EXAM PAPERS PRACTICE

Organisation of an Ecosystem

These practice questions can be used by students and teachers and is suitable for GCSE AQA Biology topic Questions 8641

Level: GCSE AQA Biology 8641

Subject: Biology

Exam board: GCSE AQA

Topic: Organisation of an Ecosystem

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.

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?

____

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(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.

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(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?

____

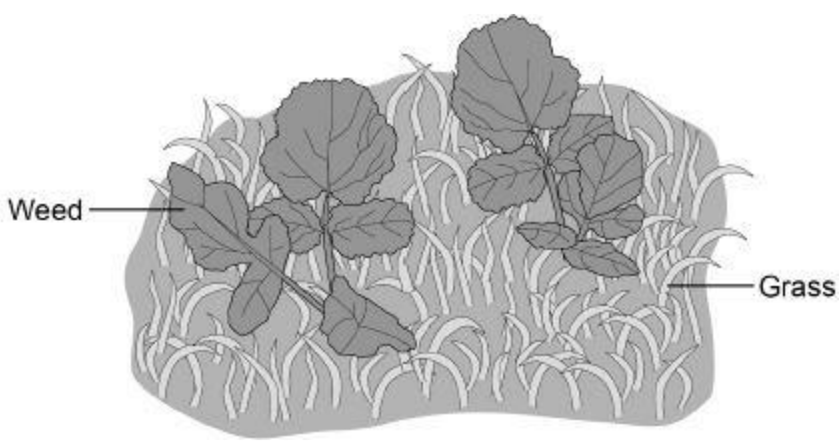
(1)
(Total 10 marks)

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)

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

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(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

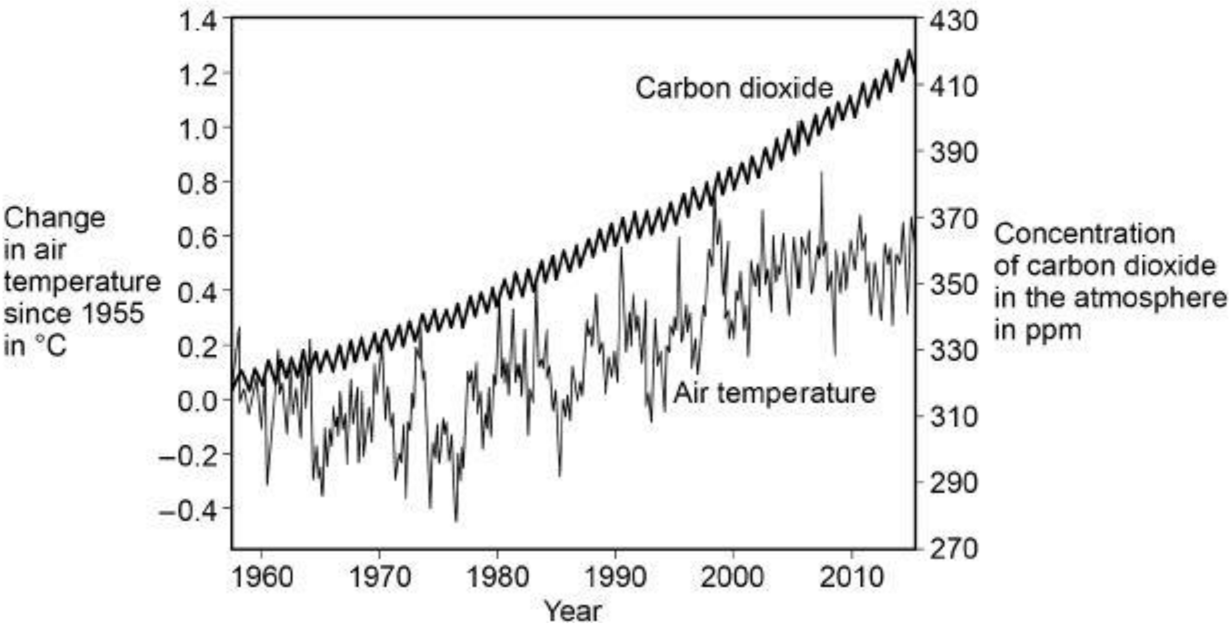
(2)

(Total 9 marks)

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**

	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.

(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.

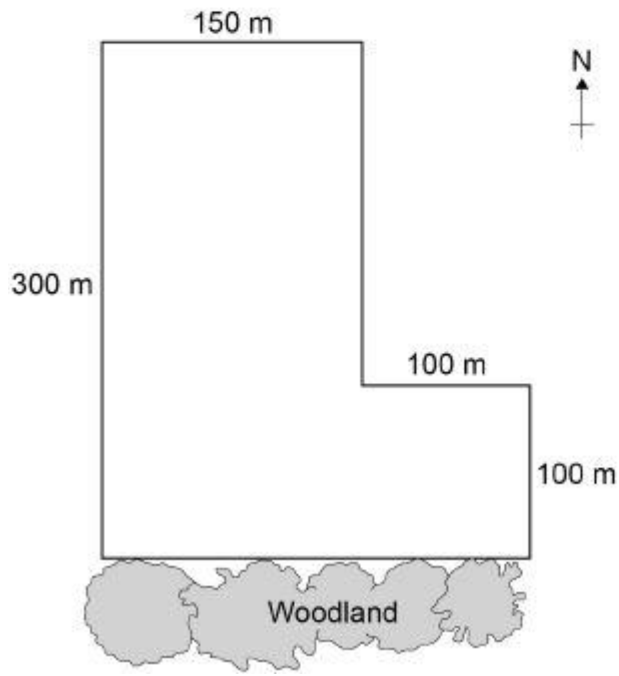
2.

(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.



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.

____

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____

____

Total number of dandelion plants = ____________________

(5)

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

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

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

(c) Plan an investigation to test this hypothesis.

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______

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______

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______

(6)

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

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

1. ____

2. ____

(2)

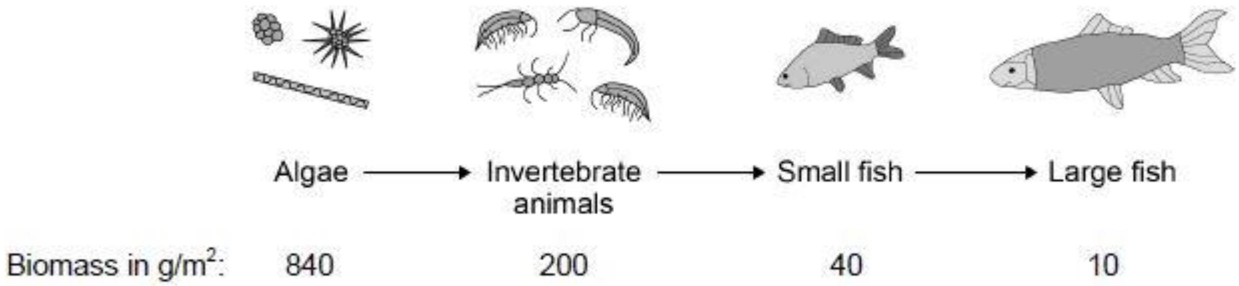
(Total 14 marks)

Q5.

Figure 1 shows:

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

Figure 1

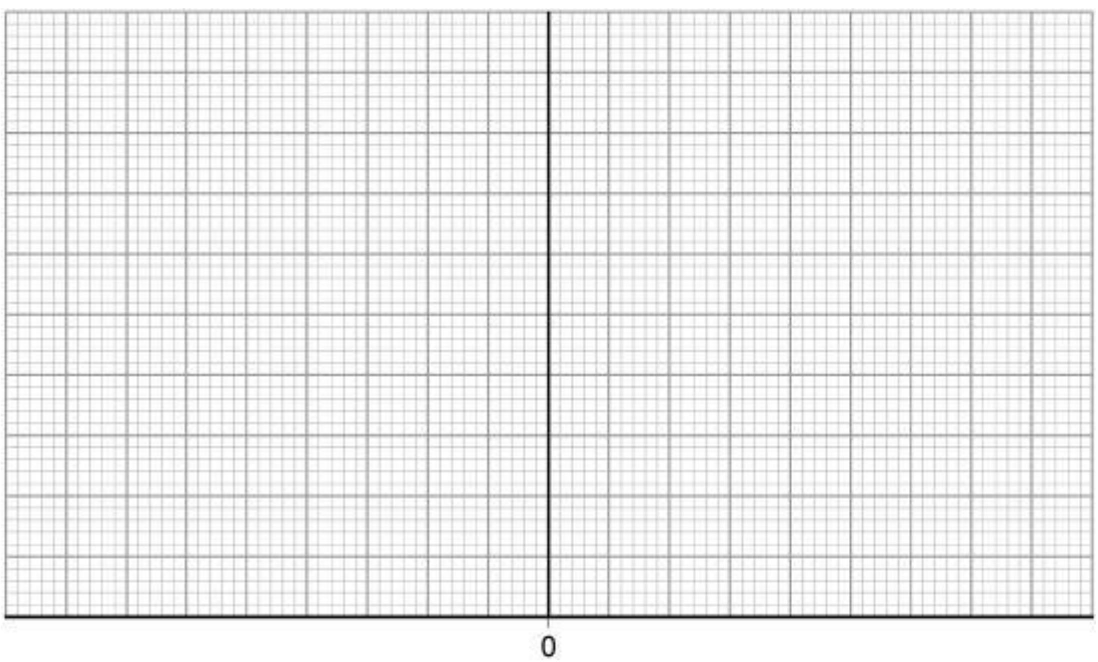


(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

You should:

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

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.

(5)
(Total 13 marks)

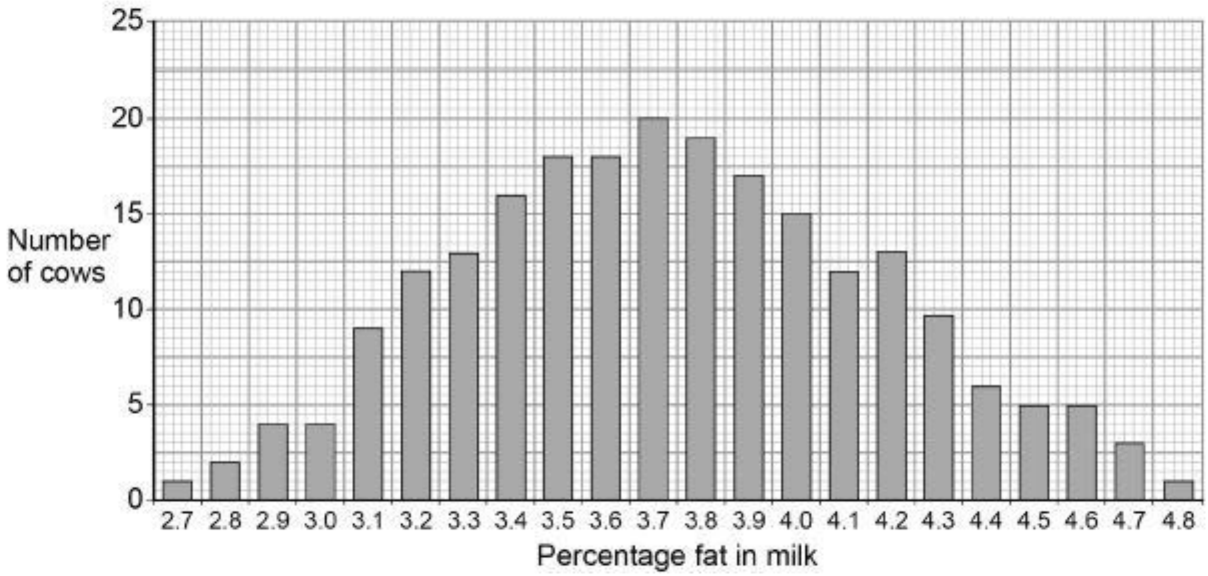
Q6.

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



(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.

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____

(3)

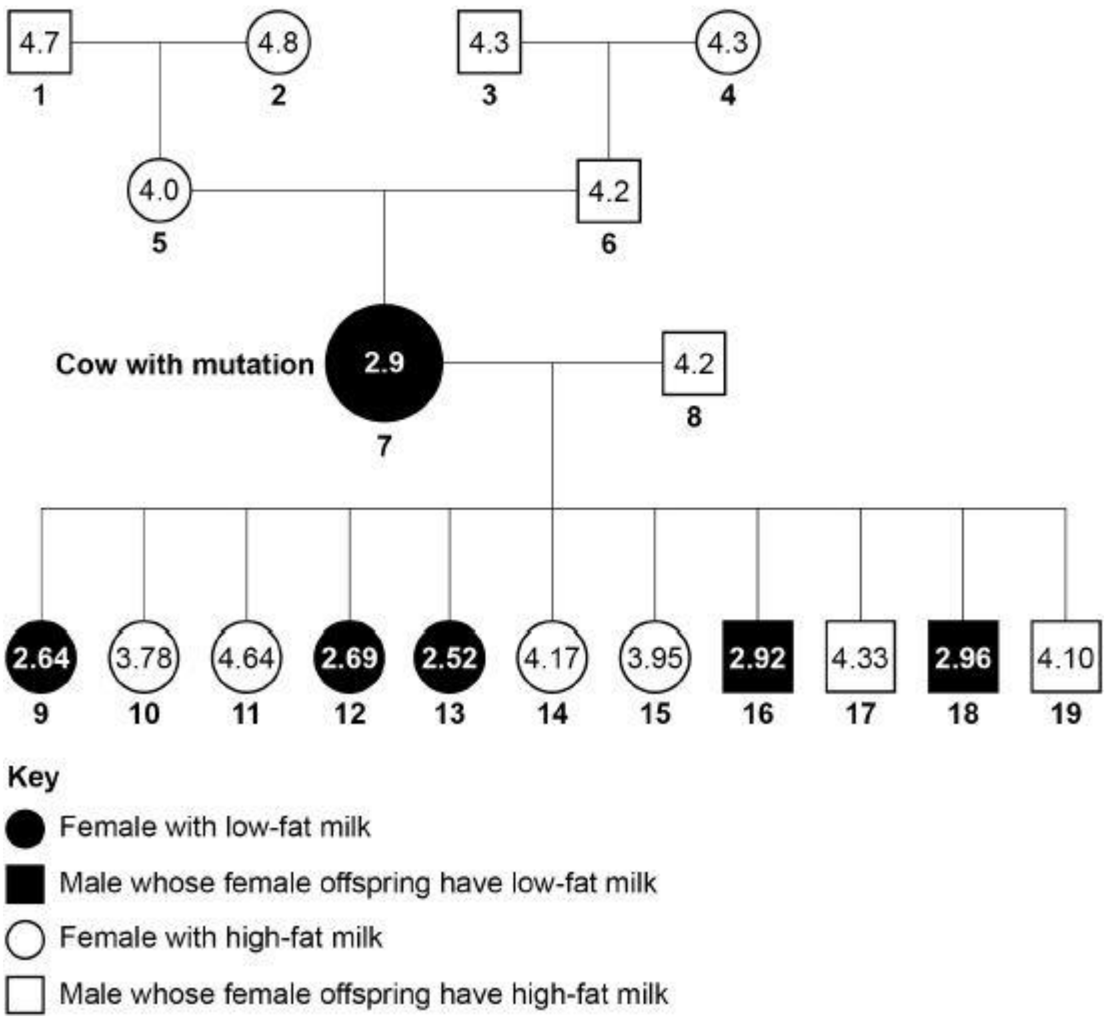
The scientists found one cow with a mutation.

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.

____

____

(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.

(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.

Figure 1

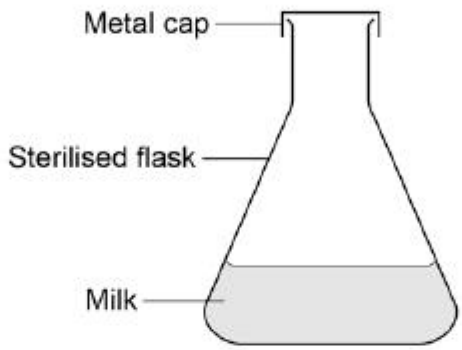
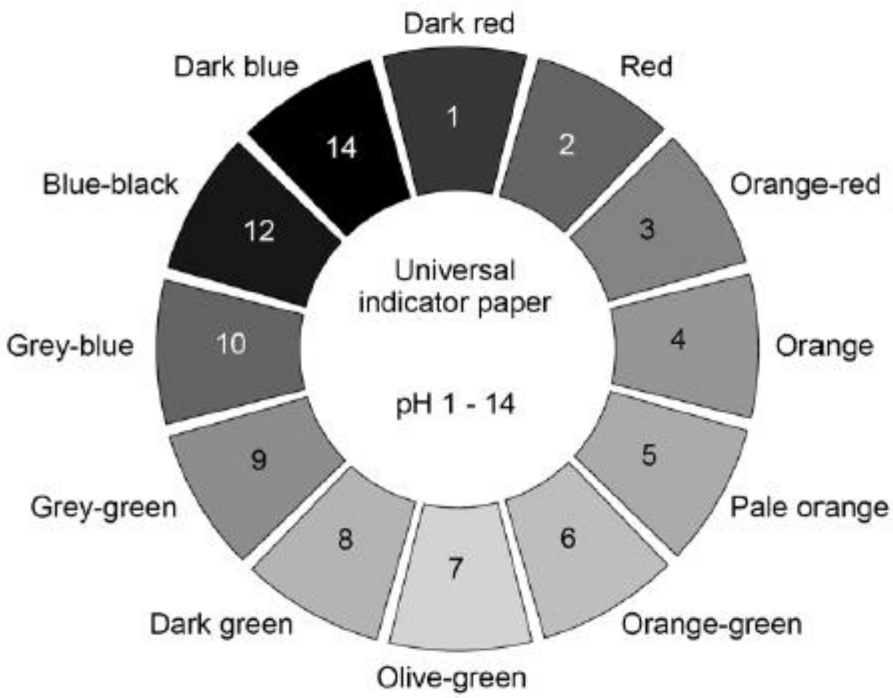


Figure 2



(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)

(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.

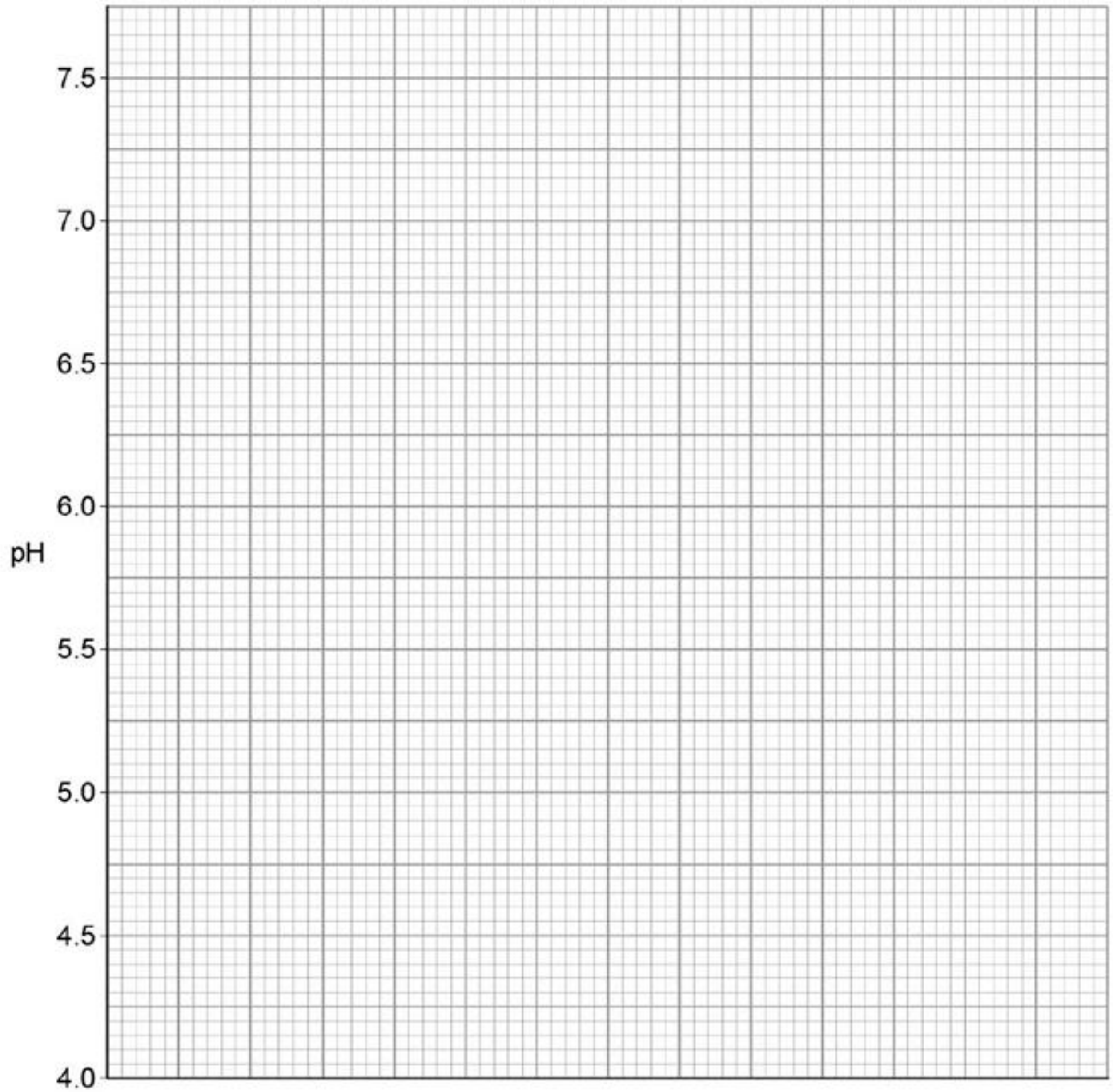
Table 2

Time in days	**pH**
0	7.0
1	7.0
2	6.7
3	6.0
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.

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)

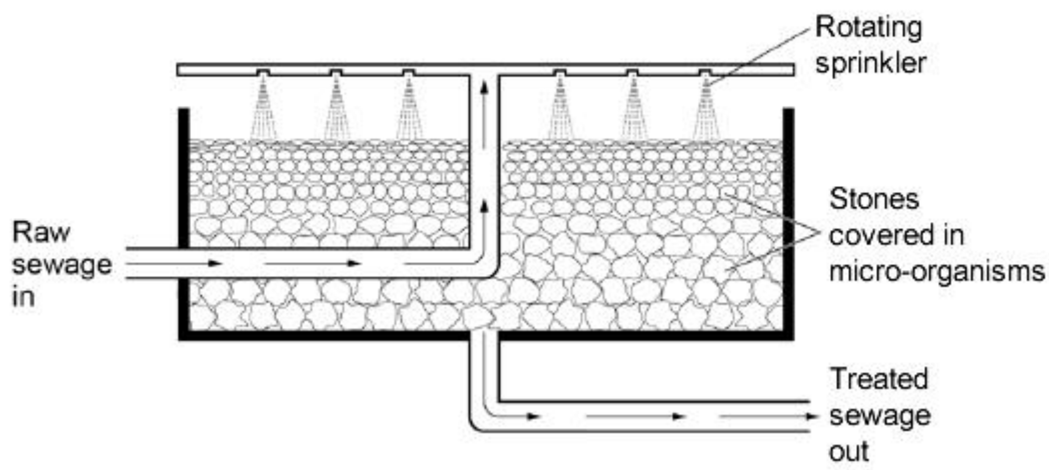
Q8.

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



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. ____

____

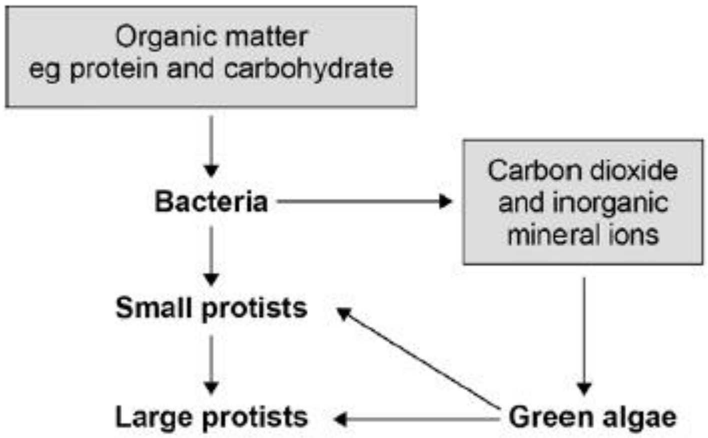
2. ____

____

(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.

(4)

(Total 8 marks)

Q9.

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

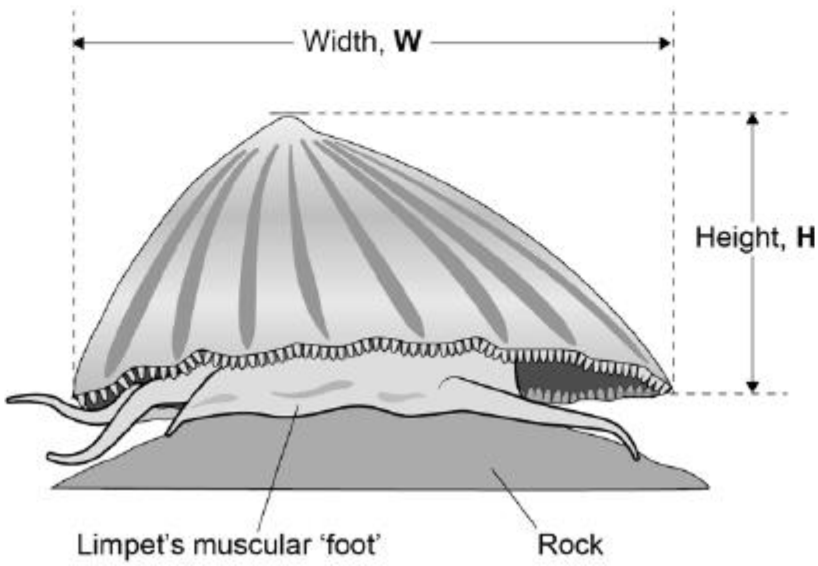
Some students investigated variation in the size of limpets living on two seashores:

- 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.

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.

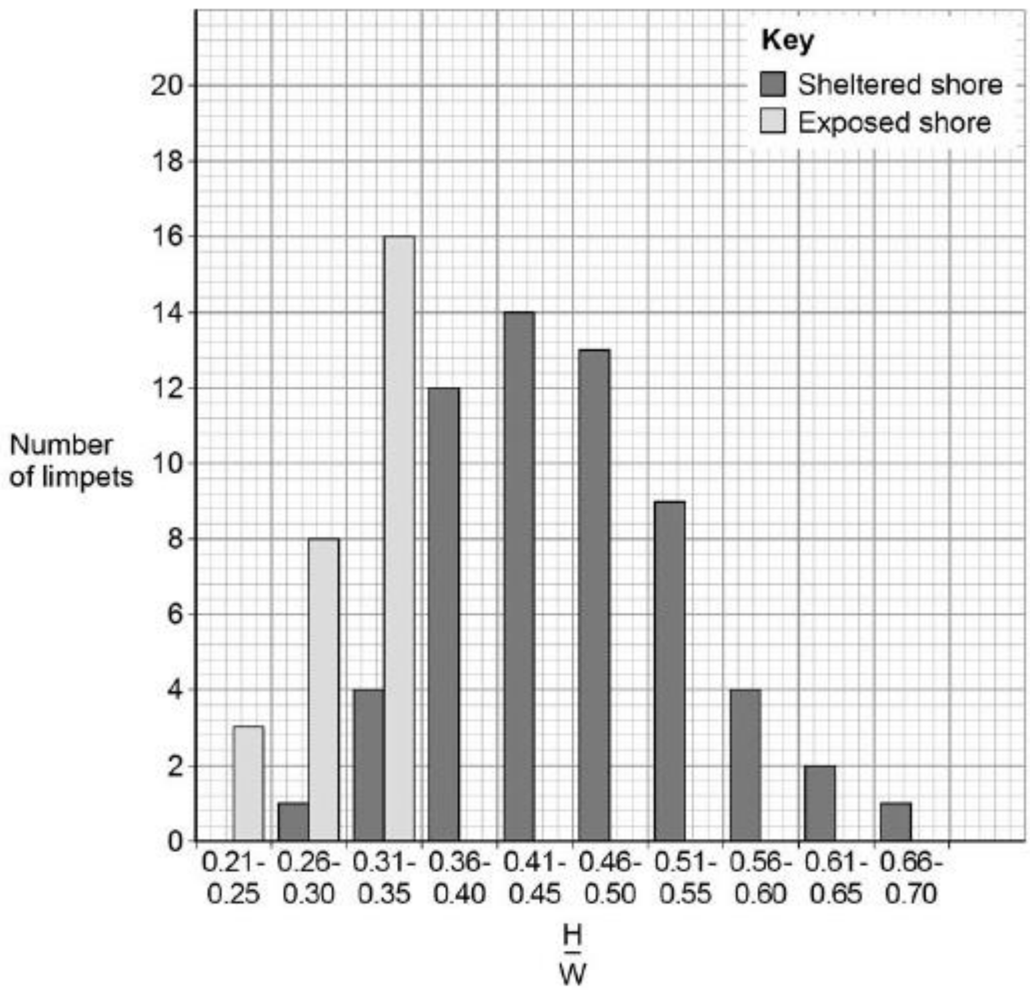
$\frac{H}{W}$	Sheltered shore		Exposed shore	
	Score	Number	Score	Number
0.21 – 0.25			III	3
0.26 – 0.30	I	1	卌 III	8
0.31 – 0.35	IIII	4	卌 卌 卌 I	16
0.36 – 0.40	卌 卌 II	12	卌 卌 卌 IIII	
0.41 – 0.45	卌 卌 IIII	14	卌 IIII	
0.46 – 0.50	卌 卌 III	13	IIII	
0.51 – 0.55	卌 IIII	9	I	
0.56 – 0.60	IIII	4		
0.61 – 0.65	II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

(b) Complete the table above.

(1)

Figure 2 shows some of the results.

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**.

____

____

____

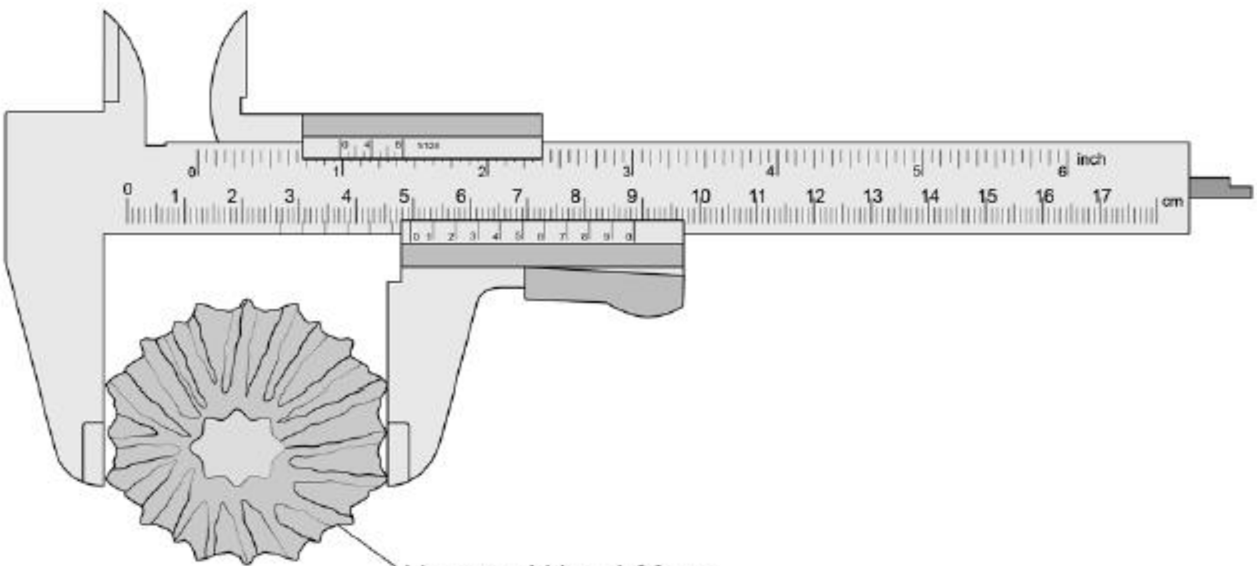
____

____

(3)

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

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 πr^2.

Take the value of π to be 3.14.

____

____

____

____

____

____

Maximum wave force = ____________________ newtons

(3)

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

1. ____

____

______

2. ____

____

(2)

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

____

____

____

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____

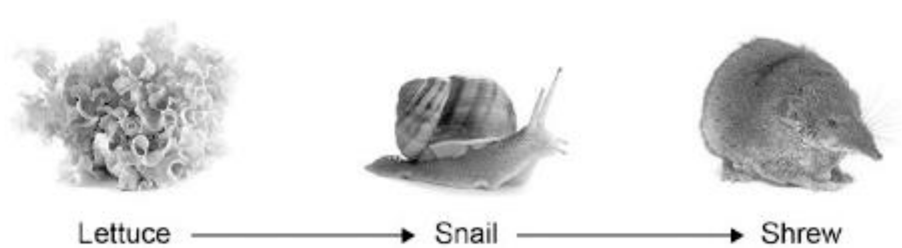
____

(3)

(Total 17 marks)

Q10.

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 ☐

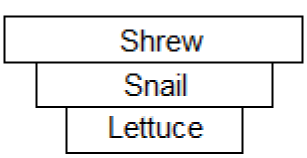
Population ☐

Territory ☐

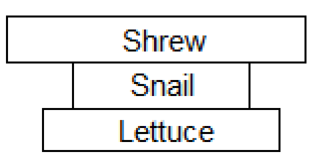
(1)

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

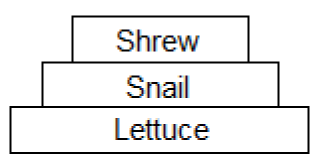
Tick **one** box.



A ☐



B ☐



C ☐

(1)

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

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

Calculate the energy transferred to the snails from the lettuces.

____

Energy = ___________________________ kJ

(1)

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

Tick **one** box.

The lettuces carry out photosynthesis	☐
The snails do not eat the roots of the lettuces	☐
Not all parts of a snail can be eaten	☐

(1)

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

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

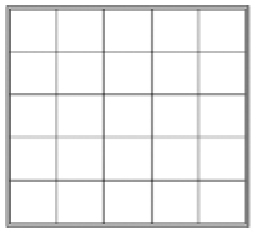
____

(1)
(Total 8 marks)

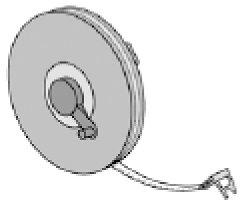
Q11.

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.
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)

Q12.

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

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

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

____

____

____

____

(2)

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

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

Look at the table below.

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

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

____

Ratio ____________________

(1)

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

Justify your answer.

____

____

(1)

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

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

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

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

(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)

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)

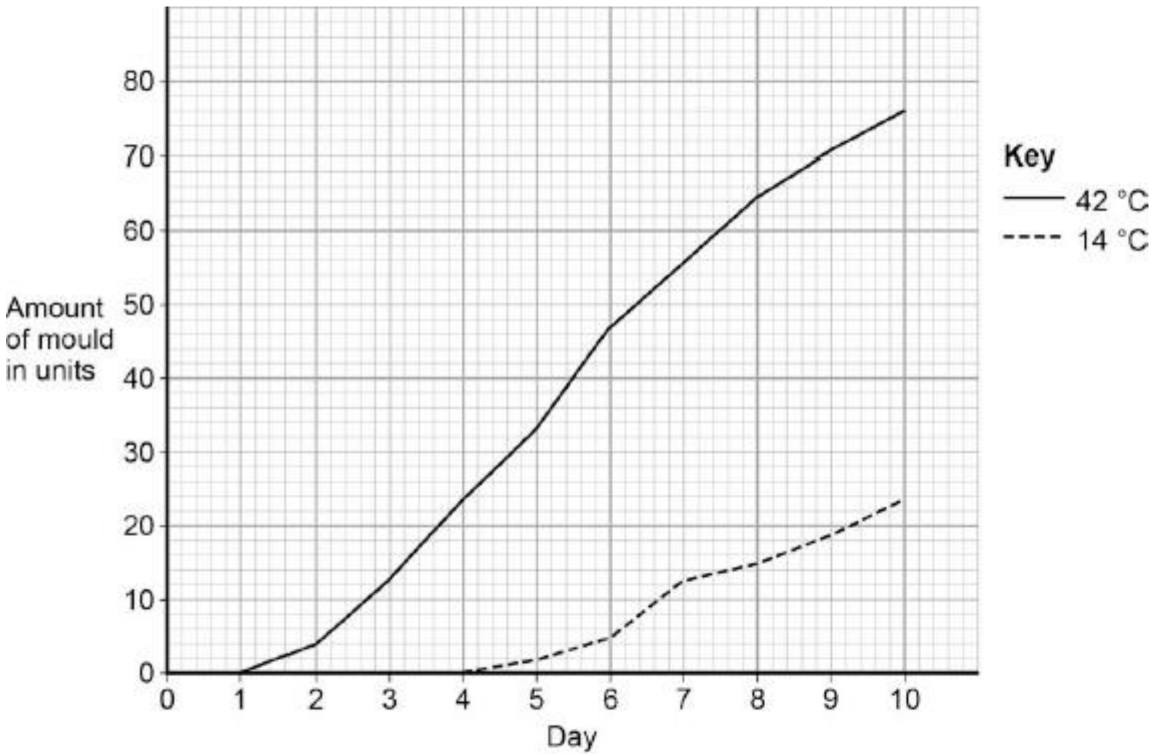
(c) Give **one** variable the student should control in the investigation.

____

(1)

(d) Another student did a similar investigation.

The diagram below shows the results.



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.

____

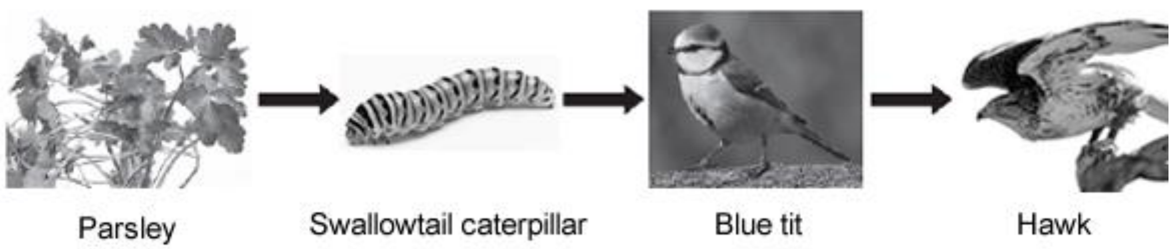
____

(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.

____

____

____

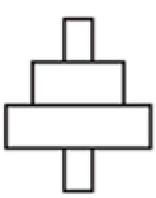
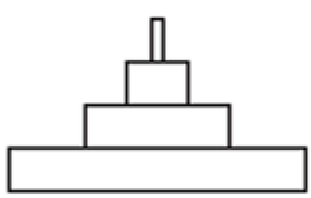
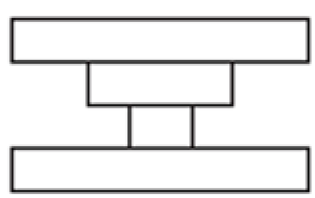
____

(2)

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

Why is photosynthesis important in the food chain?

Tick (✓) **one** box.

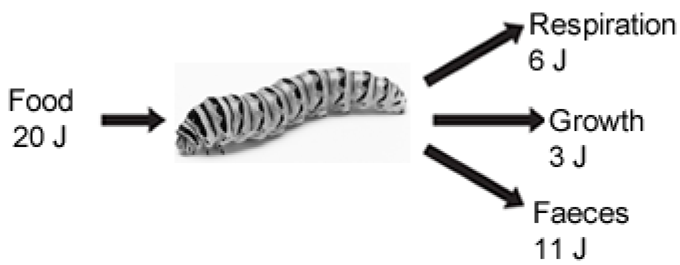
  

☐ ☐ ☐

(1)

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

Figure 2



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

____

____

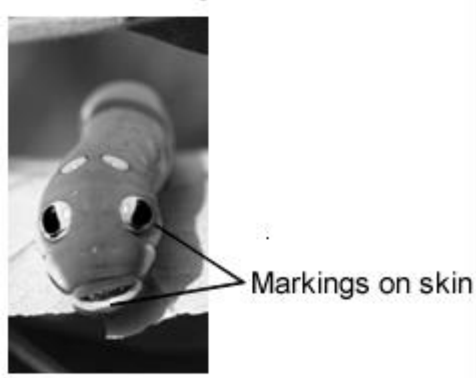
Percentage = ____________________________

(2)

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

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

Figure 3



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

____

(2)

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

Figure 4

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

1.

2.

(2)
(Total 9 marks)

Q15.

Students investigated decomposition.

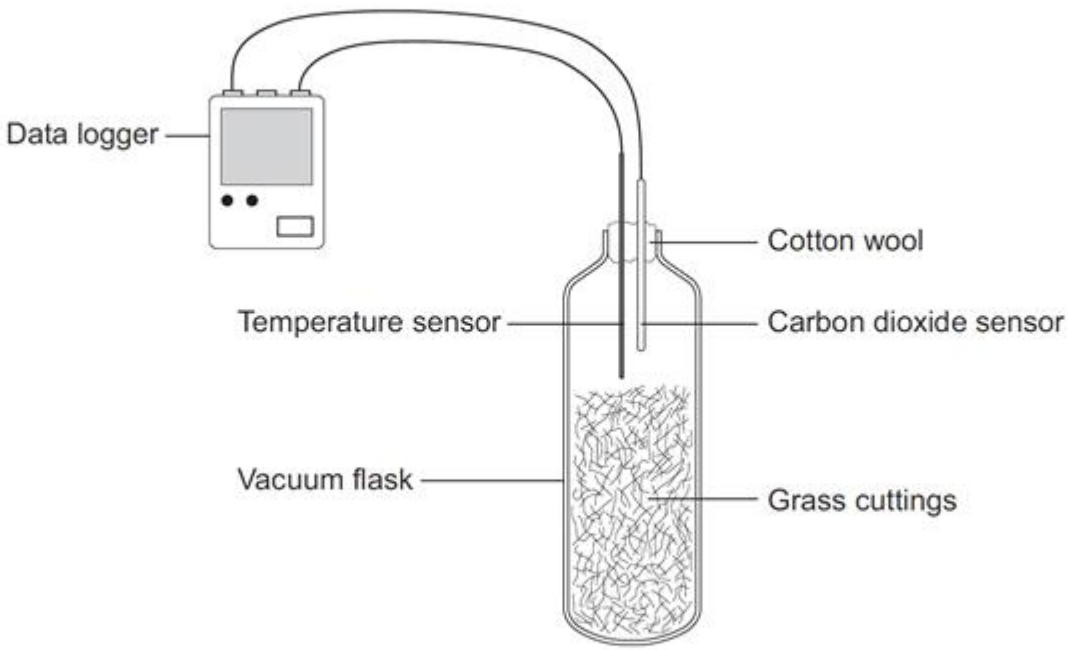
The students:

- 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.

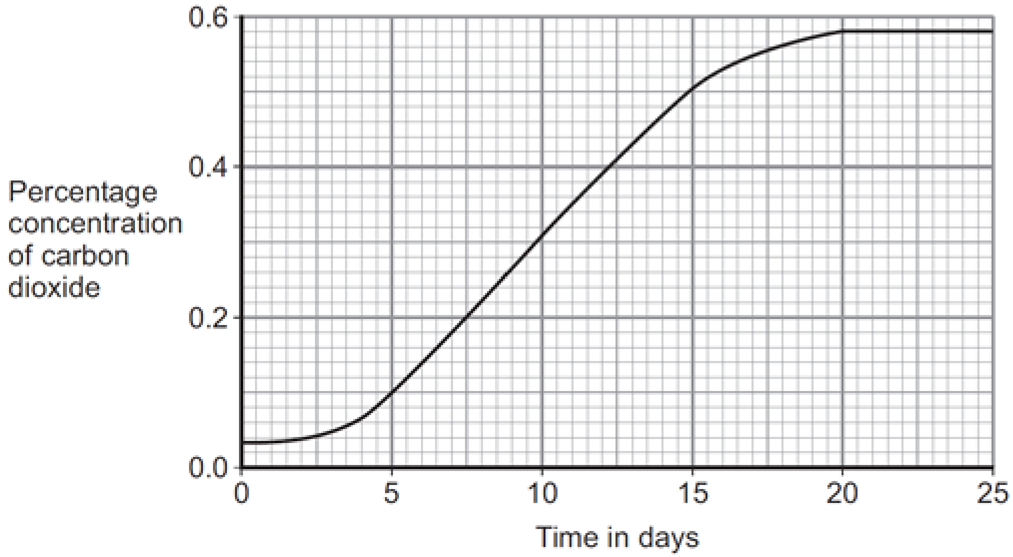
____

____

(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



(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)

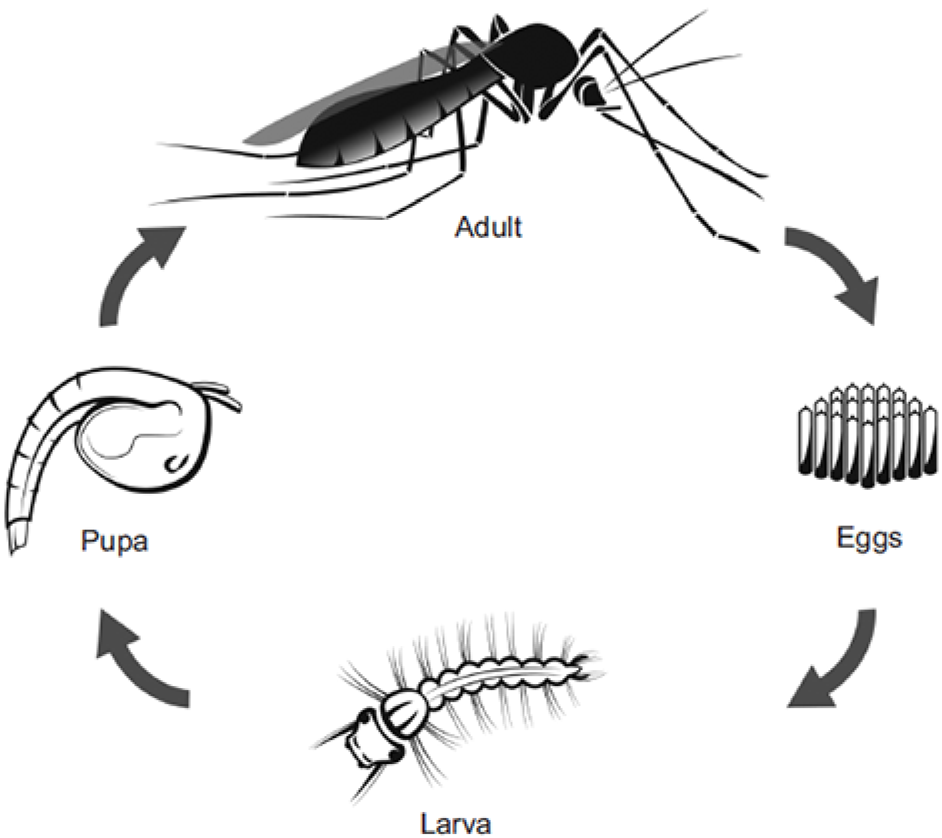
(Total 5 marks)

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.



© watcharapon/iStock

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

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

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

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

____

____

(2)

(b) An internet article states:

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

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

Explain why.

(2)

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

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

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

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

(4)

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

(3)

(Total 11 marks)

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

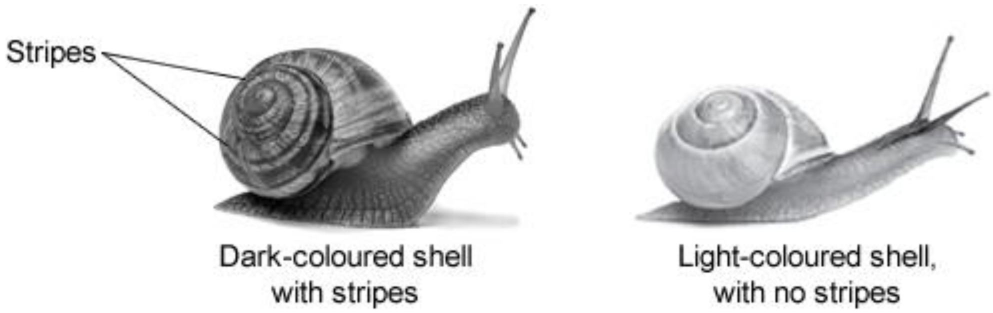
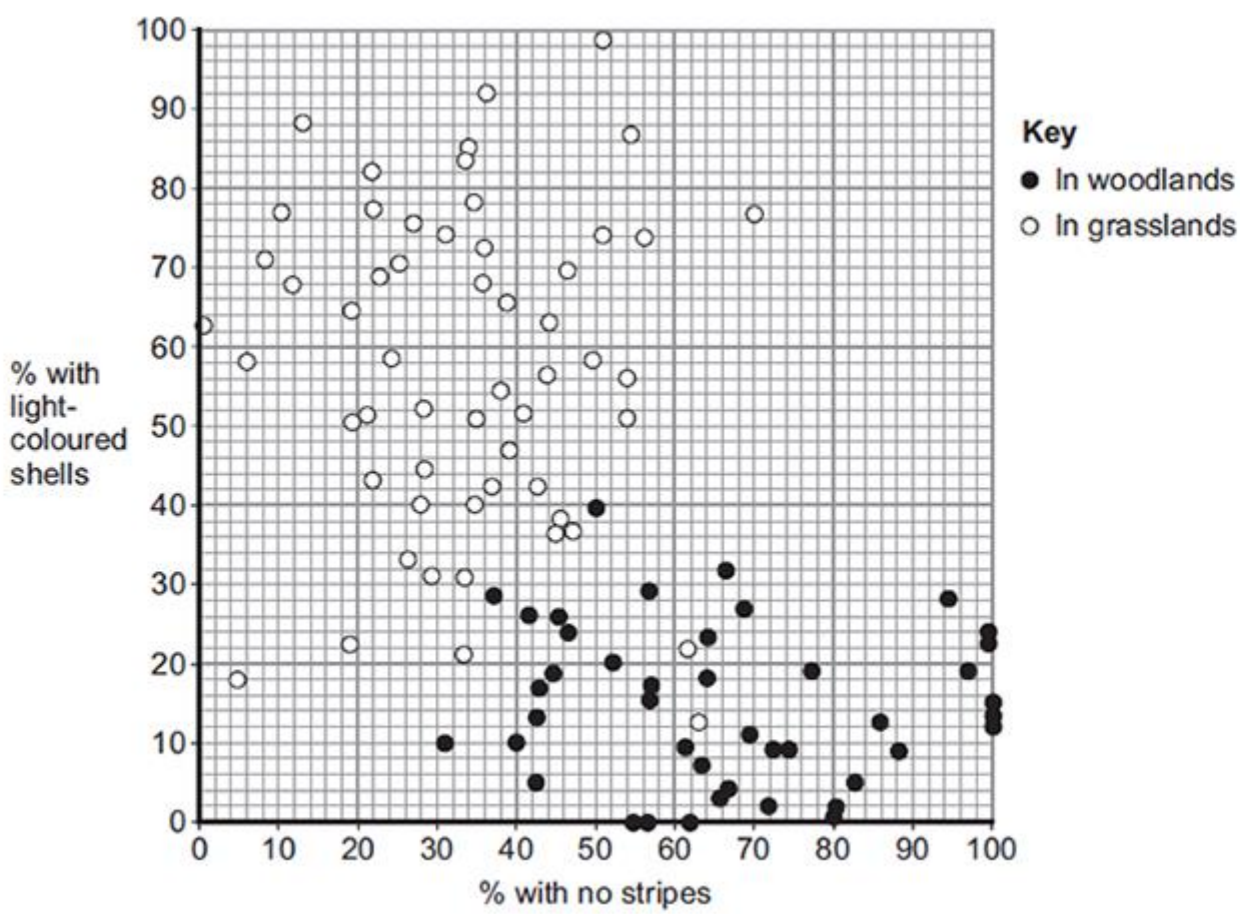


Figure 2 shows results from surveys in woodlands and in grasslands of the percentage of snails with light-coloured shells and the percentage of snails with no stripes.

