

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL A-LEVEL BIOLOGY (9610)

Unit 3 Populations and Genes

Tuesday 6 January 2026

07:00 UK Time

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	



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

0 1

Nitrogen is a chemical element found in some organic substances in living organisms.

0 1 . 1

Name **one** organic substance in plants that:

- contains nitrogen
- does **not** contain nitrogen.

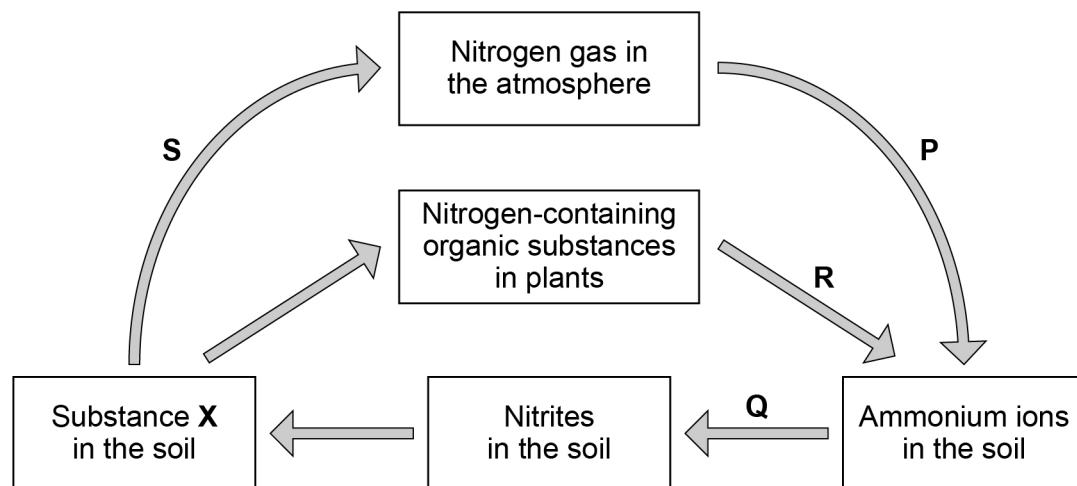
[2 marks]

Contains nitrogen _____

Does **not** contain nitrogen _____

Figure 1 shows part of the nitrogen cycle.

Figure 1



0 1 . 2 Name substance **X** shown in **Figure 1**.

[1 mark]

0 1 . 3 Name process **P** and process **Q** in **Figure 1**.

[2 marks]

Process **P** _____

Process **Q** _____

0 1 . 4 What type of bacterium does process **R** in **Figure 1**?

[1 mark]

A farmer does **not** want process **S** in **Figure 1** to occur in a field.

Ploughing is done before planting crops. Ploughing turns over and loosens the soil.

Table 1 shows the effect of ploughing on the mass of nitrogen gas released to the atmosphere per hectare of land.

A hectare is an area of 10 000 m²

Table 1

	Mass of nitrogen gas released to the atmosphere / kg hectare ⁻¹
Before ploughing	22
After ploughing	6

0 1 . 5 Calculate the percentage change in mass of nitrogen gas released to the atmosphere after ploughing.

Use **Table 1**.

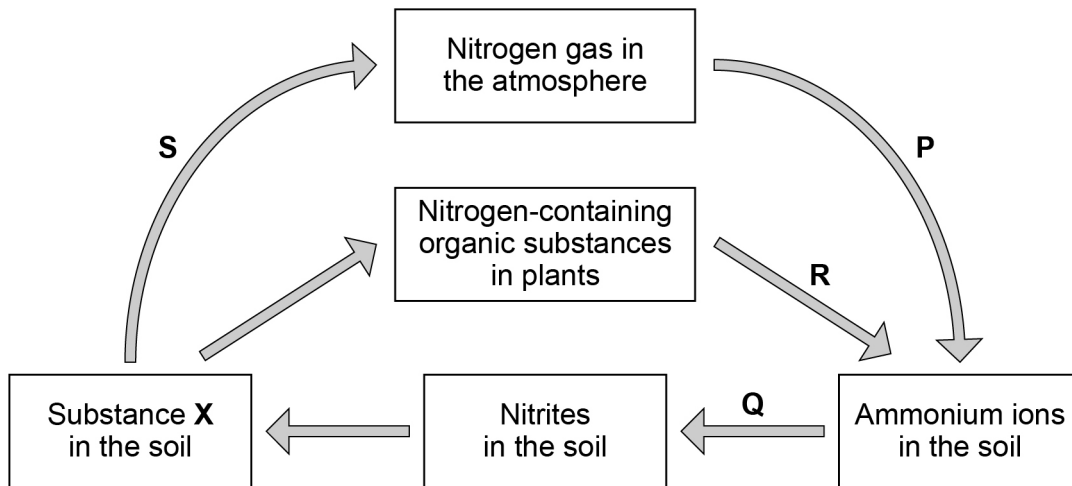
[1 mark]

