Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8776688941

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 2023**

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.

DC (PQ/CT) 313406/4

1 (a) Table 1.1 lists cell structures that can be found in eukaryotic cells or prokaryotic cells. Some of these cell structures can be found in both types of cell.

Complete the table using a tick (✓) to show that the cell structure can be present in a particular type of cell and a cross (✗) to show that the cell structure **cannot** be present.

Put a tick or a cross in every box.

The top row has been completed for you.

Table 1.1

cell structure	eukaryotic cells	prokaryotic cells
nucleus	✓	✗
Golgi body		
circular DNA		
70S ribosome		

[2]

(b) All cells have a cell surface membrane. Fig. 1.1 shows a transmission electron micrograph of part of **two** adjacent animal cells, cell 1 and cell 2.

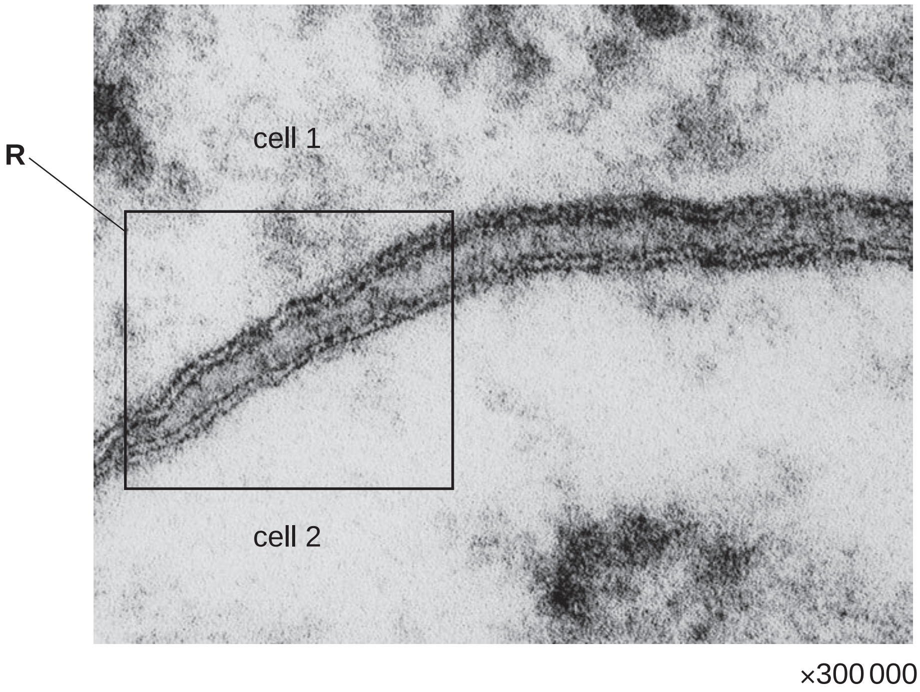

Fig. 1.1

In the space provided, draw a diagram of the region in the box labelled **R** on Fig. 1.1. Your diagram should show the four dark lines.

Label the diagram to identify what is shown by the dark lines and each of the three spaces between them.

space for diagram:

[3]

(c) Mitogens are short chains of amino acids that function as cell-signalling molecules. Mitogens are released from secretory cells and travel in the blood to target cells, where the mitogens bind to cell surface receptors. The target cells respond by progressing from the G_1 phase to the S phase of the mitotic cell cycle.

(i) Outline what happens in the G_1 phase and S phase of the mitotic cell cycle.

G_1 phase ....

....

....

S phase ....

....

....
[2]

(ii) As a result of mutation, the production and release of mitogens into the blood can be greatly increased.

Suggest a possible consequence for target cells of increased concentrations of mitogens in the blood.

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.... [1]

[Total: 8]

2 **(a)** Cysteine is an amino acid containing sulfur. Fig. 2.1 shows the structure of the molecule formed by joining two cysteine molecules together.

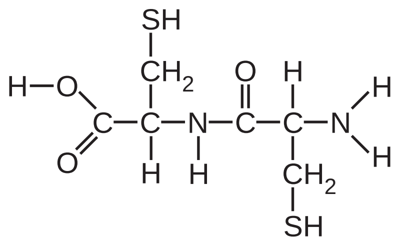

Fig. 2.1

Draw a circle around an R-group in the molecule shown in Fig. 2.1. [1]

(b) Goblet cells in the human gas exchange system produce proteins called mucins.