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

Figure 2



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

Why is a scatter graph used for this data?

___

___

(1)

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

___

___

___

___

(2)

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

___

___

(1)
(Total 7 marks)

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
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)

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)

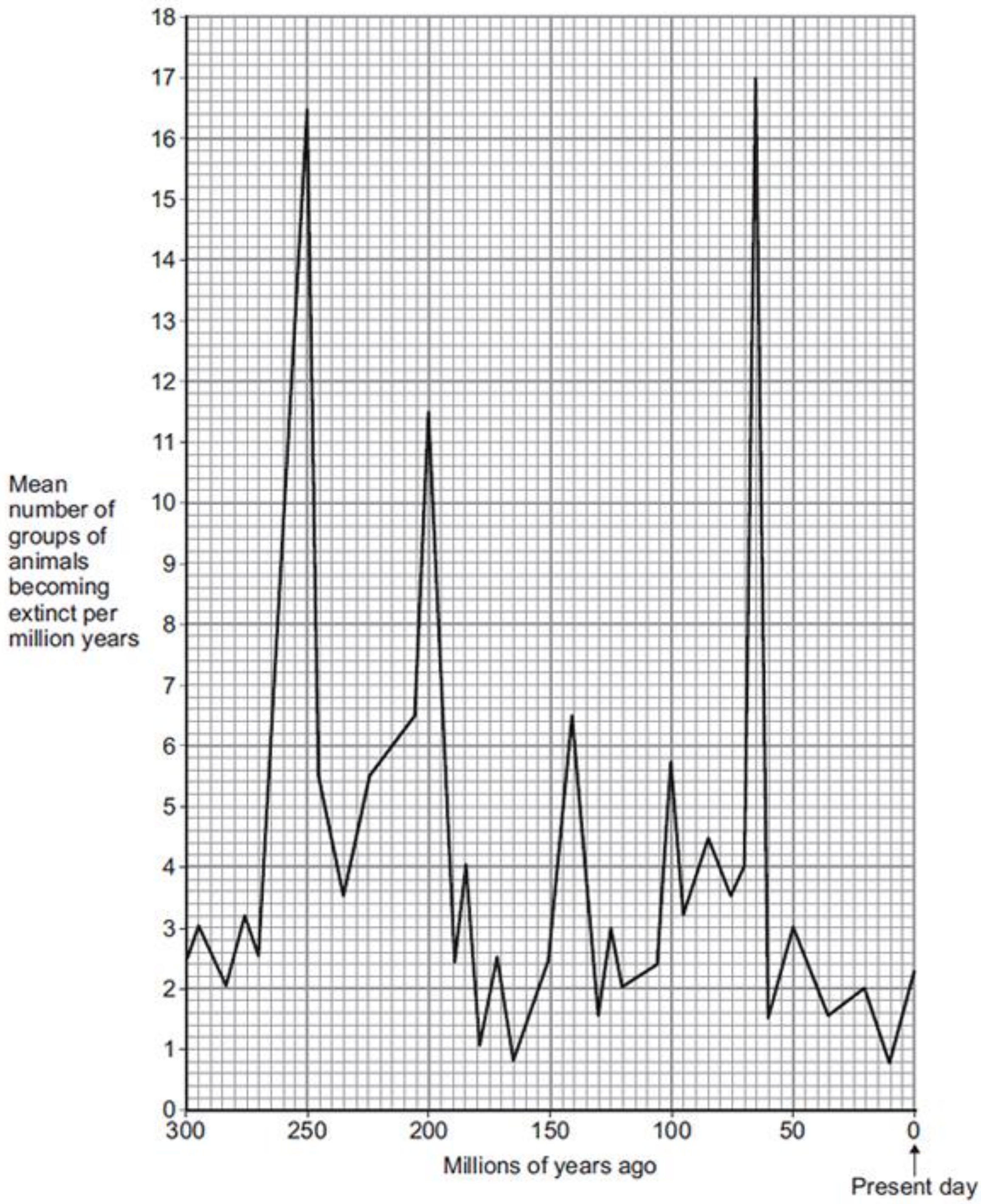
(iii) Give **two** reasons, other than collision with an asteroid, why groups of animals may become extinct.

1.

2.

(2)

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



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

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

____

(1)

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

____

____

(1)

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

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

Tick (✓) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

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

_________________ groups per million years

(1)

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

____

____

(1)

(Total 9 marks)

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
3	4
4	1
5	3
6	2
7	4
8	1
9	1
10	1

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

Use the students' results from the table above.

Total number of plantains in 10 quadrats = ______________________________

Total area of 10 quadrats = ____ m^2

Mean number of plantains per m^2 = __________________________________

____

Area of field = ____ m^2

Therefore estimated number of plantains in field = ______________________

____

(3)

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

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

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

Improvement 1

____

Reason

____

____

Improvement 2

____

Reason

____

____

Improvement 3

____

Reason

____

____

(3)

(Total 6 marks)

Q21.

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

Figure 1
Battery chickens

Figure 2
Free-range chickens

© studiodr/iStock/Thinkstock

© xlikovec/iStock/Thinkstock

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

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

____

____

____

____

____

(2)

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

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

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

____

____

(1)

(ii) One product of anaerobic respiration is methane.

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

1. ____

2. ____

(2)

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

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

____

____

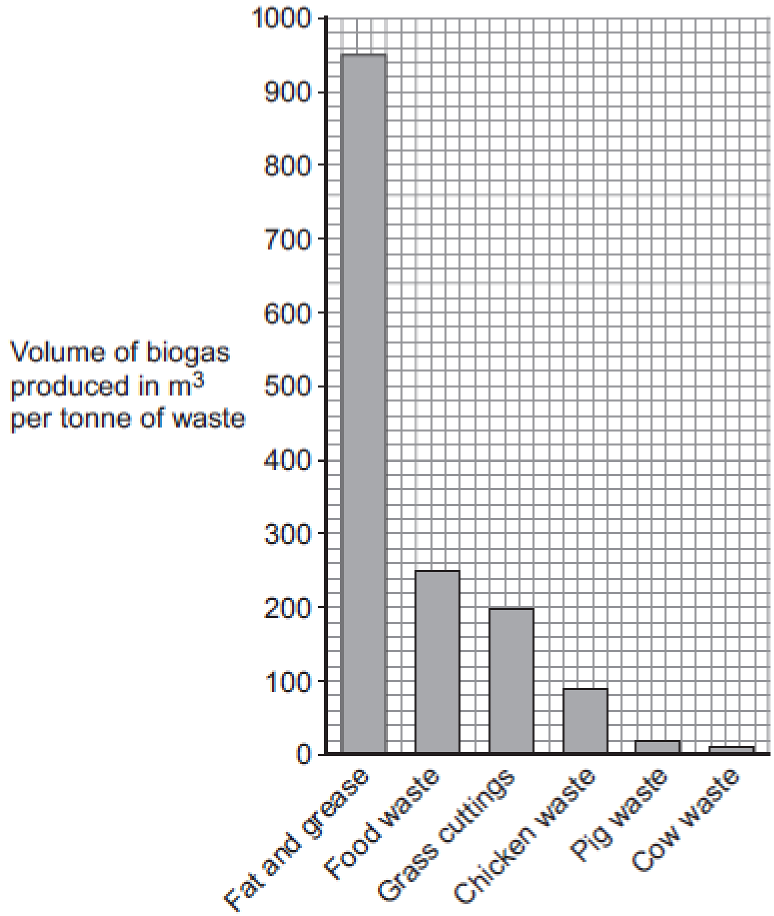
____

____

(2)

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

Figure 3



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

_______________ m^3

(1)

(ii) Biogas is 60% methane.

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

_______________ m^3

(1)

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

____

____

(2)
(Total 11 marks)

Q22.

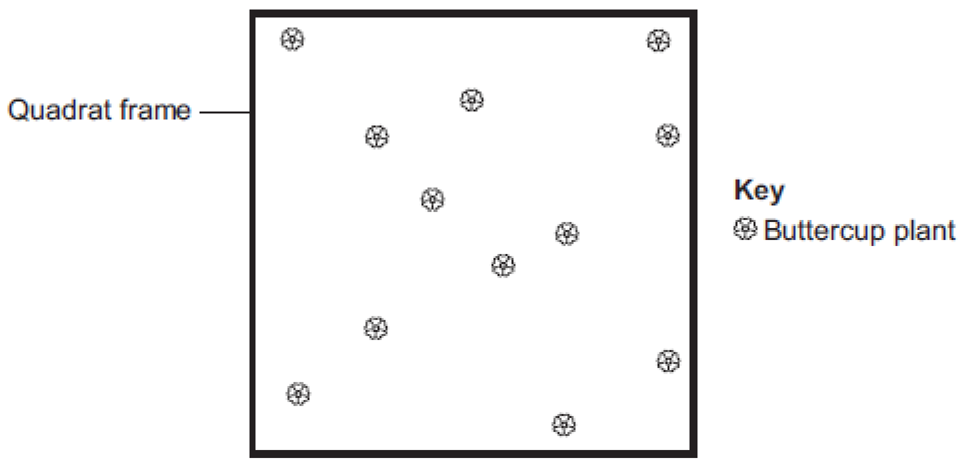
A grassy field on a farm measured 120 metres by 80 metres.

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?

(2)

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

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

(2)

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

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

1.

2.

3.

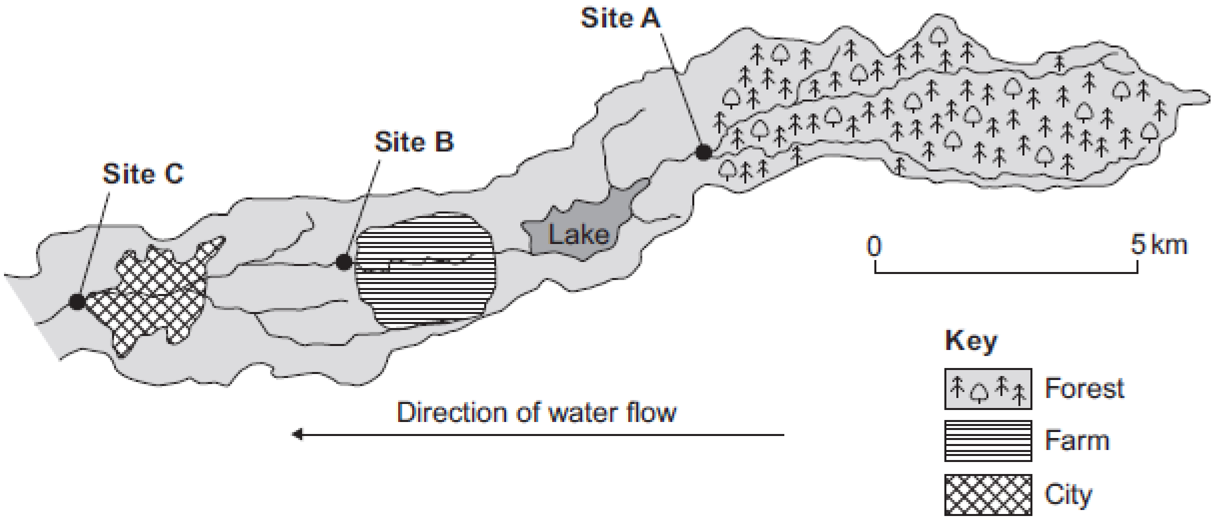
(3)

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

(3)

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

Figure 2



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

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

Explain why the concentration of oxygen decreases.

____

____

____

____

____

____

____

____

____

____

(5)

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

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

____

(1)

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

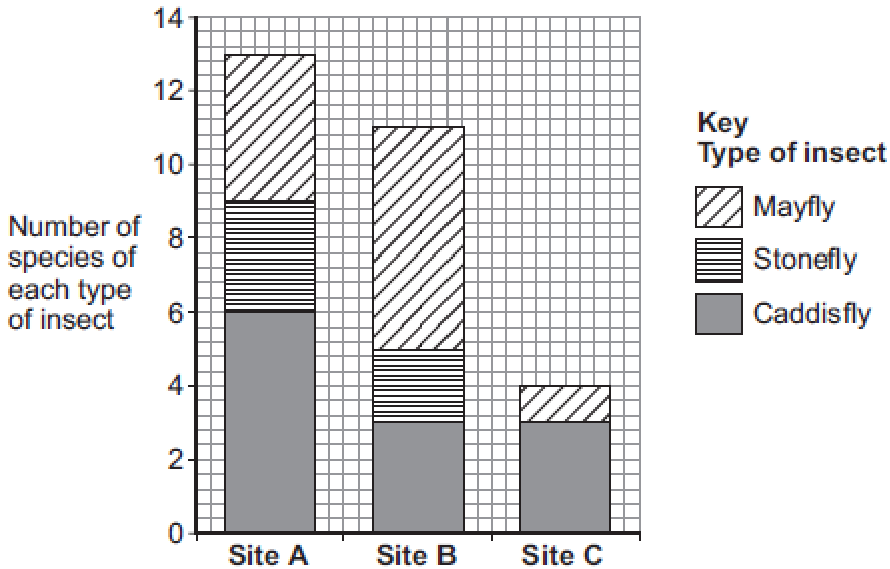
Scientists took many samples of river water from these sites.

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

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

Figure 3 shows the scientists' results.

Figure 3



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

____

(1)

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

____

____

(1)

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

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

(1)

(Total 19 marks)

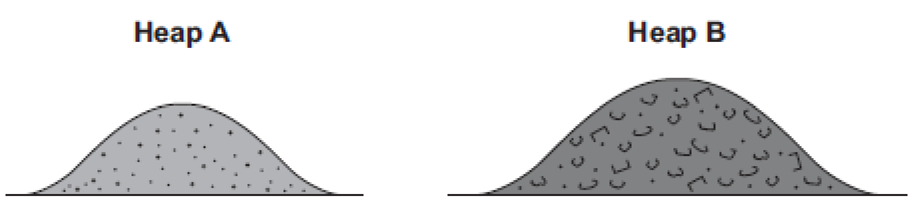
Q23.

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

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



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

1. ____

2.

(2)

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

(1)

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

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

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

(1)

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

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

____

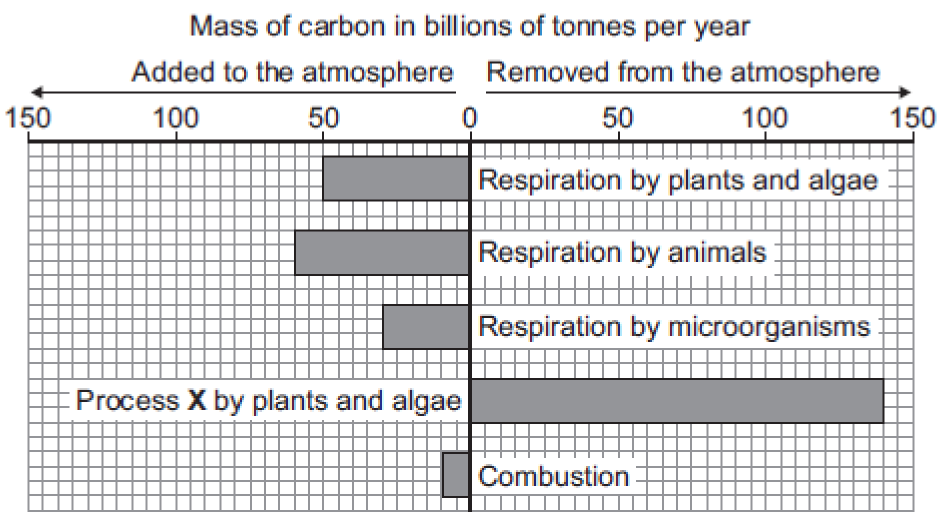
____

(2)
(Total 6 marks)

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?

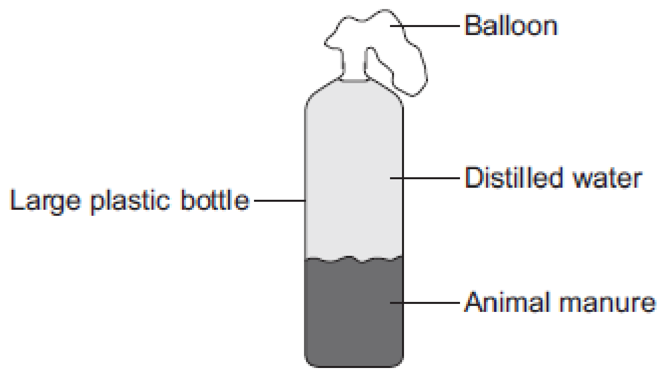
____

(1)
(Total 3 marks)

Q25.

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

The diagram shows the apparatus they used.



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

The students' results are shown in the table.

Type of animal manure	**Diameter of balloon on day 10 in cm**
Cow	29
Horse	26
Sheep	34
Pig	32

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

(1)

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

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

Suggest **two** reasons why.

1. ____

____

2. ____

____

(2)

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

Why would adding potato increase the amount of biogas produced?

Tick (✓) **one** box.

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

(1)
(Total 4 marks)

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**.

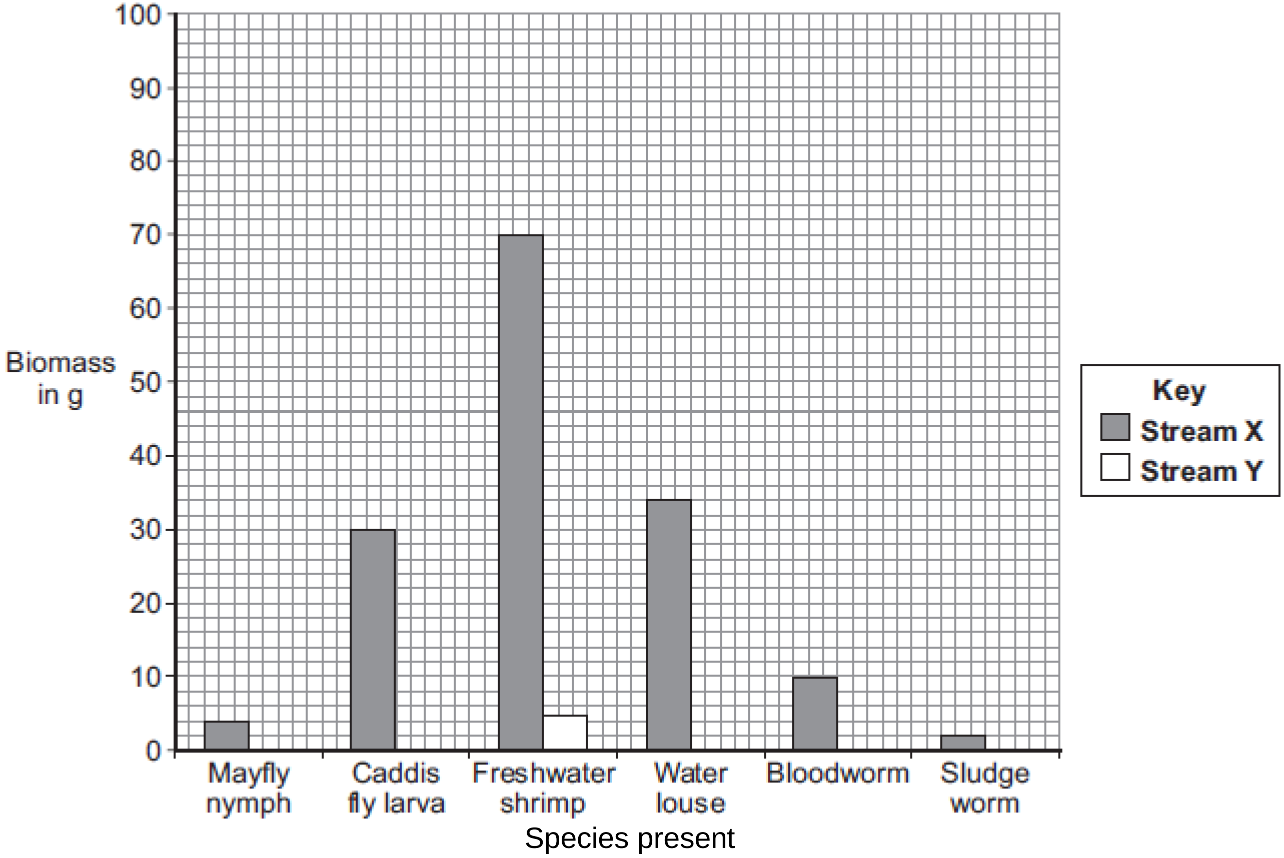
Table 1

	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**.

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

Use the data in **Table 1**.



(2)

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

Table 2

Pollution level	**Invertebrate species likely to be present**
Clean water	Mayfly nymph
Low pollution	Caddis fly larva, Freshwater shrimp
Medium pollution	Water louse, Bloodworm
High pollution	Sludge worm

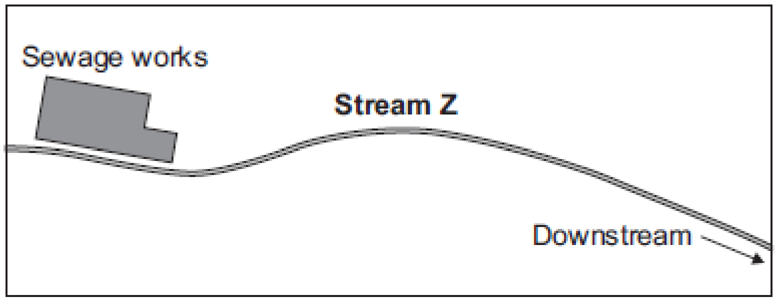
Which stream, **X** or **Y**, is more polluted?
Use the information from **Table 1** and **Table 2** to justify your answer.

___

___

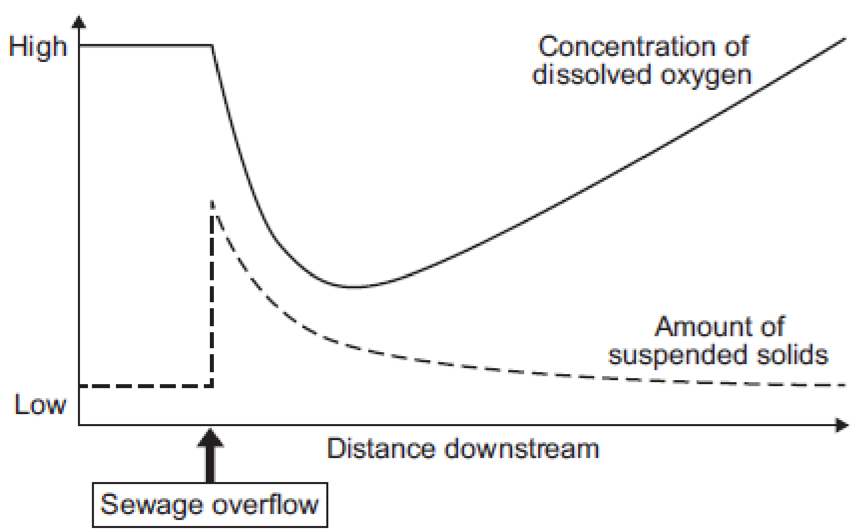
(2)

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

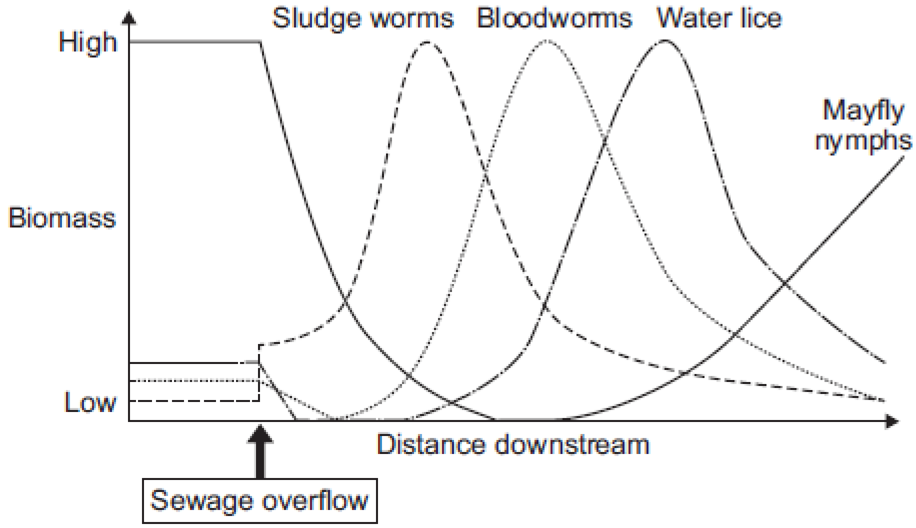


An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow



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

____

____

____

____

____

____

____

____

(4)

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

____

(3)

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

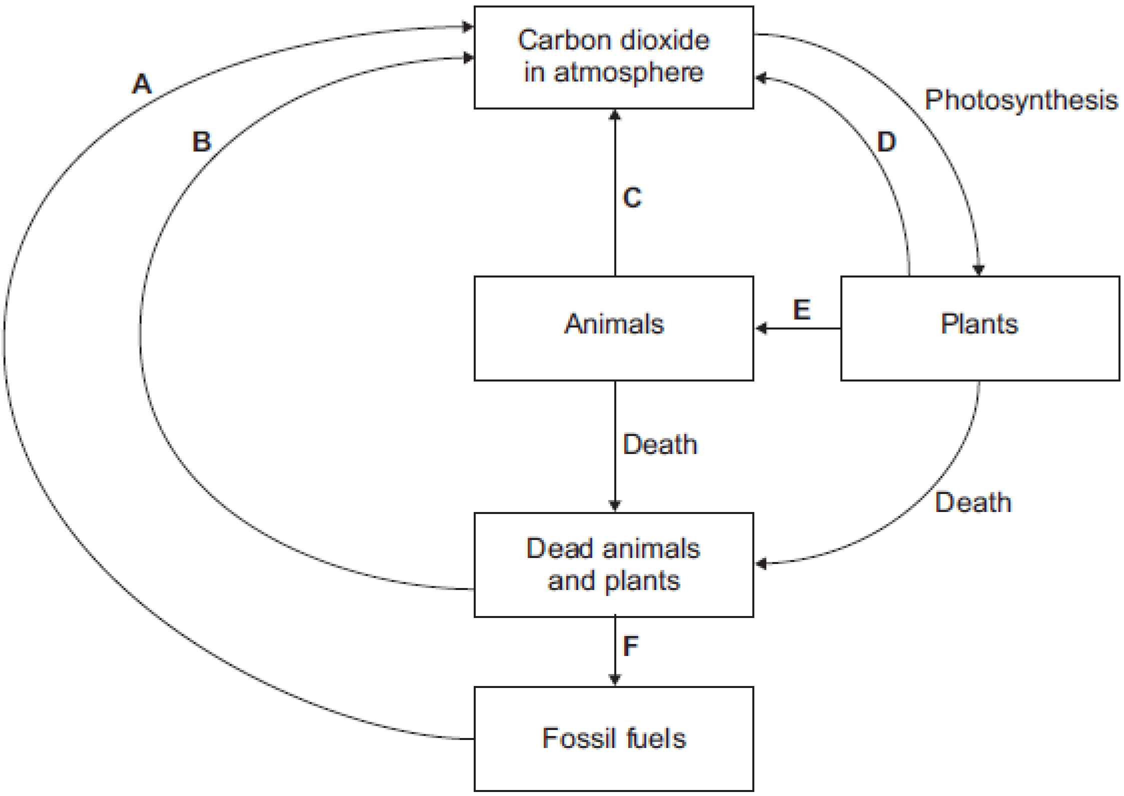
Explain why microorganisms cause the level of oxygen in the water to decrease.

(2)

(Total 13 marks)

Q27.

(a) The diagram shows the carbon cycle.



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

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

1. ____

2. ____

(2)

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

☐ and ☐

(2)

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

☐

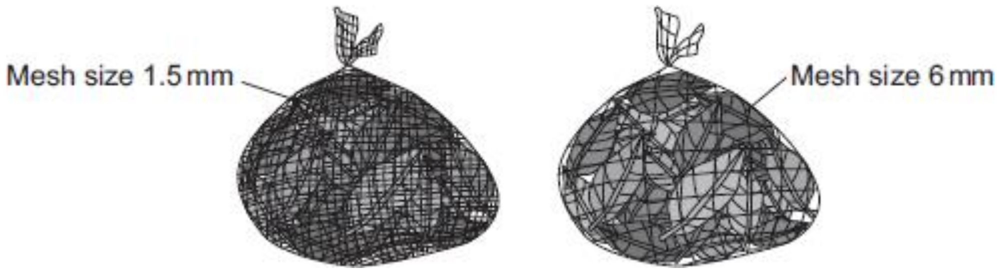
(1)

(b) Scientists investigated the breakdown of dead leaves.

The scientists:

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

Mesh bags containing leaves

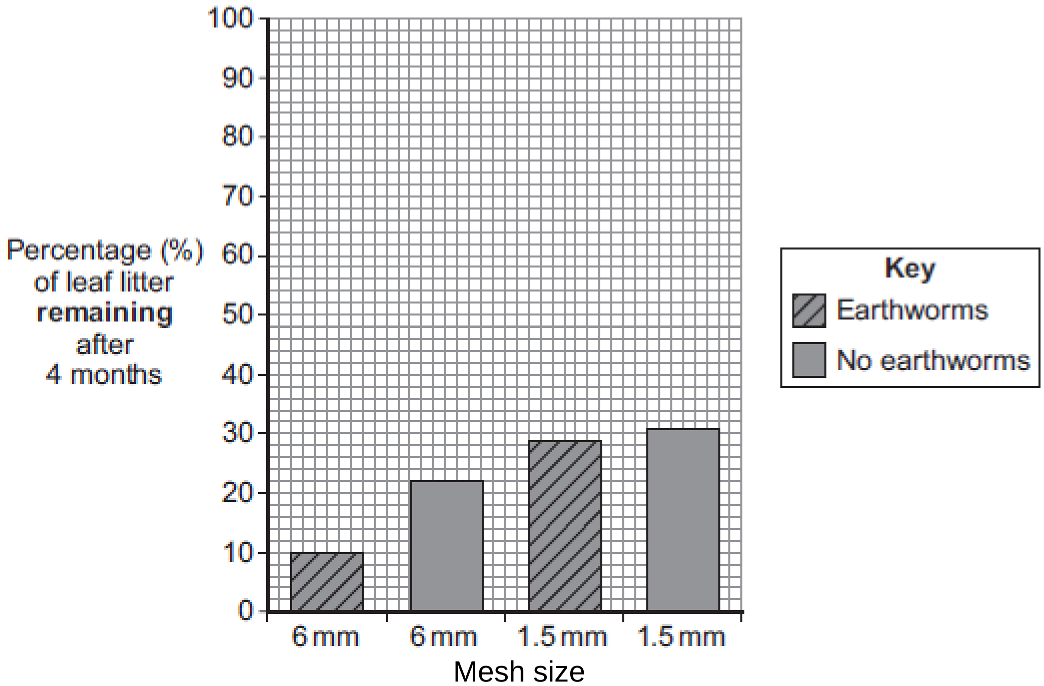


The scientists then:

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

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

The bar graph shows the scientists' results.



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

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

with earthworms ____________________ %

without earthworms? ____________________ %

(2)

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

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

____

____

____

____

(1)

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

Explain why.

____

____

____

____

(2)

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

Explain how the results show this.

____

____

____

____

____

____

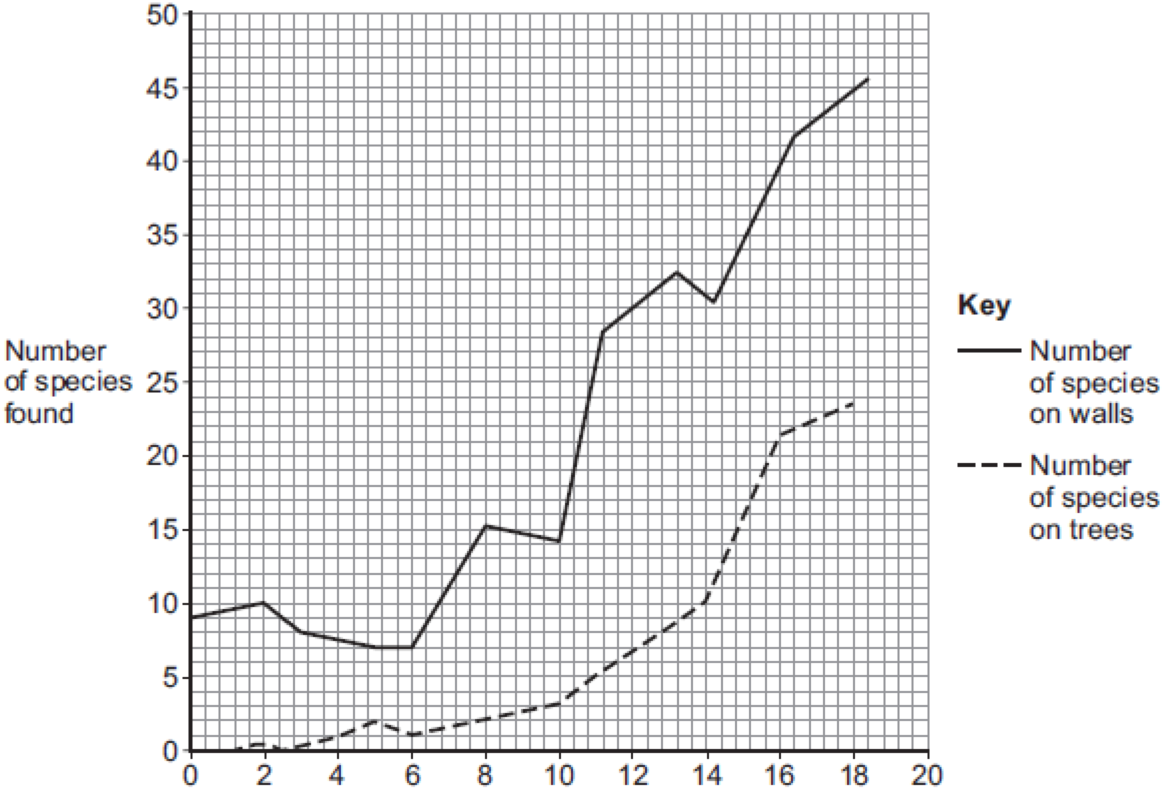
(2)

(Total 12 marks)

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.



Distance from city centre in km

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

____

(1)

(ii) Describe the patterns in the data.

____

____

____

____

____

(3)

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

Distance from city centre in km	**SO_2 concentration in g per m^3**
0	200
3	160
8	110
13	85
18	65

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

(2)

(c) Nitrogen oxides are also air pollutants.

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

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

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

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

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

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

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.

(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.

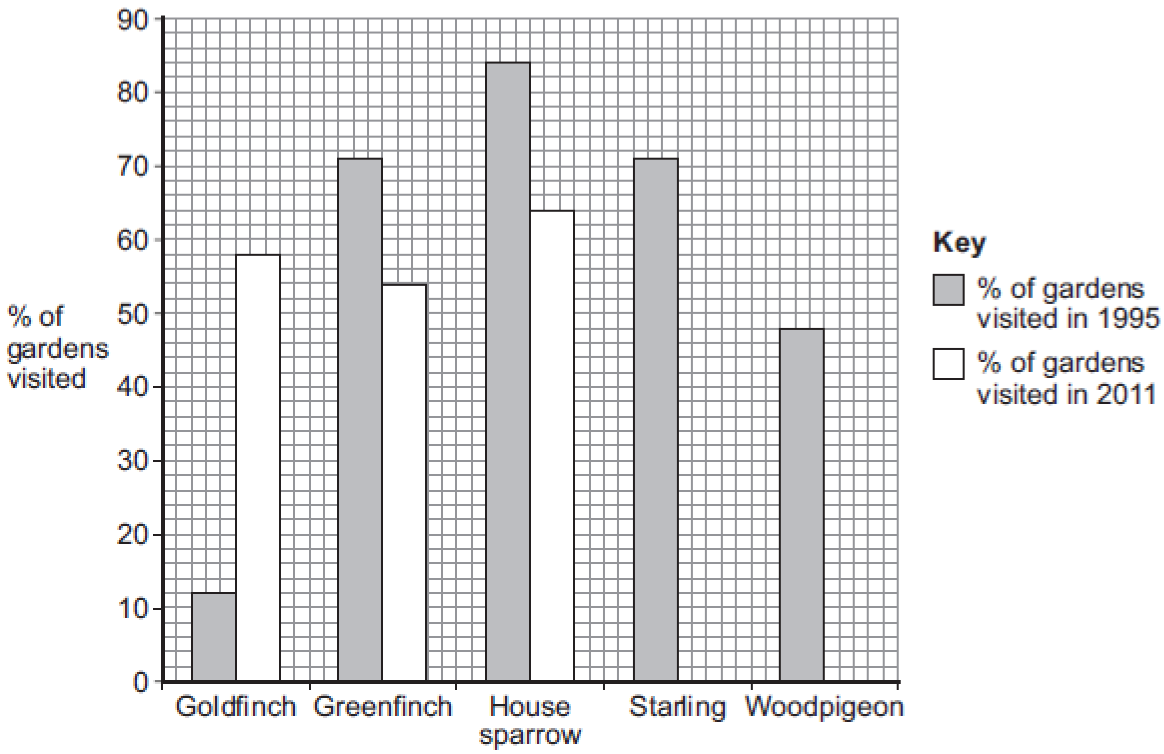
Bird species	% of gardens visited in 1995	% of gardens visited in 2011
Goldfinch	12	58
Greenfinch	71	54
House sparrow	84	64
Starling	71	42

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.



Bird species

(2)

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

How many gardens were visited by woodpigeons in 2011?

____

(2)

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

____

(1)

(c) The change in the number of woodpigeons may be partly because they have

spread to towns and cities.
Suggest why this increase in woodpigeons in towns and cities might have occurred.

___

___

(1)
(Total 7 marks)

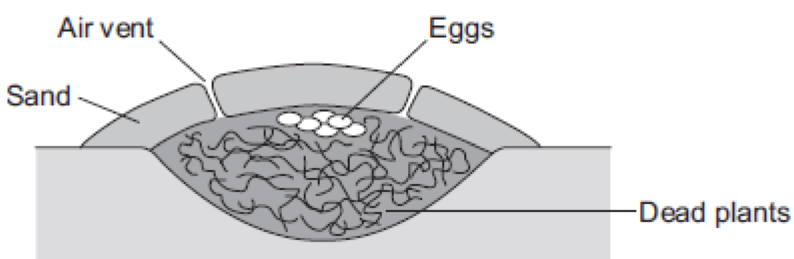
Q30.

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.

(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

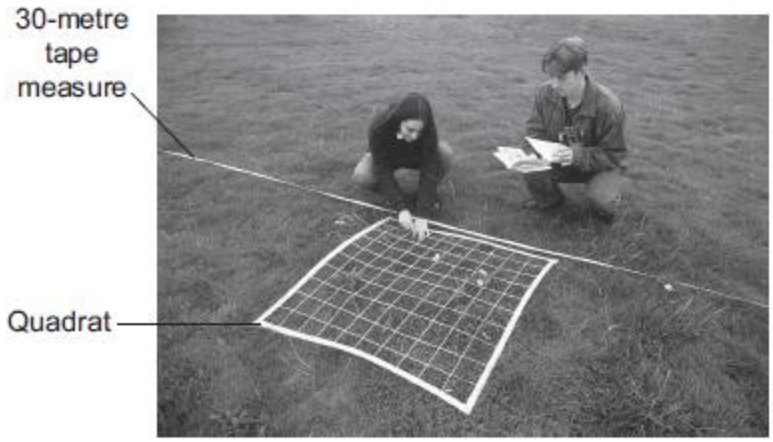
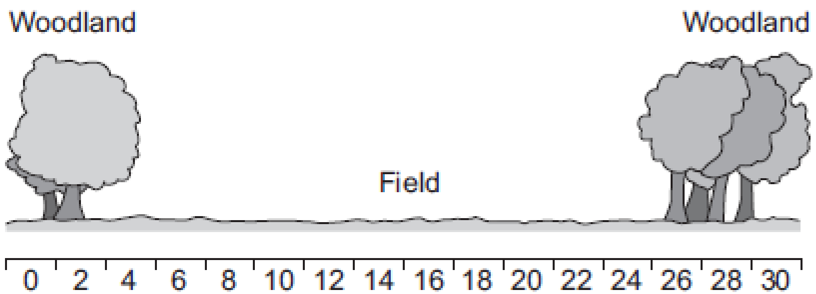


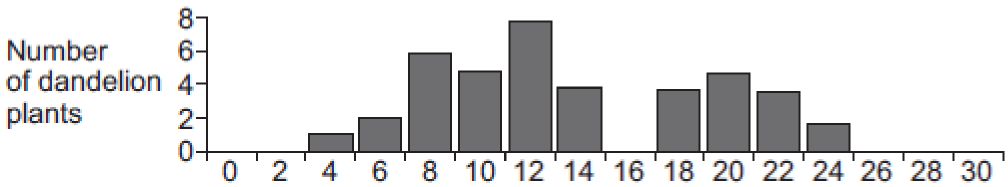
Figure 2 shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

Figure 2



Distance in m

Figure 3



Distance in m

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

Use information from **Figure 1**.

____

____

____

____

____

____

(3)

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

____

____

(1)

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

____

____

(1)

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

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

____

(2)
(Total 7 marks)

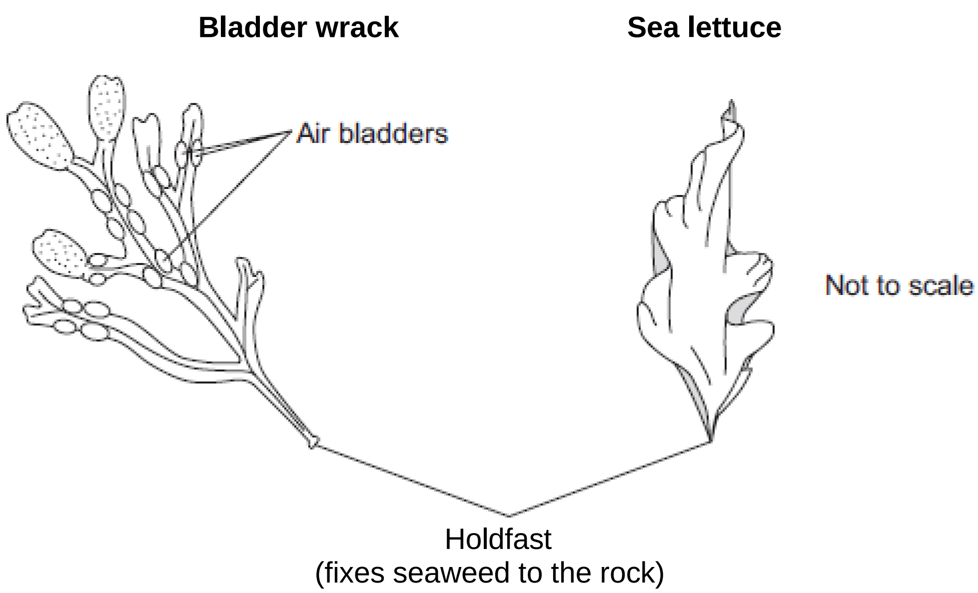
Q32.

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

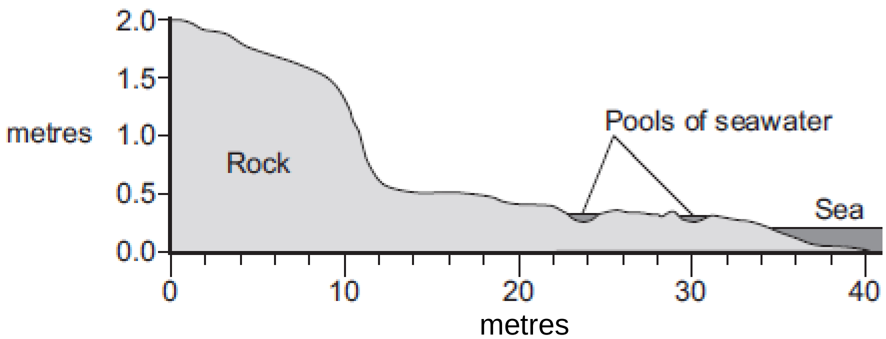
3 recorded whether each species was present or not.

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

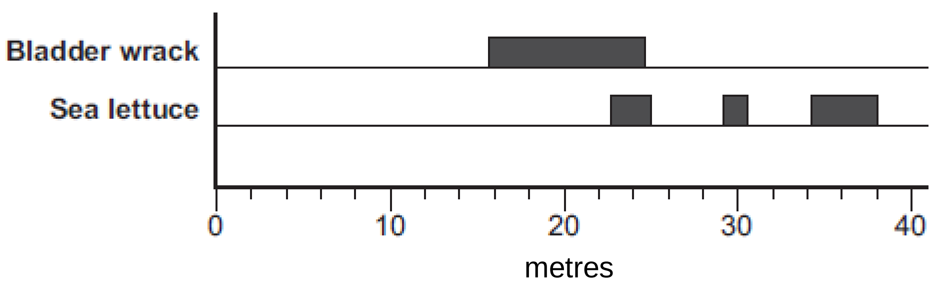
Figure 2 shows a section of the seashore and the students' results.

Figure 2

Section of the seashore



Students' results



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

Explain why.

____

____

____

____

(2)

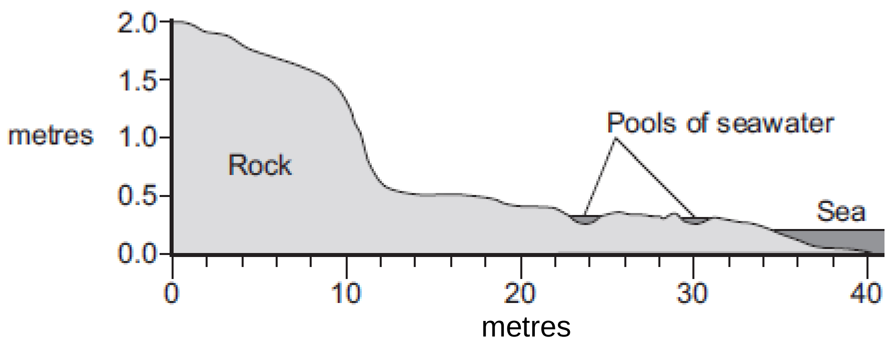
(ii) How could the students have improved their investigation to ensure that they produced valid data?

(2)

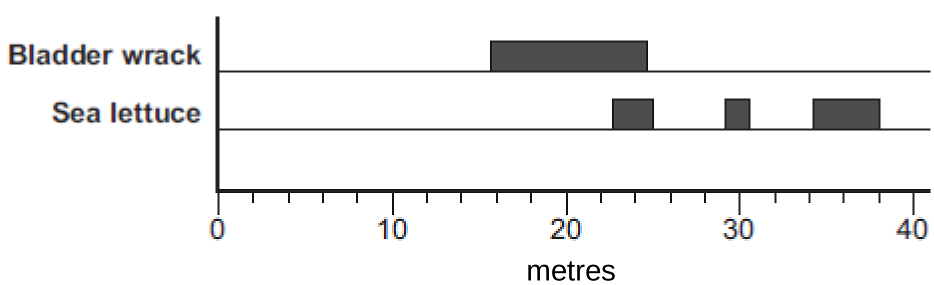
(iii) **Figure 2** is repeated here to help you answer this question.

Figure 2

Section of the seashore



Students' results



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

What is the evidence for this conclusion?

Use information from **Figure 2**.

(2)

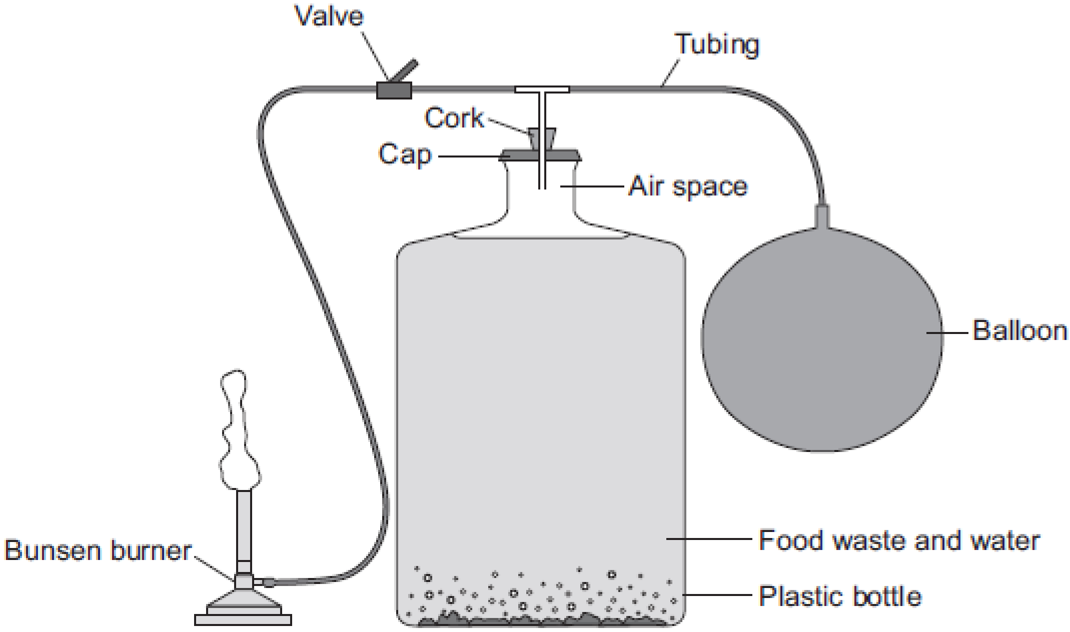
(b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

(2)
(Total 8 marks)

Q33.

The image below shows a model biogas generator.



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

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

The students:

- put 500 g of potato peelings in the plastic bottle with some water and sealed the apparatus
- released the gas from the balloon after day two and timed how long the gas burned for
- released the gas that had collected in the balloon from day two to day four and timed how long the gas burned for
- repeated the investigation using 500 g of cooked rice, then 500 g of cabbage leaves and then 500 g of cooked pasta.

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

Table 1

Type of food waste	**Length of time the gas burned in seconds**	
	After day two	**From day two to day four**

Potato peelings	0	175
Cooked rice	0	100
Cabbage leaves	0	150
Cooked pasta	0	160

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

___

___

___

___

___

(3)

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

___

___

(1)

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

Table 2 shows the scientists' results.

