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BIOLOGY **0610/41**

Paper 4 Theory (Extended) **October/November 2024**

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 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 Fig. 1.1 is a photomicrograph of a cross-section of part of a leaf.

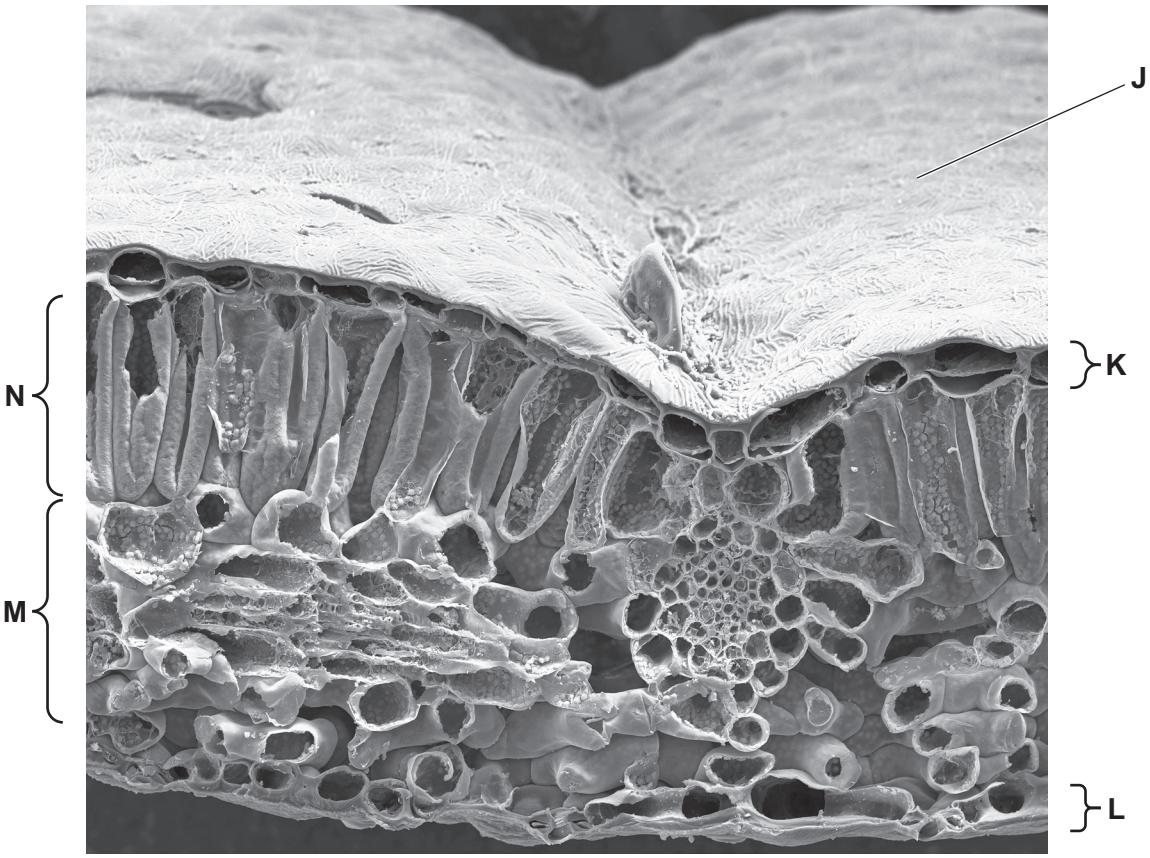

Fig. 1.1

(a) **(i)** State the letter in Fig. 1.1 that identifies where:

gas exchange is controlled .....

most photosynthesis occurs .....

spongy mesophyll cells are found. .....

[3]

(ii) Draw a circle **on Fig. 1.1** to identify a vascular bundle. [1]

(iii) Translocation occurs in the vascular bundle.

State the names of **two** substances that are only moved by translocation.

1 .....

2 .....

[2]

DO NOT WRITE IN THIS MARGIN

(b) Explain how xylem vessels are adapted for their functions.

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..... [3]

(c) Describe how water moves through a plant from the soil to the air spaces in a leaf.

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..... [4]

(d) Explain why plants need nitrate ions.

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..... [2]

[Total: 15]

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2 **(a)** Chlamydia is a sexually transmitted infection (STI) that is caused by a bacterium.

