OXFORD AQA

INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL A-LEVEL

BIOLOGY (9610)

Unit 5 Synoptic paper

Thursday 5 June 2025 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Answer **all** questions in the spaces provided

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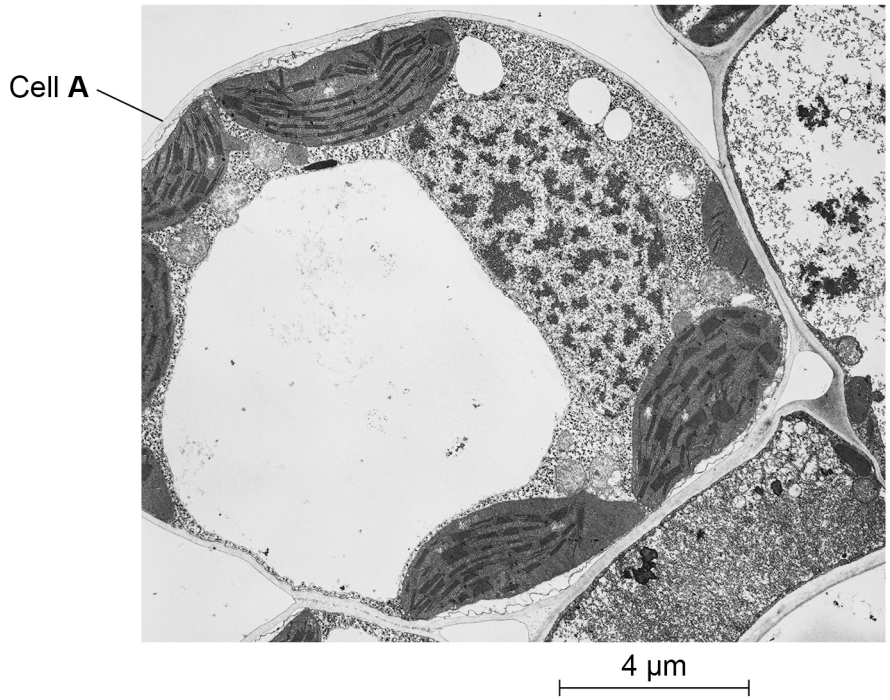
0 1 A plant leaf is an organ that provides food for the plant.

Figure 1 shows a section through cells in the leaf of a dicotyledonous plant.

Figure 1



0 1 . 1 In the box below, draw a large, clear diagram of cell **A** in **Figure 1**.

[3 marks]

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0 1 . 2 The scale bar in **Figure 1** represents 4 µm

Calculate the magnification of **Figure 1**.

[2 marks]

Magnification = _____

0 1 . 3 Cells like cell **A** in **Figure 1** may contain 80–120 chloroplasts.

Only 7 chloroplasts can be seen in cell **A**.

Explain why so few chloroplasts are seen in cell **A**.

[2 marks]

_____

_____

_____

_____

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_____

Question 1 continues on the next page

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2,4-dichlorophenoxyacetic acid (2,4-D) is a selective weedkiller. 2,4-D can be sprayed on a crop of cereal plants, such as wheat or barley, to kill weeds.

Figure 2 shows a farmer spraying a cereal crop with 2,4-D.

Figure 2

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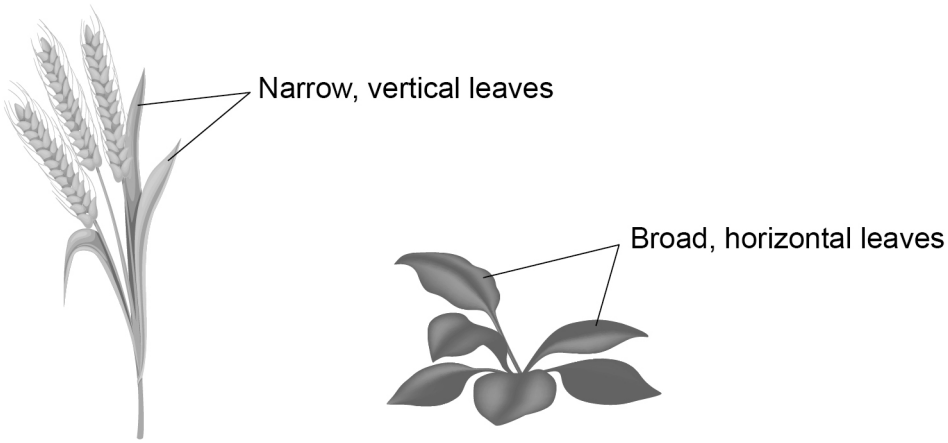
0 1 . 4 Cereal plants are monocotyledonous and have narrow, vertical leaves. Weeds are mainly dicotyledonous plants with broad, horizontal leaves.

