OCR
Oxford Cambridge and RSA

Thursday 25 May 2023 – Morning

AS Level Biology A

H020/02 Depth in biology

Time allowed: 1 hour 30 minutes

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

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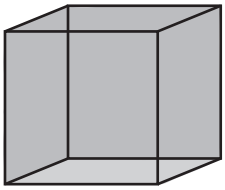
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1 **(a)** **Fig. 1.1** shows two cubes that represent a large and a small multicellular plant.

Fig. 1.1

Large multicellular plant	Small multicellular plant
	
Length = 2 cm Width = 2 cm Depth = 2 cm	Surface area : volume = 6:1

(i) Using the data provided in **Fig. 1.1**, calculate the surface area : volume of the large multicellular plant.

Surface area : volume = ... **[2]**

(ii) Explain why a large multicellular plant needs a transport system but a small multicellular plant does not.

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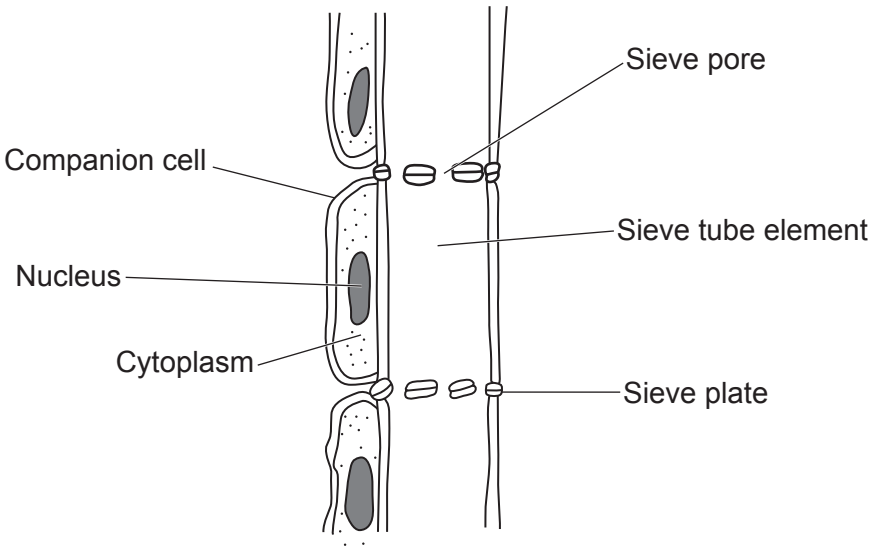
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(b)* **Fig. 1.2** shows a diagram of phloem tissue in the stem of a herbaceous dicotyledonous plant.

Fig. 1.2



With reference to **Fig. 1.2** outline the structure and function of phloem tissue in the stem of a herbaceous dicotyledonous plant.

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2 **(a)** **(i)** State the cause of transpiration in plants.

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(ii) Two factors that affect the rate of transpiration in plants are humidity and air movement.

Name **one** other factor that affects the rate of transpiration in plants.

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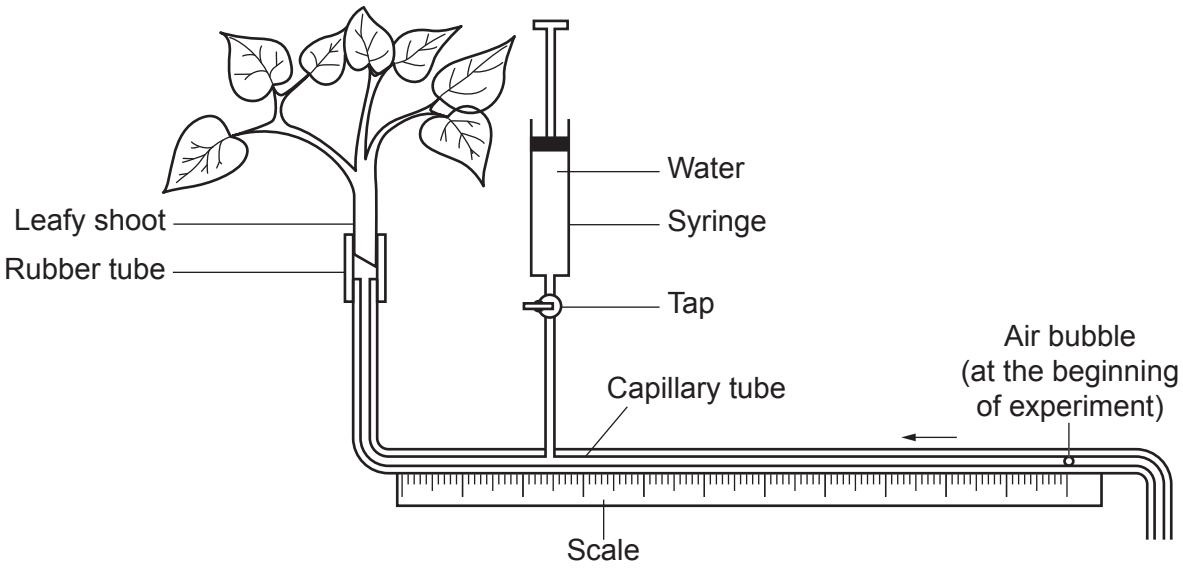
(b) A class of students investigated the effect of humidity on the rate of transpiration from a leafy shoot.

