Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4134613706

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **February/March 2020**

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. Blank pages are indicated.

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Answer **all** questions.

1 Phloem sap is transported from sources to sinks in phloem sieve tubes. Each sieve tube is constructed from phloem sieve tube elements.

(a) The structure of a phloem sieve tube element is adapted to its function.

Each of explanations **A** to **F** describes how a particular structural feature of a phloem sieve tube element in a source is suited to the function of transporting phloem sap.

The matching structural feature for each explanation is listed in Table 1.1.

A for entry of sucrose and other organic compounds

B for rapid entry of water to create high hydrostatic pressure

C provides pores to allow the flow of phloem sap from one sieve tube element to the next

D to form very long tubular structures for the transport of phloem sap from source to sink

E decreases resistance to the flow of phloem sap within each sieve tube element, so the speed of flow is maintained

F provides more space to increase the volume of phloem sap transported per unit time

Complete Table 1.1 by writing the correct letter from **A** to **F** in the last column of each row, so that each structural feature is matched to the correct explanation.

Use each letter only **once**.

The first row has been completed for you.

Table 1.1

structural feature of phloem sieve tube element	explanation
There is no nucleus or large permanent vacuole.	**F**
The end walls are perforated to form sieve plates.	
There is only a thin layer of cytoplasm around the edge of the cell.	
The cell is elongated and arranged end to end with other cells.	
The cell has plasmodesmata connecting to a companion cell.	
There is a thin cellulose cell wall.	

[4]

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(b) At the sink, sucrose and other organic compounds are unloaded from the phloem sieve tube element.

Explain why the process of unloading helps the mass flow of phloem sap from the source to the sink.

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..... [3]

[Total: 7]

2 Phosphatidate phosphatase (PAP) enzymes have an important role in lipid metabolism.

The reaction catalysed by PAP is shown in Fig. 2.1.

$$\text{phosphatidate} + H_2O \xrightarrow{\text{PAP}} \text{diglyceride} + \text{inorganic phosphate (Pi)}$$

Fig. 2.1

Experiments were carried out to investigate the activity of PAP extracted from the cotyledons (seed leaves) of bitter gourd, *Momordica charantia*.

(a) There are two types of PAP enzymes:

- PAP1 enzymes need magnesium ions (Mg^{2+}) in the active site to function
- PAP2 enzymes do not need Mg^{2+}.

The effect of different concentrations of Mg^{2+} on the activity of PAP extracted from *M. charantia* was investigated.

The results are shown in Fig. 2.2.

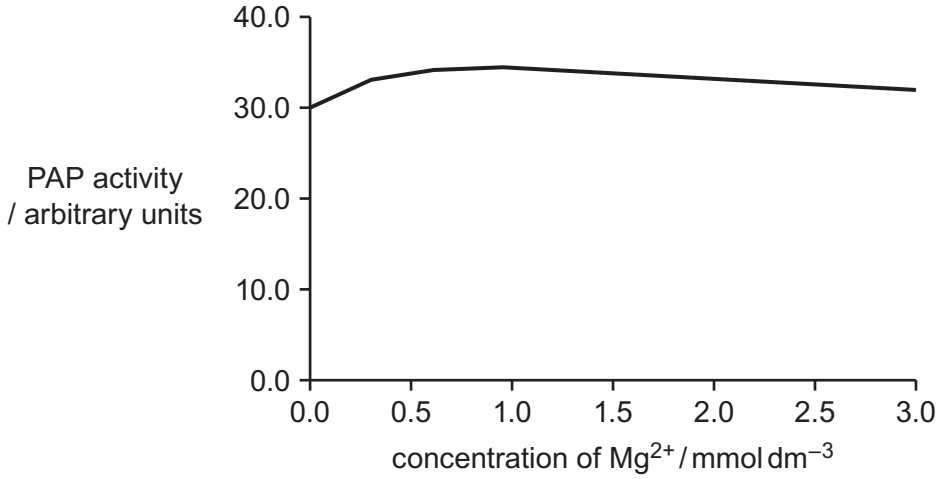


Fig. 2.2

Explain, with reference to Fig. 2.2, whether the PAP extracted from *M. charantia* is a PAP1 enzyme or a PAP2 enzyme.

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..... [2]

(b) Fig. 2.3 shows the effect of increasing phosphatidate concentration on the activity of PAP extracted from *M. charantia*.