Percentage change _____ %

Turn over ►



Figure 1 repeated



0 1 . 6 Explain how ploughing decreases the amount of process **S** in **Figure 1**.

[2 marks]

Turn over for the next question

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0 5

0 2

Humans have different blood groups using the ABO system.

The ABO system has four blood groups: A, AB, B, and O.

Gene **I** has three alleles that result in different carbohydrates on the surface of red blood cells.

The three alleles are: **I^A**, **I^B**, and **I^O**.

Alleles **I^A** and **I^B** are codominant.

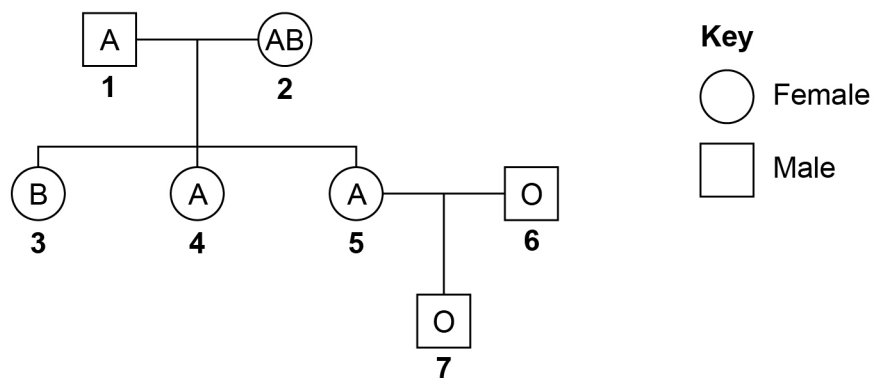
Allele **I^O** is recessive to **I^A** and to **I^B**.

0 2 . 1

Define **codominant**.

[1 mark]

Figure 2 shows the inheritance of blood groups in one family.

Figure 2**0 2 . 2**

Give the genotypes of individual **1** and individual **3**.

[2 marks]

Individual **1** _____

Individual **3** _____



0 2 . 3 Individual **5** and individual **6** have another child.

Calculate the probability that the child is blood group O.

Draw a genetic diagram.

[2 marks]

Probability of blood group O = _____

Question 2 continues on the next page

Turn over ►



Scientists investigate a large population to find the frequency of alleles I^A , I^B and I^O .

0 2 . 4 The frequency of I^A is 0.16 and the frequency of I^B is 0.21

Calculate the frequency of I^O .

[1 mark]

Frequency of I^O = _____

The scientists:

- use the Hardy–Weinberg equation to predict the percentage of people in the population with blood groups A, AB, B, and O
- use a statistical test to compare the percentage of people with each blood group to the predicted percentage.

0 2 . 5 Name the statistical test the scientists could use.

Give the reason for your choice.

[1 mark]

Statistical test _____

Reason for choice _____

0 2 . 6 The scientists use a probability table to determine the P value.

Give the number of degrees of freedom the scientists should use.

[1 mark]

Number of degrees of freedom = _____



0	2	.	7
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Other scientists find a link between blood group and an increased risk of cancer in a large population.

Explain the reason why the Hardy–Weinberg principle may **not** apply to this population.

[2 marks]

10

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0 3

Isle Royale is an island in a large lake in North America. Migration of animals to and from the island is low.

