AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



EXAM QUESTION PACK

4.7.1 ADAPTATIONS, INTERDEPENDENCE AND COMPETITION (PACK 1)

SCORE	PERCENTAGE
/324	%

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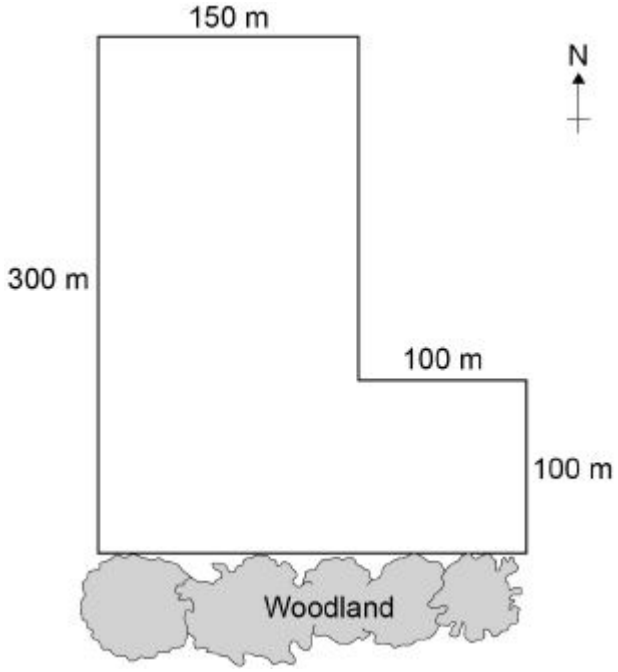
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Q1.

Some students investigated the size of a population of dandelion plants in a field.

The diagram below shows the field.



The students:

- placed a 1 m × 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

The table below shows the students' results.

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2
8	1
9	8
10	11

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(a) Why did the students place the quadrats at random positions?

_____

_____

(1)

(b) Estimate the total number of dandelion plants in the field.

Calculate your answer using information from the diagram and the table above.

Give your answer in standard form.

_____

_____

_____

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Total number of dandelion plants = _____

(5)

Quadrats **5**, **7** and **8** were each placed less than 10 metres from the woodland.

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

'Light intensity affects the number of dandelion plants that grow in an area.'

(c) Plan an investigation to test this hypothesis.

_____

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(6)

(d) Light is an environmental factor that affects the growth of dandelion plants.

Give **two** other environmental factors that affect the growth of dandelion plants.

1. _____

2. _____

(2)

(Total 14 marks)

Q2.

Cell division is needed for growth and for reproduction.

(a) The table below contains three statements about cell division.

Complete the table.

Tick **one** box for each statement.

	Statement is true for		
Statement	**Mitosis only**	**Meiosis only**	**Both mitosis and meiosis**

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All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

(2)

Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

(b) One advantage of asexual reproduction for bluebells is that only **one** parent is needed.

Suggest **two** other advantages of asexual reproduction for bluebells.

1. _____

_____

2. _____

_____

(2)

(c) Explain why sexual reproduction is an advantage for bluebells.

_____

_____

_____

_____

_____

_____

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_____

_____

_____

(4)

(Total 8 marks)

Q3.

Figure 1 shows a ring-tailed lemur.

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Figure 1



The table below shows part of the classification of the ring-tailed lemur.

Classification group	**Name**
Kingdom	*Animalia*
Phylum	*Chordata*
	Mammalia
	Primates
	Lemuroidea
Genus	*Lemur*
	catta

(a) Complete the table above to give the names of the missing classification groups.

(2)

(b) Give the binomial name of the ring-tailed lemur.

Use information from the table above.

_____

(1)

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 2 shows information about water currents.

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Figure 3 shows the distribution of three species of lemur on Madagascar.

Figure 2

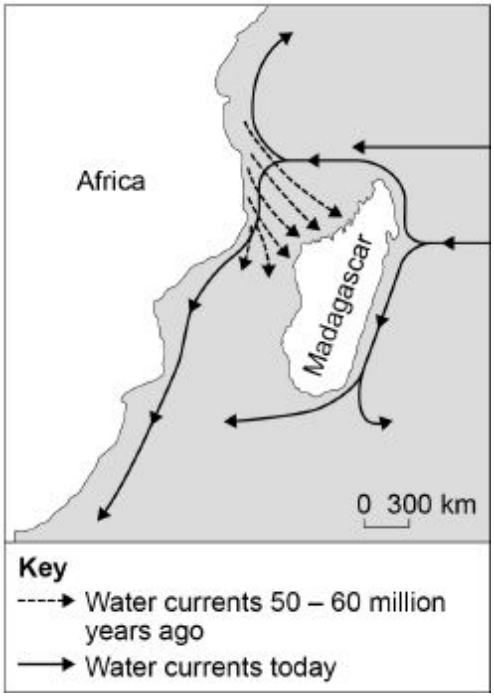
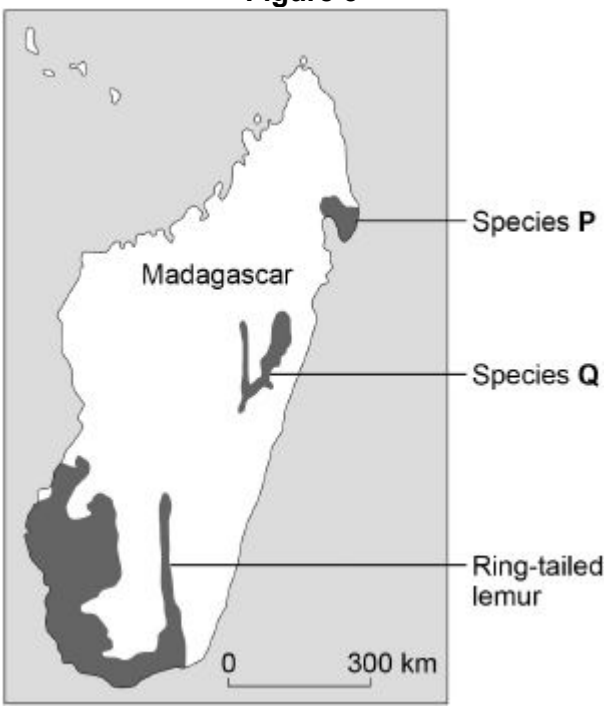


Figure 3



(c) Suggest how ancestors of modern lemurs reached Madagascar.

_____

_____

(1)

(d) Describe how the ancestors of modern lemurs may have evolved into the species shown in **Figure 3**.

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

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_____

_____

(5)

(Total 9 marks)

Q4.

Living organisms are classified into the following groups:

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

(a) Which scientist first suggested this type of classification system?

Tick **one** box.

Alfred Russel Wallace	☐
Carl Linnaeus	☐
Charles Darwin	☐
Gregor Mendel	☐

(1)

The stone plant, *Lithops bromfieldi*, is adapted to live in very dry deserts.

Figure 1 shows several stone plants.

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Figure 1



(b) Give the genus to which the stone plant belongs.

_____

(1)

(c) The stone plant has many adaptations that help it to survive in the desert.

Draw **one** line from each adaptation to how the adaptation helps the stone plant to survive.

Adaptation	How the adaptation helps survival
	Can trap a lot of light
Plants look like stones	Absorb water from deep in the ground
Leaves with thick, waxy cuticles	Help cross-pollination
Many long, branching roots	Are not easy to see and so are not eaten
Thick, fleshy leaves	Reduce water loss
	Store water

(4)

The jerboa is a small desert animal.

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Figure 2 shows a jerboa.

Figure 2



The jerboa is adapted for survival in the desert.
The jerboa spends the daytime in its underground burrow.
The jerboa only leaves its burrow to look for food during the night.

(d) Describe how these adaptations help the jerboa to survive in the desert.

_____

_____

_____

_____

(2)

(e) What type of adaptations are described in Question (d)?

Tick **one** box.

Behavioural ☐

Functional ☐

Structural ☐

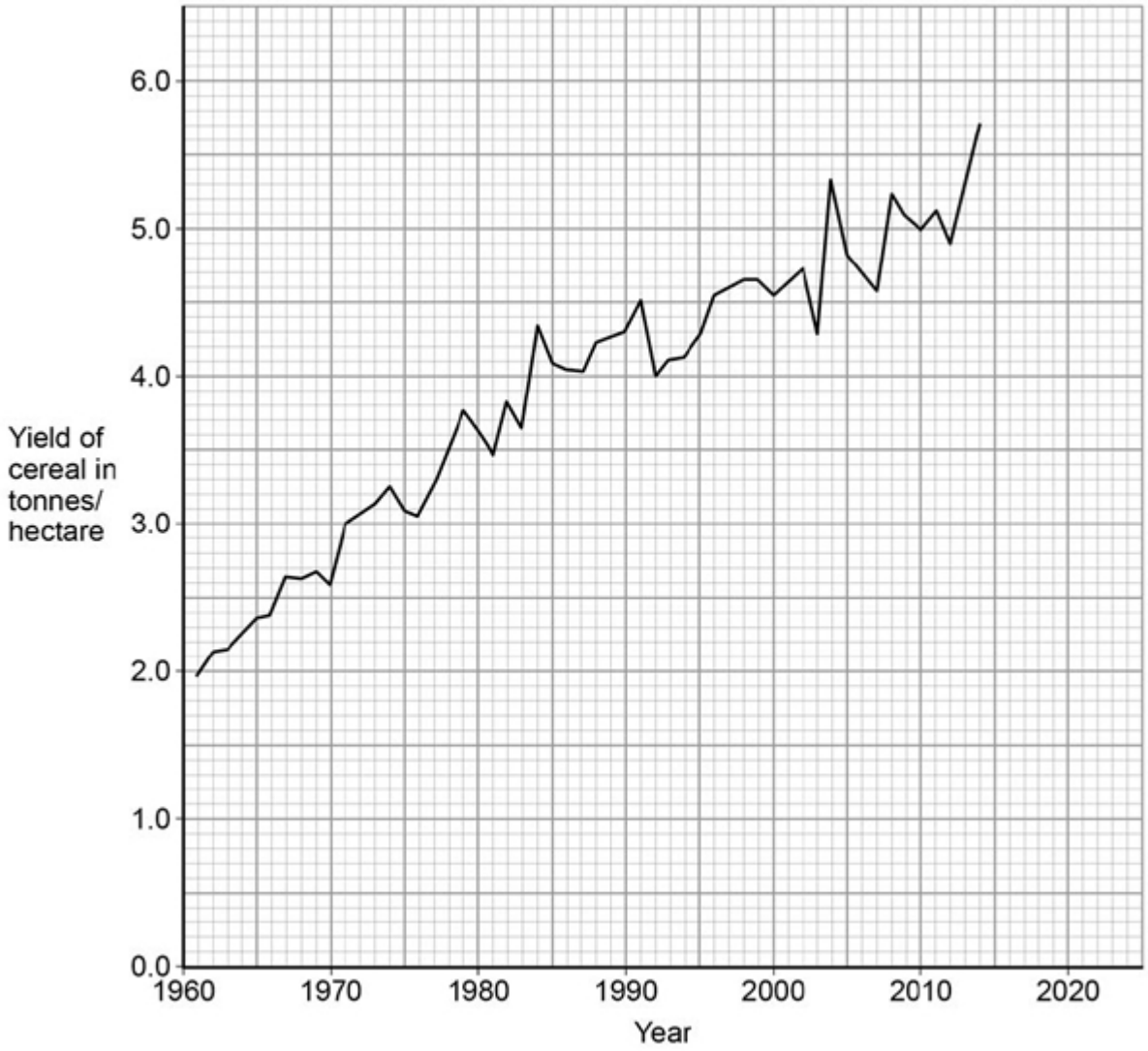
(1)

(Total 9 marks)

Q5.

The graph shows information about the yield of cereal crops grown in the European Union.

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(a) Calculate the increase in the yield of cereal between 1970 and 2010.

_____

_____

_____

Increase in yield = _____ tonnes/hectare

(2)

(b) Estimate by what fraction the yield of cereal increased between 1971 and 1992.

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{5}$ ☐ $\frac{1}{2}$ ☐ $\frac{3}{4}$ ☐

(1)

(c) The increase in yield is partly due to increased use of nitrate fertilisers.

Which substance do plants make using nitrate ions?

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Tick **one** box.

Cellulose ☐

Fat ☐

Protein ☐

Starch ☐

(1)

(d) The yield of cereal in 2004 was much greater than the yield in 2003.

Suggest **three** possible reasons for the increased yield in 2004.

Tick **three** boxes.

A genetically-modified variety of seed was sown in 2004. ☐

A pathogenic fungus grew on the cereal in 2004. ☐

Farmers added more nitrate to the soil in 2003. ☐

More cereal seeds were sown in 2003. ☐

More rain fell in spring and early summer in 2004. ☐

The mean summer temperature was lower in 2003. ☐

(3)

Humans eat cereals.

Humans also eat the animals that feed on cereals.

Figure 1 and **Figure 2** show two food chains.

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Figure 1

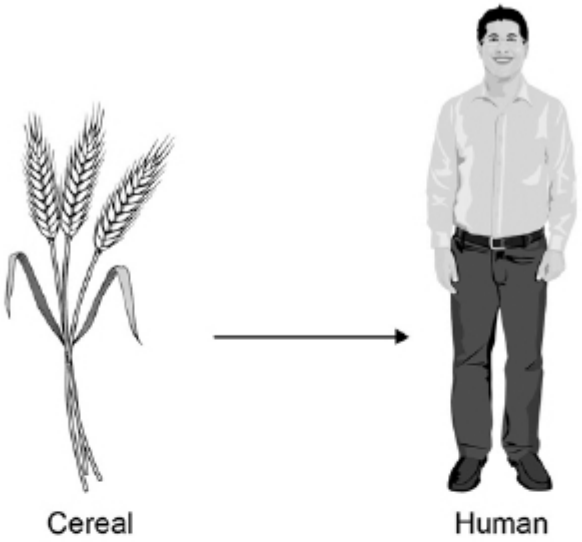
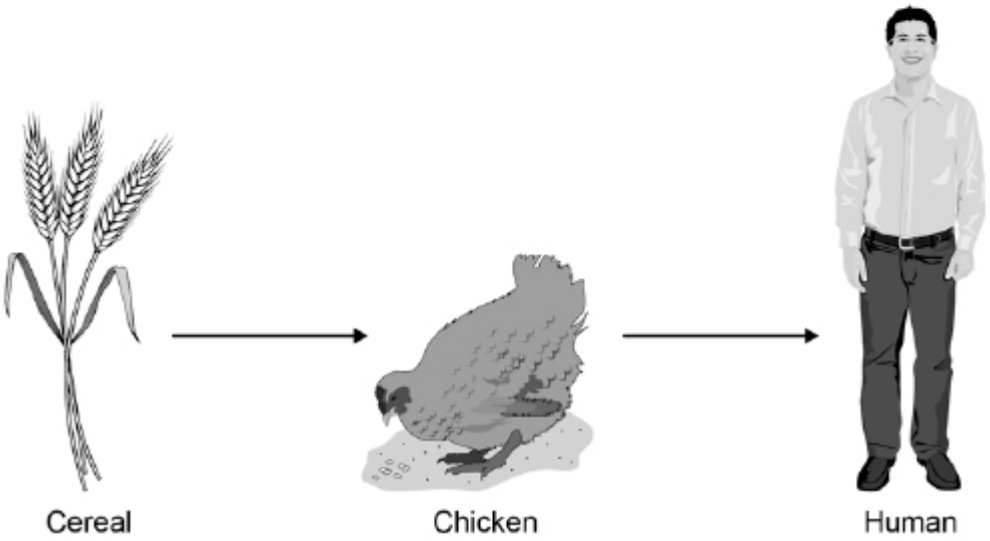
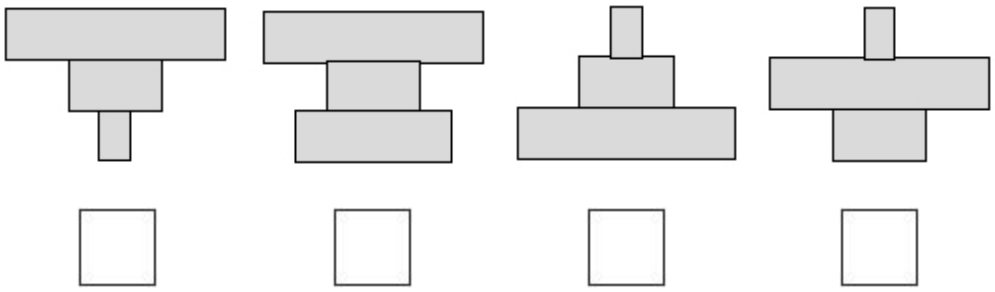


Figure 2



(e) Which pyramid of biomass is correct for the food chain shown in **Figure 2**?

