Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0286506244

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.

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Answer **all** questions.

1 Fig. 1.1 is a diagram of a molecule of haemoglobin.

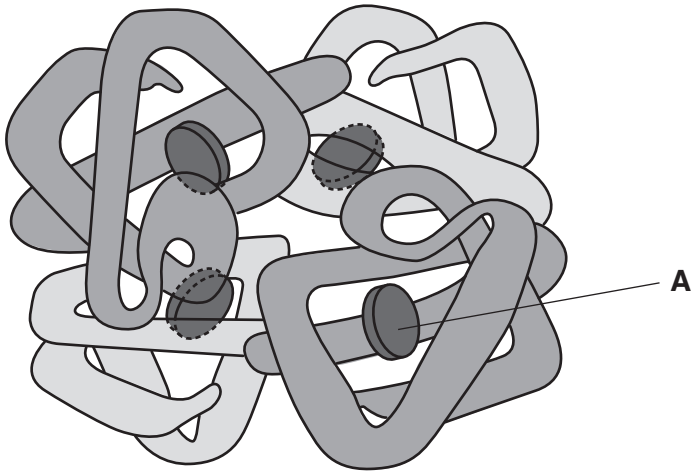

Fig. 1.1

(a) (i) Name the structure labelled **A** on Fig. 1.1.

..... [1]

(ii) State the function of structure **A**.

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..... [1]

(b) Haemoglobin is described as a globular protein. Explain why this protein is described as *globular*.

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..... [2]

(c) The gene *HBB* codes for the β-globin polypeptide.

State why a polypeptide, such as β-globin, is described as a polymer.

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..... [2]

(d) A single base change in the DNA of the gene *HBB* results in a change to the amino acid sequence of β-globin. In the sequence, a single glutamic acid is replaced by valine.

Outline the effects of this change in the amino acid sequence of β-globin on the structure and function of a haemoglobin molecule.

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..... [3]

(e) Haemoglobin interacts with carbon dioxide and carbon monoxide.

Outline the role of haemoglobin in the transport of carbon dioxide.

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..... [3]

[Total: 12]

2 Meristematic tissue is found in the growing region of plants, such as root tips.

Fig. 2.1 shows a section through the meristematic region of a root tip of onion, *Allium cepa*.

