Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8866550395

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **May/June 2021**

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.

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Answer **all** questions.

1 **(a)** Fig. 1.1 is a photomicrograph of a region of eukaryotic tissue. Some of the cells are in stages of mitosis.

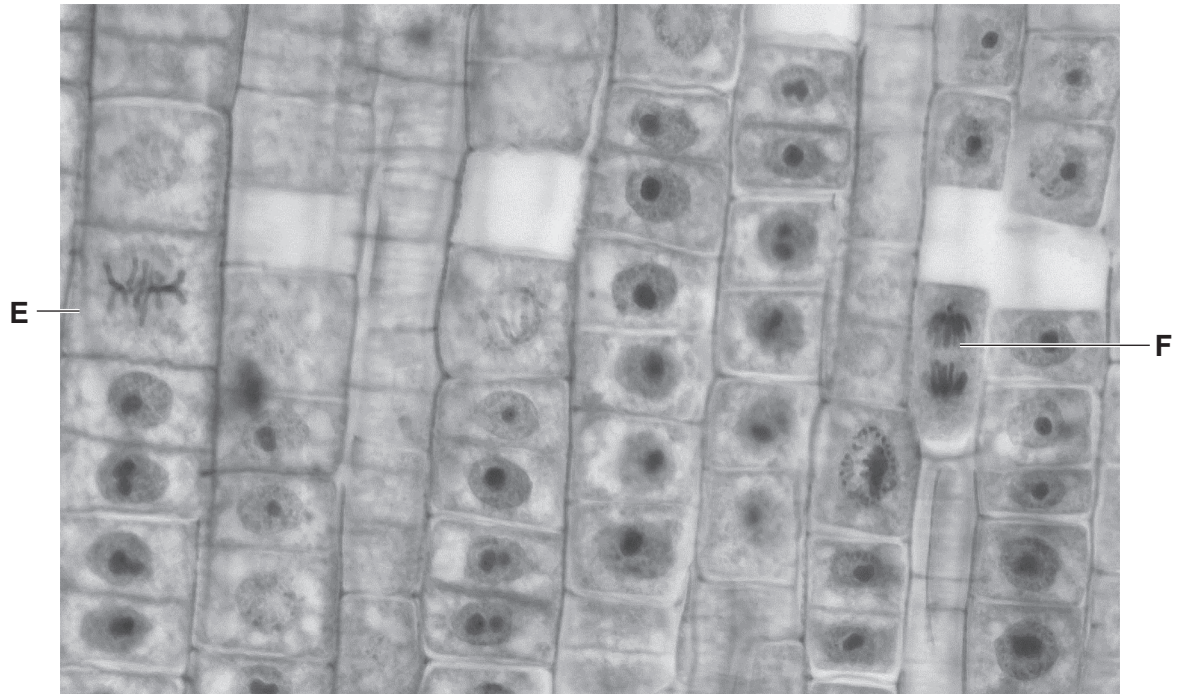


Fig. 1.1

(i) Identify which stage of mitosis is shown in cell **E** and in cell **F** in Fig. 1.1.

E .....

F ..... [2]

(ii) Microtubules are present within the cells that are in stages of mitosis, but these are not visible in Fig. 1.1.

State the function of microtubules in mitosis.

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..... [1]

(iii) State, with a reason, whether Fig. 1.1 shows a region of animal or plant tissue.

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..... [1]

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(b) Semi-conservative replication of DNA occurs during interphase, before mitosis begins.

Write the correct term in the spaces provided to complete each of statements **A** to **D**.

A The DNA double helix unwinds and is separated into two template strands when ..... bonds holding the two strands together are broken.

B One of the template strands of DNA is copied in fragments. The enzyme ..... is required to join the fragments together to form a continuous strand of DNA.

C Complementary DNA nucleotides are added to the template strands, catalysed by the enzyme ..... .

D ..... are regions of repeating nucleotide sequences at the ends of chromosomes that allow the continued replication of DNA, without the loss of genes.

[4]

[Total: 8]

2 Sugars are transported within phloem sieve tubes from a source, such as a mature leaf, to a young leaf, which acts as a sink. The young leaf also needs water and dissolved mineral ions, which arrive at the leaf within xylem vessels.

(a) As the young leaf matures, the quantity of sugar taken up by the leaf decreases to zero, but the need for water increases.

