Questions are for both separate science and combined science students unless indicated in the question

Q1.

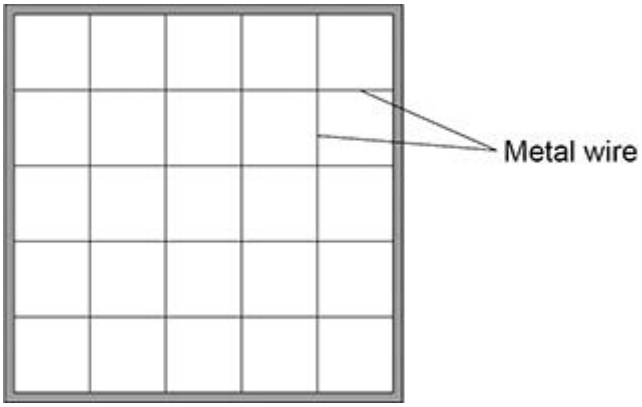
A student estimated the percentage cover of buttercup plants in a field.

The student used a quadrat.

The quadrat was divided into 25 equal squares.

Figure 1 shows the quadrat.

Figure 1



This is the method used.

1. Place the quadrat on the ground.
2. Record how many squares in the quadrat contain buttercup plants.
3. Place the quadrat in a new position in the field.
4. Record how many squares in the quadrat contain buttercup plants.
5. Repeat steps 3 and 4 another three times.

(a) What method should the student have used for placing the quadrat?

Tick (✓) **one** box.

Place the quadrat where there are many buttercup plants.	☐
Place the quadrat only where there are no trees.	☐
Place the quadrat using random coordinates.	☐
Use the same person to place all the quadrats.	☐

(1)

The student calculated the percentage cover of buttercup plants for each quadrat.

The table below shows the student's results.

Quadrat number	Number of squares containing buttercup plants	Percentage cover of buttercup plants
1	10	40
2	13	52
3	22	88
4	20	80
5	10	40
	Mean	**X**

(b) Calculate mean value **X** in the table above.

_____

_____

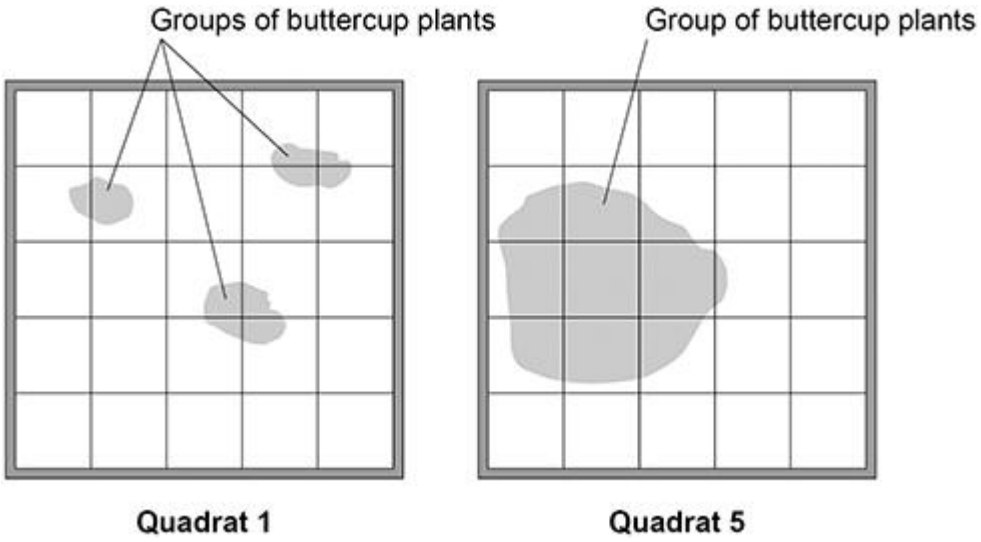
X = _____ %

(2)

The table above shows that quadrat **1** and quadrat **5** each had 40% cover of buttercup plants.

Figure 2 shows the results for quadrat **1** and quadrat **5**.

Figure 2



(c) The student's method of estimating the percentage cover of buttercup plants is **not** accurate.

How does **Figure 2** show this?

Tick (✓) **one** box.

Quadrat 1 has more groups of buttercup plants.	☐
The area of buttercup plants in quadrat 5 is much larger.	☐
The buttercup plants are in ten squares in both quadrats.	☐

(1)

(d) The student wanted to get a more valid estimate of the percentage cover of buttercup plants in the field.

Suggest **two** improvements to the method to make the results more valid.

1 _____

_____

2 _____

_____

(2)

(e) Give **three** environmental factors that would affect the growth of buttercup plants in a field.

1 _____

2 _____

3 _____

(3)

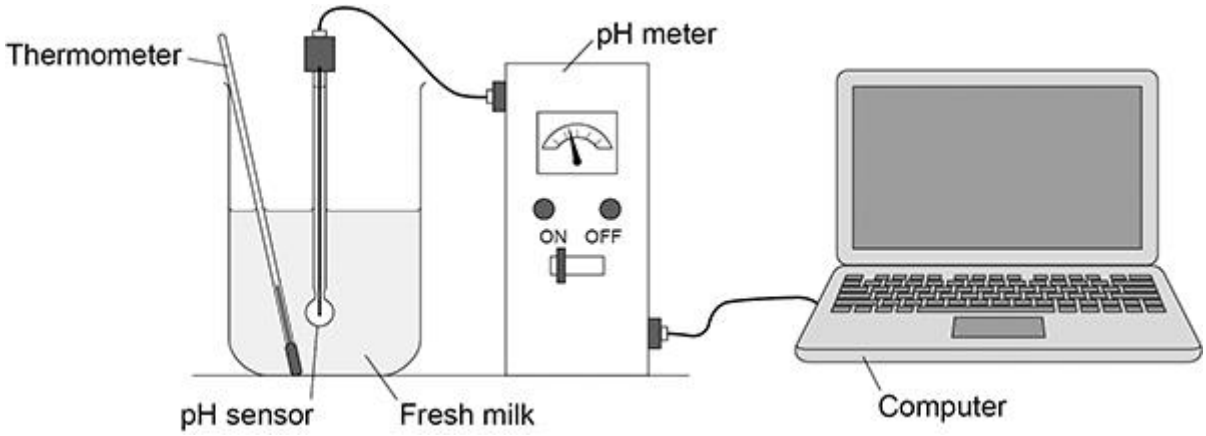
(Total 9 marks)

Q2. (separate only)

A student investigated the effect of temperature on the decay of milk.

