OXFORD AQA
INTERNATIONAL QUALIFICATIONS

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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Tuesday 7 January 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	
7	
TOTAL	

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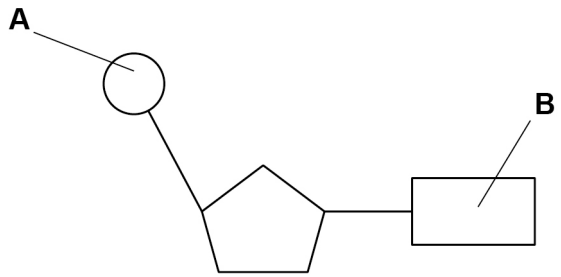
Answer **all** questions in the spaces provided.

0 1 . 1 DNA is a polymer made of repeating units called nucleotides.

Figure 1 shows a DNA nucleotide.

Figure 1



Name the structures labelled **A** and **B**.

[2 marks]

A _____

B _____

0 1 . 2 In the following passage, the numbered spaces can be filled with biological terms.

In eukaryotes, DNA is a linear molecule associated with proteins. Some of these proteins are called _____(1)_____.

DNA contains genes. In a gene, only some regions code for amino acid sequences. These coding regions are called _____(2)_____.

Genes are found at fixed positions called _____(3)_____ on particular DNA molecules.

Write the correct biological term beside each number below that matches the space in the passage.

[3 marks]

1 _____

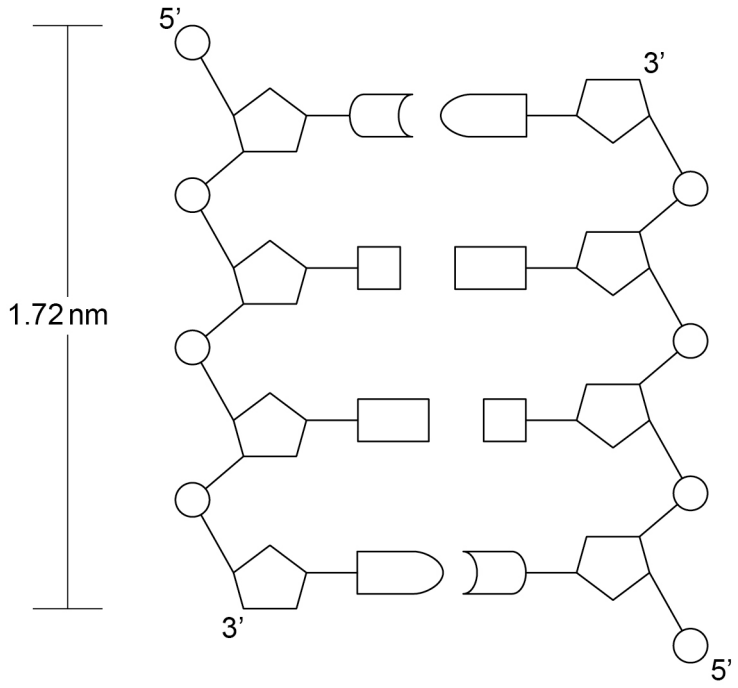
2 _____

3 _____

Do not write outside the box

Figure 2 shows the structure of part of a DNA molecule.

Figure 2



0 1 . 3 A gene found in the bacterium *E. coli* is 1383 nucleotides long.

Use **Figure 2** to calculate the length of this gene.

Give your answer to 3 significant figures.

[2 marks]