Suggest **and** explain why the quantity of sugar taken up by the developing leaf decreases to zero over time, but the need for water increases.

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..... [3]

(b) The features listed in Table 2.1 are present in one or more of the three cell types:

- companion cell
- phloem sieve tube element
- xylem vessel element.

Complete Table 2.1 using a tick (✓) if the feature is present and a cross (✗) if the feature is absent.

Table 2.1

feature	companion cell	phloem sieve tube element	xylem vessel element
cytoplasm			
cell surface membrane			
lignified cell wall			
nucleus			

[4]

[Total: 7]

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3 In mammals, some cell signalling molecules are steroid (lipid) hormones. These hormones are transported in the bloodstream to reach capillary networks.

At a capillary network, hormones pass out of the blood into tissue fluid.

(a) Fig. 3.1 is a diagram of a capillary network.

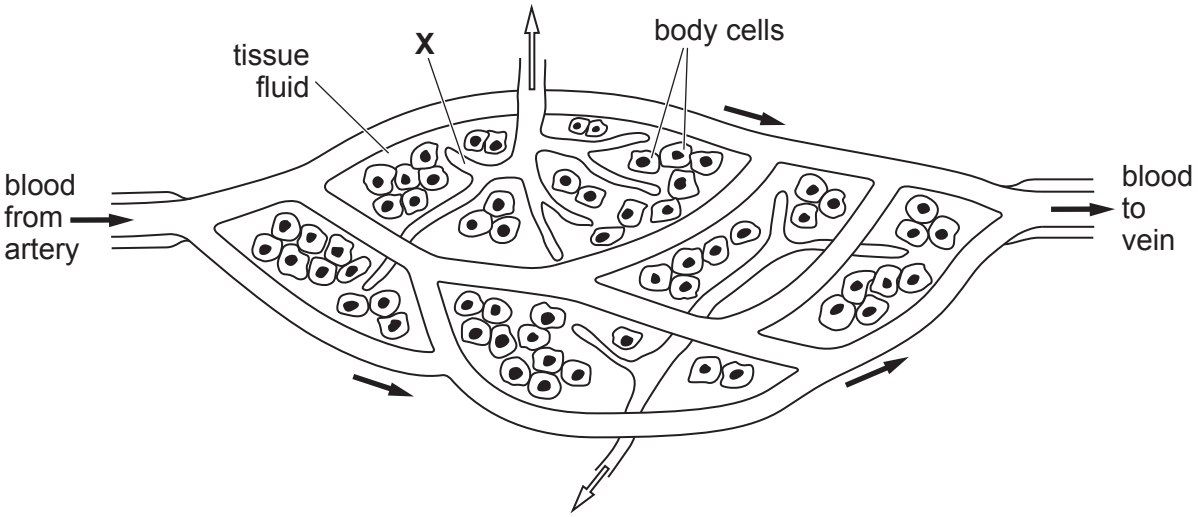


Fig. 3.1

(i) Describe the **differences** between the blood arriving at the arterial end of the capillary network and the tissue fluid surrounding the body cells.

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..... [3]

(ii) Not all the tissue fluid passes back into the blood capillaries to enter the bloodstream. Some of the tissue fluid drains into blind-ended vessels, such as vessel **X** shown in Fig. 3.1.

Name the fluid that is formed in vessel **X**.

..... [1]

Hormone **S** is a steroid hormone involved in cell signalling.

Fig. 3.2 shows the sequence of events that occurs when hormone **S** enters a target cell.