Figure 3 shows a cereal plant and a weed plant.

Figure 3



Cereal plant **Weed plant**

Use this information to suggest why a farmer can use 2,4-D to kill weeds with broad leaves in a field of cereal crop.

[2 marks]

Question 1 continues on the next page

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0 1 . 5 Suggest why some people do **not** agree with spraying crops with weedkillers such as 2,4-D.

[3 marks]

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Question 1 continues on the next page

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0 1 . 6 Cereal plants belong to the grass family of plants.

Grasses contain large amounts of the element silicon (Si) in the surface cells of stems and leaves. Scientists think the silicon may help to protect the plant from pathogens and from herbivores.

Scientists investigate the effects of silicon on the leaf structure of one species of grass and on the growth of two species of insect that feed on the grass. The grass leaves have two types of hair-like structures on their surfaces: 'macrohairs' and 'prickle cells'.

The scientists:

- grow 24 grass plants with their roots in a solution of mineral ions, including potassium silicate (Si+)
- grow 24 grass plants with their roots in a solution of mineral ions, with potassium chloride instead of potassium silicate (Si-)
- starve several insects of two species (species 1 and species 2) by not allowing them to eat for 24 hours
- put the insects on the grass plants for 48 hours
- remove the insects and starve them again for a further 24 hours.

Starving the insects for 24 hours allows all the food in their digestive systems to be lost as faeces.

Table 1 shows the measurements the scientists take from the leaves and the relative growth rates of the two species of insect.

Relative growth rate is calculated using:

$$\frac{\text{mass gained}}{\text{starting mass}}$$

Table 1

Measurements	**Mean ± SE (standard error)**		**Probability from comparing means**
	Si-	**Si+**	
Leaf thickness / mm	0.15 ± 0.004	0.16 ± 0.004	0.290
Number of macrohairs per mm^2	0.44 ± 0.12	0.68 ± 0.09	0.068
Number of prickle cells per mm^2	121.7 ± 4.6	99.5 ± 3.3	0.004
Prickle cell size / μm^2	176 ± 6.9	246 ± 10.1	0.002
Relative growth rate – insect species 1	–26.8 ± 8.7	–149.5 ± 6.1	< 0.001
Relative growth rate – insect species 2	–1.3 ± 3.7	–6.4 ± 1.1	0.002

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The scientists conclude that silicon in large prickle cells on the surface of the leaves can reduce damage by insects.

Evaluate the scientists' conclusion.

Use information from the scientists' method and from **Table 1**.

[5 marks]

