Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0957704213

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2022**

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 **20** pages. Any blank pages are indicated.

[Turn over

1 **(a)** Fig. 1.1 is a transmission electron micrograph showing a section of a human liver cell.

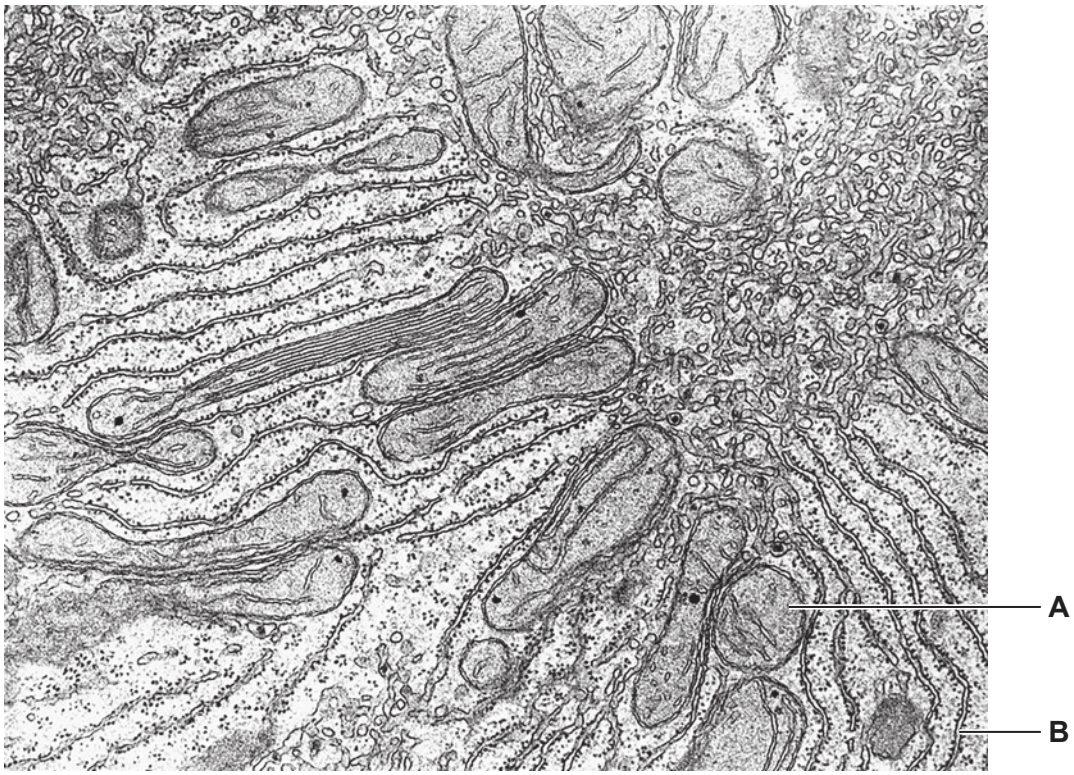

Fig. 1.1

(i) Name organelles **A** and **B** shown in Fig. 1.1.

A .....

B .....
[2]

(ii) In liver cells, enzymes are attached to the membrane of smooth endoplasmic reticulum.

With reference to the functions of smooth endoplasmic reticulum, suggest the advantages of having enzymes attached to the membrane rather than free in the lumen.

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..... [3]

(b) Explain the advantages of using a transmission electron microscope compared with a light microscope when viewing a liver cell.

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..... [3]

[Total: 8]

