



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.

A-level

ENVIRONMENTAL SCIENCE

Paper 2

Friday 6 June 2025

Morning

Time allowed: 3 hours

Materials

For this paper you may use:

- a calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions 1 to 10 and **one** essay from question 11.
- 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).
- 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 120.
- All questions should be answered in continuous prose.
- You will be assessed on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	



J U N 2 5 7 4 4 7 2 0 1

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

0 1 . 1

Explain why the distance of a planet from the Sun and the temperature of a planet are negatively correlated.

[1 mark]

Table 1 shows information about planets in the solar system.

Table 1

Planet	Distance from the Sun / $\times 10^6$ km	Mean temperature / $^{\circ}\text{C}$	Minimum temperature / $^{\circ}\text{C}$	Maximum temperature / $^{\circ}\text{C}$
Mercury	57.9	167	-180	430
Venus	108.2	467	462	471
Earth	149.6	15	-88	58
Mars	227.9	-55	-153	20
Jupiter	778.3	-145	-163	-125

0 1 . 2

Suggest **one** feature of Venus that could help to explain why it does **not** fit the trend of the mean temperatures for planets in **Table 1**.

[1 mark]



0 1 . 3 Mercury's speed of rotation causes a large temperature range.

Explain **one** reason why.

[2 marks]

0 1 . 4 State why Jupiter is unlikely to have life despite water being present.

Use information from **Table 1** in your answer.

[1 mark]

5

Turn over for the next question

Turn over ►



0 2

Ground-nesting seabirds may become threatened when rats colonise islands.
Rats feed on their eggs and the young birds.

A conservation project was set up to eradicate rats from an island.

Scientists wanted to first estimate the population of rats.
It was suggested that the mark-release-recapture method could be used.
However, this method was criticised for being limited by too many assumptions.

0 2 . 1

Describe **one** assumption of the mark-release-recapture method.

[1 mark]

0 2 . 2

It was estimated that there were $965 \pm 20\%$ rats on the island.

The island has an area of 18.9 hectares.

Calculate the range in density of rats per hectare (ha^{-1}).

Show your working.

[3 marks]

_____ rats ha^{-1}

0 2 . 3

State **two** ways the introduction of a species may threaten indigenous species.

Do **not** include predation in your answer.

[2 marks]

1 _____

2 _____



0 2 . 4

State the name of **one** piece of UK legislation that bans the release of non-indigenous species into the wild.

[1 mark]

0 2 . 5

Explain why invasive species are usually r-selected and threatened species are usually k-selected.

[3 marks]

10

Turn over for the next question

Turn over ►



0 3

Plant growth is affected by pH and nitrate concentration.

0 3 . 1

Describe how to measure the pH and nitrate concentration of water.

[4 marks]

pH _____

Nitrate concentration _____

Table 2 shows some nutrients and their importance for plant growth.**Table 2**

Nutrient	Chemical symbol	Importance for plant growth
Nitrogen	N	
Phosphorus	P	
	K	Ion transport

0 3 . 2Complete **Table 2**.**[3 marks]**

An investigation was set up to determine the impact of pH on the growth of lettuce plants.

Four groups of ten lettuce plants were grown using water of different pH levels.

The lettuce plants were left to grow for 60 days and mean growth rates were calculated.

Table 3 shows the results.

Table 3

pH	Mean starting mass / g	Mean growth rate / g day ⁻¹
5.0	5.23	4.42
5.8	4.96	4.67
6.5	5.04	4.70
7.0	5.11	4.95

0 3 . 3

Use **Table 3** to calculate the difference in the mean mass of the lettuce plants grown at pH 5.8 and pH 7.0 at the end of the investigation.

Show your working.

[2 marks]

_____ g

0 3 . 4

Suggest **one** reason for the trend in mean growth rate shown in **Table 3**.

[1 mark]



0 4

Table 4 shows some information about four species considered for a conservation programme.

Table 4

Species	Red list status	Extent of habitat fragmentation	Endemic	Keystone	Flagship
A	Endangered	Medium	No	No	Yes
B	Endangered	Medium	No	No	No
C	Vulnerable	High	No	Yes	No
D	Critically Endangered	High	Yes	No	No

Species D was prioritised for conservation over the other three species.

