..... [1]

(ii) Use the information in Fig. 4.1 to explain why one of the strands of DNA is **not** transcribed.

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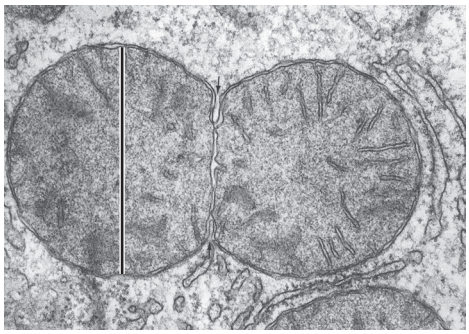
..... [2]

(c) New mitochondria are formed when a mitochondrion divides into two.

Fig. 4.2 is a transmission electron micrograph of a mitochondrion that is dividing.



magnification ×50 000

Fig. 4.2

(i) State **two** features of mitochondria that are **visible** in Fig. 4.2.

1 .....

2 .....

[2]

(ii) The line on Fig. 4.2 shows the diameter of one of the mitochondria.

Calculate the actual diameter of the mitochondrion.

Give your answer to one significant figure.

answer = ... μm [1]

(d) Mitochondrial DNA codes for some polypeptides of proteins used within the mitochondrion. Some of the proteins allow movement of ions into and out of the mitochondria.

Outline the ways in which ions can move into mitochondria.

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..... [3]

[Total: 11]

[Turn over

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5 In flowering plants, transport of assimilates occurs in phloem tissue between sources and sinks.

(a) (i) Explain why a root can be a source **and** a sink.

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..... [2]

(ii) State **two** examples of assimilates that are transported in the phloem.

..... [1]

(b) Describe **and** explain the mechanism that is responsible for the movement of phloem sap in sieve tubes.

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..... [4]

[Turn over

(c) Tobacco mosaic virus (TMV) infects many crop plants. The virus passes between cells in the leaves and can travel throughout plants in the phloem.

The enzyme pectin methylesterase (PME) is involved with the production of cell walls. The enzyme is also known to influence the movement of TMV through plants. Scientists investigated the effect of PME on the transport of TMV through plants.

The scientists used three varieties of tobacco plants. Two varieties, **V1** and **V2**, have small quantities of PME. A third variety, **C**, has the normal quantity of PME and was used as the control in this investigation.

The plants in each group were infected with TMV at the same time. The accumulation of the virus particles transported to the leaves at the top of the plants was determined over 36 days.

The results are shown in Fig. 5.1. The arrow indicates when all the plants were infected with TMV.

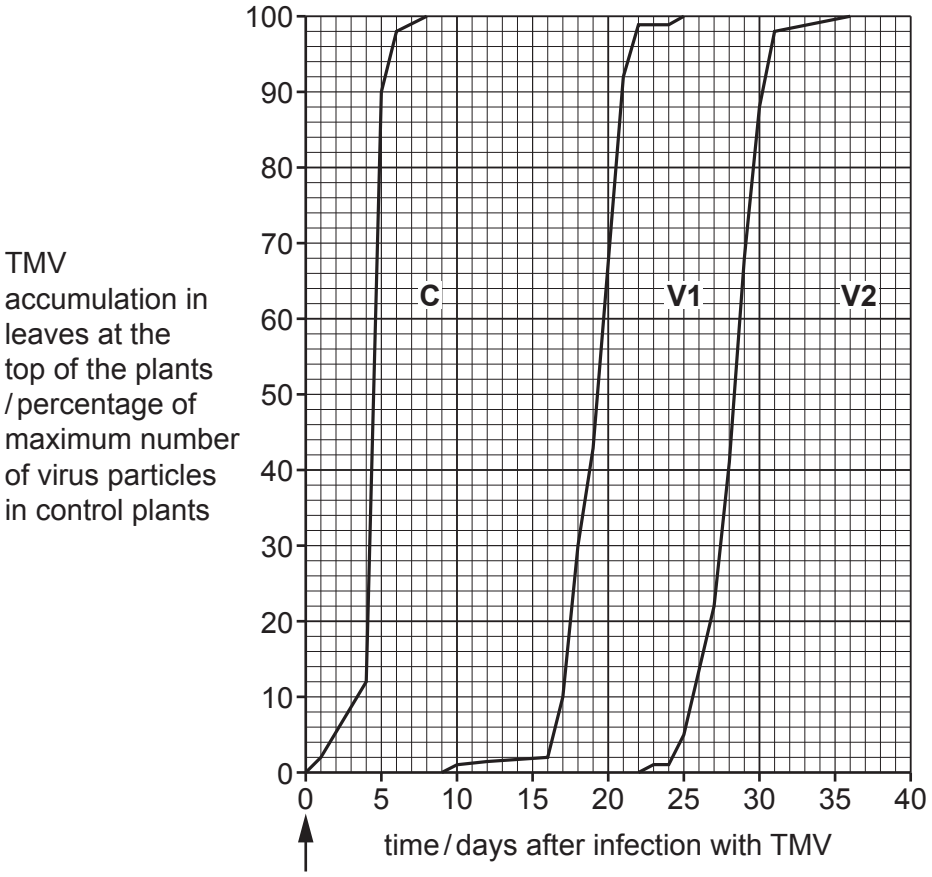

Fig. 5.1

Compare the results for varieties **V1** and **V2** with the control group of plants, **C**.

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..... [3]

[Total: 10]

6 The mammalian heart consists of four chambers.

(a) Explain why the ventricles have thicker walls than the atria.

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..... [2]

(b) Complete Table 6.1 to identify the structure in the heart responsible for each function listed.

Table 6.1

function	structure in the heart
initiates the heartbeat	
delays the wave of depolarisation between the atria and the ventricles	
transmits the wave of depolarisation through muscles of the ventricle	
closes when the left ventricle contracts	

[4]

[Total: 6]