AQA GCSE BIOLOGY (HIGHER) · 8461

# BIOLOGY



EXAM QUESTION PACK

## 4.7.2 ORGANISATION OF AN ECOSYSTEM (PACK 1)

| SCORE | PERCENTAGE |
| --- | --- |
| /335 | % |

STEMUP

# These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

## What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

## Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

## Q1.

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.



STEMUP.CO.UK

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.

_____

_____

_____

_____

_____

_____

**(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)**



STEMUP.CO.UK

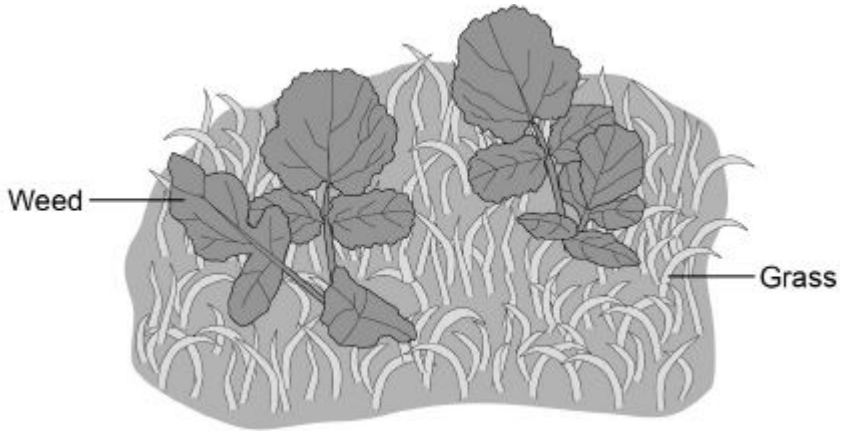
**(Total 10 marks)**

## Q2.

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)**



STEMUP.CO.UK

(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 = _____



STEMUP.CO.UK

**(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 _____

_____

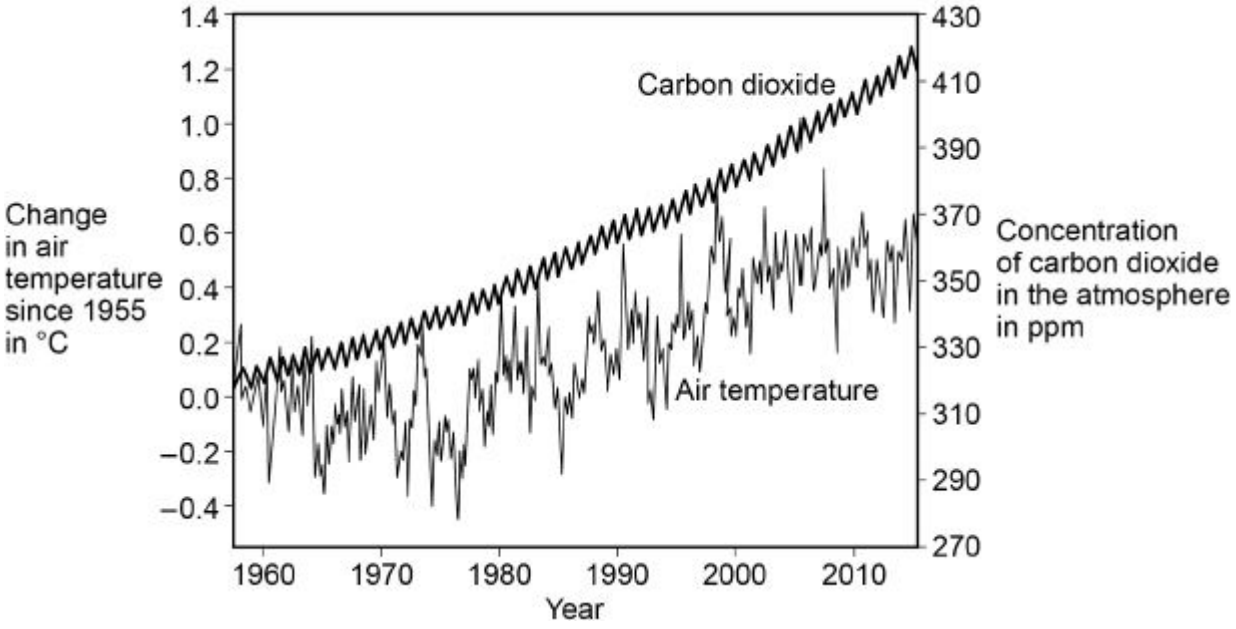
**(2)**

**(Total 9 marks)**

## Q3.

Many scientists think that global air temperature is related to the concentration of carbon dioxide in the atmosphere.

The graph below shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.




(a) Complete the table below.

Use information from the graph above.

Choose answers from the box.

You may use each answer once, more than once or not at all.

| | | |
|---|---|---|
| **constant** | **decreasing** | **increasing** |



STEMUP.CO.UK

| | 1960 − 1977 | 1977 − 2003 | 2003 − 2015 |
|---|---|---|---|
| **Trend in carbon dioxide concentration** | Increasing | | |
| **Trend in air temperature** | | | |

**(2)**

Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.

(b) How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature?

_____

_____

**(1)**

(c) Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature.

Use data from the graph above and your own knowledge.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____



STEMUP.CO.UK

_____

**(4)**

In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

(d) Give **one** human activity that could cause the higher concentration of carbon dioxide in the winter.

_____

_____

**(1)**

(e) Give **one** biological process that could cause the lower concentration of carbon dioxide in the summer.

_____

_____

**(1)**

(f) Give **two** possible effects of an increase in global air temperature on living organisms.

1. _____

_____

2. _____

_____

**(2)**

**(Total 11 marks)**

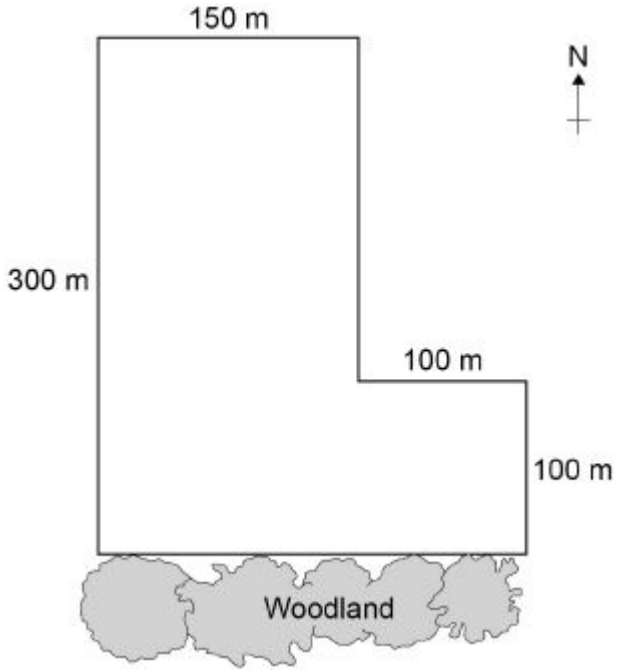
## Q4.

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

The diagram below shows the field.



STEMUP.CO.UK




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)**



STEMUP.CO.UK

(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.



STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

**(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)**

## Q5.

**Figure 1** shows:

- a food chain for organisms in a river
- the biomass of the organisms at each trophic level.

**Figure 1**



| Algae | → | Invertebrate animals | → | Small fish | → | Large fish |
|---|---|---|---|---|---|---|
| Biomass in g/m$^2$: | 840 | | 200 | 40 | | 10 |

(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

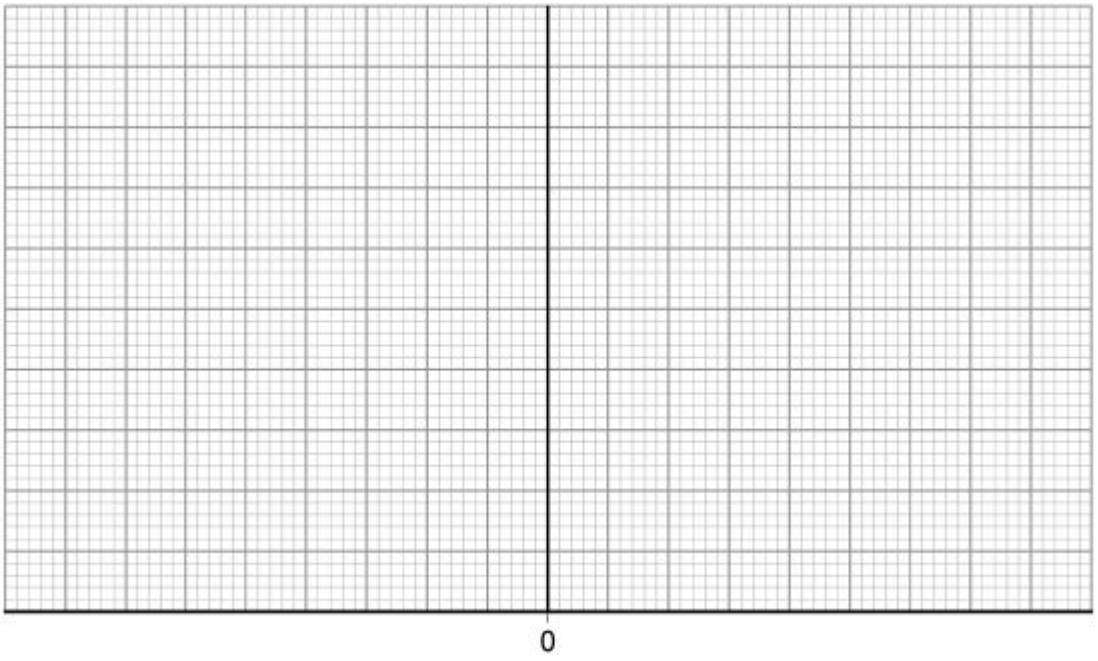
You should:

- use a suitable scale
- label the x-axis
- label each trophic level.



STEMUP.CO.UK

**Figure 2**




**(4)**

(b) Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

_____

Percentage loss = _____

**(3)**

(c) Give **one** way that biomass is lost between trophic levels.

_____

_____

**(1)**

(d) A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died.

_____



STEMUP.CO.UK

**(5)**
**(Total 13 marks)**

## Q6.

Scientists want to breed cows that produce milk with a low concentration of fat.

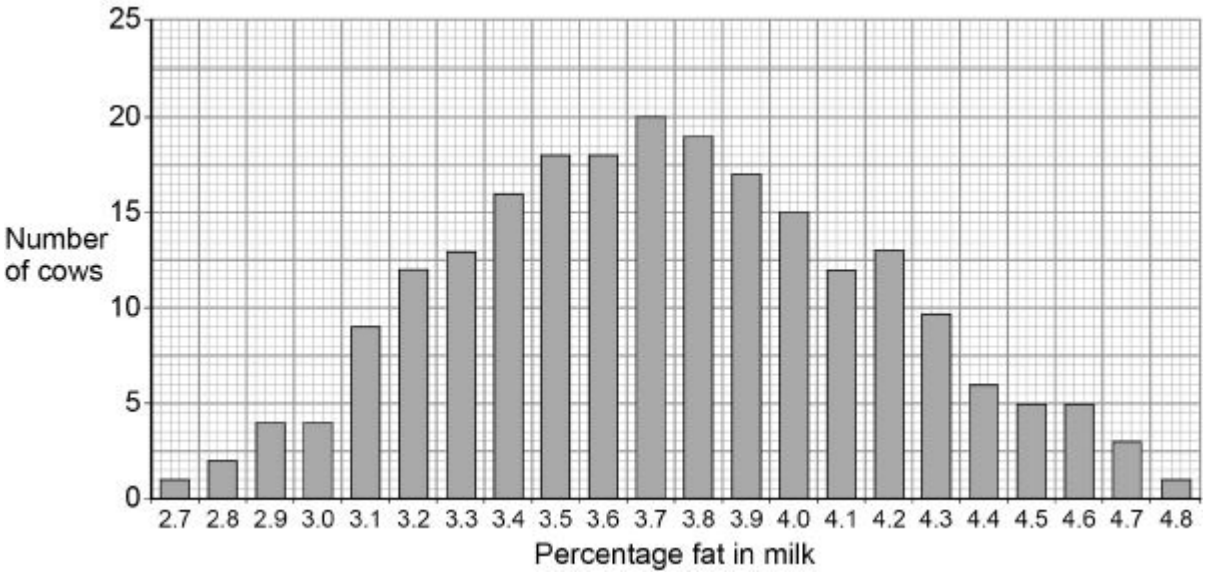
**Figure 1** shows information about the milk in one group of cows.

The cows were all the same type.

**Figure 1**



STEMUP.CO.UK




(a) In **Figure 1** the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

Mean percentage = _____

**(1)**

(b) A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

Tick **one** box.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | ☐ | 3 | ☐ | 22 | ☐ | 46 | ☐ |

**(1)**

(c) Give the evidence from **Figure 1** which shows the percentage of fat in the milk is controlled by several genes.