0 4

1

Identify and explain **three** reasons why **species D** was prioritised for conservation.

Use information from **Table 4**.

[3 marks]

1

2

3



0 4 . 2

Identify and explain one reason why the conservation of **species A** may help the conservation of other species.

Use information from **Table 4**.

[1 mark]

0 4 . 3

Identify and explain one reason why the conservation of **species C** may help the conservation of other species.

Use information from **Table 4**.

[1 mark]

5

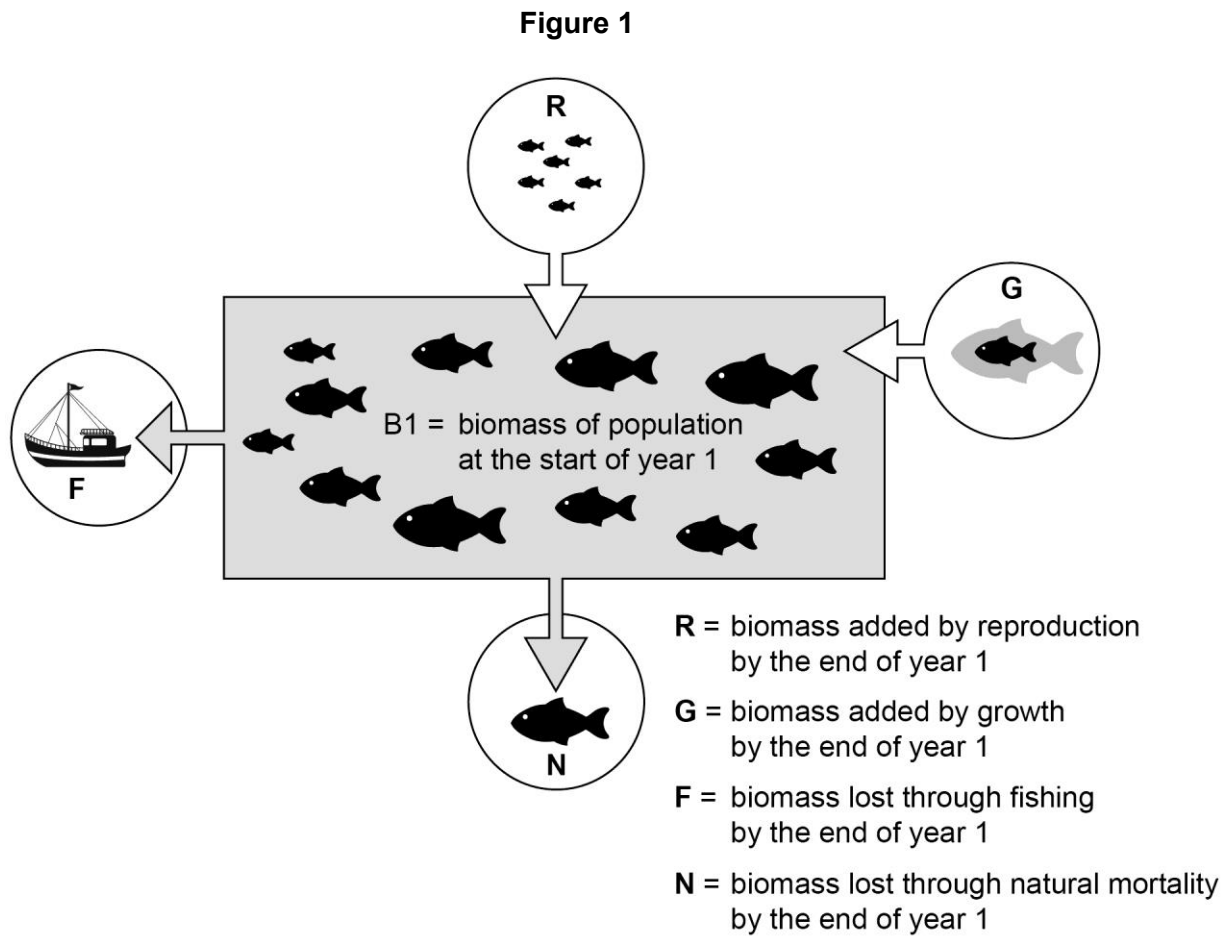
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Turn over ►



0 5

Figure 1 shows information about the factors affecting a fish population.