(i) The ends of mucin molecules contain many cysteine residues. Mucin strands are formed by joining the ends of mucin molecules together through covalent bonds between R-groups.

State the name of these covalent bonds.

.... [1]

(ii) Mucin strands are transported out of the goblet cells and then absorb water to form mucus.

Suggest **and** explain how mucin strands are transported out of the goblet cells.

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.... [3]

Cystic fibrosis is a genetic disease caused by a mutation in the human *CFTR* gene. This results in mucus that is thicker than normal.

(c) Suggest how thicker mucus interferes with the maintenance of healthy gas exchange surfaces in the lungs.

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.... [2]

(d) Row 1 and row 2 of Table 2.1 show the DNA base sequences of part of the normal *CFTR* allele and the same part of a mutated *CFTR* allele. The base sequences shown are for the DNA strands used in the synthesis of RNA. When Table 2.1 is completed, row 3 will show the base sequence of the RNA synthesised from the same part of the mutated *CFTR* allele.

Table 2.1

1	DNA base sequence of part of the normal *CFTR* allele	T	A	G	T	A	G	A	A	A	C	C	A
2	DNA base sequence of part of the mutated *CFTR* allele	T	A	G	T	A	A	C	C	A	C	A	A
3	RNA base sequence synthesised from the mutated *CFTR* allele												

(i) The difference between the DNA base sequence in row 1 and the DNA base sequence in row 2 of Table 2.1 is caused by a single gene mutation.

State the name of this type of gene mutation.

.... [1]

(ii) Row 1 and row 2 in Table 2.1 show the DNA strands used in the synthesis of RNA.

State the term used to describe the DNA strand that is used in the synthesis of RNA.

.... [1]

(iii) Complete Table 2.1 to show the missing bases in row 3. [1]

(iv) The normal *CFTR* allele is approximately 189 000 base pairs in length. The CFTR polypeptide consists of only 1480 amino acids.

Explain the reasons for this difference between the number of base pairs and the number of amino acids.

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.... [3]

[Total: 13]

3 (a) Fig. 3.1 is a diagram of an area of phloem tissue from a transverse section through the stem of a squash plant, *Cucurbita pepo*.

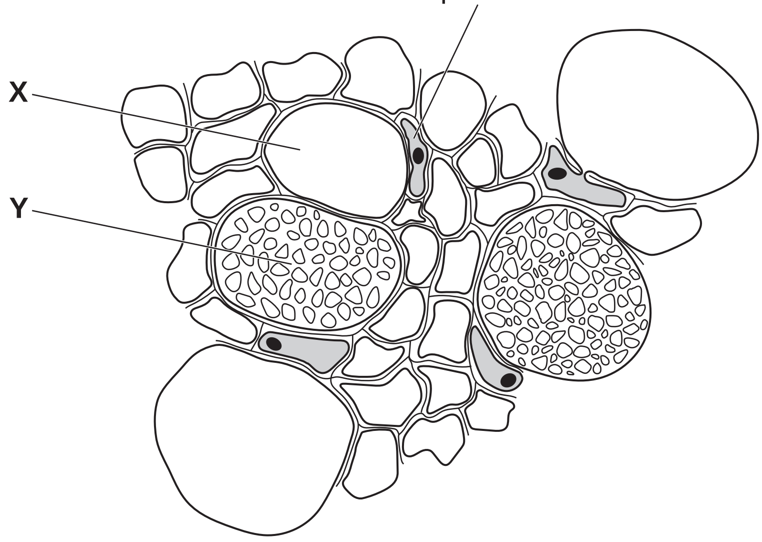

Fig. 3.1

(i) Cell **X** and cell **Y** in Fig. 3.1 are sieve tube elements.

Explain why cell **X** and cell **Y** have very different appearances in this transverse section.

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.... [2]

(ii) Sucrose is formed from the glucose synthesised by mesophyll cells in the leaves of *C. pepo.*

Explain how companion cells are involved in the transfer of sucrose into phloem sieve tubes.

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.... [4]

(b) Hydrogen bonding is important in the movement of water in xylem.

(i) Explain how hydrogen bonding occurs between two water molecules.

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.... [2]

(ii) Outline how hydrogen bonding is involved in water transport in the xylem of a plant stem.

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.... [3]

(iii) Hydrogen bonding between water molecules gives water a relatively high latent heat of vaporisation.

Suggest why it is important to plants that water has a high latent heat of vaporisation.

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.... [2]

[Total: 13]

Question 4 starts on page 12.