2 Fig. 2.1 is a simplified diagram of the human circulatory system.

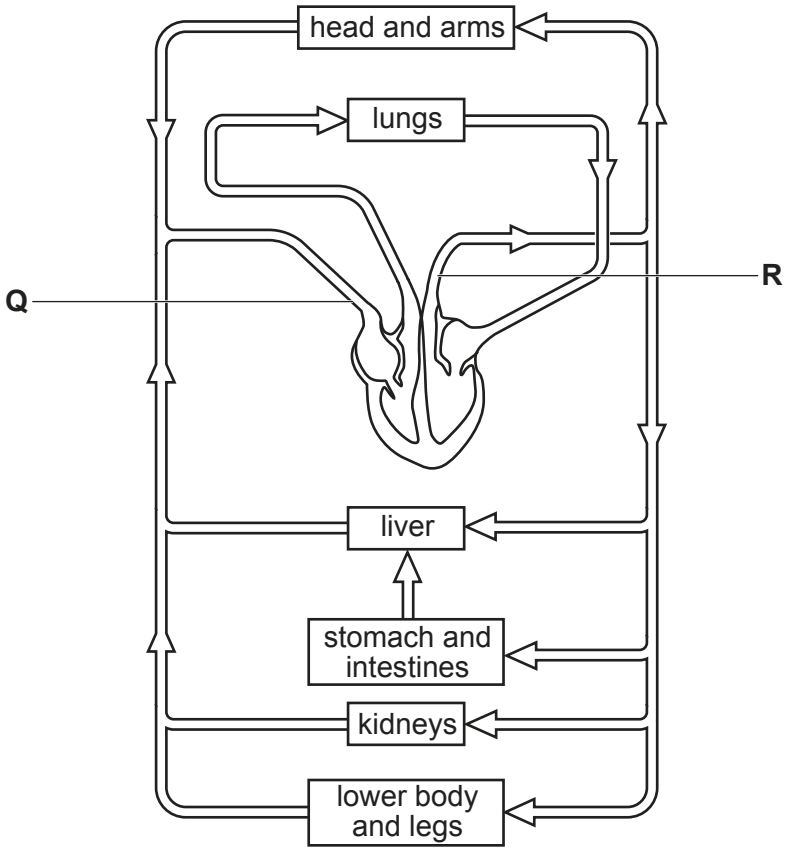

Fig. 2.1

(a) (i) State why the human circulatory system is described as a closed, double circulation.

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..... [2]

(ii) Identify blood vessel **Q** and blood vessel **R**, shown in Fig. 2.1.

Q .....

R .....

[1]

(iii) Blood leaving the heart passes through valves before it enters blood vessel **R**.

Describe the differences between the structure of blood vessel **Q** and the structure of blood vessel **R**. Do **not** refer to valves in your answer.

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..... [3]

(b) Blood plasma plays an important role in the transport of molecules such as antibodies.

Scientists discovered that some of the antibodies in the blood plasma of sharks have a different structure to the antibodies found in human blood plasma.

Fig. 2.2 shows the structure of an antibody molecule found in the blood plasma of a shark.

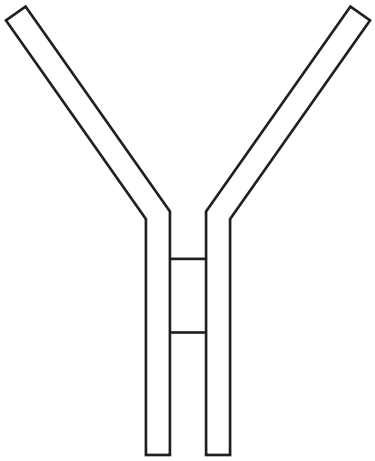

Fig. 2.2

(i) State how the quaternary structure of a human antibody molecule differs from the quaternary structure of the shark antibody molecule shown in Fig. 2.2.

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..... [1]

(ii) Human antibodies are used in the treatment of some forms of cancer. However, the antibodies injected into the bloodstream can only reach a small percentage of the cancer cells that form the cancerous tumour.

Shark antibodies are smaller than human antibodies. Scientists are researching the possibility of injecting shark antibodies into the bloodstream to treat cancerous tumours in humans.

Suggest how using the smaller shark antibodies may be more effective in reaching a greater percentage of cancer cells than human antibodies and lead to greater success at treating cancer.

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..... [2]

(iii) Antibodies can also be used in the prevention of infectious diseases.

Explain how injection of antibodies into the bloodstream can protect a person from disease after infection by a pathogen.

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..... [3]

[Total: 12]

3 Carbonic anhydrase is a globular protein found in red blood cells.

(a) (i) Explain why this protein is described as globular.

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..... [2]

(ii) State the function of carbonic anhydrase in red blood cells.

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..... [2]

(b) A protein such as carbonic anhydrase is coded for by a gene. A gene forms part of a DNA molecule.

Fig. 3.1 is a diagram of a small section of a DNA molecule.

