Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

6818086455

BIOLOGY **5090/21**

Paper 2 Theory **May/June 2024**

1 hour 45 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 80.
- 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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1 The lungs are part of the human gas exchange system.
Breathing moves air into and out of the lungs.

(a) **(i)** Fig. 1.1 shows parts of the human gas exchange system and their functions.
On Fig. 1.1, draw a line from each part to its function.
One has already been done for you.

part	**function**
intercostal muscles	exchange gases
goblet cells	remove pathogens
alveoli	carry air to bronchi
cilia	change volume of thorax
trachea	release mucus

Fig. 1.1

[4]

(ii) State **two** features of alveoli that make them suitable for gas exchange.

1 .....

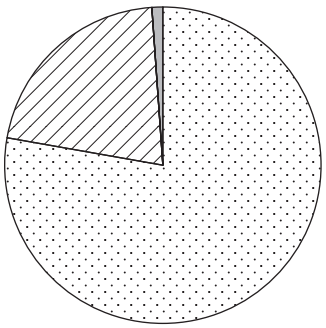
2 .....

[2]

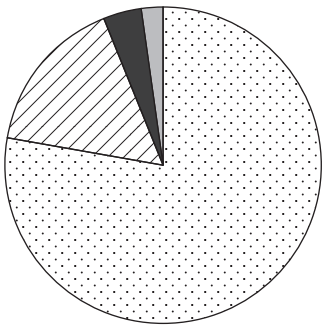
(b) Gas exchange changes the percentages of some gases in the lungs.
The pie charts in Fig. 1.2 show how the percentages of gases in the lungs change during one breath.

Complete the pie chart titles and the key which shows which gases are represented by different types of shading.

..... air



..... air



key	
	.....
	.....
	.....
	other gases

Fig. 1.2

[4]

[Total: 10]

2 Brown bread, made from the flour of whole wheat grains, contains both starch and fibre.

(a) **(i)** A man eats a piece of brown bread.
In his digestive system, the starch in the bread is chemically digested to maltose and then to glucose.

Describe where and how this digestion takes place as the bread travels through his digestive system.

.....

.....

.....

.....

.....

..... [4]

(ii) Describe what happens to the fibre as it passes through his digestive system.

.....

.....

..... [2]

(b) Glucose passes from the digestive system into the blood by diffusion and active transport.

Give **two** ways in which active transport is different from diffusion.

1 .....

.....

2 .....

.....
[2]

(c) Scientists have found that there are different types of starch which have molecules of different shapes. Some molecules are digested rapidly and others are digested slowly.

The graph in Fig. 2.1 shows the effect on the concentration of glucose in the blood after eating two types of starch.

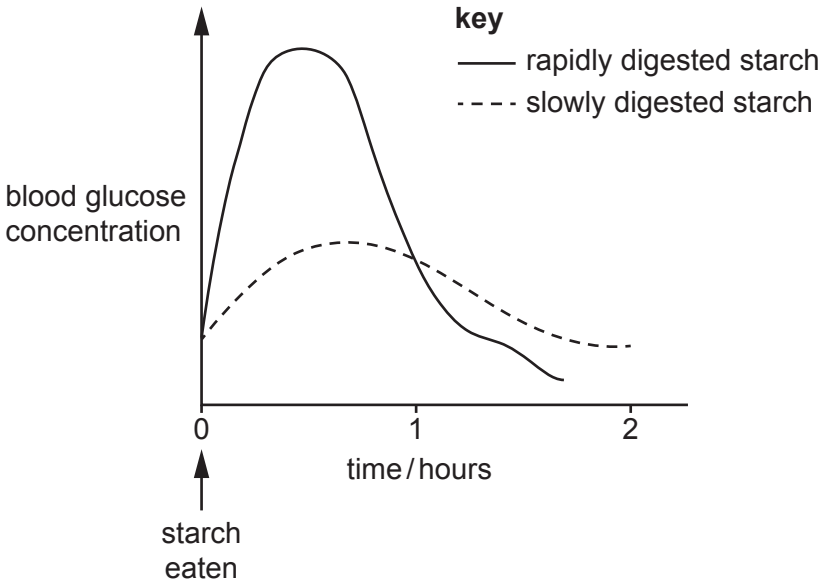


Fig. 2.1

(i) There is already glucose in the blood when the starch is eaten.
Explain how Fig. 2.1 shows this.

