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EDEXCEL GCSE BIOLOGY: QUESTIONS BY TOPIC

Ecosystems and Material Cycles (9)

GCSE Biology (Higher) Topic 9

20 questions · 197 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Biology 1BI0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

20 questions · 197 marks · lowest tariff first



6-MARK QUESTIONS

1 question in this booklet



1 (a) Bloodworms in a pond indicate that the water is polluted.

(i) Which species also indicates that the water is polluted?

(1)

- ☐ A fertiliser
- ☐ B lichen
- ☐ C stonefly
- ☐ D sludgeworm

(ii) Bloodworms have a high level of haemoglobin in their blood.

Give a reason why this helps them survive in polluted water.

(1)

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.....

(iii) Carbon dioxide diffuses from the body of the bloodworm into the water.

Give **two** factors that affect the rate of diffusion.

(2)

1

.....

2

.....



(b) Figure 1 shows part of a diseased rose plant from a garden.



(Source: © Manfred Ruckzio/Shutterstock)

Figure 1

Explain what Figure 1 indicates about the air quality in the garden.

(2)

(Total for Question 1 = 6 marks)

7-MARK QUESTIONS

3 questions in this booklet



- 1 (a) Figure 1 shows the sources of pollution and different levels of water pollution in a river.

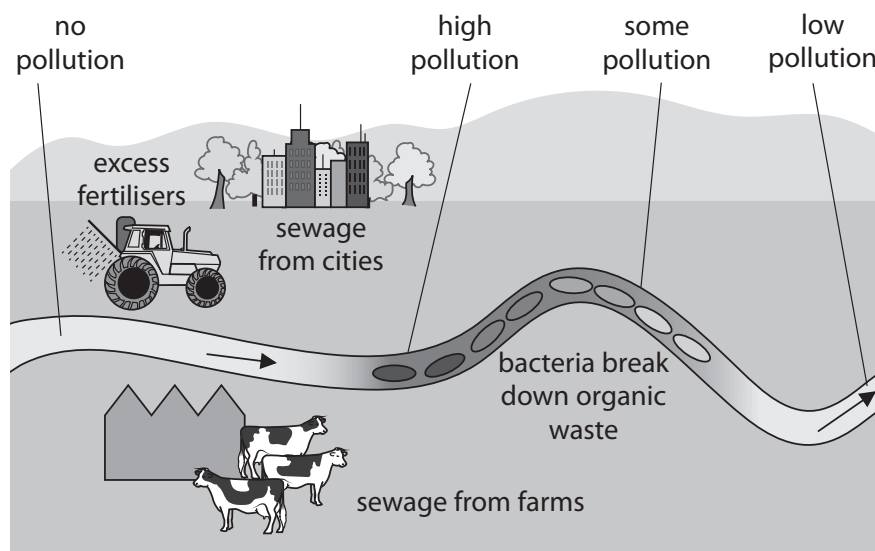


Figure 1

- (i) Which part of the river will have the largest number of bloodworms?

(1)

- ☐ A no pollution
- ☐ B high pollution
- ☐ C some pollution
- ☐ D low pollution

- (ii) Give the names of the **two** indicator species from the box which provide evidence for clean water.

blackspot fungus	lichen
freshwater shrimp	sludgeworm
	stonefly

(2)

1

2

- (b) Explain why sewage pollution in the river can decrease the oxygen levels in the water.

(2)

.....

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- (c) (i) Excess fertilisers can cause a build-up of nitrates in the rivers and lakes.

State the name given to a build-up of nitrates in the lake.

(1)

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- (ii) State why the build-up of nitrates is less likely to affect a river than a lake.

(1)

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.....

(Total for Question 1 = 7 marks)



- 1 The population of native white-clawed crayfish in English rivers is decreasing due to an increasing population of American imported signal crayfish.

Figure 1 shows a white-clawed crayfish.

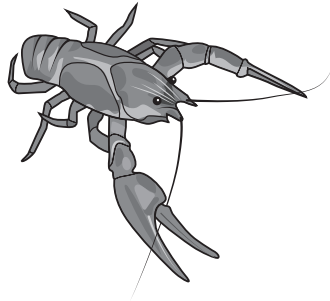


Figure 1

- (i) Which term is used to describe the American imported signal crayfish now that it is living in English rivers?

(1)

- ☐ A indigenous species
- ☐ B non-indigenous species
- ☐ C non-invasive species
- ☐ D pathogenic species

- (ii) American imported signal crayfish may eat white-clawed crayfish.

Explain **one** other reason why the increasing population of American imported signal crayfish may have caused the decrease in white-clawed crayfish.

(2)

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(iii) The Environment Agency is developing methods of increasing the population of white-clawed crayfish in English rivers.

Which term describes these methods?

(1)

- ☐ A mutation
- ☐ B conservation
- ☐ C predation
- ☐ D mutualism

(iv) White-clawed crayfish cannot survive in rivers with a low concentration of oxygen.

Explain how eutrophication can cause the population of white-clawed crayfish to decrease.

(3)

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(Total for Question 1 = 7 marks)



- 1 Figure 1 shows a stream flowing near a fertiliser factory.
- The factory burns coal as a source of energy.
- The factory releases waste into the stream and sulfur dioxide into the air.
- Samples of water were taken at five points, A, B, C, D and E, as shown on Figure 1.

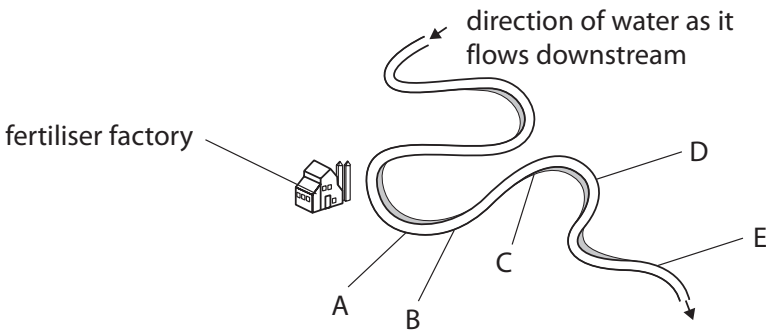


Figure 1

Figure 2 shows the oxygen concentration in the water at the five points along the stream.

point along stream	oxygen concentration (ppm)
A	1.5
B	2.7
C	3.4
D	4.4
E	4.5

Figure 2

- (a) (i) Calculate how many times greater the oxygen concentration is at point E than at point A.

(1)

..... times greater

- (ii) State how the oxygen concentration changes from point A to point E.

(1)

.....

.....

- (iii) Which indicator species would be most likely to be seen in the water at point A?

(1)

- ☐ **A** freshwater shrimp
- ☐ **B** lichen
- ☐ **C** sludgeworm
- ☐ **D** stonefly

- (iv) Explain where the biodiversity will be highest in the stream.

(3)

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(b) Figure 3 shows rose leaves infected with blackspot fungus.



(Source: © Manfred Ruckzio/Shutterstock)

Figure 3

State why rose plants growing near this factory are not infected with blackspot fungus.

(1)

(Total for Question 1 = 7 marks)

9-MARK QUESTIONS

3 questions in this booklet



- 2 Figure 2 shows an area of woodland with some small plants growing in the ground between the trees.



small plants

(Source: © Maksym Holovinov/Shutterstock)

Figure 2

- (a) Name a group of organisms that break down the dead leaves and release mineral ions into the soil.

(1)

- (b) The mineral ions are absorbed from the soil into the roots of plants.

Describe how these mineral ions are transported from the roots to the leaves of the plants.

(2)

- (c) A scientist recorded the mean light intensity and the mean number of small plants per m^2 for six 25 m^2 areas of the woodland.

Figure 3 shows the results.

area of woodland	mean light intensity in lux	mean number of small plants per m^2
A	1500	2.7
B	1300	1.6
C	1000	1.1
D	800	0.6
E	550	0.3
F	350	0.1

Figure 3

- (i) Explain the effect of light intensity on the number of small plants per m^2 .

(2)

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- (ii) State **one** variable the scientist should have controlled to make sure the light intensity measurements could be compared.

(1)

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.....

- (d) The scientist selects an area near the edge of the woodland where many stinging nettles are growing.

This area is partly shaded by the trees.

Describe how the scientist should use a belt transect to investigate how light intensity affects the growth of stinging nettles.

(3)

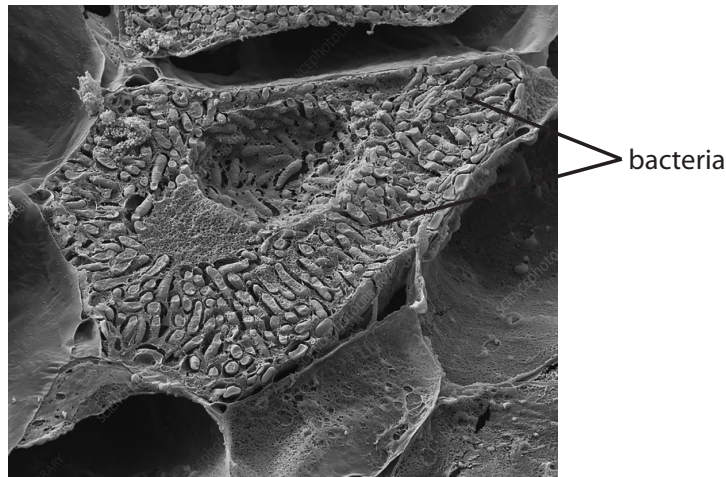
(Total for Question 2 = 9 marks)



- 5 (a) Figure 8 shows a cross-section of a root nodule on a leguminous plant.