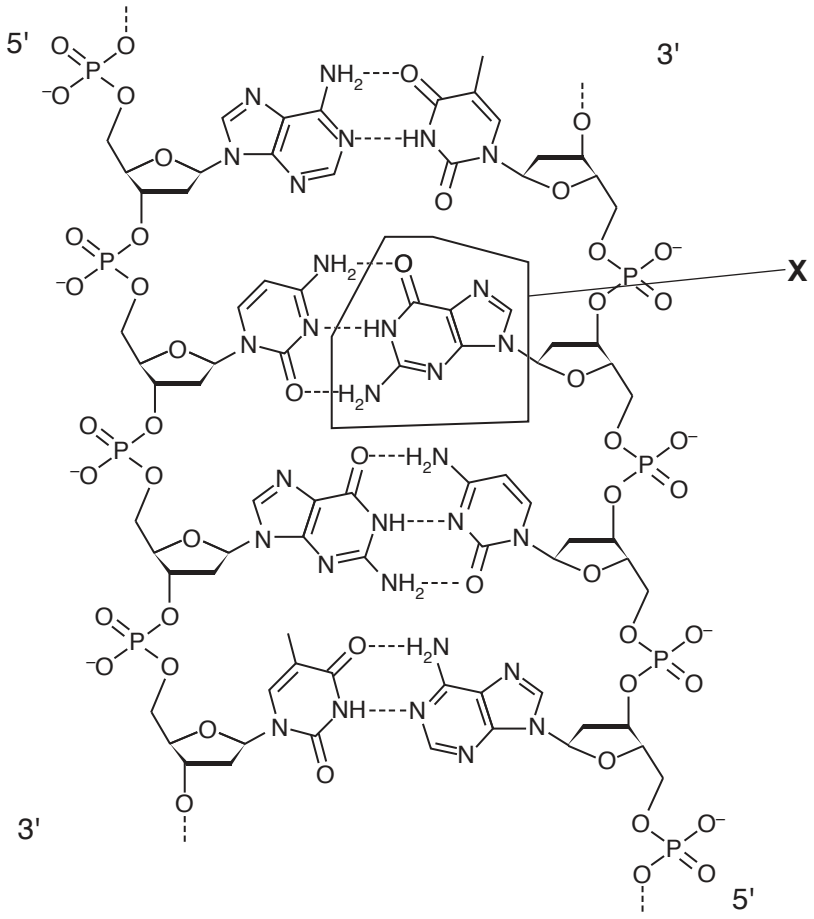

Fig. 3.1

(i) Identify the base **X and** state the evidence in Fig. 3.1 that supports this identification.

base **X** .....

evidence from Fig. 3.1 .....

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[3]

(ii) The section of the DNA molecule in Fig. 3.1 is part of a gene coding for a polypeptide.

Base **X**, shown in Fig. 3.1, is located in an exon on the strand of DNA that is transcribed during protein synthesis. A mutation that results in the deletion of base **X** will affect the polypeptide produced.

Explain how this deletion may affect the polypeptide produced during protein synthesis.

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..... [4]

(iii) Gene mutations can occur in either introns or exons.

Suggest the effect of a gene mutation in an intron.

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..... [1]

[Total: 12]

4 **(a)** Scientists have produced structures known as virosomes, which are used in certain vaccines. Virosomes do **not** cause disease.

Fig. 4.1 is a diagram of a section through a virosome used in some vaccinations to protect against the virus which causes influenza.