Tick **one** box.



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In **Figure 1**, 1 hectare of cereal crop would provide enough energy for 8 people for a year.

In **Figure 2**, 10 hectares of cereal crop would be needed to provide enough energy for only 1 person for a year.

(f) It is much more efficient for humans to get energy by eating cereals than by eating chickens.

Calculate how many times more efficient.

_____

_____

Answer = _____ times

(1)

(g) Why is it more efficient for humans to get energy by eating cereals than by eating chickens?

Tick **two** boxes.

Cereals gain extra energy from mineral ions in the soil.	☐
Chickens contain more protein per gram than cereals.	☐
Chickens use energy for movement and for keeping warm.	☐
Much of the food eaten by chickens is wasted as faeces.	☐
Not all parts of the cereal plants are edible.	☐

(2)

(Total 11 marks)

Q6.

The limpet is a snail-like animal that lives attached to a rock on the seashore.

Some students investigated variation in the size of limpets living on two seashores:

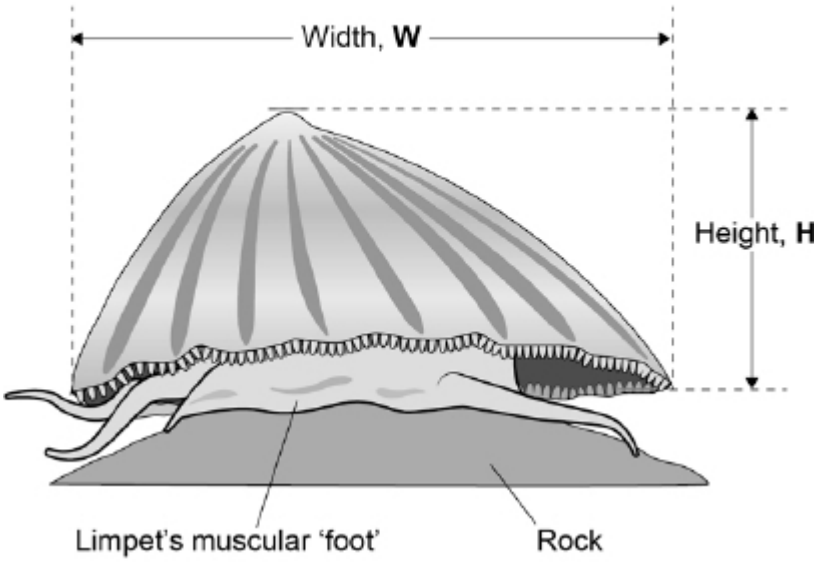
- one shore was in a sheltered bay
- the other shore was exposed to the full force of the sea.

The students measured the heights (**H**) and widths (**W**) of 60 limpets on each shore.

Figure 1 shows a limpet and the measurements made by the students.

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Figure 1



(a) On each shore, the students measured a large number of limpets at random locations.

Explain why the students did this.

Large number of limpets:

_____

_____

Random locations:

_____

_____

(2)

The students calculated $\frac{H}{W}$ for each limpet.

The table below shows the students' results.

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$\frac{H}{W}$	Sheltered shore		Exposed shore	
	Score	Number	Score	Number
0.21 – 0.25			|||	3
0.26 – 0.30	|	1	𝍸 |||	8
0.31 – 0.35	||||	4	𝍸 𝍸 𝍸 |	16
0.36 – 0.40	𝍸 𝍸 ||	12	𝍸 𝍸 𝍸 ||||	
0.41 – 0.45	𝍸 𝍸 ||||	14	𝍸 ||||	
0.46 – 0.50	𝍸 𝍸 |||	13	||||	
0.51 – 0.55	𝍸 ||||	9	|	
0.56 – 0.60	||||	4		
0.61 – 0.65	||	2		
0.66 – 0.70	|	1		

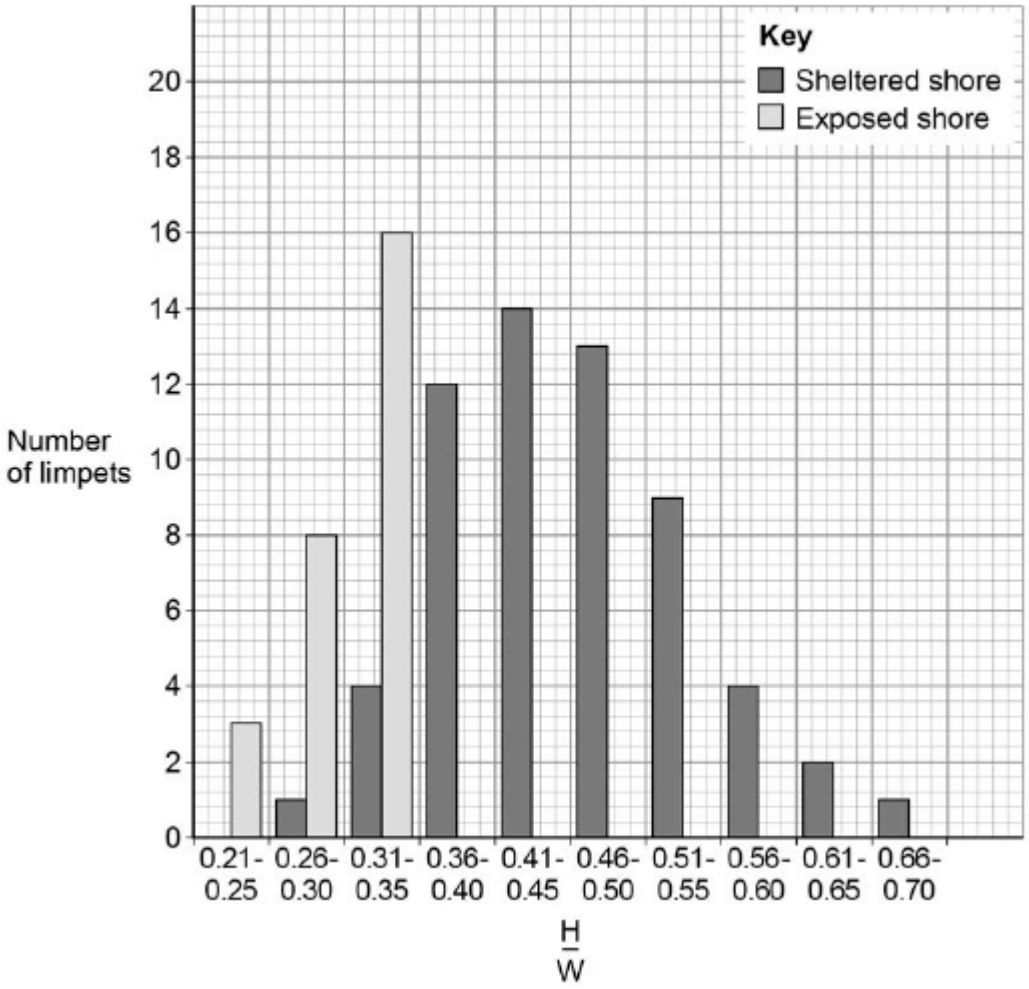
(b) Complete the table above.

(1)

Figure 2 shows some of the results.

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Figure 2



(c) Complete **Figure 2**.

(1)

(d) Compare the patterns in the results for the exposed shore and the sheltered shore.

Use information from **Figure 2**.

_____

_____

_____

_____

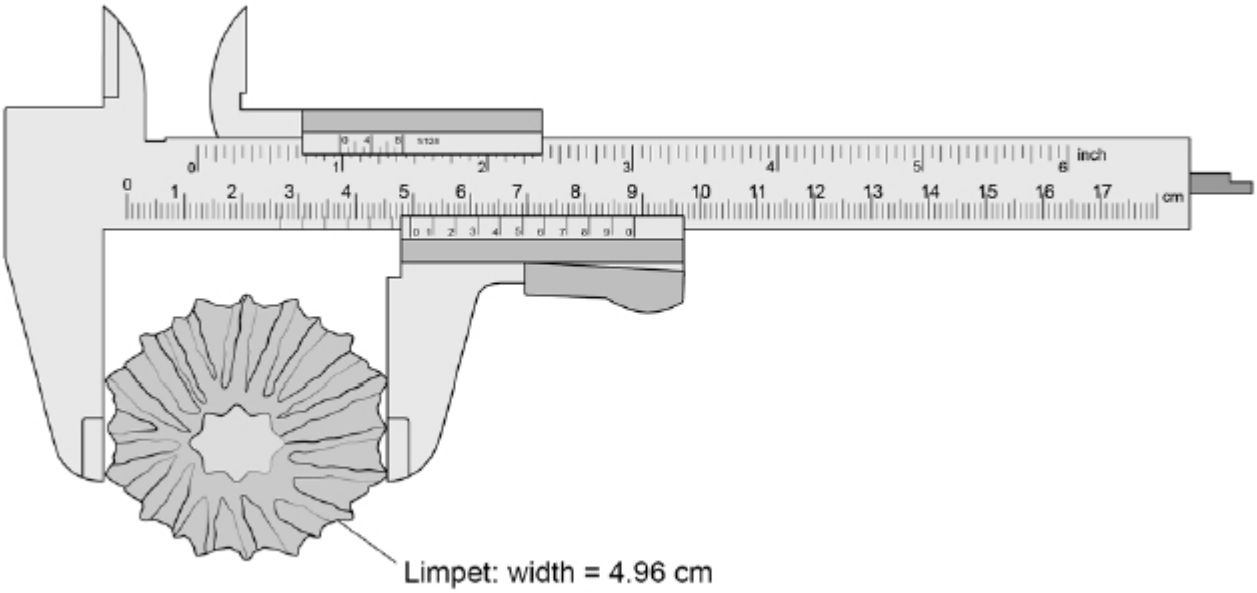
_____

(3)

Figure 3 shows how the students measured the width of a limpet with a vernier calliper.

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Figure 3



(e) One student recorded

- sheltered shore: mean $\overline{\frac{H}{W}}$ = 0.4659182
- exposed shore: mean $\overline{\frac{H}{W}}$ = 0.3542183

The student's teacher stated that the data did **not** justify such a high number of decimal places.

Give the **two** mean values corrected to an appropriate number of decimal places.

Sheltered shore: mean $\overline{\frac{H}{W}}$ = _____

Exposed shore: mean $\overline{\frac{H}{W}}$ = _____

(2)

(f) A limpet clings to a rock on the sea shore using its muscular 'foot', as shown in **Figure 1**.

Scientists have found that limpets can exert a force of 2 newtons / cm^2 of 'foot'.

To remain attached to its rock, a limpet must exert a force at least as large as the force of the waves.

Calculate the maximum wave force the limpet shown in **Figure 3** could withstand without being knocked off its rock.

Assume that the surface of the foot is a circle.

The area of a circle is πr^2.

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Take the value of π to be 3.14.

Maximum wave force = _____ newtons

(3)

(g) Suggest **two** reasons why your answer to Question (e) might **not** be very accurate.

1. _____

2. _____

(2)

(h) Suggest biological reasons for the lower mean $\frac{H}{W}$ values for limpets on the exposed shore.

(3)

(Total 17 marks)

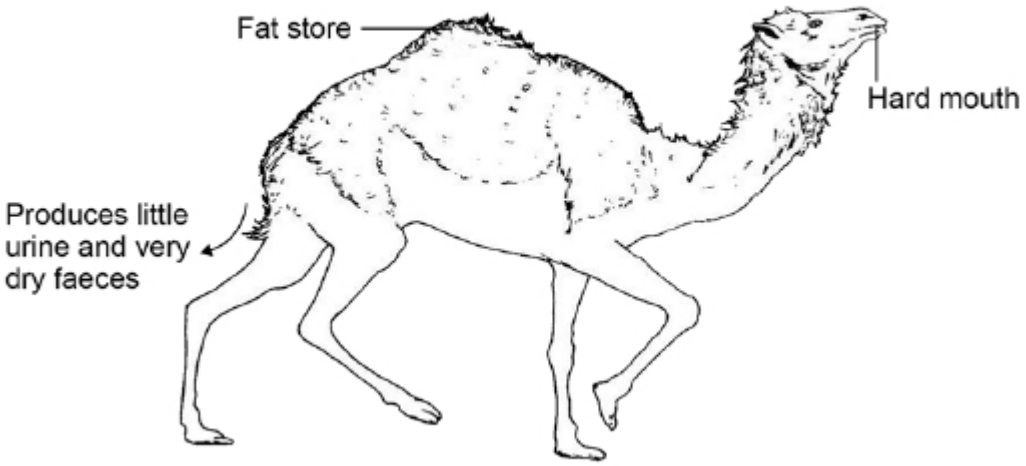
Q7.

Figure 1 shows a type of camel called a dromedary (*Camelus dromedarius*).

The dromedary lives in hot, dry deserts.

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Figure 1



(a) One adaptation of the dromedary is 'temperature tolerance'.

This means that the animal's body temperature can rise by up to 6 °C before it starts to sweat.

Explain how temperature tolerance can help the dromedary to survive in the desert.

