Cambridge Assessment International Education

Cambridge International AS & A Level

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BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2022**

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.

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1 **(a)** Fig. 1.1 is a transmission electron micrograph showing a section of a human liver cell.

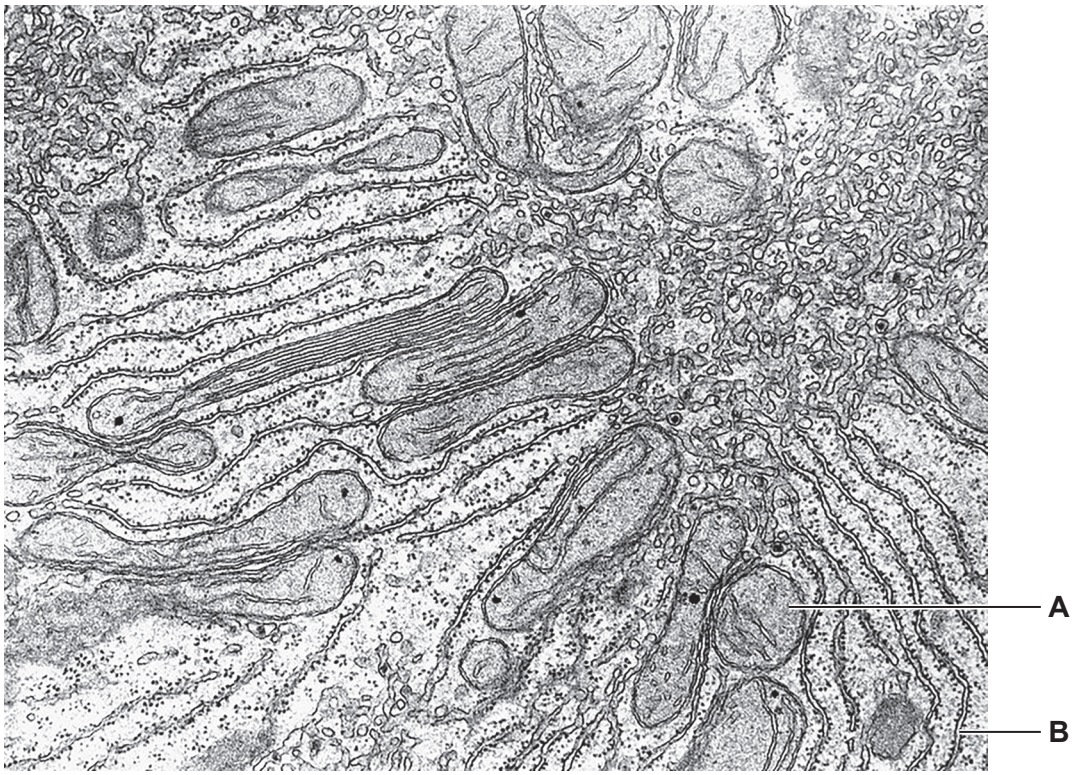


Fig. 1.1

(i) Name organelles **A** and **B** shown in Fig. 1.1.

A .....

B .....
[2]

(ii) In liver cells, enzymes are attached to the membrane of smooth endoplasmic reticulum.

With reference to the functions of smooth endoplasmic reticulum, suggest the advantages of having enzymes attached to the membrane rather than free in the lumen.

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..... [3]

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(b) Explain the advantages of using a transmission electron microscope compared with a light microscope when viewing a liver cell.

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..... [3]

[Total: 8]

2 Fig. 2.1 is a simplified diagram of the human circulatory system.

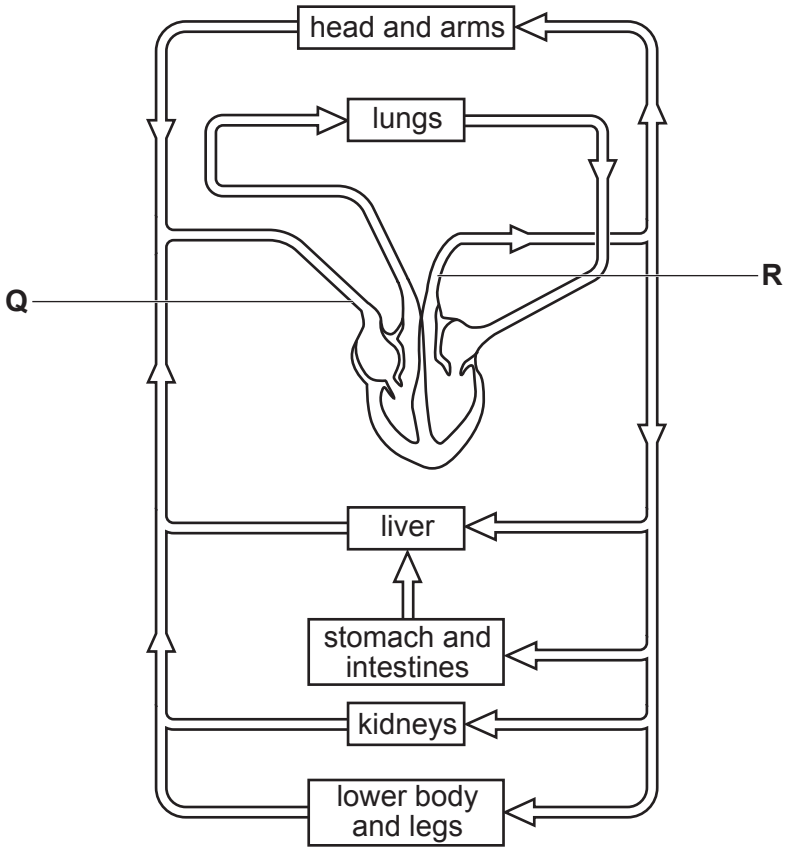


Fig. 2.1

(a) (i) State why the human circulatory system is described as a closed, double circulation.

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..... [2]

(ii) Identify blood vessel **Q** and blood vessel **R**, shown in Fig. 2.1.

Q .....

R .....

[1]

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(iii) Blood leaving the heart passes through valves before it enters blood vessel **R**.

Describe the differences between the structure of blood vessel **Q** and the structure of blood vessel **R**. Do **not** refer to valves in your answer.

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..... [3]

(b) Blood plasma plays an important role in the transport of molecules such as antibodies.

Scientists discovered that some of the antibodies in the blood plasma of sharks have a different structure to the antibodies found in human blood plasma.

Fig. 2.2 shows the structure of an antibody molecule found in the blood plasma of a shark.

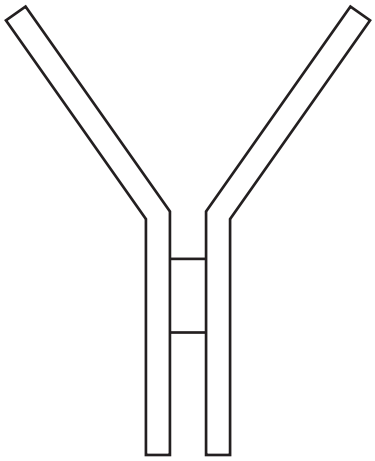


Fig. 2.2

(i) State how the quaternary structure of a human antibody molecule differs from the quaternary structure of the shark antibody molecule shown in Fig. 2.2.

.....

.....

..... [1]

(ii) Human antibodies are used in the treatment of some forms of cancer. However, the antibodies injected into the bloodstream can only reach a small percentage of the cancer cells that form the cancerous tumour.

Shark antibodies are smaller than human antibodies. Scientists are researching the possibility of injecting shark antibodies into the bloodstream to treat cancerous tumours in humans.

Suggest how using the smaller shark antibodies may be more effective in reaching a greater percentage of cancer cells than human antibodies and lead to greater success at treating cancer.

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..... [2]

(iii) Antibodies can also be used in the prevention of infectious diseases.

Explain how injection of antibodies into the bloodstream can protect a person from disease after infection by a pathogen.

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..... [3]

[Total: 12]

3 Carbonic anhydrase is a globular protein found in red blood cells.

(a) (i) Explain why this protein is described as globular.

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..... [2]

(ii) State the function of carbonic anhydrase in red blood cells.

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..... [2]

(b) A protein such as carbonic anhydrase is coded for by a gene. A gene forms part of a DNA molecule.

Fig. 3.1 is a diagram of a small section of a DNA molecule.

