Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 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 shows the structure of the human gas exchange system.

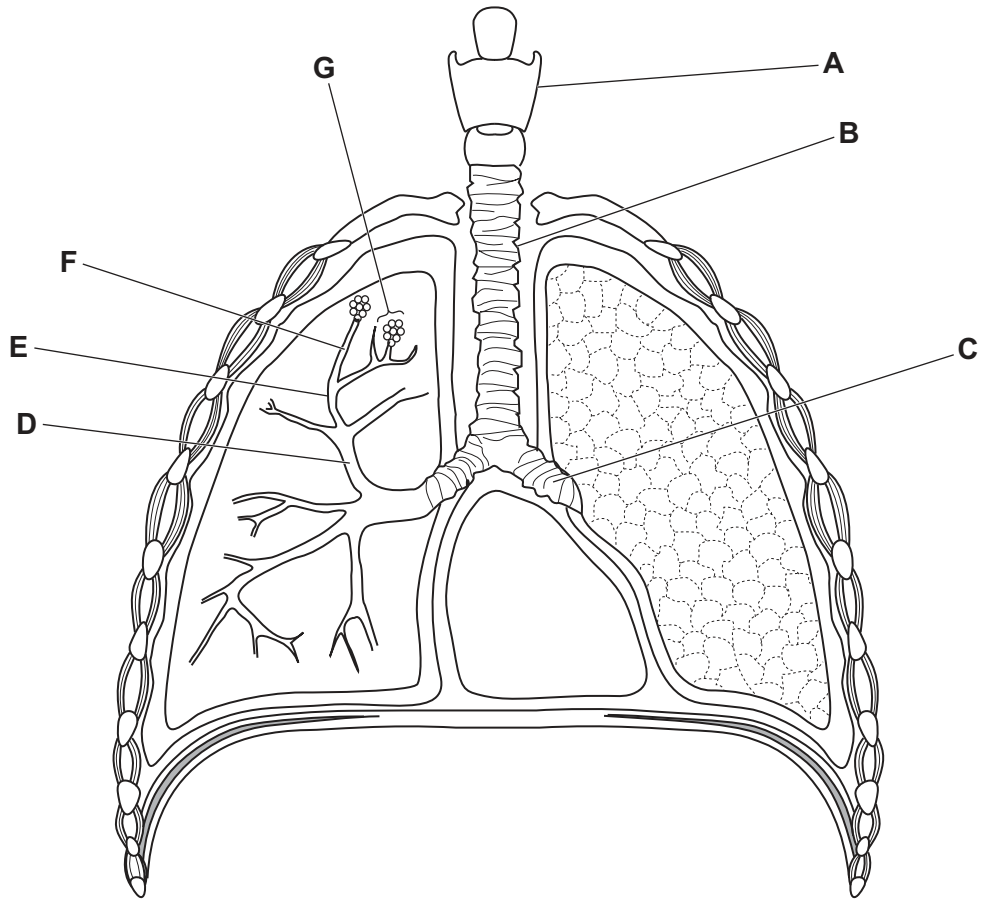

Fig. 1.1

(a) (i) Use the letters in Fig. 1.1 to identify the parts of the gas exchange system that contain cartilage.

..... [1]

(ii) Describe the role of cartilage in the gas exchange system.

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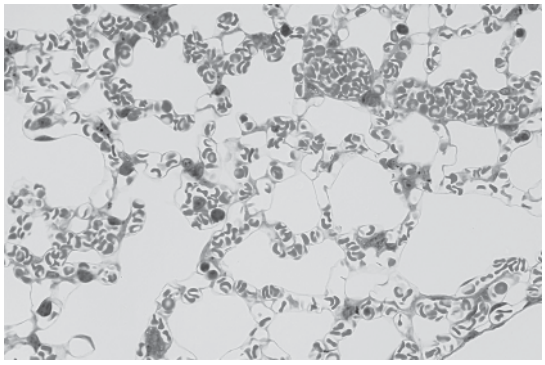
..... [2]

