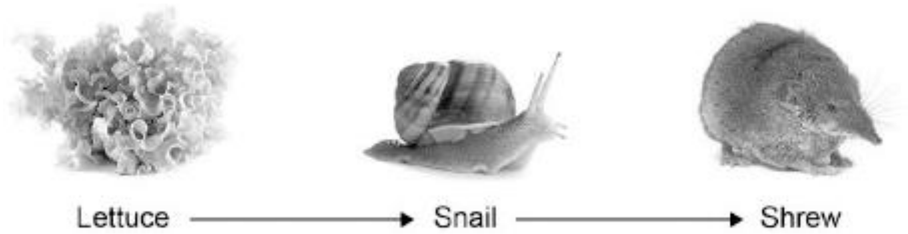
ORGANISATION OF AN ECOSYSTEM PART 1

Q1.

The diagram below shows a food chain in a garden.



(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 ☐

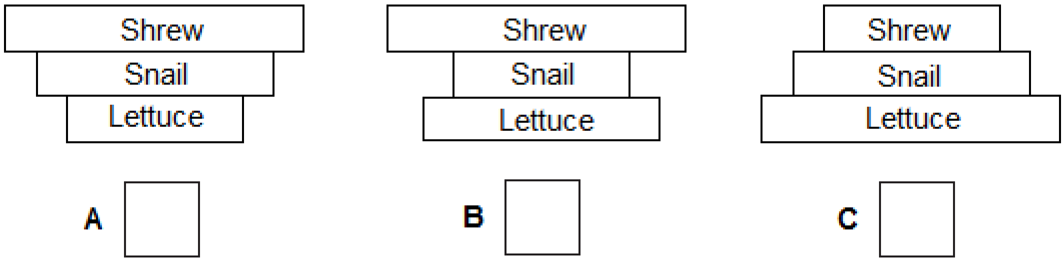
Population ☐

Territory ☐

(1)

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

Tick **one** box.



(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.

____

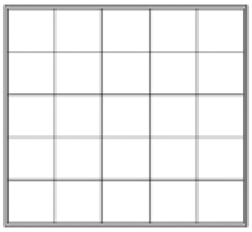
(1)

(Total 8 marks)

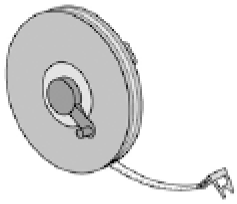
Q2.

A student was asked to estimate how many clover plants there are in the school field.

The image below shows the equipment used.



Quadrat



Tape

Identification key

Not drawn to scale

This is the method used.

1. Throw a quadrat over your shoulder.
2. Count the number of clover plants inside the quadrat.
3. Repeat step **1** and step **2** four more times.
4. Estimate the number of clover plants in the whole field.

(a) What is the tape in the image above used for in this investigation?

____

____

(1)

(b) The teacher told the student that throwing the quadrat over his shoulder was **not** random.

The method could be improved to make sure the quadrats were placed randomly.

Suggest **one** change the student could make to ensure the quadrats were placed randomly.

____

____

(1)

(c) How could the student improve the investigation so that a valid estimate can be made?

Tick **two** boxes.

Weigh the clover plants	☐
Compare their results with another student's results	☐
Count the leaves of the clover plants	☐
Place more quadrats	☐
Place the quadrats in a line across the field	☐

(2)

(d) The table below shows the student's results.

Quadrat number	**Number of clover plants counted**
1	11
2	8
3	11
4	9
5	1
Total	40

The area of the school field was 500 m^2.

The quadrat used in the table above had an area of 0.25 m^2.

Calculate the estimated number of clover plants in the school field.

____

____

____

Estimated number of clover plants = ____________________

(3)

(e) What was the mode for the results in the table above?

Tick **one** box.

1 ☐

8 ☐

11 ☐

40 ☐

(1)

(f) Suggest which quadrat could have been placed under the shade of a large tree.

Give **one** reason for your answer.

Quadrat number ____________________

Reason ____

____

(1)

(Total 9 marks)

Q3.

A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

___

___

___

___

(2)

(b) The gardener finds this research on the Internet:

'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

___

Ratio ___

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

___

___

(1)

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

____

____

____

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____

____

____

____

____

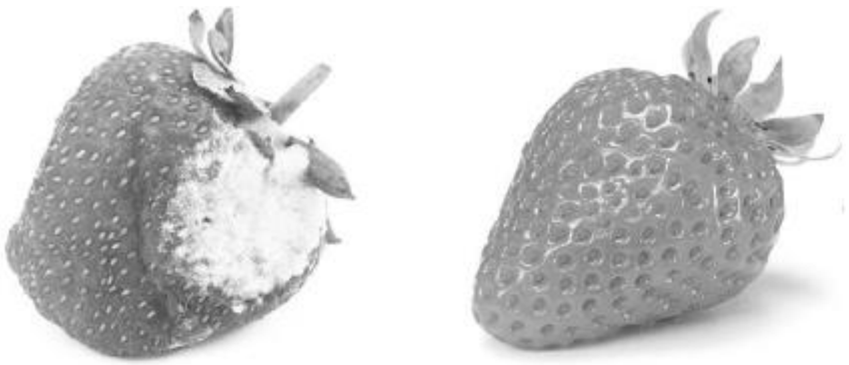
____

(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1. ____

____

2. ____

____

3. ____

____

(3)

(Total 13 marks)

Q4.

A student plans an investigation using mould.

(a) Mould spores are hazardous.

Give **one** safety precaution the student should take when doing this investigation.

____

____

(1)

(b) A student made the following hypothesis about the growth of mould:

'The higher the temperature, the faster the growth of mould'.

The student planned to measure the amount of mould growing on bread.

The student used the following materials and equipment:

- slices of bread
- sealable plastic bags
- a knife
- a chopping board
- mould spores.

Describe how the materials and equipment could be used to test the hypothesis.

____

____

____

____

____

____

____

____

(4)

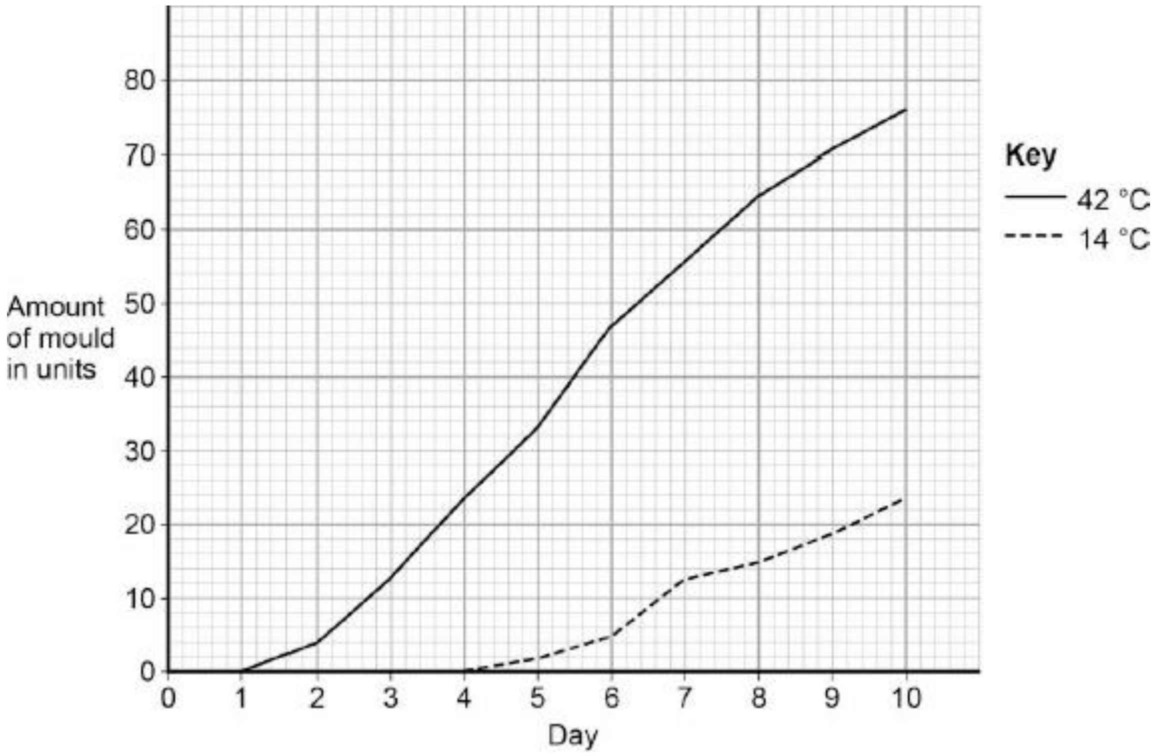
(c) Give **one** variable the student should control in the investigation.

____

(1)

(d) Another student did a similar investigation.

The diagram below shows the results.



Determine the rate of mould growth at 42 °C between day 2 and day 7.

___

___

Rate of mould growth = ________________ units per day

(2)

(e) The growth of mould shows decomposition of the bread.

Give a conclusion about decomposition from the results in the diagram above.

___

___

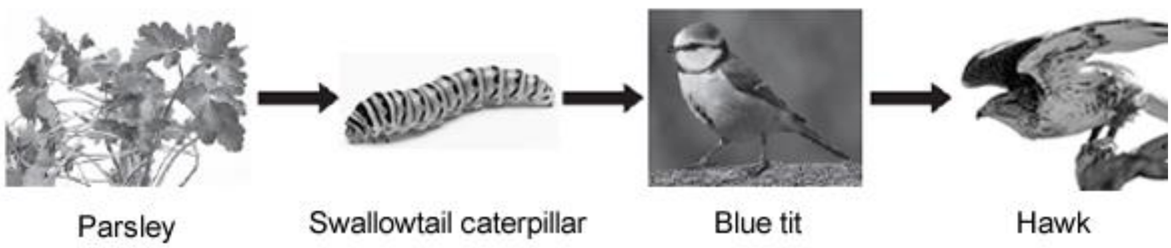
(1)

(Total 9 marks)

Q5.

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

Figure 1



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

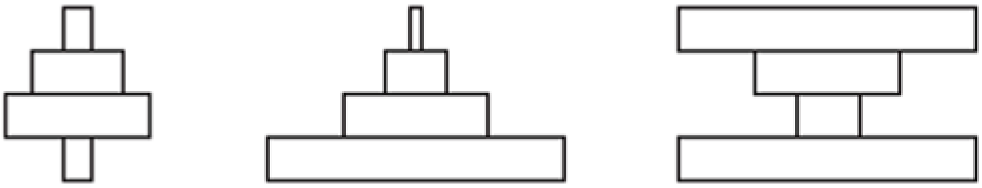
___

(2)

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

Why is photosynthesis important in the food chain?

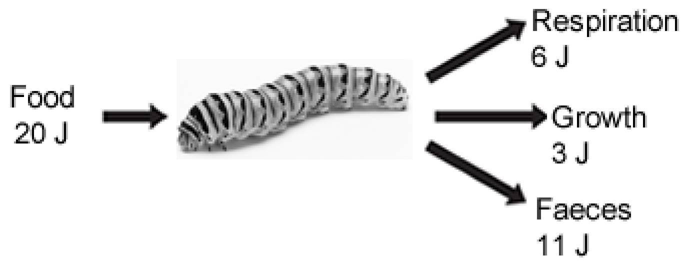
Tick (✔) **one** box.



(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?

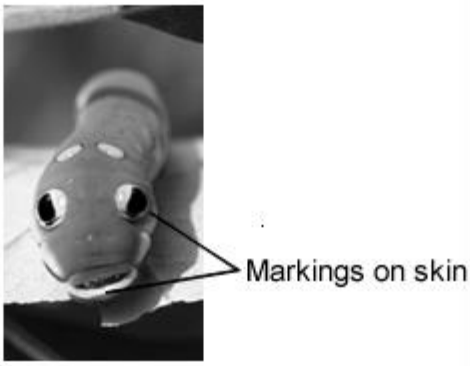
Percentage = ______________

(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. ____

____

2. ____

____

(2)

(Total 9 marks)

Q6.

Students investigated decomposition.

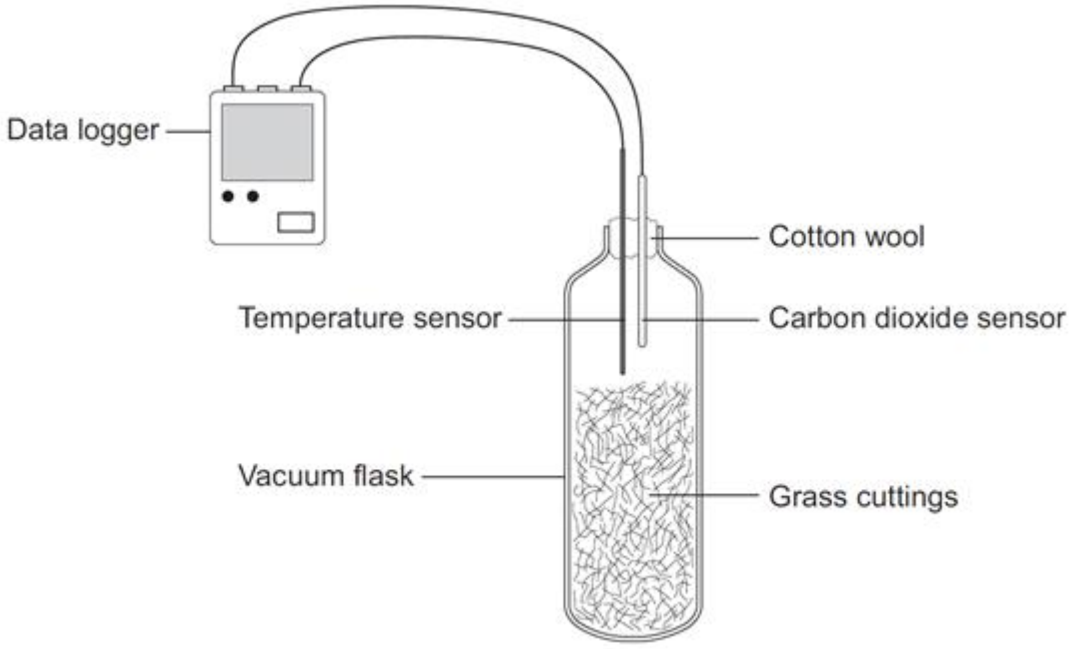
The students:

- put some decaying grass cuttings into a vacuum flask
- put a carbon dioxide sensor and a temperature sensor in the flask
- attached the sensors to a data logger
- closed the flask with cotton wool.

A vacuum flask was used to reduce the loss of thermal energy.

Figure 1 shows the investigation.

Figure 1



(a) Give **one** advantage of using a temperature sensor attached to a data logger instead of a thermometer.

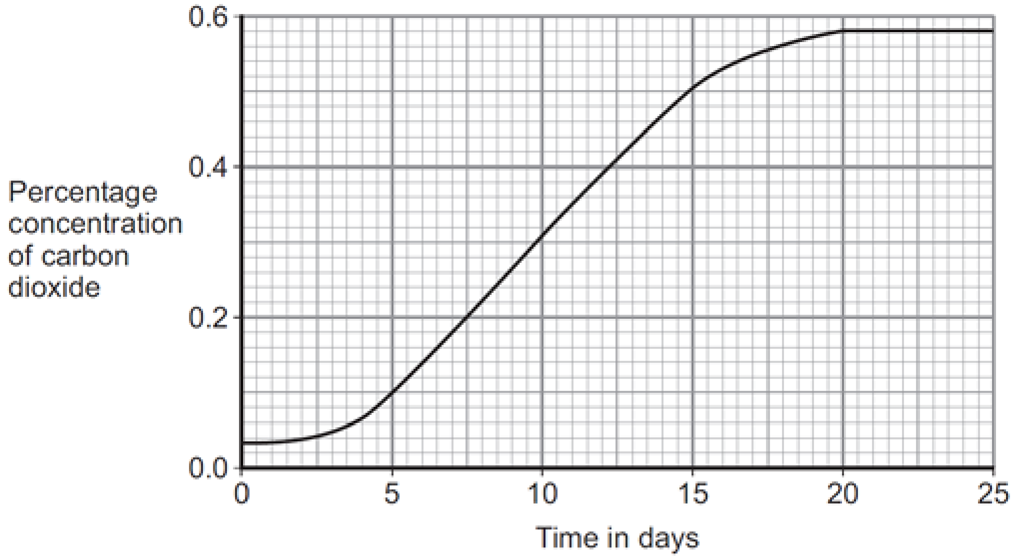
____

____

(1)

(b) **Figure 2** shows the results from the data logger for carbon dioxide concentration in the flask for the next 25 days.