4 Tuberculosis (TB), influenza and polio are examples of infectious diseases.

(a) (i) Explain what is meant by an infectious disease.

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.... [2]

(ii) Name a species of organism that causes TB.

.... [1]

(b) Immunity can be described as artificial or natural **and** passive or active.

Name the type of immunity that a mother gives to her baby through breast milk.

.... [1]

(c) The influenza virus can mutate frequently to produce different strains of the virus. A new vaccine is often necessary to stimulate the production of new antibodies to these new strains.

Explain why different antibodies need to be produced to give immunity to these new strains.

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.... [3]

(d) Polio is a serious viral disease affecting young children. In 1996, polio caused paralysis in more than 75 000 children across Africa. A long-term vaccination programme allowed the World Health Organization (WHO) to declare that Africa was largely free of polio in 2020.

(i) Explain how vaccination programmes can help to control the spread of infectious diseases, such as polio.

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.... [3]

(ii) Antibiotics, such as penicillin, do **not** help to prevent the spread of viral diseases, such as polio.

Explain why penicillin is **not** effective against viruses.

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.... [1]

[Total: 11]

5 Pneumonia is a severe lung disease that can interfere with gas exchange. A person with pneumonia can be connected to an ECMO machine. This machine performs the gas exchange functions of the lungs.

A cannula (tube) is inserted into the right atrium and this takes blood to the ECMO machine. In the ECMO machine, blood is passed firstly to an artificial pump and then to an oxygenator, where gas exchange occurs. The blood is then warmed and returns by another cannula to the vena cava.

(a) Complete Fig. 5.1 to show how the ECMO machine is connected to the right atrium and to the vena cava. Use a single line to represent each cannula.

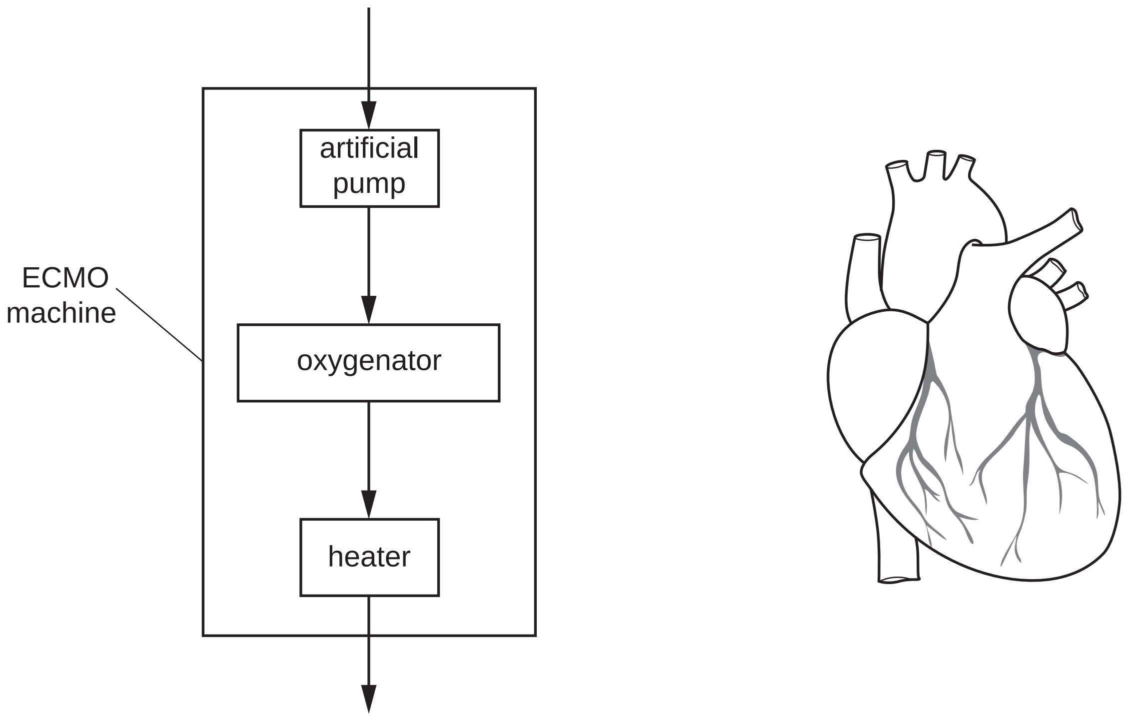

Fig. 5.1

[1]

(b) In the oxygenator, a partially permeable membrane separates the blood from air that has been enriched with extra oxygen.

