

1 Ragwort is a plant that often grows as a weed in grassland.

The image below shows a ragwort plant.



© Difydave/iStock

Some students estimated the number of ragwort plants growing in a field on a farm.

The students:

- placed a quadrat at 10 random positions in the field
- counted the number of ragwort plants in each quadrat.

The quadrat measured 1 metre  $\times$  1 metre. The area of the field was 80 000 m<sup>2</sup>.

The table below shows the students' results.

Quadrat number	Number of ragwort plants
1	1
2	0
3	3
4	0
5	0
6	0
7	5
8	0
9	0
10	2

- (a) Complete the following calculation to estimate the number of ragwort plants in the field.

Use information from the table above.

Total number of ragwort plants in 10 quadrats = \_\_\_\_\_

Mean number of ragwort plants in 1 m<sup>2</sup> = \_\_\_\_\_

Therefore estimated number of ragwort plants in field = \_\_\_\_\_

(2)

- (b) What could the students do to get a more accurate estimate?

Tick (✓) **one** box.

Place the quadrat in 100 random positions.

Place the quadrat only in areas where they could see ragwort plants.

Place the quadrat in positions at the edge of the field.

(1)

(c) The farmer who owned the field kept horses.

If horses eat ragwort, the ragwort can poison them.

The farmer considered two methods of controlling ragwort in his field.

**Method 1:** Spraying with a selective weed killer

**Method 2:** Pulling out the ragwort plants by hand

In **Method 1:**

- the cost of the weed killer was £420
- the weed killer would not harm the grass but would kill all other plants
- the farmer could apply the weed killer from a sprayer towed by a tractor.

**Method 2** could be done by local volunteers.

What are the advantages and disadvantages of using **Method 2** instead of **Method 1** for controlling ragwort?

Advantages of **Method 2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Disadvantages of **Method 2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

(Total 6 marks)

**2**

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

<b>clones</b>	<b>chromosomes</b>	<b>embryos</b>	<b>genes</b>
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GM crops are produced by cutting \_\_\_\_\_ out of the  
\_\_\_\_\_ of one plant and inserting them into the cells of a crop  
plant.

(2)

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. \_\_\_\_\_  
\_\_\_\_\_

2. \_\_\_\_\_  
\_\_\_\_\_

**(2)**

(ii) Give **two** reasons why many people are against the growing of GM crops.