Length of gene = _____ nm

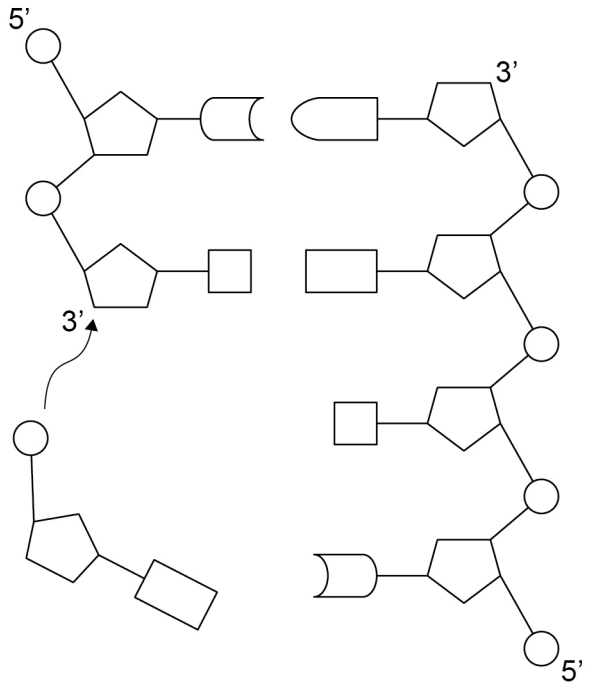
Question 1 continues on the next page

Do not write outside the box

Semi-conservative replication involves the formation of a new polynucleotide strand.

Figure 3 shows a free nucleotide joining to form the new polynucleotide strand.

Figure 3



0 1 . 4 Describe the role of DNA helicase and DNA polymerase in the process of semi-conservative replication.

[4 marks]

DNA helicase _____

_____

_____

_____

_____

DNA polymerase _____

_____

_____

_____

_____

Do not write outside the box

0 1 . 5 Nucleotides can only join at the 3' end of the new polynucleotide.

Suggest why nucleotides can only be joined to the 3' end of the new polynucleotide strand.

Use your knowledge of enzyme action.

[2 marks]

_____

_____

_____

_____

_____

_____

13

Turn over for the next question

Do not write outside the box

0 2 An enzyme is a protein that catalyses a specific reaction.

0 2 . 1 Explain how an enzyme increases the rate of a reaction.

[2 marks]

_____

_____

_____

_____

_____

_____

0 2 . 2 Some enzymes have more than one polypeptide chain.

Which name describes the highest level of organisation in an enzyme with more than one polypeptide chain?

Tick (✓) **one** box.

[1 mark]

Primary structure ☐

Quaternary structure ☐

Secondary structure ☐

Tertiary structure ☐

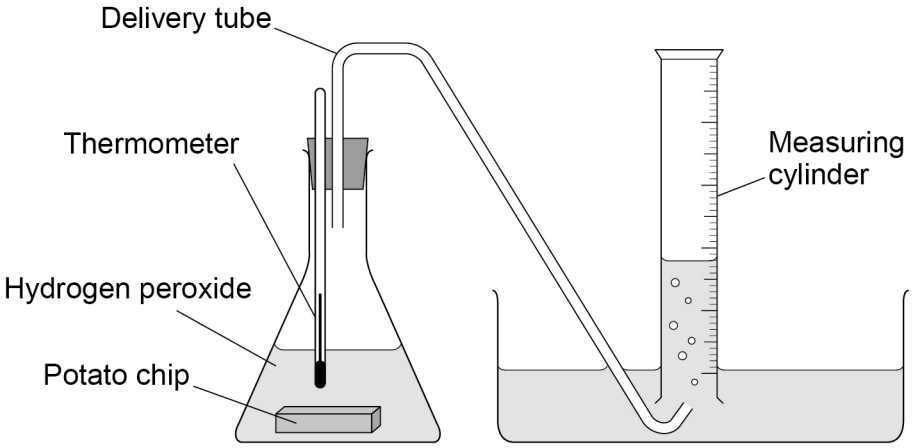
Do not write outside the box

Catalase is an enzyme found in the cells of a potato.
The enzyme catalyses the following reaction.

Hydrogen peroxide → water + oxygen

A student investigates the rate of catalase activity using the equipment in **Figure 4**.

Figure 4



The student:

- puts a potato chip into a conical flask
- adds 25cm^3 of hydrogen peroxide to the conical flask
- puts the bung into the conical flask and the delivery tube into the measuring cylinder
- records the volume of oxygen collected in the measuring cylinder every minute for 25 minutes
- repeats the investigation using a potato chip of the same size that is crushed into small pieces.

