Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/22**

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

[Turn over

Question 1 starts on page 3.

1 (a) Table 1.1 shows three of the processes by which substances in solution can move across cell membranes. It also lists five statements that may apply to each of these three processes.

Complete Table 1.1 to show which of the statements apply to each of the three processes shown.

Use a tick (✓) to show that the statement applies or a cross (✗) to show that the statement does not apply.

Each box must contain a tick or a cross.

The first row has been completed for you.

Table 1.1

statement	process		
	active transport	**facilitated diffusion**	**simple diffusion**
movement of oxygen into a red blood cell	✗	✗	✓
occurs in both animal and plant cells			
uses carrier proteins			
movement of non-polar molecules between the fatty acid tails of the phospholipid molecules			
movement of ions down a concentration gradient			

[4]

(b) Fig. 1.1 is a simplified diagram representing a transverse section of part of a young root. The diagram is not to scale.

(i) On Fig. 1.1 draw a label line and label with the letter **C** to identify the Casparian strip. [1]

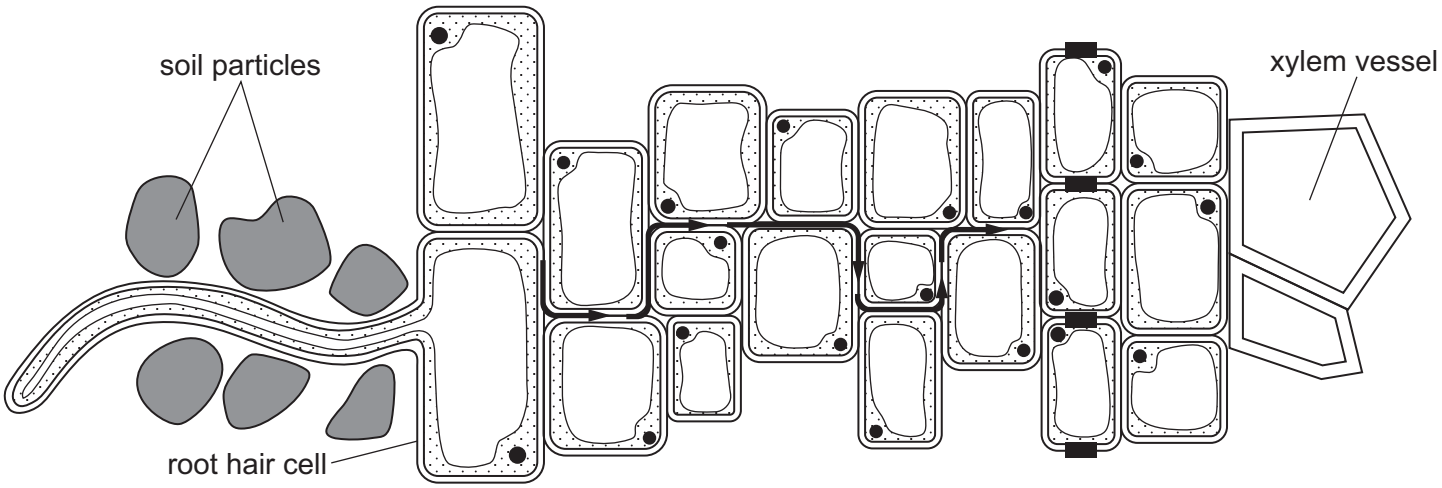

Fig. 1.1

(ii) Root hairs measure approximately 5 μm in diameter and 500 μm in length.

Explain how this adapts root hairs for the absorption of water.

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..... [1]

(iii) Name the pathway for the movement of water shown by the arrows in Fig. 1.1.

..... [1]

(c) Water enters the xylem vessels shown in Fig. 1.1.

Explain how water moves up the xylem vessels to the leaves in a continuous column.

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..... [3]

[Total: 10]

2 **(a)** Fig. 2.1 shows a cell at one of the main stages of mitosis in the mitotic cell cycle.