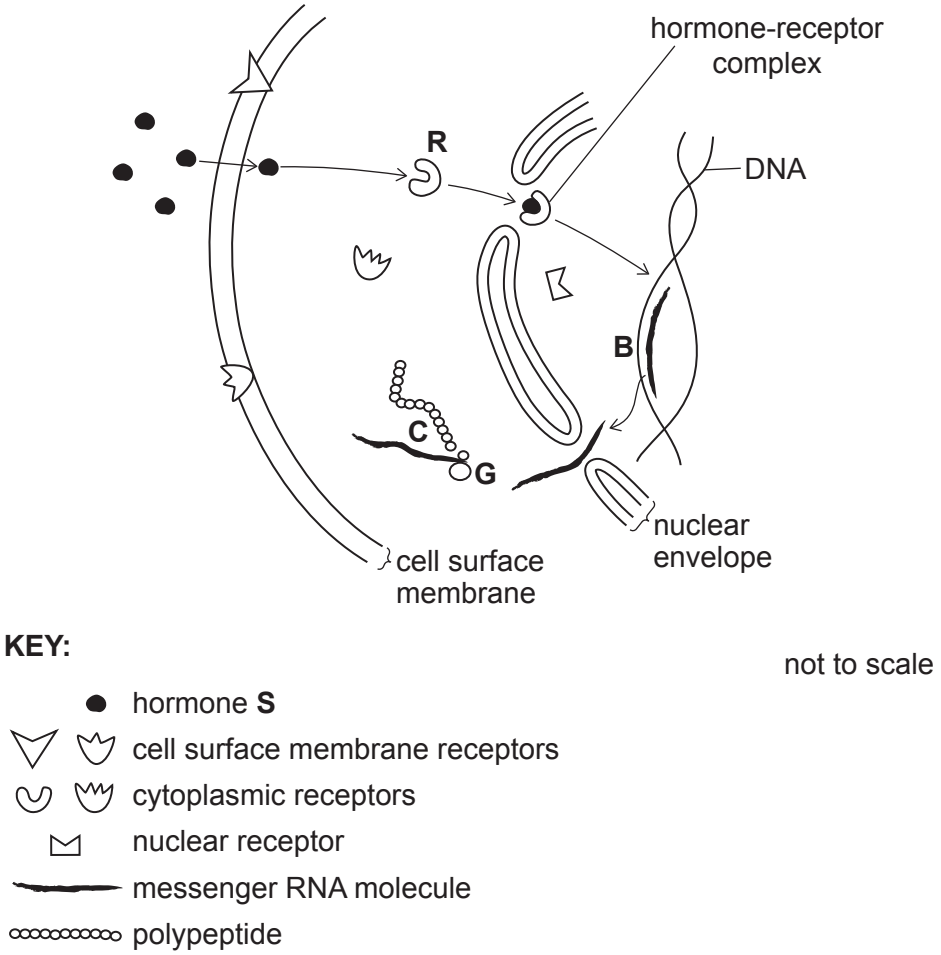


Fig. 3.2

(b) Explain why hormone **S**, shown in Fig. 3.2, does not need to pass through a transport protein to enter the cytoplasm of the target cell.

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..... [2]

(c) The target cell can respond to other cell signalling molecules in addition to hormone **S**. The cell has receptors in the cell surface membrane, in the cytoplasm and in the nucleus.

Explain why hormone **S** binds only with receptor **R** in the cytoplasm and **not** with the other receptors shown in Fig. 3.2.

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.....

..... [1]

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(d) The hormone-receptor complex shown in Fig. 3.2 enters the nucleus and binds to DNA. This switches on a gene coding for a polypeptide that is synthesised in the cytoplasm.

(i) Name the structure through which the hormone-receptor complex enters the nucleus.

..... [1]

(ii) Name the processes occurring at **B** and **C**.

B .....

C ..... [2]

(iii) Name structure **G**.

..... [1]

(e) Cell signalling by hormone **S** results in the production of a functioning globular protein molecule composed of three identical polypeptide chains.

After the synthesis of these polypeptides, changes need to occur to form the functioning globular protein molecule.

Outline the changes that need to occur to form the functioning globular protein molecule.

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..... [4]

[Total: 15]

4 A person who is exposed to tobacco smoke is at greater risk of lung cancer and chronic obstructive pulmonary disease (COPD).

Many people with COPD have both chronic bronchitis and emphysema. These diseases cause changes in the gas exchange system. For example, changes occur in the total lung surface area to volume ratio (SA:V).

(a) Tar in tobacco smoke has a number of effects on the cells lining the gas exchange system.

State the main effects of tar on the cells lining the gas exchange system that are related to lung cancer **and** to chronic bronchitis.

lung cancer .....

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.....

chronic bronchitis .....

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.....

..... [3]

(b) A student investigated the effect of SA:V on diffusion.

Agar was prepared with Universal Indicator solution and sodium hydroxide solution. The agar was coloured blue.

Three cubes, **A**, **B**, and **C**, were cut from a solid block of blue agar. Each cube was a different size.

