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EDEXCEL INTERNATIONAL GCSE BIOLOGY: QUESTIONS BY TOPIC

Ecology and the Environment (4)

International GCSE Biology Section 4

49 questions · 547 marks · Mark schemes included

Pearson Edexcel International GCSE (9–1) Biology 4BI1, Papers 1B, 1BR, 2B & 2BR, June 2019 - June 2025

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HOW TO USE THIS BOOKLET

Questions are grouped by specification sub-topic; within each sub-topic they run from the lowest mark tariff to the highest.

Click any sub-topic heading or question row below to jump straight to it.

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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4(b) FEEDING RELATIONSHIPS		20 questions · 216 marks	20
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4(d) HUMAN INFLUENCES ON THE ENVIRONMENT

13 questions · 173 marks

101

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QUESTIONS

49 questions · 547 marks · grouped by sub-topic



SUB-TOPIC 4(a)

THE ORGANISM IN THE ENVIRONMENT

6 questions in this sub-topic · 56 marks · lowest tariff first



2 Ecology is the study of organisms in their environment.

(a) (i) State what is meant by the term **population**.

(1)

(ii) State what is meant by the term **community**.

(1)

(iii) State what is meant by the term **ecosystem**.

(1)

(b) Which of these is an abiotic factor?

(1)

- ☐ A availability of mates
- ☐ B number of pathogens
- ☐ C number of predators
- ☐ D acidity of soil

(c) Which apparatus would be suitable for estimating the population size of a woodland plant?

(1)

- ☐ A potometer
- ☐ B quadrat
- ☐ C spotting tile
- ☐ D sweep net

(d) Describe how the biodiversity of a woodland differs from the biodiversity of a farmed field of wheat plants.

(2)

(Total for Question 2 = 7 marks)



- 7 The biodiversity in an ecosystem can be determined by counting the number of different species present and the number of individuals of each species present.

(a) Give the term that describes the number of individuals of one species present in a habitat at one time.

(1)

(b) Students compared the biodiversity of two fields, A and B.

They determined the number of individual plants of three species in each field.

They also calculated the percentage of each species of plant compared to the total number of plants of all three species for each field.

The table shows the results.

Species	Field A		Field B	
	Number of each plant	Percentage (%) of each species	Number of each plant	Percentage (%) of each species
daisy	19	76	15	
dandelion		16	18	38
buttercup		8	14	30
total	25	100	47	100

(i) Complete the table by calculating the missing values.

(2)

(ii) Explain which field has the greater biodiversity.

(2)

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(c) Explain how a shortage of one named mineral could affect the size of plants in the fields.

(2)

(Total for Question 7 = 7 marks)



6 A group of students compares the distribution of plant species in two fields using this method.

- use random sampling
- use a $0.5\text{ m} \times 0.5\text{ m}$ quadrat
- count the number of each species in a quadrat

Repeat this method for five quadrats in each field.

The tables show the students' results.

Species	Field A						
	Number of plants in each quadrat						Number of plants per m^2
	First	Second	Third	Fourth	Fifth	Mean	
dandelion	7	0	6	3	4	4	16
buttercup	2	1	0	3	2	2	6
violet	1	0	2	1	2	1	5
heather	2	3	1	2	1	2	7

Species	Field B						
	Number of plants in each quadrat						Number of plants per m^2
	First	Second	Third	Fourth	Fifth	Mean	
dandelion	7	3	2	1	2		
buttercup	0	0	0	0	0	0	0
violet	0	0	0	1	0	0	0
heather	0	0	0	0	0	0	0

(a) Describe how the students would obtain random samples from each field.

(2)

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(b) (i) Calculate the mean number of dandelions per quadrat in field B.

(1)

mean number = ...



(ii) Calculate the number of dandelions per m^2 in field B.

(1)

number of dandelions per m^2 = ...

(c) Describe the differences in species distribution in field A and field B.

(2)

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(d) A teacher suggests that there are no buttercups in field B because of poor water drainage from the field.

Describe what further experiment the students could do to investigate this suggestion.

(3)

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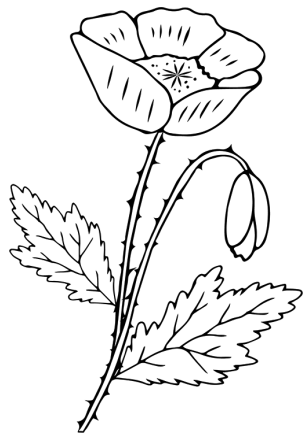
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(Total for Question 6 = 9 marks)



3 Scientists study the populations of plants in two fields, X and Y, in southern England.

They investigate the numbers of three different wildflower species, A, B and C, so that they can compare the biodiversity in each field.



(Source: © Dew_gdragon/Shutterstock)

Species A



(Source: © Patrick Guenette/Alamy Stock Vector)

Species B



(Source: © M_Morozova/Shutterstock)

Species C

The table shows the numbers of plants of each species per m² counted in each field.

Species	Number of plants per m ²							
	Field X				Field Y			
	Count 1	Count 2	Count 3	Mean	Count 1	Count 2	Count 3	Mean
A	19	22	25	22	0	0	0	0
B	5	3	13	7	21	26	22	
C	10	13	13	12	1	5	6	4

(a) (i) Calculate the mean number of plants of species B in Field Y.

(1)

mean number = ... per m²

- (ii) Describe how the scientists could determine the number of each plant species per m^2 in each field.

(3)

- (b) Discuss what the results show about the distribution of species in each field and the difference in biodiversity between the two fields.

(4)



(c) Name an abiotic factor that could affect the distribution of the plant species.

(1)

(Total for Question 3 = 9 marks)



- 4 (a) The table gives some examples of biological processes.

Complete the table by giving the name of each process.

The first one has been done for you.

(3)

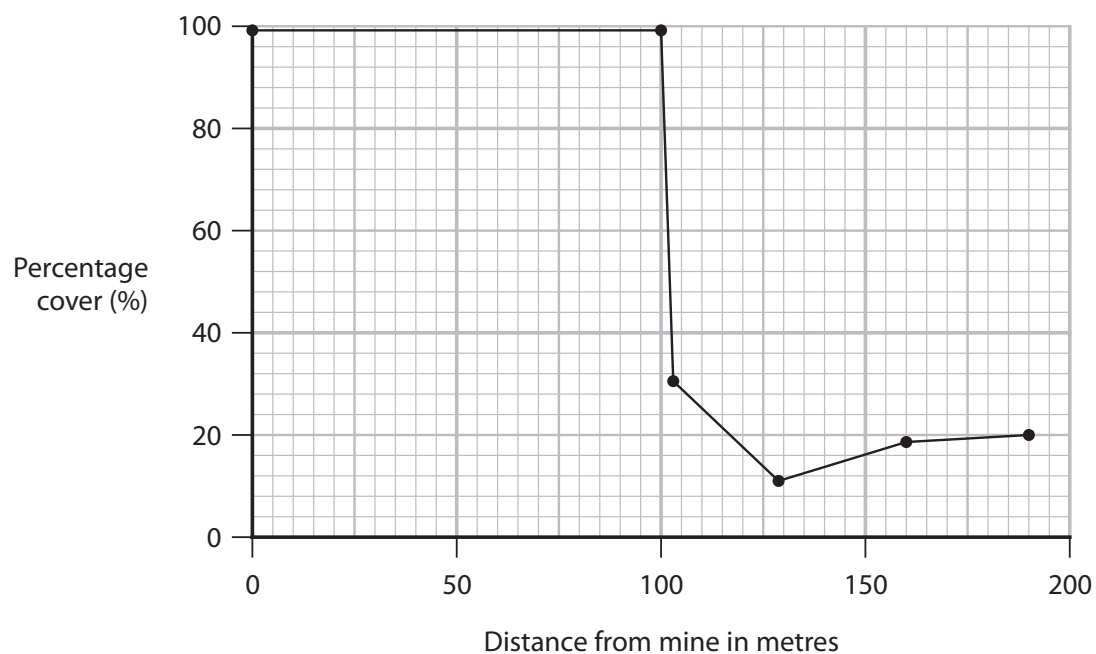
Example of process	Name of process
plants with a short growing season survive drought	natural selection
growth of algae in rivers polluted by fertiliser	
pollen transferred from one plant to another by an insect	
absorption of nitrate ions from soil using ATP	

- (b) Zinc is poisonous to many plants and can affect natural selection.

A scientist investigates the ability of one grass species to survive at different distances from a zinc mine.

The scientist uses a sampling method to measure the percentage cover of this grass species at different distances from the zinc mine.

The graph shows the scientist's results.



- (i) The zinc concentration in soil is higher near the zinc mine than it is further from the zinc mine.

Explain how natural selection could be responsible for the results shown in the graph between 0 and 100 metres.

(4)

- (ii) Describe a method the scientist could use to compare the population size of the grass species at 50 metres and 100 metres from the mine.

(4)

(Total for Question 4 = 11 marks)



4 A group of students investigate the biodiversity in two fields, A and B.

Field A is grazed by cattle and field B has no cattle.

(a) Explain what is meant by the term **biodiversity**.

(2)

(b) The students investigate the plant species in each field.

They counted the number of each species in five 0.5 m × 0.5 m quadrats.

They repeated this for each field.

Table 1 shows their results.

Species	Number of plants									
	quadrats in field A					quadrats in field B				
	1	2	3	4	5	1	2	3	4	5
ribwort plantain		5	20	15	15					
common tormentil	5				15					
meadow buttercup	4	6		10	5			20		
creeping buttercup	5	5								
yellow rattle	10	20	15	15	5					
common sorrel						20	5		10	
dandelion	1		4							
white clover	5		10	5				5	10	
stinging nettle						10				

Table 1

- (i) Describe how the quadrats should be placed to obtain unbiased species numbers for each field.

(2)

- (ii) For the most frequently occurring plant species in field B, calculate the number of plants in one square metre.

(3)

number of plants = ...

- (iii) Name the species with the greatest variation in number of plants recorded in quadrats for field B.

(1)



Table 1 is repeated here.

Species	Number of plants									
	quadrats in field A					quadrats in field B				
	1	2	3	4	5	1	2	3	4	5
ribwort plantain		5	20	15	15					
common tormentil	5				15					
meadow buttercup	4	6		10	5			20		
creeping buttercup	5	5								
yellow rattle	10	20	15	15	5					
common sorrel						20	5		10	
dandelion	1		4							
white clover	5		10	5				5	10	
stinging nettle						10				

Table 1

(iv) The students conclude that grazing affects the species in field A.

Using information in Table 1 and your own knowledge, discuss the students' conclusion.

(5)

(Total for Question 4 = 13 marks)



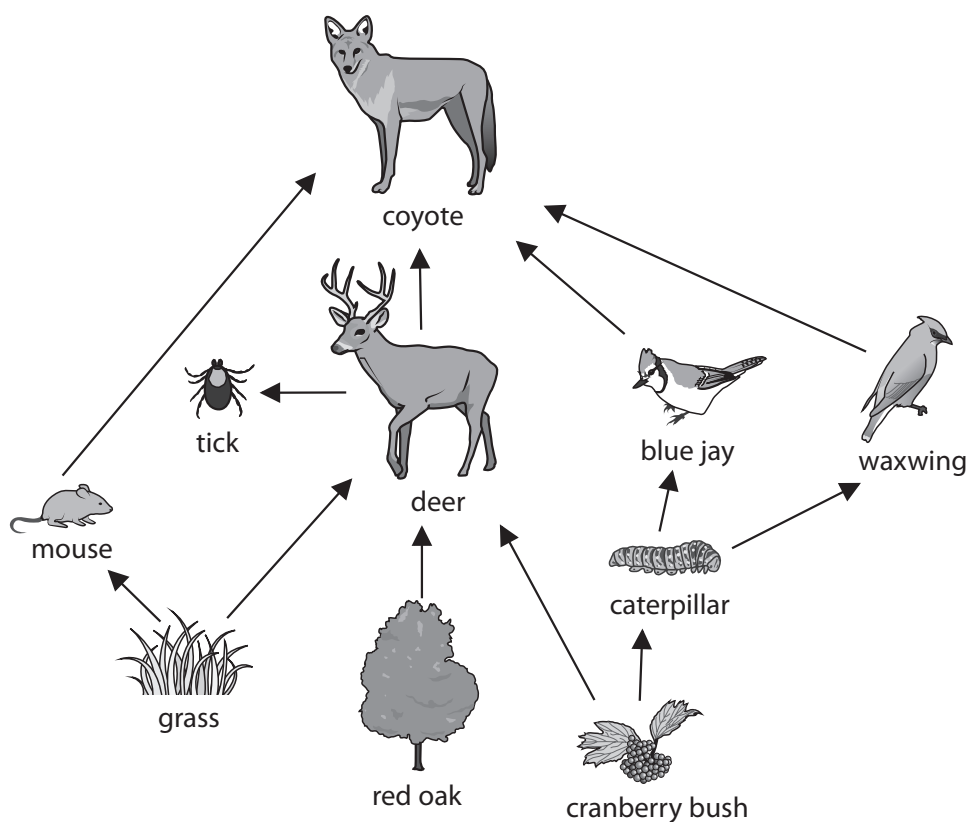
SUB-TOPIC 4(b)

FEEDING RELATIONSHIPS

20 questions in this sub-topic · 216 marks · lowest tariff first



1 The diagram shows a forest food web.



(a) (i) How many producers are shown in this food web?

(1)

- ☒ A one
- ☒ B three
- ☒ C four
- ☒ D nine

(ii) How many secondary consumers are shown in this food web?

(1)

- ☒ A one
- ☒ B three
- ☒ C four
- ☒ D seven

(b) The coyote uses some of its senses to catch deer.

(i) Name the sense that uses receptor cells in the retina.

(1)

(ii) A coyote runs 530 metres in 30.0 seconds trying to catch a deer.

Calculate the speed of this coyote in metres per second.

(2)

speed = ... m/s

(c) The coyote will not catch the deer if too much lactic acid builds up in its muscles.

Explain why lactic acid builds up in the coyote's muscles when it runs.

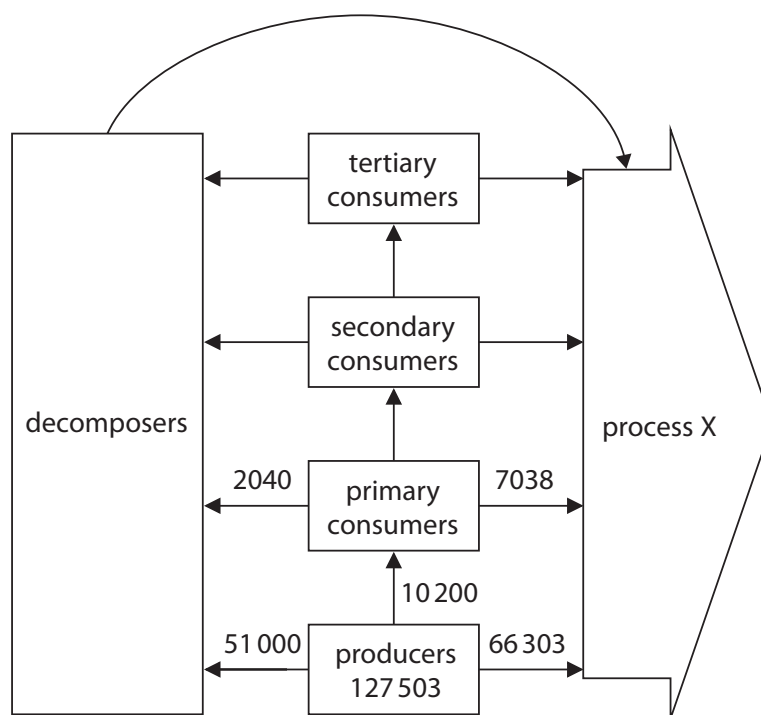
(2)

(Total for Question 1 = 7 marks)



6 The diagram shows some energy transfers along a food chain.

The numbers give the energy transfers in kJ per m² per year.



(a) Give the name of process X.

(1)

(b) Determine the energy transferred from the primary consumers to the secondary consumers.

(1)

energy transferred = ... kJ per m² per year

(c) Decomposers can be described as saprotrophs.

(i) Describe how saprotrophs cause decomposition.

(2)

(ii) Forty per cent of the energy in the producers transfers to decomposers.

Only twenty per cent of the energy in the primary consumers transfers to decomposers.

Explain this difference in energy transfer.

(3)

(Total for Question 6 = 7 marks)



- 6 Pyramids of biomass and energy transfer are ways of representing what happens in an ecosystem.

- (a) Diagram 1 shows pyramids of biomass for a crop field ecosystem and for a coral reef ecosystem.

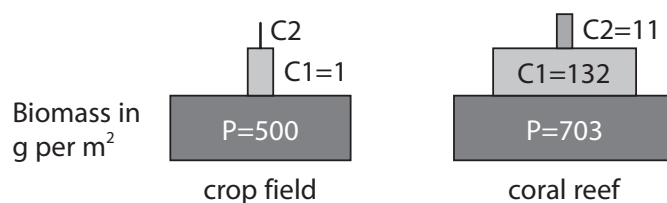


Diagram 1

- (i) Use data from Diagram 1 to calculate the efficiency of the transfer of biomass from producers (P) to primary consumers (C1) in the coral reef.

(1)

producer to primary consumer = ... %

- (ii) The efficiency of the transfer of biomass from primary consumers (C1) to secondary consumers (C2) in the crop field is 1%.

Calculate the biomass of the secondary consumers in the crop field in g per m².

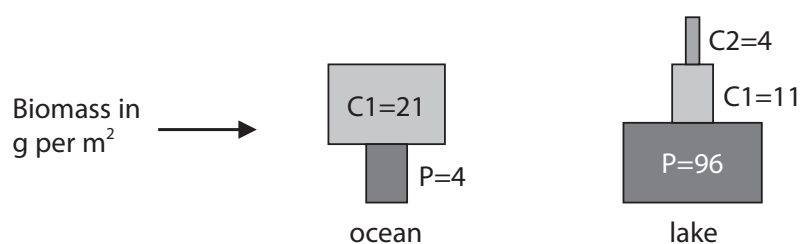
(1)

biomass = ... g per m²

(iii) Suggest why the biomass transfer is different in the coral reef compared to the crop field.

(1)

(b) Diagram 2 shows pyramids of biomass for an ocean and a lake.



Explain the shape of the pyramid of biomass for the ocean.

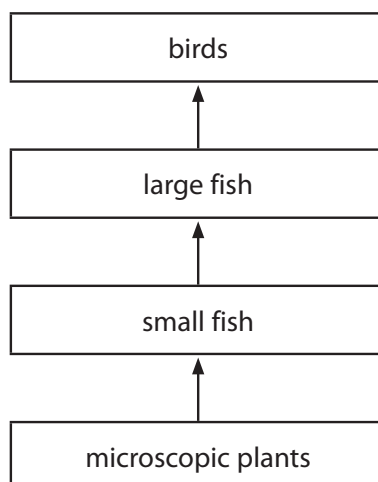
(2)

(c) Suggest how scientists could estimate the energy of the producers in 1 m² of the crop field.

(2)

(Total for Question 6 = 7 marks)

2 The diagram shows a food chain from a lake.



(a) Name the primary consumer in this food chain.

(1)

(b) The microscopic plants convert light energy into chemical energy.

(i) Describe the process that converts light energy into chemical energy.

(3)

(ii) Give two reasons why some of the energy in the microscopic plants is not transferred to the small fish.

(2)

1

2

(c) The birds do not have teeth.

The fish they eat is initially crushed in part of their digestive system called a gizzard.

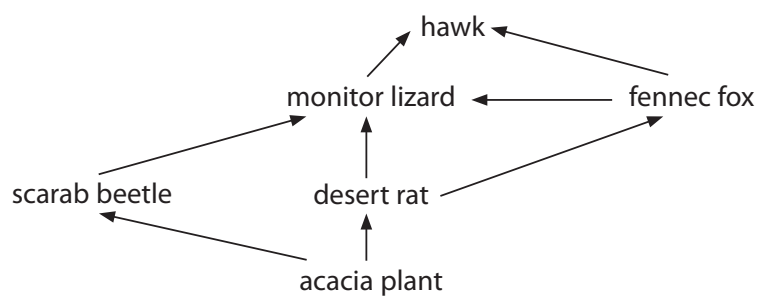
Suggest why crushing the fish in the gizzard helps the birds to digest the fish.

(2)

(Total for Question 2 = 8 marks)



1 The diagram shows part of a food web for a desert community.



(a) (i) How many organisms in this food web are secondary consumers?

(1)

- ☐ A 2
- ☐ B 3
- ☐ C 4
- ☐ D 5

(ii) Draw the longest food chain in this food web.

(1)

(iii) Explain why most of the energy in the producers is **not** transferred to the hawk.

(3)

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(b) The photograph shows a fennec fox.



(Source: anolis01.123rf.com/PAL)

Fennec foxes live in the Sahara Desert, which is very hot. They have very large ears and a thin body.

Explain how the body shape of the fennec fox has evolved by natural selection.

(4)

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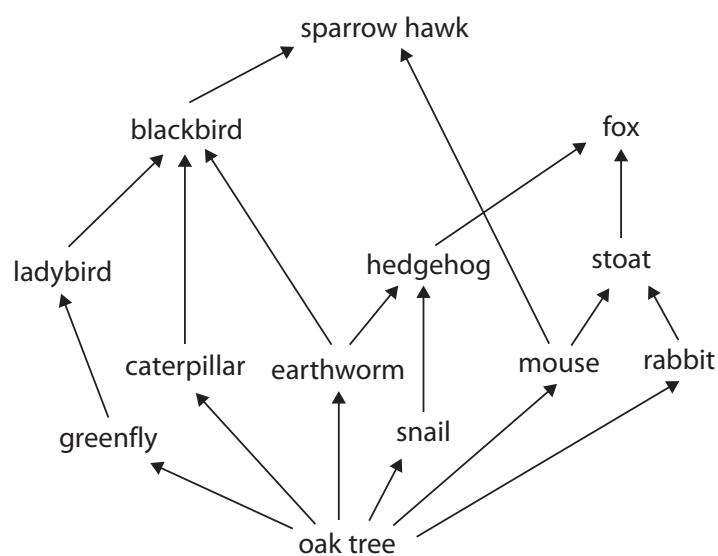
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(Total for Question 1 = 9 marks)

1 This food web comes from a woodland ecosystem.



(a) (i) Which organism is the producer?

(1)

- ☐ A caterpillar
- ☐ B earthworm
- ☐ C oak tree
- ☐ D stoat

(ii) Which organism is a secondary consumer?

(1)

- ☐ A caterpillar
- ☐ B earthworm
- ☐ C fox
- ☐ D ladybird

(iii) Which organism is both a secondary and a tertiary consumer?

(1)

- ☐ **A** blackbird
- ☐ **B** earthworm
- ☐ **C** fox
- ☐ **D** stoat

(b) A farmer is using a pesticide in fields next to the woodland.

The pesticide is reducing the numbers of greenfly and caterpillars in the woodland.

(i) Explain what effect this may have on the blackbirds in the woodland.

(3)

(ii) Describe a different method the farmer could use to reduce the number of greenfly on his crops.

(3)

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(Total for Question 1 = 9 marks)

6 A student studies the organisms in a pond community.

(a) Which of these is the correct description of a community?

(1)

- ☐ A the living organisms together with their non-living environment
- ☐ B the area where organisms live
- ☐ C the organisms of all species in a habitat
- ☐ D the organisms of one species in a habitat

(b) The table shows the number of organisms per m² at different trophic levels in a pond community.

It also shows the total biomass of these organisms per m².

Trophic level	Number of individuals per m ²	Total biomass in g per m ²
secondary consumers	100	1.0
primary consumers	1.5×10^4	2.5
producers	7.2×10^{10}	17.5

(i) Calculate the mean mass in g of a single primary consumer.

Give your answer in standard form.

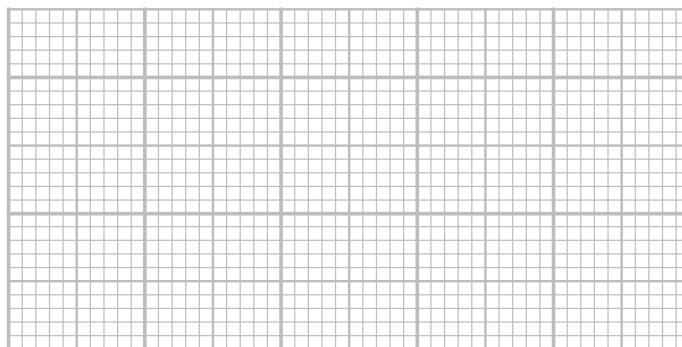
(3)

mean mass = ... g



(ii) Use the grid to draw a pyramid of biomass for the pond community.

(2)



(c) The number of secondary consumers is low because energy transfer is not 100% efficient.

(i) Explain why egestion is one reason why energy transfer is not 100% efficient.

(2)

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(ii) Give two other reasons why energy transfer is not 100% efficient.

(2)

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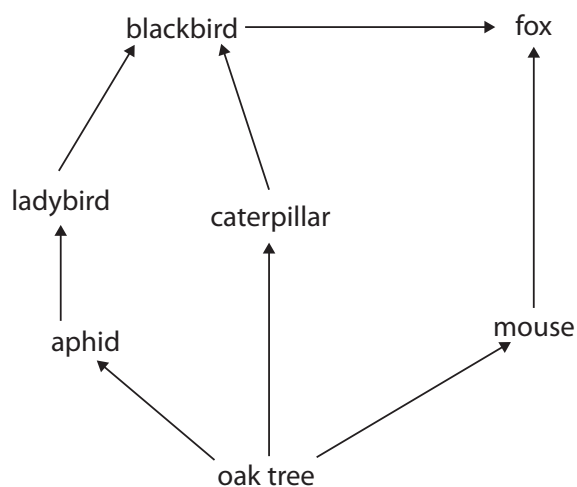
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(Total for Question 6 = 10 marks)

3 The diagram shows part of a woodland food web.



(a) (i) Which organism is a primary consumer in this food web?