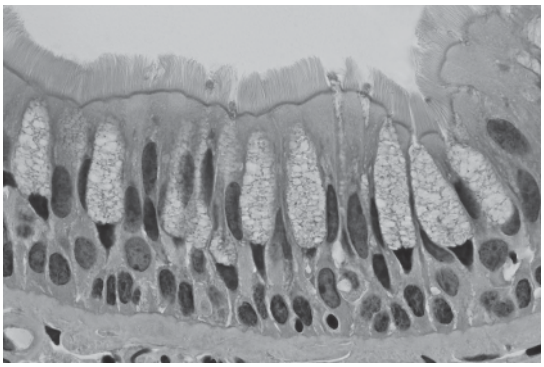
(iii) Microscope slides were prepared from two regions of the gas exchange system.

Fig. 1.2 and Fig. 1.3 are photomicrographs of the two slides.



×120

Fig. 1.2



×560

Fig. 1.3

Complete Table 1.1.

- Use the letters from Fig. 1.1 to identify the regions of the gas exchange system from which the two slides were prepared.
- Identify **one** feature visible in Fig. 1.2 **and one** feature visible in Fig. 1.3.
- State **one** way in which each feature relates to its function.

Table 1.1

Fig.	region of the gas exchange system (A, B, C, D, E, F or G)	one visible feature	one way in which the feature relates to its function
1.2			
1.3			

[4]

(b) There is a regular and efficient supply of blood from the heart to the lungs.

Describe the sequence of events that occurs in the heart to make sure that there is a regular and efficient supply of blood to the lungs.

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..... [5]

[Total: 12]

Question 2 starts on page 6

2 Stem cells are found throughout the human body. $Lgr5^+$ stem cells are found in the lining of the small intestine.

Fig. 2.1 is a flow chart showing stages in the development of one of the daughter cells produced by the mitotic division of an $Lgr5^+$ stem cell.