Question 2 continues on the next page

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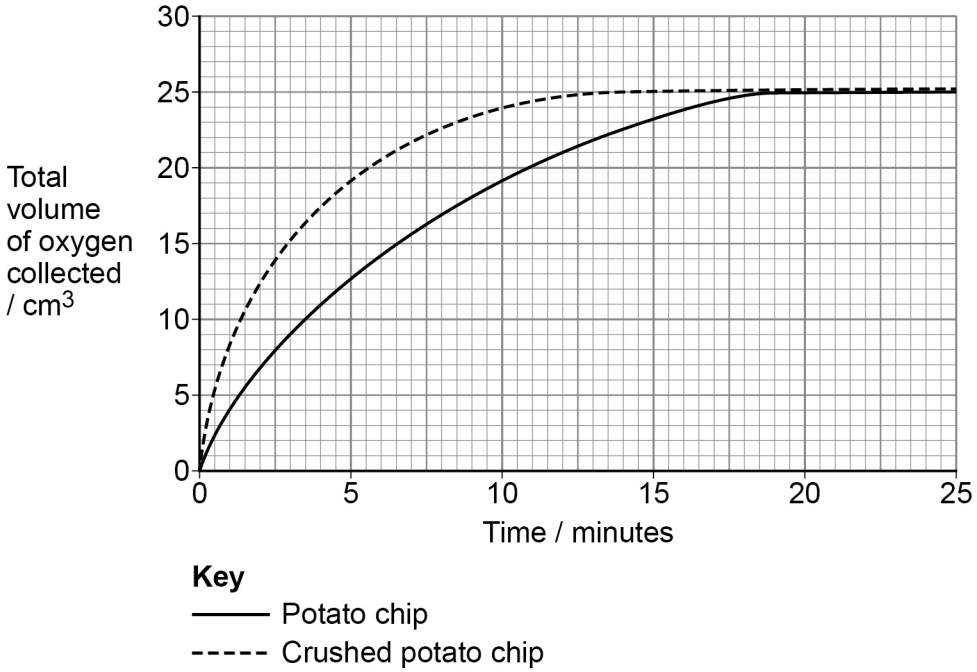
Figure 5 shows the results of the investigation.

Figure 5



0 2 . 3 The temperature inside the conical flask increases slightly when the reaction is taking place.

Suggest why the temperature inside the conical flask increases.

[1 mark]

_____

_____

_____

Do not write outside the box

0 2 . 4 Explain the differences between the curves for each potato chip.

Use **Figure 5**.

[3 marks]

0 2 . 5 The student maintains the temperature of the investigation at the optimal temperature of 35 °C

Describe how the student could maintain the optimal temperature.

State why this is important.

[2 marks]

How the student maintains the optimal temperature

Why this is important

0 2 . 6 Suggest **one** change to the investigation that could increase the initial rate of reaction.

[1 mark]

Do not write outside the box

0 2 . 7 One student suggests that the breakdown of hydrogen peroxide is not caused by an enzyme in the potato.

Describe how the student could use the equipment in **Figure 4** to show that the breakdown of hydrogen peroxide is caused by an enzyme in the potato.

[3 marks]

