Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

9211408766

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2024**

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.

[Turn over

1 The Zika virus is a pathogen that can infect human cells.

(a) Fig. 1.1 is a drawing of the structure of a Zika virus.

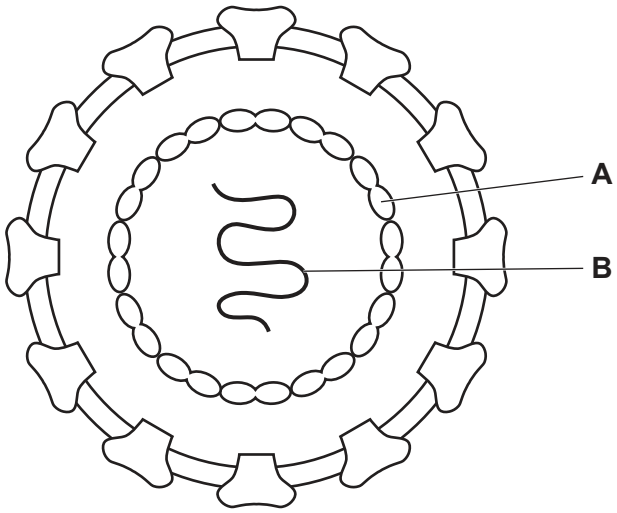


Fig. 1.1

(i) In Fig. 1.1, structure **A** is made of protein.

Name structure **A**.

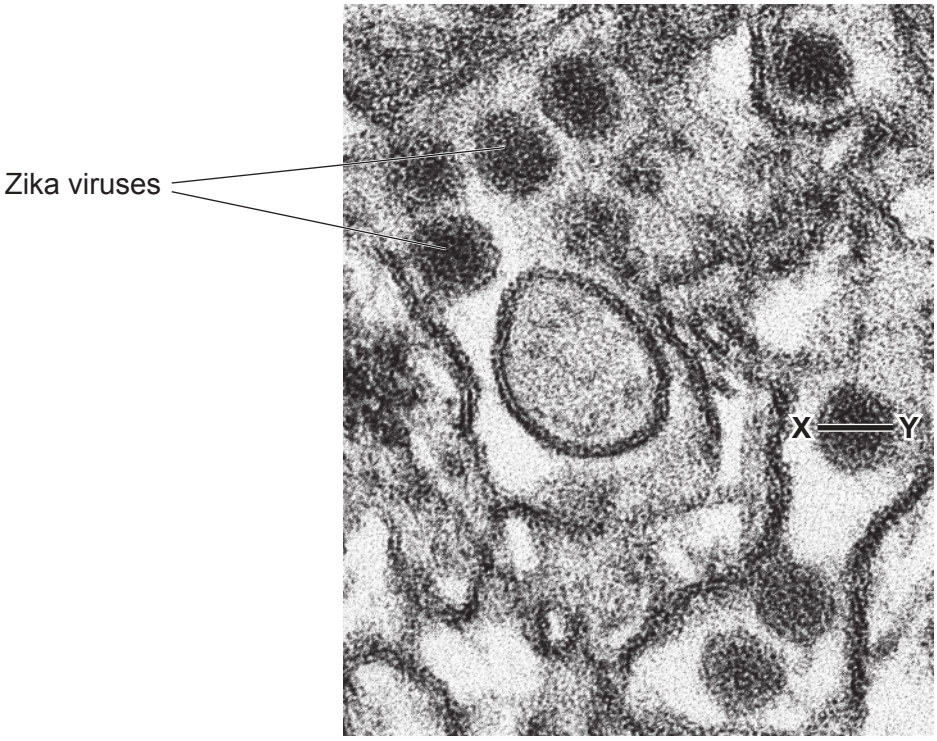
..... [1]

(ii) In Fig. 1.1, structure **B** is a single-stranded molecule.

Suggest the name of structure **B**.

..... [1]

(b) Fig. 1.2 is a transmission electron micrograph of human kidney cells infected with Zika viruses.



magnification ×200 000

Fig. 1.2

(i) Calculate the actual diameter of a Zika virus using the line **X**–**Y** in Fig. 1.2.

Show your working.

Give your answer in nanometres (nm).

diameter = ... nm [2]

(ii) A magnification of ×200 000 cannot be achieved by a light microscope. The resolution of a transmission electron microscope is also higher than a light microscope.

Describe what is meant by the resolution of a microscope.

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..... [1]

(c) The vector for Zika virus is the mosquito *Aedes aegypti*. The mosquito feeds on the blood of an infected person and transmits the virus to another person when it feeds again.

Describe the similarities and differences between the transmission of Zika virus disease and the transmission of malaria.

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..... [3]

(d) Zika virus vaccines have been developed by scientists.

One of the vaccines contains small proteins from the Zika virus.