17

Turn over for the next question

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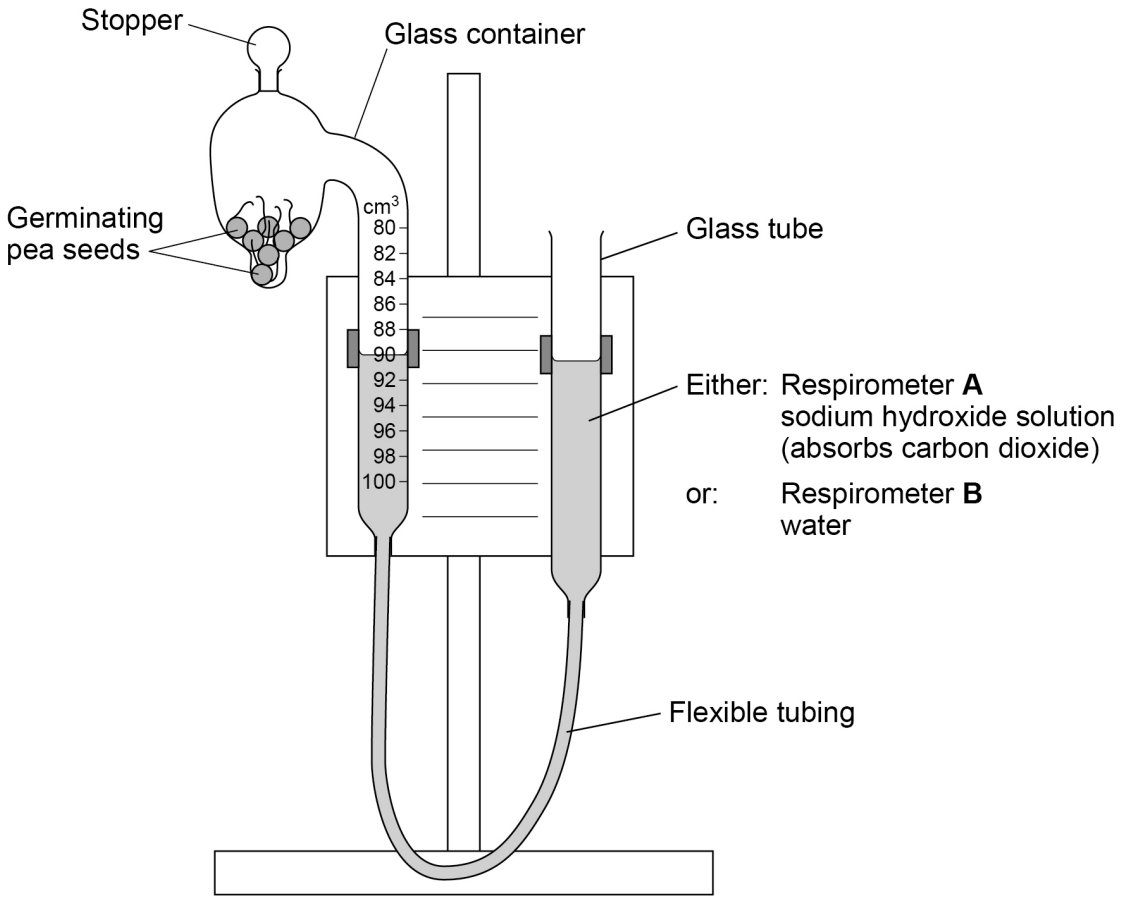
0 2 A respirometer is a piece of equipment used for measuring respiration.

Students use two respirometers (**A** and **B**) to measure:

- the rate of respiration of germinating pea seeds
- the respiratory quotient (RQ) of the pea seeds.

Figure 4 shows how the respirometers are set up.

Figure 4



The students:

- put 3.5 g of germinating pea seeds in each respirometer
- put both respirometers in a dark cupboard
- measure the volume of gas in respirometer **A** and in respirometer **B** at intervals for 48 hours.

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0 2 . 1 Explain why the students keep the respirometers in a dark cupboard during the investigation.

[3 marks]

0 2 . 2 The volume of gas in respirometer **A** decreased during the 48 hours of the investigation.

Explain why.

[3 marks]

Question 2 continues on the next page

Table 2 shows the students' results.

Table 2

Time / hours	Volume of gas in respirometer / cm^3	
	A	**B**
0	100.0	90.0
5	99.0	89.5
9	97.5	89.5
17	95.0	90.0
30	90.0	90.5
37	87.0	90.0
48	83.5	90.0

