Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 2018**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **13** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

Answer **all** the questions.

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

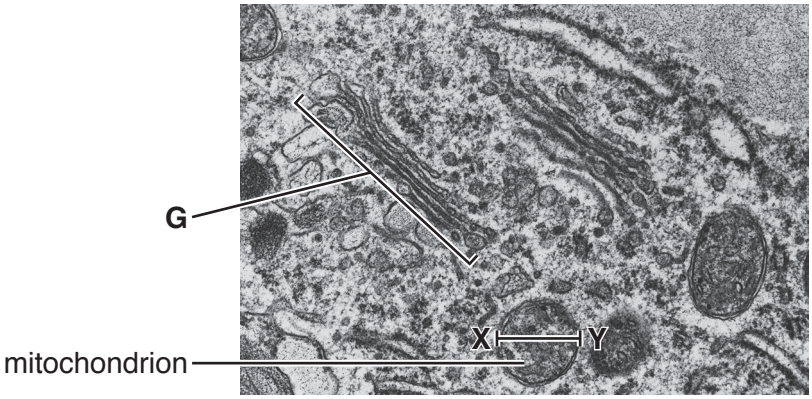

Fig. 1.1

(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 internal network of membranes in 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) The inner and outer membranes of the mitochondrion have a fluid mosaic structure similar to other cell membranes. They are both approximately 6 to 7 nanometres (nm) thick.

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

There is space below for a diagram.

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..... [3]

(ii) The inner and outer membranes of the mitochondrion differ in the detail of their membrane components. The inner membrane is also much less permeable than the outer membrane.

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

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..... [1]

[Total: 9]

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 latent (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) State the location in the body where macrophages have their origin.

..... [1]

(ii) Describe the mode of action of a macrophage.

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..... [3]

(iii) It is sometimes possible for *M. tuberculosis* to survive within macrophages.

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.

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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]

(e) The standard treatment for TB continues for six months and initially involves the use of four different antibiotics.

If no antibiotic resistance is detected, the treatment is reduced to two of the four antibiotics. The two antibiotics used are rifampicin and isoniazid.

Suggest the benefits of beginning the treatment with four different antibiotics.

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..... [2]

Multidrug-resistant TB (MDR-TB) occurs if resistance develops to rifampicin and isoniazid.

The treatment for MDR-TB can last up to 30 months and involves different antibiotics to the standard treatment.

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

(f) State the trends shown in Table 2.1.

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..... [2]

(g) TB is a disease of global importance.

Discuss the factors influencing the trends shown in Table 2.1.

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..... [3]

[Total: 17]

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.

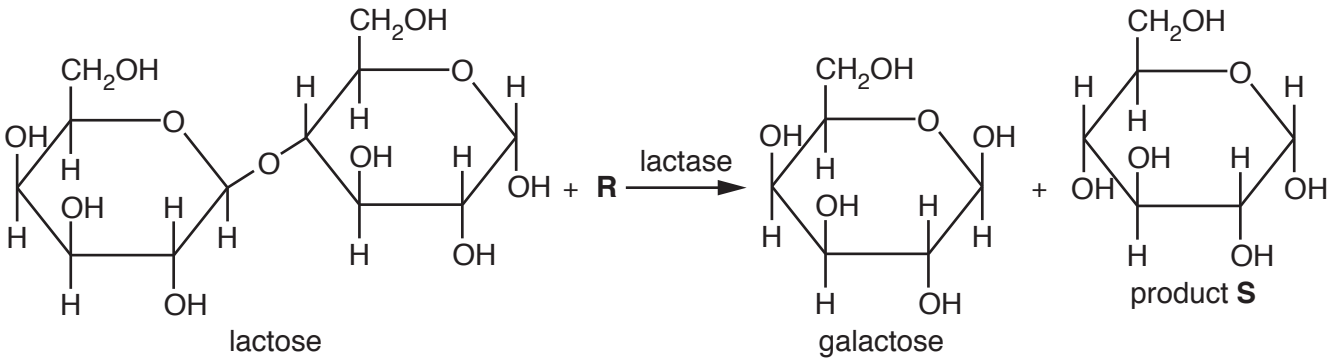

Fig. 3.1

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

In your answer, identify **R** and product **S**.

