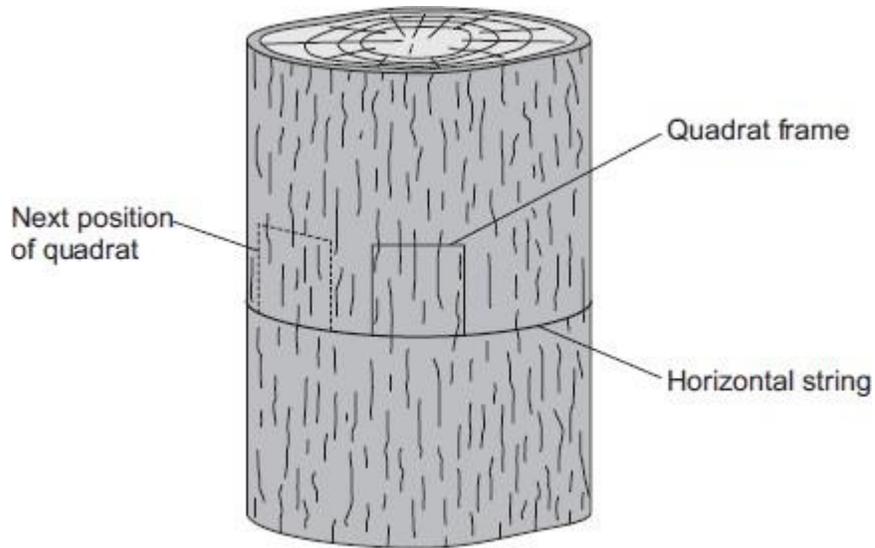


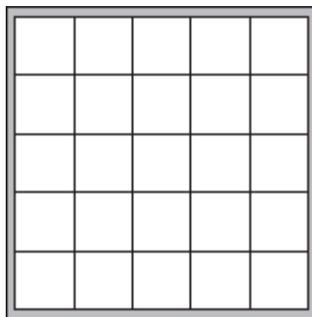
1 Students investigated the distribution of a green alga on a tree trunk.



The students:

- tied a piece of string horizontally round a tree
- put a quadrat on the string so that the quadrat faced south
- estimated the percentage of the area in the quadrat covered with the green alga
- repeated the observation with the quadrat facing south west, west, north west, north, north east, east and south east.

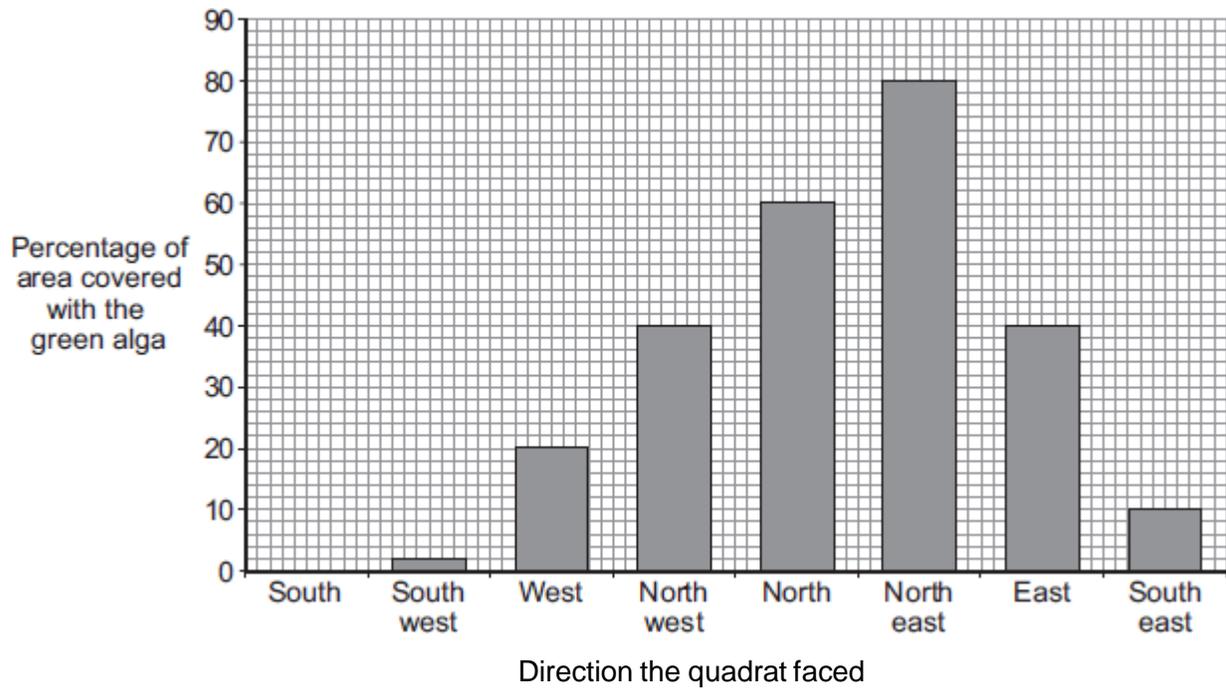
(a) The diagram shows the quadrat the students used.



