Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1531906350

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 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.

1 **(a)** Fig. 1.1 is a diagram representing part of the phospholipid bilayer of a cell surface membrane.

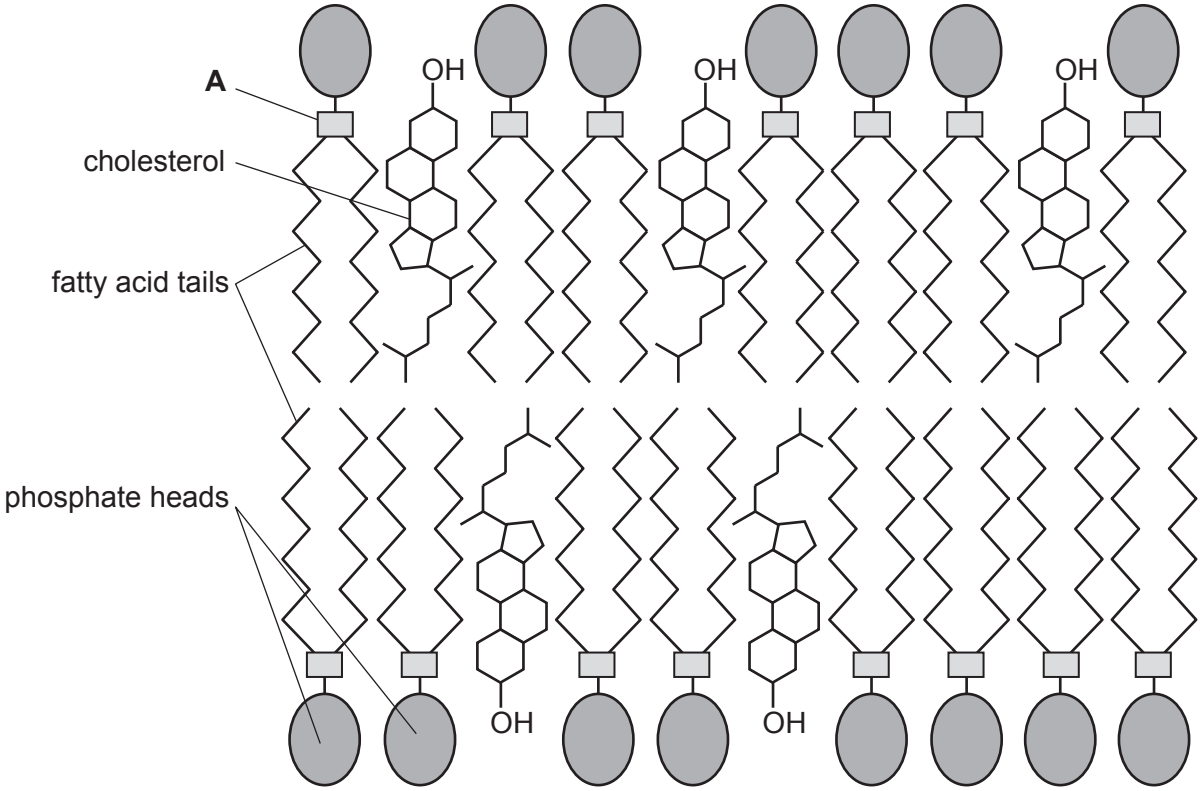

Fig. 1.1

(i) Identify the part of a phospholipid molecule, labelled **A** in Fig. 1.1, that forms bonds with the phosphate heads and with the fatty acid tails.

..... [1]

(ii) Cholesterol is an important lipid component of many cell surface membranes. Fig. 1.2 shows the structure of a cholesterol molecule.