Bacteria in the root nodule provide the leguminous plant with nitrogen compounds.

The leguminous plant provides the bacteria with sugars.



(Source: © Nigel Downer / Science Photo Library)

Figure 8

- (i) Which term describes the relationship between this leguminous plant and the bacteria?

(1)

- ☐ **A** parasitism
- ☐ **B** indigenous
- ☐ **C** biodiversity
- ☐ **D** mutualism

- (ii) The width of this root nodule is 7.5 mm.

Give the width in μm .

(1)

..... μm

(b) Figure 9 shows part of the nitrogen cycle.

dead animals and plants $\xrightarrow{\text{X}}$ ammonia $\xrightarrow{\text{Y}}$ nitrates

Figure 9

(i) Identify the types of microorganism involved in process X and process Y.

(2)

X.....

Y.....

(ii) Explain how crop rotation increases nitrate levels in the soil.

(3)

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(iii) Explain why increased nitrate levels in the soil improve crop yield.

(2)

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(Total for Question 5 = 9 marks)



- 3 (a) In 2018, all the plants were removed from the soil in a 1000 m² area.

A wall was built around this area to keep people out.

In 2019, three species of plants were recorded growing in this area.

Two of these species were indigenous.

- (i) State what is meant by the term 'indigenous'.

(1)

- (ii) Name **one** piece of equipment that could be used to sample the number of indigenous plants in this area.

(1)

- (b) The area was surveyed every year and the number of plants of each species (A to H) was estimated.

Figure 6 shows the results.

estimated number of each plant species found in the survey								
year	A	B	C	D	E	F	G	H
2018	—	—	—	—	—	—	—	—
2019	491	23	66	—	—	—	—	—
2020	664	48	186	1	8	—	—	—
2021	470	25	283	3	6	7	1	—
2022	120	41	354	7	4	11	7	—
2023	44	39	421	21	6	11	9	8

Figure 6



- (i) State the trend shown by the data in Figure 6 for plant species C from 2019 to 2023.

(1)

- (ii) A scientist suggested that the decrease in the number of plants of species B in 2021 was caused by competition from one of the other species of plant.

Which species is most likely to have out-competed species B in 2021?

(1)

- ☐ **A** species A
- ☐ **B** species C
- ☐ **C** species D
- ☐ **D** species H

- (iii) Explain **one** way that this species could have out-competed species B.

(2)

- (iv) Give **one** way that species H could have moved into the area.

(1)



(c) Plants also need water to grow.

Explain how water is absorbed into the plant.

(2)

(Total for Question 3 = 9 marks)

10-MARK QUESTIONS

3 questions in this booklet



7 Figure 13 shows part of a food web of organisms found in the cold Antarctic Ocean.

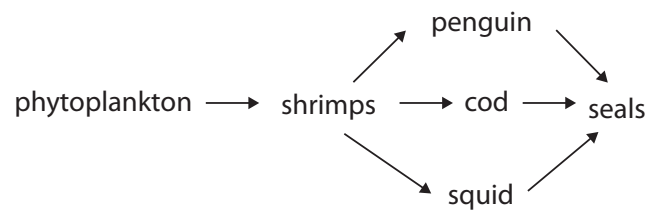


Figure 13

(a) Which term describes phytoplankton in this food web?

(1)

- ☐ A consumer
- ☐ B producer
- ☐ C predator
- ☐ D prey

(b) Humans are removing large numbers of cod from the Antarctic Ocean.

(i) State why the removal of cod could lead to a decrease in the numbers of squid and penguins.

(1)

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.....

(ii) Explain why the removal of cod could lead to an increase in the numbers of squid and penguins.

(2)

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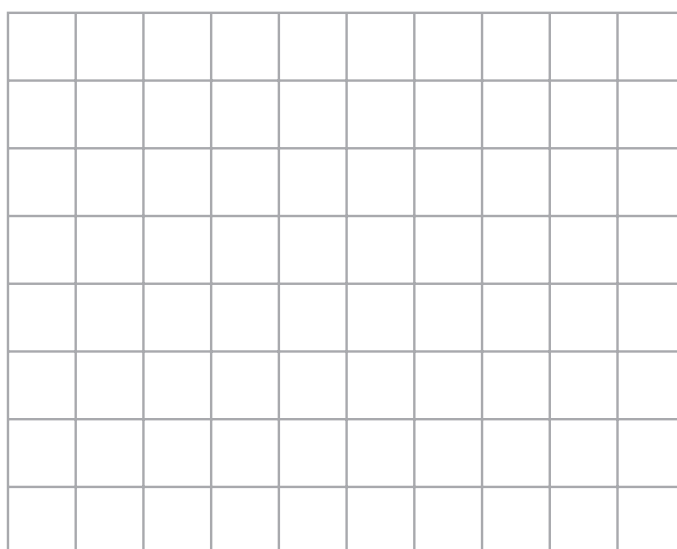
- (c) Figure 14 shows information about the biomass of some organisms in one part of the Antarctic Ocean.

organism	biomass in tonnes
phytoplankton	200
shrimps	40
cod	10
seals	0.5

Figure 14

- (i) Draw and label a pyramid of biomass for this food chain.

(2)



- (ii) Seals are mammals.

Explain why the conversion of biomass from phytoplankton to shrimps is more efficient than the conversion of biomass from cod to seals.

(2)

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(d) Cod are being overfished in the Antarctic Ocean.

Suggest **two** actions that could be taken by humans to increase the number of cod in the Antarctic Ocean.

(2)

1

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2

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(Total for Question 7 = 10 marks)



(iii) Mistletoe is a parasite that grows on some trees.

Figure 6 shows a tree with mistletoe growing on it.



(Source: © NagyDodo/Shutterstock)

Figure 6

Describe the feeding relationship between the mistletoe and the tree.

(2)

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(b) Nitrate fertilisers are used in the garden.

Explain why nitrate fertilisers are used in gardens.

(2)

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(Total for Question 5 = 10 marks)

- 7 (a) Figure 13 shows the biomass of each population of organisms in a food chain.



Figure 13

- (i) Calculate the percentage efficiency of biomass transfer from the aphids to the ladybirds.

Use the equation:

$$\text{percentage efficiency} = \frac{\text{biomass in higher trophic level}}{\text{biomass in previous trophic level}} \times 100$$

Give your answer to the nearest whole number.

(3)

.....%

- (ii) Give **two** reasons why the biomass of ladybirds is lower than the biomass of aphids in this food chain.

(2)

1

.....

2

.....

(iii) Aphids are a problem for rose growers as they damage the leaves of rose plants.

Explain how ladybirds could be used to reduce the number of aphids.

(2)

(b) As human population rises, food security is an increasing problem throughout the world.

Give **three** factors that reduce the amount of food available for humans throughout the world.

(3)

1

2

3

(Total for Question 7 = 10 marks)

11-MARK QUESTIONS

8 questions in this booklet



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) In France, Siberian chipmunks have very few natural predators.

Describe how this affected the Siberian chipmunk population in France.

(2)

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(iii) The percentage of energy transferred from the acorns to the chipmunks is 9.5%.

The energy contained in the acorns is 97 500 kJ.

Calculate the amount of energy transferred to the chipmunks.

Give your answer to the nearest whole number.

(3)

.....kJ



9



(b) The black-legged tick (*Ixodes scapularis*) is a parasite that feeds on the blood of animals including Siberian chipmunks and humans.

The tick transmits the Lyme disease pathogen.

Figure 9 shows the number of cases of Lyme disease in humans in France in 2003 and 2015.

Number of cases of Lyme disease in humans in France	
2003	2015
9 500	27 000

Figure 9

(i) Calculate the percentage increase in the number of cases of Lyme disease in humans in France from 2003 to 2015.

(2)

.....%

(ii) Explain why there has been an increase in the number of cases of Lyme disease in humans in France.