Figure 2



(i) Why did the concentration of carbon dioxide in the flask increase?

____

____

____

____

____

____

(3)

(ii) Suggest what has happened in the flask to cause the carbon dioxide concentration to level off after 20 days.

____

____

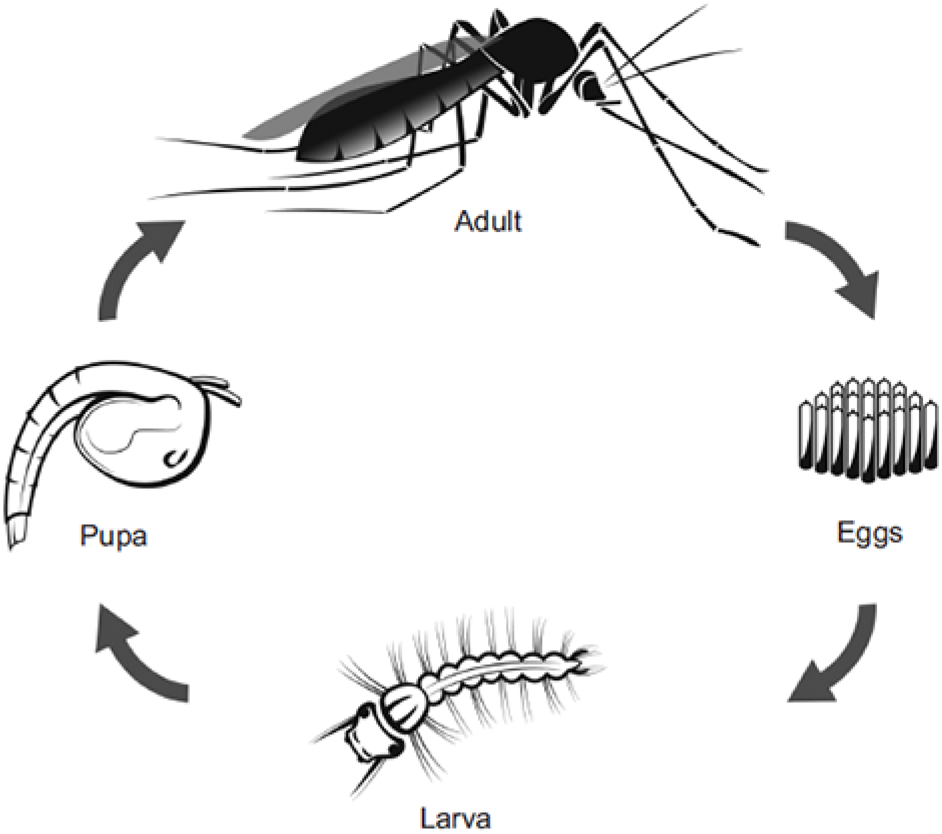
(1)
(Total 5 marks)

Q7.

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.



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.

(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.

(4)

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

(3)
(Total 11 marks)

Q8.

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.

____

____

____

____

(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%.

____

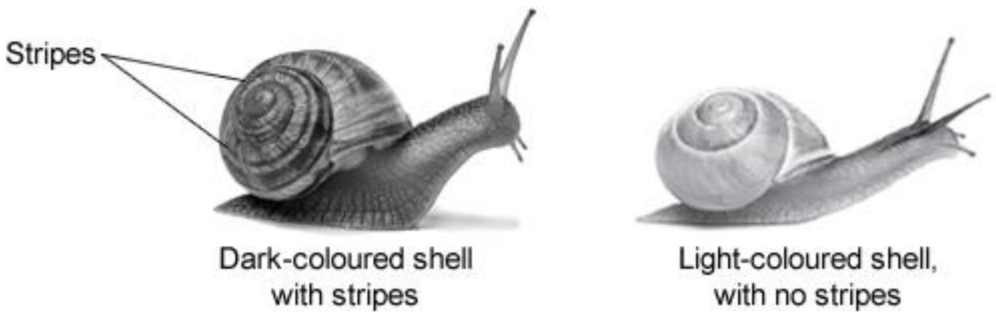
____

(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

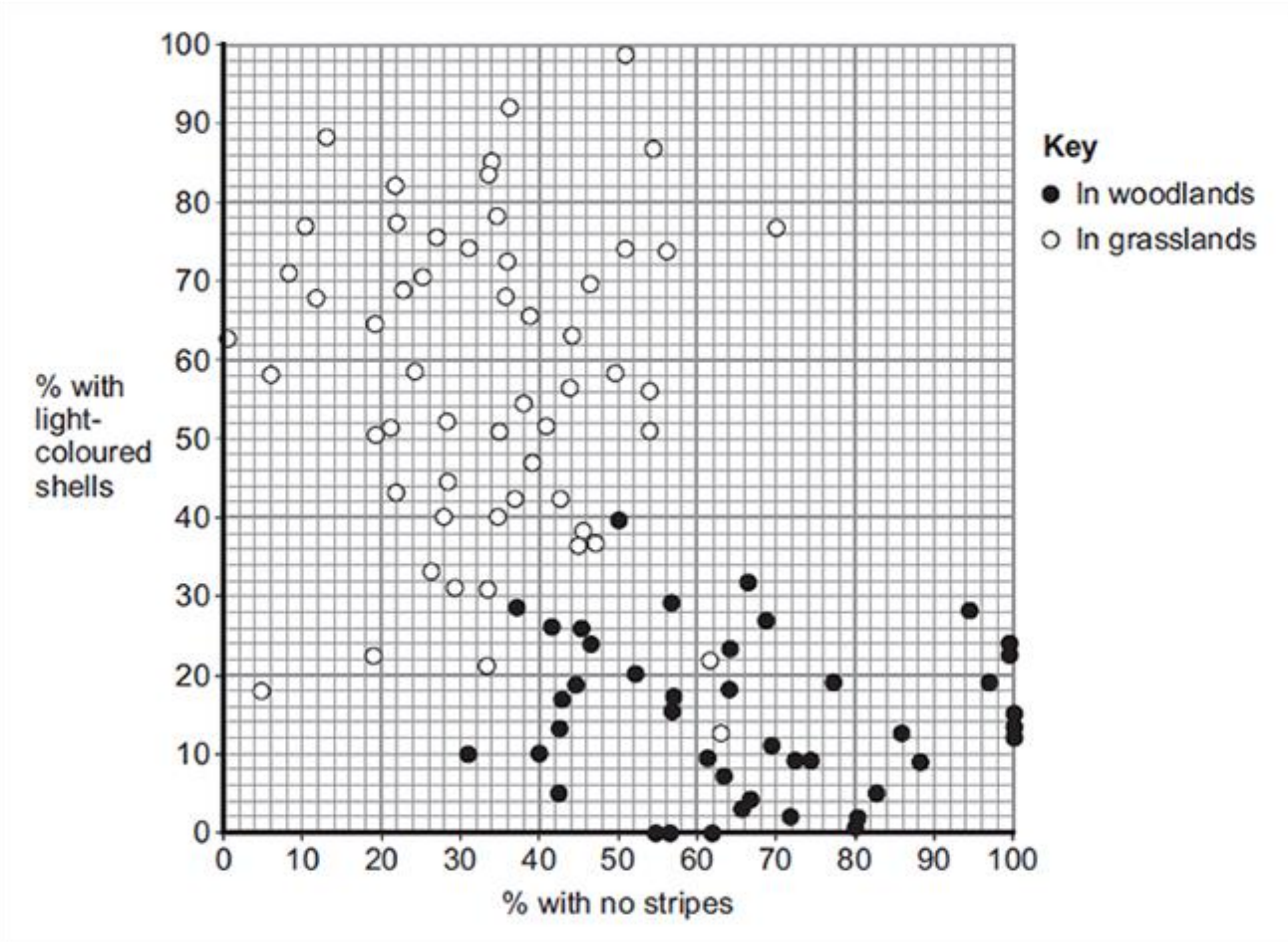


© Eric Lsselee/iStock © filipfoto/iStock

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



(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)

Q9.

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 × 1 metre. The area of the field was 80 000 m^2.

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^2 = ___________________________

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)

Q10.

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.

____

____

(1)

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

____

____

(1)

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

1. ____

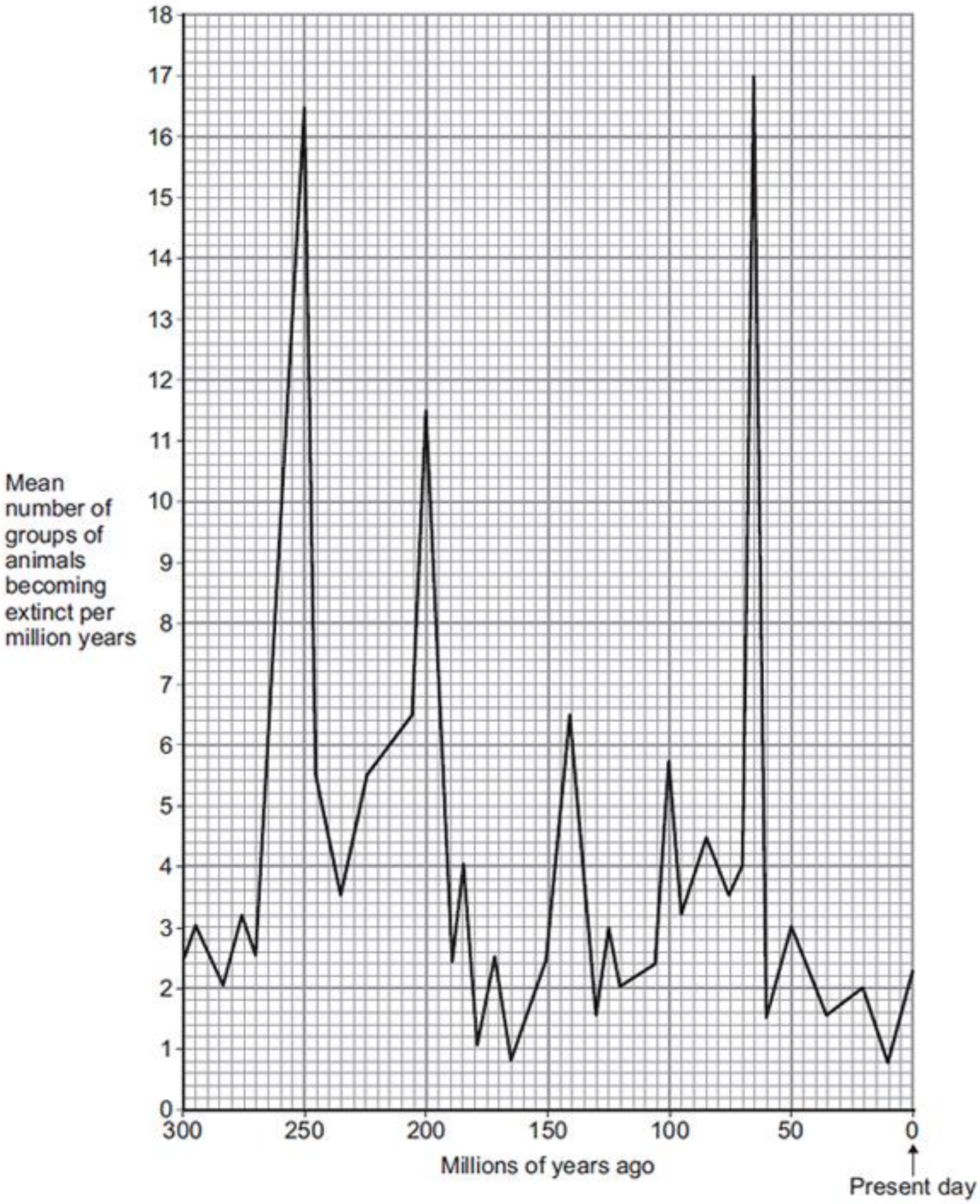
____

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?

____

____

(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?

____

____

(1)

(Total 9 marks)

Q11.

Some students wanted to estimate the number of plantain plants in a grassy field.

The field measured 100 metres × 50 metres.

The students:

- chose areas where plantains were growing
- placed 10 quadrats in these areas
- counted the number of plantains in each of the 10 quadrats.

Each quadrat measured 25 cm × 25 cm.

The table below shows the students' results.

Quadrat number	Number of plantain plants
1	2
2	1
3	4
4	1
5	3

6	2
7	4
8	1
9	1
10	1

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

Use the students' results from the table above.

Total number of plantains in 10 quadrats = ______________________________

Total area of 10 quadrats = ____ m^2

Mean number of plantains per m^2 = ___________________________________

____

Area of field = ____ m^2

Therefore estimated number of plantains in field = _______________________

____

(3)

(b) The students' method would **not** give a valid estimate of the number of plantain plants in the field.

Describe **three** improvements you could make to the students' method.

For each improvement, give the reason why your method would produce more valid results than the students' method.

Improvement 1 ____

Reason ____

____

Improvement 2 ____

Reason ____

____

Improvement 3 ____

Reason ____

____

(3)

(Total 6 marks)

Q12.

Figures 1 and **2** show battery chickens and free-range chickens.

Figure 1
Battery chickens

© studiodr/iStock/Thinkstock

Figure 2
Free-range chickens

© xlikovec/iStock/Thinkstock

Battery chickens are kept in cages indoors. Free-range chickens can walk around outside.

(a) Give **one** way in which food production might be more efficient from battery chickens than from free-range chickens. Give a reason for your answer.

____

____

____

____

____

(2)

(b) Some farms use waste from chickens to produce biogas in an anaerobic digester.

Microorganisms in the digester break down the waste by anaerobic respiration.

(i) What does **anaerobic** mean?

____

____

(1)

(ii) One product of anaerobic respiration is methane.

Name **two** other products of anaerobic respiration.

1. ____

2. ____

(2)

(c) The best temperature for anaerobic digesters is about 35 °C.

Explain why the volume of biogas produced would be **less** at higher temperatures.

____

____

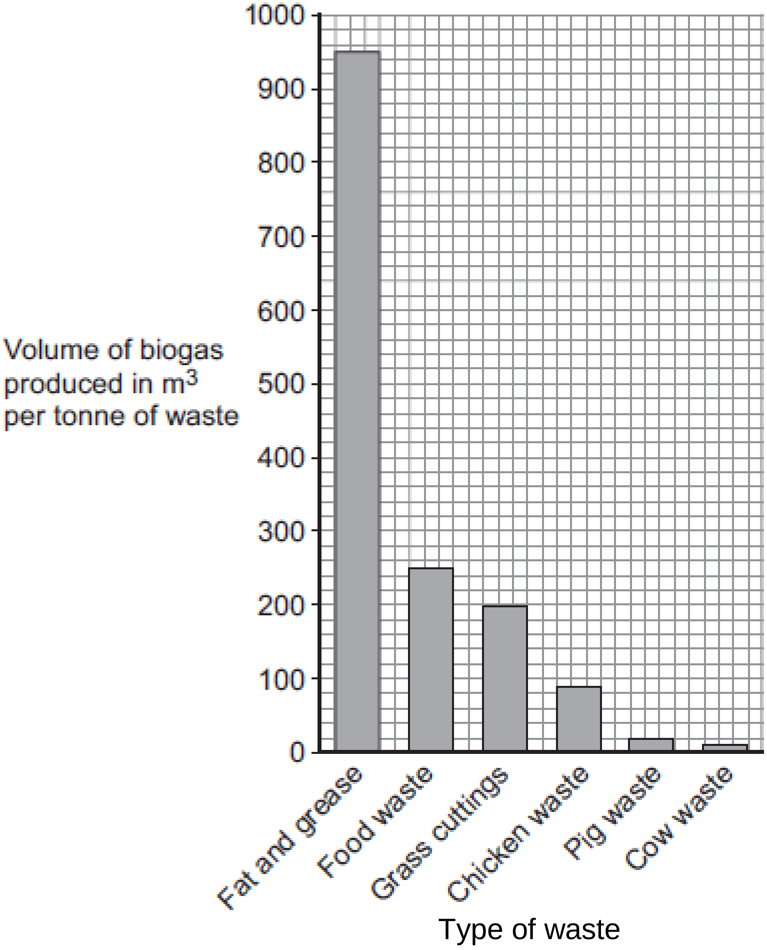
____

____

(2)

(d) **Figure 3** shows other types of waste that can be used in an anaerobic digester to produce biogas.