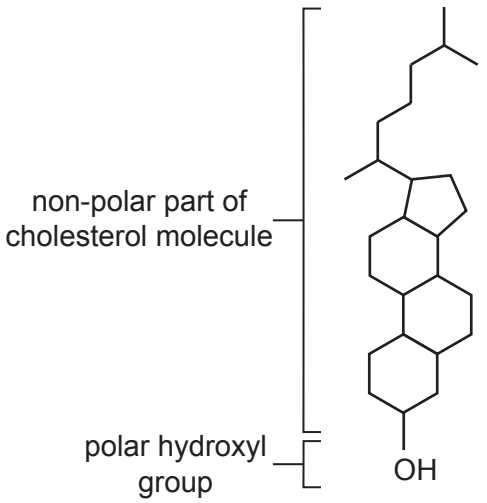

Fig. 1.2

Using the information in Fig. 1.2, explain the orientation (positioning) of cholesterol molecules in the phospholipid bilayer, as shown in Fig. 1.1.

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..... [1]

(iii) State **one** role of cholesterol in phospholipid bilayers.

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..... [1]

(b) (i) Explain why sodium ions **cannot** cross phospholipid bilayers by simple diffusion.

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..... [1]

(ii) Ions and some molecules move across cell surface membranes by facilitated diffusion and active transport.

Compare facilitated diffusion and active transport by stating **one** way in which they are similar and **two** ways in which facilitated diffusion is different from active transport.

similarity .....

.....

difference 1 .....

.....

.....

difference 2 .....

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.....

[3]

(c) Prostaglandins are small lipids produced in many tissues of the body. One role of prostaglandins is to cause inflammation at the site of an injury or infection. Inflammation is the normal first response of the immune system to injury or infection.

Cyclooxygenase (COX) is an enzyme that catalyses one of the steps in the reaction pathway for the formation of prostaglandins from phospholipids. The reaction pathway occurs in the smooth endoplasmic reticulum (SER) of cells. Part of the reaction pathway is shown in Fig. 1.3.

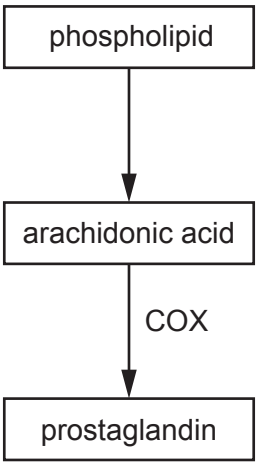

Fig. 1.3

(i) Suggest an advantage for this reaction pathway occurring in the smooth endoplasmic reticulum of a cell rather than in the cytoplasm.

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..... [1]

(ii) Sometimes inflammation can have side-effects, such as pain. Aspirin is a drug that can be used to reduce these side-effects.

Aspirin reduces the catalytic activity of the COX enzyme by modifying the R-group of one of the amino acids.

Suggest how modifying the R-group of an amino acid in the COX enzyme can reduce the catalytic activity of the enzyme.

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..... [3]

(iii) Prostaglandins are examples of cell-signalling molecules.

Outline the process of cell signalling that leads to a response by the cells involved in inflammation.

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..... [2]

[Total: 13]

2 **(a)** Table 2.1 shows descriptions of three types of white blood cell.

Complete Table 2.1 by stating the names of these three types of white blood cell.

Table 2.1

description	name of white blood cell
A large cell that has a bean-shaped (kidney-shaped) nucleus. It can develop into a macrophage.	
A cell that has a large spherical nucleus and little cytoplasm. It responds to non-self antigens.	
A cell that has a lobed nucleus. It is phagocytic.	

[3]

(b) Dromedary camels are classified in the family Camelidae and live in desert habitats of North Africa and Asia. In these hot, dry environments, dromedary camels can lose up to 30% of their body mass from dehydration, causing their blood to become more viscous (thicker).

Fig. 2.1 shows a drawing of red blood cells of a dromedary camel. Fig. 2.2 is a drawing of human red blood cells.