Figure 1 shows the apparatus the student used.

Figure 1



This is the method used.

1. Set up the apparatus as shown in the figure above with the milk at 20 °C.
2. Record the pH over 5 days using the computer.
3. Repeat with another batch of fresh milk at 25 °C.

(a) How could the student keep the milk at a constant temperature for 5 days? **(separate only)**

_____

_____ **(1)**

(b) Give **one** variable the student should keep constant.

Do **not** refer to temperature in your answer. **(separate only)**

_____

_____ **(1)**

The table below shows the student's results for the milk at 20 °C.

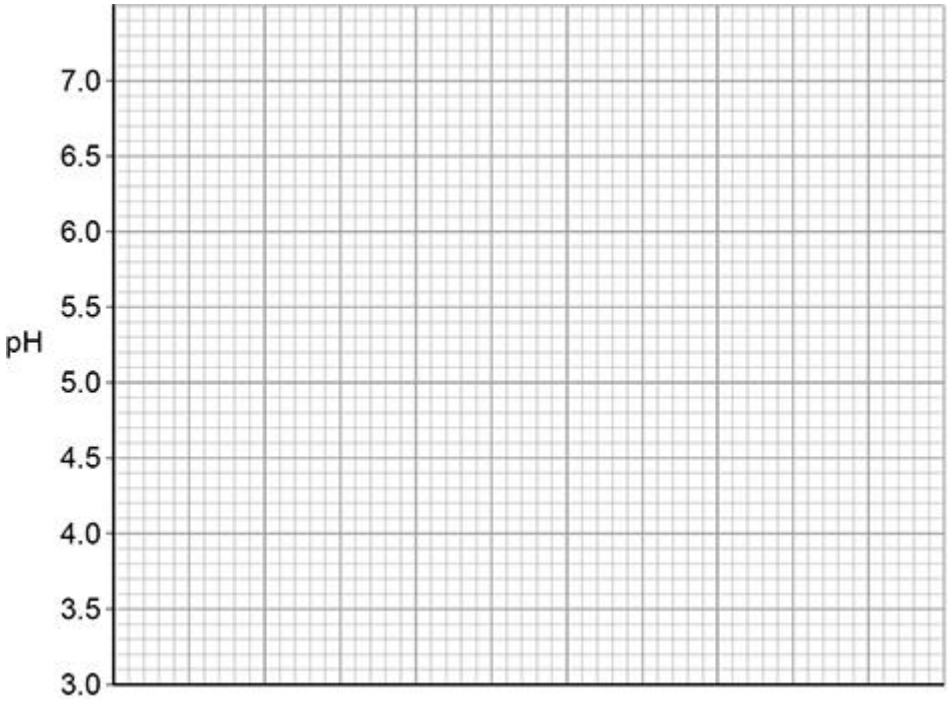
Time in days	0	1	2	3	4	5
pH	6.7	6.7	6.3	5.3	4.6	4.4

(c) Complete **Figure 2**. **(separate only)**

You should:

- label the x-axis
- use a suitable scale for the x-axis
- plot the data from the table above
- draw a line of best fit.

Figure 2



(4)

(d) The data you plotted in part (c) were obtained at 20 °C. **(separate only)**

Sketch a line on **Figure 2** to show the results you would expect at 25 °C.

Label this line '25 °C'.

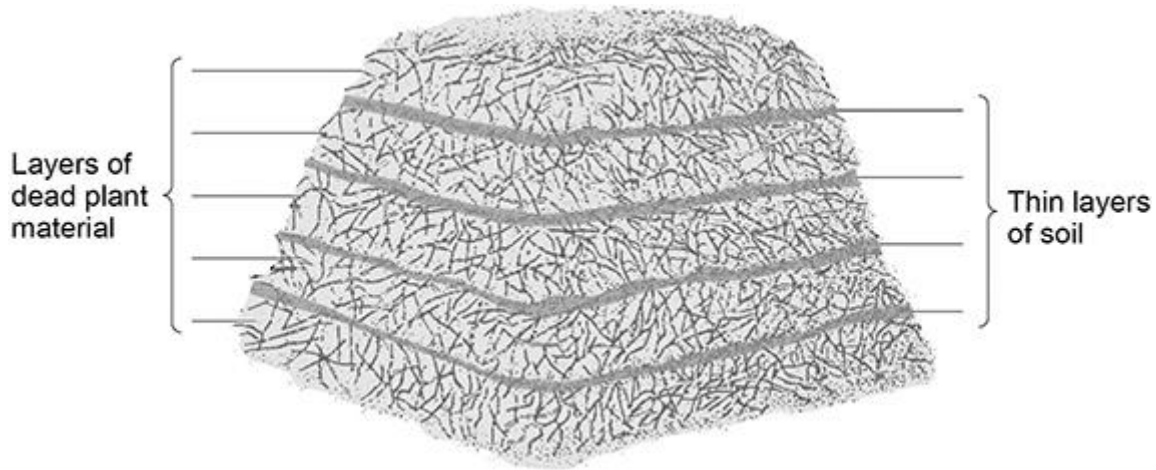
(2)

(Total 8 marks)

Q3. (separate only)

Decay occurs in a compost heap.

The figure below shows a compost heap.



Describe:

- how microorganisms in the layers of soil help to recycle chemicals in the dead plants
- how the chemicals are used again by living plants. **(separate only)**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q4.

The growth of daisy plants on a lawn is affected by biotic factors and by abiotic factors.

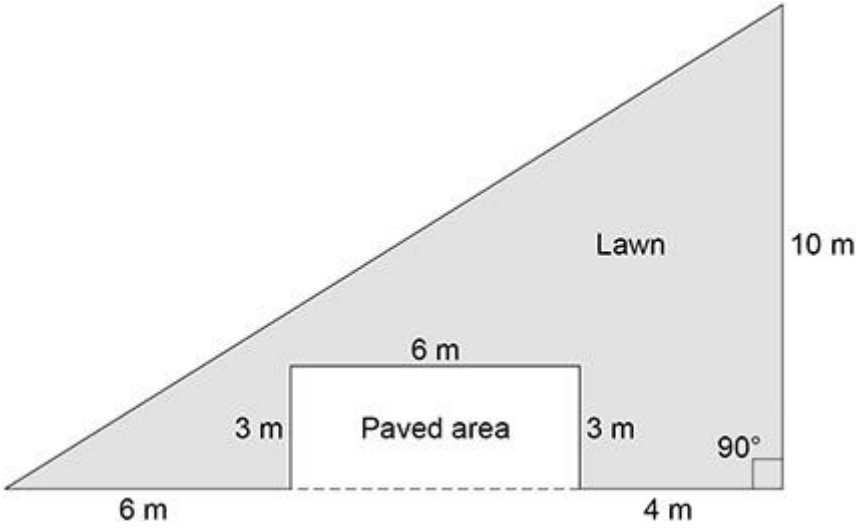
(a) The table below shows six factors.