Figure 3



(i) What is the volume of biogas produced by a tonne of grass cuttings?

________________ m^3

(1)

(ii) Biogas is 60% methane.

Calculate the volume of methane gas produced per tonne of grass cuttings.

________________ m^3

(1)

(e) Why should biogas **not** be allowed to escape into the atmosphere?

___

___

___

___

(2)
(Total 11 marks)

Q13.

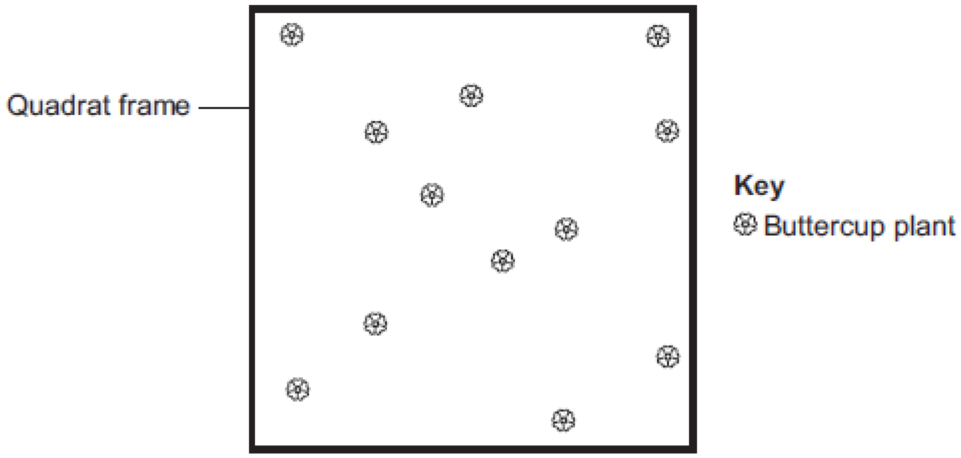
A grassy field on a farm measured 120 metres by 80 metres.

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?

____

____

____

____

(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. ____

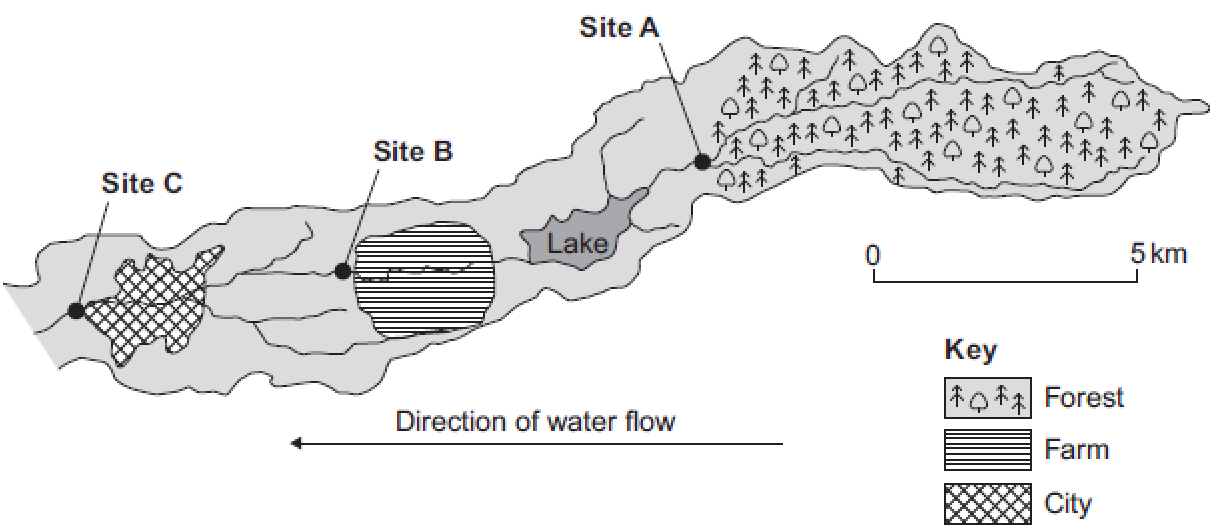
(3)

(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.

(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**.

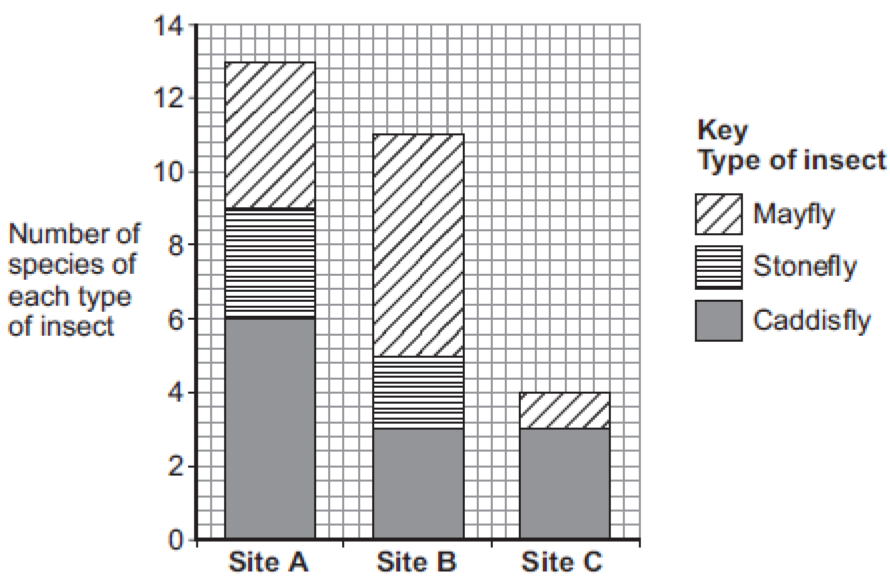
Scientists took many samples of river water from these sites.

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**?

____

(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)

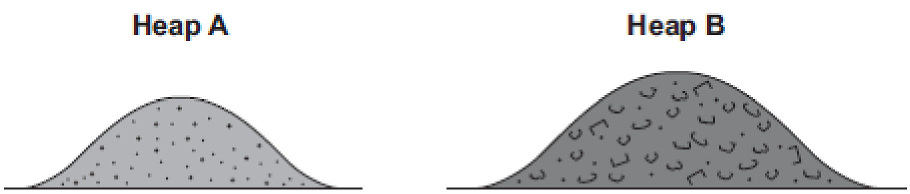
Q14.

A gardener investigates if turning over the waste in a compost heap makes the waste decay more quickly.

The gardener:

- makes two separate heaps of garden waste, heap **A** and heap **B**
- turns over the material in heap **A** every 2 weeks
- does **not** turn over the material in heap **B**
- estimates the amount of decay in the two heaps after 6 months.

The diagram shows the two heaps of garden waste at the beginning of the investigation.



(a) Suggest **two** factors, other than time, the gardener should control to make the investigation fair.

1. ____

____

2. ____

____

(2)

(b) Name **one** type of living thing that causes decay.

____

(1)

(c) The gardener's results are shown in the table.

Compost heap	Estimated amount of decay
A	A lot
B	Very little

(i) Why does turning over the material in heap **A** make the material decay more quickly?

____

____

(1)

(ii) The gardener puts decayed material around his plants to help them grow.

Suggest why the plants in a woodland grow well each year **without** material from compost heaps being added.

____

____

____

____

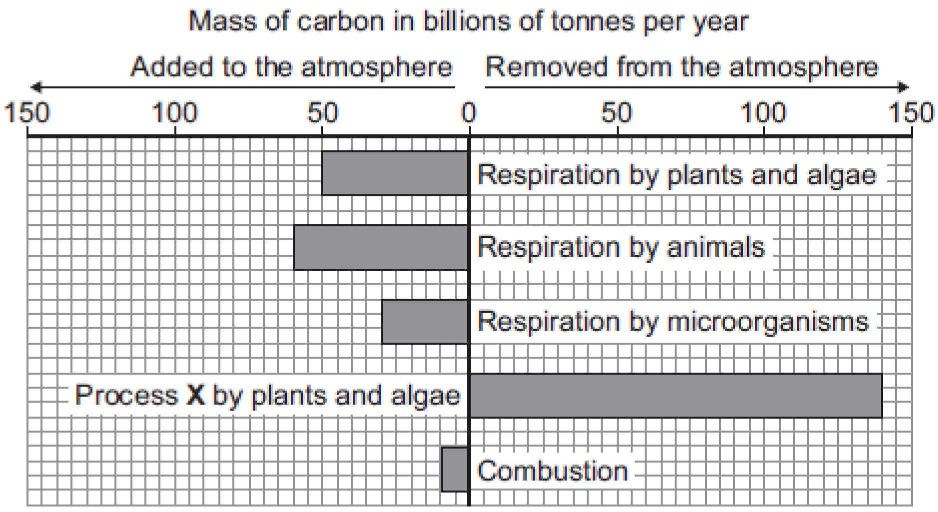
(2)

(Total 6 marks)

Q15.

This question is about carbon.

The graph shows the mass of carbon added to and removed from the atmosphere each year.



(a) Name process **X**.

____

(1)

(b) (i) Calculate the mass of carbon added to the atmosphere by respiration per year.

Answer = ____________________ billion tonnes

(1)

(ii) Some scientists are concerned that the mass of carbon in the atmosphere is changing.

How does the data in the graph support this idea?

____

____

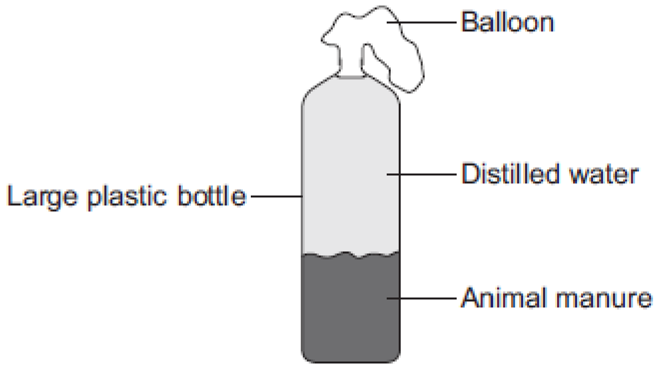
(1)

(Total 3 marks)

Q16.

Some students set up biogas generators to find out which type of animal manure produced the most biogas.

The diagram shows the apparatus they used.



The students:
Step 1: Put some cow manure into the plastic bottle
Step 2: Filled the bottle with distilled water
Step 3: Attached a balloon over the top of the bottle
Step 4: Put the bottle in a warm room for 10 days
Step 5: Measured the diameter of the balloon on day 10
Step 6: Repeated steps 1 to 5 using each type of animal manure.

The students' results are shown in the table.

Type of animal manure	**Diameter of balloon on day 10 in cm**
Cow	29
Horse	26
Sheep	34

Pig	32

(a) What is the main gas found in biogas?

___

(1)

(b) The students concluded that sheep manure is the best type of manure to use in a biogas generator.

A teacher told the students that the design of their investigation meant that their conclusion might **not** be correct.

Suggest **two** reasons why.

1. ___

___

2. ___

___

(2)

(c) Another student suggested that adding potato to the manure would increase the amount of biogas produced.

Why would adding potato increase the amount of biogas produced?

Tick (✓) **one** box.

The potato contains a lot of carbohydrate.	☐
The potato contains a lot of protein.	☐
The potato contains a lot of water.	☐

(1)
(Total 4 marks)

Q17.

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

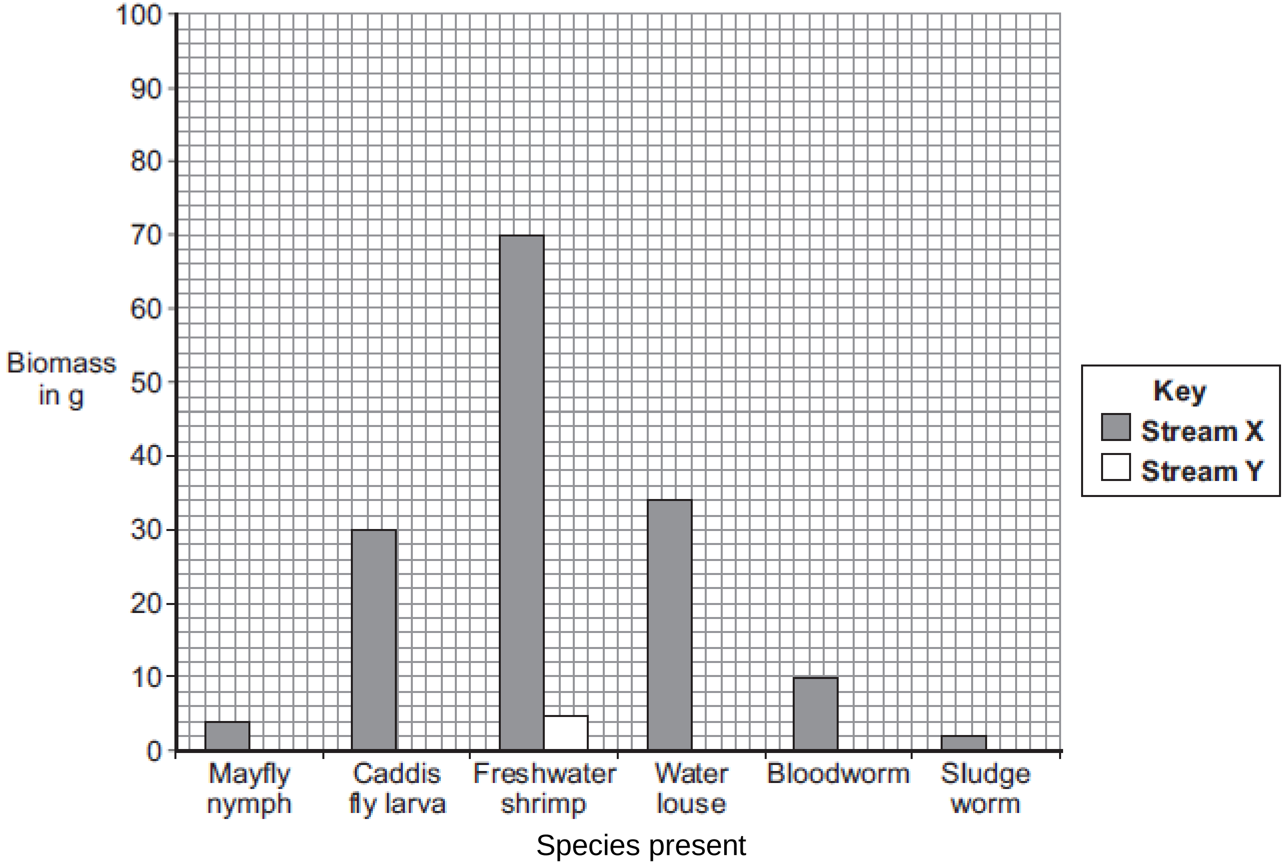
	Biomass in g

Invertebrate species	Stream X	Stream Y
Mayfly nymph	4	0
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
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.

