Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5158650078

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 2021**

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 **16** pages. Any blank pages are indicated.

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Answer **all** questions.

1 **(a)** Fig. 1.1 is an image of a transverse section through the trachea of the gas exchange system.

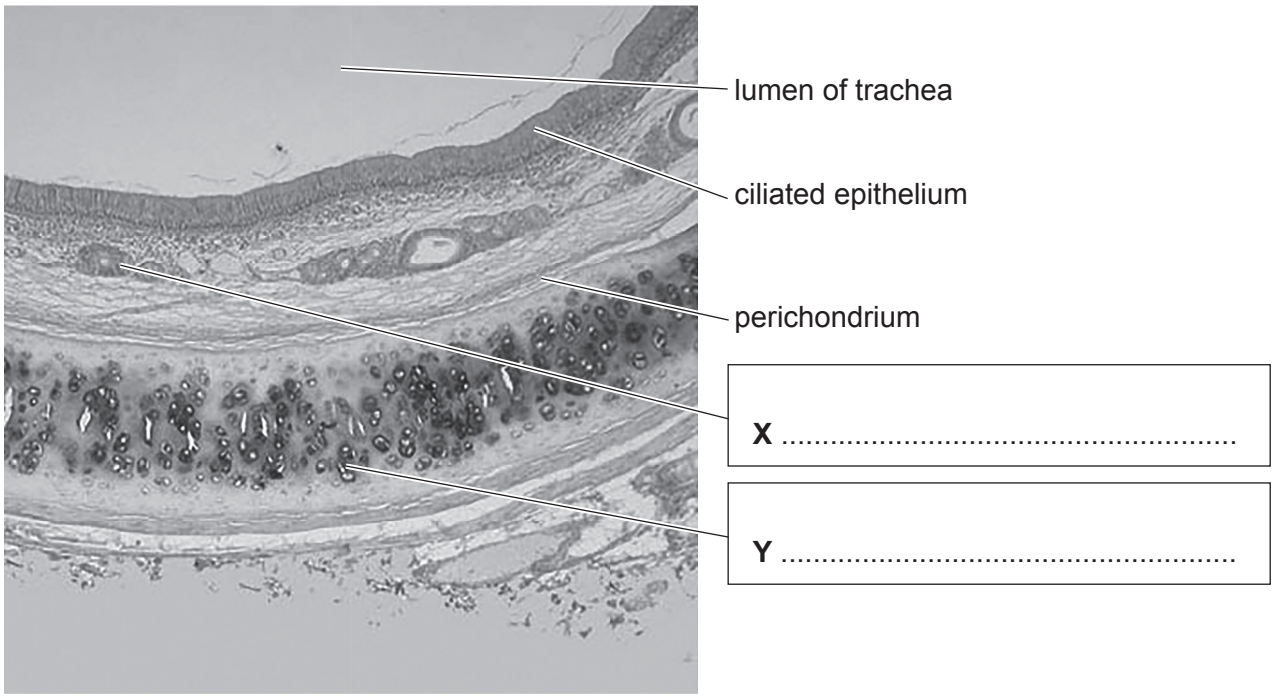


Fig. 1.1

Write the names of structures **X** and **Y** on Fig. 1.1 in the boxes provided. [2]

(b) The perichondrium contains collagen fibres, composed of collagen molecules.

Collagen is an example of one type of biological molecule.

State the name of the type of biological molecule of which collagen is an example.

..... [1]

(c) Some structures in the gas exchange system are listed in alphabetical order in Table 1.1.

- Write **YES** in the box provided if the structure contains smooth muscle.
- Write **NO** in the box provided if the structure does **not** contain smooth muscle.

Table 1.1

alveolus	
bronchiole	
bronchus	
trachea	

[1]

[Total: 4]

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2 Starch molecules are the main storage molecules in many types of cereal grain, such as the grain of the barley plant.

(a) When the seed inside a barley grain germinates, genes coding for digestive enzymes are switched on. The enzymes that are synthesised catalyse the hydrolysis of storage molecules such as proteins and starch.