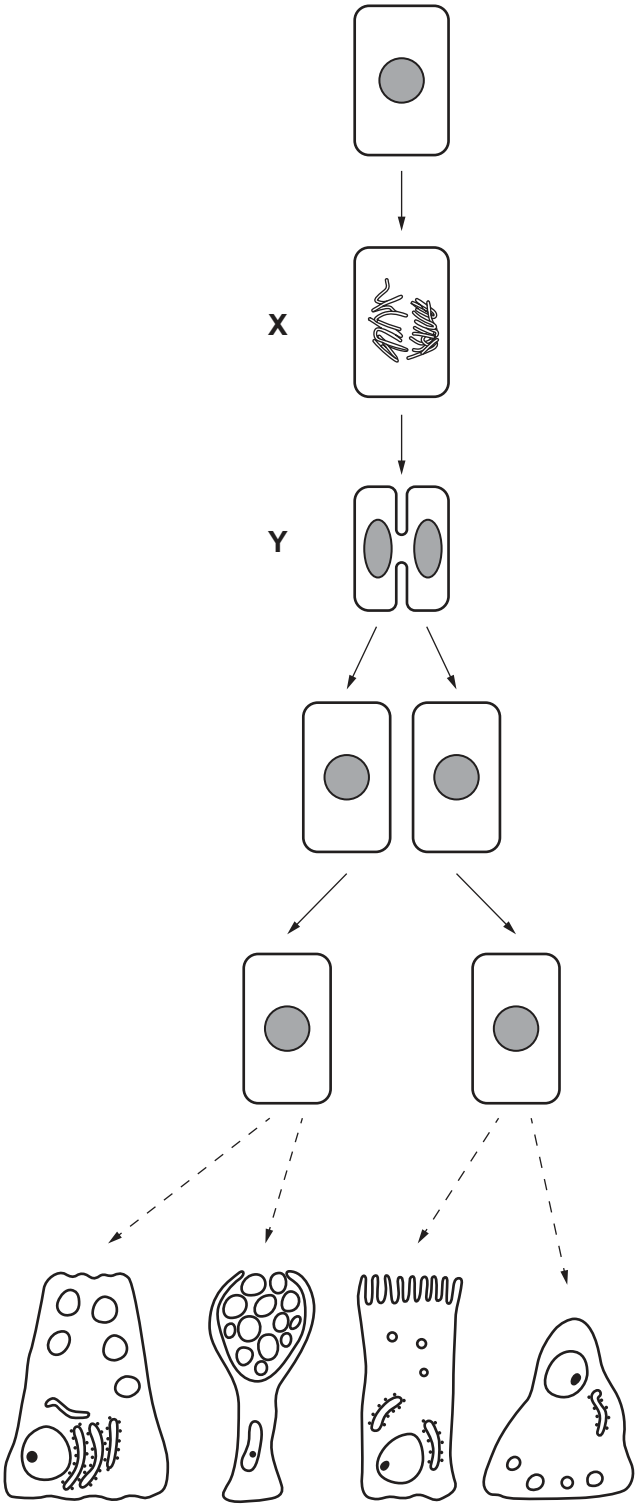

Fig. 2.1

(a) **(i)** Explain why stem cells are required in places such as the lining of the small intestine.

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..... [2]

(ii) Name the stage of mitosis shown in cell **X** in Fig. 2.1.