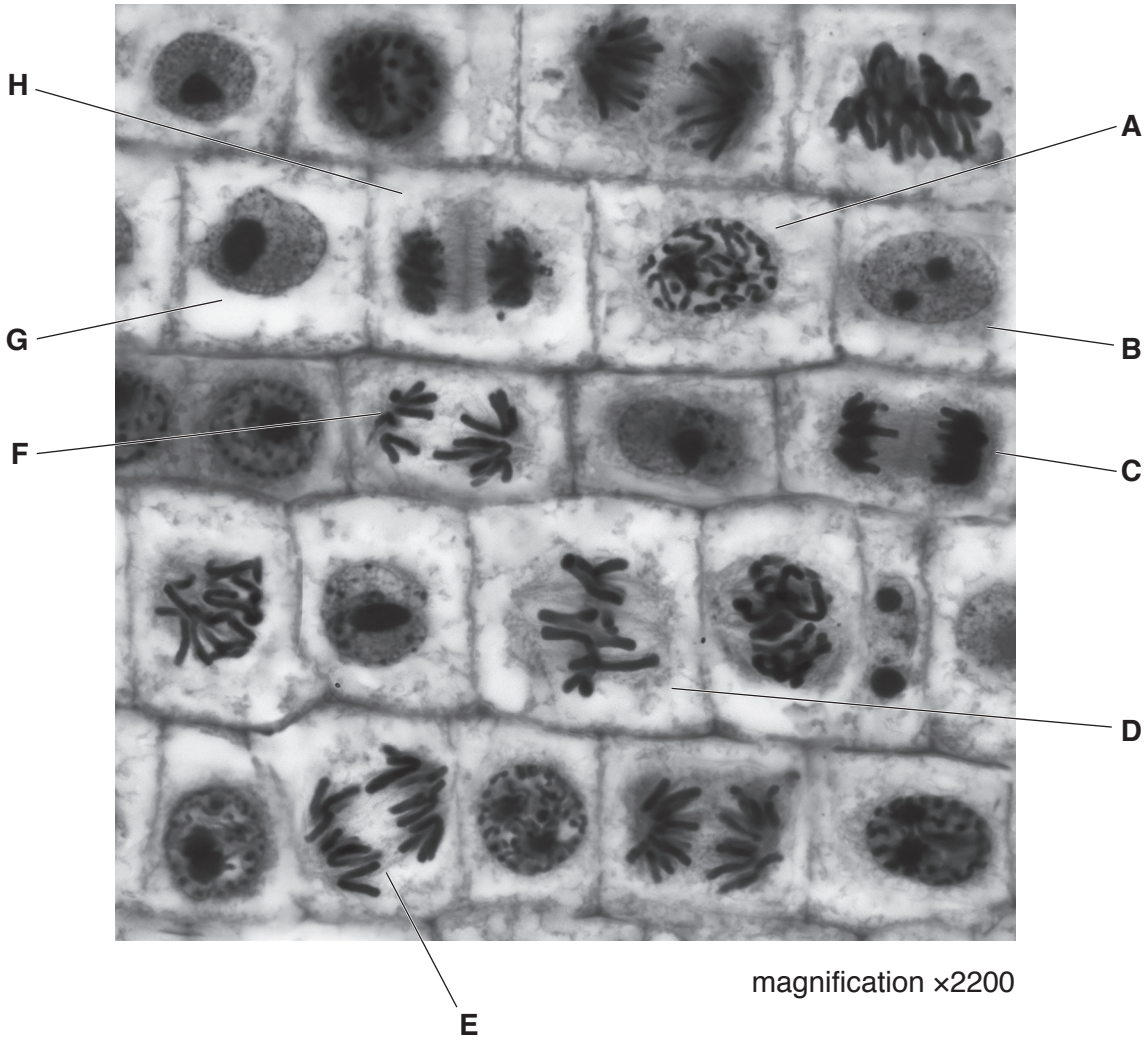

Fig. 2.1

Table 2.1 shows the numbers of cells in different stages of the cell cycle that were observed in sections of the meristematic regions of root tips of *A. cepa*.

Table 2.1

stage of cell cycle	one example of cell from Fig. 2.1	number of cells counted in each stage			
		replicate 1	replicate 2	replicate 3	mean
interphase		4686	4709	4808	4734
prophase		148	159	155	154
metaphase		38	47	40	42
anaphase		25	33	28	29
telophase		38	47	39	41
				total	5000

(a) Complete Table 2.1 by using the letters **A** to **H** from Fig. 2.1 to identify **one** cell in each stage of the cell cycle. [3]

(b) The total length of time taken for meristematic cells of *A. cepa* to complete one cell cycle at 25 °C is 12 hours.

Using sections similar to the one in Fig. 2.1, the length of time spent in each stage of the cell cycle can be estimated. To obtain the estimate, the percentage of cells in that stage is calculated.

Using the data in Table 2.1, calculate:

- the percentage of cells in anaphase
- the mean length of time in **minutes** for anaphase.

Show your working.

percentage of cells in anaphase = ... %

mean length of time in anaphase = ... min
[2]

(c) State **one** event that occurs during cytokinesis in the cell cycle of plant cells, such as those shown in Fig. 2.1.

.....

..... [1]

[Total: 6]

3 (a) The tomato plant, *Solanum lycopersicum*, does not tolerate periods of drought (water shortage). Researchers have produced a tomato plant that has an improved tolerance of drought.

The researchers measured the width and the length of open stomata in plants that are tolerant of drought and tomato plants that are not tolerant.

Fig. 3.1 is the formula used to calculate the size of an open stoma (stomatal aperture).

$$\text{stomatal aperture} = \frac{\text{width of open stoma}}{\text{length of open stoma}}$$

Fig. 3.1

Fig. 3.2 shows the mean stomatal aperture of the two groups of tomato plants.

Fig. 3.3 shows the rates of transpiration of the two groups of tomato plants when kept in identical conditions of drought.