(i) Explain what is meant by a gene.

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..... [2]

(ii) The hydrolysis of proteins in the barley seed produces amino acids that can be used in the synthesis of the proteins required for formation of the seedling (young plant).

Fig. 2.1 is an incomplete diagram of the molecular structure of the smallest amino acid, glycine. Each molecule of glycine has two carbon atoms.

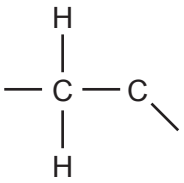


Fig. 2.1

Complete Fig. 2.1 to show the molecular structure of glycine. [2]

(iii) Starch is a mixture of two different molecules.

Name these **two** molecules.

.....

..... [1]

Two of the enzymes synthesised by the barley seed are α-amylase and maltase. These are involved in the hydrolysis of the stored starch during seedling formation.

In the food industry, the starch extracted from barley seeds (barley starch) is used in the production of sugar syrups. Fig. 2.2 summarises the reactions catalysed by α-amylase in the production of maltose syrup and by maltase in the production of glucose syrup.

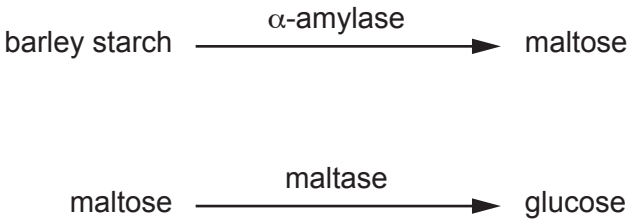


Fig. 2.2

(b) Some of the substances shown in Fig. 2.2 are listed in Table 2.1.

Complete Table 2.1 to identify which of the terms polysaccharide, monosaccharide and macromolecule apply to each of the substances listed.

Use a tick (✓) if the term applies and a cross (✗) if the term does not apply.

Put a tick (✓) or a cross (✗) in every box.

Table 2.1

substance	polysaccharide	monosaccharide	macromolecule
glucose			
maltase			
maltose			
starch			

[3]

When producing sugar syrups, there are advantages in using enzymes extracted from microorganisms.

For example, some enzymes extracted from microorganisms are heat stable. Heat-stable enzymes are used to increase productivity because the reactions can be carried out at higher temperatures.

(c) Suggest **one other** advantage of using enzymes obtained from microorganisms, rather than enzymes extracted from barley seeds, in the production of sugar syrups.

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..... [1]

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(d) Fig. 2.3 is a graph showing how the activity of α-amylase extracted from barley seeds changes as the temperature increases from 10 °C to 66 °C.