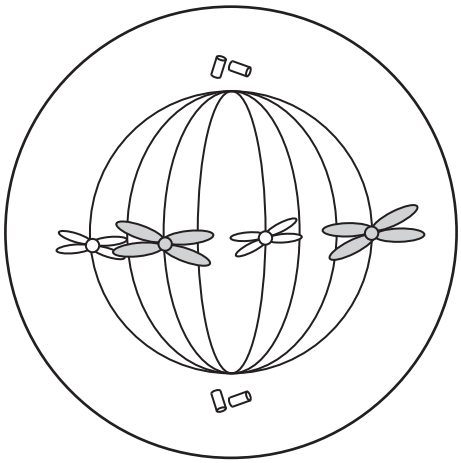

Fig. 2.1

(i) Name the stage of mitosis shown in Fig. 2.1.

..... [1]

(ii) Fig. 2.2 shows the cell in Fig. 2.1 at the start of cytokinesis.

Complete Fig. 2.2 to show the daughter chromosomes in each nucleus.

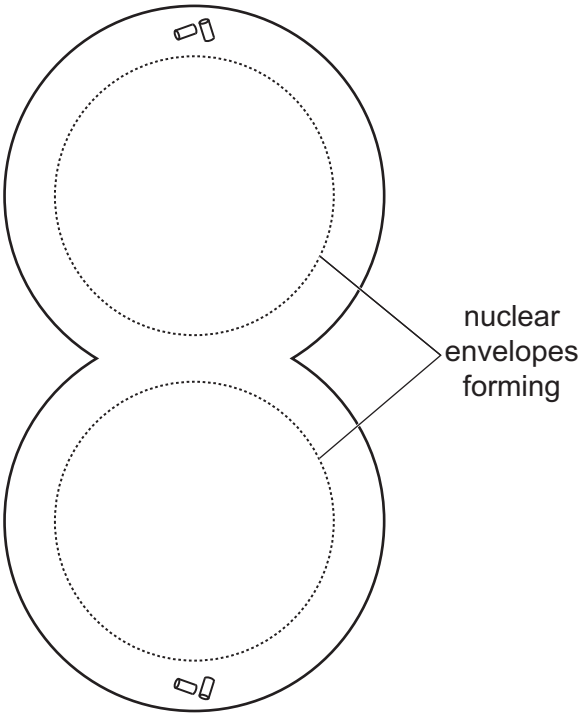

Fig. 2.2

[2]

(b) State the role of telomeres during DNA replication.

.....

.....

..... [1]

(c) Multiple myeloma is a type of cancer in the bone marrow where some of the stem cells start to produce abnormal blood cells.

- One treatment is to collect stem cells from the bone marrow of the person with multiple myeloma. Healthy stem cells are isolated and grown in the laboratory.
- Radiation is then used to destroy all stem cells and cancerous cells in the bone marrow.
- Finally, large numbers of the healthy stem cells grown in the laboratory are returned to the bone marrow.

Suggest the role of stem cells in this treatment of multiple myeloma.

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..... [3]

[Total: 7]

[Turn over

3 **(a)** Enzymes are polymers of amino acids.

Complete Fig. 3.1 to show the general structure of an amino acid.

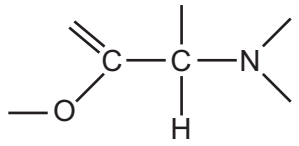

Fig. 3.1

[1]

(b) When bananas are peeled, the exposed tissue gradually turns brown in the presence of oxygen in the air. This is due to an enzyme called catechol oxidase, which acts on the substrate catechol. Catechol and catechol oxidase are present in the banana tissue.

The overall reaction is shown in Fig. 3.2.

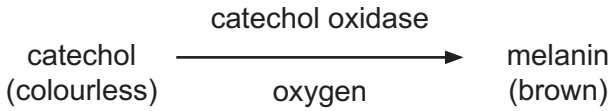

Fig. 3.2

A student investigated how the concentration of catechol oxidase affects the rate of this reaction. All other variables were kept constant throughout the investigation.

For each concentration of catechol oxidase used, the student mixed catechol oxidase solution with catechol and recorded the time taken for the mixture to reach a standard brown colour.

The rate of reaction, **R**, for each concentration of catechol oxidase used was then calculated using the formula:

$$\mathbf{R} = \frac{1}{\text{time to reach standard brown colour in minutes}}$$

(i) Calculate the rate of reaction when the standard brown colour was reached in 2 minutes 30 seconds.

rate of reaction = ... min^{-1} [1]

(ii) Fig. 3.3 is a graph showing the results of the investigation.