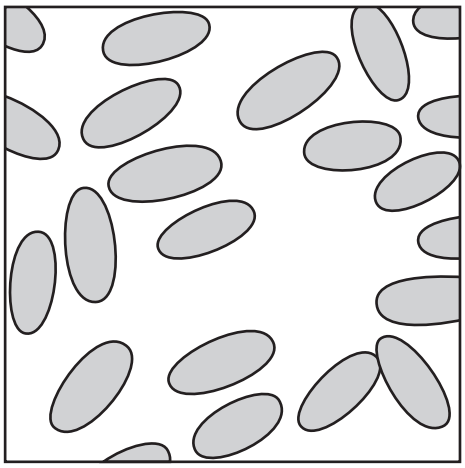

Fig. 2.1

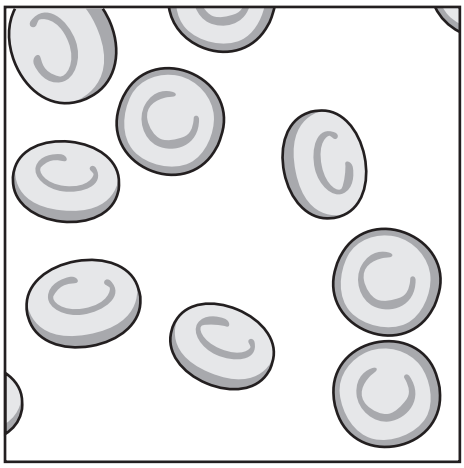

Fig. 2.2

Fig. 2.1 and Fig. 2.2 show differences between the red blood cells of dromedary camels and the red blood cells of humans.

Suggest how these differences adapt dromedary camels for living in hot, dry environments.

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..... [3]

(c) The llama is also classified in the family Camelidae. Llamas live in mountainous areas of South America, often at altitudes of 3500 m or higher. As the altitude above sea level increases, the air pressure decreases.

The partial pressure of oxygen in the lungs of mammals at 3500 m is 6.4 kPa.

Fig. 2.3 shows the oxygen dissociation curve of adult human haemoglobin and adult llama haemoglobin.