..... [1]

(iii) State the part of the cell cycle shown at **Y** in Fig. 2.1.

..... [1]

(b) Explain the role of centromeres in the cell cycle.

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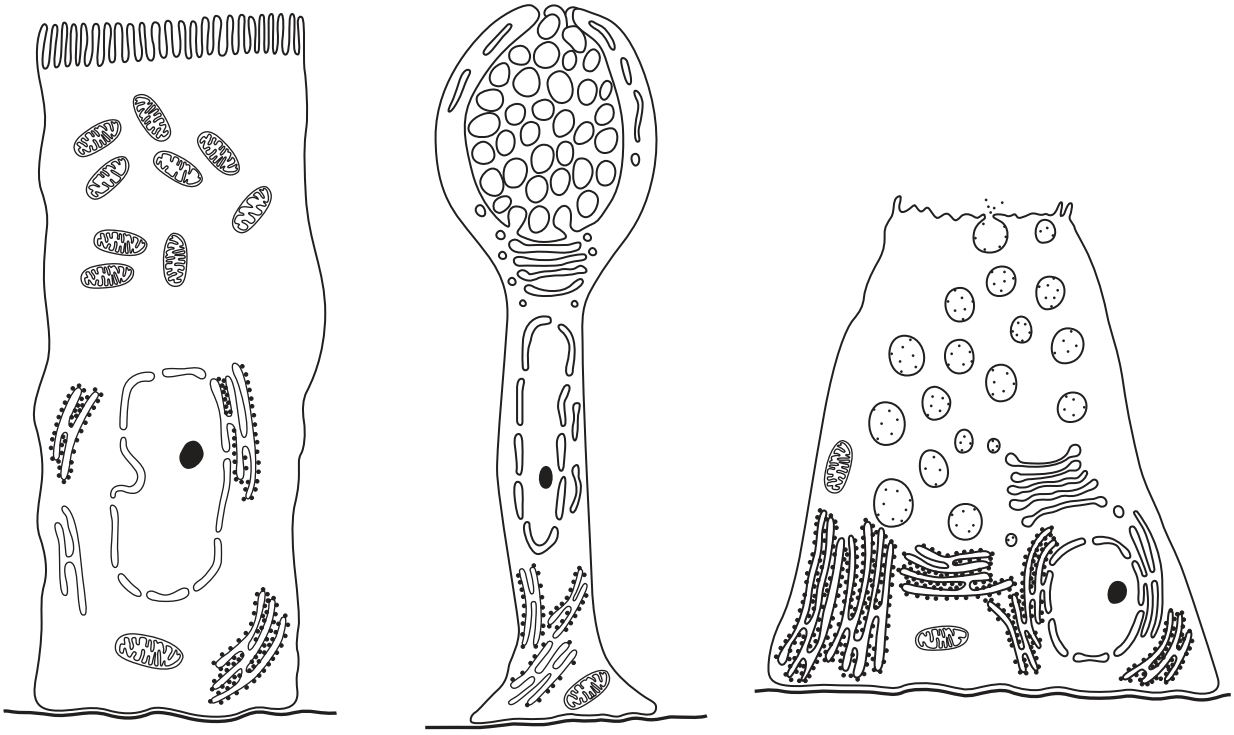
..... [2]