(1)

- ☐ A aphid
- ☐ B blackbird
- ☐ C fox
- ☐ D oak tree

(ii) Which of these describes the woodland community?

(1)

- ☐ A all the abiotic and biotic factors in the area
- ☐ B all the blackbirds in the area
- ☐ C all the different species and the habitat
- ☐ D all the different species in the area

(b) This is one food chain from the food web.

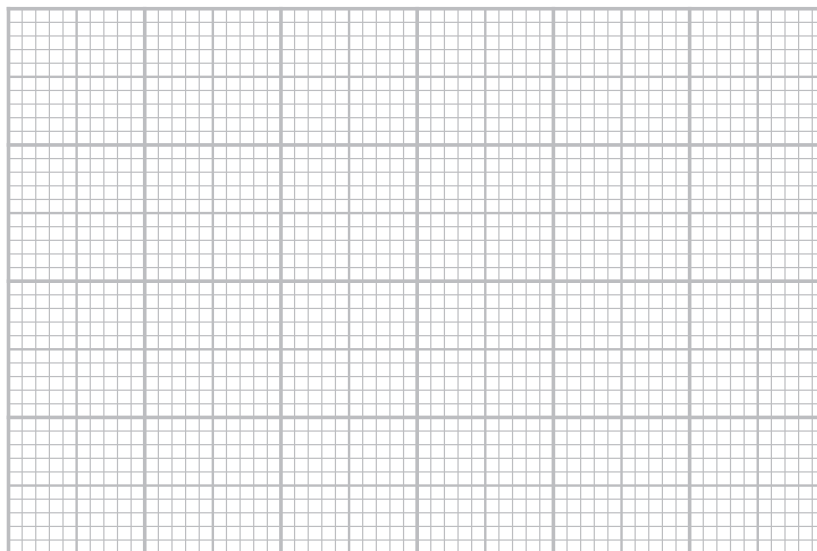
oak tree → mouse → fox

- (i) A student counted 20 mice living around 4 oak trees. There were also 2 foxes in the area.

Draw a labelled pyramid of numbers for this food chain on the grid.

Your pyramid should be drawn to scale.

(3)



- (ii) Photosynthesis results in 25 000 kJ of energy being transferred to the biomass of the oak trees each year.

Only 8% of this energy is transferred to the biomass of the 20 mice each year.

Calculate the mean amount of energy transferred to the biomass of one mouse each year.

(2)

mean amount of energy = ... kJ



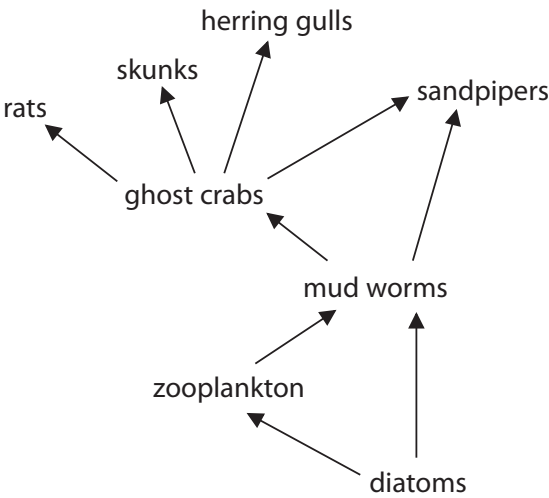
(iii) Explain why only 8% of the energy stored in the biomass of the oak trees is used by the mice for growth.

(3)

(Total for Question 3 = 10 marks)



3 The diagram shows a food web.



- (a) Use information from the food web to complete the table.
- The first one has been done for you.

(3)

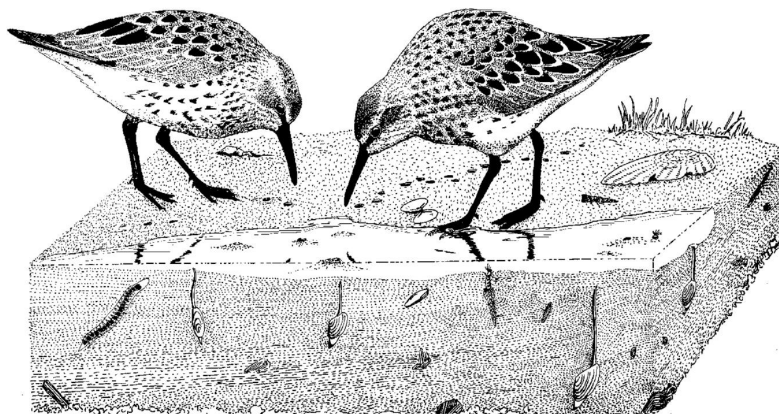
number of organisms	8
number of producers	
number of primary consumers	
number of food chains	

- (b) Explain why the energy in the mud worms is not all transferred to the organisms that eat them.

(4)

(c) The diagram shows sandpipers feeding.

Sandpipers have long beaks so that they can dig for worms in the mud.



(Source: © Birchside www.fotosearch.com)

Explain how sandpipers evolved to have long beaks.

(4)

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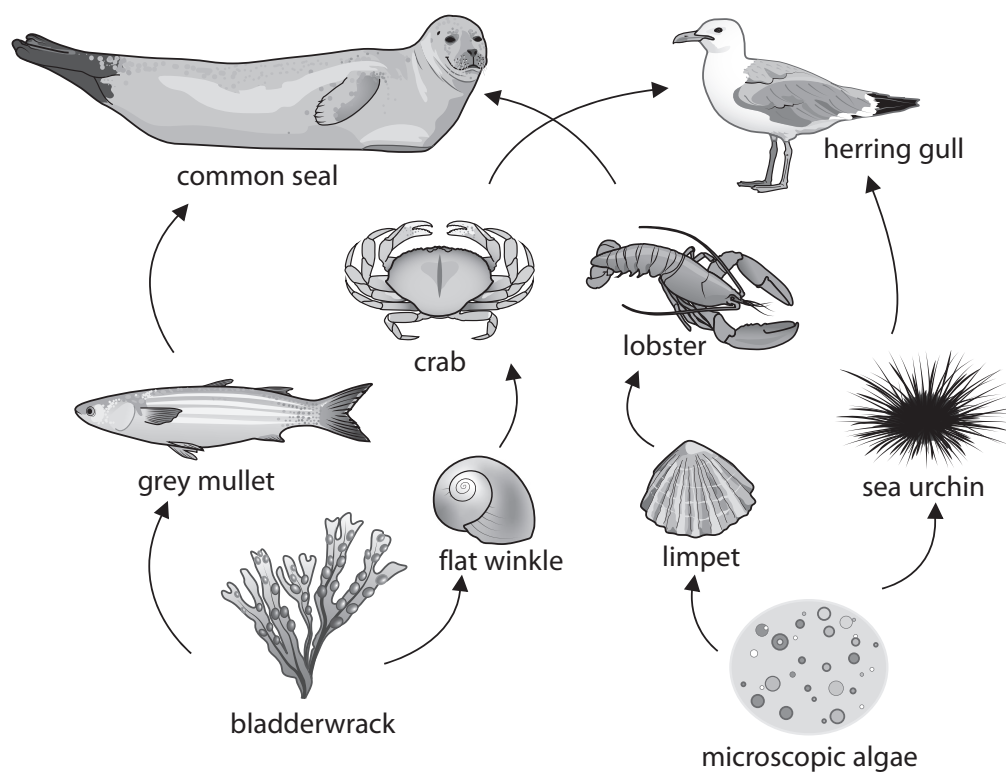
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(Total for Question 3 = 11 marks)

9 The diagram shows an ocean food web.



(a) (i) Name the producers in this food web.

(2)

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(ii) Name two secondary consumers in this food web.

(2)

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(iii) Draw a food chain from this food web that contains four organisms and includes the herring gull.

(2)

(b) (i) This food chain is found in the food web.

microscopic algae → limpet → lobster → common seal

Sketch and label the pyramid of energy for this food chain.

(2)

(ii) Explain why the amount of energy available to the organisms changes along this food chain.

(3)

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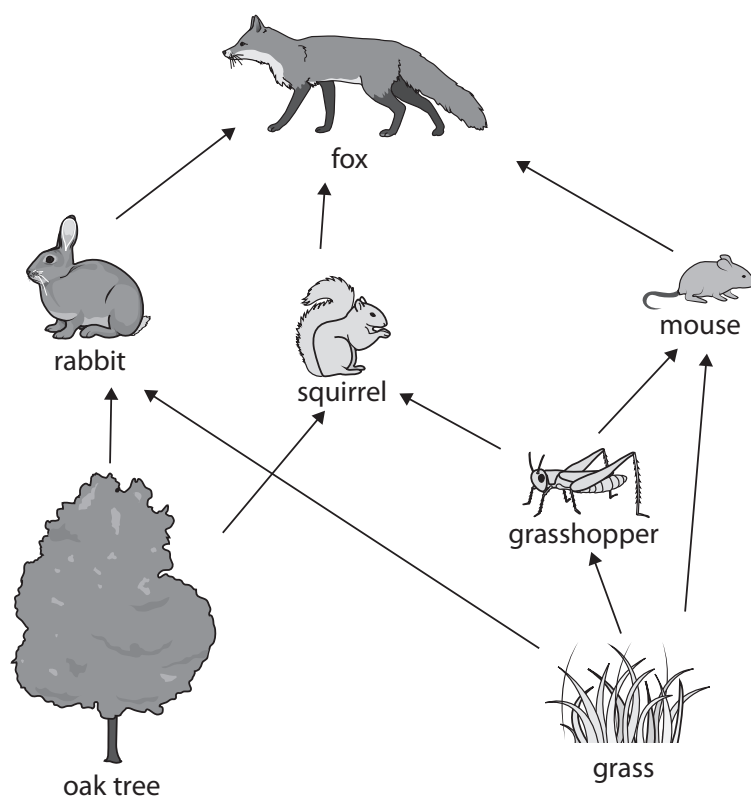
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(Total for Question 9 = 11 marks)



3 The diagram shows a forest food web.



(a) (i) How many secondary consumers are there in this food web?

(1)

- ☐ A 1
- ☐ B 2
- ☐ C 3
- ☐ D 4

(ii) Which term describes all the organisms in the food web together with their environment?

(1)

- ☐ A community
- ☐ B ecosystem
- ☐ C habitat
- ☐ D population

(iii) The fox receives 1% of the energy present in the oak tree.

The fox receives 0.04% of the energy present in the grass.

Explain why a higher proportion of the energy reaches the fox from the oak tree than reaches the fox from the grass.

(3)



(b) A student uses this method to estimate the total area of the woodland floor that is covered by grass.

- randomly place a 0.25 m^2 quadrat in one location of the woodland
- estimate the percentage of the quadrat that is covered by grass
- repeat at one other location
- calculate the mean percentage covered by grass for both quadrats
- measure the total area of the woodland floor
- calculate the total area of the woodland covered by grass.

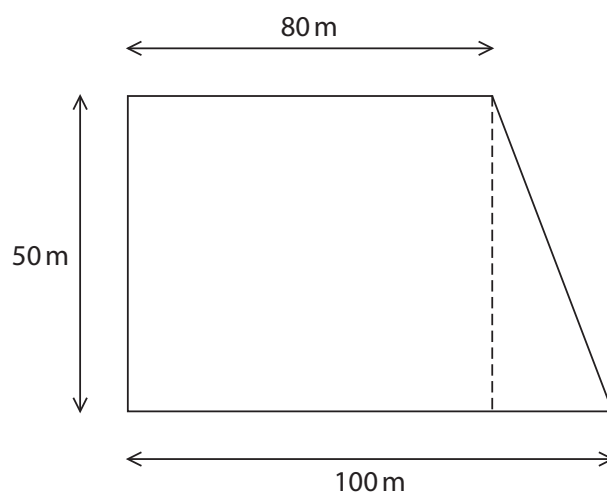
(i) State why the student placed the quadrats randomly at each location.

(1)

(ii) Explain how the student could improve their method, to obtain a more reliable estimate of the total area of woodland covered by grass.

(2)

(iii) The diagram shows the dimensions of the woodland.



The student finds the mean percentage of the two quadrats covered by grass is 65%.

Use this value to calculate the total area of the woodland floor covered by grass.

(3)

total area covered by grass = ...m²

(Total for Question 3 = 11 marks)

8 Ecology is the study of organisms and their environment.

(a) (i) State what is meant by the term **ecosystem**.

(1)

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(ii) State what is meant by the term **community**.

(1)

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(iii) State what is meant by the term **population**.

(1)

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(b) Complete the passage about feeding relationships by writing a suitable word or words in each blank space.

(8)

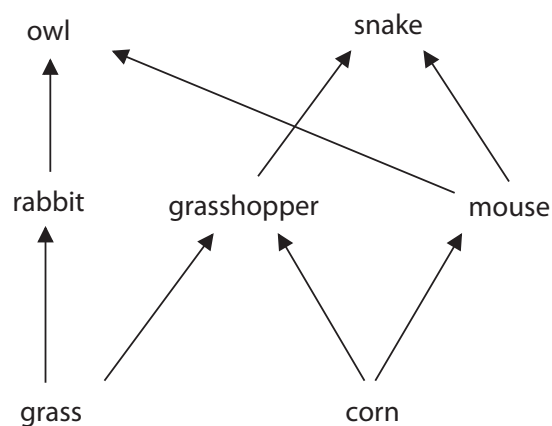
Food chains show the flow of energy through an ecosystem from one organism to the next. The arrows in a food chain show the of energy flow. The first organism in a food chain is a The position that an organism has in a food chain is known as its level.

Not all the energy from one level reaches organisms in the next level. Some of the energy is released as energy during or movement. Some of the energy remains in undigested food which is released as Some of the energy is released in metabolic waste which is excreted as Some of the energy remains in the dead organism until the organism is broken down by decomposers such as and fungi.

(Total for Question 8 = 11 marks)



1 The diagram shows a food web.



(a) Which of these organisms is a secondary consumer in this food web?

(1)

- ☐ A corn
- ☐ B grasshopper
- ☐ C mouse
- ☐ D owl

(b) Explain why the grass in this food web contains energy.

(2)

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(c) Explain why a large percentage of the energy in rabbits is not available for growth in owls. (3)

(d) The corn becomes infected by a fungus.

(i) Explain how this fungus feeds on the corn. (3)

(ii) Which of these organisms will be hunted more often by predators when the corn is infected by a fungus? (1)

- ☐ A grass
- ☐ B owl
- ☐ C rabbit
- ☐ D snake



(e) The snake does not chew the mice it eats.

It swallows each mouse whole.

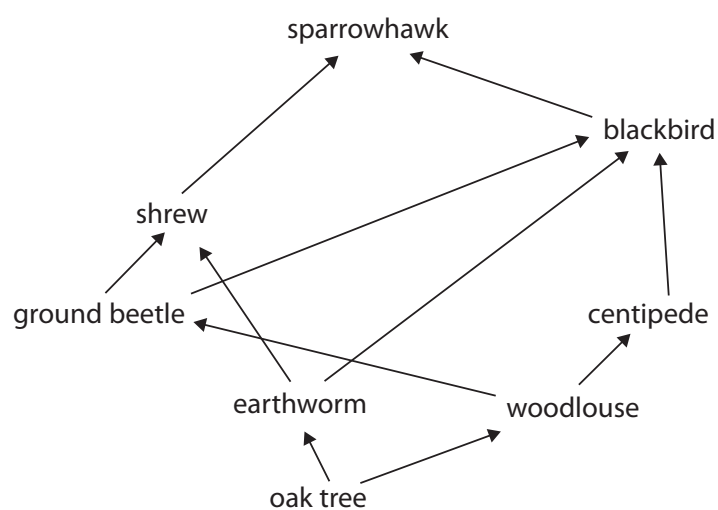
Explain how this method of feeding affects the time taken for the snake to digest a mouse.

(2)

(Total for Question 1 = 12 marks)



7 The diagram shows a food web from a woodland ecosystem.



(a) (i) Which organism in the food web is the producer?

(1)

- ☐ A blackbird
- ☐ B centipede
- ☐ C earthworm
- ☐ D oak tree

(ii) Which organism acts as both a secondary consumer and a tertiary consumer in the food web?

(1)

- ☐ A blackbird
- ☐ B earthworm
- ☐ C ground beetle
- ☐ D sparrowhawk

(b) The amount of energy transferred changes as you move along a food chain.

The data comes from an ecosystem containing producers, primary consumers and secondary consumers.

Level	Energy in each level in kJ per m ² per year
producers	8.7×10^5
primary consumers	1.4×10^4
secondary consumers	1.6×10^3

(i) The light energy reaching the producers is 7.1×10^6 kJ per m² per year.

Explain why the plants cannot absorb all of this energy.

(2)

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(ii) The table shows that energy is transferred between producer and primary consumer and between primary consumer and secondary consumer.

A student states that the energy transfer between producer and primary consumer is the most efficient.

Determine whether the student's statement is correct.

(2)

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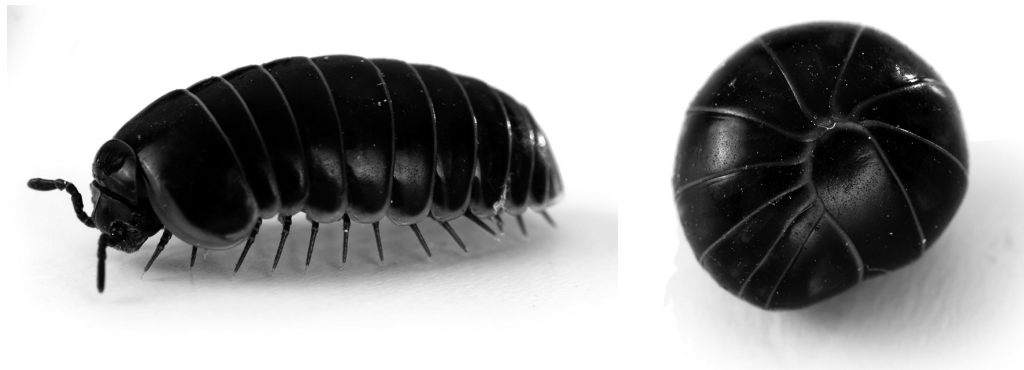
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- (c) Woodlice feed on dead and decaying plant material in the soil.
The photographs show how a woodlouse can curl up into a ball.

This behaviour is an example of a reflex response.



(Source: © StellaNature Alamy Stock Photo)

- (i) State what is meant by a reflex response.

(1)

- (ii) Give a reason why this reflex response benefits the woodlouse.

(1)

(iii) Describe how this reflex response could have evolved by natural selection.

(4)

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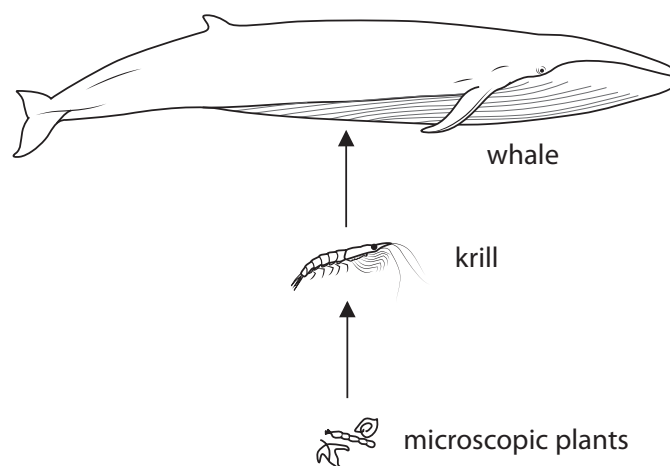
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(Total for Question 7 = 12 marks)



4 The diagram shows a food chain in the Antarctic ocean.



(a) (i) Which term describes the trophic level of the krill?

(1)

- ☒ A predator
- ☒ B prey
- ☒ C primary consumer
- ☒ D secondary consumer

(ii) Draw a labelled pyramid of biomass to represent this food chain.

(2)

- (b) The microscopic plants float in seawater, but also grow on the lower surface of ice.

The krill feed on the microscopic plants.

They remove microscopic plants from the lower surface of the ice at a rate of 1.6 cm^2 per second.

Calculate the time taken for the krill to remove microscopic plants from one square metre of ice.

Give your answer in minutes.

(2)

time taken = ... minutes

- (c) A student investigates the rate that krill feeding removes microscopic plants floating in seawater.

Suggest how the student could do this investigation in a laboratory.

(4)

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(d) Krill obtain most of their food from microscopic plants growing on the lower surface of ice.

Explain how global warming could affect the whale population in the Antarctic ocean.

(4)

(Total for Question 4 = 13 marks)



- 4 The plants in a woodland are eaten by mice and caterpillars.

The mice also eat the caterpillars.

The mice are eaten by birds called owls.

- (a) Draw a food web showing these feeding relationships.

(2)

- (b) Give the term that describes the trophic level of a caterpillar.

(1)

- (c) The woodland covered a total area of 5 km².

A scientist investigates the number of mice and owls in the woodland.

He counts the number of mice and owls on the same summer day each year for five years.

The table shows the scientist's results.

Year	Number of mice per km ²	Number of owls in entire woodland
1	2×10^3	10
2	2×10^3	12
3	3×10^3	12
4	5×10^3	16
5	1×10^3	14



(i) Calculate the number of mice in the total area of woodland in year 3.

(2)

number of mice = ...

(ii) Suggest why there were more mice in year 4 than in the other years.

(3)

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(iii) Suggest why the number of owls was fairly constant each year.

(2)

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(iv) Suggest a method you would use to estimate the number of mice in the woodland. (3)

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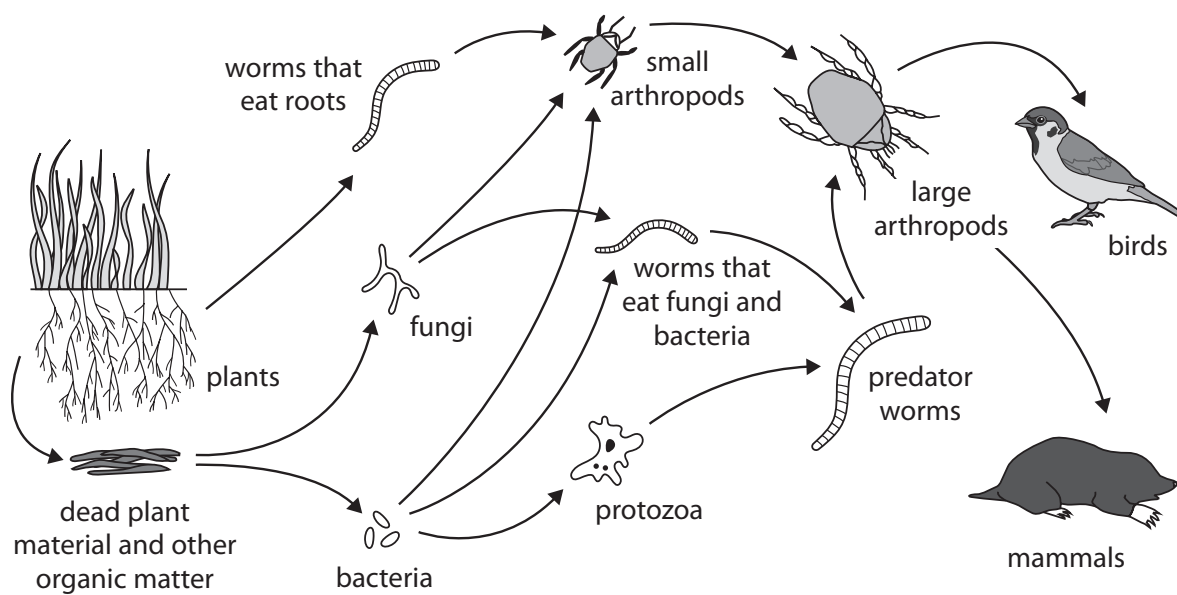
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(Total for Question 4 = 13 marks)

2 The diagram shows part of a food web from an ecosystem.



- (a) (i) Using the information in the food web, draw a food chain that contains five trophic levels and includes the birds.

(2)

(ii) Describe how the bacteria and fungi obtain energy from the organic matter.

(3)

(b) A pesticide gets into this ecosystem.

The pesticide kills small and large arthropods.

Explain how this affects the population of birds and the population of worms that eat roots.

(3)



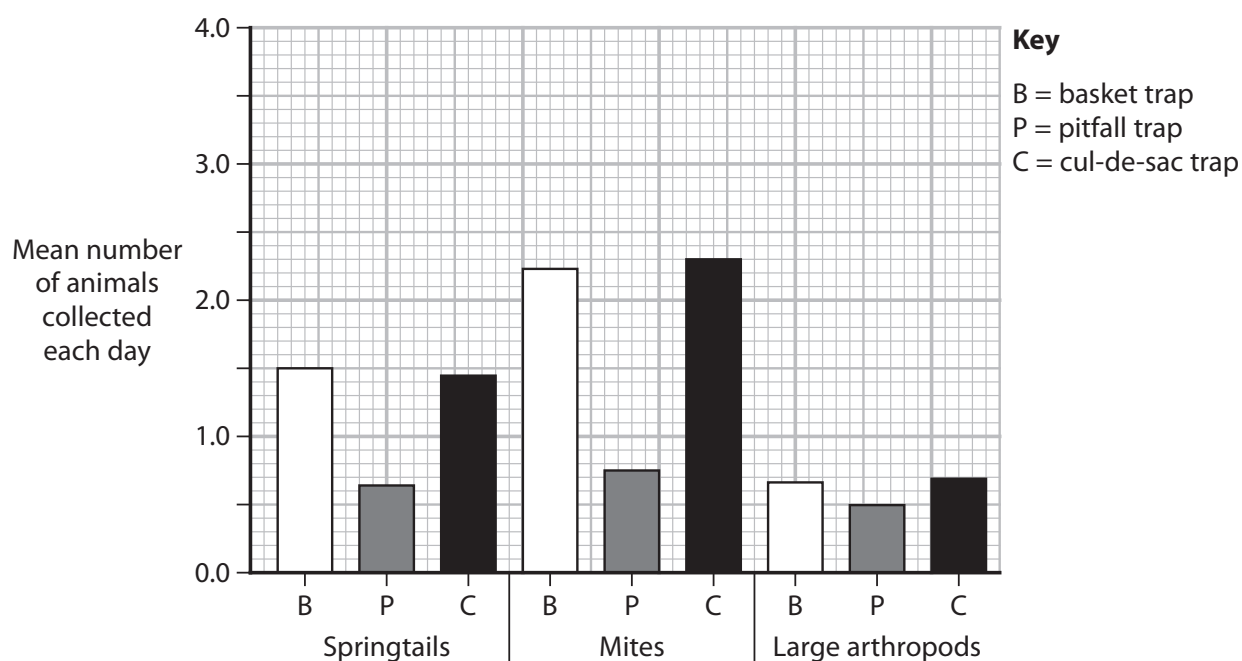
(c) Scientists use three different traps to collect some soil animals.