_____

_____

**(1)**

(d) One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

_____



STEMUP.CO.UK

_____

_____

_____

_____

_____

**(3)**

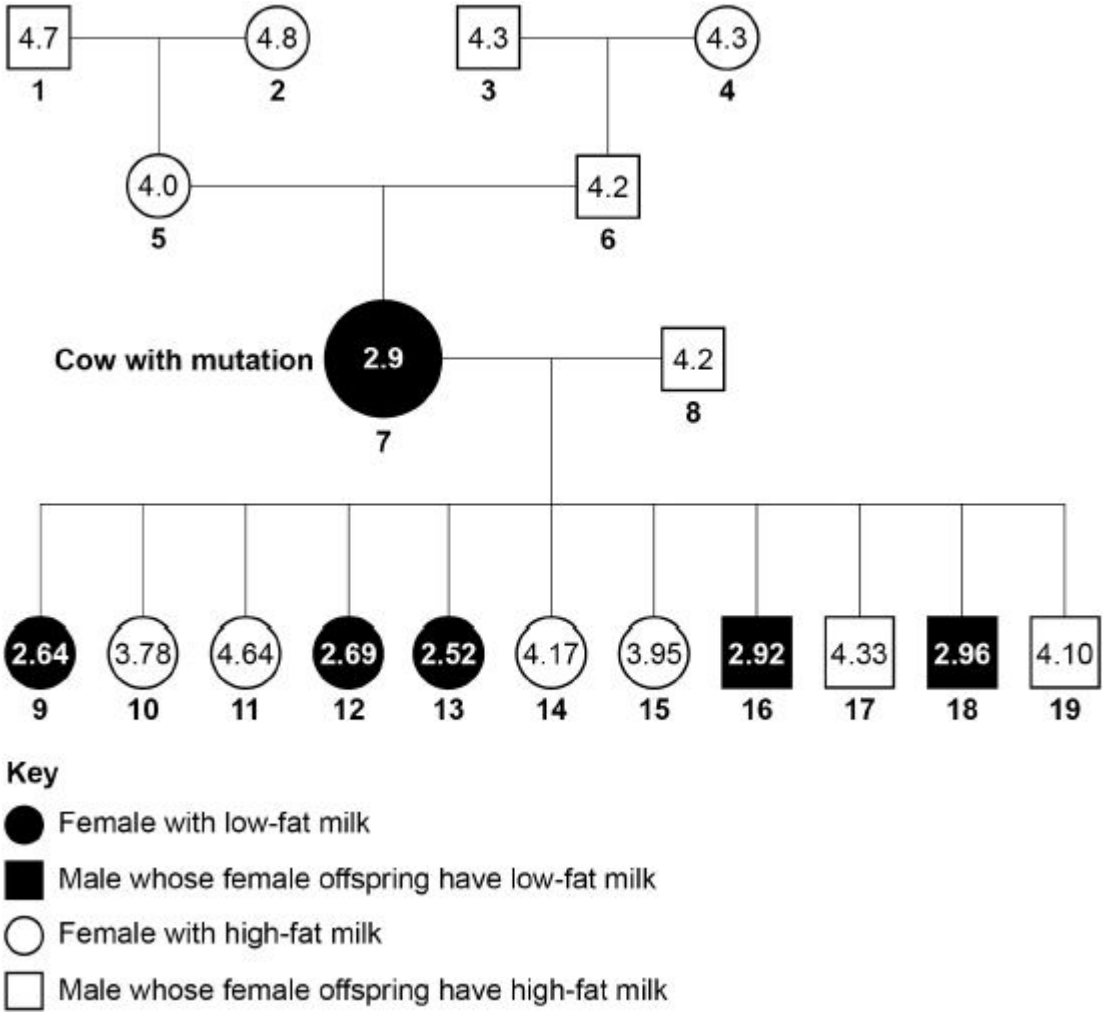
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

**Figure 2** shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

**Figure 2**




(e) Animal **8** is homozygous.

The mutation in animal **7** produced a dominant allele for making low-fat milk.

Give evidence from **Figure 2** that animal **7** is heterozygous.



STEMUP.CO.UK

_____

_____

**(1)**

(f) Animals **7** and **8** produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals **7** and **8** to mate naturally.

_____

_____

**(1)**

(g) Draw a Punnett square diagram to show a cross between animals **7** and **8**.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

Use the following symbols:

**D** = dominant allele for making low-fat milk

**d** = recessive allele for making high-fat milk

**(4)**

(h) The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in **Figure 2**.

Describe how the scientists would do this.

_____

_____

_____

_____

_____

_____



STEMUP.CO.UK

_____

_____

_____

_____

**(4)**

**(Total 16 marks)**

## Q7.

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.



STEMUP.CO.UK

**Figure 1**

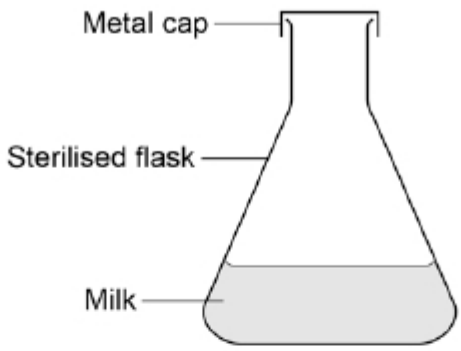
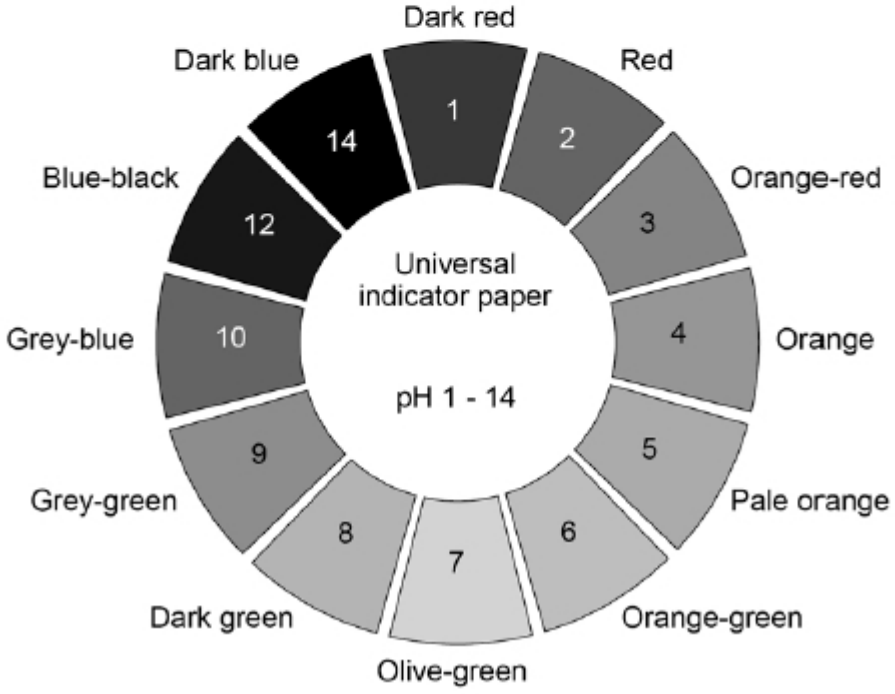



**Figure 2**




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

_____

_____

**(1)**

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

_____

_____

_____

_____

**(2)**



STEMUP.CO.UK

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

_____

_____

**(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**.

**(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.

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 |



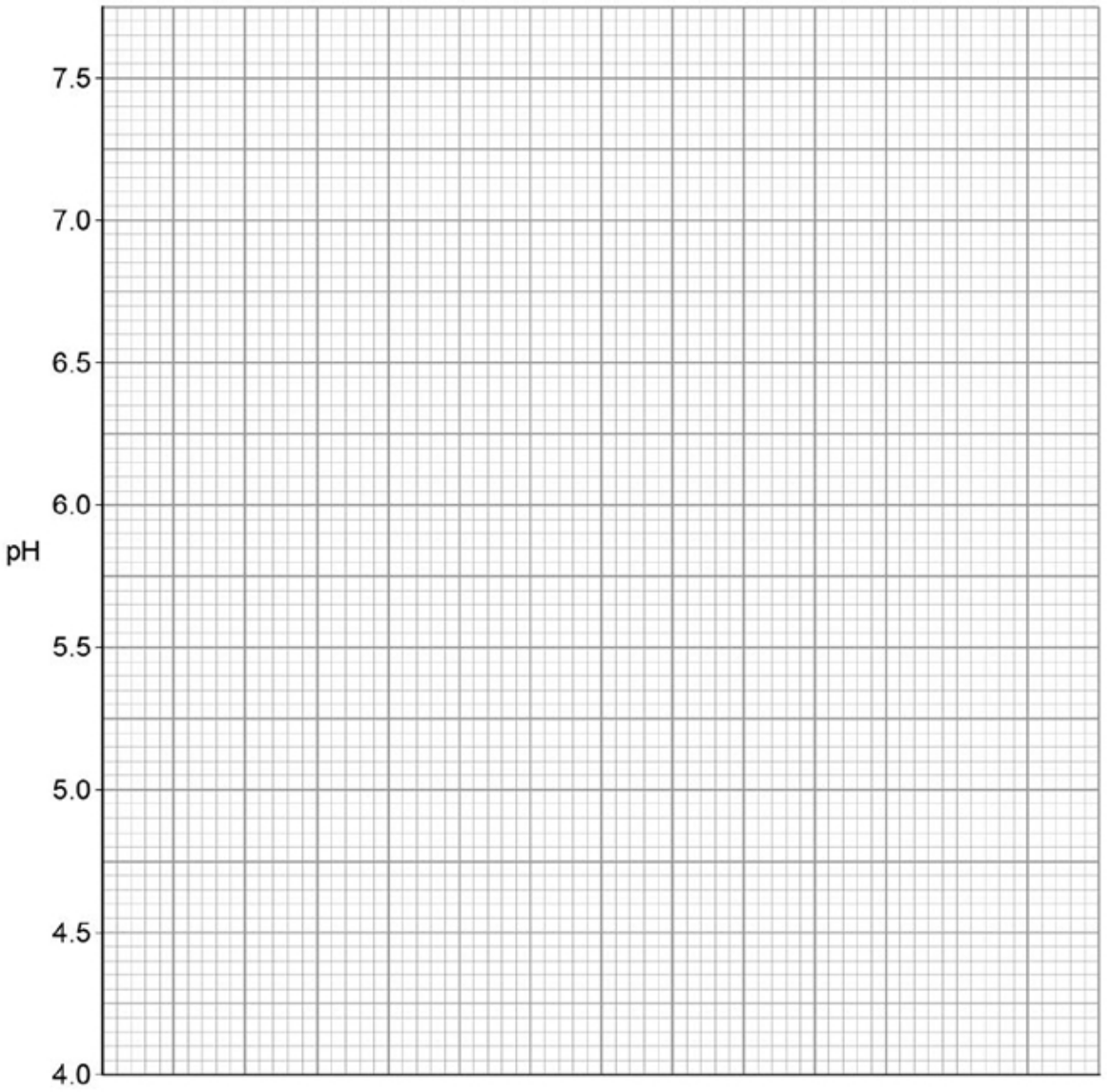
STEMUP.CO.UK

| | |
|---|---|
| 4 | 5.0 |
| 5 | 4.5 |
| 6 | 4.5 |

(f) Complete the graph below.

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.

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



STEMUP.CO.UK

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:

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

Similarity _____

_____

Difference _____

_____

**(2)**

**(Total 16 marks)**

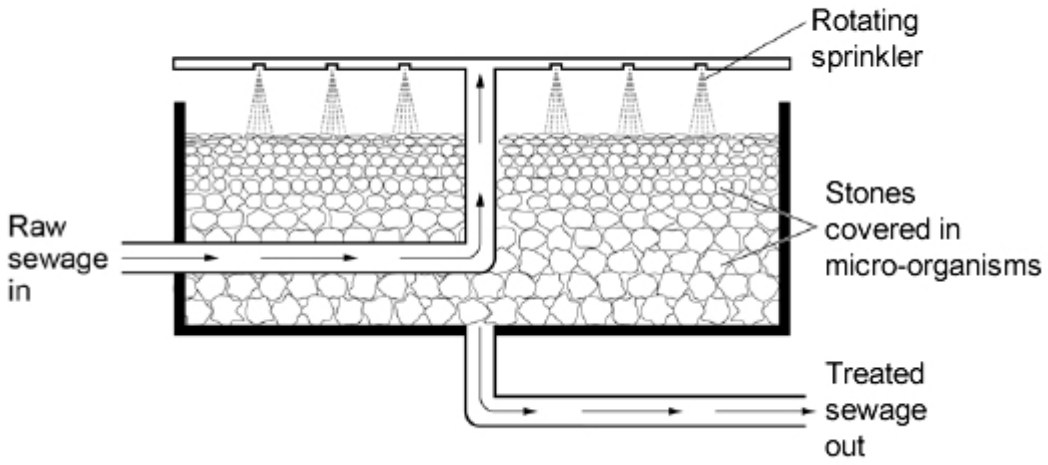
## Q8.

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**






STEMUP.CO.UK

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. _____

_____

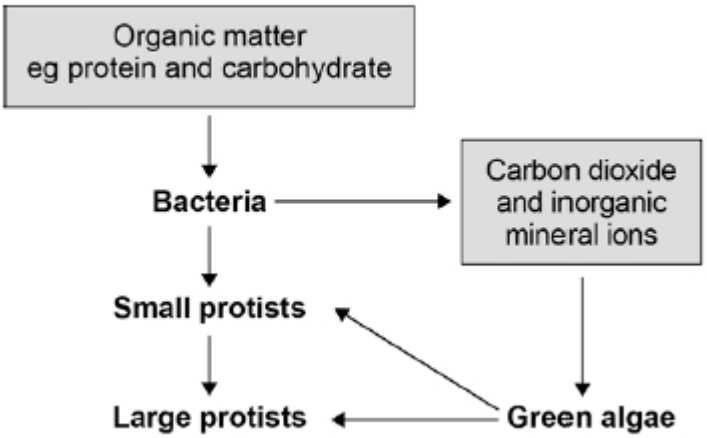
2. _____

_____

**(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)**



STEMUP.CO.UK

(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.