Fig. 2.1 shows the number of chlamydia cases in a country in 2018.

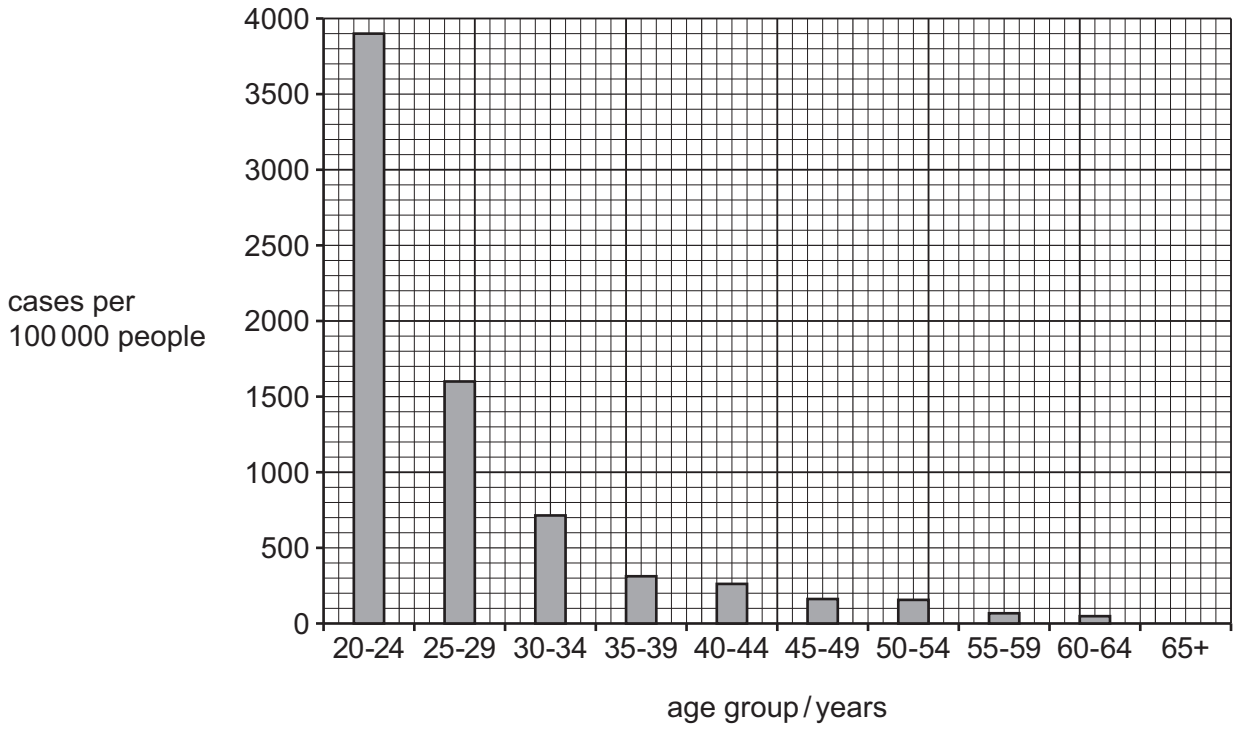

Fig. 2.1

(i) Calculate the percentage decrease in the number of chlamydia cases between the age groups 20–24 and 25–29.

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

Space for working.

.....% [3]

DO NOT WRITE IN THIS MARGIN

(ii) Describe how the spread of STIs, such as chlamydia, can be controlled.

.....

.....

.....

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.....

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.....

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..... [4]

(b) Chlamydia can damage the reproductive system.

(i) State the name of the part of the female reproductive system that produces oestrogen.

..... [1]

(ii) Describe the role of oestrogen at puberty.

.....

.....

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..... [3]

DO NOT WRITE IN THIS MARGIN

(c) Complete the sentences about drug resistance and genetic variation by writing a suitable word or phrase in the spaces provided.

Bacteria can be killed by drugs called ..... . The development of strains of bacteria that are resistant to these drugs is an example of ..... selection.

Resistant strains of bacteria have gene mutations that enable them to survive drug treatment. Gene mutations are caused by random changes in the ..... of bases in DNA and result in the formation of new ..... in the bacteria. Mutation rates can be increased by ..... radiation and some chemicals.

In animals and plants, another source of genetic variation is a type of nuclear division called ..... .

