Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1995506884

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2024**

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 **20** pages. Any blank pages are indicated.

[Turn over

1 Fig. 1.1 is a diagram showing part of a cell surface membrane of an animal cell.

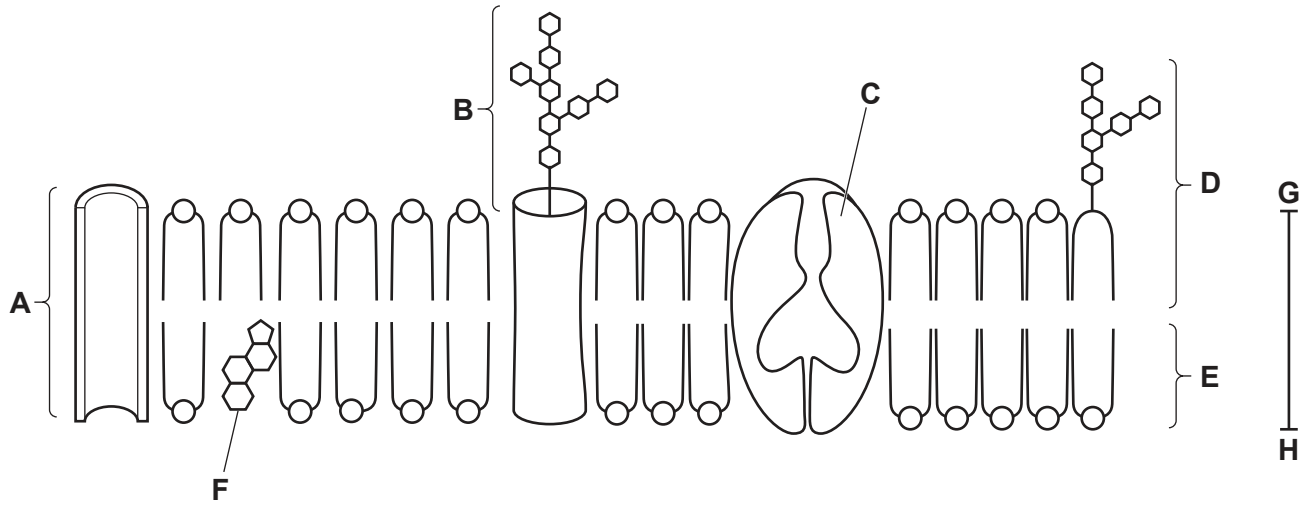

Fig. 1.1

(a) (i) State the approximate thickness of the membrane as shown by the line **G**–**H**.

..... [1]

(ii) Complete Table 1.1 to show:

- the names and functions of the components of the cell surface membrane
- the letters of the labels in Fig. 1.1 that identify each component.

Table 1.1

component	function	letter on Fig. 1.1
channel protein		
phospholipid		
	receptor for cell signalling	
		F

[4]

(b) Fig. 1.2 is a drawing of a transmission electron micrograph (TEM) of a cell from the palisade mesophyll of a leaf.

The drawing does **not** show all of the organelles visible in a transmission electron micrograph.