Table 2

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

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

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

____

____

Volume of methane = ___________ m^3

(2)

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

What is the evidence for this conclusion?

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

____

____

____

____

____

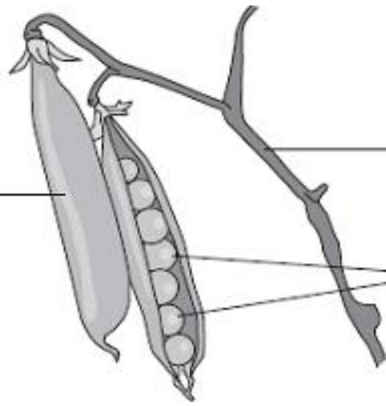
____

(2)

(Total 8 marks)

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

(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.

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

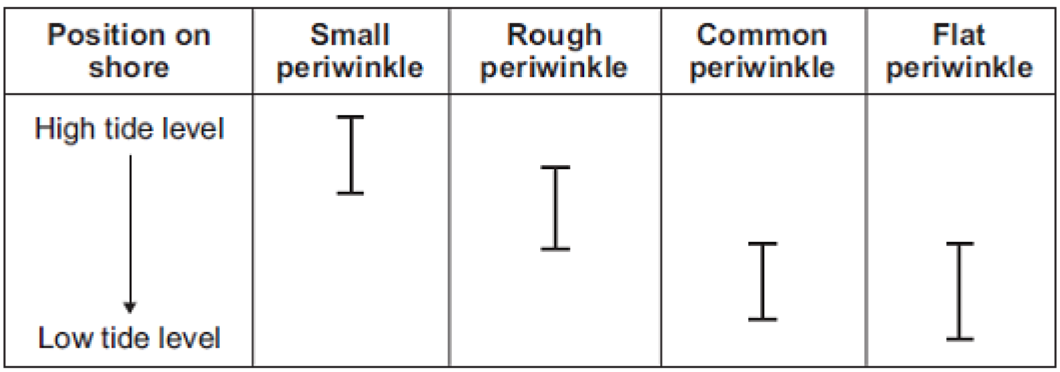
What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

____

(1)

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

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



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

____

(1)

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

____

____

(1)

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

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

1.

2.

(2)
(Total 5 marks)

Mark schemes

Q1.

(a) diffusion

1

(b) A

1

(c) B

1

(d) (earthworm) can absorb more oxygen (in a given time)
or
increases / more gas exchange

allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food

1

(e) lipase

1

(f) more oxygen (in soil with earthworms)

allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q2.

(a) description of a method to achieve random placement

examples could include random number generator or random coordinates

*allow throw over the shoulder **or** with eyes shut*

ignore throw unqualified

1

(b) any **one** from:

- random (location)
  allow by chance
- avoid bias
- obtain valid / representative results
  allow more accurate / precise mean
  ignore fair test / accurate / precise unqualified

1

(c) as a control / comparison
allow see the difference

1

or
B varies from A in only one factor
*do **not** accept a control variable*
(to) show results (in A) are due to weed killer
allow to see the effect of the weed killer
allow so the results are valid

1

(d) 11
allow eleven

1

(e) $\frac{10-2}{10} \times 100$

1

80

1

*an answer of 80 scores **2** marks*

(f) use more quadrats
allow use larger quadrats
allow repeat

1

original may not be representative **or** reference to weeds being distributed unevenly
allow mean is more reliable / accurate / precise
ignore more valid

1

or

leave for more than two weeks (1)

original may not be representative (1)
allow mean is more reliable / accurate / precise
allow weed killer may take longer than two weeks to work (fully)

ignore more valid

[9]

Q3.

(a)

	1960 − 1977	1977 − 2003	2003 − 2015	
trend in carbon dioxide concentration		increasing	increasing	1
trend in air temperature	decreasing	increasing	constant / decreasing	1

allow synonyms e.g. level / goes up / goes down

(b) traps heat / energy or (long-wavelength / IR) radiation

*do **not** accept light / UV*

or
less loss of heat

allow stops (some) heat escaping
*do **not** accept stops all heat escaping*

or
insulates

ignore greenhouse effect
ignore reference to ozone layer

1

(c) **Level 2:** Some logically linked reasons are given. There may also be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

0

Indicative content

for the theory:
- (overall increased CO_2 parallels) overall increased temperature (e.g. by 0.4 (°C))
- CO_2 traps (long-wave) radiation / IR / heat

against the theory:
- in some years (e.g. 1960–1977) temperature falls (while CO_2 is rising)
- many (large and small) erratic rises and falls in temperature
- overall correlation does not necessarily mean a causal link
- other (unknown) factors may be involved in temperature change

to access level 2 there must be evidence both for and against the theory **and** use of data from the graph

(d) burning of (fossil) fuels

allow e.g. coal / oil / gas
allow driving cars
allow any activity which leads to burning fuels – e.g. using central heating

ignore power stations unqualified
ignore burning / fires unqualified
ignore deforestation

1

(e) photosynthesis

allow full description or full equation
allow a symbol equation which is not balanced

1

(f) any **two** from:

- (some) plants grow faster / higher yield
- loss of habitat
- migration **or** change in distribution*
- extinction*

if neither is given allow alters biodiversity for **1 mark*

allow (in terms of extinction) death due to e.g. lack of water / food or increased disease

ignore death unqualified

2

allow points made using examples

[11]

Q4.

(a) there is an uneven distribution of dandelions
or
(more) representative / valid
or
avoid bias
or
more accurate / precise mean

ignore accurate / precise unqualified
ignore repeatability / reproducibility / reliability / fair test

1

(b) (correct mean per m^2 =) 6 or 6.0

1

(correct field area =) 55 000 (m^2)

1

mean × area – e.g. 6(.0) × 55 000

allow incorrect calculated values for mean and / or field area

1

330 000

allow correct calculation from previous calculation

1

3.3×10^5

allow calculated value in standard form

1

an answer of 3.3×10^5 scores ***5*** *marks*

an answer of 330 000 scores ***4*** *marks*

(c) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- placing of quadrat
- large number of quadrats used
- how randomness achieved − e.g. table of random numbers **or** random number button on calculator **or** along transect
- quadrats placed at coordinates **or** regular intervals along transect
- in each of two areas of different light intensities **or** transect running through areas of different light intensity
- for each quadrat count number of dandelions
- for each quadrat measure light intensity
- compare data from different light intensity

to access **level 3** the key ideas of using a large number of quadrats randomly, or along a transect, and counting the number of dandelions in areas of differing light intensity need to be given to produce a valid outcome

(d) any **two** from:

- temperature

  allow heat

- water

  allow moisture / rain

- (soil) pH

  allow acidity

- minerals / ions

  allow e.g. magnesium ions ***or*** *nitrate* *allow salts / nutrients*

- winds
- herbivores

allow trampling
ignore carbon dioxide
ignore space
ignore competition unqualified
*do **not** accept oxygen*

2

[14]

Q5.

(a) *x*-axis: scale + labelled, including units

scale ≥ ½ width of graph paper label: biomass in g/m²

1

bar widths correct

± ½-square each side
allow 1 mark if 3 correct

2

all 4 bars correctly labelled

large fish + small fish + invertebrate (animals) + algae
or
(trophic level) 4 + 3 + 2 + 1
or
tertiary consumer + secondary consumer + primary consumer + producer

ignore bar heights

1

(b) $\frac{840 - 10}{840} \times 100$

allow equivalent calculation

1

98.809523... / 98.810 / 98.81 / 98.8

1

99

allow answer given to two significant figures from an incorrect calculation in step 2

1

*an answer of 99 scores **3** marks*

(c) inedible parts / example

*allow eaten by other animals **or** not all organisms eaten*

or

egested / faeces

allow not digested
allow excretion / urine
ignore waste

or

respiration / as CO_2

ignore energy losses

ignore movement

1

(d) bacteria decay organic matter / sewage / algae / dead plants

1

(by) digestion

allow example such as starch broken down to sugar
or
protein broken down to amino acids

1

(and) bacteria respire aerobically
or
respire using oxygen

1

(which) lowers oxygen concentration (in water)
or
fish have less oxygen

allow reduced respiration of fish

1

(so) reduced energy supply causes death of fish

allow toxins in the sewage kill fish

ignore pathogens or (pathogenic) bacteria cause disease in fish and kills them

1

[13]

Q6.

(a) 3.7

1

(b) 2

1

(c) (different combinations of alleles cause) many / 22 values

allow continuous variation

or
in-between values
or
large range of values

or
there are not only two values

allow there are not only 3 values if 3 is given in part ***(b)***

1

(d) different protein made

allow change in shape (of enzyme) or change in 3-D structure
ignore denature

1

active site changed

1

so substrate does not fit / bind

allow description of substrate
allow cannot form E-S complex
ignore lock and key description

1

(e) produces (some) offspring with high-fat milk
or
not all offspring have low-fat milk

ignore reference to alleles

1

(f) takes less time (to obtain results)
or
more offspring at the same time

allow other sensible suggestion − e.g. allows screening ***or*** *allow cow 7 to continue to produce eggs* ***or*** *avoid injury to cow 7 during mating or giving birth*

1

(g) male gametes correct: d (and d)

1

female gametes correct: D and d

1

allow ***1*** *mark if gametes are correct but gender not identified*

correct derivation of offspring genotypes from given gametes

allow 2 × 2 ***or*** *2 × 1 derivation*

1

Dd identified as low-fat **and** dd identified as high-fat in offspring

if DD offspring are produced, must also identify as low-fat

1

(h) find female with low(est) fat in milk **and** high(est) milk yield

allow choose from 7, 9, 12, 13 which has the *highest yield*

1

find male whose female offspring have high(est) milk yield **and** low(est) fat in milk

allow choose from 16 or 18 whose female offspring has the highest yield

1

or

find female with lowest fat in milk
or cow 13 (1)*

*****or***
allow female with high(est) milk yield

find male whose female offspring have high(est) milk yield (1)*

*****or***
allow male whose female offspring have lowest fat in milk / male 16

cross the best (for both features) female with the best male

1

select best offspring (for both features) from each generation and repeat for several generations

1

[16]

Q7.

(a) to kill microorganisms on / in the flask
or
so only microorganisms in the milk caused the results

allow bacteria / fungi / microbes

*do **not** accept viruses*

ignore germs

1

(b) heating

1

to over 100 °C

allow place in oven / pressure cooker

*do **not** accept disinfectant*

allow other suitable method – e.g. use of UV

1

(c) to prevent microorganisms entering from the air

allow bacteria / fungi / microbes for microorganisms

*do **not** accept viruses*

ignore germs

1

(d)

0	olive-green	**7**
1	olive-green	**7**
2	olive-green	**7**
3	orange-green	**6**

*all correct for **1** mark*

1

(e) (pH meter) – more accurate / more precise

allow more exact

allow can measure to 0.1 pH unit

***or** to smaller intervals of pH*

1

(leaving…6 days) – obtain greater pH change

or

because there was (very) little change in 3 days

allow more acid will be made

1

(f) scale > $\frac{1}{2}$ of x-axis

and

x-axis labelled (time in) days

1

points plotted correctly

*all 7 correct = **2** marks*

*5 or 6 correct = **1** mark*

2

line of best fit = smooth curve through points

*do **not** accept ruled point-to-point*

1

(g) (1st day) too few bacteria

1

(after day 1 more bacteria so more) acid made

1

(days 5-6) sugar / food used up

or

low pH denatures enzymes

or

low pH kills bacteria

allow enzymes do not work

*do **not** accept enzymes killed*

1

(h) (similarity) – same start pH / pH7 and end pH / pH4.5

or
same pH change / change = 2.5

1

(difference) – faster

1

[16]

Q8.

(a) any **two** from:
- sprinkled through air
- air spaces between stones
- thin layer over stones (for efficient diffusion)
- slow flow (for efficient diffusion)

2

(b) green algae

1

(c) (large / small) protist

1

(d) **Level 2 (3-4 marks):**
Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

Level 1 (1-2 marks):
Facts, events or processes are identified and simply stated but their relevance is not clear.

No relevant content (0 marks)

Indicative content

digestion:
- (external) enzymes released
- role of enzymes – e.g. amylase / protease / lipase
- substrates & products – e.g. starch ⟶ sugar / protein ⟶ amino acids / fat ⟶ fatty acids

absorption:
- by diffusion / active transport

deamination:
- amino acids ⟶ ammonia / ammonium ions

release of other ions:
- e.g. phosphate / nitrate / magnesium

respiration:
- produces carbon dioxide (+ water)
  or
  equation is given
- release of energy allows other processes to take place e.g. active transport

[8]

Q9.

(a) large number – more representative and so more valid (mean can be calculated)

allow more reliable

1

random – avoid bias

1

(b) correct figures in table:

(3)
(8)
(16)
19
9
4
1

1

(c) all bars plotted correctly

± 1 mm

allow ecf from the table

1

(d) any **three** from:

- much overlap of values between the 2 shores

sheltered shore:

accept converse for exposed shore

- wider range **or** use of figures – e.g. approx 0.26 to 0.70 cf 0.21 to 0.55
- higher mode **or** use of figures – e.g. 0.41 to 0.45 cf 0.36 to 0.40

  allow ecf for figures from (b)
- there are no limpets at 0.21 to 0.25

  allow there are no limpets on exposed shore at 0.56 to 0.70

3

(e) sheltered – 0.47 **or** 0.466

1

exposed – 0.35 **or** 0.354

1

(f) radius = 2.48 cm

an answer of 38.6 / 38.62 / 38.64 scores ***3*** *marks*

1

(area = 3.14 × $(2.48)^2$ =) 19.3 cm^2

allow area calculated from incorrect radius

1

(force = 19.3 × 2 =) 38.6 (newtons)
or
(force = [3.14 × $(2.48)^2$] × 2)
= 38.62 (newtons)

or
(force = [$\pi \times (2.48)^2$] × 2)
= 38.64 (newtons)

allow force calculated from 1 previous error

1

(g) any **two** from:

- foot may not be circular
- foot may be larger / smaller than outside of shell
- scientists' value is approximate
- variation between limpets / described

  *e.g. re muscle development **or** greater 'awareness' of some limpets*
- variation in rock surface texture

2

(h) any **three** from:

- more force of waves to dislodge limpets
- lower height lowers exposure to waves
- wider foot gives greater grip
- those with this / these feature(s) pass on alleles / genes to offspring leading to population of broad squat limpets

  allow converse for sheltered shore throughout, if clearly stated

3

[17]

Q10.

(a) snail
or
shrew

additional incorrect answer negates correct answer

1

(b) shrew

additional incorrect answer negates correct answer

1

(c) fewer shrews to eat them

1

(d) population

1

(e) **C**

1

(f) (11 000 × 0.1 =)
1 100 (kJ)

1

(g) the snails do not eat the roots of the lettuces

1

(h) any **one** from:

- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)
- wind intensity / speed

  ignore wind direction
- carbon dioxide (levels)
- oxygen (levels)

1

[8]

Q11.

(a) measure the length / area of the field

1

(b) use (a) random number(s) (generator)
or
use coordinates method explained

1

(c) compare their results with another student's results

1

place more quadrats

1

(d) 0.25 × 5 = 1.25

1

500 / 1.25 = 400

1

(40 × 400 =) 16 000

*allow 16 000 with no working shown for **3** marks*

1

(e) 11

1

(f) (quadrat) 5

*both quadrat number and correct reason must be given for **1** mark*

1

very few or only 2 growing (here)

[9]

Q12.

(a) methane is produced

ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

Q13.

(a) wear a face mask

allow wear gloves

1

(b) **Level 2 (3–4 marks):**
A detailed and coherent plan covering all the major steps. It sets out the steps needed in
a logical manner that could be followed by another person to produce an outcome which
will address the hypothesis.

Level 1 (1–2 marks):
Simple statements relating to steps are made but they may not be in a logical order. The plan may not allow another person to produce an outcome which will address the hypothesis.

0 marks:
No relevant content.

Indicative content

Plan:

- cut a specified number of pieces of bread to the same size
- place mould spores on the bread
- the number of mould spores needs to be the same quantity of mould spores on each piece of bread
- place bread in different sealable plastic bags
- place in different temperatures (minimum of three) eg fridge, room, incubator
- leave each for the same amount of time eg four days
- measure the percentage cover of mould on each piece of bread
- repeat experiment

additional examiner guidance:

- good level 2 answer will describe how the growth of mould can be measured and will give a range of different temperatures to be used
- allow equivalent levels of credit for alternative methodologies that would clearly produce a measurable outcome in terms of mould growth at various temperatures

4

(c) any **one** from:

- type of mould
- amount of mould (put on each piece of bread)
- amount of air in the plastic bags
- size of the pieces of bread
- type of bread
- amount of moisture / water added

1

(d) (56 − 4 = 52) / 5

1

10.4

*allow 10.4 with no working shown for **2** marks* 1

*ecf for incorrectly read figures for **1** mark*

(e) (decomposition occurs at a faster rate when the temperature is higher
or
amount of decomposition is higher when temperature is higher 1

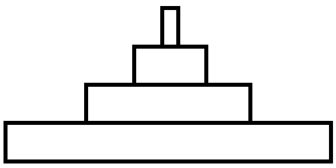
[9]

Q14.

(a) any **two** from:

- *idea of* absorption of light / energy
- transfer to chemical energy
  allow produce sugars / glucose / starch / carbohydrate / food / biomass
- provides food / energy for animals / caterpillar
- releases oxygen

2

(b) 

1

(c) 15(%)

*allow **1** mark for* $\frac{3 \times 100}{20}$ *with no answer or incorrect answer*
or
*allow **1** mark for 0.15*

2

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

- markings look like eyes / face / mouth of much larger animal
- looks fierce / scary / dangerous
  allow it looks like a snake
- to frighten blue tit / bird

max 1 if reference to camouflage

2

(ii) any **two** from:

- sharp / long / big claws
  ignore strong
- sharp / hooked beak
  ignore strong / big
- large wings **or** flies quickly
  allow streamlined / aerodynamic
  ignore powerful wings
- good eyesight

2

[9]

Q15.

(a) any **one** from:

- continuous readings
- do not need to be there

    allow automatic readings
- (more likely to be) accurate

    allow greater resolution

    *do **not** allow valid*
- reduces human error

    allow easier to read

1

(b) (i) microorganisms

allow microbes / bacteria / fungi / decomposers for microorganisms, throughout

1

(microorganisms) respire

1

respiration / decay / microorganisms releases carbon dioxide

ignore carbon released

1

(ii) all grass decomposed / decayed / rotted

*allow idea that all microorganisms dead (due to accumulation of waste **or** lack of oxygen)*

allow lack of / no oxygen (for respiration of microorganisms)

1

[5]

Q16.

(a) 0.67(%)

allow $0.\dot{6}$ or 0.7

*allow **1** mark for evidence of* $(2 \times 10^6) \div (3 \times 10^8)$

or

*allow **1** mark for 0.0067 or 0.6*

2

(b) (i) idea that food chains start with plants / producers

*allow food chains do not start with animals **or** larvae are consumers*

1

idea that these make food (for other organisms in the chain)

*allow idea that plants / producers photosynthesise **or** plants / producers get energy from the sun*

*allow mosquito larvae do not make food / photosynthesise **or** mosquito larvae do not get energy from the sun*

1

(ii) any **four** from:
- reasoned argument for **or** against release
  must refer to at least one advantage and one disadvantage.
  *max **3** marks for either only advantages **or** only disadvantages*

advantages:
- fewer mosquitos biting **or** spreading malaria
- fewer people get / die from malaria
  allow people won't get / die from malaria
- lower medical costs (for those infected **or** for treatment) **or** less healthcare needed
- better economically for developing / tropical countries.

disadvantages:
- fewer crops reproduce
  allow fewer crops pollinated
- poorer crop yield
- possible starvation (of people)
- high cost of GM production / mosquito release
- less food for bats / birds **or** bats / birds die
  *allow disruption to food chain / ecosystem **or** reduction of biodiversity*
- gene could 'escape' into other wildlife / species
  ignore into plants

4

(iii) any **three** from:
- gene from bacteria cut out
  allow allele for gene
- ref to enzymes (anywhere in process)
  allow at any point in process, ie in cutting or in splicing
- (gene) transferred to chromosome of mosquito
  allow DNA for chromosome
- at an early stage of development
  allow egg / embryo

3

[11]

Q17.

(a) (i) any **two** from:
- not all eaten
  allow eaten by other animals
- used for respiration
  ignore used / lost in heat / movement
- lost as CO_2 / water / urea
- lost as faeces **or** not all digested
  if neither mark awarded allow 1 mark for lost as waste

  ignore references to energy losses

  do not allow for growth / repair / reproduction

2

(ii) any **one** from:
- thrushes eat other things
- thrush numbers likely to vary (considerably)
  allow it is only an estimate (of population size) ***or*** *only counted thrushes for 5 hours*
- thrushes were not present all the time
- thrushes feed on a much bigger area

1

(b) (i) any **one** from:
- there are two dependent variables
- there is no independent variable
- to show the association / correlation / pattern (between the two variables)

1

(ii) (snails in woodlands)
more have dark(er) colour(ed shells) **or** fewer have light-coloured shells
allow converse for grassland, if clear

1

(shells have) no / fewer stripes or have no stripes
allow converse for grassland, if clear

1

(iii) less likely to be seen (by predators / birds / thrushes)
allow camouflaged (from predators / birds / thrushes)
allow light coloured shells with stripes would be more visible (to predators / birds / thrushes in woodland (than grassland)).

1

[7]

Q18.

(a) 88 000

correct answer = 2 marks

allow 1 mark for 1.1 (in 1 m^2)

or

allow 1 mark for answer = [candidate's value in 1m^2] × 80 000

2

(b) Place the quadrat in 100 random positions.

1

(c) any **three** from:

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

Advantages:
- less cost / free
- less likely to kill other (harmless species of) plants

- weedkiller may be toxic **or** may cause water pollution
- weedkiller may accumulate up food chains

  allow uneven distribution of ragwort so much wastage of weedkiller

Disadvantages:
- volunteers may mistake other species for ragwort
- volunteers may miss plants

  allow weeds will grow back
- some ragwort left to poison horses
- time consuming
- difficulties getting enough volunteers

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

3

[6]

Q19.

(a) (i) reduced photosynthesis

ignore growth

*do **not** allow need light for respiration*

1

(ii) less food (for animals) **or** less oxygen (for animals)

allow loss of habitat

1

(iii) any **two** from:

accept 2 physical factors or 2 biological factors or one of each for full marks

examples of physical factors, eg
- flooding
- drought
- ice age / temperature change

  ignore pollution
- volcanic activity

examples of biological factors, eg
- (new) predators (allow hunters / poachers)
- (new) disease / named pathogen
- competition for food
- competition for mates
- cyclical nature of speciation
- isolation
- lack of habitat or habitat change

  *If no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for **1** mark*

2

(b) (i) 3

1

(ii) fossils

ignore bones, remains, fossil fuels

1

(c) (i) 65 million years ago

1

(ii) 17

allow ecf

1

(iii) fossil record incomplete

or

some fossils destroyed

accept not enough evidence

or

cannot perform experiment to test

1

[9]

Q20.

(a) 160 000

if incorrect answer / no answer:

allow max. 2 for method:

1 mark for mean = total number ÷ area of ten quadrats

eg $\frac{20}{0.625}$ *or* $\frac{20 \times 8}{5}$ *or* $\frac{160}{5}$ *or 32*

1 mark for final answer = mean × field area

eg mean × 5000

3

(b) Improvement: place quadrats randomly

and

Reason: avoid bias / (more) representative / (more) reliable

allow 1 mark if 2 correct improvements but no reasons / only incorrect reasons

1

Improvement: more quadrats

and

Reason: overcome random variation / (more) typical / (more) representative / (more) reliable / repeatable

1

Improvement: larger quadrats **or** repeat when plants are bigger

and

Reason: less likely to miss plants

ignore accurate, valid, precise and fair

ignore anomalies

1

[6]

Q21.

(a) limiting their movement
or
controlling the temperature of their surroundings

1

reason:

reduces energy transfer

*if no other marks awarded, allow **1** mark for: 'fit more chickens in same space'*

1

(b) (i) without oxygen

ignore 'without air'

1

(ii) any **two** from:

- ethanol

  allow alcohol

- carbon dioxide
- lactic acid.

  ***do not accept** energy / ATP (apply list rule)*

2

(c) enzymes are denatured / change shape

ignore microbes are killed

1

(enzyme) shape is vital for function **or** won't work (as efficiently)

1

(d) (i) 200

1

(ii) 120

allow ecf from (d)(i)

e.g.

$\frac{60}{100} \times$ *(i)*

1

(e) causes global warming

1

one predicted consequence of global warming

eg rising sea levels, climate change, change in migration patterns, change in distribution of species

or

methane is flammable
so might cause fire / damage

*if no other marks awarded, allow methane is a greenhouse gas for **1** mark*

1

[11]

Q22.

(a) (i) counts / 12

1

× 120 × 80 / × 9600
or
× area of field

1

(ii) (more) quadrats / repeats

1

placed randomly

ignore method of achieving randomness

1

(b) (i) any **three** from:

- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)

  allow nutrients / fertiliser / soil fertility

  ignore food
- pH (of soil)
- trampling
- herbivores

  ignore predators
- competition (with other species)
- pollution qualified e.g. SO_2 / herbicide
- wind (related to seed dispersal).

  ignore space / oxygen / CO_2 / soil unqualified

3

(ii) light needed for photosynthesis

1

for making food / sugar / etc.

1

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

1

(c) (i) fertiliser / ions / salts cause growth of algae / plants

1

(algae / plants) block light

1

(low light) causes algae / plants to die

1

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

1

(aerobic) <u>respiration</u> (by microbes) uses O_2

*do **not** allow anaerobic*

1

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

allow suitable named examples eg metals such as Pb / Zn / Cr / oil / SO_2 / acid rain / pesticides / litter

ignore chemicals unqualified

ignore waste unqualified

ignore human waste / domestic waste / industrial waste unqualified

1

(d) (i) 2

1

(ii) more food

allow other sensible suggestion eg more species colonise from tributary streams after forest

1

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

allow fewer species in more polluted water

ignore none are found at site C

1

[19]

Q23.

(a) any **two** from:

- amount of waste on each heap

  allow size of heap
- (type of) materials on each heap

  *if neither marking points one or two awarded, allow **1** mark for same waste*
- put heaps in same (environmental) conditions.

  e.g. keep at same (outside) temperature

  allow put in same place

2

(b) microorganisms / microbes / bacteria / fungi / decomposers

ignore detritivores / examples (such as worms, maggots, insects)

ignore pathogens / germs

*do **not** allow viruses*

1

(c) (i) oxygen / air added (when turning over)

allow idea that decay will be aerobic

allow bacteria / microorganisms need oxygen / air *allow (microorganisms) respire faster*

1

(ii) any **two** from:

- dead leaves / fruit / plants (fall off / onto the ground)
- (fallen dead leaves / fruit / plants) decay
- minerals / ions / nutrients are recycled / released.

ignore references to carbon dioxide

*allow animal waste **or** dead animals*

2

[6]

Q24.

(a) photosynthesis

1

(b) (i) 140

1

(ii) (10 billion tonnes) more added (to atmosphere) than removed

allow ecf from part (b)(i)

1

[3]

Q25.

(a) methane / CH_4

allow CH_4

*do **not** allow CH4 **or** ch4 or CH4*

1

(b) any **two** from:

- didn't carry out repeats
- only tested four types of manure
- don't know the mass of manure was the same each time
- inaccuracies in measuring (diameter of) balloon
- bottles might have been different sizes
- temperature of the room may have been different.

2

(c) The potato contains a lot of carbohydrate

1

[4]

Q26.

(a) (i) correct bar heights

*three correct **2** marks*

*two correct **1** mark*

*one or none correct **0** marks*

ignore width

2

(ii) (Stream Y)

has many sludge worms / bloodworms

or

has no mayflies / caddis or few shrimp

*allow **1** mark if invertebrate not named but correct association given*

1

which indicate medium or high pollution

1

(b) (i) suspended solids increase (as a result of sewage overflow)

1

then decrease downstream / return to original levels

1

oxygen levels decrease (after sewage overflow)

1

and then rise again

1

(ii) any **three** from:

- mayflies decrease (to zero) near overflow
  accept 'have died out'
- because oxygen is low **or** mayflies have high oxygen demand
- mayflies repopulate / increase as oxygen increases again
- can't be sure if dissolved oxygen or suspended solids is the cause

3

(c) they respire / respiration

*aerobic respiration gains **2** marks*

1

this requires / uses up the oxygen

1

[13]

Q27.

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

- burning (fossil) fuels / one named example
  allow combustion / driving cars
  accept breathing
- deforestation / described
  *do **not** allow power stations unqualified*
- destruction of peat bogs

2

(ii) any **two** from:

B, C, D

in any order

2

(iii) B

1

(b) (i) with worms: 90

1

without worms: 78

1

(ii) increase

1

(iii) 6 mm mesh is large enough to let (more / bigger) worms in

allow converse for 1.5 mm mesh

1

worms entering increased breakdown

or ate more leaves

1

(iv) breakdown occurs with 1.5 mm mesh (which is smaller than worms)

1

breakdown with no worms ≈ 70% / ≈ 30% remaining

allow a lot / most breakdown without worms

accept approximate figures

1

[12]

Q28.

(a) (i) 10

1

(ii) any **three** from:

- both increase with distance
- more spp on walls than on trees
- no lichen spp on trees for first 1 km from city
- more steady / less erratic increase on trees than walls (or converse)
- rate of increase increases with distance

3

(b) SO_2 decreases with distance from centre

accept converse

Ignore pollution

1

high SO_2 reduces survival or kills lichen

accept converse

1

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

- (line) transect
- quadrat / reference to specific area
- count number of lichens or coverage on trees
- at regular intervals / set distances

3

(ii) (more) Xanthoria nearest road

allow 'nitrogen-loving' for Xanthoria

1

(more) Usnea further from the road

allow 'nitrogen-sensitive' for Usnea

1

because most nitrogen oxide from vehicles (near road)

or

because nitrogen oxide levels will be falling / less further away (from road)

accept converse

1

[12]

Q29.

(a) any **one** from:

- get lots of data
  accept more reliable / reproducible
  do not accept more accurate
- cheap / free
- unlikely to be biased
- can cover a wide area at the same time / takes less time
- see seasonal variations

1

(b) (i) correct bar heights

__1__ mark for each correct bar

ignore width of bars

2

(ii) 12 800

(16000 / 100)x80 on its own for __1__ mark

2

(iii) goldfinch

1

(c) any **one** from:

- more food available
  accept fewer predators
- people feed them
  accept less habitat / food in countryside
- more rubbish / waste to eat

1

[7]

Q30.

(a) microorganisms

allow microbes / bacteria / fungi / decomposers

1

(microorganisms) respire

*do **not** allow dead plants respire*

1

(respiration / decay / microorganisms) releases (thermal) energy / ‘heat’

ignore produce ‘heat’

*do **not** allow produce energy*

*do **not** allow dead plants release ‘heat’*

1

(b) (i) any **three** from:

- (opening) allows oxygen in
- microorganisms / eggs need oxygen
  allow air for oxygen
- oxygen needed for respiration
- (opening) allows release of carbon dioxide (from microorganisms / respiration / eggs)
  allow gaseous exchange (1 mark) of / for microorganisms / eggs (1 mark) if none of first four points given
- (opening) allows energy / ‘heat’ to escape
- (closing) retains energy / ‘heat’ if too cool / at night
  *if no mark awarded for either of these points allow 1 mark for vents open in the day to prevent overheating **and** close at night to prevent it getting too cold*
- (closing) retains moisture
  allow (opening) releases moisture

3

(ii) any **one** from:

- maintains sex balance
  e.g. equal / best / correct numbers of male and female
- (survival of species depends on there being) males and females in population
  allow so the offspring are not all the same sex

1

[7]

Q31.

(a) any **three** from:

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

  ignore 'record the results'

  ignore measures / estimates dandelions
- repeat every 2 metres

  allow every metre / at regular intervals

3

(b) (i) low light / it is shady

allow no light

ignore sun / rays

or

not enough water / ions / nutrients

accept correct named ion

ignore no water / ions / nutrients

or

wrong pH of soil

accept competition with trees for light / water / ions

ignore competition for space and competition unqualified

accept soil too acidic / too alkaline

ignore temperature

1

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

1

(c) repeat (transect) / compare with the results of other groups

allow 'do it in two different locations' for 2 marks

1

at different / random location(s) / elsewhere (across the field)

*do **not** allow 'in other fields'*

1

[7]

Q32.

(a) (i) to get data re position of seaweed / of organism

1

in relation to distance from sea / distance down shore / how long each seaweed was exposed

1

(ii) repeat several times

minimum = 2 repeats

1

elsewhere along the shore

1

(iii) bladder wrack is further up the shore (than the sea lettuce) / exposed for longer

ignore found in dry areas / on bare rock

1

sea lettuce (only) in rock pools / in the sea / (only) in water

1

(b) gets more light / closer to light

allow better access to CO_2

1

(so) more photosynthesis

allow 1 mark for light for photosynthesis

allow 1 mark for CO_2 for photosynthesis

ignore reference to oxygen for respiration

'more' only needed once for 2 marks

1

[8]

Q33.

(a) (i) (initially there is) oxygen

accept:
oxygen hasn't been used up yet (so not anaerobic conditions yet)

1

(so) aerobic respiration (by microorganisms)

accept (because) methane is produced in anaerobic (fermentation)

1

producing CO_2 (which does not burn)

accept there is no methane
ignore inflammable

1

(ii) (peelings had) the most carbohydrate / organic material

answer must be comparative

accept contained more microorganisms / decomposers / bacteria

ignore water

*do **not** allow fat or protein*

1

(b) (i) 0.22 / 0.221

correct answer with or without working gains 2 marks *allow 0.2 for 1 mark*

allow 22.1 for 1 mark

allow 0.34 × 65 / 0.65 for 1 mark

2

(ii) (sheep manure) produces a higher volume of biogas / almost double **or** produces 0.27 (m^3 per kg) more

accept 0.408(7) / 0.41 / 0.409 (m^3) from sheep for 2 marks

accept 0.1877 / 0.188 / 0.19 (m^3) more than cow's manure for 2 marks

1

(sheep manure) produces biogas with a higher percentage methane **or** produces 2% more methane

allow correct difference in volume calculated using 0.408(7) / 0.41 / 0.409 minus answer given in (i) for 2 marks

1

[8]

Q34.

(a) any correct named physical environmental condition, e.g. light / water / rain / temperature / minerals / nutrients / space (between plants)

ignore carbon dioxide / climate / weather / sun / pollution

1

genes / inheritance

ignore 'variety'

OR

any correct named biotic factor e.g. predation / disease

1

(b) mass of crop also depends on number of pods (per plant) / size / mass of each pea

ignore number of plants

1

(c) microorganisms / bacteria / fungi / decomposers / detritus feeders / named

1

decompose / rot / break down / decay / digest

ignore feed / eat

1

(these organisms) respire

*do **not** allow respiration by pea (plants)*

1

(decay / respiration / microorganisms etc) releases carbon dioxide

*do **not** allow combustion / fossilisation*

1

[7]

Q35.

(a) extremophile(s)

1

(b) (i) common (periwinkle) and flat (periwinkle)

either order, ***both*** *required*

1

(ii) (common and flat) both live in the same habitat / area / named area

allow habitats overlap the most

1

(iii) any **two** from:

- would have wrong food
- would otherwise be exposed to (specific) predators
- cannot tolerate extended exposure to air **or** reduced submersion in seawater
  allow cannot tolerate temperature / dehydration
- cannot tolerate high salt concentration (in rock pools)
  allow low salt concentration (in rock pools)
- cannot compete with small periwinkle

2

[5]

Q1.

The photographs show four different species of bird.

Great tit

© JensGade/iStock

Blue tit

© Marcobarone/iStock

Coal tit

Long-tailed tit

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

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

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

Answer = ____________ kJ per day per gram of body mass

(2)

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

(1)

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

(2)

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

(2)
(Total 7 marks)

Q2.

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

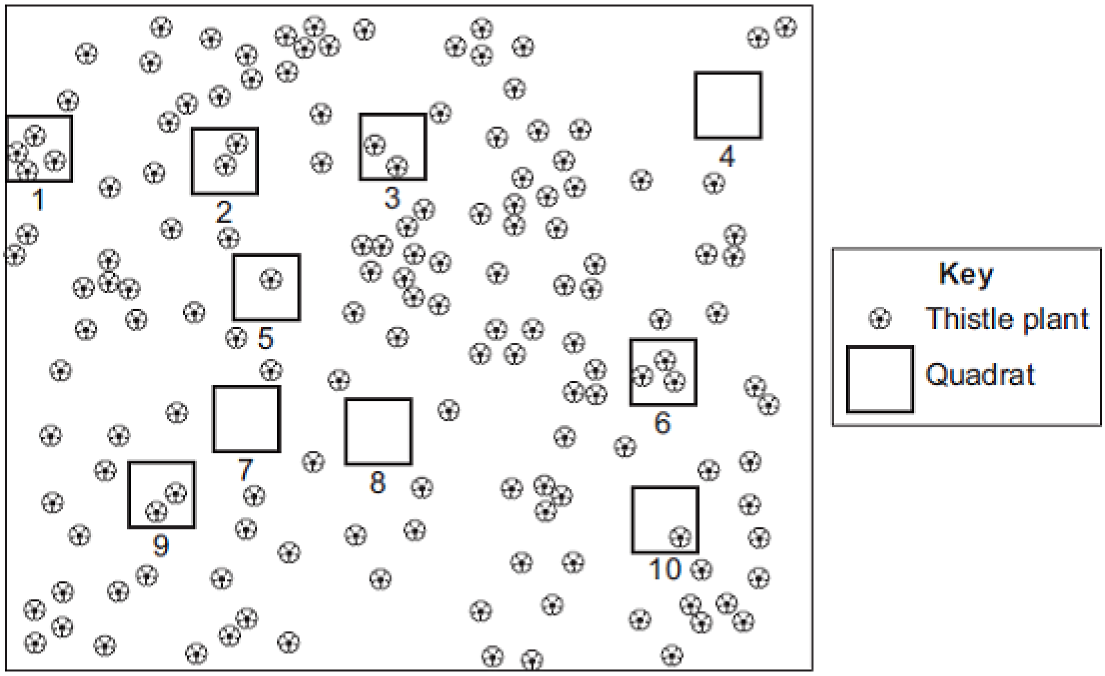
(a) Which method should the students use to decide where to place the 10 quadrats?

Tick (✓) **one** box.

Place the quadrats as evenly as possible around the lawn.	☐
Place 5 quadrats in areas with many thistle plants and 5 quadrats in areas with only a few thistle plants.	☐
Place all the quadrats randomly on the lawn.	☐

(1)

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



(i) Complete the table to show:

- how many thistle plants the students found in each of the first four quadrats
- the total number of thistle plants found in all 10 quadrats.

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

(2)

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

____

Mean = ___________________________

(1)

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

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

____

____

Estimated number of thistle plants = _______________

(2)

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

____

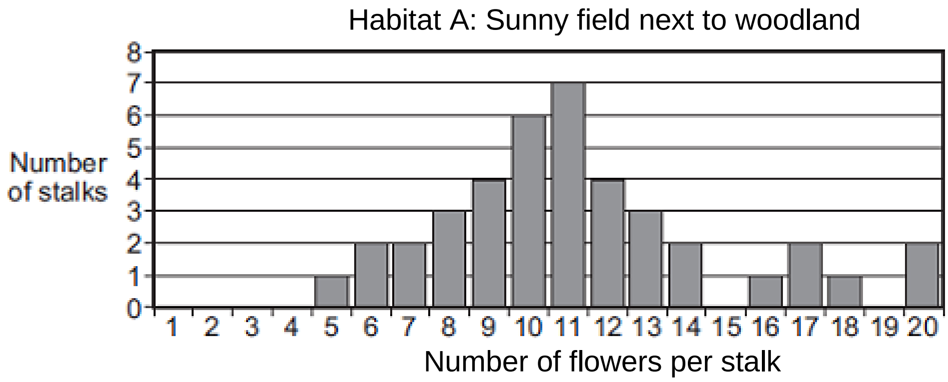
(1)
(Total 7 marks)

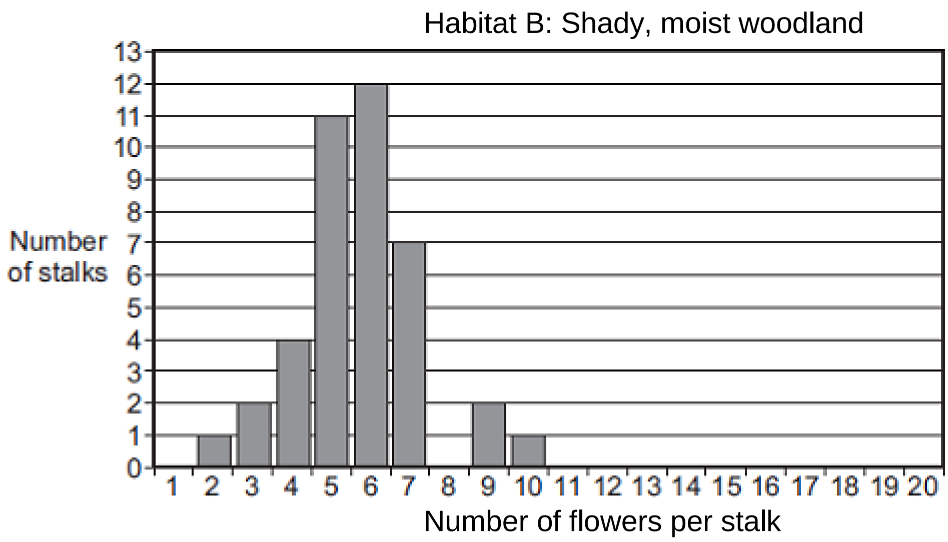
Q3.

Some students studied bluebell plants growing in two different habitats.

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

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





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

___

(2)

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

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

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

Mode = ___

(1)

(ii) The students suggested the following hypothesis:

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

Suggest why.

___

___

___

___

(2)

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

___

___

___

___

(2)

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

___

___

___

___

(2)

(Total 9 marks)

Q4.

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

(a) Over the next year the leaves decay.

Which living things cause decay?

____

(1)

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

Give **one** reason why.

____

____

(1)

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

Which gas is needed for decay?

Tick (✓) **one** box.

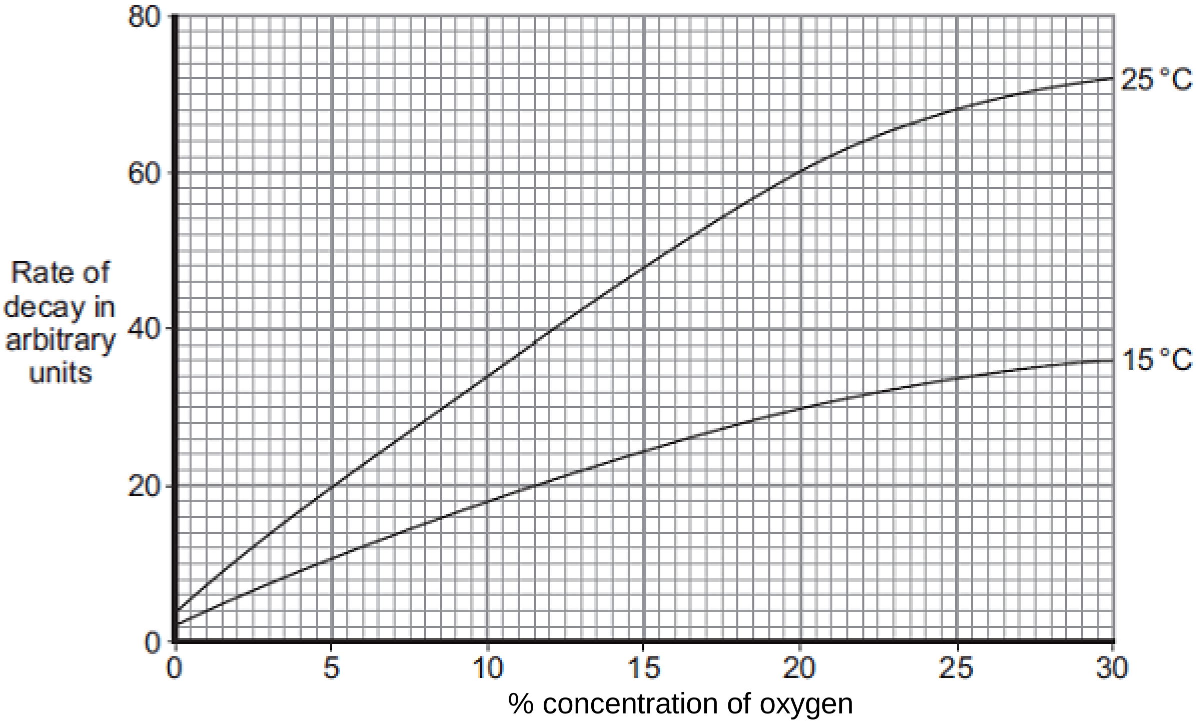
Carbon dioxide	☐
Nitrogen	☐
Oxygen	☐

(1)
(Total 3 marks)

Q5.

Gardeners often put waste material onto compost heaps.

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



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

____

____

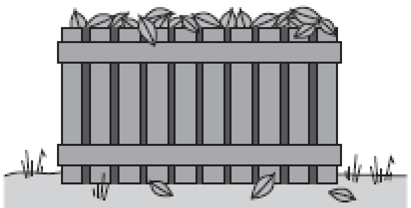
____

____

____

(2)

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



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

Explain why.

____

____

(2)

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

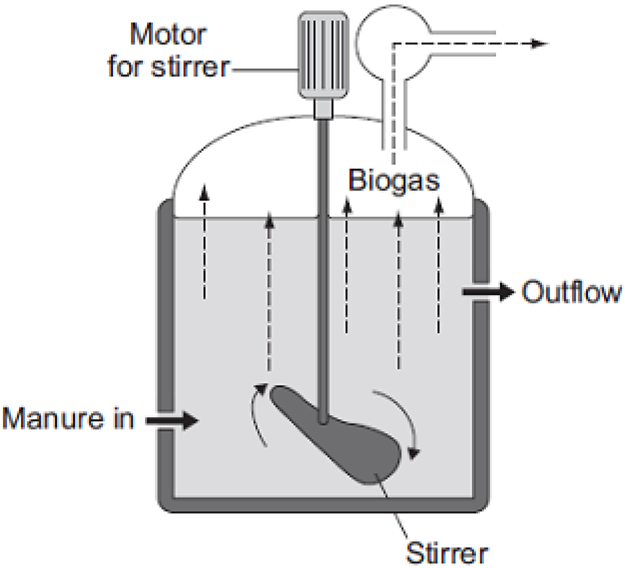
The gardener put some decayed compost onto the soil, around the plants.
One month later the plants were growing well.

Explain why.

(1)
(Total 5 marks)

Q6.

The diagram shows one type of biogas generator.



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

Suggest **one** reason for this.

Tick (✓) **one** box.

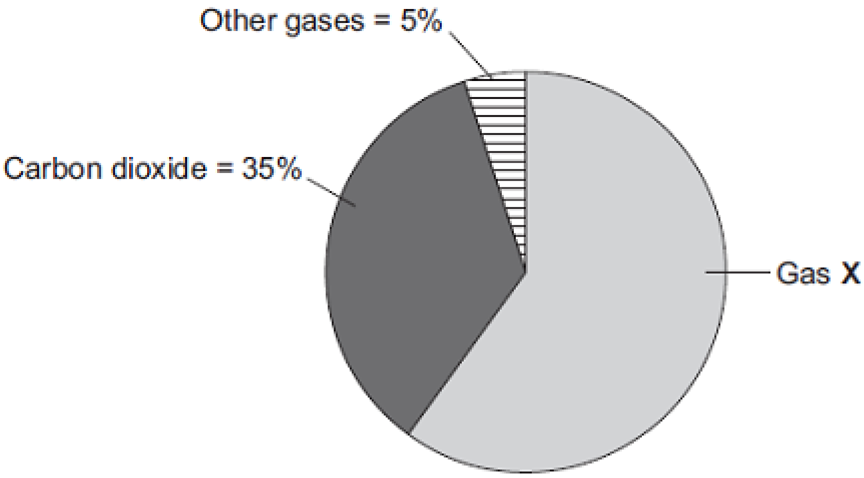
A higher concentration contains too little oxygen. ☐

A higher concentration would be difficult to stir. ☐

A higher concentration contains too much carbon dioxide. ☐

(1)

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



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

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

Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

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

Show clearly how you work out your answer.

____

____

Percentage of gas **X** = ____________________

(2)

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

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

aerobic respiration.

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

anaerobic respiration.
fermentation.

(1)

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

ammonia.
nitrogen.
oxygen.

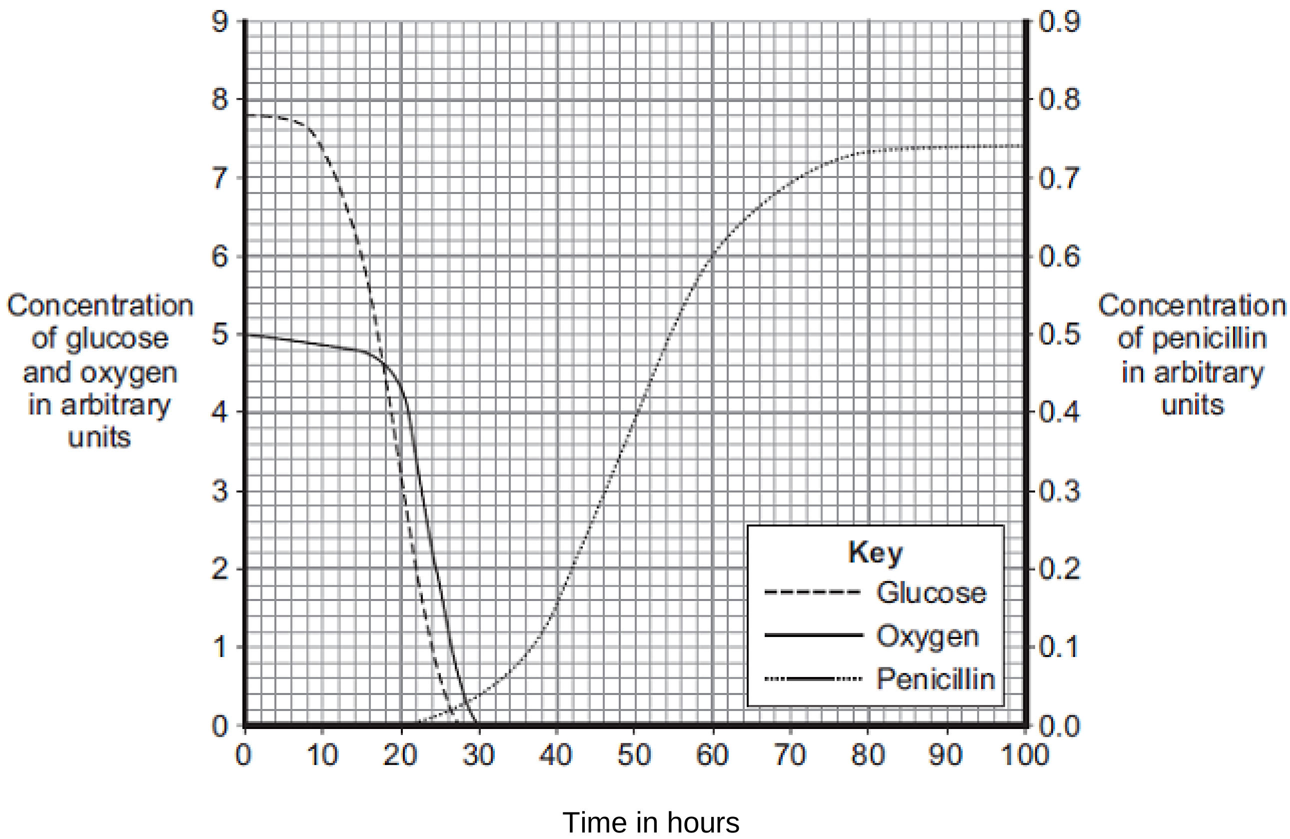
(1)

(Total 6 marks)

Q7.