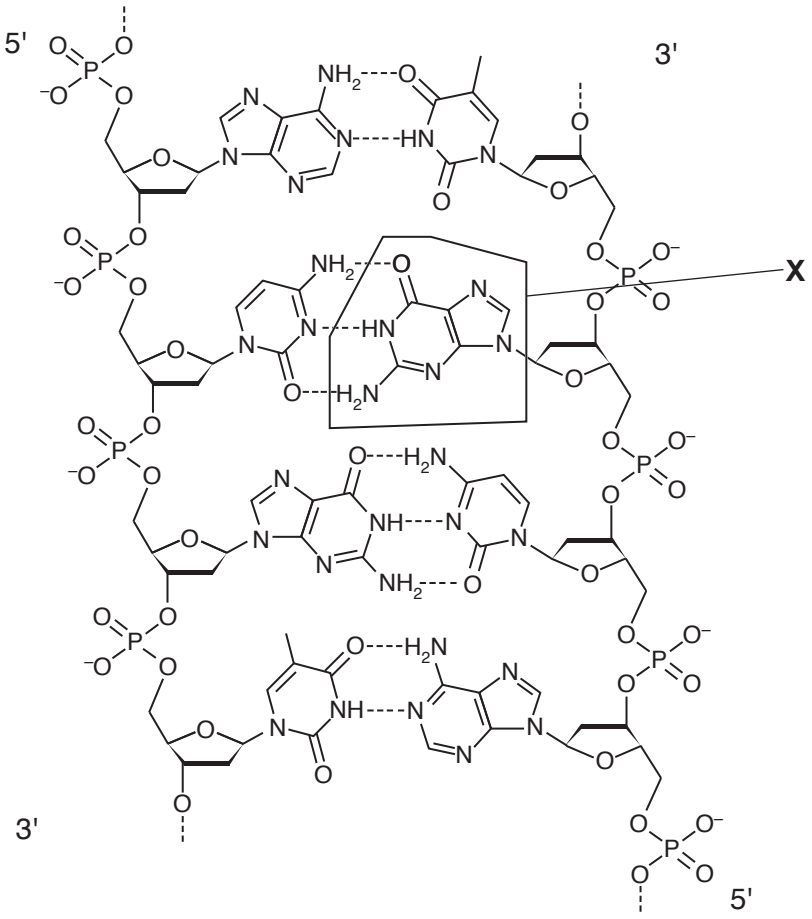


Fig. 3.1

(i) Identify the base **X and** state the evidence in Fig. 3.1 that supports this identification.

base **X** .....

evidence from Fig. 3.1 .....

.....

.....

.....

.....

[3]

(ii) The section of the DNA molecule in Fig. 3.1 is part of a gene coding for a polypeptide.

Base **X**, shown in Fig. 3.1, is located in an exon on the strand of DNA that is transcribed during protein synthesis. A mutation that results in the deletion of base **X** will affect the polypeptide produced.

Explain how this deletion may affect the polypeptide produced during protein synthesis.

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..... [4]

(iii) Gene mutations can occur in either introns or exons.

Suggest the effect of a gene mutation in an intron.

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..... [1]

[Total: 12]

4 **(a)** Scientists have produced structures known as virosomes, which are used in certain vaccines. Virosomes do **not** cause disease.

Fig. 4.1 is a diagram of a section through a virosome used in some vaccinations to protect against the virus which causes influenza.

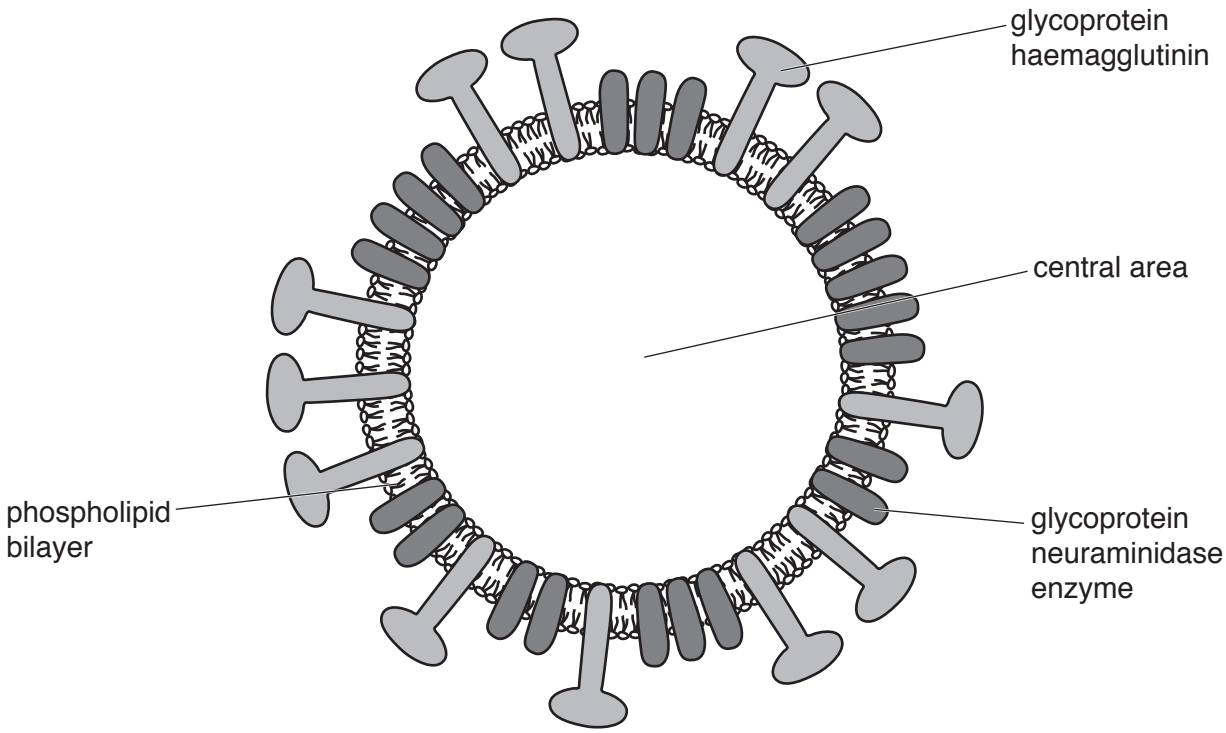


Fig. 4.1

(i) State the differences between the structure of a virosome and a virus.

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..... [2]

(ii) Explain how the structure of the virosome shown in Fig. 4.1 suggests that the central area of the virosome is aqueous.

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..... [2]

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(b) The glycoproteins haemagglutinin and neuraminidase are found in the influenza virus and in the virosomes used in a vaccine against the influenza virus.

Haemagglutinin binds to a receptor in the cell surface membrane of phagocytes.

Suggest why haemagglutinin is present in virosomes used in the vaccine for influenza.

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..... [2]

(c) Different strains of the influenza virus have formed as a result of mutations. Each strain of the virus contains the enzyme neuraminidase. Neuraminidase helps the virus to leave host cells after the virus has replicated. In each strain of the influenza virus, the primary structure of the active site of the neuraminidase enzyme remains unchanged.

Suggest why the primary structure of the active site of neuraminidase remains unchanged in each strain of the influenza virus.

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..... [2]

[Total: 8]

5 **(a)** When water molecules enter a plant through the roots, the molecules cross the cortex and enter the xylem tissue to be transported to other parts of the plant.

There are two pathways that water can take when crossing the root to the xylem tissue.

Complete Table 5.1 with information about the two pathways.

Table 5.1

name of pathway	outline of pathway
	movement of water from cell to cell through plasmodesmata

[2]

(b) Fig. 5.1 is a photomicrograph of a transverse section through the stem of a flowering plant.