These traps are a basket trap, a pitfall trap, and a cul-de-sac trap.

The number of animals collected by each trap are counted each day.

The animals collected are classified into three types: springtails, mites and large arthropods.

The graph shows the scientists' results.



Discuss the number of each animal type collected by the three traps.

Refer to the scientists' results in your answer.

(5)

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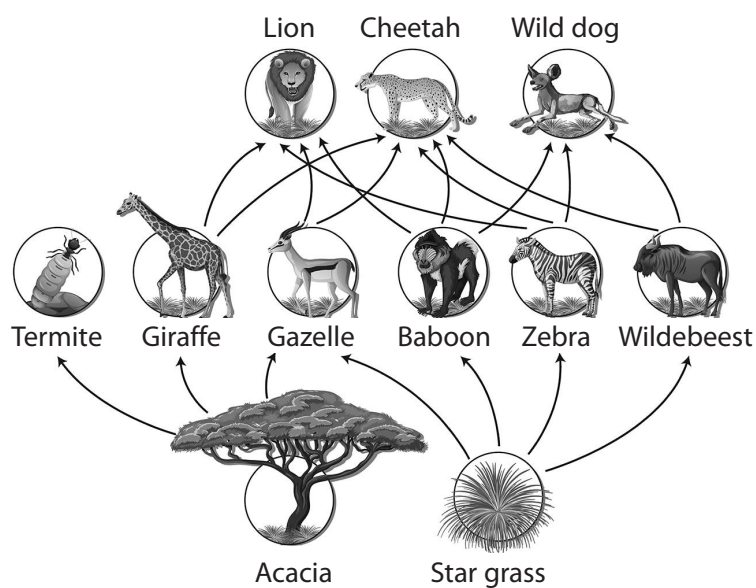
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(Total for Question 2 = 13 marks)



7 This food web is from an ecosystem in Africa.



(Source: © BlueRingMedia/Shutterstock)

(a) (i) Which organism is a primary consumer?

(1)

- ☐ A acacia
- ☐ B lion
- ☐ C star grass
- ☐ D zebra

(ii) Which of these has the least efficient energy transfer?

(1)

- ☐ A giraffe to cheetah
- ☐ B star grass to baboon
- ☐ C wildebeest to wild dog
- ☐ D zebra to lion

(iii) Which organism will be least affected by a reduction in the population of star grass?

(1)

- ☐ A baboon
- ☐ B gazelle
- ☐ C wildebeest
- ☐ D zebra

(b) (i) Explain why only a small proportion of the energy contained within one trophic level is transferred to the next trophic level.

(4)

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(ii) Describe how a scientist could compare the population size of star grass in two areas of the ecosystem.

(4)

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(c) Wild dogs hunt a variety of prey species. They usually eat the weak and sick animals.

Explain how this behaviour may benefit the species the dogs hunt.

(3)

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(Total for Question 7 = 14 marks)

7 This food chain comes from a Swedish lake.

algae → crustacea → perch → pike → osprey

(a) (i) Name the trophic level of the algae in this food chain.

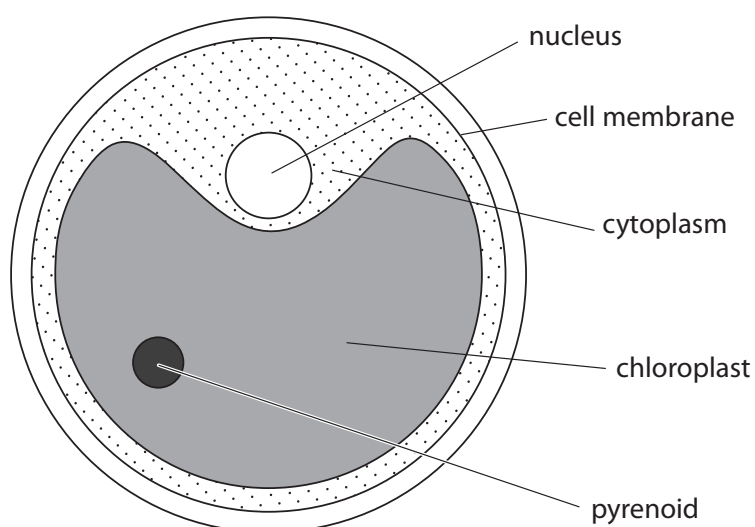
(1)

(ii) Name the trophic level of the pike in this food chain.

(1)

(b) Some algae are single-celled such as *Chlorella* whilst other algae are multicellular such as seaweeds.

The diagram shows a species of *Chlorella*.



(i) The actual diameter of the *Chlorella* is $10\text{ }\mu\text{m}$.

Calculate the magnification of the diagram.

[$1\text{ mm} = 1000\text{ }\mu\text{m}$]

(2)

magnification = ...

- (ii) Calculate the volume of the *Chlorella*.

Assume *Chlorella* is a sphere with a radius (r) of $5.00\text{ }\mu\text{m}$.

$$[\text{volume of sphere} = \frac{4}{3} \pi r^3 \quad \pi = 3.14]$$

(2)

volume = ... μm^3

- (iii) The cytoplasm contains a very large chloroplast.

Describe the function of the chloroplast.

(2)

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- (iv) *Chlorella* contains many starch granules.

Describe the function of the starch granules in the organism.

(2)

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(c) A student wants to compare the number of individuals in seaweed populations on two different beaches.

Describe how the student could carry out this investigation.

(4)

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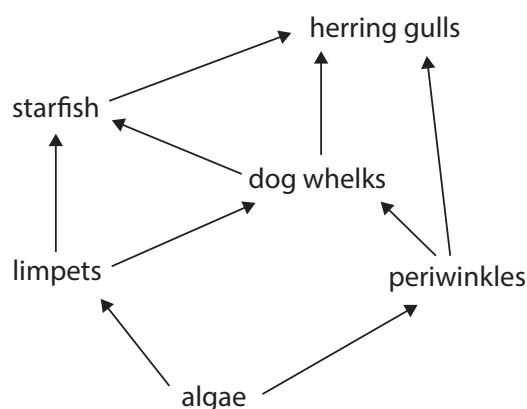
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(Total for Question 7 = 14 marks)

7 Limpets are marine animals that attach to rocks on coastal shores.

The diagram shows a food web that contains limpets.



(a) (i) Which are the trophic levels of the starfish in this food web?

(1)

- ☒ **A** primary consumer and secondary consumer
- ☒ **B** primary consumer and tertiary consumer
- ☒ **C** secondary consumer and tertiary consumer
- ☒ **D** secondary consumer only

(ii) State what is meant by the term **population**.

(1)

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(iii) Explain why only 1% of the energy in the algae is transferred to the starfish.

(3)

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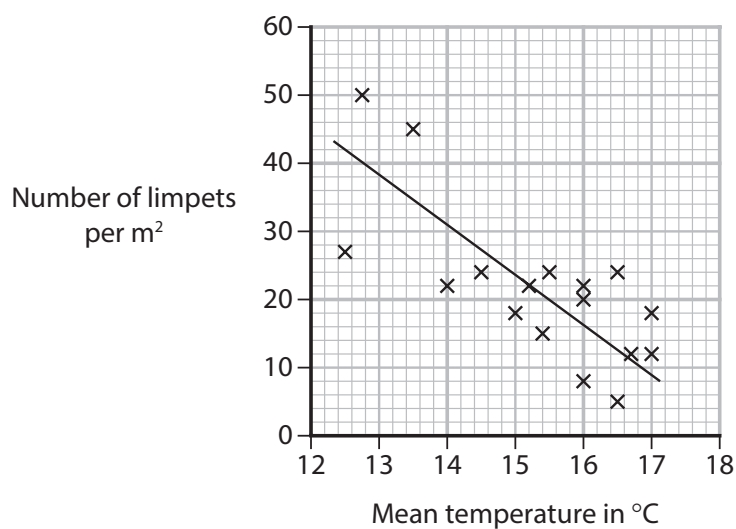
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- (b) Some scientists think that food webs on rocky shores are at risk from an increase in greenhouse gases.

The scientists record these two factors during August every year for 17 years.

- the number of limpets per m^2 on a rocky shore
- the mean temperature at the same rocky shore

The graph shows the scientists' results.



- (i) Describe how the scientists could determine the number of limpets on the rocky shore.

(3)

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(ii) Give one factor the scientists should control when comparing the number of limpets per m² each year.

(1)

(iii) The scientists conclude that the combustion of fossil fuels is a risk to the food web.

Discuss the scientists' conclusion.

Use the information in the graph and your own knowledge to support your answer.

(5)

(Total for Question 7 = 14 marks)

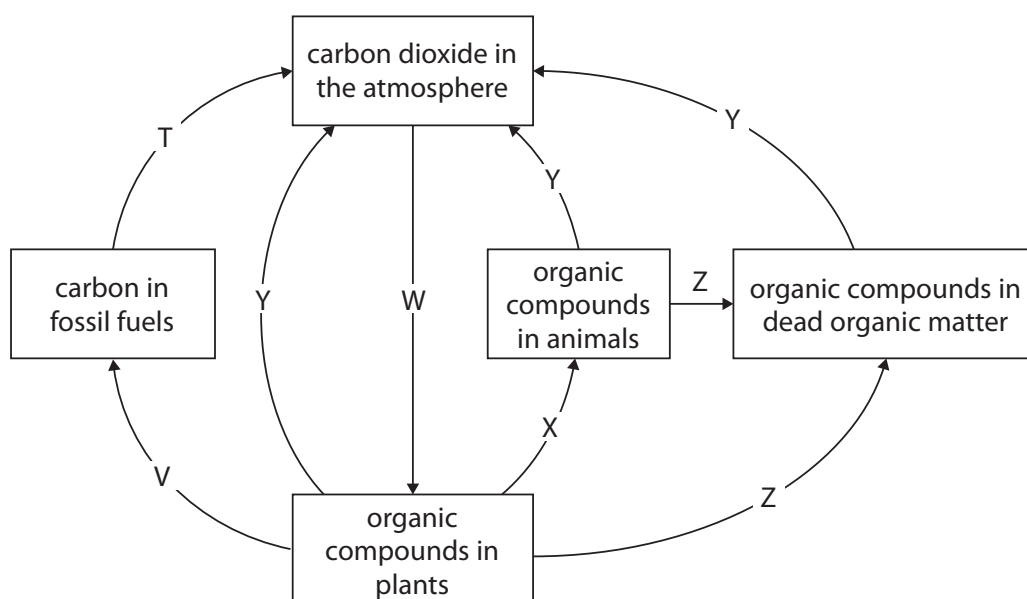
SUB-TOPIC 4(c)

CYCLES WITHIN ECOSYSTEMS

10 questions in this sub-topic · 102 marks · lowest tariff first



8 The diagram shows the carbon cycle.



(a) (i) Which letter in the diagram represents respiration?

(1)

- ☒ **A** T
- ☒ **B** X
- ☒ **C** Y
- ☒ **D** Z

(ii) Give the name of the process labelled W.

(1)

- (b) Carbon dioxide, methane, and nitrous oxide are three greenhouse gases.

The table shows a comparison of these greenhouse gases.

The Global Warming Potential (GWP) is the ratio of the heat absorbed by a greenhouse gas in the atmosphere relative to the heat absorbed by the same mass of carbon dioxide gas.

Greenhouse gas	Percentage of all greenhouse gas emissions (%)	Global Warming Potential (GWP)	Length of time gas stays in atmosphere in years
carbon dioxide	77.00	1	1000
methane	16.00	30	25
nitrous oxide	0.77	270	298

- (i) Name one other greenhouse gas.

(1)



(ii) Evaluate the information in the table to identify which of these gases is likely to contribute most to global warming.

(5)

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(Total for Question 8 = 8 marks)

2 Deforestation is the cutting down of trees.

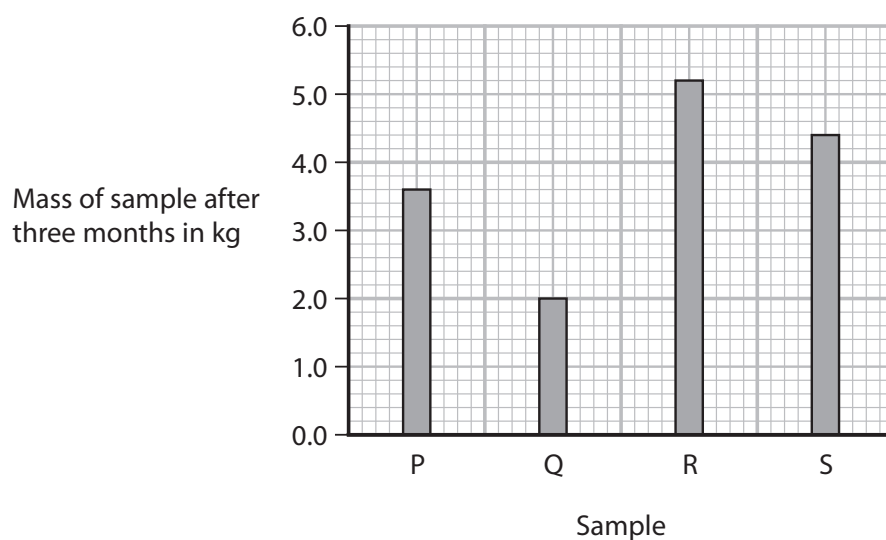
After deforestation many dead leaves are left on the forest floor.

A student investigates the decomposition of these leaves.

This is her method.

- collect four samples of dead leaves each with a mass of 6.0 kg
- label the samples P, Q, R and S
- cut sample P into small pieces and keep at 10 °C
- cut sample Q into small pieces and keep at 20 °C
- do not cut sample R and keep at 10 °C
- do not cut sample S and keep at 20 °C
- measure the mass of each sample after three months

The graph shows her results.



(a) Explain the results obtained by the student.

(4)

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(b) Calculate the difference between the rate of decomposition in sample P and the rate of decomposition in sample Q.

(3)

Give your answer in kg per month.

difference = ... kg per month

(c) The student needs to control biotic variables in her investigation.

Give two biotic variables she should control.

(2)

1

2

(Total for Question 2 = 9 marks)



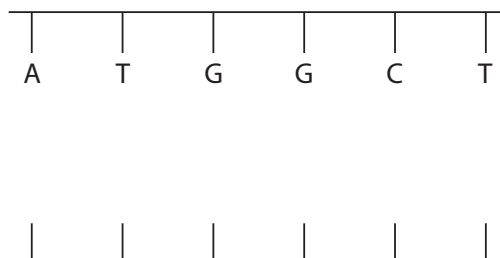
5 Decomposer bacteria are involved in the nitrogen cycle.

The bacteria release an enzyme called urease.

(a) The diagram shows part of one strand of DNA used to make urease.

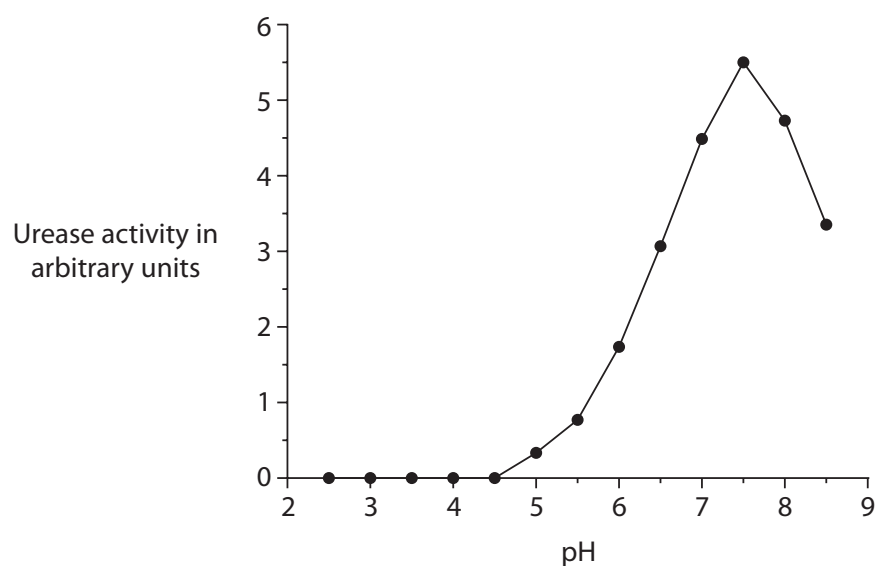
Complete the diagram by giving the missing bases on the other strand of DNA.

(1)



(b) Urease acts on urine to produce ammonia.

The graph shows how pH affects the activity of urease.



(i) Which of these is the optimum pH for urease?

(1)

- ☐ A 2.5
- ☐ B 4.5
- ☐ C 7.5
- ☐ D 8.5

(ii) Explain the activity of urease at pH 8.5

(2)

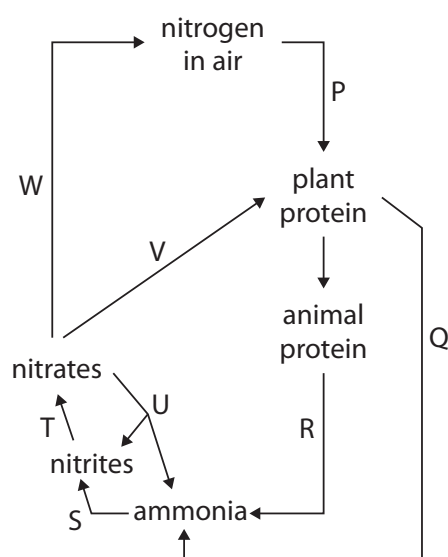
(c) Describe the role of the other bacteria involved in the nitrogen cycle.

(5)

(Total for Question 5 = 9 marks)



4 The diagram shows the nitrogen cycle. Some of the stages have been labelled.



(a) (i) Which stage shows nitrogen fixation?

(1)

- ☐ A P
- ☐ B Q
- ☐ C T
- ☐ D V

(ii) Which stage shows nitrification?

(1)

- ☐ A Q
- ☐ B U
- ☐ C T
- ☐ D W

(iii) Which stage shows denitrification?

(1)

- ☐ A P
- ☐ B T
- ☐ C V
- ☐ D W

(b) Farmers sometimes add chemical fertiliser to the soil.

(i) Describe how pollution by fertiliser can affect aquatic ecosystems.

(5)

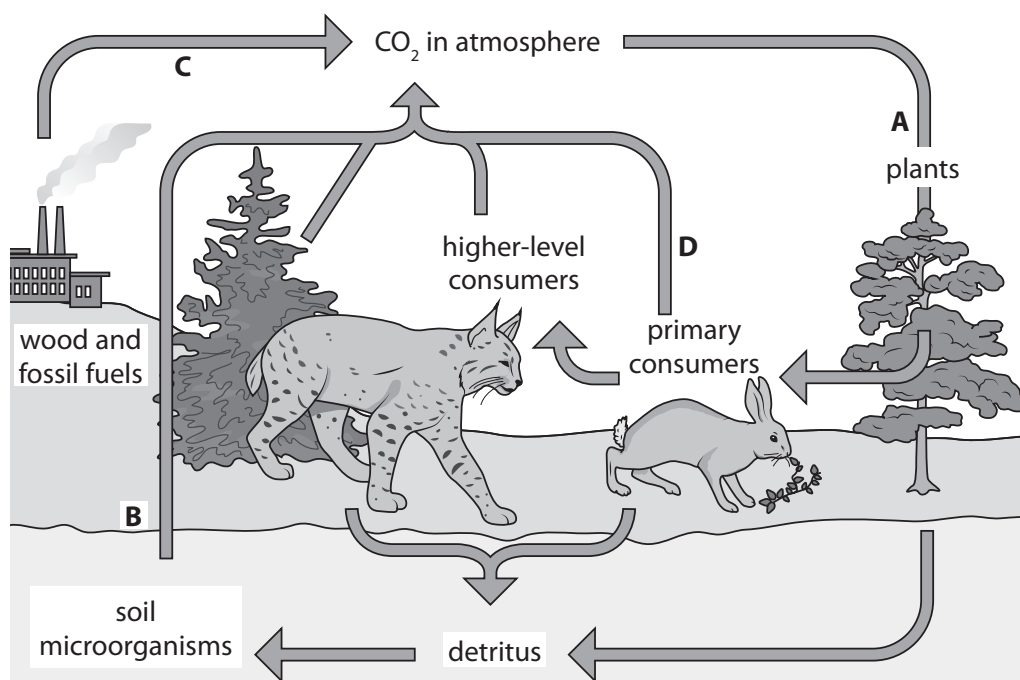
(ii) Give an alternative to chemical fertiliser that a farmer could use.

(1)

(Total for Question 4 = 9 marks)



- 11 The diagram shows a cycle that is important for the recycling of biological molecules. Processes in the cycle are labelled A, B, C and D.



- (a) (i) Give the name of this cycle.

(1)

- (ii) Which process reduces CO₂ in the atmosphere?

(1)

- ☐ A
☒ B
☐ C
☒ D

- (iii) Name the two groups of microorganisms that carry out process B.

(2)

- 1
 2

(b) The breakdown of dead plant material by microorganisms is affected by many factors.

Design an investigation to determine the temperature at which plant material is broken down most effectively.

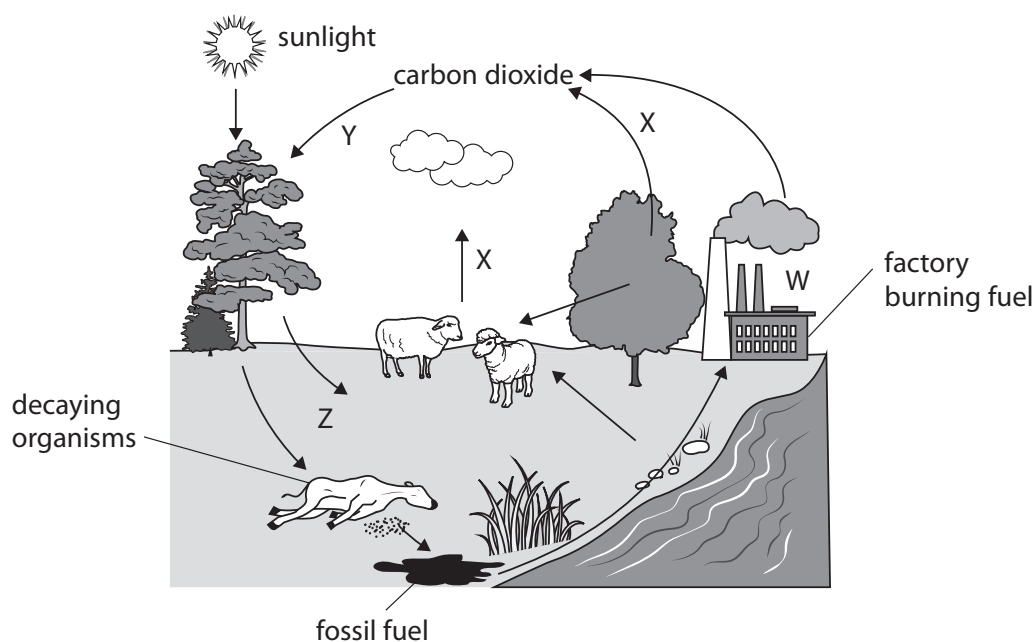
Include experimental details in your answer and write in full sentences.

(6)

(Total for Question 11 = 10 marks)



3 The diagram shows a cycle found in ecosystems.



(a) Give the name of the cycle.

(1)

(b) (i) Which process is represented by the letter W?

(1)

- ☐ A combustion
- ☐ B decomposition
- ☐ C feeding
- ☐ D respiration

(ii) Which process is represented by the letter X?

(1)

- ☐ A combustion
- ☐ B decomposition
- ☐ C feeding
- ☐ D respiration

(c) Name a group of organisms that is responsible for decomposition.

(1)

- (d) Carbon dioxide is released into the atmosphere by the decomposition of organic material.

The rate of this decomposition depends on a number of factors.

Design an investigation to find out if changing the pH of organic material affects the rate of decomposition.

Include experimental details in your answer and write in full sentences.

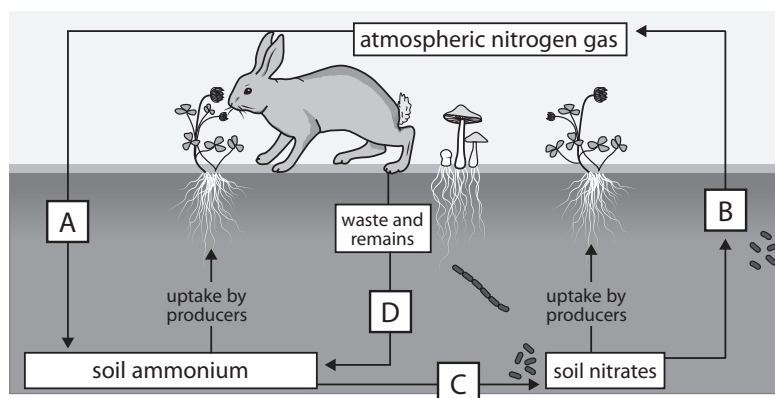
(6)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 3 = 10 marks)



- 4 (a) The diagram shows the nitrogen cycle with four processes labelled A, B, C and D.