Describe how you would estimate the percentage of the area covered with the green alga in one quadrat.

(2)

(b) The bar chart shows the students' results.



(i) How does the direction that the quadrat faced affect the percentage area covered with the green alga?

(2)

(ii) What was the mode of the percentage area covered with the green alga?

Mode = _____%

Give the reason for your answer.

(2)

(iii) Give **three** environmental factors that might affect the distribution of the green alga on the tree.

1. _____
2. _____
3. _____

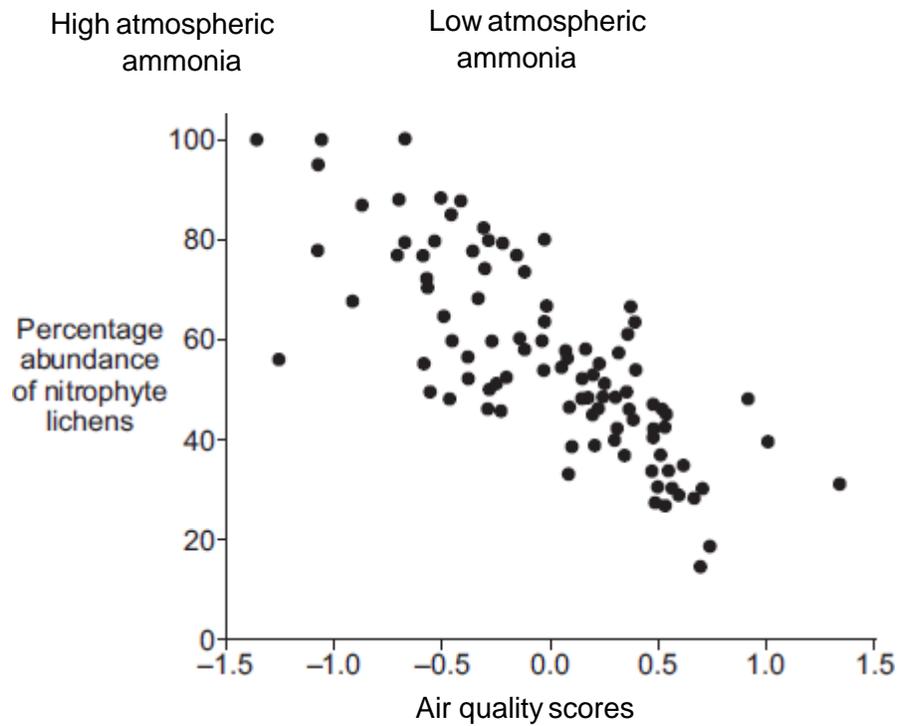
(3)

- (iv) Suggest how **one** of the factors you gave in part **(b) (iii)** might have caused the distribution of the green alga shown on the bar chart.