_____

_____

_____

_____

_____

_____

_____

_____

**(4)**

**(Total 8 marks)**

## Q9.

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

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

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

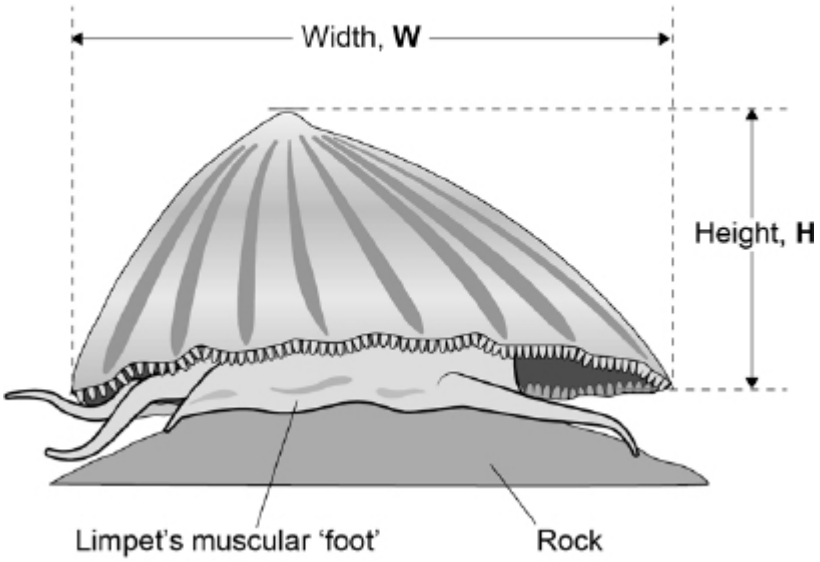
The students measured the heights (**H**) and widths (**W**) of 60 limpets on each shore.

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



STEMUP.CO.UK

Figure 1




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

Explain why the students did this.

Large number of limpets:

_____

_____

Random locations:

_____

_____

**(2)**

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

The table below shows the students' results.



STEMUP.CO.UK

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

(b) Complete the table above.

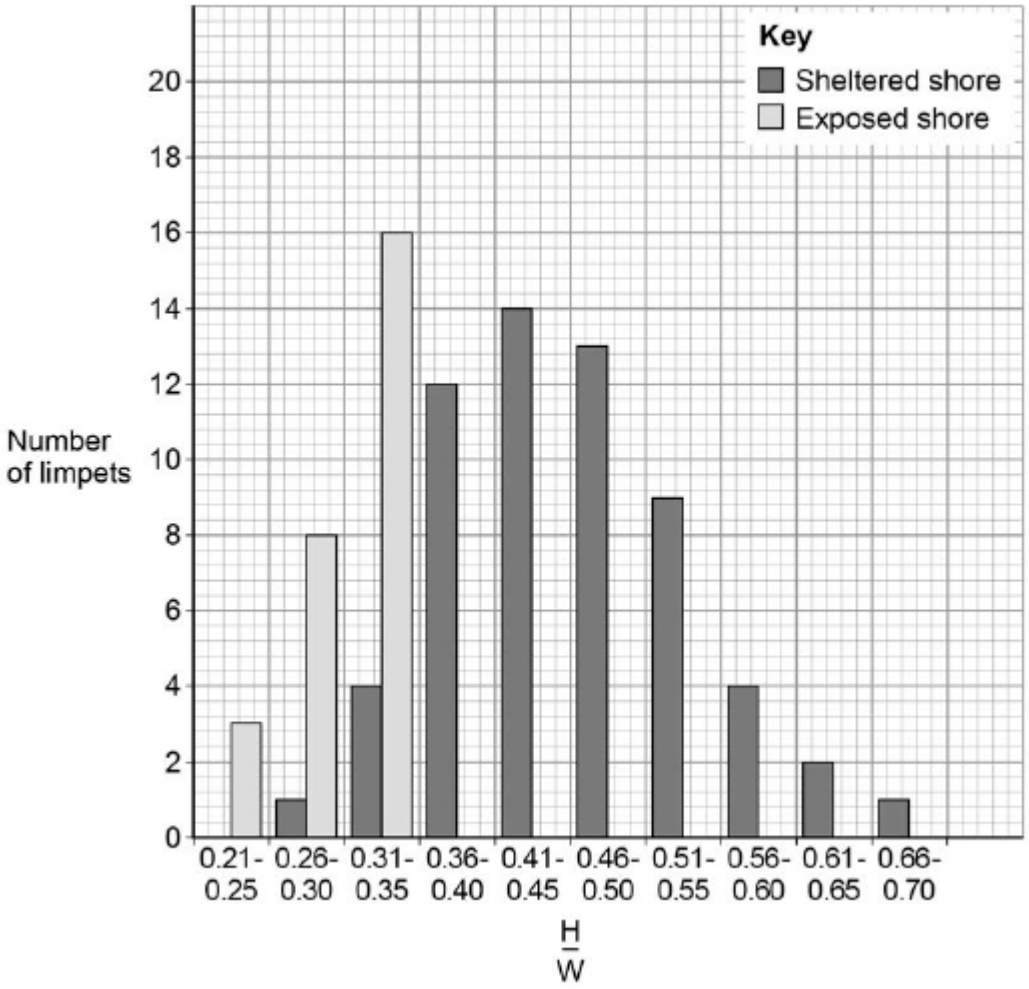
**(1)**

**Figure 2** shows some of the results.



STEMUP.CO.UK

Figure 2




(c) Complete **Figure 2**.

**(1)**

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

Use information from **Figure 2**.

_____

_____

_____

_____

_____

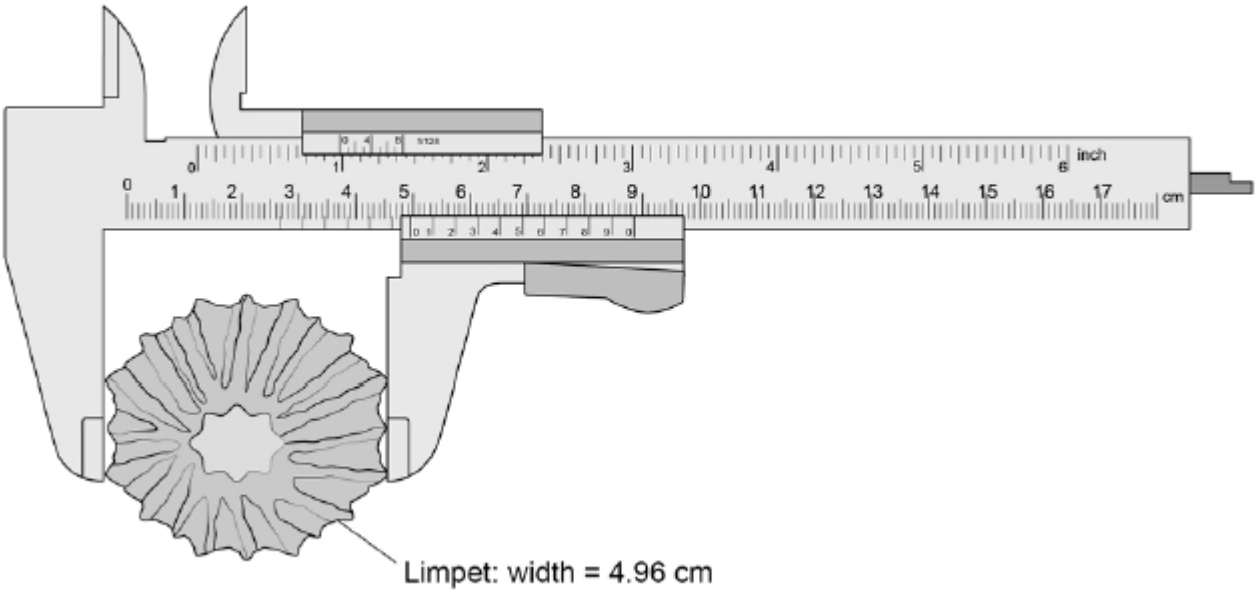
**(3)**

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



STEMUP.CO.UK

Figure 3




(e) One student recorded

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

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

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

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

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

**(2)**

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

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

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

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

Assume that the surface of the foot is a circle.

The area of a circle is $\pi r^2$.



STEMUP.CO.UK

Take the value of $\pi$ to be 3.14.

_____

_____

_____

_____

_____

_____

Maximum wave force = _____ newtons

**(3)**

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

1. _____

_____

2. _____

_____

**(2)**

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

_____

_____

_____

_____

_____

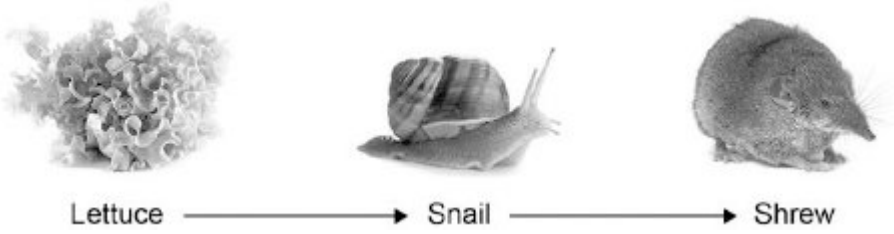
_____

**(3)**

**(Total 17 marks)**

## Q10.

The diagram below shows a food chain in a garden.






STEMUP.CO.UK

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 ☐

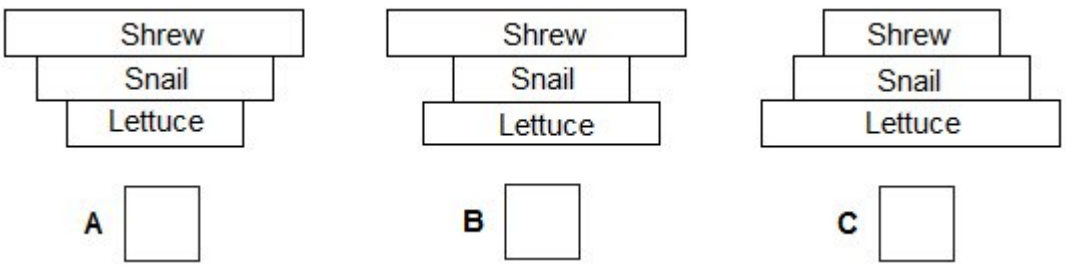
Population ☐

Territory ☐

**(1)**

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

Tick **one** box.




**(1)**

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.



STEMUP.CO.UK

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.

_____

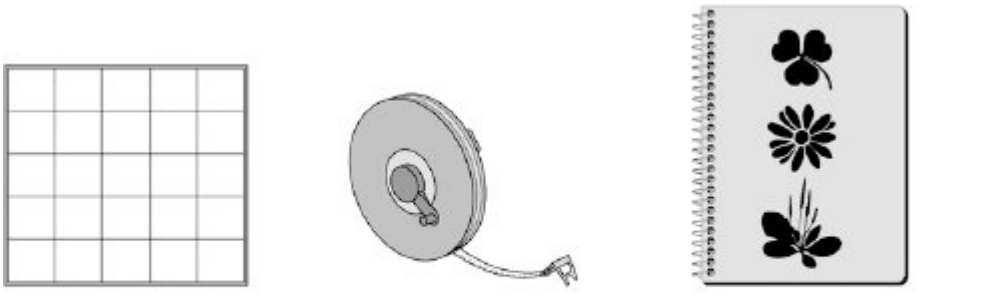
**(1)**

**(Total 8 marks)**

## Q11.

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.



STEMUP.CO.UK

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 |



STEMUP.CO.UK

| | |
|---|---|
| 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)**

## Q12.

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



STEMUP.CO.UK

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.

_____



STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

_____

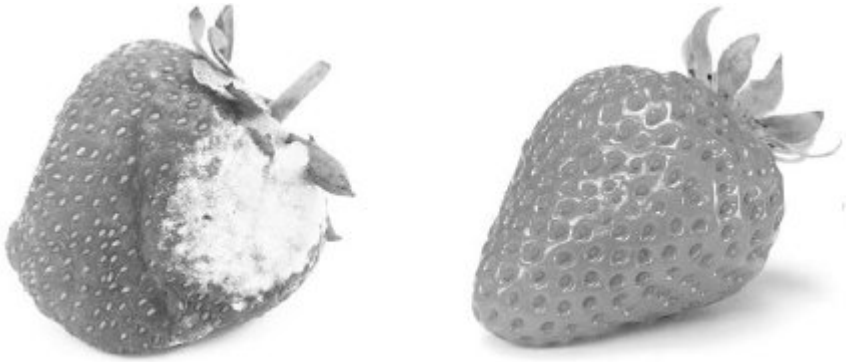
_____

**(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)**



STEMUP.CO.UK

## Q13.

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.