They made the assumption that the volume of water uptake by a leafy shoot is equivalent to the volume of water lost through transpiration.

This is the method the class followed:

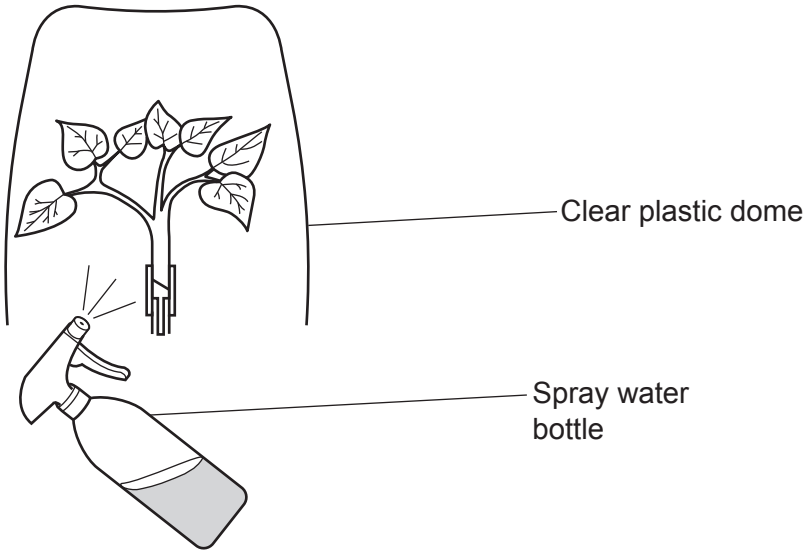
- The class was divided into three groups.
- Each group had a potometer and a leafy shoot, shown in **Fig. 2.1**.
- Each group investigated one humidity level and completed three trials.
- They measured the distance moved by the air bubble in a fixed time.
- Group A used only the apparatus shown in **Fig. 2.1**.
- Groups B and C added to the apparatus. They put a clear plastic dome over the leafy shoot and used a water spray to vary the humidity around the leafy shoot. This is shown in **Fig. 2.2**.

Fig. 2.1



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Fig. 2.2



(i) Suggest **three** improvements the students could have made to their investigation.

Improvement 1

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Improvement 2

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Improvement 3

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[3]

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The students' results are shown in the tables.

Group A. Experiment conducted for 3 minutes.

Number of sprays of water	Distance moved by bubble (mm)				
	Trial 1	Trial 2	Trial 3	Mean	Rate of bubble movement (mm min^{-1})
0	34	30	31	.....	.....

Group B. Experiment conducted for 5 minutes.

Number of sprays of water	Distance moved by bubble (mm)				
	Trial 1	Trial 2	Trial 3	Mean	Rate of bubble movement (mm min^{-1})
1	31	34	32	32.3	6.5

Group C. Experiment conducted for 5 minutes.

Number of sprays of water	Distance moved by bubble (mm)				
	Trial 1	Trial 2	Trial 3	Mean	Rate of bubble movement (mm min^{-1})
2	12	10	9	10.3	2.1

(ii) Complete the table by filling in the missing values for mean **and** rate of bubble movement for group A.

Give your answers to **1** decimal place.

Mean = ... mm

Rate of bubble movement = ... mm min^{-1}

[2]

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(iii) State the conclusion that can be drawn from the students' results.

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(c) The students wanted to see how air movement affects rate of transpiration.