Tick (✓) **one** box in each row to show whether the factor is biotic or abiotic.

Factor	**Biotic**	**Abiotic**
Nitrates in the soil		
Rabbits eating the plants		
Shading by a building		
Soil pH		
Temperature		
Trampling by people		

(3)

The figure below shows a plan of a garden.



A student estimates the number of daisy plants growing on the lawn.

The student places a quadrat at 10 different positions on the lawn.

The quadrat measures 50 cm × 50 cm.

The student counts the number of daisy plants in each quadrat.

(b) How should the student decide where to place the quadrat?

Give the reason for your answer.

_____

_____

_____

_____

(2)

(c) The mean number of daisy plants in each quadrat is 6.

Calculate the number of daisy plants on the lawn.

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Number of daisy plants on the lawn = _____

(6)

(d) Using the mean from this investigation to calculate the number of daisy plants on the lawn may **not** be accurate.

Give **two** reasons why.

1 _____

_____

2 _____

_____

(2)

(Total 13 marks)

Q5.

This question is about the decay of milk.

(a) Name **two** types of microorganism that cause decay.

1. _____

2. _____

(2)

(b) Cows' milk is pH 6.6.

As milk decays, lipids in the milk are broken down.

One of the products of the breakdown of lipids causes the pH of milk to decrease.

Name the product that causes the pH to decrease. **(separate only)**

_____

(1)

A student investigated the effect of temperature on the time taken for different types of milk to decay.

This is the method used.

1. Put cows' milk in six test tubes.
2. Keep each test tube at a different temperature.
3. Measure the pH of the milk in each tube every day for 12 days.
4. Record the number of days taken to reach pH 5.
5. Repeat steps 1 to 4 with goats' milk and with almond milk.

(c) Give **one** way the pH can be measured. **(separate only)**

_____

(1)

(d) Give **two** control variables the student should have used in this investigation. **(separate only)**

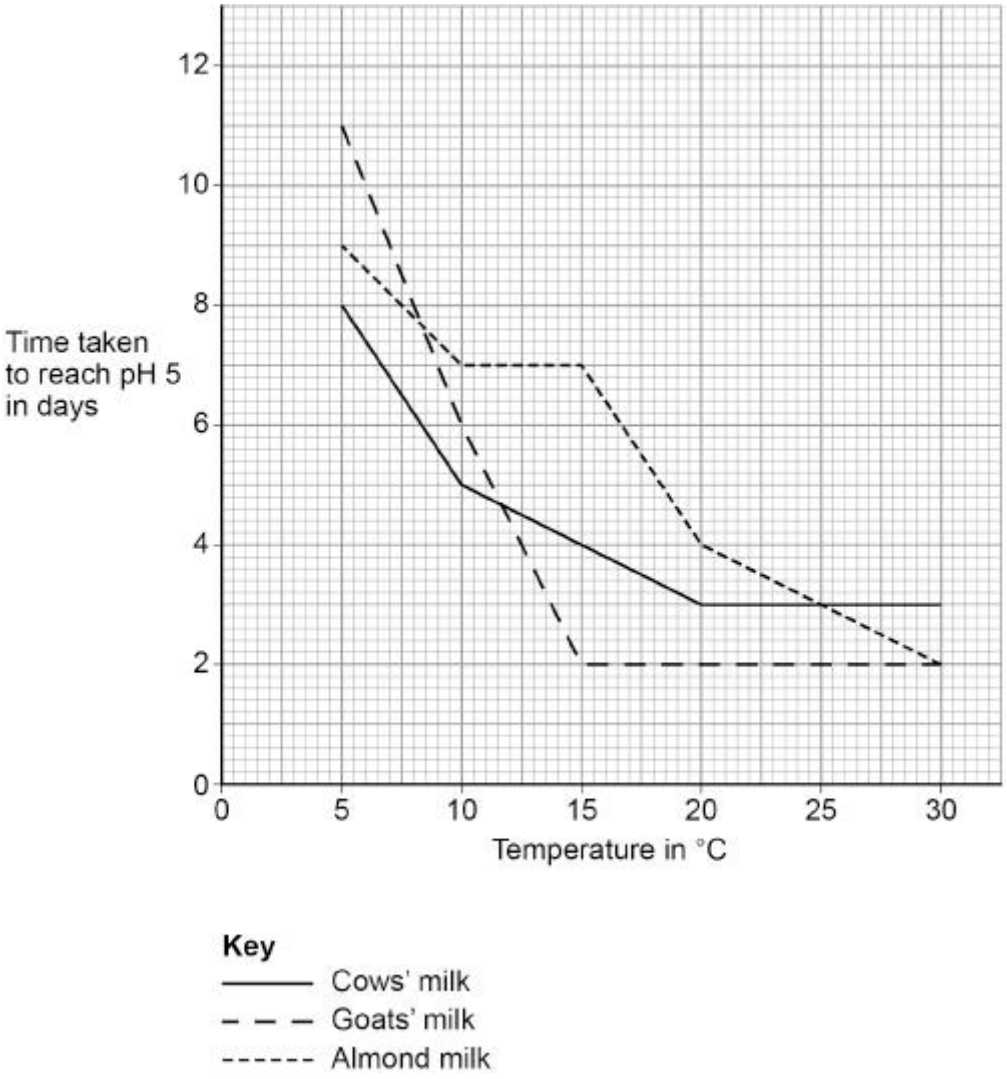
1. _____

2. _____

(2)

The student improved the investigation to produce valid results.

The graph shows the results.



(e) Which type of milk stays fresh the longest at 10 °C? **(separate only)**

_____

(1)

(f) Describe the effect of temperature on the time taken for **goats'** milk to reach pH 5.