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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) Suggest 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 in a commercial application 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) For a commercial application using an enzyme, the progress of the enzyme-catalysed reaction needs to be studied.

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

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..... [3]

[Total: 11]

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

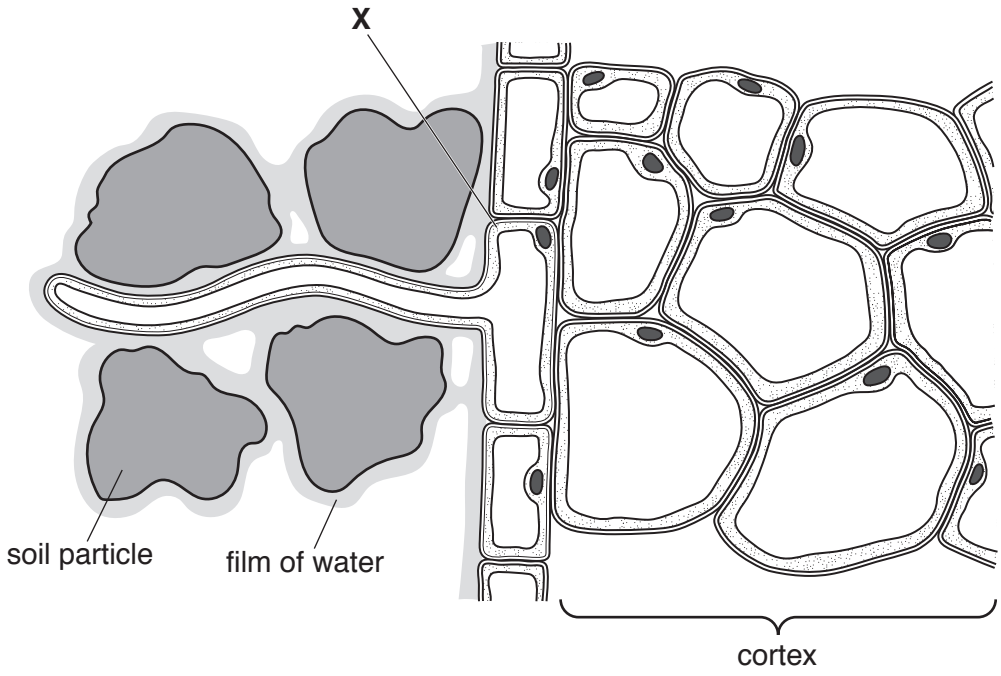

Fig. 4.1

(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) There is a greater density of mitochondria in the cytoplasm of cell **X** than in the cytoplasm of a cell of the cortex.

Suggest why this is so.

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..... [1]

[Total: 5]

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

Outline the roles of the SAN **and** the AVN in the initiation and control of heart action.

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..... [3]