(i) State the name of a structure in the gas exchange system that has the same function as the partially permeable membrane of the oxygenator.

.... [1]

(ii) In the oxygenator, blood and oxygen-enriched air flow in opposite directions.

Suggest **and** explain how the oxygenator carries out the functions of gas exchange that normally occur in the lungs.

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.... [3]

(c) Fig. 5.2 is a photomicrograph showing a transverse section of part of the human aorta.

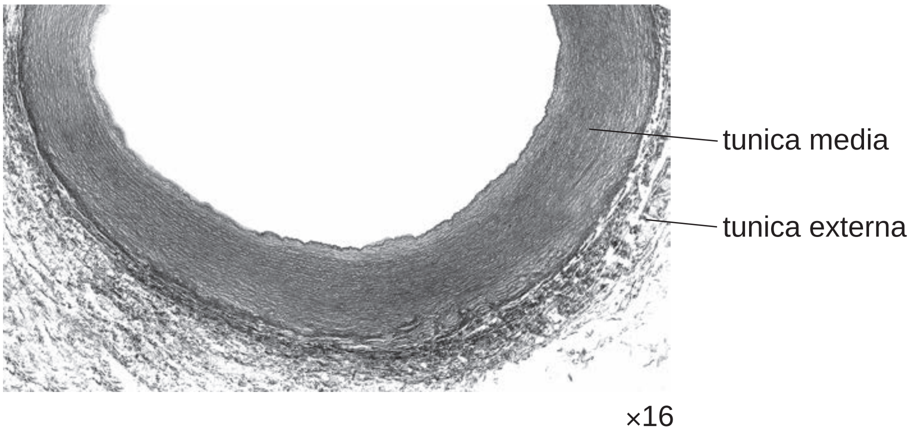

Fig. 5.2

Explain how the structure of the tunica media in Fig. 5.2 is different from the structure of the tunica media in a muscular artery **and** relate the difference to the function of the aorta.

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.... [3]

(d) Some biologists investigated the transport of carbon dioxide in the blood of *Caiman latirostris*, a type of reptile.

The biologists found that when *C. latirostris* respires:

- most of the carbon dioxide is converted into hydrogencarbonate ions in red blood cells
- the hydrogencarbonate ions combine with haemoglobin inside the red blood cells
- the hydrogencarbonate ions remain combined with haemoglobin until the blood reaches the lungs.

(i) Explain why the physiology of *C. latirostris* requires carbonic anhydrase.

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.... [1]

(ii) Explain why the physiology of *C. latirostris* does **not** require the chloride shift.

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.... [1]

[Total: 10]

Question 6 starts on page 18.

6 **(a)** Collagen is the most common structural protein in vertebrates. Collagen provides the skin with flexibility and strength.

Explain how the structure of a collagen fibre provides the skin with strength.

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.... [3]

(b) The enzyme collagenase breaks down collagen. Collagenase has several important medical uses, such as in the treatment of burnt skin.

Scientists investigated the effect of pH on the activity of collagenase at 37 °C.

The results of their investigation are shown in Fig. 6.1.

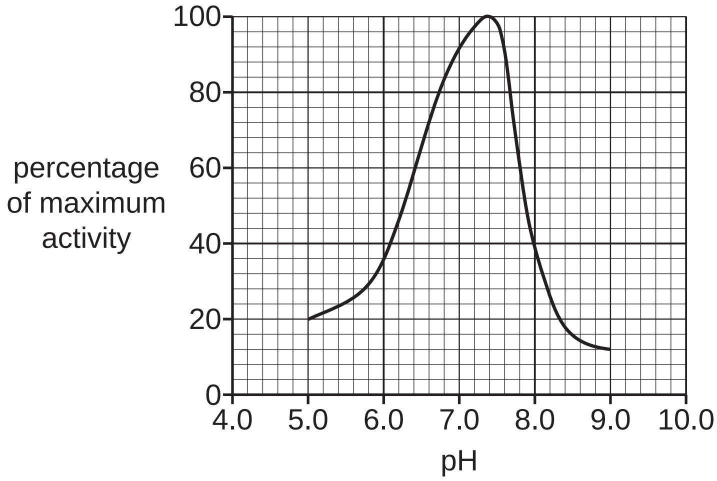

Fig. 6.1

Explain why the activity of collagenase is lower at pH 8.0 than at the optimum pH.

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.... [2]

[Total: 5]

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