(2)

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(Total for Question 4 = 11 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

4 Figure 7 shows the world human population from 1800 to 2015.

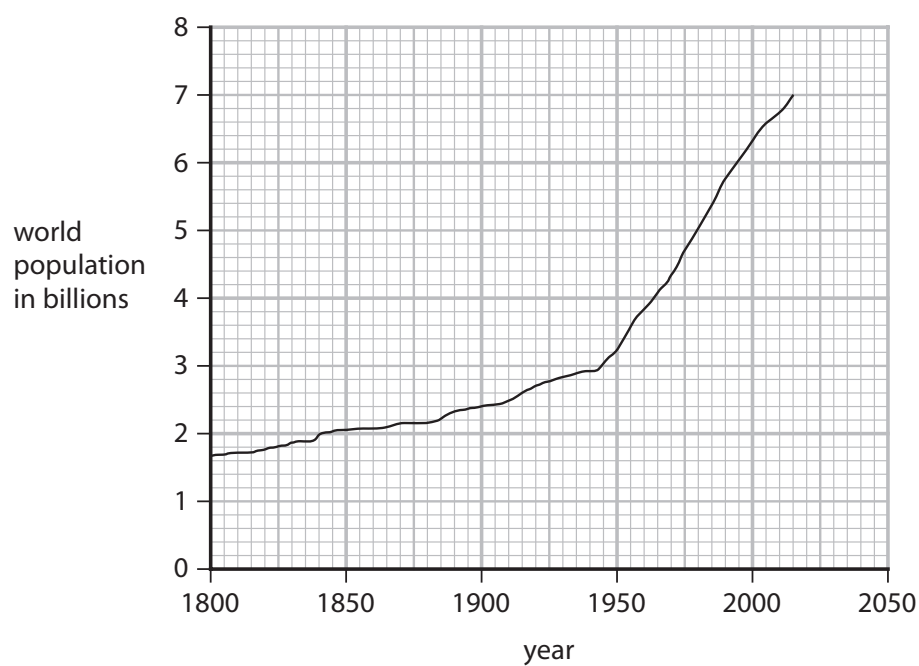


Figure 7

(a) In 2015, 13% of the world human population were classified as malnourished.

Calculate, using Figure 7, how many people were classified as malnourished in 2015.

(2)

..... billion

(b) Protein is an important nutrient.

Describe the laboratory test for protein.

(2)

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(c) Figure 8 shows the mass of meat eaten in the world from 1980 to 2010.

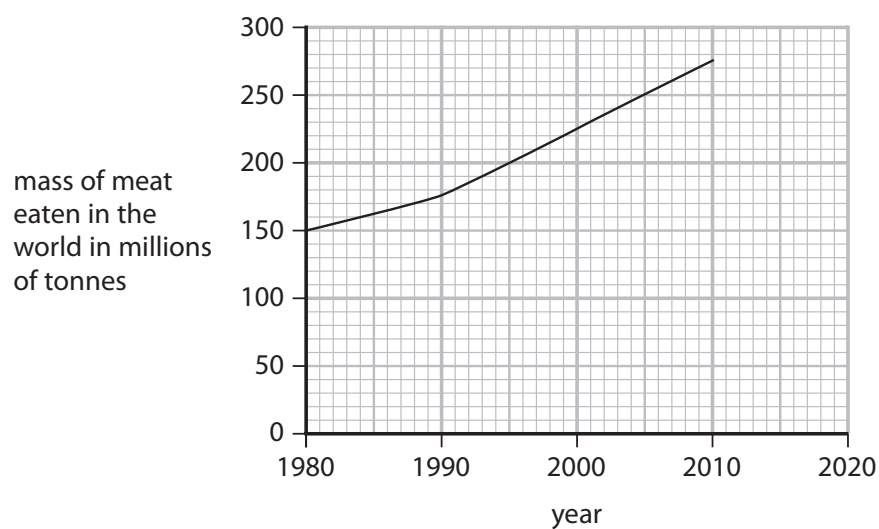


Figure 8

Calculate the rate of increase in the mass of meat eaten in the world from 2000 to 2010.

(2)

..... millions of tonnes per year

(d) Figure 9 shows an energy pyramid.

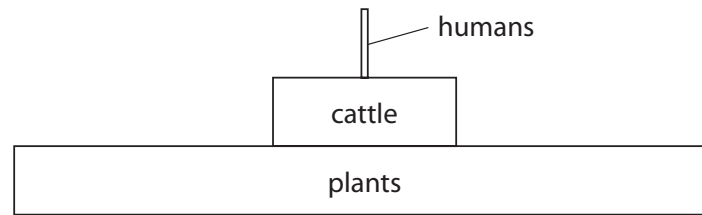


Figure 9

(i) Explain why the area labelled cattle is smaller than the area labelled plants.

(2)

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(ii) The World Health Organisation uses this definition of food security.

'When all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life'

Explain how a large increase in the mass of meat eaten will decrease food security in the future.

(3)

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(Total for Question 4 = 11 marks)

8 A student investigated the decomposition of leaves from different types of tree.

(a) Decomposers in the soil convert

(1)

- ☐ **A** nitrogen into nitrates
- ☐ **B** nitrates into nitrogen
- ☐ **C** urea into ammonia
- ☐ **D** ammonia into urea

(b) The student collected and weighed some fresh leaves from a beech tree.

- The leaves were placed on top of soil in a tray.
- This was repeated for leaves from three other types of tree.
- The trays were kept in the same abiotic conditions for 40 days.
- The leaves were reweighed after 40 days.

(i) State **two** abiotic factors that should be kept the same in this investigation.

(2)

1

2

(ii) Explain how this investigation could be improved to make the results more comparable.

(2)

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(c) Figure 12 shows the mean rate of decomposition for this investigation.

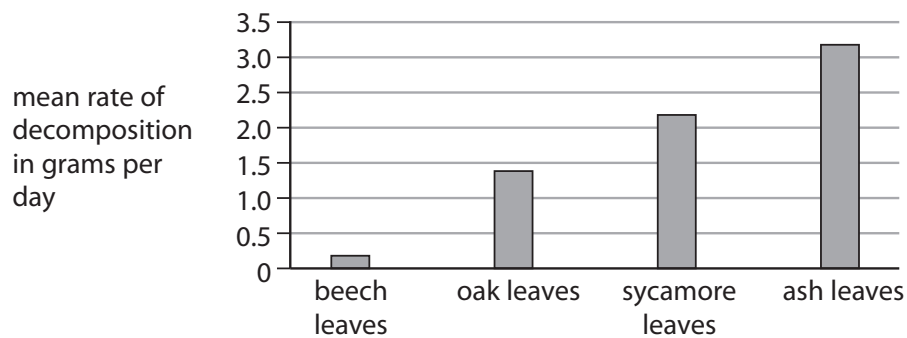


Figure 12

(i) Which leaves would produce compost in the least time?

(1)

- ☐ **A** beech leaves
- ☐ **B** oak leaves
- ☐ **C** sycamore leaves
- ☐ **D** ash leaves

(ii) The same investigation was extended to include the leaves of a silver birch tree.

The starting mass of the leaves was 28.2 grams.

After 40 days the mass of the leaves was 19.7 grams.

Calculate the rate of decomposition of the leaves of the silver birch tree.

Give your answer to three significant figures and include the units.

(3)

rate of decomposition

(d) Explain how the concentration of oxygen in a compost bin would affect the rate of decomposition.

(2)

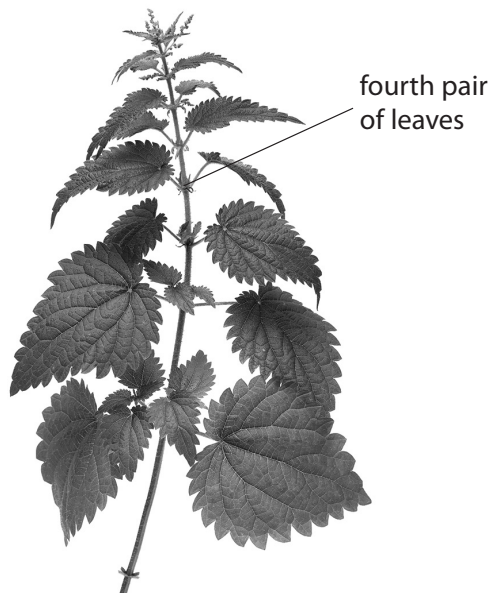
(Total for Question 8 = 11 marks)



- 4 A student investigated the width of leaves on nettle plants growing in two areas next to a woodland.

Figure 5a shows a nettle plant and Figure 5b shows a map of the woodland showing area A and area B.

The woodland caused area A to be in the shade.



(Source: © Alila Medical Media/Shutterstock)

Figure 5a

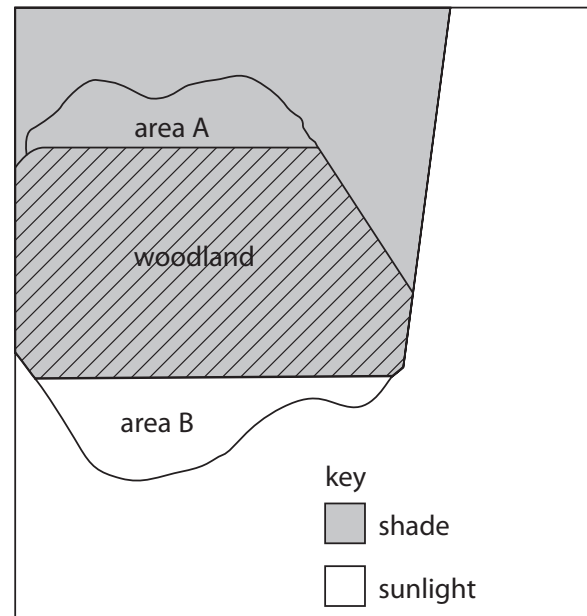


Figure 5b

The student measured the maximum width of leaves on five plants from each area.

