Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1991982440

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 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 The Golgi body, rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER) form part of the internal membrane system of a cell. The membranes have a fluid mosaic structure.

Fig. 1.1 is a transmission electron micrograph of one area of a liver cell showing a region with RER and a region with SER. Mitochondria are also visible in the image.

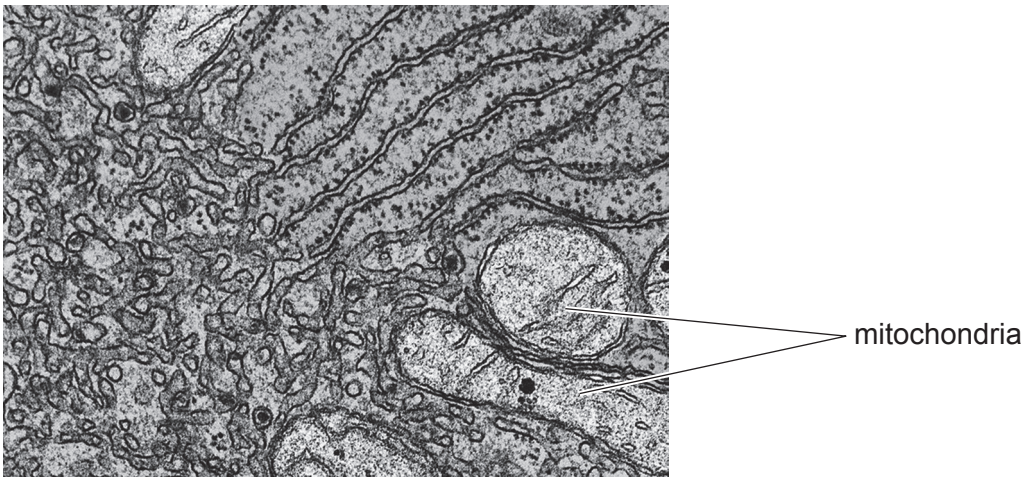


Fig. 1.1

(a) Describe the differences in structure **and** function between RER and SER.

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..... [3]

(b) Phospholipids are one of the main components of membranes.

Describe the structure of a phospholipid molecule.

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..... [2]

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(c) One function of a Golgi body is to package molecules into Golgi vesicles.

(i) A Golgi body and Golgi vesicles are **not** visible in Fig. 1.1.

Describe the features, **other than** the presence of Golgi vesicles, that would help you identify a Golgi body in a transmission electron micrograph of another area of the same liver cell.

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..... [2]

(ii) Some Golgi vesicles contain secretory proteins for release from the cell.

Describe the sequence of events that occurs following the packaging of a secretory protein into a Golgi vesicle to its release from the cell.

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..... [3]

(iii) Some Golgi vesicles contain glycoproteins or glycolipids to be added to the cell surface membrane.

Outline the role of **glycolipids** in the cell surface membrane.

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..... [1]

[Total: 11]

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[Turn over

2 Smallpox, measles and HIV/AIDS are infectious diseases caused by different viruses. These different viruses share some structural features.

(a) State **one** structural feature that would confirm that a pathogen is a virus.

..... [1]

(b) The virus that causes smallpox belongs to a different genus to the virus that causes measles.

Name the viruses that cause these diseases.

smallpox .....

measles ..... [2]

(c) Explain why antibiotics, such as penicillin, **cannot** be used to treat measles.

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..... [2]

(d) Antibiotics may be prescribed for a person with HIV/AIDS.

Suggest why antibiotics may be prescribed for a person with HIV/AIDs.

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..... [1]

(e) Smallpox is the only infectious disease of humans that has been globally eradicated. This eradication was due mainly to a successful global vaccination programme. Most people who were given the vaccine gained immunity to the disease.

A student correctly listed four reasons for the success of the global vaccination programme for smallpox. These reasons are listed in Fig. 2.1.

- The virus did not mutate.
- A live virus, closely related to the smallpox virus, was used in the vaccine.
- The vaccine was freeze-dried and so was thermostable (heat stable).
- The vaccine was easy to administer (give), so little training was required.

Fig. 2.1

(i) Discuss how the reasons listed in Fig. 2.1 contributed to the success of the eradication of smallpox.