Universal Indicator solution changes to a red colour in the presence of acid.

The student prepared Table 4.1 to show the sizes and SA:V of each cube.

Table 4.1

cube	length of each side / cm	total surface area / cm^2	volume /	SA:V
A	1	6	1	6:1
B	2	24	8	3:1
C	3			2:1

Complete Table 4.1 by:

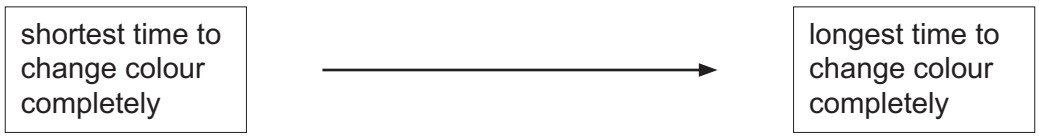
- writing the correct units for volume
- calculating the total surface area, and volume, of cube **C**.

[2]

(c) Cubes **A**, **B** and **C** were placed in a small beaker. At time 0 seconds, dilute hydrochloric acid was added to the beaker to cover the cubes.

The student timed how long it took for each cube to change colour completely.

Complete Fig. 4.1 to show the results that were obtained.



cube ..... → cube ..... → cube .....

[1]

Fig. 4.1

(d) Some people with emphysema may be offered lung volume reduction surgery (LVRS), in which diseased lung tissue is surgically removed.

One expected outcome of the surgery is an improvement in total lung surface area to volume ratio (total lung SA:V).

Suggest why there is an improvement in total lung SA:V after the surgery has been carried out.

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..... [2]

(e) In humans, blood that becomes oxygenated in the lungs reaches body tissues without coming into contact with blood that is deoxygenated.

Explain how the blood that becomes oxygenated in the lungs is kept separate from blood that is deoxygenated.

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..... [2]

[Total: 10]

5 Fig. 5.1 is a transmission electron micrograph showing parts of two plant cells. The function of the middle lamella is cell-to-cell adhesion. The middle lamella is composed of a polysaccharide known as pectin.

Pectin interacts with the polysaccharides cellulose and hemicellulose in the cell walls of the plant cells so that the cell walls are held close together, as shown in Fig. 5.1.

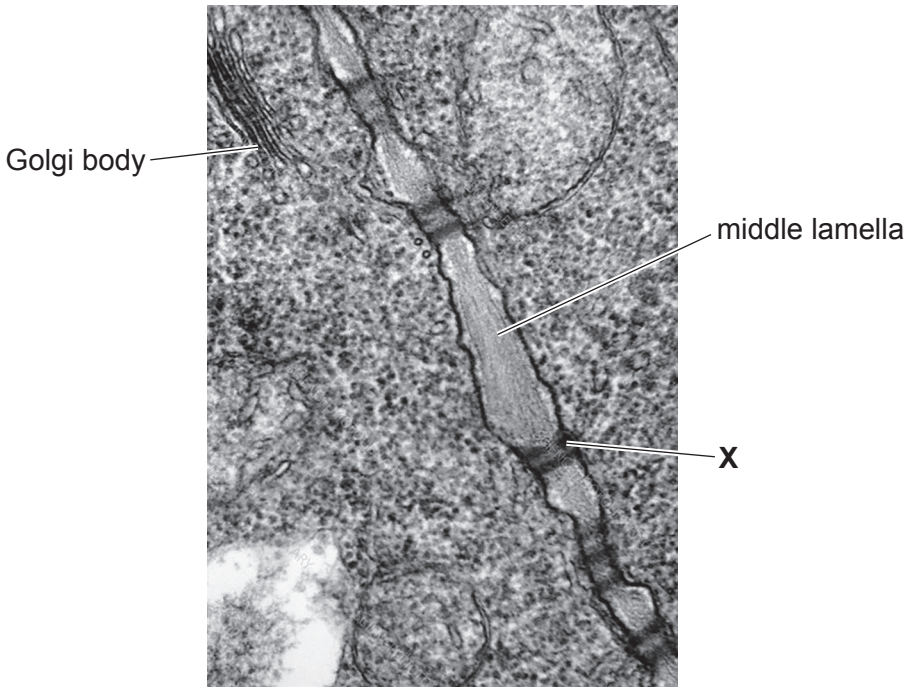


Fig. 5.1

(a) Cell structure **X** in Fig. 5.1 is a cytoplasmic channel with strands of cytoplasm passing through the cell walls of the two cells.