The student always measured one leaf from the fourth pair of leaves.

- (a) Give **one** reason why the student always measured a leaf from the fourth pair of leaves.

(1)

(b) Figure 6 shows the results.

nettle plant	width of the leaf in millimetres (mm)	
	area A	area B
1	45	33
2	50	25
3	48	27
4	52	48
5	47	28
mean	48	28

Figure 6

(i) Why did the student **not** include the circled width when calculating the mean for area B?

(1)

- ☐ **A** it has not been measured in millimetres
- ☐ **B** it is an anomalous result
- ☐ **C** it is a repeat result
- ☐ **D** it is the mode value

(ii) Explain the difference in the mean width of leaves in the shade and those in the sunlight.

(2)

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.....

(c) The student also studied some of the animals in areas A and B.

The student saw caterpillars eating the leaves of some nettles.

The student also saw a toad eating a large beetle.

Large beetles eat ladybirds.

Ladybirds eat caterpillars.

(i) Give the food chain for these feeding relationships.

(3)

(ii) Frogs also eat large beetles.

Figure 7 shows the energy transferred between these animals.

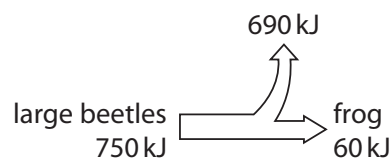


Figure 7

Calculate the percentage efficiency of energy transfer from the large beetles to the frog.

(2)

.....%

(iii) Give **two** reasons why only some of the energy in the biomass of the large beetles is transferred to the biomass of the frog.

(2)

1

.....

2

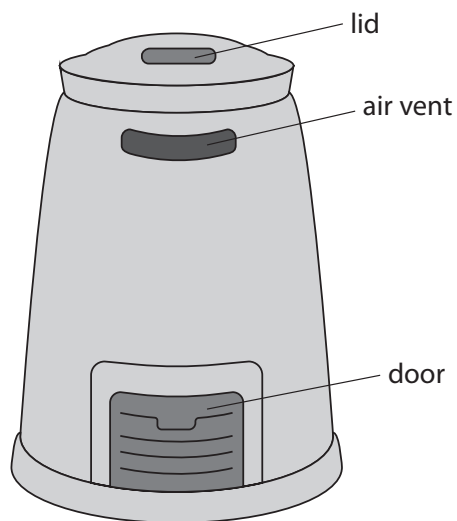
.....

(Total for Question 4 = 11 marks)



- 7 (a) A gardener read information on a gardening society website about how to use a compost bin.

Figure 11 shows the compost bin and some of the instructions.



- add soil in between layers of vegetation
- mix the contents of the compost bin once a month to add air
- keep the lid on to prevent water entering

Figure 11

- (i) Give **one** reason why the gardener thought the gardening society website was a good source of information.

(1)

.....

.....

- (ii) Give reasons why soil is added to the compost bin and why the contents are turned to add air.

(2)

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(iii) The gardener noticed the compost bin became warm a few days after vegetation was added.

Why did the contents of the compost bin become warm?

(1)

- ☐ **A** respiration occurred and this is an endothermic reaction
- ☐ **B** respiration occurred and this is an exothermic reaction
- ☐ **C** photosynthesis occurred and this is an endothermic reaction
- ☐ **D** photosynthesis occurred and this is an exothermic reaction

(iv) The mass of the contents of the compost bin at the start was 40 kg.

After 60 days the mass of the contents was 32 kg.

Which is the rate of decay?

(1)

- ☐ **A** 1.8 kg per day
- ☐ **B** 0.66 kg per day
- ☐ **C** 0.53 kg per day
- ☐ **D** 0.13 kg per day

*(b) Explain the uses of auxins, gibberellins and ethene in the commercial production of plants and fruits.

(6)

(Total for Question 7 = 11 marks)



- 6 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 10 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 10

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound.

This allows the numbers of male bitterns to be counted.

In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

(3)

.....%

The bitterns are difficult to see in the reeds of the wetland habitat.

- (ii) Give **one** benefit of this to the bittern.

(1)

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- (iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.

Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.

(3)

- (b) Describe how selective breeding can be used to produce a large population of animals that are not closely related.

(2)



(c) Sex determination in birds is different from humans.

Males are homozygous Z and females are heterozygous ZW.

Complete the Punnett square to show how sex is determined in birds.

(2)

		male	
female			

(Total for Question 6 = 11 marks)

4 A student investigated the decomposition of two different types of leaf.

The student placed 200 grams of holly leaves in a net bag.

The student placed 200 grams of oak leaves in another net bag.

The bags were left in a classroom.

The mass of the leaves in each bag was recorded every 10 days for 50 days.

(a) State **two** variables that would need to be controlled in this investigation.

(2)

1

.....

2

.....



(b) The results of this investigation are shown in Figure 4.

time in days	mass of leaves in grams	
	holly	oak
0	200	200
10	191	181
20	176	154
30	159	122
40	147	96
50	120	70

Figure 4

(i) Calculate the rate of decomposition of holly leaves from 0 to 50 days.

(2)

..... grams per day

(ii) Compare the trends shown in the data for holly leaves and oak leaves.

(2)

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.....

(c) Explain why it is important for the environment that dead leaves are decomposed. (2)

(d) Name **one** type of organism that decomposes leaves. (1)

(e) Leaves are eaten by snails.

1 600 grams of leaves and 10 snails were kept in a container for one month.

A scientist measured the mass of the leaves and the mass of the snails at the start and end of one month.

Figure 5 shows the results.

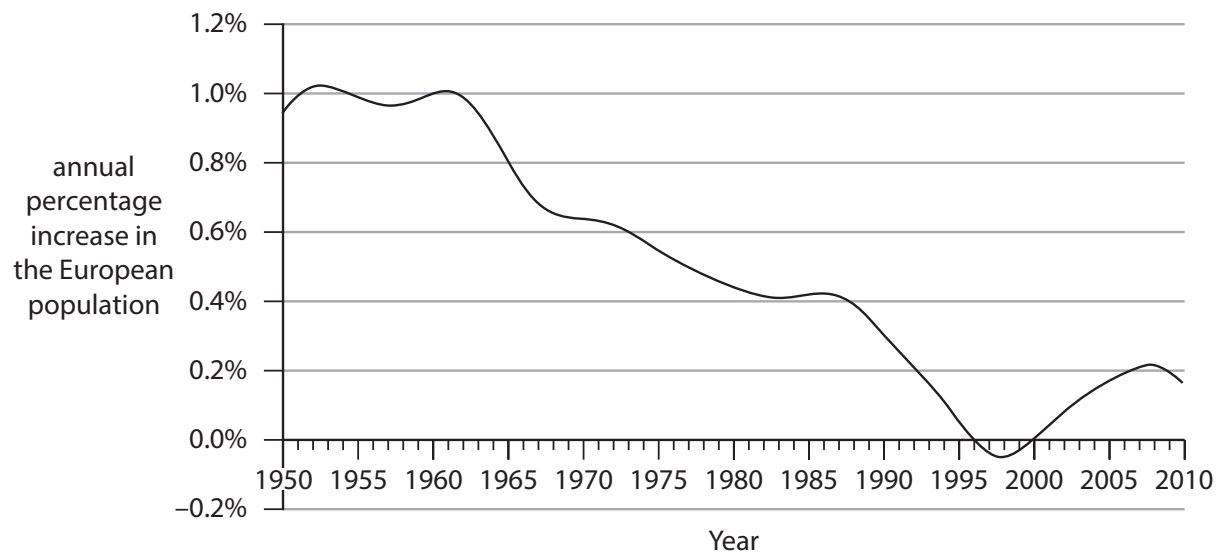
	mass in grams	
	at start of month	at end of month
leaves	1 600	400
snails	200	320

Figure 5

Explain why the change in mass of the leaves is not the same as the change in mass of the snails. (2)

(Total for Question 4 = 11 marks)

- 10 (a) Figure 14 shows the annual percentage increase in the European population from 1950 to 2010.



(Source: *UN World Population Prospects: The 2012 revision*)

Figure 14

State the number of years when there was no annual increase in the European population.

(1)

- (b) Fertilisers are used by farmers.

- (i) Give **one** advantage and **one** disadvantage of using fertilisers.

(2)

advantage

disadvantage

(ii) In an investigation, a farmer sprayed fertiliser onto three fields of the same size.

One field was sprayed with 1% fertiliser, one with 5% fertiliser and the third with 10% fertiliser.

Wheat was grown in all three fields.