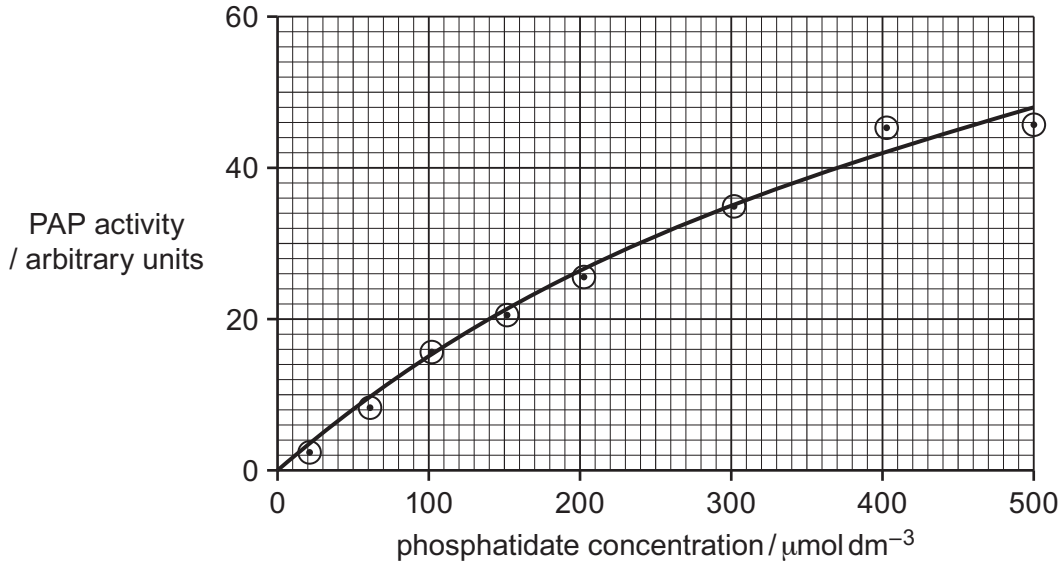


Fig. 2.3

With reference to Fig. 2.3, describe **and** explain the effect of increasing phosphatidate concentration on the activity of PAP.

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..... [4]

(c) The diglycerides formed as a result of the action of PAP can be used to synthesise triglycerides and membrane phospholipids.

(i) Explain how the structure of a triglyceride is suited to its function as an energy storage molecule.

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..... [2]

(ii) Explain why phospholipids are able to form a bilayer in cell membranes.

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..... [2]

[Total: 10]

3 During one cardiac cycle:

- blood enters the heart from the lungs and from the rest of the body
- blood leaves the heart to be transported to the lungs and to the rest of the body.

(a) Name the blood vessels entering the heart that bring blood from the rest of the body.

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..... [1]

(b) One phase of the cardiac cycle is ventricular diastole (ventricular relaxation). A number of events occur in the heart during this phase.

Outline **and** explain the events that occur in the heart during ventricular diastole.

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..... [4]

Blood arriving in the lungs from the heart is oxygenated as it passes through the pulmonary capillaries.

Sickle-shaped red blood cells are present in a person with sickle cell anaemia. These cells have a very high quantity of abnormal (sickle cell) haemoglobin and take up and transport less oxygen than red blood cells containing normal haemoglobin.

(c) The cause of the differences between sickle cell haemoglobin and normal haemoglobin is a mutation in the gene that codes for one of the two types of polypeptide found in a haemoglobin molecule. This mutation leads to a change in the mRNA produced during transcription, causing a change in the primary structure of the polypeptide formed.

Fig. 3.1 shows some of the changes that occur as a result of this gene mutation.