Use data from the graph above in your answer. **(separate only)**

_____

_____

_____

_____

(2)

(g) The time taken for cows' milk to reach pH 5 at 10 °C is less than the time taken for cows' milk to reach pH 5 at 5 °C.

Suggest **one** reason why. **(separate only)**

_____

_____

(1)

(h) Suggest **two** reasons why the different types of milk took different lengths of time to reach pH 5. **(separate only)**

1 _____

_____

2 _____

_____

(2)

(i) The student said:

'The temperature milk is stored at affects how likely the milk is to cause food poisoning.'

How can the investigation be developed to find out if the student is correct?

Tick (✓) **one** box. **(separate only)**

Determine the types of bacteria present in the milk ☐

Record the pH every 12 hours ☐

Use more than three different types of milk ☐

(1)

(Total 13 marks)

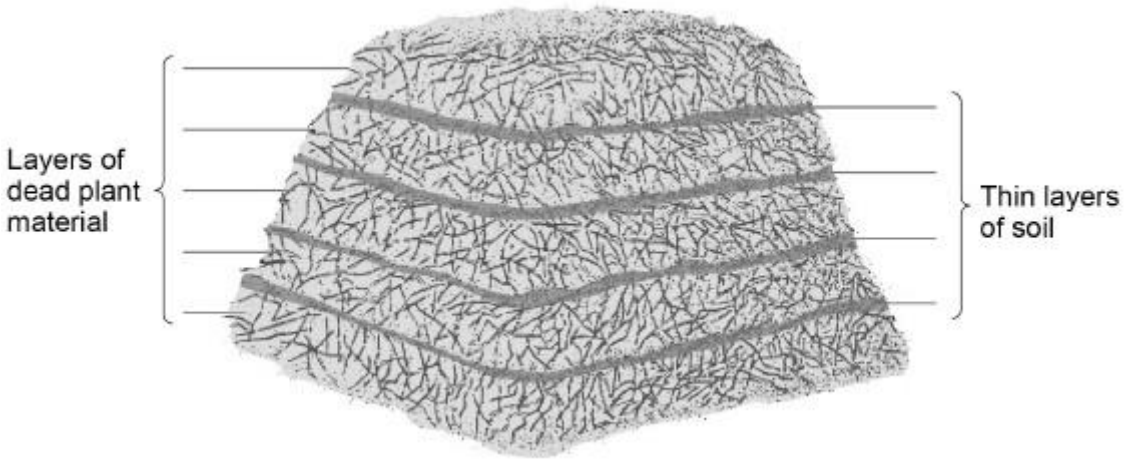
Q6.

Gardeners sometimes make compost heaps from dead plant material.

The dead plants decay in the compost heap.

Figure 1 shows a compost heap.

Figure 1



(a) The thin layers of soil contain organisms that cause decay.

Which **two** types of organism cause decay?

Tick (✓) **two** boxes.

Bacteria ☐

Fungi ☐

Grass ☐

Insects ☐

Worms ☐

(2)

The rate of decay in the compost heap depends on several environmental factors.

(b) Explain how the rate of decay would be affected by: **(separate only)**

- an increase in oxygen concentration
- a temperature increase from 5 °C to 25 °C

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Give **one** environmental factor needed for decay. **(separate only)**

Do **not** refer to oxygen or temperature in your answer.

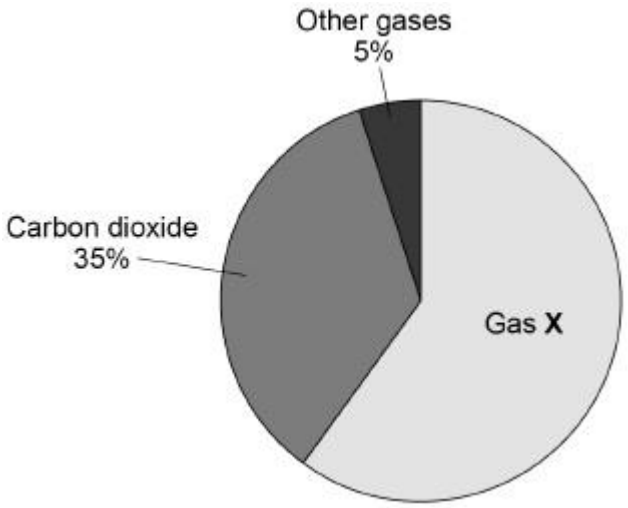
_____

(1)

Dead plant material can also be decayed in a biogas generator.

Figure 2 shows the percentages of the gases found in a sample of biogas.

Figure 2



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

What is gas **X**?

Tick (✓) **one** box. **(separate only)**

Carbon monoxide ☐

Hydrogen ☐

Methane ☐

Nitrogen ☐

(1)

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

_____

_____

_____

Percentage = _____%

(1)

(f) The dead plant material in the compost heap and biogas generator does **not** decay completely.

Explain why a farmer might spread the remaining dead plant material onto his fields.

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

Q7.

Earthworms are small animals that live in soil. Earthworms have no specialised gas exchange system and absorb oxygen through their skin.

(a) What is the name of the process in which oxygen enters the skin cells?

Tick **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Respiration ☐

(1)

The table below shows information about four skin cells of an earthworm.

Cell	Percentage of oxygen	
	Outside cell	**Inside cell**
A	9	8
B	12	8
C	12	10
D	8	12

(b) Which cell has the smallest difference in percentage of oxygen between the outside and the inside of the cell?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(c) Which cell will oxygen move **into** the fastest?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(d) Earthworms have a large surface area to volume ratio.

Suggest why a large surface area to volume ratio is an advantage to an earthworm.

_____

_____

(1)

(e) The earthworm uses enzymes to digest dead plants.

Many plants contain fats or oils.

Which type of enzyme would digest fats?

_____

_____

(1)

(f) Earthworms move through the soil.

This movement brings air into the soil.

Dead plants decay faster in soil containing earthworms compared with soil containing **no** earthworms.

Explain why. **(separate only)**

_____

_____

_____

_____

_____

_____

(3)

(g) When earthworms reproduce, a sperm cell from one earthworm fuses with an egg cell from a different earthworm.

Name the process when an egg cell and a sperm cell fuse.

_____

(1)

(h) Some types of worm reproduce by a process called fragmentation.

In fragmentation, the worm separates into two or more parts. Each part grows into a new worm.

What type of reproduction is fragmentation?