(Source: <https://www.shutterstock.com/image-vector/diagram-nitrogen-cycle-process-by-which-1400843660>)

- (i) Which process is nitrogen fixation?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

- (ii) Which process is decomposition?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

- (iii) Which process is nitrification?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

- (iv) Name a type of organism that carries out process C.

(1)

- (b) A student does an investigation to determine if nitrate ions are required for plant growth.

He uses this method.

Step 1 Use a measuring cylinder to add 10 cm^3 of the control solution containing all the minerals a plant requires to a test tube

Step 2 Cover the top of the tube with foil

Step 3 Make a small hole in the foil

Step 4 Push the root of a germinated bean seedling through the hole so it is in the solution

Step 5 Rinse the measuring cylinder with distilled water

Step 6 Repeat Steps 1 to 4 using a test solution containing all the mineral a plant requires apart from nitrate ions

Step 7 Wrap both tubes in black paper

Step 8 Place both tubes in a test tube rack in bright sunlight

- (i) Explain why the control solution contains all the mineral ions the plant requires but the test solution contains all the mineral ions the plant requires except nitrate.

(2)

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- (ii) State the purpose of Step 5.

(1)

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(iii) Explain the purpose of Step 7.

(2)

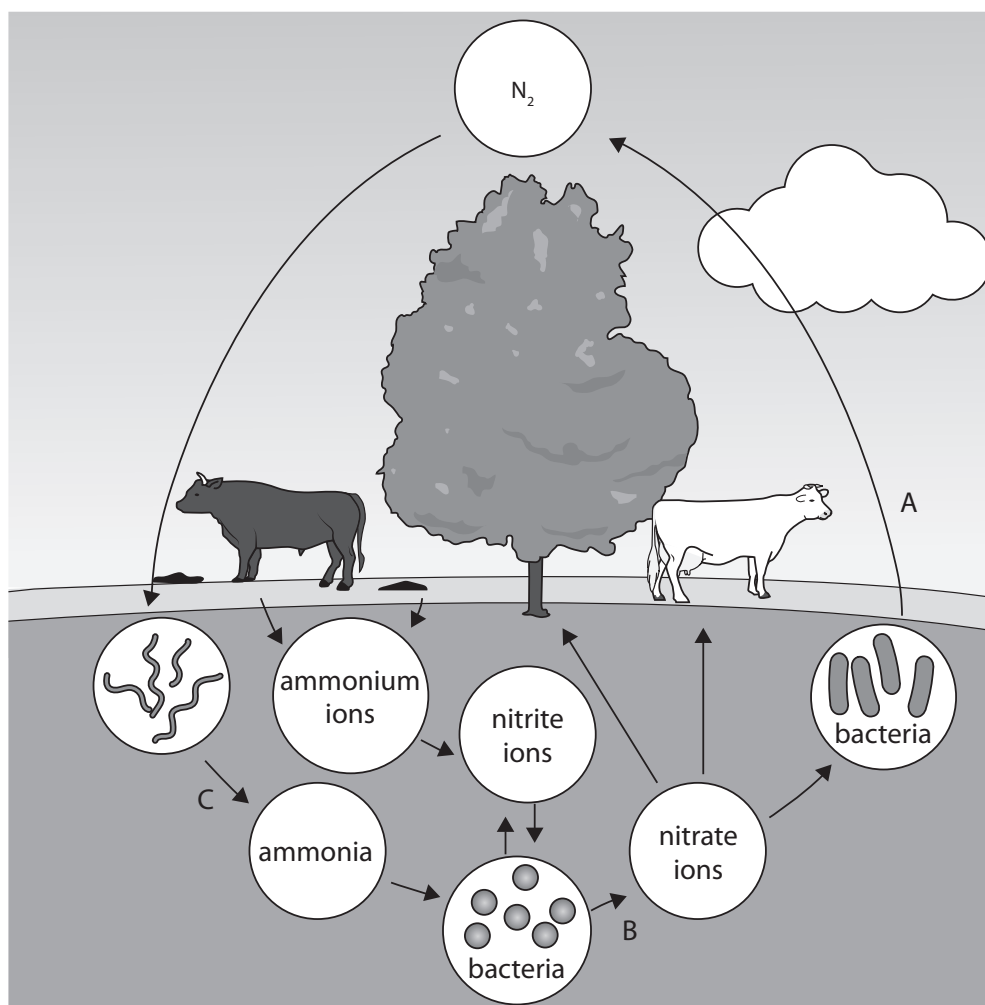
(iv) Explain the measurements that the student could make to determine if nitrate ions are required for plant growth.

(2)

(Total for Question 4 = 11 marks)



4 The diagram shows some parts of the nitrogen cycle.



(a) Name the processes labelled A, B and C.

(3)

A

B

C

- (b) The mass of nitrogen that moves within the nitrogen cycle has been estimated and some of the masses are given in the table.

Process	Mass of nitrogen per year in $\text{g} \times 10^{12}$
released into atmosphere by burning of biomass	40
removed from atmosphere for manufacture of fertiliser	120
released into atmosphere by denitrification	100
removed from atmosphere by nitrogen fixation	58
removed from atmosphere by lightning	5
released into atmosphere in the form of ammonia	60
released into atmosphere as oxides of nitrogen	5
removed from atmosphere by deposition of oxides of nitrogen	70

- (i) Some of these processes remove nitrogen from the atmosphere.

Calculate the total mass of nitrogen removed from the atmosphere by these processes.

Give your answer in standard form.

(2)

mass = ... g



- (ii) Calculate the percentage of the nitrogen released into the atmosphere that comes from burning of biomass.

(2)

percentage = ...

- (iii) Explain how burning biomass returns nitrogen to the atmosphere.

(2)

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- (c) Explain the effect of nitrous oxide on global warming.

(2)

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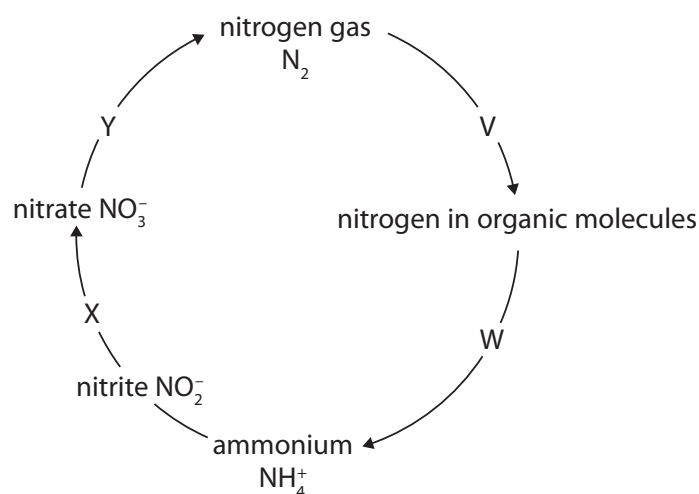
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(Total for Question 4 = 11 marks)

5 The diagram shows the nitrogen cycle with some processes labelled.



(a) (i) Explain why plants need nitrate ions.

(2)

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(ii) Name the processes V, X and Y.

(3)

V

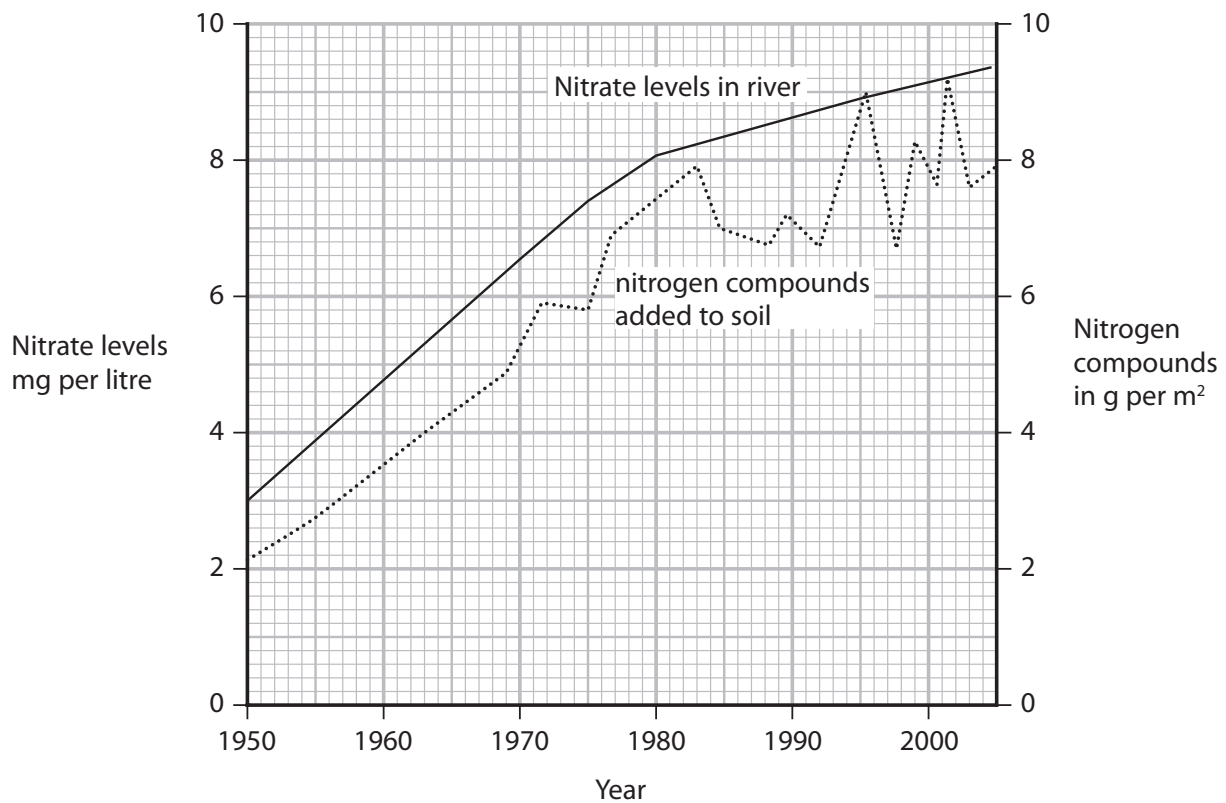
X

Y

- (b) Scientists measure the dissolved nitrate levels in a river that passes through farmland.

They also measure the nitrogen compounds being used on the farmland either as fertiliser or as manure from livestock.

The graph shows how the nitrate levels in the river and the nitrogen compounds applied to the farmland changed from 1950 to 2005.



(Source: Graph: Trends in Nitrate Levels in Maumee River | U.S. Geological Survey (usgs.gov))

(i) Comment on the relationship between nitrate levels in the river and the nitrogen compounds applied to the farmland.

(4)

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(ii) Describe the changes within the river that would have occurred between 1950 and 2000.

(3)

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(Total for Question 5 = 12 marks)

3 Bags made from starch are better for the environment than plastic bags made from fossil fuels.

Bags made from starch are decomposed by microorganisms such as soil fungi.

(a) (i) Which of these is a feature of fungi?

(1)

- ☐ **A** chloroplasts in the cytoplasm
- ☐ **B** starch stored in the cytoplasm
- ☐ **C** thread-like hyphae
- ☐ **D** walls made of cellulose

(ii) The soil fungi release an enzyme called amylase that digests the bag.

What is the product of this digestion?

(1)

- ☐ **A** amino acids
- ☐ **B** fatty acids
- ☐ **C** glycerol
- ☐ **D** maltose



(iii) Amylase is a protein.

Describe how protein is made in a cell.

(5)

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- (b) A student investigates the effect of soil pH on the decomposition of bags made from starch.

She uses this method.

- cut two small squares from a bag
- measure the mass of each small square
- place one square in a beaker of soil with a pH of 7.0
- place the other square in a beaker of soil with a pH of 9.0
- after 10 days, remove the squares and measure their mass again

The table shows the student's results.

pH of soil	Mass of square in g		Percentage loss in mass (%)
	at start	after 10 days	
7.0	2.00	1.00	50.0
9.0	2.10	0.62	

- (i) Calculate the percentage loss in mass shown by the square in pH 9.0 soil.

(1)

percentage = ...

- (ii) Calculate the difference between the percentage loss in mass for the two squares.

(1)

difference = ...



(4)

(Total for Question 3 = 13 marks)



SUB-TOPIC 4(d)

HUMAN INFLUENCES ON THE ENVIRONMENT

13 questions in this sub-topic · 173 marks · lowest tariff first



- 9 Large quantities of food are wasted every year. Waste food needs to be disposed of using methods that do not harm the environment.

The table shows the mass of each gas released into the air from three different methods of waste disposal.

Method of waste disposal	Mass of each gas released into the air from 1000 kg of waste food in kg			
	carbon dioxide	carbon monoxide	methane	sulfur dioxide
anaerobic digester	37	0.012	3.05	0.23
burying in landfill	220	0.680	14.70	0.14
burning	680	0.059	3.12	0.08

- (a) Calculate how much carbon dioxide would be released from 125 kg of waste food when using an anaerobic digester.

Give your answer to two significant figures.

(2)

mass of carbon dioxide released = ... kg

(5)

(Total for Question 9 = 7 marks)



9 Pollution can occur in the atmosphere and in rivers.

(a) Carbon monoxide can pollute the atmosphere.

Describe the effects of carbon monoxide pollution on humans.

(3)



(b) Water pollution can occur if sewage enters a river.

Explain the biological consequences of sewage pollution on a river ecosystem.

(6)

(Total for Question 9 = 9 marks)



- (b) The atmosphere can be polluted by gases such as carbon monoxide released from industry.

Describe the effects of carbon monoxide on the human body.

(2)

- (c) Which of these is **not** a greenhouse gas?

(1)

- ☐ **A** carbon dioxide
- ☐ **B** methane
- ☐ **C** nitrogen
- ☐ **D** nitrous oxide

(Total for Question 6 = 9 marks)

11 Pollution of air or water can affect ecosystems.

(a) (i) Explain the biological consequences of air pollution by sulfur dioxide.

(3)

(ii) State how sulfur dioxide pollution can be reduced.

(1)



- (b) Some scientists have suggested that adding hydrogencarbonate solution to soil, instead of adding water, can increase plant growth.

Design an investigation to discover the effect that adding hydrogencarbonate solution has on the growth of seedlings.

Include experimental details in your answer and write in full sentences.

(6)



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(Total for Question 11 = 10 marks)



6 Lichens are organisms that grow well on stone walls in unpolluted air.

Lichens grow less well in polluted air.

Car exhaust fumes contain sulfur dioxide that pollutes air.

A scientist investigates the effect of pollution by cars in a city.

This is her method.

- measure the percentage area of a stone wall in the city centre covered by lichen
- repeat this measurement at different distances from the city centre

The table shows her results.

Distance from city centre in km	Percentage area covered by lichen (%)
0	0
2	6
4	20
6	30
8	50
10	64
12	70

(a) Explain the results shown in the table.

(2)

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(b) Describe a method to measure the percentage of a stone wall covered by lichen.

(3)

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- (c) Adding water to a powder called sodium metabisulphite will release sulfur dioxide gas.

Devise a laboratory investigation to find out the effect of sulfur dioxide gas on the heat released by germinating seeds.

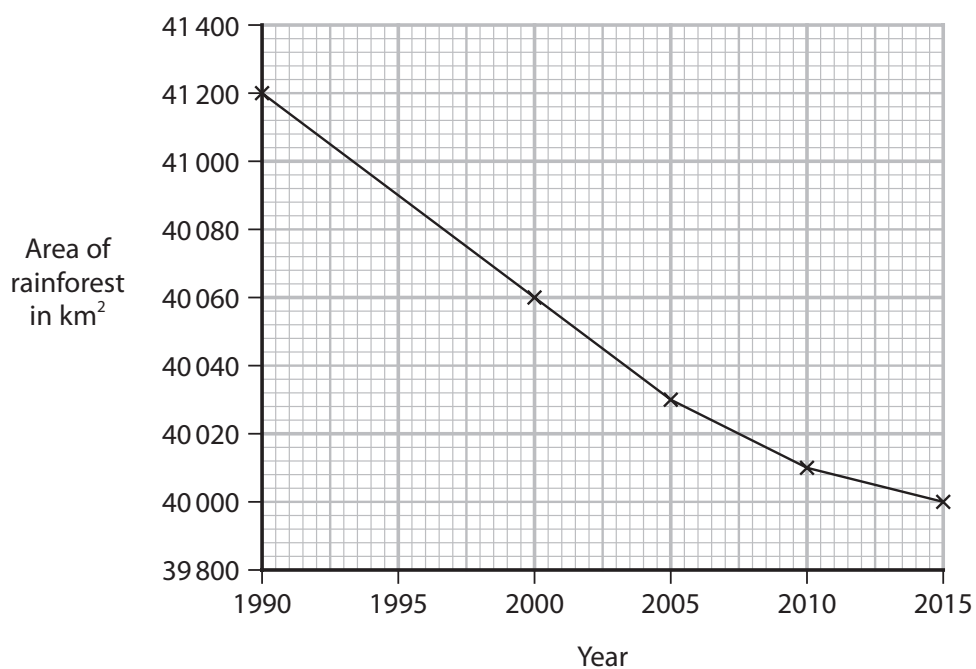
Include experimental details in your answer and write in full sentences.

(6)

[illegible]

(Total for Question 6 = 11 marks)

- 5 (a) The graph shows the change in area of rainforest on the Earth from 1990 to 2015.



- (i) Determine the mean rate of decrease of rainforest area, in km² per year, from 1990 to 2015.

(2)

mean rate of decrease = ... km² per year

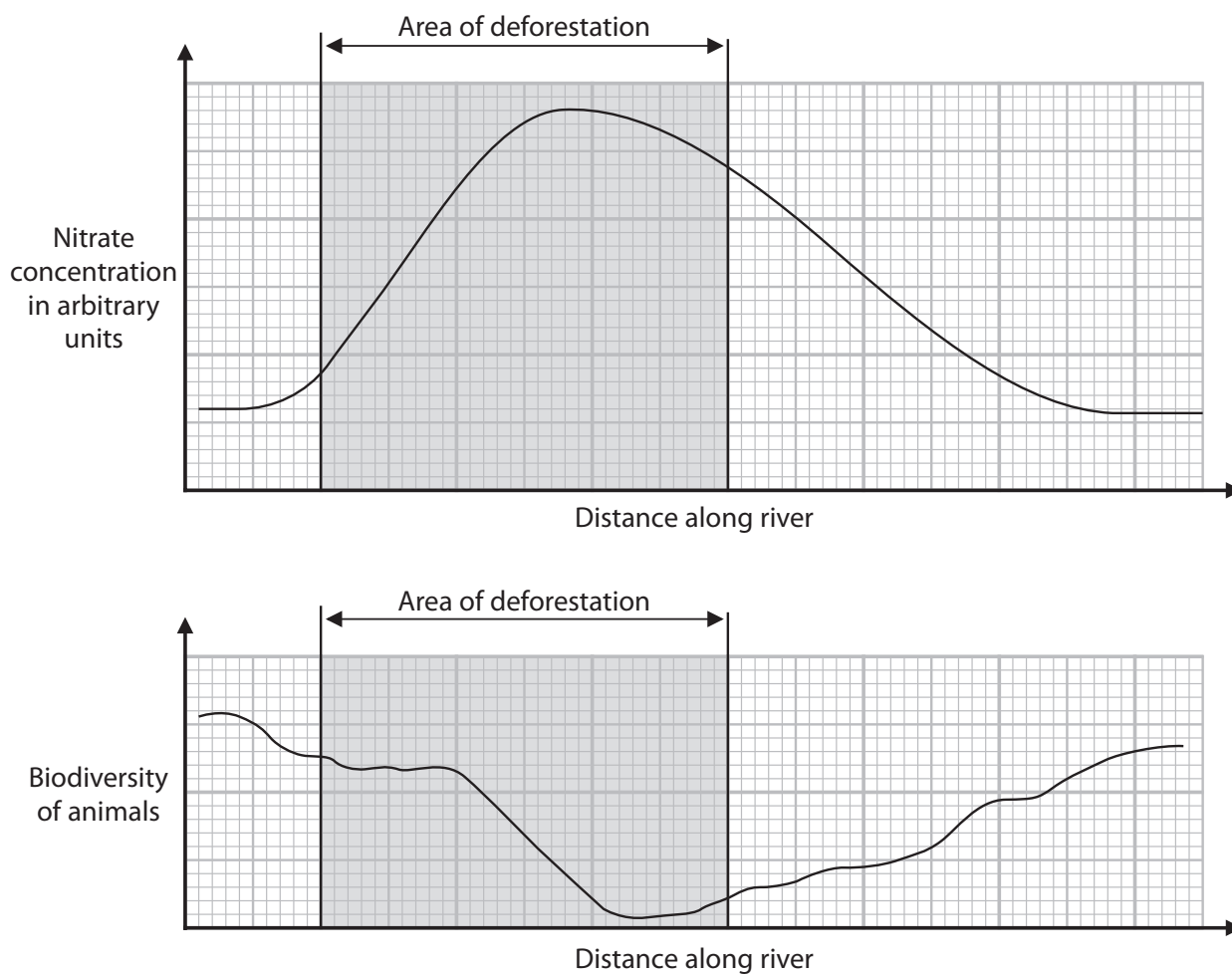
(ii) Loss of rainforests causes an increase in atmospheric carbon dioxide gas.

Explain the negative effects of an increase in atmospheric carbon dioxide gas.

(3)

- (b) Scientists investigated the effect of deforestation on a river. The river flows through a forest, part of which has been deforested.

The graphs show the changes in nitrate concentration and the biodiversity of animals in the river as it flows through the forest.



- (i) Describe the role of microorganisms in the conversion of organic waste into nitrate ions in the river.

(3)

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- (ii) The number of different animal species living in the river was recorded as a measure of the biodiversity of animals.

Give a reason why this may not be a complete measure of biodiversity.

(1)

- (iii) Explain the change in the biodiversity of animals along the river.

Use information from the graphs in your answer.

(4)

(Total for Question 5 = 13 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Global warming and the Great Barrier Reef

The Great Barrier Reef is found in the sea off the North-East coast of Australia. It is the largest coral reef in the world.



5 Coral reefs are underwater ecosystems. Coral grows best on rock found in shallow, clear moving water. The coral is made from a hard calcium shell that contains small animals. Inside the bodies of these animals there are microscopic organisms called algae. These animals and algae have a mutualistic relationship. In a mutualistic relationship, both species benefit by living together.

10 A scientific study found that higher sea temperatures in 2016 caused the worst destruction of corals ever recorded on Australia's Great Barrier Reef. Many scientists believe that the increase in sea temperature is the result of an increase in carbon dioxide in the atmosphere.

15 About 70% of coral died in the northern section of the reef. One of the worst-hit areas was around Lizard Island in North Queensland, where almost 90% of the coral died. The situation was better in the central section, where only about 5% died. The southern section of the reef was healthy. Scientists warn that recovery of the coral reefs will be difficult if climate change continues.

20 Some coral death is the result of overheating. However, far more coral has been lost through bleaching. Coral bleaching happens when sea temperatures rise for a long period of time. The algae cannot survive so the coral starves. The pigments in the algae give coral its colour. After bleaching, the coral appears white because it is now without the colourful algae that provide its main source of energy.

Some coral survives the higher sea temperatures. However, another study has found that this coral has now come under increased threat from predators such as snails and the crown-of-thorns starfish.

25 Scientists are hopeful that the reef is capable of recovery, but fear it may not have an opportunity as sea temperatures continue to rise. The Australian Government has published recommendations in a long-term sustainability plan for the coral reef.

(a) What is meant by the term **ecosystem** (line 3)?

(2)

(b) Suggest how the mutualistic relationship between the small animals and the algae inside them is of benefit to both species (lines 6 and 7).

(2)

(c) (i) Explain why coral grows best in shallow, clear water (lines 3 and 4).

(2)

(ii) Suggest why coral grows best in moving water (lines 3 and 4).

(2)



- (d) Suggest how scientists are able to find the percentage of coral that has died in a section of the reef.

(3)

- (e) Give one reason why coral that survives higher sea temperatures is under increased threat from predators (lines 22 to 24).

(1)

- (f) Suggest what recommendations should be included in the sustainability plan for the coral reef (lines 26 and 27).

(3)

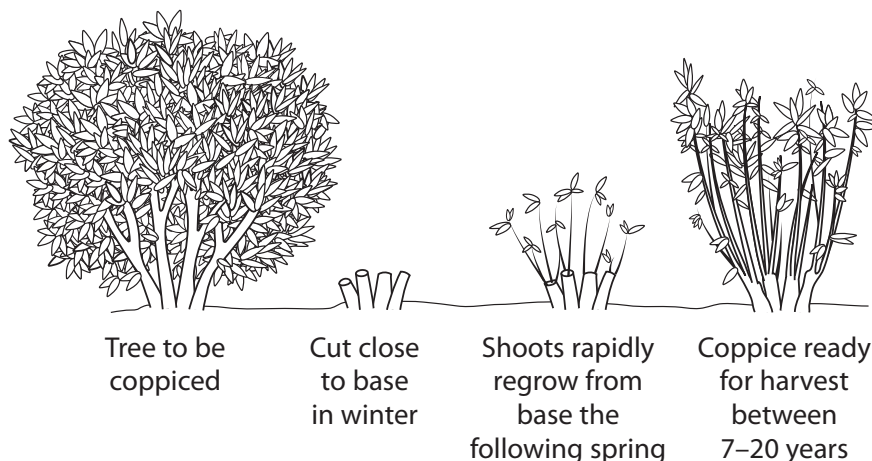
(Total for Question 1 = 15 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Coppicing

Coppicing is a traditional woodland management technique that was commonly used until about 70 years ago. Coppicing involves repeatedly cutting trees near to their base and allowing them to regrow. This provides a sustainable supply of timber. Coppicing has several benefits compared with replanting. Coppiced trees

5 already have developed root systems, making regrowth quicker. They are also less likely to be eaten by species such as deer. Coppicing also reduces shading.