(i) Explain how giving this vaccine to a person can lead to the development of long-term immunity against Zika virus disease.

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..... [4]

(ii) Explain how a vaccination programme may limit the spread of Zika virus disease through a population.

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..... [2]

[Total: 14]

2 Collagen is a fibrous protein that is found in many tissues in animals.

(a) Describe the structure of a collagen molecule **and** the structure of a collagen fibre.

collagen molecule .....

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collagen fibre .....

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[5]

(b) Some amino acids in collagen can be modified to improve the stability of the protein. For example, the amino acid lysine can be modified to form hydroxylysine.

Fig. 2.1 shows a disaccharide bonded to the amino acid hydroxylysine in a collagen molecule. The disaccharide is made from two monosaccharides, which are indicated by the labels **D** and **E** in Fig. 2.1.

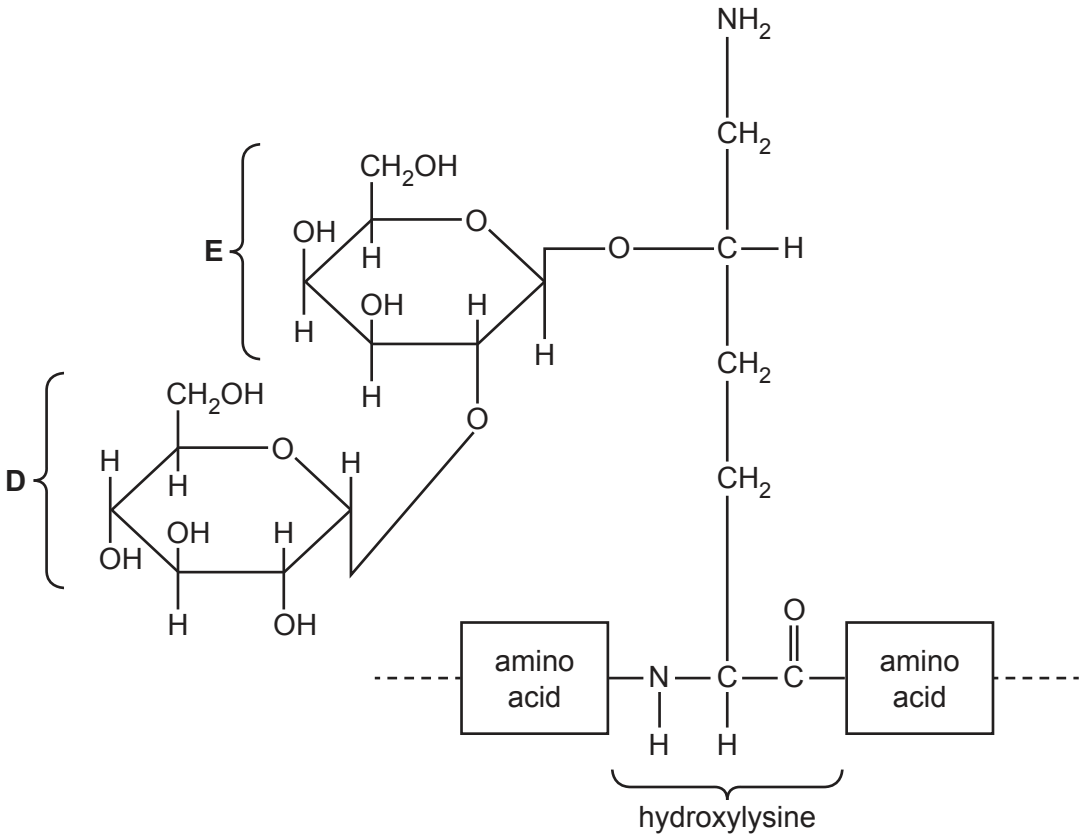

Fig. 2.1

(i) Give the precise name of the monosaccharide labelled **D** in Fig. 2.1.

..... [1]

(ii) On Fig. 2.1, label the glycosidic bond with the letter **G**.

Write your answer on Fig. 2.1. [1]

(iii) On Fig. 2.1, draw a circle around the R group of hydroxylysine and label the circle with the letter **R**.

Write your answer on Fig. 2.1. [1]

(c) Osteogenesis imperfecta is a disease that results from a deficiency in collagen.

Suggest how a **named** tissue or structure is affected in a person who has this disease.

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..... [2]

[Total: 10]

3 Arteries, capillaries and veins are three types of blood vessel.

(a) Table 3.1 shows some features of these three types of blood vessel.

Complete Table 3.1 by using a tick (✓) if the feature is present in the blood vessel and a cross (✗) if the feature is absent from the blood vessel.

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

Table 3.1

feature	artery	capillary	vein
smooth muscle			
endothelium			
tunica media			

[3]

(b) Fig. 3.1 shows a transmission electron micrograph of part of an alveolus and part of the adjacent capillary.