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

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



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

Draw a ring around **one** answer.

0 – 20 hours **40 – 60 hours** **80 – 100 hours**

(1)

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

____

____

____

____

(2)

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

Tick (✓) **two** boxes.

The oxygen concentration changes after the glucose concentration.	☐
The oxygen concentration changes before the glucose concentration.	☐
The oxygen concentration changes less than the glucose concentration.	☐
The oxygen concentration changes more than the glucose concentration.	☐

(2)

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

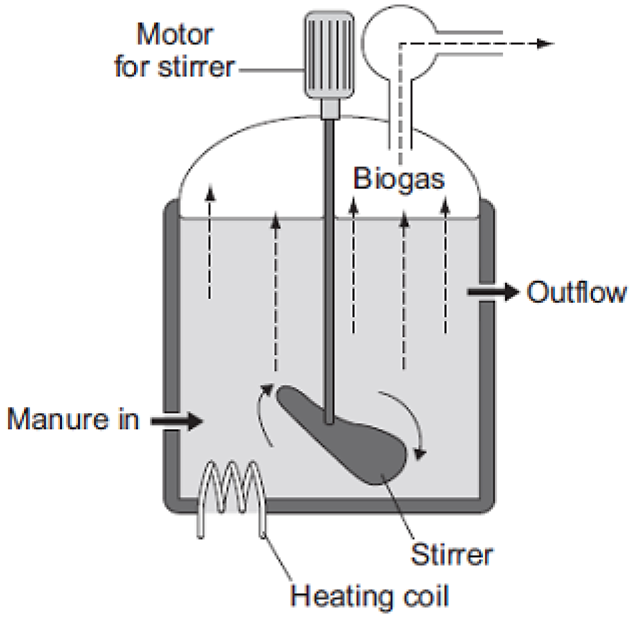
Draw a ring around **one** answer.

distillation **filtration** **respiration**

(1)
(Total 6 marks)

Q8.

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



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

____

____

(1)

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

Suggest **one** reason why.

____

____

(1)

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

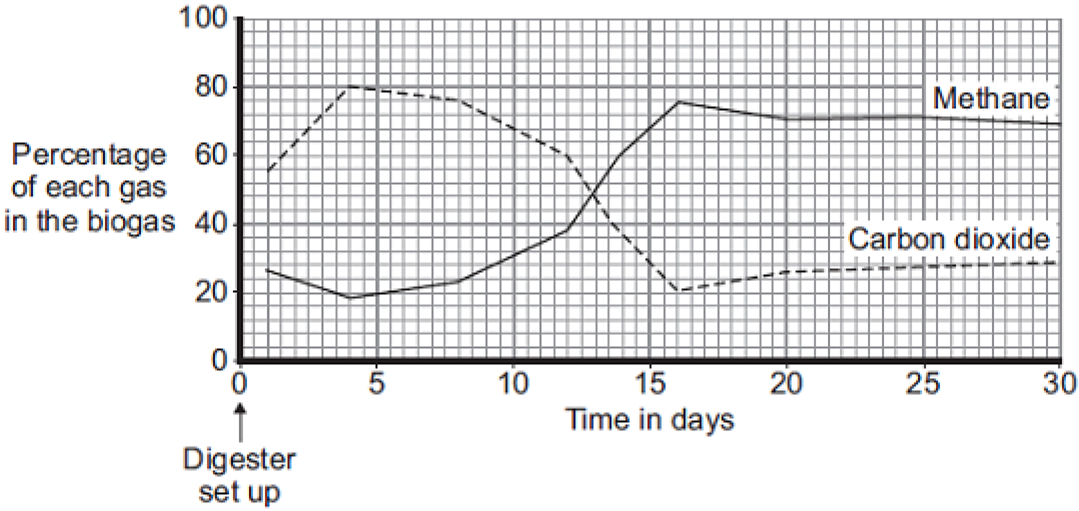
Suggest **one** reason why.

____

____

(1)

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



Use information from the graph to answer the following questions.

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

____

____

____

____

____

____

(3)

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

(1)

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

Suggest an explanation for this.

____

____

____

____

(2)

(Total 9 marks)

Q9.

Microorganisms can decay potatoes.

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

Describe how.

____

____

____

____

(2)

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

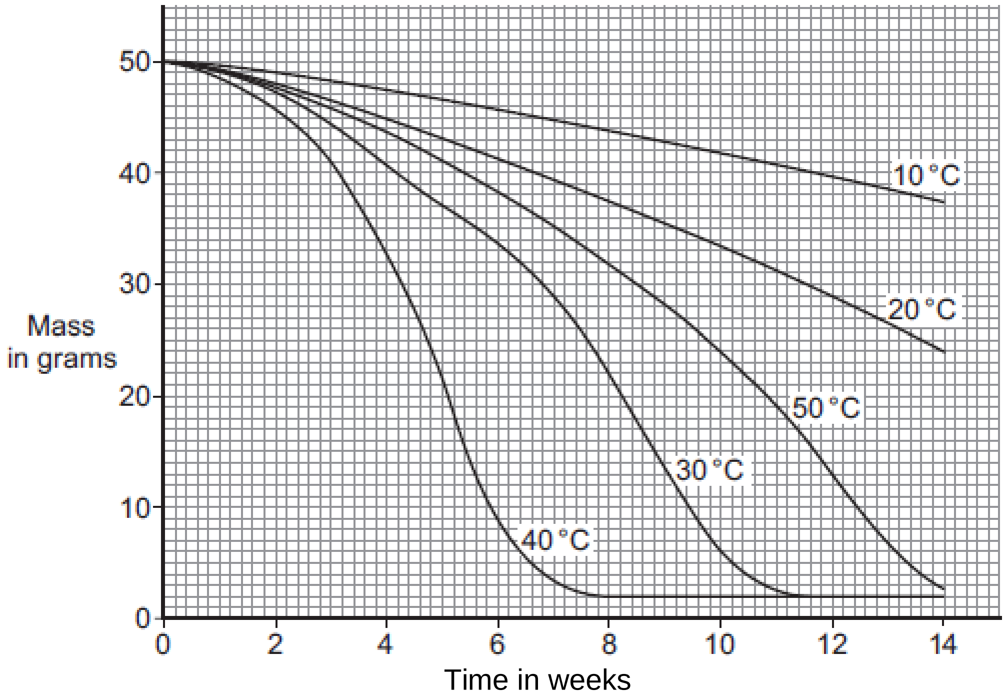
The students made the hypothesis:

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

The students:

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

The results are shown in the graph.



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

Explain why.

____

(3)

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

Explain your answer.

(2)
(Total 7 marks)

Q10.

Human activities affect the environment.

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

Give **two** reasons why.

(2)

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

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

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

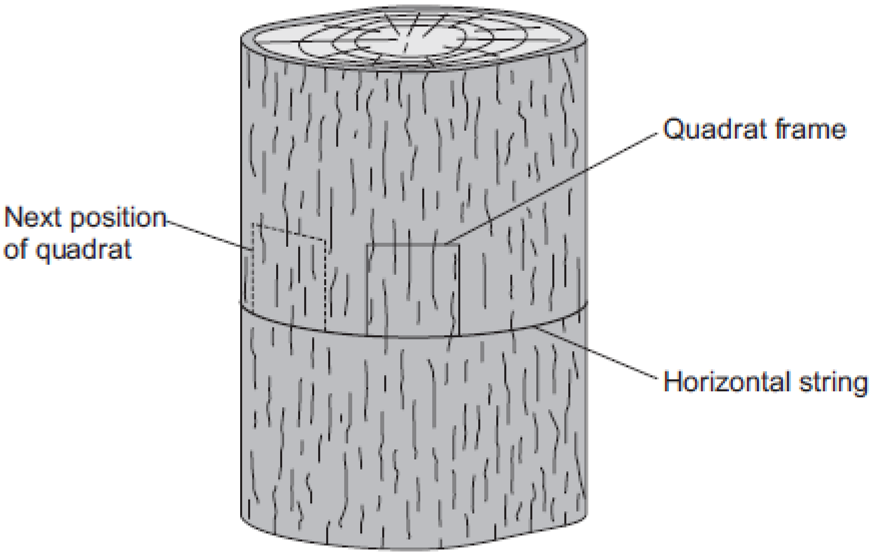
Explain why.

(6)

(Total 8 marks)

Q11.

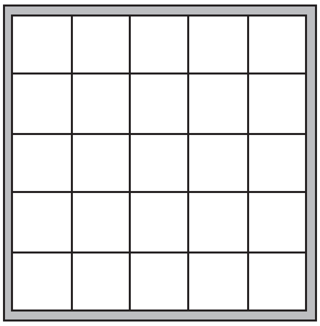
Students investigated the distribution of a green alga on a tree trunk.



The students:

- tied a piece of string horizontally round a tree
- put a quadrat on the string so that the quadrat faced south
- estimated the percentage of the area in the quadrat covered with the green alga
- repeated the observation with the quadrat facing south west, west, north west, north, north east, east and south east.

(a) The diagram shows the quadrat the students used.



Describe how you would estimate the percentage of the area covered with the green alga in one quadrat.

____

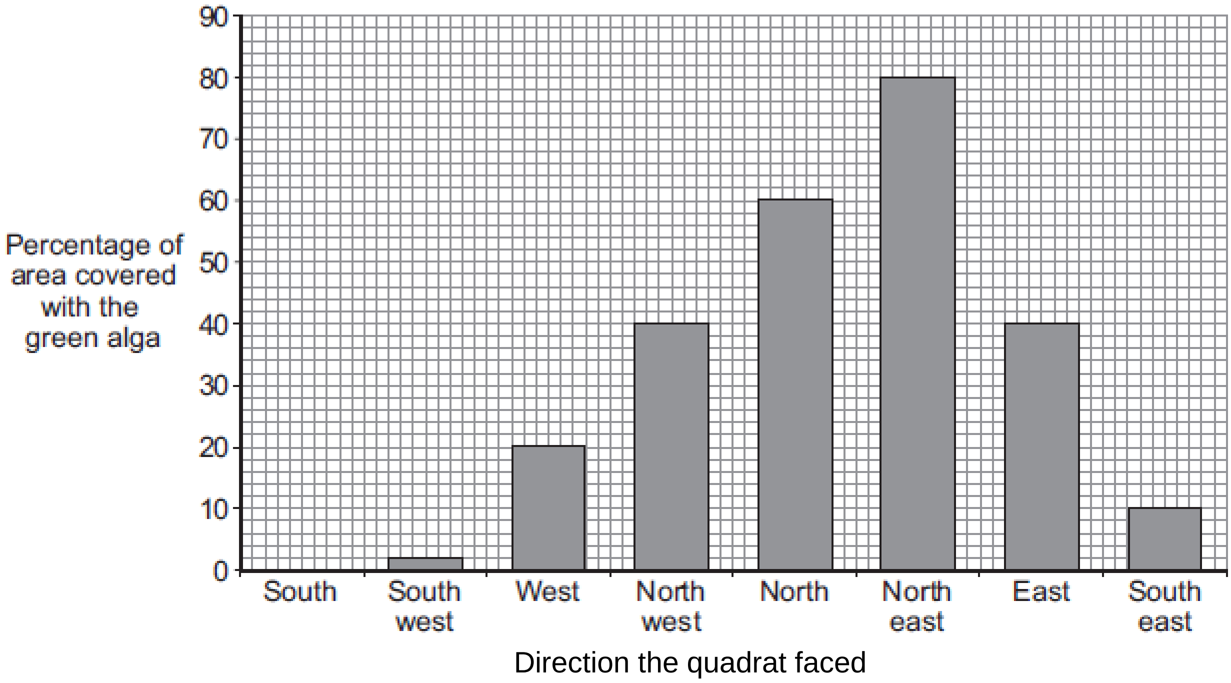
____

____

____

(2)

(b) The bar chart shows the students' results.



(i) How does the direction that the quadrat faced affect the percentage area covered with the green alga?

____

____

____

____

(2)

(ii) What was the mode of the percentage area covered with the green alga?

Mode = ________________________ %

Give the reason for your answer.

____

____

(2)

(iii) Give **three** environmental factors that might affect the distribution of the green alga on the tree.

1. ____

2. ____

3. ____

(3)

(iv) Suggest how **one** of the factors you gave in part **(b) (iii)** might have caused the distribution of the green alga shown on the bar chart.

Factor ____

____

____

____

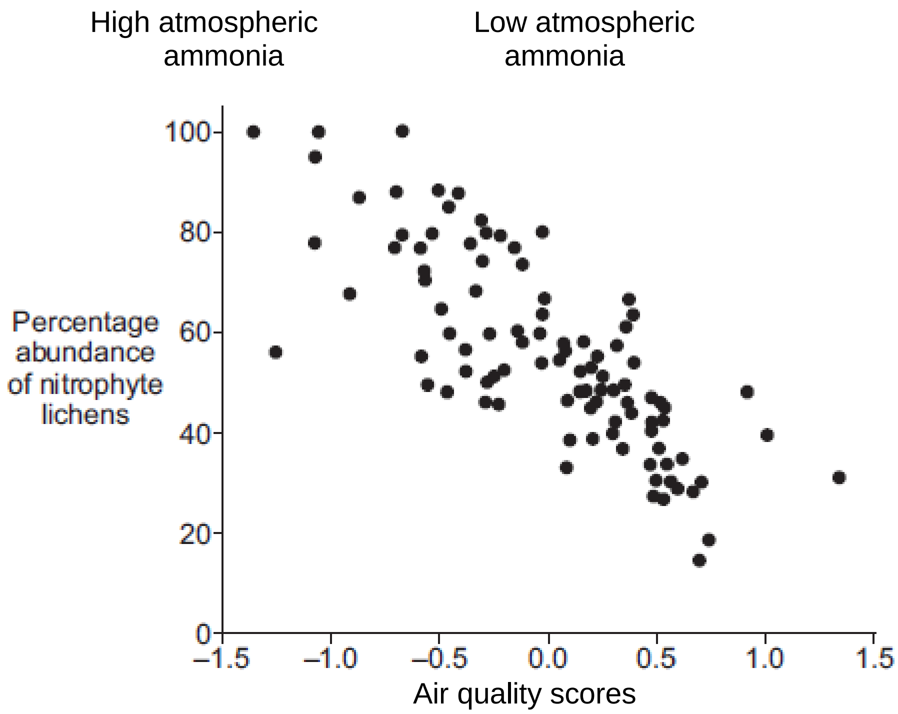
____

____

____

(3)

(c) Nitrophyte lichens grow on the bark of trees. These lichens are indicators of air pollution by ammonia. Ammonia concentrations in the atmosphere are often high in agricultural areas.
The graph shows the relationship between air quality and the distribution of nitrophyte lichens.



(i) Describe the relationship between atmospheric ammonia and the abundance of nitrophyte lichens.

____

____

____

____

(2)

(ii) How useful would a particular value for the abundance of nitrophyte lichens be as an indicator of ammonia pollution of the atmosphere?
Explain your answer.

___

___

___

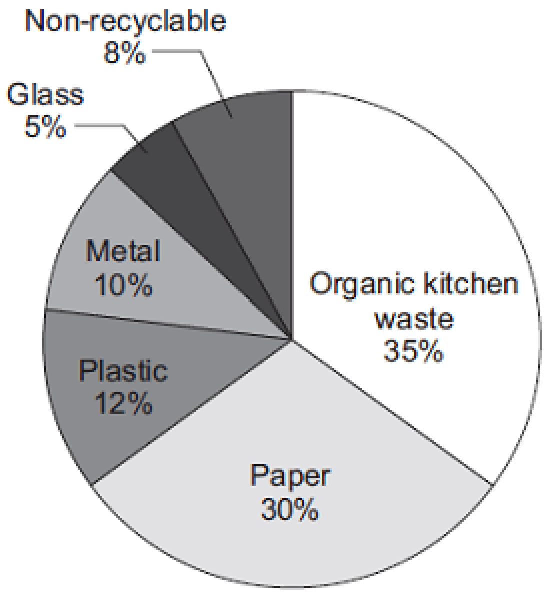
___

(2)
(Total 16 marks)

Q12.

This question is about recycling.

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



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

Organic kitchen waste can be put onto compost heaps.

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

___

___

Answer = ___________ million tonnes

(2)

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

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

____

____

(1)

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

____

____

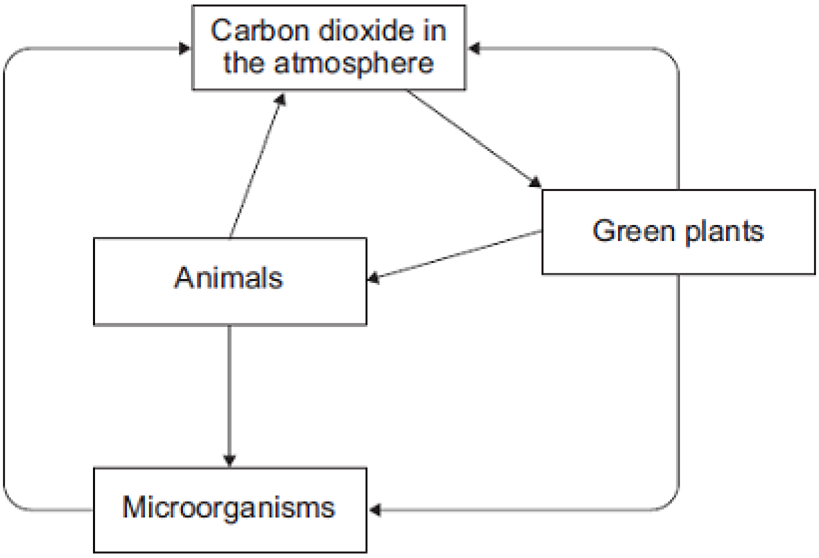
(1)

(Total 4 marks)

Q13.

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

The diagram shows part of the carbon cycle.



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

____

____

____

____

____

____

____

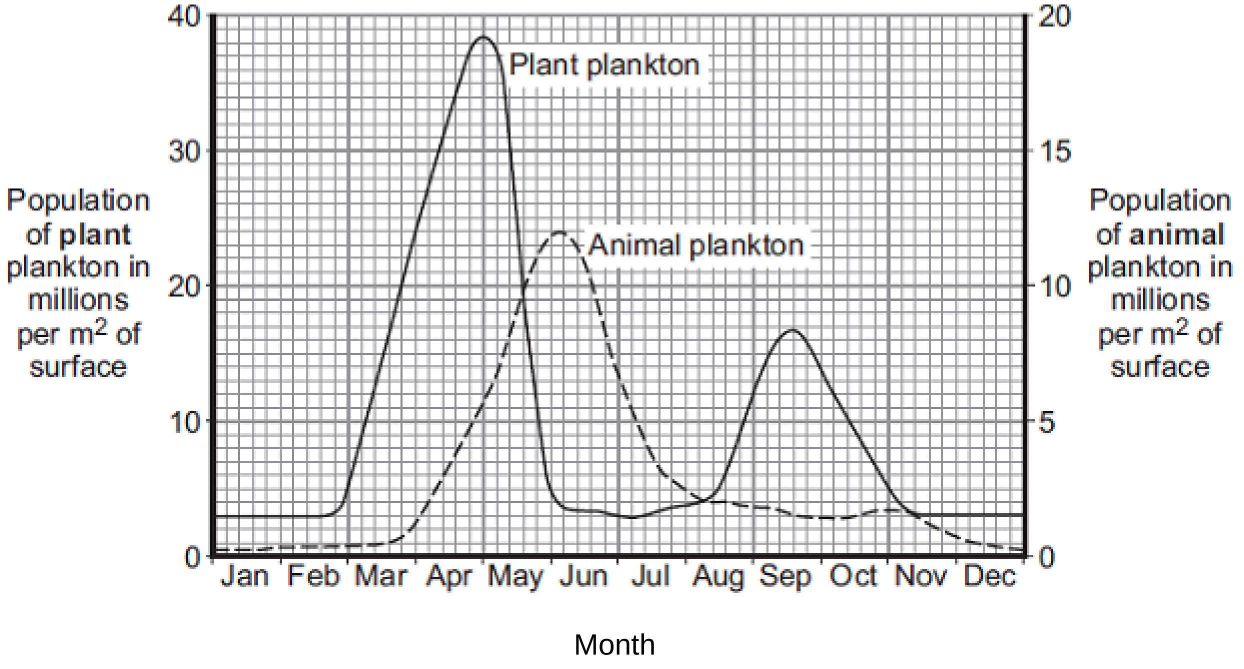
(Total 6 marks)

Q14.

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

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

Graph 1

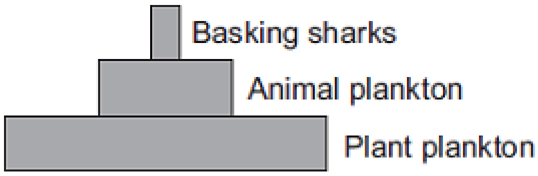


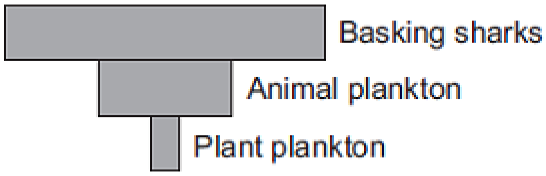
(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

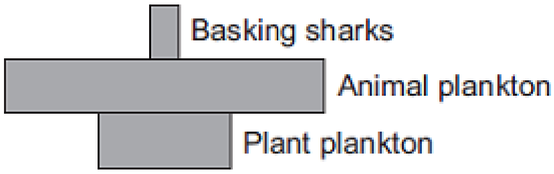
Look at the diagram and **Graph 1**.

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

Tick (✓) **one** box.

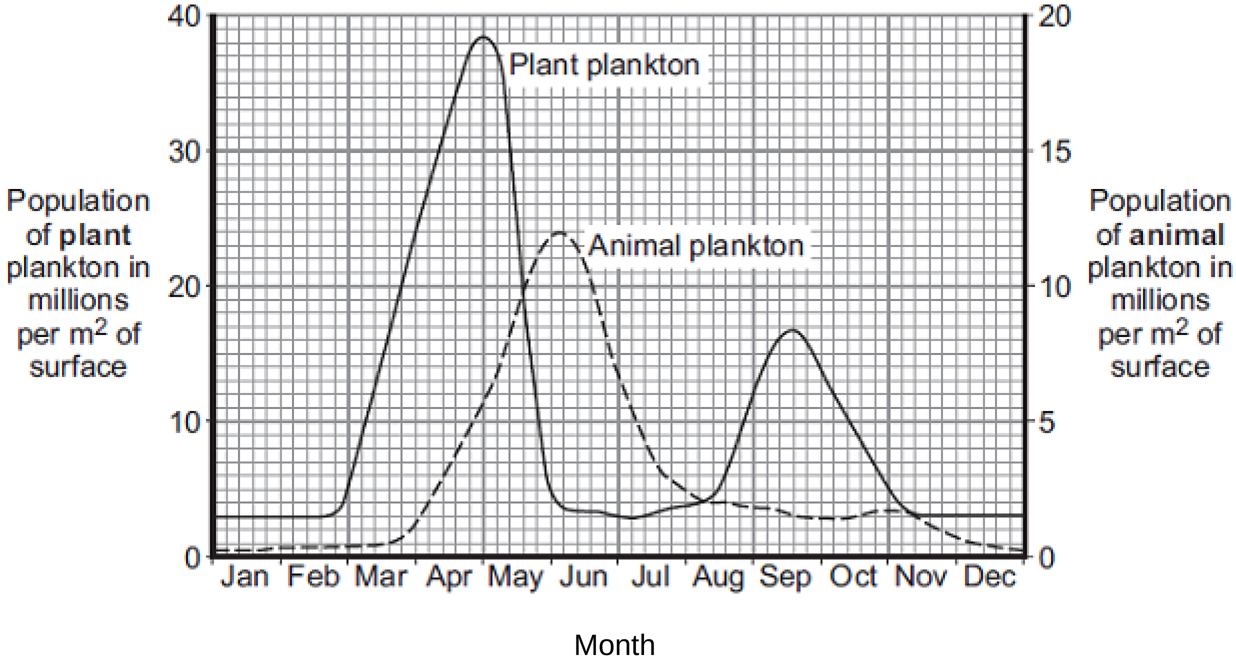






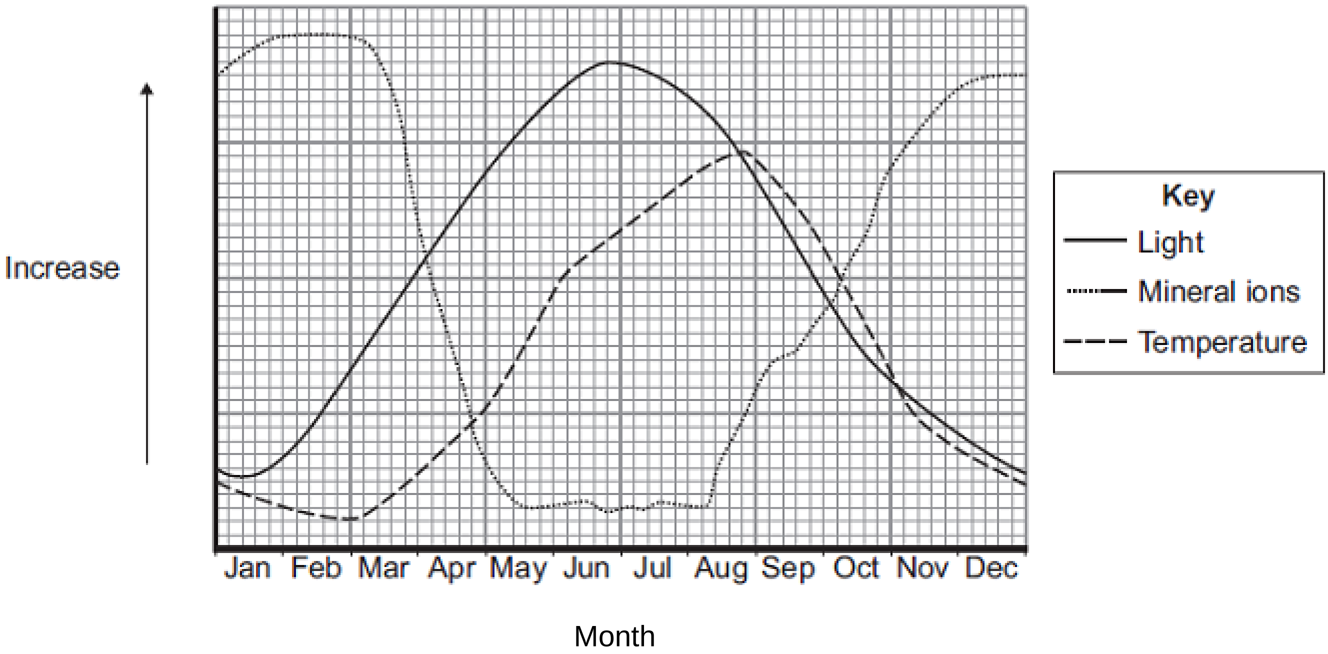
(1)

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



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

Graph 2



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

Suggest **one** reason for the increase.

Explain your answer.

____

____

____

____

(2)

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

Suggest explanations for the changes.

____

____

____

____

____

(2)

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

Suggest explanations for the changes.

(3)

(Total 8 marks)

Q15.

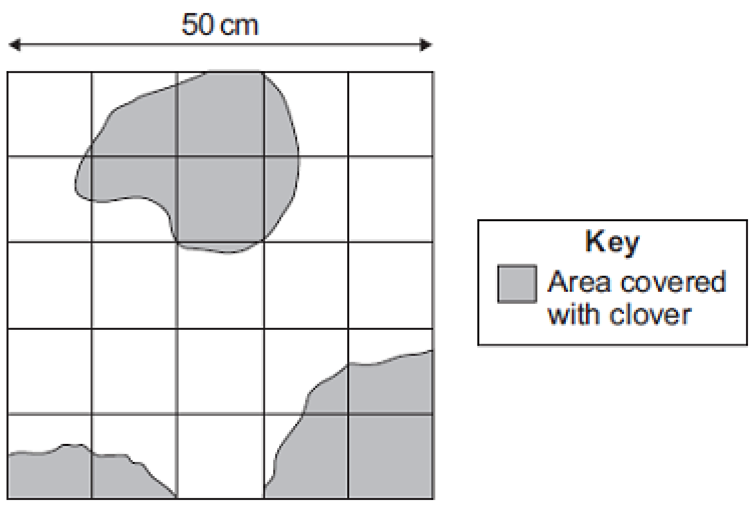
Some students were asked to investigate the distribution of clover in a field of grass. They noticed that the clover grew in patches amongst the grass.

(a) The students decided to use quadrats.

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

(2)

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



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

Number of squares = ______________

(1)

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

____

____

____

(1)

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

____

____

____

Answer = ______________ %

(2)

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

____

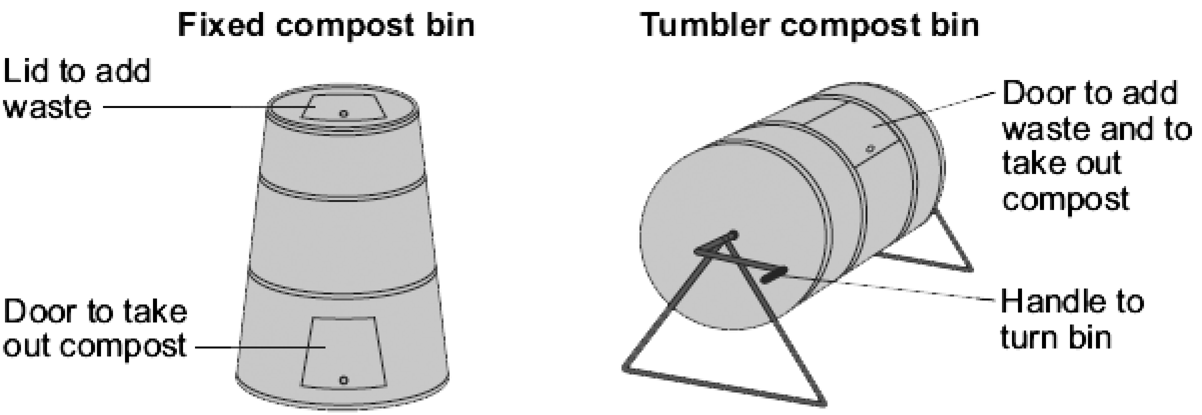
(1)

(Total 7 marks)

Q16.

Garden waste can be recycled.
One way of recycling garden waste is to use a compost bin.

The diagram shows two types of compost bin.
Each bin can contain the same amount of waste.



Information about the compost bins is given below.

Fixed compost bin

- Compost can be taken out after two years.
- The bin costs about £40.
- The bin takes up an area of 1 m^2.

Tumbler compost bin

- The bin is turned twice a day using the handle.
- Six weeks later compost can be taken out.
- The bin costs about £80.
- The bin takes up an area of 2 m^2.

(a) A gardener is buying a compost bin.

(i) Give **one** advantage to the gardener of buying a tumbler compost bin and not a fixed compost bin.

____

____

(1)

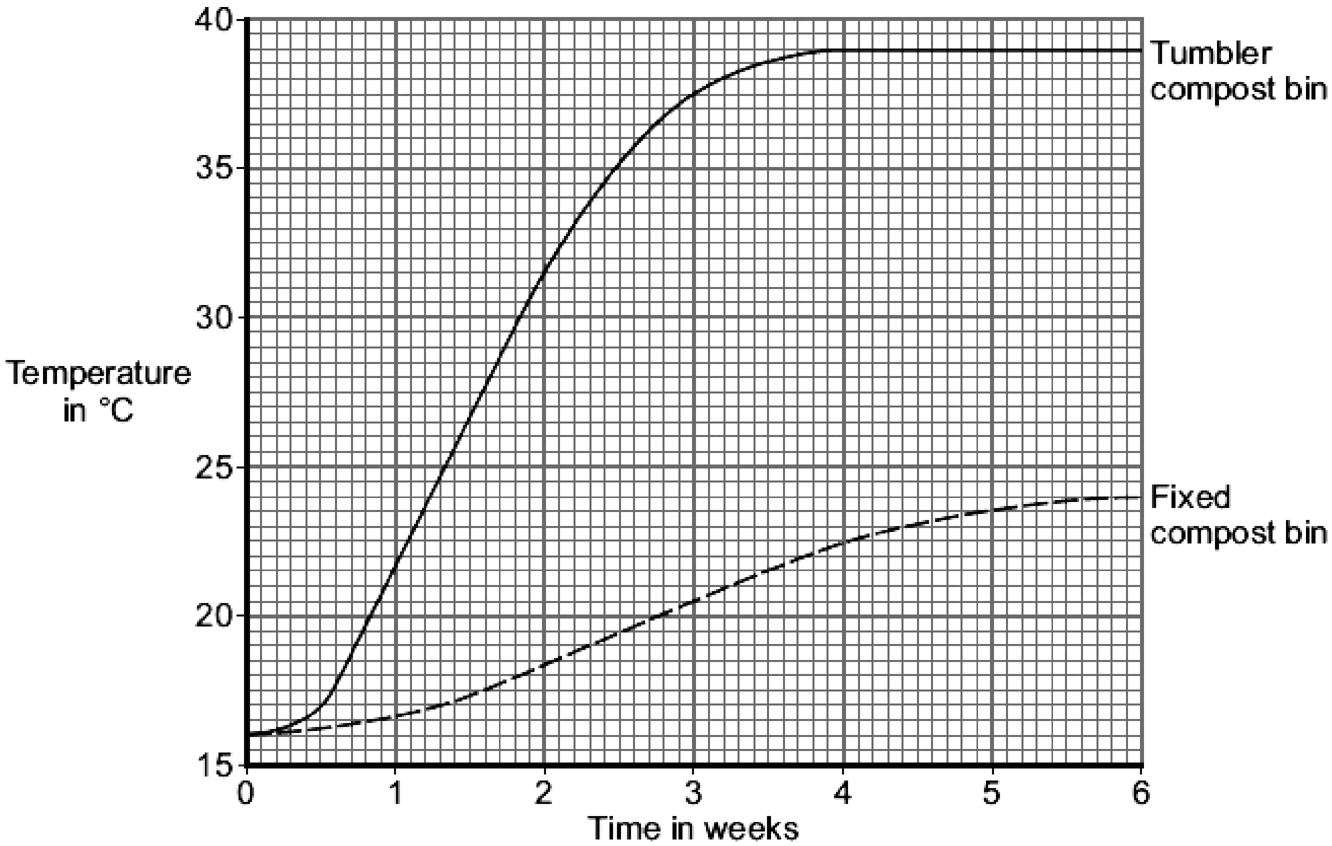
(ii) Give **two** advantages to the gardener of buying a fixed compost bin and not a tumbler compost bin.

1. ____

2. ____

(2)

(b) The same amounts of waste were added to the two types of bin.
The graph shows the temperature in the bins in the first six weeks after the waste was added.



(i) Give **two** differences between the results for the tumbler compost bin and the fixed compost bin.

1. ____

____

2. ____

____

(2)

(ii) Complete the sentences.

The waste is converted into compost by organisms

called ______________________________

The conversion of waste into compost works best in warm, moist

and ______________________________ conditions.

(2)

(iii) There was a big difference in the final temperatures in the two bins.

Suggest an explanation for this temperature difference.

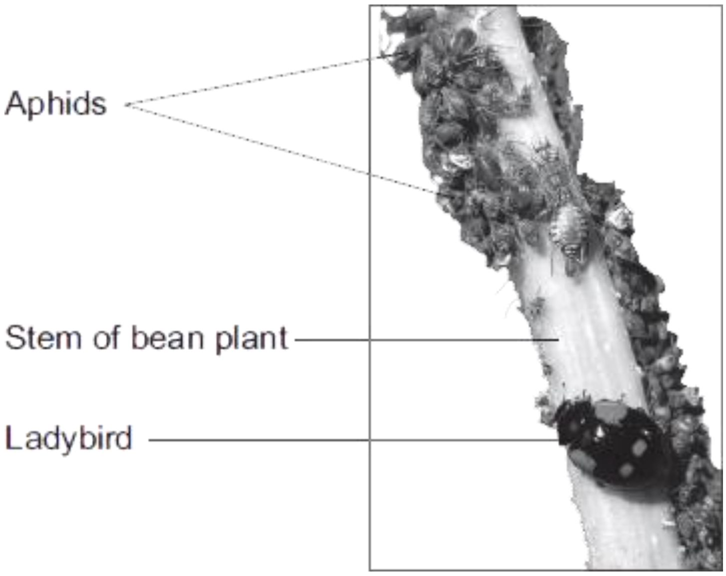
____

(2)
(Total 9 marks)

Q17.

Students investigated a food chain in a garden.

The students found 650 aphids feeding on one bean plant.
Five ladybirds were feeding on the aphids.



Photograph supplied by Hemera/Thinkstock

(a) (i) Draw a pyramid of biomass for this food chain.
Label the pyramid.

(2)

(ii) The biomass in the five ladybirds is less than the biomass in the bean plant.

Give **two** reasons why.

(2)

(b) The carbon in dead bean plants is returned to the atmosphere via the carbon cycle.

Describe this part of the carbon cycle.

___

___

___

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___

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___

___

___

(4)
(Total 8 marks)

Q18.

In a woodland, bluebells grow well every year.

Bluebells growing well in woodland

Mick Garratt [CC-BY-SA-2.0], via Wikimedia Commons

Each year the dead flowers and leaves of the bluebells and leaves from the trees fall onto the ground.
The bluebells do not run out of mineral ions.

Explain why the bluebells do **not** run out of mineral ions.

The words in the box may help you.

roots	**dead leaves**	**mineral ions**
	microorganisms	**decay**

____

____

____

____

____

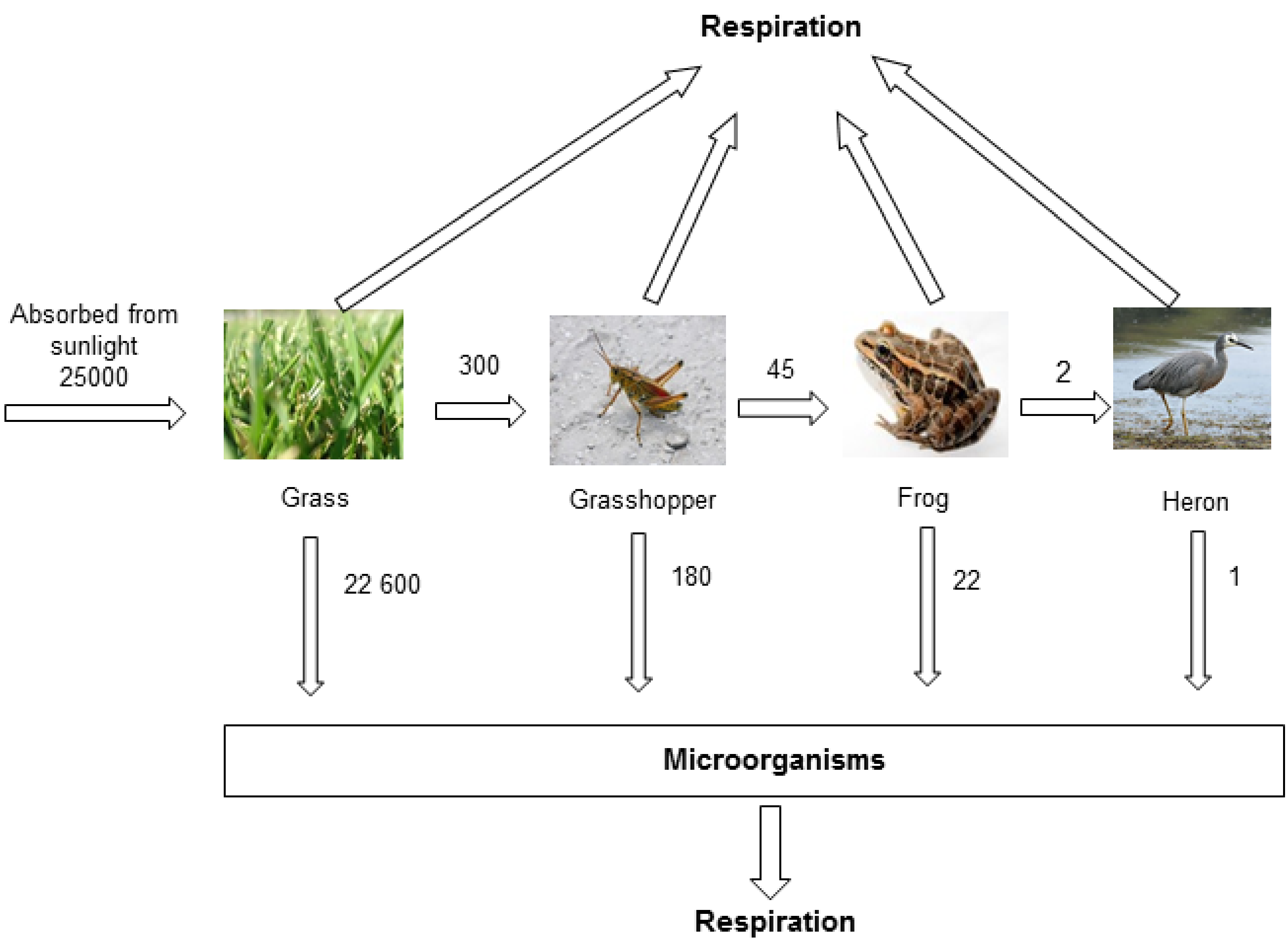
____

(Total 3 marks)

Q19.

The diagram shows the annual energy flow through 1 m^2 of a habitat.

The unit, in each case, is kJ per m^2 per year.



(a) Calculate the percentage of the energy absorbed by the grass from sunlight that is transferred to the frog.

Show clearly how you work out your answer.

____

____

Answer ______________________ %

(2)

(b) All of the energy the grass absorbs from the sun is eventually lost to the surroundings.

In what form is this energy lost?

____

(1)

(c) Food chains are usually **not** more than five organisms long.

Explain why.

To gain full marks you must use data from the diagram.

____

____

____

____

(2)

(d) In this habitat microorganisms help to recycle materials.

Explain how.

____

____

____

____

____

____

(3)

(Total 8 marks)

Q20.

Some scientists set up a biogas generator.

The table shows how the rate of biogas production and the composition of the biogas changed over the first 30 days.

Time in days	**Rate of biogas production in cm^3 per hour**	**Composition of the biogas**	
		Percentage of methane	**Percentage of carbon dioxide**
1	110	27	56
5	90	20	78
10	50	30	68
15	170	68	30
20	115	72	26
25	110	71	27
30	105	70	28

(a) (i) Name the process that produces the methane in biogas.

____

(1)

(ii) For the first 10 days, the gas released from the generator contained a high concentration of carbon dioxide. This was because there was air in the generator when it was first set up.

Explain why the presence of air results in a high concentration of carbon dioxide in the biogas.

____

____

____

____

____

____

____

____

____

(3)

(b) The scientists concluded that it would not be profitable to collect biogas from the generator until after about 20 days.

Use the data to explain why.

____

____

(1)

(c) The rate of biogas production slowed down towards the end of the investigation.

Suggest **one** reason why.

____

____

(1)

(Total 6 marks)

Q21.

Green plants are found at the start of all food chains.

(a) Complete the sentences.

(i) The source of energy for green plants is radiation from the ________________

(1)

(ii) Green plants absorb some of the light energy that reaches them for a

process called ________________________________

(1)

(b) Draw a ring around the correct answer to complete each sentence.

(i) This process transfers light energy into	chemical sound electrical	energy.

(1)

(ii) The process uses the gas	carbon dioxide. oxygen.

water.

(1)

(iii) The process produces carbon-containing compounds called

carbohydrates.
minerals.
salts.

(1)

(c) The amount of living material (biomass) at each stage in a food chain is less than at the previous stage.

The diagram shows a food chain.

oak tree → **caterpillar** → **blue-tit** → **hawk**

Give **two** ways in which biomass is lost in this food chain.

Tick (✓) **two** boxes.

As carbon dioxide from the caterpillar	☐
As food eaten by the hawk	☐
As oxygen from the oak tree	☐
As faeces (droppings) from the blue-tit	☐

(2)

(Total 7 marks)

Q22.

When animals die, they usually fall to the ground and decay.
In 1977 the body of a baby mammoth was discovered.
The baby mammoth died 40 000 years ago and its body froze in ice.

The picture shows the mammoth.

By Thomas Quine [CC BY-SA 2.0], via Wikimedia Commons

(a) Explain why the body of the baby mammoth did **not** decay.

____

____

____

____

(2)

(b) Mammoths are closely related to modern elephants.
The pictures show these two animals.

What scientists think a mammoth looked like

By WolfmanSF (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

Modern elephant

By Caitlin from Hertfordshire, UK [CC-BY-2.0], via Wikimedia Commons

Mammoths are *extinct*. What does *extinct* mean?

____

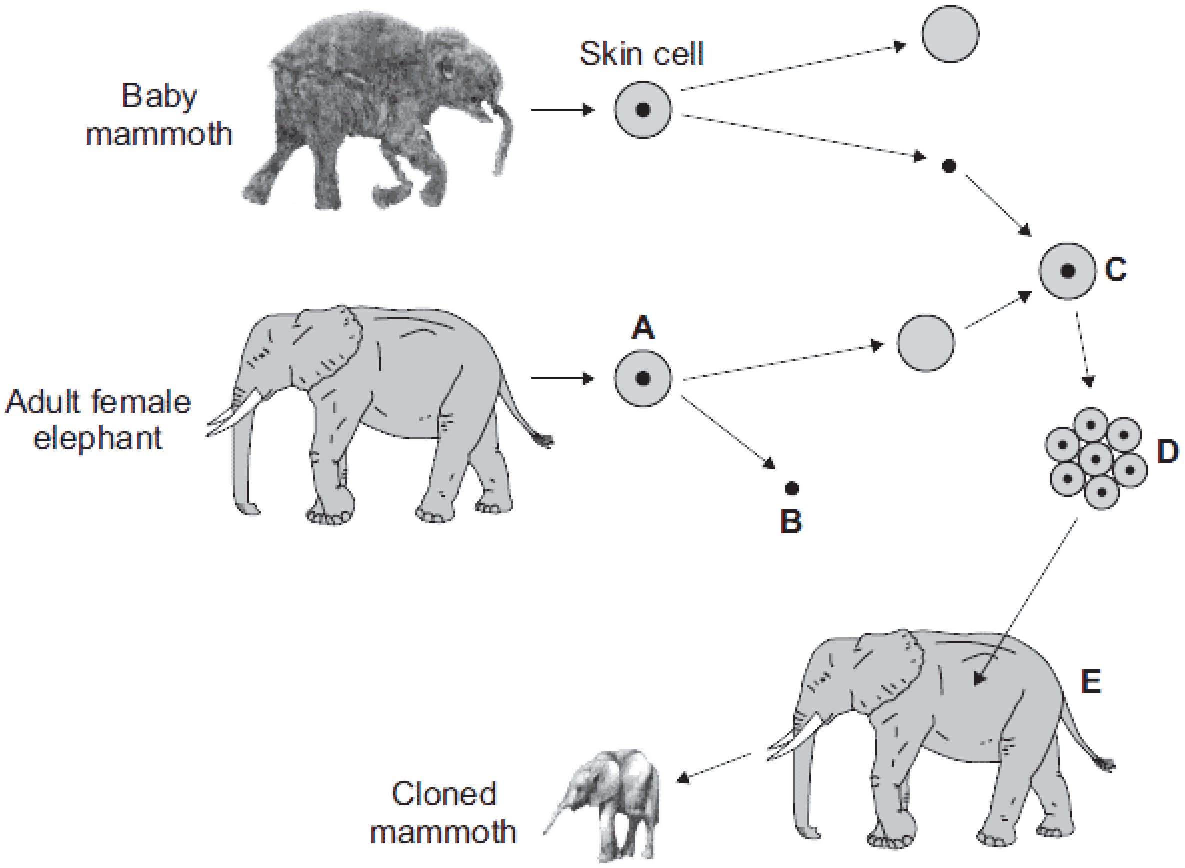
____

(1)

(c) Scientists believe they may be able to use adult cell cloning to recreate a living mammoth.

The scientists will use a skin cell from the baby mammoth.

The diagrams show how the skin cell will be used.



In each question, draw a ring around the correct answer.

(i) What type of cell is cell **A**?

skin cell **egg cell** **sperm cell**

(1)

(ii) Part **B** is removed from cell **A**.

What part of the cell is part **B**?

nucleus **cytoplasm** **cell membrane**

(1)

(iii) After cell **C** is formed, it divides into embryo cells.

What is done to cell **C** to make it divide?

Cell **C** is

treated with enzymes.
mixed with sperm cells.
given an electric shock.

(1)

(iv) The embryo cells form a ball of cells. The ball of cells will be put into female elephant, **E**.

Which part of elephant **E** is the ball of cells put into?

womb **stomach** **ovary**

(1)

(d) The scientists expect any offspring of the adult cell cloning to look like a mammoth and **not** like an elephant.

Why?

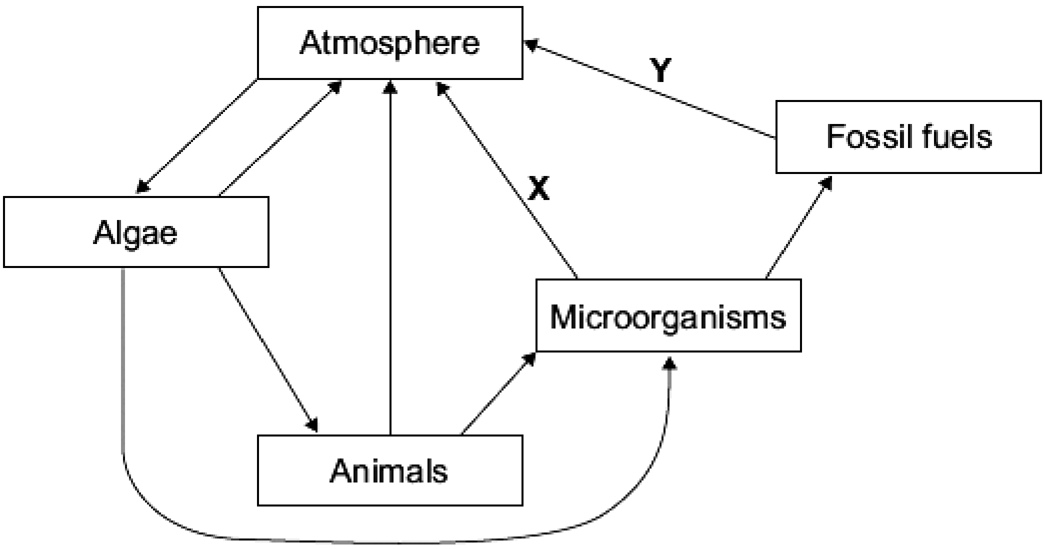
____

____

(1)
(Total 8 marks)

Q23.