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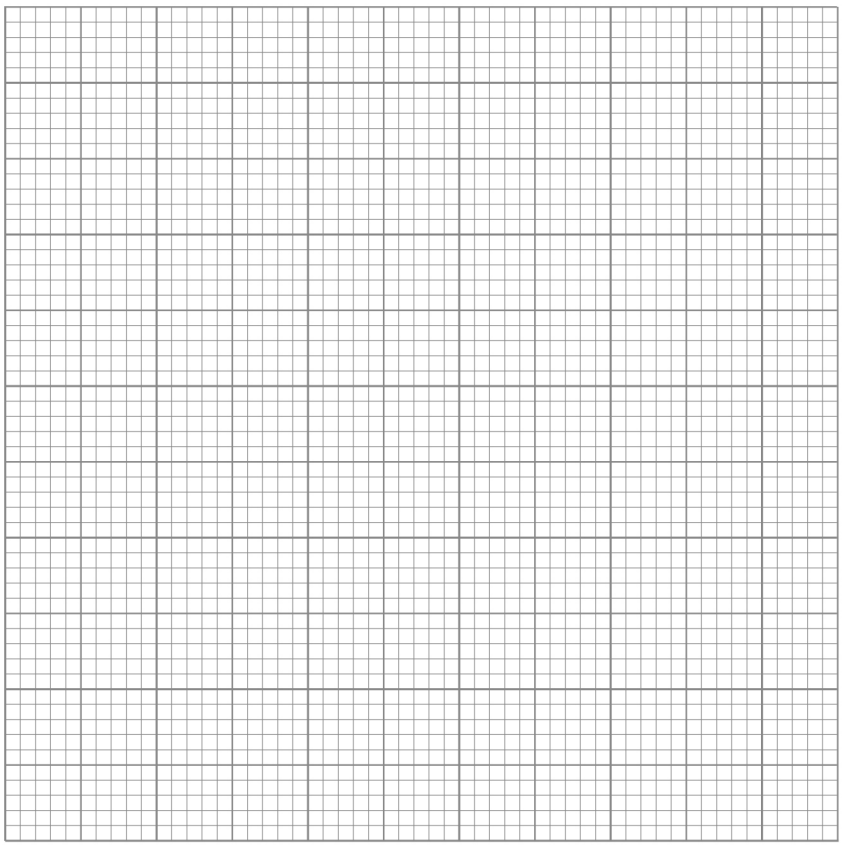
0 2 . 3 Draw a graph of the results for respirometer **A**.

Draw a line of best fit on your graph.

[3 marks]



0 2 . 4 Calculate the rate of respiration of the germinating pea seeds.

Use data from your graph.

Give your answer in mm^3 oxygen per gram of germinating pea seeds per hour, to the nearest whole mm^3

[2 marks]

Rate of respiration = _____ mm^3 oxygen g^{-1} h^{-1}

Question 2 continues on the next page

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0 2 . 5 Explain how the results for respirometer **B** show that the RQ of the germinating pea seeds is 1.0

[3 marks]

0 2 . 6 What does RQ = 1.0 suggest about the type of respiration **and** the respiratory substrate used by the germinating pea seeds?

[2 marks]

Type of respiration _____

Respiratory substrate _____

16

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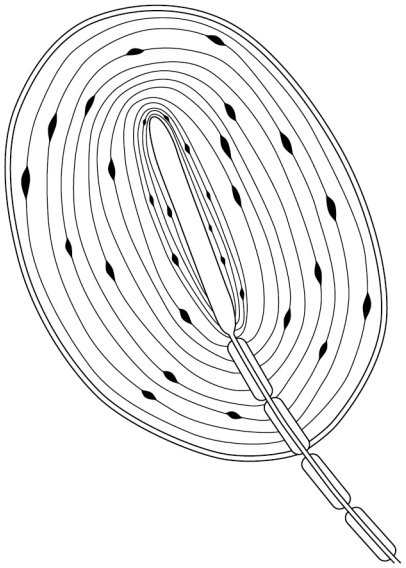
0 3 The skin contains several types of receptor.

Figure 5 shows one type of touch receptor in human skin.

Figure 5



0 3 . 1 Name the type of touch receptor shown in **Figure 5**.

[1 mark]

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0 3 . 2 Students investigate the distribution of touch receptors in the skin.

One student makes the hypothesis:

> 'There will be more touch receptors per cm^2 in the fingertips than in the back of the hand.'