1. \_\_\_\_\_  
\_\_\_\_\_

2. \_\_\_\_\_  
\_\_\_\_\_

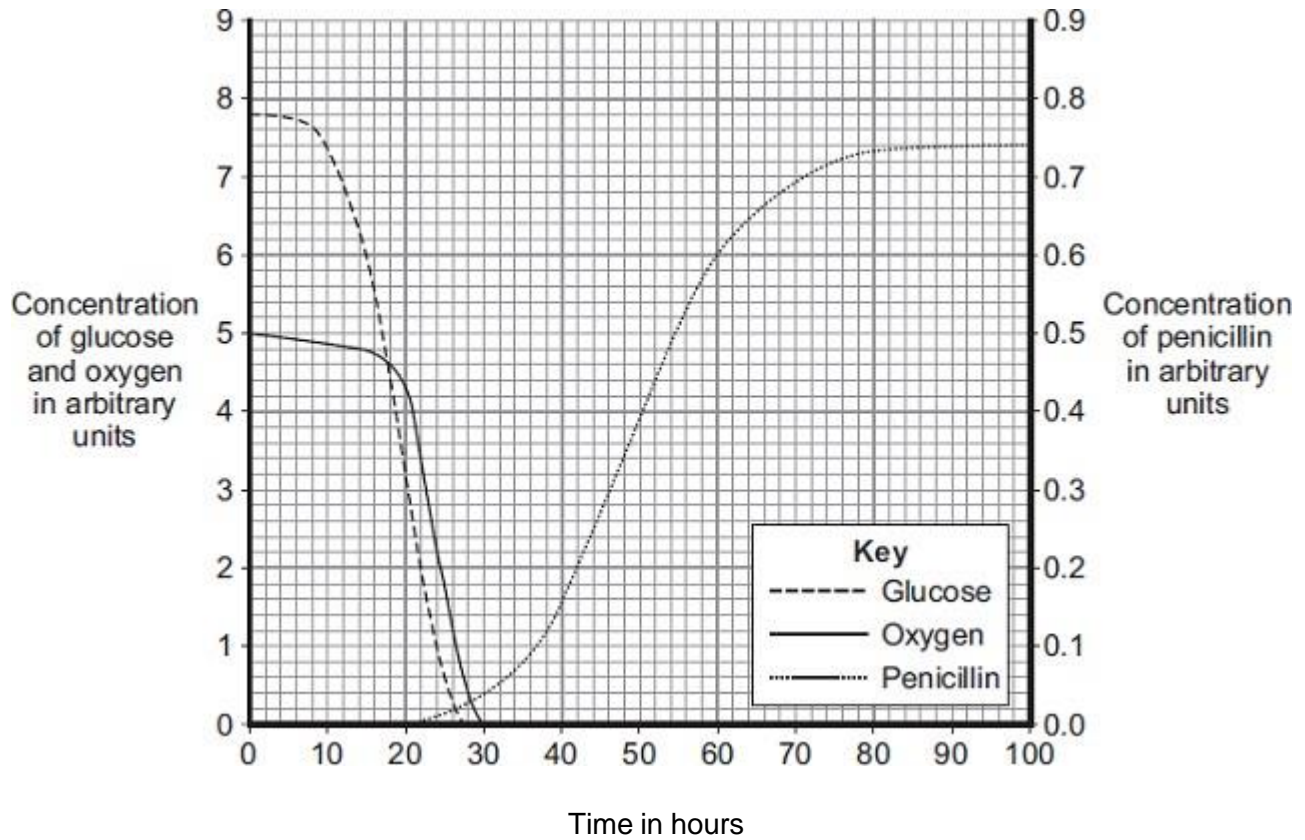
**(2)**

**(Total 6 marks)**

3

The mould *Penicillium* can be grown in a fermenter. *Penicillium* produces the antibiotic penicillin.

The graph shows changes that occurred in a fermenter during the production of penicillin.



(a) During which time period was penicillin produced most quickly?

Draw a ring around **one** answer.

**0 – 20 hours**

**40 – 60 hours**

**80 – 100 hours**

(1)

(b) (i) Describe how the concentration of glucose in the fermenter changes between 0 and 30 hours.

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(2)

- (ii) How does the change in the concentration of oxygen in the fermenter compare with the change in concentration of glucose between 0 and 30 hours?

Tick (✓) **two** boxes.

The oxygen concentration changes after the glucose concentration.

The oxygen concentration changes before the glucose concentration.

The oxygen concentration changes less than the glucose concentration.

The oxygen concentration changes more than the glucose concentration.

(2)

- (iii) What is the name of the process that uses glucose?

Draw a ring around **one** answer.

**distillation**

**filtration**

**respiration**

(1)

(Total 6 marks)

**4**

- (a) Which term describes organisms that can tolerate very hot or very cold places?

Draw a ring around the correct answer.

**an environmental  
species**

**an extremophile  
species**

**an indicator  
species**

(1)

- (b) **Figure 1** shows photographs of an Adelie penguin and a chinstrap penguin. Adelie penguins and chinstrap penguins live in the Antarctic at temperatures below 0 °C.