_____

(1)

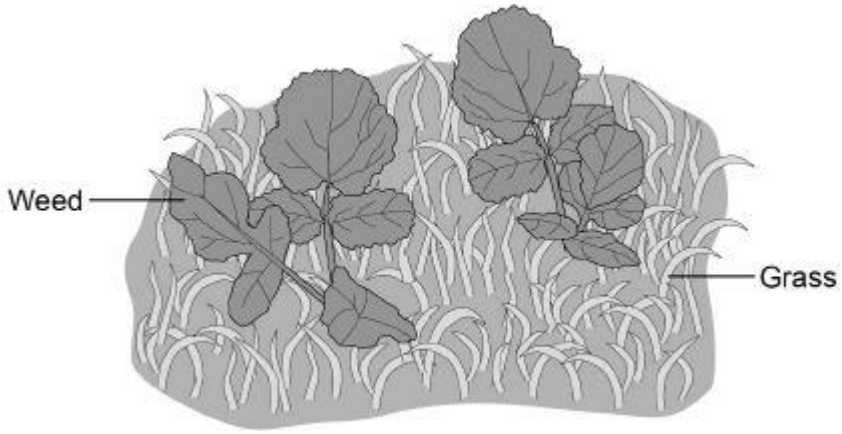
(Total 10 marks)

Q8.

Some weed killers are selective.

Selective weed killers kill broad-leaved weed plants, but do **not** kill narrow-leaved grass plants.

The diagram below shows some weeds growing on a grassy lawn.



Some students investigated the effect of a selective weed killer on the weeds growing in a lawn. They used 0.5 m × 0.5 m quadrats.

The lawn was 20 metres long and 10 metres wide.

This is the method used.

1. Divide the lawn into two halves, side **A** and side **B**.
2. Place 5 quadrats in different positions on side **A**.
3. Place 5 more quadrats in different positions on side **B**.
4. Count the number of weed plants in each quadrat.
5. Spray side **A** with weed killer solution.
6. Spray side **B** with the same volume of water.
7. Repeat steps 2-4 after 2 weeks.

(a) Suggest a method the students should have used to place each quadrat.

_____

_____

_____

(1)

(b) Give the reason for the method you suggested in part **(a)**.

_____

_____

(1)

(c) Explain why the students used water on one side of the lawn instead of weed killer.

_____

_____

_____

_____

(2)

The table below shows the students' results.

	Number of weeds per quadrat			
	At start		After 2 weeks	
	Side A (Weed killer)	Side B (Water)	Side A (Weed killer)	Side B (Water)
	8	14	3	8
	2	9	4	15
	12	3	0	7
	15	16	2	12
	13	3	1	13
Mean	10	9	2	**X**

(d) Calculate the mean value, **X**, in the table above.

_____

_____

Mean value, **X** = _____

(1)

(e) Calculate the percentage decrease in the number of weeds on side **A** after 2 weeks.

Use the following equation:

$$\text{percentage decrease} = \frac{(\text{mean at start} - \text{mean after 2 weeks})}{\text{mean at start}} \times 100$$

_____

_____

_____

_____

Percentage decrease = _____

(2)

(f) One student thought the results were **not** valid.

Suggest **one** improvement the students could have made to the method to make the results more valid.

Give the reason for your answer.

Improvement _____

_____

Reason _____

_____

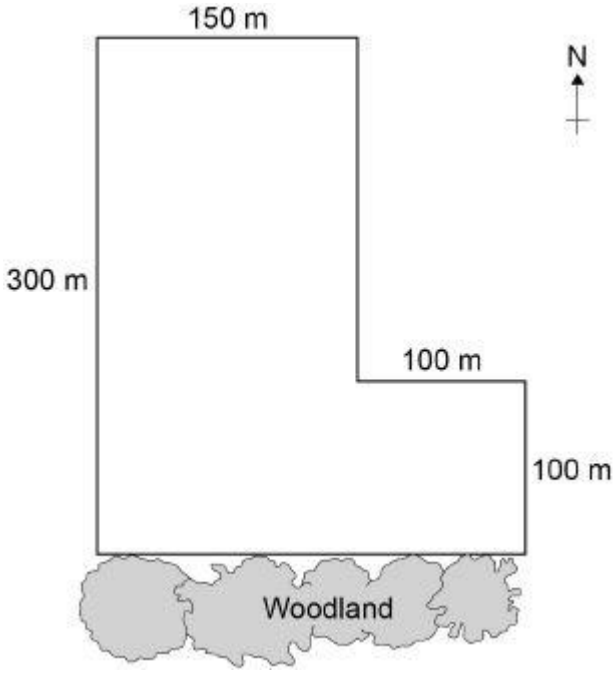
(2)

(Total 9 marks)

Q9.

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

(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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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.

(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)

Q10. (separate only)

Fresh milk contains bacteria.

Some students investigated decay caused by the bacteria in fresh milk.

This is the method used:

1. Put 200 cm^3 of fresh milk in a sterilised flask.
2. Leave the flask for 3 days at 20 °C.
3. Measure the pH of the milk each day using universal indicator paper.

Figure 1 and **Figure 2** show the apparatus the students used.

Figure 1

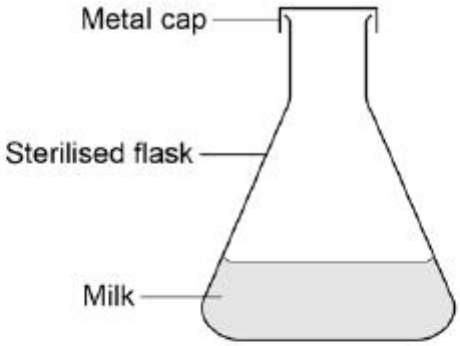
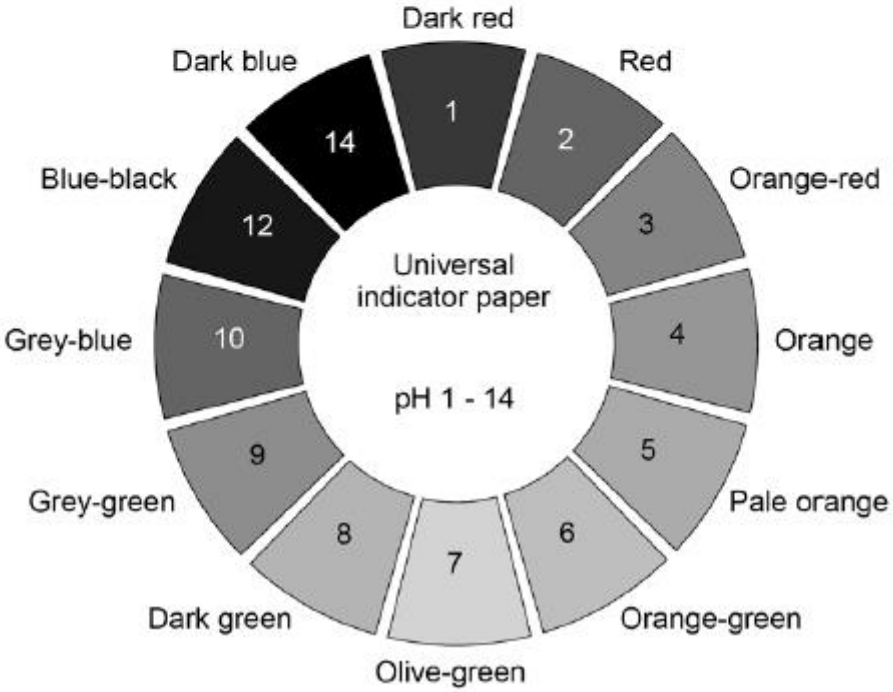