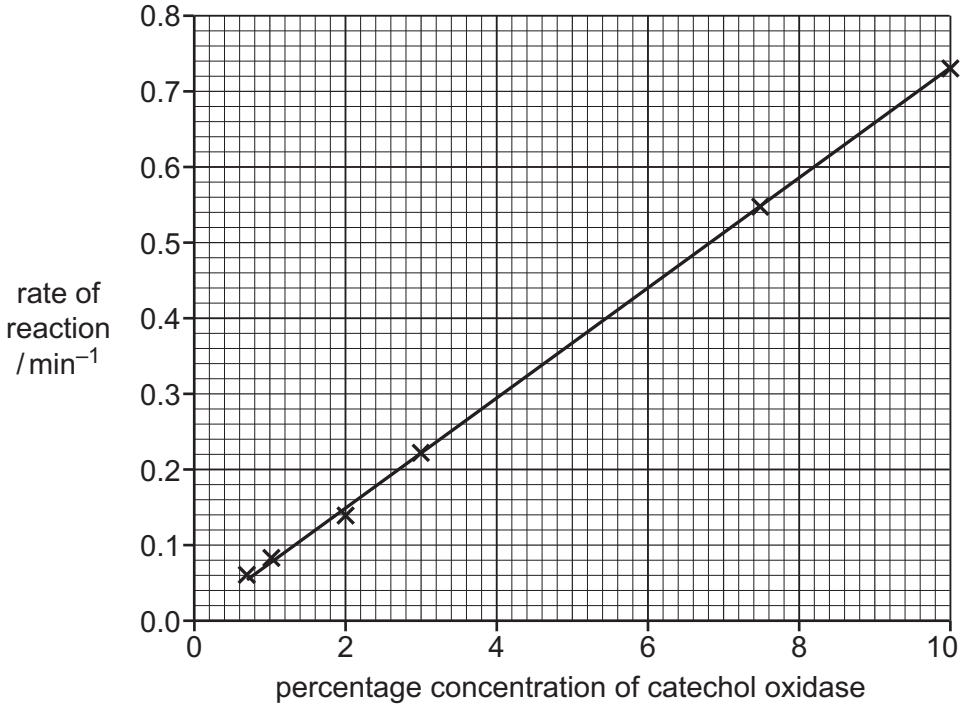

Fig. 3.3

State how the results shown in Fig. 3.3 show that substrate was in excess at all concentrations of catechol oxidase tested.

.....

.....

..... [1]

(c) The student carried out a further experiment to investigate how the concentration of catechol affects the initial rate of reaction. All other variables were kept constant throughout this investigation.

Fig. 3.4 is a graph showing the effect of varying the concentration of catechol on the initial rate of reaction.