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

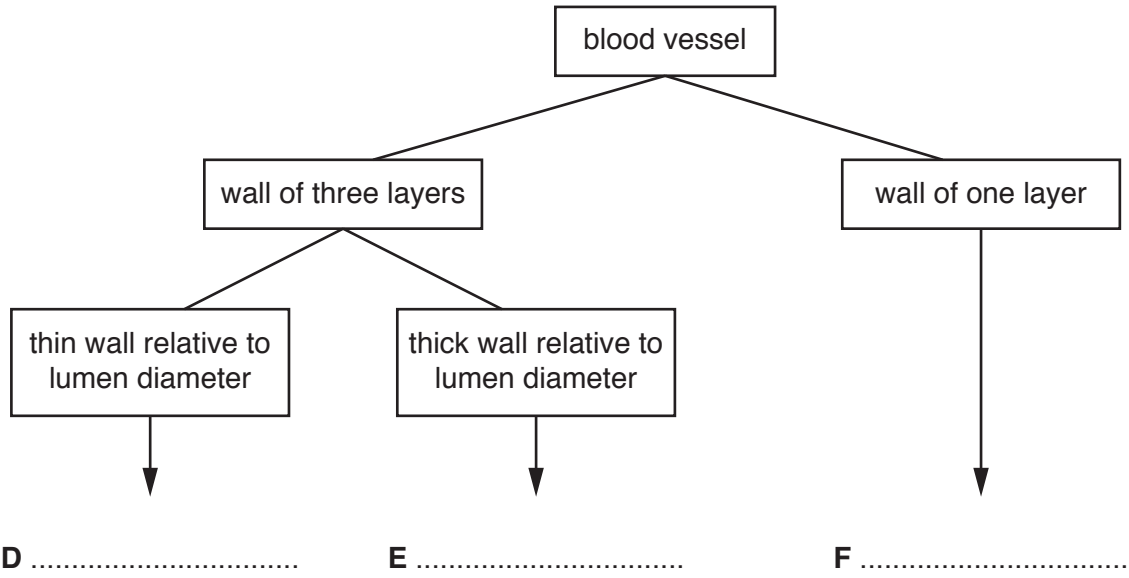

Fig. 5.1

(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 this 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).

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 activated with two additional phosphates and 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, ... , 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.

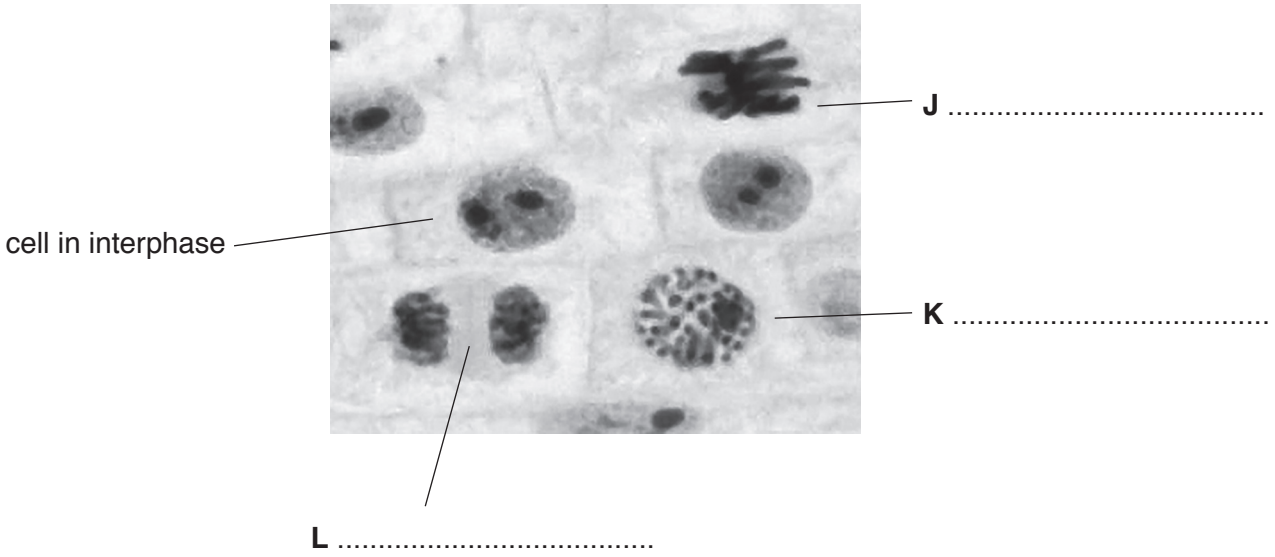

Fig. 6.2

(i) Name the stage of mitosis shown in each of cells **J**, **K** and **L** in Fig. 6.2.

Write your answer in the space next to each letter on Fig. 6.2. [3]

(ii) Explain how it is possible to deduce that the labelled cell in interphase shown in Fig. 6.2 is in late, rather than early, interphase.

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..... [1]

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

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..... [2]

[Total: 12]

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