_____

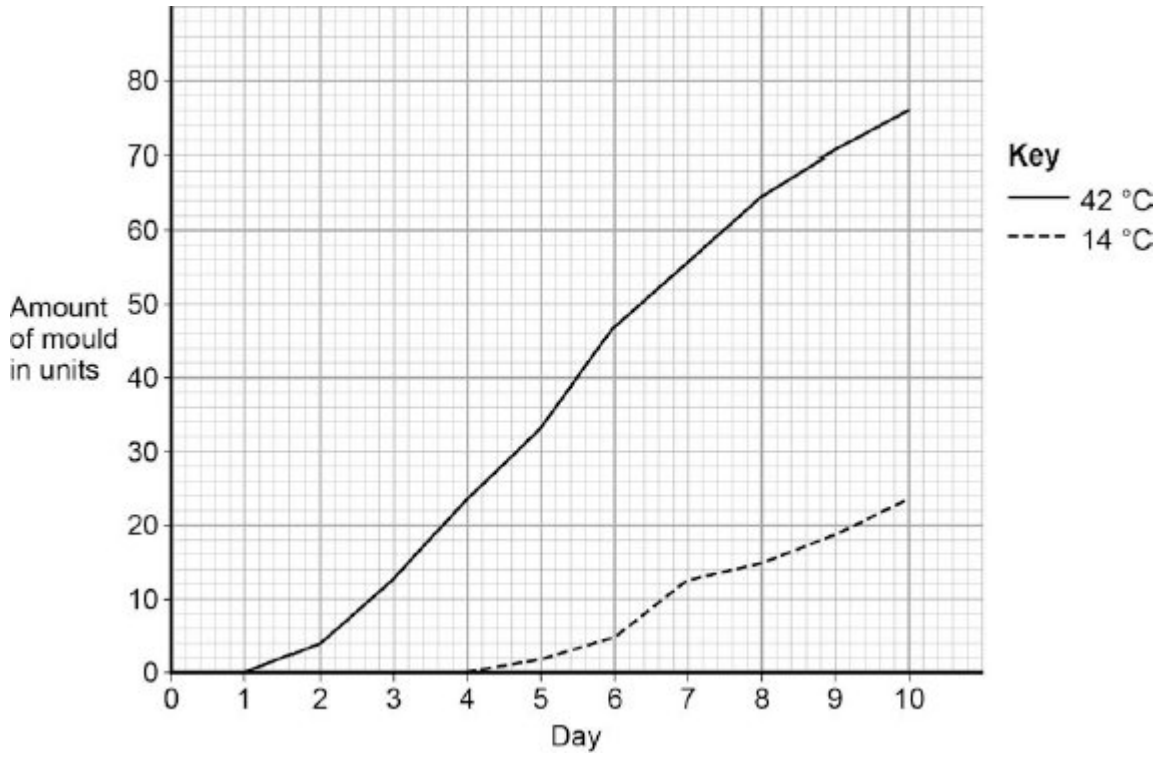
**(1)**

(d) Another student did a similar investigation.

The diagram below shows the results.



STEMUP.CO.UK




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.

_____

_____

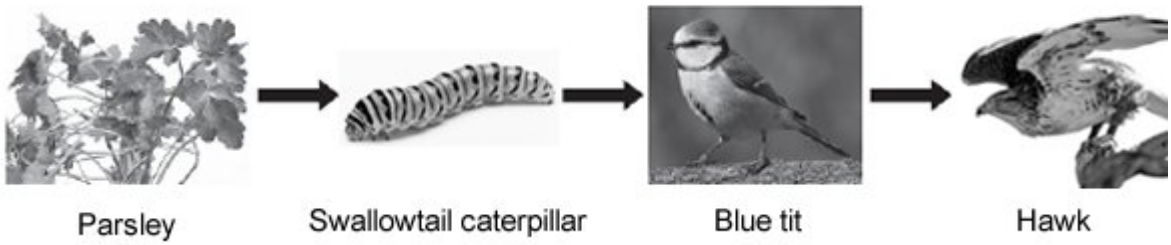
**(1)**

**(Total 9 marks)**

## Q14.

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

**Figure 1**




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



STEMUP.CO.UK

_____

_____

_____

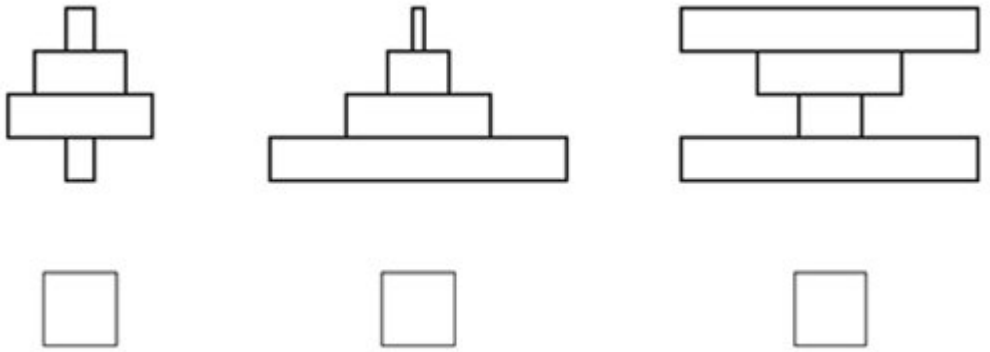
_____

**(2)**

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

Why is photosynthesis important in the food chain?

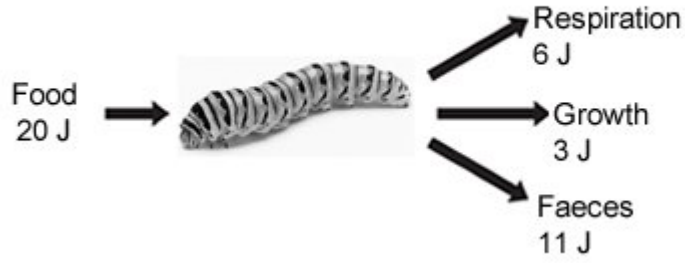
Tick (✔) **one** box.



**(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)**

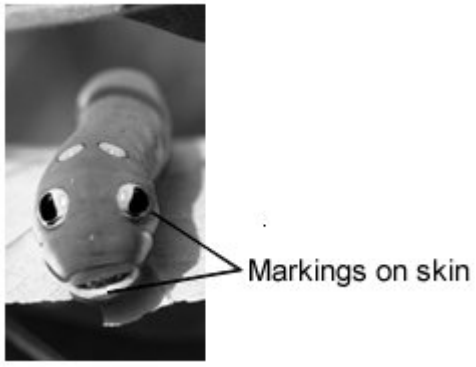
(d) The organisms in the food chain are adapted for survival.

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



STEMUP.CO.UK

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)**

Blue tit: ©JensGade/iStock
Parsley: © Warren_Price/iStock



STEMUP.CO.UK

Caterpillar ©prettyzhizhi/iStock
Hawk: © kojihirano/iStock
Swallowtail caterpillar: © Anna_Po/iStock

## Q15.

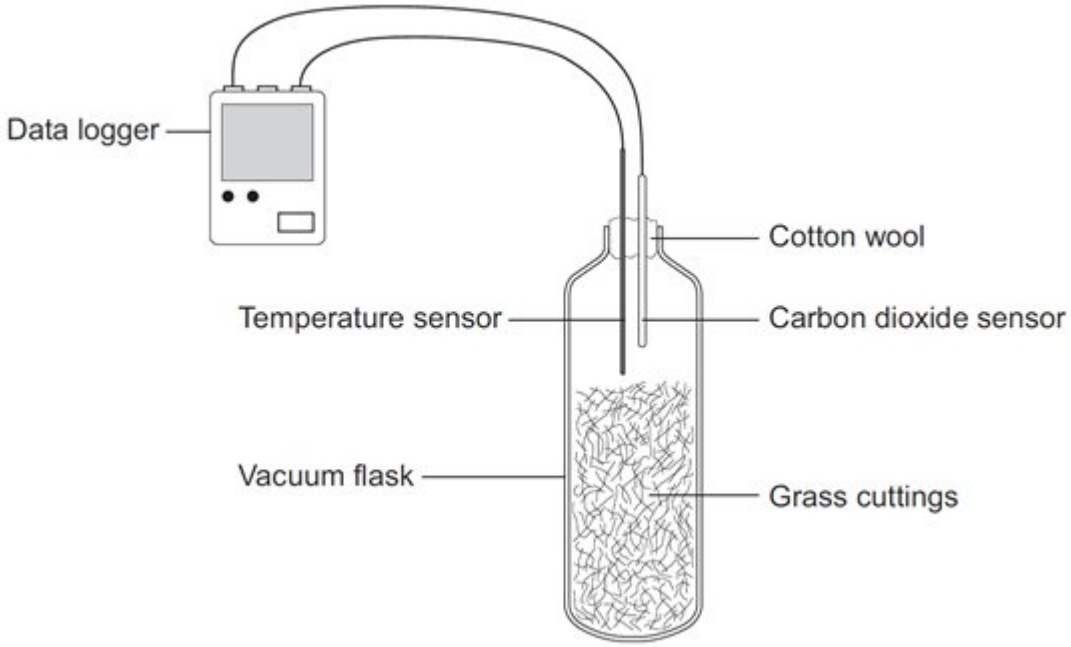
Students investigated decomposition.

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.

_____

_____

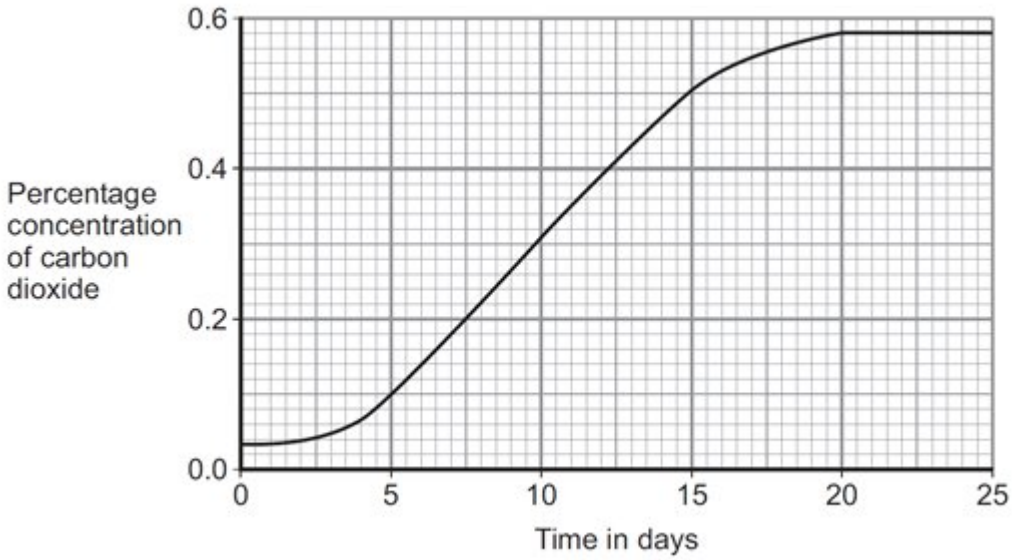
**(1)**

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

**Figure 2**



STEMUP.CO.UK




(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)**

## Q16.

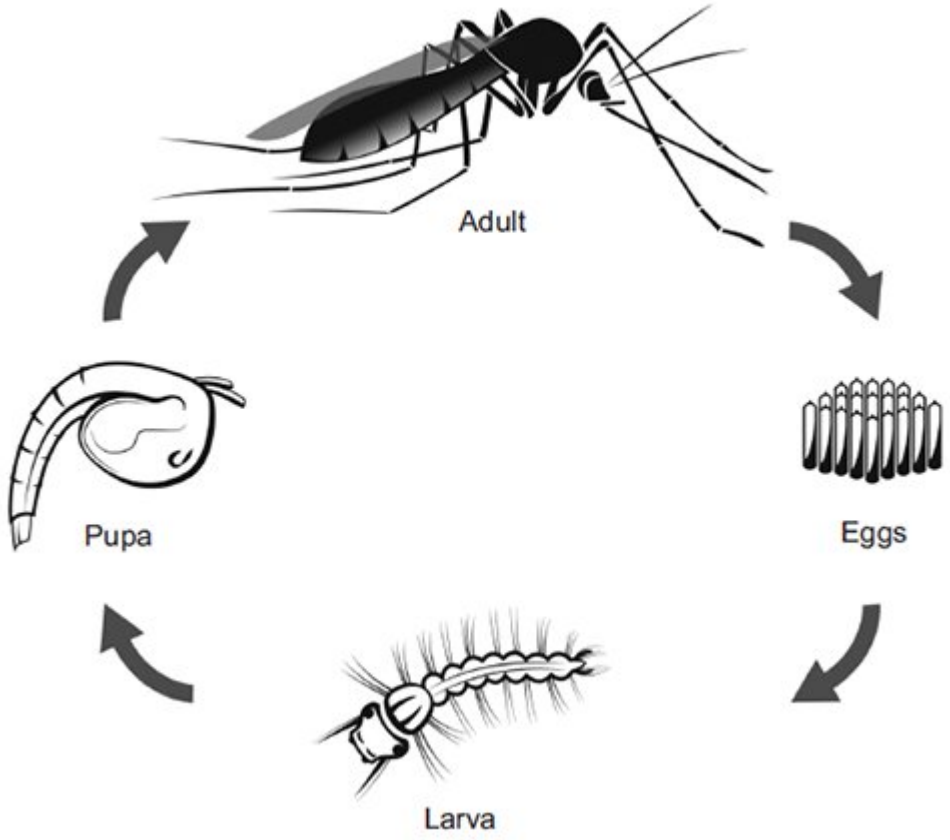
Malaria is a disease caused by a microorganism carried by mosquitoes.

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

The figure below shows the life cycle of a mosquito.



STEMUP.CO.UK




© watcharapon/iStock

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

Scientists estimate that malaria kills $2 \times 10^6$ 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.