Figure 15 shows the crop yield of wheat for each field.

percentage concentration of fertiliser (%)	yield of wheat in tonnes
1	3.12
5	3.75
10	3.62

Figure 15

Which is the percentage increase in the yield of wheat when 5% fertiliser was added compared with 1% fertiliser?

(1)

- ☐ A 4%
- ☐ B 17%
- ☐ C 20%
- ☐ D 83%

(iii) The farmer concluded that the 5% solution of fertiliser was the best concentration to use.

State **two** improvements to this investigation that the farmer should make to confirm this conclusion.

(2)

1

.....

2

.....

- (c) Using ladybirds to reduce the number of aphids in a greenhouse is an alternative to using pesticides.

Which is the name for this method?

(1)

- ☐ **A** distribution analysis
- ☐ **B** selective breeding
- ☐ **C** biological control
- ☐ **D** genetic engineering

- (d) Describe how tissue culture is used to produce genetically identical plants.

(4)

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(Total for Question 10 = 11 marks)

12-MARK QUESTIONS

1 question in this booklet



- 9 Figure 16 shows a photomicrograph of two stomata in a leaf.

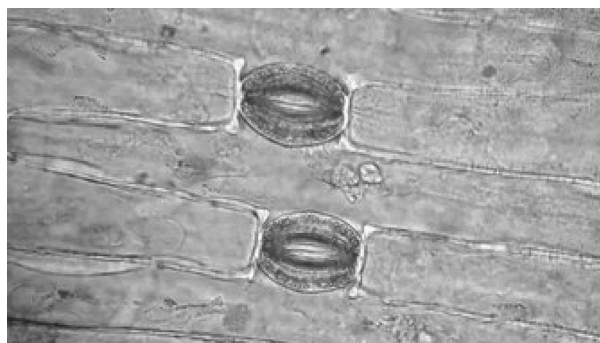


Figure 16

- (a) (i) The length of one guard cell in this image is 6 mm.

Convert the length of this guard cell into micrometres (μm).

(1)

- (ii) The image has been magnified 150 $\times$.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

..... mm

- (b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

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.....

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(6)

(Total for Question 9 = 12 marks)



13-MARK QUESTIONS

1 question in this booklet



- 9 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

These animals are released and after a period of time the population is sampled again.

This second sample includes some recaptured animals that have marks on them.

The population can be estimated using this equation

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

A scientist used this technique to determine the change in the population size of snails in a pond from March to July.

Figure 14 shows the results.

month	number marked in the first sample	size of the second sample	number of recaptured animals	population size
March	18	22	8	50
July	12	18	10	

Figure 14

- (i) Using data from Figure 14, calculate the difference in the population size from March to July.

(3)

Difference in the population size



(ii) State **two** factors the scientist should control when sampling the habitat in March and July.

(2)

1

2

(b) This pond is affected by eutrophication.

Explain **one** possible cause of eutrophication.

(2)

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*(c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

(Total for Question 9 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Mark
1 (a)(i)	D sludgeworm The only correct answer is D <i>A is not correct because fertiliser is not an indicator species</i> <i>B is not correct because lichen is an air pollution indicator</i> <i>C is not correct because stonefly are clean water indicators</i>	(1) AO1 1

Question Number	Answer	Additional Guidance	Mark
1 (a)(ii)	haemoglobin binds oxygen / increases the rate of diffusion / polluted water is low in oxygen	accept allows them to get more oxygen	(1) AO2 1

Question Number	Answer	Additional Guidance	Mark
1 (a)(iii)	Any two from: - concentration gradient (1) - diffusion distance (1) - surface area (1)	accept thickness of membrane accept temperature (1)	(2) AO1 1

Question Number	Answer	Additional Guidance	Mark
1 (b)	An explanation linking: - blackspot fungus present (1) - which indicates clean air / low sulfur dioxide (1)	accept high / good air quality	(2) AO3

(Total for question 1 = 6 marks)



Question number	Answer	Mark
1(a)(i)	B high pollution The only correct answer is B high pollution A is incorrect because bloodworms are not found in unpolluted water C is incorrect because there are only low levels of bloodworms in areas of some pollution D is incorrect because there are only low levels of bloodworms in areas of low pollution	(1)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	Stone fly (1) Freshwater shrimp (1) Accept phonetic misspellings	answers can be in either order	(2)

Question number	Answer	Additional guidance	Mark
1(b)	An explanation linking the following points: - increased levels of (aerobic) bacteria (1) - use oxygen from the water in respiration (1) OR - prevent plants from getting light/kills plants (1) - so no oxygen produced by photosynthesis (1)	accept microorganisms / bloodworms / sludgeworms / decomposers accept plants broken down by decomposers	(2)

Question number	Answer	Additional guidance	Mark
1(c)(i)	eutrophication / nitrification accept phonetic misspellings		(1)

Question number	Answer	Additional guidance	Mark
1(c)(ii)	water is moving (so the nitrates are moved away) (1)	accept the water in lakes is still/not moving	(1)

Total for question 1 = 7 marks



Question Number	Answer	Mark
1 (a)(i)	B non- indigenous species The only correct answer is B <i>A is not correct because the species is not native</i> <i>C is not correct the species is invasive not non-invasive</i> <i>D is not correct because pathogens are disease causing organisms</i>	(1) A01 1

Question Number	Answer	Additional guidance	Mark
1 (a)(ii)	An explanation linking: - competition between species (1) - for resources / named resources (1) OR - signal crayfish may carry {microorganisms / parasites} (1) - which causes disease in the indigenous population (1)	accept for food / habitat accept signal crayfish have a disease	(2) A02 1

Question Number	Answer	Mark
1 (a)(iii)	B conservation The only correct answer is B <i>A is not correct because mutation is a change in DNA</i> <i>C is not correct because predation is eating other animals</i> <i>D is not correct because mutualism is two organisms working together for mutual benefit</i>	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
1 (a)(iv)	An explanation linking three from: • eutrophication causes oxygen levels to decrease (1) • because nitrates levels in the water are increased (1) • causing an overgrowth of algae (1) • which blocks sunlight from the plants in the water (1) • plants in the water die and are decomposed (1) • by microorganisms for respiration (1)	ignore nitrogen accept plants on the surface for algae accept plants die because they can't photosynthesise accept decomposers for microorganisms	(3) AO2 1

(Total for question 1 = 7 marks)

Question number	Answer	Mark
1(a)(i)	$4.5 \div 1.5 = 3$ (times greater)	(1)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	oxygen concentration increases (then levels off)	accept correctly quoted data if linked to increase (then level off)	(1)

Question number	Answer	Mark
1(a)(iii)	The correct answer is C sludgeworm A is incorrect because freshwater shrimps are not found in polluted waters B is incorrect because lichen is an air quality indicator not water quality indicators D is incorrect because stonefly is not found in polluted waters	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iv)	An explanation linking the following: - there would be most biodiversity in the stream at {point D to E / E / furthest from the factory} (1) - as oxygen concentration is highest here (1) - so organisms can {survive / respire}(1)	accept before the factory in the stream accept {less pollution / waste} here	(3)

Question number	Answer	Additional guidance	Mark
1(b)	blackspot fungus will not grow where areas have high sulfur dioxide	accept sulfur	(1)

(Total marks for question 1 = 7 marks)

Question Number	Answer	Additional guidance	Mark
2(a)	Any one from: bacteria / fungi / decomposers / prokaryotes	accept microorganisms accept named decomposing organisms e.g. worms	(1) A01 1

Question Number	Answer	Additional guidance	Mark
2(b)	A description including two from: • (dissolved) in water (1) • diffusion through the root (1) • (so water moves) through the xylem (1) • by transpiration (stream) (1) • into leaves by diffusion (1)	accept active transport through the plant reject phloem accept evaporated from the leaves	(2) A02 1

Question Number	Answer	Additional guidance	Mark
2(c) (i)	An explanation linking: • as light intensity decreases the number of (small) plants (per m²) decreases (1) • because the (small) plants will not be able to photosynthesise enough (1)	accept reverse argument	(2) A03 1ab

Question Number	Answer	Additional guidance	Mark
2(c) (ii)	Any one from: • same time of day (1) • same meter (1) • same position(s) in area / measure the same size area (1) • same person makes the readings (1) • meter held vertically each time (1)	accept other valid variables that should be controlled	(1) A03 1ab

Question Number	Answer	Additional guidance	Mark
2(d)	A description including three from: • place a quadrat along a {rope / tape} measure (1) • tape measure to measure along the transect (1) • measure light intensity at different distances (from the wood) (1) • measure the stinging nettles {along the transect / at different light intensities} (1) • way of measuring growth of stinging nettles (in the quadrats) (1)	reject quadrant accept good descriptions of quadrats – e.g. ½ metre wire square accept use a light meter/lux meter accept named examples – e.g. {height / mass/ dry mass / number of leaves / number of plants}	(3) AO3 3a

(Total for question 2 = 9 marks)