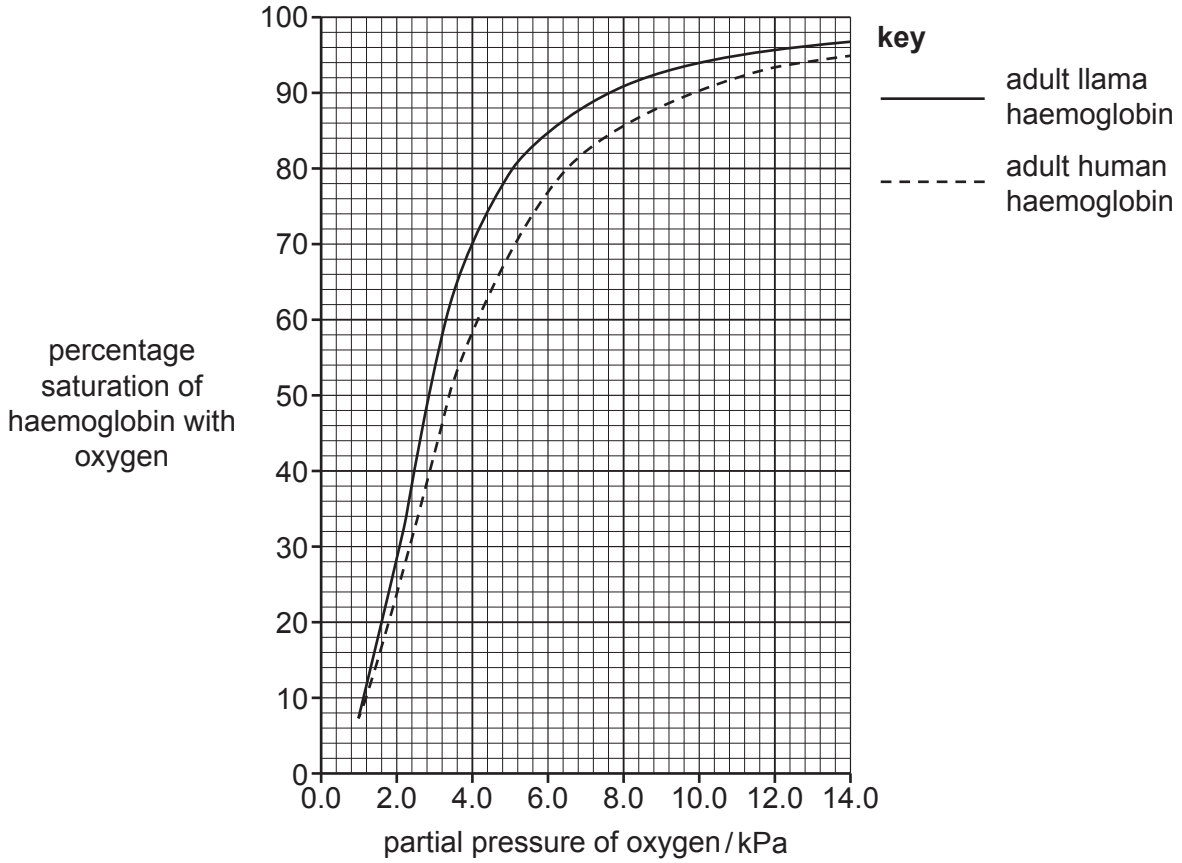

Fig. 2.3

(i) With reference to Fig. 2.3, explain how the differences between the oxygen dissociation curves for humans and llamas show that llamas are better adapted for living at high altitudes than humans.

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..... [3]

(ii) Sketch a curve on Fig. 2.3 to show the effect of an increased carbon dioxide concentration on the percentage saturation of adult **human** haemoglobin with oxygen. [1]

(iii) Explain the importance of the Bohr shift in metabolically active organs, such as the liver.

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..... [3]

[Total: 13]

3 **(a)** Fig. 3.1 is a photomicrograph showing part of a transverse section through the root of an iris, *Iris germanica*. Irises are herbaceous monocotyledons. These plants have the same transport tissues as herbaceous dicotyledons, but the transport tissues are distributed differently. In monocotyledons, the central tissue in the root is parenchyma (packing tissue).