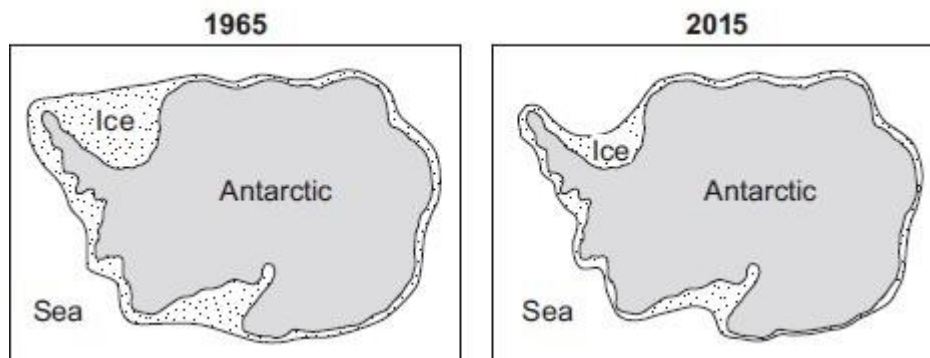
**Figure 1**



Adelie penguins spend most of their time on the ice around the Antarctic.  
Chinstrap penguins live mainly in the sea around the ice.  
Since 1965 the number of Adelie penguins has **decreased** by 6 million.

**Figure 2** shows changes to the ice around the Antarctic over the past 50 years.

**Figure 2**



- (i) Use information from **Figure 2** to explain why the number of Adelie penguins has decreased since 1965.

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(2)

- (ii) Suggest what has happened to the number of chinstrap penguins since 1965.

Draw a ring around your answer. **increase / decrease**

Give a reason for your answer.

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(1)

- (c) The number of penguins can be used to monitor changes in temperature of the environment.

Temperature readings could also be taken using a thermometer.

What is the advantage of using penguins, instead of a thermometer, to monitor changes in temperature of the environment?

Tick (✓) **one** box.

Living organisms show long-term changes.

Thermometers cannot measure temperatures below 0 °C.

Thermometers do not give accurate readings.

(1)

(Total 5 marks)



**5**

Some students wanted to find the number of thistle plants growing on a lawn.  
The students placed 10 quadrats at different positions on the lawn.  
Each quadrat measured 1 metre × 1 metre.  
The students counted the number of thistle plants in each quadrat.

(a) Which method should the students use to decide where to place the 10 quadrats?

Tick (✓) **one** box.

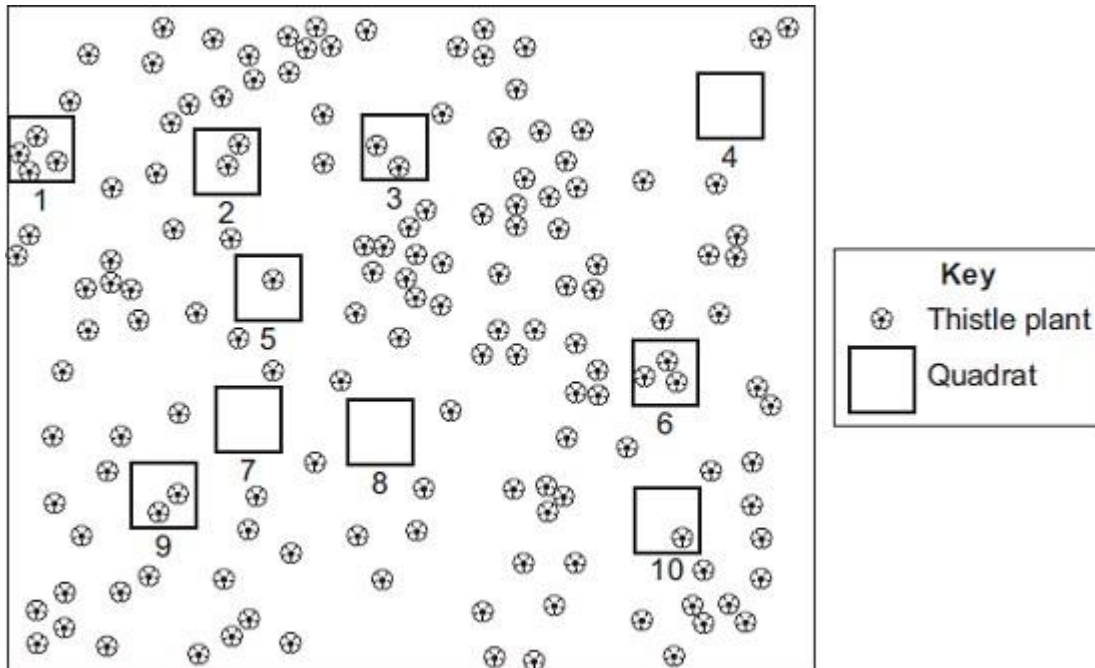
Place the quadrats as evenly as possible around the lawn.