The island has a wolf population and a moose population. The wolf is a predator of the moose.

Figure 3 shows a wolf.

Figure 3



Figure 4 shows a moose.

Figure 4



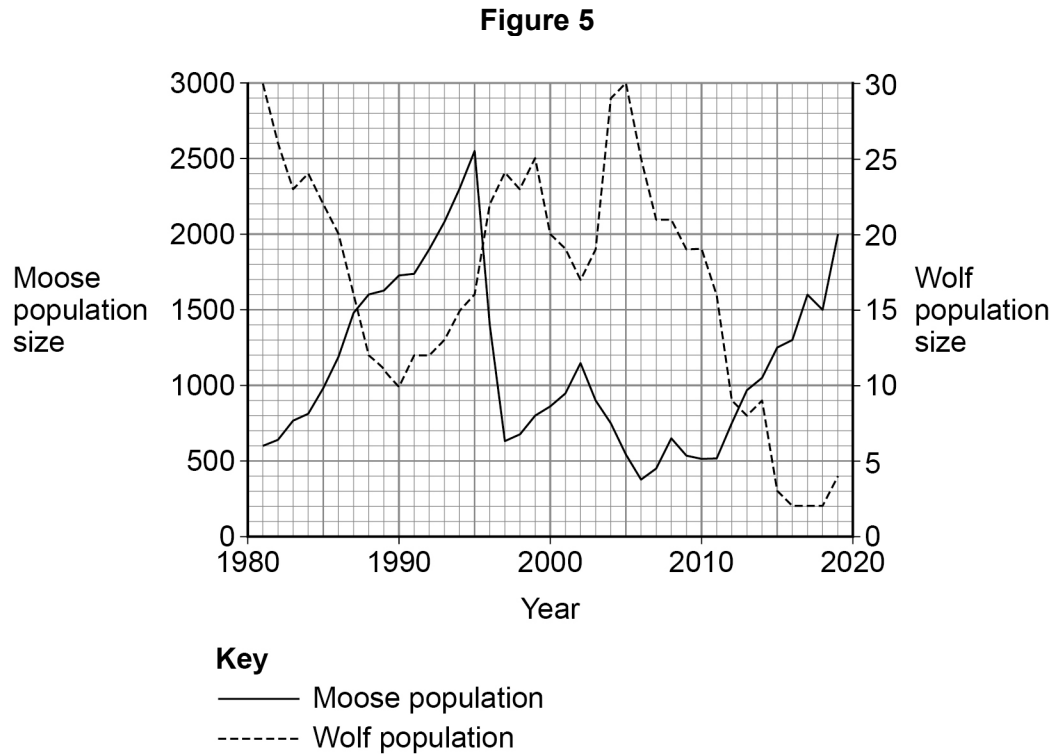
Question 3 continues on the next page

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Scientists study the predator–prey relationship between the wolf population and the moose population.

Figure 5 shows the wolf population and the moose population sizes between 1981 and 2019.



0 3 . 1 The ratio of moose number to wolf number changes over time. The ratio was 500 : 1 in 2019.

Calculate:

- the moose to wolf ratio in 1981
- how many times **greater** the ratio was in 1981 than in 2019.

Use data from **Figure 5**.

[2 marks]

Ratio in 1981 = _____ : 1

Number of times greater _____



[illegible]

Turn over ►



0	3	.	4
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By 2006, the moose population had decreased to a very small size.

Describe how the moose population could become better adapted over many generations.

[3 marks]

10



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0 4

Students investigate the effect of intraspecific competition on seedling growth.

This is the method the students use.

1. Put soil in plastic containers of the same size.
2. Collect seeds from plants of the same species.
3. Put the seeds in the plastic containers at low, medium and high density:
 - low density – 5 seeds in each container
 - medium density – 10 seeds in each container
 - high density – 25 seeds in each container.
4. Repeat each density 20 times.
5. Put the plastic containers in a room with optimum light and temperature.
6. Add water to the soil when necessary.
7. Check the seeds every day and record the day that each shoot appears.

At the end of the investigation, the students measure the dry biomass of each seedling.