___

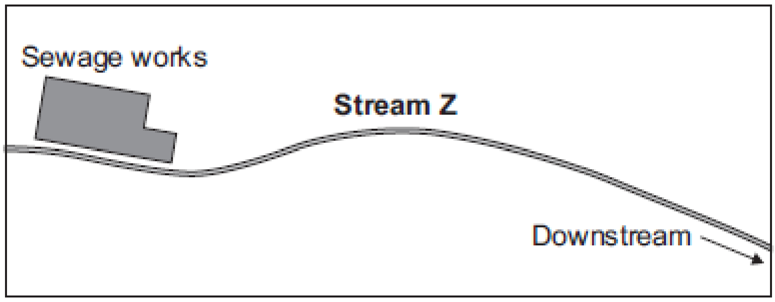
___

___

___

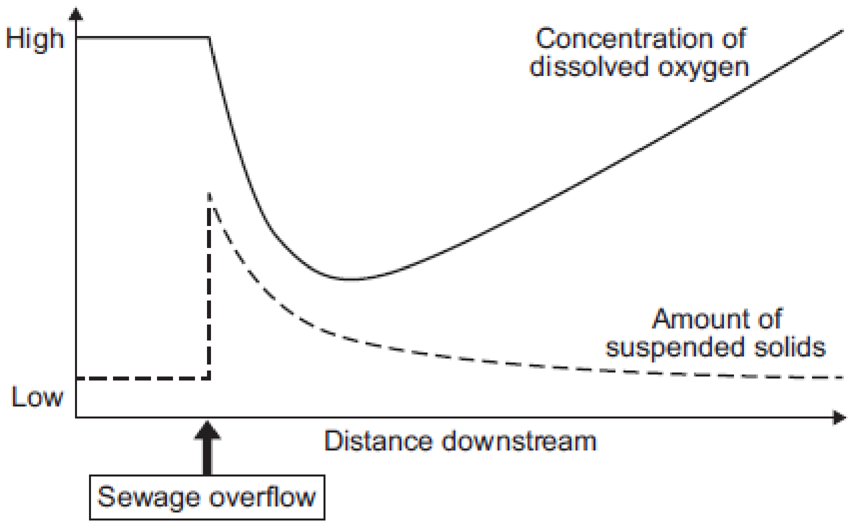
(2)

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

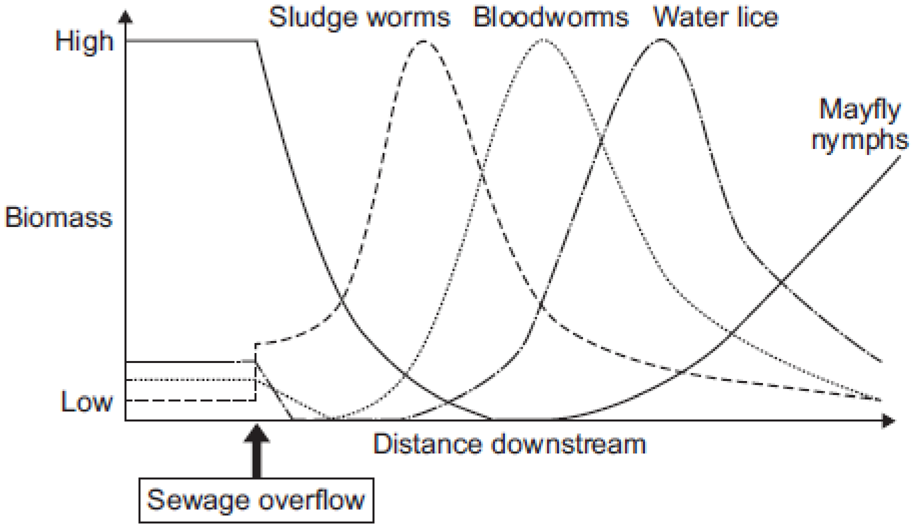


An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow



(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.

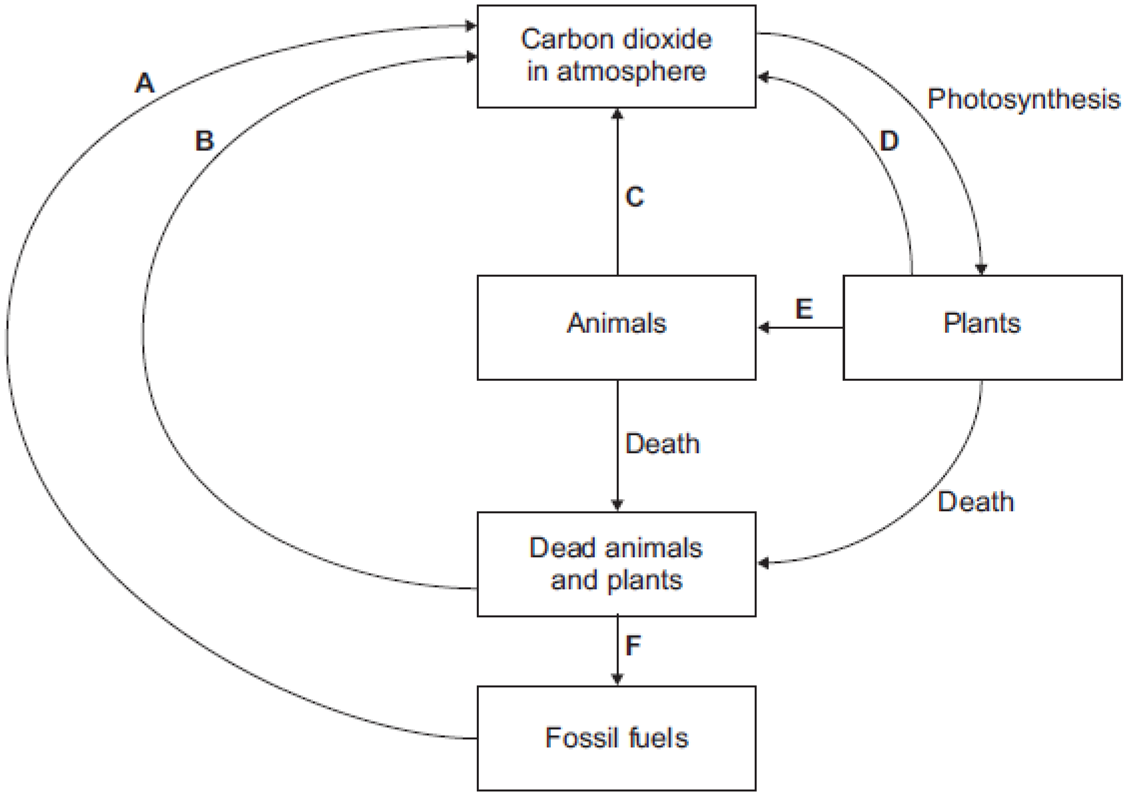
Explain why microorganisms cause the level of oxygen in the water to decrease.

(2)

(Total 13 marks)

Q18.

(a) The diagram shows the carbon cycle.



(i) The concentration of carbon dioxide in the atmosphere has increased over the last 100 years.

Give **two** human activities that might have caused this increase.

1. ______________________________

2. ______________________________

(2)

(ii) Give the letters of **two** arrows in the diagram which show respiration.

☐ and ☐

(2)

(iii) Give the letter of **one** arrow which shows decay.

☐

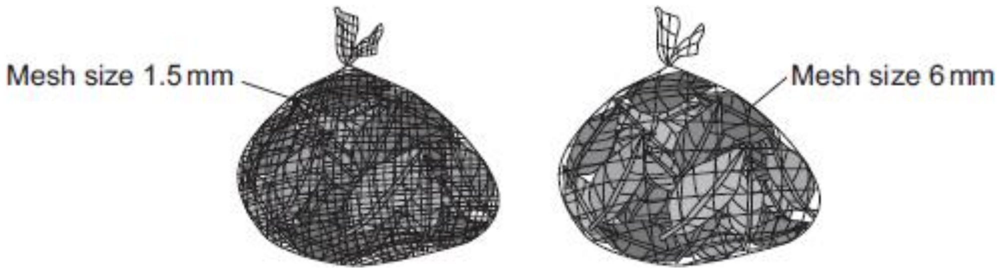
(1)

(b) Scientists investigated the breakdown of dead leaves.

The scientists:

- placed dried leaves in mesh bags. Half of the bags had a mesh size of 1.5 mm; the others had a mesh size of 6 mm.

Mesh bags containing leaves

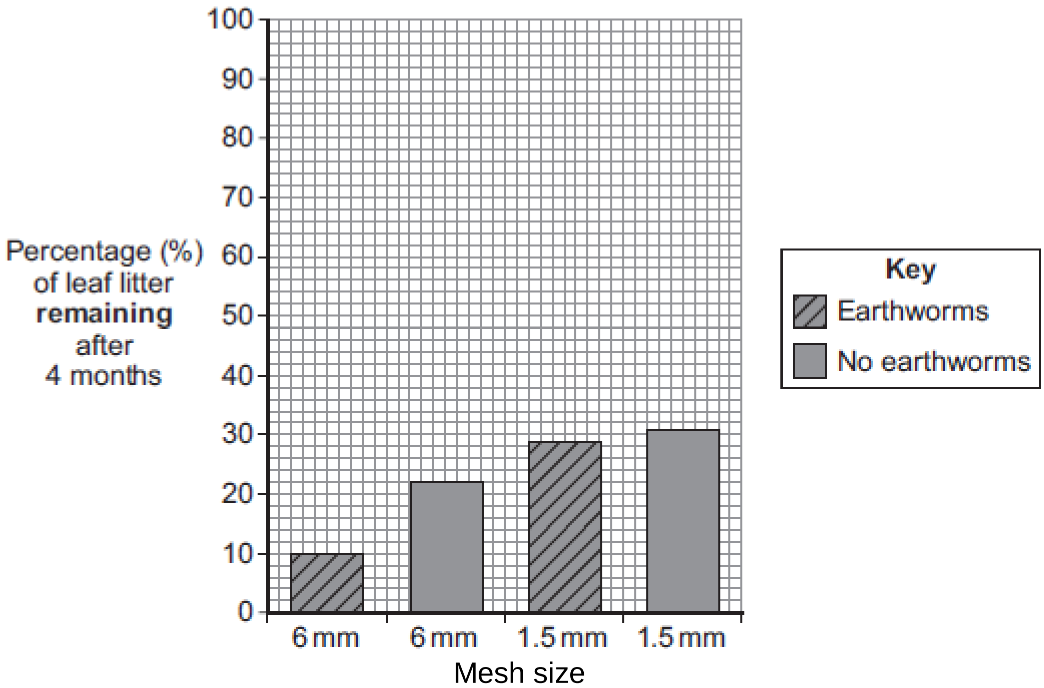


The scientists then:

- weighed the dried leaves in each bag at the start of the investigation
- placed the bags of leaves on soil: some of the bags were placed in areas where there **were earthworms** in the soil; the other bags were placed in areas where there were **no earthworms**
- left the bags for four months
- collected the bags, dried the leaves and weighed them again.

Most earthworms are between 3 mm and 6 mm in diameter.

The bar graph shows the scientists' results.



(i) The percentage of leaf litter at the start of the investigation was 100% in each bag.

What percentage of the leaf litter was broken down in the 6 mm mesh bags . . .

with earthworms ____________ %

without earthworms? ____________ %

(2)

(ii) What effect do earthworms have on the amount of leaves broken down in the 6 mm mesh bags?

Use your answer to part **(b) (i)** to show how you arrive at your answer.

____

____

____

____

(1)

(iii) When there were earthworms in the soil, the results for the 6 mm mesh bags were different from the results for the 1.5 mm mesh bags.

Explain why.

____

____

____

____

(2)

(iv) Other organisms, smaller than earthworms, cause most of the breakdown of the leaves.

Explain how the results show this.

____

____

____

____

____

____

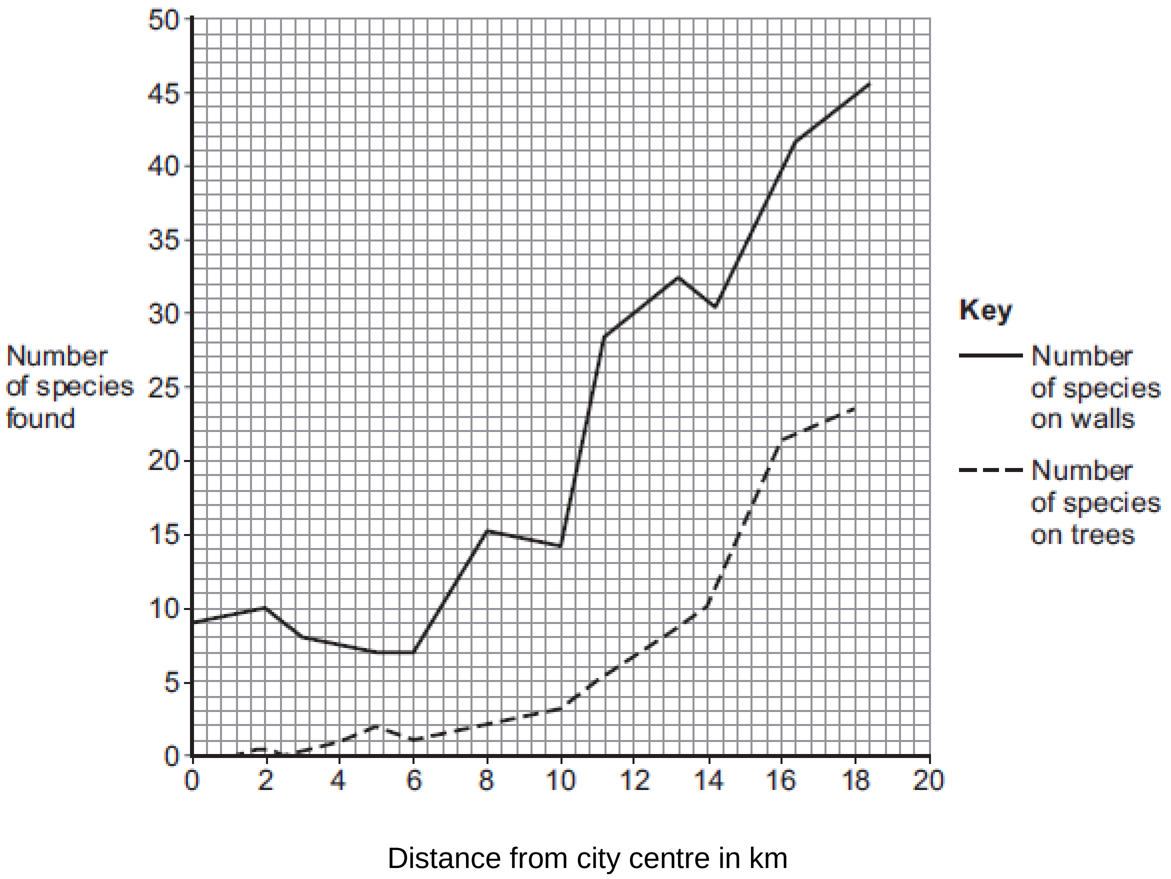
(2)

(Total 12 marks)

Q19.

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.



(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
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* 

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

____

____

____

____

____

____

(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)

Q20.

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.