(c) Fig. 2.2 shows three types of specialised cell that develop from Lgr5^{+} stem cells in the small intestine.



P **Q** **R**

Fig. 2.2

The structural features of a cell indicate its likely function.

Suggest a function of each of the cells shown in Fig. 2.2, **and** explain how the structure of each cell supports your suggestion.

cell **P** function .....

explanation .....

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cell **Q** function .....

explanation .....

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cell **R** function .....

explanation .....

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[6]

[Total: 12]

3 The five bases found in nucleic acids are described as nitrogenous organic compounds. There are two types of base.

Fig. 3.1 shows the structure of the five bases.

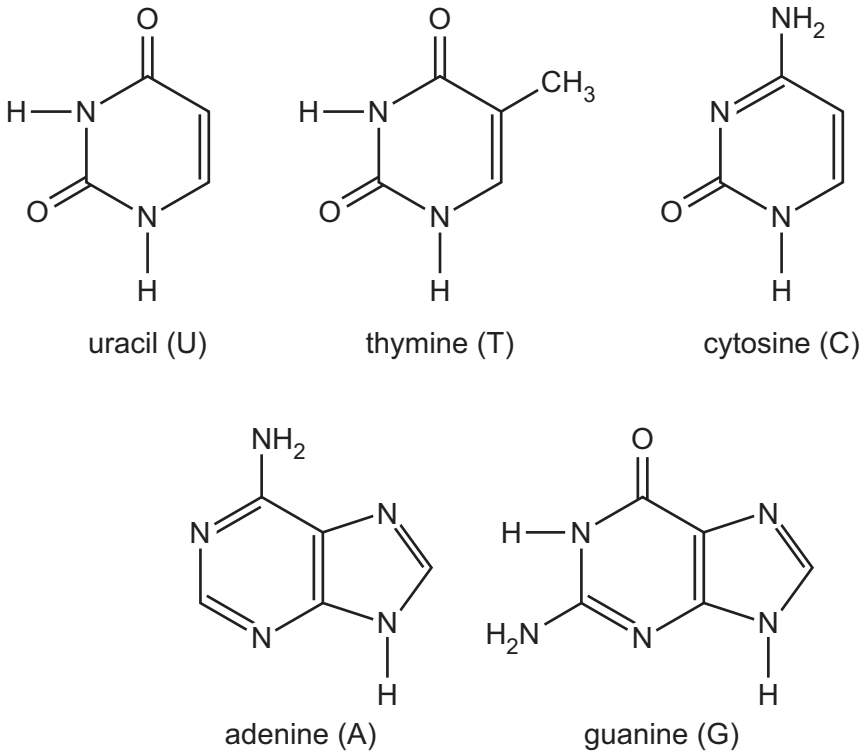

Fig. 3.1

(a) (i) State the name of the type of base that includes U, T and C.

..... [1]

(ii) State why it is **not** correct to say that all nucleic acids have five bases.

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..... [1]

(b) Fig. 3.2 shows a stage in the replication of DNA. The circled part is enlarged in Fig. 3.3 to show the elongation of the DNA strand that is being synthesised.