Question Number	Answer	Mark
5 (a)(i)	D mutualism The only correct answer is D <i>A is not correct because it is not parasitism</i> <i>B is not correct because it is not indigenous</i> <i>C is not correct because it is not biodiversity</i>	(1) AO1

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	7500 (µm)	accept 7.5×10^3 reject 7.5×10^{-3}	(1) AO1 1

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	X – decomposers Y – nitrifying (bacteria)	accept fungi / decomposing bacteria accept named nitrifying bacteria reject denitrifying bacteria / nitrogen-fixing bacteria	(2) AO1 1

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation linking three from: - leguminous crops planted (1) - that have nitrogen-fixing bacteria (1) - in root (nodules) (1) - which fix nitrogen (gas) (1)	accept named leguminous crops accept use nitrogen from the air / use atmospheric nitrogen / make ammonia ignore produce nitrates	(3) AO1

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	An explanation linking: - nitrates are needed to make {protein / amino acids} (1) - which are needed for growth (1)	accept for DNA / genetic material	(2) AO1

(Total marks for question 5 = 9 marks)

Question number	Answer	Mark
3(a)(i)	native (species) / (species) from the country of origin	(1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	quadrat / stated size of square area	accept {belt / line} transect / a grid	(1)

Question number	Answer	Mark
3(b)(i)	increases / goes up / rises	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	The only correct answer is B species C A is incorrect because Species A is decreasing so will not out-compete C is incorrect because species D has only increased by 2 so will not out-compete B D is incorrect because species H is not present so will not out-compete species B		(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An explanation linking: - taller / bigger / had larger leaves / had larger roots (1) (got more) water / minerals / nutrients / light / photosynthesis (1)	ORA accept grows / reproduces / takes up more space / higher population accept named minerals accept disease / eaten by animals (1)	(2)

Question number	Answer	Mark
3(b)(iv)	(seeds) blown in by the wind / (seeds) brought in by animals / {roots / shoots} growing under the wall	(1)

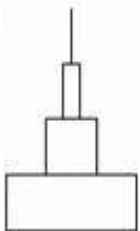
Question number	Answer	Additional guidance	Mark
3(c)	An explanation including two from: • through the root (hair cells) (1) • by osmosis (1) • across the {semi / partially} permeable membrane (1) • from a high water concentration to a low water concentration (1)	accept down a concentration gradient / from high water potential to low water potential	(2)

Total for Question 3 = 9 marks

Question number	Answer	Mark
7(a)	The only correct answer is B producer A is incorrect because a consumer eats other organisms C is incorrect because a predator hunts and kills other animals for food D is incorrect because prey are hunted by predators	(1)

Question number	Answer	Mark
7(b)(i)	seals will eat more penguins and squid	(1)

Question number	Answer	Mark
7(b)(ii)	An answer linking: - less competition for food (for penguins and squid)(1) - because fewer shrimps will be eaten by the cod / more shrimps available / more food available (1)	(2)

Question number	Answer	Mark
7(c)(i)	1 mark for pyramid shape and dimensions 1 mark for correct labels  seals cod shrimps phytoplankton	(2)

Question number	Answer	Additional guidance	Mark
7(c)(ii)	An explanation including two of the following: - the idea that seals have (to maintain) a constant body temperature (1) - there is more heat loss (1) - so more food / glucose is used (1) - not all of the cod can be eaten / digested (1)	accept seals are homeothermic / seals thermoregulate ignore energy accept reverse argument for phytoplankton to shrimps	(2)

Question number	Answer	Mark
7(d)	Any two of the following: - reduce the amount of fishing for cod / fishing quotas (1) - breed in captivity / release new cod / use fish farms (1) - only catch fish of a large size/ don't catch young fish / use larger holed nets (1) (do not fish) in protected zones / breeding grounds (1) - limit catches of shrimps (1) - cull seals (1)	(2)

(Total for question 7 = 10 marks)

Question number	Answer	Additional guidance	Mark
5(a)(i)	A plan including three from: • use a quadrat (1) • use a random number generator (to decide the areas to sample) / use random co-ordinates (1) • (use a key) to identify the plants (1) • count the number of plant species (1)	ignore belt transect accept square / grid ignore sample the number of plant species	(3) AO3 3a

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Any three from: • measure the temperature with a thermometer (1) • measure the light levels using a {lux / light} meter (1) • measure the levels of water in the soil using a water {meter / sensor / wet - dry mass of soil sample} (1) • rainfall using a {measuring cylinder / beaker} (1) • humidity using a humidity {meter / sensor} (1) • depth of the soil using a ruler (1) • wind {direction / strength} using {wind sock / wind meter} (1)	accept heat for temperature accept photometer / phone app / light sensor accept data logger accept datalogger accept hygrometer accept anemometer / weather vane / air flow meter	(3) AO1 2

Question number	Answer	Additional guidance	Mark
5(a)(iii)	A description including two from: - the tree is the host (1) - the mistletoe gains {nutrients / water} from the tree (1) - the tree is damaged by the mistletoe (1)	accept any indication of harm including killing the tree	(2) AO1 1

Question number	Answer	Additional guidance	Mark
5(b)	An explanation including: (fertilisers are used) to increase {growth / repair} of plants (1) (because nitrates are needed) to make proteins (1)	accept DNA / amino acids for proteins	(2) AO1 1

(Total for question 5 = 10 marks)



Question number	Answer	Additional guidance	Mark
7(a)(i)	Substitution $207 \div 2013$ (1) answer $\times 100$ (1) Evaluation 10%	Full marks for correct answer with no working award 2 marks for 10.28 / 10.3	(3)

Question number	Answer	Mark
7(a)(ii)	Any two from: - energy used keeping warm / thermoregulation (1) - respiration (1) - excretion (1) - not all the organism is eaten / digested (1) - movement (1)	(2)

Question number	Answer	Additional guidance	Mark
7(a)(iii)	An answer linking two from: - ladybirds eat aphids (1) - so aphids cannot damage the rose plants (1) - this is biological control (1)	accept prey on aphids accept roses remain healthy	(2)

Question number	Answer	Additional guidance	Mark
7(b)	A description including three from: • increased meat consumption (1) • increased animal farming (1) • environmental change / climate change (1) • pests / pathogens / disease (1) • biofuel production / growing crops for animals (1) • less land available for farming / building houses on land / deforestation (1) • drought / flood / famine / wild fires (1) • war / conflict (1)	accept overfishing / over farming of animals accept pollution / global warming accept solar farms / landfill accept increased food wastage (1)	(3)

Total for Question 7 = 10 marks



Question number	Answer	Additional guidance	Mark
4(a)(i)	Pyramid of biomass - pyramid shape with labels (1) - correct proportions: chipmunks must be {equal to/less than} 50% of the acorns, wild dogs must be {equal to/less than} 50% of chipmunks (1)	accept names in bars or triangle for this mp must be bars: reject triangle against this mp.	(2) AO 2 2

Question number	Answer	Mark
4(a)(ii)	An answer that combines two of the following points of application and understanding to provide a logical description: - few chipmunks are { eaten / killed } (due to the lack of predators) (1) - so the number of chipmunks (in France) will increase (1) - therefore more chipmunks can reproduce (1)	(2) AO 2 1

Question number	Answer	Additional guidance	Mark
4(a)(iii)	Substitution $9\,7500 \div 100 = 975$ (1) Evaluation $975 \times 9.5 = 9\,262.5$ (1) Nearest whole number 9 263 (kJ) OR 97500×0.095 (1) $= 9\,262.5$ (kJ) Nearest whole number 9 263 (kJ)	award full marks for correct answer with no working	(3) AO 1 2

Question number	Answer	Additional guidance	Mark
4(b)(i)	Substitution $27\,000 - 9\,500 = 17\,500$ (1) Evaluation $(17\,500 \div 9\,500) \times 100 = 184.2$ / 184 (%)	award full marks for correct answer with no working accept answer to any number of decimal places rounded correctly from: 184.2105263158	(2) AO 2 1

Question number	Answer	Mark
4(b)(ii)	An explanation including the following: • (the number chipmunks in the wild have increased) {so the ticks have more food /there are more ticks} (1) • so humans are more likely to be bitten (and contract Lyme disease) (1)	(2) AO 2 1

Total for Question 4 = 11 marks

Question number	Answer	Additional guidance	Mark
4(a)	7 (billion) (1) 0.91 (billion)	award full marks for answer without working accept 910 000 000 for 1 mark	(2)

Question number	Answer	Additional guidance	Mark
4(b)	A description including the following: • add Biuret (reagent / solution) (1) • colour change (from blue) to mauve / purple (1)	accept sodium hydroxide and copper sulfate	(2)

Question number	Answer	Additional guidance	Mark
4(c)	substitution (from graph) increase = $275 - 225 (= 50)$ (1) evaluation rate = $50 \div 10 = 5$	accept tolerance ± 2 for graph readings accept values of 4.6 to 5.4 award full marks for answer without working	(2)