Name cell structure **X and** state **one** function of this cell structure.

name .....

function .....

..... [2]

(b) Researchers have discovered that pectin is synthesised within the Golgi body. Golgi vesicles containing pectin are moved to the cell surface membrane for release.

(i) Suggest why researchers would **not** have investigated ribosomes as being the possible location for the synthesis of pectin.

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..... [1]

(ii) Name the mechanism that is used to transport pectin out of the cell.

..... [1]

Juices that are extracted commercially from fruits can be made less cloudy by the breakdown of the cell wall using the enzymes cellulase, pectinase and xylanase:

- cellulase hydrolyses cellulose
- pectinase hydrolyses pectin
- xylanase hydrolyses hemicellulose.

(c) Fig. 5.2 is a graph showing the effect of cellulose concentration on the activity of cellulase, which is used in making fruit juice less cloudy.

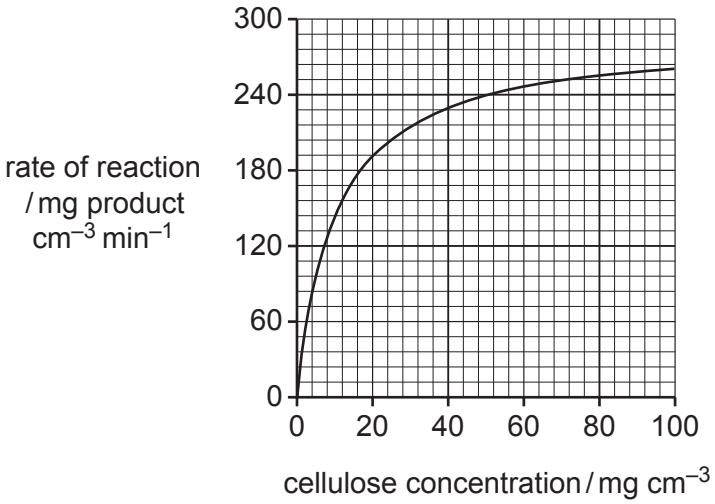


Fig. 5.2

Describe **and** explain the curve shown in Fig. 5.2.

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..... [3]

(d) Ultrasound is one possible method that can be used to destroy microorganisms that contaminate fruit juices. Ultrasound is the term given to sound waves that are out of the range of human hearing.

An investigation was carried out into the effect of ultrasound on the activity of cellulase, pectinase and xylanase used in fruit juice manufacture.

For each enzyme, the effect of ultrasound was compared with no ultrasound on the:

- maximum rate of reaction (V_{max})
- Michaelis-Menten constant (K_m)
- catalytic efficiency (V_{max}/K_m)

Table 5.1 summarises the results. A higher V_{max}/K_m indicates a higher catalytic efficiency.

Table 5.1

enzyme	method	comparison of V_{max}	comparison of K_m	V_{max}/K_m / min^{-1}
cellulase	ultrasound	higher	higher	34
	no ultrasound	lower	lower	29
pectinase	ultrasound	same	lower	945
	no ultrasound	same	higher	759
xylanase	ultrasound	higher	same	146
	no ultrasound	lower	same	125

(i) In terms of changes in the interaction between enzyme and substrate when ultrasound is used, suggest explanations for the lower K_m for pectinase and the higher V_{max} for xylanase, as shown in Table 5.1.

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..... [3]

(ii) Explain whether the data shown in Table 5.1 supports the recommendation that ultrasound can be used in the manufacture of fruit juices.

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..... [1]

[Total: 11]

6 The diseases myasthenia gravis (MG) and HIV/AIDS both involve disorders of the immune system.

(a) The cause of MG involves a response by B-lymphocytes.

Explain why MG is called a disorder of the immune system.

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..... [2]

(b) Studies have indicated that T-lymphocytes are involved in stimulating the B-lymphocyte response that causes MG.

Research has been carried out on a vaccine that will provide a person with **active immunity** against these T-lymphocytes and B-lymphocytes.

Suggest **and** explain how this vaccine will provide a person with active immunity against the T-lymphocytes and B-lymphocytes responsible for causing MG.