Factor _____

(3)

- (c) Nitrophyte lichens grow on the bark of trees. These lichens are indicators of air pollution by ammonia. Ammonia concentrations in the atmosphere are often high in agricultural areas. The graph shows the relationship between air quality and the distribution of nitrophyte lichens.



© U.S. Department of Agriculture

- (i) Describe the relationship between atmospheric ammonia and the abundance of nitrophyte lichens.

(2)

- (ii) How useful would a particular value for the abundance of nitrophyte lichens be as an indicator of ammonia pollution of the atmosphere?
Explain your answer.

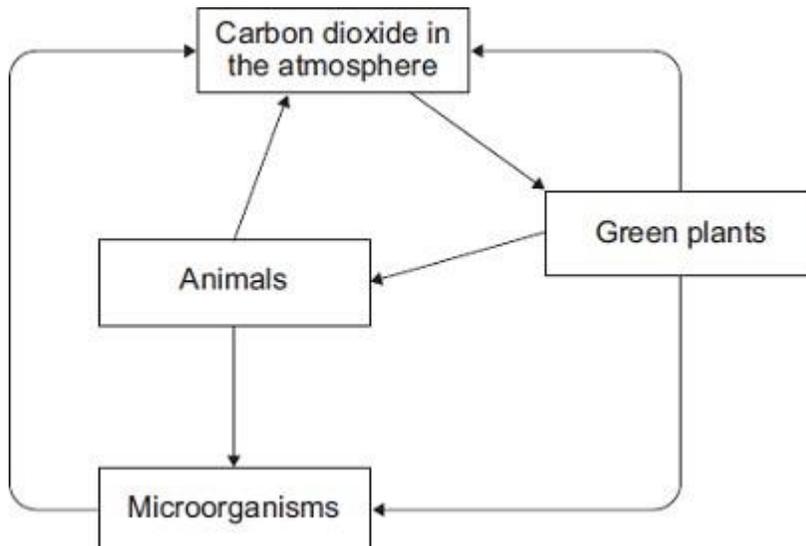
(2)

(Total 16 marks)

2

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The diagram shows part of the carbon cycle.



3

In the winter wild birds cannot find food easily.

A student carried out an investigation to find the best kind of food to put out for wild birds in winter.

- She nailed six black dishes to a piece of wood.
- She put 100 g of a different type of seed into each dish.
- She placed the piece of wood in her garden.
- She observed the birds that visited each of the dishes before school, after school and at weekends.
- At the end of the investigation, she weighed the amount of each type of seed remaining.
- She also calculated the percentage of each type of seed that was eaten by the birds.

(a) Name **two** control variables in this investigation.

1. _____

2. _____

(2)

(b) **Table 1** shows the number of bird visits to each dish of seeds that she recorded.

Table 1

Bird species	Number of visits to each dish of seeds					
	Corn	Niger	Safflower	Sunflower	Peanut	Millet
Morning Dove	12	10	6	13	2	10
Red-bellied Woodpecker	1	0	0	1	4	0
Dark-eyed Junco	3	6	1	4	0	3
Northern Cardinal	0	0	1	1	2	0
American Goldfinch	0	31	5	18	0	0
House Finch	1	5	23	19	1	3
House Sparrow	16	1	0	4	0	11
Total visits	33	53	36	60	9	27

Which type of seed had visits from the greatest number of **different** bird species?

(1)

- (c) **Table 2** shows:
- the percentage of each type of seed eaten
 - the percentage of fat in each type of seed.

Table 2

Type of seed	Percentage eaten	Percentage of fat
Corn	68	2
Niger	77	40
Safflower	86	3
Sunflower	91	35
Peanut	4	48
Millet	99	2

- (i) The girl concluded that the most popular seeds for the birds were the seeds with the highest percentage of fat.