13

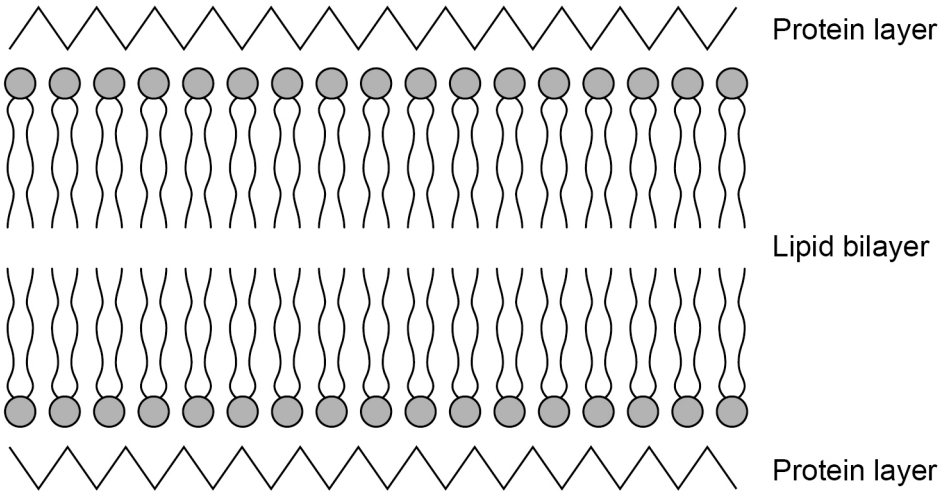
Do not write outside the box

0 3 In 1972, scientists suggested the fluid mosaic model of membrane structure.

Before 1972, there was a different model of membrane structure called the unit membrane model.

Figure 6 shows the unit membrane model of membrane structure.

Figure 6



0 3 . 1 Give **one** similarity and **one** difference between the unit membrane model and the fluid mosaic model of membrane structure.

Use **Figure 6**.

[2 marks]

Similarity _____

_____

_____

Difference _____

_____

_____

Question 3 continues on the next page

Do not write outside the box

A scientist investigates how the rate of absorption of potassium ions through a membrane varies with and without oxygen.

The scientist:

- adds cells into a 2 mg dm^{-3} potassium ion solution that contains no oxygen
- measures the potassium ion concentration in the solution at regular intervals for 40 minutes
- adds oxygen to the solution at 40 minutes
- measures the potassium ion concentration in the solution at regular intervals for another 80 minutes.

0 3 . 2 The scientist used water containing no dissolved oxygen to make the solution.

Suggest **one** way the scientist can prevent oxygen entering the solution during the first 40 minutes.

[1 mark]

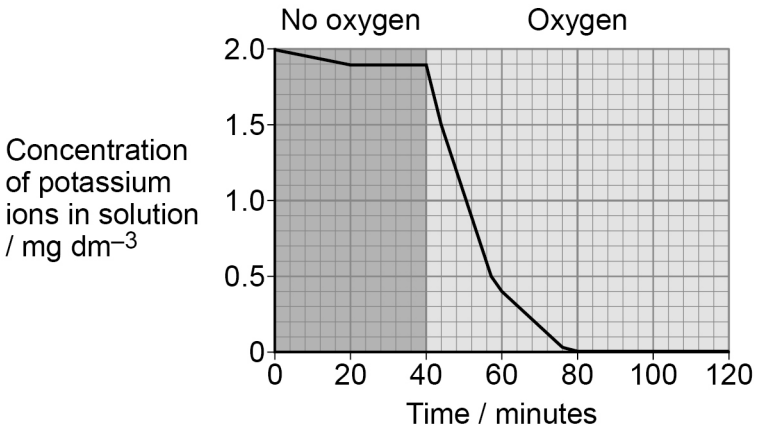
_____

_____

_____

Figure 7 shows the scientist's results.

Figure 7



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0 3 . 3 Calculate the percentage decrease in potassium ion concentration between 40 minutes and 50 minutes.

Use **Figure 7**.

Give your answer to the nearest whole number.

[2 marks]

Percentage decrease = _____%

0 3 . 4 State how potassium ions are transported across cell membranes with oxygen and with no oxygen.

Give evidence from the graph to support your answer.

[4 marks]

With oxygen _____

_____

_____

_____

_____

_____

No oxygen _____

_____

_____

_____

_____

_____

9

Turn over for the next question

Do not write outside the box

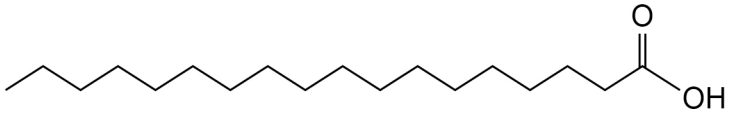
0 4 . 1 Describe how a triglyceride is formed.

[3 marks]

Figure 8 shows the structures of three lipids, **A** to **C**.