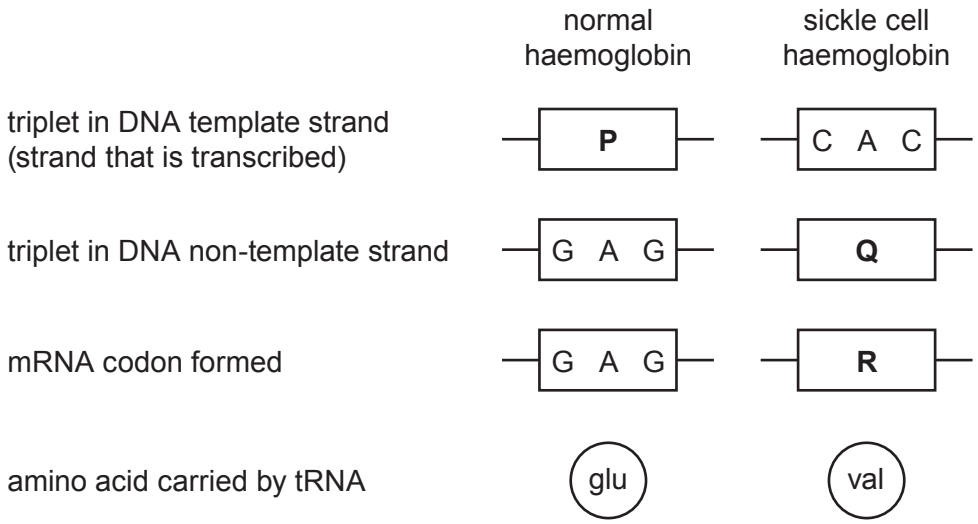


Fig. 3.1

(i) With reference to Fig. 3.1, state:

- the base sequence of DNA triplet **P**

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- the base sequence of DNA triplet **Q**

  .....

- the base sequence of mRNA codon **R**.

  .....

[3]

(ii) Name the type of polypeptide in a haemoglobin molecule that is different in sickle cell haemoglobin compared to normal haemoglobin.

..... [1]

(d) Fig. 3.2 shows the oxygen dissociation curve for adult haemoglobin in a person who does not have sickle cell anaemia.

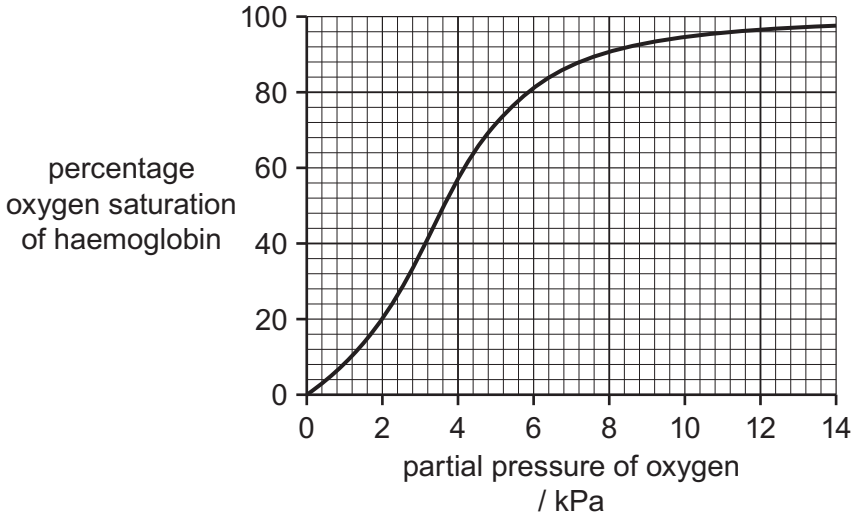


Fig. 3.2

Compared to Fig. 3.2, the oxygen dissociation curve for adult haemoglobin in a person with sickle cell anaemia is shifted to the right.

The uptake of oxygen by haemoglobin in the lungs and the release of oxygen by haemoglobin in respiring tissues is different in a person with sickle cell anaemia compared with a person who does not have the disease.

With reference to Fig. 3.2, state **and** explain these differences.

uptake of oxygen .....

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release of oxygen .....

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[3]

[Total: 12]

4 **(a)** When a section of lung tissue is viewed using a light microscope, it is possible to identify the trachea, the bronchus, the bronchioles and the alveoli.

Other than differences in their diameters, describe **one** structural difference visible between:

- the trachea and a bronchus

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- a bronchus and a bronchiole

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- a bronchiole and an alveolus.

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[3]

(b) The mitotic cell cycle of the stem cells present in the gas exchange system is carefully controlled. During interphase of the mitotic cell cycle, cells grow by increasing in size.

Complete Table 4.1 by:

- listing, in order, the three phases that occur during interphase
- stating **one** process, other than growth and respiration, that occurs in each of these three phases to help prepare the cell for mitosis.

Table 4.1

phase	process occurring during phase

[4]

[Total: 7]

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5 Myasthenia gravis and HIV/AIDS both involve disorders of the immune system.

(a) Outline why myasthenia gravis is described as a disorder of the immune system.

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..... [2]

A person with HIV/AIDS has a weakened immune system. This is because HIV infects cells of the immune system, in particular T-helper lymphocytes (T_h cells). The pathogen can remain inactive within host cells. In some people, the pathogen becomes active and causes the number of T_h cells to decrease.

