Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0123456789

BIOLOGY **9700/02**

Paper 2 AS Level Structured Questions **For examination from 2022**

SPECIMEN PAPER **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 **14** pages. Blank pages are indicated.

1 Fig. 1.1 is an electron micrograph of part of a eukaryotic cell.

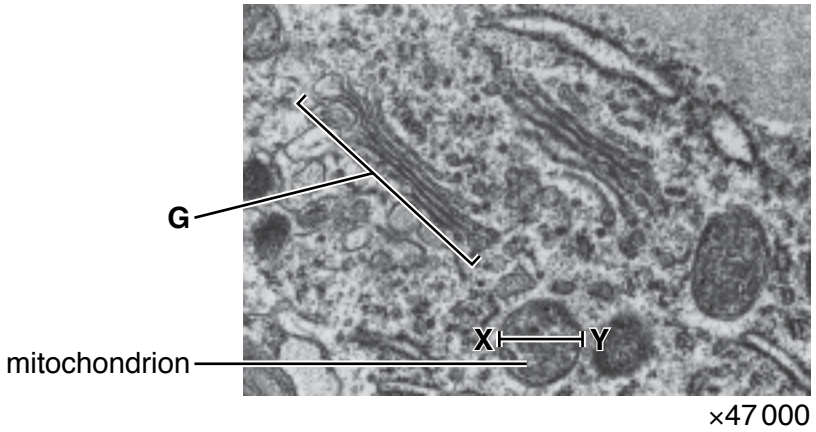

Fig. 1.1

(a) State how it is possible to deduce that Fig. 1.1 is a transmission electron micrograph and **not** a scanning electron micrograph.

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..... [1]

(b) Both the Golgi body and the rough endoplasmic reticulum are part of the network of membranes inside cells.

Outline structural features shown in Fig. 1.1 that identify **G** as the Golgi body and **not** the rough endoplasmic reticulum.

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..... [2]

(c) Calculate the actual diameter, **X–Y**, of the mitochondrion labelled in Fig. 1.1.

Write down the formula that you will use to make your calculation. Give your answer to the nearest whole **nanometre** (nm).

formula

actual diameter = ... nm [2]

(d) Many of the cell structures in Fig. 1.1 are surrounded by membranes.

Membranes are approximately 6 nm to 7 nm wide.

(i) Describe the fluid mosaic model of membrane structure.

There is space below for a diagram.

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..... [3]

(ii) The inner membrane of the mitochondrial envelope is much less permeable than the outer membrane.

Suggest **one** way in which the structure of the inner membrane of the mitochondrion may differ from that of the outer membrane to produce a **less permeable** inner membrane.

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..... [1]

[Total: 9]

[Turn over

2 The main cause of tuberculosis (TB) in humans is the bacterium *Mycobacterium tuberculosis*. Most cases of the disease involve the lungs. The bacterium can enter cells and remain inactive in a dormant state. However, the bacterium can become active to produce symptoms of the disease.

In a person with active TB, the pathogen can be present in airborne droplets that are exhaled. Generally, a healthy person who inhales these droplets has effective defence mechanisms in the gas exchange system to prevent infection.

(a) One example of a defence mechanism against pathogens in the gas exchange system involves the action of macrophages.

(i) Describe the mode of action of a macrophage against a bacterial cell.

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..... [3]

(ii) Sometimes *M. tuberculosis* survives within a macrophage instead of being destroyed by the macrophage.

Suggest one way in which *M. tuberculosis* may survive within a macrophage.

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..... [1]

(b) A healthy person has other defence mechanisms in the gas exchange system to prevent bacteria entering cells.

Describe these defence mechanisms **and** explain how bacteria in inhaled air are prevented from entering cells of the gas exchange system.

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..... [3]

(c) In people with a weakened immune system, *M. tuberculosis* can infect other organs and tissues, such as the kidneys and joints.

Suggest how the bacteria may spread from the lungs to other organs and tissues.

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..... [1]

(d) TB in humans can be caused by another species of bacterium, *M. bovis*.

State the mode of transmission of this pathogen to humans.

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..... [1]

[Turn over

(e) Rifampicin is one antibiotic that can be used to kill mycobacterial cells. Although rifampicin is very effective at killing mycobacterial cells, it is often the first antibiotic to which resistance develops.

Rifampicin binds to a section of RNA polymerase that has attached to the DNA template strand.

Explain how binding to RNA polymerase allows rifampicin to kill mycobacterial cells.

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..... [2]

The standard treatment for TB continues for six months. Initially, four antibiotics are prescribed. This is then reduced to two of the four antibiotics, rifampicin and isoniazid, if the person responds to treatment.