0 4 . 1

Give **two** limitations of the students' method.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

0 4 . 2

Describe how the students find the dry biomass of the seedlings.

[2 marks]

- _____
- _____
- _____
- _____
- _____
- _____



Table 2 shows the median day that shoots appear at each density.

Table 2

Seed planting density	Median day that shoots appear
Low density	13
Medium density	10
High density	8

0 4 . 3

The students use a statistical test to see if there is a significant difference between the median day that shoots appear in each planting density.

The calculated value of $P = 0.44$

Explain what this P value shows.

[2 marks]

Question 4 continues on the next page

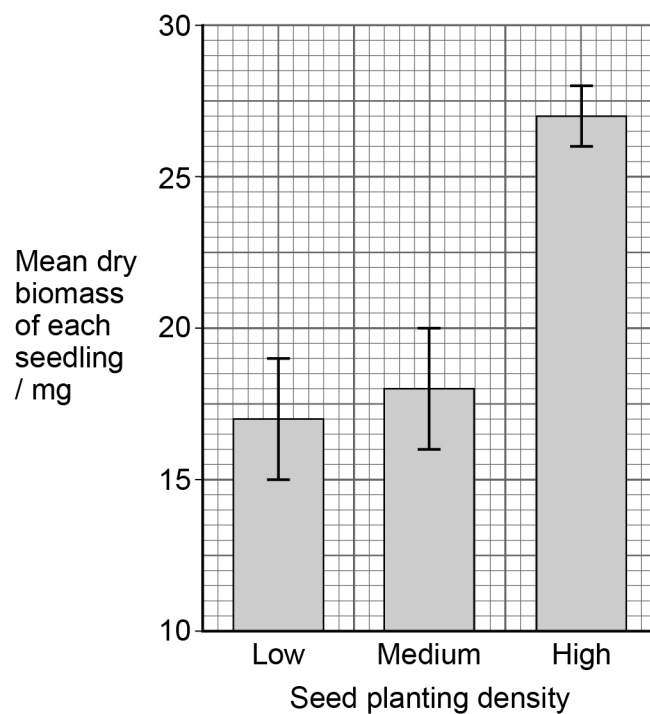
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Figure 6 shows the mean dry biomass of the seedlings at each density.

The error bars show $\pm$ standard error.

Figure 6



0 4 . 4

Give **two** conclusions from the results in **Figure 6**.

[2 marks]

1 _____

2 _____



Table 2 shows the median day that shoots appear at each density.

Table 2 (repeated)

Seed planting density	Median day that shoots appear
Low density	13
Medium density	10
High density	8

0 4 5 Explain the results shown in **Figure 6**.

Use information from **Table 2**.

[2 marks]

10

Turn over for the next question

Turn over ►



0 5

Weedkiller is a chemical that kills unwanted plants.

A student investigates the effect of a weedkiller on the rate of photosynthesis using a chloroplast suspension.

The student uses an indicator that changes colour when it is reduced.

This is the method the student uses.

1. Add the indicator to a chloroplast suspension **without** weedkiller.
2. Measure the time taken for the indicator to change colour.
3. Repeat steps 1 and 2 twice more.
4. Repeat steps 1 to 3 using a chloroplast suspension **with** weedkiller.

Figure 7 shows the student's raw data.

Figure 7

Results
without weedkiller: 1 min 20 secs, 2 mins, 1 min 30 secs
with weedkiller: 3 mins 6 secs, 3 mins 45 secs, 3 mins 40 secs



0 5 . 1

Draw a suitable table for the student's data from **Figure 7**.

Your table should include the student's mean results.