Place 5 quadrats in areas with many thistle plants and 5 quadrats in areas with only a few thistle plants.

Place all the quadrats randomly on the lawn.

**(1)**

- (b) The diagram shows the lawn with the positions of the thistle plants and the students' 10 quadrats.



- (i) Complete the table to show:
- how many thistle plants the students found in each of the first four quadrats
  - the total number of thistle plants found in all 10 quadrats.

Quadrat number	Number of thistle plants in each quadrat
1	
2	
3	
4	
5	1
6	3
7	0
8	0
9	2
10	1
Total	

(ii) Calculate the mean number of thistle plants in one quadrat.

\_\_\_\_\_

Mean = \_\_\_\_\_

(1)

(iii) The lawn measured 12 metres long and 10 metres wide.

Use your answer from part (b)(ii) to estimate the number of thistle plants on the lawn.

\_\_\_\_\_

\_\_\_\_\_

Estimated number of thistle plants = \_\_\_\_\_

(2)

(c) How could the students make their estimate more accurate?

\_\_\_\_\_

\_\_\_\_\_

(1)

(Total 7 marks)

**6**

Animals and plants are adapted in different ways in order to survive.

(a) Plants may have to compete with other plants.

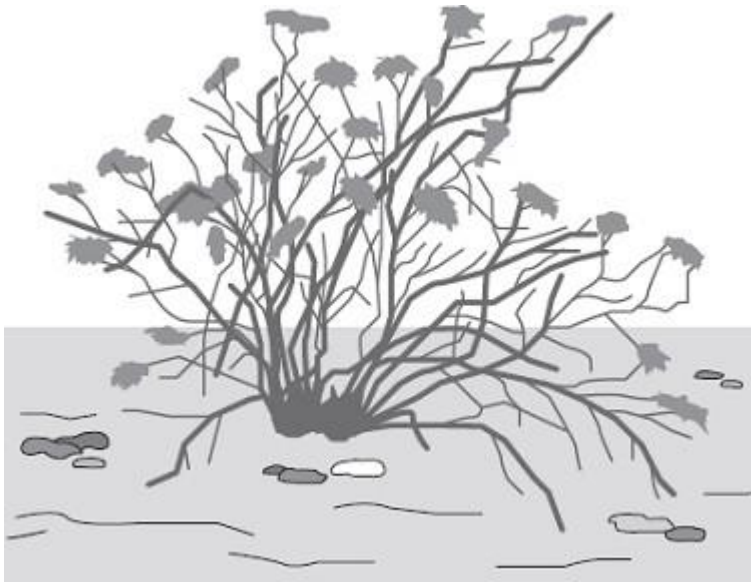
(i) Name **two** things for which plants compete.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(ii) The drawing shows a creosote bush.



This bush lives in a desert.

The creosote bush produces a poison that kills the roots of other plants.

How does this poison help the creosote bush to survive in the desert?

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(1)

(b) The photograph shows an insect called a katydid.



By Ltshears (Own work) [Public domain], via Wikimedia Commons

The katydid is preyed on by birds.

How does the appearance of the katydid help it to survive?

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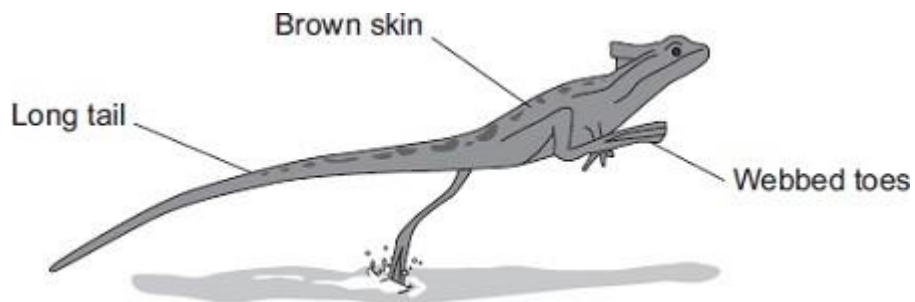
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(1)  
(Total 4 marks)

7 The picture shows a basilisk lizard. Some of the adaptations of the lizard are labelled.



Basilisk lizards are often found resting on branches of trees that grow next to water.  
Basilisk lizards can run across the surface of the water.