- The demand for coppiced timber is beginning to increase again, as timber prices rise and other uses of coppiced timber develop. These uses include wood for biofuel. Much of this wood is used for heating schemes for homes and small
- 10 factories. One exception is the huge Drax power station in North Yorkshire, United Kingdom, which has been using coppiced wood to generate electricity since 2004.

- Coppicing is still a popular conservation practice because of the benefits it provides to trees and wildlife. Trees naturally lose their branches, which extends
- 15 their lifespan. Coppicing is an artificial way of removing branches and increasing the lifespan of the tree.

- Coppicing also increases woodland biodiversity, as greater amounts of light can reach the ground, allowing other plant species to grow. Many of these species are food sources for butterflies and other insects, providing food for birds and
- 20 mammals such as bats.

In managed coppiced woodland the varied age structure of the vegetation also provides good habitat and shelter for different bird species.

Coppicing is a good way to ensure that there is a range of different light levels in a woodland, which leads to an increase in plant biodiversity.

(a) Suggest what is meant by the term **sustainable** (line 3).

(1)

(b) Explain why having a developed root system makes regrowth quicker (lines 4 to 5).

(2)

(c) Coppiced wood can be used as a biofuel (lines 8 to 9).

Give similarities and differences in the use of biofuel compared with the use of fossil fuels.

(3)

(d) New growth in woodland is often destroyed by species such as deer (lines 5 to 6).

Suggest one way to protect woodland from this damage.

(1)

(e) Coppicing increases biodiversity in woodland ecosystems (line 17).

Describe a method to investigate the effect of coppicing on the biodiversity of plants in a woodland.

(5)

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(f) Coppicing increases the number of insects in woodland.

A farmer owns a field next to a coppiced woodland.

(i) Give one reason why more insects in the woodland might be an advantage for the farmer.

(1)

(ii) Give one reason why more insects in the woodland might be a disadvantage for the farmer.

(1)

(g) Explain why a range of different light levels in a woodland leads to an increase in plant biodiversity (lines 23 to 24).

(2)

(Total for Question 1 = 16 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Plastic pollution

A mass of 12.7 million tonnes of plastic is dumped into our oceans every year. This is equivalent to the mass of 1.8 million adult elephants. This plastic pollution is a concern because of its harmful effect on living organisms.

- 5 Turtles eat plastic bags, mistaking them for jellyfish, and sea birds have been found with stomachs full of plastic. Researchers have reported 800 kg of plastic found in the carcass of a stranded whale in France. The stomach of another whale in Australia contained six square metres of plastic sheeting and 30 plastic carrier bags. Plastic items can block the tubes leading from the mouth to the stomach and to the lungs in some animals. This can cause death
10 because it affects digestion and gas exchange.

- Whale sharks are the largest fish in the world, yet feed on microscopic plankton that photosynthesise. The plankton is also eaten by crustaceans, which are then eaten by fish. These fish are eaten by humans. Many whales are filter feeders. They swallow hundreds of cubic metres of water a day
15 to capture plankton and may take in microplastics during the process. The microplastics are produced from the breakdown of larger pieces of plastic. Microplastics are similar in size and mass to many types of plankton. These microplastics are not biodegradable and build up in the bodies of organisms that occupy higher trophic levels in food chains. This is called
20 bioaccumulation.

Plastic pollution may be responsible for putting filter feeding whale sharks and other filter feeders at risk of extinction. The whale shark, for example, is listed as being endangered.

- 25 Studies have found toxic chemicals associated with plastics in the bodies of large filter feeders. Scientists think these chemicals might reduce the population sizes of the large filter feeders. This is because the toxins might affect many biological processes involving hormones that regulate the body's growth and development, metabolism, and reproduction.

- 30 Whale sharks feeding in the Sea of Cortez near Mexico, an important breeding ground, ingest 200 microplastic particles per day. Fin whales in the Mediterranean Sea ingest 2000 microplastic particles per day. Any reduction in the reproduction of these species will have consequences for biodiversity.

- Attempts are being made to reduce the use of plastic. Coffee companies are being encouraged to use wooden spoons and straws rather than plastic ones.
35 Also, shoppers are being given biodegradable plastic bags, or paper bags.

1 (a) (i) Which organism named in the passage is a producer?

(1)

- ☐ **A** crustaceans
- ☐ **B** microscopic plankton
- ☐ **C** sea birds
- ☐ **D** turtles

(ii) Which organism named in the passage is a tertiary consumer?

(1)

- ☐ **A** crustaceans
- ☐ **B** fin whale
- ☐ **C** human
- ☐ **D** whale shark

(b) Explain how blocked tubes leading from the mouth can lead to death in some animals. (lines 8 to 10)

(5)

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- (c) Suggest why bioaccumulation of microplastics is a problem for humans.
(lines 17–20)

(2)

- (d) Calculate the difference between the number of plastic particles ingested in a year
by a fin whale and a whale shark. (lines 29–31)

Give your answer in standard form.

(3)

difference = ...

- (e) Explain the effects of reduced reproduction on biodiversity. (lines 31–32)

(2)

(f) Suggest a benefit of using biodegradable plastic bags. (line 35)

(2)

(Total for Question 1 = 16 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

When the Oceans Glow

- 5 In some areas of the world the oceans around the coast sometimes glow with a blue light. The photograph shows an area of coast that is glowing. This blue light is produced by the presence of thousands of microscopic, living organisms called dinoflagellates. These dinoflagellates are protists. The production of light by living organisms is called bioluminescence, a process that has evolved many times in different species of organism.



(Source: © AMIRREZA KAMKAR/SCIENCE PHOTO LIBRARY)

- To generate light, dinoflagellates use special proteins and the ATP produced within their cells. Many species of dinoflagellate contain chlorophyll and are able to photosynthesize. The appearance of glowing dinoflagellates in the sea used to be a rare event but this now occurs much more frequently. Many of the events occur in the sea around river estuaries and scientists think that intensive farming and deforestation could be to blame. Due to
10 overpopulation of dinoflagellates in these areas, other species of animal are often harmed. After a series of glowing events, large numbers of dinoflagellates die causing oxygen levels in the water to decrease.

- People have often wondered why dinoflagellates glow. They only glow in areas where the water moves around, such as when waves hit a beach. Scientists now think that the production of light is a type of warning to stop predators eating the dinoflagellates. If an animal eats
15 dinoflagellates, the dinoflagellates in the area glow making the animal obvious to its own predators. To test this, scientists placed dinoflagellates into a tank along with 15 copepods, which are predators of dinoflagellates. When the dinoflagellates glowed, the copepods ate
20 1200 dinoflagellates in two hours. When the dinoflagellates did not glow, the copepods ate 2100 dinoflagellates in two hours.

- Some scientists think that we could make use of the dinoflagellates to provide sustainable street lighting. Tanks of dinoflagellates could be placed on top of lamp posts. The
25 dinoflagellates would photosynthesize during the day when it is light. A stirrer powered by a small battery would then move them at night so that they would glow. These sustainable lamps could be carbon neutral and help to reduce pollution.

(a) Which of these processes produces ATP? (line 6)

(1)

- ☐ **A** active transport
- ☐ **B** diffusion
- ☐ **C** respiration
- ☐ **D** transpiration

(b) (i) Explain why intensive farming and deforestation would cause an increase in populations of dinoflagellates. (lines 9 to 11)

(3)

(ii) Explain why oxygen levels decrease after a series of glowing events. (lines 10 to 13)

(2)

(c) Which type of bacteria converts ammonia into nitrates?

(1)

- ☐ A decomposer
- ☐ B denitrifying
- ☐ C nitrifying
- ☐ D nitrogen fixing

(d) (i) Each of the 15 copepods ate glowing dinoflagellates at a mean rate of 40 dinoflagellates per hour.

Calculate the mean rate at which each copepod ate dinoflagellates that were not glowing. (lines 18 to 21)

(2)

mean rate = ... dinoflagellates per hour

(ii) Explain how natural selection could have resulted in the evolution of dinoflagellates that glow. (lines 15 to 18)

(4)

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(e) Explain why using dinoflagellates for street lighting would help to reduce pollution. (lines 22 to 26)

(3)

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(Total for Question 1 = 16 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Plants to the rescue

Since the early 20th century, the concentration of carbon dioxide in the atmosphere has increased rapidly. This has further increased in recent years due to more cars and the increased demand for electricity for homes and industry.

- 5 Scientists have found that plants play a critical part in removing this excess carbon dioxide from the atmosphere. Using computer models, the scientists concluded that photosynthesis has increased by 30 per cent.

- The scientists measured carbonyl sulfide found in ice cores and air samples. In addition to carbon dioxide, plants take in carbonyl sulfide gas during their natural carbon cycle, and this is frequently used as a measure of photosynthesis on a
10 global scale. Terrestrial plants are removing about 29 per cent of carbon dioxide emissions that would otherwise contribute to an increase in the atmospheric carbon dioxide concentration.

- A carbon sink is an ecosystem, such as a forest, that absorbs more carbon dioxide than it releases. The size of the carbon sink depends on the rate of photosynthesis
15 but also on the levels of deforestation and respiration. The model the scientists used showed that the role of photosynthesis in producing a carbon sink in land plants is larger than estimated in most other models.

- Other scientists are less confident about using carbonyl sulfide as a measure of photosynthesis. Plant absorption of carbonyl sulfide can vary depending
20 upon the amount of light the plants receive. Therefore, the measure of global photosynthesis could be overestimated.

- Regardless of the rate at which photosynthesis has increased, scientists agree that excess carbon dioxide is boosting the growth of plants. Trees are becoming leafier, and there is more wood. The wood is where most of the carbon is stored in
25 the plant.

- In experimental research, scientists exposed plants to double the normal concentration of carbon dioxide found in the atmosphere. Under these increased carbon dioxide conditions, the composition of the leaf tissues changed. This made the leaves tougher for herbivores to eat and made it harder for insect larvae
30 to grow.

Scientists have also observed that when plants are exposed to increasing levels of carbon dioxide, the size of the stomatal pores on a leaf increases.



- (a) Explain why more cars would result in an increase in atmospheric carbon dioxide.
(Lines 1-3)

(2)

- (b) Explain how increased carbon dioxide can cause climate change.

(2)

- (c) Explain why increasing carbon dioxide concentration can increase photosynthesis in plants.

(2)

(d) Explain why the carbon sink depends upon respiration and deforestation as well as photosynthesis. (Lines 13 to 15)

(2)

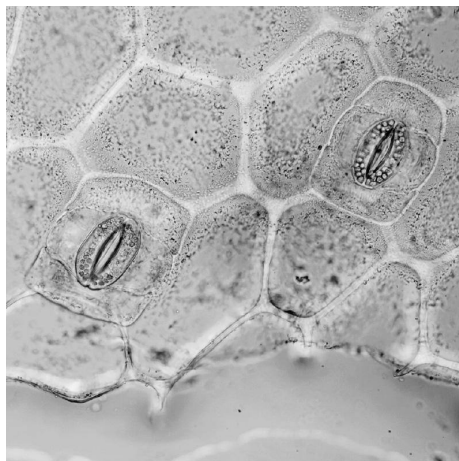
(e) Light affects gas exchange in leaves. (Lines 19 and 20)

Describe an experiment that shows how the net gas exchange from a leaf varies with light intensity.

(3)



(f) The photograph shows stomata on a small square of the lower surface of a leaf.



← 400 μm (0.4 mm) →

(Source: © Kallayanee Naloka/Shutterstock)

The total area of the lower surface of the leaf is 150 cm^2 .

Using the photograph and the total lower surface area of the leaf, estimate the number of stomata on the lower surface of the leaf.

(3)

number of stomata = ...

(g) Stomata also have a role in water transport in the plant.

Explain the role of stomata in water transport.

(2)

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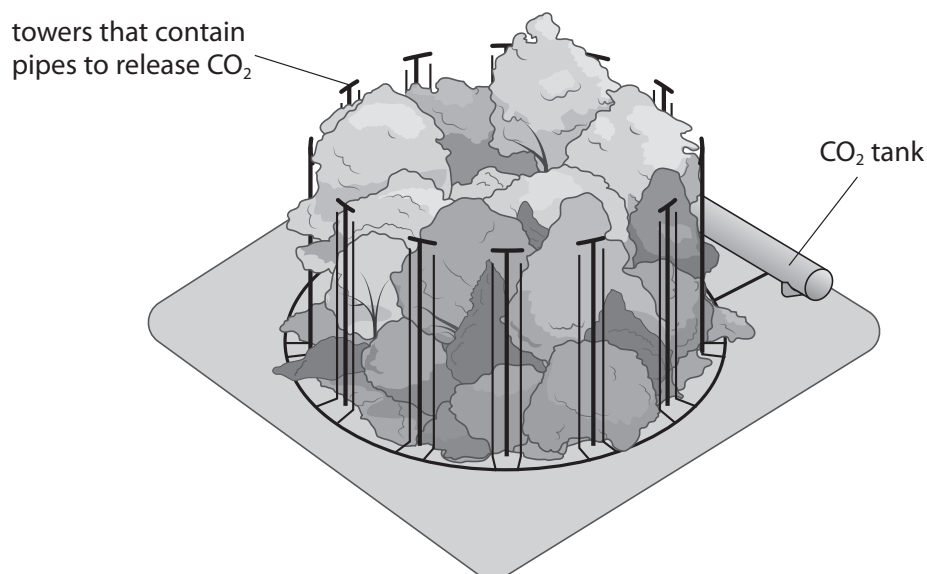
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(Total for Question 1 = 16 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

The FACE Programme



The global concentration of carbon dioxide (CO₂) in the atmosphere has risen by 35% since 1800. It is higher now than at any time in the past 25 million years and is predicted to increase further by 2050.

- Free air carbon dioxide enrichment (FACE) is when scientists increase the concentration of CO₂ in the air surrounding crop plants. A typical FACE plot is circular and surrounded by a ring of pipes. These pipes release CO₂ at the base of the plant and all the way to the top of the plant. Wind direction, wind speed and CO₂ concentration are measured at the centre of each plot. A computer uses this information to maintain a high concentration of CO₂.
- Plants do not just respond to increasing CO₂ in the atmosphere. They can also change the concentration of CO₂ by increasing the amount they absorb. Much of what we used to know about plant responses to rising CO₂ came from studies in glasshouses. However, in FACE experiments the effect of increasing CO₂ can be studied in a natural environment. This should provide a better idea of how plants and ecosystems will respond to higher global concentrations of CO₂.

- One of the effects of higher concentrations of CO₂ is an increase in the rate of photosynthesis. FACE experiments were done in various parts of the world using different plant species. In these experiments, raised CO₂ concentrations increased the rate of photosynthesis by about 40%. CO₂ concentrations also affect how open stomata are. Open stomata allow CO₂ to diffuse into leaves for photosynthesis, but also allow water to escape from leaves. Plants respond by changing how open their stomata are as a compromise. As CO₂ concentrations increase, plants can maintain a high rate of photosynthesis with a lower rate of transpiration. Growth with raised CO₂ decreases water loss by about 22%. This can have consequences for the water cycle of entire ecosystems.

In FACE experiments, dry mass production increased by about 30%. This increased growth leads to a greater yield in crops such as wheat, rice and soybean.

- (a) Explain why the carbon dioxide concentration is predicted to increase further by 2050 (line 3).

(2)

- (b) Suggest why wind direction and speed are measured in FACE plots (lines 7 and 8).

(1)

- (c) Scientists conclude that FACE experiments are more useful than experiments in glasshouses (lines 11 to 15).

Evaluate this conclusion.

(3)



(d) Explain why an increase in carbon dioxide concentration would lead to an increase in the rate of photosynthesis (lines 16 to 17).

(2)

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(e) Describe an experiment to estimate the rate of water loss from a plant.

(4)

[illegible]

(f) Plants respond by changing how open their stomata are as a compromise (lines 21 to 22).

Explain the compromise that plants must make.

(2)

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(g) An increased concentration of carbon dioxide in the atmosphere is causing climate change.

Scientists hope that an increase in the rate of photosynthesis may limit climate change.

Describe three other methods of reducing climate change.

(3)

1

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2

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3

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(Total for Question 1 = 17 marks)

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Rivers – the arteries of the world

Rivers are important supplies of water for drinking, farming, industry, and leisure activities. Like our circulatory system, rivers are essential for transport, and have a homeostatic effect on nature. The biodiversity in rivers is high as they are the habitat for many different species. In many countries rivers are under threat from human impact, particularly the release of untreated sewage.

Flooding can cause untreated sewage to run into rivers from pipelines. Scientists estimated that in England and Wales during 2022, sewage was released into rivers for a total time of 300 000 hours. This sewage came from 1200 different pipelines. Untreated sewage may contain fertilisers, pesticides, pathogenic bacteria, and pharmaceutical drugs.



(Source: © ANDY DAVIES / SCIENCE PHOTO LIBRARY)

The photograph shows sewage being released into a river. The sewage causes the growth of something called 'sewage fungus'. Sewage fungus looks like fungus but is a solid collection of several types of anaerobic bacteria. Sewage fungus is common in rivers that are polluted with untreated sewage or are near to cattle and intensive crop farms. If sewage fungus is found in a river it often indicates that the biodiversity of the river will be low.

Pesticides from agriculture are also released into rivers, and these are frequently transferred through natural food chains. Even pharmaceutical drugs, such as those containing the hormones oestrogen and progesterone, have been found in polluted rivers. These drugs must have been consumed by humans, excreted and then released into the sewage flowing into rivers.

Untreated sewage can also contain pathogenic species of bacteria that then enter rivers. If humans are infected with these bacteria, the large intestine absorbs less water, causing diarrhoea. Some of the bacteria found in sewage are resistant to antibiotics.

30 Scientists are looking for ways to prevent river pollution. One way is to reduce the risk of pollution from fertilisers and from cattle urine and faeces. Woodchip bioreactors are being trialled in agricultural fields that are near to rivers. These bioreactors are pits filled with woodchips and denitrifying bacteria. Water drains through these bioreactors, which helps to remove nitrates before they reach the rivers. In some countries, efforts are being made to replant forests in areas upstream of rivers to reduce river flooding and the risk of untreated sewage release.

- (a) Rivers have a homeostatic effect on nature. This is similar to the role of homeostasis in humans.

State what is meant by the term **homeostasis** (lines 2 and 3).

(1)

- (b) Calculate the mean number of hours that each pipeline released sewage into rivers in 2022 (lines 7 and 8).

(1)

mean number = ... hours

- (c) (i) Sewage fungus is not a fungus but is made from several different species of bacteria.

Which of these structures are present both in fungi and in bacteria?

(1)

- ☐ A cell wall and cytoplasm only
- ☐ B cell wall and nucleus only
- ☐ C cell wall, cytoplasm and nucleus
- ☐ D cytoplasm and nucleus only

(ii) Explain why rivers near to farms may have low biodiversity (lines 13 to 16).

(4)

(d) Oestrogen and progesterone in polluted water lower the levels of FSH and LH in mammals.

(i) State why lower levels of FSH can reduce fertility in mammals.

(1)

(ii) State why lower levels of LH can reduce fertility in mammals.

(1)

(e) (i) Pathogenic bacteria produce poisons that prevent the active transport of salt into the blood vessels surrounding the intestines.

Explain why preventing the transport of salt into the blood vessels will cause more water to be present in faeces (lines 22 to 24).

(2)



- (ii) Explain why overuse of antibiotics has led to an increase in antibiotic-resistant bacteria (lines 24 and 25).

(3)

- (f) (i) Explain how woodchip bioreactors reduce pollution in rivers (lines 27 to 31).

(2)

- (ii) Explain why replanting forests in areas upstream of rivers will reduce flooding (lines 31 to 33).

(2)

(Total for Question 1 = 18 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
2(a) (i)	number of / amount / all of a species / one species / an organism (in an area / habitat) (1)	Ignore group	1

Question Number	Answer	Mark
2(a) (ii)	(different/all) species / types / organisms / populations (in a habitat / area / place / environment / ecosystem)	1

Question Number	Answer	Additional guidance	Mark
2(a) (iii)	(all) organisms / community / (different / all) species / biotic factors and environment / area / habitat / abiotic factors / non-living factors / physical factors (1)	Ignore animals and plants	1

Question Number	Answer	Mark
2(b)	The only correct answer is D acidity of soil <i>A is not correct as availability of mates is not an abiotic factor</i> <i>B is not correct as number of pathogens is not an abiotic factor</i> <i>C is not correct as number of predators is not an abiotic factor</i>	1

Question Number	Answer	Mark
2 ©	The only correct answer is B quadrat <i>A is not correct as a potometer is not suitable</i> <i>C is not correct as a spotting tile is not suitable</i> <i>D is not correct as a sweep net is not suitable</i>	1

Question Number	Answer	Additional guidance	Mark
2 (d)	An answer that makes reference to the following: • more (biodiversity) in woodland (1) • more species / different organisms / different types / different plants / greater variety of species / more species rich / eq (1)	Allow converse for wheat field	2

Total 7 marks

Question Number	Answer	Mark
7(a)	population (1)	1

Question Number	Answer	Mark																													
7(b)(i)	<table><tr><th rowspan="2">Species</th><th colspan="2">Field A</th><th colspan="2">Field B</th></tr><tr><th>Number of each plant</th><th>Percentage (%) of each species</th><th>Number of each plant</th><th>Percentage (%) of each species</th></tr><tr><td>daisy</td><td>19</td><td>76</td><td>15</td><td>32</td></tr><tr><td>dandelion</td><td>4</td><td>16</td><td>18</td><td>38</td></tr><tr><td>buttercup</td><td>2</td><td>8</td><td>14</td><td>30</td></tr><tr><td>total</td><td>25</td><td></td><td>47</td><td></td></tr></table> Scores one mark for 4 and 2 (1) Scores one mark for 32(%) (1)	Species	Field A		Field B		Number of each plant	Percentage (%) of each species	Number of each plant	Percentage (%) of each species	daisy	19	76	15	32	dandelion	4	16	18	38	buttercup	2	8	14	30	total	25		47		2
Species	Field A		Field B																												
	Number of each plant	Percentage (%) of each species	Number of each plant	Percentage (%) of each species																											
daisy	19	76	15	32																											
dandelion	4	16	18	38																											
buttercup	2	8	14	30																											
total	25		47																												

Question Number	Answer	additional guidance	Mark
7(b)(ii)	An explanation that makes reference to two of the following points: (although) both / A and B, have 3 different species / same number of species / eq / (1) - B (is more diverse) because it has more even / similar numbers of each species / eq (1)	Allow converse	2

Question Number	Answer	additional guidance	Mark
7(c)	An explanation that makes reference to the following points: - named mineral / nitrate / magnesium (1) - correct function / amino acids/ protein / chlorophyll / photosynthesis /eq (1)	Allow other correct named minerals award mp 2 only if correct mineral given Ignore nitrogen e.g. Nitrogen for amino acids is one mark only	2

total = 7 marks

Question Number	Answer	Additional guidance	Mark
6 (a)	A description that makes reference to two of the following points: • use random number tables / computer / eq (1) • to generate coordinates in field / place tape measures along edge of field / eq (1)	Allow grid area / split area into squares (1)	2

Question Number	Answer	Mark
6(b)(i)	3 (1)	1

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	12 (1)	ECF from 6(b)(i)	1

Question Number	Answer	Additional guidance	Mark
6 (c)	A description that makes reference to two of the following points: • more plants / named plants in field A / more plants per quadrat / more of each species (1) • more species in field A (1) • higher (bio)diversity in field A / eq (1) • more species evenness in field A (1) / even distributions	Allow converse for all mark points Allow A has 39 plants, B has only 16 Allow A has 4 species, B has only 2 Allow only dandelions (and 1 violet) in B / all species present in A	2

Question Number	Answer	Additional guidance	Mark
6 (d)	A description that makes reference to three of the following points: EITHER METHOD 1 • measure water content of soil / field / eq (1) • take repeated samples (1) • along a transect / at random locations (1) • count buttercups / compare number of buttercups to water content of soil (1) OR METHOD 2 • plant buttercups in one field / pots with poor drainage and one with good drainage / eq (1)	Mark either of the two methods Allow calculate mean water content Allow plant in high soil water and low soil water	

	• repeat (1) • control temperature / minerals / light / rainfall / water added / eq (1) • count number of buttercups (1)		3
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Total marks 9 marks



Question Number	Answer	Mark
3(a)(i)	• 23 (1)	1

Question Number	Answer	additional guidance	Mark
3(a)(ii)	A description that that makes reference to the following points: • use quadrat (1) • random (number generator) / use random coordinates / eq (1) • count number of <u>each species</u> in quadrat(1) • divide number by area of quadrat/s (1)	not just count plants no credit for repeat	3

Question Number	Answer	additional guidance	Mark
3(b)	An answer that that makes reference to four of the following points: 1. Field X has 3 species / more species / all 3 species / greater richness / eq (1) 2. Field X shows little variation in numbers/ even distribution of species A eq (1) 3. Field X shows little variation in numbers/ even distribution of species C / eq (1) 4. Field X shows more variation in numbers/ uneven distribution of species B eq (1) 5. Field X has more 'evenness' of species number 6. Field X has greater biodiversity / eq (1) 7. Only 3 counts of each / limited data set / more repeats needed /eq (1)	Y has 2 / fewer / no species A Y shows more variation in numbers/ uneven distribution of species C eq (1) Y shows little variation in numbers / even distribution of species B / eq (1) Y less even / dominated by species B Y less biodiversity	4

Question Number	Answer	Mark
3(c)	• temperature / water / sunlight / wind speed / mineral ions/ eq	1