On Fig. 5.1, draw a label line and the letter **T** to identify xylem tissue. [1]

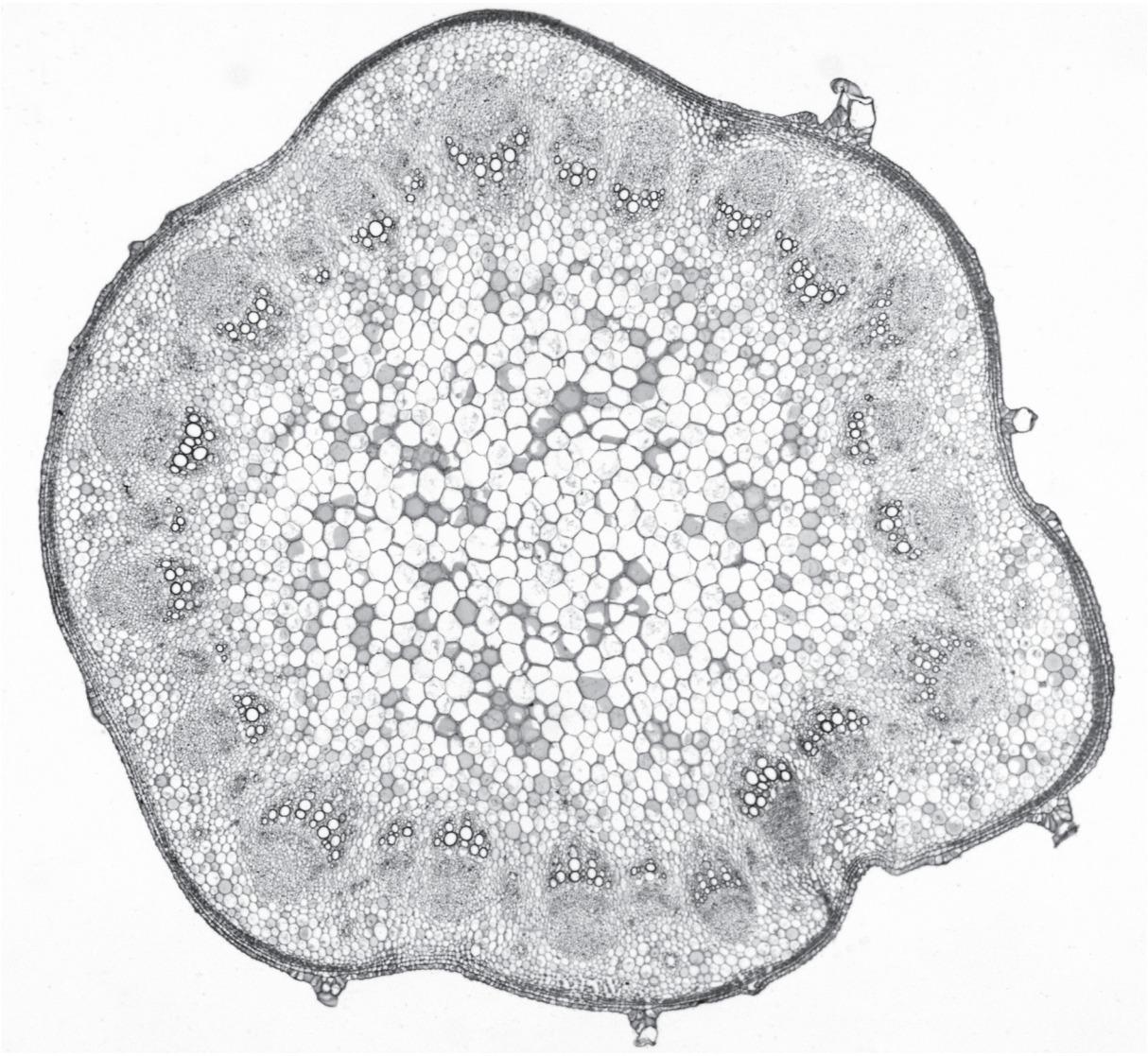


Fig. 5.1

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(c) Scientists have studied the process of cell death that occurs during the development of the cells that become mature xylem vessel elements.

During this development, the tonoplast ruptures (bursts) and releases hydrolytic enzymes contained in the vacuole into the cytoplasm.

(i) Name an organelle found in animal cells that has a similar function to the vacuole in the developing xylem vessel elements.

..... [1]

(ii) The rupture of the tonoplast during development of xylem vessel elements is due to changes in permeability of the tonoplast.

Suggest how the permeability of the tonoplast changes **and** explain how this change could result in the rupture of the tonoplast.

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..... [3]

(iii) During development of the xylem vessel elements the pH of the cytoplasm decreases. This change in pH activates enzymes in the cytoplasm that cause organelles to swell.

Suggest how a change in pH of the cytoplasm can activate enzymes.

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..... [2]

(d) Some insects are vectors of disease.

(i) When an insect feeds on the xylem fluid it can act as a vector of plant diseases such as Pierce's disease. This bacterial disease affects many fruit trees causing the leaves to turn brown and drop from the plant, resulting in much less fruit being produced.

Explain why Pierce's disease can be described as an infectious disease.

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.....[2]

(ii) Malaria is another infectious disease that also involves an insect vector.

State the type of organism that causes malaria **and** name **one** organism that causes malaria in humans.

type of organism .....

name .....
[2]

[Total: 13]

6 **(a)** Fig. 6.1 is a photomicrograph of plant cells in stages of the mitotic cell cycle.

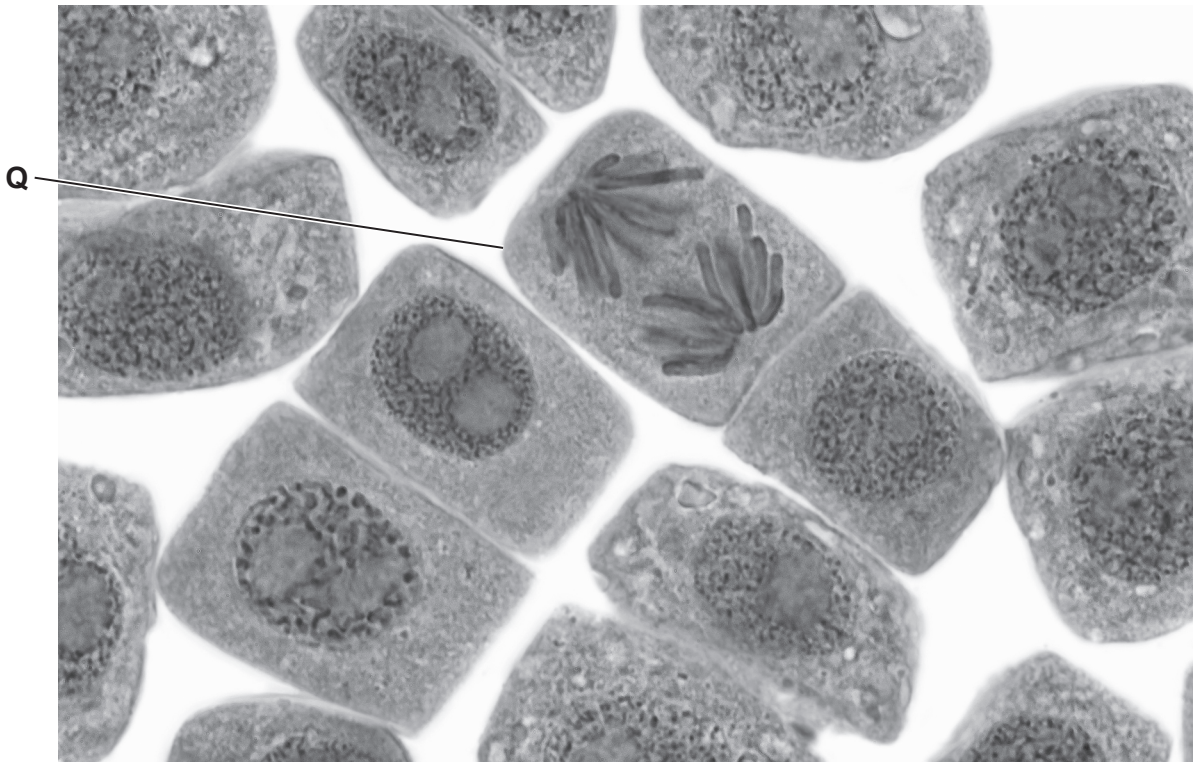


Fig. 6.1

(i) Name the stage of mitosis shown in cell **Q**.

..... [1]

(ii) Outline the roles of mitosis in a healthy plant.

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..... [2]

(b) Uncontrolled mitosis can cause cancer in humans.
Paclitaxel is a drug used in the treatment of some forms of cancer.

Researchers investigated the effect of Paclitaxel on the mitotic cell cycle of cancer cells.

- The cancer cells were grown for two days and then divided into groups.
- Each group was treated with a different concentration of Paclitaxel.