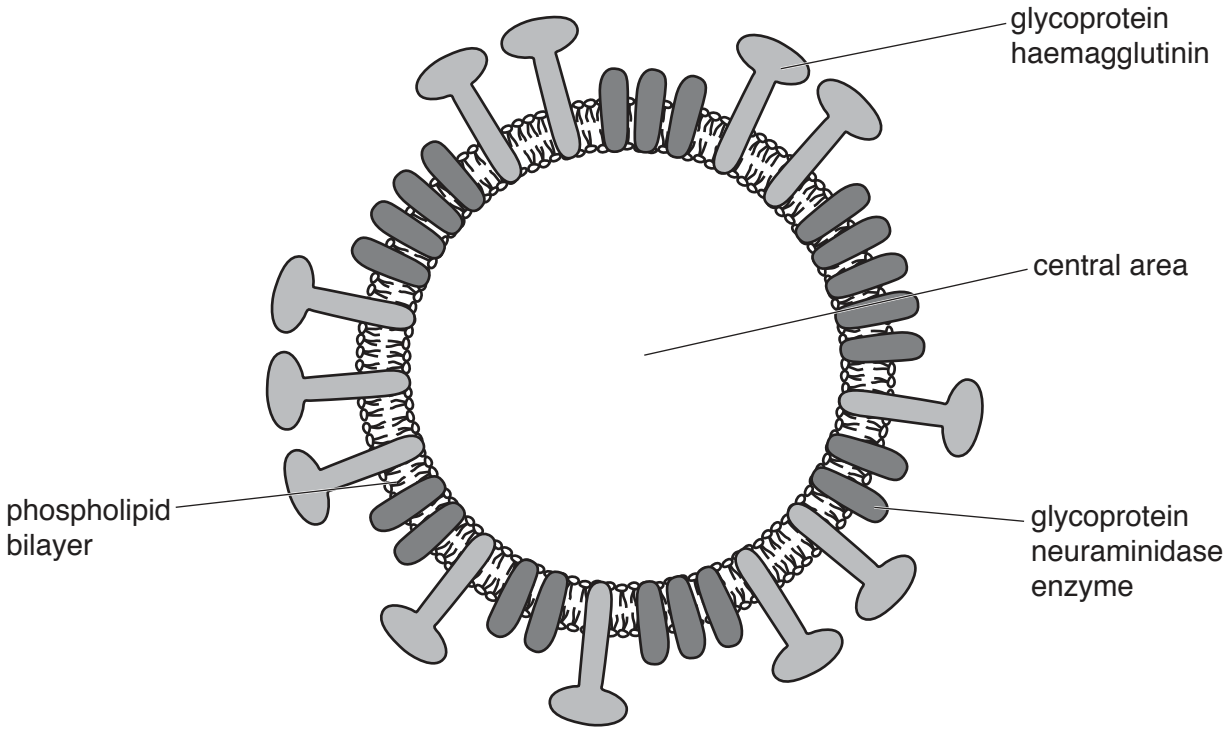

Fig. 4.1

(i) State the differences between the structure of a virosome and a virus.

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..... [2]

(ii) Explain how the structure of the virosome shown in Fig. 4.1 suggests that the central area of the virosome is aqueous.

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..... [2]

(b) The glycoproteins haemagglutinin and neuraminidase are found in the influenza virus and in the virosomes used in a vaccine against the influenza virus.

Haemagglutinin binds to a receptor in the cell surface membrane of phagocytes.

Suggest why haemagglutinin is present in virosomes used in the vaccine for influenza.

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..... [2]

(c) Different strains of the influenza virus have formed as a result of mutations. Each strain of the virus contains the enzyme neuraminidase. Neuraminidase helps the virus to leave host cells after the virus has replicated. In each strain of the influenza virus, the primary structure of the active site of the neuraminidase enzyme remains unchanged.

Suggest why the primary structure of the active site of neuraminidase remains unchanged in each strain of the influenza virus.

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..... [2]

[Total: 8]

5 **(a)** When water molecules enter a plant through the roots, the molecules cross the cortex and enter the xylem tissue to be transported to other parts of the plant.

There are two pathways that water can take when crossing the root to the xylem tissue.

Complete Table 5.1 with information about the two pathways.

Table 5.1

name of pathway	outline of pathway
	movement of water from cell to cell through plasmodesmata

[2]

(b) Fig. 5.1 is a photomicrograph of a transverse section through the stem of a flowering plant.

On Fig. 5.1, draw a label line and the letter **T** to identify xylem tissue. [1]