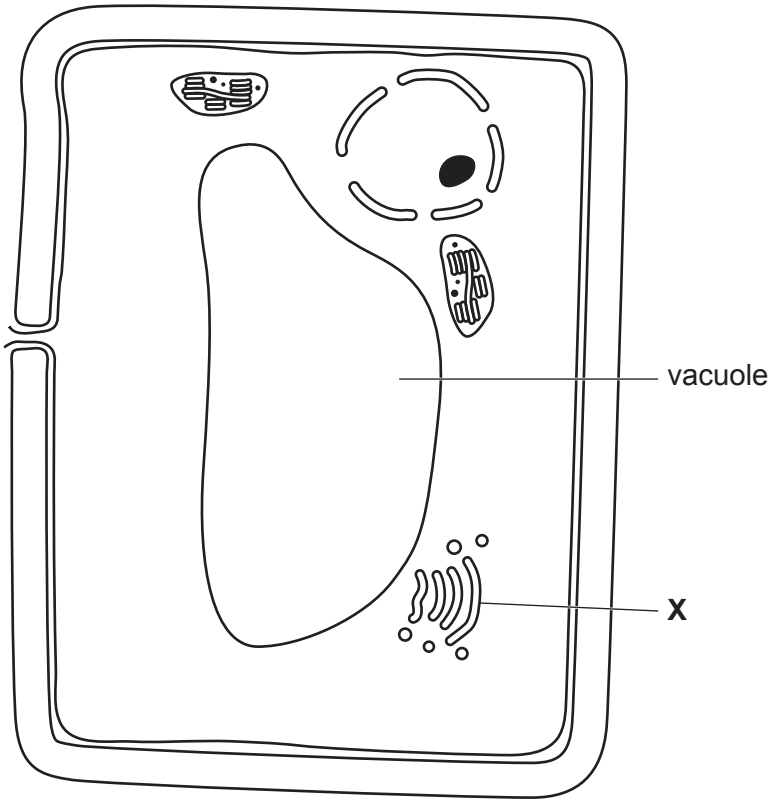

Fig. 1.2

(i) Complete Fig. 1.2 by drawing **and** labelling:

- a mitochondrion
- rough endoplasmic reticulum
- smooth endoplasmic reticulum.

Your drawings should show the detail that can be seen in a transmission electron micrograph. [3]

(ii) Identify the organelle labelled **X and** state **one** function of this organelle.

name .....

function .....

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[2]

[Total: 10]

2 **(a)** Water is the main component of blood.

Explain how the properties of water make it suitable as the main component of blood.

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..... [3]

(b) Fig. 2.1 is a diagram of the circulation in a mammal.