After 28 hours (one cell cycle):

- the percentage of cells in stages of mitosis was calculated
- the ratio of the number of cells in anaphase to the number of cells in metaphase was determined.

The results of the investigation are shown in Fig. 6.2.

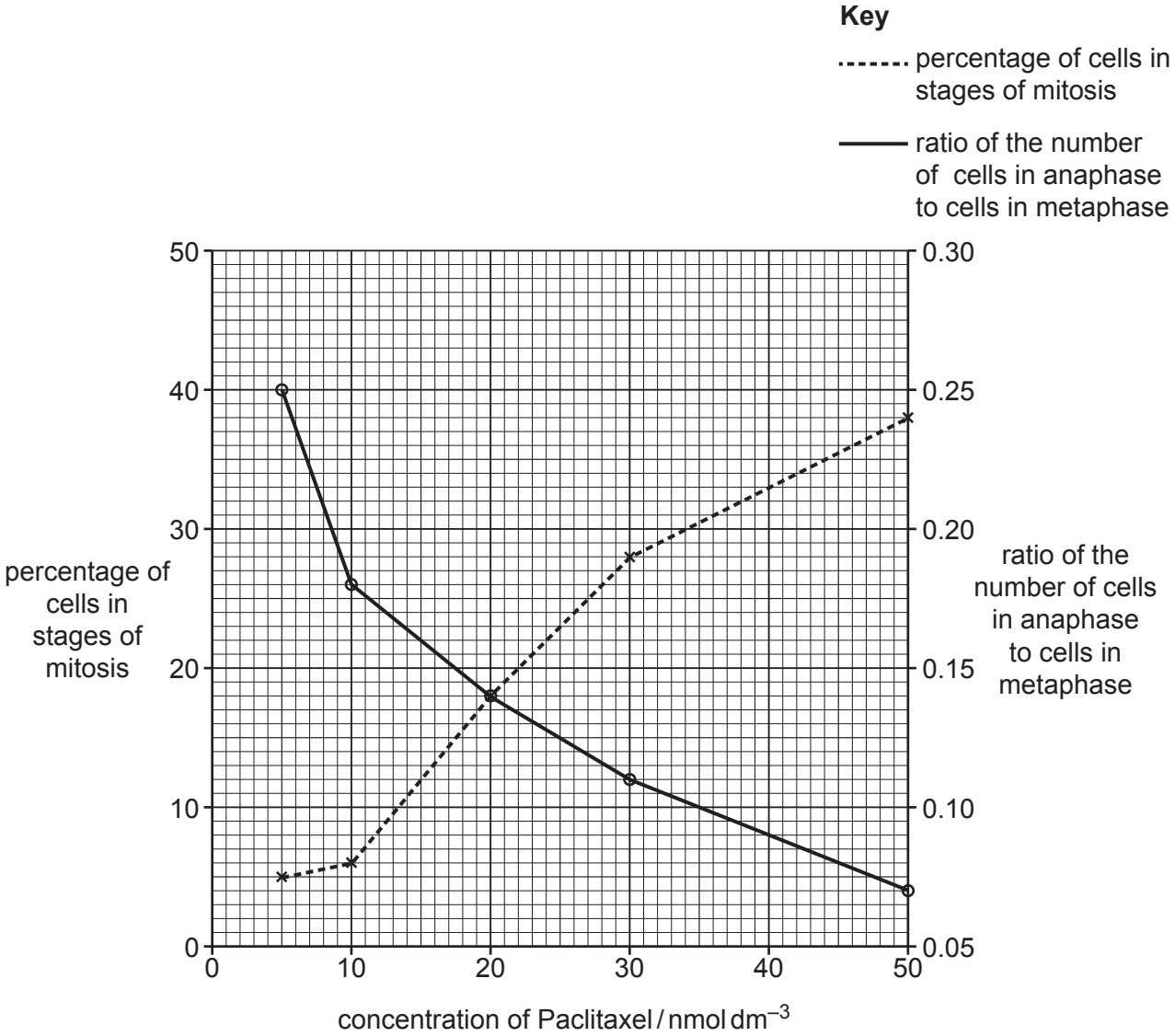


Fig. 6.2

With reference to Fig. 6.2, describe the results and suggest an explanation for the effect of Paclitaxel on the mitotic cell cycle.

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..... [4]

[Total: 7]

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6043855252

BIOLOGY **9700/22**

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1 hour 15 minutes

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[Turn over

1 The mammalian circulatory system is adapted for the long-distance transport of the respiratory gases, oxygen and carbon dioxide.

The system is described as a closed double circulation.

(a) Name:

- the two different circulations of the double circulatory system of mammals

  .....

  .....

- the main vein returning deoxygenated blood to the heart.

  .....

[3]

(b) In a closed circulation, blood is kept within vessels at all times.

Name the type of blood vessel that connects capillaries and veins.

..... [1]

(c) Fig. 1.1 is a diagram of a section through the heart.

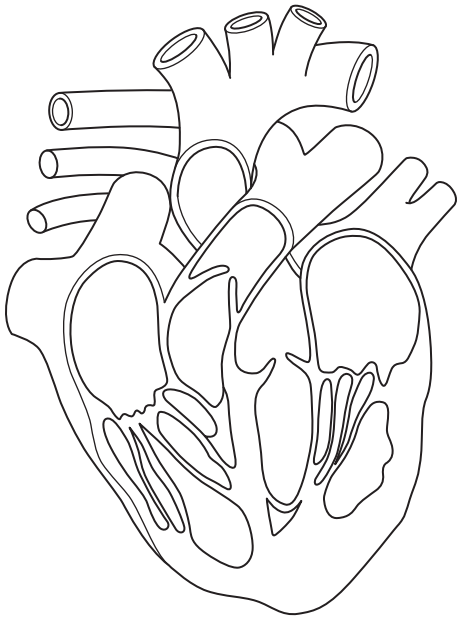


Fig. 1.1

On Fig. 1.1:

- add a label line and the letter **L** to show the artery that takes blood from the heart to the lungs
- add a label line and the letter **R** to show the valve that closes when the right ventricle is in systole. [2]

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(d) The entry of carbon dioxide into red blood cells results in the production of hydrogencarbonate ions. This involves the enzyme carbonic anhydrase.

Complete the passage summarising the production of hydrogencarbonate ions by:

- writing the correct biological term in the spaces provided
- writing the molecular formula for **two** of the terms in the spaces in brackets.

Carbonic anhydrase has an overall spherical shape and is known as a ..... protein. The enzyme acts within the cell so can be described as an ..... enzyme. When blood passes into the capillary network through actively respiring tissues, carbon dioxide (CO_2) diffuses into red blood cells and carbonic anhydrase catalyses a reaction where ..... (.....) is combined with CO_2 to form ..... (H_2CO_3), which rapidly forms ..... ions (.....) and hydrogencarbonate ions (HCO_3^-). [5]

[Total: 11]

2 Human cytomegalovirus (HCMV) is a common virus affecting humans. In people with a fully functioning immune system, infection by HCMV usually causes no, or only mild, symptoms.

Fig. 2.1**A** is a diagram of a section through HCMV. In Fig. 2.1**B**, only the outer part of HCMV is sectioned.

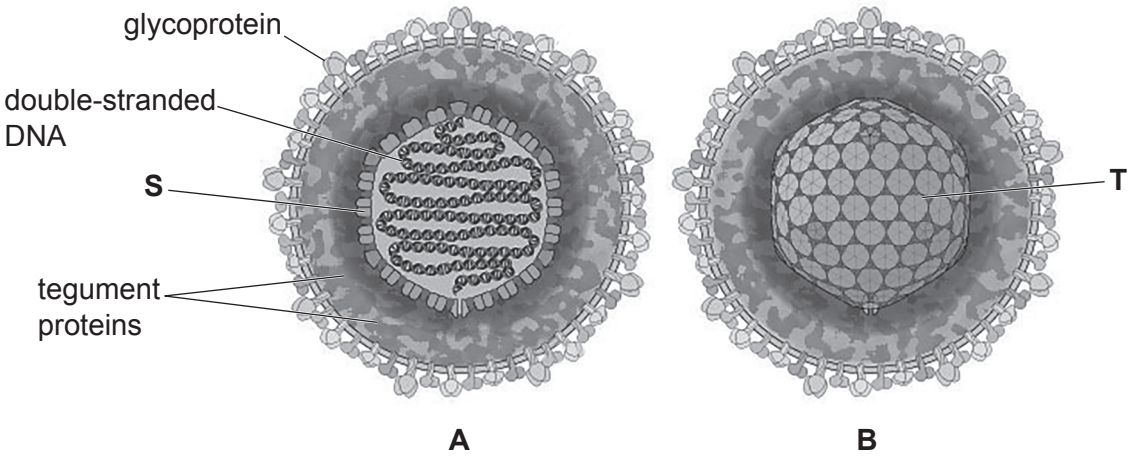


Fig. 2.1

The viral DNA shown in Fig. 2.1 contains genes that code for proteins important in viral replication and viral structure, including viral DNA polymerase and proteins known as tegument proteins.