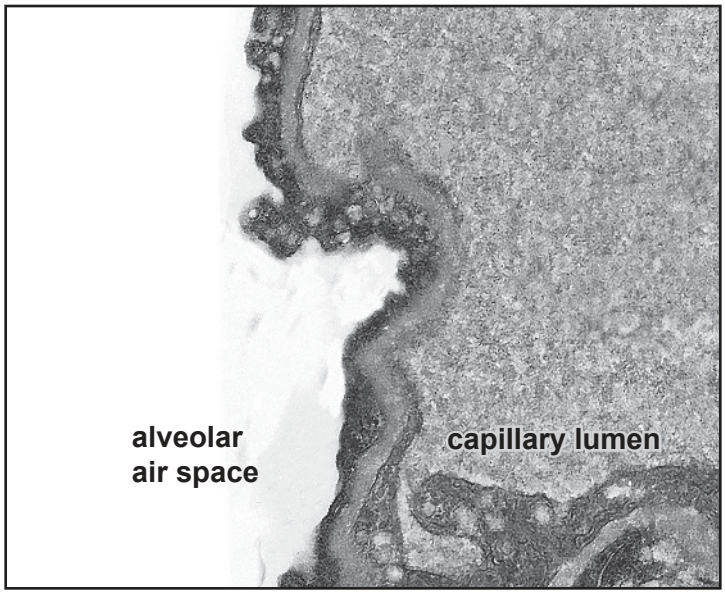

Fig. 3.1

(i) Draw **two** labelled arrows on Fig. 3.1 to show the direction of movement of oxygen and the direction of movement of carbon dioxide during gas exchange in the lungs. [1]

(ii) Suggest **and** explain how a steep oxygen concentration gradient is maintained in the lungs.

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..... [4]

(c) The passage outlines the roles of blood vessels associated with the heart.

Complete the passage by using the most appropriate scientific terms.

The ……. carries blood to the left atrium. After passing from the left atrium to the left ventricle, blood is pumped into the aorta. The aorta is one of two large arteries that carry blood away from the ventricles of the heart. Blood that leaves the heart to enter these arteries must pass through the ……. valves.

Oxygenated blood is supplied to the cardiac muscle cells through the

……. arteries.

[3]

[Total: 11]

4 Lignin and suberin are polymers that are present in plant tissues.

(a) Describe **and** explain the roles of lignin and suberin in the transport of water through the roots and stem of a plant.

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..... [4]

(b) The enzyme laccase catalyses the formation of lignin in plants.

Fig. 4.1 is a diagram of the mode of action of laccase.

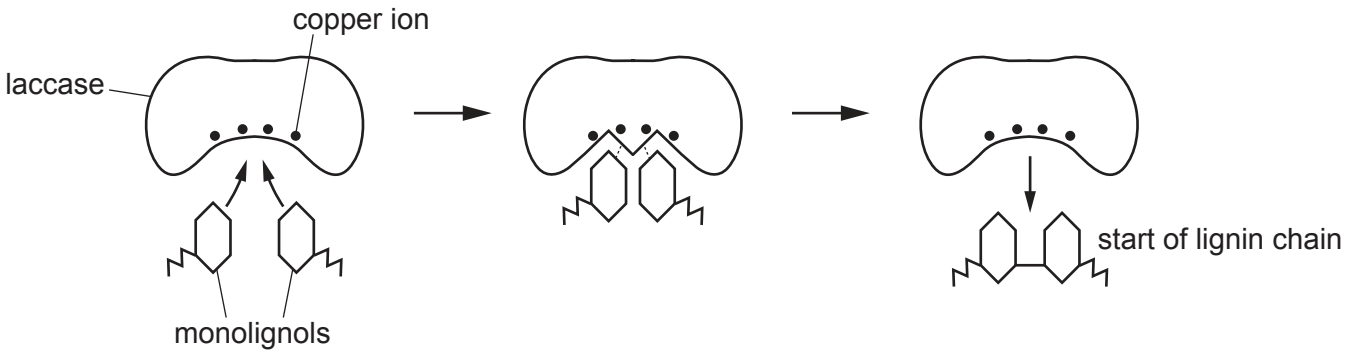

Fig. 4.1

Describe **and** explain the mode of action of laccase when catalysing the formation of lignin.

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..... [5]

[Total: 9]

5 Cyclin-dependent kinases (CDKs) are enzymes that regulate the cell cycle.

(a) Cell signalling by ligands causes the activation of CDKs in target cells.

Outline the main stages in the process of cell signalling by ligands that can cause specific responses in target cells.

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..... [2]

(b) The activity of CDKs is reduced by CDK inhibitors. Many of these inhibitors occur naturally in cells.