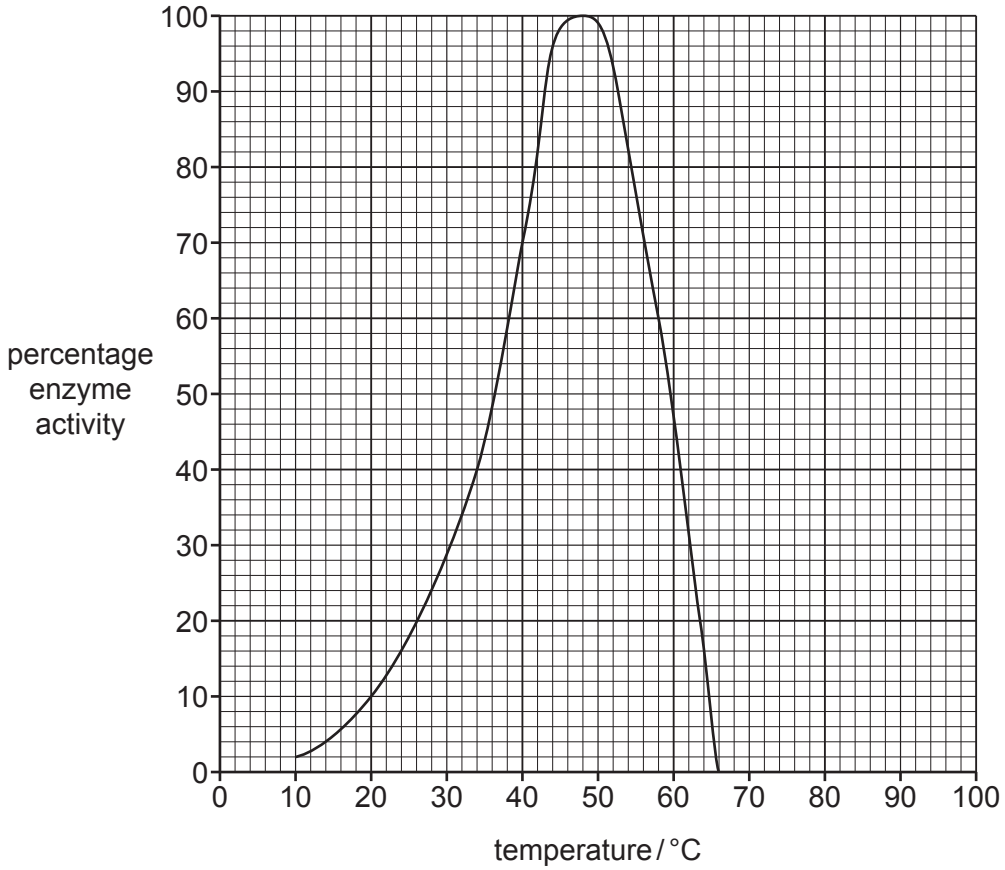


Fig. 2.3

(i) Explain the effect of temperature on the activity of α-amylase extracted from barley seeds, as shown in Fig. 2.3.

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..... [3]

(ii) Sketch on Fig. 2.3 the curve that would be obtained using α-amylase enzyme that is heat stable. [2]

[Total: 14]

3 T-helper lymphocytes and Leydig cells are two types of mammalian cells. The main role of T-helper lymphocytes and Leydig cells is to synthesise and secrete cell-signalling molecules.

- T-helper lymphocytes synthesise proteins known as cytokines.
- Leydig cells synthesise the steroid (lipid) hormone testosterone from cholesterol. Leydig cells also synthesise cholesterol.

(a) State **one** way in which cytokines are involved in an immune response.

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.....

..... [1]

(b) Fig. 3.1 shows part of a mammalian cell.

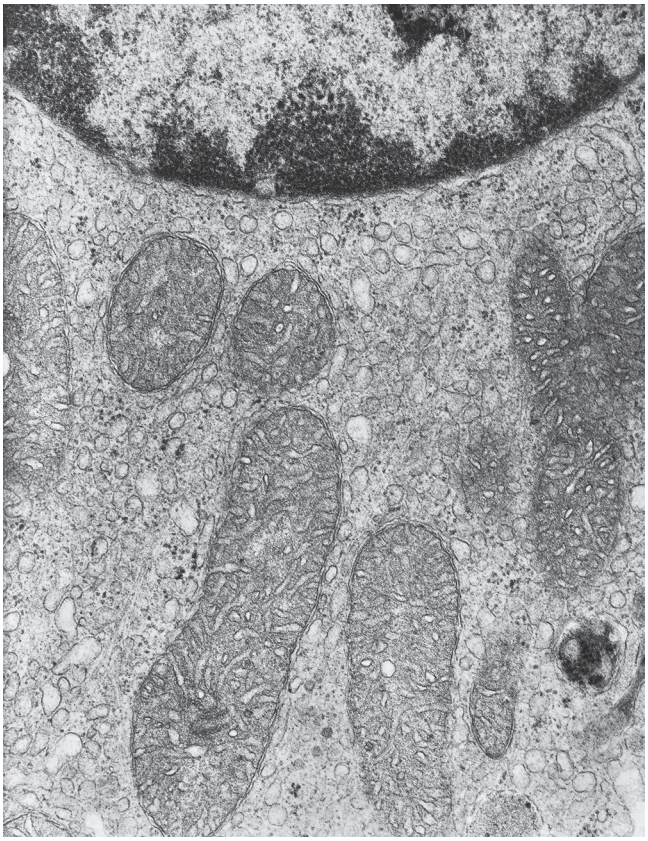


Fig. 3.1

(i) State, with reasons, whether Fig. 3.1 shows part of a Leydig cell or part of a T-helper lymphocyte.