Viruses can only replicate in host cells as they need to use processes and contents of the host cell. Complete viral particles that are released from the host cell are known as virions.

(a) Structure **S** in Fig. 2.1**A** is a subunit of structure **T** in Fig. 2.1**B**.

Name the chemical compound used to make structure **S and** name structure **T**.

S .....

T .....
[2]

(b) The actual diameter of the HCMV shown in Fig. 2.1 is 0.17 micrometres (μm).

Calculate the actual diameter of the virus in nanometres (nm).

..... [1]

(c) Suggest the role of viral DNA polymerase within the host cell.

..... [1]

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(d) The virus in Fig. 2.1 is drawn as a spherical shape. Structure **T** is always the same shape. However, electron micrographs show that HCMV virions are not all the same shape.

Suggest how HCMV virions can be of different shapes.

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..... [2]

(e) With reference to Fig. 2.1**A**, state **one** similarity **and one** difference between the genetic material of HCMV and the genetic material of a typical bacterial cell.

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..... [2]

(f) HCMV is known to infect some types of human cell that carry out the mitotic cell cycle.

Studies have shown that in the presence of one tegument protein, UL69, the cell cycle stops in the G1 stage.

Outline the effects the presence of UL69 will have on the normal activity of the mitotic cell cycle.

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..... [3]

(g) After a person has been infected with HCMV, the virus remains in a dormant state in the body for life.

If the virus becomes active again (reactivates), the virus will only cause serious illness if the person has a weak immune system at that time.

Explain why the response to reactivation of HCMV is more likely to cause serious illness in a person who has a weak immune system.

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..... [4]

[Total: 15]

3 *Plasmodium falciparum* is one species of *Plasmodium* that causes the life-threatening disease malaria. With early diagnosis and the correct drug treatment, the pathogen can be eliminated from the body, particularly if the disease is not severe.

(a) Name the type of pathogen that causes malaria.

..... [1]

(b) To help prevent the development and spread of drug resistance in *Plasmodium*, the World Health Organization (WHO) recommends using a treatment known as artemisinin-based combination therapy (ACT).

ACT involves two different types of drug:

- a fast-acting drug derived from a compound known as artemisinin, which causes a rapid decrease in the number of *P. falciparum*
- one or more longer-acting, non-artemisinin, drugs that eliminate any remaining pathogens.

(i) Suggest why using ACT with the two different types of drug is more effective in preventing the development of drug resistance in *Plasmodium* than a treatment using only one type of drug.

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..... [2]

(ii) In some areas, partial artemisinin resistance has developed. This means ACT takes a longer time for the pathogen to be eliminated from the body.

Explain why there is an increased risk of transmission of the pathogen to other people if a person is receiving ACT and the pathogen has partial artemisinin resistance.

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..... [2]

(c) ACT can act on the stage of the life cycle of *P. falciparum* that occurs within red blood cells. The cells of *P. falciparum* in this stage are known as trophozoites.

Fig. 3.1 is a photomicrograph of a blood smear (thin layer of cells). Some of the red blood cells contain trophozoites.

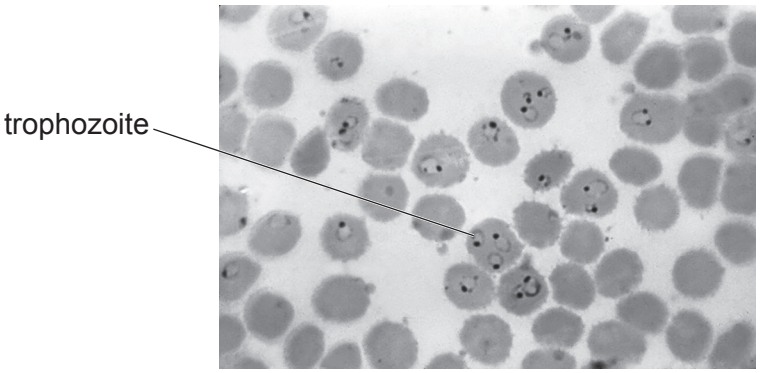


Fig. 3.1

PfK13 is a protein that has an important role in the development of the trophozoite stage of *P. falciparum*. The gene *kelch13* codes for PfK13.

Two different mutations of *kelch13*, known as F446I and C580Y, were investigated to see if they were associated with partial artemisinin resistance. Details of these mutations are summarised in Table 3.1.

Table 3.1

name of mutation	change in DNA		change in protein PfK13	
	nucleotide present in *kelch13*	**nucleotide present after mutation**	**amino acid before mutation**	**amino acid after mutation**
F446I	thymine (T)	adenine (A)	phenylalanine (phe)	isoleucine (ile)
C580Y	guanine (G)	adenine (A)	cysteine (cys)	tyrosine (tyr)

(i) Using gene *kelch13* and mutation F446I as examples, explain the difference between a gene and a gene mutation.

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..... [3]

(ii) In the investigation, the survival rate of trophozoites within red blood cells was determined for two different concentrations of an artemisinin-based drug known as DHA.

Two different strains, **A** and **B**, of *P. falciparum* were tested. Three different cultures of each strain were involved:

- no mutation in *kelch13* (control)
- *kelch13* F446I mutation
- *kelch13* C580Y mutation.

Table 3.2 shows the six different cultures tested and the trophozoite survival rate for each culture.

Table 3.2

culture number	culture details	mean percentage survival rate of trophozoite	
		DHA concentration 20 nmol dm^{-3}	DHA concentration 700 nmol dm^{-3}
1	strain **A** no mutation	3.15	0.00
2	strain **A**, F446I mutation	26.00	0.73
3	strain **A**, C580Y mutation	33.08	0.91
4	strain **B** no mutation	2.86	0.00
5	strain **B**, F446I mutation	13.50	0.53
6	strain **B**, C580Y mutation	17.50	0.63

State the main conclusions that can be drawn from the results shown in Table 3.2.

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..... [3]

[Total: 11]

4 The airways of the gas exchange system are lined with epithelium. Gradual changes in the structural features of this epithelium occur as the airways branch and become increasingly narrow.

(a) Table 4.1 shows the changes that occur in the number of goblet cells in the epithelium of the different structures of the gas exchange system.

Table 4.1

gas exchange structure	number of goblet cells in epithelium
trachea	many
bronchi	many
larger bronchioles	very few
smaller bronchioles	none
alveoli	none

Goblet cells produce mucus, which is important in maintaining the health of the airways.

The smallest bronchioles closest to the alveoli are known as respiratory bronchioles.

Suggest **and** explain why respiratory bronchioles do not have any goblet cells.

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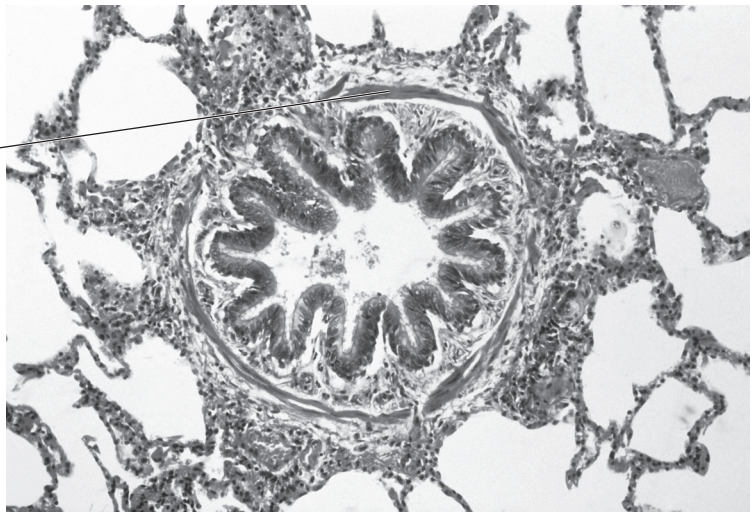
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..... [2]

(b) Fig. 4.1 is a photomicrograph of a section through a bronchiole, which is surrounded by alveoli.



magnification ×40

Fig. 4.1

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(i) There are structural differences between the epithelium of the bronchiole and the epithelium of an alveolus.