0 5 . 1

Write an equation that calculates the biomass (**B2**) of the fish population at the **end** of year 1.

Use the letters shown in **Figure 1**.

[1 mark]

B2 = _____

0 5 . 2

Explain why data for **F** are more reliable than data for **R**, **G**, and **N** in **Figure 1**.

[2 marks]



F is affected by fishing effort.

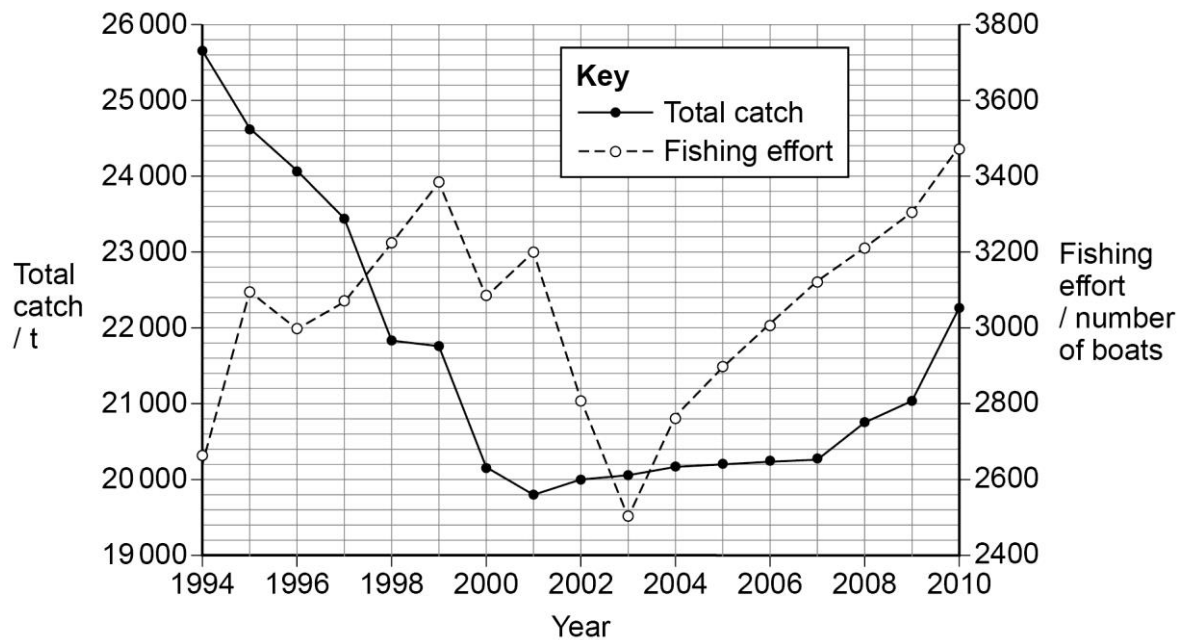
One factor that contributes to fishing effort is the number of boats fishing.

0 5 . 3 State **one other** factor that contributes to fishing effort.

[1 mark]

Figure 2 shows fishing data on one species of fish from 1994 to 2010.

Figure 2



Catch Per Unit Effort (CPUE) is a measure of fishing catch related to fishing effort. It can be calculated as the mean catch in tonnes per boat.

0 5 . 4 Use data from **Figure 2** to calculate the CPUE for 2001.

Show your working.

[2 marks]

_____ t boat⁻¹



0 5 . 5

Explain how a decrease in CPUE affects the sustainability of fishing.

[4 marks]

10

[1 mark]

[9 marks]

Extra space



Turn over for the next question

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outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0 7

The white-tailed eagle, *Haliaeetus albicilla*, became extinct in the UK in 1918.

This extinction came after humans deliberately eradicated them.