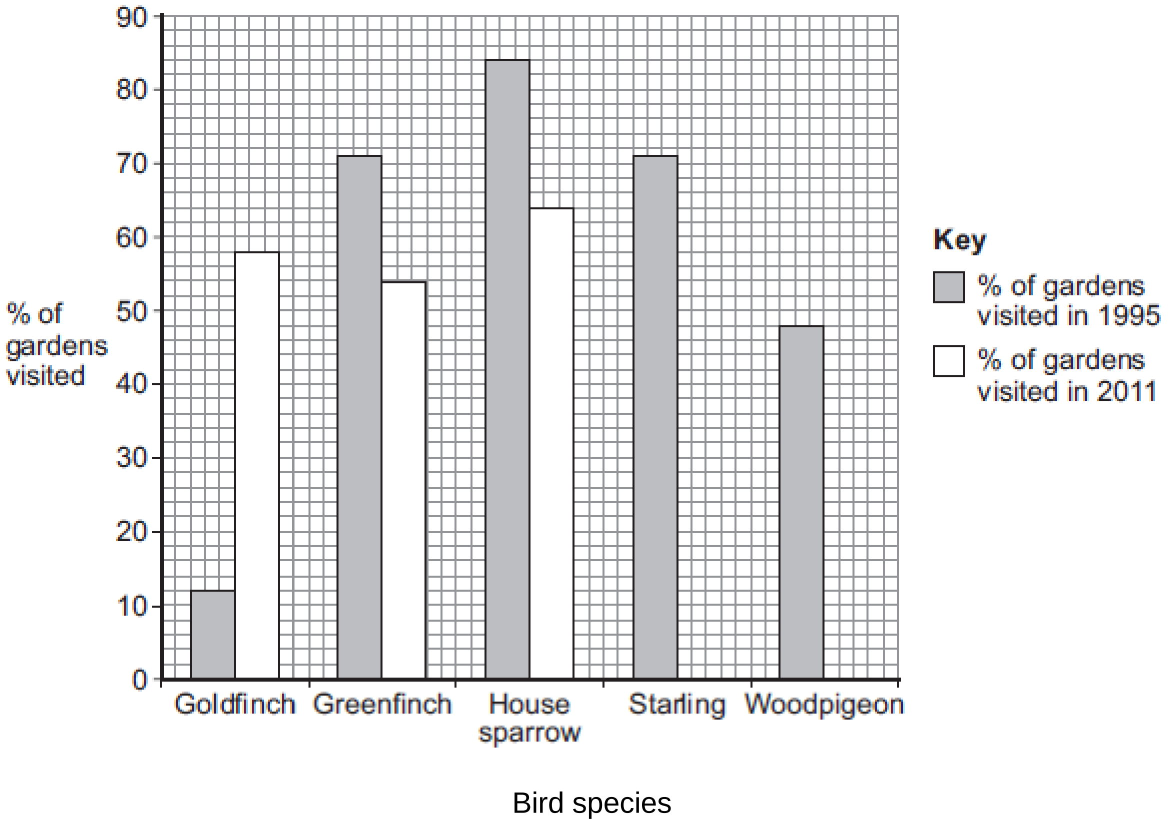
The table below shows the percentage (%) of gardens visited by different bird species in 1995 and in 2011.

Bird species	**% of gardens visited in 1995**	**% of gardens visited in 2011**
Goldfinch	12	58
Greenfinch	71	54
House sparrow	84	64
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)
(Total 7 marks)

Q21.

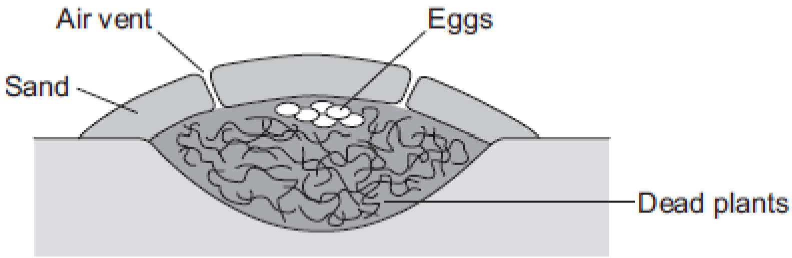
Most birds sit on their eggs to keep them warm until they hatch.

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.



(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)

Q22.

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

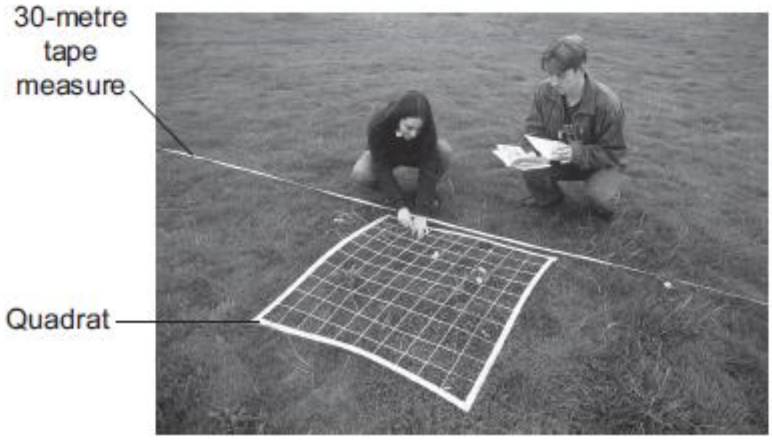
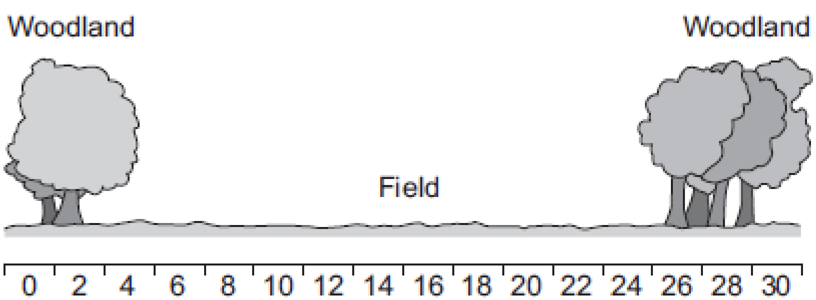


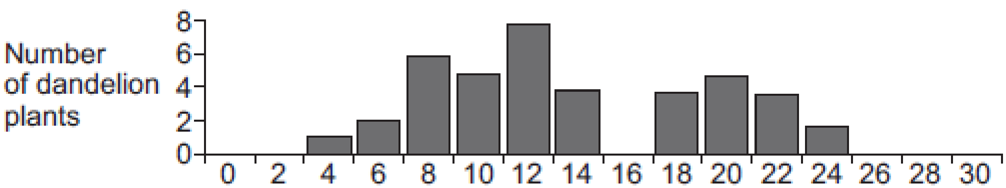
Figure 2 shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

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**.

____

____

____

____

____

____

(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)

Q23.

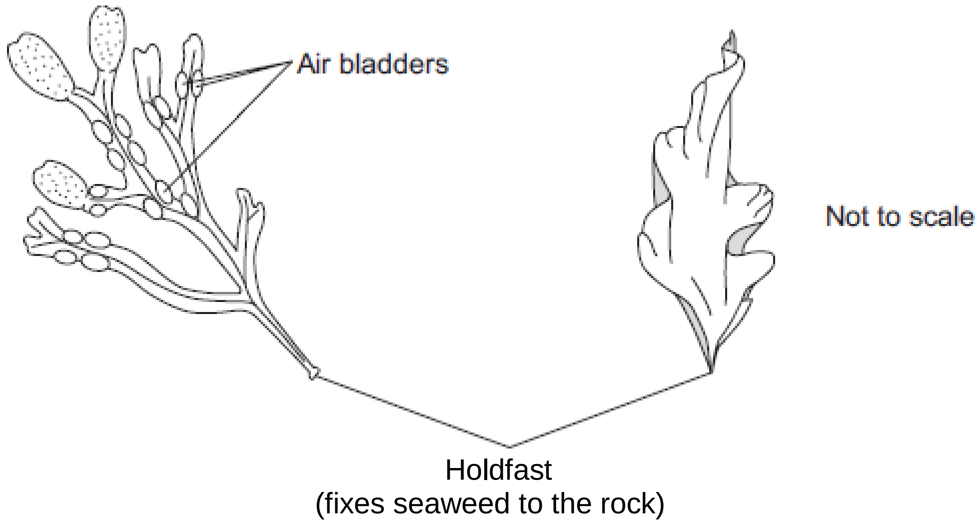
At the seashore, the tide comes in and goes out twice each day.

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**



(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

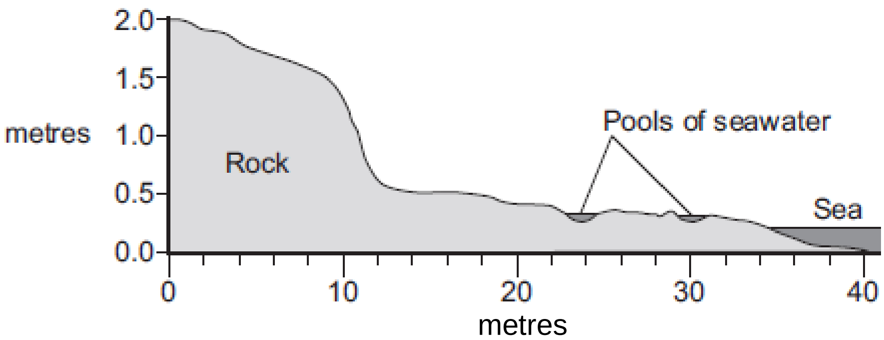
3 recorded whether each species was present or not.

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

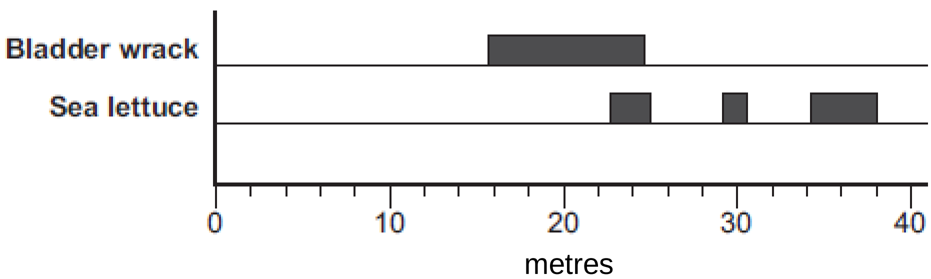
Figure 2 shows a section of the seashore and the students' results.

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.

Explain why.

(2)

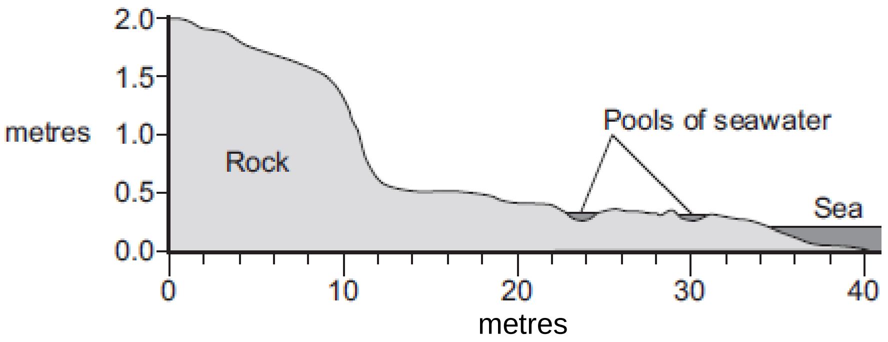
(ii) How could the students have improved their investigation to ensure that they produced valid data?

(2)

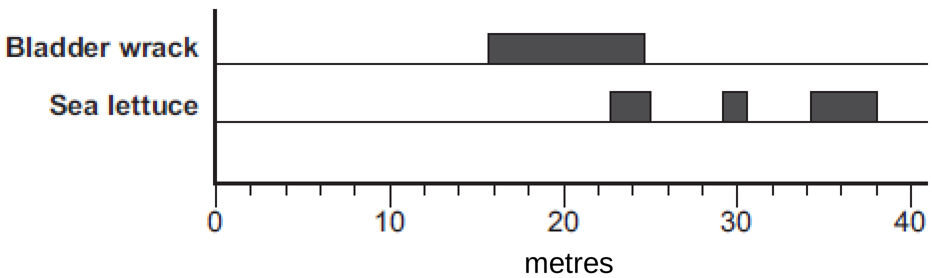
(iii) **Figure 2** is repeated here to help you answer this question.

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**.

(2)

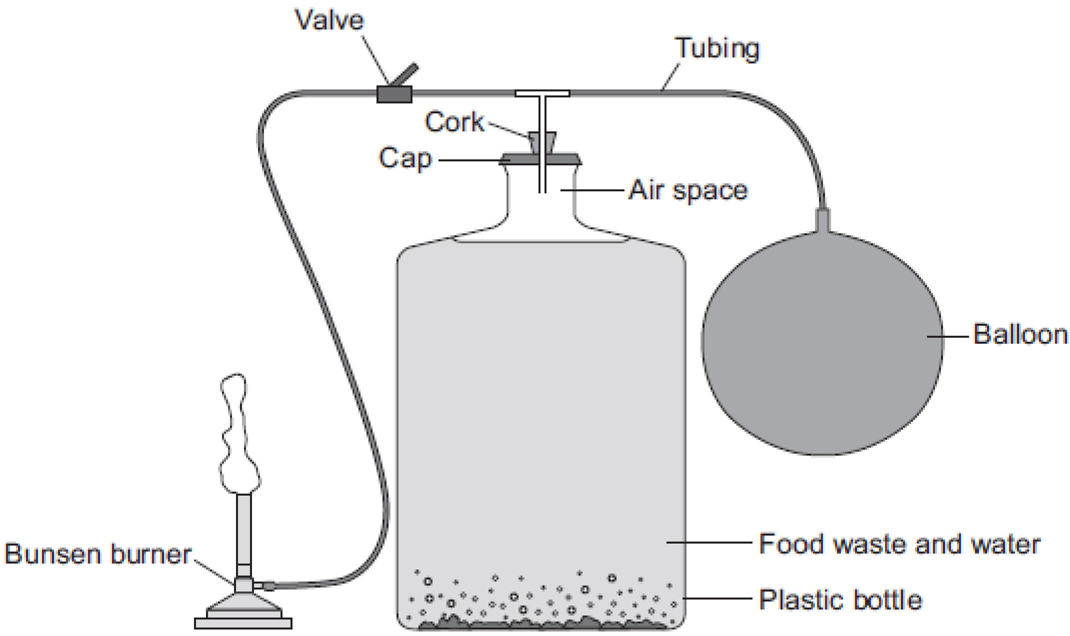
(b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

(2)
(Total 8 marks)

Q24.

The image below shows a model biogas generator.



Students used the model biogas generator to investigate which type of food waste produces the greatest yield of biogas.

Gas collects in the balloon. The gas is then released through the valve and is burned at the Bunsen burner.

The students:

- put 500 g of potato peelings in the plastic bottle with some water and sealed the apparatus
- released the gas from the balloon after day two and timed how long the gas burned for
- released the gas that had collected in the balloon from day two to day four and

timed how long the gas burned for

- repeated the investigation using 500 g of cooked rice, then 500 g of cabbage leaves and then 500 g of cooked pasta.

(a) **Table 1** shows the students' results.

Table 1

Type of food waste	Length of time the gas burned in seconds	
	After day two	From day two to day four
Potato peelings	0	175
Cooked rice	0	100
Cabbage leaves	0	150
Cooked pasta	0	160

(i) Suggest why the gas collected in the balloon and released after day two did not burn.

___

___

___

___

___

(3)

(ii) Suggest why potato peelings produced the most biogas.

___

___

(1)

(b) Scientists investigated the production of biogas from different types of animal manure.

Table 2 shows the scientists' results.

Table 2

Type of mannure	Volume of biogas produced in m^3 per kg of manure	Methane in the biogas as % of total volume
Cow	0.34	65

Pig	0.58	68
Hen	0.62	60
Horse	0.30	66
Sheep	0.61	67

(i) Calculate the volume of methane produced from 1 kg of cow manure.

____

____

Volume of methane = ___________ m^3

(2)

(ii) One scientist concluded that it would be better to use sheep manure in a biogas generator than to use cow manure.

What is the evidence for this conclusion?

Use information from **Table 2** in your answer.

____

____

____

____

____

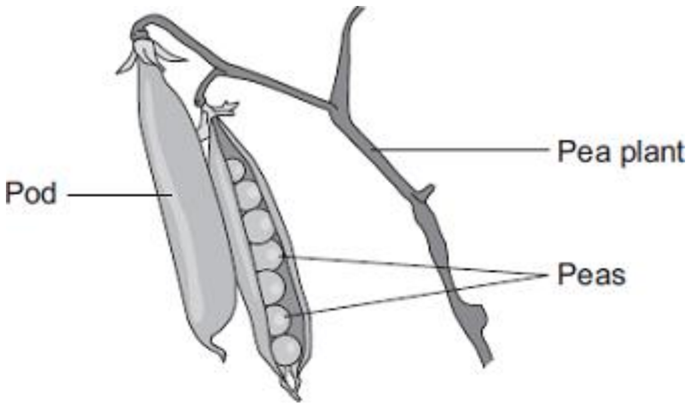
____

(2)

(Total 8 marks)

Q25.