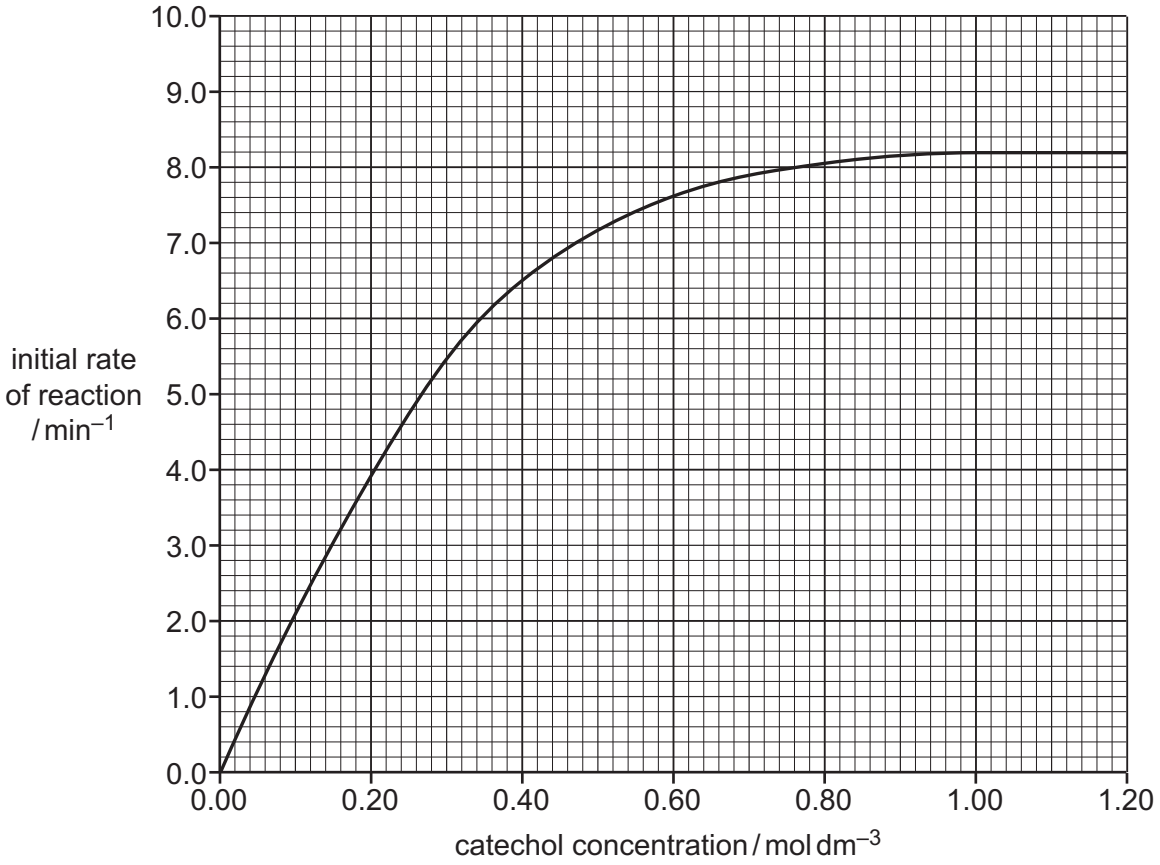

Fig. 3.4

(i) Explain the shape of the curve shown in Fig. 3.4.

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..... [3]

(ii) Use Fig. 3.4 to calculate the value of the Michaelis–Menten constant (K_m) for the reaction between catechol oxidase and catechol.

K_m = ... $mol\,dm^{-3}$ [1]

(iii) Methylcatechol has a similar shape to catechol. Catechol oxidase can also use methylcatechol as a substrate.

The K_m value for the reaction using methylcatechol as the substrate was found to be much lower than the K_m value for the reaction using catechol as the substrate, when the reactions were carried out under the same conditions.

State what these K_m values indicate about the relationship between the enzyme and the two substrates.

.....

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..... [1]

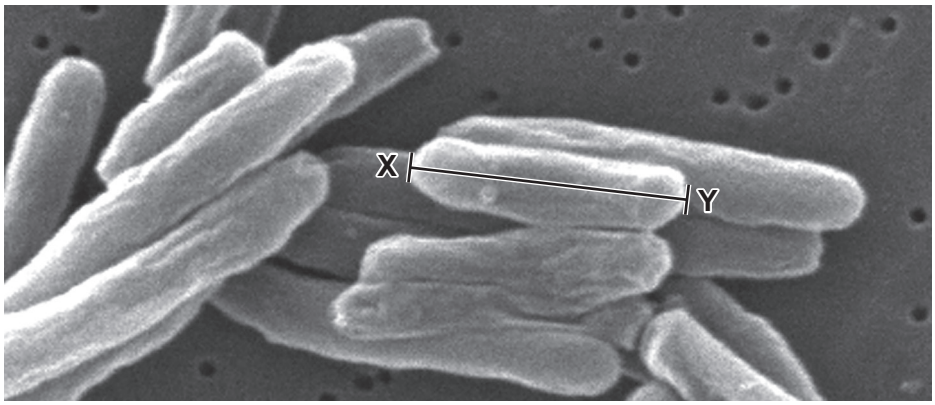
[Total: 8]

4 Tuberculosis (TB) is a major cause of ill health worldwide.

(a) State the name of a bacterium that causes TB in humans.