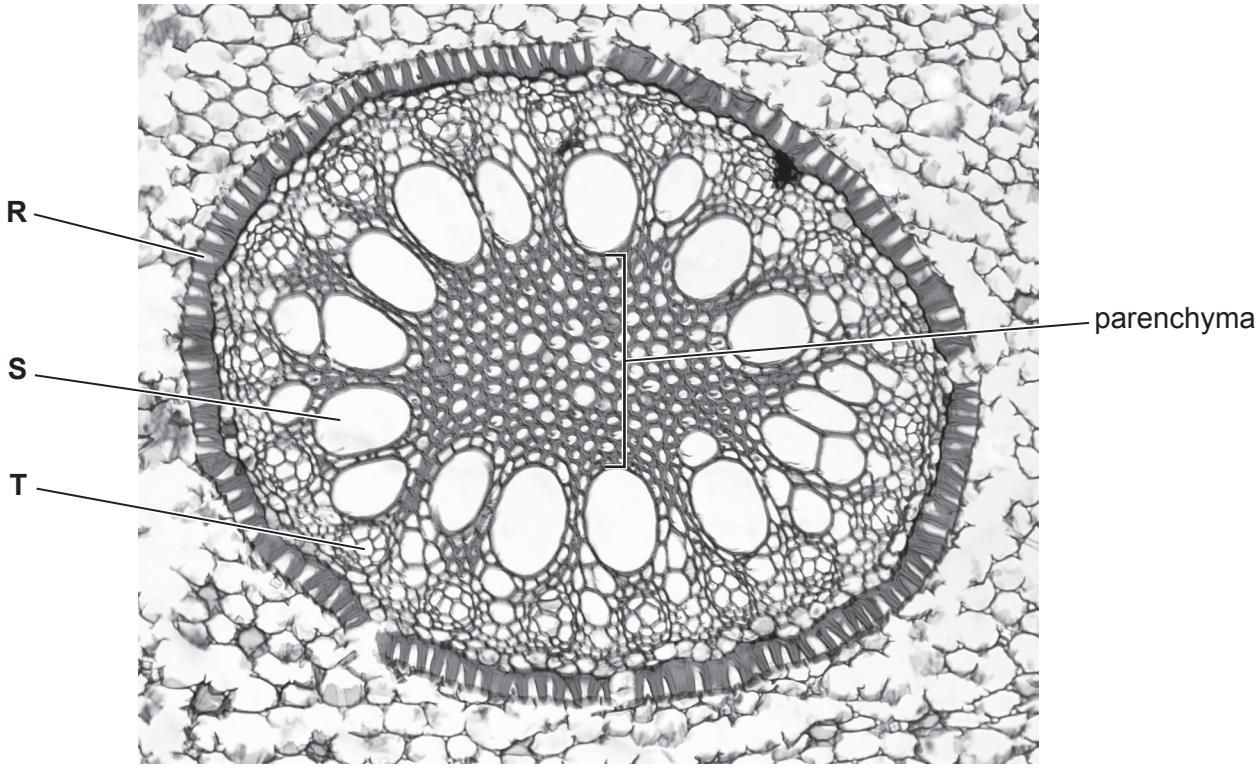

Fig. 3.1

(i) Cells **R**, **S** and **T** in Fig. 3.1 are found in different tissues.

Name the tissues in which the cells labelled **R**, **S** and **T** are found.

tissue in which cell **R** is found .....

tissue in which cell **S** is found .....

tissue in which cell **T** is found .....

[3]

(ii) Outline the role of the tissue in which cell **R** is found in Fig. 3.1.

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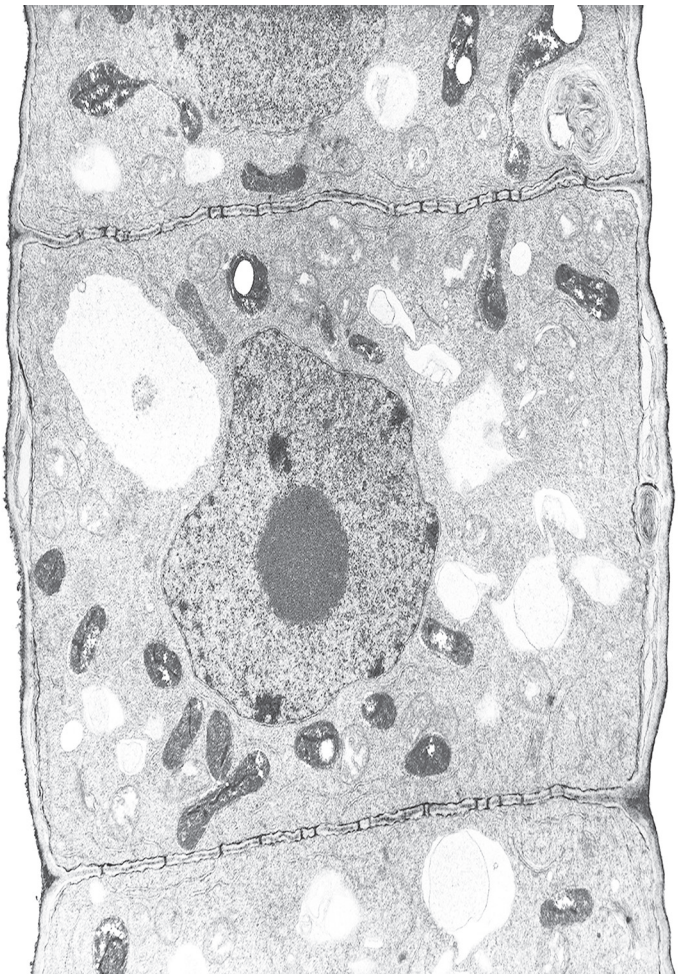
..... [2]

(iii) State an example of an organic compound that is translocated in the root of an iris.

..... [1]

(b) The electron micrograph in Fig. 3.2 shows a section through some root cells in an onion, *Allium cepa*.



×6250

Fig. 3.2

On Fig. 3.2, draw a label line and label it with the letter **P** to identify **one** plasmodesma. [1]

(c) Table 3.1 contains information about four polysaccharides found in animals or plants.

Complete Table 3.1 by filling in the missing information.

Table 3.1

polysaccharide	monomer	glycosidic bond(s)	function
amylopectin	α-glucose	1,4 and 1,6	energy storage in plants
amylose		1,4	energy storage in plants
cellulose	β-glucose		structural role in plant cell walls
glycogen	α-glucose	1,4 and 1,6	

[3]

[Total: 10]

Question 4 starts on page 14.