_____

_____

_____

_____

(2)

(b) Three more adaptations of the dromedary are given in **Figure 1**.

Give a reason why each adaptation helps the animal survive in the desert.

Fat store _____

_____

Produces little urine and very dry faeces _____

_____

Hard mouth _____

_____

(3)

There are several species of the camel family alive today.

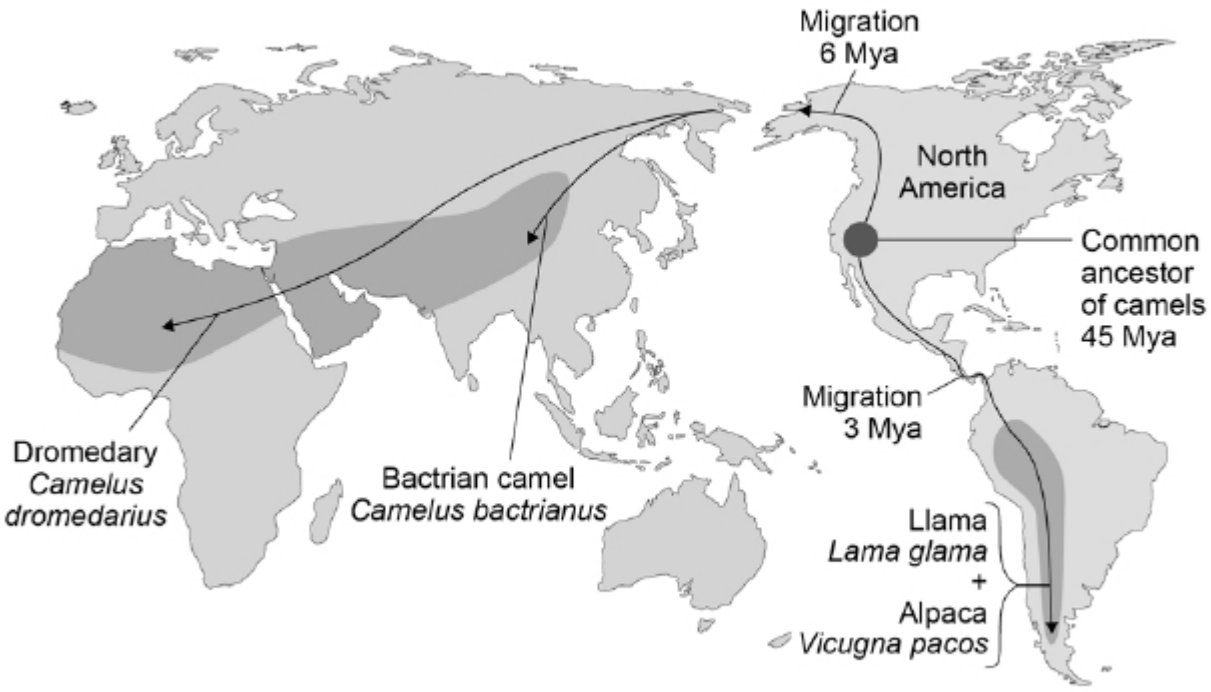
Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

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Figure 2 shows:

- where four modern species of the camel family live today
- how the ancestors of these camels migrated from North America.

Figure 2



(c) Which **two** of the four modern species of camel do scientists believe to be most closely related to each other?

Give the reason for your answer.

_____ and _____

Reason _____

_____

(1)

(d) Describe the type of evidence used for developing the theory of camel migration shown in **Figure 2**.

_____

_____

_____

_____

(2)

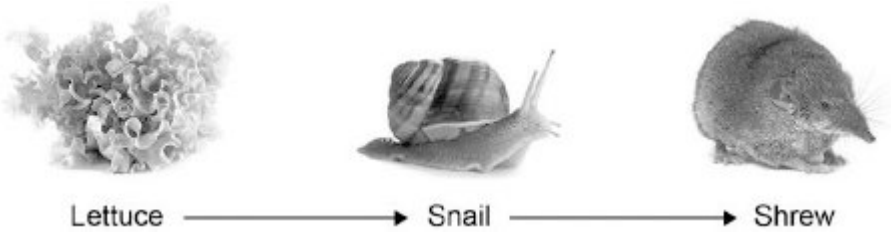
(e) Explain how several different species of camel could have evolved from a common ancestor over 45 million years.

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(6)
(Total 14 marks)

Q8.

The diagram below shows a food chain in a garden.



Lettuce © destillat/iStock/Thinkstock; Snail ©Valengilda/iStock/Thinkstock; Shrew © GlobalT/iStock/Thinkstock

(a) Name **one consumer** shown in the diagram above.

_____

(1)

(b) Name **one carnivore** shown in the diagram above.

_____

(1)

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

_____

_____

(1)

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

Population ☐

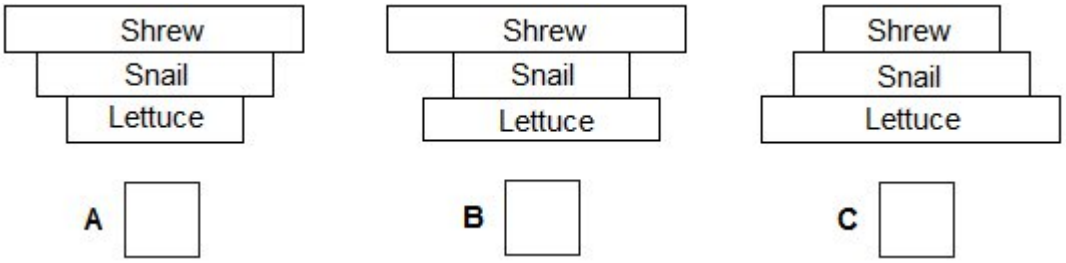
Territory ☐

(1)

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.

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A ☐ B ☐ C ☐

(1)

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

_____

Energy = _____ kJ

(1)

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

(1)

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

_____

(1)

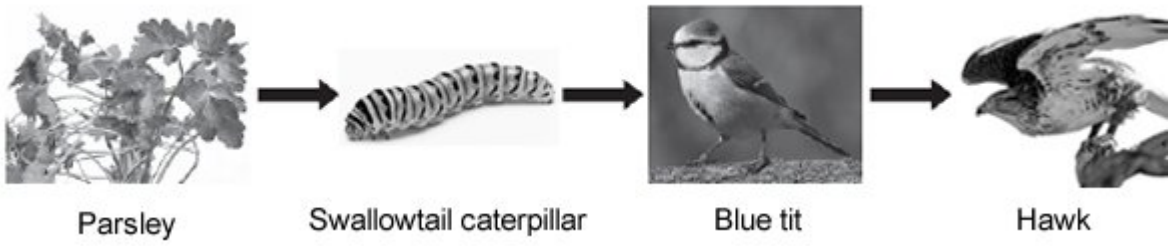
(Total 8 marks)

Q9.

Figure 1 shows how energy and biomass pass along a food chain.

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Figure 1



(a) The parsley shown in **Figure 1** carries out photosynthesis.

_____

_____

_____

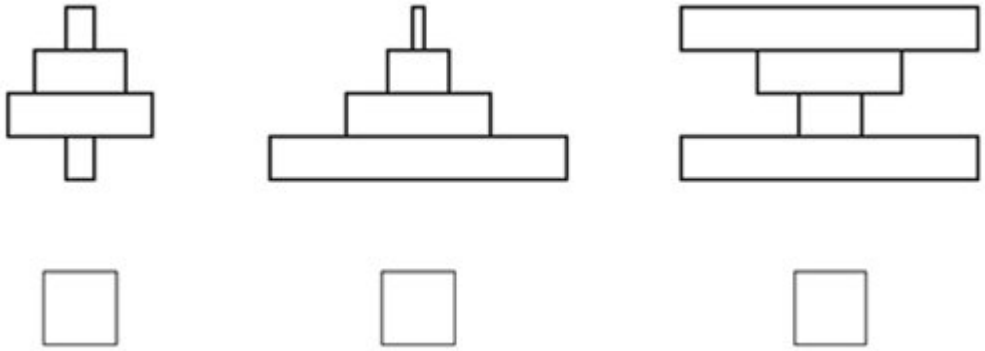
_____

(2)

(b) Which diagram shows the pyramid of biomass for the food chain in **Figure 1**?

Why is photosynthesis important in the food chain?

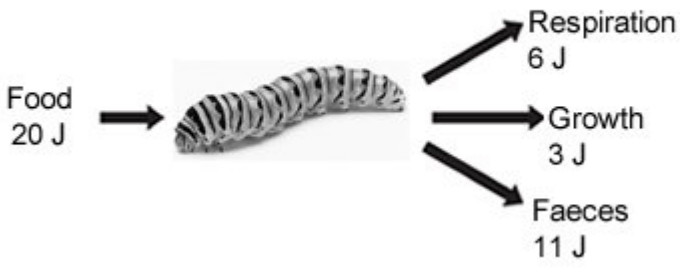
Tick (✔) **one** box.



(1)

(c) **Figure 2** shows the ways a swallowtail caterpillar transfers 20 J of energy from food.

Figure 2



What percentage of the energy in the caterpillar's food is used for growth?

_____

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_____

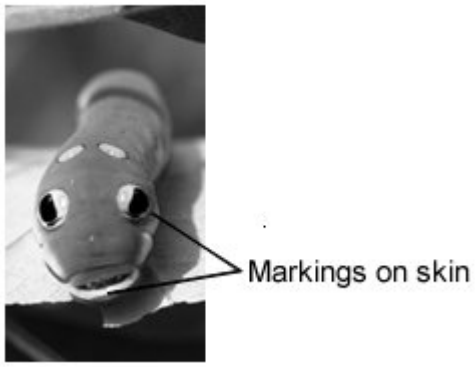
Percentage = _____

(2)

(d) The organisms in the food chain are adapted for survival.

(i) **Figure 3** shows a swallowtail caterpillar seen from the back.

Figure 3



Suggest how the swallowtail caterpillar shown in **Figure 3** is adapted to reduce the chance of being eaten by blue tits.

_____

_____

_____

_____

(2)

(ii) **Figure 4** shows a hawk.

Figure 4



Suggest **two** ways that the hawk is adapted to catch and kill blue tits.

1. _____

_____

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2. _____

_____

(2)

(Total 9 marks)

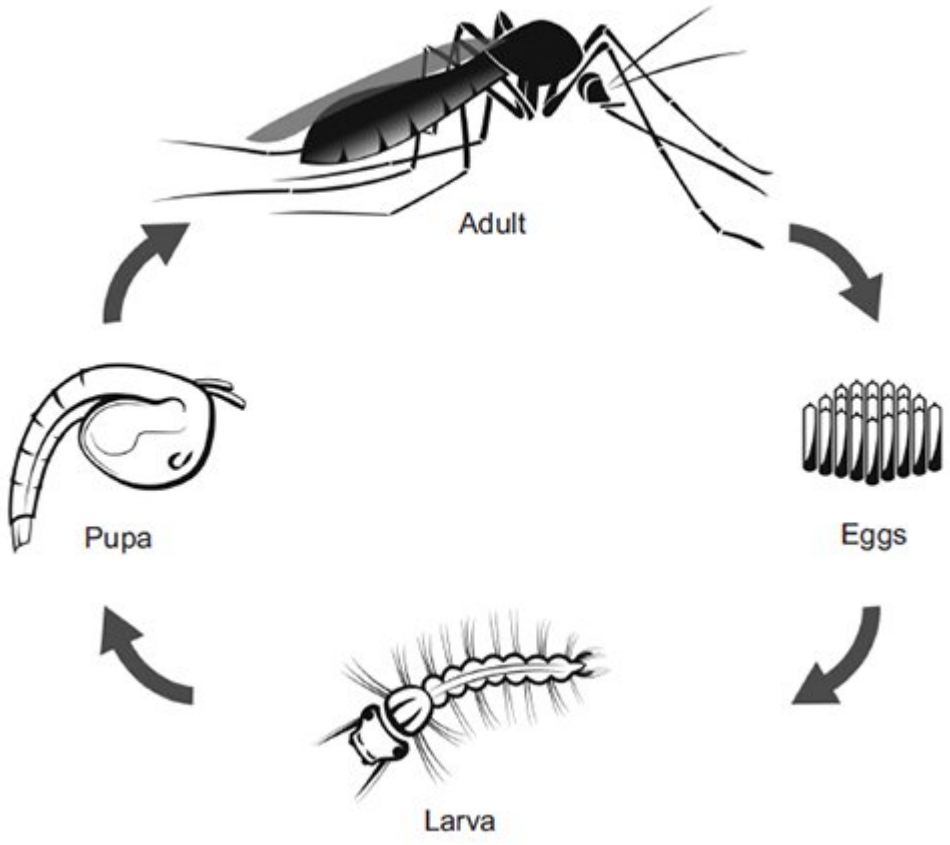
Blue tit: ©JensGade/iStock
Parsley: © Warren_Price/iStock
Caterpillar ©prettyzhizhi/iStock
Hawk: © kojihirano/iStock
Swallowtail caterpillar: © Anna_Po/iStock

Q10.

Malaria is a disease caused by a microorganism carried by mosquitoes.

The microorganism is transferred to humans when adult female mosquitoes feed on human blood.

The figure below shows the life cycle of a mosquito.



© watcharapon/iStock

The World Health Organisation estimates that 3×10^8 people are infected with malaria every year.

Scientists estimate that malaria kills 2×10^6 people every year.

The people who are infected with malaria but do not die, may be seriously ill and need health care for the rest of their lives.

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(a) Based on the estimated figures, what percentage of people infected with malaria die from the disease?

_____

_____

_____

_____

(2)

(b) An internet article states:

1 Mosquito larvae are at the start of the food chain for some fish.
2 Adult mosquitoes provide food for bats and birds.
3 Mosquitoes are also important in plant reproduction because they feed from flowers of crop plants.

(i) The first sentence in the article is **not** correct.

Explain why.

_____

_____

_____

_____

(2)

(ii) A company plans to produce genetically modified (GM) adult male mosquitoes.
The GM mosquitoes will carry a gene from bacteria. The gene causes the death of offspring before they become adults.

Male mosquitoes do **not** feed on blood.
Scientists are considering releasing millions of adult male GM mosquitoes into the wild.

Do you think scientists should release millions of male GM mosquitoes into the wild?

In your answer you should give advantages and disadvantages of releasing GM mosquitoes into the wild.

_____

_____

_____

_____

_____

_____

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_____

_____

(4)

(iii) Describe the process for creating a GM mosquito.

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q11.

Students investigated a food chain in a garden.

lettuce → snail → thrush (bird)

The students:

- estimated the number of lettuce plants in the garden
- estimated the number of snails feeding on the lettuces
- counted two thrushes in the garden in 5 hours.

The table below shows the students' results and calculations.