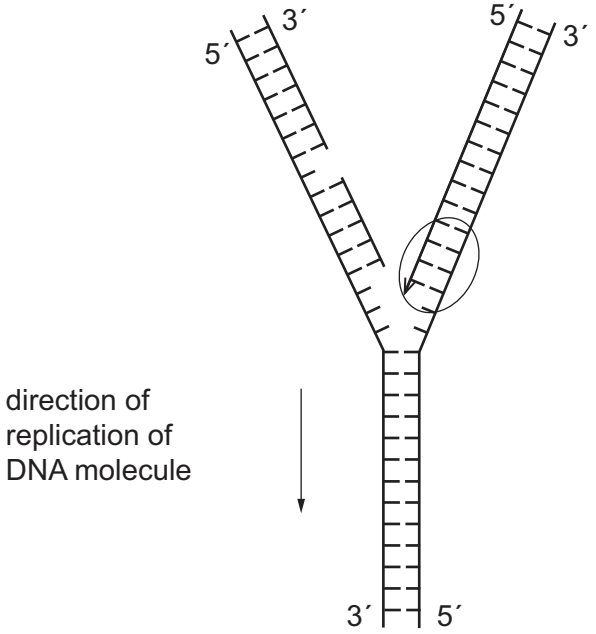

Fig. 3.2

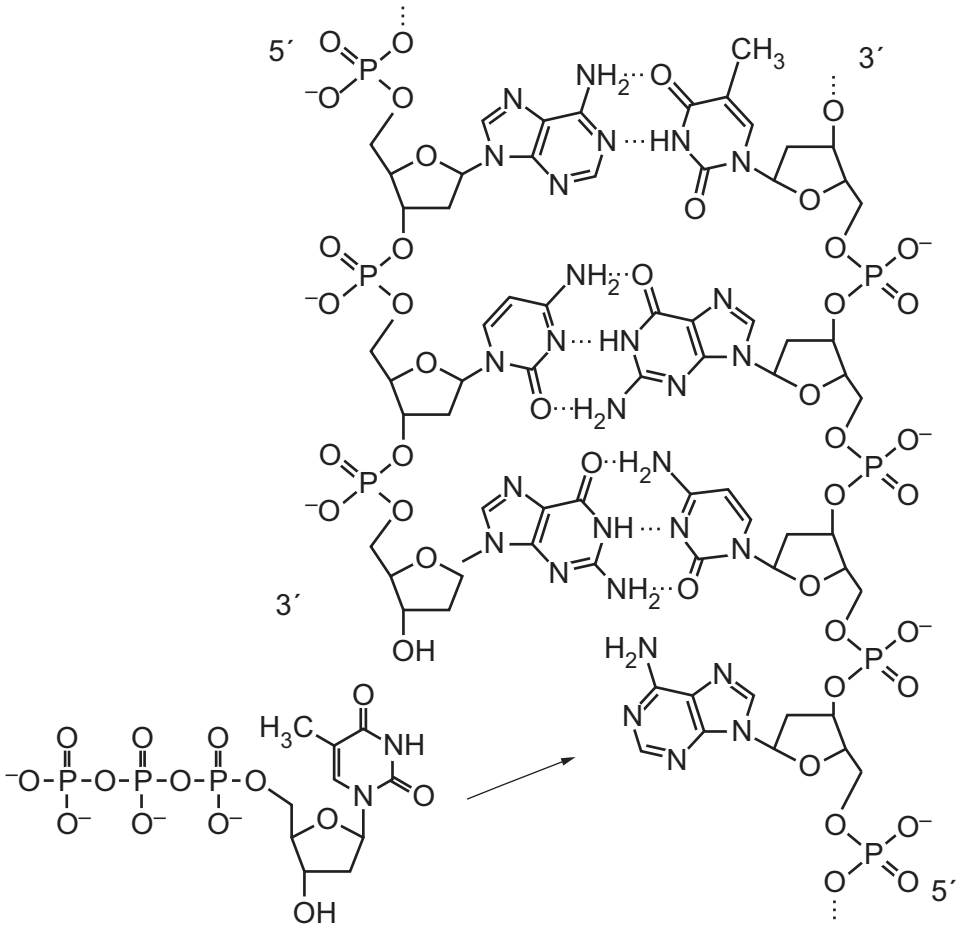

Fig. 3.3

Describe the sequence of events that occurs at the stage shown in Fig. 3.3 to extend the synthesised strand.

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..... [4]

(c) The two strands in a molecule of DNA are described as antiparallel.

With reference to Fig. 3.2 and Fig. 3.3, state what is meant by antiparallel, **and** explain how the antiparallel arrangement of the strands determines how new strands are synthesised.

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..... [3]

[Total: 9]

4 (a) Biofuels contain alcohols that are produced by the fermentation of sugars derived from crop waste. This waste contains cellulose and other organic compounds in cell walls.

Scientists investigated the production of sugars from crop waste for biofuel production. The scientists discovered that a strain of the fungus *Penicillium citrinum*, isolated from soil, was a good source of three different extracellular enzymes, **M**, **N** and **O**. These enzymes break down polysaccharides in cell walls.

The scientists cultured *P. citrinum* in a liquid medium containing cell wall material. Samples of the liquid were taken, and the three enzymes were separated from the medium. Each enzyme was placed in a reaction mixture with an appropriate substrate. The activity of each enzyme was determined to give a measurement of the quantity of enzyme produced by *P. citrinum*.

The results are shown in Table 4.1.

Table 4.1

enzyme	maximum activity / arbitrary units
M	292.83
N	111.72
O	6.54

Optimum conditions for each enzyme were used to obtain the results in Table 4.1. The conditions were different for each enzyme.

The scientists carried out further research so that a solution containing the three enzymes (enzyme mixture) could be used for the most efficient production of sugars from crop waste.

Suggest what the scientists needed to find out in their research.

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..... [4]

(b) Students investigated the composition of the cell wall of leaf cells of thale cress, *Arabidopsis thaliana*. The students began by isolating the cell wall components from the rest of the cell material.

The students used enzymes extracted from a fungal pathogen of *A. thaliana* to hydrolyse the cell wall components to smaller molecules.

The students prepared a reaction mixture containing the cell wall components and the enzymes.

After 24 hours, they separated and identified the smaller molecules found in the reaction mixture.

Four types of molecule were identified:

- short chains of β-glucose
- β-glucose
- peptides
- amino acids.

Explain the presence of these molecules in the reaction mixture after 24 hours of hydrolysis.