Peas grow in pods on pea plants.



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.

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)

Q26.

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.

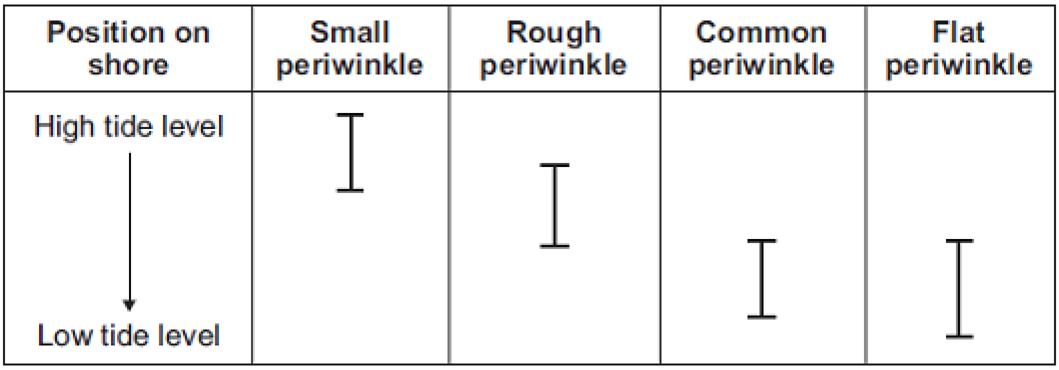
What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

____

(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.



(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)

Q27.

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)

(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)

Q28.

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?

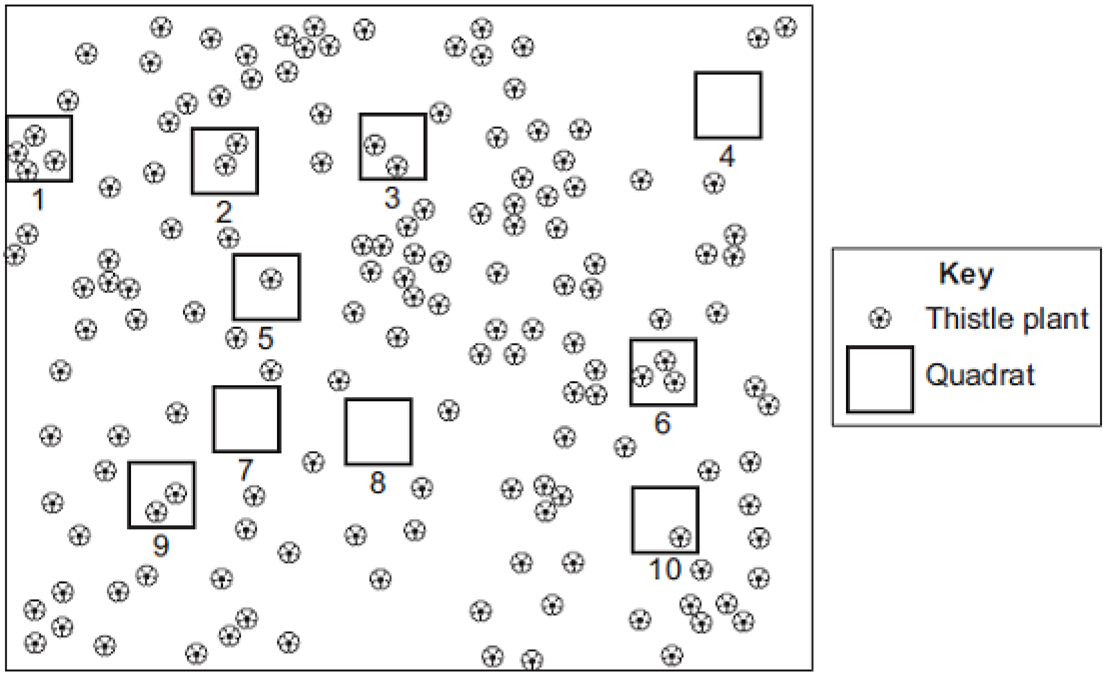
Tick (✓) **one** box.

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	

(2)

(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)

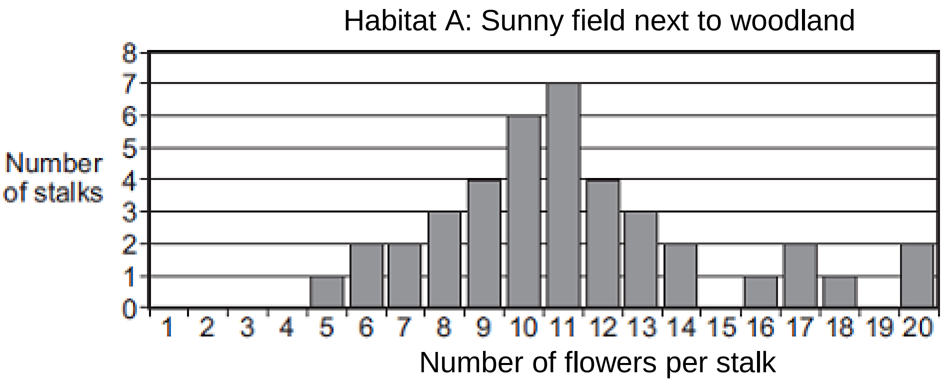
(Total 7 marks)

Q29.

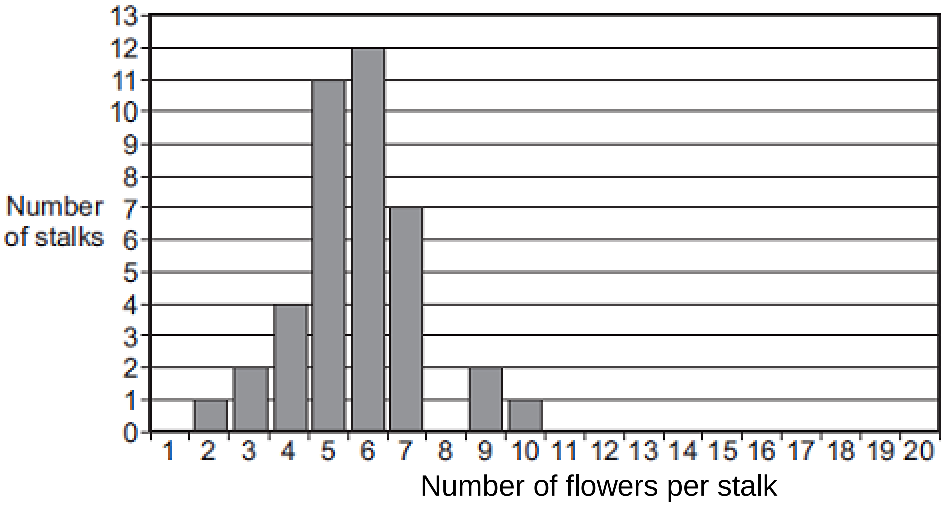
Some students studied bluebell plants growing in two different habitats.

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.



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)

(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)

Q30.

Gardeners often collect fallen leaves in autumn and place them on compost heaps.

(a) Over the next year the leaves decay.

Which living things cause decay?

(1)

(b) The leaves decay more quickly in summer than in winter.

Give **one** reason why.

(1)

(c) The compost heap has holes in its sides to let gases enter.

Which gas is needed for decay?

Tick (✓) **one** box.

Carbon dioxide ☐

Nitrogen ☐

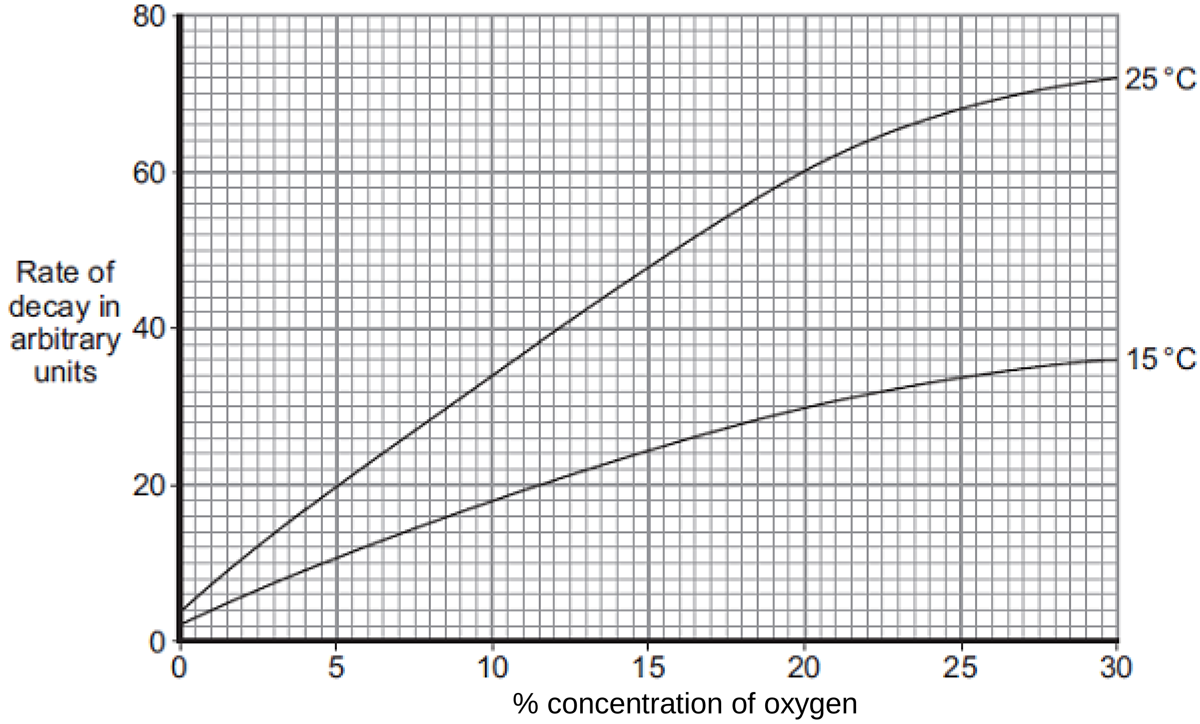
Oxygen ☐

(1)
(Total 3 marks)

Q31.

Gardeners often put waste material onto compost heaps.

The graph shows how the conditions in a compost heap affect how quickly waste material in the compost heap decays.



(a) (i) Describe the effect of increasing the temperature from 15°C to 25°C on the rate of decay at 20% oxygen concentration.

____

____

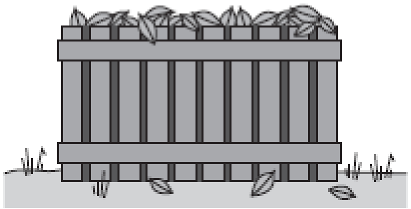
____

____

____

(2)

(ii) Gardeners are advised to put waste materials into special compost bins. These bins have holes in their sides.



Holes in the sides of the compost bin help the waste materials to decay faster.

Explain why.

____

____

____

____

____

(2)

(b) A gardener noticed that some of his plants were growing poorly.

The gardener put some decayed compost onto the soil, around the plants.
One month later the plants were growing well.

Explain why.

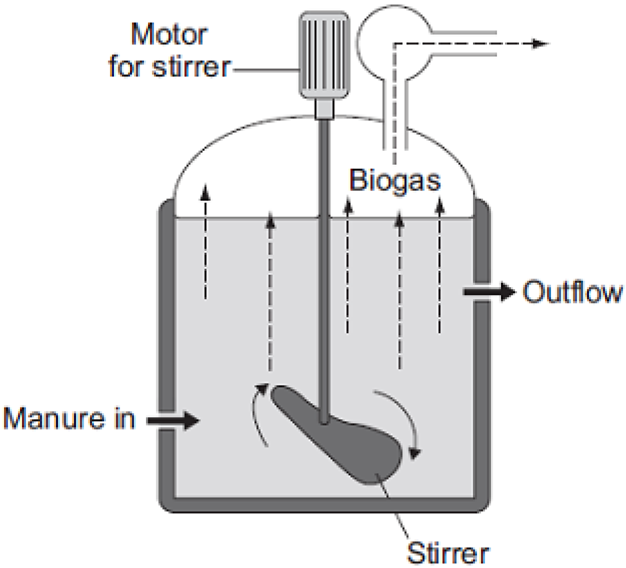
____

____

(1)
(Total 5 marks)

Q32.

The diagram shows one type of biogas generator.



(a) With this type of biogas generator, the concentration of solids that are fed into the reactor must be kept very low.

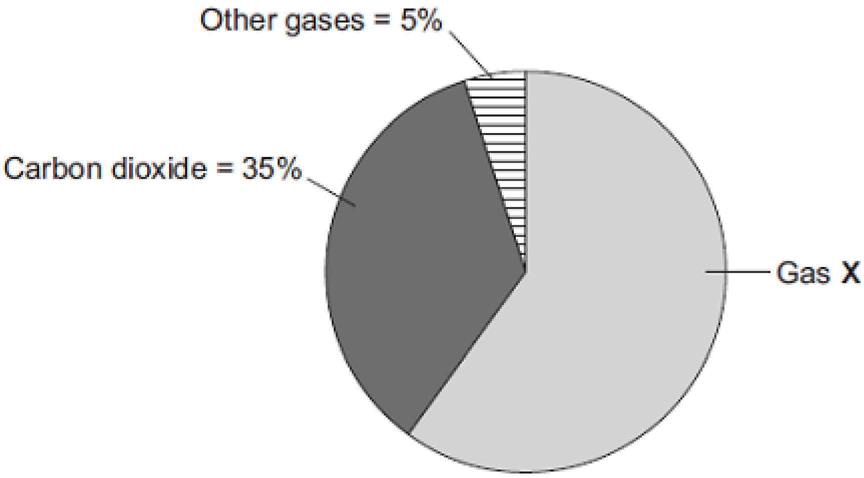
Suggest **one** reason for this.

Tick (✓) **one** box.

A higher concentration contains too little oxygen.	☐
A higher concentration would be difficult to stir.	☐
A higher concentration contains too much carbon dioxide.	☐

(1)

(b) The pie chart shows the percentages of the different gases found in the biogas.



Gas **X** is the main fuel gas found in the biogas.

(i) What is the name of gas **X**?

Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

(ii) What is the percentage of gas **X** in the biogas?

Show clearly how you work out your answer.

____

____

Percentage of gas **X** = ________________

(2)

(c) If the biogas generator is not airtight, the biogas contains a much higher percentage of carbon dioxide.

Draw a ring around **one** answer in each part of this question.

(i) The air that leaks in will increase the rate of

aerobic respiration.
anaerobic respiration.
fermentation.

(1)

(ii) The process in part (c)(i) occurs because the air contains

ammonia.
nitrogen.
oxygen.