(a) Draw **one** line from each adaptation of the lizard to the advantage of the adaptation.

Adaptation	Advantage
Toes on the back feet are webbed	For camouflage on branches of trees
Long tail	Helps the lizard to balance when running
Brown skin	Warning colours to deter predators
	Increases surface area in contact with the water

(3)

(b) Suggest **one** advantage to the basilisk lizard of being able to run across the surface of the water.

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(1)

(c) Animals, such as lizards, compete with each other.

Give **two** factors that animals compete for.

Tick (✓) **two** boxes.

Oxygen

Food

Territory

Light

(2)

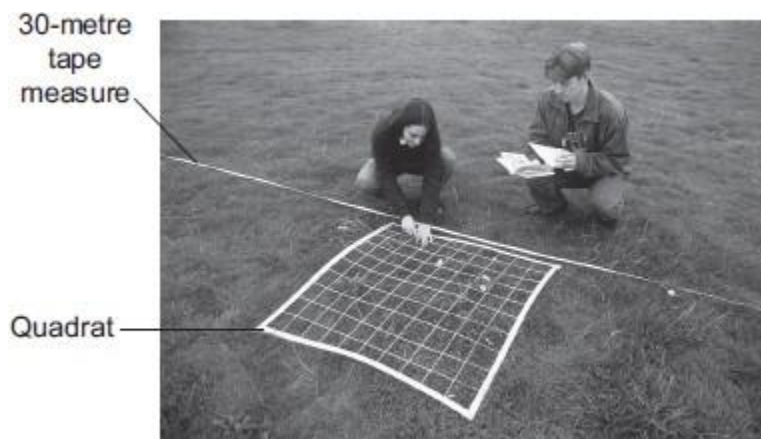
(Total 6 marks)

8

Some students investigated the distribution of dandelion plants in a grassy field. The grassy field was between two areas of woodland.

**Figure 1** shows two students recording how many dandelion plants there are in a 1 metre x 1 metre quadrat.

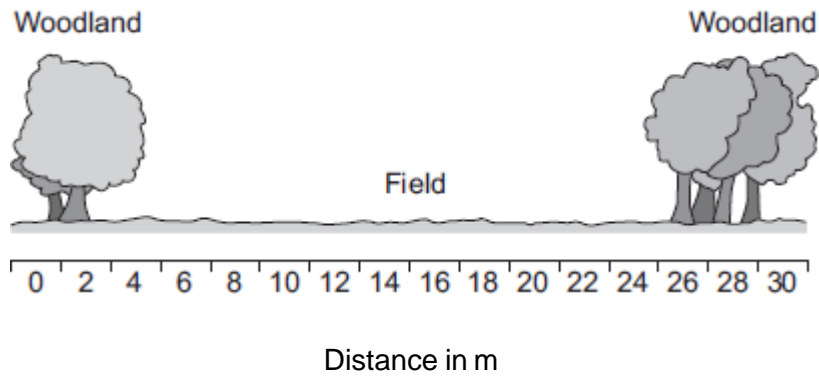
**Figure 1**



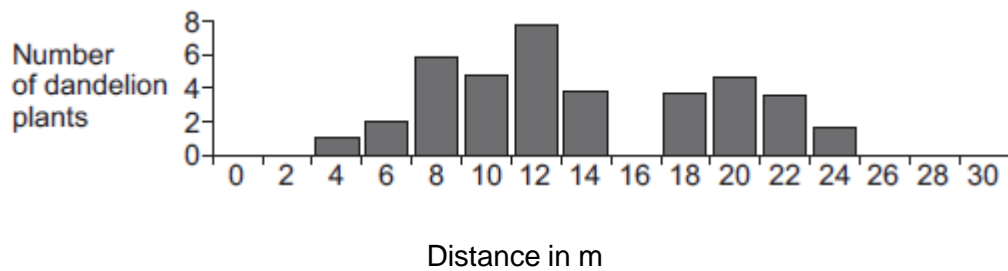
© Science Photo Library

**Figure 2** shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

**Figure 2**



**Figure 3**



- (a) How did the students use the quadrat and the 30-metre tape measure to get the results in **Figure 3**?