STEMUP.CO.UK

_____

_____

_____

_____

**(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)**



STEMUP.CO.UK

## Q17.

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**



STEMUP.CO.UK




Dark-coloured shell with stripes

© Eric Lsselee/iStock

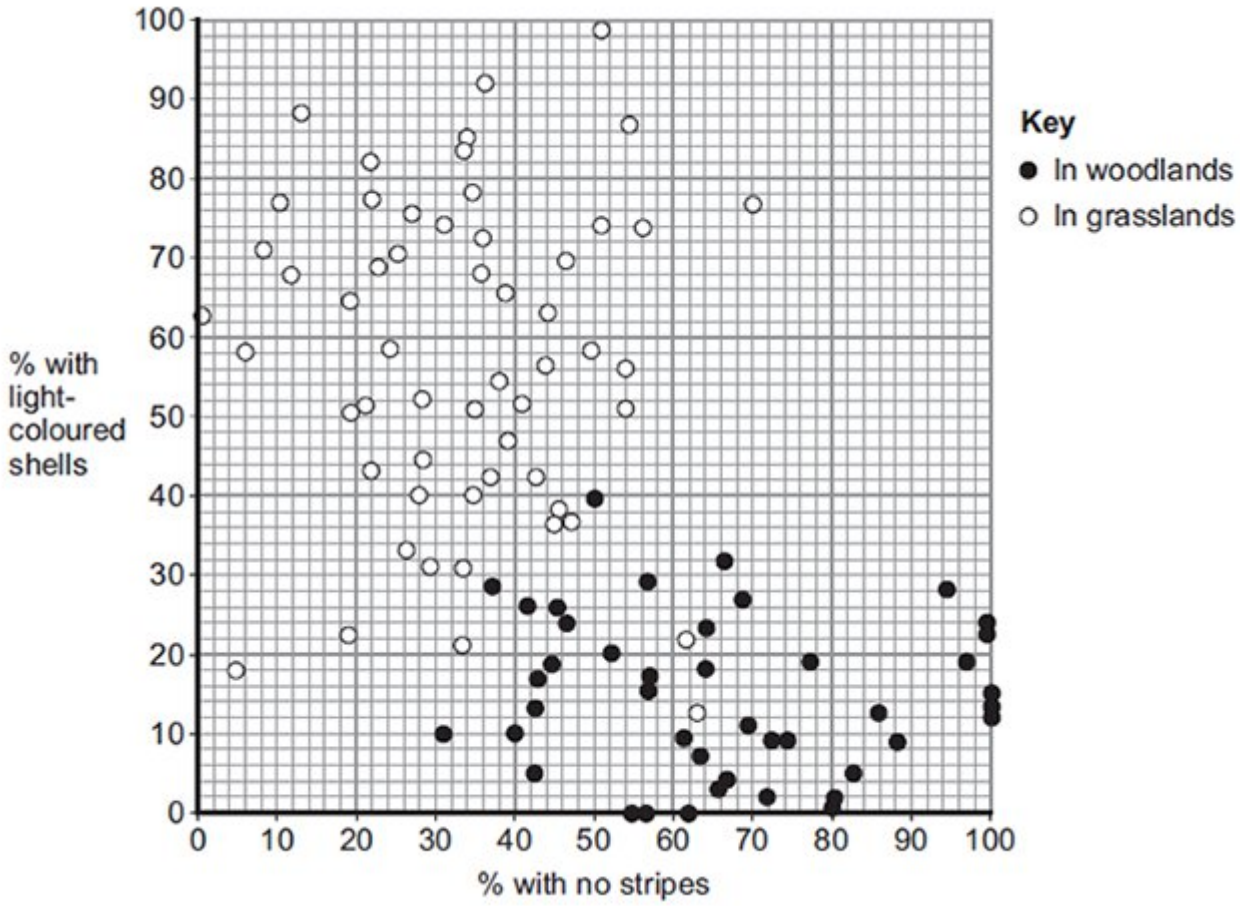
Light-coloured shell, with no stripes

© 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)**



STEMUP.CO.UK

(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)**

## Q18.

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 |
|---|---|



STEMUP.CO.UK

| | |
|---|---|
| 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**:



STEMUP.CO.UK

- 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)**

## Q19.

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)**



STEMUP.CO.UK

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

1. _____

_____

2. _____

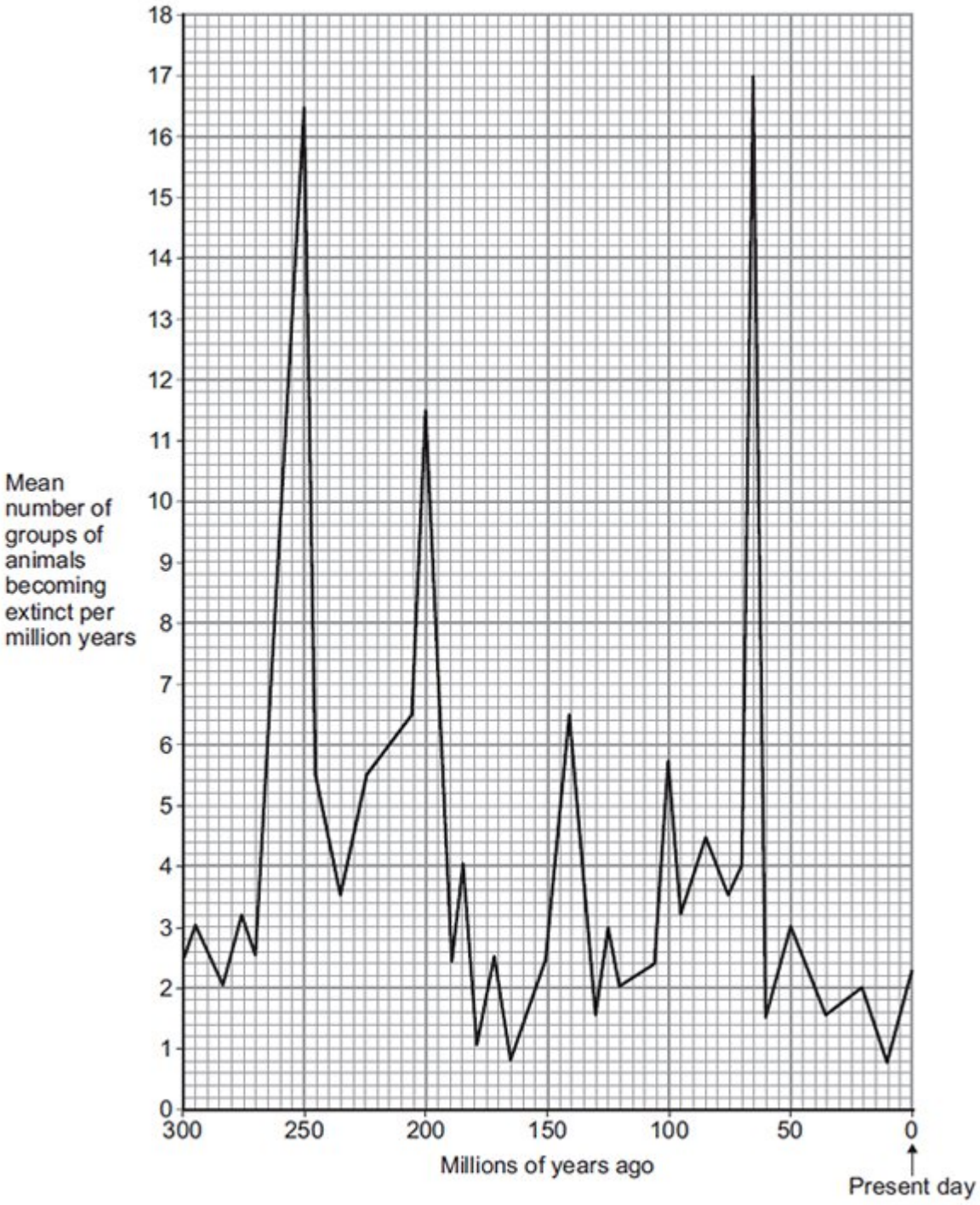
_____

**(2)**

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



STEMUP.CO.UK




(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?

_____



STEMUP.CO.UK

_____

**(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)**

## Q20.

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 |



STEMUP.CO.UK

| | |
|---|---|
| 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 _____



STEMUP.CO.UK

_____

**(3)**

**(Total 6 marks)**

## Q21.

**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?

_____

_____



STEMUP.CO.UK

**(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.

_____

_____

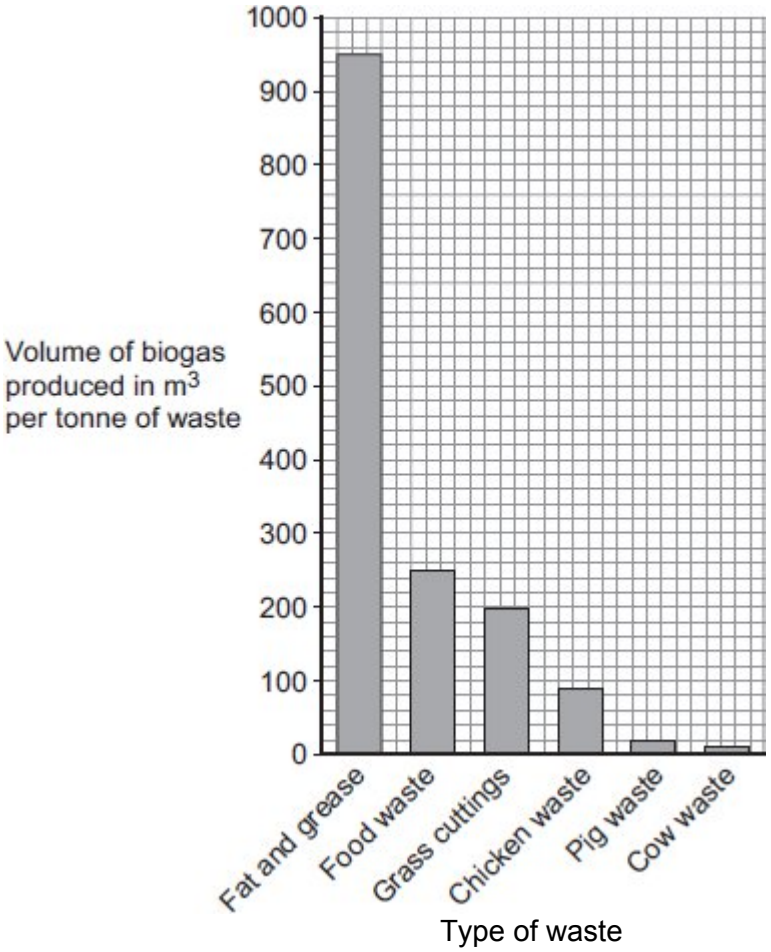
_____

_____

**(2)**

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

**Figure 3**






STEMUP.CO.UK

(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)**

## Q22.

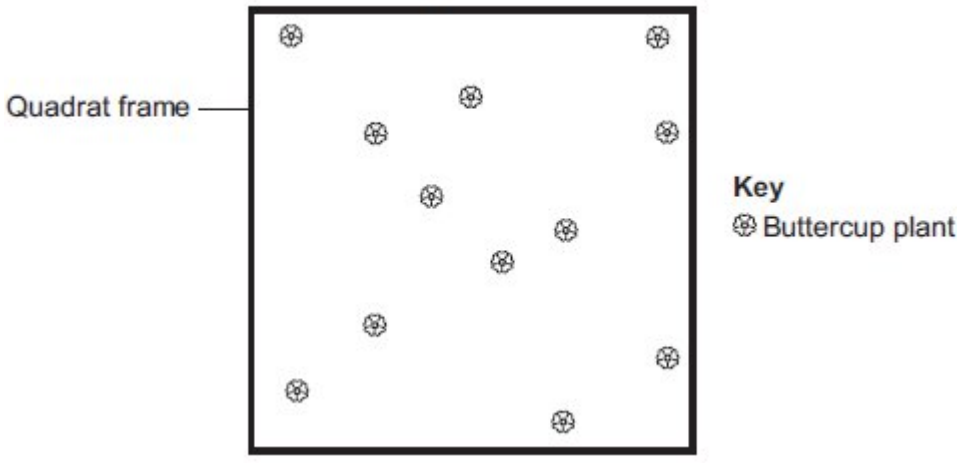
A grassy field on a farm measured 120 metres by 80 metres.

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?