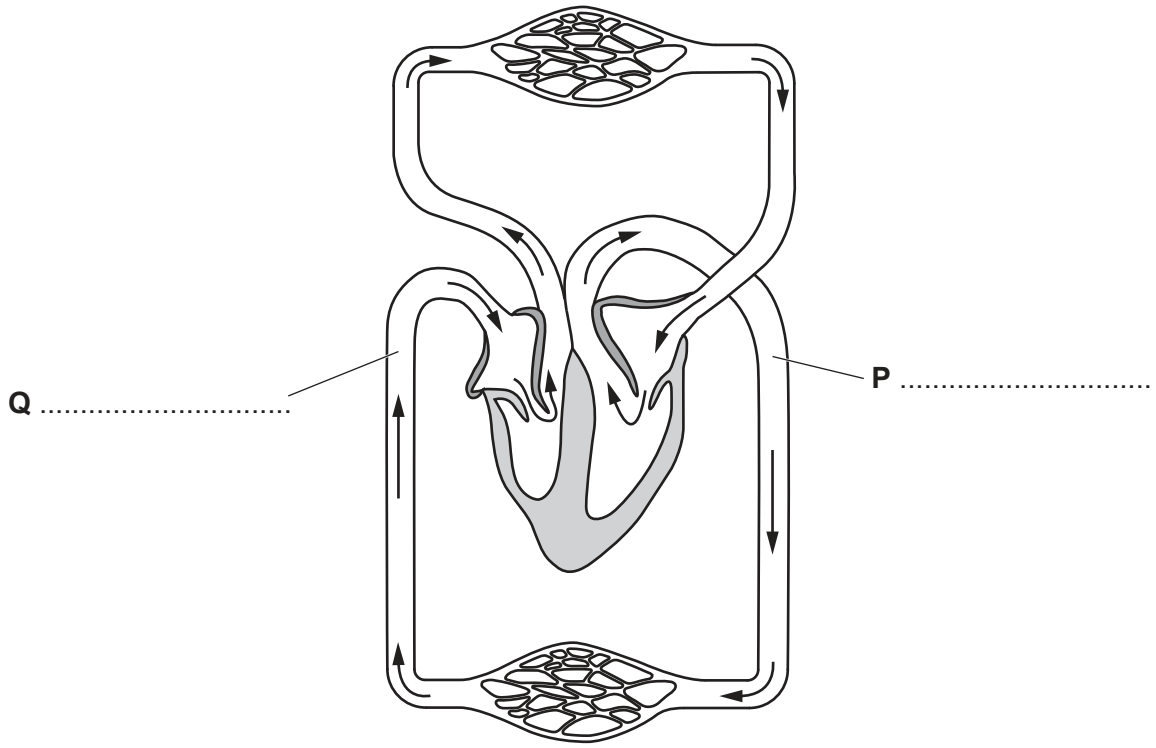

Fig. 2.1

(i) Complete Fig. 2.1 by naming **P** and **Q**. Write your answers on Fig. 2.1. [1]

(ii) Describe the functions of **P** and **Q**.

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..... [2]

(iii) Explain why the mammalian circulation is described as a closed, double circulation.

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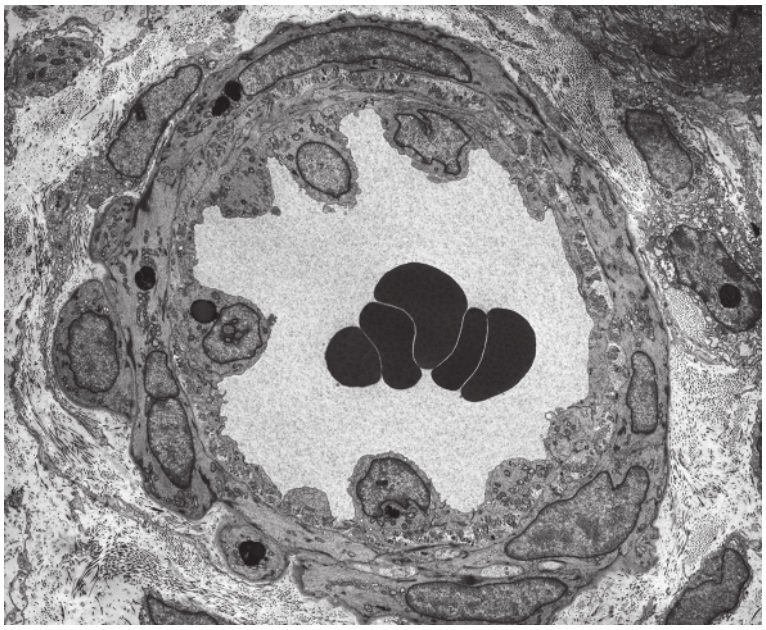
..... [2]

(c) Fig. 2.2 is a transmission electron micrograph of a cross-section of an arteriole. Blood flows from muscular arteries through arterioles into capillary networks.

The lining of the arteriole is folded because the arteriole has constricted. This constriction causes the blood pressure to decrease from 12.7 kPa in the muscular artery to 2.7 kPa at the end of the arteriole.



magnification ×2000

Fig. 2.2

(i) Explain why it is important that the pressure of blood decreases as it passes through arterioles.

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..... [2]

(ii) Compare the structure of a muscular artery with the structure of the arteriole shown in Fig. 2.2.

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..... [3]

[Total: 13]

3 **(a)** A class of students was studying the features of some human pathogens. One of the students constructed a flow chart to identify four different human pathogens. The student used information about the structure and mode of transmission of each of these pathogens.

Fig. 3.1 shows the partially completed flow chart.