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..... [4]

(ii) Table 2.1 lists four types of immunity.

Complete each row of Table 2.1 with a tick (✓) or a cross (✗) to summarise the types of immunity gained by a person who received the smallpox vaccine.

Table 2.1

type of immunity	**gained (✓) not gained (✗)**
active immunity	
artificial immunity	
natural immunity	
passive immunity	

[1]

[Total: 11]

3 HIV protease is an enzyme composed of two identical polypeptide chains. Each polypeptide chain is 99 amino acids long. During translation, the amino acids are joined by peptide bonds to form the polypeptide chain.

(a) Describe how a polypeptide of HIV protease is produced by the process of translation.

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..... [4]

(b) The synthesised polypeptide has a primary protein structure and can form a tertiary protein structure after translation. There are more bond types in the tertiary structure.

Compare the peptide bond formed during translation with the types of bond made during tertiary structure formation.

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..... [3]

(c) Some polypeptides are translated as part of one long polyprotein chain. After translation, enzymes cut the polyprotein into separate functioning proteins.

HIV protease cuts a polyprotein that has been produced within the host cells of actively replicating HIV. The separate proteins are required in the replication of the virus.

Fig. 3.1 shows how the two polypeptide chains of HIV protease form an enzyme with an active site enclosed by flaps, forming the flap region.

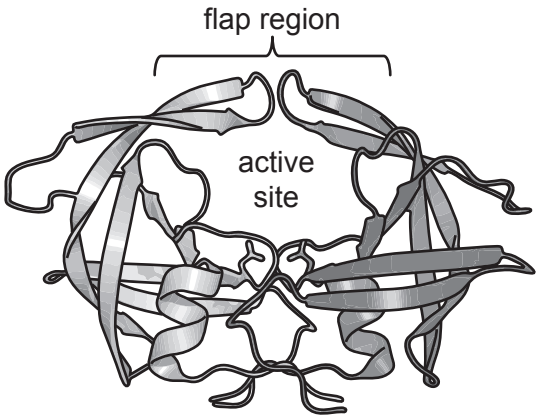


Fig. 3.1

(i) The flap region of HIV protease is flexible.

With reference to Fig. 3.1, suggest **and** explain how the mechanism of action of HIV protease can be described as an induced fit.

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..... [3]

(ii) Indinavir is one of the therapeutic drugs used in HIV anti-retroviral therapy (ART). It is similar to the polyprotein substrate of HIV protease.

Suggest **and** explain how indinavir acts as a therapeutic drug.

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..... [2]

[Total: 12]

4 Phloem sap is transported within phloem sieve tubes.

(a) Monosaccharides and disaccharides are transported as part of phloem sap, but polysaccharides are not components of phloem sap.

Define the terms disaccharide **and** polysaccharide.

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..... [2]

(b) Sieve tubes are composed of phloem sieve tube elements.

Fig. 4.1 is a diagram of one sieve tube element and its companion cell.

Some of the structural features of the sieve tube element have not been included in the diagram.