Organism	Population size	Mean mass of each organism in g	Biomass of population in g	Biomass from previous organism that is lost in g	Percentage of biomass lost
Lettuce	50	120.0	6000		
Snail	200	2.5	500	5500	91
Thrush	2	85.0	170	330	66

(a) (i) Give **two** ways that biomass is lost along a food chain.

_____

_____

_____

_____

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(2)

(ii) Scientists estimate that about 90% of the biomass in food is lost at each step in a food chain.

Suggest **one** reason why the students' value for the percentage of biomass lost between the snails and the thrushes is only 66%.

_____

_____

(1)

(b) European banded snails have shells with different colours (light or dark) and with stripes or with no stripes.

Figure 1 shows two examples of European banded snails.

Figure 1



Dark-coloured shell with stripes

© Eric Lsselee/iStock

Light-coloured shell, with no stripes

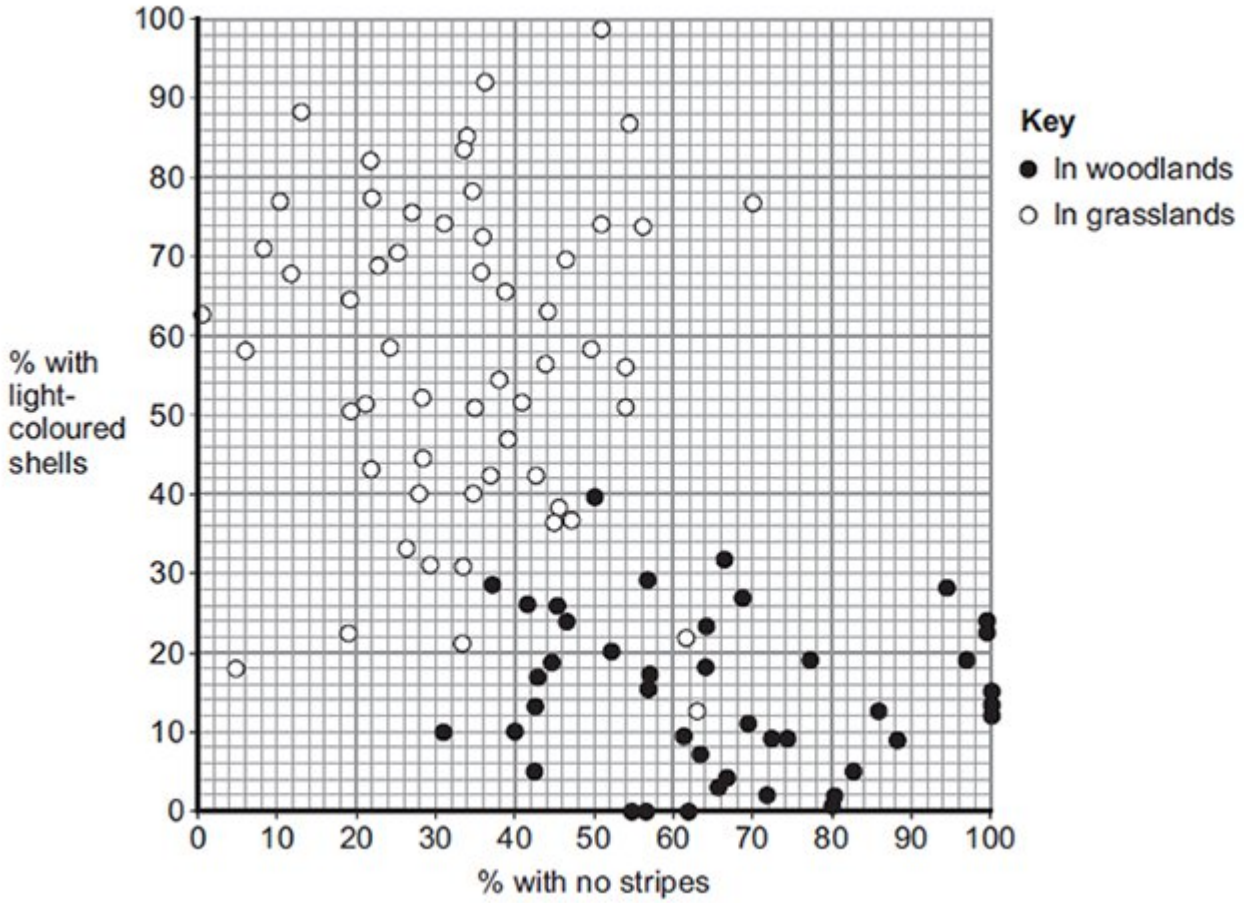
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Figure 2 shows results from surveys in woodlands and in grasslands of the percentage of snails with light-coloured shells and the percentage of snails with no stripes.

Each point on the graph represents the results of one survey in one habitat.

Figure 2

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(i) **Figure 2** is a scatter graph.

Why is a scatter graph used for this data?

_____

_____

(1)

(ii) Compare the general appearance of snails that live in woodlands with the general appearance of snails that live in grasslands.

_____

_____

_____

_____

(2)

(iii) Suggest a reason for the general appearance of snails that live in woodlands.

_____

_____

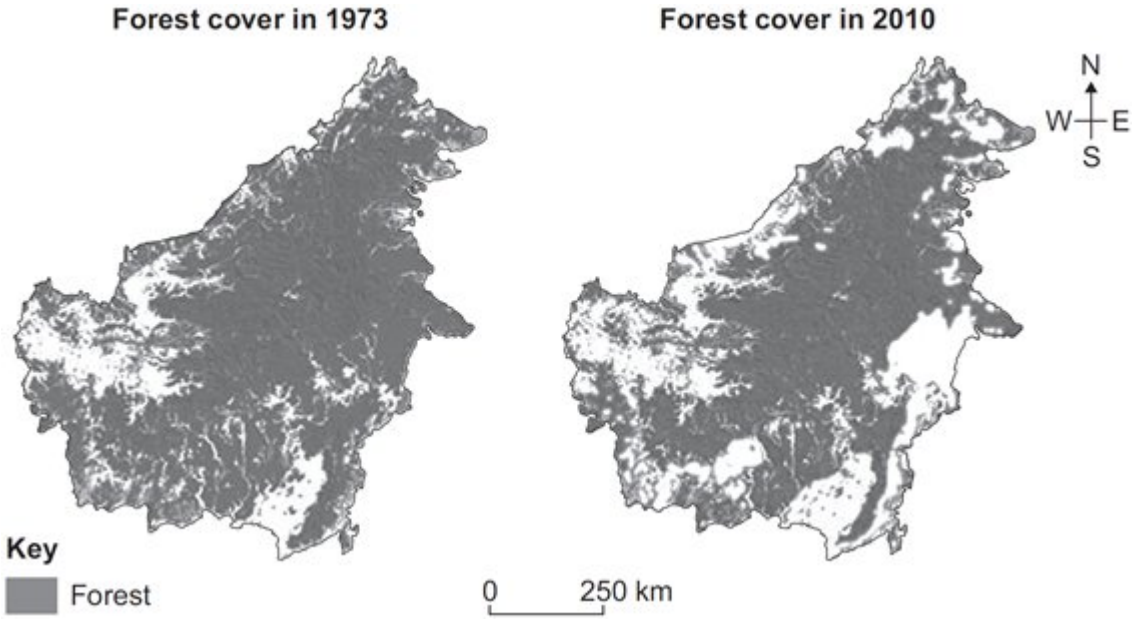
(1)

(Total 7 marks)

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Q12.

The figure below shows the amount of forest cover on an island in Asia, in 1973 and in 2010.



(a) (i) Deforestation has decreased the amount of forest cover on the island.

Describe the change in the pattern of forest cover on the island.

_____

_____

_____

_____

(2)

(ii) Give **two** possible reasons why the amount of forest has decreased between 1973 and 2010.

1. _____

_____

2. _____

_____

(2)

(b) Scientists are concerned about the effects of a decrease in forest cover on ecosystems.

Give **two** possible negative effects of the decrease in forest cover on ecosystems.

1. _____

_____

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2. _____

_____

(2)

(Total 6 marks)

Q13.

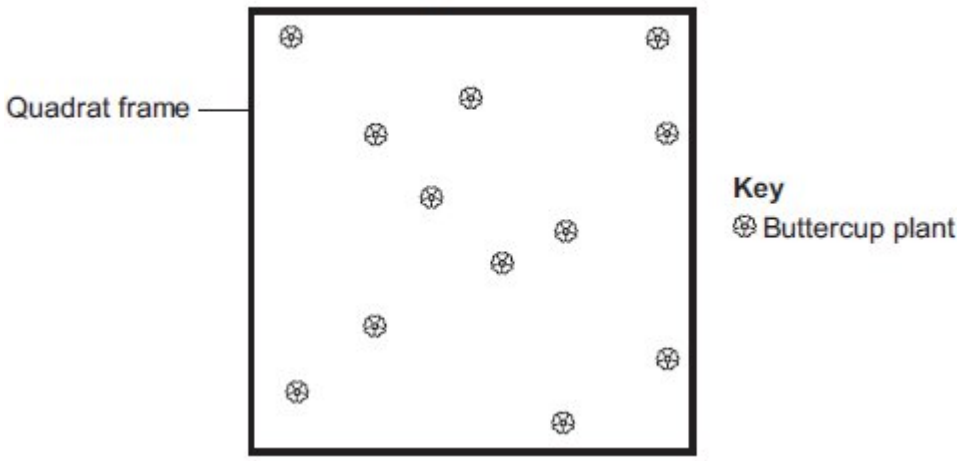
A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

Figure 1 shows the buttercup plants in the quadrat.

Figure 1



The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

_____

_____

_____

_____

(2)

(ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

_____

_____

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_____

_____

(2)

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1. _____

2. _____

3. _____

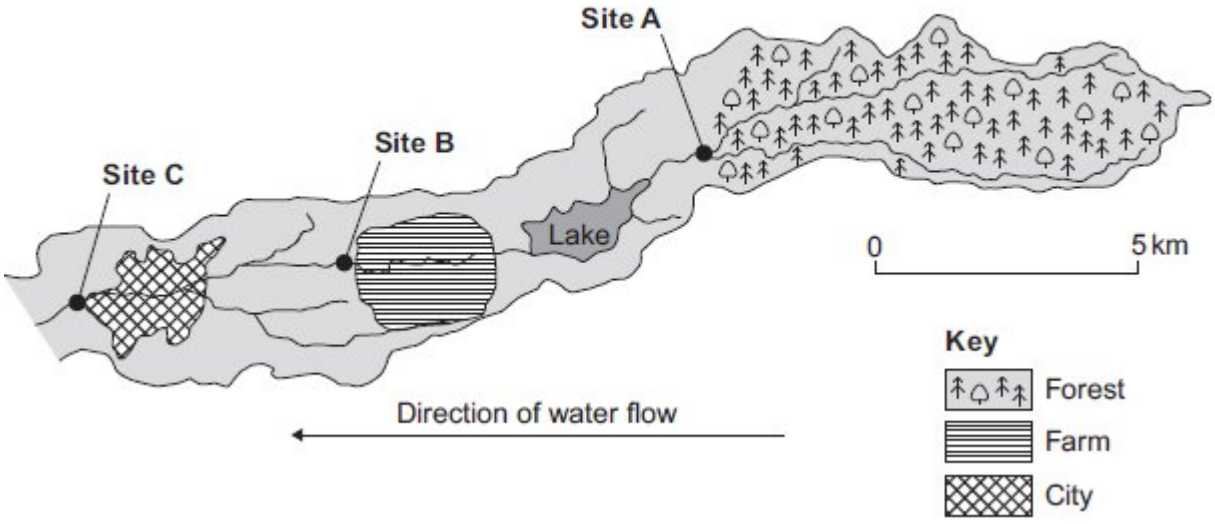
(3)

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

(3)

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

Figure 2



Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

_____

_____

_____

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_____

_____

_____

_____

_____

_____

_____

(5)

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

_____

(1)

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

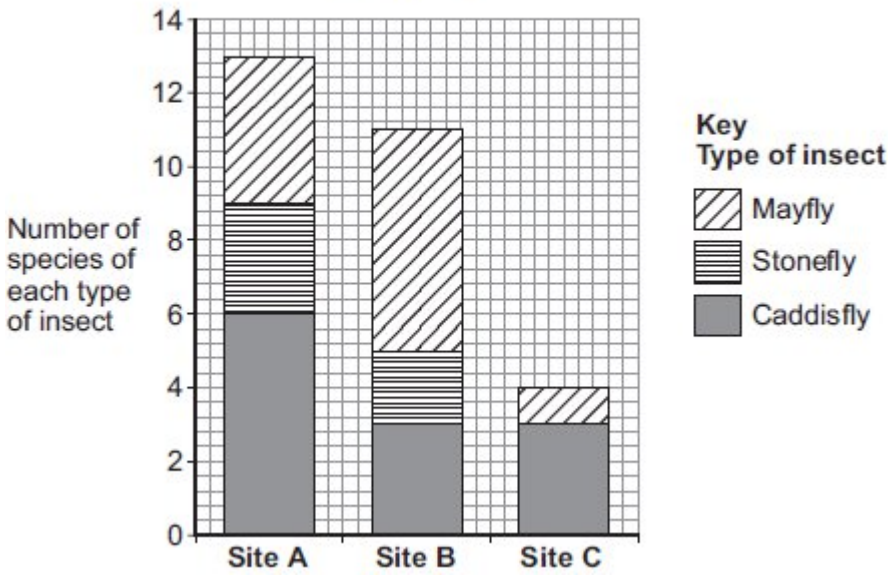
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists' results.

Figure 3



(i) How many more species of mayfly were there at Site **B** than at Site **A**?

_____

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(1)

(ii) Suggest what caused this increase in the number of species of mayfly.

_____

_____

(1)

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

(1)

(Total 19 marks)

Q14.

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

Draw a ring around the correct answer.

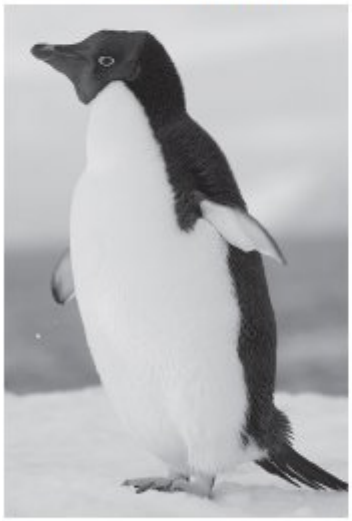
an environmental species **an extremophile species** **an indicator species**

(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 penguin



© pilipenkoD/iStock/Thinkstock

Chinstrap penguin



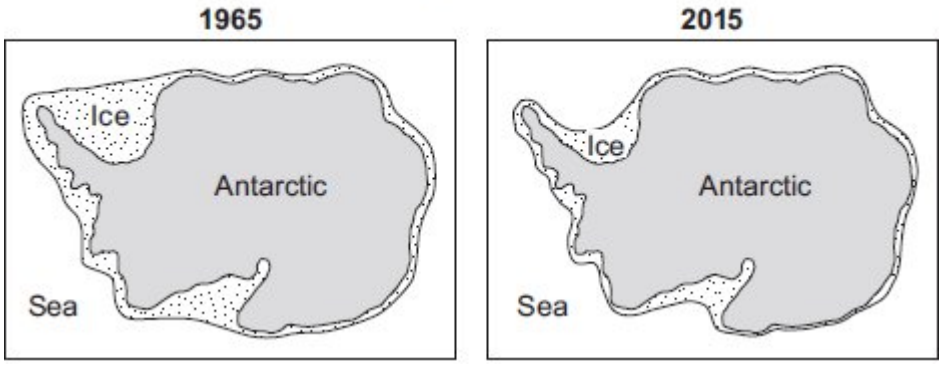
© Jenny Grayson/iStock/Thinkstock

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.