A person with multidrug-resistant TB (MDR-TB) does not respond to treatment with rifampicin and isoniazid. The treatment for MDR-TB involves other antibiotics and can last for up to 30 months.

Table 2.1 shows the number of reported cases of TB and MDR-TB in the South-East Asia region between 2005 and 2014, as published by the World Health Organization (WHO).

Table 2.1

year	total number of reported cases of TB	total number of reported cases of MDR-TB
2005	1 947 603	68
2006	2 104 673	779
2007	2 202 149	918
2008	2 287 803	1 717
2009	2 328 230	2 560
2010	2 332 779	4 263
2011	2 358 127	6 615
2012	2 331 455	14 957
2013	2 297 033	18 384
2014	2 580 605	17 386

Table 2.1 shows that between 2005 and 2014 there is an overall increase in the total number of reported cases for both TB and MDR-TB.

(f) Describe the **differences** between the trend in the total number of reported cases for TB and the trend in the total number of reported cases of MDR-TB, as shown in Table 2.1.

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..... [2]

(g) Many social and economic factors need to be considered in the prevention and control of MDR-TB.

Outline **three** of these factors.

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..... [3]

[Total: 16]

3 The unicellular fungus *Kluyveromyces lactis* is found in dairy products. It is a safe microorganism to culture for the extraction of the enzyme lactase.

Lactase catalyses the breakdown of lactose, a sugar found in milk.

The reaction catalysed by lactase is summarised in Fig. 3.1.

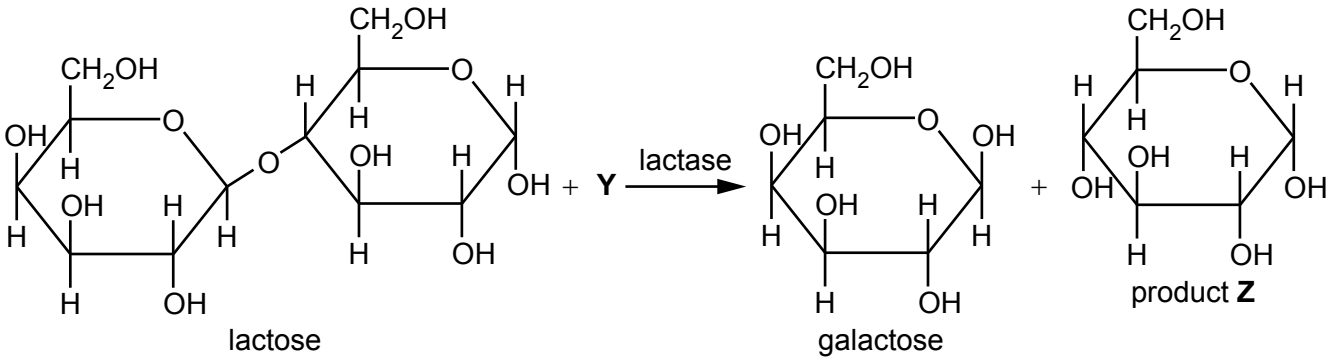

Fig. 3.1

(a) Describe the reaction that is catalysed by lactase. Use Fig. 3.1 to help you.

In your answer, identify **Y** and product **Z**.

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..... [4]

(b) On a commercial scale, immobilised lactase can be used to produce lactose-free milk.

One of the products of the reaction shown in Fig. 3.1 acts as an inhibitor of lactase. This is an example of product inhibition.

(i) Explain why product inhibition is useful in *K. lactis* when lactase is acting as an intracellular enzyme, but can be a disadvantage when extracted lactase is used free in solution for the production of lactose-free milk.

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..... [2]

(ii) Suggest how using immobilised lactase for the production of lactose-free milk helps to reduce the problem of product inhibition.

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..... [1]

(iii) The first large-scale production of lactose-free milk with an immobilised enzyme used lactase trapped in cellulose triacetate fibres.

Suggest **one** feature of cellulose triacetate that makes it useful as an immobilising material.

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..... [1]

(c) When developing an enzyme-catalysed reaction for use in industry, the progress of the reaction is studied.

Outline how the progress of an enzyme-catalysed reaction can be investigated experimentally.