Suggest how the students could investigate this hypothesis.

[3 marks]

4

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0 4 A plant seed contains an embryo plant and a food store.

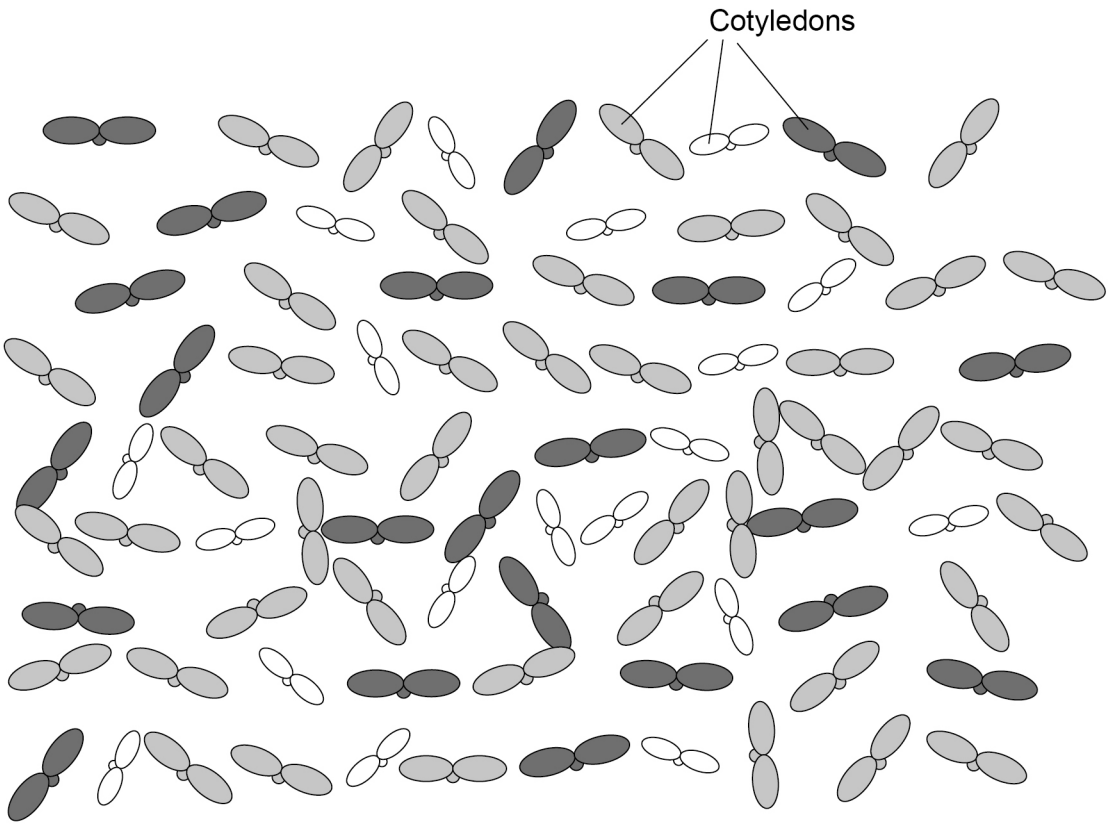
When a tomato seed germinates, the first leaf-like structures are the **cotyledons** from the seed.

A student puts seeds from a tomato plant in a tray of soil.

Figure 6 shows the seedlings after 7 days, seen from above.

Some of the seedlings have dark green cotyledons, some have light green cotyledons and some have white cotyledons.

Figure 6



Key

Seedling with dark green cotyledons

Seedling with light green cotyledons

Seedling with white cotyledons

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0 4 . 1 Complete **Table 3** to show:

- the number of seedlings of each phenotype
- the ratio of the phenotypes.

[2 mark]

Table 3

Phenotype	**Dark green**	**Light green**	**White**
Number of seedlings			
Ratio of phenotypes	1.00 : _____ : _____		

In Questions **04.2** and **04.3**, use the following symbols:

$\mathbf{C^G}$ = allele for dark green cotyledons
$\mathbf{C^W}$ = allele for white cotyledons.