Describe the differences between the epithelium of bronchioles and the epithelium of alveoli, **other than** differences in the number of goblet cells.

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..... [3]

(ii) Tissue **X**, shown in Fig. 4.1, is located in the wall of the bronchiole.

Name tissue **X and** outline the function of tissue **X** in the bronchiole.

tissue **X** = ...

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

5 Fibroblasts are one of the cell types of connective tissue. The cells synthesise and secrete collagen, which forms part of the supporting external cellular environment, known as the extracellular matrix.

(a) Fig. 5.1 shows the primary structure of a section of a polypeptide chain of collagen.

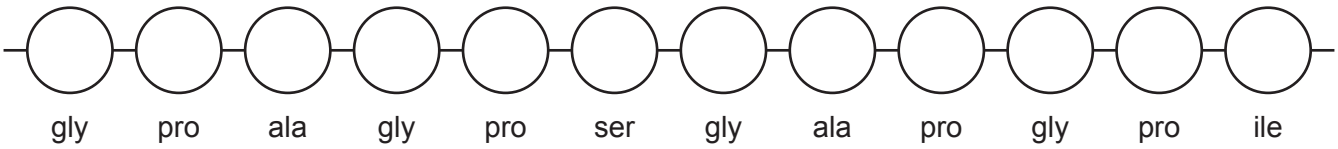


Fig. 5.1

Explain how the primary structure shown in Fig. 5.1 indicates that the structure of the polypeptide is suited to be a component of a collagen molecule.

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..... [3]

(b) After final processing in the Golgi body, collagen is released to the outer surface of the cell by exocytosis.

Complete the passage to describe the process of exocytosis.

After final processing in the Golgi body,
.....

.....

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..... [3]

(c) Hydrolytic enzymes, known as collagenases, are secreted by cells in an inactive form.

Cells also secrete inhibitors of collagenases. The activity of the enzymes and inhibitors is regulated so that the development and maintenance of the extracellular matrix is controlled.

(i) State **and** explain what the outcome will be for the composition of the extracellular matrix if collagenase inhibitor activity is needed.

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..... [2]

(ii) Synthetic inhibitors have been trialled as potential treatment for diseases caused by a lack of regulation of collagenase activity.

Research involves investigating the mechanism of action of an inhibitor.

State the effect that a **non-competitive** inhibitor will have on the maximum rate of reaction, V_{max}, and the Michaelis–Menten constant, K_m, of collagenase.

V_{max} .....

K_m .....
[2]

[Total: 10]

6 Xylem and phloem are the transport tissues of plants. Both tissues have more than one cell type.

The conducting cells of xylem contain xylem sap and those of phloem contain phloem sap. The composition of xylem sap differs from the composition of phloem sap.

(a) The main component of xylem sap and phloem sap is water.

Explain why water is the main component of xylem sap and phloem sap.

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..... [2]

(b) Three types of cell associated with the translocation of sucrose are:

- companion cell
- mesophyll cell
- phloem sieve tube element.

A, **B** and **C** are three events that occur at the source. Each event refers to '**the cell**' but does not name the type of cell concerned.

A Sucrose moves through plasmodesmata into **the cell**.
B Hydrogen ions are transported out of **the cell**.
C Sucrose moves into **the cell** through cotransporter proteins.

Complete Table 6.1 by matching the event with a correct cell type.

Each cell type may be identified once, more than once, or not at all.

Table 6.1

event	cell type
A	
B	
C	

[3]

[Total: 5]

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4364943727

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2022**

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 [ ].

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[Turn over

1 **(a)** During translation, a polypeptide is synthesised when amino acids are added to a growing chain of amino acids.

Fig. 1.1 shows part of a growing chain of amino acids and the amino acid cysteine.

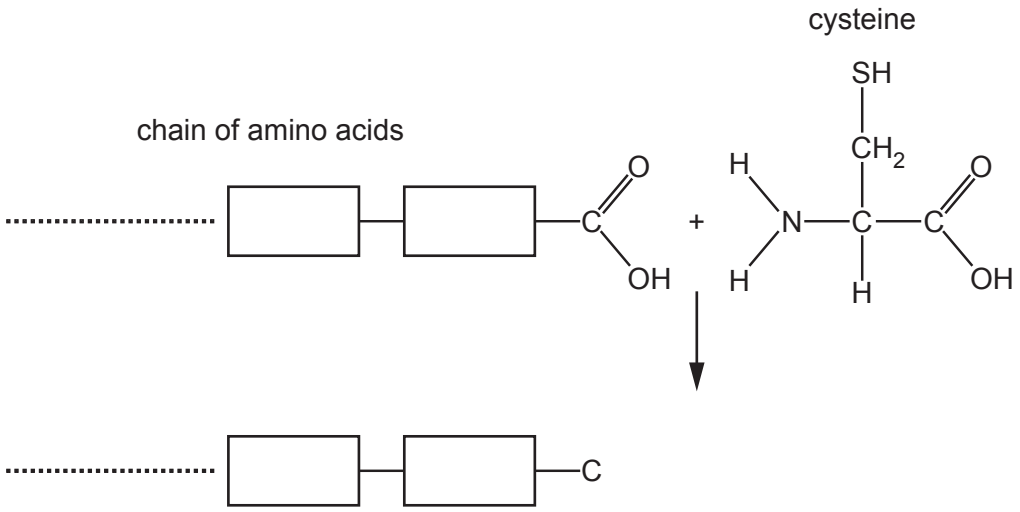


Fig. 1.1

(i) Complete Fig. 1.1 by showing the formation of the bond between cysteine and the growing chain of amino acids in the process of translation. [3]

(ii) State the name of the covalent bond that forms when cysteine is added to the growing chain of amino acids.

..... [1]

(iii) State the organelle where the reaction shown in Fig. 1.1 takes place.

..... [1]

(b) Fig. 1.2 is a ribbon diagram showing the three-dimensional structure of a protein from the bacterium *Streptococcus*.

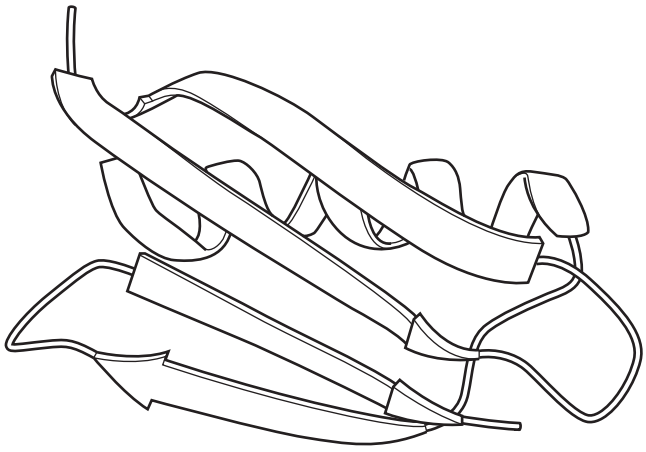


Fig. 1.2

(i) Describe the secondary structure of the protein shown in Fig. 1.2.

.....

.....

.....

.....

..... [2]

(ii) Explain why the protein shown in Fig. 1.2 has tertiary structure, but not quaternary structure.

.....

.....

.....

.....

..... [2]

(iii) An analysis of the amino acid composition of the protein in Fig. 1.2 showed that it does **not** contain any cysteine residues.

Explain how the three-dimensional structure of the protein shown in Fig. 1.2 is held in place.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

2 Fig. 2.1 is a scanning electron micrograph showing a macrophage engulfing some bacteria.



Fig. 2.1

(a) (i) Describe how macrophages engulf bacteria.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Explain the functions of lysosomes in cells such as macrophages.

.....

.....

.....

.....

.....

.....

..... [3]

Question 2 continues on page 6.