.....

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.....

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..... [2]

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(ii) Underline the correct name for the type of image shown in Fig. 3.1 **and** explain your choice.

photomicrograph

scanning electron micrograph

transmission electron micrograph

explanation .....

.....

.....

.....

.....

[2]

(c) Testosterone molecules and cytokine molecules are transported in the circulatory system to reach their target cells. Testosterone molecules are able to enter their target cells and bind to receptors within the cytoplasm.

(i) Outline **one** way in which testosterone molecules could enter their target cells.

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..... [2]

(ii) Cytokine molecules are not able to enter their target cells.

Suggest **and** explain why cytokine molecules are **not** able to cross the cell surface membrane to enter their target cells.

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..... [2]

[Total: 9]

4 **(a)** Using a light microscope at a magnification of ×400, it is possible to identify different types of blood cell in prepared slides of mammalian blood.

Fig. 4.1 is a key to identify different types of blood cell in prepared slides of mammalian blood.

In Fig. 4.1, letters **C**, **D**, **E** and **F** represent four different types of blood cell.

key

1a nucleus present ..... go to 2
1b nucleus absent ..... **C**

2a large rounded (spherical) nucleus ..... **D**
2b nucleus not rounded ..... go to 3

3a nucleus is kidney shaped ..... **E**
3b nucleus is lobed ..... **F**

Fig. 4.1

(i) Identify the cell types **C**, **D**, **E** and **F** in Fig. 4.1.

C .....

D .....

E .....

F .....

[3]

(ii) Explain why blood taken from a person with an infectious disease may have a different number of white blood cells compared with blood taken from a healthy person.

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..... [2]

As part of a research project, a team of doctors and scientists carried out tests to investigate the effect of altitude on the ability of blood to carry oxygen. They assessed the changes in the oxygen-carrying ability of their own blood as they walked from 1530 m above sea level to 5700 m above sea level, over a period of 14 days. 5700 m above sea level is an extremely high altitude.

Table 4.1 is a summary of some of their results.

Table 4.1

	day 1 at 1530 m	**day 14 at 5700 m**
percentage saturation of haemoglobin with oxygen in blood leaving the lungs	95	82
volume of oxygen delivered to tissues by 100 cm^3 of blood / cm^3	19.3	19.2

(b) Compare the results for day 1 with the results for day 14 in Table 4.1 **and** explain the results shown for **day 14**.

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..... [4]

(c) The results of the research project have led to an improved understanding of diseases such as sickle cell anaemia.

Explain why sickle cell anaemia is an example of a disease.

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..... [2]

[Total: 11]

5 Each meristem cell in a leaf bud is able to grow and divide by mitosis to produce two daughter cells that are genetically identical to each other and to the original dividing cell.

(a) Fig. 5.1 lists the stages in the mitotic cell cycle of a meristem cell.