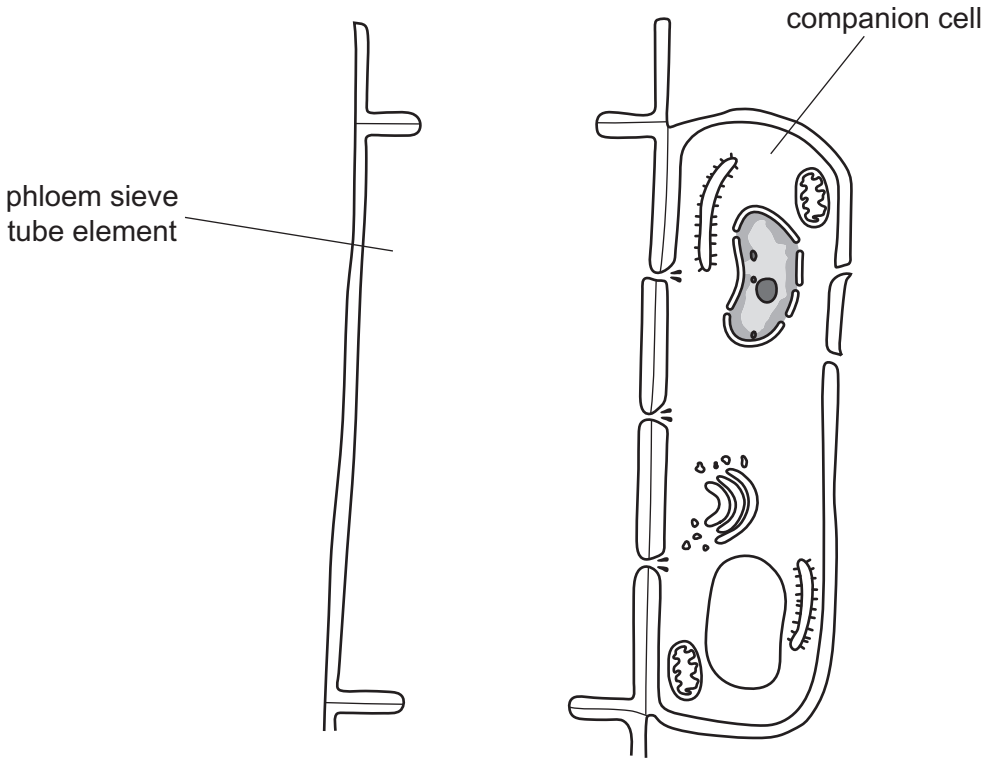


Fig. 4.1

(i) Complete Fig. 4.1 by drawing **and** labelling the structural features of the sieve tube element that have not been included in the diagram. [3]

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(ii) A pressure gradient in a sieve tube causes the mass flow of phloem sap from the source to the sink.

At the source, a decrease in water potential in the phloem sap and an increase in the hydrostatic pressure of the phloem sap can be measured.

Describe the events that cause each of these changes in the phloem sap.

decrease in water potential .....

.....

.....

increase in hydrostatic pressure .....

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..... [2]

[Total: 7]

5 **(a)** Fig. 5.1 shows four types of cell that can be seen in a prepared slide of blood taken from a mammal.

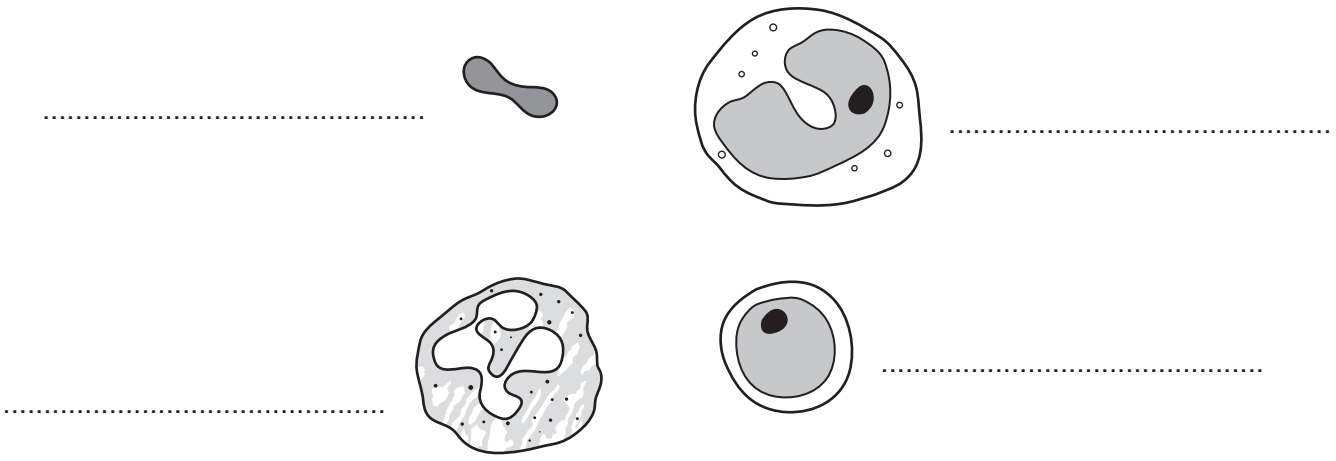


Fig. 5.1

Identify the four types of cell shown in Fig. 5.1.