Antiretroviral therapy (ART) is used to treat people who are infected with HIV (living with HIV). ART aims to keep the number of T_h cells at a healthy level.

(b) State the full name of the pathogen known as HIV.

..... [1]

(c) Explain why it is important that ART maintains a healthy number of T_h cells in a person living with HIV.

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..... [3]

(d) Fig. 5.1 shows global estimates of:

- the percentage of people living with HIV who received treatment with ART in each year from 2000 to 2015
- the number of people who died from HIV/AIDS in each year from 2000 to 2015.

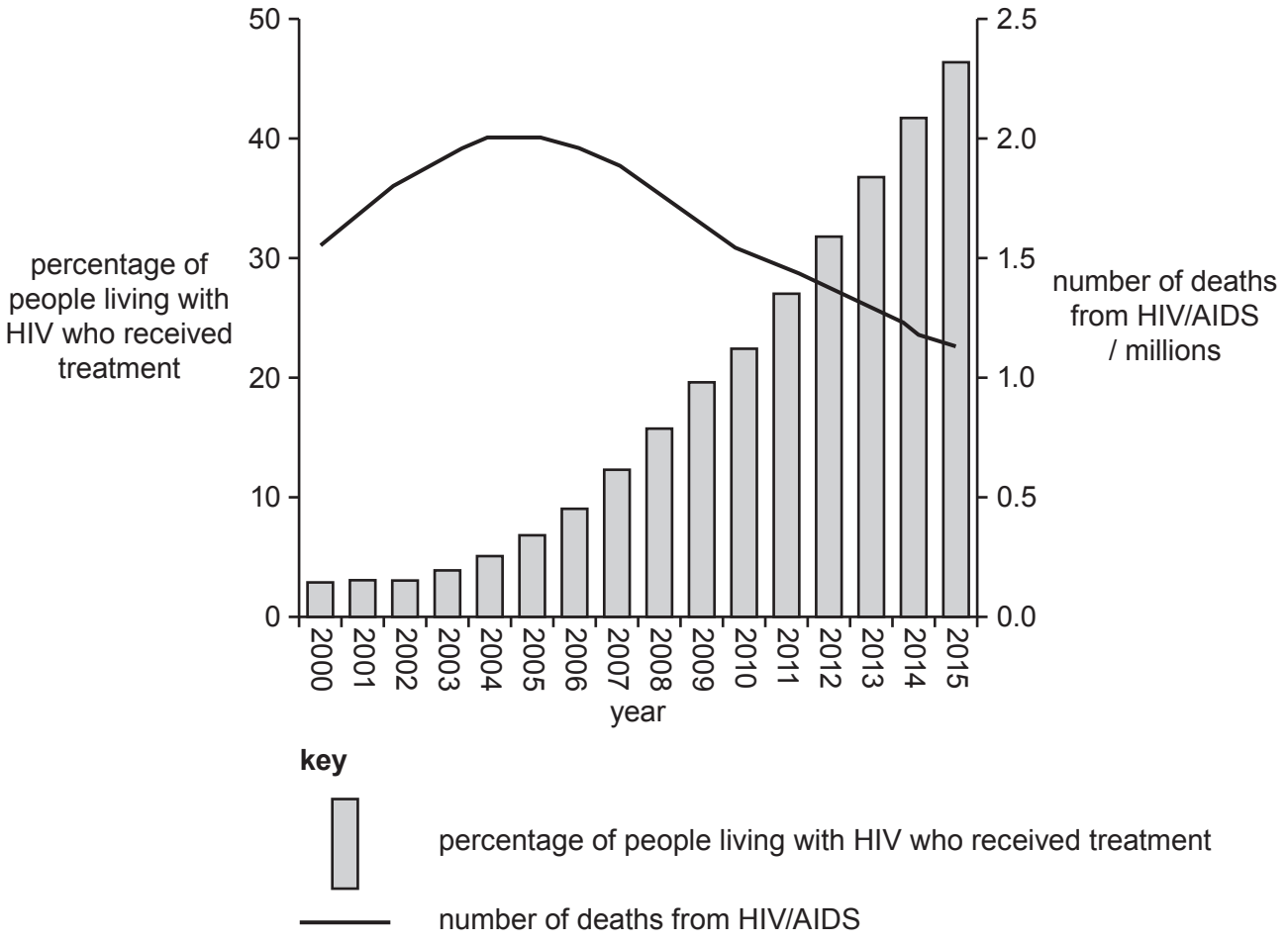


Fig. 5.1

(i) Describe the trends shown in Fig. 5.1.