Was her conclusion justified by the data in **Table 2**?

Draw a ring round your answer. **Yes / No**

Give a reason for your answer.

(1)

- (ii) Most winter bird food for sale in shops contains niger and sunflower seeds. Use the information in **Table 1** and **Table 2** to suggest **two** reasons why.

1. _____

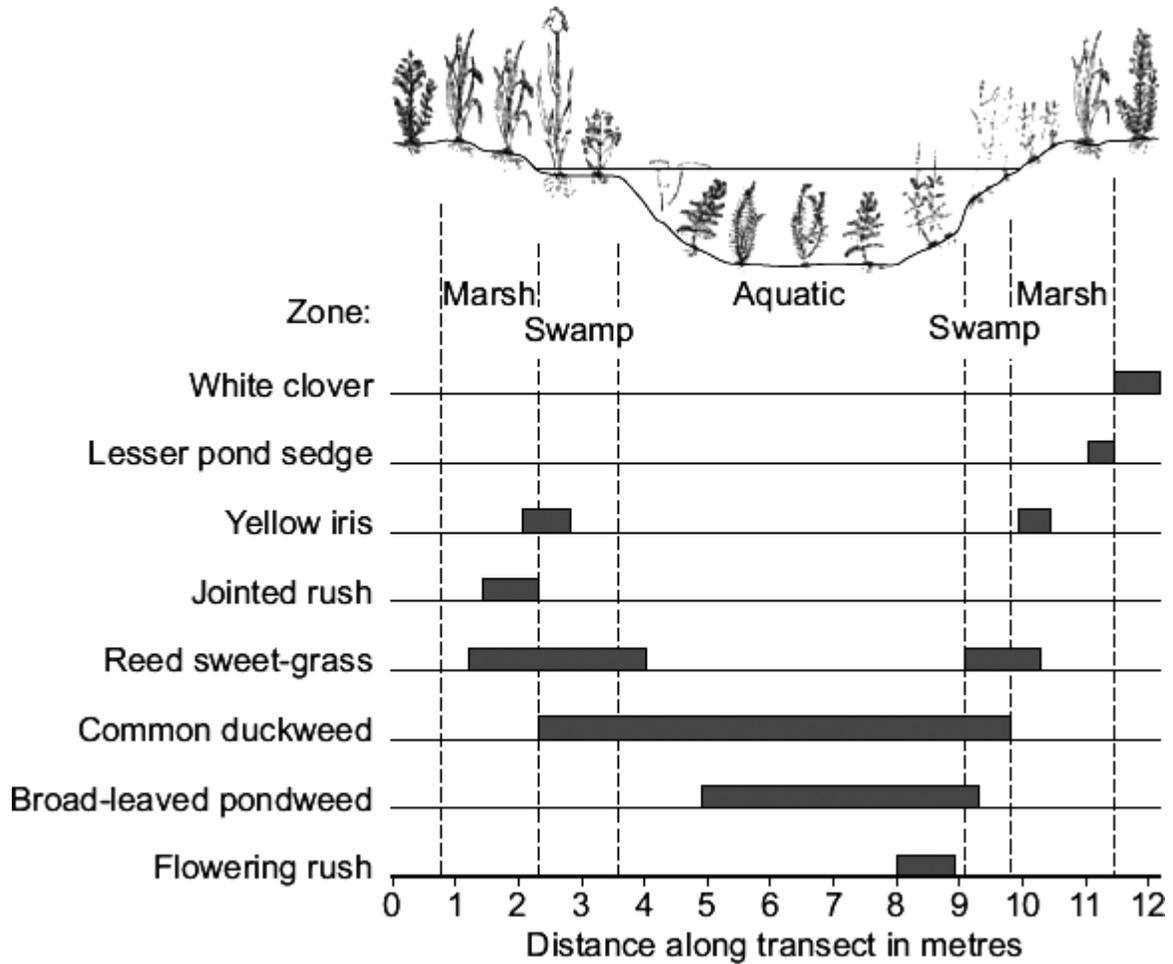
2. _____

(2)

(Total 6 marks)

- 4 Some students investigated the distribution of some of the plants growing in and around a shallow stream. They sampled along a transect line.