Write the name of the cell type on the answer line provided by each cell in Fig. 5.1. [4]

(b) During systole and diastole of the cardiac cycle, changes in blood pressure occur in the four chambers of the heart.

Fig. 5.2 shows changes in the blood pressure in the **left** side of the heart and the aorta during one cardiac cycle.

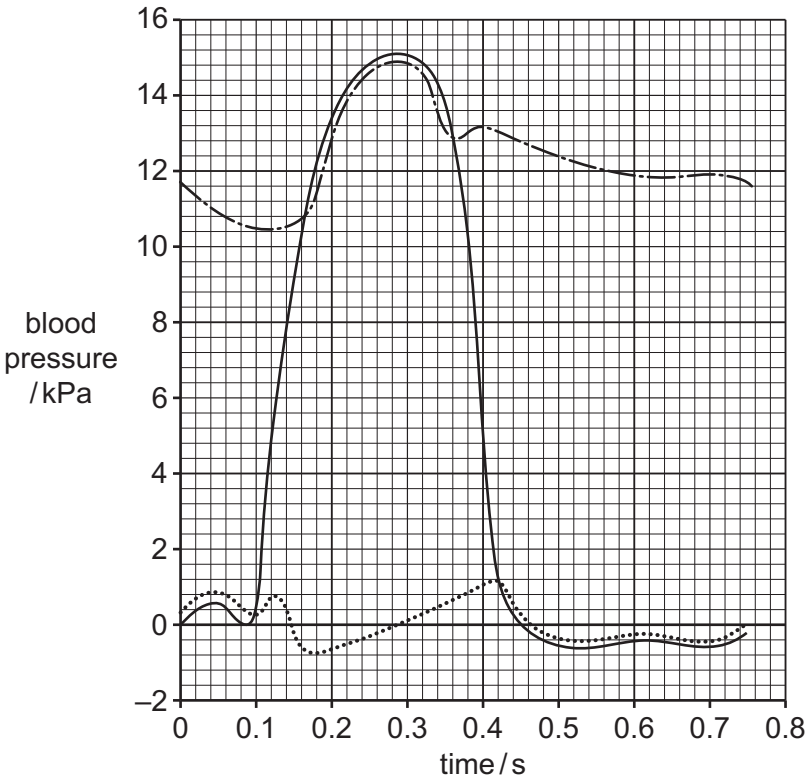


Fig. 5.2

With reference to the blood pressure changes shown in Fig. 5.2:

- state the maximum blood pressure reached in the left ventricle ..... kPa
- state the time at which the bicuspid (left atrioventricular) valve closes. ..... s

[2]

(c) Chronic obstructive pulmonary disease (COPD) can cause a condition known as pulmonary hypertension. This involves an increase in systolic blood pressure in the right ventricle and in the pulmonary arteries.

Fig. 5.3 is a summary of some of the events that can result from COPD.

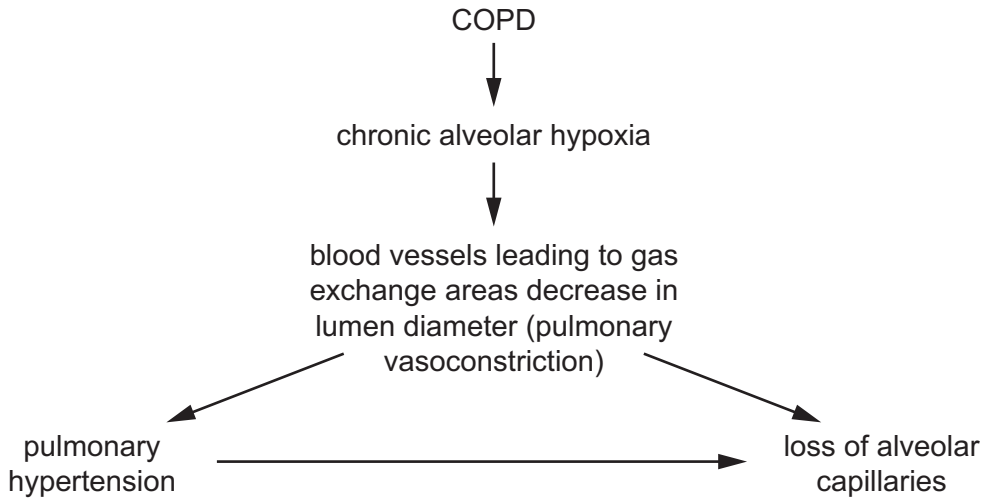


Fig. 5.3

(i) Chronic alveolar hypoxia describes a condition where the partial pressure of oxygen in the gas exchange regions of the lungs is always lower than normal.