The diagram shows part of a carbon cycle in a habitat.



(a) Name the processes shown by arrows **X** and **Y**.

X ______________________________

Y ______________________________

(2)

(b) Describe the part played by algae in this carbon cycle.

____

____

____

____

____

____

(3)

(c) In tropical rainforests process **X** is much faster than in most other habitats.

Suggest why.

____

____

____

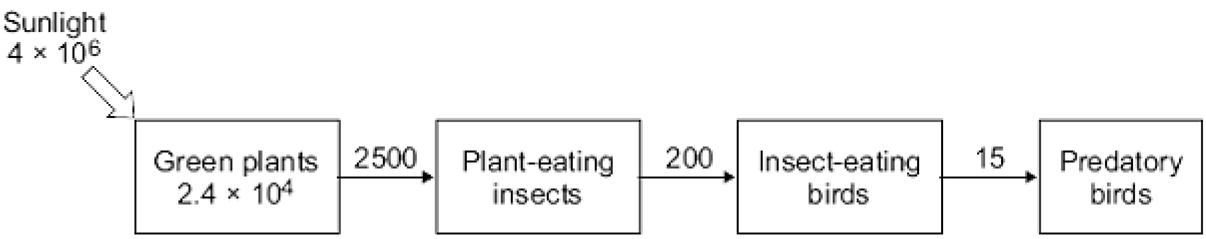
____

(2)
(Total 7 marks)

Q24.

The diagram shows the annual flow of energy through a habitat.

The figures are in kJ m^{-2}.



(a) (i) Calculate the percentage of the energy in sunlight that was transferred into energy in the green plants.

Show clearly how you work out your answer.

____

Answer = ____________________ %

(2)

(ii) Suggest reasons why the percentage energy transfer you calculated in part (a)(i) was so low.

____

____

____

____

(2)

(b) Compare the amount of energy transferred to the insect-eating birds with the amount transferred to the predatory birds.

Suggest explanations for the difference in the amount of energy transferred to the two types of bird.

____

____

____

____

____

____

____

____

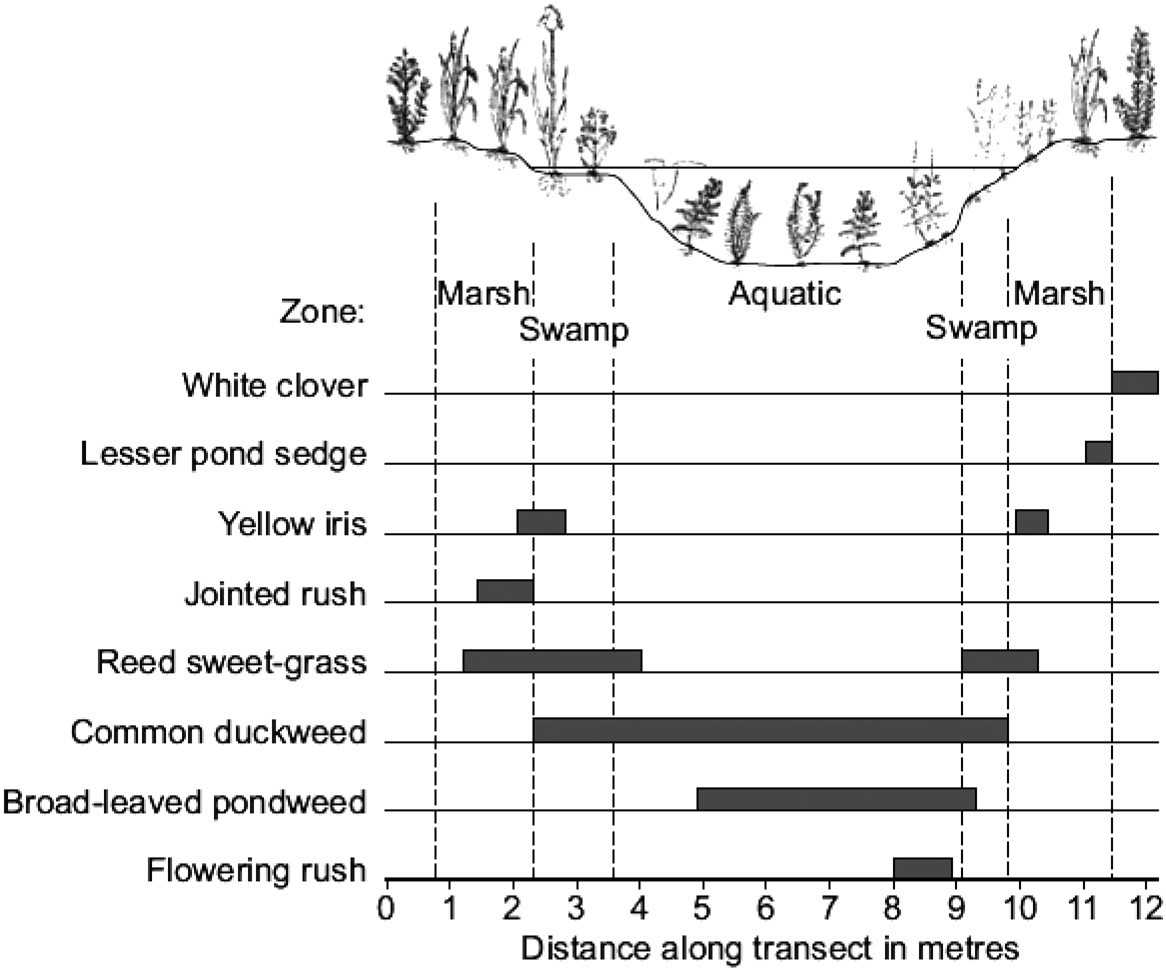
(3)

(Total 7 marks)

Q25.

Some students investigated the distribution of some of the plants growing in and around a shallow stream. They sampled along a transect line.

The diagram shows their results.



(a) (i) Name the **one** species that grew only in the driest conditions.

____

(1)

(ii) Only **one** species grew in the marsh, the swamp and in the aquatic zones.

Which species?

____

(1)

(iii) Duckweed grows floating in water. What evidence is there for this in the students' results?

____

____

(1)

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

Describe how you would use a $\frac{1}{2}$-metre × $\frac{1}{2}$-metre quadrat frame and a 30-metre tape measure to obtain data similar to the data shown in the diagram.

You should include details of how you would make sure that you would obtain valid results.

(6)

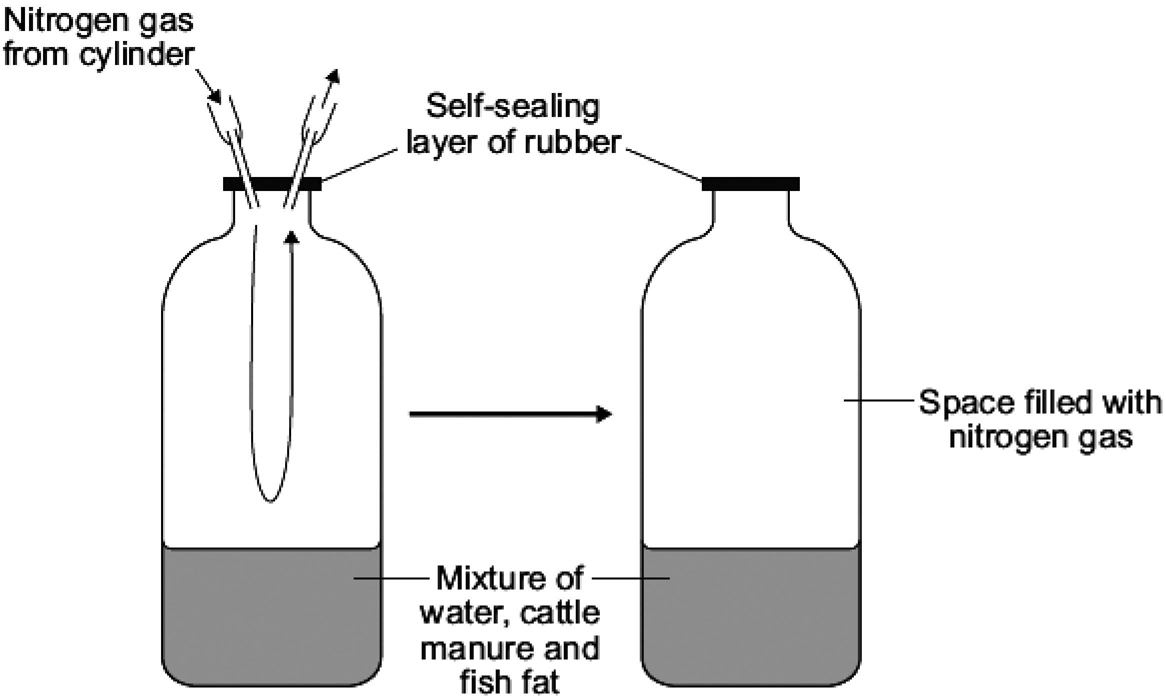
(Total 9 marks)

Q26.

Norway has a large fishing industry. Norwegian scientists investigated the effect of adding waste fish fat to cattle manure to improve the production of biogas.

The scientists set up many jars containing different concentrations of fish fat added to the cattle manure. The air in each jar was removed and replaced with pure nitrogen gas.

The diagram shows how one of these jars was set up.



The scientists then kept all the jars in an incubator at 35 °C for 6 weeks.

(a) The scientists sealed each jar with a layer of rubber and replaced the air in the jars with nitrogen gas.

Explain why.

___

___

___

___

(2)

(b) The scientists removed samples of gas from each jar at intervals over the 6 weeks.

The table shows some of the scientists' results.

Contents of jar	Yield of biogas in cm^3 per gram	Yield of methane in cm^3 per gram	Proportion of methane in the biogas
Cattle manure	426	256	0.60
Cattle manure + 2.5 % fish fat	686	426	

Cattle manure + 5 % fish fat	861	543	0.63
Cattle manure + 10 % fish fat	999	630	0.63

(i) The final column of the table shows the proportion of methane in the biogas.

Apart from the methane and the added nitrogen, name the other gas that makes up most of the rest of the biogas.

____

(1)

(ii) Calculate the proportion of methane in the biogas when 2.5 % fish fat was added to the manure.

Show clearly how you work out your answer.

____

____

Proportion of methane = ______________________________

(2)

(iii) Describe the effects on biogas production of adding fish fat to cattle manure.

____

____

____

____

____

(2)

(iv) Olaf is a Norwegian farmer. Olaf's farm is 110 kilometres from the sea. He has a biogas generator on his farm. Olaf adds manure from his 50 cattle to his biogas generator.

Olaf decided **not** to add fish fat to his biogas generator.

Suggest **one** reason why.

____

____

(1)

(Total 8 marks)

Q27.

The amount of carbon dioxide in the atmosphere is increasing.

The table shows the estimated mass of carbon dioxide exchanged with the atmosphere in one year.

	Mass of carbon dioxide exchanged with the atmosphere in millions of tonnes	
	Passed out into the atmosphere	**Taken in from the atmosphere**
Plants	30	64
Animals	10	0
Microorganisms	24	0
Combustion	6	0

(a) (i) Calculate the total mass of carbon dioxide passed out into the atmosphere in one year.

Show clearly how you work out your answer.

____

____

Answer ______________________ million tonnes

(2)

(ii) Calculate the increase in the mass of carbon dioxide in the atmosphere in one year.

You should use your answer to part (a)(i) in your calculation.

Show clearly how you work out your answer.

____

____

Answer ______________________ million tonnes

(2)

(b) Draw a ring around the correct answer to complete the sentence.

decomposition.

Plants use carbon dioxide in the process of	photosynthesis. respiration.

(1)
(Total 5 marks)

Q28.

Animals in a habitat compete with each other.

(a) Give **two** factors for which animals may compete.

1. ____________________

2. ____________________

(2)

(b) The photographs show a mule deer and a white-tailed deer.

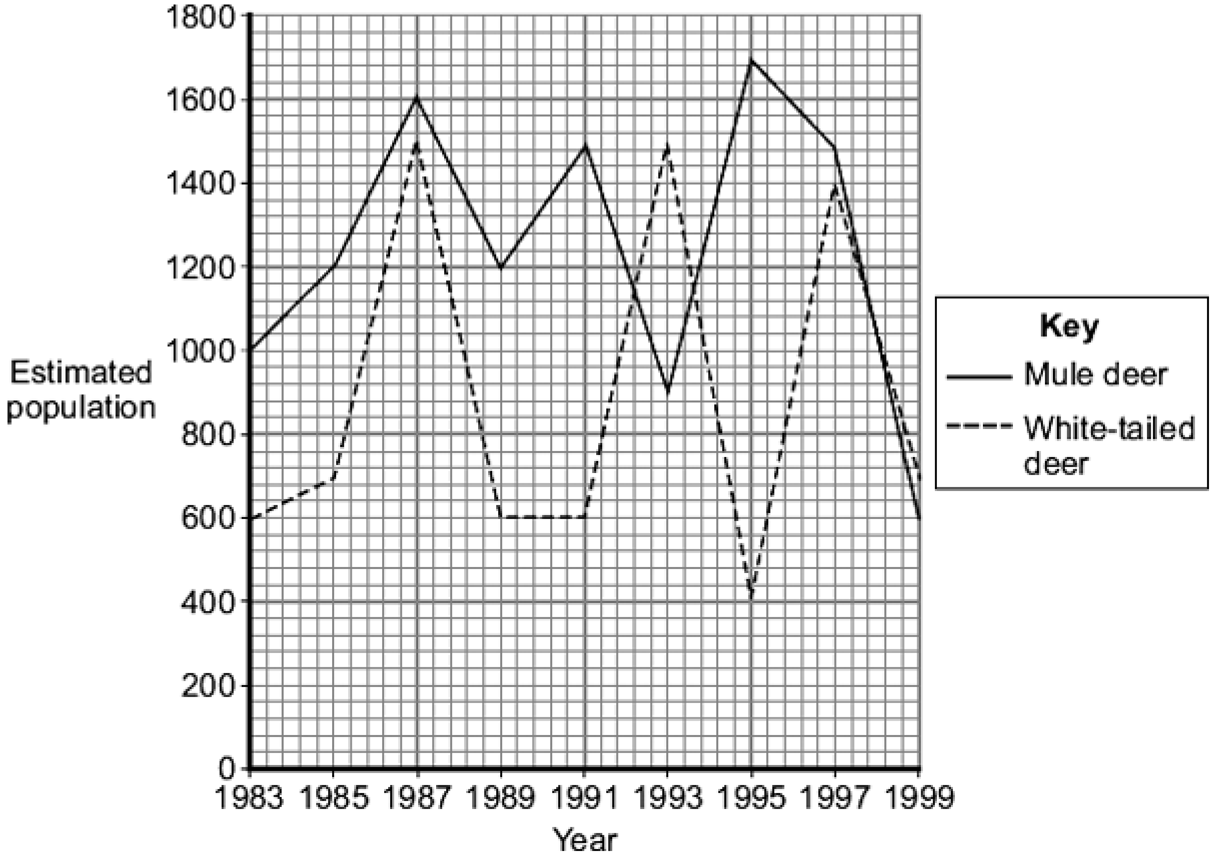
Mule deer

White-tailed deer

Mule deer by Dcrjsr (Own work) [CC-BY-3.0], via Wikimedia Commons. White-tailed deer by Clay Heaton (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

Mule deer and white-tailed deer live together in the same national park in the USA.

The graph shows changes in the populations of the two deer species between 1983 and 1999.



(i) Describe the changes in the population of white-tailed deer between 1991 and 1995.

____

____

____

____

(2)

(ii) Use information from the graph to suggest an explanation for changes in the population of white-tailed deer between 1991 and 1995.

____

____

____

____

(2)
(Total 6 marks)

Q29.

The table shows energy transfers in a large insect and a small mammal.

Both animals feed mainly on grass.

Energy transfer	Amount of energy in kJ.	
	Large insect	Small mammal
Eaten as grass	4.00	25.00
Absorbed into body	1.60	12.50
Leaves body as faeces	2.40	12.50
Production of new tissue	0.64	0.25
Transferred by respiration	0.96	12.25

(a) What percentage of the energy in food is transferred into new tissue in the large insect?

Show clearly how you work out your answer.

___

___

___

Answer = ______________________ %

(2)

(b) The proportion of energy in the food transferred into new tissue is much greater in the large insect than in the small mammal.

Explain why as fully as you can.

You should include references to the data in your answer.

___

___

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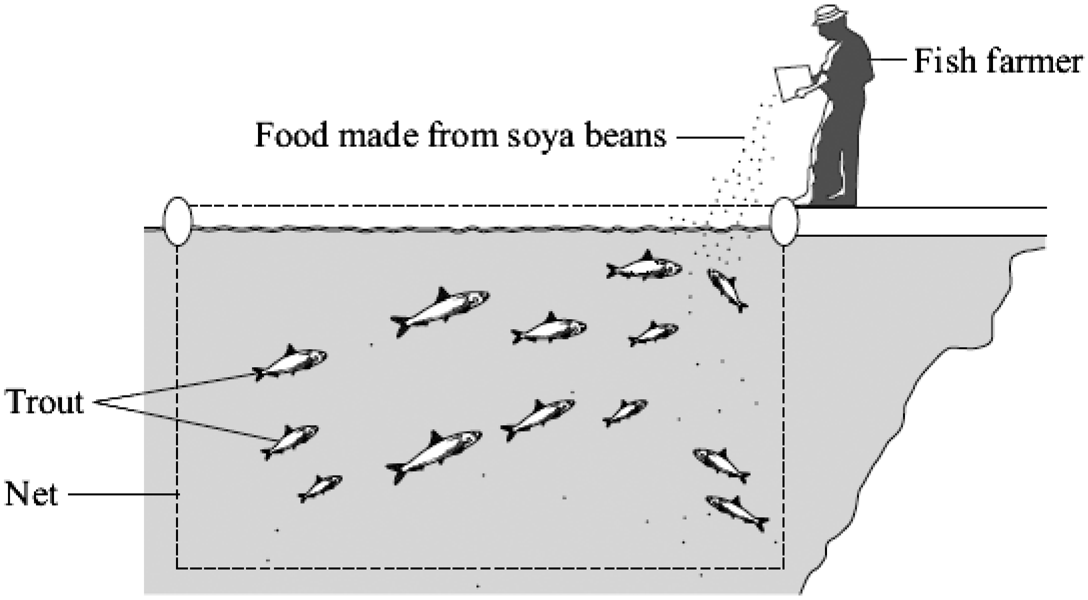
___

(3)
(Total 5 marks)

Q30.

A fish farmer keeps trout in a large net in a lake.



The fish farmer feeds the trout on food made from soya beans.

When the trout are large enough the farmer sells them for food for people.

(a) Draw a pyramid of biomass for the three organisms in this food chain.

Label the pyramid.

(2)

(b) It would be more energy efficient if people ate the soya beans rather than eating the trout.

Which **two** of the following are reasons for this?

Tick (✓) **two** boxes.

Some people do not like eating animals such as trout.	☐

The trout release energy when they respire.	☐
Soya bean plants release energy when they respire.	☐
Some energy will be lost in waste from the trout.	☐
Soya bean plants absorb energy during photosynthesis.	☐

(2)

(c) Suggest **one** advantage to the fish farmer of keeping the trout in a large net instead of letting them swim freely in the lake.

____

____

(1)

(d) Some trout die before they are large enough to be sold.
The dead trout contain carbon.

Use your knowledge of the carbon cycle to describe how this carbon is returned to the atmosphere after the trout die.

____

____

____

____

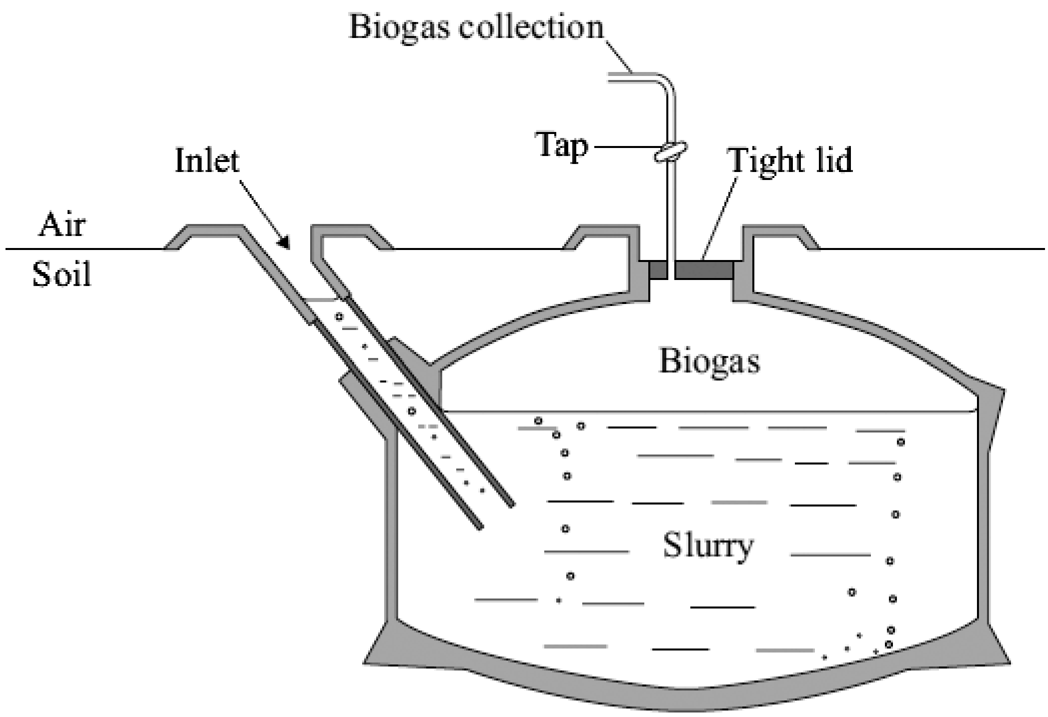
____

(2)

(Total 7 marks)

Q31.

The diagram shows one type of biogas generator.



(a) Give **two** advantages of having the biogas generator underground.

Tick (✓) **two** boxes.

It allows the digested slurry to soak into the soil.	☐
The biogas produced will be at a lower pressure.	☐
Very little of the biogas generator will be seen.	☐
It prevents unpleasant smells escaping.	☐
The temperature inside will not change much.	☐

(2)

(b) The table shows the percentages of the different gases found in this biogas.

Gas	Percentage
Carbon dioxide	35.0
Hydrogen sulfide	1.5
Ammonia	1.5

Water vapour	2.0
Gas **X**	

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

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

Draw a ring around **one** answer.

hydrogen **methane** **oxygen**

(1)

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

Show clearly how you work out your answer.

____

____

____

Percentage of gas **X** = ____________________

(2)

(Total 5 marks)

Q32.

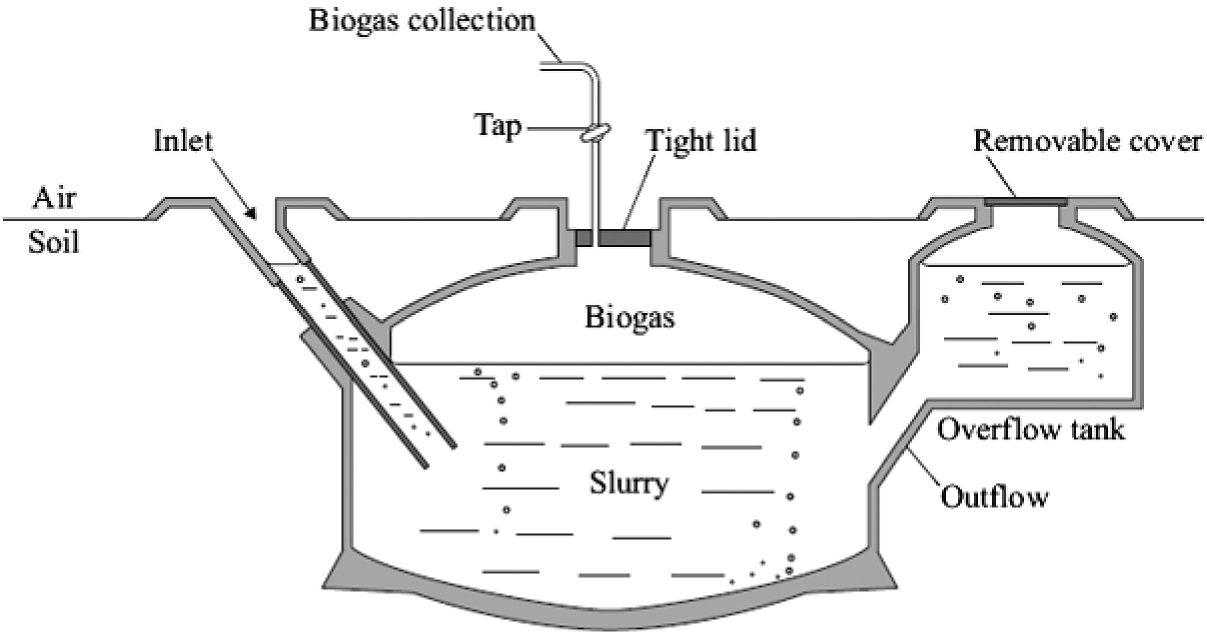
Biogas can be produced from waste materials that contain carbohydrates.

(a) Complete the sentence.

The main fuel gas present in biogas is ____________________________

(1)

(b) The diagram shows one type of biogas generator.



(i) Suggest **two** advantages of having the biogas generator underground.

1. ____

____

2. ____

____

(2)

(ii) It is important that the level of liquid in the inlet and in the overflow tank is above that of the slurry.

Explain why.

____

____

____

(1)

(c) Temperatures in the UK are usually between 0 °C and 25 °C.

At a sewage works in the UK, some of the biogas produced from sewage sludge is burned and is used to heat water. The hot water is then pumped through metal pipes
which pass back through the biogas generator.

Explain why this would be helpful in biogas production.

____

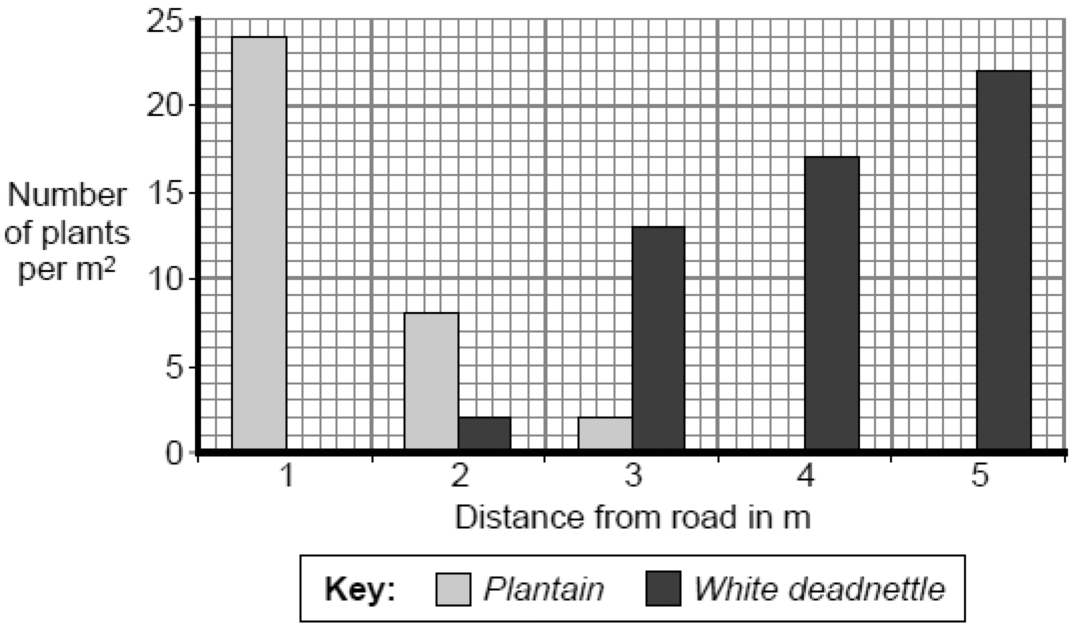
____

(2)

(Total 6 marks)

Q33.

Students investigated the distribution of two plant species near a busy road. The bar chart shows their results.



(a) (i) Name the piece of apparatus used in sampling a $1m^2$ piece of land.

(1)

(ii) Describe how this piece of apparatus could be used to obtain the data shown in the bar chart.

(2)

(iii) Describe the pattern shown in the data for the *Plantain* plants.

(1)

(b) Suggest explanations for:

(i) the distribution of the *White deadnettle* plants

(2)

(ii) the distribution of the *Plantain* plants.

(2)
(Total 8 marks)

Q34.

This question is about what happens during decay.

Draw a ring around the correct word to complete each sentence.

(a) After living things die, they are decayed by

animals.
microorganisms.
plants.

(1)

(b) Decay happens faster when there is plenty of oxygen and conditions are

cold.
dry.
moist.

(1)

(c) During decay carbon dioxide is produced by

osmosis.
respiration.
photosynthesis.

(1)

(d) Decay releases mineral salts into the soil.

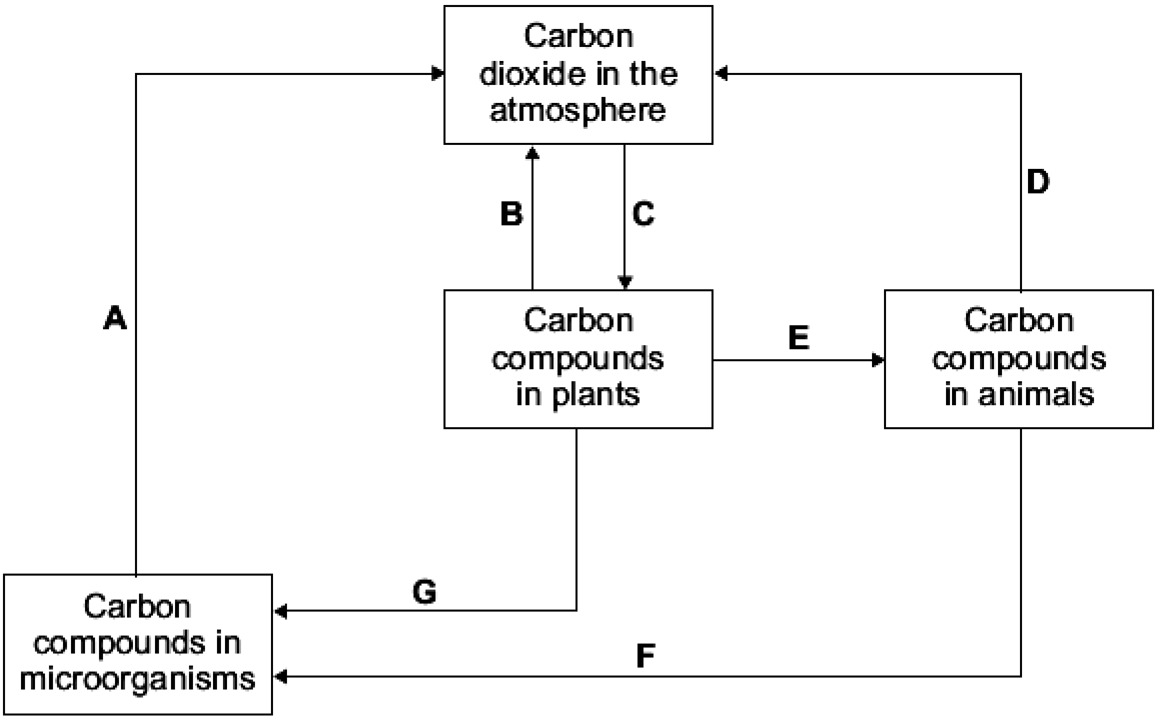
These mineral salts are absorbed by plant

leaves.
roots.
stems.

(1)
(Total 4 marks)

Q35.

The diagram shows part of the carbon cycle.



(a) Letter **A** represents respiration.

Which **two** other letters represent respiration?

☐ and ☐

(1)

(b) Other than carbon dioxide name **two** carbon compounds found in plants.

1. ____

2. ____

(2)

(c) Gardeners use compost heaps to decay dead plants. Decayed compost is then spread onto the soil in a garden.

Explain why gardeners spread decayed compost onto the soil.

____

____

____

____

(2)

(Total 5 marks)

Mark schemes

Q1.

(a) (i) 5.2

*award **2** marks for correct answer, irrespective of working or lack of it*

*award **1** mark for 62.4 ÷ 12 only with incorrect or no answer*

2

(ii) the smaller the (mass of the) bird the more energy is needed (per gram of body mass)

allow converse

ignore figures

1

(iii) smaller bird has larger surface area : volume / mass ratio

allow converse

1

so heat / energy lost more quickly

allow lose more heat / energy

*if (a)(ii) describes a trend of more energy with increasing body mass allow **one** mark for idea of more energy needed for flight*

1

(b) larger birds spend less time feeding

accept converse

allow the less energy they need per day the longer they spend feeding

1

since they need less food per gram of body mass (to satisfy energy needs)

1

[7]

Q2.

(a) place all the quadrats randomly on the lawn

1

(b) (i)

1	4
2	2
3	2
4	0

all 4 counts correct

1

Total = 15

total correct for their figures
1

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

(iii) 180
correct answer with or without working
*if answer incorrect, allow **1** mark for $\frac{15}{10}$ x 120 **or** 15 x 20*
***or** $\frac{15}{10}$ x 12 x 10*
***or** 1.5 x 12 x 10 **or** 1.5 x 120*
allow ecf from (b)(ii)
*allow **1** mark if only 1 error*
2

(c) use a larger sample size / more quadrats
ignore repeats but allow repeat in different places
ignore 'count them all'

or

use bigger quadrats
1
[7]

Q3.

(a) use of quadrat / point frame
allow description
1

randomly placed / random sampling
ignore reference to transects
1

(b) (i) 6
1

(ii) more light in A / in field / where sunny
ignore sun
1

more / better / faster photosynthesis in A / with more light
allow converse
1

(iii) use light meter / measure light intensity in both habitats
1

take many measurements at same time of the day
1

or

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)

counting point is dependent on investigation point

(c) more glucose / energy available

allow other named product eg protein

allow if more energy produced

1

for growth

dependent on 1st mark

1

[9]

Q4.

(a) microorganisms / microbes / bacteria / fungi / decomposers

*allow named example **or** mould*

ignore germs / worms / other detritivores

1

(b) (weather / it is) warm(er) / hot(ter)

accept optimum conditions for enzymes

allow cold(er) <u>in winter</u>

ignore wet(ter) / light(er) / sun

*do **not** accept heat dries the leaves out*

1

(c) oxygen

no mark if more than one box is ticked

1

[3]

Q5.

(a) (i) increase / higher / faster / quicker

1

numerical comparison eg from 30 to 60 **or** by 30 **or** it is 30 at 15°C *and* 60 at 25°C

*award **2** marks for doubles / goes twice as fast or 30 units <u>more</u>*

1

(ii) any **two** from:

- oxygen / air (in)

  ignore air out

  *do **not** accept lets oxygen*

  ignore reference to other substances / light passing in or out

- for microorganisms / bacteria / microbes / fungi / decomposers
  ignore microorganisms passing in
  ignore worms / germs / bugs / other detritivores
- (for aerobic) respiration (of microorganisms)
- let excess heat out
  ignore heat in

2

(b) compost contains minerals / nutrients / elements / ions / named
allow improve drainage / moisture
allow contains nitrogen
ignore CO_2 / food / goodness / fertiliser
*do **not** accept vitamins / glucose*

1

[5]

Q6.

(a) a higher concentration would be difficult to stir

1

(b) (i) methane

1

(ii) 60
100 - (5 + 35) but incorrect answer allow 1 mark

2

(c) (i) aerobic respiration

1

(ii) oxygen

1

[6]

Q7.

(a) 40 – 60 hours

1

(b) (i) decrease

1

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

1

(ii) oxygen after glucose
extra box ticked cancels 1 mark

1

oxygen less than glucose

1

(iii) respiration
1
[6]

Q8.

(a) (i) without <u>oxygen</u>

ignore reference to 'air'
1

(ii) otherwise difficult to stir / to pump / to transfer

allow prevent 'clogging' owtte
1

(iii) need to stir / pump / heat
1

(b) (i) rises then falls
1

then levels / slight rise
1

quantitative descriptor
- e.g. to 80% / max. on day
4 / min. on day 16

accept other valid quantitative descriptor

allow accuracy ± ½ small square
1

(ii) 16 (15.5 to 16.4)
1

(c) any **two** from:

- oxygen present
- (CO_2 produced) by <u>aerobic</u> respiration

  or not much anaerobic respiration
- **not** much methane / CH_4 produced

2
[9]

Q9.

(a) any **two** from:
- (microorganisms) produce enzyme / amylase / carbohydrase
- to break down / digest starch / carbohydrate (in potato)
- into sugars / glucose
- which diffuse back into microorganism

accept decomposer / fungus / bacterium / cell
2

(b) (i) (microorganisms)

(accept bacteria / fungi / decomposers)

digest the potato (starch)

allow breakdown / feed on / consume / decompose

*do **not** accept eat*

1

use starch / glucose / carbohydrate for <u>respiration</u>

1

which releases carbon dioxide / CO_2 (into the atmosphere)

1

(ii) up to 40 °C the potato took less time to decay / the rate is faster

ignore yes / no

answers must be comparative

1

but at 50 °C it took longer / the rate is slower

or

at 50 °C / a high(er) temperature the enzymes have denatured

accept at a higher temperature / above 40 °C

1

[7]

Q10.

(a) any **two** from:

- <u>fewer</u> trees to take in carbon dioxide for photosynthesis
- decomposers / microorganisms respire (as they decay debris) releasing carbon dioxide
- burning of wood releases carbon dioxide

allow carbon dioxide released by burning fossil fuels in vehicles / factories

2

(b) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best − fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1 − 2 marks)
There is a brief description of some steps in the process but the order is not clear with little biological vocabulary used.

Level 2 (3 − 4 marks)
There is a reasonably clear description of the process involving many of the steps and using some biological vocabulary.

Level 3 (5 − 6 marks)
There is a clear, logical and detailed scientific description of the process using appropriate biological vocabulary.

examples of biology points made in the response:

- this contains mineral ions (and organic matter)
- this increases growth of algae / water plants
- the plants / algae (underneath) die
- due to lack of light / photosynthesis / space
- decomposers / microorganisms feed on decaying matter **or** multiply rapidly
- the respiration of decomposers uses up all the oxygen
- so invertebrates die due to lack of oxygen
- this is called eutrophication

6

[8]

Q11.

(a) estimate / count number of squares covered

*do **not** allow number of squares containing algae*

1

divide by total number of squares and multiply by 100 / multiply by 4

1

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

- more / most in North east facing
- followed by the North facing
- the South facing had no green alga / least

2

(ii) 40 (%)

1

two directions had this value (rest of directions had only one)

accept this is the most common percentage / value

2nd mark only if 40(%)

1

(iii) any **three** from:

- light / sunlight
  ignore Sun / carbon dioxide
- temperature
  *do **not** accept oxygen*
- availability of water / humidity
- availability of nutrients
- wind
- pollution qualified eg SO_2, acid rain, soot
- grazing by animals eg slugs
- competition with other species
- pH

3

(iv) eg (*for light*)

allow overlap between factors

light intensity *least* on north / north east facing parts of tree (1)

1

green algae adapted for photosynthesis in low light intensities (1)

allow, since less light from Sun, cooler so less evaporation

1

negative effect of high light intensity on green algal chlorophyll / photosynthetic pigments (1)

allow green algae unable to withstand desiccation

1

or (*for temperature*)

temperature highest on south (and west) facing parts of tree

(causing) more water to evaporate from this side of tree

green algae unable to withstand desiccation

or (*for moisture / rainfall*)

rainfall highest on north / north east facing parts of tree (1)

(giving) more moisture on this part of tree (1)

green algae less likely to desiccate (1)

or (*for wind*)

wind speed / duration greatest on south (and west) facing parts of tree (1)

(causing) more water to evaporate from this side of tree (1)

allow wind carries pollutants

allow pollutants toxic to algae

green algae unable to withstand desiccation (1)

or (*from pollution*)

from south / south west (1)

wind carries pollutants (1)

pollutants toxic to / kill algae (1)

(c) (i) as the concentration of ammonia increases so does the % abundance of nitrophyte lichens

allow positive correlation / proportional

allow directly proportional

1

scattered results / wide spread

allow use of approximate numbers to demonstrate scattering

or

for any value of one parameter there is a wide range of the other

allow not a strong relationship / correlation

1

(ii) not very useful / unreliable

accept only gives a rough idea / only a general indication

1

for any value of one parameter there is a wide range of the other

allow correlation rather than direct relationship

or

scattered results

1

[16]

Q12.

(a) 8.05 / 8.1 / 8

*correct answer with or without working gains **2** marks*

*allow **1** mark for 8.0 **or** 8.10*

*allow 35/100 x 23 (million) for **1** mark if no answer or incorrect answer*

*allow **1** mark for 805 **or** 8 050 000*

2

(b) (i) any **one** from:

- less landfill sites used
- less cost (of landfill sites) / saves money
- less effort / cost to collect

  allow less to collect

1

(ii) compost can be used on garden

*allow idea of compost can be used to help plant growth **or** compost provides minerals / named **or** compost improves the soil*

1

[4]

Q13.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

Level 1 (1-2 marks)
For at least one process **either** the organism that carries it out **or** the carbon compound used **or** the carbon compound produced is described **or** for at least one organism **either** the carbon compound it uses **or** the carbon compound it produces is described **or** at least one process is named

Level 2 (3-4 marks)
For some processes (at least one of which is named) **either** the organisms involved **or** the carbon compounds used **or** the carbon compounds produced are described

Level 3 (5-6 marks)
For at least one named process an organism **and** either the carbon compound used for the process **or** the carbon compound produced by the process are described **and** for other processes (at least one of which is named) **either** the organism **or** the carbon compounds used **or** the carbon compounds produced are described (as in Level 2)

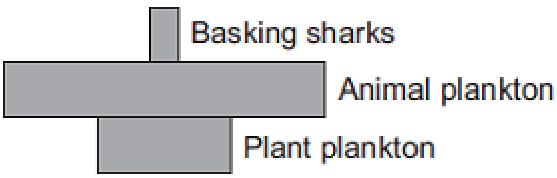
Examples of Biology points made in the response:

- (green) plants photosynthesise
- photosynthesis takes in carbon dioxide
- (green) plants use carbon to make carbohydrate / protein / fat / organic compounds / named (e.g. enzymes / cellulose)
- animals eat (green) plants (and other animals)
- (green) plants respire
- animals respire
- respiration releases carbon dioxide
- (green) plants and animals die
- microorganisms decay / decompose / rot / break down / feed on dead organisms
- microorganisms respire

[6]

Q14.

(a)



if more than one box is ticked award no mark

1

(b) increasing / higher light / temperature *ignore references to months other than February – April*

*do **not** accept mineral / ions increase*

1

more / increased photosynthesis

*for both marks there must be a reference to 'more' at least once (e.g. 'more light for photosynthesis' gains **2** marks)*

*allow **1** mark for reference to light **and** photosynthesis without an idea of 'more'*

1

(c) increase due to increase in plant plankton / food

ignore references to months other than April – July

1

decrease due to fall in plant plankton / food **or** decrease as eaten by (basking) sharks

allow decrease as eaten by predators / animals / fish

1

(d) fall due to use / intake by <u>plant</u> (plankton)

ignore ref to no change section of graph

for fall allow March / April

ignore May / February

1

increase due to decay / decomposition / breakdown

for increase allow any month in range August to November

ignore December

1

of dead (plant / animal) plankton

allow of dead organisms / waste

1

[8]

Q15.

(a) chose places <u>randomly</u>

1

method of obtaining randomness, e.g. (grid and) random numbers

allow thrown qualified e.g. over shoulder, eyes shut

allow max 1 for mention of a transect with sampling at regular or random intervals

1

(b) (i) 7 **or** 8

allow fractions / decimals between 7 and 8

1

(ii) count number of whole squares and add estimate of area covered by part squares

allow reference to counting squares with ½ cover or more *allow clear working on diagram and / or (b)(i)*

1

(iii) 28 – 32 (in range)

allow ecf

if answer incorrect allow ***1*** *mark for reasonable reference to divided by 25 or multiplied by 4*

2

(c) nutrients / minerals / ions / fertiliser / water

allow light / pH / trampling / soil texture / grazing / mowing / weed killer / where seeds originally fell

ignore pollution / soil / competition if unqualified

ignore temperature / wind

1

[7]

Q16.

(a) (i) (compost produced) quicker / faster / takes less time

it = tumbler bin

answers should be comparative eg ***only*** *6 weeks = 1 mark*

6 weeks = 0 marks

1

(ii) any **two** from:

- takes less space
- cheaper (to buy)
- don't need to turn / rotate it

it = fixed bin

references to space and cost should be comparative

do ***not*** *accept unqualified data*

2

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

- faster rise (in tumbler)
- higher (in tumbler) **or** 2 correct number readings
- levels off (in tumbler) **or** continues to rise in fixed

it = tumbler bin

ignore eg faster compost

2

(ii) microorganisms / microbes / decomposers

allow bacteria / fungi / detritus feeders / worms / other named examples of detritus feeders / mould

1

aerobic

allow air(y)

allow oxygen(ated)

1

(iii) faster respiration / decay / **or** microorganisms / microbes / decomposers work faster (in tumbler)

allow converse
allow bacteria / fungi / mould

1

so more heat produced (in tumbler)

ignore heat produced by friction

OR

more air / more oxygen(ation) (in tumbler) (1)

so more respiration / faster decay / bacteria work faster (in tumbler) (1)

1

[9]

Q17.

(a) (i) triangular pyramid with 3 layers

may be as blocks or as triangle

ignore food chains and arrows

1

layers appropriately labelled:
bean / plant

aphid,

ladybird

*labelled in food chain order must **not** contradict correct pyramid*

*allow correctly labelled inverted pyramid for **2** marks*

1

(ii) any **two** from:
(for aphid / ladybird)

ignore energy

- not all digested / faeces
- loss in urine
- loss of CO_2
  ignore loss of CO_2 from bean plant
- not all eaten
  *if none of first 3 points given then allow waste (materials) / excretion for **1** mark*

2

(b) microorganisms / microbes / bacteria / fungi / decomposers / detritivores /named

*do **not** accept germs*

allow mould

ignore aphids

1

decay / breakdown / digest / decompose / rot (bean plant)

ignore eat

1

respiration (of microorganisms etc / aphids)

allow burning / combustion

1

carbon dioxide released (from respiration of microorganisms etc / aphids)

allow carbon dioxide released / produced (from burning / combustion)

ignore other parts of the carbon cycle
ignore formation of fossil fuels

1

[8]

Q18.

any **three** from:

ignore references to carbon cycle

accept digested / decomposed / broken down / rotted for decay throughout

ignore eating

- dead leaves / flowers / bluebells are decayed
- idea that microorganisms do the decaying

  accept microbes / bacteria / fungi / mould / decomposers for microorganisms
- minerals / ions / nutrients / named <u>released</u> (by decay / microorganisms)

  ***not** mineral ions unqualified*
- (released) into soil **or** minerals / ions / nutrients taken up / in by (bluebell) roots (next year)

  look for idea that minerals / ions / nutrients are in soil (eg released into soil or taken up from soil)

3

[3]

Q19.

(a) 0.18

award both marks for correct answer irrespective of working

if no answer or incorrect answer
*allow **1** mark for 45 × 100 / 25000*

2

(b) heat / thermal

allow heat <u>from</u> respiration

1

(c) energy / mass / biomass lost / not passed on **or** energy / mass / biomass is used **or** not enough energy / mass / biomass left

ignore reference to losses via eg respiration / excretion / movement / heat

1

a sensible / appropriate use of figures including heron

*eg <u>only</u> **2** from frog / to heron*
ignore units

1

(d) any **three** from:

accept marking points if candidate uses other terms for microorganisms

- (microorganisms) decay / decompose / digest / breakdown / rot
  ignore eat
- (breakdown) releases minerals / nutrients / ions / salts / named
  ignore food
- (microorganisms) respiration
  ignore other organisms respiring
- (microorganisms / respiration) release of carbon dioxide

3

[8]

Q20.

(a) (i) <u>anaerobic</u> respiration

or

fermentation

1

(ii) <u>oxygen</u> is present

accept O_2
*do **not** accept O, O^2 or O_2*

1

<u>aerobic respiration</u> occurs

ignore anaerobic

1

CO_2 from <u>respiration</u>

allow from <u>fermentation</u>

1

(b) high methane after this time

ignore CO_2

1

(c) organic matter / food / nutrients / named eg used up / reactants

allow <u>too</u> hot / accumulation of toxins / named

*do **not** allow products*

ignore energy

1

[6]

Q21.

(a) (i) sun

ignore light

apply list principle

1

(ii) photosynthesis

apply list principle

allow approximate spelling

*do **not** accept phototropism*

1

(b) (i) chemical

1

(ii) carbon dioxide

1

(iii) carbohydrates

1

(c) As carbon dioxide from the caterpillar

if more than 2 boxes ticked deduct one mark for each additional incorrect box

1

As faeces (droppings) from the blue-tit

1

[7]

Q22.

(a) too cold / very cold **or** oxygen / microbes cannot reach it

allow not enough energy / heat / warmth

ignore frozen

1

for microorganisms / microbes / bacteria / fungi / enzyme / reaction (to work) *ignore other consumers*

1

(b) no longer exist
or no more left
or died out / all died

ignore died unqualified

1

(c) (i) egg cell

1

(ii) nucleus

1

(iii) given an electric shock

1

(iv) womb

1

(d) has mammoth genes / chromosomes

accept genetic information / DNA / alleles / nucleus
accept converse

1

[8]

Q23.

(a) **X** respiration

correct order only
allow decay / decomposition / rotting
ignore breakdown / disintegrate

1

Y combustion / burning

1

(b) any **three** from:

- photosynthesise / absorb carbon dioxide

  *accept are producers **or** produce / make biomass / glucose / other named*
  *do **not** accept photosynthesis releases CO_2*

- release carbon dioxide / respire
- eaten by animals
- fed on / decayed by microorganisms

  ignore eaten by microorganisms

3

(c) any **two** from:

(in tropical rainforest conditions are)

- warm(er) / hot
- damp / moist / wet / humid

  ignore rain
- a lot of microorganisms
- a lot of material to decay

  *allow warm(er) so enzymes work faster for **2** marks*

2

[7]

Q24.

(a) (i) 0.6 **or** 6×10^{-1}

for correct answer

if no / incorrect answer $\frac{2.4 \times 10^{4}}{4 \times 10^{6}} \times 100$

or

*0.006 **or** 6×10^{-3} gains **1** mark*

2

(ii) any **two** from:

- reflected

  ignore some of light is green
- not absorbed **or** misses chloroplasts / chlorophyll

  *allow transmitted **or** passes through leaves*
  allow hits other plant parts
- wrong wavelength
- photosynthesis inefficient

  accept other limiting factors / named
- allow some lost through respiration / as heat (from respiration)

2

(b) energy lost via faeces / not digested / waste / excreted (of insect-eating birds)

1

energy loss via respiration / movement / muscle contraction / heat (by insect-eating bird)

accept examples of muscle contraction
*do **not** accept energy used for respiration*

1

some of (insect eating) bird not eaten <u>but</u> all / most / more of insect is eaten

1

[7]

Q25.