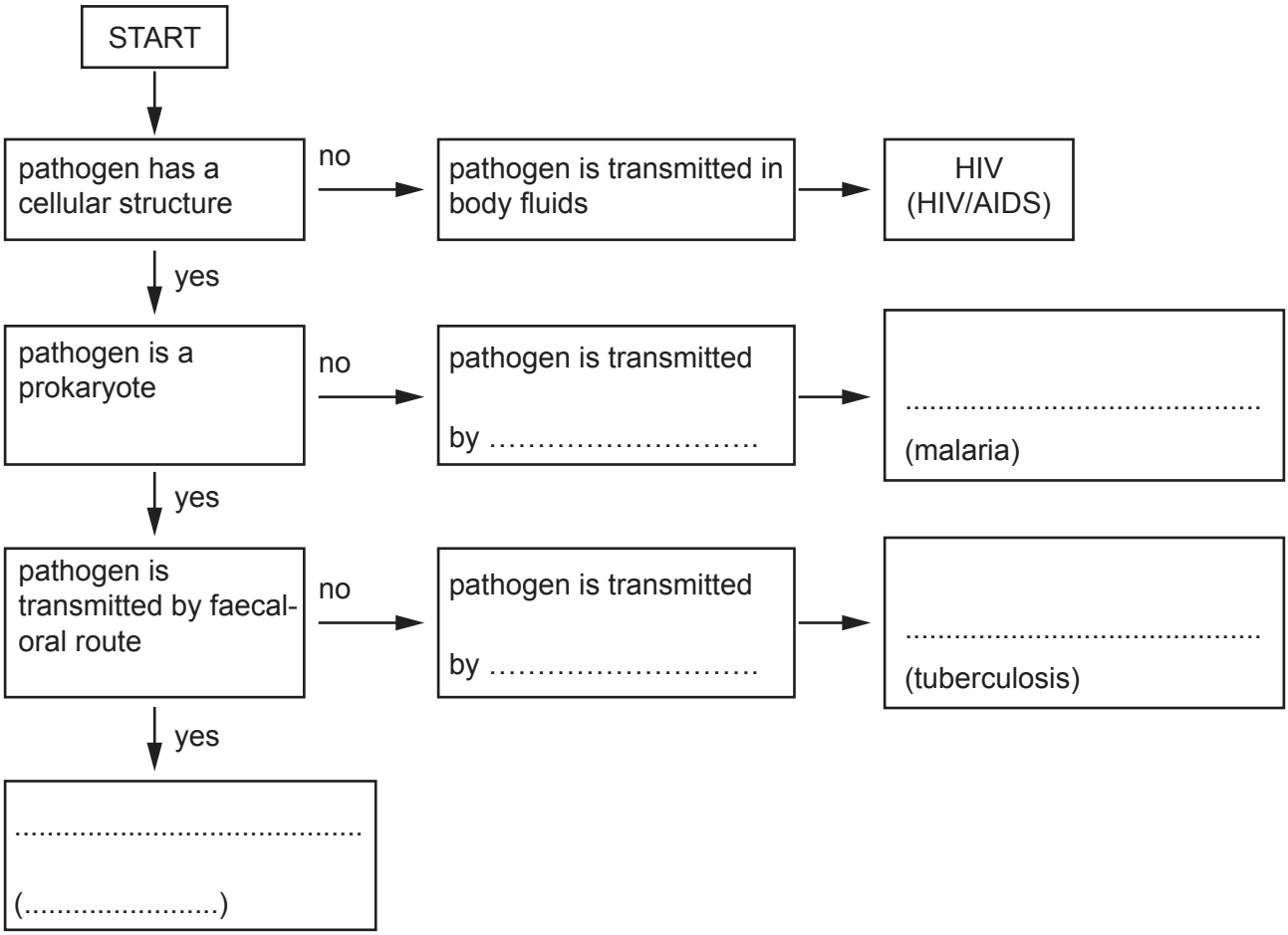


Fig. 3.1

Complete the flow chart in Fig. 3.1 by identifying:

- the modes of transmission
- the scientific names of the pathogens
- the name of one of the diseases.