[3 marks]

Question 5 continues on the next page

Turn over ►



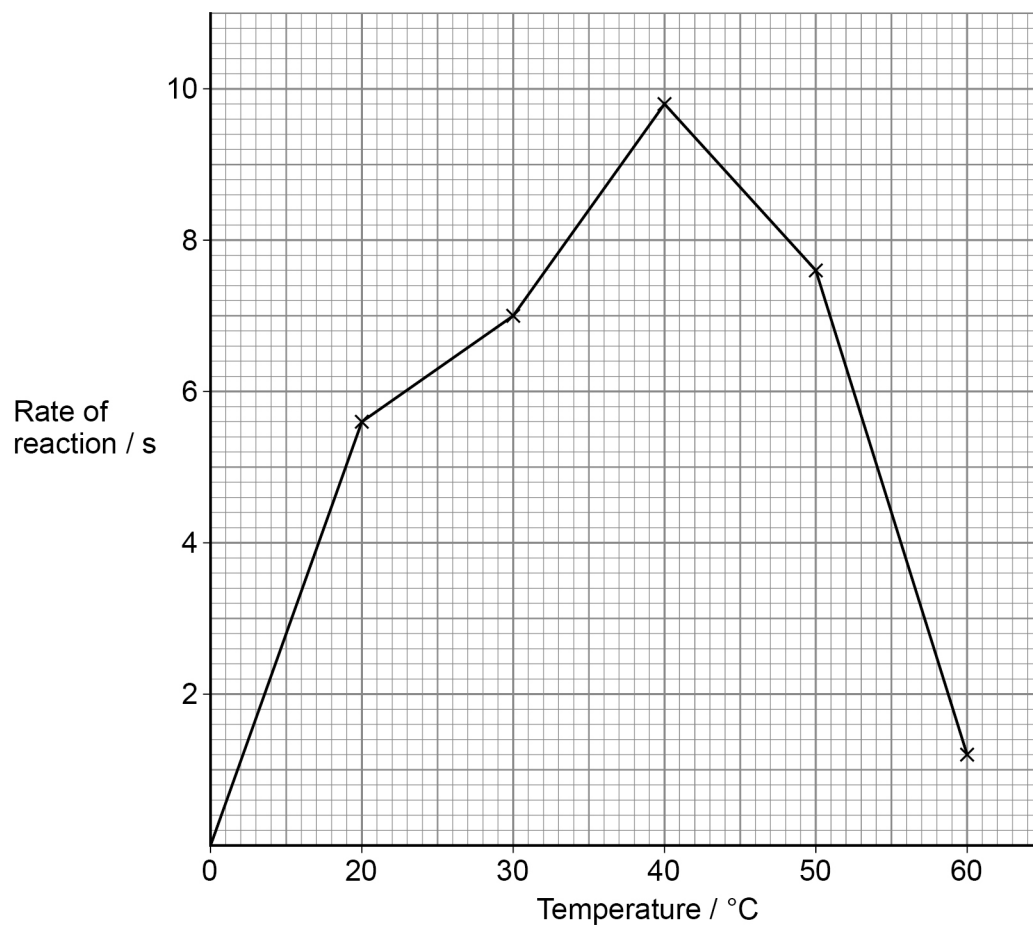
A different student investigates the effect of temperature on the rate of photosynthesis.

The student uses a chloroplast suspension and measures the time taken for the indicator to change colour at five different temperatures.

The student calculates the rate of photosynthesis and plots a graph of the results.

Figure 8 shows the student's graph.

Figure 8



0	5	.	2
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The student's graph in **Figure 8** has some errors.

Identify **two** errors.

[2 marks]

1 _____

2 _____

Question 5 continues on the next page

Turn over ►



A scientist investigates the effect of carbon dioxide concentration on the rate of photosynthesis at 20 °C in one species of plant.