_____



STEMUP.CO.UK

_____

_____

_____

**(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.

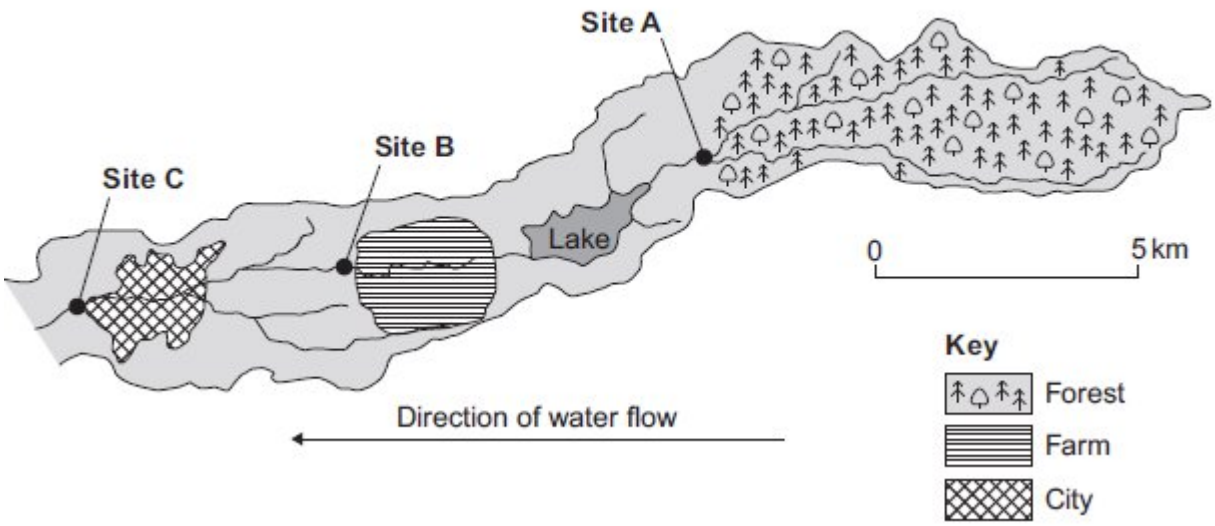
**(3)**

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



STEMUP.CO.UK

**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**.



STEMUP.CO.UK

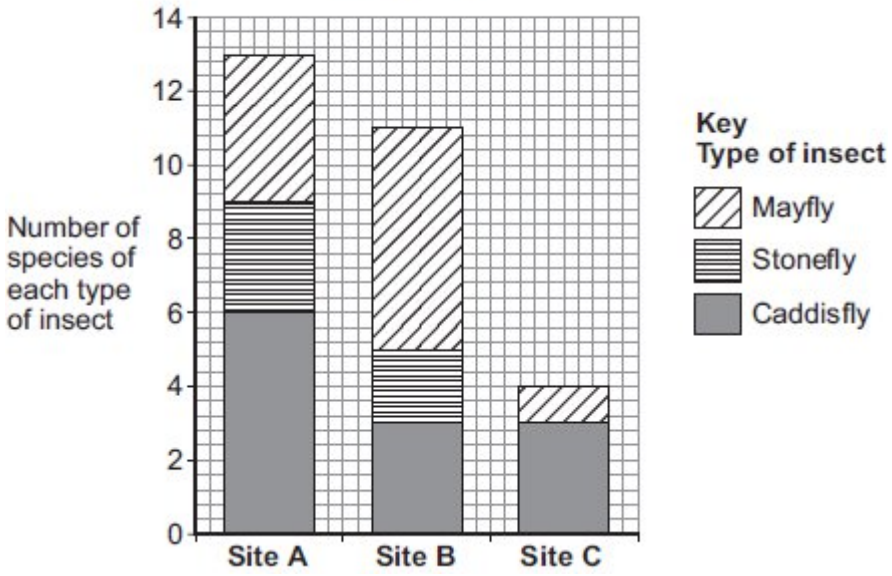
Scientists took many samples of river water from these sites.

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)**

## Q23.

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

The gardener:

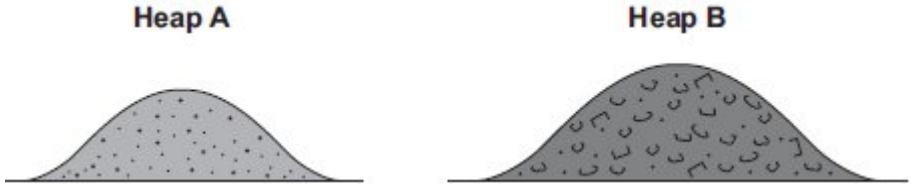
- makes two separate heaps of garden waste, heap **A** and heap **B**



STEMUP.CO.UK

- 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.

_____



STEMUP.CO.UK

_____

_____

_____

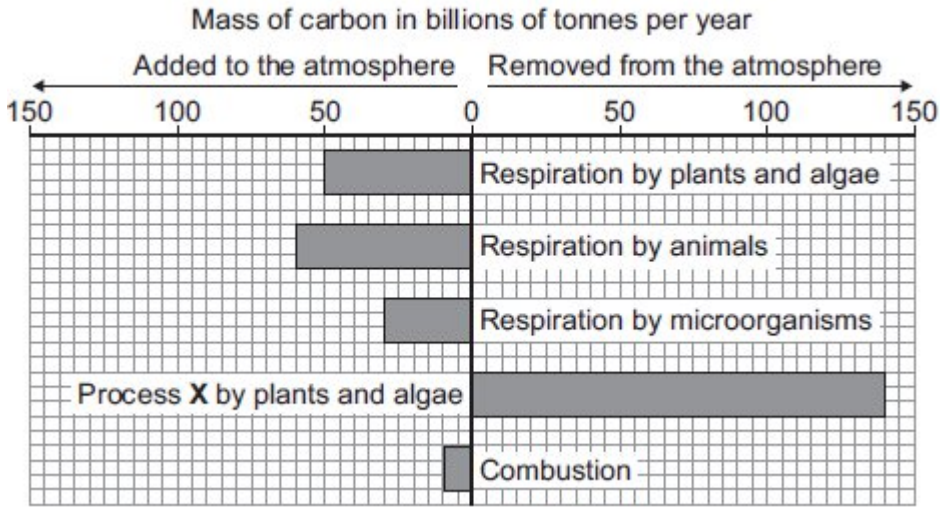
**(2)**

**(Total 6 marks)**

## Q24.

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)**

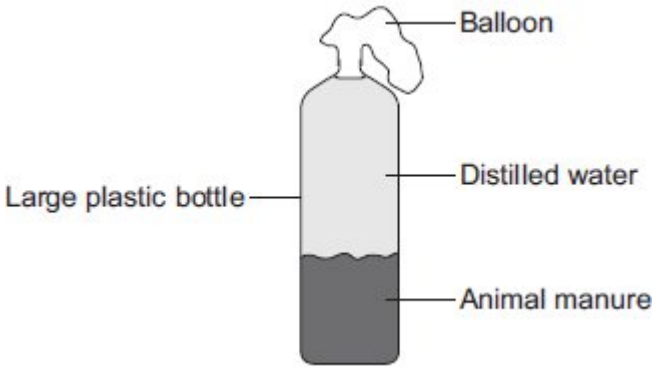
## Q25.



STEMUP.CO.UK

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. _____



STEMUP.CO.UK

_____

**(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)**

## Q26.

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** |

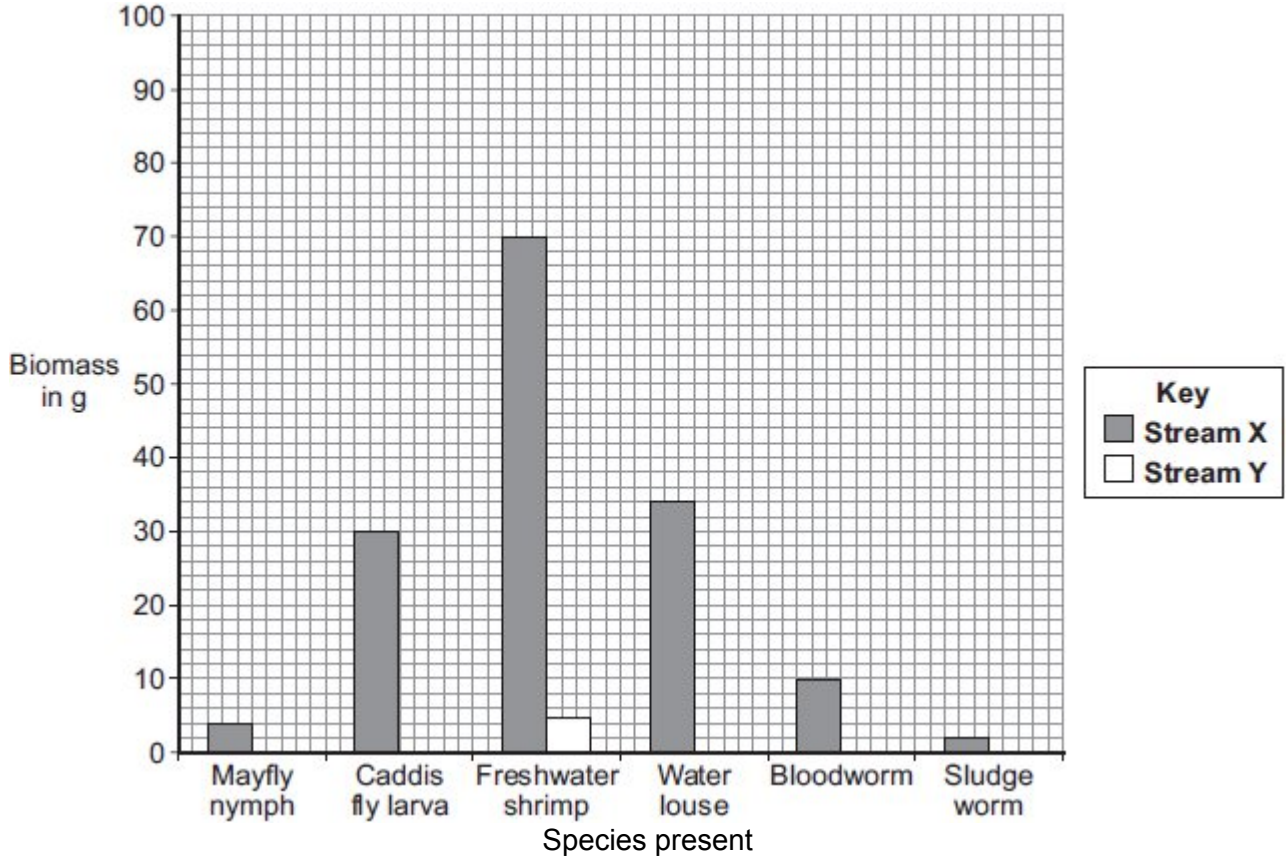
(a) The bar chart below shows the biomass of invertebrate species found in **Stream X**.



STEMUP.CO.UK

(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.