Total = 9 marks

Question Number	Answer	Mark										
4(a)	<table><tr><th>Example of process</th><th>Name of process</th></tr><tr><td>plants with a short growing season survive drought</td><td>natural selection</td></tr><tr><td>growth of algae in rivers polluted by fertiliser</td><td>eutrophication (1)</td></tr><tr><td>pollen transferred from one plant to another by an insect</td><td><u>insect</u> pollination (1)</td></tr><tr><td>absorption of nitrate ions from soil using ATP</td><td>active transport (1)</td></tr></table>	Example of process	Name of process	plants with a short growing season survive drought	natural selection	growth of algae in rivers polluted by fertiliser	eutrophication (1)	pollen transferred from one plant to another by an insect	<u>insect</u> pollination (1)	absorption of nitrate ions from soil using ATP	active transport (1)	3
Example of process	Name of process											
plants with a short growing season survive drought	natural selection											
growth of algae in rivers polluted by fertiliser	eutrophication (1)											
pollen transferred from one plant to another by an insect	<u>insect</u> pollination (1)											
absorption of nitrate ions from soil using ATP	active transport (1)											

Question Number	Answer	additional guidance	Mark
4(b)(i)	An explanation that makes reference to four of the following points: • (more) grass flourishes / grows well / survives / not killed by zinc / eq (near mine) (1) • less competition (1) • mutation (1) • reproduce (1) • pass allele / gene / DNA on to offspring (1)	other species killed by zinc near mine	4

Question Number	Answer	additional guidance	Mark
4(b)(ii)	A description that makes reference to four of the following points: • use tape measure (1) • <u>quadrat</u> (1) • repeat / several (1) • count plants / estimate percentage cover described (1)	allow belt transect for mp1 allow for quadrats how many	4

Total 11 marks

Question Number	Answer	Additional guidance	Mark
4(a)	An explanation that makes reference to two of the following • (number / amount / how many / range) the different species / eq (1) • number / abundance / how many of each species / eq (1) • variation / variety (of organisms) (in an ecosystem) / eq (1)	species richness species evenness	2

Question Number	Answer	Additional guidance	Mark
4(b)(i)	A description that makes reference to the following • place at random / eq (1) • (place quadrats at) co-ordinates / eq (1)	Use random coordinates = 2 marks	2

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	Calculation steps not mark points common sorrel $20 + 5 + 10 = 35$ $35 \div (5 \times 0.25)$ $35 \div 1.25$ $= 28 \text{ per m}^2 \text{ (3)}$	Allow one mark for 'species mark' for common sorrel or $(20 + 5 + 10)$ or 35 or 1025 Allow one for area mark $\div (5 \times 0.25) \text{ or } \div 1.25$ Or $\div 0.25$ or $\times 1/0.25$ or $\times 4$ Or allow 2 marks for 47 or 46.67 as this has selected correct species and used area Or allow 2 marks for 140 as this has	3

		selected correct species and used area	
		Allow 3 marks for 28 per m ²	

Question Number	Answer	Mark
4(b)(iii)	meadow buttercup (1)	1

Question Number	Answer	additional guidance	Mark
4(b)(iv)	An answer description that makes reference to five of the following 1. more species present / eq (1) 2. more even distribution / similar numbers of each / eq (1) 3. common sorrel / stinging nettles absent/ eq (1) 4. more biodiversity / grazing increases biodiversity /eq (1) 5. reliable / repeated / more than one quadrat done in each field / eq (1) 6. no information on water / sunlight / temperature / fertilisers / minerals / seasons / eq (1) 7. only done on one field /repeat in other fields / eq (1) 8. no information about amount of animals / age of animals / duration /eq (1) 9. grazing reduces competition allows different species to grow / prevents succession /eq (1) 10. grazing provides increased nitrates/ minerals / manure /eq (1)	allow converse for B /ungrazed more variation between quadrats	5 E

Question Number	Answer	Mark
1(a)(i)	The only correct answer is B as there are three producers in the web <i>A is incorrect as there is not one producer in web</i> <i>C is incorrect as there are not four producers in web</i> <i>D is incorrect as there are not nine producers in web</i>	1

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is C as there are four secondary consumers in the web <i>A is incorrect as there is not one secondary consumer in the web</i> <i>B is incorrect as there are not three secondary consumers in the web</i> <i>D is incorrect as there are not seven secondary consumers in the web</i>	1

Question Number	Answer	Additional guidance	Mark
1(b)(i)	(eye) sight / vision / seeing / visual / optic / eq (1)	Allow any word that implies vision no credit for retina / eyes No credit for sight and smell	1

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	$530 \div 30.0$ $18 / 17.7 / 17.67$ $17.6(\text{recurring})$	award full marks for correct numerical answer without working also allow any version of 17.667 17.6667 etc one mark for $530 \div 30.0$ or 17.6	2

Question Number	Answer	Mark
1(c)	An explanation that makes reference to two of the following points: • anaerobic respiration (1) • provide energy / ATP (1) • less / need more/ without oxygen (1)	2

Total = 7 marks

Question Number	Answer	Mark
6(a)	respiration / heat loss	1

Question Number	Answer	Mark
6(b)	1122	1

Question Number	Answer	Additional guidance	Mark
6(c)(i)	A description that makes reference to two of the following points: • digest / break down (1) • dead organisms / waste / faeces / organic matter / eq (1) • use extracellular enzymes / secrete enzymes / release enzymes onto / eq (1)	Ignore feed	2

Question Number	Answer	Mark
6(c)(ii)	A description that makes reference to three of the following points: • producers / plants contain cellulose (1) • less energy in producers absorbed / transferred to (primary) consumers / eq (1) • (more) producers / plants are undigested / not digested / not eaten / eq (1) • decomposers can digest cellulose / eq (1) • (primary) consumers lose more energy in respiration / respire more / more heat loss (1) • (primary) consumers lose more energy in movement / eq (1)	3

Total 7 marks



Question Number	Answer	additional guidance	Mark
6(a)(i)	producer to primary consumer = $132 / 703 \times 100 = 19\%$	allow 18.8 / 18.78 / 18.777 18.7767 / eq	1

Question Number	Answer	Mark
6(a)(ii)	primary consumer to secondary consumer = 1% of 1 = 0.01	1

Question Number	Answer	additional guidance	Mark
6(a)(iii)	more energy transferred / less energy lost / less heat loss / less movement in aquatic / more of producer eaten /eq (1)	allow converse not all crop eaten	1

Question Number	Answer	Additional Guidance	Mark
6(b)	An explanation that makes reference to two the following points - less biomass in producers than consumers / consumers have more biomass / eq (1) - but producers have more energy /eq (1) - producers have low mass at any one point in time / are continually being consumed / replaced / high reproduction rate (1) - consumers feed in other areas/ eq (1)	ignore number	2

Question Number	Answer	Mark
6(c)	An answer that makes reference to two of the following points • sampling using quadrats (1) • burn plants to release energy (1) • use of calorimeter / how heat energy released is measured when burning / heat volume of water and note temperature change/ eq (1)	2

Total 7 marks



Question Number	Answer	Mark
2(a)	small fish	1

Question Number	Answer	additional guidance	Mark
2(b)(i)	A description that makes reference to three of the following points: • photosynthesis (1) • chloroplasts / chlorophyll (1) • absorbs / traps light /eq (energy) (1) • starch / glucose / carbohydrate (1)	allow formula or from equation	3

Question Number	Answer	additional guidance	Mark
2(b)(ii)	An answer that makes reference to two of the following points: • respiration / heat loss (by plant) (1) • cannot digest / egested / not absorbed /eq (1) • uneaten / die / decomposition (1) • excretion (1)		2

Question Number	Answer	Mark
2(c)	An answer that makes reference to the following points: • increase surface area (1) • enzymes (1)	2

Total 8 marks



Question Number	Answer	Mark
1 (a)(i)	A - 2 <i>B is incorrect as there are not 3 secondary consumers</i> <i>C is incorrect as there are not 4 secondary consumers</i> <i>D is incorrect as there are not 5 secondary consumers</i>	1

Question Number	Answer	Mark
1 (a)(ii)	Acacia / plant → (desert) rat → fennec / fox → monitor / lizard → hawk (1)	1

Question Number	Answer	Additional guidance	Mark
1 (a)(iii)	An explanation that makes reference to three of the following: • (energy is lost due to) indigestible parts / faeces / not absorbed / eq (1) • (energy is lost due to) excretion / metabolic waste / urine / eq (1) • (energy is lost due to) organisms / parts of organisms that are not consumed / eq (1) • (energy is released) in respiration / by heat loss / in active transport / due to metabolism (1) • (energy is lost due to) movement (1)	Accept some organisms / food not eaten Accept loss to death / decay	3

Question Number	Answer	Mark
1 (b)	An explanation that makes reference to four of the following: • mutation / genetic variation (1) • (the fox has / ears have) large surface area to lose heat / keep body cool (1) • (which) enables survival (1) • breeding occurs / (fox) produces offspring (1) • passes on alleles / genes (for ear shape) (to next generation) (1)	4

Total for Question 1 = 9 marks

Question Number	Answer	Mark
1(a)(i)	The only correct answer is C (oak tree) A is not the answer as caterpillar is not a producer B is not the answer as earthworm is not a producer D is not the answer as stoat is not a producer	1

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is D (ladybird) A is not the answer as caterpillar is not a secondary consumer B is not the answer as earthworm is not a secondary consumer C is not the answer as fox is not a secondary consumer	1

Question Number	Answer	Mark
1(a)(iii)	The only correct answer is A (blackbird) B is not the answer as earthworm is not a secondary and a tertiary consumer C is not the answer as fox is not a secondary and a tertiary consumer D is not the answer as stoat is not a secondary and a tertiary consumer	1

Question Number	Answer	Additional guidance	Mark
1 (b) (i)	An explanation that makes reference to three of the following: • fewer blackbirds / numbers fall / population reduces / die / migrate / eq (1) • less food (for blackbirds) fewer (caterpillars) to eat / fewer ladybirds / eq (1) • less food for ladybirds / fewer greenfly for ladybirds to eat/ eq (1) • (blackbirds) will eat more earthworms / will eat only earthworms / eq (1) • blackbirds consume pesticide / bioaccumulation / pesticide kills blackbirds / eq (1)	Allow might / may fall	3

Question Number	Answer	Mark
1 (b) (ii)	A description that makes reference to the following: • <u>biological control</u> (1) • introduce predator / increase ladybirds / eq (1) • to eat / consume / prey on greenfly / eq (1)	3

Total 9 marks



Question Number	Answer	Mark
6(a)	The only correct answer is C the organisms of all species in a habitat A is not correct as is not a community B is not correct as is not a community D is not correct as is not a community	1

Question Number	Answer	Additional guidance	Mark
6(b)(i)	$1.5 \times 10^4 = 15\,000$ $2.5 \div 15\,000 =$ $1.7 \times 10^{-4} (3)$	award full marks for correct numerical answer without working 1 mark for $2.5 \div 15000$ or $2.5 \div 1.5 \times 10^4$ 2 marks for 0.00017 2 marks for 17×10^{-5} allow $1.67 \times 10^{-4} = 3$ allow 1.66 recurring $\times 10^{-4} = 3$	3

Question Number	Answer	additional guidance	Mark
6(b)(ii)	- correct order / names (1) - correct pyramid / shape / eq (1)	ignore shape ignore names	2

Question Number	Answer	additional guidance	Mark
6(c)(i)	An explanation that makes reference to the following points: - undigested / not absorbed / waste / faeces / not assimilated / eq (1) - contains energy / cellulose (1)	cellulose not digested = 2 marks energy trapped in faeces = 2 marks	2

Question Number	Answer	Mark
6(c)(ii)	An answer that makes reference to two of the following points: - respiration / heat loss (1) - movement / eq (1) - uneaten / die / not consumed /eq (1) - excretion (1)	2

Total 10 marks

Question Number	Answer	Mark
3 (a)(i)	The only correct answer is A (aphid) B is incorrect because blackbirds are secondary / tertiary consumers C is incorrect because foxes are secondary / tertiary / quaternary consumers D is incorrect because oak trees are producers	1

Question Number	Answer	Mark
3 (a)(ii)	The only correct answer is D (all of the different species in the area) A is incorrect because it describes an ecosystem B is incorrect because it describes a population C is incorrect because it describes an ecosystem	1

Question Number	Answer	Additional guidance	Mark
3 (b) (i)	An answer that makes reference to the following: • symmetrical pyramid with correct shape (1) • pyramid labelled (1) • pyramid bars drawn to scale (1)	Pyramid should be narrow at base, wider in middle and narrow at top Allow asymmetric pyramids +/- 1 small square Bar heights should be the same	3

Question Number	Answer	Additional guidance	Mark
3 (b)(ii)	100 (kJ) (2)	Allow one mark for 2000 or $\div 20$ Correct answer with no working gains full marks	2

Question Number	Answer	Additional guidance	Mark
3 (b)(iii)	An explanation that makes reference to three of the following: - not all organisms are eaten / some parts not eaten / eq (1) - energy is lost due to respiration / heat loss / movement / eq (1) - some die / decompose / eq (1) - some is not digested / absorbed / some is egested / some lost as faeces / eq (1) - energy lost as excretion / urea / eq (1)	Excrete faeces alone / excrete undigested food = 1 mark	3

(Total for Question 3 = 10 marks)

Question Number	Answer	Mark	
3(a)		3	
	number of organisms		8
	number of producers		1 / one
	number of primary consumers		2 / two
	number of food chains		10 / ten

Question Number	Answer	Additional guidance	Mark
3(b)	An explanation that makes reference to the following points: • respiration / movement / heat loss (1) • egested / undigested / faeces / not absorbed / not assimilated (1) • excreted / urine / urea (1) • uneaten (1) • death / <u>decomposition</u> (1)	Mp1 Ignore exercise / metabolism Mp3 excreted from the digestive system = 0	4

Question Number	Answer	Additional guidance	Mark
3 (c)	An answer that makes reference to four of the following points: • <u>variation</u> / <u>variety</u> / <u>varied</u> (1) • mutation (1) • longer beak means more worms/food / longer beak can reach deeper for worms/food (1) • <u>survival</u> and reproduction / breeding / offspring (1) • pass on gene / allele / DNA (1)	Allow converse for Mps 3, 4 and 5 mutation passed on = 1	4

Total 11 marks

Question Number	Answer	additional guidance	Mark
9(a)(i)	- algae (1) - bladder wrack (1)	minus 1 mark for each extra incorrect organism	2

Question Number	Answer	additional guidance	Mark
9(a)(ii)	An answer that makes reference to two of the following: (common) seal (1) - crab (1) - lobster (1) (herring) gull (1)	minus 1 mark for each extra incorrect organism	2

Question Number	Answer	Additional Guidance	Mark
9(a)(iii)	bladder wrack → winkle → crab → gull (2)	Allow 1 mark for order without arrows or arrows in wrong direction no credit for pyramids	2

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	• order correct (1) • shape correct (1)	Require names for order Allow 1 mark for order of names but wrong shape (of pyramid) Allow 1 mark for correct pyramid shape without names no credit for food chain	2

Question Number	Answer	Mark
9(b)(ii)	An explanation that makes reference to three of the following points: • energy lost (between each stage / level) / eq (1) • as heat / used in respiration / movement (1) • excreted / urine / eq (1) • not eaten / not digested / egested / faeces / eq (1) • decompose / die (1)	3

Total = 11 marks

Question Number	Answer	Mark
3(a)(i)	The only correct answer is C (3) <i>A is incorrect as there are more than 1 secondary consumers</i> <i>B is incorrect as there are more than 2 secondary consumers</i> <i>D is incorrect as there are fewer than 4 secondary consumers</i>	1

Question Number	Answer	Mark
3 (a)(ii)	The only correct answer is B (ecosystem) <i>A is incorrect as the community does not include the environment</i> <i>C is incorrect as the habitat does not include the organisms</i> <i>D is incorrect as population is the number of one species</i>	1

Question Number	Answer	Additional guidance	Mark
3 (a)(iii)	An explanation that makes reference to three of the following. - shorter food chain to oak tree / one species between fox and oak tree / eq (1) AND two from (energy lost from) - excretion / urine / eq (1) - inedible parts / parts not eaten / eq (1) - indigestible parts / faeces / egestion / eq (1) - death / decomposition / decay / some organisms not eaten / eq (1) - respiration / heat loss / eq (1) - movement /eq (1)	Allow converse for grass Allow fox is a secondary consumer from oak tree / tertiary consumer from grass / eq Allow fewer / 3, levels in oak tree food chain / eq Allow only rabbit / squirrel between tree and fox / eq Do not award two marks for excrete faeces	3

Question Number	Answer		Mark
3 (b)(i)	An answer that makes reference to the following. avoid bias / make sample representative / more accurate (result) / makes (survey) fair / eq (1)	Allow fair test / valid Ignore reliable	1

Question Number	Answer	Additional guidance	Mark
3 (b)(ii)	An explanation that makes reference to two of the following. - grid area / eq (1) - repeats / more quadrats / eq (1) - identify anomalies / calculate mean / average / to see if they are similar / eq (1)	Ignore larger quadrat	2

Question Number	Answer	Additional guidance	Mark
3 (b)(iii)	2925 (3)	Correct answer gains all three marks two marks for 4500 If answer incorrect then up to max 2 of: one mark for 4000 or 50 x 80 one mark for 500 or (20 x 50) / 2 one mark for 0.65 x OR 65/100 x	3

(Total for Question 3 = 11 marks)

Question Number	Answer	additional guidance	Mark
8(a) (i)	community / organisms and their (non-living) environment / habitat / eq (1)	allow biotic and abiotic factors	1

Question Number	Answer	additional guidance	Mark
8(a)(ii)	all of the of organisms of all species in an area / all organisms in an area / all species in an area / eq (1)	allow different species allow in habitat	1

Question Number	Answer	additional guidance	Mark
8(a)(iii)	all of one species / a species in an area / eq (1)	allow in habitat / ecosystem	1

Question Number	Answer	Mark
8 (b)	- direction (1) - producer / plant (1) - trophic (1) - heat / thermal (1) - respiration (1) - faeces / manure (1) - urine / urea / sweat (1) - bacteria (1)	8

Question Number	Answer	Mark
1(a)	D owl <i>A is incorrect because corn is a producer</i> <i>B is incorrect because the grasshopper is a primary consumer</i> <i>C is incorrect because the mouse is a primary consumer</i>	1

Question Number	Answer	Mark
1(b)	An explanation that makes reference to two of the following points: • <u>photosynthesis</u> (1) • (light energy to) <u>chemical</u> energy / ATP (1) • carbohydrate / sucrose / glucose / starch (1)	2

Question Number	Answer	Additional guidance	Mark
1(c)	An explanation that makes reference to three of the following points: • respiration / movement / heat loss (1) • egested / undigested / faeces / not absorbed / not assimilated (1) • excretion / urine / urea (1) • uneaten / bone / teeth / fur (1) • death / <u>decomposition</u> (1)	Excreted as faeces = 1	3

Question Number	Answer	Additional guidance	Mark
1(d)(i)	An explanation that makes reference to three of the following points: • hyphae / mycelium (1) • enzymes / named enzyme (1) • extracellular <u>digestion</u> / <u>digestion</u> outside fungus (1) • <u>absorption</u> / <u>absorbed</u> (1) • saprotrophic / saprophytic / saprobiontic (1)	Ignore breakdown Ignore reabsorbed Allow parasitic	3

Question Number	Answer	Mark
1(d)(ii)	C rabbit <i>A is incorrect because grass is not hunted by predators</i> <i>B is incorrect because the owl is a predator</i> <i>D is incorrect because the snake is a predator</i>	1

Question Number	Answer	Mark
1(e)	An explanation that makes reference to the following points: • takes long(er) / increases time / digestion slow(er) (1) • whole mouse has a small(er) surface area (to volume ratio) / chewed mouse has larg(er) surface area (to volume ratio) (1)	2

Total 12 mark



Question Number	Answer	Mark
7(a)(i)	The only correct answer is D oak tree A blackbird is not correct as it is not the producer B centipede is not correct as it is not the producer C earthworm is not correct as it is not the producer	1

Question Number	Answer	Mark
7(a)(ii)	The only correct answer is A blackbird is a secondary and tertiary consumer B earthworm is not a secondary and tertiary consumer	1

	C ground beetle is not a secondary and tertiary consumer D sparrowhawk is not a secondary and tertiary consumer	
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Question Number	Answer		Mark
7 (b)(i)	An explanation that makes reference to the following: • some light / colours / wavelengths reflected (1) • light falls on flowers / not on leaves / some does not fall on chloroplasts / chlorophyll / eq (1)	ignore shade allow not enough chloroplasts	2

Question Number	Answer	additional guidance	Mark
7 (b)(ii)	• producer to primary consumer $1.4 / 87 \times 100 = 1.61 \% (1)$ allow 1.6% • primary to secondary consumer $1.6 / 14 \times 100 = 11.4 \% (1)$ allow 11% 11.43% or ENERGY LOST producer to primary 98.4% (1) ENERGY LOST primary to secondary 88.6% (1) so student is incorrect primary to secondary consumer most efficient	must calculate % to score allow 1 mark for each correct calculation allow calc of energy lost	2

Question Number	Answer	Mark
7 (c)(i)	involuntary / automatic / does not involve the brain / spontaneous / without thinking / unconscious / eq (1)	1

Question Number	Answer	additional guidance	Mark
7 (c)(ii)	protects from predators / only exposes hard shell /eq (1)	ignore danger / harm /injury	1

Question Number	Answer	additional guidance	Mark
7(c)(iii)	An answer that makes reference to four of the following: (gene) mutation/ mutated gene / eq (1) - variation (1) - woodlice that roll up survive / not eaten /eq (1) - reproduce / eq (1) - pass on <u>alleles/ genes</u> (for rolling behaviour) (1)	allow converse allow converse not just pass on mutation /behaviour	4

total 13 marks

Question Number	Answer	Mark
4(a)(i)	C primary consumer <i>A is not correct as krill is not a predator</i> <i>B is not correct as prey is not a trophic level</i> <i>D is not correct as krill is not a secondary consumer</i>	1 comp

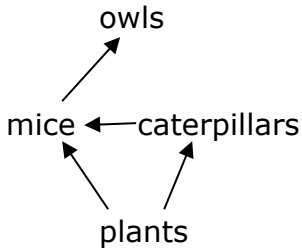
Question Number	Answer	additional guidance	Mark
4(a)(ii)	A sketch that shows the following points: • upright pyramid shape (1) • names in correct order: plants at bottom, krill in middle. whale at top (1)	ignore names ignore shape	2 grad

Question Number	Answer	Additional guidance	Mark
4(b)	division $10\,000 \div 1.6 = 6\,250\text{ s}$ division $\div 60 =$ $104.17 / 100 / 104 / 104.16$ recurring or $1.6 \times 60 = 96\text{ cm}^2$ per minute $10\,000 \div 96 =$ $104.17 / 100 / 104 / 104.2 / / 104.167 / 104.16$ recurring	award full marks for correct numerical answer without working allow 100 mins as 2 sig figs allow 1 mark for dividing by 1.6 or dividing by 96	2 exp

Question Number	Answer	Mark
4(c)	An answer that makes reference to the following points: • use container of sea water (1) • add same / stated number/ amount/ count number / mass of microscopic plants (1) • add stated number / mass of krill (1) • leave for same / stated time / measure time taken to (1) • (re)measure number / amount/mass / percentage change in plants(1) • repeat /eq (1)	4 exp

Question Number	Answer	Mark
4(d)	An explanation that makes reference the four of the following points: • fewer whales / whales die / migrate (1) • ice melts (1) • no / less surface for microscopic plants (1) • so fewer microscopic plants (available) (1) • fewer krill / krill die / migrate (1) • carbon dioxide causes acidification (1) • could affect krill (eggs) (1)	4 exp

Total = 13 marks

Question Number	Answer	Additional guidance	Mark
4(a)	An answer that makes reference to the following points: - arrows in correct direction (1) - food web includes four organisms (in correct places) (1)  <pre> graph BT plants --> mice plants --> caterpillars mice --> owls caterpillars --> owls </pre>	Allow MP1 if only one food chain plants →caterpillars →mice→owls = one mark No marks if more than one web drawn and one is incorrect	2 grad

Question Number	Answer	Mark
4(b)	primary consumer / 1^o consumer	1 cler

Question Number	Answer	Additional guidance	Mark
4(c)(i)	$3 \times 10^3 = 3000$ per km^2 (1) $\times 5 = 15\,000$ (1)	Allow $\times 5$ for one mark Allow 3000 for one mark Allow $1.5 \times 10^4 / 15 \times 10^3$ Award full marks for correct numerical answer without working	2 grad

Question Number	Answer	Additional guidance	Mark
4(c)(ii)	An answer that makes reference to three of the following points: • more food / plants / caterpillars / other sources of food available (1) • warmer weather (1) • fewer other predators / owls ate other species (1) • less disease / infection (1) • higher birth rate than death rate (1)	Ignore fewer owls	3 exp

Question Number	Answer	Mark
4(c)(iii)	An answer that makes reference to two of the following points: • feed on other prey (1) • insufficient food / energy to maintain more owls (1) • have no predators (1) • birth rate = death rate / birth rate and death rate are similar (1) • owls produce few offspring (so population will not rapidly increase) (1)	2 exp

Question Number	Answer	Mark
4(c)(iv)	An answer that makes reference to three of the following points: • use a trap / use filming / use a sample area / use a quadrat (1) • random sampling (1) • repeat (1) • count number of mice / faeces (in quadrat) (1) • calculate average (1) • multiply up to total area (1)	3 exp

Total 12 marks



Question Number	Answer	Additional guidance	Mark
2(a)(i)	plants → worms (that eat roots) → small arthropods → large arthropods → birds (dead) plants → fungi → small arthropods → large arthropods → birds (dead) plants → bacteria → small arthropods → large arthropods → birds	1 mark for 5 including birds correct order and 1 for arrow direction correct food chains with 5 and birds but lines or incorrect arrow scores 1 No credit for pyramid	2