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Figure 2



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

_____

_____

_____

_____

_____

_____

(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.

_____

_____

(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. ☐

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Thermometers do not give accurate readings. 

(1)

(Total 5 marks)

Q15.

Gardeners sometimes use weed killers to control the growth of plants.

(a) A gardener wanted to get rid of daisy plants growing in a lawn.

The gardener investigated the use of a weed killer.

The gardener:

- recorded the number of daisy plants growing in different 10 m^2 areas of the lawn
- made solutions of the weed killer (each solution had a different concentration)
- put 5 dm^3 of each solution on different 10 m^2 areas of the lawn
- recorded the number of daisy plants growing in each area after 2 weeks.

The table shows the results.

Concentration of weed killer in arbitrary units	Number of daisy plants per 10 m^2	
	Before using weed killer	2 weeks after using weed killer
0 (water)	8	8
20	6	8
40	9	6
60	5	2
80	4	0
100	8	0

(i) To make the investigation fair, the gardener controlled some variables.

Give **one** variable the gardener controlled in the investigation.

_____

_____

(1)

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(ii) The gardener decided that the result for a concentration of 20 arbitrary units of weed killer was anomalous.

Suggest why the gardener decided this result was anomalous.

_____

_____

(1)

(iii) Why did the gardener put 0 arbitrary units of weed killer on one area of the lawn?

_____

_____

(1)

(iv) The gardener concluded that the best concentration of weed killer to use all over a lawn is 100 arbitrary units.

Suggest why the gardener cannot be sure about this conclusion.

_____

_____

(1)

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

Plants respond to different environmental factors.

Describe how different environmental factors affect:

- the direction of growth of roots
- the direction of growth of shoots.

In your answer you should refer to the role of plant hormones.

Do **not** refer to the artificial use of plant hormones by gardeners or scientists.

_____

_____

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(6)

(Total 10 marks)

Q16.

Organisms compete with each other.

(a) **Figure 1** shows two types of seaweed which live in similar seashore habitats.

Figure 1



Most of the time the two seaweeds are covered with water.

Bladder wrack has bladders filled with air.

Bladder wrack grows more quickly than saw wrack.
Suggest an explanation why.

_____

_____

_____

_____

_____

_____

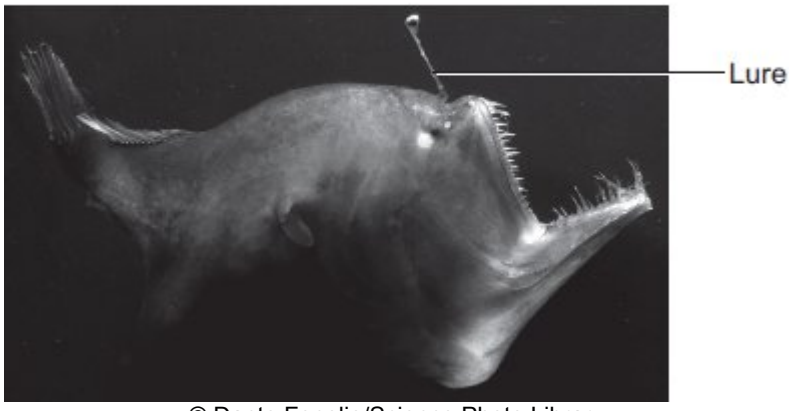
_____

(3)

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(b) **Figure 2** shows an angler fish.

Figure 2



© Dante Fenolio/Science Photo Library

Angler fish live at depths of over 1000 m.

In clear water, sunlight does not usually reach more than 100 m deep.
Many angler fish have a transparent 'lure' containing a high concentration of bioluminescent bacteria.
Bioluminescent bacteria produce light.

Suggest an advantage to the angler fish of having a lure containing bioluminescent bacteria.

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q17.

In January 2011 more than 600 000 people collected results for the UK national bird survey.

People recorded the number of each species of bird they saw in 1 hour on 1 day in their garden.

Some of the results are shown in the table below.

Species	Mean number of birds seen per garden	Percentage of gardens in which the bird was seen

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House sparrow	4.1	64.5
Starling	3.9	51.3
Blackbird	3.2	95.2
Goldfinch	1.5	33.5

(a) A student looked at the table and said:

"In the UK, house sparrows are more common than blackbirds."

Suggest **three** reasons why the student's statement may **not** be true.

_____

_____

_____

_____

_____

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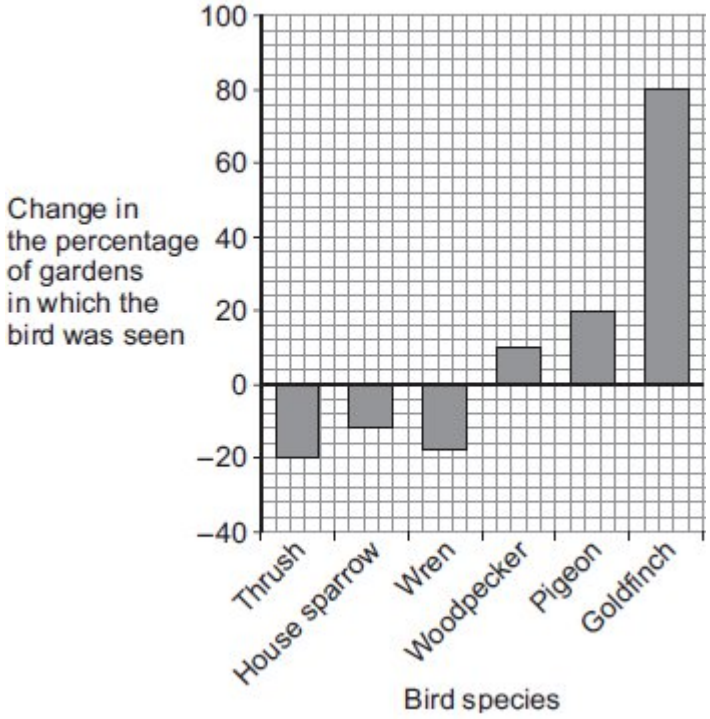
_____

(3)

(b) A survey in 2012 was done in the same way as the 2011 survey.

The graph below shows changes in the percentages of gardens in which some birds were seen from 2011 to 2012.

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(i) Calculate the percentage of gardens in which goldfinches were seen in 2012.

Use information from the graph and the table.

_____

_____

Answer = _____ %

(2)

(ii) Suggest **two** reasons why goldfinches were seen in more gardens in 2012 than in 2011.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q18.

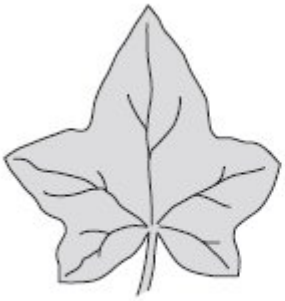
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Ivy plants can grow up trees and walls.

Figure 1 shows two ivy leaves. One leaf is from an ivy plant growing up a tree in the centre of a shady woodland area. The other leaf is from an ivy plant growing up a tree in a sunny area at the edge of the woodland.

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Figure 1



Ivy leaf from shady woodland area
(centre of woodland)



Ivy leaf from sunny area
(edge of woodland)

A student makes the following hypothesis.

"The size of ivy leaves decreases as light intensity increases."

How would you use the apparatus shown in **Figure 2** to test this hypothesis?

You should include details of how you would make sure the results are valid.

Figure 2



100 m tape measure



Ruler



Light meter

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q19.

The photograph shows a fossil of a prehistoric bird called *Archaeopteryx*.

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By Ghedoghedo (own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/BY-SA-3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via Wikimedia Commons; By Steenbergs from Ripon, United Kingdom (Small Fishing Boat In North Sea) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons.

(a) Describe **three** ways fossils can be made.

_____

_____

_____

_____

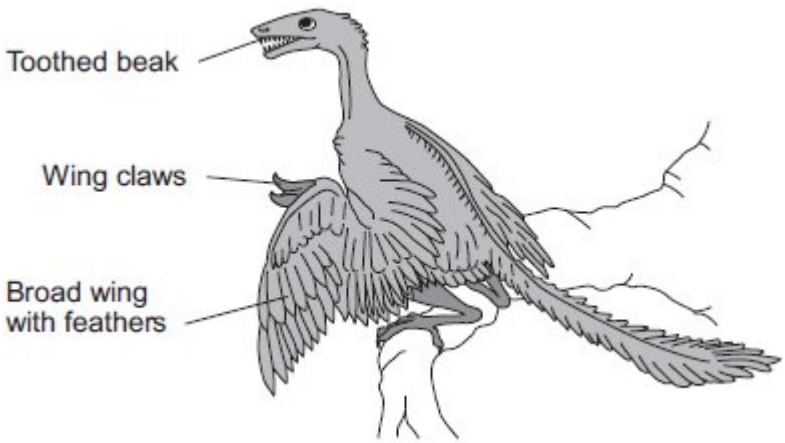
_____

_____

(3)

(b) The drawing shows what an *Archaeopteryx* might have looked like when it was alive.

Scientists think that *Archaeopteryx* was a predator.



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(i) Look at the drawing.

Write down **three** adaptations that might have helped *Archaeopteryx* to catch prey.

How would **each** adaptation have helped *Archaeopteryx* to catch prey?

Adaptation 1 _____

How it helps _____

_____

Adaptation 2 _____

How it helps _____

_____

Adaptation 3 _____

How it helps _____

_____

(3)

(ii) *Archaeopteryx* is now extinct.

Give **two** reasons why animals may become extinct.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q20.

Freshwater streams may have different levels of pollution. The level of pollution affects which species of invertebrate will live in the water.

Table 1 shows the biomass of different invertebrate species found in two different streams, **X** and **Y**.

Table 1

	Biomass in g	
Invertebrate species	**Stream X**	**Stream Y**
Mayfly nymph	4	0

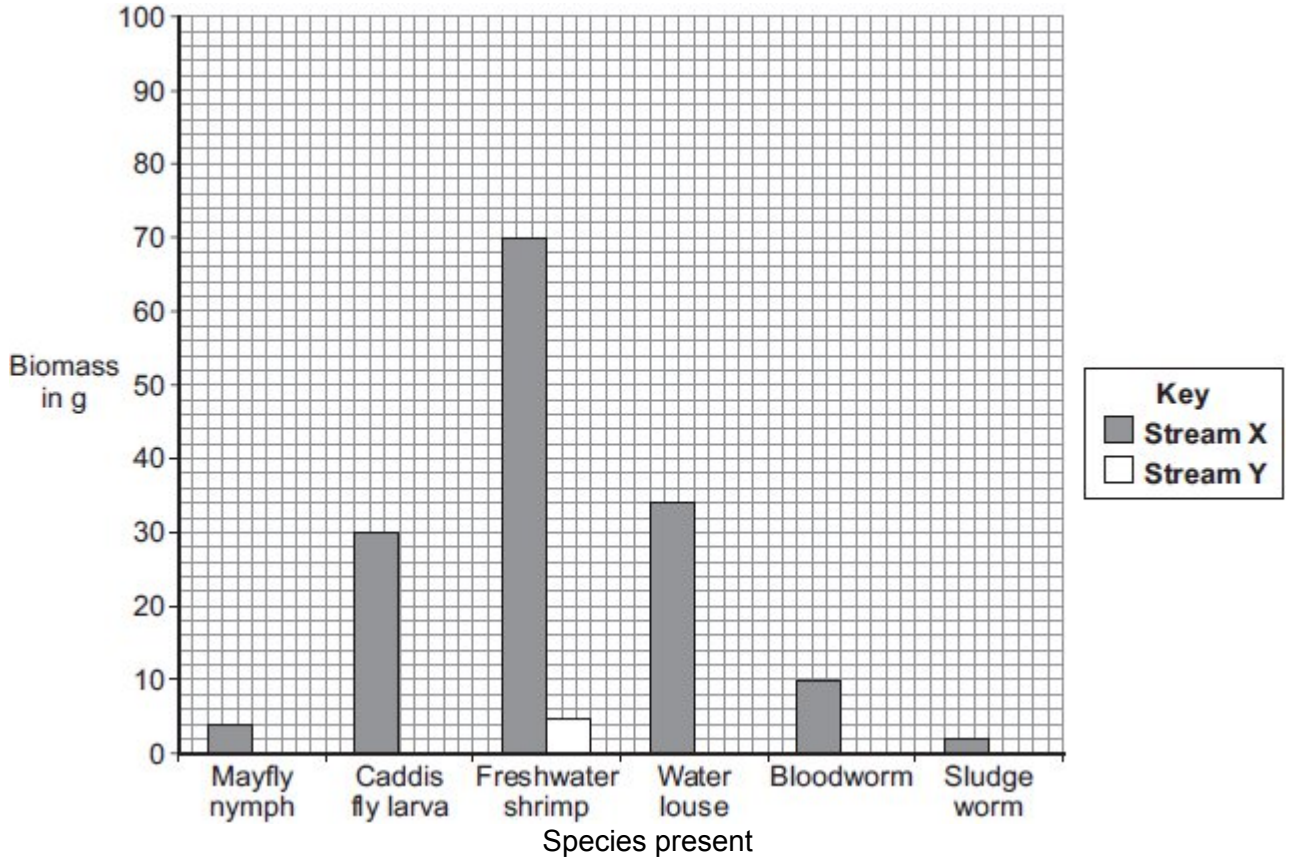
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Caddis fly larva	30	0
Freshwater shrimp	70	5
Water louse	34	10
Bloodworm	10	45
Sludge worm	2	90
Total	**150**	**150**

(a) The bar chart below shows the biomass of invertebrate species found in **Stream X**.

(i) Complete the bar chart by drawing the bars for water louse, bloodworm and sludge worm in **Stream Y**.

Use the data in **Table 1**.



(2)

(ii) **Table 2** shows which invertebrates can live in different levels of water pollution.

Table 2

Pollution level	**Invertebrate species likely to be present**
Clean water	Mayfly nymph

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Low pollution	Caddis fly larva, Freshwater shrimp
Medium pollution	Water louse, Bloodworm
High pollution	Sludge worm

Which stream, **X** or **Y**, is more polluted?
Use the information from **Table 1** and **Table 2** to justify your answer.