Question number	Answer	Additional guidance	Mark
4(d)(i)	An explanation including two from: • there is less energy in the cattle than in the plants (1) • not all of the energy from the plants is passed on to the cattle (1) • (because) not all plant material is digested / eaten (1) • (and) some energy is used for respiration / movement / metabolism (1)	accept plants are eaten by cattle accept excretion	(2)

Question number	Indicative content	Additional guidance	Mark
4(d)(ii)	An explanation linking three of the following: • there will be less food for people to eat (1) • farming meat does not produce as much food (per acre as arable farming) (1) • so more land used for {meat farming / animal feed} (1) • means less {arable land / food (crops) grown for humans} (1)	accept a diet including a large amount of meat has health implications e.g. high cholesterol (1)	(3)

Question 4 = 11 marks

Question Number	Answer	Mark
8(a)	C urea into ammonia The only correct answer is C <i>A is incorrect because this is the role of nitrogen fixing bacteria</i> <i>B is incorrect because this is the role of denitrifying bacteria</i> <i>D is incorrect because decomposers produce ammonia not urea</i>	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
8(b)(i)	Any two from: • temperature (1) • water availability (1) • pH of soil (1) • area of leaves in contact with the soil (1) • {mineral ions / nitrates} in the soil (1) • oxygen concentration (1)	accept humidity accept light intensity (1)	(2) AO2 2

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	An explanation linking: - repeat the investigation / have more than one tray of each type of leaf (1) - obtain more data / to calculate a mean / identify anomalies (1) OR - a variable that can be controlled (1) linked to why this would improve the investigation and make the results more comparable (1)	accept so that the data is more reliable e.g. accept use the same mass for each type of leaf e.g. accept use the same {mass / type} of soil (1) e.g. accept as leaves can be different sizes (1) e.g. accept so that the number of decomposing organisms is the same (1) ignore references to valid / accurate / precise	(2) AO3 3b

Question Number	Answer	Mark
8(c)(i)	D ash leaves The only correct answer is D <i>A is incorrect because beech leaves decompose the slowest</i> <i>B is incorrect because oak leaves decay at a slower rate than ash leaves</i> <i>C is incorrect because sycamore leaves decay at a slower rate than ash leaves</i>	(1) AO3 1a

Question Number	Answer	Additional guidance	Mark
8(c) (ii)	selection (28.2 – 19.7 =) 8.5 (1) calculation (8.5 ÷ 40 =) 0.213 units grams per day (1)	accept 0.213 for two marks award one mark for 0.2125 accept g/day	(3) AO1 2

Question Number	Answer	Additional guidance	Mark
8(d)	An explanation linking: - increasing oxygen concentration increases the rate of decomposition (1) - because there is more respiration (1)	accept reverse argument	(2) AO2 1

(Total for question 8 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
4 (a)	Any one from: - so the leaves are the same age (1) - so the results can be compared (1) - to control a variable (1)	accept similar for same accept so the results are valid (1)	(1) AO2 2

Question Number	Answer	Mark
4 (b)(i)	B it is an anomalous result The only correct answer is B <i>A is not correct because it is measured in millimetres</i> <i>C is not correct because it is not a repeat</i> <i>D is not correct because it is not the mode</i>	(1) AO3 1a

Question Number	Answer	Additional Guidance	Mark
4 (b)(ii)	An answer linking: - the leaves in the {shade / area A} are wider (1) - to give a larger surface area / to absorb more light (1)	accept reverse argument	(2) AO3 2a+2b

Question Number	Answer	Additional Guidance	Mark
4 (c)(i)	nettles → caterpillars → ladybirds → beetles → toads (3)	If food chain is incorrect allow 1 mark for each correct link up to a maximum of 2 marks.	(3) A02 1

Question Number	Answer	Additional Guidance	Mark
4 (c)(ii)	substitution $60 \div 750 = 0.08$ (1) $\times 100$ 8 (%)	award full marks for the correct answer with no working	(2) A02 1

Question Number	Answer	Additional Guidance	Mark
4 (c)(iii)	Any two from: - not all the beetle is eaten (1) - not all the beetle can be digested (1) - movement (1) - respiration (1) (transferred to surroundings) as heat (1)	ignore maintaining body temperature	(2) A02 1

(Total for question 4 = 11 marks)

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	(the gardener thought) they were experts / it was a reliable source	accept the content has been checked / peer review	(1) AO2 1

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	An answer including: - to introduce microorganisms / decomposers (1) - to provide oxygen (1)	accept bacteria / worms for decomposers accept for respiration	(2) AO2 1

Question Number	Answer	Mark
7 (a)(iii)	B respiration occurred and this is an exothermic reaction The only correct answer is B <i>A is not correct because respiration is not endothermic</i> <i>C is not correct because it is not photosynthesis</i> <i>D is not correct because it is not photosynthesis</i>	(1) AO2 1

Question Number	Answer	Mark
7 (a)(iv)	D 0.13 kg per day The only correct answer is D <i>A is not correct because 8/60 is not 1.8</i> <i>B is not correct because 8/60 is not 0.66</i> <i>C is not correct because 8/60 is not 0.53</i>	(1) AO2 1

Question number	Indicative content	Mark
7 *(b)	AO1 / AO2 6 marks Auxins • used in selective weed killers • targets broad leaf plants • kills the weeds and not narrow leaf crops • rooting powder • added to the end of cuttings to stimulate the growth of roots Gibberellins • to stimulate germination in dormant seeds • initiate breakdown of starch • stimulate flower formation • promotes fruits formation • sprayed onto plants before pollination • stimulate development of seedless fruits Ethene • fruit ripening • unripe fruit is harvested • ethene is added so the fruits ripens for selling	(6) AO1 1 AO1 2

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - Presents an explanation with some structure and coherence.
Level 2	3-4	- Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed. - Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5-6	- Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- An identification of one commercial use of auxin, gibberellins or ethene in plants - The response links the use to the process involved or when it is used.
Level 2	3-4	- An identification of at least two commercial use of auxin, gibberellins or ethene in plants - The response links the use to the process involved or when it is used.
Level 3	5-6	- An identification of the commercial uses of auxin, gibberellins and ethene in plants - The response links the use to the process involved or when it is used.



Level	Marks	Possible responses
Level 1	1	auxins act as weedkillers/gibberellins are involved in fruit formation / ethene ripens fruit
	2	auxins act as weedkiller on broad leaf plants / gibberellins form seedless fruit which are nicer to eat / ethene ripens fruit so it can be transported unripened.
Level 2	3	auxins act as weedkillers and rooting powders /auxins act as weedkillers and gibberellins are involved in fruit formation / ethene causes fruit to ripen and auxins are in rooting powder.
	4	auxins act as weedkiller on broad leaf plants and gibberellins form seedless fruit which are nicer to eat / gibberellins form seedless fruit which are nicer to eat and ethene ripens fruit so it can be transported unripened.
Level 3	5	auxins act as weedkillers and gibberellins are involved in fruit formation and ethene ripens fruit / auxins act as rooting powders and gibberellins cause flower formation and ethene is involved in the ripening of fruits.
	6	auxins act as weedkiller on broad leaf plants and gibberellins form seedless fruit which are nicer to eat and ethene causes fruit to ripen which means they can be picked when not ripe and transported.

(Total for question 7 = 11 marks)

Question number	Answer	Additional guidance	Mark
6(a)(i)	subtraction $221 - 11$ or 210 (1) calculation $210 \div 11 \times 100$ (1) evaluation 1909 (%)	award full marks for the correct answer without workings accept ecf from incorrect subtraction or no subtraction accept 1909.1 accept answer to any number of decimal places correctly rounded accept 19.09 for 2 marks	(3)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	increased survival rate / hidden from predators / hidden from prey	accept camouflaged / increased chance of getting food	(1)

Question number	Answer	Additional guidance	Mark
6(a)(iii)	An explanation linking three from: - all genetically similar / there is less variation (1) - if there is a selection pressure (1) - they will {be susceptible / die} (due to the selection pressure) / no survival of the fittest (1) - fewer birds will be able to reproduce (1) - the species cannot evolve (1)	accept decreased gene pool / similar {DNA / genes / alleles} accept examples of selection pressure e.g. disease / change in the environment accept affected for susceptible accept it's less likely there will be adapted bitterns to survive accept fewer offspring are produced	(3)

Question number	Answer	Additional guidance	Mark
6(b)	An answer including two of the following: • breed animals who are {not genetically similar / genetically different} (1) • repeat the process over many generations (1)	animals with different characteristics accept this occurs over several generations accept prevent the animals inbreeding (1)	(2)

Question number	Answer	Additional guidance	Mark
6c	male Z Z female Z W ZW ZZ ZW ZZ ZW correct parental genotypes (1) correct offspring genotypes (1)	ecf for incorrect parental genotype if Z and W used. accept WZ	(2)

(Total for question 6 = 11 marks)

Question number	Answer	Additional guidance	Mark
4(a)	Any two from: • temperature (1) • humidity / water levels (1) • {size / volume / size of holes / material} of bag (1)	accept the bags need to be identical	(2)