..... [1]

(b) Fig. 4.1 is a scanning electron micrograph of bacteria that cause TB.



magnification ×21 000

Fig. 4.1

Calculate the actual length of the bacterial cell shown in Fig. 4.1, along the line **X–Y**.

Write the formula you will use in the box.

Give your answer in micrometres (μm) to two significant figures.

formula

actual length = ... μm
[2]

(c) Bacteria are unicellular prokaryotic cells with a diameter of 1–5 μm.

State **two other** structural features that would identify a cell as prokaryotic.

1 .....

2 .....
[2]

(d) The World Health Organization (WHO) Global Tuberculosis Report for 2019 published data on the estimated number of deaths from TB and HIV/AIDS in 2018. All deaths of people from TB who were infected with HIV were also counted as deaths of people with HIV/AIDS.

Fig. 4.2 shows these data. The dark grey boxes show the estimated number of deaths of people from TB who were also counted as deaths of people with HIV/AIDS.

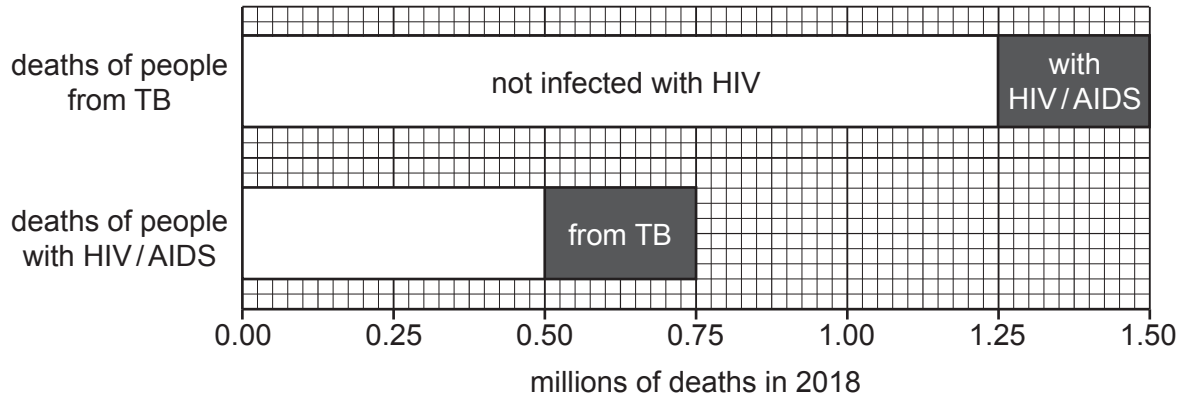


Fig. 4.2

A student used the data in Fig. 4.2 to predict that measures to control the spread of HIV will decrease the number of deaths from TB.

Discuss whether the data in Fig. 4.2 support this prediction.

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..... [3]

(e) In healthy people, the number of T-helper cells ranges from 500 to 1200 cells per cm^3 of blood. In untreated people infected with HIV, the number of T-helper cells can decrease to below 200 cells per cm^3 of blood.

Explain how a low number of T-helper cells makes it more likely that untreated people infected with HIV will die if they are also infected with TB.

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..... [3]

[Total: 11]

5 Control of heartbeat is myogenic. This means the electrical activity controlling the rhythm of a regular heartbeat begins in the heart muscle itself.

Atrial fibrillation (AF) is an abnormal heart rhythm that causes rapid and irregular contractions of the atria. Untreated cases of AF can lead to a stroke.

(a) A stroke is caused when a small blood clot, often forming in the left atrium, is carried by the blood to the brain where it blocks a small artery and leads to brain damage.

(i) List all of the structures through which a blood clot in the left atrium must travel to reach the blood vessels supplying the brain.

The structures must be listed in the correct sequence.

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..... [1]

(ii) Explain why blocking a small artery in the brain leads to brain damage.

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..... [1]

(b) A common cause of AF is when a small group of muscle cells in the wall of the left atrium starts to send out electrical impulses to the surrounding heart muscle cells.

Explain how the control of heartbeat by the sinoatrial node can be disrupted by AF, resulting in rapid and irregular atrial contractions.

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..... [3]

(c) Red blood cells are involved in the transport of oxygen and carbon dioxide in the blood.