(a) (i) (white) clover

1

(ii) reed sweet-grass

allow reed

allow grass

1

(iii) (only) found in swamp and aquatic zones **or** <u>only</u> found in water **or** doesn't grow in marsh

ignore wet conditions

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)
There is a basic description which describes how a quadrat **or** a metre tape could be used to collect data

Level 2 (3-4 marks)
There is a clear description of how a quadrat **and** a metre tape could be used to collect data along a line

Level 3 (5-6 marks)
There is a clear, logical and detailed description of a method that will produce valid, repeatable results across / at intervals along the stream.

examples of procedural points made in the response:

- use of tape measure to produce transect
- placing of quadrats
- transect placed across stream
- score presence of each plant species
- use quadrat at regular intervals along tape
- repeat transect several times (≥ 3)
- along stream
- at random **or** regular intervals

6

[9]

Q26.

(a) (biogas / methane is made) by fermentation / anaerobic respiration

accept reverse argument

*accept for **1** mark so no oxygen in jar **or** so oxygen can't enter **or** makes conditions anaerobic*

ignore references to keeping other microbes out

ignore air

2

(b) (i) carbon dioxide

accept CO_2 / CO2

*do **not** accept CO^2*

1

(ii) 0.62 look for answer in table

*correct answer with or without working gains **2** marks*

*allow 62% for **2** marks but 62 for **1** mark if incorrect / no answer*

$\frac{426}{686}$ *gains **1** mark*

2

(iii) (more fat → much) more biogas / methane

allow more implied by giving two numbers or a subtraction / division

1

(more fat →) only <u>small</u> increase in proportion / concentration / percentage of methane

*allow increases only from 0.60 to 0.63 **or** <u>only</u> changes by 0.03*

or approximately constant

or no change above 5%

1

(iv) fat (too) expensive **or** fat (too) expensive to transport (from coast to farm)

accept any suitable reference to extra cost / effect on environment eg more pollution from transport

1

[8]

Q27.

(a) (i) 70

*award **2** marks for correct answer irrespective of working*

*allow **1** mark for 30 + 10 + 24 + 6 (with wrong answer or no answer), do **not** award this sum if other figure(s) are included in the addition*

2

(ii) 6

*award **2** marks for correct answer irrespective of working*

*award **2** marks for correct answer to (a)(i) – 64 (ecf)*

*award **1** mark either for 70 – 64 or answer to (a)(i) – 64 with no answer or incorrect answer*

2

(b) photosynthesis.

1

[5]

Q28.

(a) any **two** from:

- food / feeding

  ignore water
- mates / mating
- territory / space / land / shelter / nesting sites

  ignore homes / place to live / habitat / resources
- status (within group)

2

(b) (i) rises to 1480 to 1500
or rises by 880 to 900
or rises until 1993

ignore incorrect figures if 1993 given

1

falls to 400 to 440 **or** falls by 1040 to 1100

*if neither mark gained then allow **1** mark for rise followed by fall **or** fell by 160 to 200*

1

(ii) <u>rises because</u>: -
less competition from mule deer
or mule deer population falling
or fewer mule deer

ignore reference to food / breeding

ignore reference to predation / disease

1

<u>falls because</u>: -
more competition from mule deer
or mule deer population rising
or more mule deer

ignore more / less suited to environment

*if neither mark gained then correct reference to competition gains **1** mark*

1

[6]

Q29.

(a) 16

*accept correct answer for **2** marks, irrespective of working*

*if no answer **or** answer incorrect accept 0.64 x 100 / 4 (.0) **or** 0.16 for **1** mark*

2

(b) insect cold-blooded / not warm blooded **or** does not control body temperature

accept mammal warm-blooded / constant (high) body temperature / controls body temperature

1

reference to insect 0.96 (kJ) **and** mammal 12.25 (kJ) transferred by respiration **or** relevant calculation of this transfer

ignore references to other data

1

(less respiration) so more energy / biomass / food available (for growth of insect)

(more respiration) so less energy / biomass / food available (for growth of mammal)

1

[5]

Q30.

(a) three layer triangular pyramid

either way up (as blocks or triangle)

1

(soya / beans / food – trout / fish – people / human (in sequence)

ignore reference to producers /herbivores / consumers

*award **1** mark only for a correct food chain with 2 correct arrows showing energy flow*

1

(b) the trout release energy when they respire

1

some energy will be lost in waste from the trout

1

(c) any **one** from eg

- easy / easier to catch / more caught

  allow easy / easier to monitor

- easy / easier to feed

  allow control food

- no / less predation

  allow less fishing / poaching

- less energy loss

  allow grow faster
- less movement

  ignore less space to move

  *do **not** allow easier to farm*

1

(d) any **two** from:

- microorganisms / bacteria /decomposers / microbes / fungi /detritus feeders
- decay / rot / decompose / digest /break down

  ignore biodegrade
- (microorganisms) respire

  *do **not** award this mark if response implies the trout respire*
- turned into fossil fuels / named fossil fuels
- carbon dioxide / $CO_{2\ \text{released}}$

2

[7]

Q31.

(a) very little of the biogas generator will be seen

*cancel **1** mark for each extra box ticked*

1

the temperature inside will not change much

1

(b) (i) methane

1

(ii) 60

correct answer with or without working

*100 – (35 + 1.5 + 1.5 + 2) but incorrect answer allow **1** mark*

2

[5]

Q32.

(a) methane / CH_4

allow CH^4 / CH4 / H4C

1

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

ignore reference to smell

- less visual impact
- less heat loss

or
(better) insulated

or
temperature will be less variable /keeps warm / keeps cool **or** easier to maintain optimum temperature

- withstand pressure build-up
- ease of adding material / slurry

2

(ii) any **one** from:

- to keep anaerobic
- to prevent oxygen / air entering
- to prevent biogas escaping
- to maintain pressure / to allow removal of biogas

1

(c) any **two** from:
ignore to keep warm

- to maintain optimum temperature
  if reference to specific temperature accept any value in range 26 – 40 °C as optimum
- to speed up production of biogas

  or

  reference to faster microbial action / named microbial process
- UK temperature is low/below 25 °C
  *UK temperature is below optimum = **2** marks*
- self sufficient / sustainable

2

[6]

Q33.

(a) (i) quadrat / grid
allow suitable description in a(i) or a(ii)
allow quadrant

1

(ii) any **two** from:

- use a transect / description
  allow measure distance of the test or sample site from road

- sample every metre

  ignore random placing of quadrat

- count plants (in quadrat)

2

(iii) the nearer to the road, the more (plantain) plants

accept the more dead nettles the less plantains

1

(b) (i) any **two** factors from: eg

- grow better / survive away from road
- sensitive to pollutant / named pollutant / dust / fumes

  ignore carbon dioxide as pollutant

- (roadside) weedkillers
- trampling /damage / turbulence
- grass cutting
- competition
- aspect eg hillier

or

give **one** mark for a factor and **one** mark for its effect eg

dust (from road) (1)

reduces photosynthesis (1)

or

'loses' in competition (1)

for light / water / nutrients / minerals / ions / space / soil (1)

ignore food for plants

2

(ii) any **two** factors eg

ignore distribution

- can withstand pollution

  allow grows better in polluted air

  ignore ?prefer' pollution

- competition
- aspect eg flat

or

give **one** mark for a factor and

one mark for its effect eg

use carbon dioxide (from traffic) (1)

enhances photosynthesis (1)

or

'wins' in competition (1)

ignore food for plants

for light / water / nutrients / minerals / ions / space (1)

2

[8]

Q34.

(a) microorganisms

1

(b) moist

1

(c) respiration

1

(d) roots

1

[4]

Q35.

(a) B and D

both required in any order

1

(b) any **two** from:

*do **not** accept compounds restricted to animals*

- carbohydrate / named example

  *allow **2** marks for 2 named examples*

  *do **not** allow a general name and a named example for **2** marks (eg award **1** mark only for carbohydrate and starch)*

- protein / enzyme

  *allow **2** marks for 2 named examples*

- amino acid
- hormone / named plant hormone
- lipid / fat / oil / wax

- chlorophyll
- DNA
- vitamin(s)

2

(c) contains minerals / salts / ions / nutrients / named

ignore 'food'
*do **not** allow vitamins / glucose / energy etc*

1

(needed by plants) for health / better growth

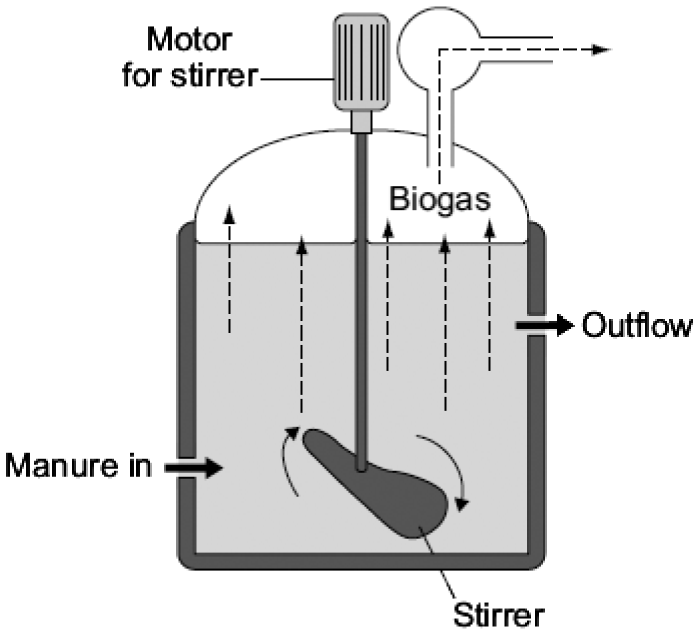
for / help plant growth is insufficient
ignore moisture retention / soil structure
ignore more plants
*allow examples linked to mineral eg contains magnesium to make chlorophyll for **2** marks*

1

[5]

Q1.

The diagram shows one type of biogas generator.



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

Suggest **one** reason for this.

Tick (✓) **one** box.

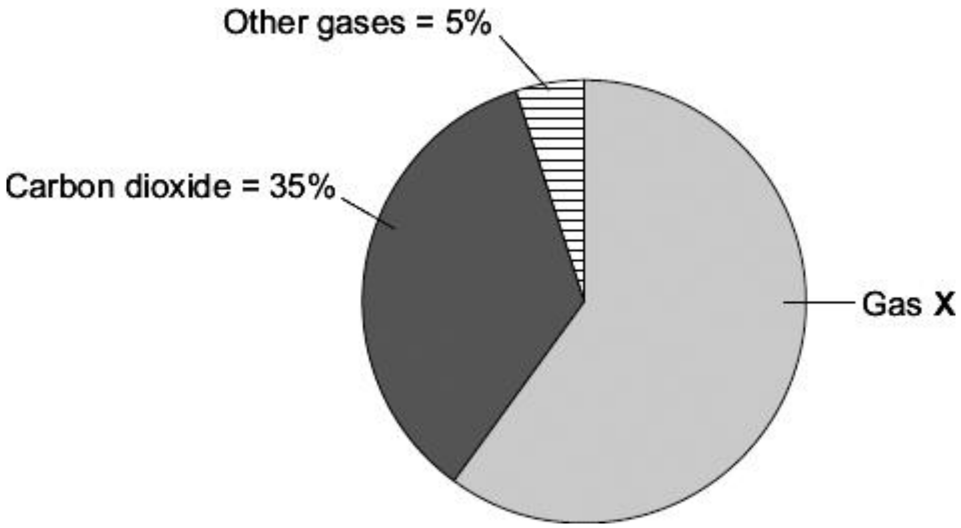
A higher concentration contains too little oxygen. ☐

A higher concentration would be difficult to stir. ☐

A higher concentration contains too much carbon dioxide. ☐

(1)

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



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

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

Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

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

Show clearly how you work out your answer.

___

___

___

Percentage of gas **X** = ___

(2)

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

Draw a ring around the correct answer to complete each sentence.

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

aerobic respiration.
anaerobic respiration.
fermentation.

(1)

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

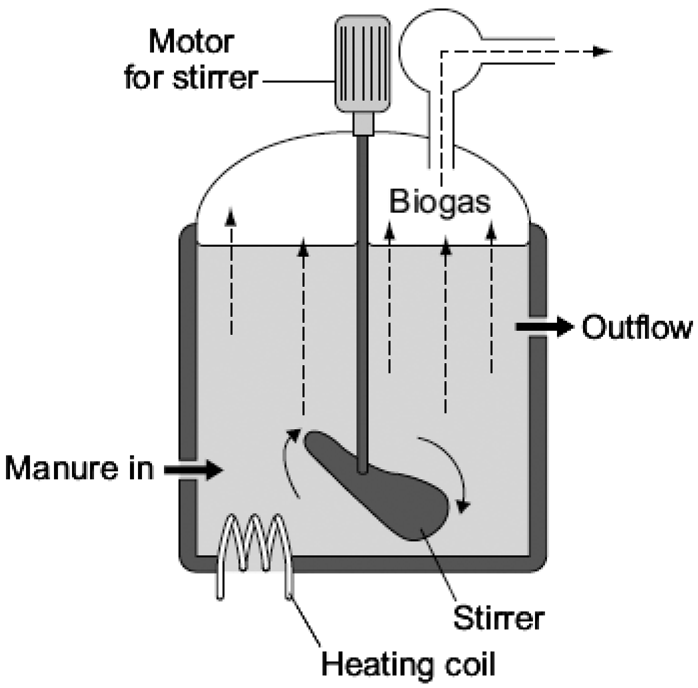
ammonia.
nitrogen.
oxygen.

(1)

(Total 6 marks)

Q2.

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



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

____

____

(1)

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

Suggest **one** reason why.

____

____

(1)

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

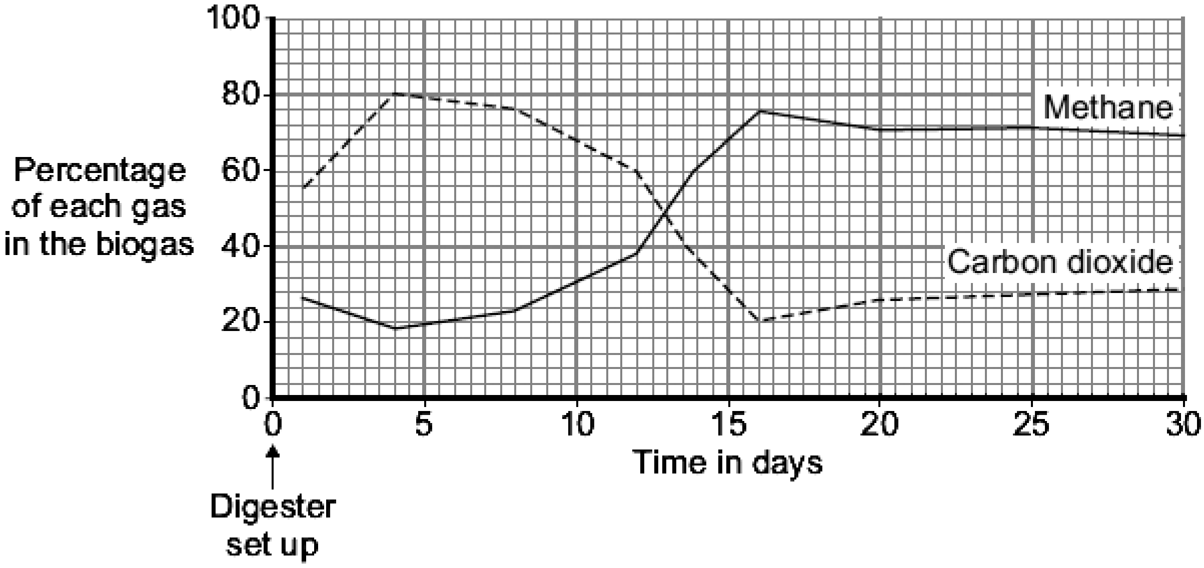
Suggest **one** reason why.

____

____

(1)

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



Use information from the graph to answer the following questions.

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

____

____

____

____

____

____

(3)

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

(1)

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

Suggest an explanation for this.

____

____

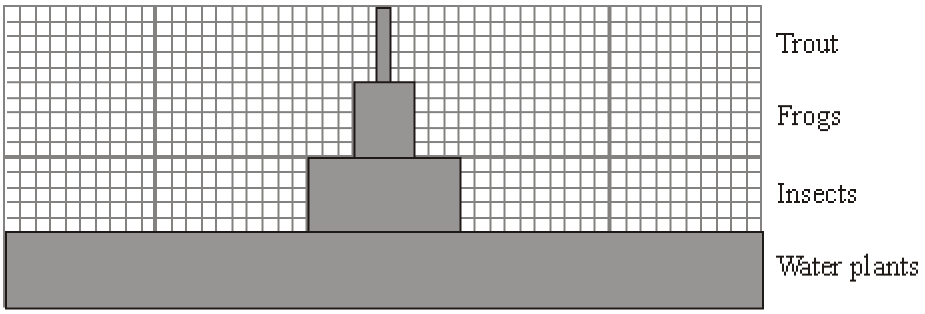
____

____

(2)
(Total 9 marks)

Q3.

The diagram shows a pyramid of biomass drawn to scale.



(a) What is the source of energy for the water plants?

____

(1)

(b) The ratio of the biomass of water plants to the biomass of insects is 5 : 1.

Calculate the ratio of the biomass of insects to the biomass of frogs.

Show clearly how you work out your answer.

____

____

ratio = ___________ : 1

(2)

(c) Give **two** reasons why the biomass of the frog population is smaller than the biomass of the insect population.

1. ____

____

2. ____

____

(2)

(d) Some insects die.

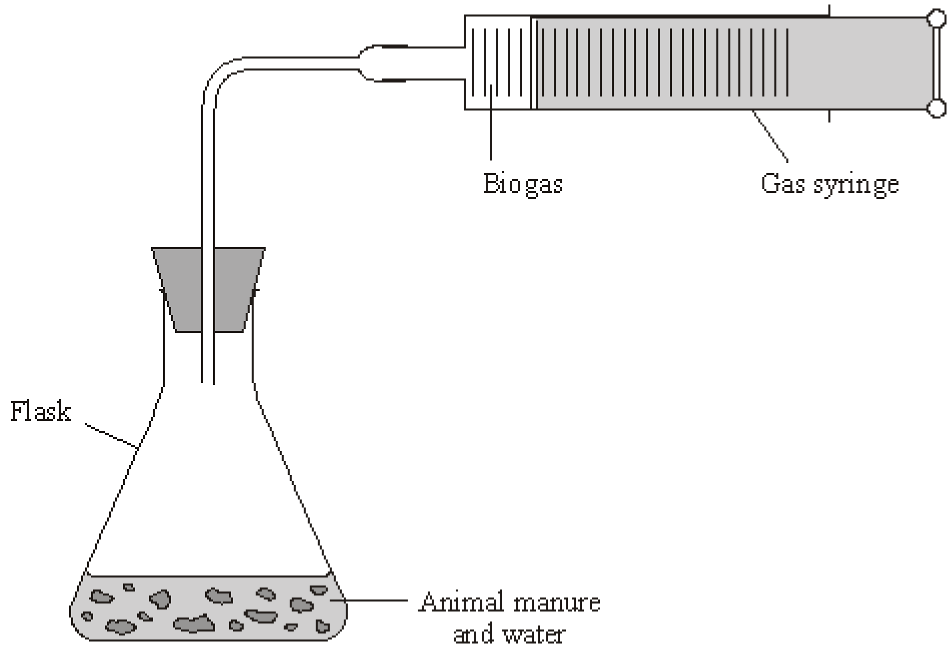
Describe how the carbon in the dead insect bodies may be recycled.

(4)
(Total 9 marks)

Q4.

Some students investigated the production of biogas from animal manure.

They used the apparatus shown in the diagram.



In their first investigation, the students collected the biogas in the gas syringe.

The table shows the percentage composition of the biogas.

Gas	**Percentage composition**
Methane	55
Carbon dioxide	40
Water vapour	5

(a) To make the biogas a more efficient fuel, the percentages of two of the gases in the table should be reduced.

Which **two** gases should these be?

1. ____________________

2. ____________________

(1)

(b) The students then used the apparatus for a second investigation.

They bubbled oxygen through some fresh manure and water for one hour.
They then set up the apparatus again and collected a second sample of biogas in the gas
syringe.

Predict the effect of this procedure on the composition of the second sample of biogas.

Explain your answer.

____

____

____

____

____

____

____

____

____

____

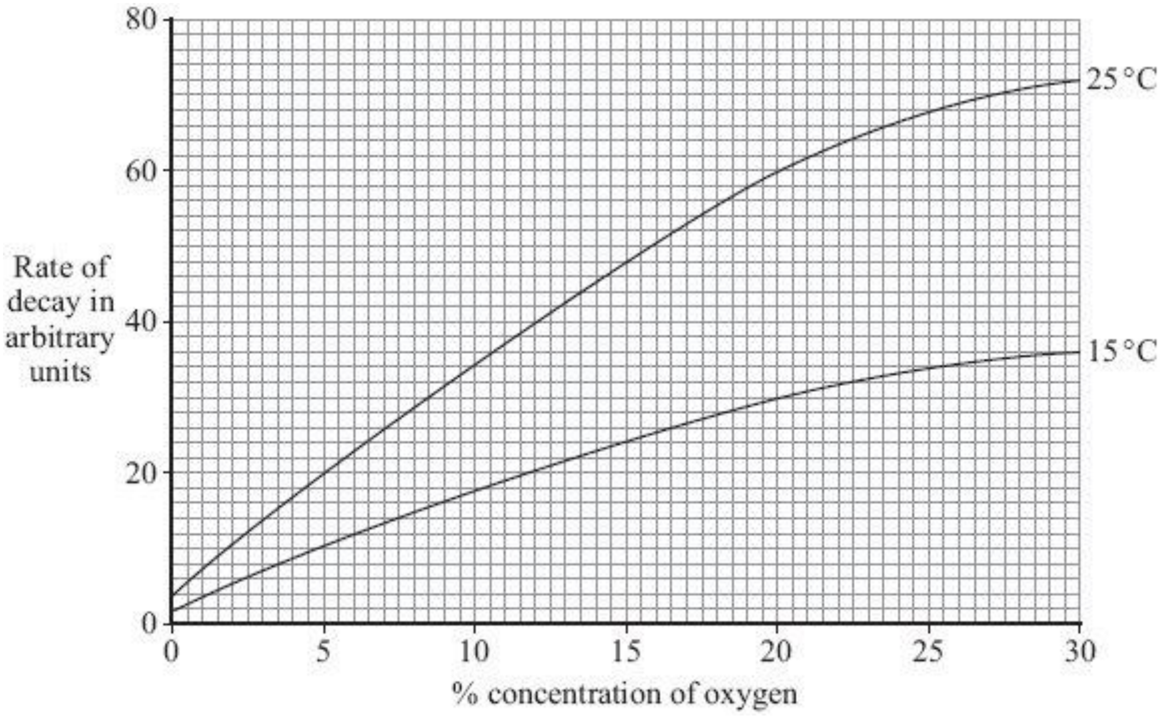
(4)

(Total 5 marks)

Q5.

Gardeners often put waste materials onto compost heaps.

The graph shows how the conditions in a compost heap affect how quickly waste materials in the heap decay.



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

____

____

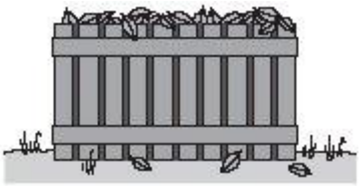
____

____

____

(2)

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



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

Explain why.

___

___

___

___

___

(2)

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

He put some decayed compost onto the soil, around the plants.
Six months later the plants were growing well.

Explain why.

___

___

(1)
(Total 5 marks)

Q6.

(a) Name the fuel gas present in biogas.

___

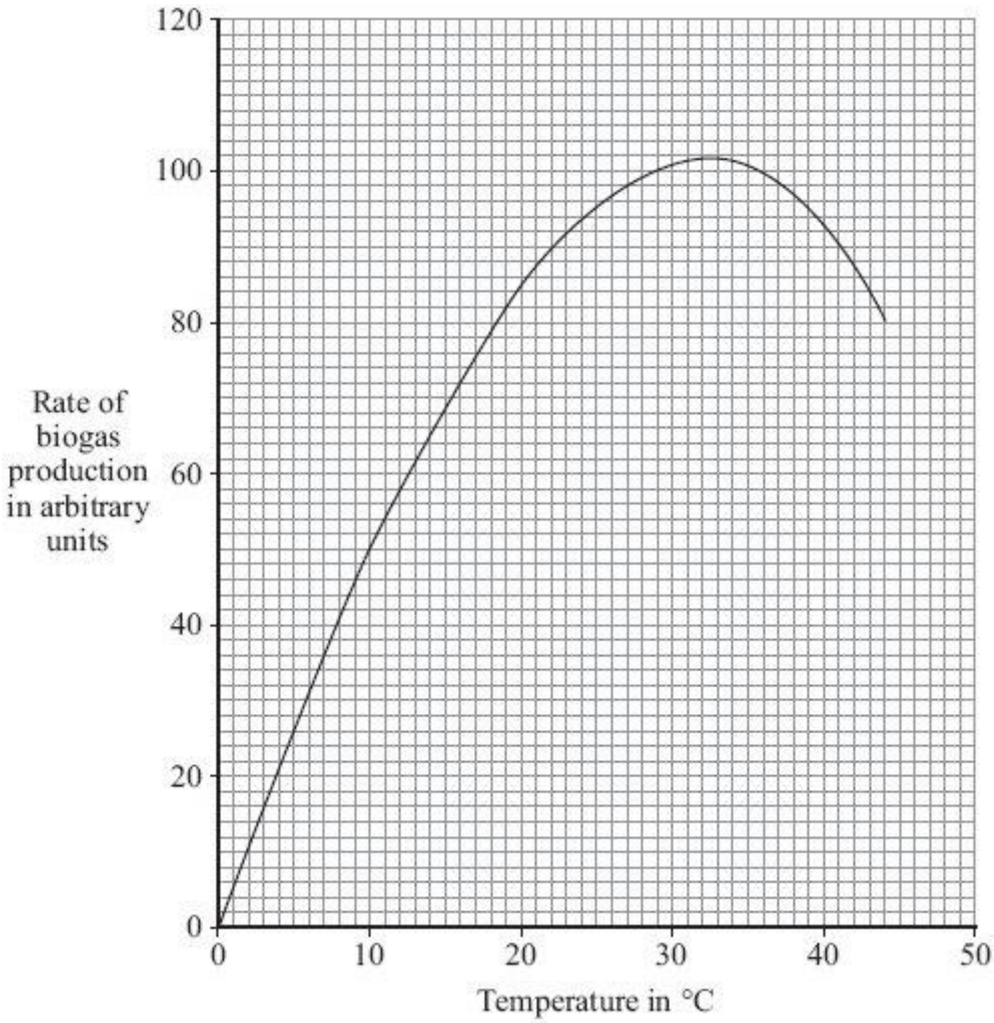
(1)

(b) Name the process that produces biogas.

___

(1)

(c) The graph shows the effect of temperature on the rate of biogas production.



(i) What is the best temperature for biogas production? ________________ °C

(1)

(ii) In India, daytime temperatures can sometimes be higher than 40 °C.
It is useful to place the biogas generator underground.

Use information from the graph to suggest why.

____

____

____

____

(2)

(d) Temperatures at the UK sewage works vary between 0 °C and 25 °C.
The UK biogas generator has concrete walls, 60 cm thick.

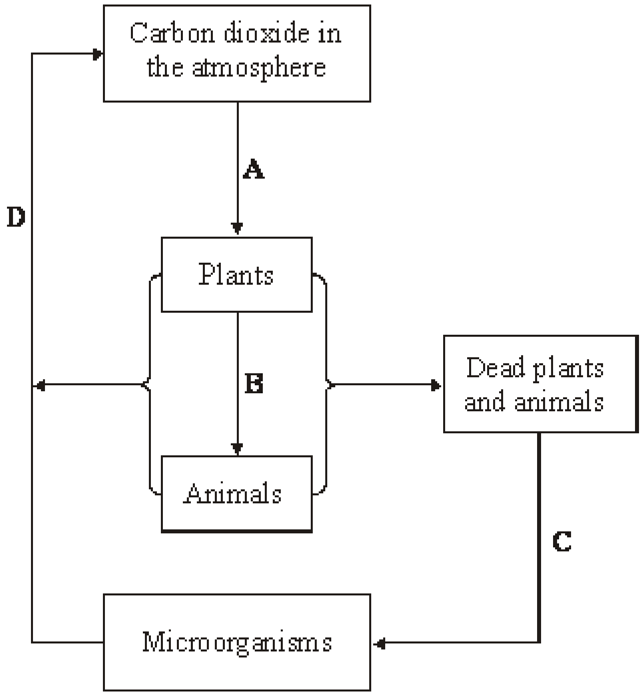
How does the thickness of the walls affect the rate of biogas production?

Give a reason for your answer.

(2)
(Total 7 marks)

Q7.

The diagram shows part of the carbon cycle.



(a) Which letter, **A**, **B**, **C** or **D**, represents:

(i) respiration ______________________ **(1)**

(ii) photosynthesis? ______________________ **(1)**

(b) Local authorities are encouraging people to recycle vegetable waste by converting it into compost.

Compost is made by mixing the vegetable waste with soil in a large container.

(i) Decay occurs more quickly if the container has holes in the sides.

Explain why.

(2)

(ii) Spreading compost on the soil between plants leads to better growth of the plants.

Explain why.

(1)
(Total 5 marks)

Q8.

Read the passage below about biogas production in Sri Lanka, which is a country with a much warmer climate than the UK.

> Mr Ratnayake is a farmer. Using nothing more than cow dung, he has enough power to cook and provide heat and light for his home without using a single piece of wood. He collects the manure from his cows in their cattle shed. He then mixes the manure with water and leaves it to ferment in a large concrete pit. The gas produced is collected in a simple storage tank and is piped into his house for use.
>
> The dried manure left after this biogas is generated is richer than ordinary manure. It makes a good organic fertiliser for Mr Ratnayake's crops. He can then sell his crops at a higher price as they are organic produce.
>
> *http://www. i-sis.org.uk*

(a) (i) What is the fuel gas present in biogas?

(1)

(ii) Name the process which produces biogas.

(1)

(b) (i) Give **two** ways in which Mr Ratnayake benefits from making biogas as described in the passage.

1. ______

2. ______

(2)

(ii) This design of biogas generator works well in Sri Lanka. It would not work so well in the UK.

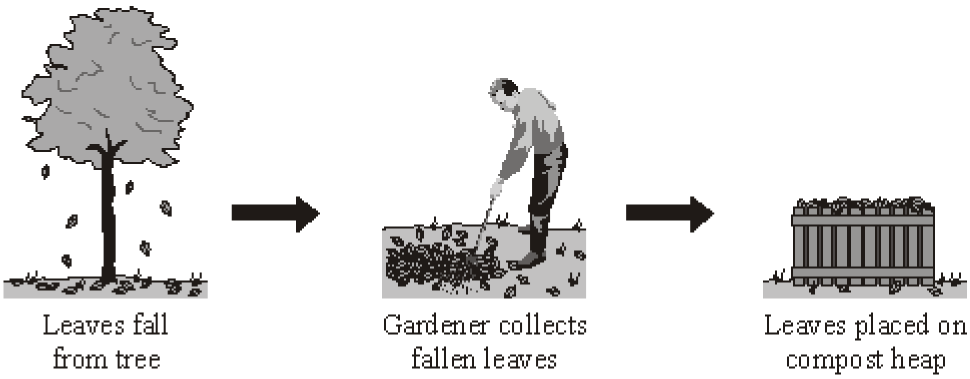
Explain why.

(2)

(Total 6 marks)

Q9.

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



(a) Over the next year the leaves decay.

Which living things cause leaves to decay?

(1)

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

Give **one** reason why.

(1)

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

Which gas is needed for decay?

Put a tick (✓) in the box next to your choice.

Carbon dioxide ☐

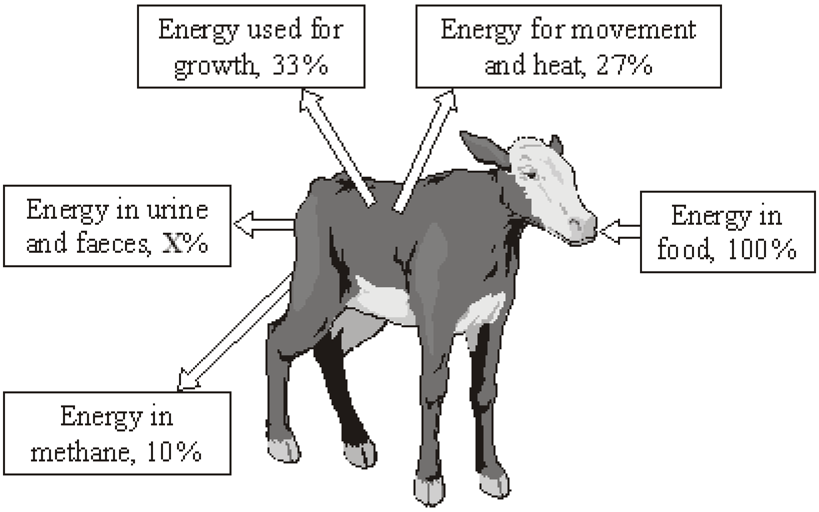
Nitrogen ☐

Oxygen ☐

(1)
(Total 3 marks)

Q10.

The diagram shows what happens to the energy in the food that a calf eats.



(a) Calculate the % energy lost as urine and faeces (**X**).
Show clearly how you work out your answer.

____

____

Energy lost as urine and faeces ____________________ %

(2)

(b) The energy in the food eaten by the calf in one day is 6 megajoules.

Calculate the amount of this energy that would be used for growth.
Show clearly how you work out your answer.

____

____

Energy used for growth ____________________ megajoules.

(2)

(c) Which process in the body transforms energy in food into heat?

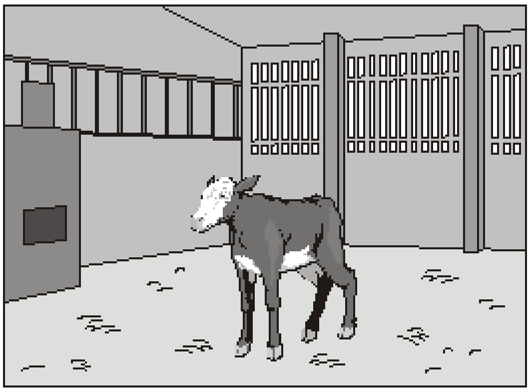
____

(1)

(d) The pictures show two methods of raising calves indoors.

Method 2 is now banned.

Method 1



Method 2

(i) Calves raised indoors grow faster than calves raised outdoors.

Suggest **one** reason why.

____

____

(1)

(ii) **Method 2** was banned after public campaigns.

Suggest **one** reason why people campaigned against this method of rearing calves.

____

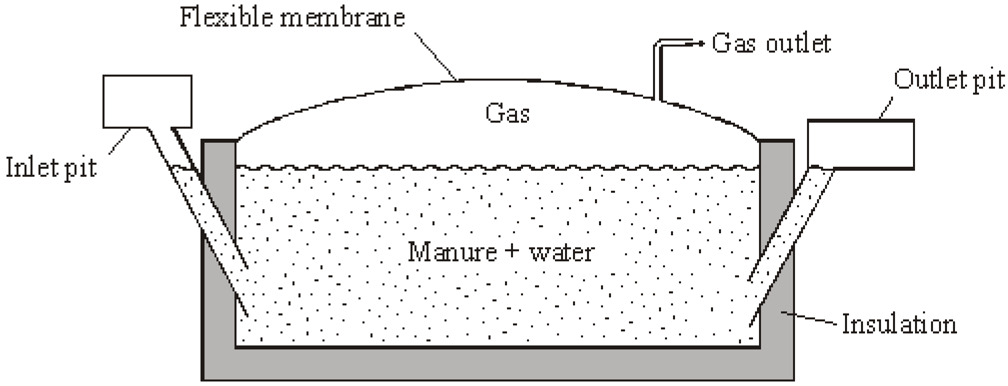
____

(1)

(Total 7 marks)

Q11.

The diagram shows one design of biogas generator used on a large dairy farm in the USA.



(a) What is the main, useful gas in biogas?

Draw a ring around **one** answer.

carbon dioxide **hydrogen** **methane**

(1)

(b) The insulation is installed so that biogas is produced at a faster rate.

Why is biogas produced at a faster rate?

___

___

(1)

(c) The table shows costs and income for this generator.

Item	**Yearly costs in dollars**	**Yearly income in dollars**
Electricity generated from biogas		22 800
Heating from burning biogas		4 200
Sale of fibre after biogas production		8 000
Operation and maintenance costs	10 000	

(i) Calculate the yearly profit from the biogas generator.

Show your working.

___

___

___

(2)

(ii) It cost 200 000 dollars to build the generator. Use your answer to part (c)(i) to calculate how many years it would take to pay back this cost.

____

____

____

(2)
(Total 6 marks)

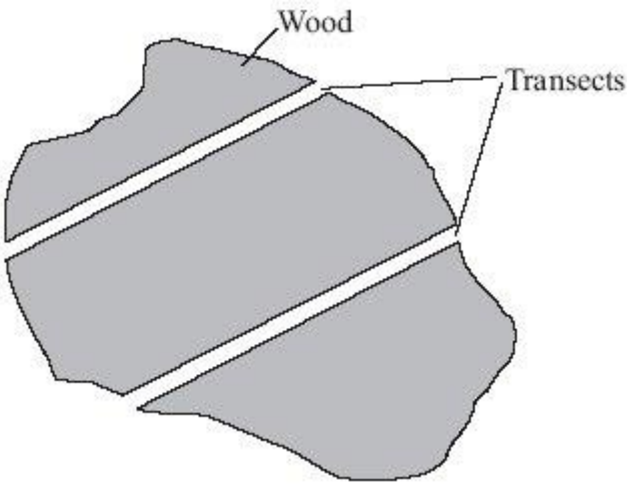
Q12.

Red squirrels live in trees. They eat seeds from the cones of conifer trees. Squirrels store cones in ‘larders’ on the ground. These larders provide food through the winter. Each red squirrel makes and defends one larder.

Scientists monitor squirrel numbers to find the best habitats for the squirrel’s survival. In one investigation, scientists estimated the numbers of squirrels in different types of woodland. Each woodland contains a different species of conifer tree.

Here is their method.

- Ten woods of each type of woodland were surveyed.
- In each wood scientists measured out two transects (strips), each 600 m long and 10 m wide.
- A scientist walked slowly down the centre of each transect, recording the number of squirrel larders he could see.



(a) (i) How many transects all together did the scientists survey in each **type** of woodland?

Number of transects ____________________________

(1)

(ii) What was the total area surveyed in **one** wood?

____

Area ______________________________ m^2

(1)

(b) Name **one** variable that was controlled in this investigation.

____

(1)

(c) (i) The scientists recorded the number of larders instead of the number of squirrels they saw.

Explain how this could have increased the accuracy of the investigation.

____

____

(1)

(ii) This method of counting the number of larders could have led to an inaccurate estimate of the number of squirrels.

Explain how.

____

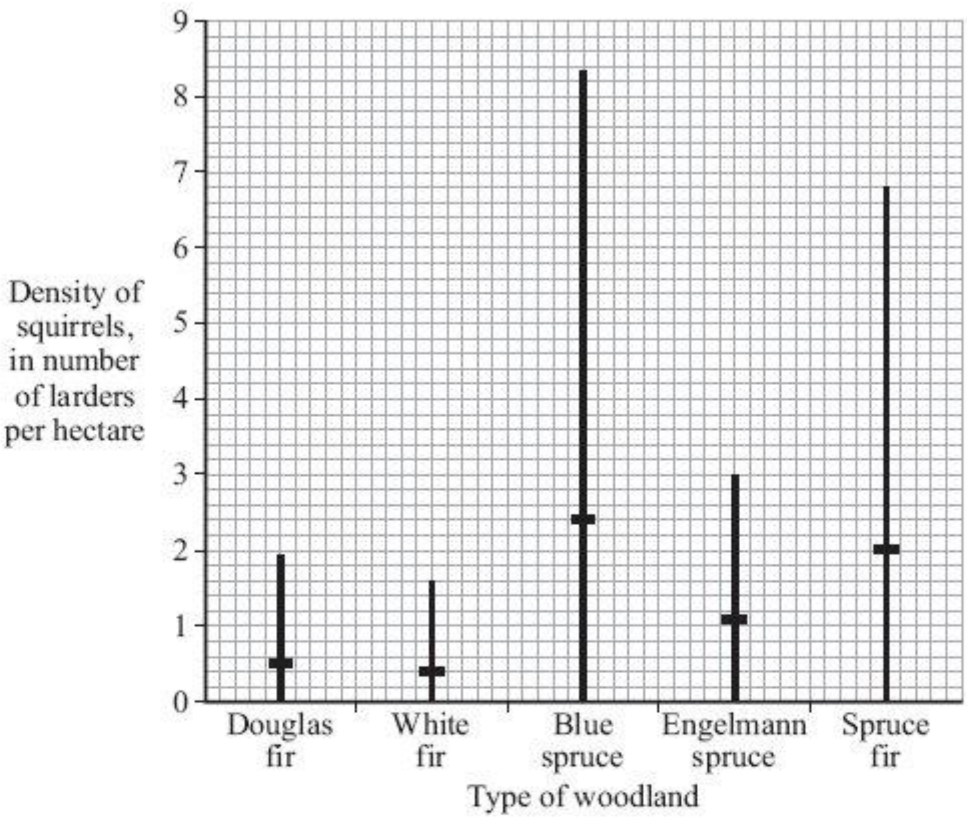
____

____

____

(2)

(d) The results of the investigation are shown in the graph.



The horizontal mark on each bar represents the mean number of larders per hectare of woodland.

The range of the number of larders observed for Douglas fir woodland was 0 to 1.9 per hectare.

(i) What was the range of the number of larders per hectare in the Spruce fir woodland?

____

(1)

(ii) The highest mean number of larders per hectare was found in Blue spruce woodland.

Suggest **one** explanation for this.

____

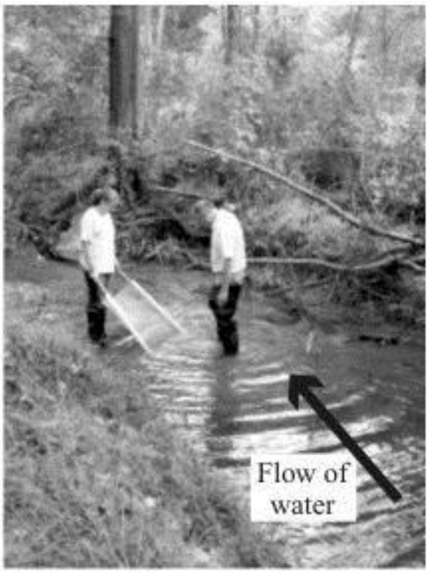
____

(1)

(Total 8 marks)

Q13.

Invertebrate animals are used to monitor pollution in streams. The photograph shows scientists collecting a sample of invertebrates from a stream.



Reproduced with the permission of John Graham

This is the method that they use.

- A 1 m^2 area of the bed of the stream is marked out.
- A net 1m wide is held by one person on the downstream side of the marked-out area.
- The other person uses their boots to gently move stones in this area of the stream bed. They do this for three minutes. This dislodges invertebrates which are then caught in the net.
- The invertebrates are then identified and counted.

(a) Name **two** control variables (variables which must be kept the same) in this investigation.

1. ______________________________

2. ______________________________

(2)

(b) Suggest **two** reasons why the results from a sample might not be accurate.

1. ______________________________

____

2. ______________________________

____

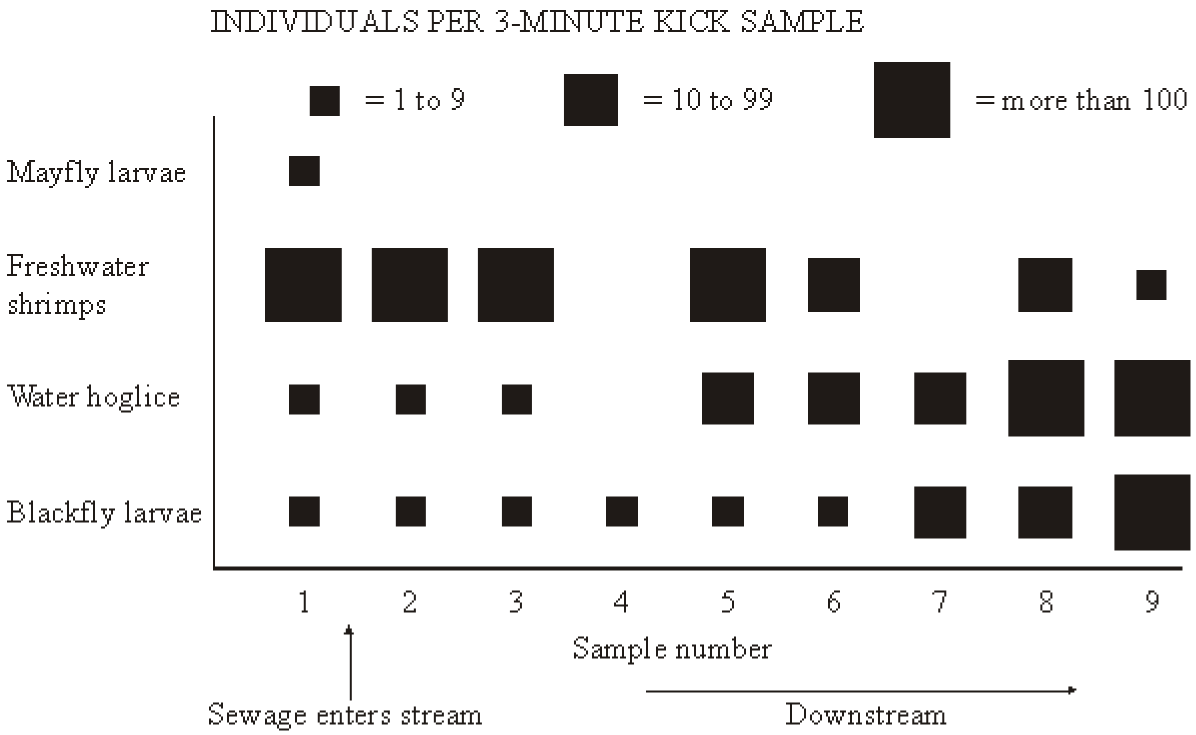
(2)

The technique described above was used to investigate the effect of sewage on stream invertebrates.

- Sample 1 was taken upstream of the point where the sewage entered the stream.

• Samples 2–9 were taken at regular intervals downstream of the sewage inflow.

The graph shows the results.



(c) What was the range of the number of blackfly larvae that could be found in sample 7?

____

(1)

(d) Describe, as fully as you can, how the number of water hoglice changed downstream from where sewage entered the stream.

____

____

____

____

(2)

(e) Which of the four invertebrates is the best indicator species for water which is **not** polluted by sewage?

____

Give the reason for your answer.

____

____

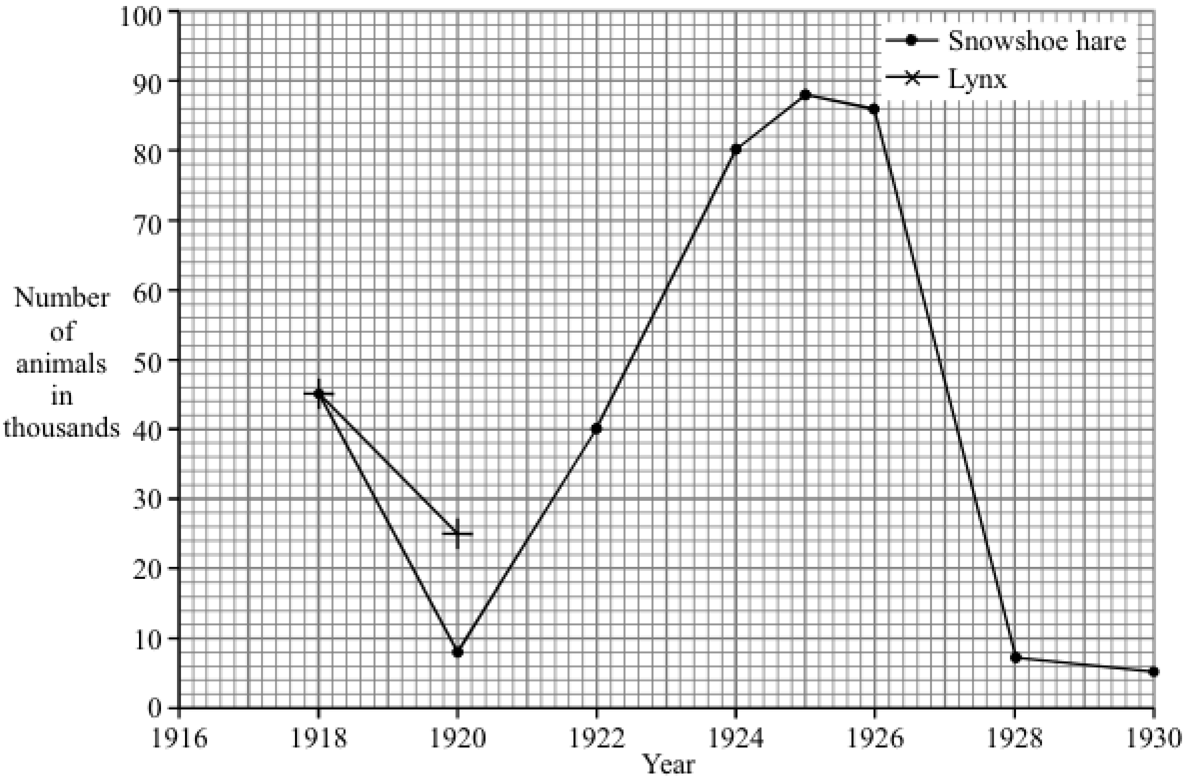
(2)
(Total 9 marks)

Q14.

The lynx is a wild cat which lives in Canada. The table shows the number of lynx trapped in a part of Canada in certain years.

Year	Number of lynx in thousands
1918	45
1920	25
1922	10
1924	20
1926	40
1928	50

The snowshoe hare is another wild animal found in Canada. The graph shows the number of snowshoe hares trapped in the same years. The lynx eats the snowshoe hare.



(a) Draw a graph of the data in the table. The first two points have been plotted for you.

(2)

(b) From your graph, predict how many lynx were trapped in 1925.

______________________________ thousand

(1)

(c) Use the information to answer the following.

(i) What would you expect to happen to the number of lynx trapped in 1930?
Draw a ring around your answer.

rise **fall** **stay the same**

(1)

(ii) Give a reason for your answer to part (c)(i).

____

____

(1)

(d) The lynx is a predator. What is a predator?

____

____

(1)

(Total 6 marks)

Q15.

The diagram shows a food chain in a pond. The figures show the amounts of energy in each type of organism, in kilojoules per m^2 of pond per year.

Plants 88 000 → Herbivores 14 000 → Carnivores 1600 → Top carnivores 88

(a) Calculate the percentage of the energy in the plants that is passed to the top carnivores. Show clearly how you work out your final answer.

____

____

____

Answer ________________ %

(2)

(b) In the space below, draw a pyramid of biomass for this food chain. Label your drawing with the names of the organisms.

(2)

(c) If humans ate organisms from this food chain, it would be more efficient to eat plants than to eat herbivores. Why is this?