[6]

[Total: 17]

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3 **(a)** Fig. 3.1 shows the structure of the pathogen that causes cholera.

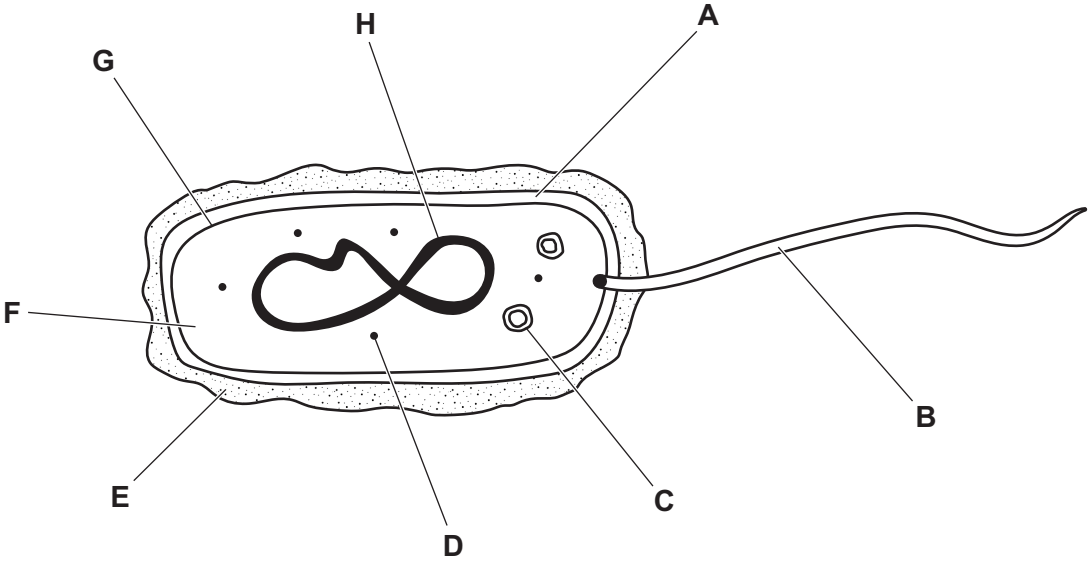

Fig. 3.1

(i) State the name of the kingdom that includes the pathogen shown in Fig. 3.1.

..... [1]

(ii) Table 3.1 shows some of the names, functions or uses, and identifying letters of the parts labelled in Fig. 3.1.

Complete Table 3.1.

Table 3.1

name	function or use	letter from Fig. 3.1
flagellum		
		G
	protein synthesis	
cell wall		
	used by humans in genetic modification	

[5]

DO NOT WRITE IN THIS MARGIN

(b) Describe how a person becomes infected with cholera.

.....

..... [1]

(c) People with cholera can become very dehydrated.

Explain how cholera causes dehydration.

.....

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.....

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..... [4]

(d) Vaccination can help to prevent the spread of diseases such as cholera.

Outline the process of vaccination and explain how it can prevent the spread of diseases.

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..... [6]

[Total: 17]

DO NOT WRITE IN THIS MARGIN

4 **(a)** Complete the sentence about the mammalian nervous system.

The ..... nervous system consists of the brain and spinal cord and the ..... nervous system consists of the nerves outside the brain and spinal cord.

[1]

(b) Fig. 4.1 shows the parts of a reflex arc.

M	effector
N	motor neurone
P	receptor cell
Q	relay neurone
R	response
S	sensory neurone
T	stimulus

Fig. 4.1

(i) Put the parts listed in Fig. 4.1 into the correct sequence, and write the letters in the boxes.

Two have been done for you.

T						**R**

[2]

(ii) State **two** stimuli that are detected by the skin.

1 .....

2 .....

[2]

(iii) The pupil reflex controls the amount of light that enters the eye.

State the name of an effector in the pupil reflex.

..... [1]

DO NOT WRITE IN THIS MARGIN

(c) Describe and explain how impulses are **only** passed in one direction from one neurone to the next.

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..... [5]

[Total: 11]

DO NOT WRITE IN THIS MARGIN

5 The gene for red-green colour vision is on the **X** chromosome.

There are two alleles for this gene:

- The allele for normal colour vision is represented by the letter **B**.
- The allele for red-green colour blindness is represented by the letter **b**.