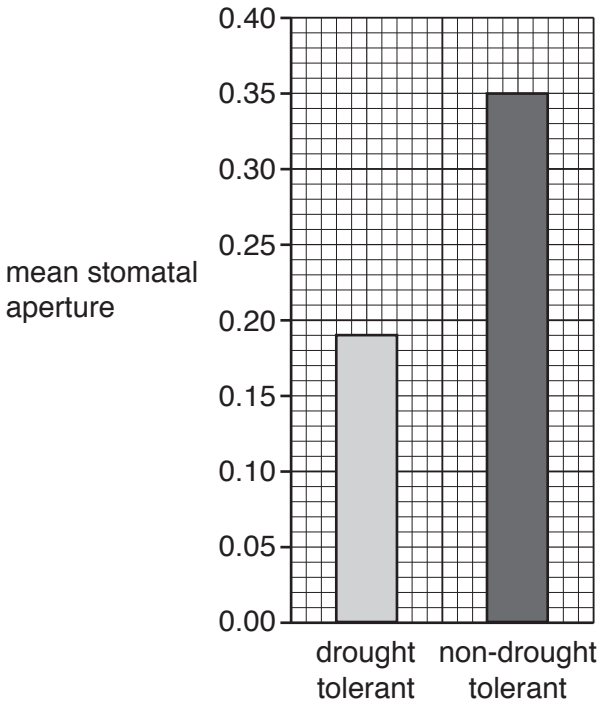

Fig. 3.2

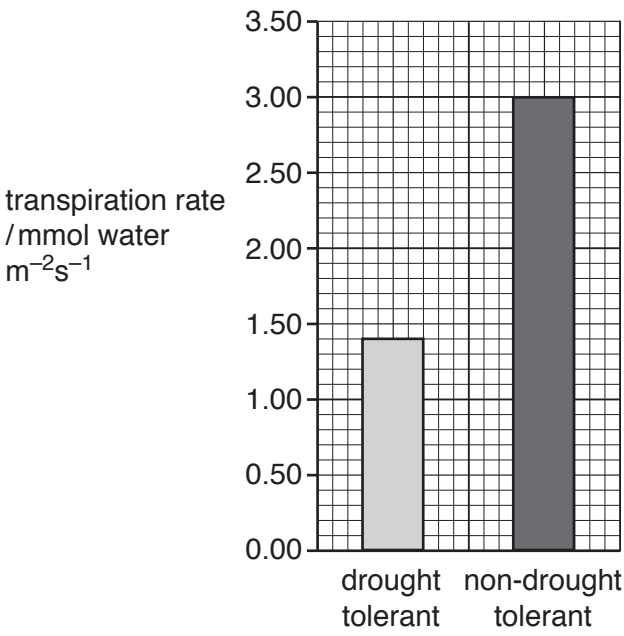

Fig. 3.3

The water uptake of leafy shoots taken from the two groups of tomato plants was measured using potometers. The leafy shoots were of similar mass and had the same number of leaves. The results are shown in Fig. 3.4.