Use information from **Figure 1**.

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(3)

- (b) (i) Suggest **one** reason why the students found no dandelion plants under the trees.

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(1)



(ii) Suggest **one** reason why the students found no dandelion plants at 16 metres.

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(1)

(c) The teacher suggested that it was **not** possible to make a valid conclusion from these results.

Describe how the students could improve the investigation so that they could make a valid conclusion.

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(2)

(Total 7 marks)

**9**

Over millions of years:

- new groups of organisms have evolved
- other groups of organisms have become extinct.

(a) If an asteroid collided with the Earth, large amounts of dust and water vapour would be thrown up into the air. This would mean less light and heat would reach the Earth's surface from the Sun.

(i) A reduced amount of light and heat could have caused the extinction of plants.

Suggest how.

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(1)

(ii) How could the extinction of plants have caused the extinction of some animals?

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(1)

(iii) Give **two** reasons, other than collision with an asteroid, why groups of animals may become extinct.

1. \_\_\_\_\_

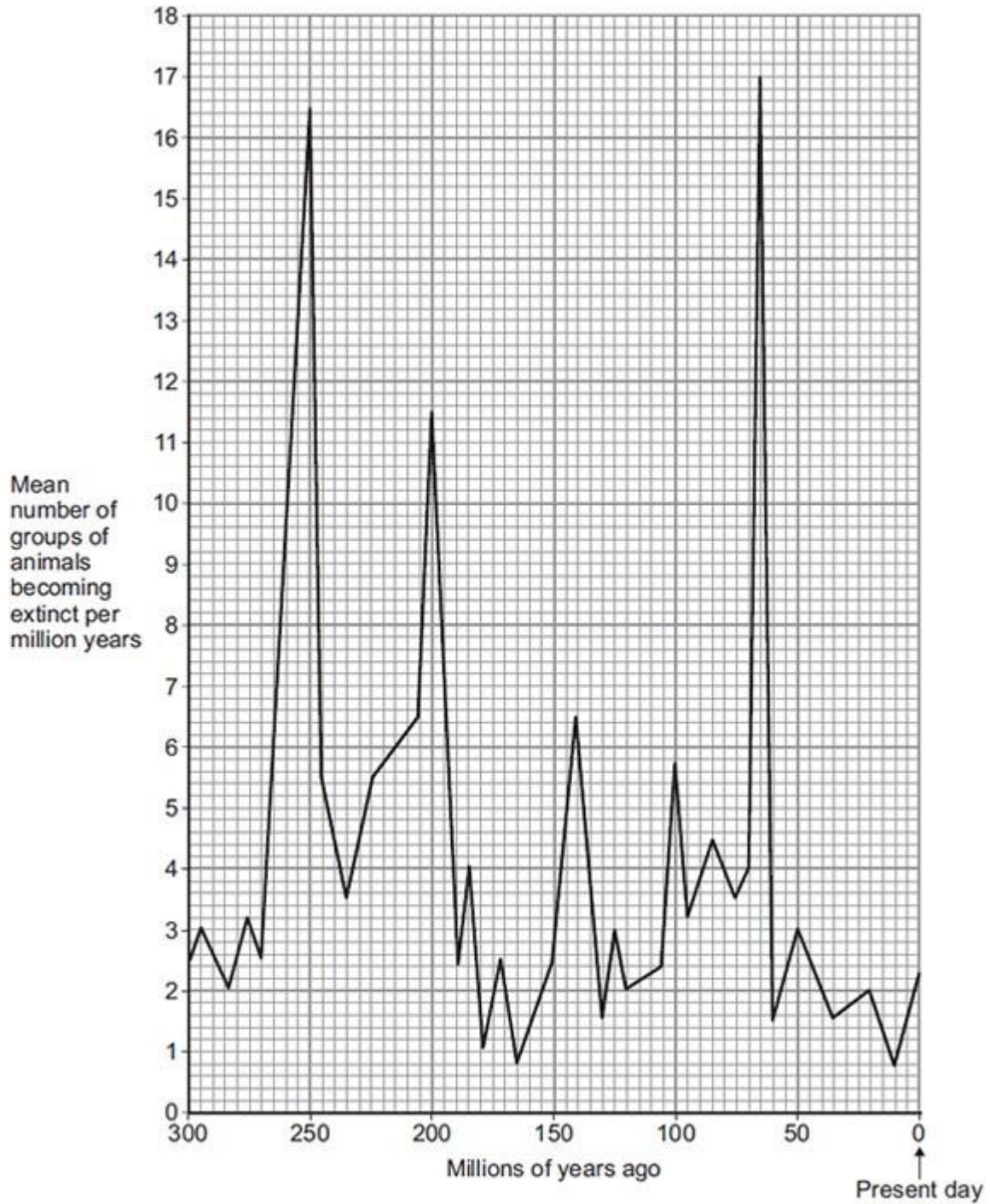
\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