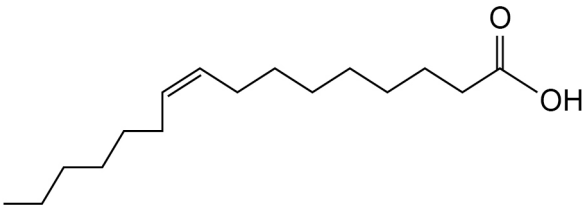
Figure 8

Lipid A



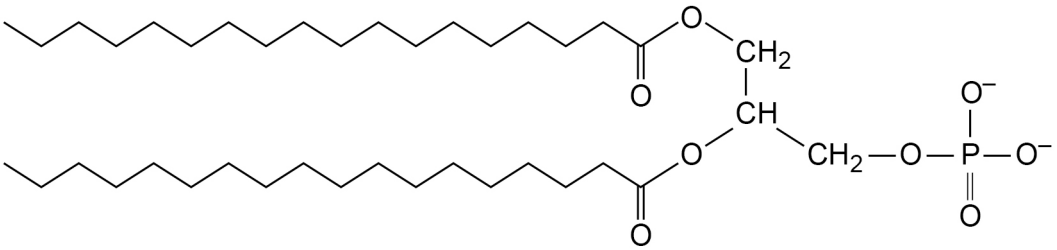
Molecular formula: $C_{17}H_{35}COOH$

Lipid B



Molecular formula: $C_{15}H_{29}COOH$

Lipid C



Molecular formula: $(C_{17}H_{35}CO)_2C_3H_5O_2PO_4^{2-}$

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Table 1 includes information about lipids **A** to **C** from **Figure 8**.

Increasing the length of the R-group results in an increased melting point.

The presence of charged molecules also results in an increased melting point.

Table 1

Lipid letter from Figure 8 (A–C)	Number of carbon atoms	Contains carbon-carbon double bonds Tick (✓) if present	Melting point / °C
			162.0
			69.0
			–0.1

0 4 . 2 Complete **Table 1** using information from **Figure 8**.

[3 marks]

0 4 . 3 Palmitic acid is a saturated fatty acid with the same number of carbon atoms as **Lipid B**.

Lipid B is liquid at room temperature but palmitic acid is solid.

Give the reason why.

[1 mark]

_____

_____

_____

0 4 . 4 A column heading in **Table 1** reads 'Contains carbon-carbon double bonds'.

Give the reason why 'carbon-carbon' needs to be specified in the heading.

[1 mark]

_____

_____

_____

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0 4 . 5 Describe how you would test for the presence of lipids in a sample of food.

[2 marks]

10

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Turn over for the next question

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0 5 It is important that substances diffuse in and out of cells at a high rate. This allows the cells to obtain enough nutrients and to remove waste products quickly.

A student investigates the effect of surface area to volume ratio on the rate of diffusion.

The student:

- uses agar that is coloured with indicator (the indicator is red initially, but turns orange when hydrochloric acid (HCl) diffuses through it)
- uses agar spheres of different sizes
- puts each sphere into dilute HCl in separate beakers
- measures the time taken for the indicator to turn orange all the way to the centre of each agar sphere
- calculates the relative rate of diffusion for each sphere.

Table 2 shows the student's results.

Table 2

Surface area of sphere / cm^2	Volume of sphere / cm^3	Surface area to volume ratio	Relative rate of diffusion
3.1	0.5	6.2 : 1	100
12.6	4.2	3.0 : 1	68
28.3	14.1	2.0 : 1	46
63.6			35

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0 5 . 1 One of the spheres the students uses has a surface area of 63.6 cm^2

The diameter of the sphere is 4.5 cm

Calculate:

- the volume of the sphere
- the surface area to volume ratio of the sphere.

Volume of sphere = $\frac{4}{3}\pi r^3$

Use π = 3.14

[3 marks]

Volume of sphere = _____ cm^3

Surface area to volume ratio = _____ : 1

0 5 . 2 The student's experiment shows that the surface area to volume ratio affects the rate of diffusion.

Give **one** other variable that could affect the rate of diffusion in this investigation.

Explain why this variable would affect the rate of diffusion of HCl into the agar.