Fig. 5.1 is a diagram representing the exchange of oxygen and carbon dioxide between a red blood cell in a capillary and a respiring cell. Some of the reactions that take place in the red blood cell are also shown. The diagram is **not** drawn to scale.

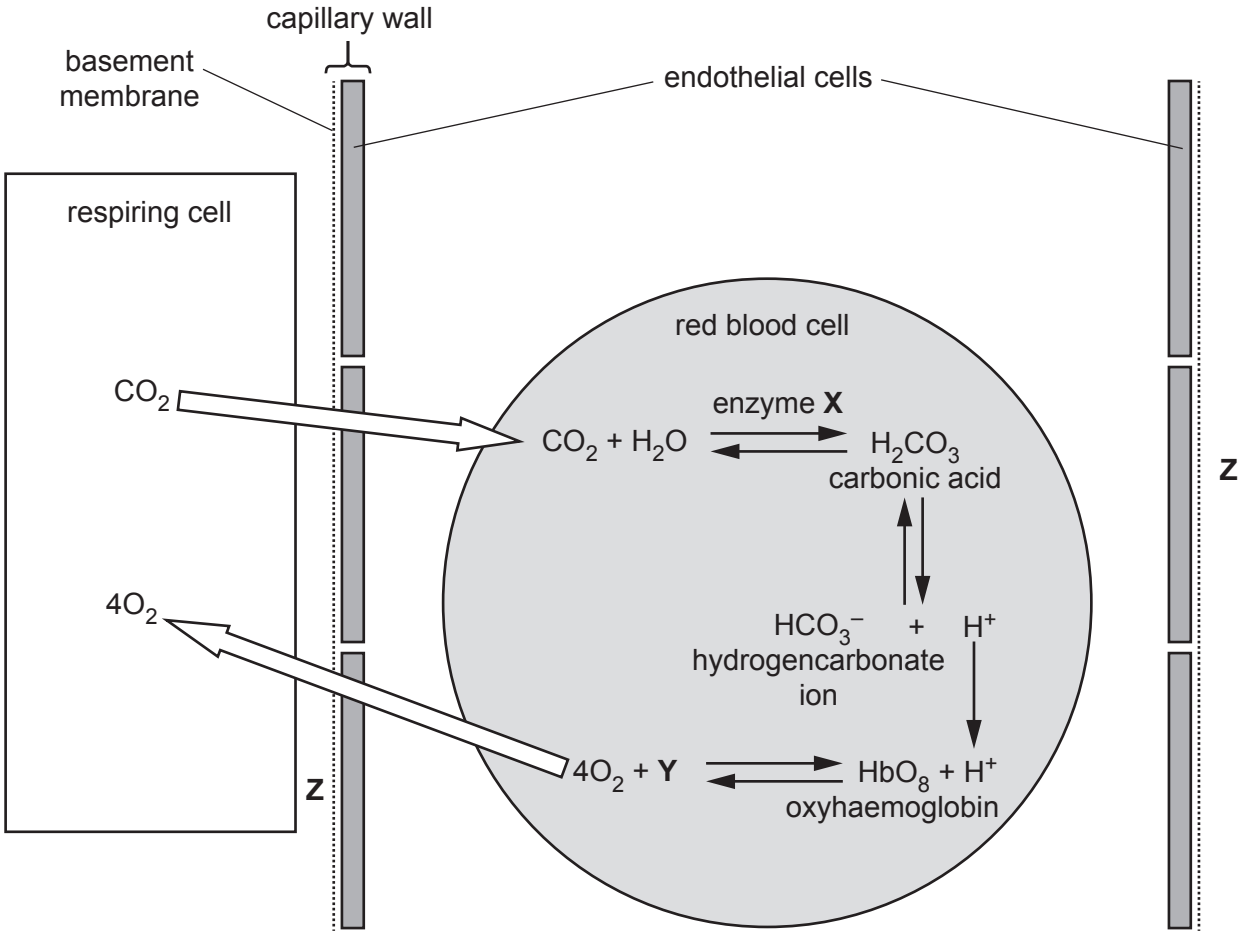

Fig. 5.1

(i) Identify enzyme **X** and molecule **Y** in Fig. 5.1.

X .....

Y .....