Explain how COPD leads to chronic alveolar hypoxia.

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..... [3]

(ii) Explain how the loss of alveolar capillaries affects the functioning of the lungs in a person with COPD.

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..... [2]

[Total: 11]

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6 The best time to obtain a clear image of chromosomes during a mitotic cell cycle is during the metaphase stage.

Fig. 6.1 is a scanning electron micrograph of a group of human chromosomes at metaphase.

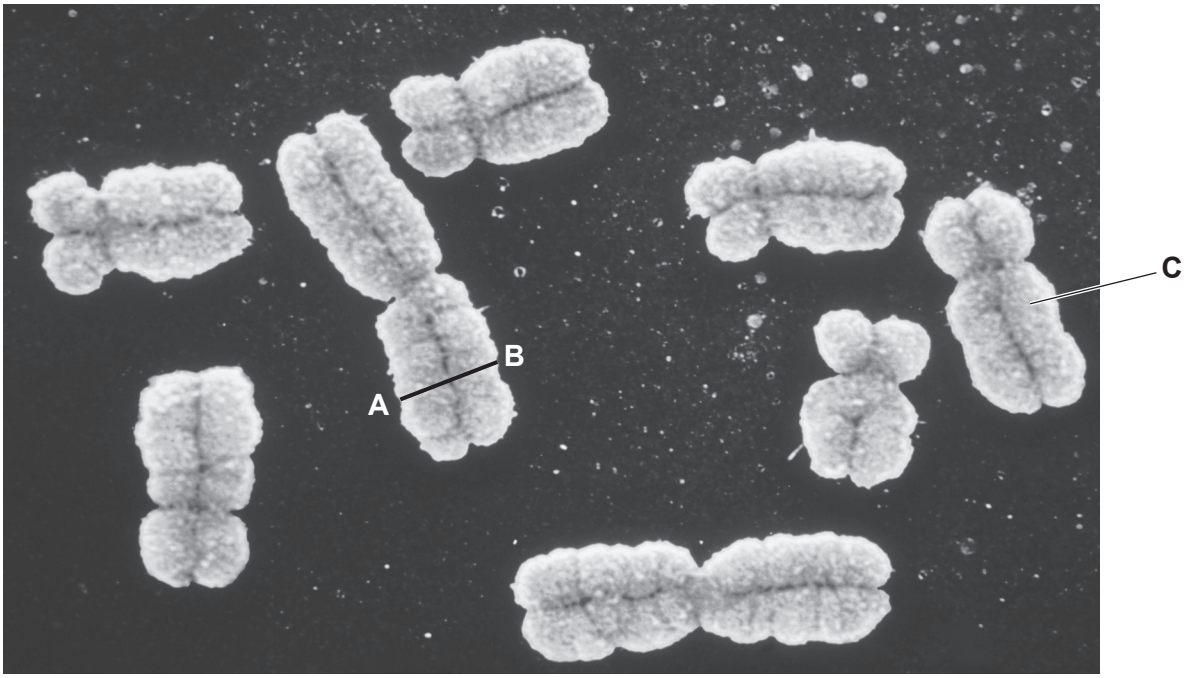


Fig. 6.1

(a) The group of chromosomes shown in Fig. 6.1 is magnified many times.

The actual width of the human chromosome between **A**—**B** is 1400 nm.

Calculate the magnification of the scanning electron micrograph shown in Fig. 6.1.

magnification × .....

[2]

(b) Draw chromosome **C** in Fig. 6.1 in the space provided.

Label your drawing to show the structure of the chromosome.

[4]

(c) Suggest why the metaphase stage is the best time during a mitotic cell cycle to obtain a clear image of chromosomes.

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..... [1]

(d) Name the stage of mitosis that immediately follows metaphase.

..... [1]

[Total: 8]

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