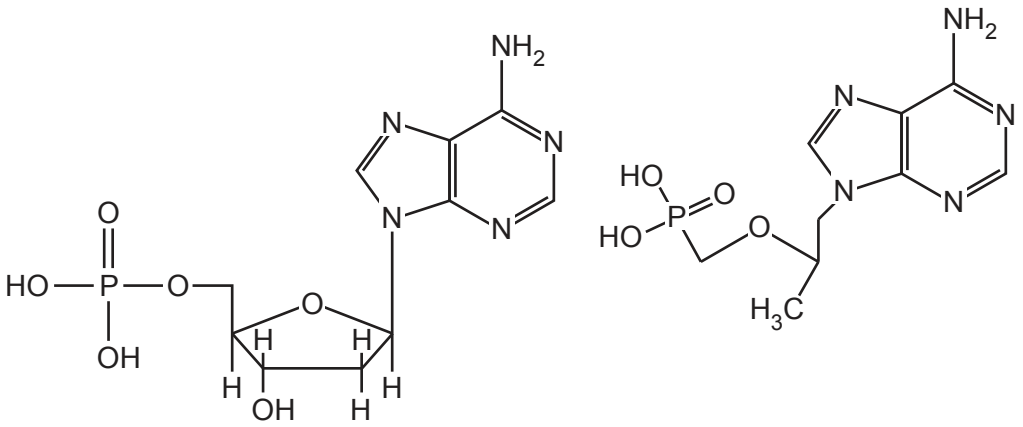
[5]

(b) HIV has a nucleic acid core of RNA. The virus also contains the enzyme reverse transcriptase.

After HIV enters T-lymphocytes, reverse transcriptase catalyses the formation of DNA using activated DNA nucleotides with the viral RNA as a template.

Some drugs, such as tenofovir, have been developed to inhibit the action of reverse transcriptase.

The structure of tenofovir is similar to the structure of deoxyribose adenosine monophosphate, as shown in Fig. 3.2.



deoxyribose adenosine monophosphate

tenofovir

Fig. 3.2

After tenofovir is absorbed into cells it is phosphorylated twice and can be used by reverse transcriptase in the synthesis of DNA.

When a tenofovir molecule is added to the DNA strand being synthesised, the process stops.

Suggest the mechanism of action of tenofovir to prevent the synthesis of DNA by reverse transcriptase. Use the information in Fig. 3.2 in your answer.

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..... [2]

(c) Pre-exposure prophylaxis (PrEP) is the use of therapeutic drugs to prevent the replication of HIV in the body following infection. The drugs are taken by people who are at risk of becoming infected. Tenofovir is one of these therapeutic drugs.

In 2016, the United Nations (UN) set a global target of 3 million PrEP users by 2020.

Table 3.1 shows the number of people across the world who received a therapeutic drug for PrEP in each of the years between 2012 and 2019.

Table 3.1

year	number of people who received PrEP
2012	10 000
2013	15 000
2014	27 500
2015	57 500
2016	95 000
2017	145 000
2018	340 000
2019	605 000

(i) Calculate the percentage of people who received PrEP in 2019 as a percentage of the target set by the UN in 2016.

Give your answer to the nearest whole number.

..... % [1]

(ii) PrEP does not prevent transmission of HIV.

State **and** explain how health authorities can reduce the transmission of HIV.

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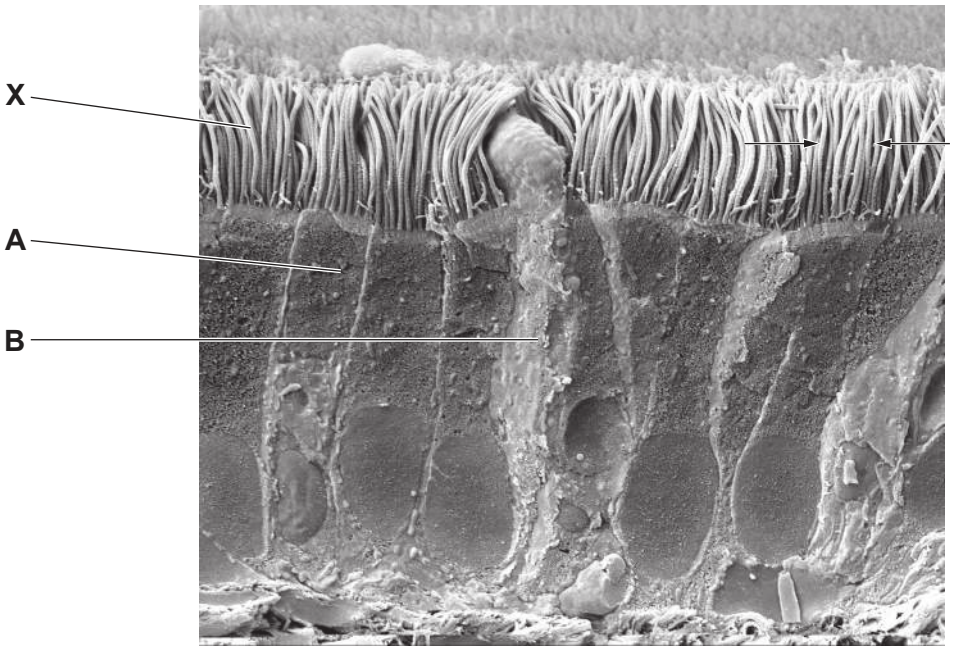
..... [4]