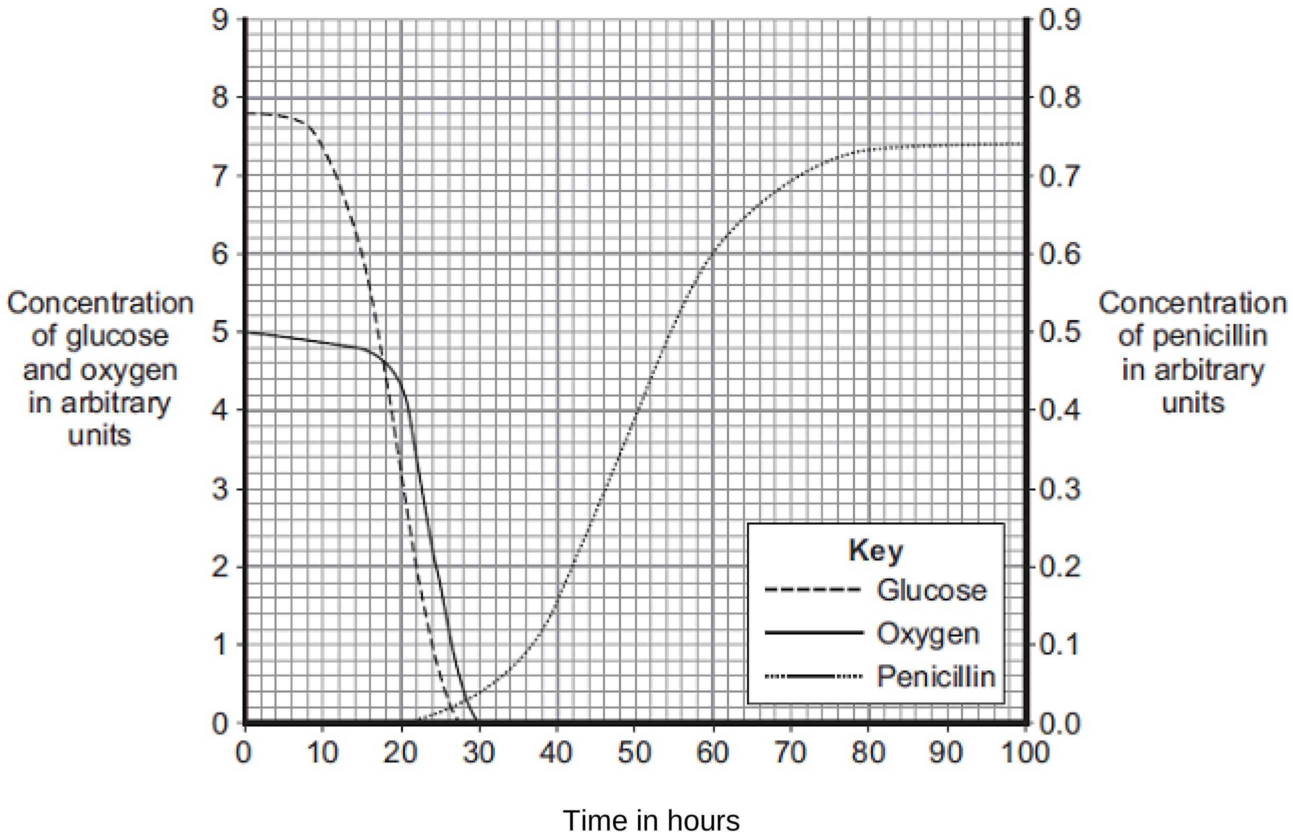
(1)

(Total 6 marks)

Q33.

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.

___

___

___

___

(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?

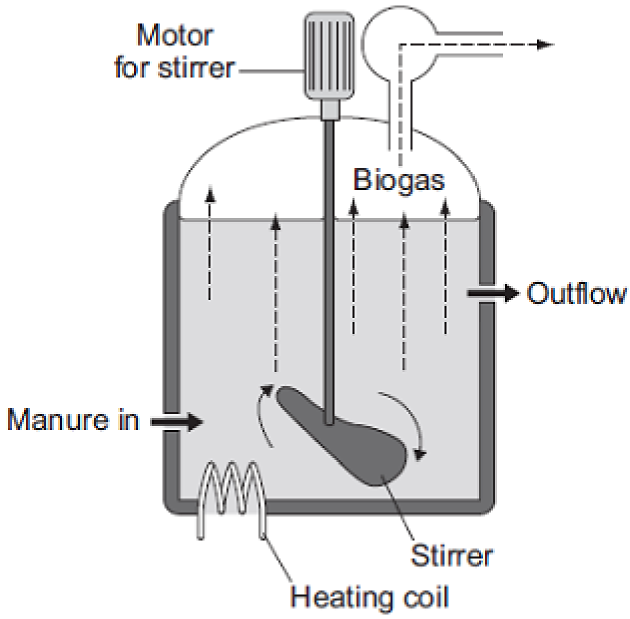
Draw a ring around **one** answer.

distillation **filtration** **respiration**

(1)
(Total 6 marks)

Q34.

The diagram shows one type of *anaerobic* digester. The digester is used to produce biogas.



(a) (i) What does *anaerobic* mean?

____

____

(1)

(ii) The concentration of solids that are fed into this digester must be kept very low.

Suggest **one** reason why.

____

____

(1)

(iii) This digester is more expensive to run than some other simpler designs of biogas generator.

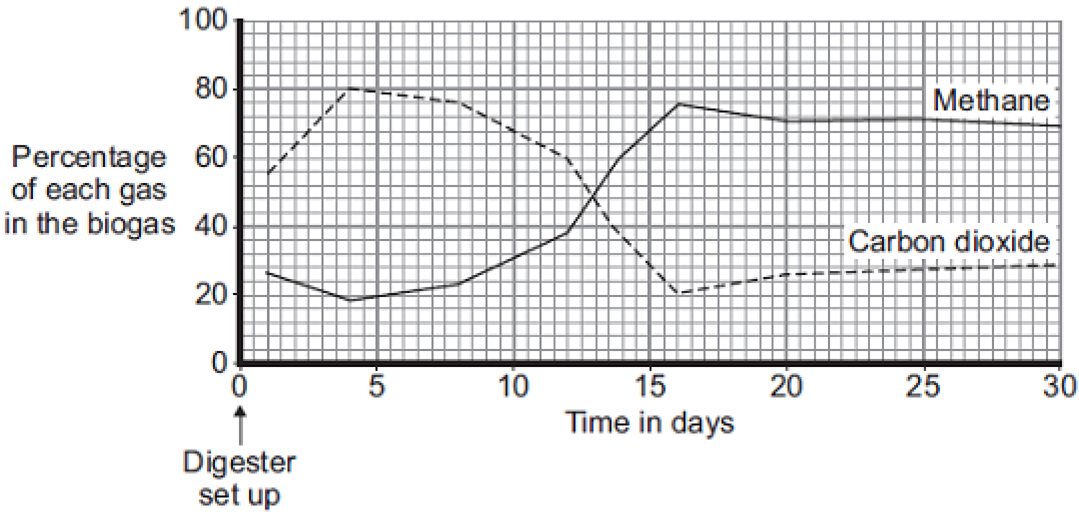
Suggest **one** reason why.

____

____

(1)

(b) The graph shows how the composition of the biogas produced by the digester changed over the first 30 days after the digester was set up.



Use information from the graph to answer the following questions.

(i) Describe how the percentage of carbon dioxide changed over the 30 days.

____

____

____

____

____

____

(3)

(ii) On which day was the best quality biogas produced? ____________

(1)

(c) Four days after the digester was first set up, the biogas contained a high percentage of carbon dioxide.

Suggest an explanation for this.

____

____

____

____

(2)

(Total 9 marks)

Q35.

Microorganisms can decay potatoes.

(a) Microorganisms obtain carbohydrates from the potato to use inside their cells.

Describe how.

(2)

(b) A group of students investigated decay in potatoes.

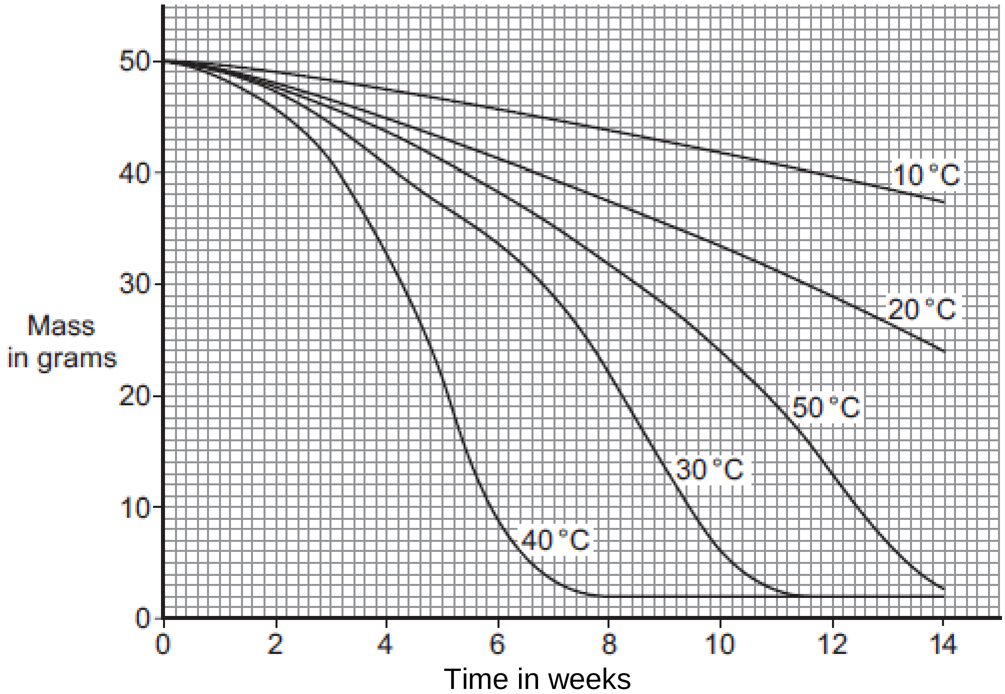
The students made the hypothesis:

'The higher the temperature the faster the potato will decay.'

The students:

- cut five 50 g cubes of potato and put each one in a Petri dish
- kept each dish at a different temperature for 14 weeks
- measured the mass of each potato cube every week and recorded the mass.

The results are shown in the graph.



(i) The potato cubes decreased in mass over the 14 weeks.

Explain why.

(3)

(ii) Do the students' results support their hypothesis?

Explain your answer.

(2)

(Total 7 marks)

Q36.

Human activities affect the environment.

(a) Deforestation results in an increase in carbon dioxide levels in the atmosphere.

Give **two** reasons why.

(2)

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

A dairy farmer washes out his cow shed each day. The waste water contains urine and faeces. The waste water overflows into a stream by mistake.

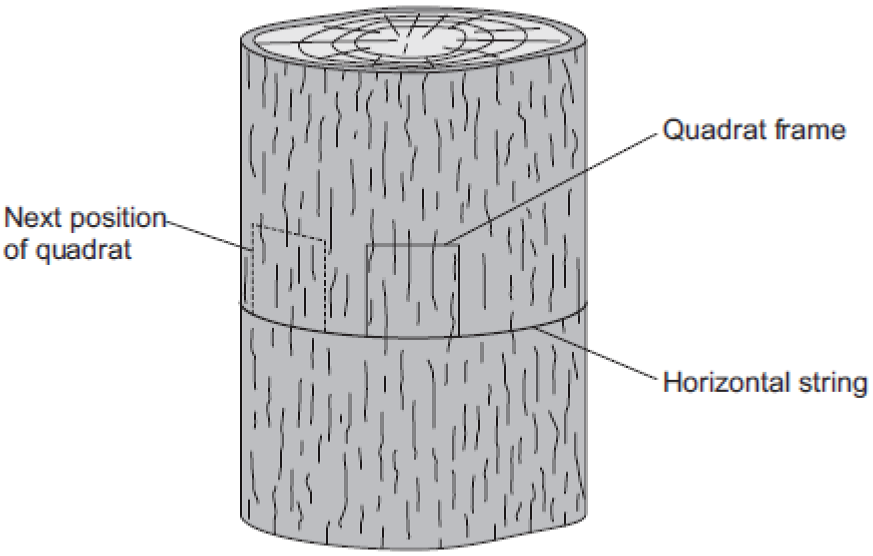
The waste water will have an effect on the plants and invertebrates living in the stream.

Explain why.

(6)
(Total 8 marks)

Q37.

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

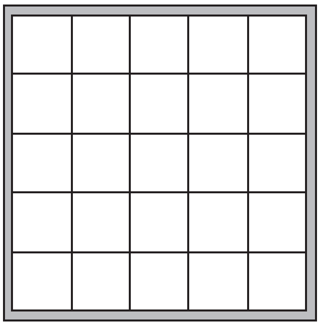


The students:

- 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.

___

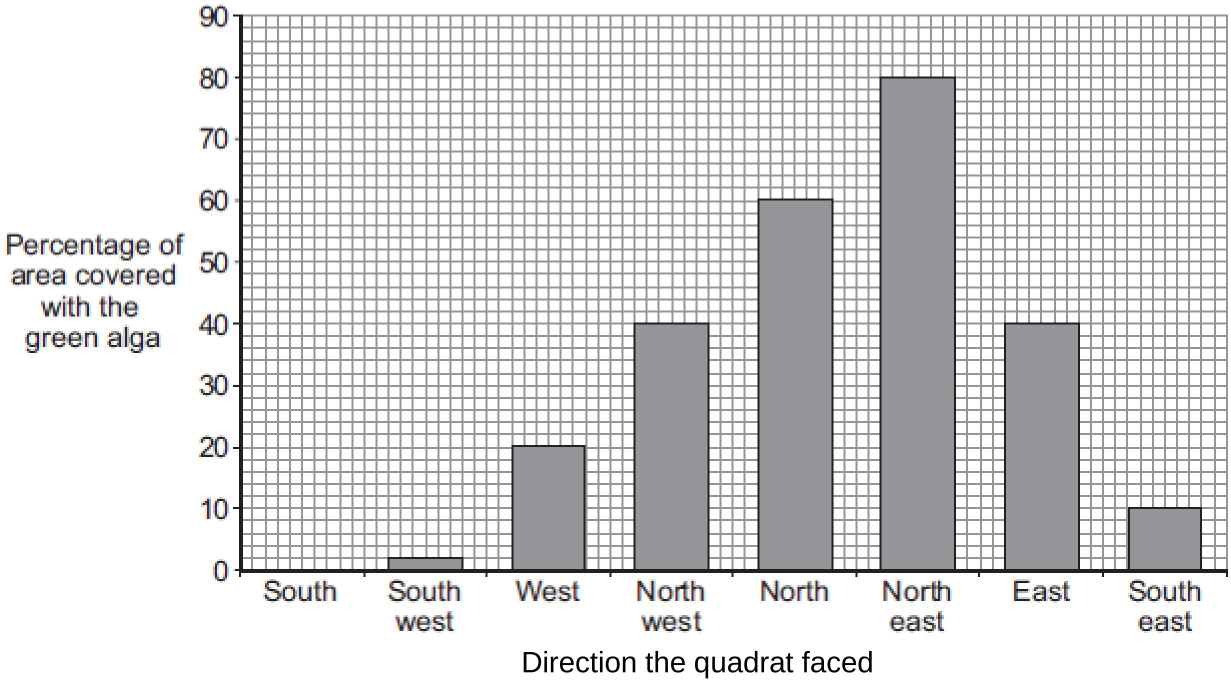
___

___

___

(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 ____

____

____

____

____

____

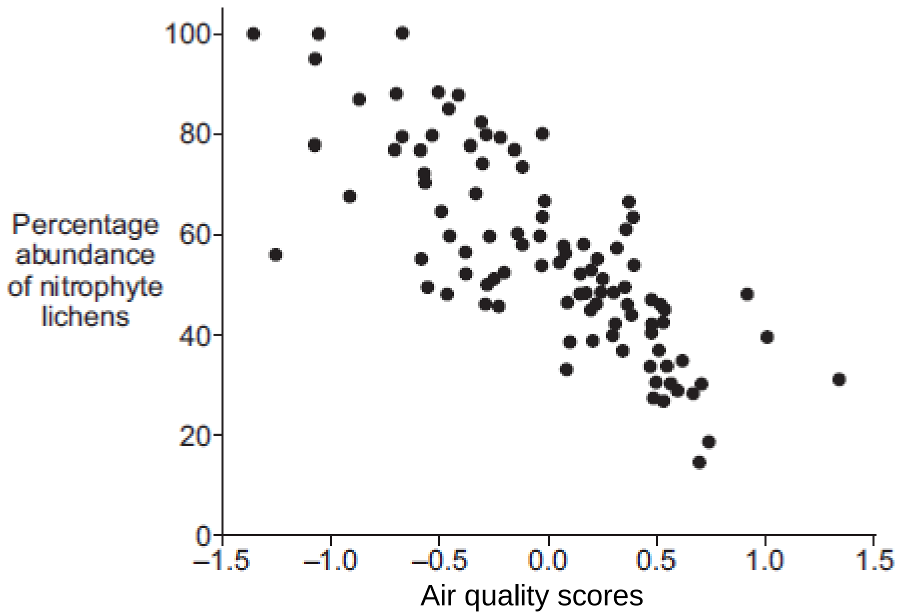
____

(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.