The diagram shows their results.



- (a) (i) Name the **one** species that grew only in the driest conditions.
- _____
- (1)
- (ii) Only **one** species grew in the marsh, the swamp and in the aquatic zones.
- Which species?
- _____
- (1)
- (iii) Duckweed grows floating in water. What evidence is there for this in the students' results?
- _____
- _____
- (1)

(b) The photograph shows cocklebur fruits.



Photograph by Robert H. Mohlenbrock. Image in the public domain as a work of the U.S. federal government. Courtesy of USDA NRCS Wetland Science Institute.

The photograph is magnified.

Suggest how cocklebur fruits are adapted for dispersing their seeds.

(2)
(Total 4 marks)

7

An animal called *Tiktaalik* became extinct about 360 million years ago.

The photograph shows the fossilised skeleton of *Tiktaalik* and a model of what scientists think *Tiktaalik* looked like.

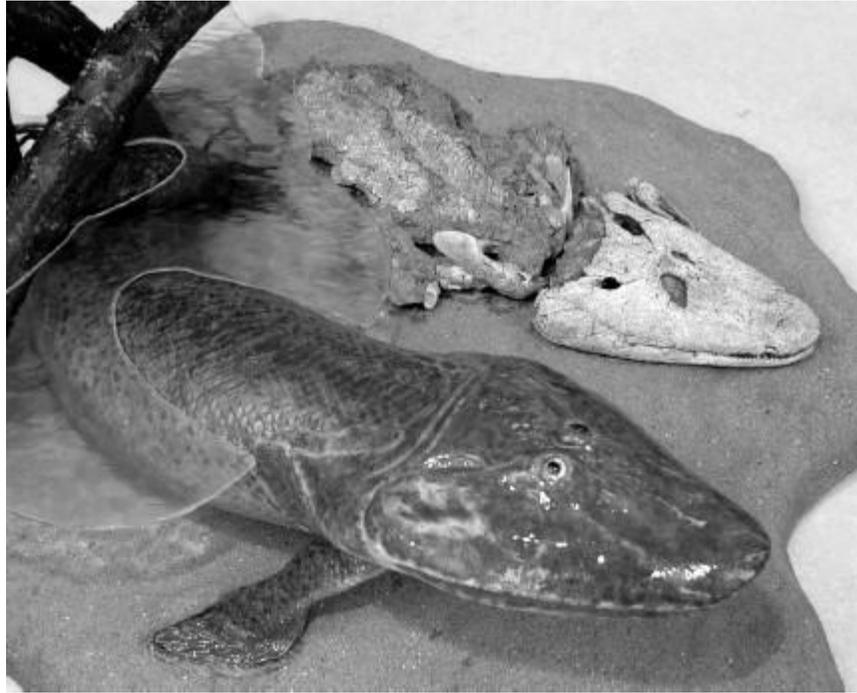


Image © University of Chicago, Shubin Lab. Model by Tyler Keillor

(a) Scientists found only the fossilised skeleton of *Tiktaalik*.

Explain why.

(2)

(b) Scientists think that *Tiktaalik* lived mostly in water, but that it was one of the first animals to be able to move onto land.

Use evidence from the photograph to suggest why.

(2)

(Total 4 marks)

8

The photograph shows a lionfish. Lionfish are normally found in the Pacific Ocean.



By Albert Kok at nl.wikipedia [Public domain], from Wikimedia Commons

In 1992 six lionfish escaped from an aquarium into the Atlantic Ocean.