[Total: 12]

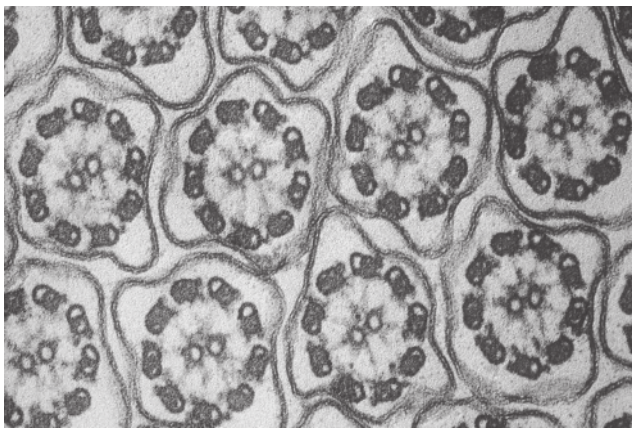
4 Fig. 4.1 is a scanning electron micrograph showing the tissue that lines the bronchi in the gas exchange system.

Fig. 4.2 is a transmission electron micrograph of a horizontal section made at the position indicated by the two arrows in Fig. 4.1.



magnification ×3000

Fig. 4.1



magnification ×80 000

Fig. 4.2

(a) (i) Name the cells labelled **A** and **B** in Fig. 4.1.

A .....

B .....

[2]

(ii) Describe how the tissue shown in Fig. 4.1 is adapted to its function in the gas exchange system.

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..... [3]

(b) (i) The structures labelled **X** in Fig. 4.1 have a characteristic internal appearance, as seen in Fig. 4.2.

Describe the internal appearance of the structures labelled **X**.

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..... [2]

(ii) Explain how Fig. 4.2 shows that each of the structures labelled **X** are intracellular.

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..... [1]

(c) Stem cells are found in the lining of the bronchi.

Describe the function of centrioles **and** explain how they are involved in the cell cycle of a stem cell.

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..... [4]

[Total: 12]

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5 The pressure of water vapour inside and outside leaves can be measured. The difference between these pressures is known as the leaf vapour pressure deficit (LVPD).

LVPD is one of the factors that influences the rate of transpiration.

Scientists measured the effect of changing the LVPD on the rate of transpiration in several species of flowering plant that live in a variety of different habitats. Two of these species were:

- *Nerium oleander*, a species that is adapted to grow in hot, dry conditions
- *Helianthus annuus*, a species that is not adapted for survival in hot, dry conditions.

Fig. 5.1 shows the effect of increasing the LVPD on the transpiration rates of the two species.