High atmospheric ammonia

Low atmospheric ammonia



(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.

____

____

____

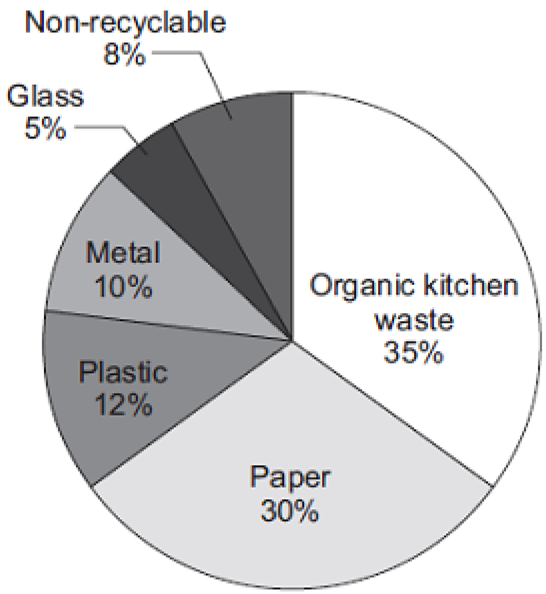
____

(2)
(Total 16 marks)

Q38.

This question is about recycling.

The pie chart shows the different types of waste from an average household in England.



(a) In 2010, councils in England collected 23 million tonnes of waste from households. Most of the waste was put into landfill sites.
Councils pay to use landfill sites.

Organic kitchen waste can be put onto compost heaps.

Calculate the mass of organic kitchen waste from households that could have been put onto compost heaps in 2010.

____

____

Answer = ___________ million tonnes

(2)

(b) Some householders put organic kitchen waste onto their compost heaps.

(i) Suggest **one** advantage of this to the council.

____

____

(1)

(ii) Suggest **one** advantage of this to the householder.

____

____

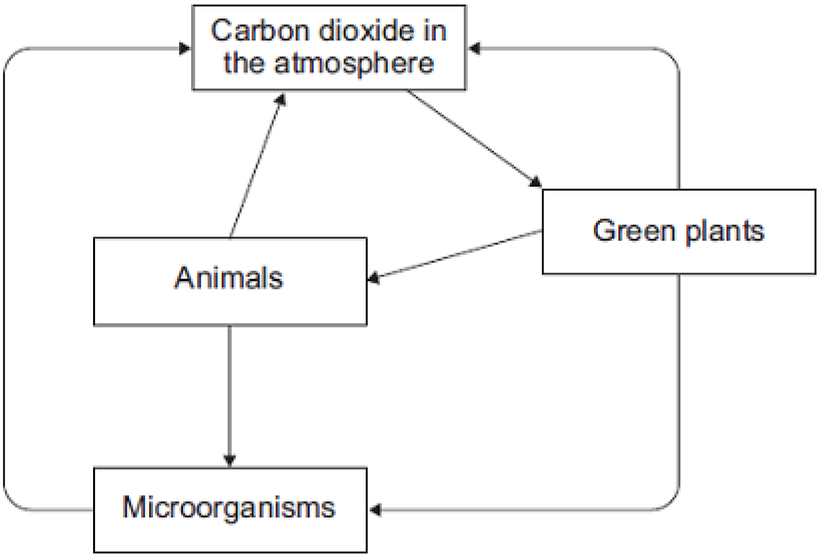
(1)

(Total 4 marks)

Q39.

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.



Describe how living things are involved in the constant cycling of carbon.

____

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____

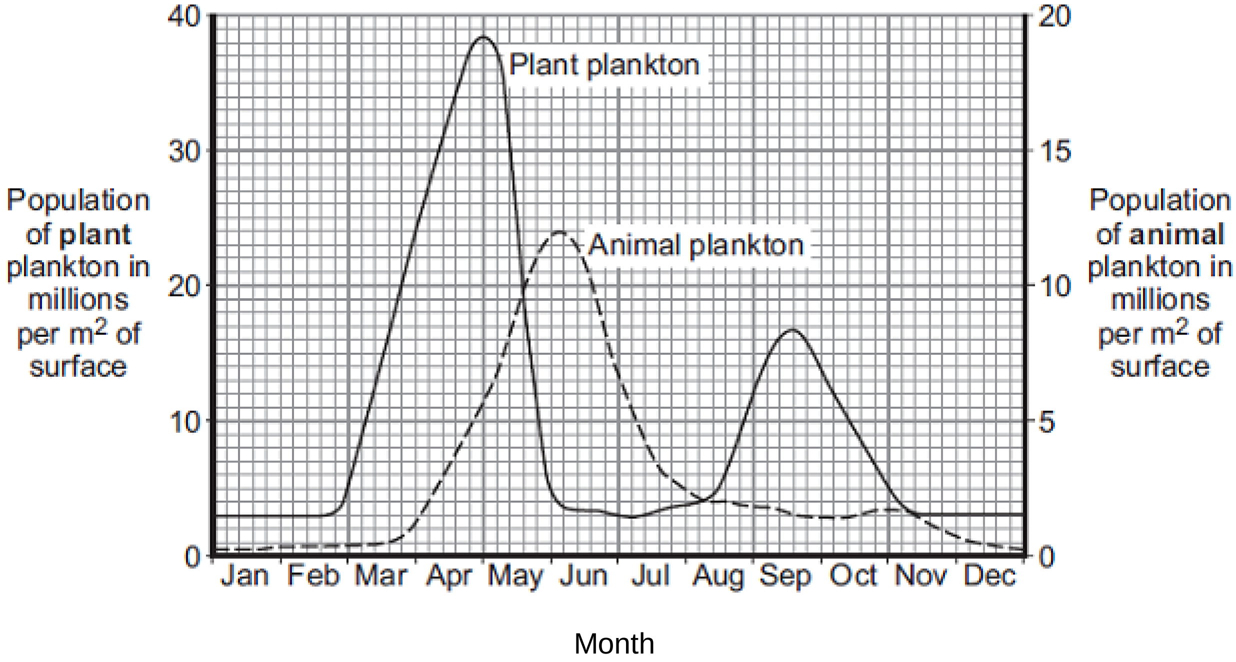
(Total 6 marks)

Q40.

Plankton live in the sea.
Animal plankton eat plant plankton.

Graph 1 shows how the populations of the plankton change through the year in the seas around the UK.

Graph 1

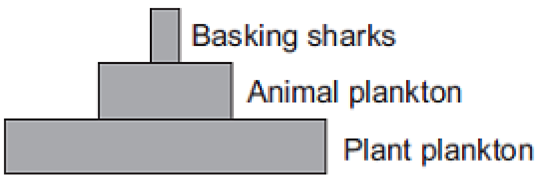


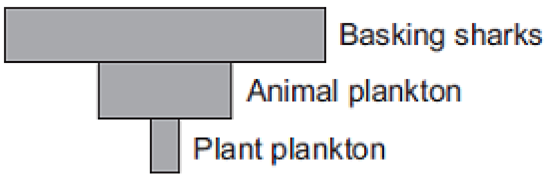
(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

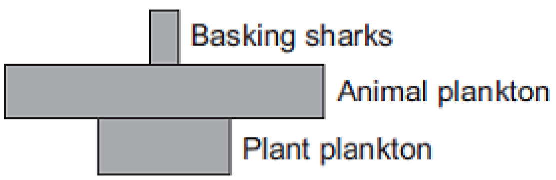
Look at the diagram and **Graph 1**.

Which is the correct shape for the pyramid of biomass to show the relationship between
plant plankton, animal plankton and basking sharks, in June?

Tick (✓) **one** box.

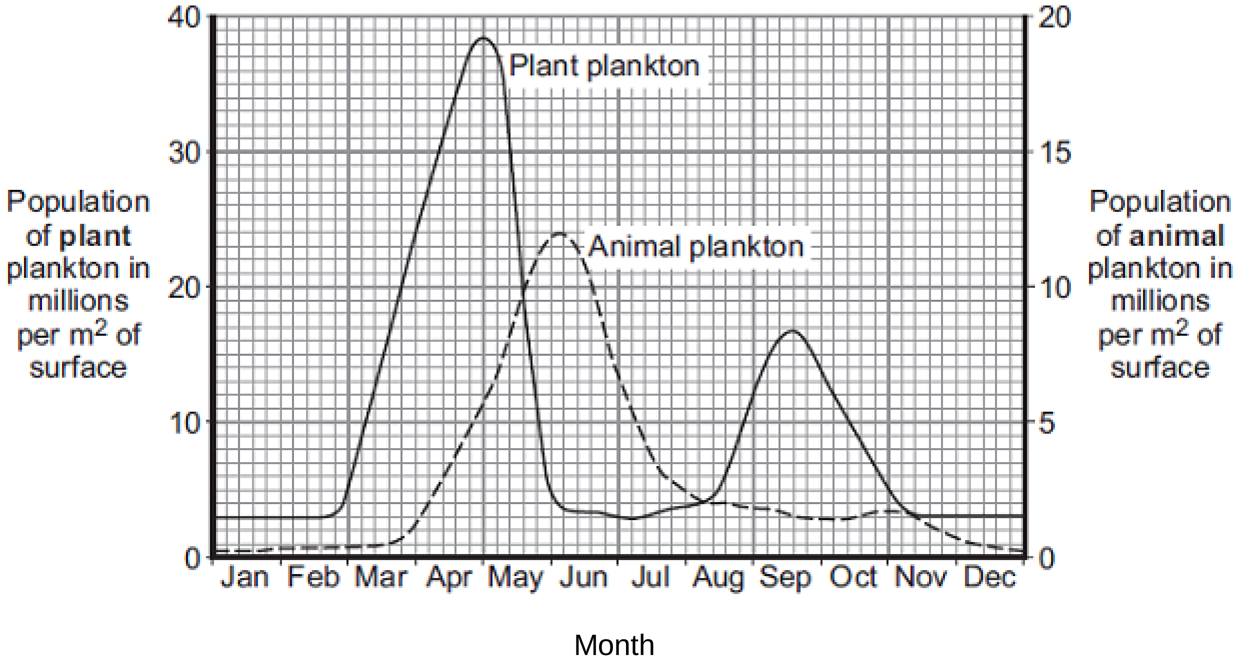






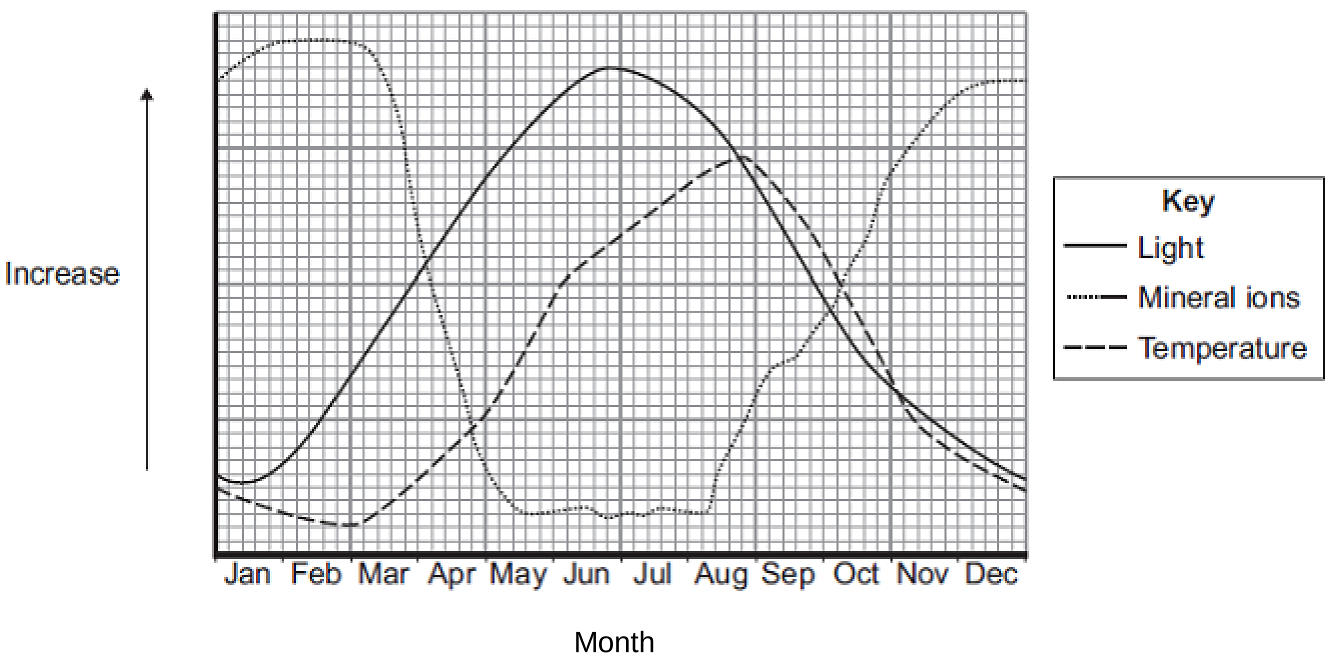
(1)

Graph 1 is repeated here to help you answer the following questions.



Graph 2 shows changes in some of the conditions in the upper layers of the sea around the UK.

Graph 2



(b) The population of plant plankton increases between February and April.

Suggest **one** reason for the increase.

Explain your answer.

____

____

____

____

(2)

(c) The population of animal plankton changes between April and July.

Suggest explanations for the changes.

____

____

____

____

____

(2)

(d) The concentration of mineral ions changes between February and December.

Suggest explanations for the changes.

____

____

____

____

____

____

____

(3)
(Total 8 marks)

Q41.

Some students were asked to investigate the distribution of clover in a field of grass. They noticed that the clover grew in patches amongst the grass.

(a) The students decided to use quadrats.

Describe how the students should decide where to place the quadrats to investigate the distribution of the clover.

____

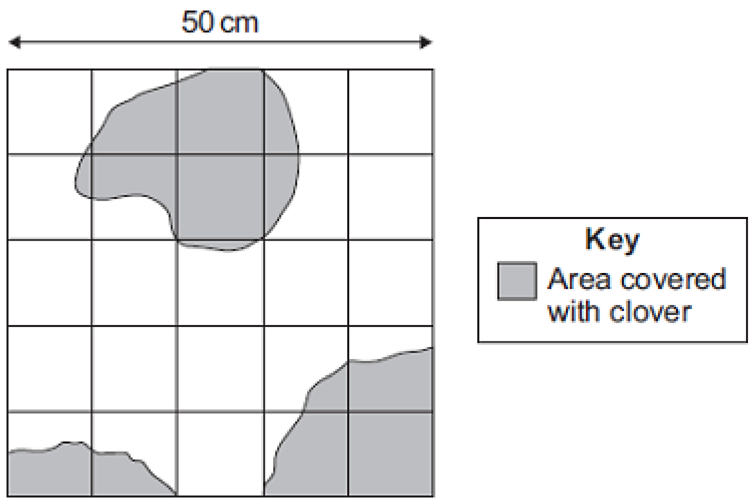
____

____

____

(2)

(b) The diagram shows one of the quadrats the students used.



(i) Estimate the number of squares of the quadrat covered with clover.

____

____

Number of squares = ________________

(1)

(ii) Describe how you worked out your answer to part (b)(i).

____

____

____

(1)

(iii) Use your answer from part (b)(i) to calculate the percentage of the quadrat covered by the clover.

____

____

____

Answer = ________________________________ %

(2)

(c) Suggest **one** factor that could account for the distribution of the clover plants.

____

(1)

(Total 7 marks)