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..... [3]

(ii) It is recommended that ART is given to all people living with HIV.

Some countries that support this recommendation find it difficult to provide ART to everyone living with HIV.

Other than the high cost of treatment, suggest **two** reasons why it is difficult to provide ART to everyone living with HIV.

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..... [2]

[Total: 11]

6 Fig. 6.1 is a transmission electron micrograph of a plant parenchyma cell.

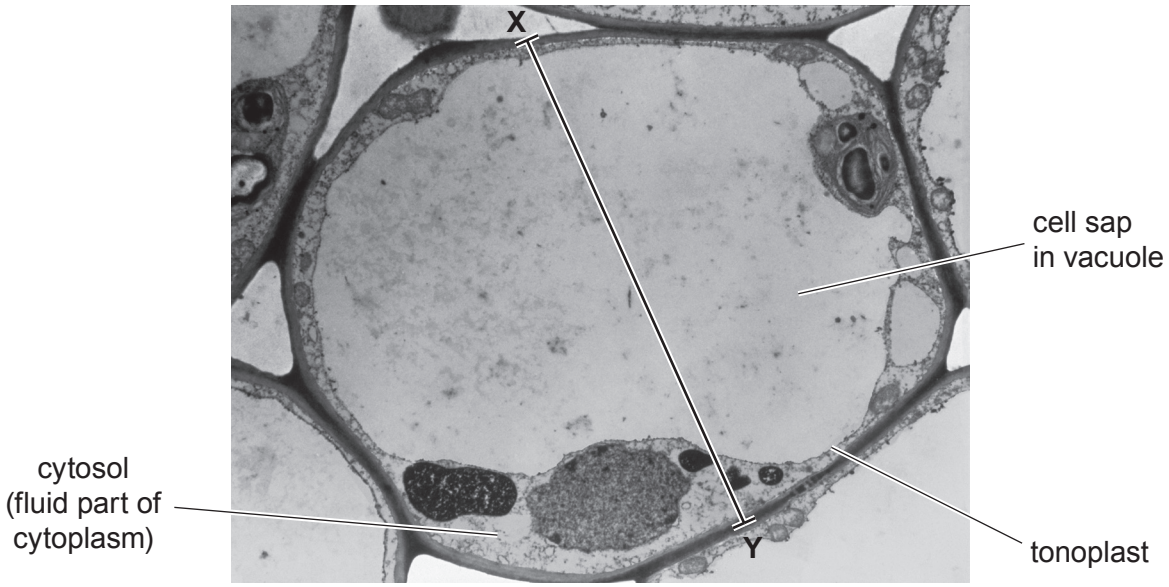


Fig. 6.1

(a) The external environment of the parenchyma cell has a higher water potential than the internal environment of the cell.

One function of parenchyma cells is to provide support to the plant.

With reference to Fig. 6.1, suggest how parenchyma cells provide support to the plant.

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..... [2]

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(b) The image shown in Fig. 6.1 is at a higher magnification than can be obtained using a typical light microscope.

(i) Explain what is meant by the term *magnification*.

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..... [1]

(ii) The actual diameter of the parenchyma cell in Fig. 6.1 along the line **X—Y** is 35 μm.

Calculate the magnification of the image.

magnification = × .....

[2]

(c) The cell sap in the vacuole of the cell shown in Fig. 6.1 has a pH of 5.0. The cytosol has a pH of 7.2.

The tonoplast controls the passage of hydrogen ions from the cytosol into the vacuole. The low pH created by the entry of hydrogen ions is optimum for the action of acid hydrolase enzymes in the vacuole. Acid hydrolase enzymes are also found in lysosomes in animal cells.

(i) Suggest which transport mechanism is used to move hydrogen ions from the cytosol of the parenchyma cell into the vacuole.

Explain your choice.

transport mechanism .....

explanation .....

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[3]

(ii) Suggest how the structure of the tonoplast allows hydrogen ions to be transported into the vacuole, but does not allow the ions to leave the vacuole.

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..... [3]

(iii) The acid hydrolases in the vacuole cannot function in neutral conditions (pH 7.0) or alkaline conditions.

Explain the advantage to the plant cell of having acid hydrolases that cannot function in neutral, near neutral or alkaline conditions.

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..... [2]

[Total: 13]

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