All other factors were kept constant.

key

——— *Helianthus annuus*

– – – – – – *Nerium oleander*

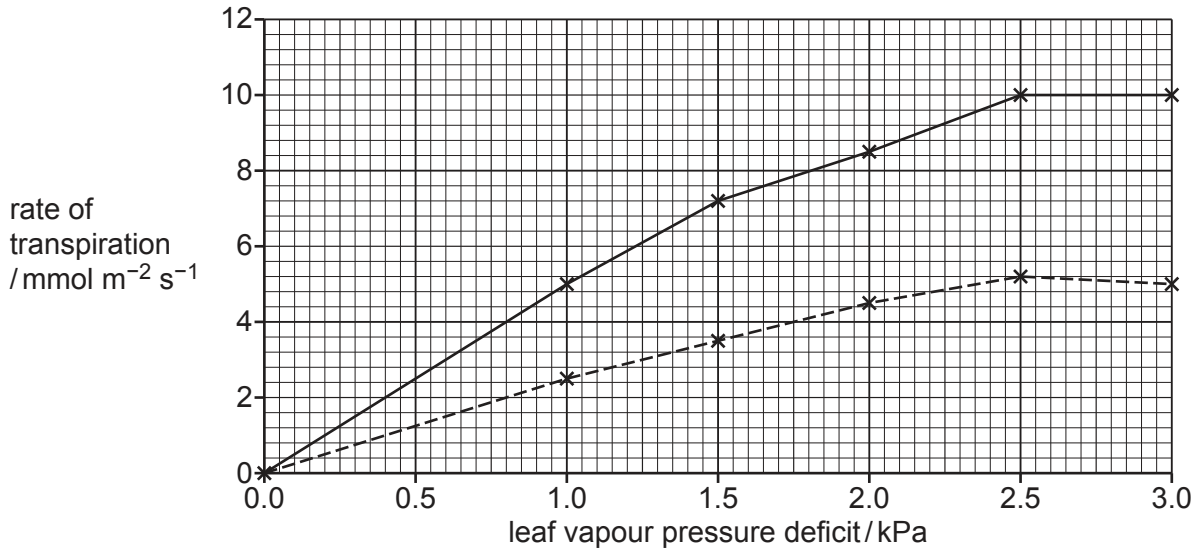

Fig. 5.1

(a) Compare the results of the two species shown in Fig. 5.1.

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..... [3]

(b) Fig. 5.2 shows part of a plant of *N. oleander*.

Fig. 5.2

Fig. 5.3 shows a cross-section of part of an oleander leaf.

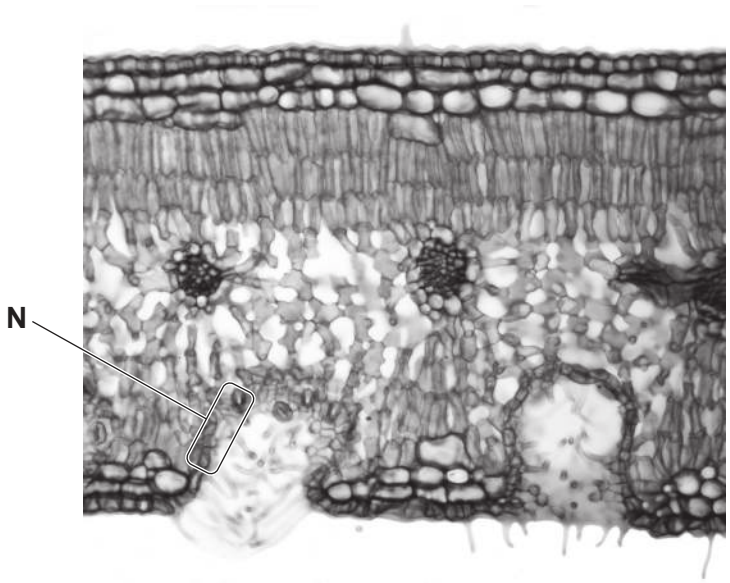

Fig. 5.3

Fig. 5.4 is a drawing of a high-power view of region **N** on Fig. 5.3.