_____

_____

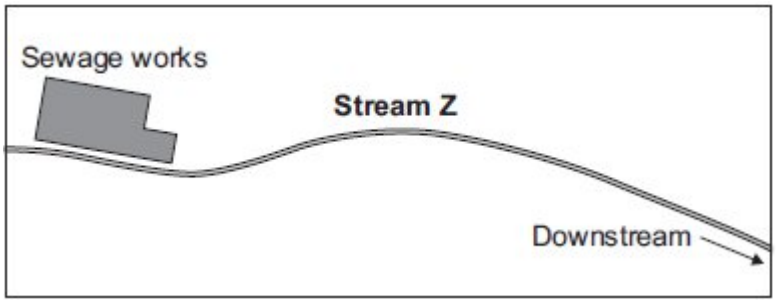
_____



STEMUP.CO.UK

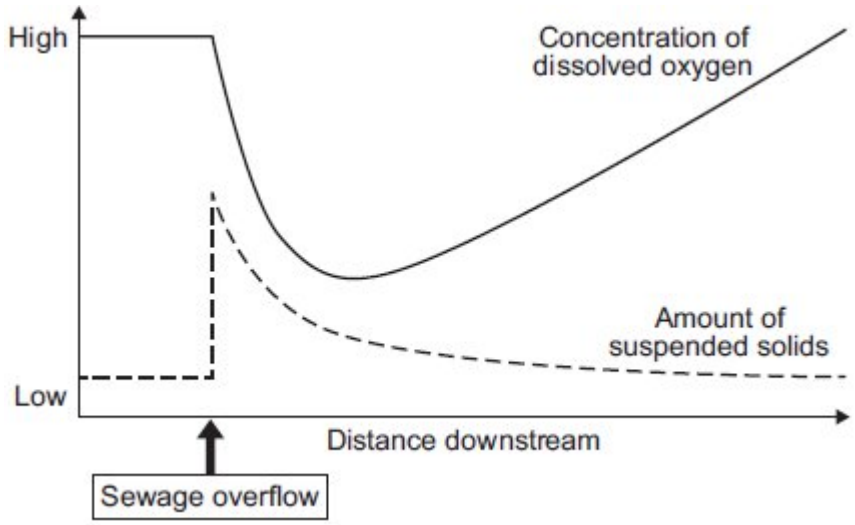
**(2)**

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

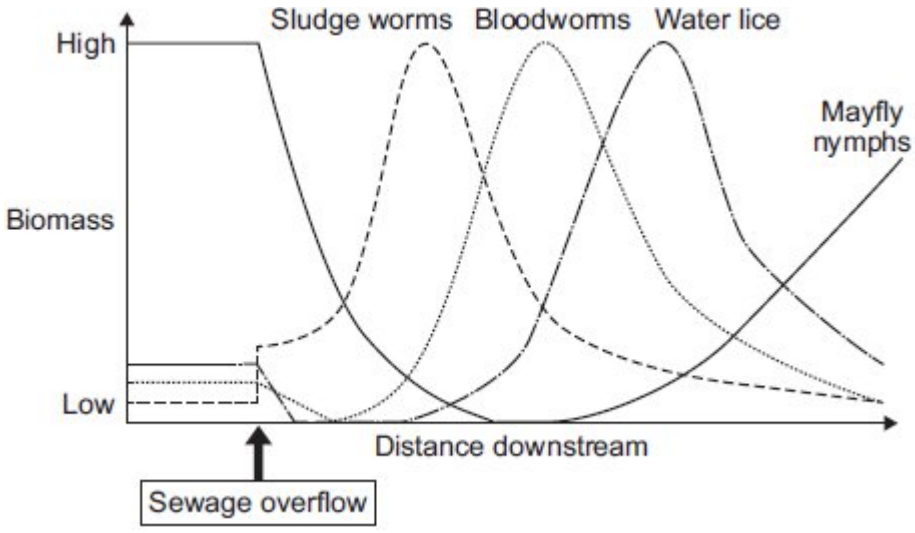



An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

**Graph P: change in water quality downstream of sewage overflow**




**Graph Q: change in invertebrates found downstream of sewage overflow**






STEMUP.CO.UK

(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)**

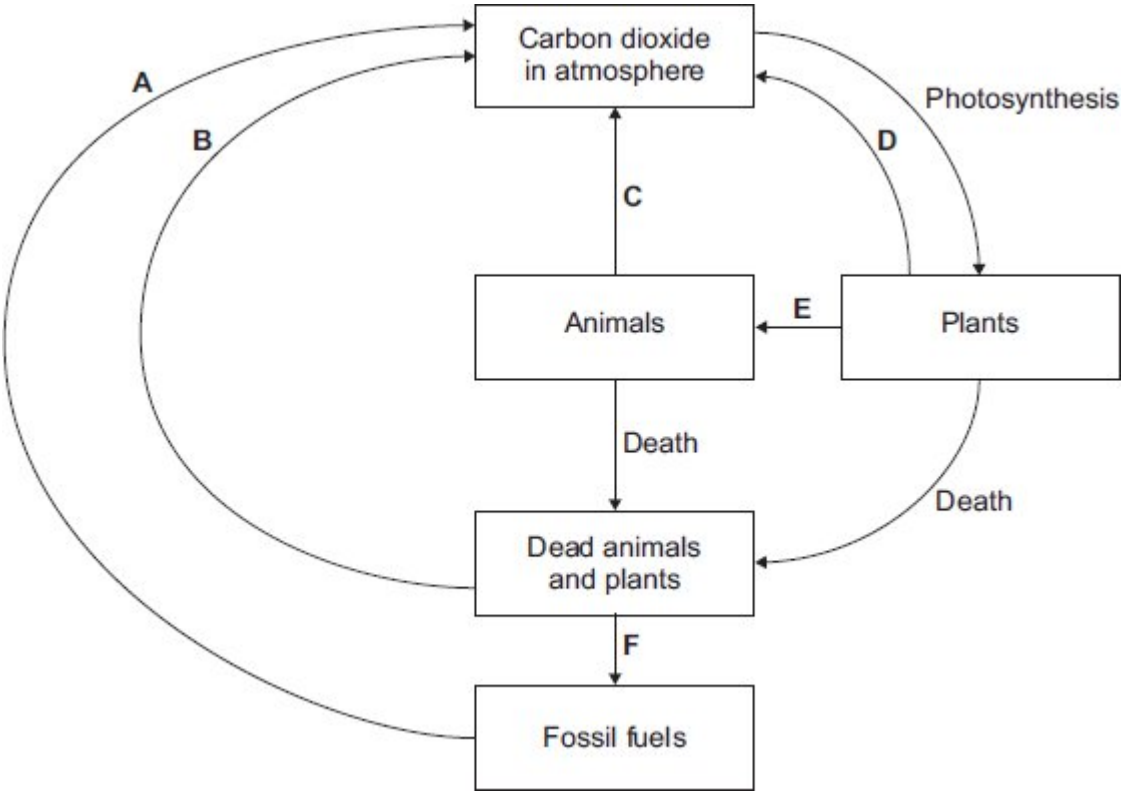
**(Total 13 marks)**

## Q27.

(a) The diagram shows the carbon cycle.



STEMUP.CO.UK




(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.

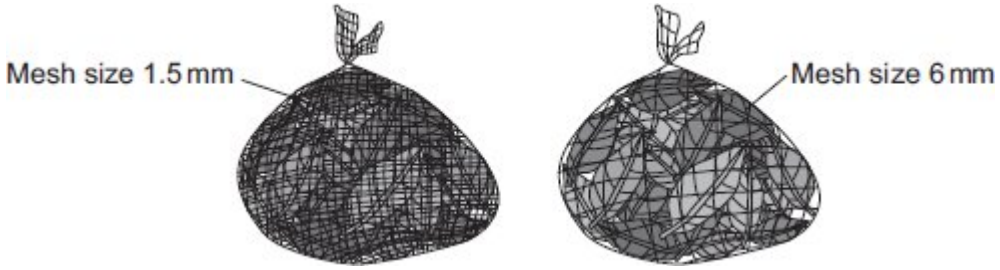
The scientists:

- 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**



STEMUP.CO.UK

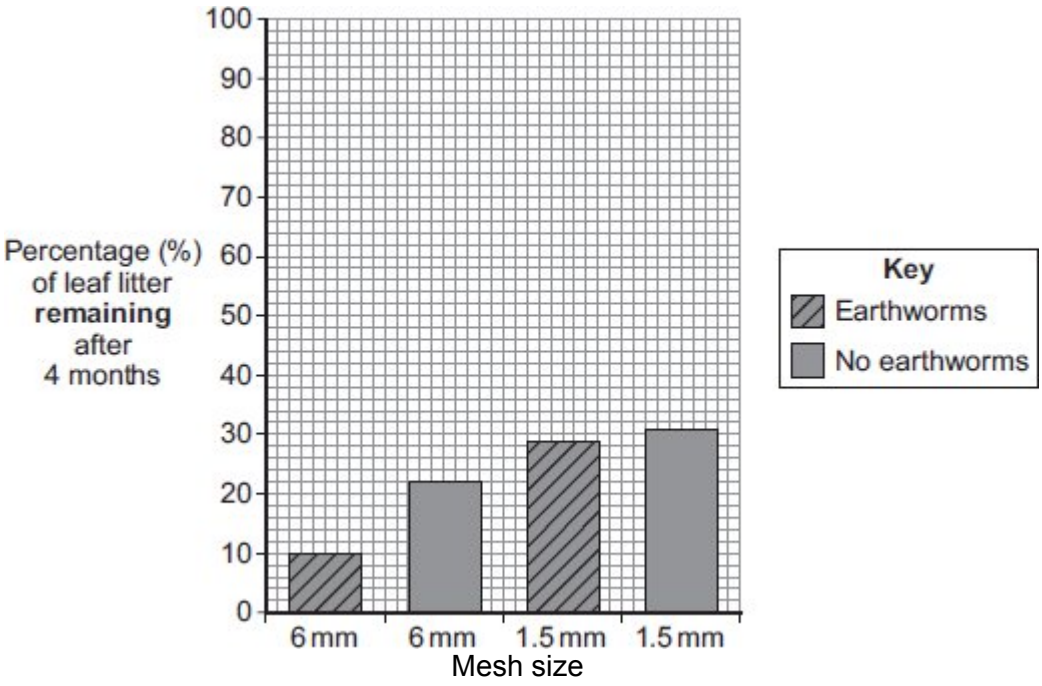



The scientists then:

- 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)**



STEMUP.CO.UK

(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)**

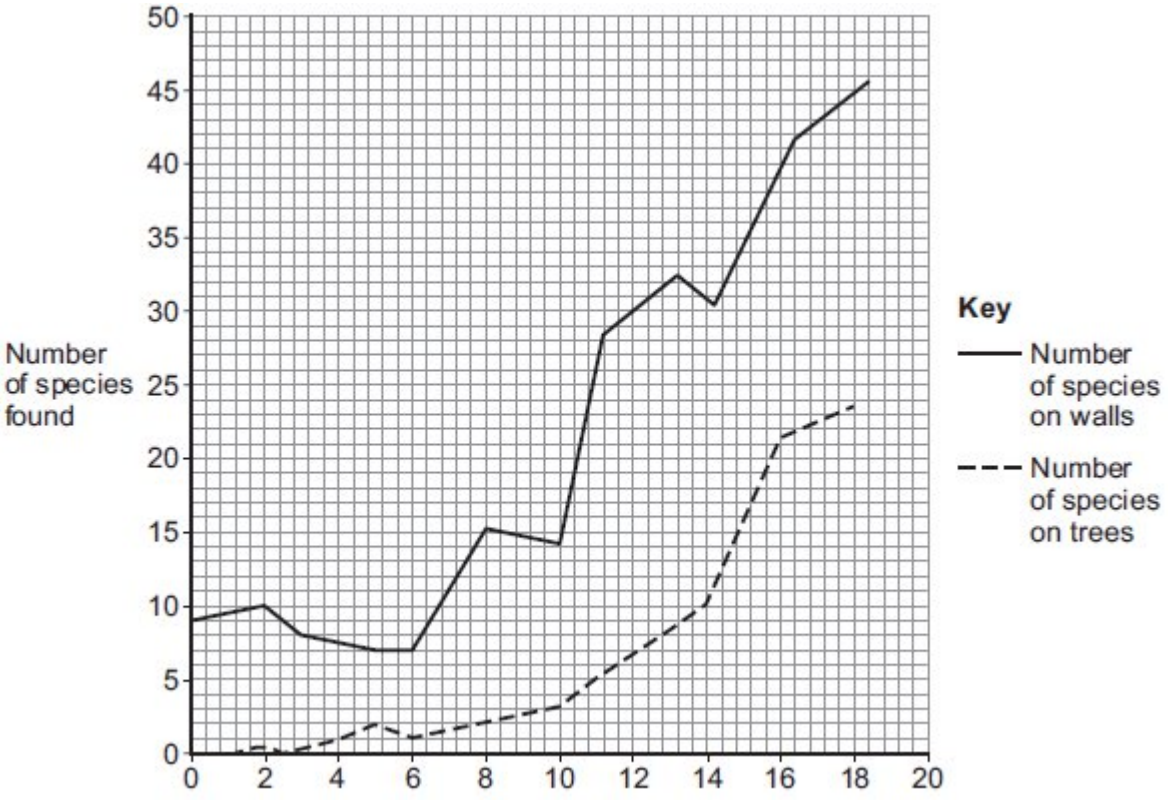
## Q28.

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.



STEMUP.CO.UK




(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 |



STEMUP.CO.UK

| | |
|---|---|
| 8 | 110 |
| 13 | 85 |
| 18 | 65 |

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

_____

_____

_____

_____

**(2)**

(c) Nitrogen oxides are also air pollutants.

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

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

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

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

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

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

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

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

_____

_____

_____



STEMUP.CO.UK

_____

_____

_____

_____

**(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)**

## Q29.

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 |



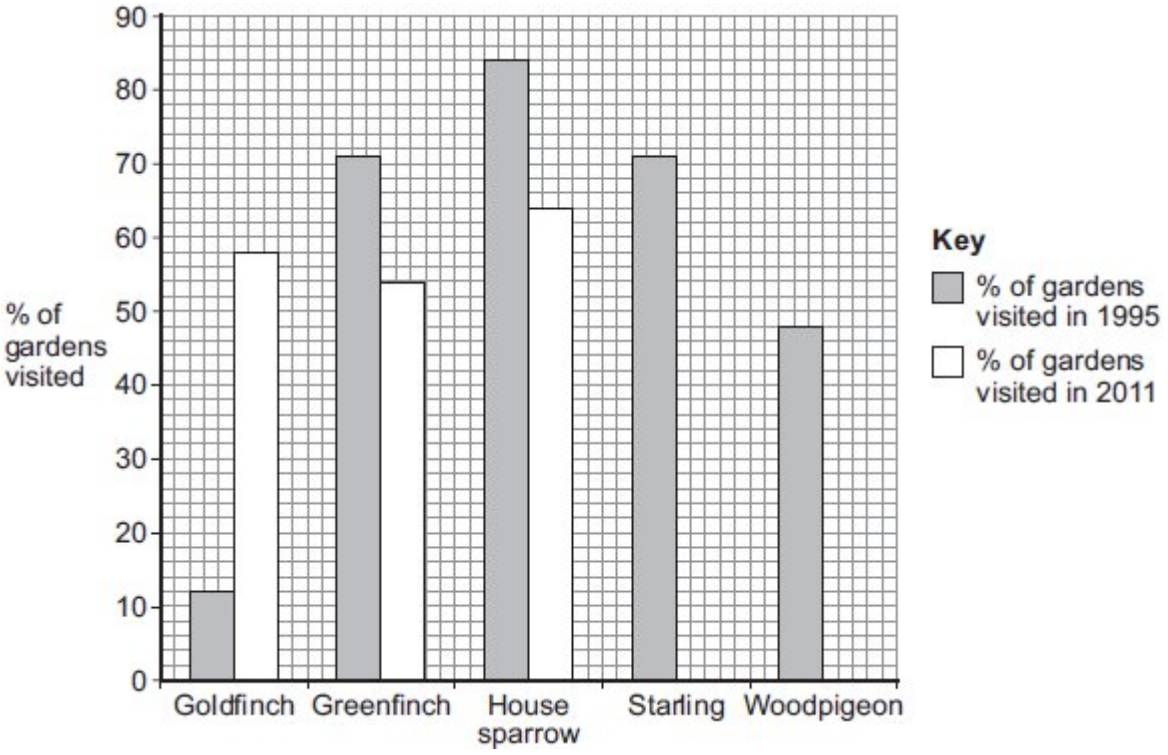
STEMUP.CO.UK

| | | |
|---|---|---|
| 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)**



STEMUP.CO.UK

**(Total 7 marks)**

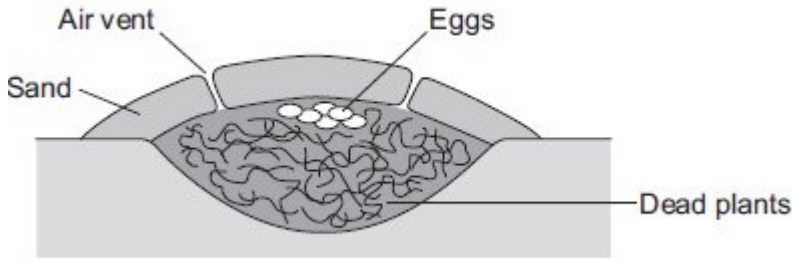
## Q30.

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.