Figure 2



(a) Give **one** reason why the students sterilised the flask before adding the milk. **(separate only)**

_____

_____

(1)

(b) Describe how the students could sterilise the flask in a school laboratory. **(separate only)**

_____

_____

_____

_____

(2)

(c) Why did the students put a cap on top of the flask? **(separate only)**

_____

_____

(1)

(d) The table shows the students' results.

Table 1

Time in days	Colour of universal indicator paper	pH
0	Olive-green	
1	Olive-green	
2	Olive-green	
3	Orange-green	

Complete **Table 1**.

Use information from **Figure 2**. **(separate only)**

(1)

(e) The students repeated their investigation with two changes to the method:

- they used a pH meter to measure the pH
- they left the apparatus set up for 6 days instead of for 3 days.

Suggest a reason why each of these changes improves the investigation.

(separate only)

Using a pH meter _____

_____

Leaving the apparatus set up for 6 days _____

_____

(2)

Table 2 shows the results of the students' second investigation.

Table 2

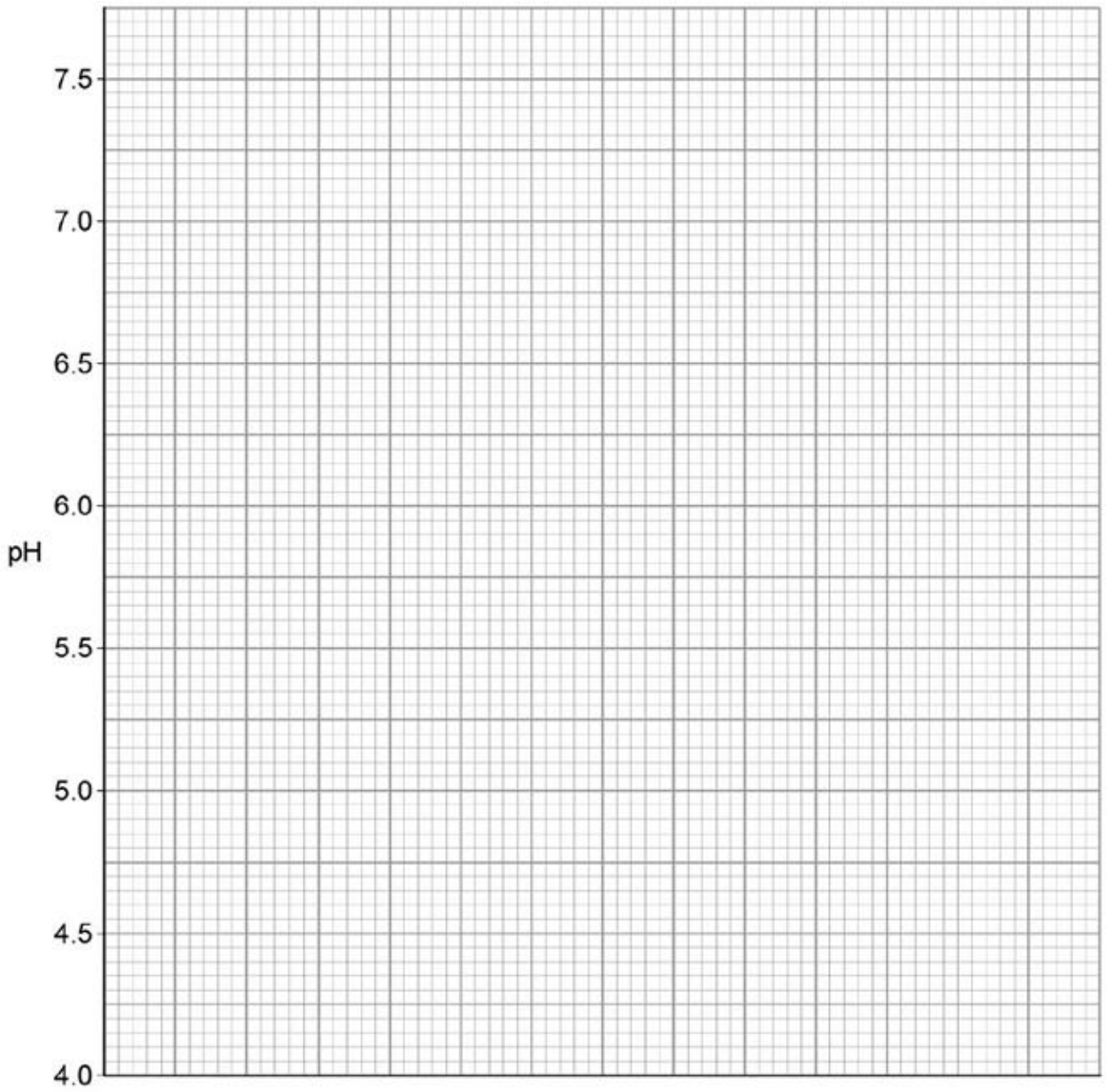
Time in days	pH
0	7.0

1	7.0
2	6.7
3	6.0
4	5.0
5	4.5
6	4.5

(f) Complete the graph below. **(separate only)**

You should:

- label the x-axis
- plot the data from **Table 2**
- draw a line of best fit.



(4)

(g) Give **one** reason for each of the following. **(separate only)**

Use information from **Table 2** and the graph above.