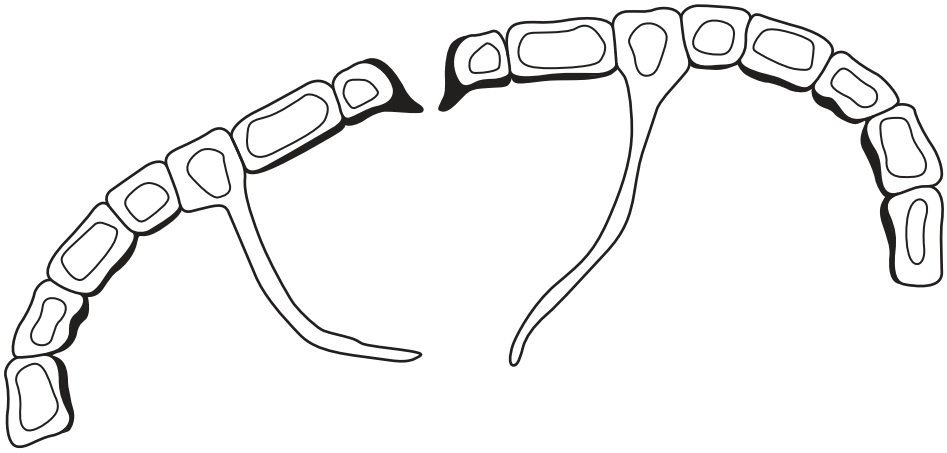

Fig. 5.4

State **and** explain **two** adaptations shown by the leaves of *N. oleander* that are visible in Fig. 5.3 and Fig. 5.4.

one adaptation visible in Fig. 5.3 .....

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explanation .....

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one adaptation visible in Fig. 5.4 .....

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explanation .....

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[4]

[Total: 7]

6 Antibodies are produced by plasma cells.

Fig. 6.1 shows antigens bound to antigen-binding sites of an antibody molecule.

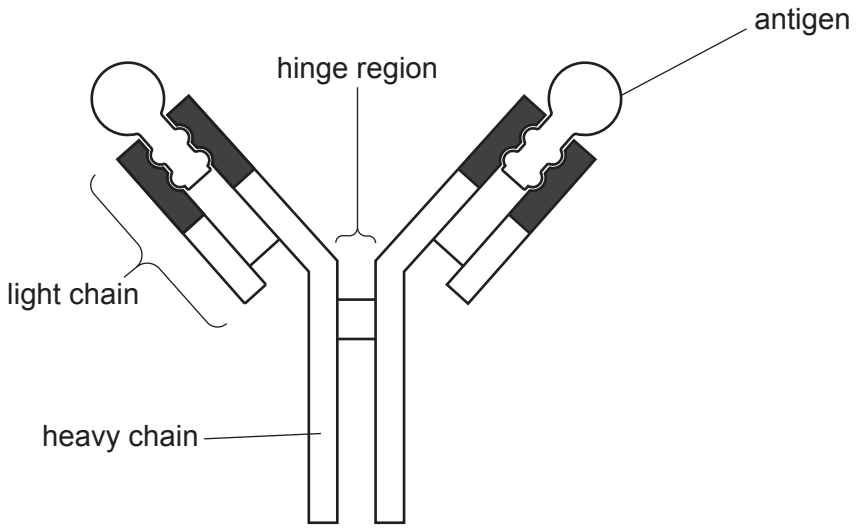

Fig. 6.1

(a) (i) Explain how the structure of an antigen-binding site makes it specific to a particular antigen, as shown in Fig. 6.1.

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..... [2]

(ii) State the function of the hinge region of the antibody shown in Fig. 6.1.

..... [1]

(iii) Antibodies can bind to membrane receptors on cells of the immune system, such as macrophages.

Suggest an advantage of antibodies binding to receptors on macrophages.

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..... [1]

(b) It is estimated that the immune system of each person can make enough antibodies to bind to over 10^{12} different antigens.

When plasma cells make antibody molecules they combine the polypeptides produced by the expression of genes for heavy chains and the genes for light chains.

Research has shown that producing this very large number of antibodies is only possible by modifying the primary transcripts of the genes that code for heavy chains and the genes that code for light chains.

Suggest how this modification of the primary transcripts occurs in plasma cells.

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..... [2]

[Total: 6]

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