(b) Fig. 2.2 shows the reported number of new cases of tuberculosis (TB) in the USA and the number of new cases per 100 000 of the population of the USA between 1993 and 2018.

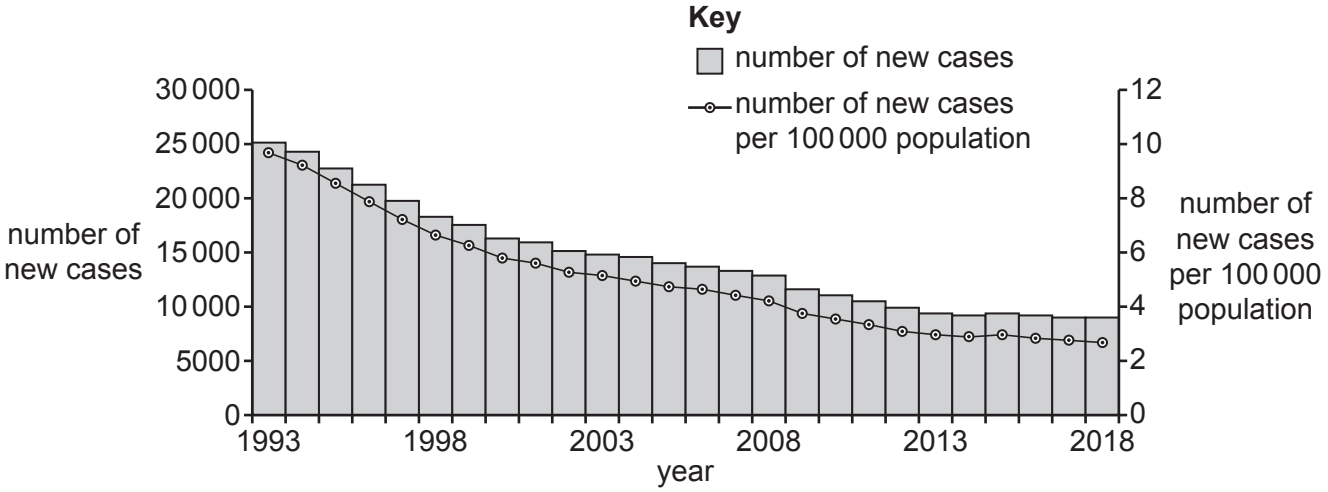


Fig. 2.2

(i) Calculate the percentage change in the number of new cases of TB in the USA between 1993 and 2018.

Show all your working.

answer ..... % [3]

(ii) Use Fig. 2.2 to describe the trend in the number of new cases of TB in the USA between 1993 and 2018.

.....

.....

.....

.....

.....

..... [2]

(c) Suggest an advantage of calculating the number of new cases per 100 000 each year in the prevention and control of TB across the world.

.....

.....

..... [1]

(d) TB is endemic (always present) in many populations across the world and many countries have high numbers of cases.

State **two** reasons why it is difficult to reduce the number of cases of TB across the world.

.....

.....

.....

.....

..... [2]

[Total: 14]

3 **(a)** Explain how water moves up xylem vessels in the trunks of trees.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Cavitation is the formation of air-filled spaces inside the columns of water in xylem vessels in trees. These air-filled spaces form more often when there are high rates of movement of water in xylem vessels.

When an air-filled space forms in a xylem vessel, a noise is made that can be detected as a 'click' by a sensor placed close to the xylem vessels in the trunk of a tree.

Students investigated the relationship between two environmental factors and the rate of cavitation in a Scots pine tree, *Pinus sylvestris*, over a 50-hour period. The two factors they investigated were:

- photosynthetically active radiation (PAR), which is the light energy available to plants that they absorb and use in photosynthesis
- wind speed.

The cavitation rate was estimated by recording the number of clicks detected by the sensor. The results are shown in Fig. 3.1.

Suggest the conclusions that can be made with reference to the data in Fig. 3.1.

.....

.....

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.....

.....

.....

..... [3]

[Total: 7]

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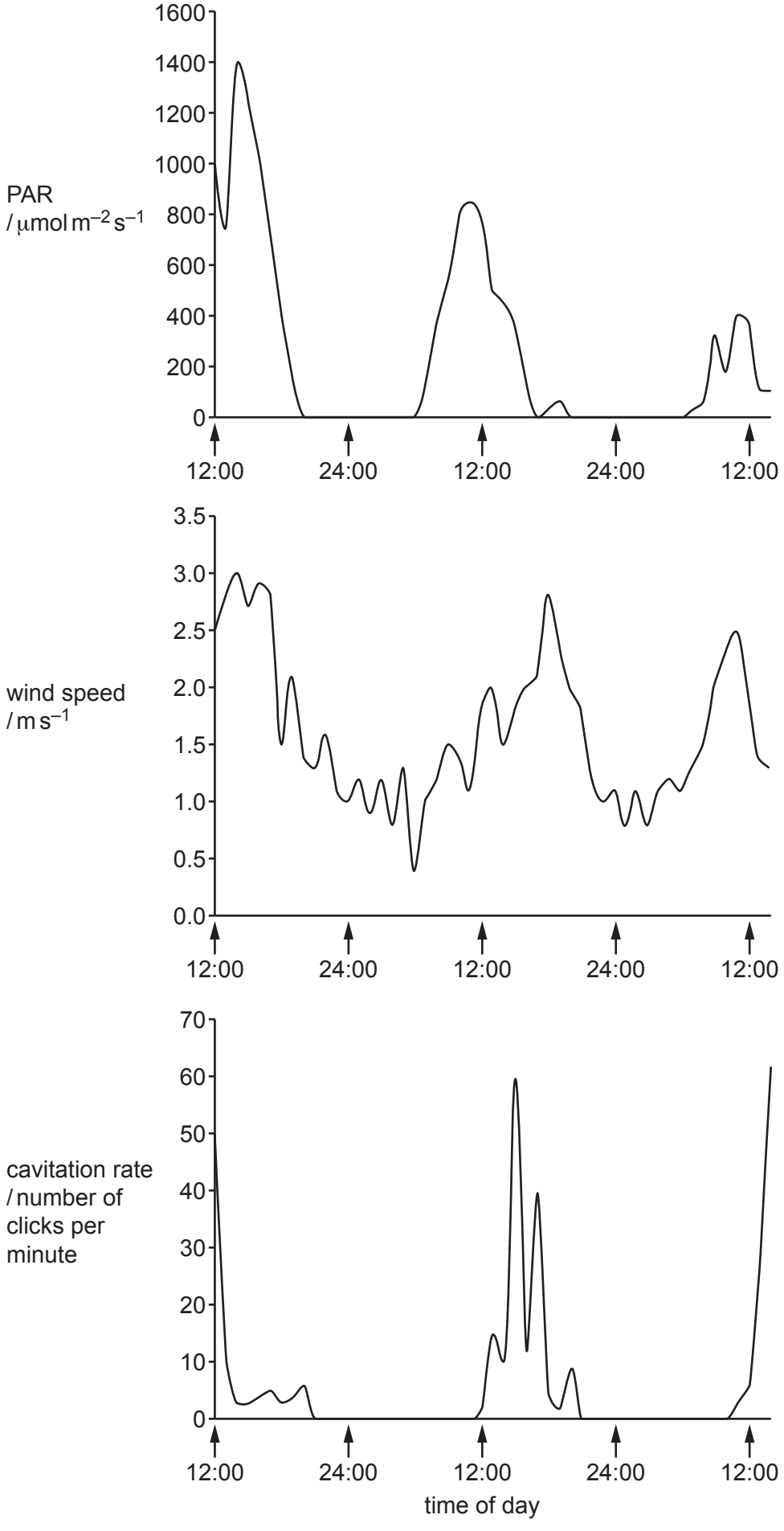

PAR / μmol m−2 s−1
1600
1400
1200
1000
800
600
400
200
0
12:00
24:00
12:00
24:00
12:00
wind speed / m s−1
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
12:00
24:00
12:00
24:00
12:00
cavitation rate / number of clicks per minute
70
60
50
40
30
20
10
0
12:00
24:00
12:00
24:00
12:00
time of day

Fig. 3.1

4 The early development of an animal involves divisions of the zygote and daughter cells by mitosis to form an embryo consisting of genetically identical cells.