Now there are thousands of lionfish in the Atlantic Ocean. Numbers of the native Atlantic fish have gone down because the lionfish have eaten many native Atlantic fish.

Suggest explanations for the large increase in the number of lionfish in the Atlantic Ocean.

(Total 3 marks)

Mark schemes

- 1 (a) estimate / count number of squares covered
*do **not** allow number of squares containing algae* 1
- divide by total number of squares and multiply by 100 / multiply by 4 1
- (b) (i) any **two** from:
- more / most in North east facing
 - followed by the North facing
 - the South facing had no green alga / least
- 2
- (ii) 40 (%) 1
- two directions had this value (rest of directions had only one)
accept this is the most common percentage / value
2nd mark only if 40(%) 1
- (iii) any **three** from:
- light / sunlight
ignore Sun / carbon dioxide
 - temperature
*do **not** accept oxygen*
 - availability of water / humidity
 - availability of nutrients
 - wind
 - pollution qualified eg SO₂, acid rain, soot
 - grazing by animals eg slugs
 - competition with other species
 - pH
- 3
- (iv) eg (*for light*)
allow overlap between factors
- light intensity *least* on north / north east facing parts of tree (1) 1
- green algae adapted for photosynthesis in low light intensities (1)
allow, since less light from Sun, cooler so less evaporation 1
- negative effect of high light intensity on green algal chlorophyll / photosynthetic pigments (1)
allow green algae unable to withstand desiccation 1

or (*for temperature*)

temperature highest on south (and west) facing parts of tree

(causing) more water to evaporate from this side of tree

green algae unable to withstand desiccation

or (*for moisture / rainfall*)

rainfall highest on north / north east facing parts of tree (1)

(giving) more moisture on this part of tree (1)

green algae less likely to desiccate (1)

or (*for wind*)

wind speed / duration greatest on south (and west) facing parts of tree (1)

(causing) more water to evaporate from this side of tree (1)

allow wind carries pollutants

allow pollutants toxic to algae

green algae unable to withstand desiccation (1)

or (*from pollution*)

from south / south west (1)

wind carries pollutants (1)

pollutants toxic to / kill algae (1)

- (c) (i) as the concentration of ammonia increases so does the % abundance of nitrophyte lichens

allow positive correlation / proportional

allow directly proportional

1

scattered results / wide spread

allow use of approximate numbers to demonstrate scattering

or

for any value of one parameter there is a wide range of the other

allow not a strong relationship / correlation

1

- (ii) not very useful / unreliable
accept only gives a rough idea / only a general indication

1

for any value of one parameter there is a wide range of the other
allow correlation rather than direct relationship

or

scattered results

1

[16]

2

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#).

0 marks

No relevant content.

Level 1 (1-2 marks)

For at least one process **either** the organism that carries it out **or** the carbon compound used **or** the carbon compound produced is described **or** for at least one organism **either** the carbon compound it uses **or** the carbon compound it produces is described **or** at least one process is named

Level 2 (3-4 marks)

For some processes (at least one of which is named) **either** the organisms involved **or** the carbon compounds used **or** the carbon compounds produced are described

Level 3 (5-6 marks)

For at least one named process an organism **and** either the carbon compound used for the process **or** the carbon compound produced by the process are described **and** for other processes (at least one of which is named) **either** the organism **or** the carbon compounds used **or** the carbon compounds produced are described (as in Level 2)

Examples of Biology points made in the response:

- (green) plants photosynthesise
- photosynthesis takes in carbon dioxide
- (green) plants use carbon to make carbohydrate / protein / fat / organic compounds / named (e.g. enzymes / cellulose)
- animals eat (green) plants (and other animals)
- (green) plants respire
- animals respire
- respiration releases carbon dioxide
- (green) plants and animals die
- microorganisms decay / decompose / rot / break down / feed on dead organisms
- microorganisms respire

[6]