.....

..... [1]

(ii) Both graph lines show an initial increase in blood glucose concentration followed by a decrease.
Suggest **two** reasons why the blood glucose concentrations decrease.

1 .....

.....

2 .....

.....
[2]

(iii) Use information from Fig. 2.1 to suggest which type of starch is healthier to have in the diet. Give a reason for your answer.

.....

.....

..... [2]

(d) Scientists want to produce a new wheat variety with an increased fibre content.
Describe **two** methods they could use to do this.

1 .....

.....

.....

2 .....

.....

.....
[4]

[Total: 17]

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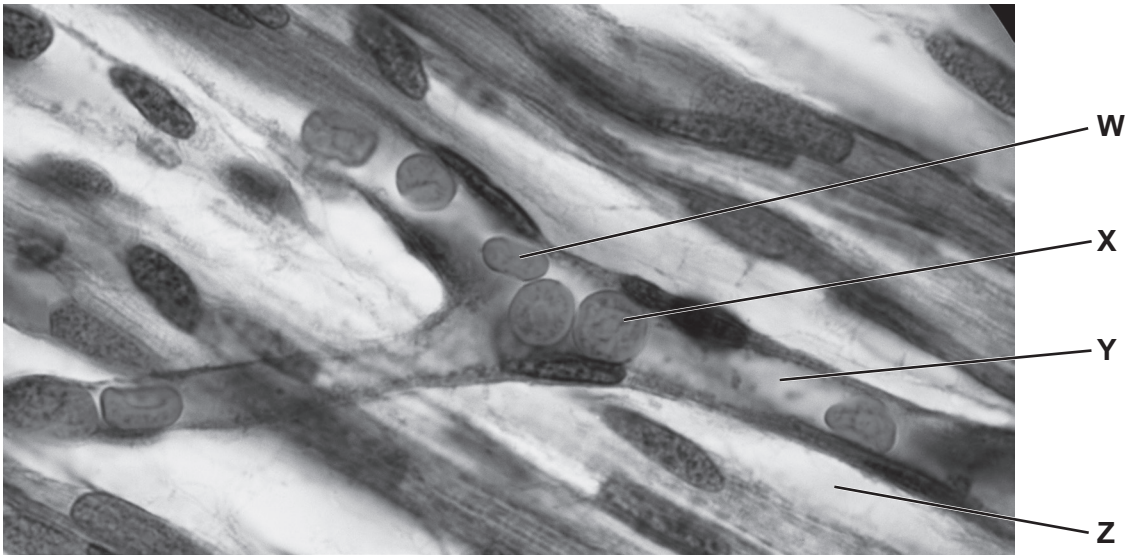
3 Fig. 3.1 is a photomicrograph showing part of a capillary network of a woman.
The structure labelled **X** is a red blood cell.



×1250

Fig. 3.1

(a) **(i)** The diameter of cell **X** in the photomicrograph is 10 mm.
Calculate the **actual** diameter of cell **X**.
Show your working and express your answer in micrometres (μm).

actual diameter of cell **X** = ... [3]

(ii) **W** and **X** are both red blood cells.
Explain why **W** and **X** appear different from each other in Fig. 3.1.

.....

.....

.....

..... [2]

(iii) **Y** and **Z** are both liquids.
Name the liquids **Y** and **Z** and explain how liquid **Z** forms from liquid **Y**.

Y .....

Z .....

explanation .....

.....

.....