Fig. 5.1 shows a pedigree chart for a family in which some of the members are red-green colour-blind.

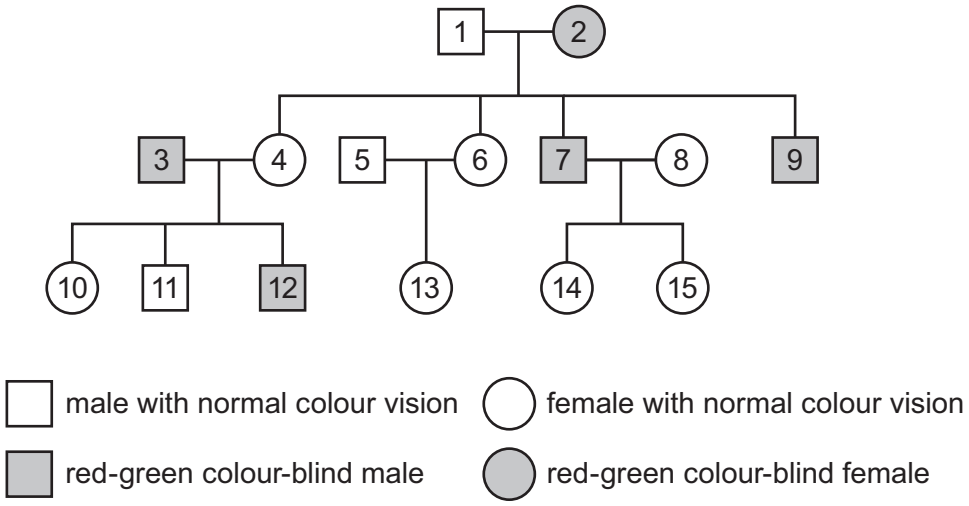

Fig. 5.1

(a) Explain why all of the male children of parent **1** and parent **2** are red-green colour-blind.

.....

.....

.....

.....

..... [2]

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(b) Parent **4** is a female who has normal colour vision and is heterozygous for red-green colour blindness.

Complete the genetic diagram to determine the probability that the offspring of parent **3** and parent **4** would be red-green colour-blind.

parents	**3**	x	**4**
parental phenotypes	red-green colour-blind male	x	female with normal colour vision
parental genotypes	.....	x	.....
gametes	..... , ...	x	..... , ...

offspring genotypes				
offspring phenotypes				

probability of offspring having red-green colour blindness .....
[5]

[Total: 7]

DO NOT WRITE IN THIS MARGIN

6 Penicillin can be produced in fermenters.

(a) State the name of the type of organism that produces penicillin.

..... [1]

(b) Fig. 6.1 shows the change in biomass of the organism that produces penicillin, when grown in a fermenter under controlled conditions.