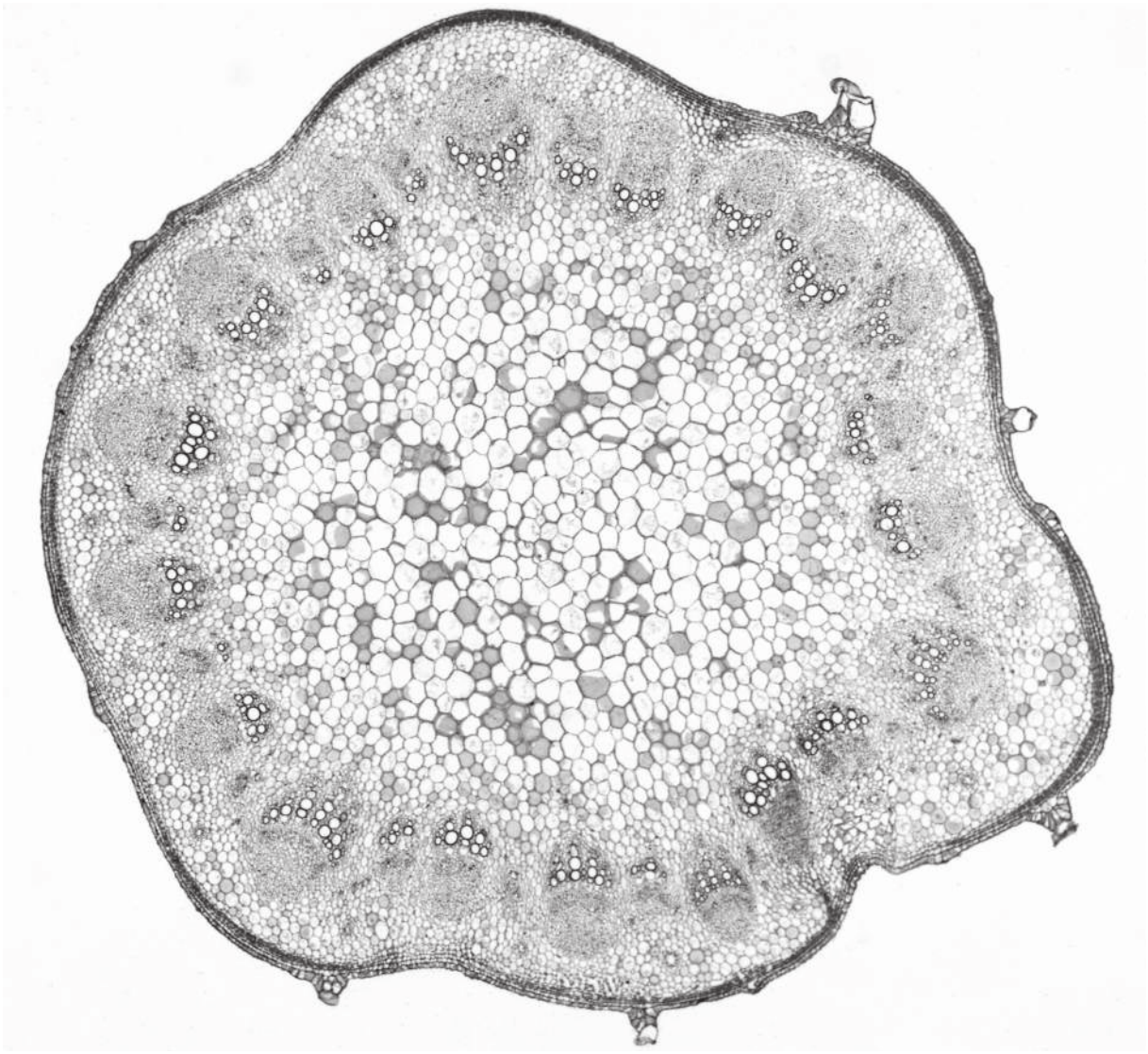

Fig. 5.1

(c) Scientists have studied the process of cell death that occurs during the development of the cells that become mature xylem vessel elements.

During this development, the tonoplast ruptures (bursts) and releases hydrolytic enzymes contained in the vacuole into the cytoplasm.

(i) Name an organelle found in animal cells that has a similar function to the vacuole in the developing xylem vessel elements.

..... [1]

(ii) The rupture of the tonoplast during development of xylem vessel elements is due to changes in permeability of the tonoplast.

Suggest how the permeability of the tonoplast changes **and** explain how this change could result in the rupture of the tonoplast.

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..... [3]

(iii) During development of the xylem vessel elements the pH of the cytoplasm decreases. This change in pH activates enzymes in the cytoplasm that cause organelles to swell.

Suggest how a change in pH of the cytoplasm can activate enzymes.

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..... [2]

(d) Some insects are vectors of disease.