.....
[3]

(b) The woman has malaria and symptoms of anaemia.
The malarial pathogens infect red blood cells where they multiply to form many new, genetically identical pathogen cells. These new pathogen cells burst out of the red blood cells.

(i) Describe how malarial pathogens can be transmitted from this woman to another person.

.....

.....

.....

.....

..... [3]

(ii) Name the type of nuclear division that results in new pathogen cells.

..... [1]

(iii) Suggest why infection with the malarial pathogen can cause anaemia.

.....

..... [1]

(iv) State **one** other cause of anaemia.

.....

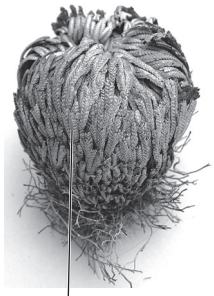
..... [1]

[Total: 14]

4 Some plants can survive extreme dehydration for a long time in a dormant state. They start growing again when water is available. They are adapted to survive in deserts. *Selaginella lepidophylla* is an example of this type of plant.

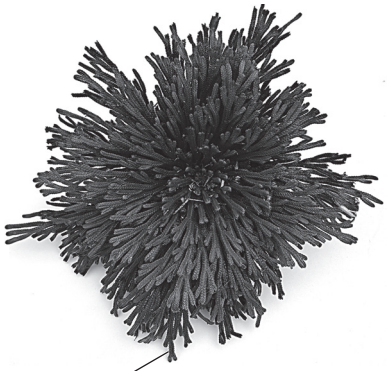
(a) Fig. 4.1 shows a *S. lepidophylla* plant after several months without water and the same plant three days after rainfall.

several months without water



plant is a brown colour

three days after rainfall



plant is a green colour

Fig. 4.1

(i) Explain how the changes in the plant, shown in Fig. 4.1, will help it to start growing again after rainfall.

.....

.....

.....

.....

.....

..... [4]

(ii) Fig. 4.2 shows the cell wall and nucleus of a cell from this plant after several months without water.

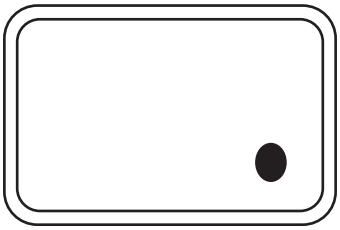


Fig. 4.2

Suggest and explain the appearance of other parts of this cell after several months without water.
You may draw on Fig. 4.2 to help you answer.

.....

.....

.....

.....

.....

..... [4]

(b) *Selaginella lepidophylla* is the scientific name for the plant species, which also has the common name 'resurrection moss'.

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

.....

.....

..... [2]

(ii) State the name of the scientific system used to name the species and suggest **one** advantage of using the scientific name rather than the common name.

name of system .....

advantage .....

.....
[2]

[Total: 12]

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5 *Bacillus subtilis* is a species of bacterium that is widely used in biotechnology.
It can be used to manufacture the protein lipase for industrial use.
Fig. 5.1 is a diagram of *B. subtilis*.

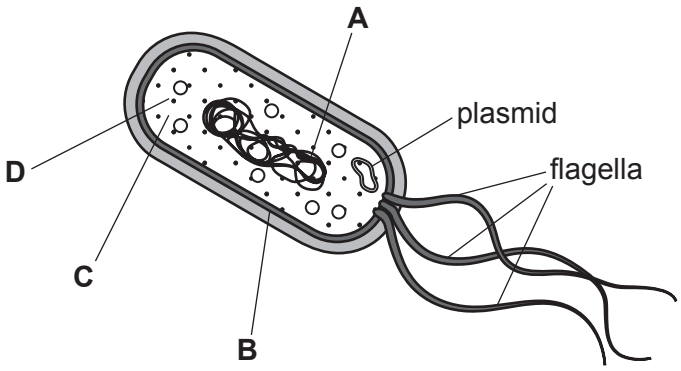

Fig. 5.1

(a) **(i)** Two of the parts labelled **A**, **B**, **C** and **D** in Fig. 5.1 are involved in the manufacture of proteins such as lipase.
Identify the **two** parts, name them and explain their role in protein manufacture.

letter ..... name .....

role .....