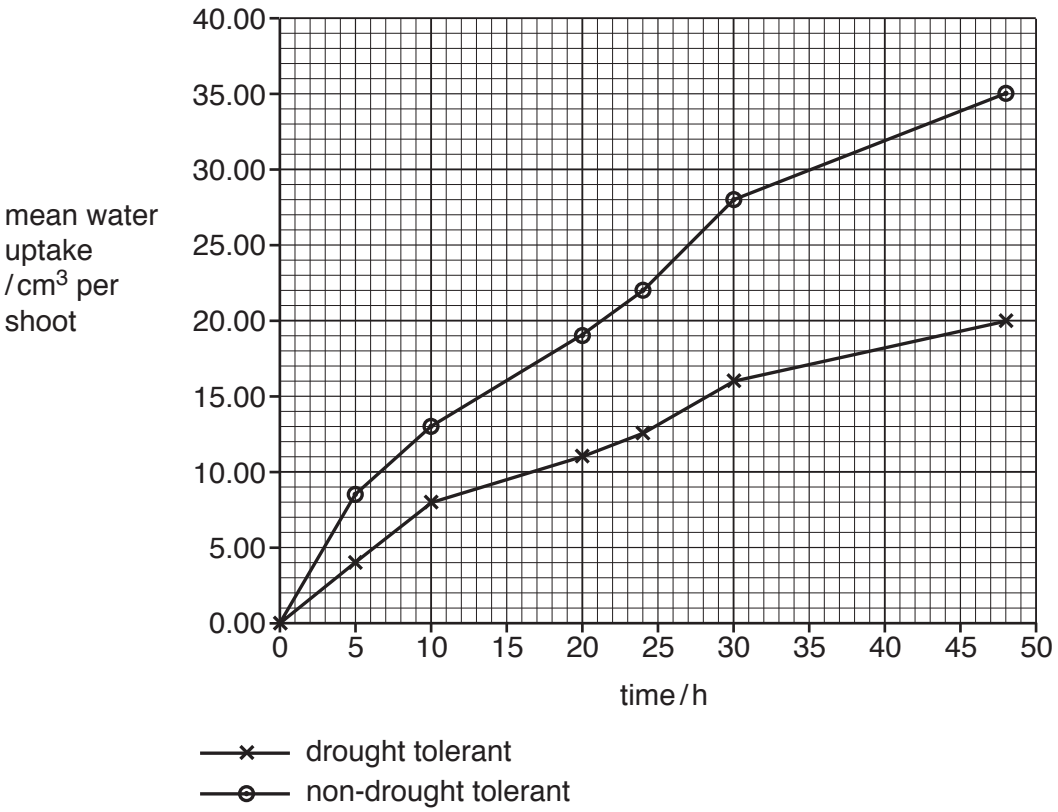

Fig. 3.4

With reference to Fig. 3.2, Fig. 3.3 **and** Fig. 3.4, describe **and** explain the differences between the plants that are drought tolerant and the plants that are non-drought tolerant.

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..... [5]

(b) The nuclei of plants produce small lengths of RNA known as microRNAs.

MicroRNAs in guard cells have been shown to prevent the synthesis of some proteins.

The guard cells of the drought-tolerant tomato plants produced more microRNA molecules than the guard cells of the non-tolerant plants.

MicroRNA molecules do **not** prevent transcription but interact with messenger RNA (mRNA).

Suggest how this microRNA can interact with mRNA to prevent the production of proteins in guard cells of *S. lycopersicum.*

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..... [3]

[Total: 8]

4 In mammals, arteries branch to form smaller blood vessels called arterioles.

Arterioles branch to form capillaries that supply blood to tissues.

(a) Explain the ways in which the structure of an artery is adapted to its function.

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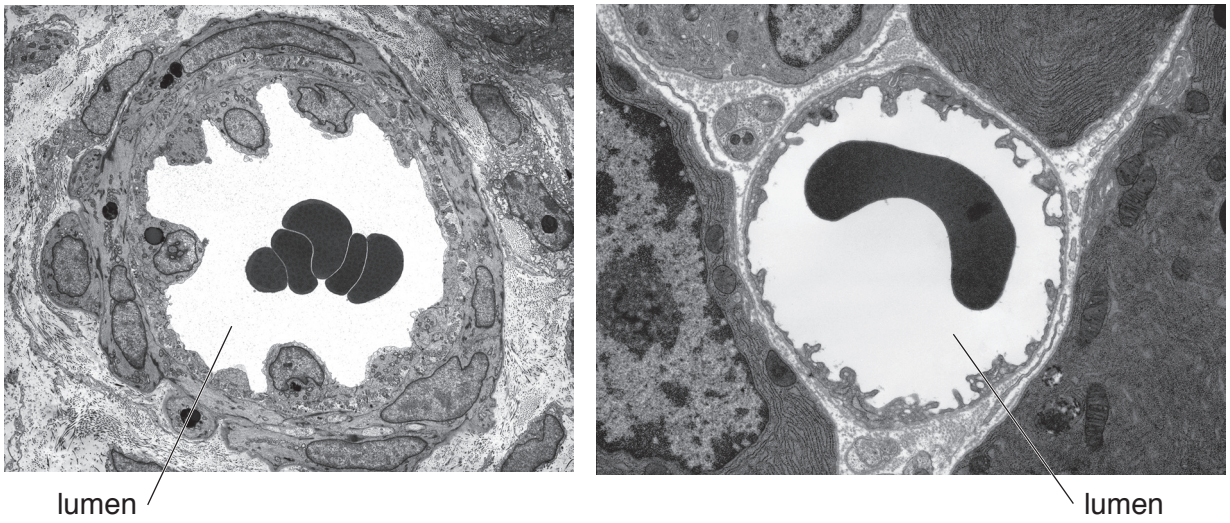
..... [4]

Fig. 4.1 shows transmission electron micrographs of cross-sections through an arteriole and a capillary.



arteriole magnification ×2000 **capillary** magnification ×6500

Fig. 4.1

(b) (i) Identify the cells inside the lumen of the arteriole in Fig. 4.1 **and** state **one** reason for your identification.

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..... [2]

(ii) Describe the differences between the arteriole and the capillary that are **visible** in Fig. 4.1.

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..... [4]

Fig. 4.2 shows a capillary network in a mammalian tissue.