**(2)**

- (b) The graph shows how the rate of extinction of groups of animals has varied over the past 300 million years.



- (i) If more than 10 groups of animals become extinct in a 1 million year period, scientists call this a 'mass extinction'.

How many mass extinctions occurred over the past 300 million years?

\_\_\_\_\_

(1)

(ii) How do we know what types of animals lived hundreds of millions of years ago?

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(1)

(c) Use information from the graph to answer part (i) and (ii).

(i) How many years ago did the most recent mass extinction of animals occur?

Tick (✓) **one** box.

50 million years ago

65 million years ago

250 million years ago

(1)

(ii) What was the mean number of groups of animals becoming extinct per million years in the most recent mass extinction?

\_\_\_\_\_ groups per million years

(1)

(iii) Why are scientists not sure how many groups of animals became extinct in the most recent mass extinction?

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(1)

(Total 9 marks)

## Mark schemes

- 1** (a) 88 000  
*correct answer = 2 marks*  
*allow 1 mark for 1.1 (in 1 m<sup>2</sup>)*  
**or**  
*allow 1 mark for answer = [candidate's value in 1m<sup>2</sup>] × 80 000*

2

- (b) Place the quadrat in 100 random positions.

1

- (c) any **three** from:

*must include at least one advantage and one disadvantage for full marks*

### Advantages:

- less cost / free
- less likely to kill other (harmless species of) plants
- weedkiller may be toxic **or** may cause water pollution
- weedkiller may accumulate up food chains

*allow uneven distribution of ragwort so much wastage of weedkiller*

### Disadvantages:

- volunteers may mistake other species for ragwort
- volunteers may miss plants
- some ragwort left to poison horses
- time consuming
- difficulties getting enough volunteers

*if no other disadvantages; allow ref. to issues with volunteers – eg don't turn up / not careful / don't finish the job*

3

**[6]**

- 2** (a) genes  
chromosomes

1

1

- (b) (i) higher yield

1

less use of pesticides

1

- (ii) any **two** from:
- uncertain about effects on health
  - fewer bees
  - might breed with wild plant
  - seeds only from one manufacturer

2

**[6]**

**3** (a) 40 – 60 hours

1

(b) (i) decrease

1

1<sup>st</sup> slowly then faster / appropriate detail from the graph – e.g. from 7.8 to 0 / faster after 4 – 10h

1

(ii) oxygen after glucose

*extra box ticked cancels 1 mark*

1

oxygen less than glucose

1

(iii) respiration

1

**[6]**

**4** (a) an extremophile species

1

(b) (i) smaller ice area  
*allow smaller amount of ice*  
*allow less ice* 1

(so) less habitat  
*allow fewer places to live / nest* 1

(ii) **either** increase  
as more sea to live in  
**or**  
as less competition for food  
  
**or** decrease  
as less space (ice) to lay eggs  
**or**  
predators more likely to eat them  
*there is no mark for increase / decrease alone. The mark is for an appropriate reason linked to increase / decrease*  
*if increase / decrease not ringed the mark may be awarded if it is clear in the explanation which is intended* 1