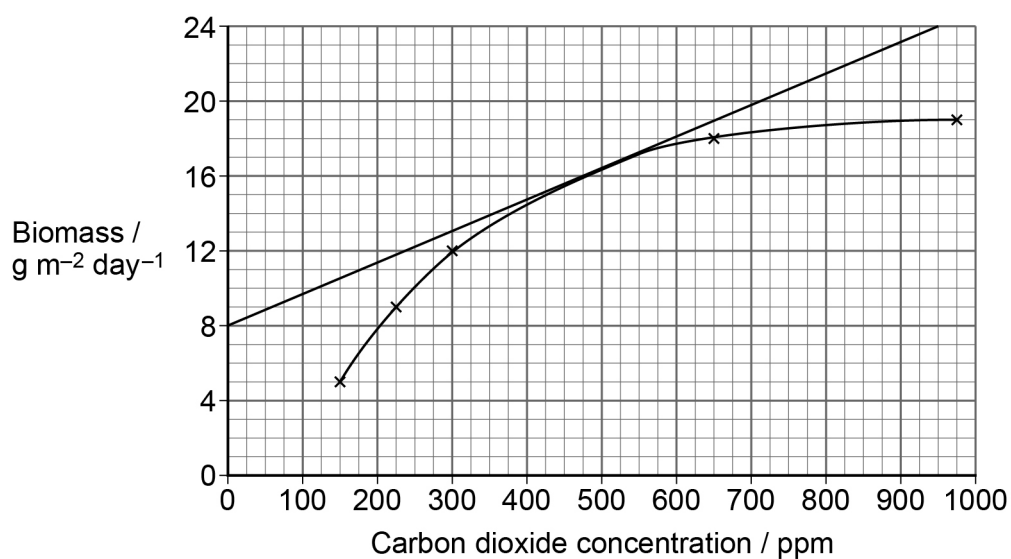
The scientist uses the increase in biomass of the plant as a measure of the rate of photosynthesis.

The scientist:

- plots a graph of the results
- draws a tangent at a carbon dioxide concentration of 500 parts per million (ppm).

Figure 9 shows the scientist's graph.

Figure 9



0 5 . 3

Calculate the rate of increase in biomass at a carbon dioxide concentration of 500 ppm

Use the tangent on **Figure 9**.

[2 marks]

Rate of increase in biomass = _____ g m⁻² day⁻¹ ppm⁻¹ CO₂



0 5 . 4 The scientist repeats the investigation at 30 °C

Sketch a new curve on **Figure 9** to show the expected result.

[1 mark]

0 5 . 5 Explain why increasing the carbon dioxide concentration increases the biomass of plants.

Use your knowledge of the light-independent reaction.

[3 marks]

0 5 . 6 The total mass of glucose produced in photosynthesis is higher than the increase in biomass of the plants.

Give the reason why.

[1 mark]

12

Turn over for the next question

Turn over ►



0 6

A new island formed in 1963 after a volcano erupted.

Scientists discovered the first plants growing on the island in 1965.

The plants on the island grow from seeds that have come from nearby islands. The seeds are distributed by different methods.

Table 3 shows the percentage of seeds distributed by each method.

Table 3

Method of seed distribution	Percentage of seeds
Air	9
Birds	64
Sea	27

0 6 . 1

Describe how you could display the information in **Table 3** as a chart.

[1 mark]

0 6 . 2

Table 3 shows that most seeds are distributed by birds, often in their faeces. The seeds then grow in the faeces.

Suggest **two** advantages of the seeds growing in faeces.

[2 marks]

1

2



Question 6 continues on the next page

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Scientists collect data about the population sizes of plants growing on the island.

Table 4 shows the number of plants of four species found on the island between 1965 and 1985.

Table 4

Plant species	Number of plants of each species in each year										
	1965	1967	1969	1971	1973	1975	1977	1979	1981	1983	1985
<i>Elymus arenarius</i>	1	4	5	9	18	12	8	5			
<i>Cochlearia officinalis</i>			4	61	186	463	261	72	33	18	4
<i>Cerastium fontanum</i>						13	78	111	140	63	18
<i>Rumex acetosella</i>								15	30	47	80

0 6 . 3

Suggest **two** features of the method the scientists would use to collect data that are representative.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____



0 6 . 4 Describe how succession occurs on the island.

Use information from **Table 4**.

[3 marks]

0 6 . 5 The climax community has **not** yet been reached on the island.

Suggest **one** reason why.

[1 mark]

9

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Coenzymes, such as NAD and NADP, are important for chemical reactions in living organisms.

Describe how coenzymes are used in:

- photosynthesis
- ATP production in respiration.

[6 marks]

[illegible]

ATP is produced in both photosynthesis and respiration.

[4 marks]

[illegible]

Turn over ►



Energy from the sun is transferred through the trophic levels in a food chain.

Give reasons why the transfer of energy through a food chain is inefficient.

[5 marks]

[illegible]

15

END OF QUESTIONS



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[illegible]