(i) When an insect feeds on the xylem fluid it can act as a vector of plant diseases such as Pierce's disease. This bacterial disease affects many fruit trees causing the leaves to turn brown and drop from the plant, resulting in much less fruit being produced.

Explain why Pierce's disease can be described as an infectious disease.

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.....[2]

(ii) Malaria is another infectious disease that also involves an insect vector.

State the type of organism that causes malaria **and** name **one** organism that causes malaria in humans.

type of organism .....

name .....
[2]

[Total: 13]

6 **(a)** Fig. 6.1 is a photomicrograph of plant cells in stages of the mitotic cell cycle.

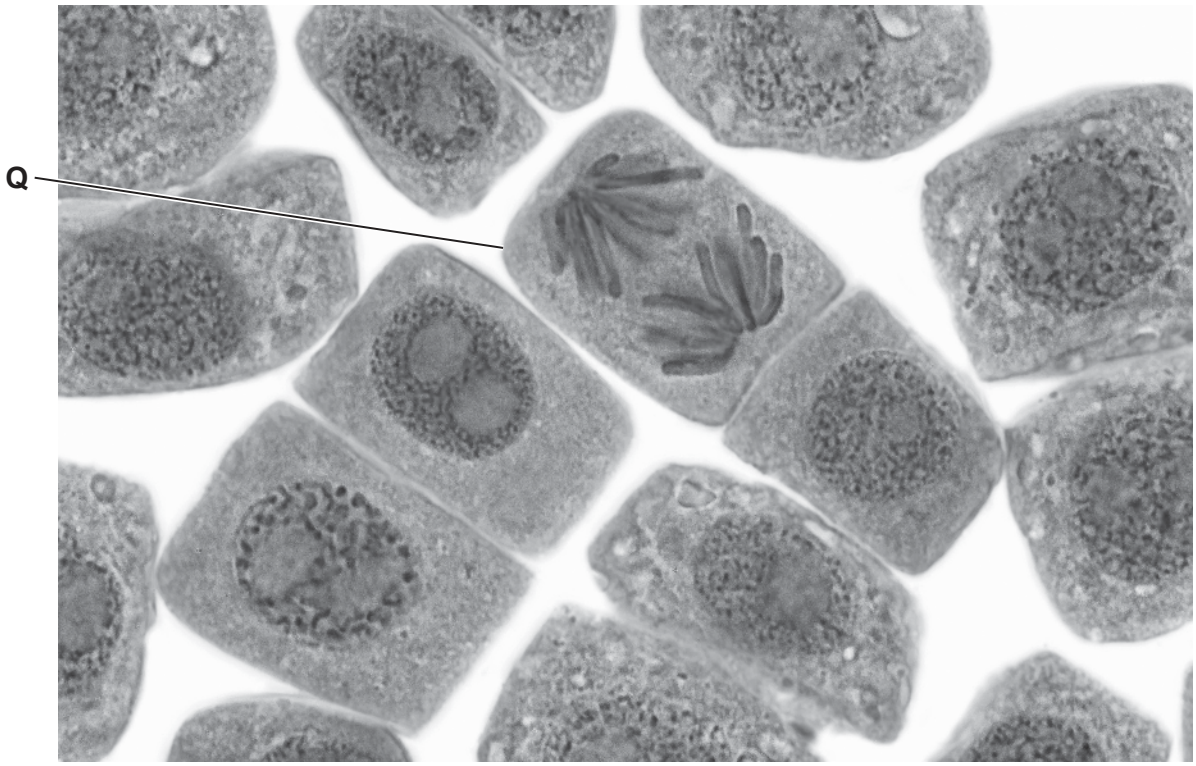

Fig. 6.1

(i) Name the stage of mitosis shown in cell **Q**.

..... [1]

(ii) Outline the roles of mitosis in a healthy plant.

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..... [2]

(b) Uncontrolled mitosis can cause cancer in humans.
Paclitaxel is a drug used in the treatment of some forms of cancer.

Researchers investigated the effect of Paclitaxel on the mitotic cell cycle of cancer cells.

- The cancer cells were grown for two days and then divided into groups.
- Each group was treated with a different concentration of Paclitaxel.

After 28 hours (one cell cycle):

- the percentage of cells in stages of mitosis was calculated
- the ratio of the number of cells in anaphase to the number of cells in metaphase was determined.