The arrows indicate the direction of flow of body fluids.

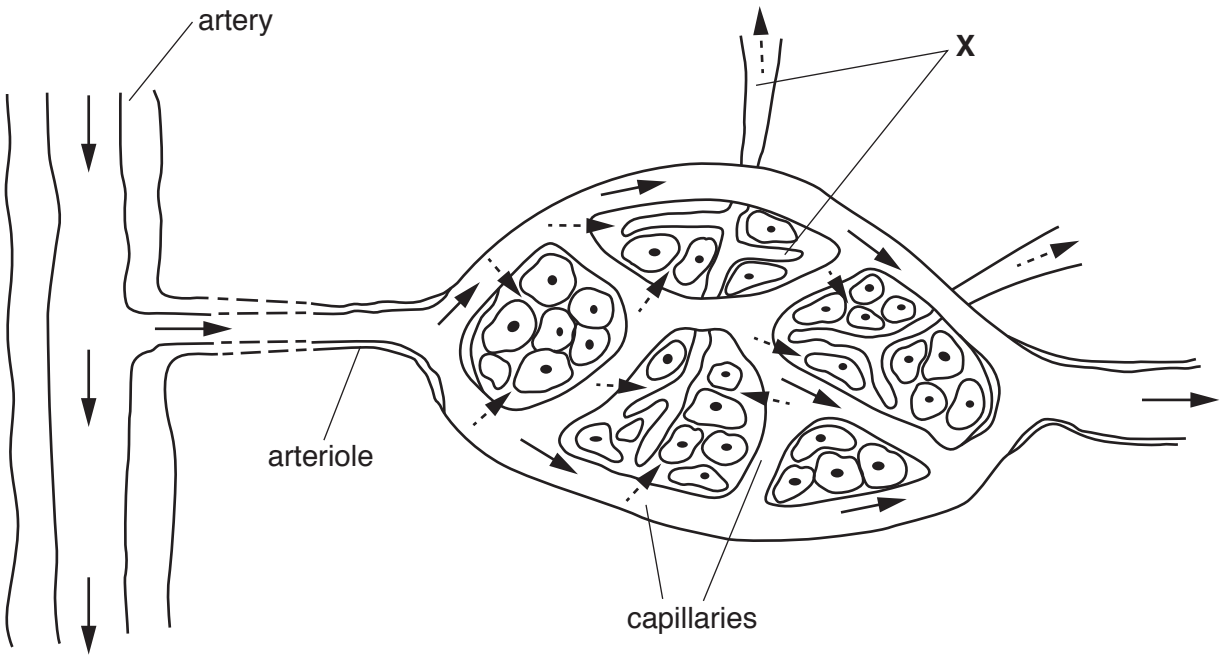

Fig. 4.2

(c) (i) Capillaries have a role in the formation of tissue fluid.

Explain how tissue fluid is formed in the capillary network.

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..... [2]

(ii) The vessels labelled **X** in Fig. 4.2 carry excess tissue fluid back into the circulatory system.

Name the fluid inside the vessels labelled **X and** state **one** way in which its composition differs from blood plasma.

name of fluid .....

difference .....

.....

[2]

[Total: 14]

5 Influenza is an infectious disease caused by the influenza A virus. This virus causes influenza in birds and mammals.

Fig. 5.1 is a diagram of an influenza A virus.

Haemagglutinin allows the virus to attach to host cells by binding to receptors on the cell surface membrane of the host cells.

Neuraminidase is an enzyme that helps the virus to leave host cells after the virus has replicated.