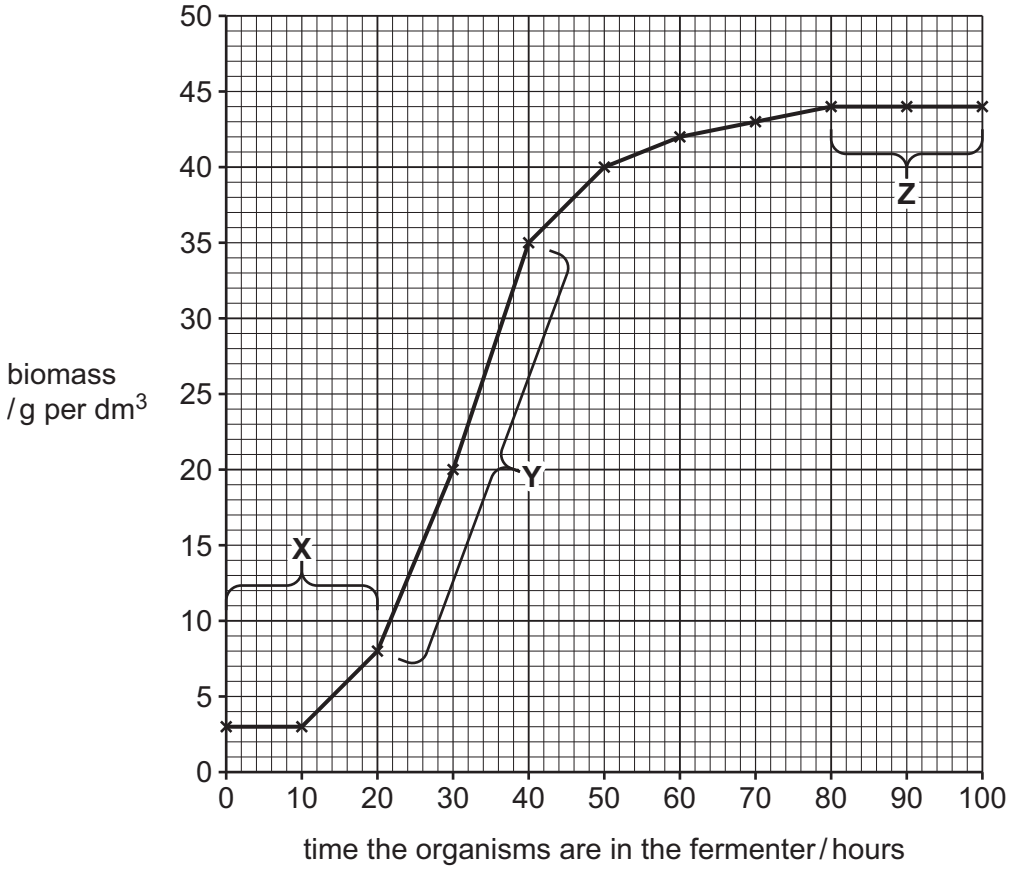

Fig. 6.1

State the name of the growth stages of the organism, shown by the letters **X**, **Y** and **Z** in Fig. 6.1.

X .....

Y .....

Z .....

[3]

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(c) Fig. 6.2 is a diagram of a fermenter containing the organisms that produce penicillin.

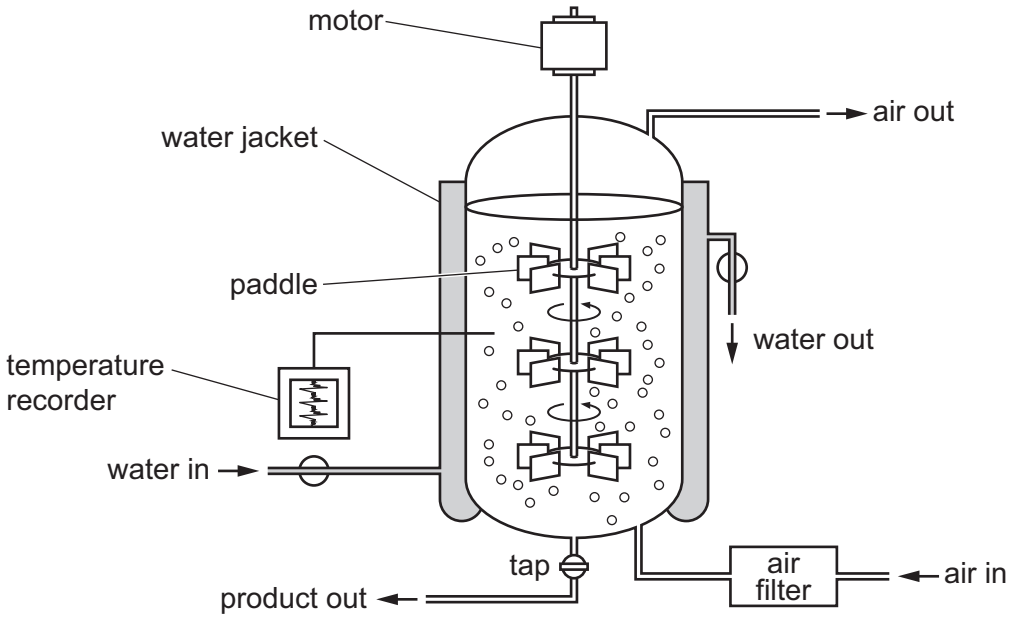

Fig. 6.2

(i) Explain why air is supplied to the fermenter shown in Fig. 6.2.

.....

.....

.....

.....

..... [2]

(ii) Explain why the temperature in the fermenter must be controlled.

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..... [3]

DO NOT WRITE IN THIS MARGIN

(iii) State the role of the paddles in the fermenter.

.....

.....

.....

.....

..... [2]

(iv) Other than penicillin, state the names of **two** commercial products that can be made using fermenters.

1 .....

2 .....
[2]

[Total: 13]

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