The results of the investigation are shown in Fig. 6.2.

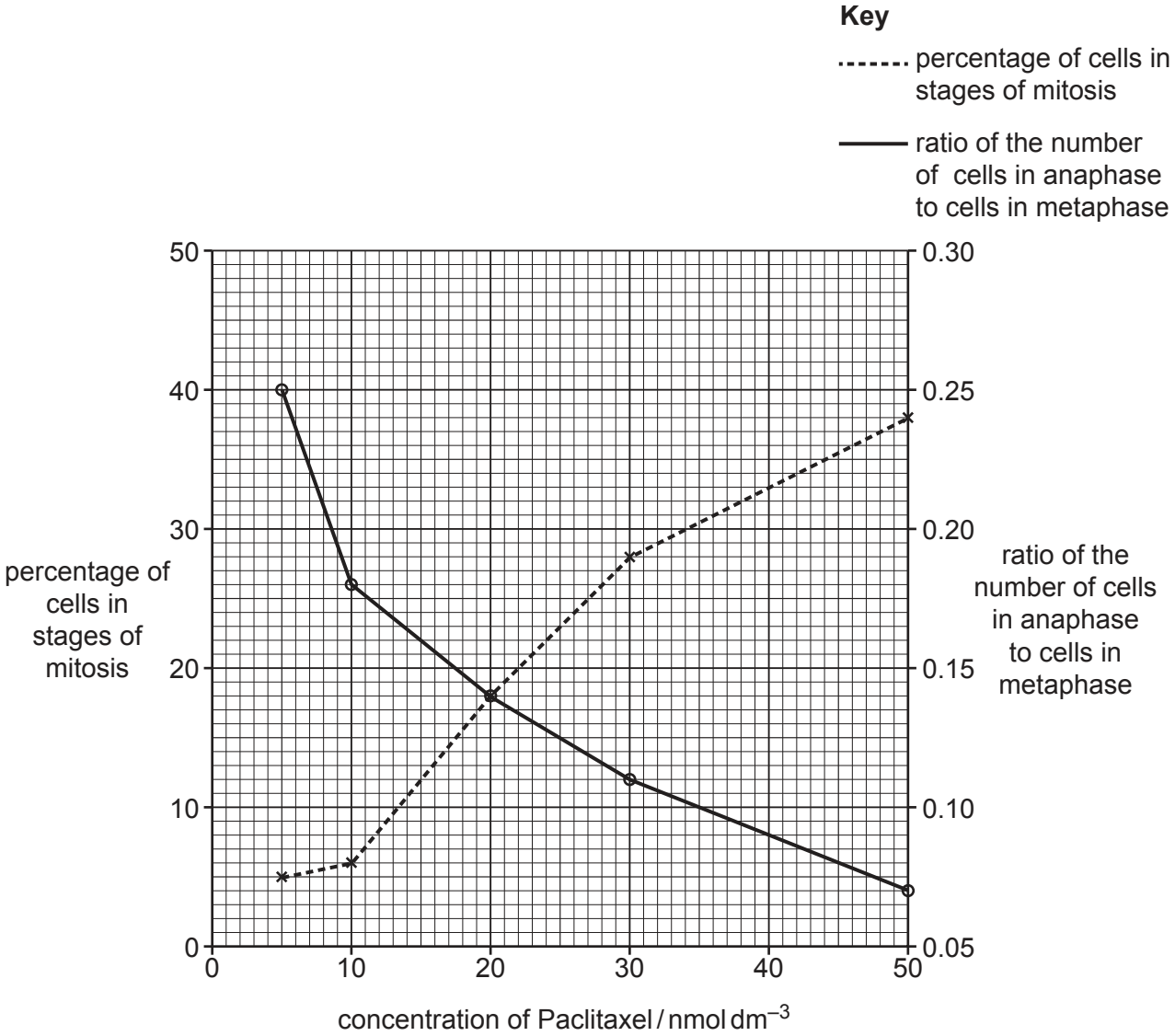

Fig. 6.2

With reference to Fig. 6.2, describe the results and suggest an explanation for the effect of Paclitaxel on the mitotic cell cycle.

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..... [4]

[Total: 7]

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