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..... [3]

[Total: 11]

[Turn over

4 Fig. 4.1 is a diagram of a section through part of a young root.

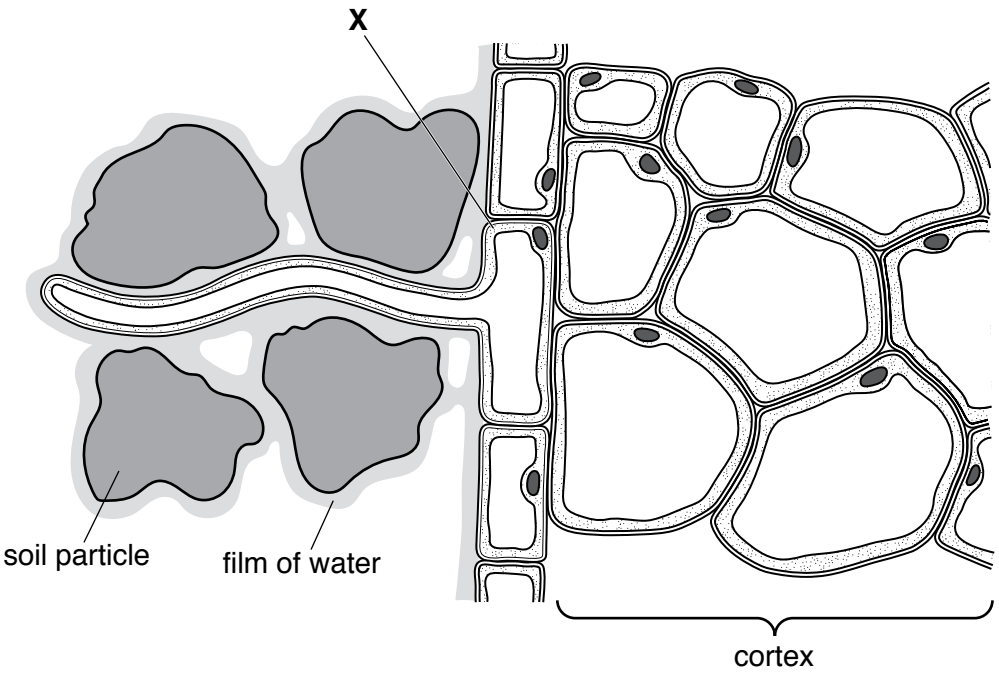

Fig. 4.1

(a) Describe the pathways by which water passes from the soil to the cells of the cortex shown in Fig. 4.1.

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..... [4]

(b) Fig. 4.1 shows the location where mineral ions in the soil enter the plant.

There is a greater density of mitochondria in cell **X** than in a cell of the root cortex.

With reference to the uptake and transport of mineral ions, suggest why there is a greater density of mitochondria in cell **X** than in a cell of the root cortex.

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..... [2]

[Total: 6]

5 **(a)** The sinoatrial node (SAN) and the atrioventricular node (AVN) are two regions of the heart.

Explain the role of the SAN **and** the role of the AVN in the cardiac cycle.

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..... [3]

(b) Fig. 5.1 shows features that are observed in transverse sections of three types of blood vessel.

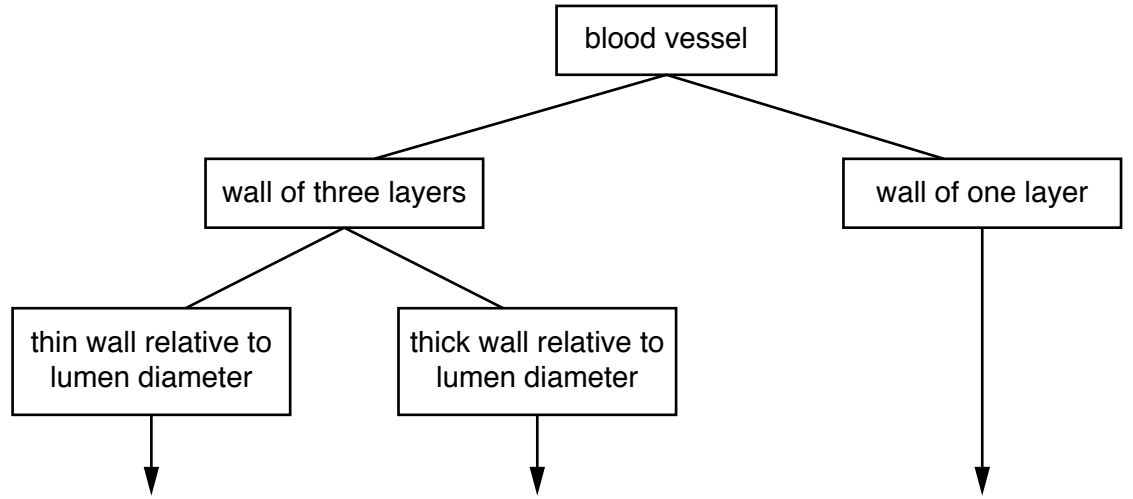

Fig. 5.1

(i) Complete Fig. 5.1 by stating the type of blood vessel indicated by **D**, **E** and **F**. [1]

(ii) The inner layer of the walls of **D** and **E** is composed of endothelial tissue.