0 7 . 1

State **one** reason why humans may want to deliberately eradicate a species.

[1 mark]

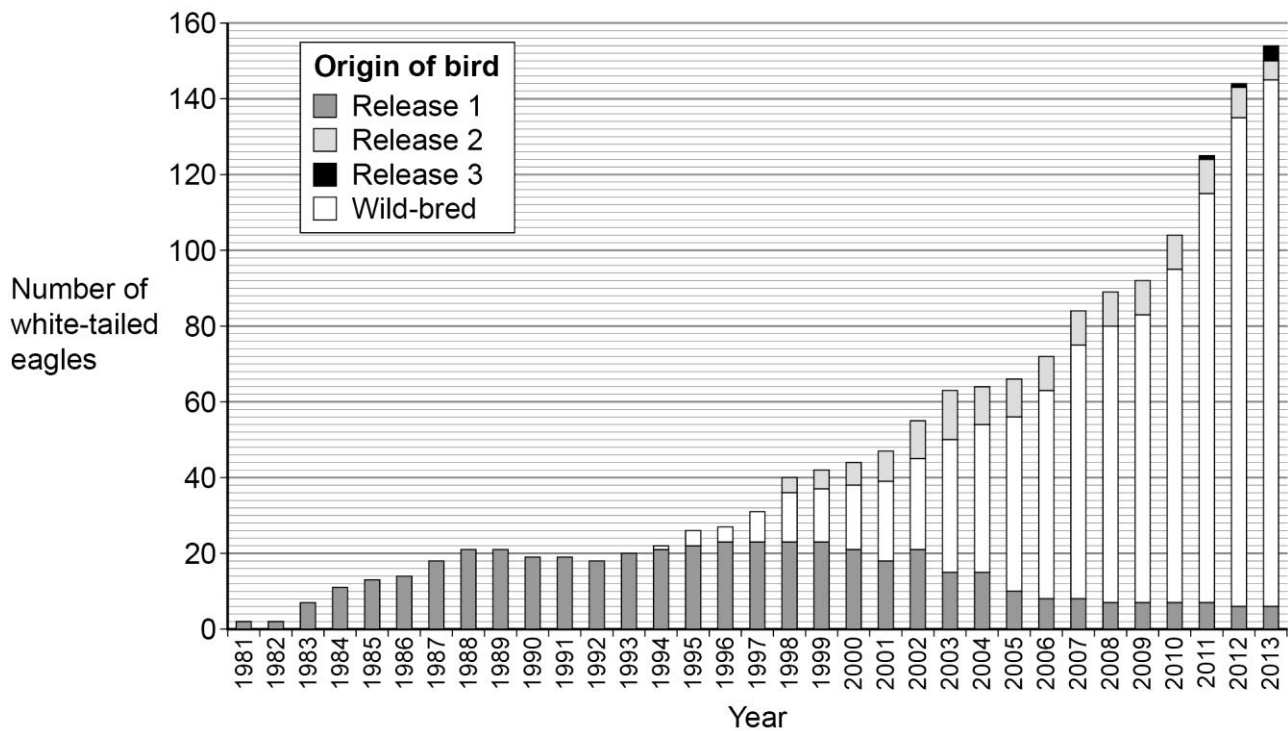
White-tailed eagles have been successfully reintroduced to Scotland.

Birds reared in captivity were released into the wild during three release periods.

The released birds bred to produce wild-bred birds that were then able to breed and increase the wild population.

Figure 3 shows the number of individual white-tailed eagles recorded in the wild from 1981 to 2013.

Figure 3



0	7	.	2
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Suggest a technique that may have been used to identify individual white-tailed eagles.

[1 mark]

0	7	.	3
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Use **Figure 3** to calculate the percentage of white-tailed eagles recorded in 2004 that were wild-bred.

Show your working.

Give your answer to the nearest whole number.