3

(a) any **two** from:

ignore size of dish

- colour of dish **or** all dishes black
- (same) amount of each seed
- position of dishes **or** all dishes in same place / garden

ignore wood

- time observed / visited / left

2

(b) sunflower

1

(c) (i) (No)

named seed does not fit pattern

or

millet / safflower / corn eaten a lot but have little fat

or

the seed with the highest percentage eaten has least fat

accept converse

1

(ii) *allow separate references to sunflower and niger*

table 1 mark

- highest number of visitors **or** large range of visitors
allow most popular

1

table 2 mark

- high percentage eaten

or

contain high fat for energy / insulation
allow most eaten

1

[6]

4

(a) (i) (white) clover

1

(ii) reed sweet-grass
allow reed
allow grass

1

(iii) (only) found in swamp and aquatic zones **or** only found in water
or doesn't grow in marsh
ignore wet conditions

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a basic description which describes how a quadrat **or** a metre tape could be used to collect data

Level 2 (3-4 marks)

There is a clear description of how a quadrat **and** a metre tape could be used to collect data along a line

Level 3 (5-6 marks)

There is a clear, logical and detailed description of a method that will produce valid, repeatable results across / at intervals along the stream.

examples of procedural points made in the response:

- use of tape measure to produce transect
- placing of quadrats
- transect placed across stream
- score presence of each plant species
- use quadrat at regular intervals along tape
- repeat transect several times (≥ 3)
- along stream
- at random **or** regular intervals

6

[9]

- 5** Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is at least one example of an adaptation of either an animal **or** a plant. However it may not be clear how the adaptation helps the organism to avoid being eaten.

Level 2 (3-4 marks)

There is a description of an adaptation of at least one animal **and** at least one plant. It is clear how at least one of these adaptations helps the organism to avoid being eaten.

Level 3 (5-6 marks)

There are clear and detailed descriptions of a range of adaptations of named animals **and** named plants. It is clear how most of these adaptations help the organisms to avoid being eaten.

examples of clear and detailed biology points made in response:

- **camouflage** – the method of camouflage should be described plus a statement that the predator is less likely to see the prey
- **mimicry / warning colouration** – the method should be described plus a statement that the predator is likely to confuse the prey with e.g. a poisonous organism
- **thorns / prickles / spines / horns** – a statement that these are sharp and are likely to hurt a predator
- **long limbs / streamlining** – a statement that these increase speed and make it more likely that prey will outrun predator
- **bad taste / poison** – a statement that predator will find this unpleasant and ‘spit out’ prey / not attack same prey again
- **large ears / position of eyes** – a statement that predators will be detected earlier so the prey can escape sooner

[6]

6

(a) (reduced) competition

ignore fighting

1

for any **one** from:

- light
ignore Sun
- water
- nutrients / ions / salts / minerals
ignore food
- space
allow less overcrowding
- colonise new areas

1

(b) hooks

allow spines

1

attach to animals / human clothing / animals carry fruits long distances

ignore wind dispersal

1

[4]

7 (a) (soft) body parts / other parts / named parts

accept flesh

1

decayed / decomposed / rotted / eaten

or

bones do not decay / decompose / rot / get eaten

ignore disintegrated / dissolved

ignore microorganisms

1

(b) any **one** aquatic feature from: eg

- streamlined body shape
- long tail
- eyes on top of head
- scales
- fins / paddles / flippers / webbed feet

ignore gills

1

any **one** terrestrial feature from:

- (front) legs / limbs / hands
- could lift front end upwards

ignore feet

accept for 2 marks eg fin / flipper can be used for walking

or *fins like legs*

1

[4]

8 there are no / few predators of the lionfish

or spines protect lionfish from predation

allow warning colouration / poisonous

or no / fewer disease organisms

1

predators / prey in Atlantic do not recognise lionfish

or not fished by humans

allow high reproduction

1

also there is abundant food in Atlantic
or there is no / less competition in Atlantic

ignore adaptation to new environment

1

[3]