4 **(a)** Table 4.1 shows a sequence of 12 nucleotides in the template strand of a short length of a DNA molecule, the corresponding primary transcript and the four amino acids coded for by the sequence. The table is incomplete.

(i) Complete Table 4.1 to show the sequence of nucleotides in the primary transcript that would result from transcription of this short length of DNA.

Table 4.1

position of nucleotide	1	2	3	4	5	6	7	8	9	10	11	12
DNA template strand	C	A	C	T	A	C	T	C	C	A	A	C
primary transcript												
amino acid	aa1			aa2			aa3			aa4		

[1]

(ii) Table 4.2 shows all the possible template strand DNA triplets that code for the amino acids labelled aa1, aa2, aa3 and aa4 in Table 4.1.

Table 4.2

amino acid	DNA triplets
val	CAA, CAG, CAT, CAC
arg	GCA, GCG, GCT, GCC, TCT, TCC
met	TAC
leu	AAT, AAC, GAA, GAG, GAT, GAC

Complete Table 4.3 to identify the four amino acids labelled aa1, aa2, aa3 and aa4 in Table 4.1.

Table 4.3

	aa1	**aa2**	**aa3**	**aa4**
amino acid				

[1]

(iii) One type of gene mutation is caused by the substitution of a DNA nucleotide.

Using the information in Table 4.2, state **and** explain the effect on the final protein structure of a substitution of the nucleotide at position 3 in Table 4.1.

.....

.....

.....

.....

..... [2]

(iv) A second type of gene mutation is caused by the deletion of a DNA nucleotide.

Using the information in Table 4.2, state **and** explain the effect on the final protein structure of a deletion of the nucleotide at position 3 in Table 4.1.

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..... [3]

(b) Replication of nuclear DNA occurs just once in every mitotic cell cycle. Six named events associated with the mitotic cell cycle are listed. The events are **not** listed in any particular order.

Draw a circle around each event where replication of nuclear DNA occurs.

cytokinesis

interphase S phase

G_2 phase G_1 phase

mitosis

[1]

(c) Outline how DNA is replicated inside the nucleus.

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..... [4]

(d) Fig. 4.1 shows the structure of an ATP molecule.

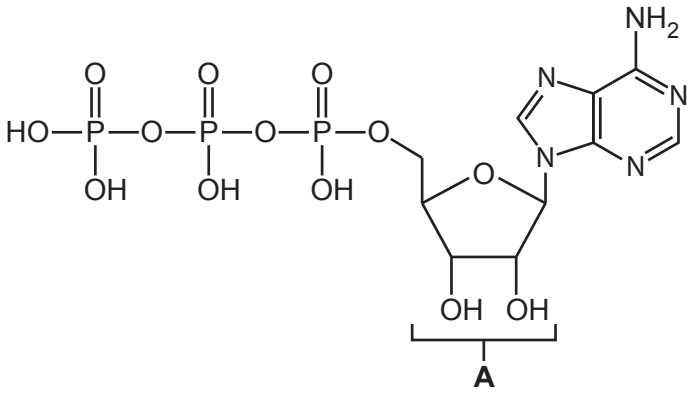

Fig. 4.1

State the name of the part of the ATP molecule labelled **A** in Fig. 4.1.

..... [1]

[Total: 13]

5 The pathogen that causes cholera is a prokaryote.

(a) Fig. 5.1 shows an electron micrograph of the pathogen that causes cholera.

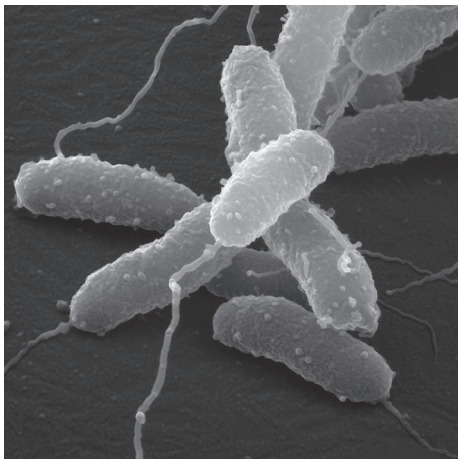

Fig. 5.1

(i) Name the type of electron microscope used to produce the image shown in Fig. 5.1.