Question number	Answer	Additional guidance	Mark
4(b)(i)	correct data selected and subtracted $200 - 120 = 80$ (1) rate calculated $80 \div 50 = 1.6$ (g per day)	accept correct answer on the answer line for 2 marks ecf accept 2.6 for 1 mark (oak)	(2)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer including: • both holly and oak leaves decrease in mass (1) • oak leaves decrease in mass faster (1)	ORA	(2)

Question number	Answer	Additional guidance	Mark
4(c)	An explanation linking: (decomposition of leaves) release minerals / named minerals (1) - which are absorbed / used by other organisms / plants / primary producers (1) OR (if they weren't decomposed) leaves would build up covering (small) plants (1) - small plants wouldn't {get light / be able to photosynthesise} (1)	accept nutrients for minerals accept recycling of minerals / nutrients for two marks accept (small) plants would die accept supplies energy to decomposers / named decomposers (1)	(2)

Question number	Answer	Additional guidance	Mark
4(d)	bacteria / fungi / detritivores	accept microorganisms / named {decomposers / detritivores}	(1)

Question number	Answer	Mark
4(e)	An explanation including two from: - the change in mass of snails is smaller than the change in mass of the leaves / {not all the mass / only 120 g} of the leaves is transferred to the snails (1) - some of the leaves were {not digested	(2)

	/ absorbed} / some of the leaves were {excreted / egested} (1) • some mass was used up in {respiration / providing energy} for the snail (1) • some mass / energy was used up by the snail moving (1) • leaf mass may be digested by decomposers (1)	
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(Total for question 4 = 11 marks)

Question number	Answer	Additional guidance	Mark
10(a)	four / 4		(1) A03 1a

Question number	Answer	Additional guidance	Mark
10(b)(i)	An answer including: one advantage from - increased crop yield (1) - increased profit (1) one disadvantage from - ingested by {herbivores/consumers} that feed on the plants (1) - pollute rivers / runs off into water (1) - fertilisers are expensive / can cost money (1) - increases the growth of weeds (1)	accept {increased / faster} growth / provides mineral ions for growth accept idea of bioaccumulation / enters the food chain / harmful to animals accept eutrophication / causes algal growth ignore damages the environment	(2) A02 1

Question number	Answer	Mark
10(b)(ii)	C 20% The only correct answer is C A, B and D as they are not the correct result of the calculation	(1) A02 1

Question number	Answer	Additional guidance	Mark
10(b)(iii)	An answering including two from: • use more concentrations of fertiliser between 1 % and 10 % (1) • use a control / do not apply fertiliser to one field (1) • repeat the test {at each concentration / at each percentage / on each field} (1) • controlling a variable e.g. all fields in the same location / crop density / crop variety / volume of fertiliser (1)	accept other ranges within 0-10% accept use smaller increments of fertiliser accept repeat the test over a larger area / more fields accept soil pH / watering / aspect of fields / idea of polytunnels accept idea of using the fertilisers in the same field ignore control the area / temperature / light intensity / greenhouse	(2) A03 3a

Question number	Answer	Mark
10(c)	C biological control The only correct answer is C A, B and D are not correct because they are not the name of the method	(1) A01 1

Question number	Answer	Additional guidance	Mark
10(d)	An answer linking: • {sample / cells / tissue} taken from the (parent) plant (1) • aseptic techniques used (1) • placed on (sterile/nutrient) growth medium (1) • hormones applied (so plantlets develop) (1)	accept take leaf discs / cuttings / meristems / explants accept aseptic technique being described accept agar / Petri dish accept the cells {differentiate / specialise} accept {roots / shoots / leaves / plantlets / callus} form	(4) AO2 1

Total for Question 10 = 11 marks

Question number	Answer	Mark
9(a)(i)	6000 μm 6×10^3 6.0×10^3 Reject 6×10^{-3}	(1)

Question number	Answer	Additional guidance	Mark
9(a)(ii)	$6 \div 150$ (1) 0.04 (mm) (1) 4.0×10^{-2} (mm)	accept 4×10^{-2} for full marks	(3)

Question number	Answer	Additional guidance	Mark
9(b)	A description linking the following: (denitrifying bacteria) convert nitrates (1) - back into (atmospheric) nitrogen (1)	accept nitrites	(2)

Question number	Indicative content	Mark
*9(c)	AO1 Biotic Plants • During photosynthesis plants take in carbon dioxide from the atmosphere • During respiration plants release carbon dioxide into the atmosphere • Plants store carbon compounds e.g. glucose • Carbon is transferred to animals when they are eaten Animals • Animals release carbon dioxide when they respire • Animals ingest carbon compounds e.g. glucose when they eat plants or animals Decomposers • Decomposers release carbon dioxide during respiration • Decomposers break things down Abiotic • Burning fossil fuels releases carbon dioxide or carbon (particulates) into the atmosphere • The oceans can absorb carbon dioxide • Carbon can be stored in carbonate rocks • Erosion of carbonate rocks releases carbon dioxide • Volcanoes releasing carbon dioxide	(6)

Level	Mark	Indicative content
	0	No rewardable material.
Level 1	1–2	• a simple description one way in which carbon is cycled • linked to a process involved
Level 2	3–4	• A detailed description of how carbon is cycled in the biotic or abiotic environment or a simple description of how carbon is cycled in each environment • Linked to two different processes involved
Level 3	5–6	• A detailed description of how carbon is cycled in the biotic and abiotic environment including the role of plants, animals and decomposers • Linked to the processes of respiration and photosynthesis and an abiotic process

(Total for question 9 = 12 marks)

Question Number	Answer	Additional Guidance	Mark
9(a)(i)	substitution $(12 \times 18 \div 10) = 21.6$ (1) whole organism (1) $= 21 / 22$ $(50 - 21 / 22) = 28 / 29$	award full marks for correct answer with no working e.c.f. from incorrect substitution using data from the table e.c.f. from incorrect whole organism award two marks for 28.4 or 27.9 or 22 or 21 without working	(3) AO2

Question Number	Answer	Mark
9(a)(ii)	Any two from: - sample at the (same) time of day (1) - sample for the (same) length of time (1) - use the (same) equipment / techniques (1) (same) time period between first and second sample (1) (same) marking process (1) - do not harm organisms when sampling (1)	(2) AO2

Question Number	Answer	Additional Guidance	Mark
9(b)	An explanation linking two from: - leaching / run off / fertilisers / dead organic matter (1) (causes) a build up of nitrates / nitrates in the water (1)	accept {sewage / mineral ions} accept phosphates ignore nutrients	(2) AO1

Question number	Indicative content	Mark
9 *(c)	AO1 6 marks Reforestation - reforestation is planting of trees - trees take up water from the soil - prevents erosion and reduces flooding - trees can be used for renewable resources - provides habitats - increases the rate of photosynthesis - removes carbon dioxide and releases oxygen - reduces greenhouse gases / global warming - provides a source of medicines / food for consumers Animal conservation - increase numbers of endangered species / prevent extinction - through controlled breeding programmes / reduction in poaching / maintaining habitats - generating income to fund conservation projects through zoos / animal parks / ecotourism - improves the number of animals / range of species - maintains the food web - maintains genetic diversity - allows re-introduction of animals into the wild	(6)



Level	Mark	Descriptor
	0	no rewardable material.
Level 1	1-2	- demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - presents an explanation with some structure and coherence.
Level 2	3-4	- demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed. - presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5-6	- demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - presents an explanation that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- A brief explanation of either the benefits of reforestation OR animal conservation projects. - The response refers to changes in atmospheric gases OR photosynthesis OR HOW animal conservation improves biodiversity
Level 2	3-4	- A brief explanation of the benefits of reforestation AND animal conservation projects - The response refers to changes a named atmospheric gas OR photosynthesis OR HOW animal conservation improves biodiversity
Level 3	5-6	- A detailed explanation on the benefits of reforestation and animal conservation projects - The response refers to changes in both named atmospheric gases AND HOW animal conservation improves biodiversity including why endangered species are preserved or the impact on food webs



Level	Marks	Possible responses
Level 1	1	Animal conservation protects endangered species / reforestation provides habitats for animals
	2	Reforestation is planting trees which take in carbon dioxide / reforestation provides habitats for animals and reduces greenhouse gases
Level 2	3	Animal conservation protects endangered species and reforestation provides habitats for animals / Animal conservation protects endangered species from hunting. Reforestation is the planting of trees which provides habitats for animals.
	4	Animal conservation protects endangered species so the numbers increase and reforestation is the planting of trees. The trees take in carbon dioxide and provide habitats for animals
Level 3	5	Animal conservation protects endangered species so the numbers increase by protecting them from hunting and maintaining habitats. Reforestation is the planting of trees. The trees take in carbon dioxide and provide habitats and food source for animals.
	6	Animal conservation protects endangered species so the numbers increase by protecting them from hunting and maintaining habitats. Reforestation is the planting of trees. The trees release oxygen and take in carbon dioxide. They also provide habitats and food source for animals.

(Total for question 9 = 13 marks)