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..... [3]

(c) Many people who are living with HIV (infected with HIV) develop tuberculosis (TB). If a person does not have any symptoms of TB, one preventive measure is to prescribe antibiotics. This reduces the overall number of cases of TB and deaths from TB.

State the **disadvantage** of prescribing antibiotics as a preventive measure against TB.

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..... [1]

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(d) Fig. 6.1 is a summary of some of the statistics published by UNAIDS (Joint United Nations Programme on HIV and AIDS) about HIV and HIV/AIDS for the year 2017.

The figures shown in Fig. 6.1 for 2017 are estimated.

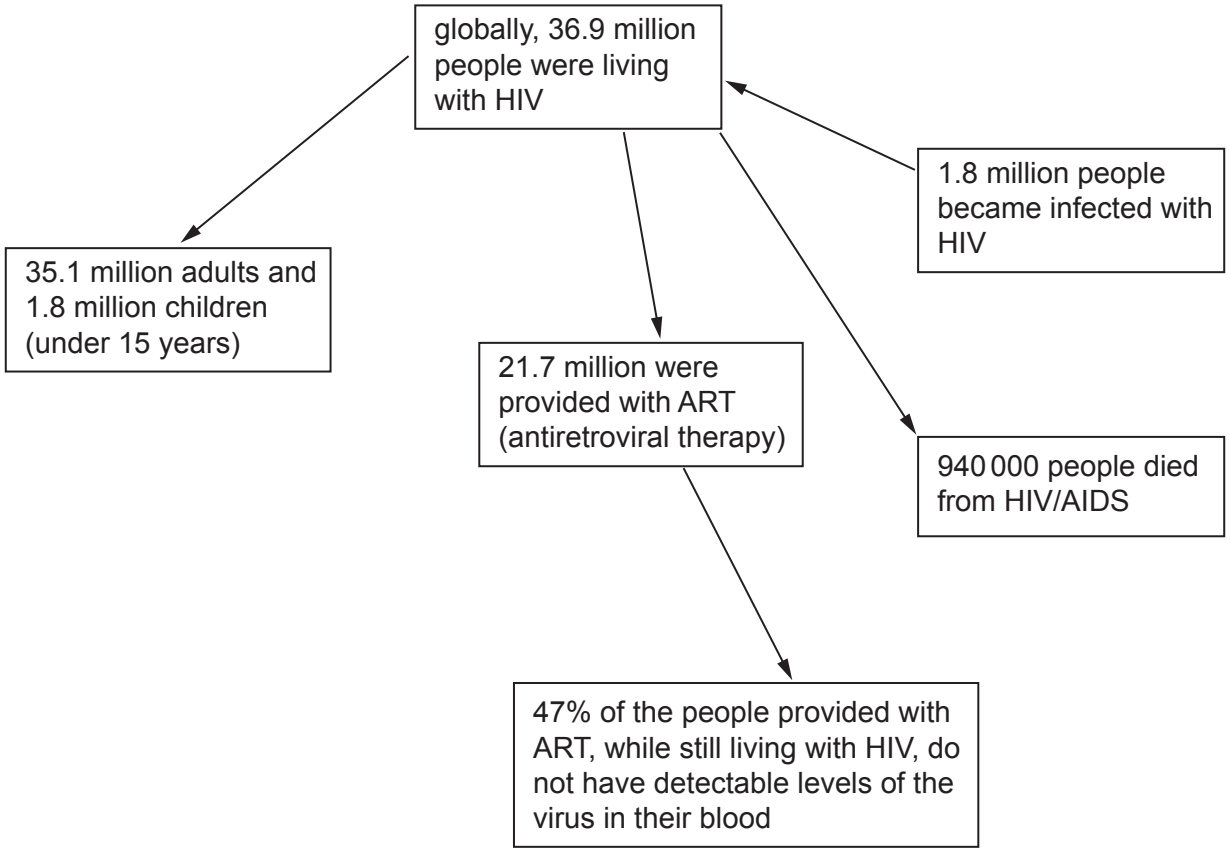


Fig. 6.1

One other statistic published by UNAIDS indicated that, in 2017, only 75% of the estimated 36.9 million people living with HIV knew that they had been infected with the virus.

With reference to the information in Fig. 6.1, discuss the importance of this statistic.

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..... [3]

[Total: 9]

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