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	A description that makes reference to three of the following • digest / decompose / decays / break down / eq (1) • enzymes (1) • saprophytic / saprotrophic / dead / eq (1) • respiration / produce ATP / (1)	ignore rot digestive enzymes = mp 1 and mp 2	3

Question Number	Answer	Mark
2(b)	An explanation that makes reference to three of the following • fewer birds / eq (1) • as fewer (large arthropods) to eat / less food / eq (1) • more worms / eq (1) • as fewer eaten (by small arthropods) / fewer predators of worms /eq (1)	3

Question Number	Answer	Additional guidance	Mark
2(c)	An answer that makes reference to five of the following 1. more mites collected (in all types/ each type of trap)/eq (1) 2. fewest arthropods collected (in all types/ each type of trap) / eq (1) 3. as more mites (in soil) / eq (1) 4. most mites collected by cul de sac traps / eq (1) 5. little difference in mite number between cul de sac and basket / eq (1) 6. fewest mites collected by pitfall traps /eq (1) 7. most springtails collected by basket / eq (1) 8. little difference in springtail numbers between cul de sac and basket / eq (1) 9. fewer springtails collected by pitfall / eq (1) 10.number of arthropods almost equal in all three traps / most arthropods collected in cul de sac/ eq (1) 11. Cul de sac collects most animals (in total) / Pitfall collects least (1)	no credit for quoting figs without comparator allow cul de sac most effective / best at collecting mites pitfall least effective at mites basket most effective with springtails pitfall least effective at springtails C most effective overall / P least effective	5

Total 13 marks

Question Number	Answer	Mark
7(a)(i)	The only correct answer is D zebra A is not correct as acacia is a producer B is not correct as lion is a secondary consumer C is not correct as star grass is a producer	1

Question Number	Answer	Mark
7(a)(ii)	The only correct answer is B star grass to baboon A is not correct as giraffe to cheetah is not least efficient C is not correct as wildebeest to wild dog is not least efficient D is not correct as zebra to lion is not least efficient	1

Question Number	Answer	Mark
7(a)(iii)	The only correct answer is B gazelle A is not correct as baboon is affected more C is not correct as wildebeest is affected more D is not correct as zebra is affected more	1

Question Number	Answer	Additional guidance	Mark
7(b)(i)	An explanation that makes reference to four of the following - not all organisms consumed / eq (1) - some die / decompose / eq (1) - some parts not eaten / bones / eq (1) - energy lost as heat / respiration / used in movement / muscle contraction / eq (1) - some food not digested / absorbed / egested / faeces / eq (1) - energy lost as excretion / urea / eq (1)	No credit for energy loss alone	4

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	A description that makes reference to four of the following - quadrat / eq (1) (placed) at random / use random number generator / eq (1) - count (number in each quadrat) / eq (1) - repeat / take average / eq (1) - multiply up / scale up to calculate numbers in area / eq (1)	quadrats = mp 1 and mp 4 ignore area coverage	4

Question Number	Answer	Additional guidance	Mark
7(c)	An explanation that makes reference to the following • weakest prey killed / faster / stronger survive / eq (1) • (strongest mate) / reproduce / weakest do not reproduce / eq (1) • pass on alleles / genes / genetic material / DNA / eq (1) • (sick animals removed) prevents infection / bacteria / virus / pathogen spreading / eq (1) • weak animals slow down herd / eq (1)	allow survival of fittest not sickness spreading	3

Total 14 marks

Question Number	Answer	Mark
7(a)(i)	producer / first / one / 1 (1)	1

Question Number	Answer	Mark
7(a)(ii)	tertiary consumer / third consumer / fourth / four / 4 (1)	1

	Answer	additional guidance	Mark
7(b)(i)	calculation method not marking points diameter = 7.5 cm = 75 mm (allow 7.4-7.6cm or 74-76mm) 75 mm = 75 × 1000 75000 μm magnification = 75000 ÷ 10 μm = × 7500 (2) (allow 7400 to 7600) ignore units in answer line	full marks for correct answer no working 1 mark for correct length <u>with correct units</u> or 1 mark for their measurement in μm ÷ 10 or 1 mark for their measurement in mm ÷ 0.01	2

	Answer	additional guidance	Mark
7(b)(ii)	calculation method not marking points radius = 5 4 × (3.14 × 125) / 3 = 523 allow (522 -524)(2)	full marks for correct answer no working allow 1 mark for × 125	2

		if they round 4/3 to 1.33 answer will be =522	
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	Answer	additional guidance	Mark
7(b)(iii)	A description that includes two of the following points: - absorbs / traps (sun)light / light energy / eq (1) - photosynthesis / eq (1) - produces glucose / carbohydrate / sugar / starch / eq (1)	ignore uses converts light energy into chemical energy scores mp 1 and mp 3	2

	Answer	Mark
7(b)(iv)	A description that includes the following points: - provides an energy store / energy reservoir / stores carbohydrate / eq (1) - respiration / eq (1)	2

	Answer	additional guidance	Mark
7(c)	A description that includes four of the following points: <u>quadrat</u> (1) - random / eq (1) - coordinates / grid / eq (1) - count number of individuals / plants / eq (1) - repeat / (calculate) mean / average / eq (1) - multiply by size of area / eq (1)	use quadrats = mp 1 and 5	4

Total 14 marks

Question Number	Answer	Mark
7(a)(i)	C (secondary consumer and tertiary consumer) <i>A is incorrect as it is not a primary consumer</i> <i>B is incorrect as it is not a primary consumer</i> <i>D is incorrect as it is also a tertiary consumer</i>	1

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	An answer that makes reference to the following: all of (the organisms of) <u>one</u> / <u>a species</u> in an area (at one time) / eq (1)	Accept amount of <u>a</u> species in an area / habitat / location eq Accept number of <u>a</u> species in an area / habitat / eq Accept number of <u>a</u> species in an ecosystem / eq	1

Question Number	Answer	Additional guidance	Mark
7(a)(iii)	An explanation that makes reference to three of the following: (energy lost) from movement / eq (1) (energy lost) from respiration / heat loss / eq (1) (energy lost) as not some not eaten / are inedible / eq (1) (energy lost) as some not digested / indigestible / faeces / egestion / eq (1) (energy loss) due to death and decay / (energy lost) to other food chains / eq (1)		3

	6. (energy lost) from excretion / metabolic waste / urine / eq (1)	Ignore excrete faeces but can still award mp4 for faeces	
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Question Number	Answer	Additional guidance	Mark
7(b)(i)	A description that makes reference to three of the following: • quadrat / square in <u>gridded</u> area (1) • place randomly / choose random coordinates / eq (1) • repeats / eq (1) • count limpets (in quadrat / square) / eq (1) • scale up for whole area multiply by area / eq (1)	Ignore quadrant quadrats = 2 marks (mp1 and mp3)	3

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	• time of day / location / area / position on shore / species of limpet / same day in August / eq (1)	Accept (day with same) weather Accept same type of limpet Accept same place Ignore season / time of year	1

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	An answer that makes reference to five of the following: - fossil fuel use releases carbon dioxide (1) - carbon dioxide is a greenhouse gas / may cause global warming / eq (1) - increased temperature reduces limpet number / eq (1) - less food /energy, for starfish / dogwhelks / gulls / eq (1) - dogwhelks / gulls / starfish / secondary consumers / would decrease / eq (1) - algae would increase / less algae eaten / more food for periwinkles (1) - there are anomalies / outliers / not all close to line of best fit (1) - other factors may affect limpet population / other greenhouse gases may have effect / eq (1) - not done for long enough time so less reliable OR done for long time / 17 years so reliable / eq (1) - data only for one month / only August / only one location / only one shore / only looks at one species / only measures limpets / no information about rest of food web / eq (1)	Accept fossil fuel use may cause global warming / climate change / temperature rise / eq Accept starfish eat more dogwhelks / dogwhelks eat more periwinkles Accept less food for other trophic levels / consumers / eq Accept starve for less food Accept die for decrease Accept more algae for periwinkles Accept few points at low temperatures / below 15°C / eq Accept named factors e.g. disease / predators / other pollutants e.g methane/ CFCs Accepts needs more repeats / there were no repeat experiments Accept needs to look at other species / other locations / other times	5

Question Number	Answer	Mark
8(a)(i)	The only correct answer is C (Y) <i>A is incorrect as T is combustion</i> <i>B is incorrect as X is consumption</i> <i>D is incorrect as Z is death</i>	1

Question Number	Answer	Mark
8 (a)(ii)	• photosynthesis (1)	1

Question Number	Answer	Additional guidance	Mark
8 (b) (i)	• CFCs / water (vapour) / eq (1)	Allow fluorinated gases e.g. hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride	1

Question Number	Answer	Additional guidance	Mark
8 (b)(ii)	An answer that makes reference to five of the following. - carbon dioxide (poses the greatest risk) (1) - carbon dioxide is released in high(est) amounts / eq (1) - carbon dioxide is produced by many human activities / fossil fuel use / eq (1) - carbon dioxide stays for long(est) time / eq (1) - carbon dioxide has low(est) global warming potential / GWP / eq (1) - methane has a high(er) GWP than carbon dioxide / has middle GWP BUT low(er) amount / second highest amount, released / more released than nitrous oxide / eq (1) - methane has a high(er) GWP than carbon dioxide / has middle GWP BUT methane does not last long / stays least time / eq (1) - nitrous oxide has high(est) GWP BUT has low(est) percentage released / eq (1) - nitrous oxide has high(est) GWP BUT stays less time than carbon dioxide / stays for a medium amount of time / eq (1)	Allow traps / absorbs heat for GWP If just quoting numbers, they need to be qualified e.g. ONLY 1 (GWP) Allow cement / vehicles / deforestation / eq Allow highest GWP BUT stays longer than methane	5

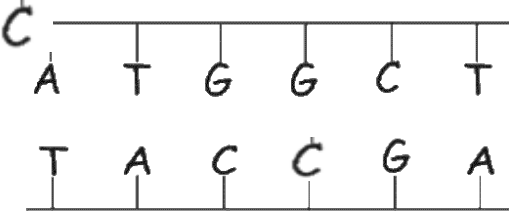
(Total for Question 8 = 8 marks)

Question Number	Answer	additional guidance	Mark
2(a)	An explanation that makes reference to four of the following points: • more (decomposition) /faster with warmer temperatures /eq (1) • enzymes (1) • more (decomposition)/ faster with cut material / eq (1) • more surface area (1) • fungi / bacteria (1)	allow mass remains high in low temp mass remains high in uncut allow converse	4 exp

Question Number	Answer	Additional guidance	Mark
2(b)	$6.0 - 3.6 = 2.4$ $2.4 \div 3 = 0.8$ $6.0 - 2.0 = 4.0$ $4.0 \div 3 = 1.3(3)$ $1.3(3) - 0.8 = 0.5(3)$ or could $4 - 2.4 = 1.6 \div 3 =$ or even $3.6 - 2 = 1.6 \div 3 =$ allow 0.5 or 0.53 or 0.533 etc for full marks	award full marks for correct numerical answer without working allow 1 for 2.4 and 4.0 or 1.3 and 0.8 and allow 1 for dividing by 3 so can get 2 marks for (2.4 and 4.0) and dividing by 3	3 exp

Question Number	Answer	additional guidance	Mark
2(c)	An answer that makes reference to two of the following points: • species/ type / of leaves / plant (1) • age of plant / leaves (1) • same (number of) / type of decomposers / eq (1) • insects or organisms that might consume leaf /eq (1)	ignore volume of leaves	2 grad

Total = 9 marks

Question Number	Answer	Mark
5(a)		1

Question Number	Answer	Mark
5(b)(i)	The only correct answer is C 7.5 <i>A is not correct as is not 2.5</i> <i>B is not correct as is not 4.5</i> <i>D is not correct as is not 8.5</i>	1

Question Number	Answer	Mark
5(b)(ii)	An explanation that makes reference to the following points: • lower / eq (1) • denatured / change in shape of active site / eq (1) • urea does not bind (into active site) / fewer E/S complexes / eq (1)	2

Question Number	Answer	additional guidance	Mark
5(c)	A description that makes reference to five of the following points: • nitrogen fixing / fixation (1) • (nitrogen fixing / fixation) nitrogen gas to ammonia (1) • nitrifying / nitrification (1) • (nitrifying / nitrification) ammonia to nitrite / nitrite to nitrate / ammonia to nitrate (1) • denitrifying /denitrification (1) • (denitrifying /denitrification) nitrate to nitrogen gas / reduces nitrogen available to plants / eq (1)	Allow nitrogen to nitrates / amino acids /eq eg nitrifying bacteria convert nitrate to nitrogen gas scores mp 3 but not mp 4	5

Total = 9 marks

Question Number	Answer	Mark
4(a)(i)	The only correct answer is A (P is nitrogen fixation) B is not correct as Q is not nitrogen fixation C is not correct as T is not nitrogen fixation D is not correct as V is not nitrogen fixation	1

Question Number	Answer	Mark
4(a)(ii)	The only correct answer is C (T is nitrification) A is not correct as Q is not nitrification B is not correct as U is not nitrification D is not correct as W is not nitrification	1

Question Number	Answer	Mark
4(a)(iii)	The only correct answer is D (W is denitrification) A is not correct as P is not denitrification B is not correct as T is not denitrification C is not correct as V is not denitrification	1

Question Number	Answer	Mark
4(b)(i)	A description that that makes reference to five of the following points: 1. increase in nitrates / phosphates/ eq (1) 2. <u>eutrophication</u> (1) 3. algal bloom / more algae / plants grow on surface / eq (1) 4. blocks sunlight / prevents photosynthesis /eq (1) 5. plants die / algae die / eq (1) 6. bacteria decompose / bacteria respire / microorganisms decompose / microorganisms respire /eq (1) 7. oxygen depleted / oxygen used (in respiration) / oxygen required (for respiration) / eq (1) 8. fish / aquatic organisms / die /eq (1)	5

Question Number	Answer	Mark
4(b)(ii)	• animal manure / dung / faeces / animal waste / eq (1)	1

Total = 9 marks

Question Number	Answer	Mark
11(a)(i)	carbon (cycle)	1

Question Number	Answer	Mark
11(a)(ii)	A <i>B is incorrect because it is decomposition increases CO₂</i> <i>C is incorrect because it is combustion increases CO₂</i> <i>D is incorrect because respiration increases CO₂</i>	1

Question Number	Answer	Mark
11(a)(iii)	An answer that includes two from: • bacteria / named correct genus / but not named bacteria (1) • fungi / <i>Mucor</i> / mould / named genus / but not named fungus (1)	2

Question Number	Answer	Mark
11(b)	An answer that makes reference to six of the following points: • C use at least two different stated temperatures (1) • O use same species of bacteria / fungi / same species of plant material (1) • R repeat each temperature / eq (1) • M1 measure change in mass / area of plant material / collect volume of gas / carbon dioxide / methane (1) • M2 measure after stated time (1) • S1 use same mass / volume / age / of plant material (1) • S2 use same moisture / humidity / oxygen / pH / soil / water / eq (1)	6

Total 10 marks

Question Number	Answer	Mark
3(a)	Carbon / C (1)	1

Question Number	Answer	Mark
3(b)(i)	The only correct answer is A W is combustion B is not the answer as W is not decomposition C is not the answer as W is not feeding D is not the answer as W is not respiration	1

Question Number	Answer	Mark
3(b)(ii)	The only correct answer is D X is respiration A is not the answer as X is not combustion B is not the answer as X is not decomposition C is not the answer as X is not feeding	1

Question Number	Answer	Mark
3(c)	bacteria / fungi / allow correct genus and species names (1)	1

Question Number	Answer	additional guidance	Mark
3(d)	A description that makes reference to six of the following points: • C different pH of organic material / add acid /alkali / add buffers/ eq (1) • O same organic material / plant / age / species / type / mass / volume of organic material(1) • R repeat (at each different pH) (1) • M1 measure <u>change</u> / <u>loss</u> in mass of organic material / initial mass – final mass /volume of carbon dioxide released / change in hydrogen-carbonate indicator / change in limewater /eq (1) • M2 after stated time period (1) • S1 same temperature / oxygen / eq (1) • S2 same water / same mineral ions / same humidity / same volume of each acid /alkali/ buffer / same bacteria / fungi / decomposer added / eq (1)	same state of decay or allow time taken M2 for same mass M1 to decompose 1 hour + allow same number of bacteria /decomposers / eq	6

total 10 marks

Question Number	Answer	Mark
4(a)(i)	The only correct answer is A B is not correct as B is not Nitrogen fixation C is not correct as C is not Nitrogen fixation D is not correct as D is not Nitrogen fixation	1

Question Number	Answer	Mark
4(a)(ii)	The only correct answer is D A is not correct as A is not decomposition B is not correct as B is not decomposition C is not correct as C is not decomposition	1

Question Number	Answer	Mark
4(a)(iii)	The only correct answer is C A is not correct as A is not nitrification B is not correct as B is not nitrification D is not correct as D is not nitrification	1

Question Number	Answer	additional guidance	Mark
4(a)(iv)	(nitrifying) bacteria / fungi allow correctly named genus / species (1)	ign denitrifying / nitrogen fixing bacteria / microorganisms	1

Question Number	Answer	Mark
4(b)(i)	An explanation that makes reference to two of the following points - compare / (look at growth in) test solution / without nitrate / eq (1) - compare with (growth of) control / shows normal growth /eq(1) - if control had no minerals / other minerals absent would not show normal growth (1)	2

Question Number	Answer	Mark
4(b)(ii)	remove nitrates / all minerals /eq (1)	1

Question Number	Answer	Mark
4(b)(iii)	An explanation that makes reference to two of the following points - block out light (from roots) /eq (1) - prevent photosynthesis (1) - prevent algal growth (1)	2

Question Number	Answer	Mark
4(b)(iv)	An explanation that makes reference to two of the following points - measure height / length / leaf area / mass of plants (1) - using ruler / balance / scales / eq (1) - of both solutions / seedlings complete with minus nitrates (1)	2

Total 11 marks

Question Number	Answer	Mark
4(a)	A denitrification / denitrifying (bacteria)(1) B nitrification / nitrifying (bacteria) (1) C nitrogen fixation / nitrogen fixing (bacteria) (1)	3

Question Number	Answer	additional guidance	Mark
4(b)(i)	$120 + 58 + 5 + 70 = 253$ 253×10^{12} 2.53×10^{14} (2)	full marks for correct answer allow 1 for 2.53 or 253 253×10^{12} scores 1	2

Question Number	Answer	additional guidance	Mark
4(b)(ii)	$40 + 100 + 60 + 5 = 205$ $40 / 205 \times 100$ 20% or 19.5 or 19.51 or 19.512 etc (2)	full marks for correct answer allow 1 for 205	2

Question Number	Answer	Mark
4(b)(iii)	An explanation that makes reference to two of the following: (biomass) contains proteins / amino acids / DNA / RNA / nucleic acids / eq (1) - N containing <u>compounds</u> (1) - produce nitrous oxides / oxides of nitrogen when burned / eq (1)	2

Question Number	Answer	additional guidance	Mark
4(c)	An explanation that makes reference to two of the following: • (nitrous oxide is a) greenhouse gas (1) • trap heat in atmosphere / absorbs IR radiation / prevents IR radiation escaping / eq (1) • increases / causes global warming (1)	not just heats up earth / atmosphere not just increases temp	2

total 11 marks

Question Number	Answer	Additional guidance	Mark
5(a)(i)	An explanation that makes reference to two of the following points: • to make amino acids / eq (1) • for protein (synthesis) / eq (1) • for growth / eq (1)	Accept DNA / RNA / chlorophyll Accept correct named protein Accept growth is slow without nitrates	2

Question Number	Answer	Mark
5(a)(ii)	• V nitrogen fixation / nitrogen fixing / nitrogen fixing bacteria (1) • X nitrification / nitrifying / nitrifying bacteria (1) • Y denitrification / denitrifying / denitrifying bacteria (1)	3

Question Number	Answer	additional guidance	Mark
5(b)(i)	An answer that makes reference to four of the following points: <i>Descriptions</i> - both increase / both have similar pattern up to 1970 / eq (1) - river nitrate more stable than nitrogen on fields / nitrogen on fields fluctuates / nitrogen on fields is more variable / relationship is less clear from 1980 / eq (1) <i>Explanations</i> Max 2 - nitrate leaches into river / washed into river / eq (1) - farmers add different amounts of nitrogen / fertiliser / nitrates to field / eq (1) - different crops are grown / eq (1) - river has other sources of nitrate / eq (1)	Accept nitrate in river increases as well as nitrogen on field Accept positive correlation Accept nitrogen on fields goes down (as well as up) Accept changes in rainfall	4

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	A description that makes reference to three of the following points: • more algal growth / eutrophication / algal bloom / growth of plants / eq (1) • (more) decomposers / bacteria / microorganisms / eq (1) • more turbidity / cloudiness / increased organic waste / less light penetration / eq (1) • less oxygen in river / anoxic / high BOD / eq (1) • fewer fish species / death of animals / death of organisms / lower biodiversity / fewer underwater plants / eq (1)	Accept use of oxygen by bacteria / eq	3

Total 12 marks

Question Number	Answer	Mark
3(a)(i)	The only correct answer is C thread-like hyphae <i>A is incorrect because fungi lack chloroplasts</i> <i>B is incorrect because fungi do not store starch</i> <i>D is incorrect because fungi walls are made of chitin</i>	1

Question Number	Answer	Mark
3(a)(ii)	The only correct answer is D maltose <i>A is incorrect because amino acids are products of protease digestion</i> <i>B is incorrect because fatty acids are products of lipase digestion</i> <i>C is incorrect because glycerol is a product of lipase digestion</i>	1

Question Number	Answer	Mark
3(a)(iii)	A description that makes reference to five of the following points: • <u>transcription</u> / <u>transcripts</u> / <u>transcribes</u> (1) • mRNA/messenger RNA and leaves <u>nucleus</u> / mRNA/messenger RNA and enters <u>cytoplasm</u> (1) • ribosomes (1) • tRNA/transfer RNA (brings) attached amino acids (1) • codons / anticodons / complementary bases (1) • <u>translation</u> / <u>translated</u> / <u>translates</u> / amino acid chain / polypeptide chain (1)	5

Question Number	Answer	Mark
3(b)(i)	70.475 to 70.5	1

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	(70.5 – 50 =) 20.5	Allow (answer from 3(b)(i) – 50) eg: 70.4 – 50 = 20.4	1

Question Number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that makes reference to four of the following points: • same surface area / mass / thickness / area / size (1) • remove soil from square (before weighing) (1) • control <u>temperature</u> / oxygen / moisture / water (1) • (soil) same mass / same amount / same volume / same type / same soil / decomposers / bacteria / fungi (1) • repeat / use more squares / obtain average / remove anomalies (1) • increase range of pH / use different pHs / more pHs (1)	Ignore more time Mp3 Ignore light / carbon dioxide Mp4 Ignore sterile soil	4

Total 13 marks

Question Number	Answer	Additional guidance	Mark
9 (a)	4.6 (2)	one mark for 4.625 / 4.63 Award full marks for correct answer	2

Question Number	Answer	Additional guidance	Mark
9(b)	A discussion that makes reference to five of the following: <i>Agreement:</i> 1. (anaerobic digesters) release less CO₂ / methane (1) 2. release less CO (1) 3. (because less CO₂ / less methane) there is less greenhouse effect / global warming / eq (1) 4. so less ice caps melting / habitat loss / climate change / other effects / flooding / coral reef damage / eq (1) 5. (because less carbon monoxide) less damage to haemoglobin / carboxyhaemoglobin / eq (1) 6. so less effect on oxygen transport / eq (1) <i>Disagreement:</i> 7. (however) anaerobic digesters release more sulfur dioxide (1) 8. (causing) acid rain (1) 9. which causes deforestation / kills fish in lakes / eq (1)	Accept less ocean acidification / extreme weather / desertification Accept other correct biological consequences of acid rain	5

Total for Question 9 = 7 marks

Question Number	Answer	Additional guidance	Mark
9(a)	A description that makes reference to three of the following points: • binds with haemoglobin / forms carboxyhaemoglobin (1) • (less) oxygen (1) • (less) respiration (1) • fatal / death / less growth / suffocation (1)	Less oxyhaemoglobin = 2	3

Question Number	Answer	Mark
9(b)	An explanation that makes reference to six of the following points: • pathogenic bacteria / cause disease (1) • urea / urine / nitrogenous waste / nitrate / phosphate (1) • <u>decomposition</u> / <u>decomposed</u> / <u>decomposers</u> (ONCE) (1) • eutrophication / plant growth / algae growth (1) • (plants) block light / prevents photosynthesis (1) • respiration (ONCE) (1) • (less) oxygen (1) • death of organisms (ONCE) / reduce biodiversity / eq (1)	6

Total 9 marks

Question Number	Answer		Mark
6(a)(i)	An answer that makes reference to one of the following points: • excess not absorbed / some washed away / eq (1) • water lost by osmosis / causes plants to wilt / less water taken in / eq (1) • crop already receiving sufficient nutrients / minerals / fertiliser / eq (1) • not limited by minerals / there are other limiting factors / other minerals (not in the fertiliser) are limiting / eq (1)	Accept cannot take up any more nutrients / minerals / fertiliser / eq Accept is already taking up maximum nutrients / minerals / fertiliser / eq Accept light / carbon dioxide / temperature is limiting / eq	1

Question Number	Answer	Mark
6(a)(ii)	An explanation that makes reference to five of the following: • (waterlogged) soil lacks oxygen / water fills up air spaces in soil / eq (1) • plant root cells cannot perform active transport / cannot take up minerals / eq (1) • leaching occurs / run off (into rivers / lakes) / eq (1) • causes algal bloom / increased plant growth / eutrophication / eq (1) • blocks (sun)light / less light (passes into water) / covers water surface / eq (1) • less / no photosynthesis (by underwater plants / algae) / eq (1) • (aquatic) plants / algae die / eq (1) • decomposers / bacteria (1) • respiration / eq (1) • less oxygen (in water) / water becomes anoxic / eq (1) • fish / (aquatic) organism die / suffocate / eq (1)	5