Describe how you would **modify** the apparatus shown in **Fig. 2.1 and Fig. 2.2** to determine how air movement affects rate of transpiration.

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3 **(a)** A group of students was provided with a sample of an unknown liquid and various chemical reagents. It was suggested that the sample of unknown liquid contained protein.

Here is the chemical test proposed by one of the students to test this suggestion:

- Add 3 cm^3 of unknown liquid sample to an equal volume of sodium hydroxide solution
- Mix
- Leave to stand for 5 minutes.

(i) The above test would not detect the presence of protein in the sample.

State the change that needs to be made to this test to enable protein to be detected.

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(ii) Sodium hydroxide is a white solid ionic compound which is highly soluble in water. It consists of anions and cations.

Complete the table below.

State the chemical symbol of the **anion** present in sodium hydroxide.	
State one use of this **anion** in a biological process.	

[2]

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(b)* The students were provided with another sample of an unknown liquid. They carried out chemical tests on this sample to determine what biological molecules were present. Their findings are shown in the table below.

Biological molecule	**Present**
Lipids	Yes
Starch	Yes

Describe the chemical tests you would carry out to see if the students' findings were correct. Include the **apparatus** and **reagents** you would use and the results that you would expect.

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(c) (i) The students were then asked to carry out an experiment to determine the glucose concentration of another test solution using a colorimeter.

Describe how the students would use a colorimeter in their experiment.

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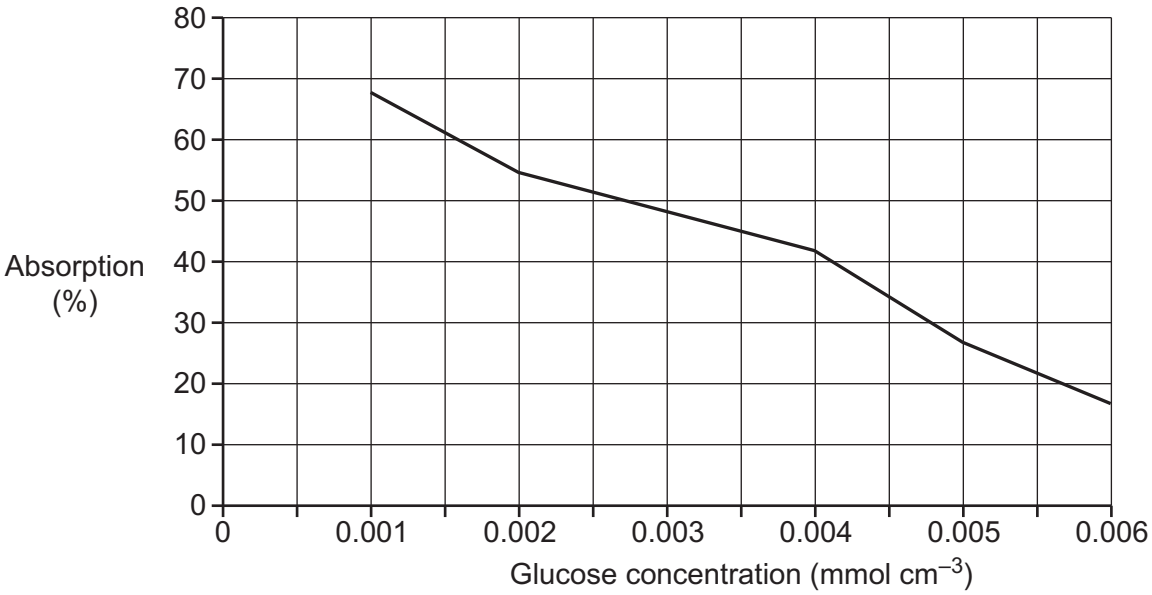
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(ii) The students plotted their results, shown in the graph.



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The students found that the test solution had an absorption value of 45%.

Use the graph to estimate the glucose concentration in the test solution.

Give your answer in mmol dm^{-3}.

Concentration = ...mmol dm^{-3} **[2]**

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4 **(a)** The Humboldt penguin is protected by the Convention on International Trade in Endangered Species (CITES).

- The Humboldt penguin lives on the Pacific coast of South America.
- The breeding grounds for the Humboldt Penguin contains layers of guano.
- Guano is the accumulated excrement of seabirds.
- Guano was collected by humans as it is a valuable fertiliser.
- Penguins were killed for their oils and skin.