List **two** structural features of endothelial tissue.

1 .....

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2 .....

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[2]
[Total: 6]

6 In a dividing cell, DNA replication occurs before mitosis.

(a) Steps in DNA replication are outlined in Fig. 6.1.

Complete Fig. 6.1 by filling in the gaps using the most appropriate terms.

1 Helicase enzyme allows the DNA double helix to unwind and the hydrogen bonds between the two strands to break, exposing the four bases, A, T, C and G.

The names of these bases are:

A = ...

T = ...

C = ...

G = ...

2 An enzyme molecule attaches to each of the two separated parental strands. The two enzyme molecules move in opposite directions, each catalysing the formation of a new strand of DNA. This enzyme is known as

..... .

3 DNA ..... ,
the monomers of DNA, are free in the nucleus for the synthesis of the new strands.

4 The bases of the DNA monomers form hydrogen bonds with the bases on each separated parental strand of DNA, according to the rules of

..... .

5 One DNA strand is synthesised continuously and the other is synthesised in sections known as Okazaki fragments. The fragments are joined by an enzyme called

..... ,
which catalyses the formation of phosphodiester bonds.

6 The result of replication is two DNA molecules, each one containing an original parental strand and a newly synthesised strand. This type of replication is described as

..... .

Fig. 6.1

[6]

(b) Fig. 6.2 is a photomicrograph of root tip cells at different stages in the cell cycle.

A cell in interphase is labelled.

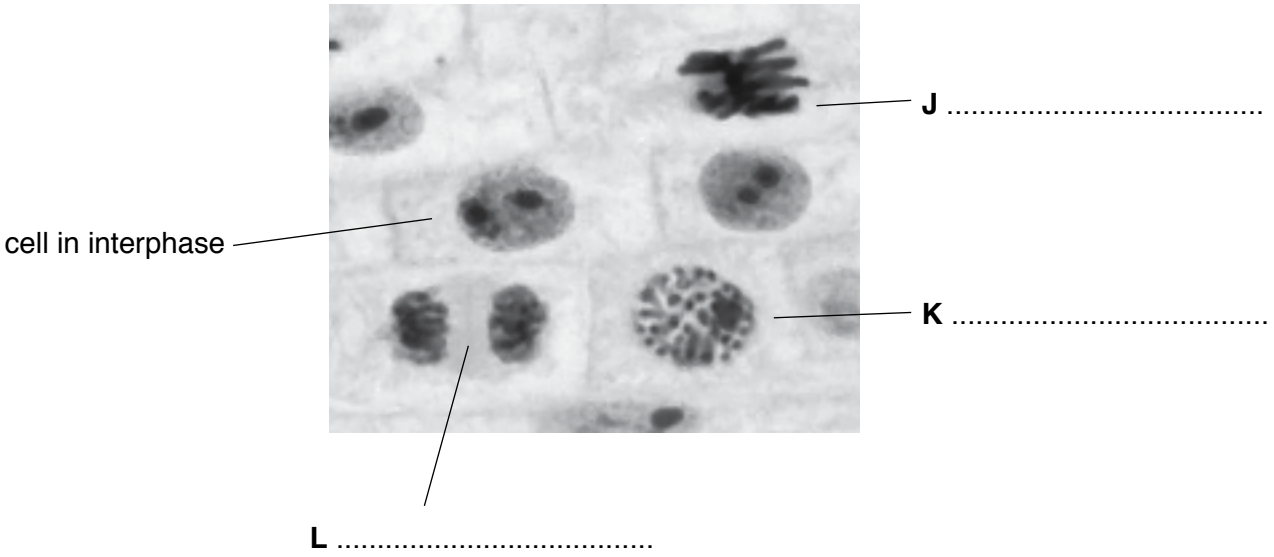

Fig. 6.2

(i) Complete Fig. 6.2 by naming the stage of mitosis shown in each of cells **J**, **K** and **L** in Fig. 6.2. [3]

(ii) State **one** feature of the cell in interphase, **visible** in Fig. 6.2, that shows this cell is **not** in early interphase.

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..... [1]

(iii) Describe the stage of mitosis shown in cell **J**.

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..... [2]

[Total: 12]