[2 marks]

_____ %

Question 7 continues on the next page

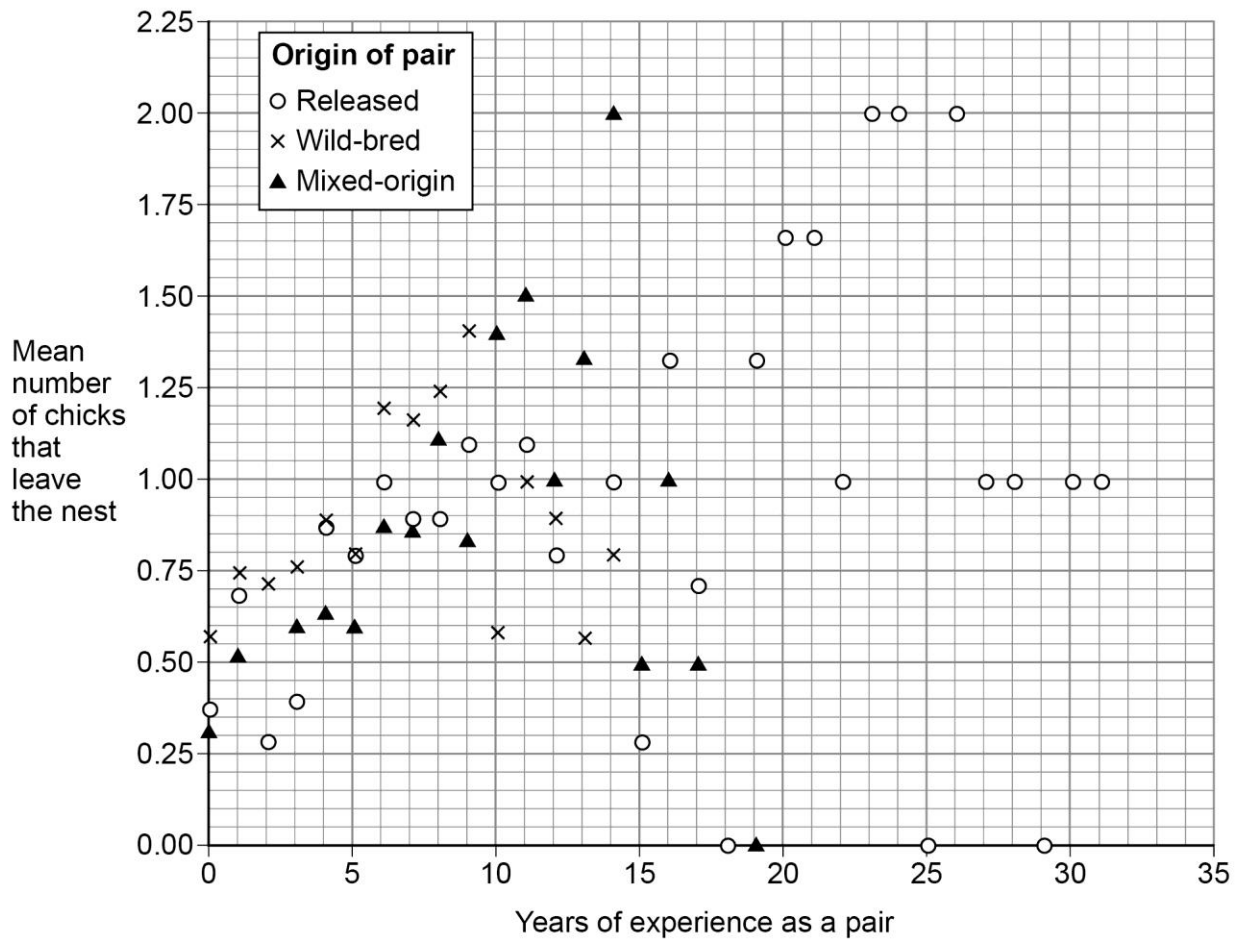
Turn over ►



White-tailed eagles mate with one partner for life. Breeding is considered successful when chicks leave the nest.

Figure 4 shows the success of breeding pairs of birds with different origins and different years of breeding experience.

Figure 4



0 7 . 4

Scientists concluded that pairs of released birds were more successful breeders than mixed-origin pairs or wild-bred pairs.

Use data in **Figure 4** to evaluate this conclusion.