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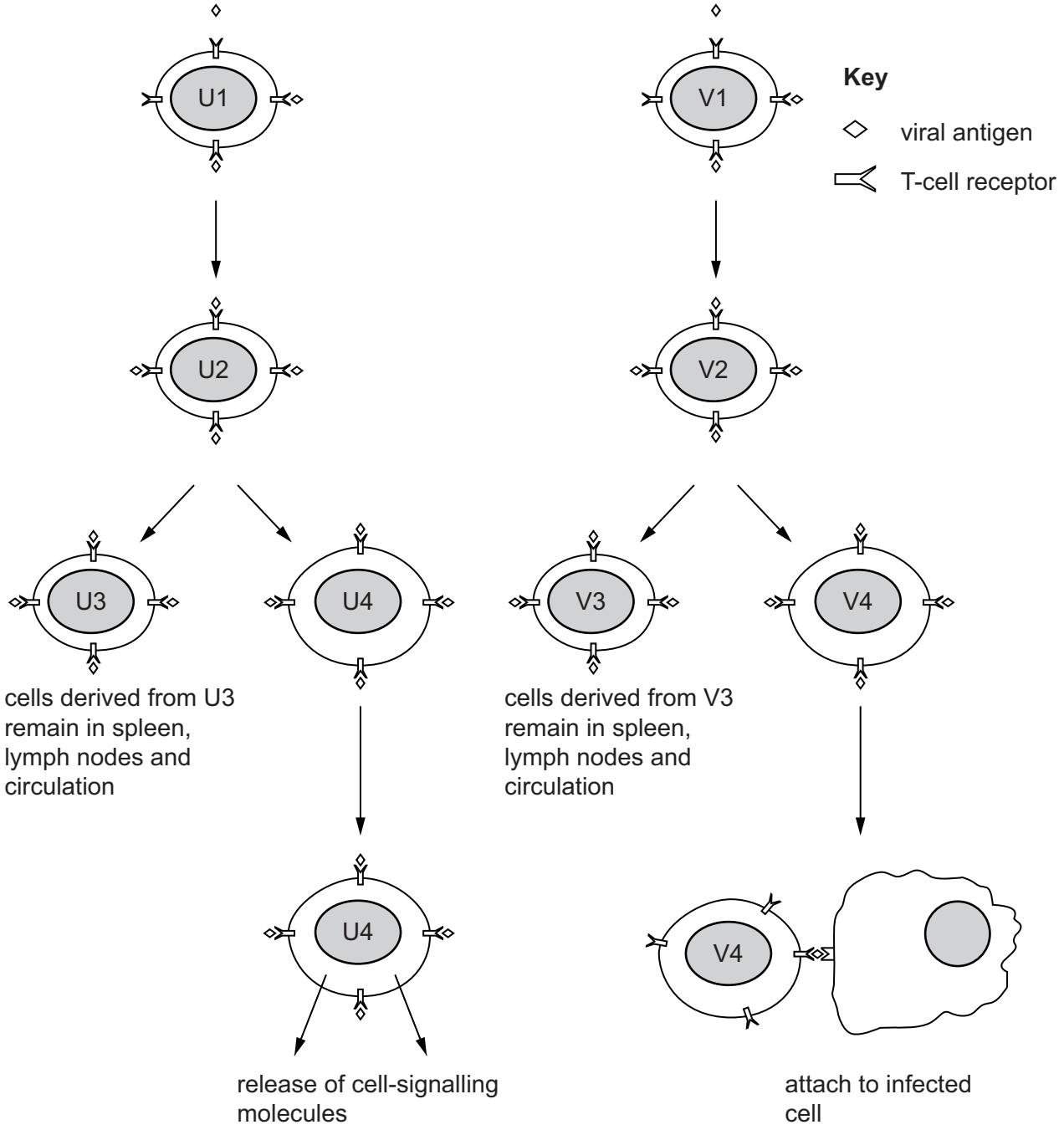
..... [4]

[Total: 8]

5 T-lymphocytes are produced in bone marrow and mature in the thymus gland.

When mature, T-lymphocytes leave the thymus gland to travel throughout the body. They remain inactive inside organs, such as the spleen and lymph nodes, until activated by the presence of antigens.

Fig. 5.1 shows what happens to two inactive T-lymphocytes, **U1** and **V1**, in the presence of an antigen from a virus.



Not to scale

Fig. 5.1

(a) **(i)** **U4** and **V4** are types of active T-lymphocyte. State the names given to these types of T-lymphocyte.

U4 .....

V4 .....

[1]

(ii) Describe the roles of cells **U4** and **V4** in a primary immune response.

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..... [4]

(b) Polio is a highly infectious viral disease. The virus infects the nervous system of humans. The disease can cause total paralysis within hours and can be fatal.

The Global Polio Eradication Initiative (GPEI) was started in 1988 by the World Health Organization. In 2022, polio had been successfully eradicated from most of the world. However, cases of the disease have been recorded in some countries.