[2 marks]

Variable _____

_____

_____

Explanation _____

_____

_____

Turn over ►

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0 5 . 3 The student only uses one agar sphere of each size.

Suggest **two** other limitations of the method (on page 18) that could affect the results.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

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Question 5 continues on the next page

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ANSWER IN THE SPACES PROVIDED

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0 5 . 4 Measuring the rate of diffusion using agar spheres gives different results from measuring the rate of diffusion in living cells.

Suggest why.

[2 marks]

0 5 . 5 Large animals have adaptations that increase the supply of oxygen to respiring tissues.

Explain why these adaptations are needed.

[2 marks]

0 5 . 6 Describe **one** example of how large animals are adapted to gain sufficient oxygen.

[1 mark]

12

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0 6 A parrot is a type of tropical bird.

Each species of parrot shows variation.

0 6 . 1 Give the scientific term that describes variation between members of the same species.

[1 mark]

_____

0 6 . 2 Give **one** cause of variation within a species.

[1 mark]

_____

_____

_____

Question 6 continues on the next page

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Scientists investigate variation:

- between individuals of different species of parrot
- between individuals of the same species of parrot.

The scientists investigate the ability of four different species of parrot, **A**, **B**, **C** and **D**, to delay eating a low-calorie food.

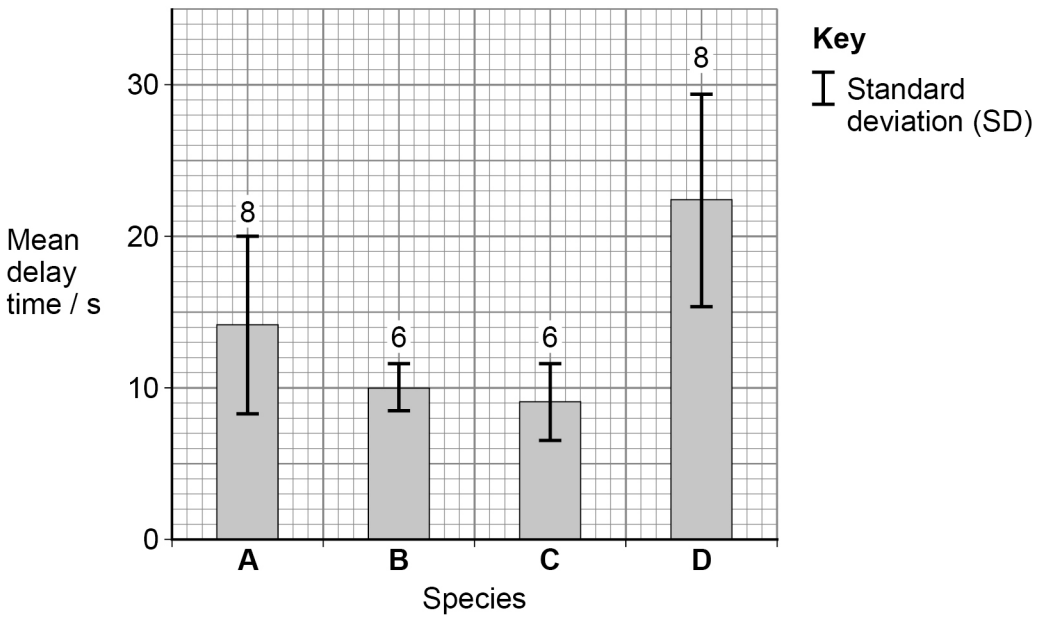
All the parrots tested are the same age and sex.

If the bird delays eating the low-calorie food, it is given a high-calorie food.

Figure 9 shows the scientists' results.

Figure 9 shows standard deviation bars for each set of data. The number above each SD bar shows the sample size.

Figure 9



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0 6 . 3 The range of a data set is always larger than the standard deviation bar.

Explain why.

[2 marks]

0 6 . 4 A journalist states that:

'The scientists' results prove that species **D** had the largest mean delay time of all the species.'

Evaluate the journalist's statement.

Use information from the scientists' method and from **Figure 9**.