_____

_____

_____

_____



STEMUP.CO.UK

_____

_____

**(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)**

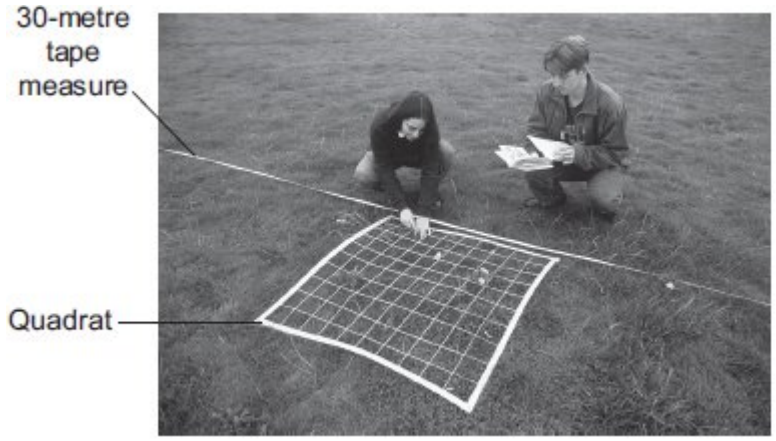
**(Total 7 marks)**

## Q31.

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

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

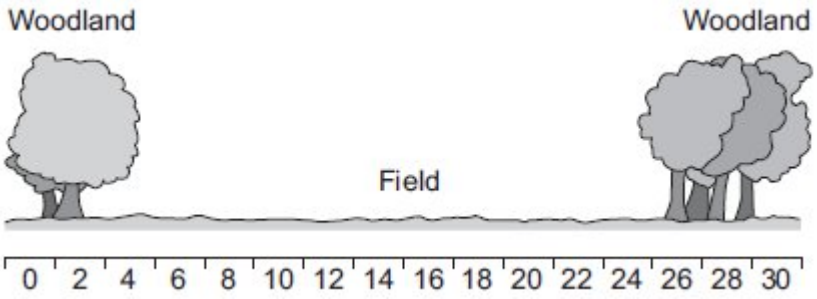
**Figure 1**




© Science Photo Library

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

**Figure 2**

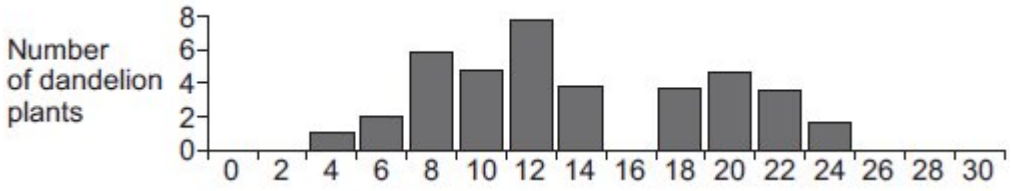





STEMUP.CO.UK

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.

_____

_____

_____



STEMUP.CO.UK

**(2)**

**(Total 7 marks)**

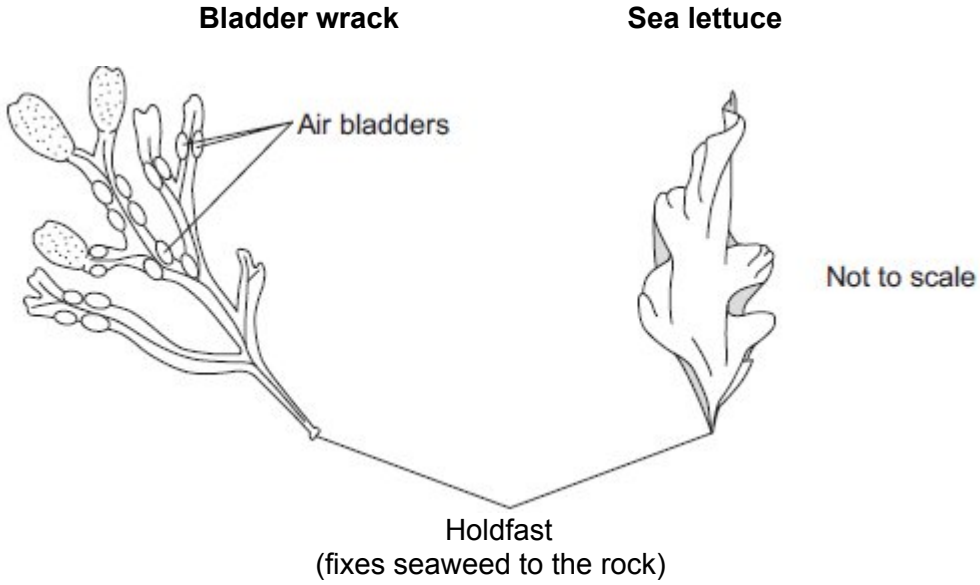
## Q32.

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**




(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.

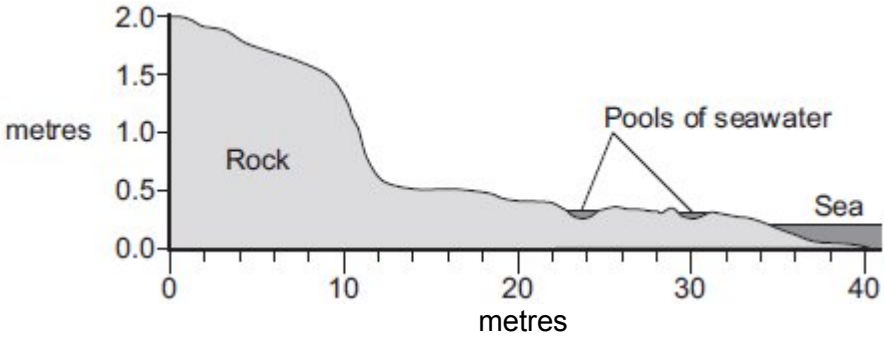
**Figure 2** shows a section of the seashore and the students' results.

**Figure 2**

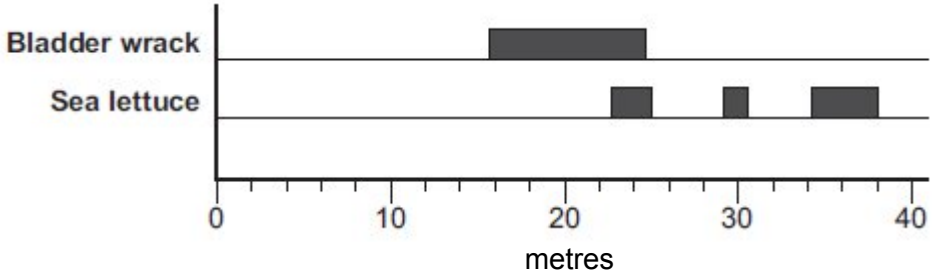
**Section of the seashore**



STEMUP.CO.UK




**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)**

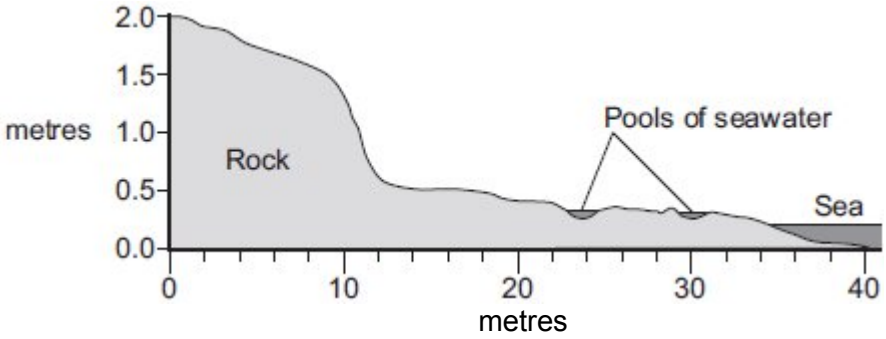
(iii) **Figure 2** is repeated here to help you answer this question.

**Figure 2**

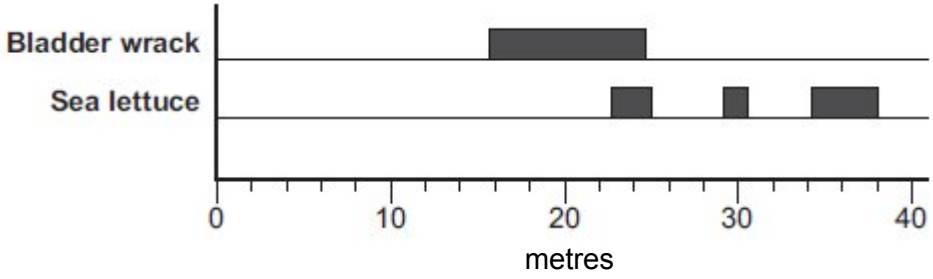
**Section of the seashore**



STEMUP.CO.UK




**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)**

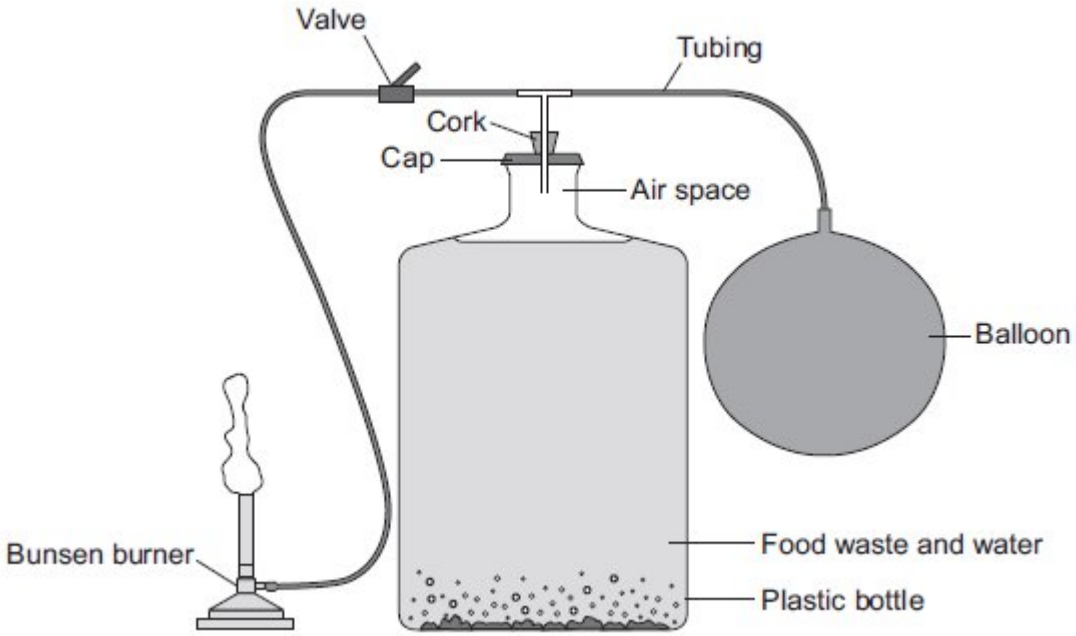
**(Total 8 marks)**

## Q33.

The image below shows a model biogas generator.



STEMUP.CO.UK




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 |



STEMUP.CO.UK

| | | |
|---|---|---|
| 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)**



STEMUP.CO.UK

(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.

_____

_____

_____

_____

_____

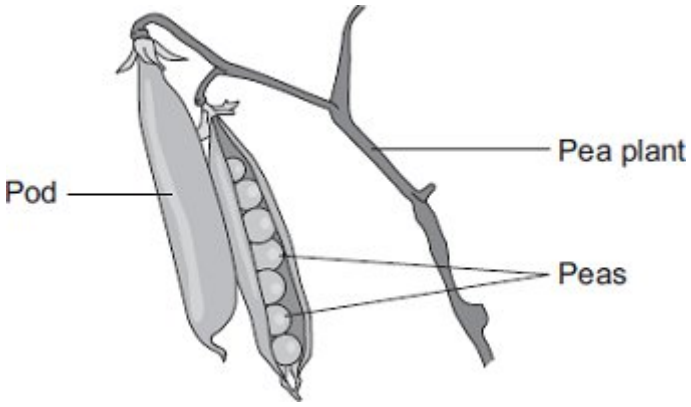
_____

**(2)**

**(Total 8 marks)**

## Q34.

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 |



STEMUP.CO.UK

(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)**

## Q35.

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



STEMUP.CO.UK

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

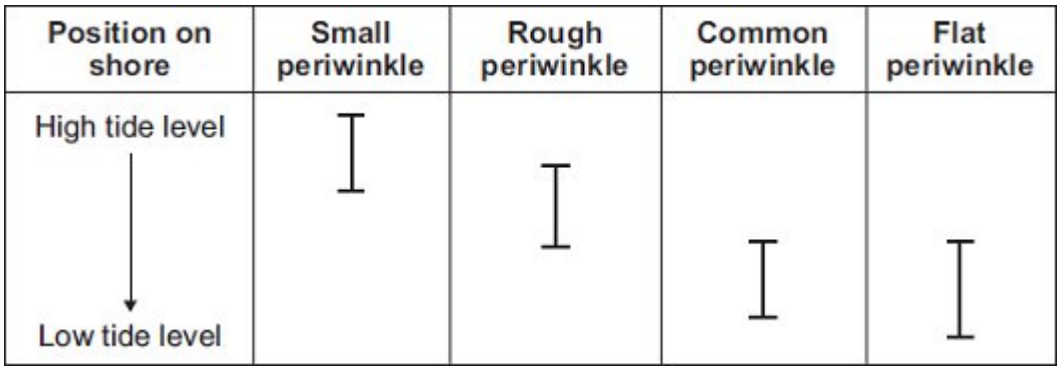
What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

_____

**(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. _____

_____



STEMUP.CO.UK

**(2)**
**(Total 5 marks)**



STEMUP.CO.UK