(c) Living organisms show long-term changes. 1

[5]

**5** (a) place all the quadrats randomly on the lawn 1

(b) (i) 1 4  
2 2  
3 2  
4 0  
*all 4 counts correct* 1

Total = 15  
*total correct for their figures* 1

(ii) 1.5  
*allow ecf from (b)(i)* 1

(iii) 180

*correct answer with or without working*

*if answer incorrect, allow 1 mark for  $\frac{15}{10} \times 120$  or  $15 \times 20$*

*or  $\frac{15}{10} \times 12 \times 10$*

*or  $1.5 \times 12 \times 10$  or  $1.5 \times 120$*

*allow ecf from (b)(ii)*

*allow 1 mark if only 1 error*

2

(c) use a larger sample size / more quadrats

*ignore repeats but allow repeat in different places*

*ignore 'count them all'*

**or**

use bigger quadrats

1

[7]

**6**

(a) (i) any **two** from:

*ignore oxygen / food / sun / carbon dioxide*

- light
- water
- space
- nutrients / ions / minerals / named

*accept two named minerals / ions for 2 marks*

2

(ii) less competition for water

*ignore space / light / food*

**or**

more water / nutrients / minerals available

1

(b) camouflage / same shape as leaf / looks like a leaf

*allow 'blends in'*

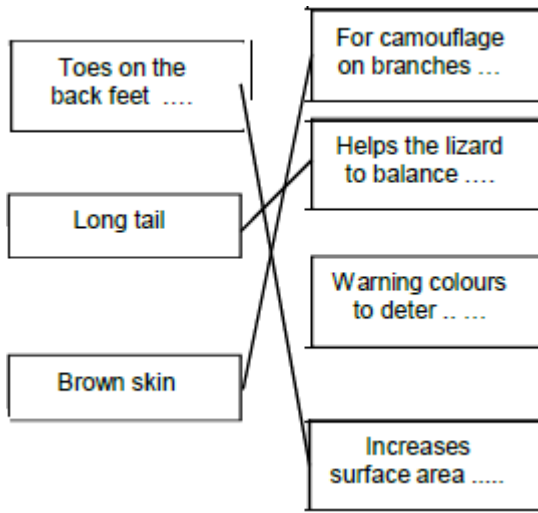
*ignore colour*

1

[4]



7 (a)



*one mark for each line*

*do **not** award mark for an adaptation if lines are drawn from it to more than one advantage*

3

(b) escape (predators)

*accept faster than swimming*

*allow chase prey*

*allow it stops them from drowning*

1

(c) food

1

territory

1

*deduct **one** mark for each tick in excess of two*

[6]

8 (a) any **three** from:

- place 30-m tape measure across field / from one wood to the other
- place quadrat(s) next to the tape
- count / record the number / amount of dandelions / plants in the quadrat

*ignore 'record the results'*

*ignore measures / estimates dandelions*

- repeat every 2 metres

*allow every metre / at regular intervals*

3

- (b) (i) low light / it is shady  
*allow no light*  
*ignore sun / rays*

**or**

- not enough water / ions / nutrients  
*accept correct named ion*  
*ignore no water / ions / nutrients*

**or**

- wrong pH of soil  
*accept competition with trees for light / water / ions*  
*ignore competition for space and competition unqualified*  
*accept soil too acidic / too alkaline*  
*ignore temperature*

1

- (ii) sensible suggestion for a small area, eg chance variation / anomaly / poisoned  
by animal waste / wrong pH of soil / eaten (by animals) / cut down / footpath

1

- (c) repeat (transect) / compare with the results of other groups  
*allow 'do it in two different locations' for 2 marks*

1

- at different / random location(s) / elsewhere (across the field)  
*do **not** allow 'in other fields'*

1

[7]

**9**

- (a) (i) reduced photosynthesis  
*ignore growth*  
*do **not** allow need light for respiration*

1

- (ii) less food (for animals) **or** less oxygen (for animals)  
*allow loss of habitat*

1