[3 marks]

0 7 . 5

Explain **three** ways the reintroduction programme may be managed to help long-term population increase of the white-tailed eagles.

[3 marks]

1

2

3

10

Turn over for the next question

Turn over ►



0 8

Scientists investigated the density of wood of different species of mangrove trees.

Trees from a variety of mangrove forests across Thailand and Indonesia were sampled. Trees of different mangrove species were cut down and the mean wood density for each species was determined.

Table 5 shows the results.

Table 5

Graph showing data for an investigation into the mean wood density for five species of mangrove tree. Data includes mean density, two standard deviations, number of samples and number of sampling sites for *Bruguiera cylindrica*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Rhizophora apiculata* and *Rhizophora mucronata*.

Accessed via:

<https://www.cambridge.org/core/journals/journal-of-tropical-ecology/article/abs/common-allometric-equations-for-estimating-the-tree-weight-of-mangroves/6067C26CECE5B0EF18A319B8DB89B771>

Table 5 not reproduced here due to third-party copyright restrictions.

0 8**1**

Explain why sampling a greater number of mangrove forest sites results in more representative data.

[2 marks]



Only **one** answer per question is allowed.

For each question completely fill in the circle alongside the appropriate answer.

CORRECT METHOD



WRONG METHODS



If you want to change your answer you must cross out your original answer as shown.



If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown.



0 8 . 2

Which **two** species from **Table 5** have significantly different mean wood densities?

Shade **one** box only.

[1 mark]

A *Rhizophora mucronata* and *Bruguiera cylindrica*

☐

B *Rhizophora mucronata* and *Bruguiera gymnorhiza*

☐

C *Rhizophora mucronata* and *Ceriops tagal*

☐

D *Rhizophora mucronata* and *Rhizophora apiculata*

☐

Question 8 continues on the next page

Turn over ►



Scientists used the data in **Table 5 on page 20** to formulate the following equations that estimate the above and below ground mass of mangrove trees:

Above ground mass (M_a)

$$M_a = 67.3 \times \rho \times D$$

Below ground mass (M_b)

$$M_b = 0.199 \times \rho^{0.899} \times D^{2.22}$$

ρ is the mean wood density.

Tree diameter (D) was measured at a standard height of 140 cm above ground level.

M_a and M_b are measured in tonnes (t).

0 8 . 3 Calculate the total mass of a *Bruguiera gymnorrhiza* with a diameter of 46.0 cm.

Use **Table 5 on page 20** and the equations.

Write your answer to the most appropriate number of significant figures.

Show your working.

[4 marks]

_____ t



0	8	.	4
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Describe **three** ways mangrove forests play an important role in reducing the impacts of climate change.

[3 marks]

1 _____

2 _____

3 _____

10

Turn over for the next question

Turn over ►



0 9

The biodiversity of moths was investigated at six woodland locations.

Moths were caught using portable ultraviolet light traps.

0 9 . 1

State **two other** pieces of equipment that could be used to catch moths.

[2 marks]

1 _____

2 _____

0 9 . 2

Suggest **two** reasons why the portable ultraviolet light trap may **not** trap all species of moths in the woodland.

[2 marks]

1 _____

2 _____

Table 6 shows the results of the investigation.

Table 6

Location	Species richness of moths	Number of individual moths
A	102	1052
B	76	491
C	92	889
D	95	756
E	67	386
F	91	828



A chi-squared test was used to analyse the species richness results.

0 9 . 3

State the **two** features of the data that made chi-squared a suitable choice of statistical test for the results in **Table 6**.

[1 mark]

The chi-squared equation is:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where:

Σ = the sum of

O = the observed value

E = the expected value

The expected value (E) was calculated to be 87.17

0 9 . 4

Show how the expected value (E) of 87.17 was calculated.

Use data from **Table 6**.

[1 mark]

Question 9 continues on the next page

Turn over ►



Table 7 shows parts of the chi-squared test in this investigation.

Table 7

Location	$(O - E)^2$	$\frac{(O - E)^2}{E}$
A	219.93	2.52
B	124.77	1.43
C	23.33	0.27
D	61.31	0.70
E	406.83	4.67
F		

0 9 . 5

Use data from **Table 6 on page 24** and the expected value (E) of 87.17 to complete **Table 7**.