Fig. 4.1 shows several cells at various stages of the cell cycle in an embryo of whitefish, *Coregonus artedi*.

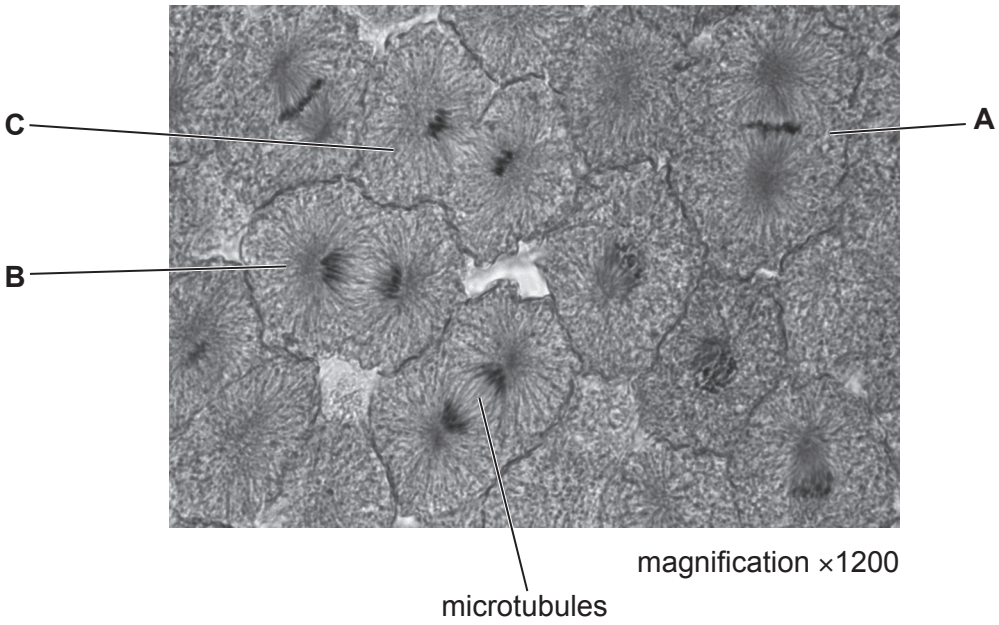


Fig. 4.1

(a) (i) Name the stage of mitosis in cell **A** and in cell **B**, shown in Fig. 4.1.

A .....

B .....

[2]

(ii) Fig. 4.1 shows microtubules in the cells that are dividing.

Describe the role of microtubules in mitosis.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) State what happens in cell **C**, shown in Fig. 4.1, until two new cells are formed.

.....

.....

.....

.....

.....

.....

..... [3]

(b) The cells produced in the developing whitefish are genetically identical.

Identify **and** explain **two** events that occur during the cell cycle that lead to daughter cells being genetically identical.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 11]

5 Cathelicidin LL-37 is a cell signalling compound that stimulates many different cells in humans. One role of cathelicidin LL-37 is stimulating the production of endothelial cells in the formation of capillaries during wound healing.

(a) (i) Explain how it is possible for many different cell types to respond to the same cell signalling compound.

.....

.....

.....

.....

..... [2]

(ii) Describe the appearance of the endothelial cells of a capillary.

.....

.....

.....

.....

..... [2]

Cathelicidin LL-37 is a protein composed of 37 amino acids.

Table 5.1 shows:

- the sequence of the first 10 amino acids in the primary structure of cathelicidin LL-37
- DNA triplets in the non-transcribed strand in the gene that codes for the first 10 amino acids in the primary structure of cathelicidin LL-37.

Table 5.1

amino acid position	1	2	3	4	5	6	7	8	9	10
amino acid	leu	leu	gly	asp	phe	phe	arg	lys	ser	lys
DNA triplet	CTG	CTG	GGT	GAT	TTC	TTC	CGG	AAA	TCT	AAA

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Table 5.2 shows the triplets of bases in **DNA** and the amino acids for which they code.

Table 5.2

first base	second base: T		C		A		G		third base
T	TTT	phe	TCT	ser	TAT	tyr	TGT	cys	**T**
	TTC		TCC		TAC		TGC		**C**
	TTA	leu	TCA		TAA	stop	TGA	stop	**A**
	TTG		TCG		TAG		TGG	try	**G**
C	CTT	leu	CCT	pro	CAT	his	CGT	arg	**T**
	CTC		CCC		CAC		CGC		**C**
	CTA		CCA		CAA	gln	CGA		**A**
	CTG		CCG		CAG		CGG		**G**
A	ATT	ile	ACT	thr	AAT	asp	AGT	ser	**T**
	ATC		ACC		AAC		AGC		**C**
	ATA	ile	ACA		AAA	lys	AGA	arg	**A**
	ATG	met	ACG		AAG		AGG		**G**
G	GTT	val	GCT	ala	GAT	asp	GGT	gly	**T**
	GTC		GCC		GAC		GGC		**C**
	GTA		GCA		GAA	glu	GGA		**A**
	GTG		GCG		GAG		GGG		**G**

(b) Mutations of DNA base sequences in a gene can affect the primary structure of proteins.

Use the information in Table 5.1 and Table 5.2 to suggest the effect on the primary structure of cathelicidin LL-37 of:

(i) the substitution of the base T with the base A in the middle of the triplet at position 5

..... [1]

(ii) the deletion of base T in the triplet at position 2

.....

.....

..... [2]

(iii) the insertion of base G between bases G and T in the triplet at position 3.

.....

.....

..... [2]

(c) The genetic code is described as universal.

Explain why the genetic code is described as universal.

.....

.....

..... [1]

(d) Use Table 5.2 to explain why some mutations have no effect on the primary structure of a protein.

.....

.....

.....

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..... [2]

[Total: 12]

6 Fig. 6.1 shows some of the events that occur when a red blood cell flows through a capillary in the lungs.

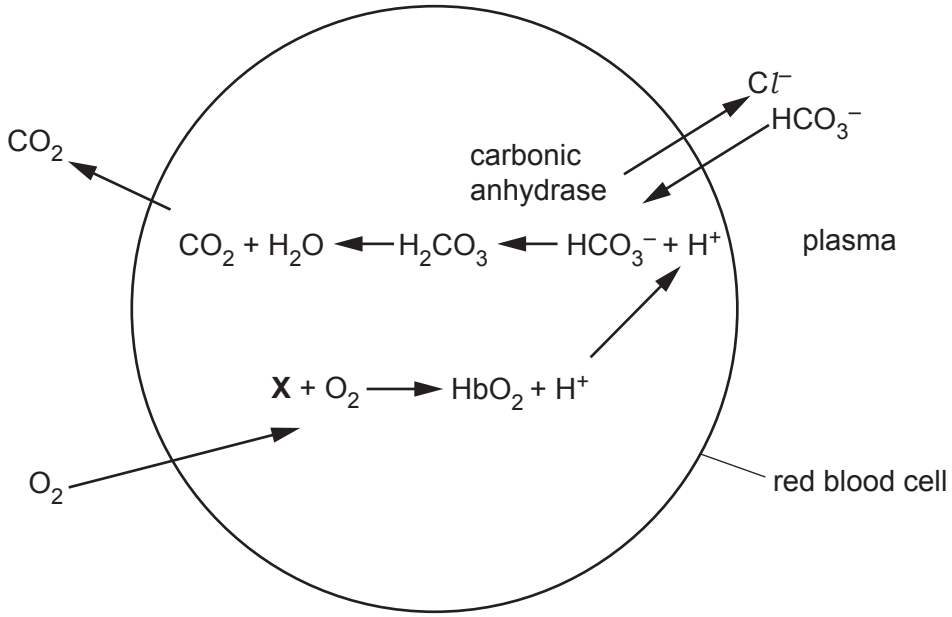


Fig. 6.1

(a) State why there are transport proteins in the membranes of red blood cells to allow the movement of hydrogencarbonate ions (HCO_3^-) and chloride ions (Cl^-).

.....

.....

..... [1]

(b) Fig. 6.1 shows that chloride ions move out of the red blood cells.

Explain why this movement is necessary when red blood cells flow through capillaries in the lungs.

.....

.....

..... [1]

(c) State why carbon dioxide molecules diffuse from the red blood cells into the plasma.

.....

..... [1]

(d) State the name of the compound indicated by **X**.

.....

..... [1]

[Total: 4]

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