____

____

____

(1)
(Total 5 marks)

Q16.

The table shows the sources of some of the energy used in India between 1960 and 1970.

	Source of energy in millions of tonnes			
	Non-renewable fuels		**Renewable fuels**	
Year	**Coal**	**Oil**	**Cow dung**	**Vegetable waste**
1960	47	7	101	31
1965	64	10	112	34
1970	71	15	123	38

(a) The change in the use of renewable fuels differs from that of non-renewable fuels. Calculate the percentage of renewable fuels used in 1960 and in 1970. Show clearly how you work out your final answer.

1960 ____

____

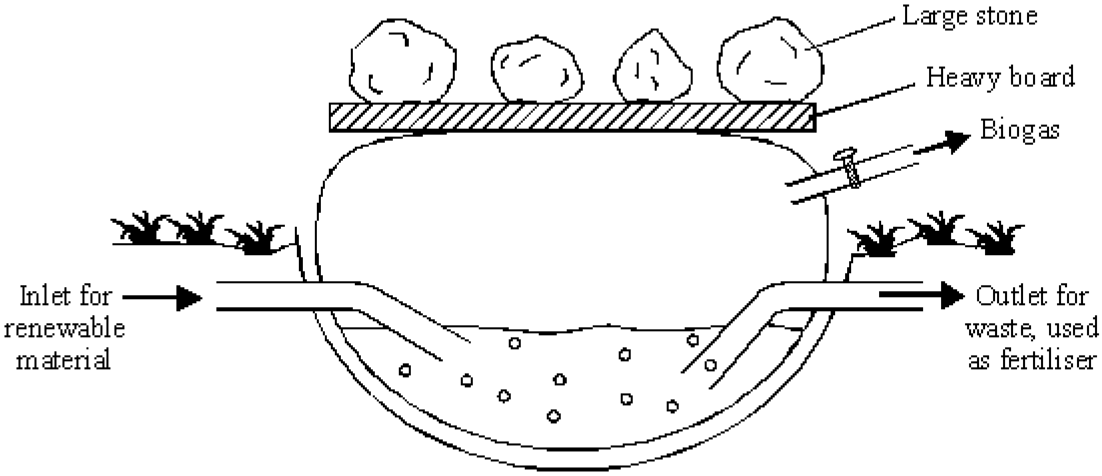
1970 ___

___

(3)

(b) The Indian government suggested that villagers should make better use of renewable resources.

They introduced biogas generators. The diagram shows one type of biogas generator.



The table shows the economic costs and benefits of using this type of generator.

Feature	**Cost or profit in £s**
Cost of generator and fitting	250
Annual maintenance costs	40
Annual profit from gas produced	30
Annual profit from fertiliser produced	40

Evaluate the advantages and disadvantages of using this type of generator.

___

___

___

___

___

___

___

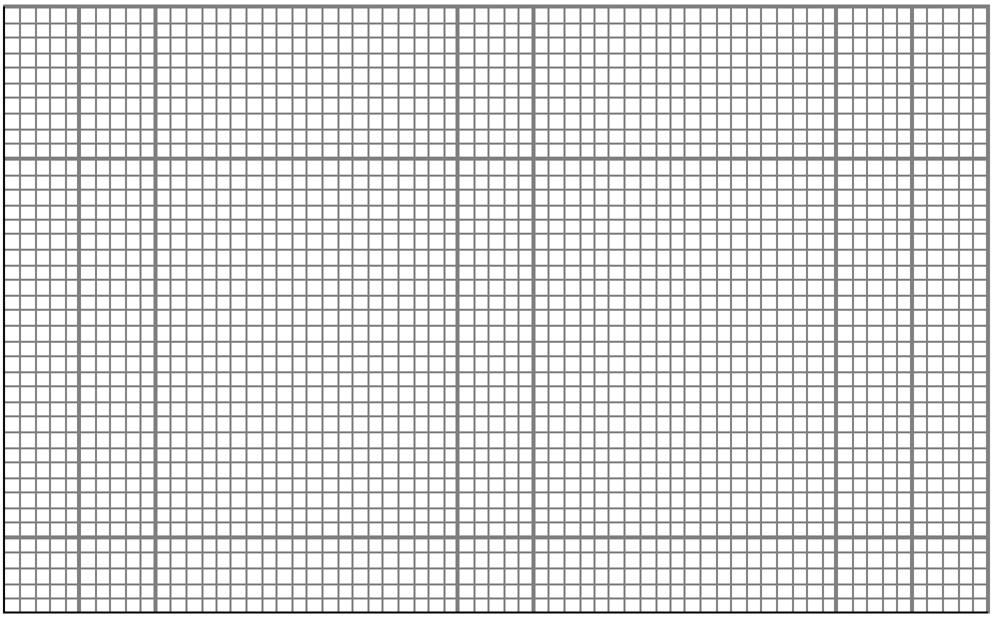
(4)

(c) The table shows how temperature affects the rate of biogas production in the generator.

Temperature in °C	10	15	20	25	30	35	40
Volume of biogas produced each day in m^3	0.50	0.55	1.50	1.70	3.00	3.45	3.30

(i) Use the grid to draw a graph to show how temperature affects the rate of biogas production.

Volume of biogas produced in m^3



Temperature in °C

(3)

(ii) Temperatures in India may reach over 35 °C. Explain the advantage of the generator being mainly underground.

____

____

____

____

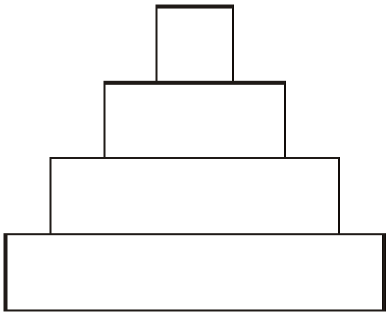
(2)
(Total 12 marks)

Q17.

This is a simple food chain.

Lettuce plant → Slug → Frog → Heron

The diagram shows a pyramid of biomass for this food chain.



____

____

____

____

(a) Write the names of the organisms in the food chain on the correct lines next to the pyramid of biomass.

(1)

(b) (i) The slug obtains its energy from the lettuce plant. What is the source of energy for the lettuce plant?

____

(1)

(ii) What is the function of chlorophyll in a lettuce plant?

____

(1)

(iii) The slugs ate some lettuce plants which contained 1620 kJ of energy. Only 10 per cent of this energy is used by the slugs for growth. Use the formula to calculate how much energy can be used by the slugs for growth. Show clearly how you work out your final answer.

$$\text{Amount of energy} = \frac{(\text{Percentage of energy used by slugs}) \times (\text{Amount of energy in lettuce})}{100}$$

____

____

____

Amount of energy = _______________ kJ

(2)

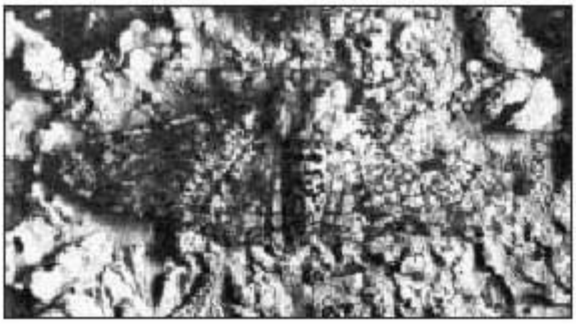
(Total 5 marks)

Q18.

The photographs show two varieties of moths, **X** and **Y**. The moths belong to the same

species.
The moths are resting on a tree trunk in open countryside.


Moth **X**


Moth **Y**

(a) Which variety of moth, **X** or **Y**, is more likely to be killed by insect-eating birds? Give a reason for your answer.

Variety of moth: ____

Reason ____

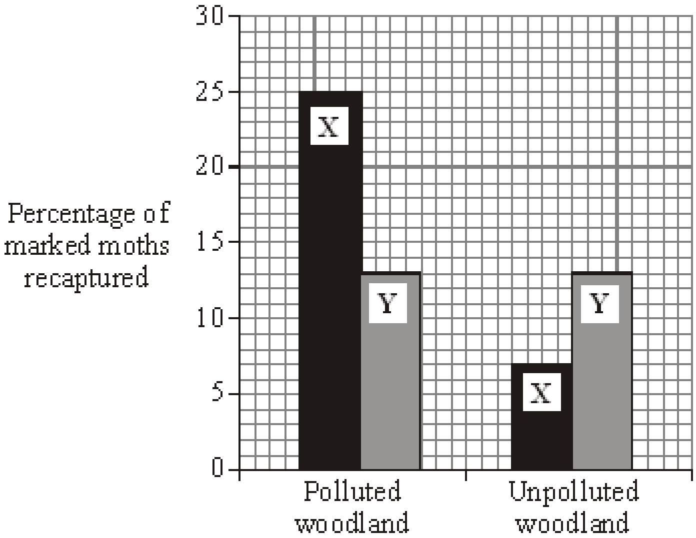
____

(1)

(b) In an experiment, large numbers of each variety of moth were caught in a trap.

- They were marked with a spot of paint on the underside of one wing and then released.
- A few days later, moths were again trapped and the number of marked moths was counted.
- The experiment was carried out in a woodland polluted by smoke and soot, and also in an unpolluted woodland.

The results are shown in the bar graph.



(i) When the moths were being marked, suggest why the paint was put on the underside of the wing and not on the top.

____

(1)

(ii) What percentage of moths of type **X** was recaptured in:

the polluted woodland; ____

the unpolluted woodland? ____

(2)

(iii) In each woodland, only a small number of marked moths of both varieties were recaptured. Suggest **one** reason for this.

____

____

(1)

(c) (i) The colour of the moths is controlled by a gene. The dark form was first produced by a mutation in the gene.

What chemical, found in a gene, is changed by a mutation? Draw a ring around your answer.

carbohydrate **DNA** **fat** **protein**

(1)

(ii) Some of the offspring from the original dark moth were also dark. What caused this?

____

____

(1)

(Total 7 marks)

Q19.

Each autumn, many trees lose their leaves.

(a) Describe how carbon compounds in the leaves can be recycled so that they can be used again by the trees.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

____

____

____

(4)

(b) Give **two** environmental conditions which speed up the processes that you have described in part (a).

1. ______________________________

2. ______________________________

(2)
(Total 6 marks)

Q20.

Figure 1 shows a food chain containing three organisms.

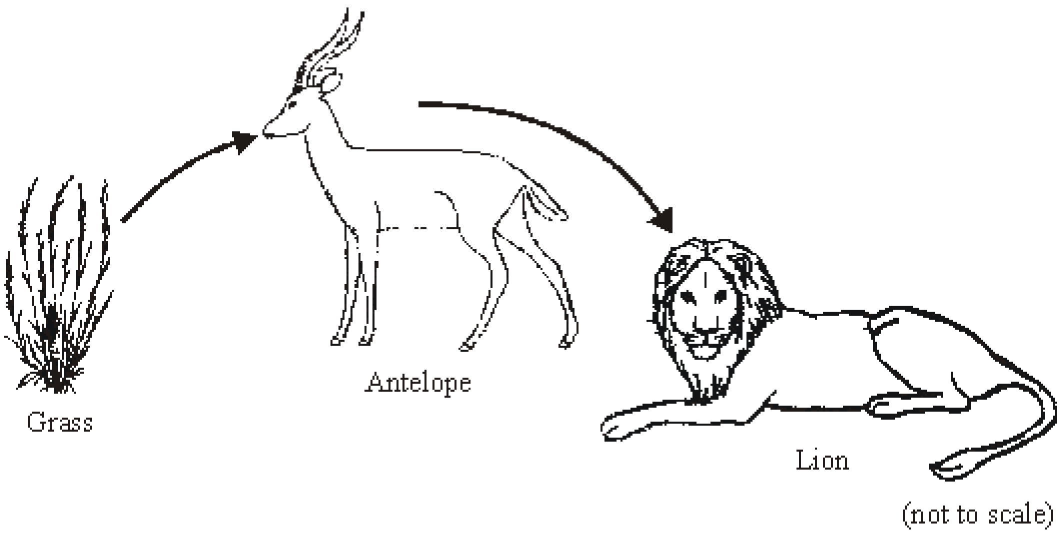


Figure 1

(a) (i) In this food chain, name:

the predator; ______________________________

the prey. ____

(2)

(ii) What is the source of energy for the grass?

Draw a ring around **one** answer.

carbon dioxide **light** **nitrates** **water**

(1)

(iii) **Figure 2** shows a pyramid of biomass for the organisms in **Figure 1.**

Write the names of the organisms on the correct lines in **Figure 2.**

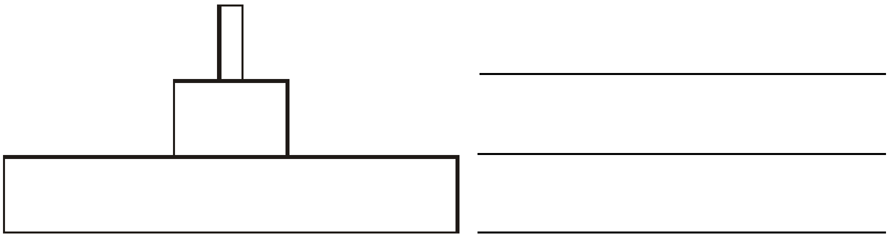


Figure 2

(1)

(b) Waste materials, like faeces from the animals, will decay,

(i) What sort of organisms cause decay?

____

(1)

(ii) **Three** of the following conditions help decay to occur rapidly.

Which conditions do this?

Draw a ring around each of the **three** answers.

aerobic **anaerobic** **cold** **dry** **moist** **warm**

(3)

(iii) The list below gives four substances. Two of these substances are produced by decay and can be used by the grass.

Which **two** substances are these?

Tick (✓) **two** boxes.

Carbon dioxide ☐

Mineral salts ☐

Oxygen ☐

Protein ☐

(2)
(Total 10 marks)

Q21.

The diagram shows the flow of energy through a forest. The figures are in kilojoules of energy per square metre per year.

(a) What percentage of the energy in the trees is passed on as food for the carnivores? Show clearly how you work out your final answer.

____

____

_________________ per cent

(2)

(b) Give **three** reasons why so little of the energy in the trees is passed on to the carnivores.

1. ____

____

2. ____

____

3. ____

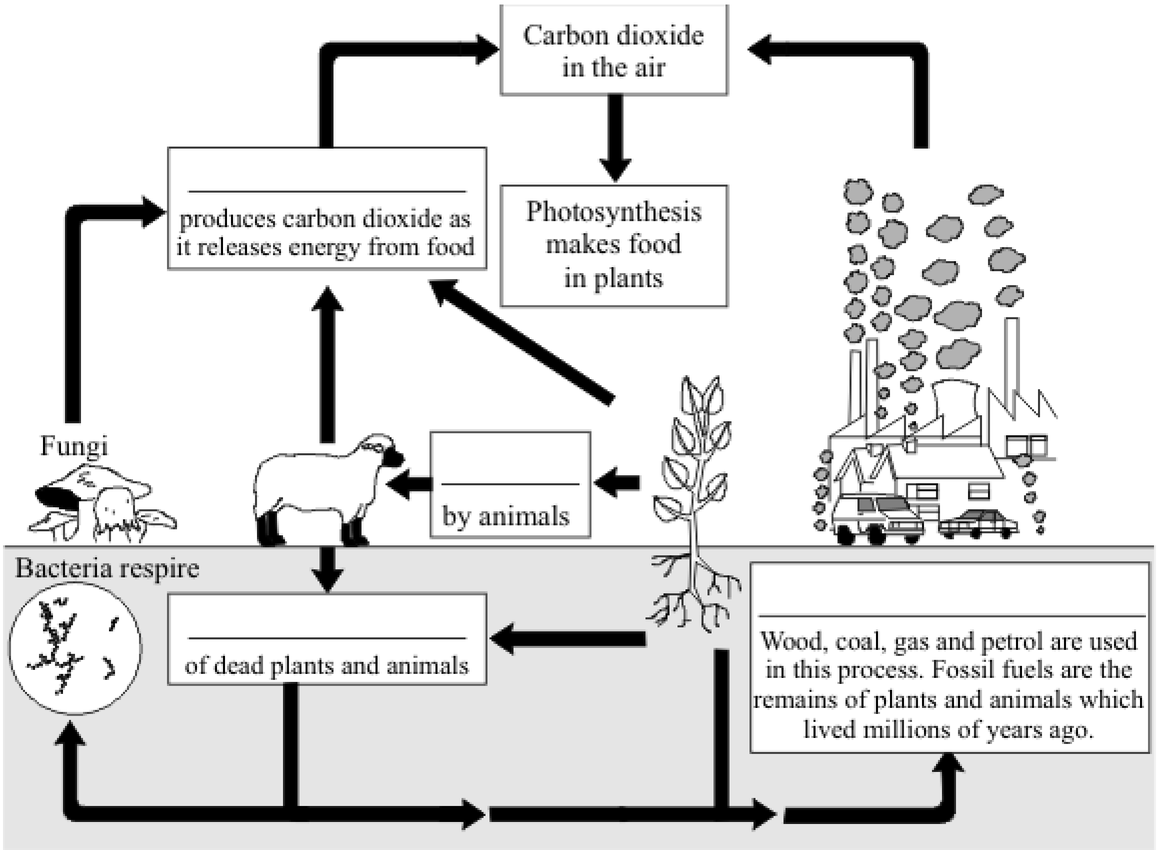
____

(3)
(Total 5 marks)

Q22.

(a) Use the words in the box to fill in the gaps in the diagram. You may use each word once or not at all.

carbon	burning	decay	eaten
nitrogen	oxygen	pollution	respiration



(4)

(b) (i) Why are fungi called decomposers?

____

(1)

(ii) Give **one** other type of decomposer.

____

(1)

(Total 6 marks)

Q23.

(a) One food chain in the wood is:

Hazel tree nuts → squirrels → owls

(i) What does this food chain tell us?

____

____

(2)

(ii) Which **one** of the organisms in the food chain is a producer?

(1)

(iii) This year the hazel bushes have produced very few nuts.

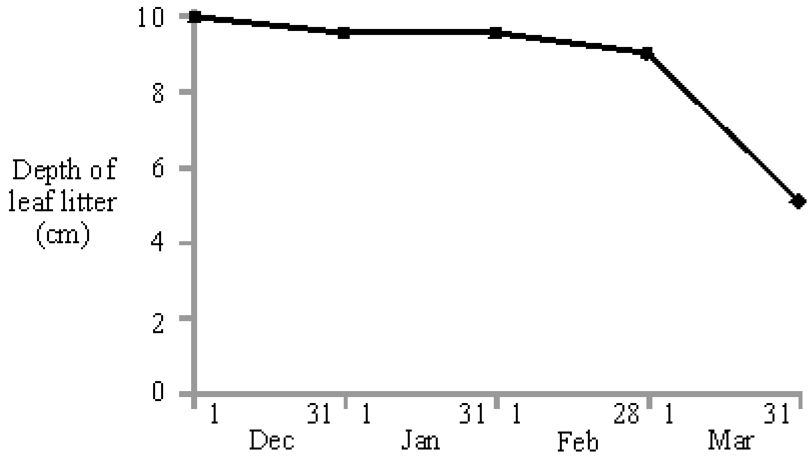
Explain, as fully as you can, how this might affect the populations of:

1. squirrels;

2. owls.

(4)

(b) An area of the floor of the wood 1 m^2 was fenced off so that animals could not reach it. The graph below shows the depth of leaf litter (dead leaves) inside the fence over the next few months.



Explain, as fully as you can,

(i) why the depth of the leaf litter decreased;

(1)

(ii) how this decrease happened.

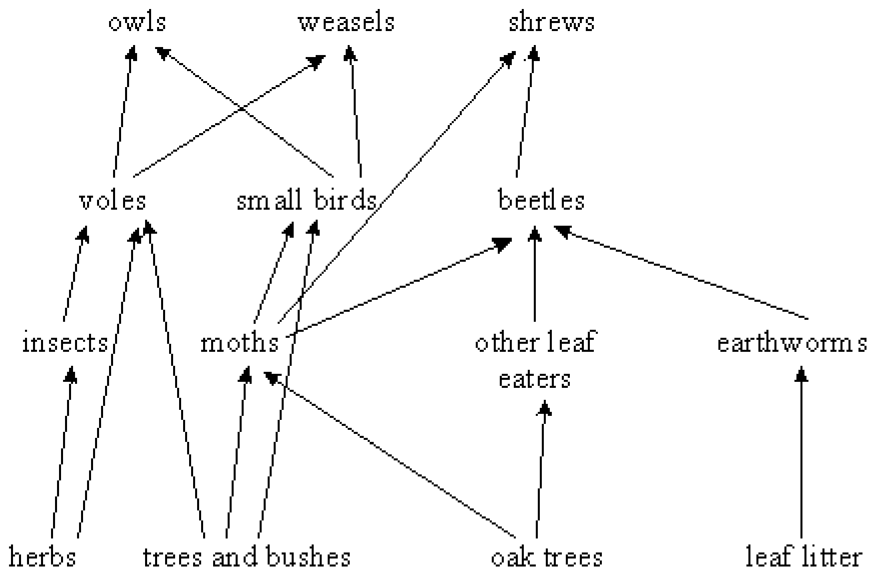
(1)

(iii) In which month does leaf litter disappear fastest? Explain why.

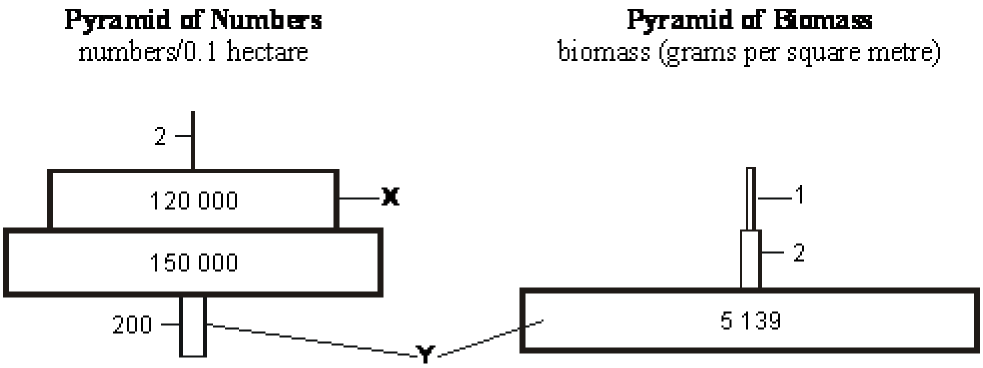
(2)
(Total 11 marks)

Q24.

The diagram below shows a food web for a wood.



(a) The diagrams below show a pyramid of the numbers and a pyramid of the biomass for 0.1 hectare of this wood.



(i) Name **one** organism from the level labelled X.

____

(1)

(ii) Explain, as fully as you can, why the level labelled Y is such a different width in the two pyramids.

____

____

____

____

(3)

(b) Explain, as fully as you can, what eventually happens to energy from the sun which is captured by the plants in the wood.

____

____

____

____

____

____

____

____

____

____

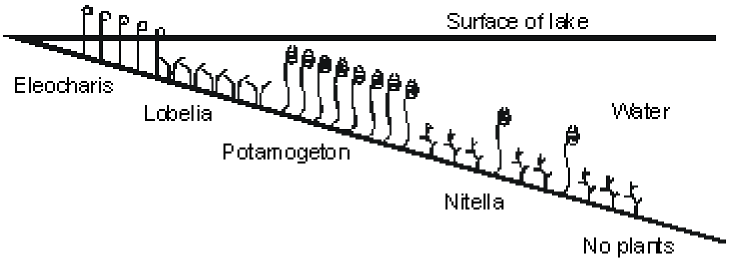
____

____

(10)
(Total 14 marks)

Q25.

This is a diagram of a belt transect showing the major types of plants growing on the bottom of a lake.



(a) Suggest, and explain, **two** reasons why a much smaller population of Nitella plants is found amongst the Potamogeton plants than further down in the lake.

1. ______________________________

2. ______________________________

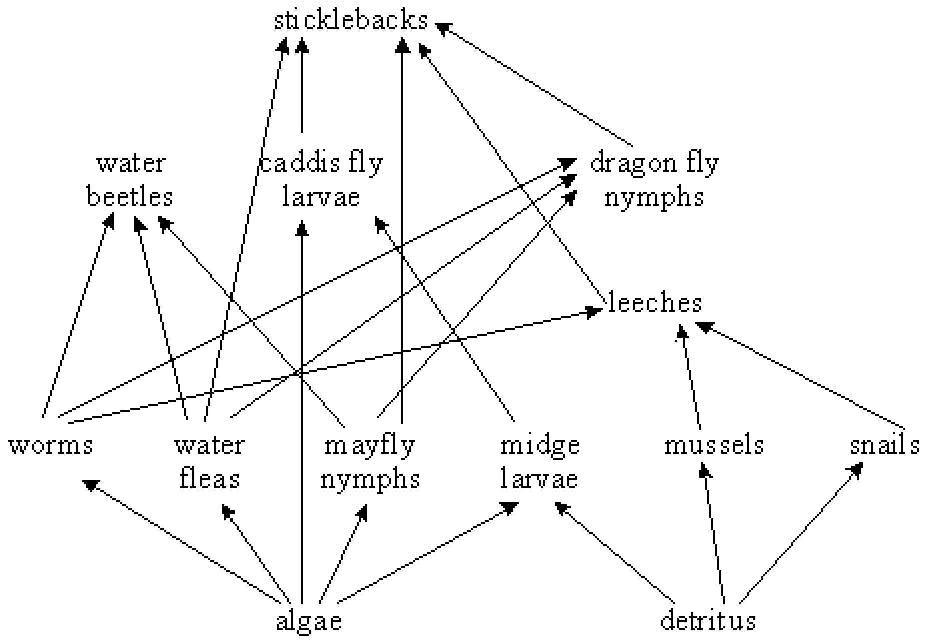
(4)

(b) Describe how you would use the belt transect technique to measure the abundance and distribution of plants which live on the bottom of a shallow lake.

(3)
(Total 7 marks)

Q26.

The diagram below shows a food web for some of the organisms which live in a pond.



You may need to use information from the food web to help you to answer the following questions.

(a) The algae photosynthesise. Complete the equation for photosynthesis.

carbon dioxide + ________ + light energy → sugar + ________

(2)

(b) Only a small percentage of the Sun's energy captured by the algae is eventually incorporated into the body tissues of the stickleback. Explain, as fully as you can, what happens to the rest of the energy captured by the algae.

___

___

___

___

___

___

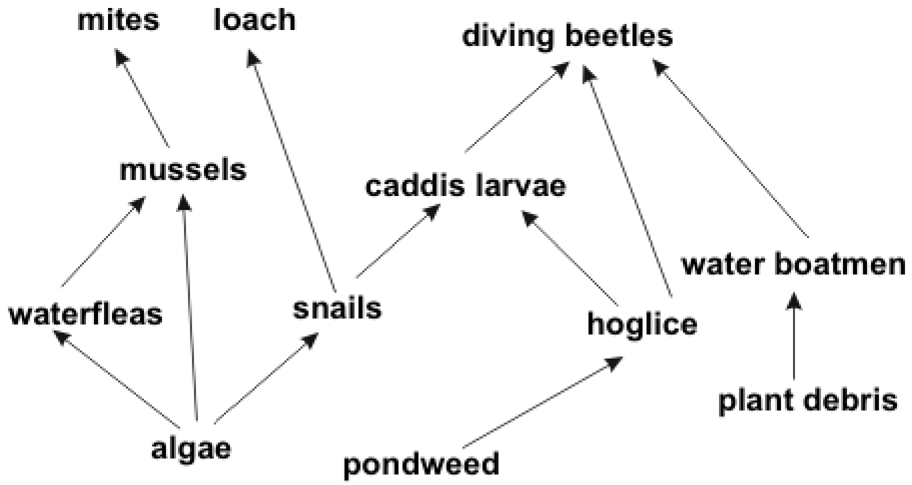
___

(8)

(Total 10 marks)

Q27.

The diagram below shows a food web for some of the organisms which live in a pond.



(a) (i) Name **one** secondary consumer in this food web.

____ **(1)**

(ii) The algae are small green plants.

Give **three** conditions needed by green plants to produce sugars.

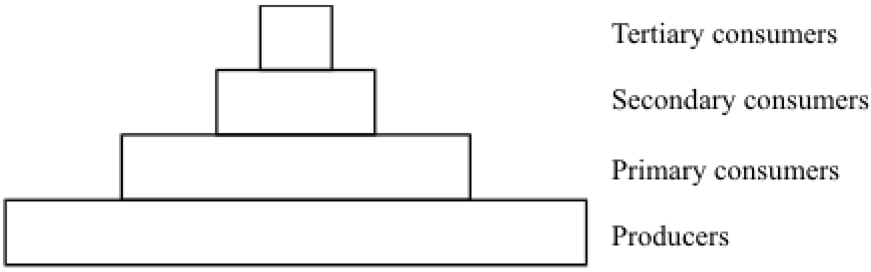
1. ____

2. ____

3. ____

(3)

(b) This is a pyramid of biomass for the organisms in the aquarium.



Some of the biomass of the producers is **not** transferred to the tertiary consumers.

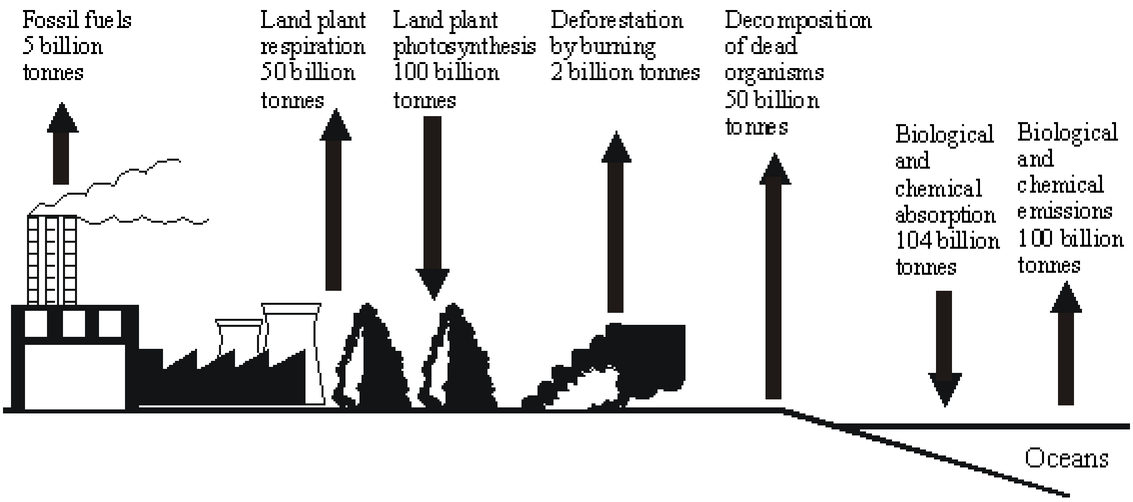
Explain, as fully as you can, what happens to this biomass.

(6)

(Total 10 marks)

Q28.

The diagram below shows the mass of carbon involved each year in some of the processes in the carbon cycle.



(a) Complete the equation for plant respiration.

| ______ | + | oxygen | → | carbon dioxide | + | ______ | + | energy |

(2)

(b) (i) Calculate the mass of carbon removed from the atmosphere each year. *(Show your working.)*

Answer ______________ billion tonnes

(1)

(ii) Calculate the percentage of this total which is removed by the photosynthesis of land plants. (*Show your working*.)

Answer ____________________ %

(2)

(iii) Calculate the net gain of carbon by the atmosphere in one year. *(Show your working.)*

Answer ______________ billion tonnes

(2)

(Total 7 marks)

Q29.

A gardener pulled up weeds and used them to start a compost heap. The compost heap soon became colonised by large numbers of earthworms and slugs. The gardener then noticed a hedgehog rooting through the compost heap, eating the earthworms and slugs. Every so often the hedgehog stopped to scratch itself. This was because it had large numbers of fleas which fed by sucking the hedgehog's blood.

(a) Use **only** information from the passage to answer the following.

Construct and label a pyramid of **biomass** for your food chain.

(2)

(b) Gardeners put plant material onto compost heaps so that it will decay. They then put the decayed compost onto soil where they are growing their plants.

Give **three** conditions which are needed for plant material to decay rapidly.

1. ____

2. ____

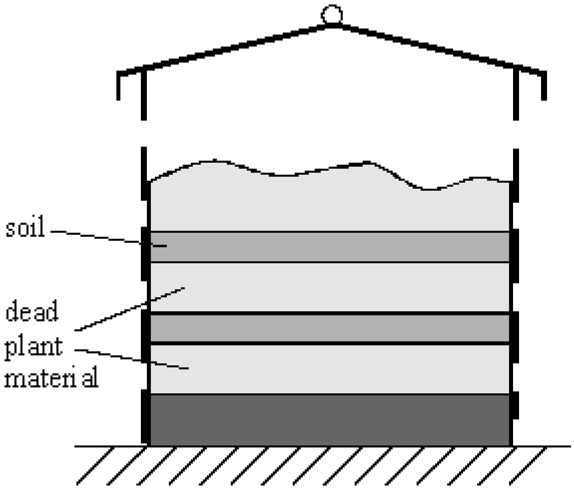
3. ____

(3)

(Total 5 marks)

Q30.

The drawing shows a section through a well-designed compost heap.



(a) Suggest why soil is put in with the dead plant material.

____

____

____

(2)

(b) Explain why the compost heap is designed with holes in the sides.

____

____

____

(2)
(Total 4 marks)

Q31.

An oak wood contained the following:

200 oak trees

150 000 primary consumers

120 000 secondary consumers

(a) Draw and label a pyramid of biomass for **this** wood. (Your pyramid does **not** have to be drawn to scale.)

(2)

(b) A scientist estimated the total amount of energy flow through each level of the pyramid per year.

The results were:

Energy absorbed by oak trees	4 600 000 kJ per m^2 per year
Energy in sugar produced by trees	44 000 kJ per m^2 per year
Energy transferred to primary consumers	2 920 kJ per m^2 per year
Energy transferred to secondary consumers	700 kJ per m^2 per year

(i) Calculate the percentage of the energy absorbed by the trees that is transferred to sugar by photosynthesis. Show your working.

Answer ________________ %

(2)

(ii) Suggest **two** reasons why a large proportion of the energy is not transferred to sugar.

1. ____

____

2. ____

____

(2)

(iii) Give **three** reasons why some of the energy in the primary consumers is not passed on to the secondary consumers.

1. ____

____

2. ____

____

3. ____

____

(3)

(Total 9 marks)

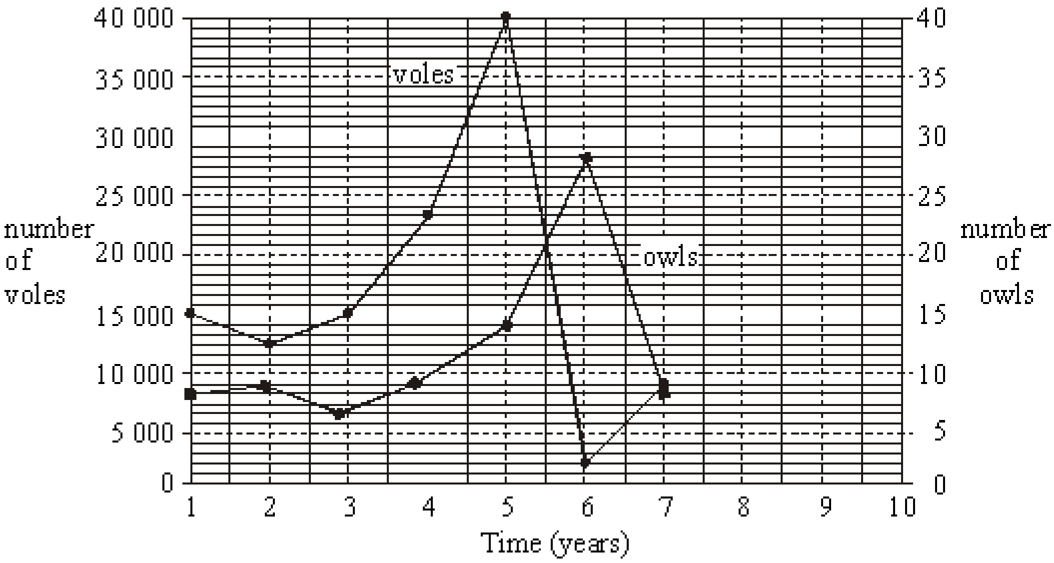
Q32.

The table shows the results of a ten-year study of the owls and voles in a forest.

YEAR	NUMBER OF VOLES (TO THE NEAREST THOUSAND)	NUMBER OF OWLS
1	15 000	8
2	12 000	9
3	15 000	7
4	23 000	9
5	40 000	14
6	2 000	28
7	9 000	8
8	19 000	9
9	10 000	14
10	8 000	16

The data for years 1 - 7 have been plotted on the grid below.

(a) Complete the graph by plotting the data for years 8 - 10.



(2)

(b) (i) What is the main factor which limits the size of the owl population?

____

(1)

(ii) Suggest **two** reasons other than owl predation, for the large fall in the numbers of voles between years 5 and 6.

1. ____

____

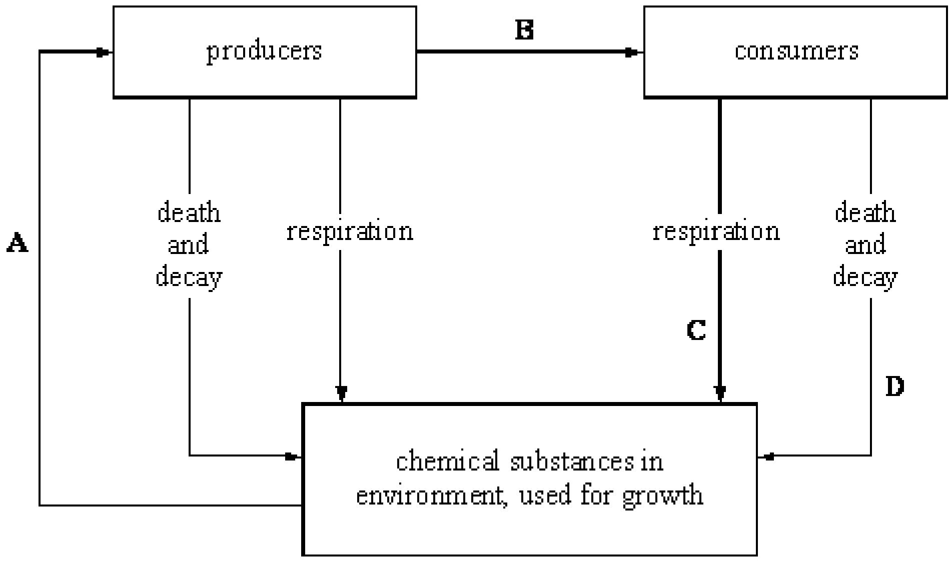
2. ____

____

(2)
(Total 5 marks)

Q33.

The diagram shows some of the stages by which materials are cycled in living organisms.



(a) In which of the stages, **A**, **B**, **C** or **D**:

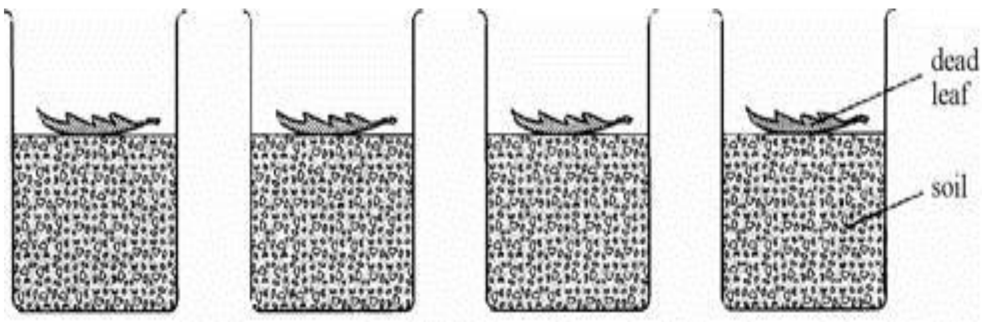
(i) are substances broken down by microbes; __________

(ii) is carbon dioxide made into sugar; __________

(iii) are plants eaten by animals? __________

(3)

(b) In an experiment, samples of soil were put into four beakers. A dead leaf was put onto the soil in each beaker. The soil was kept in the conditions shown.



W	**X**	**Y**	**Z**
Warm and wet	Cold and wet	Warm and dry	Warm and dry

In which beaker, **W**, **X**, **Y** or **Z**, would the dead leaf decay quickest? ___________

(1)
(Total 4 marks)

Q34.

Read the passage.

Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

Use the information from the passage and your own knowledge and understanding to give the arguments for and against killing koalas to reduce the koala population on Kangaroo Island.

____

____

____

____

____

____

____

(Total 4 marks)

Q35.

Read the passage.

Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

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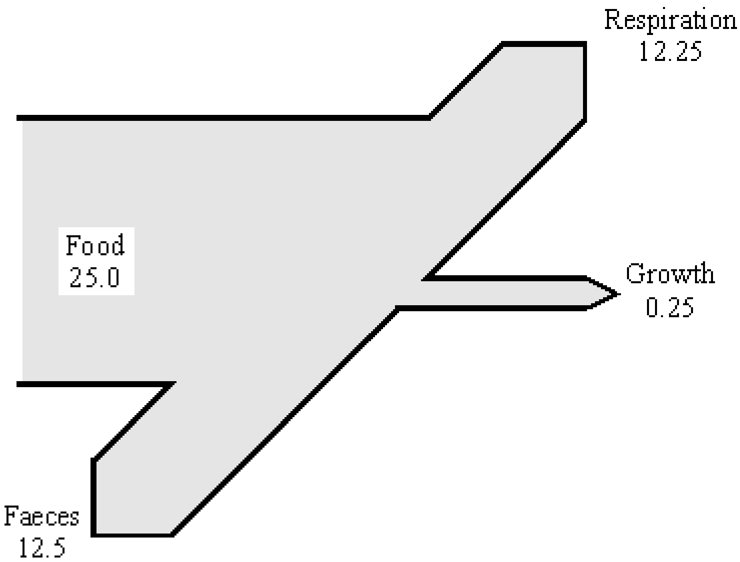
The diagram shows the flow of energy through a koala.
The numbers show units of energy.



(i) Calculate the percentage of the food intake which is converted into new tissues for growth. Show your working.

____________ %

(2)

(ii) Give **three** different ways in which the koala uses the energy released in respiration.

1. ____

____

2. ____

____

3. ____

____

(3)

(Total 5 marks)

Mark schemes

Q1.

(a) A higher concentration would be difficult to stir

1

(b) (i) methane

1

(ii) 60

*100 - (5 + 35) but incorrect answer allow **1** mark*

2

(c) (i) aerobic respiration

1

(ii) oxygen

1

[6]

Q2.

(a) (i) without <u>oxygen</u>

ignore reference to air

1

(ii) otherwise difficult to stir / to pump / to transfer

allow prevent 'clogging' owtte

1

(iii) need to stir / pump / heat

1

(b) (i) rises then falls

1

then levels / slight rise

1

quantitative descriptor eg to 80% / max. on day 4 / min. on day 16

accept other valid quantitative descriptor

allow accuracy ± $\frac{1}{2}$ small square

1

(ii) 16 (15.5 to 16.4)

1

(c) oxygen present

1

(CO_2 produced) by <u>aerobic</u> respiration

or not much <u>anaerobic</u> respiration

or not much methane / CH_4 produced

1

[9]

Q3.

(a) the sun / light / sunshine / solar

allow radiation <u>from the sun</u>

ignore photosynthesis / respiration

apply list principle

*do **not** allow water / minerals / heat*

1

(b) 2.5 (:1)

correct answer with or without working

ignore rounding with correct working

*do **not** allow other equivalent ratios for both marks*

*evidence of selection of 10(insects) **and** 4(frogs) **or** 50 **and** 20 **or** 1 **and** 0.4 for **1** mark*

if no other working allow **1** mark for 0.4:(1) on answer line

2

(c) any **two** from:

*allow for insects **or** frogs*

allow energy for biomass

- some parts indigestible / faeces
- waste / examples of waste eg urea / nitrogenous compounds / urine / excretion
- movement / eg of movement

  allow keeping warm
- heat
- not all eaten / eg of not all eaten
- respiration

  do not accept energy for respiration

2

(d) any **four** from:

- (bodies) consumed by animals / named / scavengers / detritus feeders
- microorganisms / bacteria / fungi / decomposers
- reference to enzymes
- decay / <u>breakdown</u> / decompose / rot

ignore digest(ion)

- respiration
- carbon dioxide produced
- photosynthesis
- sugar / glucose produced
  accept other organic molecules
- fossilisation / fossil fuels / named
- combustion / burning
  must be linked with fossilisation / fossil fuels
- (burning) produces carbon dioxide
  allow carbon dioxide produced once only

4

[9]

Q4.

(a) carbon dioxide **and** water vapour
either order

1

(b) less methane

1

because less anaerobic respiration

1

more CO_2
ignore water

1

because (more) aerobic respiration

1

[5]

Q5.

(a) (i) increase / higher / faster / quicker

1

numerical comparison eg from 30 to 60 / by 30 **or** it is 30 at 15°C and 60 at 25°C
*award **2** marks for doubles / goes twice as fast or 30 units <u>more</u>*

1

(ii) any **two** from:

- oxygen / air (in)

*do **not** accept lets oxygen / air out*
ignore reference to other substances / light passing in or out
ignore microorganisms passing in

- for microorganisms / bacteria / microbes / fungi / decomposers

  ignore worms / germs / bugs
- (for aerobic) respiration
- let heat out

  ignore heat in
- heat kills microorganisms

2

(b) compost contains minerals / nutrients / elements / ions / named

allow improve moisture / drainage
allow nitrogen
ignore CO_2 / food / goodness / fertilisers
*do **not** accept vitamins / glucose etc*

1

[5]

Q6.

(a) methane

accept CH_4 / CH4 / CH^4 extras cancel

1

(b) **anaerobic** respiration **or** fermentation

ignore decay / decomposition / digestion

*do **not** allow aerobic*

1

(c) (i) in range 32 – 33

1

(ii) keep cool(er)
or keep below 40 (°C)
or insulate from heat

allow keep at optimum temperature if (c)(i) < 40

1

high(er) / optimum rate of biogas production
or rate decreases at higher temperatures
or works more efficiently

allow correct reference to rate of enzyme action eg high temperature would denature enzyme owtte

1

(d) increases rate / high rate

allow 'works better'

1

insulates / keeps warm

allow maintains optimum temperature

1

[7]

Q7.

(a) (i) **D**

1

(ii) **A**

1

(b) (i) air / oxygen (can enter)

ignore other factors entering or leaving

1

for (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(ii) (more) minerals / nutrients /salt(s) / ions

or

named mineral / element available

ignore fertility / fertiliser

allow symbols

*allow eg mulching / reducing weeds **or** retain water*

1

[5]

Q8.

(a) (i) methane

apply list principle

allow symbols

1

(ii) anaerobic respiration / (anaerobic) fermentation

ignore decay / decomposition etc

1

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

- manure disposed of
- gains fertiliser (for crops)
- gets (free) fuel **or** cheap supply of energy
  or (free) cooking / heating / lighting

  allow converse

  allow not using wood / trees

- can sell crops at higher price

2

(ii) in the UK

allow converse arguments for Sri Lanka

lower temperature
or
not enough heat

ignore other factor(s)

1

process is slower
or
enzymes action slower

ignore references to efficiency / 'bacteria working'

1

[6]

Q9.

(a) microorganisms / bacteria / fungi / microbes

allow named example ***or*** *mould*

ignore decomposers unqualified / germs / maggots / worms

1

(b) it is warm(er) / hot / increased heat / increased temperature

ignore 'sun is hot' unqualified

1

(c) oxygen

1

[3]

Q10.

(a) 30

award ***both*** *marks for correct answer, irrespective of working*

100 – (33 + 27 + 10) or equivalent for ***1*** *mark*

2

(b) 2 **or** 1.98

award ***both*** *marks for correct answer, irrespective of working*

(33 / 100) × 6 or <u>*equivalent*</u> *for* ***1*** *mark*

2

(c) respiration

1

(d) (i) less / no heat loss / movement

do ***not*** *accept 'energy' / warmth unqualified*

1

(ii) any reference to cruelty eg stress to calf / cramped conditions *ignore references to disease / hygiene*

1

[7]

Q11.

(a) methane

1

(b) (insulation maintains) higher temperature / warm(er) / keeps heat in / prevents heat loss / optimum temperature / heat increases rate of reaction

*do **not** allow hot(ter) / high temperature*

ignore same / constant temperature

1

(c) (i) ($)25 000

ignore units
ignore working or lack of working

add 3 figures and subtract 10 000

or

*use of 35 000 and 10 000 but wrong answer for **1** mark*

2

(c) (ii) 8 years = **2** marks

ignore working or lack of working

or

correct answer from (c)(i) = **2** marks

$\frac{200000}{(c)(i)}$ *but wrong answer = **1** mark*

2

[6]

Q12.

(a) (i) 20

1

(ii) 12000

1

(b) area of strips

or

length / width / size of transect

or

number of transects

1

(c) (i) since squirrels mobile

or

squirrels could be counted twice

or

squirrels hide

1

(ii) any **two** from:

- numbers of larders observed likely to be lower than actual
  *do **not** accept squirrels share larders*
  or squirrels have more than one larder
- since unlikely that all could be spotted if 5 m away
- old larder
- squirrels moved on / died
- young squirrels
- haven't made a larder

2

(d) (i) 0 to 6.8

1

(ii) any **one** from:
*do **not** accept squirrels prefer blue spruce*

- squirrels prefer blue spruce cones / seeds / nuts as food
- more cones / food
- more nesting sites
- fewer predators / competitors

1

[8]

Q13.

(a) any **two** from:
control variables from information given

- area of bed sampled
- sampling time
- size of net

- kicking action
- net position

2

(b) any **two** from:

must be ideas related to a sample

- some animals not dislodged

  ignore reliability etc

- some animals missed / through / escaped net
- invertebrates difficult to identify
- invertebrates from outside area

2

(c) 10 to 99 **or** 10 – 99 **or** 99 to 10 **or** 99 – 10

1

(d) any **two** from:

- increased / goes up

  allow increase implied from all data described

- 0 at sample 4
- to (more than) 100

2

(e) mayfly

1

because not found downstream of point where sewage enters stream **or** only in the unpolluted water

1

[9]

Q14.

(a) points plotted accurately

$+\frac{1}{2}$ square

deduct 1 mark per error
ignore the line

2

(b) 30 **or** correct from candidate's graph

accept 30 000 lynx
*do **not** accept 30 000*

1

(c) (i) fall

mark (i) and (ii) separately

1

(ii) fewer hares **or** lack of food

*do **not** accept no hares or food*

1

(d) kills / preys / preys on / hunts / catches
and eats / for food (other) animals

*must have the eat **and** kill for the point*

1

[6]

Q15.

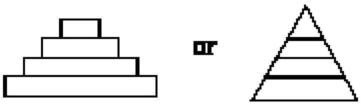
(a) 0.1

ignore working or lack of working

$\frac{88 \times 100}{88\,000}$ *for 1 mark*

2

(b) shape: pyramid with 4 tiers



1

labels:

Plants + Herbivores + Carnivores + Top carnivores
(in sequence – largest to smallest)

allow suitable named examples

*inverted pyramid correctly labelled = **1** mark*

1

(c) more energy / biomass / materials / matter available or less energy lost or energy used up (by herbivores)

***not** just plants*

1

[5]

Q16.