0 4 . 2 Predict the genotype of the tomato plant that produced the seeds the student used.

[1 mark]

_____

0 4 . 3 Draw a genetic diagram to show how the tomato plant produced the seedlings shown in **Figure 6**.

Include the predicted ratio of offspring phenotypes.

[3 marks]

Question 4 continues on the next page

0 4 . 4 The student uses the χ^2 (chi-squared) test to analyse the results.

The student calculates a value of $\chi^2 = 0.396$

Table 4 gives probability values for different values of χ^2

Table 4

Degrees of freedom	Probability value					
	0.99	**0.95**	**0.10**	**0.05**	**0.01**	**0.001**
1	0.0002	0.0039	2.71	3.84	6.63	10.83
2	0.020	0.103	4.61	5.99	9.21	13.82
3	0.115	0.352	6.25	7.81	11.34	16.27
4	0.297	0.711	7.78	9.49	13.28	18.47

Explain if the student's results fit the expected ratio.

Use the calculated value of $\chi^2 = 0.396$ and data from **Table 4**.

[3 marks]

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0 4 . 5 **Figure 6** (on page 18) shows the seedlings 7 days after the tomato seeds were planted.

At 14 days after planting, there are **no** seedlings with white cotyledons.

Suggest why there are seedlings with white cotyledons at 7 days but **none** at 14 days.
[4 marks]

13

Turn over for the next question

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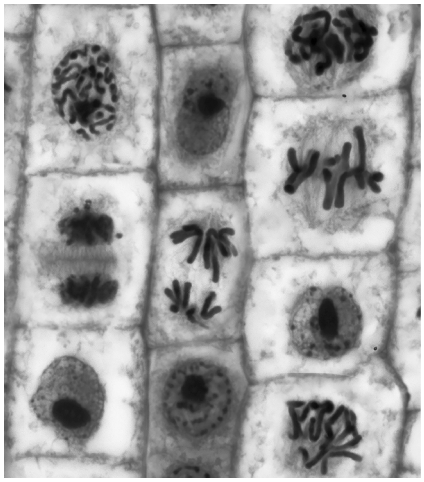
0 5 In plants, cells divide by mitosis during growth.

Figure 7 shows cells from a plant root.

Figure 7



0 5 . 1 Determine how many cells in **Figure 7** are in metaphase and in interphase.

[2 marks]

Metaphase _____

Interphase _____

0 5 . 2 Describe how you could prepare a slide of onion root tissue to show the stages of mitosis in **Figure 7**.

[3 marks]

_____

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5

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You are reminded that **2 marks** will be awarded for the quality of written communication in **Question 6**.

0 6 Enzymes are catalysts. All living organisms use enzymes.

Catalase and DNA polymerase are two examples of enzymes.

0 6 . 1 Explain why living organisms need enzymes.

In your answer, include:

- how enzymes catalyse specific reactions
- **two** different types of reaction and a named enzyme that catalyses each type.

Do **not** refer to catalase or DNA polymerase in your answer.

[6 marks]

Question 6 continues on the next page

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0 6 . 2 Potatoes and sweet potatoes both contain the enzyme catalase.

Catalase controls the reaction:

$$2H_2O_2 \xrightarrow{\text{Catalase}} 2H_2O + O_2$$

$2H_2O_2$		$2H_2O$	O_2
Hydrogen peroxide (liquid)		Water (liquid)	Oxygen (gas)

Plan an experiment to find if potatoes **or** sweet potatoes contain a higher concentration of catalase.

[6 marks]

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0 6 . 3 The enzyme *Taq* polymerase is a DNA polymerase enzyme made by the bacterium *Thermus aquaticus*.

Thermus aquaticus lives in hot water habitats.

Taq polymerase is used in the polymerase chain reaction (PCR).

In PCR, scientists treat DNA in a thermal cycler machine with stages at 55 °C, 72 °C and 95 °C

Explain how PCR is used for making large amounts of DNA from a small sample.

[6 marks]

Quality of written communication [2 marks]

END OF QUESTIONS

20

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