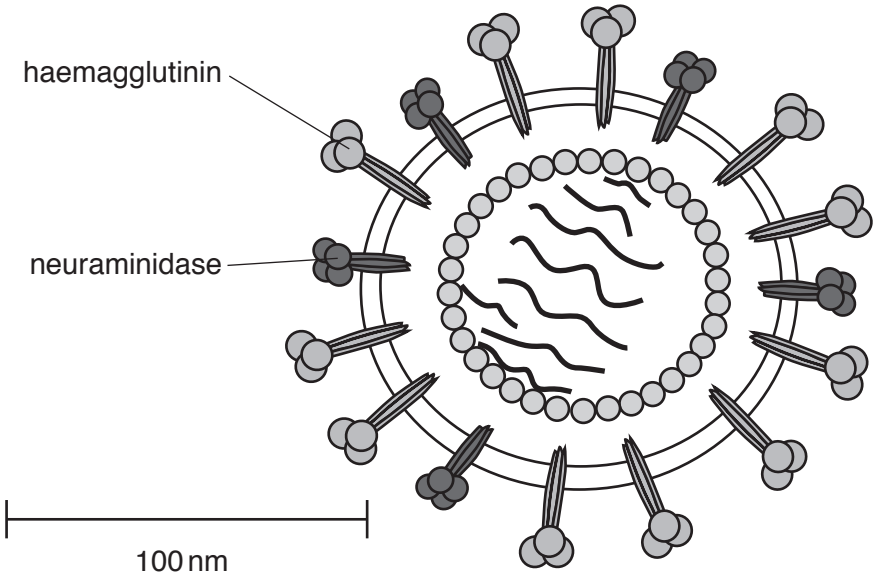

Fig. 5.1

(a) State **two** features of all viruses that are visible in Fig. 5.1.

1 .....

2 .....
[2]

(b) Neuraminidase removes parts of the host cell receptors that bind to haemagglutinin. This helps newly-formed viruses to leave host cells.

Drugs have been developed to act on neuraminidase. These drugs prevent viruses from leaving host cells.

Suggest **and** explain how these drugs act to prevent viruses leaving cells.

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..... [3]

(c) The human immune system produces antibodies in response to the presence of antigens, such as neuraminidase and haemagglutinin.

Outline the events that occur during an immune response leading to the production of antibodies against an antigen, such as haemagglutinin.

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..... [4]

(d) Researchers are developing methods to produce antibodies to give artificial passive immunity to influenza.

(i) Suggest the advantages **and** disadvantages of artificial passive immunity.

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..... [3]

(ii) State **two** ways in which mammals can acquire **natural** passive immunity to infectious diseases, such as influenza.

1 .....

2 .....

[2]

[Total: 14]

6 Fig. 6.1 is a diagram of the cell surface membrane of a squamous epithelial cell lining an alveolus.

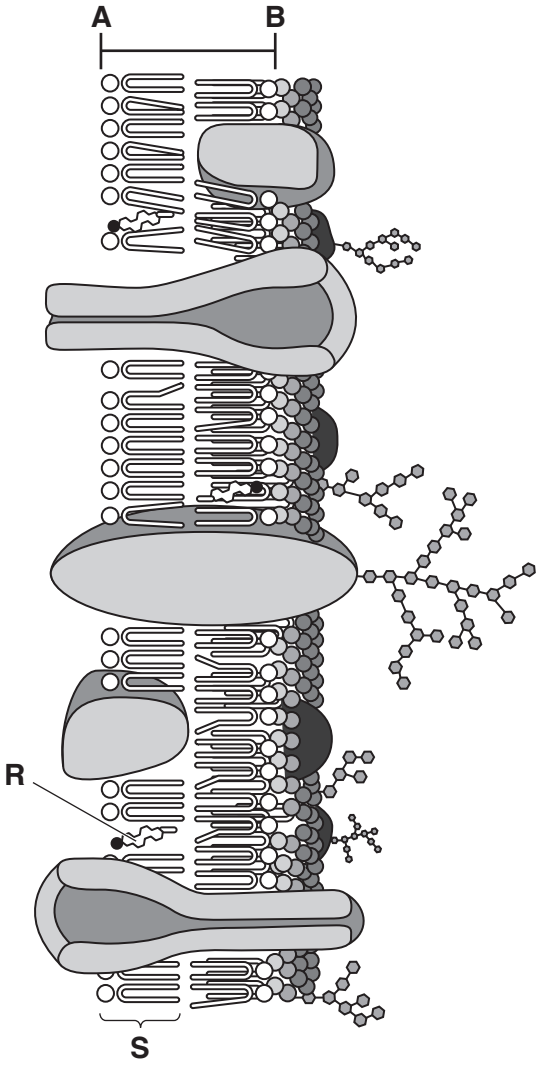

Fig. 6.1

(a) (i) A student measured the line **A**–**B** and calculated the actual width of the membrane in Fig. 6.1.

State the unit that the student should use for the actual width of the membrane.

..... [1]

(ii) With reference to Fig. 6.1, state how to identify the external surface of the cell surface membrane.

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..... [1]

(b) Name **R** and **S** in Fig. 6.1 **and** describe their roles in the membrane.

*component **R***

name .....

role .....

.....

*component **S***

name .....

role .....

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[4]

[Total: 6]

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