Discuss the steps that must be taken by health authorities during a vaccination programme if an infectious disease, such as polio, is to be eradicated from the whole world.

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..... [4]

[Total: 9]

6 **(a)** A student constructed a table to compare the structural features of a plant cell, a prokaryotic cell and a virus.

Complete Table 6.1.

Table 6.1

feature	plant cell	prokaryotic cell	virus
external structure	cell wall composed of cellulose	cell wall composed of ……..	capsid composed of ……
size of ribosomes	80S and 70S	……..	no ribosomes
nucleic acids	DNA and RNA	DNA and RNA	……..

[4]

(b) The cholera bacterium releases a protein toxin called choleragen. The toxin causes the loss of chloride ions and water from epithelial cells into the lumen of the intestine.

Fig. 6.1 shows the events that occur in cells lining the intestine when choleragen binds to the membrane of one of these cells.

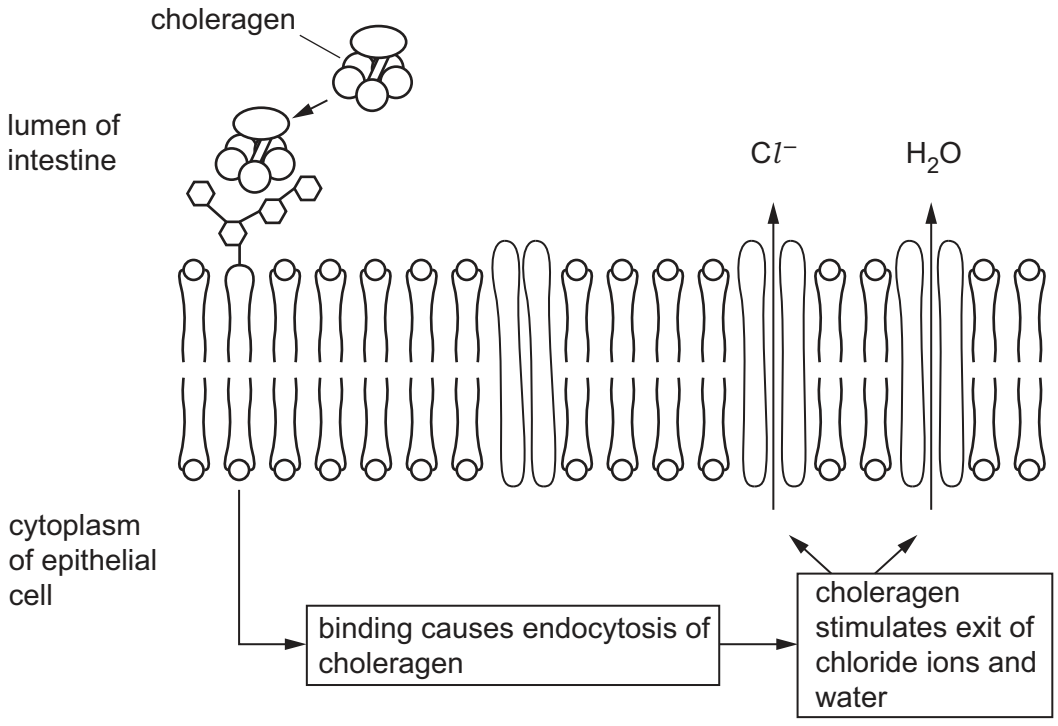

Fig. 6.1

(i) State **one** likely source of an outbreak of cholera.

..... [1]

(ii) With reference to Fig. 6.1, state why choleragen molecules are described as having quaternary structure.

..... [1]

(iii) State the type of cell membrane component that forms the receptor for choleragen.

..... [1]

(iv) The process by which chloride ions leave the epithelial cell requires energy.

Name the phosphorylated nucleotide that is needed for this process.

..... [1]

(v) Explain why water also moves from epithelial cells into the lumen of the intestine when choleragen is present.

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..... [2]

[Total: 10]

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