Question Number	Answer		Mark
6(b)	An explanation that makes reference to two of the following: - combines with <u>haemoglobin</u> / forms carboxy<u>haemoglobin</u> / eq (1) - prevents oxygen transport / less oxyhaemoglobin / oxygen cannot bind haemoglobin / eq (1) - less respiration / more anaerobic respiration / less energy released / more lactic acid formed / eq (1)	Accept forms carboxyhaemoglobin rather than oxyhaemoglobin for 2 marks Accept binds to haemoglobin instead of oxygen for 2 marks	2

Question Number	Answer	Mark
6(c)	The only correct answer is C (nitrogen) A is not the answer as it is a greenhouse gas B is not the answer as it is a greenhouse gas D is not the answer as it is a greenhouse gas	1

Total 9 marks

Question Number	Answer	Mark
11(a)(i)	An explanation that makes reference to 3 of the following points. • (sulfur dioxide) released dissolves in water (vapour) (1) • forms sulfuric acid (1) • acid rain (1) • causes damage to plants / deforestation / eq (1) • breathing problems for humans / animals / eq (1) • death of fish / aquatic organisms / eq (1)	3

Question Number	Answer	additional guidance	Mark
11(a)(ii)	• less burning / use of fossil fuels / named fossil fuel / low sulfur fuel / named example of alternative to using fossil fuels / eq (1)	allow examples use public transport / use wind power / cycling / electric/hybrid vehicles / etc	1

Question Number	Answer	additional guidance	Mark
11(b)	An answer that makes reference to 6 of the following points. • C with and without HCO_3^- / changes concentrations of HCO_3^- (1) • O use same species / age / size / strain / type of seedling /eq (1) • R repeat (for each concentration of HCO_3^-) (1) • M1 measure / yield / height / mass / count number of leaves / number of plants that germinate / eq (1) • M2 after <u>stated time</u> 48 hours + (1) • S1 control light / CO_2 / temperature /eq (1) • S2 control compost / water / humidity / moisture /minerals / fertiliser/ volume of solution / eq (1)	not just same time for M2	6 Exp

Total = 10

Question Number	Answer	Additional guidance	Mark
6(a)	An explanation that makes reference to two of the following points: - as distance from city centre increases, percentage coverage by lichen increases (1) - more cars in city centre / more car pollution in city centre (1) - more sulfur dioxide in city centre (1)	Allow correlation idea eg as lichen increases so does distance Allow converse Allow converse Allow converse	2 grad

Question Number	Answer	Additional guidance	Mark
6(b)	An answer that makes reference to three of the following points: - measure area of lichen (1) - measure the (total) area of stone (1) - divide (lichen) cover by total area and x 100 (1) - repeat (to find mean) (1)	Allow use a grid / quadrat to measure percentage cover / count squares with lichen	3 exp

Question Number	Answer		Mark
6(c)	An answer that makes reference to six of the following points: • C seeds exposed to SO₂ and not exposed to SO₂ / different concentrations of SO₂ (1) • O same species / age / variety/ type of seed (1) • R lots of seeds / repeat experiments (1) • M1 measure temperature change (1) • M2 using thermometer (1) • S1 thermos flask to contain seeds / insulate / prevent heat loss / eq (1) • S2 same moisture / humidity oxygen / water carbon dioxide / same starting temperature / light intensity / wash seeds with disinfectant / time / eq (1)	Allow seeds with metabisulphite and seeds without	6 exp

Total 11 marks

Question Number	Answer	Additional guidance	Mark
5 (a)(i)	48 (2)	One mark for division by 25 or 41200 – 40000 or 1200 correct answer gains full credit	2

Question Number	Answer	Additional guidance	Mark
5 (a)(ii)	An explanation that makes reference to three of the following: - carbon dioxide is a greenhouse gas / causes greenhouse effect / increased reflection of radiation / global warming / increased temperature / heat trapped / eq (1) - ice cap melting / glacier melting / sea level rise / flooding / habitat loss / eq (1) - climate change / weather pattern changes / droughts / storms / extreme weather / desertification / eq (1) - extinctions / change in distribution of organisms / migration / pest spread / food chains affected / ecosystem loss / eq (1) - ocean acidification / coral reef bleaching / eq (1)		3

Question Number	Answer	Additional guidance	Mark
5 (b)(i)	An explanation that makes reference to three of the following: - decomposition / decomposers / eq (1) (decomposer) bacteria / fungi (1) (organic waste) to ammonia / ammonification (1) - ammonium to nitrite / nitrite converted to nitrate (1) - nitrification / nitrifying bacteria (convert ammonium to nitrite / nitrite to nitrate / ammonium to nitrate) (1)	Ignore breakdown Allow decomposer bacteria for 2 marks Allow ammonia Ignore ammonium to nitrate	3

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation that makes reference to one of the following: - does not consider plants / bacteria / fungi / protocists / eq (1) - does not take into account the population sizes / numbers of organisms / abundance / some species may have different numbers / eq (1) - some species may be seasonal / migrate (1)		1

Question Number	Answer	Additional guidance	Mark
5 (b) (iii)	An explanation that makes reference to four of the following: • as nitrate increases, diversity decreases / deforestation reduces biodiversity / eq (1) • soil erosion / run off / leaching of minerals / leaching of nitrates / release of organic waste into river / eq (1) • eutrophication occurs / algae grow / (river) plants grow / eq (1) • less light penetration / eq (1) • death of plants / less photosynthesis (1) • (dead algae / organic waste) decomposes (1) • less oxygen / eq (1) • due to (bacterial) respiration (1) • fish / animal species die (1) • loss of food / disruption of food chains / loss of nesting sites / habitat / eq (1)	Allow converse Allow leaching occurs Ignore nutrients	4

Total 13 marks

Question Number	Answer	Additional guidance	Mark
1(a)	An answer that makes reference to the following points: • (all) living organisms / community / (different / all) species (1) • and environment / area / habitat / abiotic factors / non-living factors / physical factors (1)	Mp1 Ignore animals and plants	2

Question Number	Answer	Additional guidance	Mark
1(b)	An explanation that makes reference to the following points: • (animals get) glucose / oxygen / energy (1) • (algae get) carbon dioxide / protection / shelter / safety / cannot be eaten (1)	Mp1 Ignore food / nutrients Mp2 Ignore place to live / food	2

Question Number	Answer	Mark
1(c)(i)	An explanation that makes reference to the following points: • (sun)<u>light</u> (1) • photosynthesis (1)	2

Question Number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that makes reference to two of the following points: • supply food / algae / plankton (1) • supply minerals / ions / named mineral (1) • supply oxygen (1) • supply carbon dioxide (1) • remove waste / faeces / carbon dioxide (1) • distribute gametes (1)	Ignore nutrients / clean water / remove bacteria / cooling	2

Question Number	Answer	Additional guidance	Mark
1(d)	An answer that makes reference to the following points: • <u>quadrat</u> (1) • repeat (1) • random / random number (1) • count / measure / number of / percentage cover of coral (1) • calculate percentage by $\text{dead} \div \text{total} \times 100$ / $\text{dead} \div \text{living} + \text{dead} \times 100$ (1)	Allow quadrants for Mp 1 and 2 quadrats = Mp1 and Mp2 Allow bleached / white as eq to dead	3

Question Number	Answer	Additional guidance	Mark
1(e)	An answer that makes reference to the following point: there is less food / less coral to eat (1)	Ignore only source of food / only coral available	1

Question Number	Answer	Additional guidance	Mark
1(f)	An answer that makes reference to three of the following points: • reduce <u>greenhouse</u> gas / <u>greenhouse</u> effect (1) • reduce carbon dioxide / CFCs / methane / N₂O / ozone / HCFCs / HFCs emissions (1) • use less fossil fuel / fewer cars / fewer vehicles / less deforestation / use renewable sources of energy / solar / wind / hydroelectric / farm fewer cattle / cycling more / fewer aerosols / eq (1) • control/reduce predators / starfish / snails (1) • reduce tourism / fishing / diving / restrict access / cordon reef / eq (1) • reintroduce coral / plant more coral / grow coral in lab and place on coral / supply other surfaces for coral to grow (1)	Mp2 Ignore carbon emissions / carbon footprint Ignore pollution	3

Total 15 marks

Question Number	Answer	Mark
1(a)	regrows / maintained / does not run out / enough / sufficient / keep going / lasts / reliable / renewable / eq (1)	1

Question Number	Answer	additional guidance	Mark
1(b)	An answer that makes reference to two of the following points: - absorb water (1) - absorb mineral (ions) / named mineral ion (1)	ignore nutrients	2

Question Number	Answer	Additional guidance	Mark
1(c)	An answer that makes reference to three of the following points: Similarities: - both produce CO₂ (1) - both are burnt / release energy / used for heating / generate electricity / eq (1) Differences: - biofuel is carbon neutral / release CO₂ previously absorbed in growth / does not contribute (as much to) to greenhouse effect / global warming / climate change / eq(1) - biofuel is renewable (1)	allow converse for differences no credit for biofuel does not release greenhouse gas	3

Question Number	Answer	additional guidance	Mark
1(d)	An answer that makes reference to one of the following points: • use fences / barriers / eq (1) • kill / cull / hunt deer / introduce predator / named predator / eq (1)	ignore biological control unqualified	1

Question Number	Answer	additional guidance	Mark
1(e)	A description that makes reference to five of the following points: • in coppiced and non-coppiced woodland / before and after coppicing (1) • use quadrats (1) • repeat / take more than one reading (1) • place at random (1) • count / how many / number (of each) <u>species</u> / each plant / each type of plant (1) • control day / year / season / eq (1) • use same species / type / same / similar woodland / woodland with same biodiversity / same plant to be coppiced (1)	allow count how many species allow use Simpson's index but not just count organisms	5

Question Number	Answer	Mark
1(f)(i)	An answer that makes reference to one of the following: • more pollination / pollinators / bees / butterflies / eq (1) • more predatory insects / insects that eat pests / ladybirds that eat caterpillars / eq (1)	1

Question Number	Answer	Mark
1(f)(ii)	An answer that makes reference to one of the following: • more (insect) herbivores / caterpillars / eat / damage / destroy / become pest for crop / eq (1) • food for birds / mammals that eat crops (1)	1

Question Number	Answer	additional guidance	Mark
1(g)	An explanation that makes reference to two of the following points: • different / some plants / species prefer / grow (best) / thrive in / require / adapted to live in low light / high light / different light / eq (1) • less competition / eq (1) • so different / more species (1)	must state species for mp3	2

Total = 16 marks

Question Number	Answer	Mark
1(a)(i)	The only correct answer is B microscopic plankton <i>A is not correct because crustaceans are not producers</i> <i>C is not correct because sea birds are not producers</i> <i>D is not correct because turtles are not producers</i>	1

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is C human <i>A is not correct because crustaceans are not a tertiary consumer</i> <i>B is not correct because fin whales are not a tertiary consumer</i> <i>D is not correct because whale sharks are not a tertiary consumer</i>	1

Question Number	Answer		Mark
1(b)	An explanation that makes reference to five of the following points: • (less) food taken in / eaten / taken in (to stomach) / starve (1) • food cannot be digested / less digestion (1) • fewer amino acids / less glucose / fatty acids / glycerol (1) • less gas exchange / less air <u>taken</u> in / can't breathe / <u>air</u> cannot flow through trachea / bronchi / suffocate (1) • less oxygen (in blood) / less oxygen (to lungs) (1) • less carbon dioxide removed / eq (1) • less (aerobic) respiration / more anaerobic respiration (1) • less energy / ATP / more lactic acid (1)	Allow less energy idea from less food / glucose / eq ONCE	5

Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to the following points: • plastic concentrate (along food chain) / plastic increases in bodies (along food chain) / more plastic in higher trophic levels / plastic works along food chain / plastic builds up / eq (1) • humans at end of food chain / humans eat plastic when eating fish / eq / humans gain plastic from the fish (1) • less catch of fish / less food for humans (if fish populations decrease) (1)	Allow toxin for plastic Allow plastic not excreted / not removed from bodies / stay in the bodies	2

Question Number	Answer	Additional guidance	Mark
1(d)	• $2000 - 200 = 1800$ • $1800 \times 365 = 657\,000$ or $660\,000$ • $= 6.57 \times 10^5$ or 6.6×10^5 (3)	Award full marks for correct numerical answer without working Allow one mark for 1800 Allow two marks for 657 000 / 660 000 Allow two marks for any 6.57 / 6.6 with wrong power	3

Question Number	Answer	Additional guidance	Mark
1(e)	An explanation that makes reference to the following points: • reduced biodiversity / eq (1) • fewer species / lower populations (1) • fewer food sources / eq / fewer niches (1)	Allow some species become extinct/ die out Allow food chain disruption idea	2

Question Number	Answer	Additional guidance	Mark
1(f)	An answer that makes reference to two of the following points: • less microplastic produced (1) • fewer animals harmed / suffocated / killed / damaged / not eaten by animals (1) • broken down / digested / decomposed (1) • by microorganisms / bacteria / fungi (1)	Allow less bioaccumulation / less toxin passed along food chains / eq Ignore (bio)degrade	2

Total = 16 marks

Question Number	Answer	Mark
1(a)	The only correct answer is C (respiration) <i>A is incorrect as active transport does not produce ATP</i> <i>B is incorrect as diffusion does not produce ATP</i> <i>D is incorrect as transpiration does not produce ATP</i>	1

Question Number	Answer	Additional guidance	Mark
1(b)(i)	An explanation that makes reference to three of the following. • soil <u>erosion</u> / soil <u>erodes</u> (1) • fertiliser / organic material (1) • run off / leaching / washed in / eq (1) • (increased) magnesium / nitr<u>ates</u> / phosphate / minerals (1) • for correct matched function e.g. magnesium for chlorophyll production / nitrates for amino acids / nitrates for proteins (1) • (more) carbon dioxide for photosynthesis (1)	Allow roots do not hold soil together Allow other correct minerals Ignore nutrients Functions must be matched to minerals Ignore growth / repair	3

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation that makes reference to two of the following. - decomposition / decay / respiration / eq (1) (by) bacteria / fungi / microorganisms / microbes (1) - less photosynthesis (1)	Ignore rot Ignore breakdown Ignore viruses	2

Question Number	Answer	Mark
1(c)	The only correct answer is C (nitrifying) <i>A is incorrect as decomposers do not release nitrates</i> <i>B is incorrect as denitrifying bacteria do not release nitrates</i> <i>D is incorrect as nitrogen fixing bacteria do not convert ammonium to nitrates</i>	1

Question Number	Answer	Additional guidance	Mark
1(d)(i)	70 (2)	One mark for $\div 15$ or $\div 2$ or $\div 30$ or 1050 or 140 Correct answer gains all marks	2

Question Number	Answer		Mark
1(d)(ii)	An explanation that makes reference to four of the following. • mutation (produced glowing dinoflagellates) (1) • (produces) variation (1) • (glowing dinoflagellates) survive / not eaten / eq (1) • reproduce / make offspring / eq (1) • pass allele / gene (for glowing on to offspring) (1)	Allow converse for non glowing throughout pass allele gene onto offspring = 2 marks	4

Question Number	Answer		Mark
1(e)	An answer that makes reference to three of the following. • photosynthesis (1) • takes in carbon dioxide / less carbon dioxide in atmosphere / less carbon dioxide released / eq (1) • less / no use of electricity / eq (1) • less fossil fuel use / oil / coal / gas / eq (1) • less (enhanced) greenhouse effect / global warming (1) • less sulfur dioxide / less acid rain (1)	Ignore carbon neutral (in text) Allow will reduce carbon dioxide / less carbon emissions Allow less greenhouse gas	3

(Total for Question 1 = 16 marks)

Question Number	Answer	Additional guidance	Mark
1(a)	An explanation that makes reference to the following points: - burning of / combustion of / eq (1) (more) petrol / fuel / diesel / eq (1)	Ignore cars release carbon dioxide	2

Question Number	Answer	Additional guidance	Mark
1(b)	An explanation that makes reference to two of the following points: - carbon dioxide is a greenhouse gas / causes a greenhouse effect / eq (1) - traps (IR) radiation / prevents escape of (IR) radiation / traps heat / eq (1) - causes global warming / causes increase in temperature / eq (1)	Accept it is a greenhouse gas Accept absorbs heat Ignore traps light	2

Question Number	Answer	Additional guidance	Mark
1(c)	An explanation that makes reference to the following points: - carbon dioxide is a reactant / raw material / is needed for photosynthesis / eq (1) - carbon dioxide can be a limiting factor / eq (1)	Accept carbon dioxide is used in photosynthesis / required by photosynthesis Accept equation	2

Question Number	Answer	Additional guidance	Mark
1(d)	An explanation that makes reference to two of the following points: • (carbon sink) absorbs more CO₂ (than it releases) / eq (1) • respiration releases carbon dioxide / eq (1) • deforestation releases carbon dioxide by decomposition / decay / combustion / eq (1)	Accept fewer trees / deforestation results in less photosynthesis / less carbon dioxide absorbed	2

Question Number	Answer	Additional guidance	Mark
1(e)	A description that makes reference to three of the following points: • place leaves in test tubes / eq with hydrogen-carbonate indicator (1) • leaf in light and leaf in dark / eq (1) • in light, indicator turns purple / dark red / eq / in dark turns yellow / eq (1) • same size leaf / species leaf / same age of leaf / same time / same temperature / same volume of indicator / same concentration of indicator / eq (1)	Accept change distance of lamp / place in bright light and dark room / other correct method Accept stays orange in dim light Accept use pond weed Accept control for same	3

Question Number	Answer	additional guidance	Mark
1(f)	2 stomata in area of $0.4\text{mm} \times 0.4\text{mm}$ $= 0.04\text{ cm} \times 0.04\text{ cm}$ 2 in 0.0016cm^2 therefore density = $2 \div 0.0016$ stomata per cm^2 total number in 150 cm^2 $= 150 \times (2 \div 0.0016)$ $= 150 \times 1250$ $= \mathbf{187500\text{ stomata (3)}}$ OR $150 / 0.0016 = 93750$ $93750 \times 2 = 187500$	Allow full marks for correct answer no working If not correct answer, look for: Accept 1875 (or other versions e.g. 18750) for 2 marks Accept 93750 (or other versions e.g. 9.375) for 2 marks OR Accept $\div '16'$ (e.g. 0.0016 or 16) for 1 mark AND Accept $\times 150$ or 150 divided by another number for 1 mark	3

Question Number	Answer	Mark
1(g)	An explanation that makes reference to the following points: • water loss / transpiration / evaporation / diffusion (through stomata) / (set up) transpiration stream / eq (1) • draws water up from roots / up stem / up xylem / into leaf / creates a (water potential) gradient / eq (1)	2

Total 16 marks

Question Number	Answer	Additional guidance	Mark
1(a)	An explanation that makes reference to two of the following points: • (burning) <u>fossil</u> fuels / use <u>fossil</u> fuels / use coal / use oil / use gas / eq (1) • deforestation / cutting down trees (1) • increasing population / eq (1)	Ignore more cars / factories	2

Question Number	Answer	Mark
1(b)	An answer makes reference to one of the following points: • wind blows CO₂ away / eq (1) • (computer) maintain / control / alter CO₂ concentration (1) • (wind affects) stomatal opening / transpiration / concentration gradient / absorption of CO₂ / eq (1)	1

Question Number	Answer	Additional guidance	Mark
1(c)	An answer that makes reference to three of the following points: • (more valid) as similar to natural world / nature / eq (1) • different plants / ecosystem / more species / community / eq (1) • temperature / humidity / rain / light not maintained / controlled (1)	Allow converse for all Mps Mp 2 Ignore larger scale Mp3 Ignore wind direction / wind speed / monitored / pH / ions	3

Question Number	Answer	Additional guidance	Mark
1(d)	An explanation that makes reference to two of the following points: • CO₂ used / required / needed / taken in / absorbed / reactant for / eq (1) • produce carbohydrate / starch / glucose / sugar / eq (1) • low concentration limits (photosynthesis) / is limiting factor / eq (1)	Mp1 and Mp2 Allow if in equation	2

Question Number	Answer	Additional guidance	Mark
1(e)	A description that makes reference to four of the following points: • (weight / bubble) potometer / eq (1) • measure bubble movement / original and final position / change in mass / weigh and reweigh / eq (1) • reference to time / eq (1) • control of named abiotic factor / light / temperature / humidity (1) • repeat / obtain average (1)	Mp 4 Ignore cover soil or plant with polythene	4

Question Number	Answer	Mark
1(f)	An explanation that makes reference to the following points: • affects CO₂ absorption / eq (1) • affects water loss / transpiration / eq (1)	2

Question Number	Answer	Mark
1(g)	An answer that makes reference to three of the following points: • use renewable energy / wind / solar / eq (1) • use less <u>fossil</u> fuel / coal / oil / gas / eq (1) • use public transport / cycling / road tax / hybrid / electric cars / less cars / less vehicles / eq (1) • prevent deforestation / plant trees / eq (1) • fewer cattle (1) • less rice farming / paddy fields (1) • less CFC / methane (CH₄) / nitrous oxide (N₂O) / ozone (O₃) / chlorofluorocarbons (CFCs) / hydrofluorocarbons (HCFCs and HFCs) / air conditioning / refrigerator / aerosols / eq (1)	3

Total 17 marks

Question Number	Answer	Additional guidance	Mark
1(a)	An answer that makes reference to one of the following points: • maintenance of constant (internal) conditions in body / eq (1) • control / regulating / maintaining internal conditions / eq (1) • control / regulating / maintaining internal environment / eq (1) • keeping conditions in body the same / within a (narrow) range / eq (1)	Ignore just examples e.g. temperature / water	1

Question Number	Answer	Additional guidance	Mark
1(b)	• 250 (1)		1

Question Number	Answer	Mark
(c)(i)	The only correct answer is A (cell wall and cytoplasm only) B is not the answer as bacteria do not have nuclei C is not the answer as bacteria do not have nuclei D is not the answer bacteria do not have nuclei	1

Question Number	Answer	Additional guidance	Mark
1(c)(ii)	An explanation that makes reference to the following points: - fertilisers / animal waste / minerals / nitrates / phosphates (run off / leach) / eq (1) - algal growth / eutrophication / eq (1) - less light (penetrates) / competition for light / less photosynthesis / eq (1) - decomposition / decay (of dead algae / plants / organisms / organic waste / manure / faeces / sewage) eq (1) - less oxygen / only anaerobic species grow / eq (1) - bacteria <u>respire</u> / other species cannot <u>respire</u> / reduced <u>respiration</u> / eq (1) - pesticides kill organisms / eq (1)	Accept other named correct minerals e.g potassium Ignore nitrogen / phosphorus Accept algal bloom Accept plants / producers grow Accept sewage fungus blocks light Accept becomes anoxic Accept decomposers <u>respire</u>	4

Question Number	Answer	Additional guidance	Mark
1(d)(i)	An answer that makes reference to one of the following points: - eggs / ova / follicles, do not mature / do not grow / eq (1) (FSH is required to) mature eggs / ova / follicles (1) (low FSH leads to) less oestrogen / (FSH) stimulates oestrogen release (1)	Accept female gametes Ignore prevents ovulation / FSH stimulates ovulation	1

Question Number	Answer	Additional guidance	Mark
1(d)(ii)	An answer that makes reference to one of the following points: - no ovulation occurs / egg not released / ova not released / eq (1) - LH / it stimulates ovulation / LH / it stimulates egg release / eq (1) (lower LH leads to) less progesterone / LH / it stimulates progesterone (1)	Accept female gametes	1

Question Number	Answer	Additional guidance	Mark
1(e)(i)	An explanation that makes reference to two of the following points: - less water absorbed / less water enters blood / less water enters capillaries / eq (1) (water moves by) <u>osmosis</u> (1) - water potential in blood is high(er) / water potential in gut / faeces / lumen is low(er) / eq (1)	Accept water does not enter blood Accept water moves from blood into faeces / gut / lumen / eq Reject water absorption in kidneys Reject salt moves by osmosis Accept blood is dilute / water concentration in blood is high(er) / water concentration in faeces / gut / lumen is low(er) Accept salt <u>concentration</u> of faeces is high(er) / salt <u>concentration</u> of blood is low (er) Accept correct reference to water potential gradient / concentration gradient	2

Question Number	Answer	Additional guidance	Mark
1(e)(ii)	An explanation that makes reference to three of the following points: 1. mutation (1) 2. (only resistant bacteria) survive / are not killed / non-resistant bacteria are die / eq (1) 3. bacteria reproduce / multiply / eq (1) 4. pass on allele / gene / mutation / eq (1)	Ignore immune Accept survival of fittest Accept breed / offspring	3

Question Number	Answer	Additional guidance	Mark
1(f)(i)	An explanation that makes reference to two of the following points: • (denitrifying bacteria convert) nitrate into nitrogen (1) • so less eutrophication / less algal growth / more oxygen in river / lower BOD / eq (1) • wood chips have large surface area (for bacteria) / wood chips are biodegradable (so do not pollute) / eq (1)	Accept nitrite to nitrogen Ignore less pollution	2

Question Number	Answer	Additional guidance	Mark
1(f)(ii)	An explanation that makes reference to two of the following points: 1. trees / roots absorb water / trees intercept water / eq (1) 2. (more) <u>transpiration</u> (1) 3. less runoff / slows down water flow / more soil permeability / more infiltration / eq (1) 4. less soil erosion / roots hold onto soil / roots stabilise soil / eq (1) 5. rivers do not get blocked (with soil) / eq (1)	Accept substrate for soil Accept trees for roots Accept do not silt up	2

(Total for Question 1 = 18 marks)

Question Number	Answer	Mark
(a)(i)	The only correct answer is B (carbon dioxide and water) A is not the answer as lungs do not excrete urea C is not the answer as lungs do not excrete urea D is not the answer lungs do not excrete urea	1