..... [1]

(ii) Name the species of prokaryote that causes cholera.

..... [1]

(b) The passage contains a description of the main features of prokaryotic cells. There is **one** factual error in the passage.

Prokaryotic cells are unicellular and generally between 1 μm and 5 μm in diameter. Prokaryotes do **not** have organelles surrounded by double membranes. They do have cell surface membranes, 70S ribosomes and a cellulose cell wall. The DNA of a prokaryotic cell is circular and is found free in the cytoplasm rather than enclosed in a nuclear envelope.

Identify **and** correct the factual error in the passage.

.....

..... [1]

[Total: 3]

6 Fig. 6.1 is a simplified diagram representing a section through the human immunodeficiency virus (HIV) particle that causes HIV/AIDS. The diagram shows the virus particle about to attach to the cell surface membrane of a T-helper cell at a receptor protein called CD4. A second protein (coreceptor) called CCR5 is also necessary for the virus particle to enter and then infect the T-helper cell.

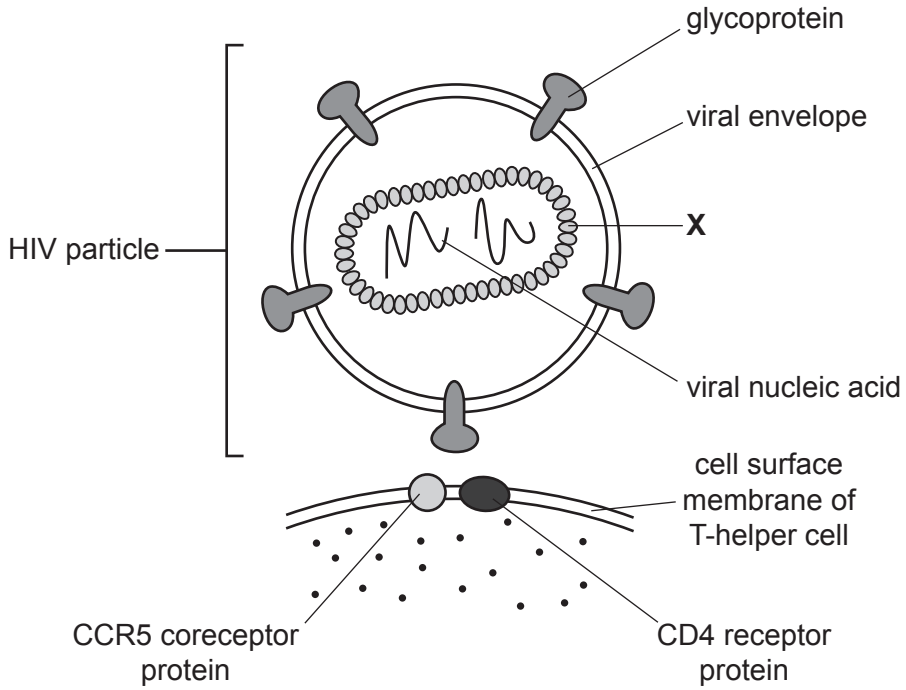

Fig. 6.1

(a) Identify structure **X** in Fig. 6.1.

..... [1]

(b) Explain how the ability of the immune system to resist the damaging effects of a pathogen is affected by destruction of T-helper cells.

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..... [3]

(c) Studies have shown that some individuals did **not** become infected with HIV even though they were repeatedly exposed to the virus. Later discoveries indicated that these individuals had a mutation in the gene for the CCR5 coreceptor protein.

Suggest how mutation of the gene for the CCR5 coreceptor protein provided protection against HIV infection.

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..... [1]

(d) The use of monoclonal antibodies against the CCR5 coreceptor protein (anti-CCR5) has been shown to be effective in the treatment of HIV infection.

Outline how anti-CCR5 monoclonal antibodies can be synthesised in the laboratory using the hybridoma method.

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..... [3]

[Total: 8]

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