.....

letter ..... name .....

role .....

.....
[4]

(ii) Suggest why *B. subtilis* has flagella.

.....

..... [1]

(iii) Explain why plasmids are useful in biotechnology.

.....

.....

..... [2]

(b) *B. subtilis* can be grown industrially in large containers.
When *B. subtilis* is in ideal conditions it can reproduce rapidly, increasing the population size and the biomass of bacteria in the container.

Graphs **E** and **F** in Fig. 5.2 show how the biomass of *B. subtilis* increases after small populations of bacteria are added to two containers with different environmental conditions.

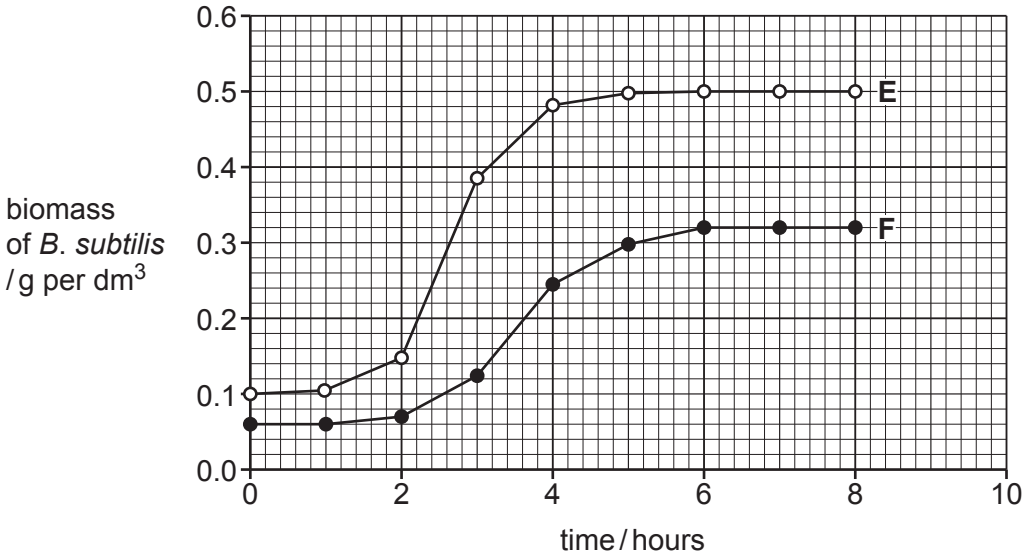

Fig. 5.2

(i) Give the name of the large industrial containers used to grow bacteria.

..... [1]

(ii) In graph **E** the biomass increases as shown in Fig. 5.2.
Indicate using the letter **M** the part of graph **E** where bacteria are reproducing **most** rapidly. [1]

(iii) Calculate the percentage increase in biomass for graph **E** in the first 6 hours.
Space for working.

percentage increase in biomass = ...% [2]

(iv) Describe **two** differences between graph **E** and graph **F**.

1 .....

.....

2 .....

.....
[2]

(v) Suggest **one** environmental condition which could have caused the differences between graph **E** and graph **F**.

..... [1]

(c) Lipase is also produced by the human body.
Explain why it is produced and how its function is different from the function of bile.

.....

.....

.....

.....

..... [3]

[Total: 17]

6 A beam of bright light shines into a human eye for two seconds.
A similar beam of light shines onto one side of the tip of a plant stem for several days.

(a) Describe the ways in which the human and the plant coordinate their responses to these beams of light.

Your answer should include:

- stimulus detection
- method of responding.

human .....

.....

.....

.....

plant .....

.....

.....

.....
[6]

(b) Describe the role of synapses in a reflex arc.

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

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