_____

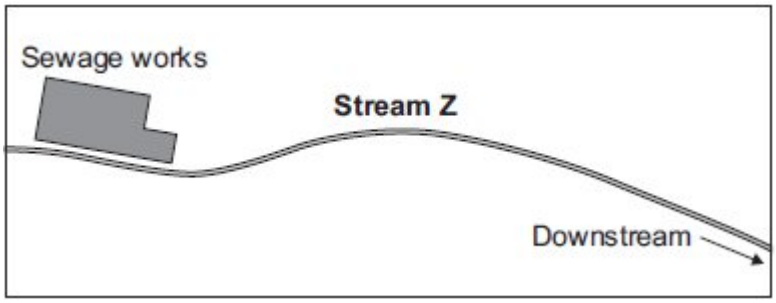
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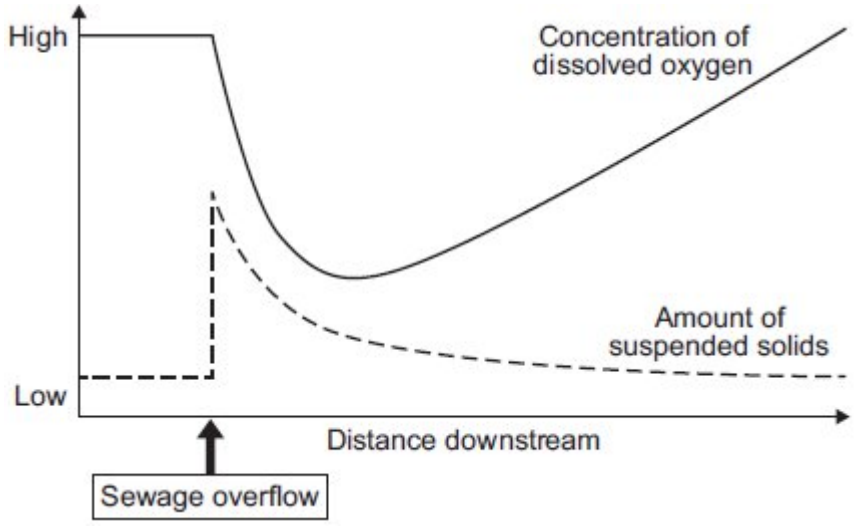
(2)

(b) There is a sewage works near another stream, **Z**.



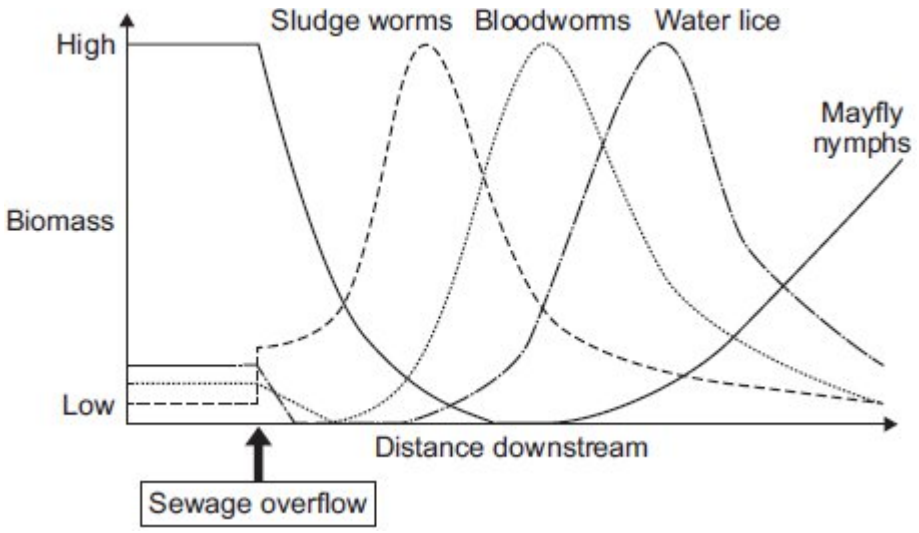
An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow

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(i) Describe the patterns shown in **Graph P**.

(4)

(ii) Describe the relationship between dissolved oxygen and the survival of mayfly nymphs in **Stream Z**. Suggest a reason for the pattern you have described.

(3)

(c) Many microorganisms are present in the sewage overflow.

Explain why microorganisms cause the level of oxygen in the water to decrease.

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_____

_____

_____

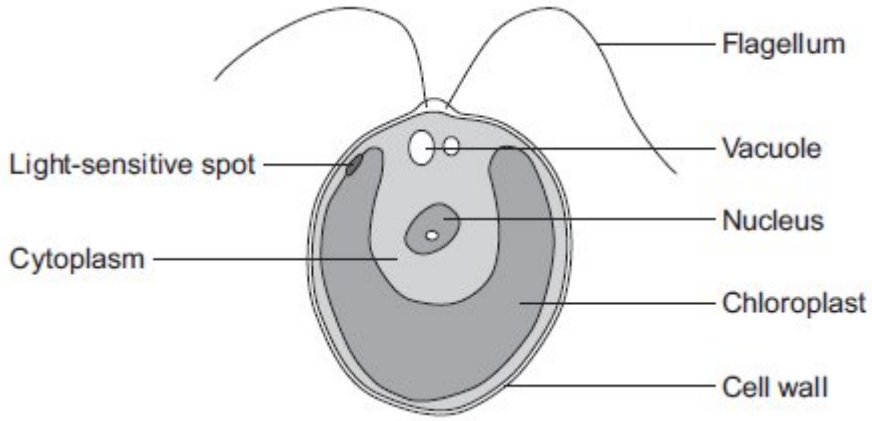
_____

(2)

(Total 13 marks)

Q21.

The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

_____

(1)

(ii) is made of cellulose?

_____

(1)

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

_____

(1)

(ii) Give the reason why the algal cell does not burst.

_____

_____

(1)

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.

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water + _____ $\xrightarrow{\text{Light energy}}$ _____ + oxygen

(2)

(ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

_____

_____

_____

_____

(2)

(d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

_____

_____

_____

_____

_____

_____

(3)

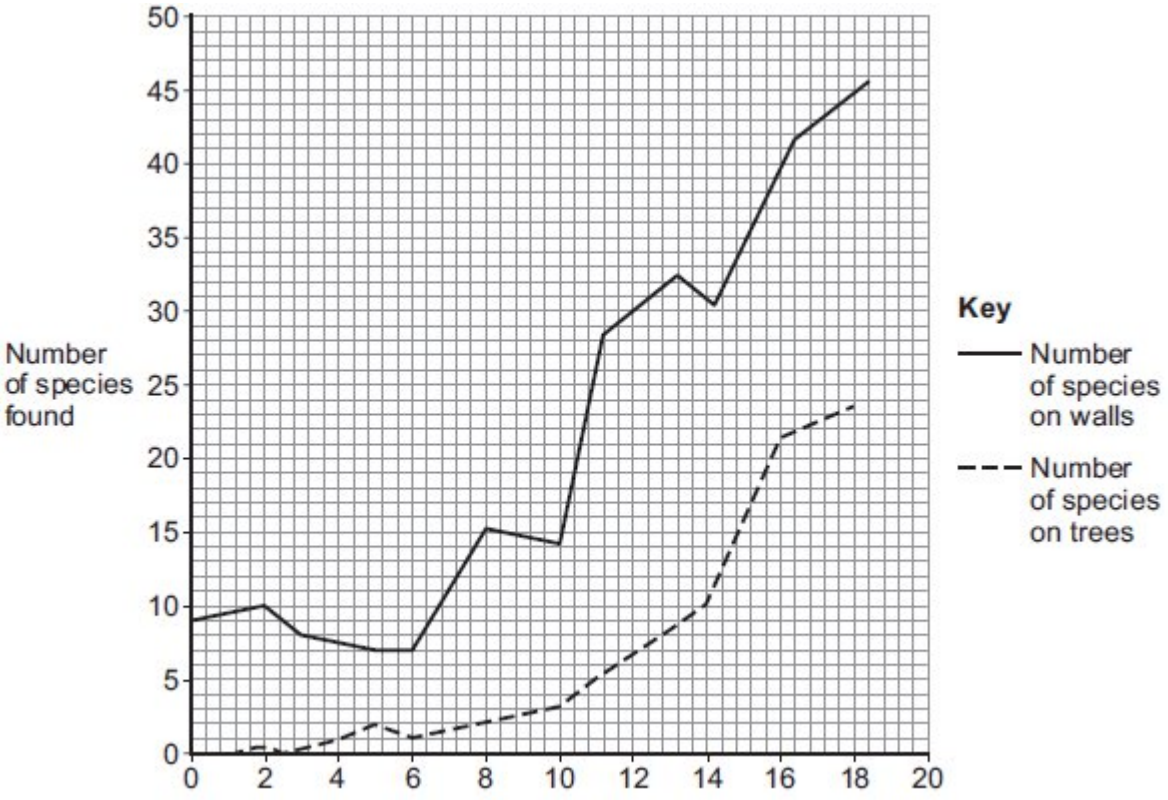
(Total 11 marks)

Q22.

Lichens can be used as air pollution indicators.

The graph below shows the number of lichen species found growing on walls and trees at increasing distances from a city centre.

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(a) (i) How many species of lichen are found on walls 2 km from the city centre?

_____

(1)

(ii) Describe the patterns in the data.

_____

_____

_____

_____

_____

_____

(3)

(b) The table below shows the concentration of sulfur dioxide (SO_2) in the air at different distances from the same city centre.

Distance from city centre in km	**SO_2 concentration in g per m^3**
0	200
3	160

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8	110
13	85
18	65

Suggest how the data in the table could explain the patterns in the graph above.

_____

_____

_____

_____

(2)

(c) Nitrogen oxides are also air pollutants.

The main source of nitrogen oxide pollution comes from road vehicles.

Different lichen species vary in their tolerance of the levels of nitrogen oxides in the air.

Some lichens can only grow in very clean air where there are low levels of nitrogen oxides. They are nitrogen-sensitive.

Some lichens grow very well in high levels of nitrogen oxides. They are nitrogen-loving.

The table below shows one lichen species which is nitrogen-sensitive and one lichen species which is nitrogen-loving.

Nitrogen-sensitive	**Nitrogen-loving**
Usnea 	*Xanthoria* 

Usnea © epantha/iStock/Thinkstock;
Xanthoria By Zakwitnij!pl Ejdzej + Iric (CC BY-SA.2.0) via wikicommons

(i) Describe how you would investigate the distribution of the two lichens at different distances into a wood from a main road.

_____

_____

_____

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_____

_____

_____

_____

(3)

(ii) Predict the results from the experiment you described in your answer to part **(c)(i)**. Explain why you made this prediction.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

Q23.

A project called Garden Bird Watch counts the UK populations of common birds. 16 000 people count the number of birds in their gardens every week of the year.

The results are analysed by researchers and written up in important scientific magazines.

(a) Suggest **one** advantage of this method of collecting data.

_____

_____

The table below shows the percentage (%) of gardens visited by different bird species in 1995 and in 2011.

Bird species	**% of gardens visited in 1995**	**% of gardens visited in 2011**
Goldfinch	12	58
Greenfinch	71	54
House sparrow	84	64

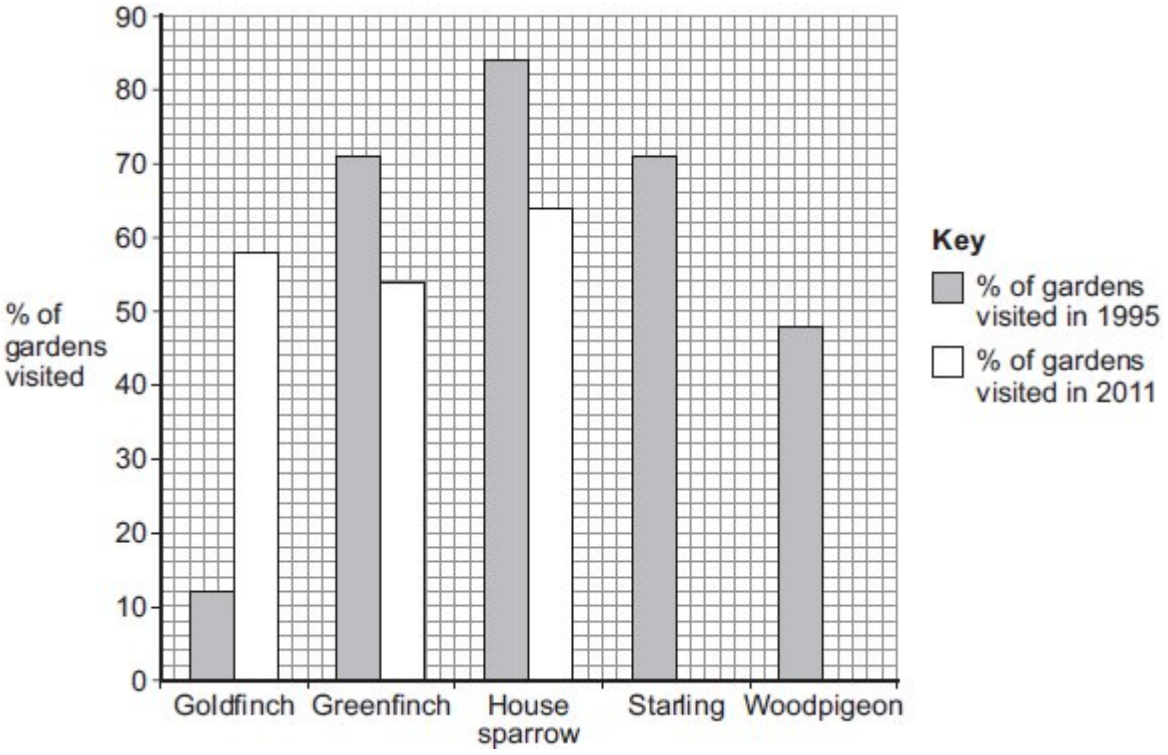
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Starling	71	42
Woodpigeon	48	80

(1)

(b) (i) Complete the bar chart below, by plotting the data from the table above for 2011.

Some have been done for you.



(2)

(ii) In this survey, the results from 16 000 gardens were sent in.

How many gardens were visited by woodpigeons in 2011?

_____

(2)

(iii) Which bird species has increased the most from 1995 to 2011?

_____

(1)

(c) The change in the number of woodpigeons may be partly because they have spread to towns and cities.
Suggest why this increase in woodpigeons in towns and cities might have occurred.