Calculate the value of χ^2 .

Use data from the completed **Table 7** and the chi-squared equation.

Give your answers to **two** decimal places.

Show your working.

[3 marks]

$$\chi^2 = \underline{\hspace{10em}}$$



Another investigation collected data from six new locations.

The chi-squared test was used to analyse the numbers of individual moths caught at these locations.

0 9 . 6

State the null hypothesis for this investigation.

[1 mark]

χ^2 was calculated to be of 12.48. A probability of 0.05 was used.

Table 8 shows a critical value table for the chi-squared test.

df (degrees of freedom) = $k - 1$

k = the number of categories

Table 8

Degrees of freedom (df)	p values		
	0.05	0.01	0.005
1	3.84	6.64	7.88
2	5.99	9.21	10.60
3	7.82	11.35	12.84
4	9.49	13.28	14.86
5	11.07	15.09	16.75
6	12.59	16.81	18.55
7	14.07	18.48	20.28
8	15.51	20.09	21.96
9	16.92	21.67	23.59
10	18.31	23.21	25.19

0 9 . 7

Explain whether the null hypothesis should be rejected **or** accepted.

Use data from **Table 8**.

[2 marks]

Turn over ►



Table 9 shows the Simpson's index of diversity of moths for the different woodland locations.

Table 9

Location	Type of woodland	Simpson's index of diversity
A	Coniferous	7.5
B	Deciduous	5.6
C	Coniferous	5.3
D	Mixed	7.5
E	Deciduous	3.9
F	Mixed	6.1

0 9 . 8 Calculate which type of woodland has the greatest mean moth biodiversity.

Use data from **Table 9**.

Outline **two** ecological reasons why your stated type of woodland would have the greatest moth biodiversity.

[3 marks]

Type of woodland _____

1 _____

2 _____

15



1 0

Polyethylene terephthalate (PET) is a common plastic used to make items such as bottles.

Scientists have been investigating a type of enzyme called cutinase that breaks down PET.

1 0 . 1

Suggest why breaking down PET could increase sustainability.

[3 marks]

Question 10 continues on the next page

Turn over ►

The effectiveness of different cutinase enzymes in breaking down PET was compared in an investigation.

The cutinase enzymes came from three different species:

- HiC from *Humicola insolens*, a species of fungus
- PmC from *Pseudomonas mendocina*, a species of bacterium
- FsC from *Fusarium solani*, a species of fungus.

Each cutinase enzyme was tested at a range of temperatures.

Figure 5 shows the results.

Figure 5

Graph showing the results of an investigation to test the effectiveness of different cutinase enzymes in breaking down PET; HiC, PmC and FsC.

Enzyme activity in arbitrary units

Accessed via:

<https://pubs.acs.org/doi/10.1021/bk-2010-1043.ch026>

Figure 5 not reproduced here due to third-party copyright restrictions.



1 0 . 2

Use **Figure 5** to describe how temperature affects the activity of HiC enzyme.**[2 marks]**

1 0 . 3

Calculate how many times greater the peak enzyme activity of HiC is than PmC.

Use data from **Figure 5**.Give your answer to **two** significant figures.**[1 mark]**

It was concluded that to increase sustainability, HiC enzyme should be used at a temperature below the optimum rate of reaction, at around 70 °C.

1 0 . 4

Explain why this was the conclusion.

[2 marks]

1 0 . 5

This investigation could be used to support the conservation of biodiversity.

Explain **two** ways that the conservation of biodiversity can benefit scientific research.**[2 marks]**1

2

10

Turn over ►



$$\boxed{1} \boxed{1} . \boxed{1}$$

[25 marks]

1 1 . 2

[25 marks]

Question

1	1	.	1	
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Question

1	1	.	2	
---	---	---	---	---

☒

WRONG METHODS

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

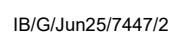
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25



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outside the
box*

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ANSWER IN THE SPACES PROVIDED**



[illegible]