The pH did not change during the first day: _____

_____

The pH decreased after day 1: _____

_____

There was no change in pH between days 5 and 6: _____

_____

(3)

(h) The students did both of their investigations at 20 °C

The students then repeated the investigation with the pH meter, but at 25 °C

Predict how the new results would be: **(separate only)**

- similar to the results at 20 °C
- different from the results at 20 °C

Similarity

_____

_____

Difference

_____

_____

(2)

(Total 16 marks)

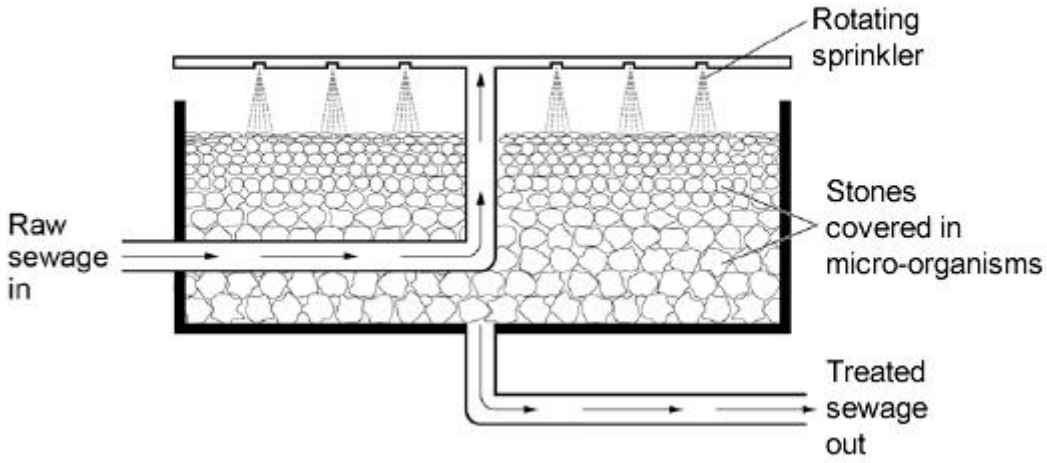
Q11.

Pollution of rivers with untreated sewage can kill plants and animals.

Figure 1 shows a sprinkler bed at a sewage works.

The sewage trickles slowly downwards over the surfaces of the stones.

Figure 1



Some of the microorganisms on the stones feed on organic matter in the sewage.

The treated sewage is safe enough to pass into a river.

(a) Most of the microorganisms in the sprinkler bed respire aerobically.

Describe **two** features of the sprinkler bed that encourage **aerobic** respiration.

Use information from **Figure 1**.

1. _____

_____

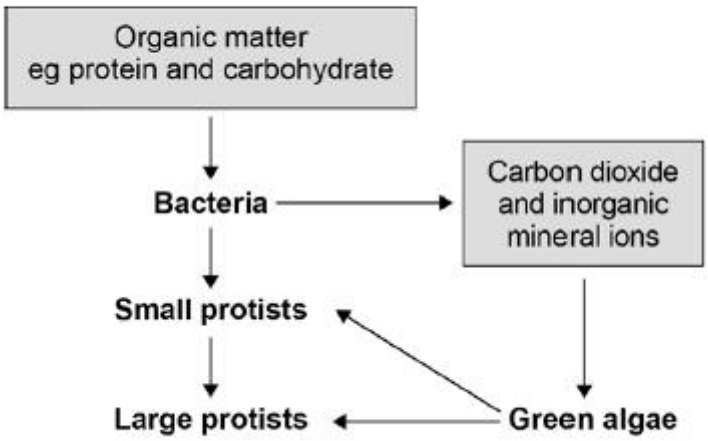
2. _____

_____

(2)

Figure 2 shows the feeding relationships between the microorganisms in the sprinkler bed.

Figure 2



(b) Which organisms in **Figure 2** are producers?

Tick **one** box.

- Bacteria ☐
- Green algae ☐
- Large protists ☐
- Small protists ☐

(1)

(c) Name **one** organism in **Figure 2** which is both a primary and a secondary consumer.

_____

(1)

(d) The bacteria are decomposers.

Figure 2 shows that the bacteria change organic matter into carbon dioxide and inorganic mineral ions.

Describe how the bacteria do this. **(separate only)**

_____

_____

_____

_____

_____

_____

_____

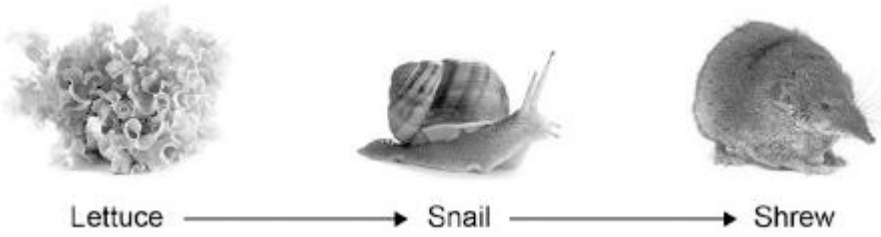
_____

(4)

(Total 8 marks)

Q12.

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 ☐

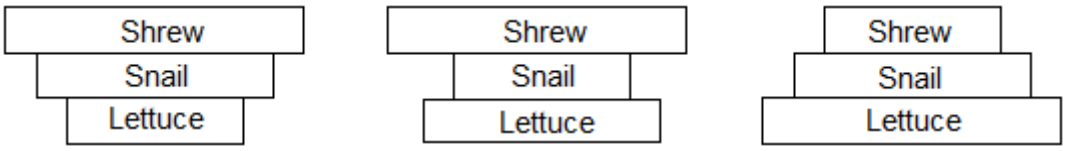
Population ☐

Territory ☐

(1)

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

Tick **one** box. **(separate only)**



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. **(separate only)**

_____

Energy = _____ kJ

(1)

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

Tick **one** box. **(separate only)**

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.