Suggest how CITES can help prevent the decline of the Humboldt penguin.

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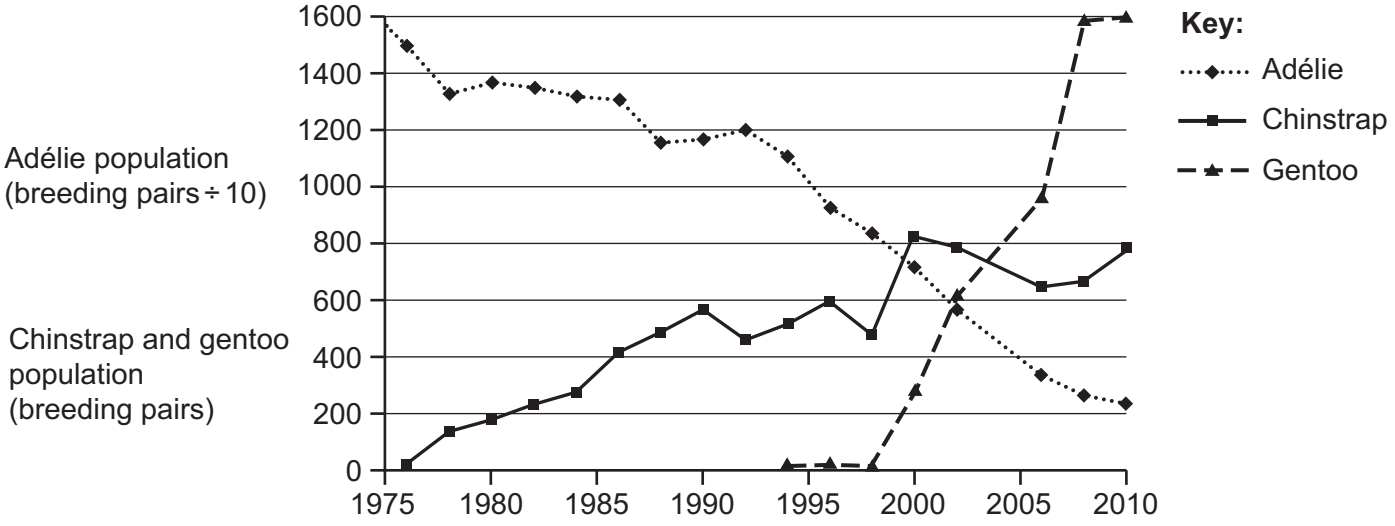
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(b) A study was carried out to monitor the population of three penguin species on an island near Antarctica.

The graph shows the results of this study.



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Use the graph to compare the species richness and species evenness of the penguins found on the island in the years 1980 and 2010.

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5 **(a)** Measles, Mumps and Rubella are communicable diseases. They can be prevented by the use of the MMR vaccine which is administered to children.

The table below shows some data on the number of children given the MMR vaccine and the incidence of measles between 2012 and 2014.

MMR vaccinations		
Date	**Country**	**Number of vaccinations administered**
2013 (Oct to Dec)	England	171,855
2014 (Jan to March)	England	162,193
Confirmed cases of measles		
Date	**Country**	**Number of confirmed cases**
2012	England and Wales	2,032
2013	England	1,414
2014	England	102

(i) Using the data provided in the table, calculate the percentage decrease in the number of vaccinations administered in England between 2013 and 2014.

Give your answer to **2** significant figures.

Percentage decrease = ... **[2]**

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(ii) Student **A** studied the data in the table and made the following statement:

'The MMR vaccination programme is not working because although the number of children vaccinated has reduced, measles incidence has also reduced.'

In response, student **B** stated:

'You cannot tell this from the data provided here.'

With reference to the data in the table, discuss whether student **B** is correct.

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(iii) A student made the following statement about the influenza (flu) vaccination programme:

'The flu vaccination programme involves giving the same flu vaccine to different age groups and to medically vulnerable people every year, as it is for the same disease.'

Discuss the accuracy of the student's statement.

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(iv) Explain how vaccination programmes can play a role in preventing epidemics.

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(b) Rheumatoid arthritis is an autoimmune disease that causes pain in skeletal joints.

(i) Explain the meaning of the term **autoimmune disease**.

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(ii) Collagen is a protein found in ligaments. Ligaments attach bone to bone and stabilise joints.