_____

_____

(1)

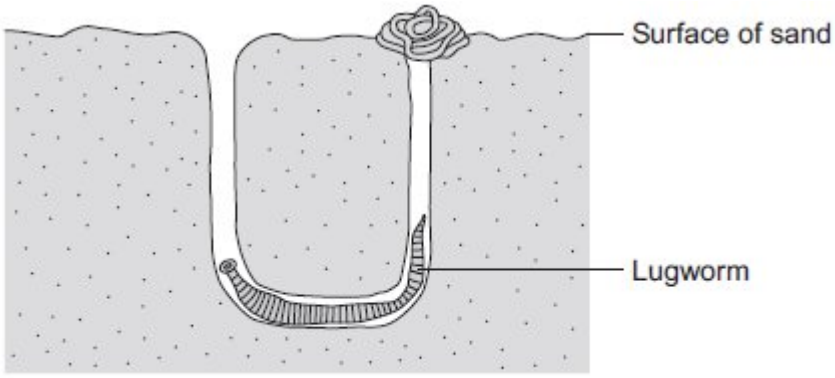
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(Total 7 marks)

Q24.

The lugworm lives in a U-shaped burrow in the sand on the seashore.

The diagram below shows a lugworm in its burrow.



(a) Some scientists investigated the effect of different salt concentrations on lugworms.

The scientists:

- collected 50 lugworms from the seashore
- separated them into five groups of 10 lugworms
- weighed each group of 10 lugworms
- placed each group into a different concentration of salt solution and left them for 8 hours
- took each lugworm out of the solution and placed it on blotting paper for 30 seconds
- re-weighed each group of 10 lugworms.

(i) Why did the scientists use groups of 10 lugworms and not just 1 lugworm at each concentration?

_____

_____

(1)

(ii) Suggest why the scientists placed each lugworm on blotting paper for 30 seconds before they reweighed the groups of lugworms.

_____

_____

(1)

(iii) How might the method of blotting have caused errors in the results?

_____

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_____

(1)

(iv) Suggest **one** improvement the scientists could make to their investigation.

_____

(1)

(b) The table below shows the scientists' results.

Concentration of salt in arbitrary units	**Mass of 10 lugworms at start in grams**	**Mass of 10 lugworms after 8 hours in grams**	**Change in mass in grams**	**Percentage (%) change in mass**
1.0	41.2	61.8	+20.6	+50
2.0	37.5	45.0	+7.5	
3.0	55.0	56.1	+1.1	+2
4.0	46.2	22.2	-24.0	-52
5.0	45.3	22.6	-22.7	-50

(i) The scientists calculated the **percentage** change in mass at each salt concentration.

Why is the **percentage** change in mass more useful than just the change in mass in grams?

Use information from the table in your answer.

_____

_____

_____

_____

(2)

(ii) Calculate the percentage change in mass for the 10 lugworms in the salt solution with a concentration of 2.0 arbitrary units.

_____

_____

Percentage change in mass = _____ %

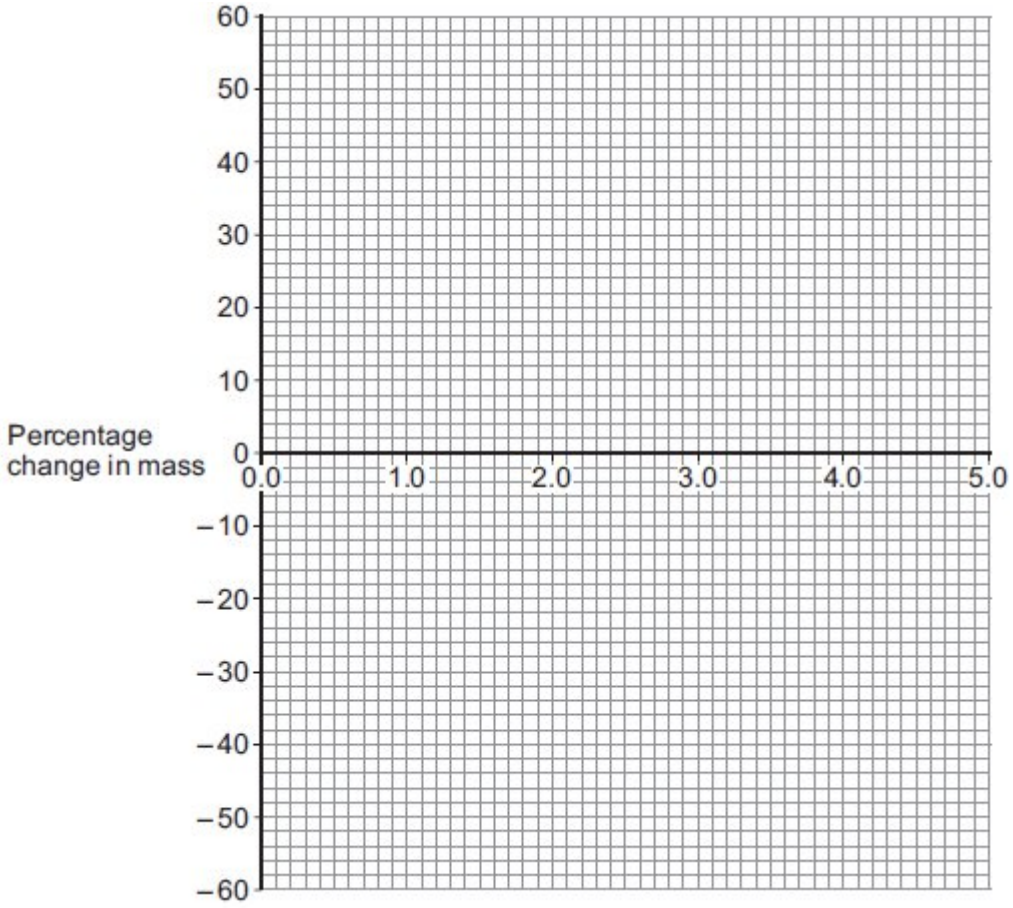
(2)

(c) (i) On the graph paper below, draw a graph to show the scientists' results:

- plot the **percentage** change in mass

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- label the horizontal axis
- draw a line of best fit.



(4)

(ii) The scientists thought one of their results was anomalous.

Draw a ring around the anomalous result on your graph.

(1)

(iii) Suggest what might have happened to cause this anomalous result.

_____

_____

(1)

(d) (i) What do you think is the concentration of salts in the lugworm's natural environment?

Use information from your graph to give the reason for your answer.

Concentration = _____ %

Reason _____

_____

_____

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_____

(2)

(ii) The mass of the lugworms decreased in the salt solution with a concentration of 5.0 arbitrary units.

Explain what caused this.

_____

_____

_____

_____

_____

_____

(3)

(Total 19 marks)

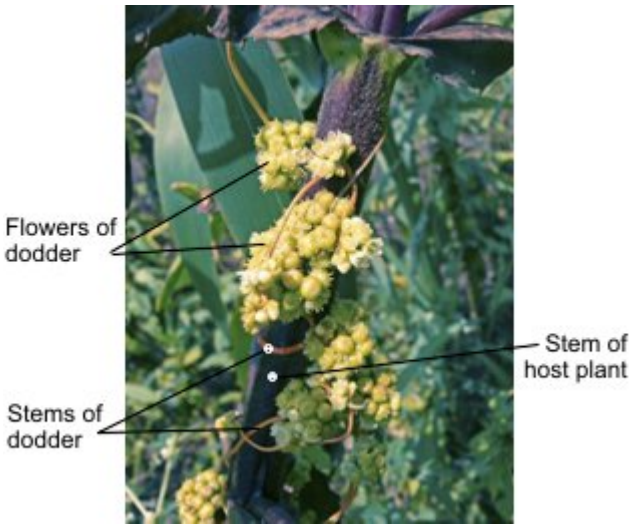
Q25.

(a) Dodder is an unusual flowering plant. It is a parasite.

The dodder plant:

- has no chlorophyll
- has no roots
- has no leaves
- grows attached to the stem of a host plant.

The image below shows dodder attached to its host plant.



© yogesh_more/iStock/Thinkstock

(i) Dodder has no chlorophyll. Most plants have leaves containing chlorophyll.

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What is the function of chlorophyll in most plants?

_____

_____

_____

_____

(2)

(ii) Parts of the dodder stem grow into the host stem and attach to the host's phloem tissue.

Suggest why it is helpful to the dodder plant to be attached to the host's phloem tissue.

_____

_____

(1)

(iii) Suggest why the dodder will have a harmful effect on the host plant.

_____

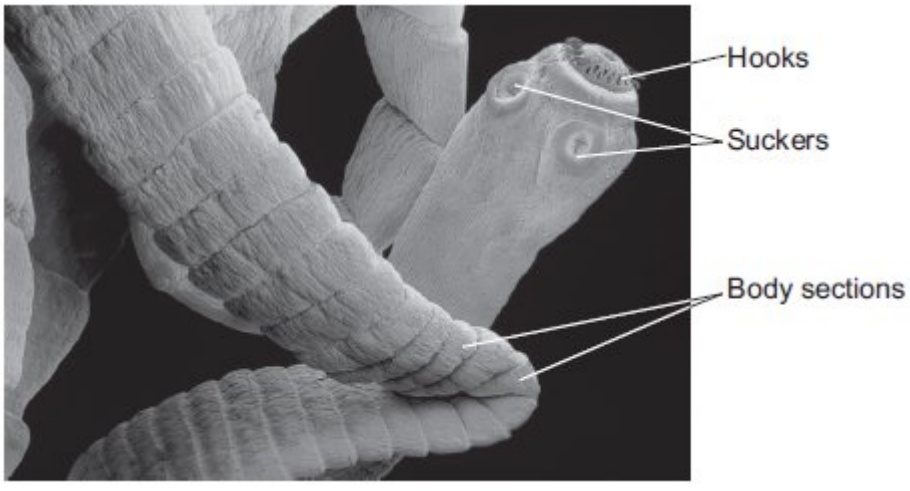
_____

(1)

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

The tapeworm is another parasite.

The image below shows part of a tapeworm.



© Science Photo Library

The tapeworm lives inside the small intestine of a mammal.

Describe and explain how the tapeworm is adapted for living inside the small intestine of its host.

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Extra space _____

(6)
(Total 10 marks)

Q26.

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

Animals and plants have features (adaptations) that allow them to survive in the conditions in which they normally live.

Describe how animals and plants are adapted to survive in dry conditions such as deserts.

For each adaptation that you give, describe how the adaptation helps the animal or plant to survive in dry conditions.

To obtain full marks you should refer to **both** animals and plants.

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Extra space _____

(Total 6 marks)

Q27.

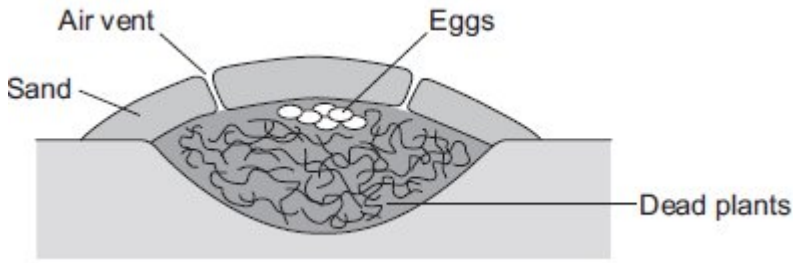
Most birds sit on their eggs to keep them warm until they hatch.

Megapode birds:

- dig a large hole in sand
- fill the hole with dead plants
- lay their eggs on top of the dead plants
- cover the surface with a thick layer of sand.

The image below shows a megapode bird's nest.

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(a) The dead plants in the nest decay. The decaying process helps to keep the eggs warm for many weeks.

Suggest how.

_____

_____

_____

_____

_____

_____

(3)

(b) (i) Megapode birds open and close the air vents of the nest at different times of the day.

Suggest reasons why it is necessary to open and close the air vents.

_____

_____

_____

_____

_____

_____

(3)

(ii) The sex of a megapode bird that hatches from an egg depends on the temperature at which the egg was kept.

Use this information to suggest why it is important for megapode birds to control the temperature of their nests.

_____

_____

(1)

(Total 7 marks)

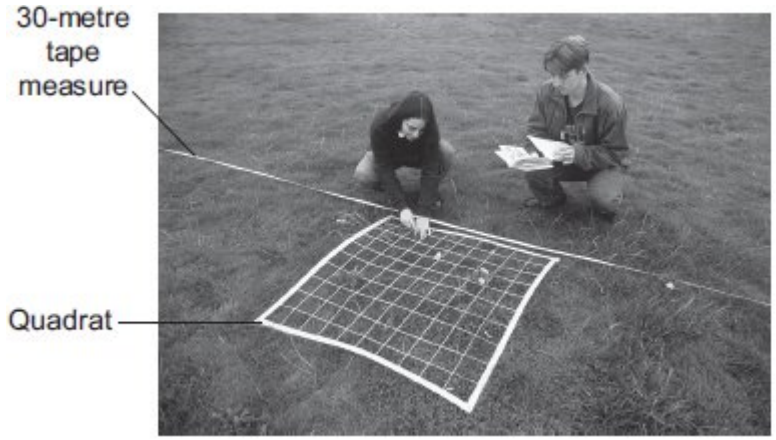
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Q28.

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.

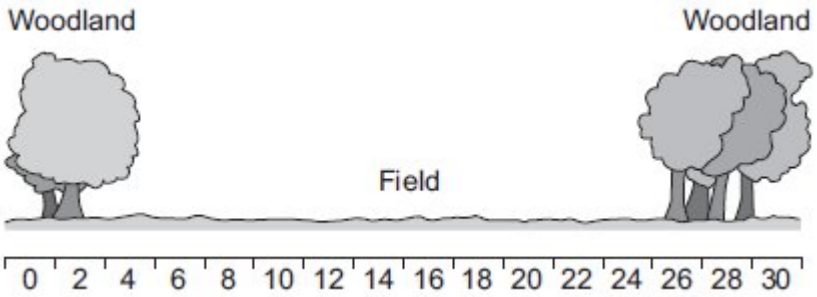
Figure 1



© Science Photo Library

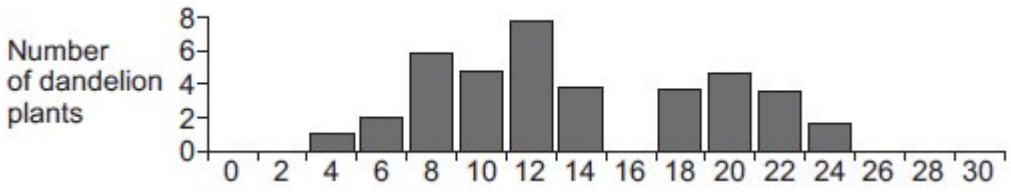
Figure 2 shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

Figure 2



Distance in m

Figure 3



Distance in m

(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.

_____

_____

(1)

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

_____

_____

(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.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q29.

At the seashore, the tide comes in and goes out twice each day.