[2]

(ii) The hydrogencarbonate ions shown in Fig. 5.1 leave the red blood cell and are replaced by chloride ions.

State why it is necessary for chloride ions to enter the red blood cell as hydrogencarbonate ions leave.

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..... [1]

(d) Identify the aqueous environment, labelled **Z** in Fig. 5.1, that surrounds the respiring cell.

..... [1]

(e) Oxygen and carbon dioxide are also exchanged between blood capillaries and alveoli in the lungs.

The gas exchange system has specialised cells to prevent harmful microscopic particles that are present in inhaled air from reaching the alveoli.

These particles are associated with many respiratory diseases.

Explain how specialised cells in the gas exchange system prevent harmful microscopic particles from reaching the alveoli.

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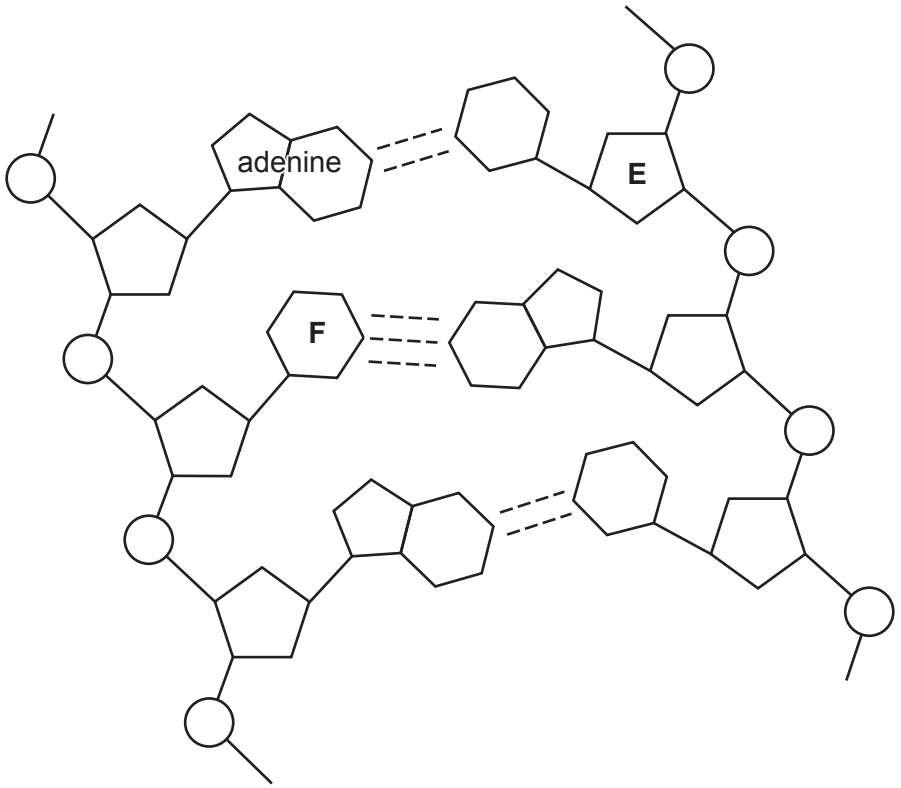
..... [3]

[Total: 12]

6 Fig. 6.1 is a diagram showing the structure of part of a DNA molecule.



key

---- one hydrogen bond

Fig. 6.1

(a) (i) Identify structure **E** and structure **F** in Fig. 6.1.

E .....

F .....
[2]

(ii) On Fig. 6.1 draw a circle around **one** nucleotide. [1]

(iii) State the name of the covalent bond that links two nucleotides together.

..... [1]

(b) Fig. 6.2 shows the RNA base sequence of a short length of primary transcript.

Complete Fig. 6.2 by writing the DNA base sequence of the template strand used to form the primary transcript.

DNA base sequence used to form the primary transcript				
primary transcript	G G U	G C U	A A U	C U A

Fig. 6.2

[1]

(c) In eukaryotic cells, the primary transcript is modified to form mRNA.

Explain how the primary transcript is modified to form mRNA.

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..... [2]

(d) The mRNA strand is translated at the ribosome to form a polypeptide.

Describe how the process of translation results in the formation of a polypeptide.

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..... [5]

[Total: 12]

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