[4 marks]

8

Turn over for the next question

Do not write outside the box

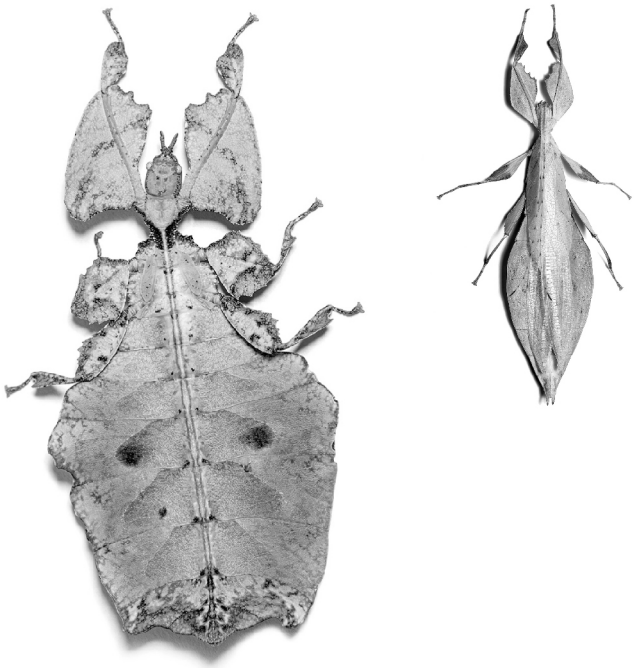
0 7 Read the following passage:

Leaf insects are found in southern Asia and in Australia. They are difficult to capture from the wild and so very little is known about them. All leaf insects belong to the same family, but are classified into 9 different genera, including *Nanophyllium* and *Phyllium*.

Figure 10 shows a female and a male leaf insect.

Figure 10

Female Male



Some leaf insect species seem to occur in nature as one sex, which led to questions about how they can breed. The all-female *Phyllium asekiense* and the all-male populations in the *Nanophyllium* genus had confused insect biologists for many years.

In 2019, eggs from a female member of *Phyllium asekiense* hatched in a laboratory to produce offspring apparently from two different genera: females from *Phyllium asekiense* and males from the *Nanophyllium* genus. This result was unexpected and so scientists investigated further by sequencing the DNA of the offspring and then breeding the offspring together.

DNA sequencing of the offspring showed that male individuals in the *Nanophyllium* genus had very similar DNA sequences, but were not similar to those in the *Phyllium* genus. Females from *Phyllium asekiense* showed many differences from other members of the *Phyllium* genus.

The scientists proposed that *Phyllium asekience* should be reclassified from *Phyllium* into *Nanophyllium*, and combined with the males from *Nanophyllium* to create a new species, *Nanophyllium asekiense*.

Do not write outside the box

Use information from the passage and your own knowledge to answer the questions below.

0 7 . 1 Leaf insects 'are difficult to capture from the wild' (lines 1–2).

Suggest a reason for this.

[1 mark]

_____

_____

_____

0 7 . 2 'All leaf insects belong to the same family' (lines 2–3).

Name the other **five** taxonomic groups to which all leaf insects belong.

[2 marks]

1 _____

2 _____

3 _____

4 _____

5 _____

0 7 . 3 Scientists originally classified *Phyllium asekiense* and members of the *Nanophyllium* genus as **two** different species. They did not use DNA sequencing or breeding studies.

Suggest why the scientists classified them as **two** species.

[1 mark]

_____

_____

_____

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0 7 . 4 Scientists investigated further by breeding the offspring together (lines 12–13).

Describe how breeding the offspring together could help determine if they were the same species.

[1 mark]

0 7 . 5 What does DNA sequencing tell us about the evolutionary origins of the male offspring (lines 14–16)?

[1 mark]

0 7 . 6 The scientists classified the new species as *Nanophyllium asekiense*.

Give the term for this system of naming organisms.

[1 mark]

0 7 . 7 The scientists used DNA sequencing and breeding studies to determine if different leaf insects were similar enough to be classified in the same species (lines 11–13).

List **three** other methods scientists could use to classify leaf insects.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

10

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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