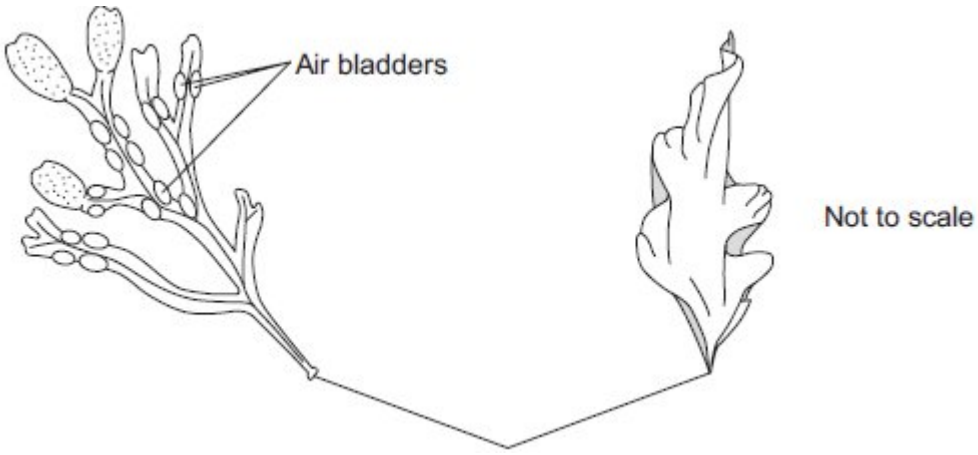
Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.
Seaweeds are plant-like organisms that make their food by photosynthesis.

Figure 1 shows the two species of seaweed that the students investigated.

Figure 1

Bladder wrack **Sea lettuce**

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(a) The students:

1 placed a 50-metre tape measure on the rocks at right angles to the sea

2 placed a quadrat next to the tape measure

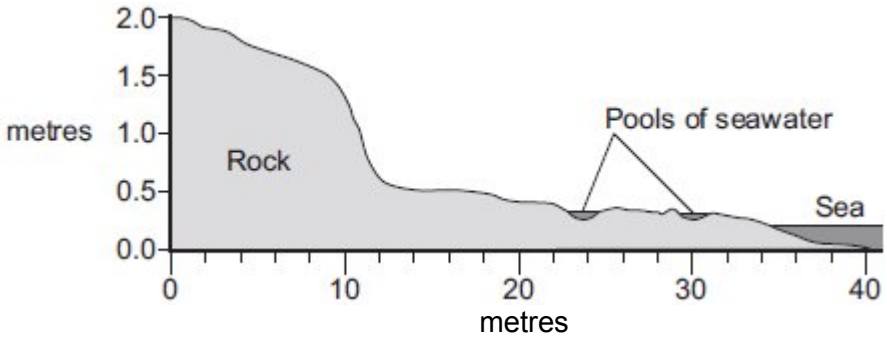
3 recorded whether each species was present or not.

The students repeated steps 2 and 3 every metre down the shore.

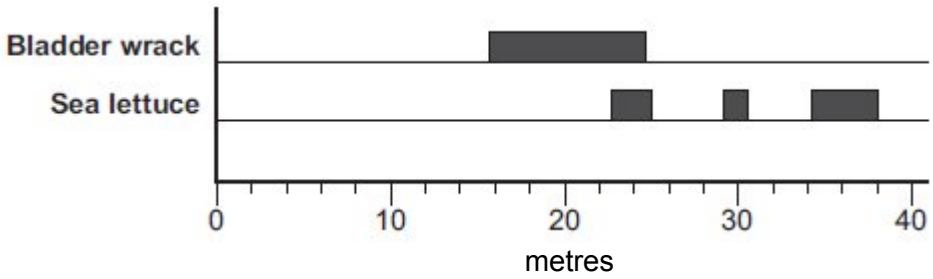
Figure 2 shows a section of the seashore and the students' results.

Figure 2

Section of the seashore



Students' results



(i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

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Explain why.

_____

_____

_____

_____

(2)

(ii) How could the students have improved their investigation to ensure that they produced valid data?

_____

_____

_____

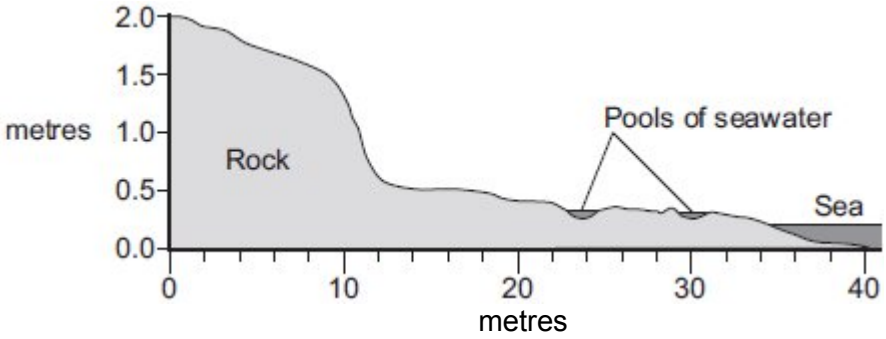
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(2)

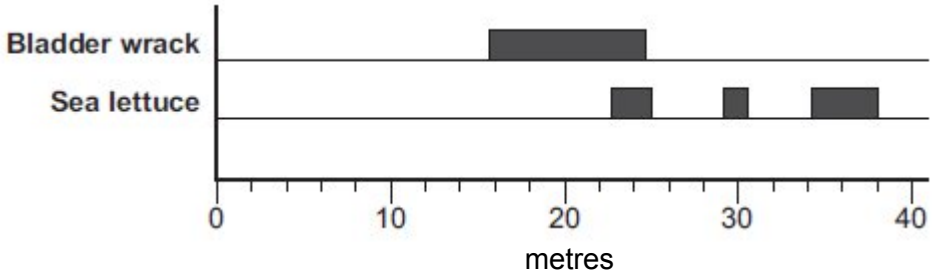
(iii) **Figure 2** is repeated here to help you answer this question.

Figure 2

Section of the seashore



Students' results



The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 2**.

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_____

_____

_____

_____

(2)

(b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

_____

_____

_____

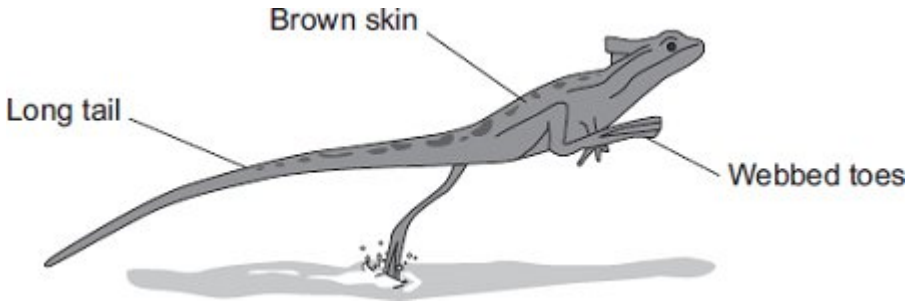
_____

(2)

(Total 8 marks)

Q30.

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**
	For camouflage on branches of trees
Toes on the back feet are webbed	
	Helps the lizard to balance when running
Long tail	
	_____

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	Warning colours to deter predators
Brown skin	
	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.

_____

_____

(1)

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

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

Tick (✓) **two** boxes.

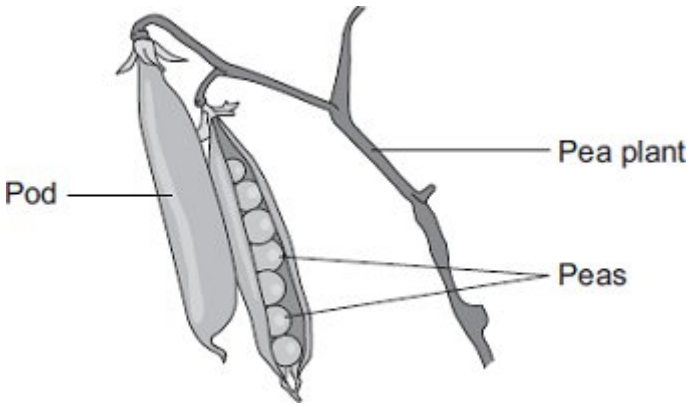
Oxygen	☐
Food	☐
Territory	☐
Light	☐

(2)
(Total 6 marks)

Q31.

Peas grow in pods on pea plants.

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A gardener grew four varieties of pea plants, **A** , **B** , **C** and **D** , in his garden.
The gardener counted the number of peas in each pod growing on each plant.

The table shows his results.

Variety	Range of number of peas in each pod	Mean number of peas in each pod
A	2–6	4
B	3–7	5
C	3–8	6
D	6–8	7

(a) Give **one** environmental factor and **one other** factor that might affect the number of peas in a pod.

Environmental factor _____

Other factor _____

(2)

(b) The gardener thinks that he will get the largest mass of peas from his garden if he grows variety **D**.

Why is the gardener **not** correct?

Suggest **one** reason.

_____

_____

(1)

(c) It is important that carbon is cycled through living things.

After he has picked the peas, the gardener puts the dead pea plants onto a compost heap.

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Over the next few months, the carbon in the carbon compounds from the pea plants is returned to the air.

Describe how.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q32.

On a rocky shore, when the tide goes in and out, organisms are exposed to the air for different amounts of time.

(a) On hot, windy days when the tide is out the concentration of the salt solution in rock pools may become very high.

What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

_____

(1)

(b) Periwinkles are types of snail.
Students surveyed the different types of periwinkle living on a rocky shore.

The diagram shows the results of the students' survey.
The highest position that the sea water reaches on the shore is called the high tide level.
Each bar represents the range of habitats for each type of periwinkle.

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Position on shore	Small periwinkle	Rough periwinkle	Common periwinkle	Flat periwinkle
High tide level ↓ Low tide level				

(i) Which **two** types of periwinkle are likely to compete with each other to the greatest extent?

_____

(1)

(ii) Explain your answer to part (b)(i).

_____

_____

(1)

(iii) The small periwinkle can survive much nearer to the high tide level than the flat periwinkle.

Suggest **two** reasons why the flat periwinkle cannot survive near to the high tide level.

1. _____

_____

_____

2. _____

_____

_____

(2)

(Total 5 marks)

Q33.

Darwin suggested the theory of natural selection.

(a) Explain how natural selection occurs.

_____

_____

_____

_____

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_____

_____

_____

(3)

(b) Latitude is a measure of distance from the Earth's equator.

Scientists investigated the effect of latitude on:

- the time taken for new species to evolve
- the number of living species.

The table shows the scientists' results.

Latitude in degrees North of equator	Time taken for new species to evolve in millions of years	Relative number of living species
0 (at the equator)	3–4	100
25	2	80
50	1	30
75 (in the Arctic)	0.5	20

As latitude increases environmental conditions become more severe.

(i) Describe the patterns shown by the data.

_____

_____

_____

_____

_____

_____

(2)

(ii) Suggest explanations for the patterns you have described in part (b)(i).

_____

_____

_____

_____

_____

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_____

(2)

(Total 7 marks)

Q34.

The photographs show four different species of bird.

Great tit



© JensGade/iStock

Blue tit



© Marcobarone/iStock

Coal tit



© MikeLane45/iStock

Long-tailed tit



© Andrew Howe/iStock

The table gives information about the four species of bird in winter.

Bird species	Mean body mass in grams	Mean energy needed in kJ per day	Mean percentage of day spent feeding
Great tit	21	84.2	75
Blue tit	12	62.4	81
Coal tit	9	49.5	88
Lond-tailed tit	7	42.0	92

(a) (i) Calculate the energy needed per day per gram of body mass for the blue tit.

_____

_____

_____

Answer = _____ kJ per day per gram of body mass

(2)

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(ii) Describe the trend for energy needed per day per gram of body mass for the four species of bird.

_____

_____

_____

(1)

(iii) Suggest an explanation for the trend you have described in part (a)(ii).

_____

_____

_____

_____

(2)

(b) Describe and explain the trend shown by the data for the time spent feeding in winter for the birds.

_____

_____

_____

_____

(2)

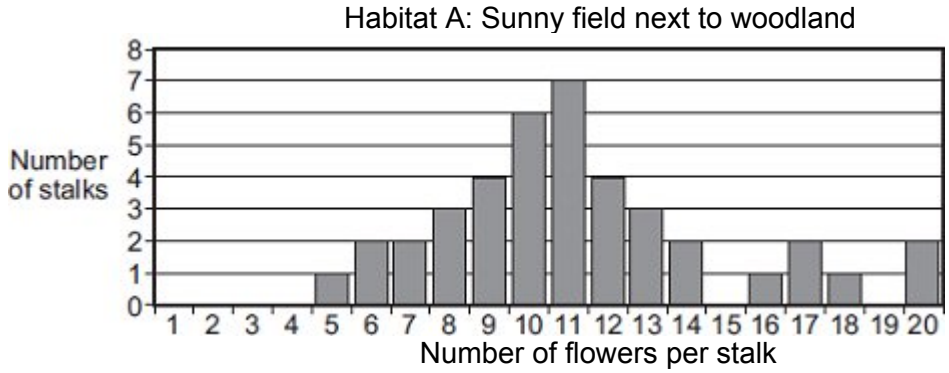
(Total 7 marks)

Q35.

Some students studied bluebell plants growing in two different habitats.

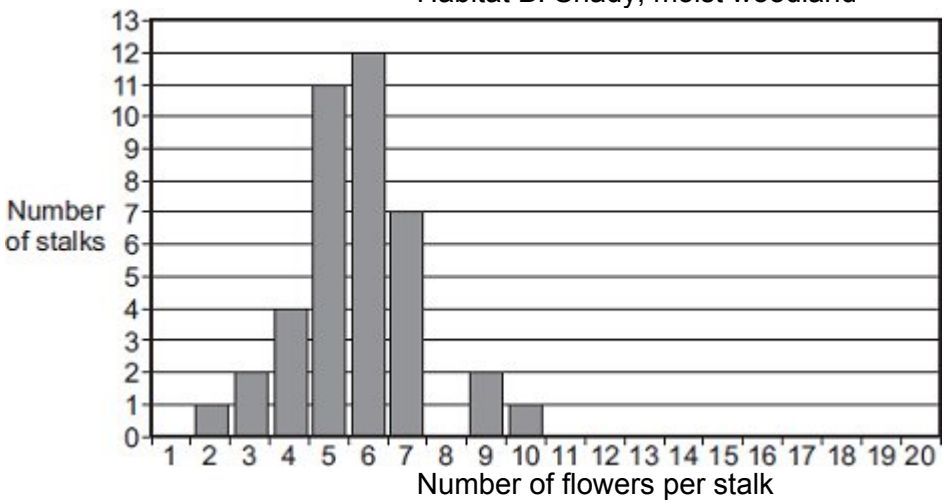
Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.



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Habitat B: Shady, moist woodland



(a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

_____

_____

_____

_____

_____

(2)

(b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = _____

(1)

(ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

_____

_____

_____

_____

(2)

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(iii) Suggest how the students could test their hypothesis for the two habitats.

_____

_____

_____

_____

(2)

(c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

_____

_____

_____

_____

(2)

(Total 9 marks)

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