Fig. 5.1 is a diagram of a CDK inhibitor binding to a CDK molecule.

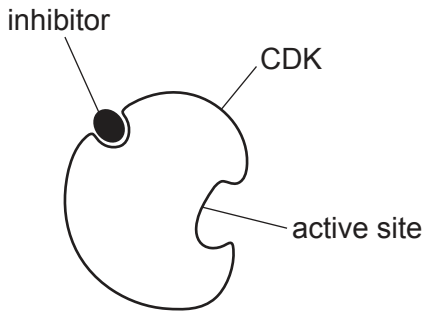

Fig. 5.1

State **and** explain how the CDK inhibitor in Fig. 5.1 prevents the activity of the CDK molecule.

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..... [2]

(c) Table 5.1 lists three different CDKs, their roles in the cell cycle and molecules that inhibit them.

Table 5.1

name of CDK	role of CDK in the cell cycle	CDK inhibitor
CDK1	regulates cell progression from G_2 to mitosis	RO-3306
CDK2	regulates the processes of the S phase	p21Cip1
CDK4	regulates cell progression from G_1 to the S phase	palbociclib

(i) With reference to Table 5.1, state which CDK inhibitor is likely to result in a cell containing **one** chromatid per chromosome. Explain your answer.

inhibitor .....

explanation .....

.....

[2]

(ii) With reference to Table 5.1, state which CDK inhibitor is likely to result in a cell with:

- a relatively high concentration of mitochondria
- **two** chromatids per chromosome.

Explain your answer.

inhibitor .....

explanation .....

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[2]

(d) Scientists have developed CDK inhibitors that are synthetic.

Explain why CDK inhibitors can be used to treat cancerous tumours.

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..... [2]

[Total: 10]

6 DNA and RNA are polynucleotides.

(a) Describe **three** ways in which the structure of messenger RNA (mRNA) differs from the structure of DNA.

In each of your answers, include information about the structure of mRNA **and** the structure of DNA.

1 .....

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2 .....

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3 .....

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[3]

(b) Scientists have synthesised four synthetic bases, Z, P, S and B. The base pairings of the synthetic bases are shown in Fig. 6.1.

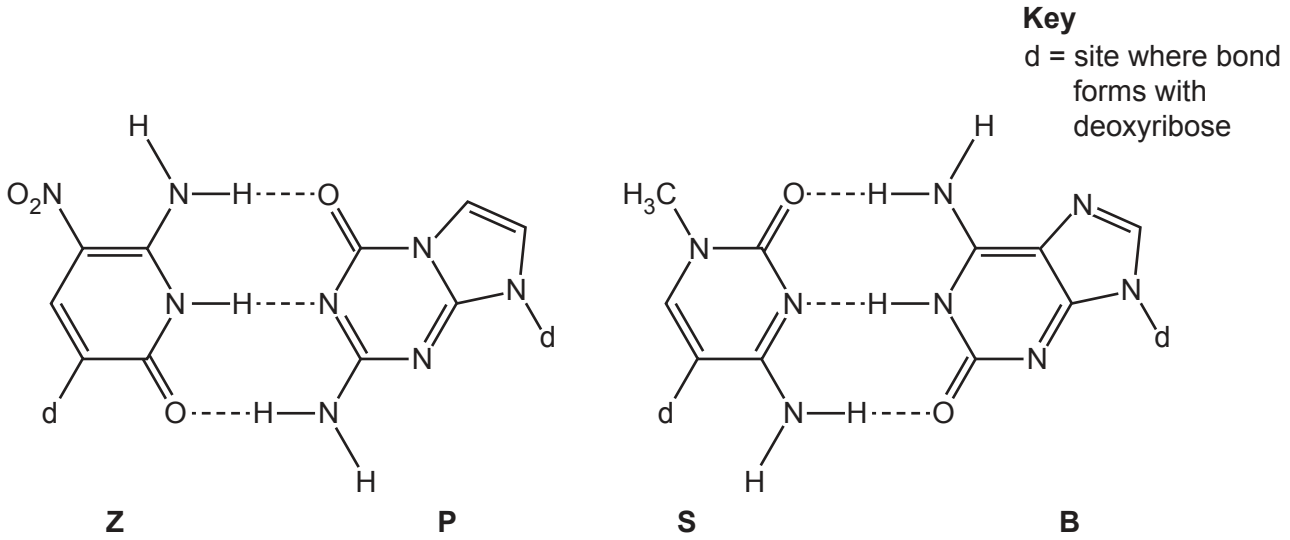

Fig. 6.1

(i) State the letters that represent the two purine synthetic bases in Fig. 6.1.

..... [1]

(ii) State **and** explain which DNA base pair is most similar to the synthetic base pairs in Fig. 6.1.

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..... [2]

[Total: 6]

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