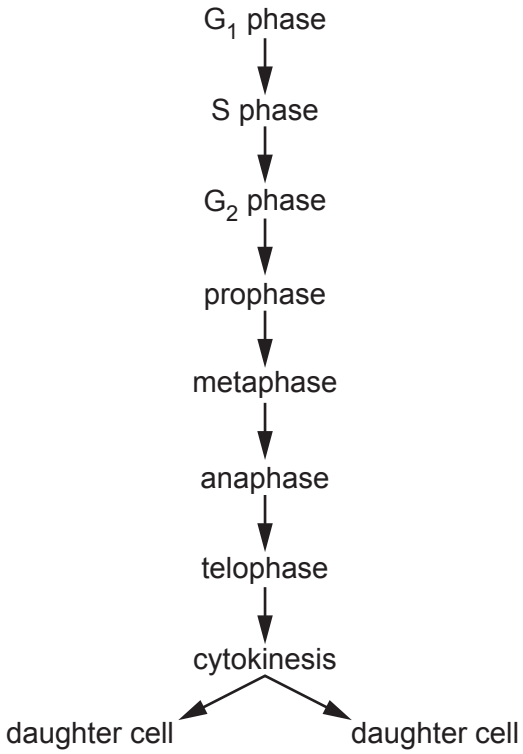


Fig. 5.1

(i) Outline **and** explain the events occurring during S phase, metaphase and anaphase of the mitotic cell cycle that are important in the production of genetically identical daughter cells.

S phase .....

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metaphase .....

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anaphase .....

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[4]

(ii) Immediately after cytokinesis, daughter cells are **not** identical even though they are genetically identical.

Suggest a reason why daughter cells are **not** identical immediately after cytokinesis.

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..... [1]

(b) Some of the cells resulting from mitotic division in the young leaf form elongated cells that develop into xylem vessel elements. The xylem vessel elements are joined end to end to form xylem vessels.

(i) Suggest the structural changes that occur when elongated cells develop into xylem vessel elements **and** explain how these changes help xylem vessels to perform their function in transport.

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..... [4]

(ii) Fig. 5.2 is a plan diagram of a transverse section through a dicotyledonous leaf.

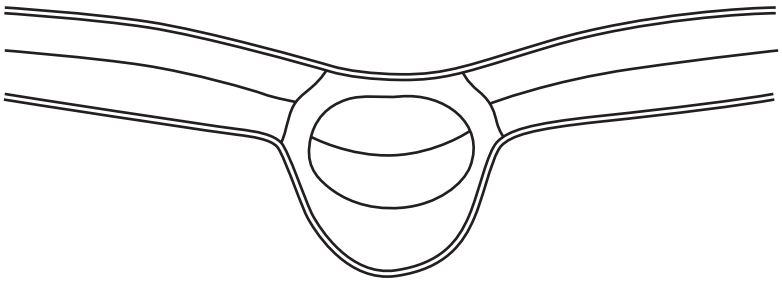


Fig. 5.2

Add a label line and the letter **X** to Fig. 5.2 to identify the location of xylem tissue. [1]

[Total: 10]

6 In March 2019, a tropical cyclone in the south-west Indian Ocean caused widespread flooding in a number of countries.

The flooding and the damage caused by the cyclone meant that many people were at serious risk of cholera.

After the natural disaster occurred, many different areas reported outbreaks of cholera. Within a short time the disease had spread widely and large numbers of people were affected.

(a) Cholera is caused by a bacterial pathogen.

Name the bacterial pathogen that causes cholera.

..... [1]

(b) Suggest **and** explain why the people affected by the cyclone were at serious risk of cholera.

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..... [3]

(c) In addition to the standard treatment for cholera, antibiotics are recommended for people who are moderately ill or seriously ill with the disease.

(i) Doxycycline is one of the main antibiotics used for the treatment of cholera.

Doxycycline enters the pathogen and binds to one of the subunits of the bacterial ribosome. This prevents growth and reproduction of the bacterial cell.

Suggest **and** explain how binding of doxycycline to ribosomes stops growth of the bacterial cell.

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..... [3]

(ii) Penicillin, which used to be prescribed for the treatment of cholera, has a different mechanism of action to doxycycline.

State which part of the bacterial cell is affected by the action of penicillin.

..... [1]

(d) Mozambique was one of the countries badly affected by the cyclone.

As part of the effort to prevent a greater number of cases of cholera from occurring, two different approaches were taken.

- Approximately 900 000 doses of the oral cholera vaccine were sent to Mozambique and a large-scale vaccination programme was organised.
- Medical centres were set up in Mozambique to treat people with cholera.

Suggest **and** explain how the **two** different approaches helped to prevent a greater number of cases of cholera from occurring.

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..... [4]

[Total: 12]

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