State the properties of collagen that make it suitable for this function.

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(iii) Neutrophils are produced by stem cells.

State where in the body these stem cells are found.

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(iv) A student wrote the following passage about the immune system:

'T helper cells produce cell signalling molecules called perforins. These stimulate the activity of B cells which increase antibody production. Agglutinins cause pathogens with antigen-toxin complexes to clump together.'

Identify **two** errors in the statement and write a correction for each error.

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[2]

(c) Parkinson's disease is a neurological condition which results in problems with co-ordination of body movements.

- It can be caused by the death of dopamine producing nerve cells in a part of the midbrain called the substantia nigra.
- Body movements become slow and abnormal due to reduction in dopamine.
- Drugs are available but they only slow down the progress of Parkinson's disease.

Suggest and explain how stem cells might be used to help treat Parkinson's disease.

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6 **(a)** Here is some information about reproduction in two members of the animal kingdom.

- Komodo dragons are large lizards that usually reproduce sexually, but very rarely females can reproduce asexually.
- Starfish can reproduce asexually by a process known as fragmentation. This is when a small piece of the adult starfish breaks off and starts to grow on its own to form a clone of its parent.

(i) Describe the role of mitosis in fragmentation.

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(ii) State **one** other function of mitosis in starfish.

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(iii) When Komodo dragons reproduce sexually the gametes are produced by meiosis.

Explain how meiosis produces genetic variation in the offspring.

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(b) HeLa cells and RPE1 cells are cell lines that are commonly used in research. Scientists can use these cell lines to observe mitosis in human tissues outside the human body.

Scientists use the term mitotic index to describe the proportion of cells in a sample that are undergoing mitosis.

A study was carried out using a chemical CDK1. This chemical increased the mitotic index of HeLa and RPE1 cells so that mitosis could be better observed.

Here are the results from the study:

- 31 HeLa cells were found to be undergoing mitosis in the field of view through a microscope.
- The mitotic index for HeLa cells was found to be 0.36.
- The mitotic index for RPE1 cells was found to be 0.16.
- Total number of RPE1 cells in the field of view were 75.

Calculate the total number of HeLa cells that were in the field of view.

Use the formula: $\text{Mitotic index} = \dfrac{\text{Number of cells in the field of view undergoing mitosis}}{\text{Total number of cells in the field of view}}$

Give your answer to **2** significant figures.

Total number of HeLa cells = ... **[2]**

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7 The diagrams below are of two specialised cells.

Fig. 7.1 shows a sperm cell from a mammal. **Fig. 7.2** shows a palisade cell from a plant.

Fig. 7.1

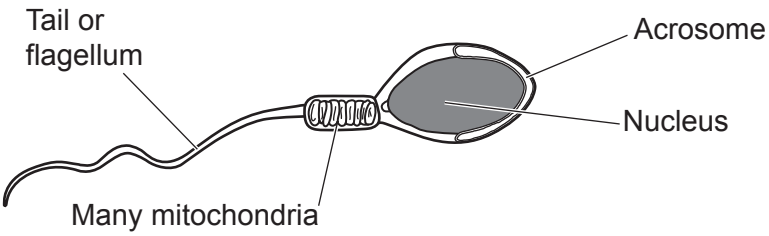
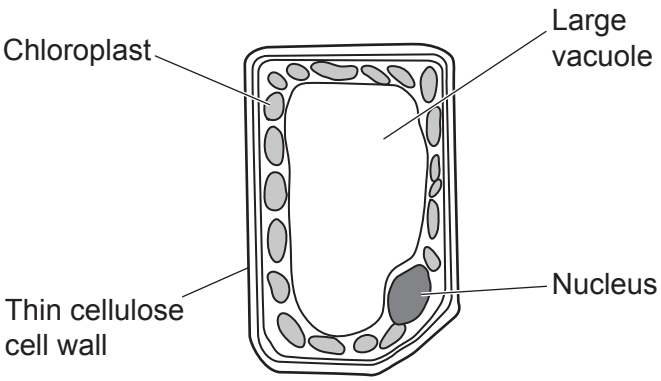


Fig. 7.2



(a) With reference to the features shown in **Fig. 7.1**, explain how the sperm cell is adapted to its function.

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(b) With reference to the features shown in **Fig. 7.2**, explain how the palisade cell is adapted to its function.

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END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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