_____

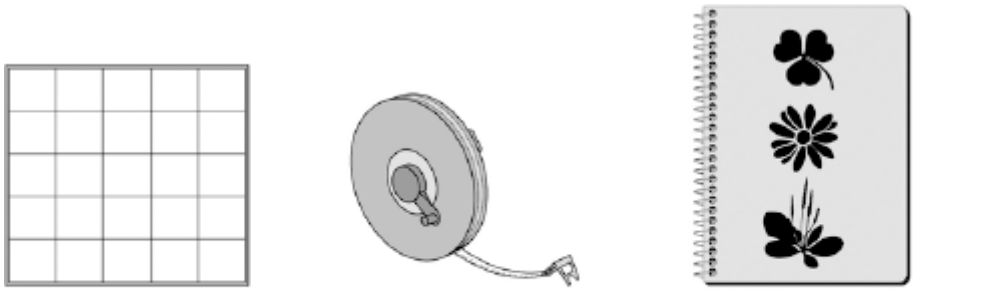
(1)

(Total 8 marks)

Q13.

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

The image below shows the equipment used.



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)

Q14.

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. **(separate only)**

_____

_____

_____

_____

(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. **(separate only)**

_____

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. **(separate only)**

_____

_____

(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.

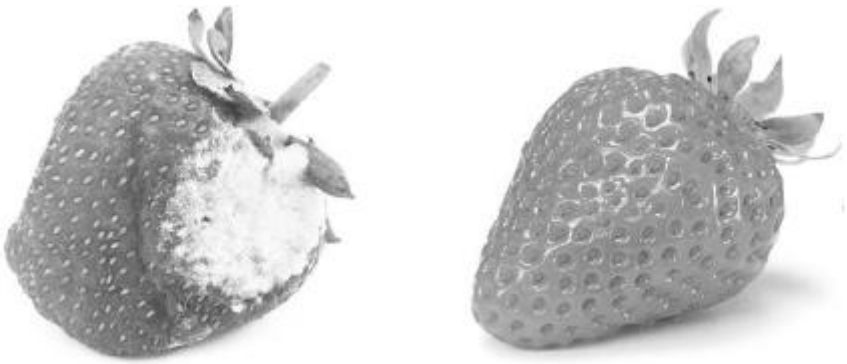
Explain how the carbon is recycled into the growth of new leaves.

(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**



Give **three** possible reasons that may have caused strawberry **A** to decay. **(separate only)**

1.

_____

2. _____

_____

3. _____

_____

(3)

(Total 13 marks)

Q15. (separate only)

Students investigated decomposition.

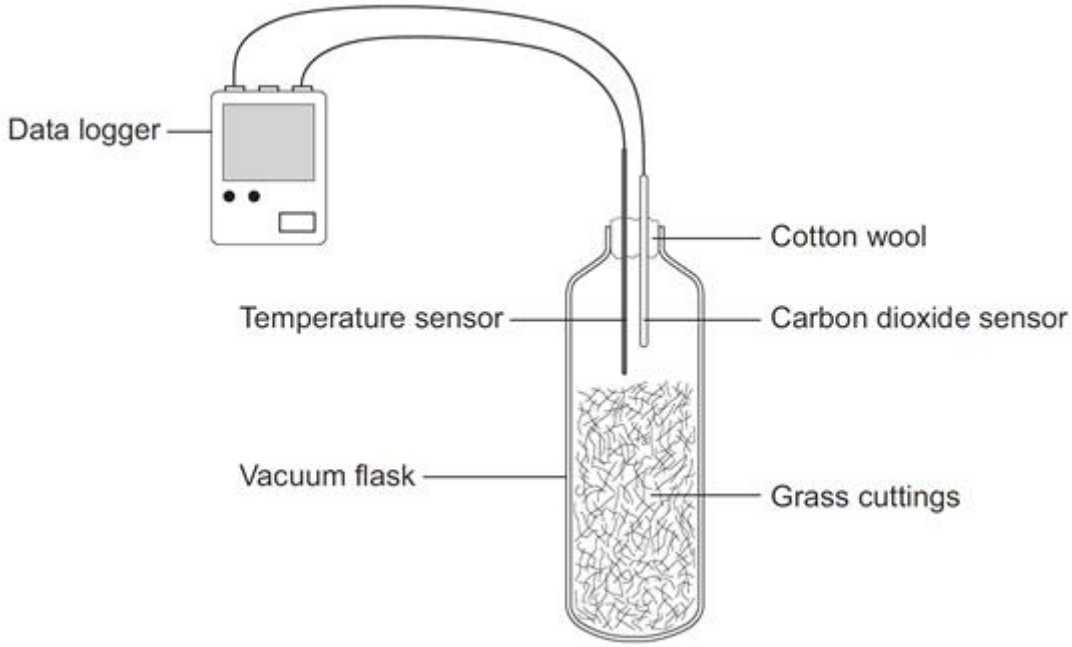
The students:

- 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. **(separate only)**

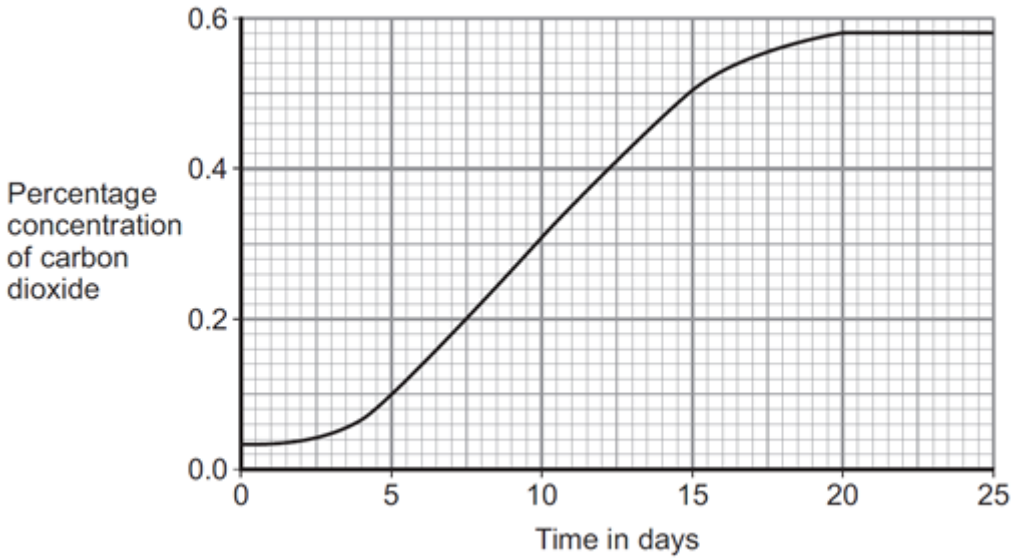
_____

_____

(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?

(separate only)

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

(1)

(Total 5 marks)

Q16.

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)