(a) any **three** from:

1960: $\frac{132}{186} \times 100$

71(%)

1970: $\frac{161}{247} \times 100$

65(%)

*if both correct – **3** marks*
*if one correct – **2** marks*
*if neither correct – check working – **1** mark each*

3

(b) **advantages (maximum 3 marks)**

reduced use of coal / oil / non renewable / fossil fuels

less smoke / sulphur dioxide

ignore pollution

cheaper in <u>long term / over 8+ years / few years</u>

(energy) self-sufficiency idea

fertiliser <u>to help crop growth</u>

accept less fertiliser bought

means of waste disposal

accept any other appropriate responses

disadvantages (maximum 3 marks)

high initial cost

explosion risk

technical **or** training required

accept any other appropriate responses

max 4

(c) (i) suitable scales;

S

1

all plots accurate;

P

1

suitable curve **or** ruled dot-to-dot **or** straight line of best fit

L

*do **not** accept lines through origin line must not be thicker than half square*

1

(ii) insulation / less temperature variation / maintain temperature

*do **not** accept 'kept cool' **or** 'warm'*

1

less chance of microbes being killed /
enzymes denatured **or** keep at optimum
temperature **or** maintain high gas production

1

[12]

Q17.

(a) In sequence:

heron
frog
slug
lettuce

1

(b) (i) light / sun

ignore photosynthesis / respiration
cancel mark if water / ions etc given
*do **not** accept heat*

1

(ii) traps / absorbs light

accept energy for light
*do **not** accept collects / attracts*
*do **not** accept 'traps sun'*

1

(iii) 162

if correct answer, ignore working / lack of working

$\frac{10 \times 1620}{100}$ *for **1** mark*

2

[5]

Q18.

(a) **X** (no mark)

X is more visible **or** **Y** is more camouflaged

1

(b) (i) so camouflage not changed **or** so not easier to see

1

(ii) 25

1

7

1

(iii) any **one** from:

- eaten (by birds) / died

- mixed in with large number of unmarked moths
- moved away

1

(c) (i) DNA

1

(ii) the gene / allele for being dark / dominant

1

[7]

Q19.

(a) **Quality of written communication**:
ideas given in a sensible order

broken down
giving products (could be CO_2, minerals or gas)
(used by trees)
Q ✓ or Q ✗

1

any **three** from:

- microorganisms / bacteria / fungi / saprotrophs
- accept saprophytes / saprobionts / detritivores (named)
- digest / break down organic matter / leaves / decompose / reference decomposers / decay / rot
- use of enzymes / correct named example
- absorption by diffusion / active transport
- must be of breakdown products
- respiration / combustion
- release of carbon dioxide

CO_2 can be used (by trees) in photosynthesis

*do **not** accept CO_2 taken in by roots*

3

(b) any **two** from:

- warmth / suitable temperature

  *do **not** accept heat / hot weather*
- damp / water / rain / humid / moisture
- oxygen
- suitable pH

2

[6]

Q20.

(a) (i) (predator) lion
1

(prey) antelope
1

(ii) light
accept other positive indications
1

(iii) <u>in sequence (top to bottom):</u>

lion
antelope
grass
1

(b) (i) bacteria / fungi / saprotrophs
accept moulds / decomposers / microorganisms / microbes / saprophytes / saprobionts
1

(ii) aerobic
1

moist
1

warm
accept other positive indications1
1

(iii) carbon dioxide
1

mineral salts
1

[10]

Q21.

(a) 1.67 / $1\frac{2}{3}$
accept 1.6 to 1.7
ignore working or lack of working $\frac{400 \times 100}{24000}$ *for **1** mark*
2

(b) any **three** from:
deduct only 1 mark for any mention of in carnivore

lost as heat **or** keeping body warm

lost in metabolic functions is not enough

lost in respiration

*do **not** accept '<u>used for</u> respiration*

movement

not eaten parts or individuals / non-edible parts / dead leaves / wood / bones / faeces / urine

ignore 'waste'

ignore references to growth / reproduction

3

[5]

Q22.

(a) **1** mark for each

respiration

eaten

decay

burning

4

(b) (i) digests **or** breaks down **or** decays dead (organic) material

accept rots for digests

accept plants for dead organic material

*do **not** accept 'live on' **or** 'decompose'*

1

(ii) bacteria **or** worms **or** maggots

*accept microbes but **not** germs **or** viruses*

1

[6]

Q23.

(a) (i) squirrels eat nuts;

each for 1 mark

owls eat squirrels

(2 marks for energy flow)

2

(ii) hazel tree

gains 1 mark

1

(iii) 1 squirrel population would decrease; because fewer nuts available as food *each for 1 mark*

2

2 owl population would decrease;
because fewer squirrels available as food

each for 1 mark

2

(b) (i) digested/broken down;

(ii) by microbes/reference to worm action;

each for 1 mark

2

(iii) March
warmer/increased activity of worms/microbes;

each for 1 mark

2

[11]

Q24.

(a) (i) vole/small bird/beetle

gains 1 mark

1

(ii) oak trees are large organisms;
therefore their biomass is large; but their numbers are small

each for 1 mark

3

(b) 8 of:
energy stored in chemicals in cells/tissues/growth;
passed up food chain;
less energy stored at each stage in food chain/pyramid level;
because only part of energy taken in used for growth;
some lost in waste;
some used for repair;
used to main body systems;
some lost in respiration;
some converted into other forms of energy;
e.g. movement;
much lost as heat;
by time detritus feeders have used remains;
all returned to environment

each for 1 mark

8

c1 → animals
c2 → decomposers

2 marks for sequencing and organising the information

2

[14]

Q25.

(a) e.g.:
competition for light because potamogeton plants taller
competition for nutrients taller plants may have longer roots

each for 1 mark

4

(b) descriptions of:
measuring tape or similar quadrat
method of estimating cover (inside quadrat)

each for 1 mark

3

[7]

Q26.

(a) water

gains 1 mark

oxygen

gains 1 mark

2

(b) e.g.:
some materials/energy lost in animals' waste materials
respiration releases energy
some materials/energy used in maintenance/repair
some energy used for movement
much lost as heat to surroundings
some organisms die (rather than eaten)
reference to detritivors
reference to microbes

each for 1 mark

8

[10]

Q27.

(a) (i) e.g. mussels/caddis loach

for 1 mark

1

(ii) 3 of:
carbon dioxide
water
chlorophyll/chloroplasts
light

any 3 for 1 mark each

3

(b) 6 of e.g.
some plant/animal material not digested by consumers passes out with faeces
respiration releases energy used in movement lost as heat
some 'lower' organisms die energy transferred to decomposers/detritivores

thence to environment

any 6 for 1 mark each

6

[10]

Q28.

(a) glucose/sugar water

for 1 mark each

2

(b) (i) 204

for 1 mark

1

(ii) 49 **gains 2 marks**

(incorrect answer, but correct method gains 1)

2

(iii) 3 **gains 2 marks**

(incorrect answer, but correct method gains 1)

2

[7]

Q29.

(a) pyramid correct shape labelled

2

(b) warm
moist
oxygen

3

[5]

Q30.

(a) soil contains the microbes which will decay the dead material

for 1 mark each

2

(b) lets in air/oxygen oxygen speeds up decay process

for 1 mark each

2

[4]

Q31.

(a) levels in correct order
sizes correct

for 1 mark each

2

(b) (i) working
0.96% (correct answer = 2)

for 1 mark each

2

(ii) 2 of e.g.
heat up leaves
absorbed by non-photosynthetic parts
transmitted through leaves

any 2 for 1 mark each

2

(iii) 3 of e.g.
respiration of primary consumers
movement of p.c.
waste from p.c.
repair/growth of p.c.; heat losses to surroundings

any 3 for 1 mark each

3

[9]

Q32.

(a) 1 mark for each correct set of plots

for 1 mark each

2

(b) (i) number of voles/amount of food

for 1 mark

1

(ii) e.g. increased number of owls
new disease

for 1 mark each

2

[5]

Q33.

(a) (i) D

(ii) A

(iii) B

for 1 mark each

3

(b) W

for one mark

1

[4]

Q34.

<u>pros e.g.:</u>

gum trees survive therefore less soil erosion
therefore food webs not disrupted
if no culling, whole Koala population may die
easier to cull because Koalas are difficult to catch

<u>cons e.g.:</u>

Koala's 'right to life' / ethical issue
better to transfer to reserves on mainland than kill
could use tranquillisers to catch without killing
could allow population to stabilise naturally

max 4 of the above; max 3 pros or cons.

[4]

Q35.

(i) 0.25 × 100 / 25

gains 1 mark

but
1%

gains 2 marks

2

(ii) muscle contraction / limb movement / moving around / chewing
heartbeat / breathing / internal muscle activity
maintaining body temperature / keeps body warm
active uptake synthesising substances (*reject* growth)

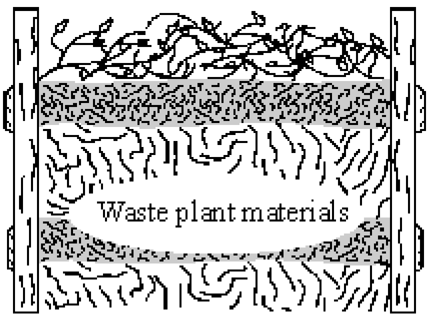
any three for 1 mark each

3

[5]

Q1.

Compost heaps are used to recycle waste plant materials.



Complete the sentences by choosing the correct words from the box.

cool	decay	dry	grow
moist	respire	warm	

The waste plant materials _______________ because they are broken down by microorganisms.

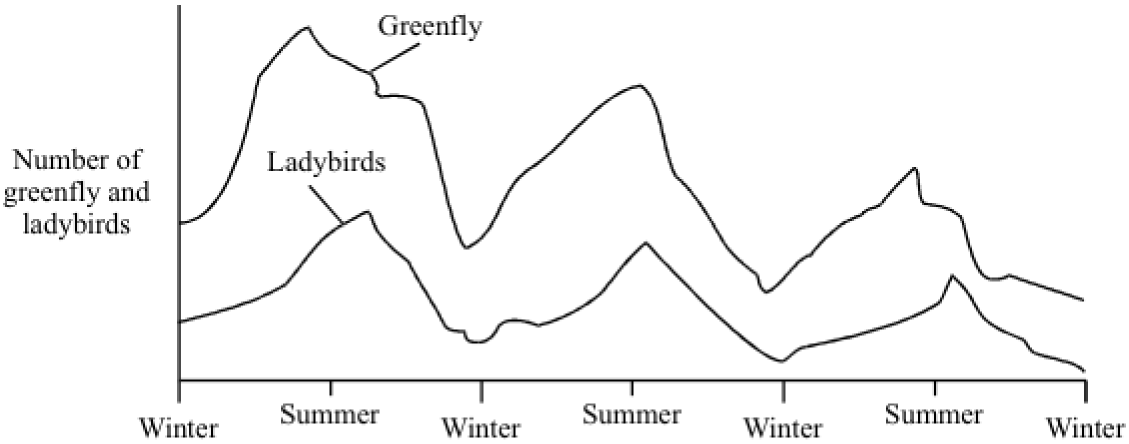
The waste plant materials are broken down faster when the conditions are ________________ and _______________ .

This process releases substances that can be used by other plants to ______________ .

(Total 4 marks)

Q2.

Greenfly feed on rose bushes. Ladybirds (predators) feed on these greenfly. The graph shows how the population of greenfly and ladybirds in a garden change over a period of three years.



(a) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Describe what happened to the population of greenfly over the three years.

____

____

____

____

____

____

____

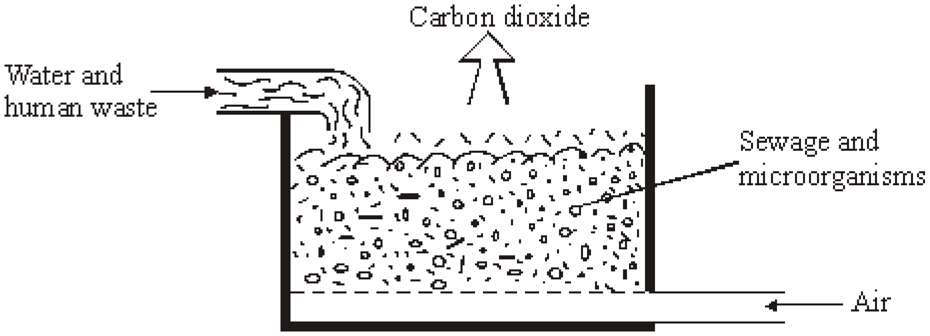
(3)

(b) Give **one** factor that limits the number of ladybirds.

(1)
(Total 4 marks)

Q3.

In a sewage works, human waste is broken down by microorganisms.
Air is blown through this sewage.



To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

Carbon dioxide is formed from the mixture of sewage, microorganisms and air. Explain how.

(3)
(Total 3 marks)

Q4.

A food chain has four organisms, **A**, **B**, **C** and **D**.

A → **B** → **C** → **D**

The table shows the amount of energy transferred by each organism in one year.

Organism	Energy transferred in kJ per year
A	87 000
B	14 000
C	1600
D	70

Explain, as fully as you can, why organism **D** would transfer much less energy than organism **A**.

(Total 5 marks)

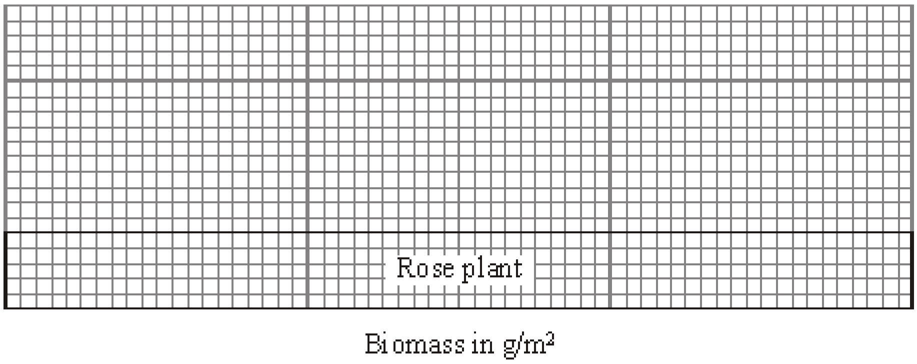
Q5.

Energy is stored in the materials that make up organisms. These materials are called biomass.

Organisms in food chain	Rose plant	→	Greenfly	→	Ladybird	→	Blackbird
Biomass in g/m^2	600		50		10		1

(a) Complete the pyramid of biomass for this food chain. The rose plant has been done for you. You should draw the rest of the pyramid to the same scale.

(5 small squares = 50 g/m².)



(3)

(b) What proportion of the energy in a rose plant is transferred to greenfly?

____

____

____

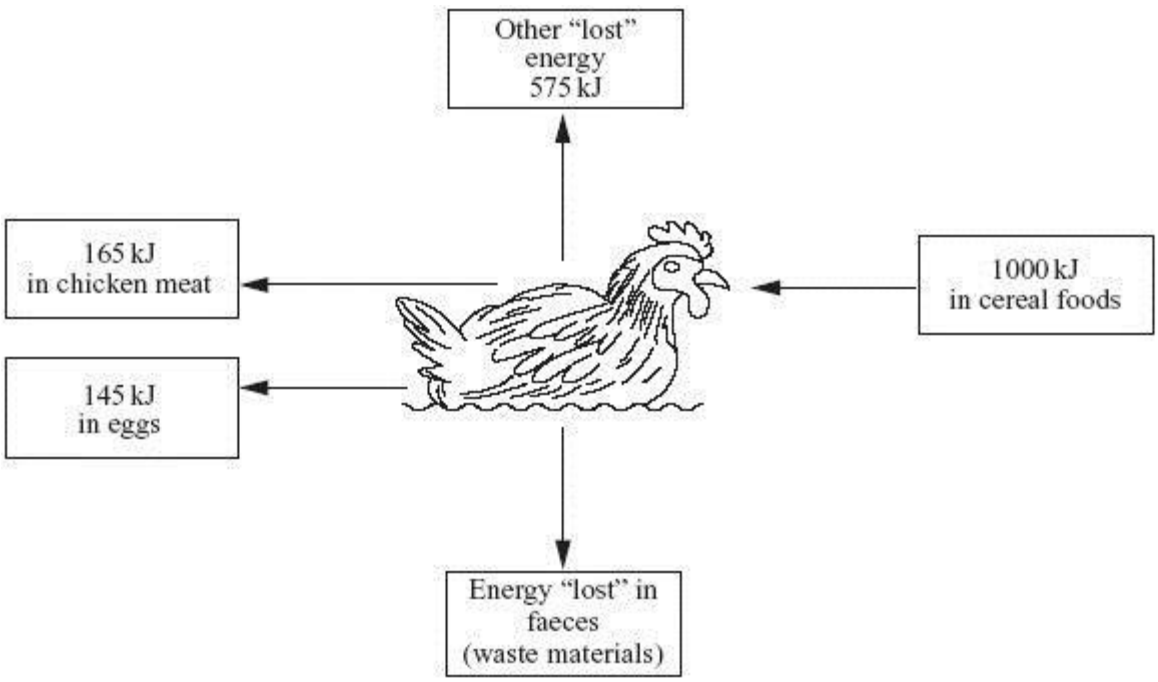
Proportion = ____________________

(2)

(Total 5 marks)

Q6.

Chickens are kept as farm animals to produce food. Free-range chickens are allowed to feed in a large space outside. The diagram shows how energy supplied in food to a free-range chicken is transferred.



(a) Calculate the amount of energy "lost" in faeces.

Energy "lost" = ______________ kJ

(1)

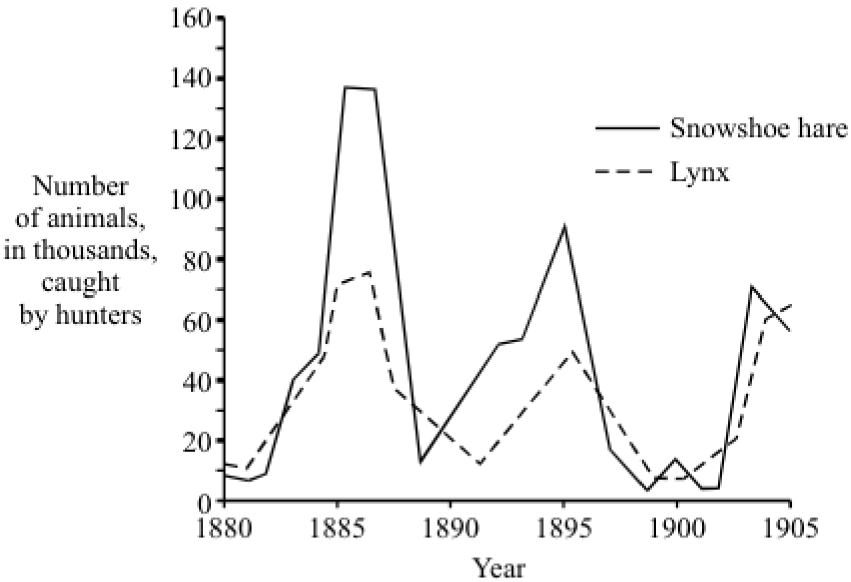
(b) Some farmers use the battery method. They keep large numbers of chickens in a small indoor space. The food yield from these chickens is higher than that from free-range chickens. Explain why, as fully as you can.

(4)

(Total 5 marks)

Q7.

The graphs give information, from a hundred years ago, about the size of the population of snowshoe hares and lynx, which live in northern Canada. Snowshoe hares are herbivores. Lynx are carnivores and prey on snowshoe hares.



(a) Give **three** factors which can affect the size of the snowshoe hare population.

1. ______

2. ______

3. ______

(3)

(b) The graph for numbers of lynx shows a similar cycle to that of the snowshoe hares. The peaks for lynx usually occur about a year later than the peaks for the snowshoe hares. Suggest why.

______

______

______

______

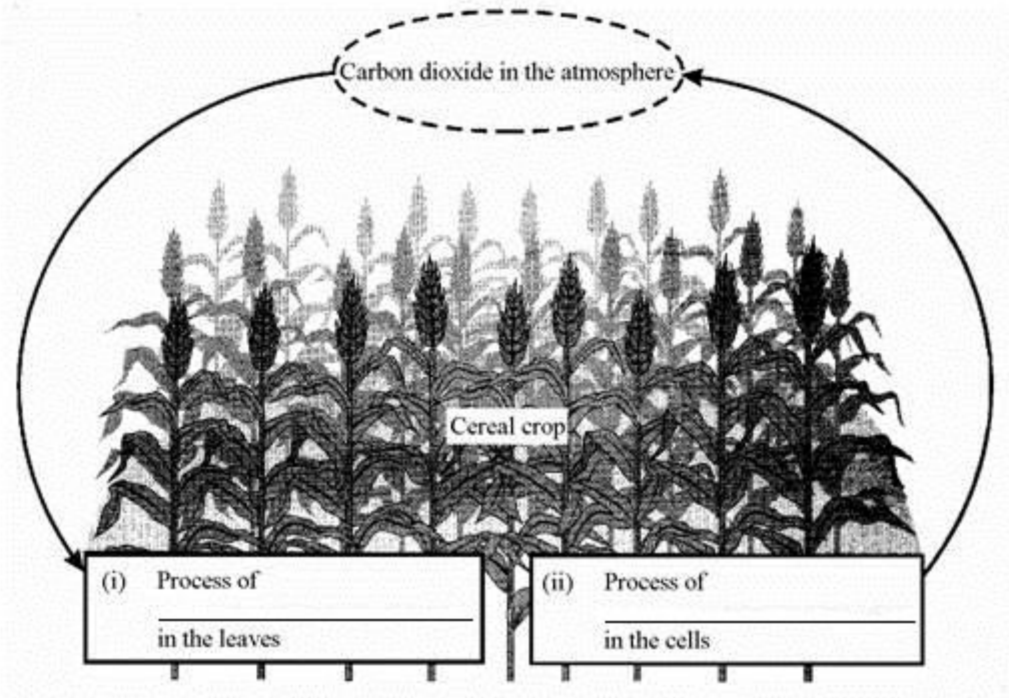
(2)

(Total 5 marks)

Q8.

(a) The diagram shows a cereal crop.

Complete spaces (i) and (ii).



(2)

(iii) What sort of weather may cause the cereal crop to wilt?

______

(1)

(b) Describe the process of transpiration in plants.

____

____

____

____

____

____

(3)
(Total 6 marks)

Q9.

(a) Use words from the box to complete the sentences about the water cycle.

boils	**condenses**	**evaporates**	**freezes**	
melts	**rain**	**sea**	**Sun**	**wind**

Water ________________ from the surface of the ________________ . Heat from the

__________________ speeds up this process and so does the __________________ .

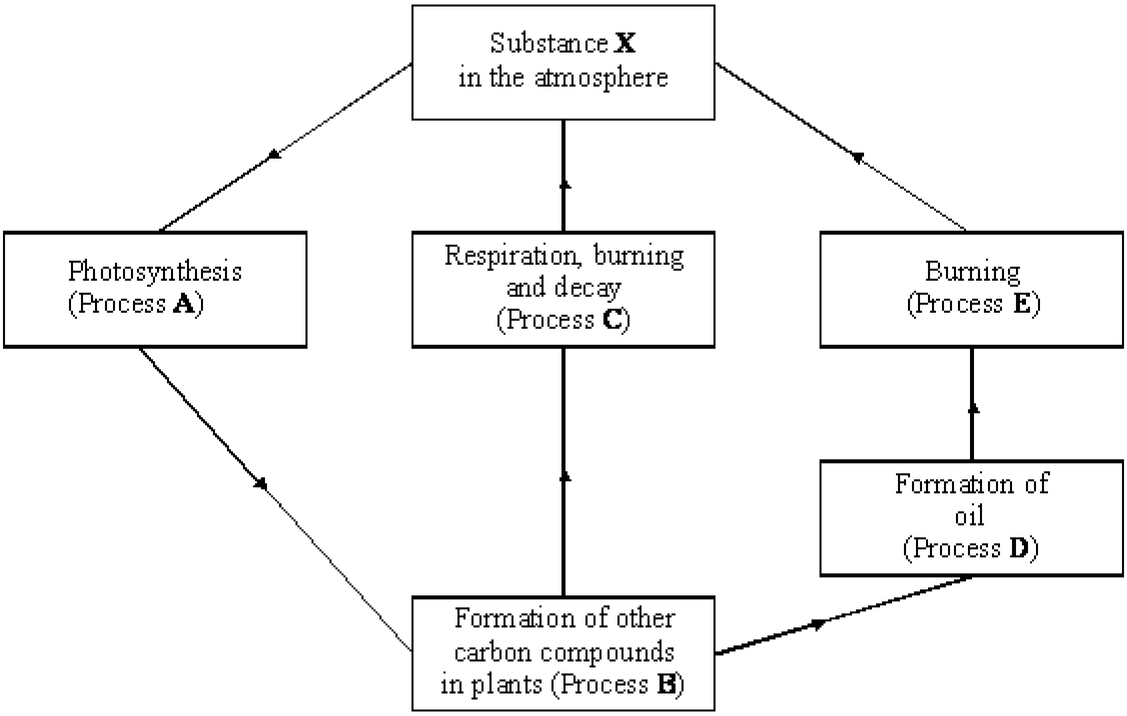
Water vapour in the atmosphere cools down and _____________ to form billions of

tiny water droplets. Some of the droplets join together and fall as _____________ .

(6)

(b) The diagram shows some processes in the carbon cycle.

![EXAM PAPERS PRACTICE]



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

____
(1)

(ii) Which process, **A**, **B, C**, **D** or **E**, takes the **longest** and approximately how long does it take?

____
(2)
(Total 9 marks)

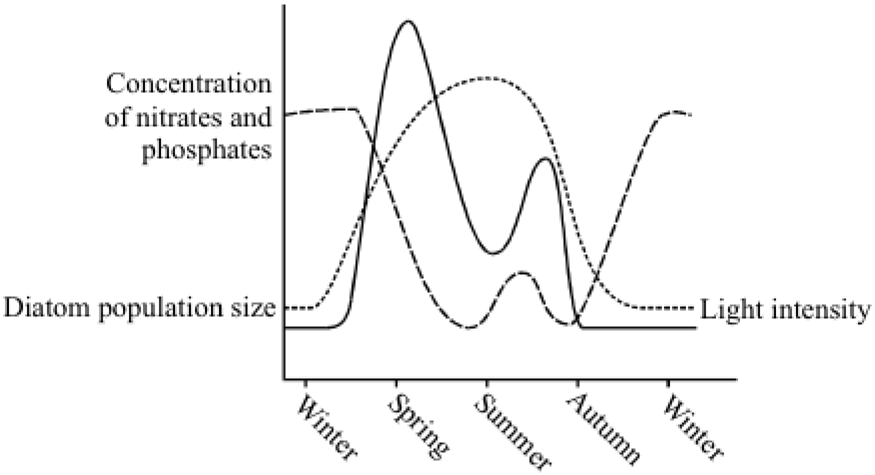
Q10.

A food chain in the North Atlantic Ocean is:

diatoms → small fish → large fish

The graphs show how over a year:

- the population size of diatoms in the North Atlantic varies;
- the light intensity alters;
- the concentration of nitrate and phosphate minerals alters.



(a) Explain why the light intensity is a major factor in controlling the numbers of diatoms.

___

___

___

(2)

(b) (i) Suggest **two** reasons why the population of diatoms decreases between spring and summer.

1. ___

___

2. ___

___

(2)

(ii) Give **two** reasons why the population of diatoms decreases in autumn.

1. ___

___

2. ___

___

(2)

(c) Use the information on the graph to suggest what change causes the number of diatoms to increase in the late summer. Give a reason for the change.

___

___

(2)
(Total 8 marks)

Q11.

(a) A gardener was told to let more air into his heap of garden waste.

Explain why this would help decay.

____

____

(1)

(b) Write down **two** further conditions which speed up the decay of garden waste in a compost heap.

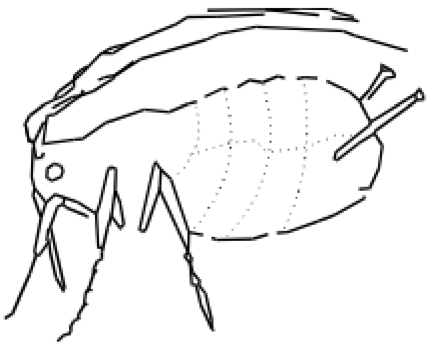
1. ____

2. ____

(2)
(Total 3 marks)

Q12.

The greenfly is an insect which is eaten by ladybirds.



Greenfly

(a) (i) What do we call animals, like the ladybird, which hunt and kill other animals for food?

____

(1)

(ii) What do we call animals, like the greenfly, which are eaten by other animals?

____

(1)

(b) What would happen to the number of ladybirds if the numbers of greenfly suddenly dropped?

____

(1)

Give a reason for your answer.

____

____

(1)

(c) Suggest **two** factors, other than the number of ladybirds, which could affect the number of greenfly.

1. ____

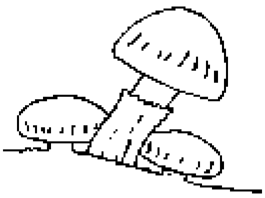
2. ____

(2)

(Total 6 marks)

Q13.

Mushrooms can be grown on compost. The compost is made by mixing straw and manure which rot down.



(a) Write down **three** things which are needed for the straw and manure to rot.

1. ____

2. ____

3. ____

(3)

(b) Some substances, like plastic, are not biodegradable.

What does this mean?

____

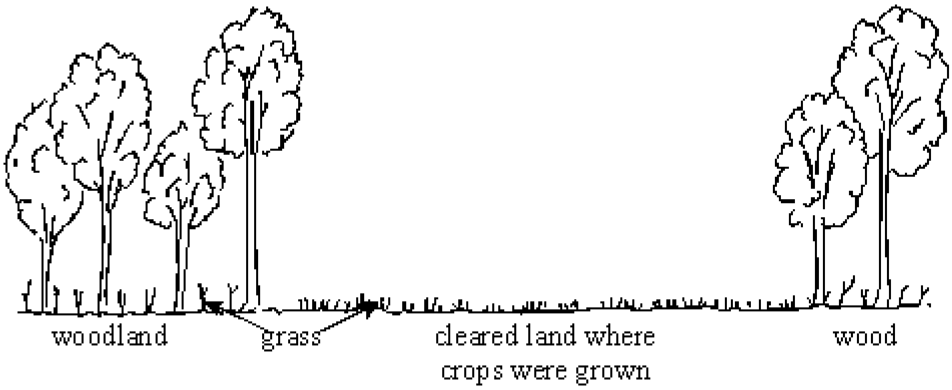
____

(1)

(Total 4 marks)

Q14.

In some developing countries woodland is cut down and burned. The ash acts as fertiliser. Crops are grown for three years. The land is then left as it is too poor to grow any more crops.



(a) In the original woodland trees and plants died and grew for hundreds of years. When cleared the land grew crops for only three years. Explain this difference in as much detail as you can.

____

____

____

____

(3)

(b) What could farmers do to make crops grow on the cleared land for more than three years?

____

____

(2)

(Total 5 marks)

Q15.

(a) $1m^2$ of a field gets about 1050MJ of light energy per year.

Only 21 500kJ of energy is stored in the new grass.

(i) How is the energy stored in the new grass?

____

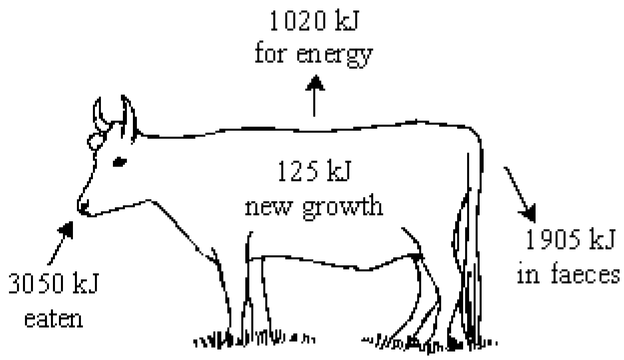
(1)

(ii) What is the % of light energy stored in the grass?

____

(1)

(b)



The diagram shows what happens to the energy from grass in part of a field which is grazed by a bullock.

Using information in the diagram suggest why food chains are usually short.

(3)

(c) Many of the animals which from part of our diet are herbivores rather than carnivores. Explain why as fully as you can.

(3)

(Total 8 marks)

Q16.

A farmer had too much manure to spread on his fields. He thought he would turn it into compost which had no smell.

(a) What makes the manure decay?

____

(1)

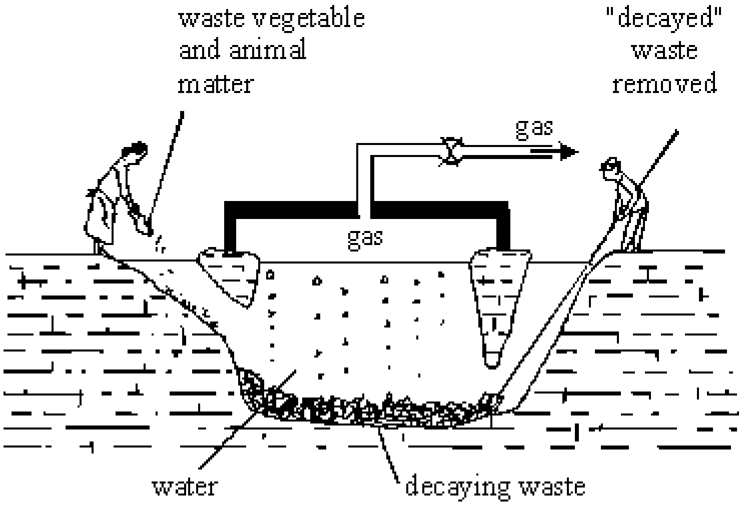
(b) Write down **two** conditions which will help the manure to decay faster.

1. ____

2. ____

(2)
(Total 3 marks)

Q17.



The diagram shows how the gas from decaying plant and animal waste can be collected.

(a) (i) Name the gas collected from the decaying waste.

____

(1)

(ii) What can the gas be used for?

____

(1)

(b) The decayed waste produces compost.

What can the compost be used for?

___

(1)
(Total 3 marks)

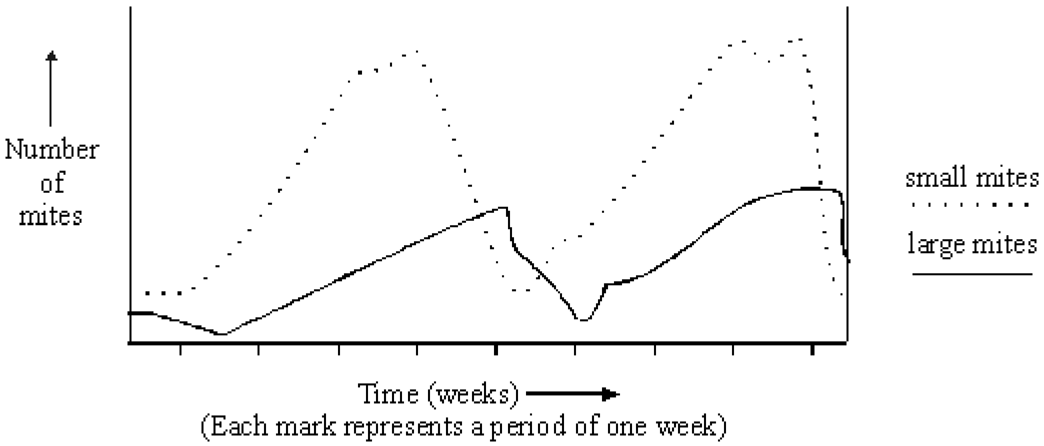
Q18.

Some small mites feed on the leaves of orange plants. Larger mites feed on the smaller mites.

(a) What do we call animals, like the large mite, which eat other animals, like the small mite?

___

(1)



The graph shows how the number of these mites changes over a period of time.

(b) (i) What happens to the number of large mites one week after the number of small mites decreases?

___

Suggest a reason for this.

___

___

___

(3)

(ii) What happens to the number of small mites as the number of large mites increases?

___

Suggest a reason for this.

(2)
(Total 6 marks)

Q19.

Earthworms are important soil organisms. When they burrow, they help to bring air into the soil as well as improving drainage. Earthworms also bury leaves in the soil. These decay making the soil more fertile. Earthworms in turn are eaten by voles, moles, foxes, badgers and birds.

New Zealand flatworm

In some parts of the United Kingdom, earthworms are being killed by New Zealand flatworms. The animals are spreading quickly and have no natural enemies.

The flatworms do not make their own burrows. They only use the burrows made by the earthworms in order to attack them.

(a) Explain, as fully as you can, why it is important to control or get rid of these New Zealand flatworms in Britain.

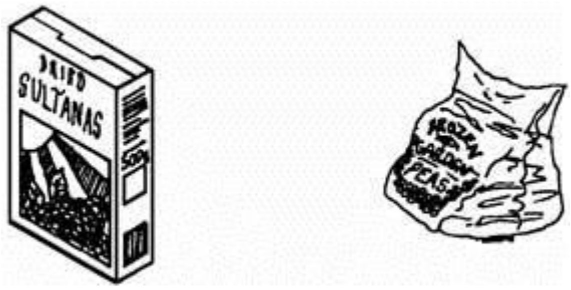
(4)

(b) Suggest **one** possible way, giving **one** advantage and **one** disadvantage, that this New Zealand flatworm could be controlled.

(3)
(Total 7 marks)

Q20.

Food decays more slowly if it is kept dry or cool.

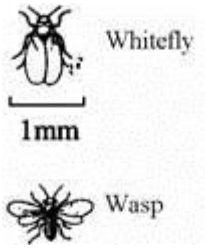


Explain why.

(Total 3 marks)

Q21.

Whitefly are pests and harm plants in glasshouses.
A small wasp can be used to control the whitefly.



The wasp can only lay its eggs in the larvae of whiteflies.
The wasp larva eats the body of the whitefly larva.
It then changes into a new wasp and flies off.

(a) Choose words from the list to complete the sentences below.

decomposer **predator** **prey** **producer**

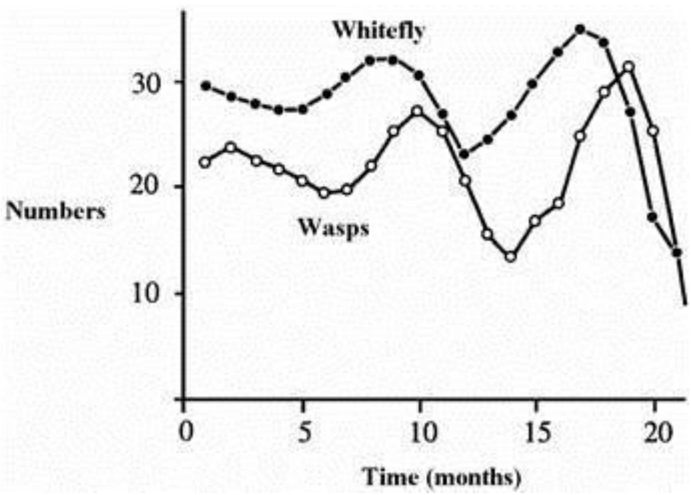
The wasp larva feeds on the whitefly larva.

The wasp is a ______________________

The whitefly is known as the wasp's ______________________

(2)

(b) The graph shows how the numbers of whitefly and wasps change over several months.



What happens to the number of wasps between 15 and 20 months?

____

Why do you think this happens? ______________________________________

____

____

____

(4)

(c) What would happen to the wasps if there were no larvae in which to lay their eggs?

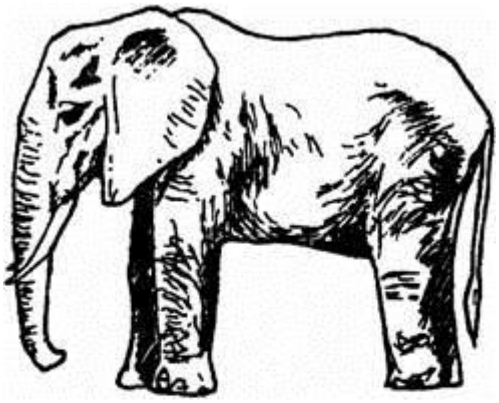
____

(1)
(Total 7 marks)

Q22.

The elephant is likely to become extinct in parts of Africa.

Use the information below to explain **three** reasons why.



- * The African elephant eats lots of trees and other plants for food.
- * In Africa the human population is increasing and more food is needed to feed the extra people.
- * More trees are cut down for fuel and to clear land for growing crops.
- * Elephants are killed by poachers who want the ivory from their tusks.
- * A herd of elephants needs a large area in which to live and feed.

1. ____

____

2. ____

____

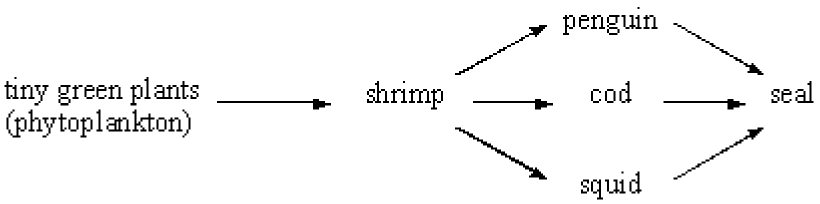
3. ____

____

(Total 3 marks)

Q23.

Scientists have found the following food web in the Antarctic Ocean.



(a) (i) Write down the name of the producer in this web.

(ii) Write down the names of **two** organisms which are prey in this web.

(3)

(b) Humans are removing large numbers of the cod.
Some scientists argue that this could lead to a decrease in the numbers of squid and penguins.
Others argue that the numbers of squid and penguins will stay the same.

Carefully explain each argument.

Why they might decrease.

Why they might stay the same.

(2)

(c) The following information is about the biomass of the organisms in one of the food chains in the web.

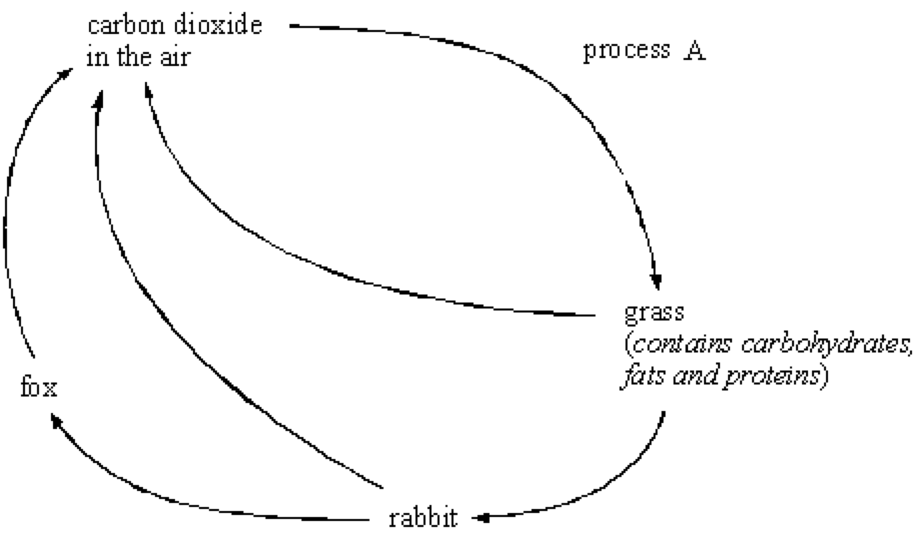
tiny green plants 1000 tonnes → shrimp 100 tonnes → cod 10 tonnes → seal 0.5 tonne

Draw and label a pyramid of biomass for this chain.

(2)
(Total 7 marks)

Q24.

The diagram shows part of the carbon cycle.



(a) Write down the name given to process A.

____

(1)

(b) Explain, as fully as you can, how some of the carbon in the grass becomes part of the fox's body.

____

____

____

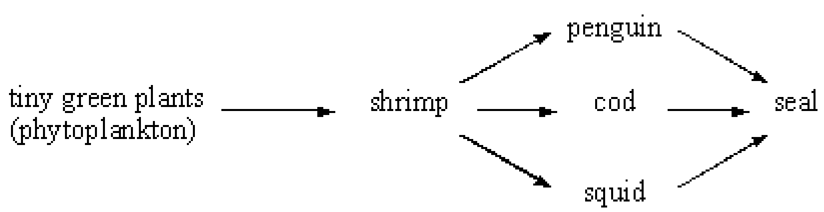
____

____

(3)
(Total 4 marks)

Q25.

Scientists have found the following food web in the cold Antarctic Ocean.



(a) Humans are removing large numbers of the cod.

Some scientists argue that this could lead to a decrease in the numbers of squid and penguins.

Others argue that the numbers of squid and penguins will stay the same.

Carefully explain each argument.

Why they might decrease.

(1)

Why they might stay the same.

(2)

(b) The following information is about the biomass of the organisms in one of the food chains in the web.

tiny green plants	→	shrimp	→	cod	→	seal
1000 tonnes		100 tonnes		10 tonnes		0.5 tonne

Draw and label a pyramid of biomass for this chain.

(2)

(c) Explain, as fully as you can, why the conversion of shrimp biomass into cod biomass is more efficient than that of cod biomass into seal biomass in the cold Antarctic Ocean.

(3)

(d) Boats from many countries fish the Antarctic Ocean. The cod are being overfished. If the numbers of cod are to increase, the population must be carefully managed.

(i) Suggest **two** control measures which would prevent a further drop in numbers,

(2)

(ii) Suggest why **one** of your control measures would be difficult to put into practice.

(1)

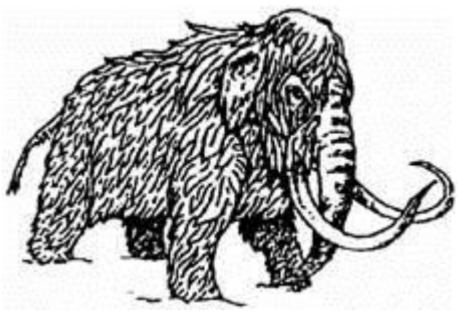
(Total 11 marks)

Q26.

When animals die, bacteria make them decay.
Warmth, moisture and oxygen are needed for this to happen.

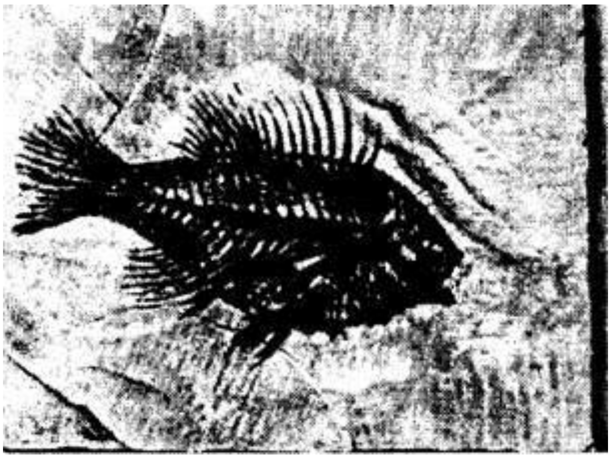
(a) (i) In northern Russia whole bodies of mammoths have been found in the frozen soils.

Explain why they did not decay.



(1)

(ii) Fish fossils have been found in mudstone rock. Explain why they did not decay?



____

____

(2)

(b) Some of the mammoths had flint weapons in their bodies.

Suggest **two** things that this tells us about human evolution.

1. ____

2. ____

(2)

(c) Mammoths are now extinct. Suggest **two** reasons for this.

1. ____

2. ____

(2)

(Total 7 marks)

Q27.

In compost heaps, dead plants are broken down by microbes.
This breakdown is much slower:

- when the weather is cold
- when the weather is dry
- when the heap is squashed down so that no air can circulate.

(a) What **three** conditions inside compost heaps are needed for microbes to work **quickly**?

1. ____

2. ____

3. ____

(3)

(b) Why is the breakdown of dead plants important for living plants?

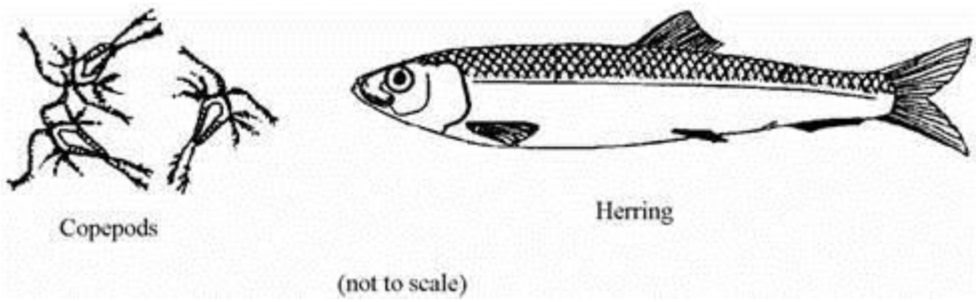
____

____

(1)
(Total 4 marks)

Q28.

Copepods are tiny animals which live in the sea.



During the day they live deep down near the sea bed.
At night they move up to the surface where they feed on tiny plants.
When the sun rises they move down to the bottom again.

(a) Suggest why the tiny **plants** live near the surface of the sea.

____

____

(2)

(b) Herring feed on copepods.

Where will herring be found during the day? Give a reason for your answer.

____

____

____

(2)
(Total 4 marks)

Q29.

Brown trout are fish that kill and eat other animals.

(a) Choose a word from this list to complete the sentence below.

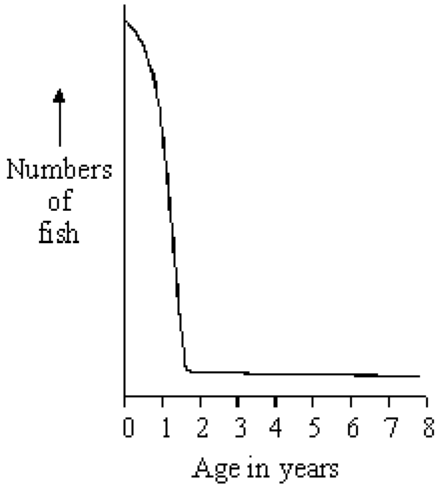
competitors **consumers** **prey** **producers**

Trout are predators, the animals they eat are their ______________________ .

(1)

(b) The graph shows the ages of the brown trout found in the river Tees.

There was no serious pollution in the river during this time.



Suggest **three** reasons why few brown trout live to be over two years old.

1. ____

2. ____

3. ____

(3)

(Total 4 marks)

Mark schemes

Q1.

decay

1

warm (*)

1

moist (*)

1

grow

(*) these words can be either order

1

[4]

Q2.

(a) **Quality of Written Communication**
The answer to this question requires ideas in good English, in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

max 2 if ideas not well expressed

in summer more greenfly

accept increase in population

1

in winter less greenfly

accept decrease in population

1

over the three years greenfly numbers decrease

accept fall ***or*** *drop for decrease*

1

(b) any **one** from

(number of) greenfly

severe **or** cold winters
toxic chemicals
destruction of habitats
disease
predators
weather
temperature

do not accept food

1

[4]

Q3.

Quality of written communication: One mark for using correct scientific terms microorganisms and respiration

1

(air contains) oxygen

1

(microorganisms break down human waste) by respiration (which releases carbon dioxide)

1

[3]

Q4.

any **five** from:

- the amount of energy (in the biomass of organisms) is reduced at each successive stage in a food chain
- all of prey organism is not consumed
- energy is 'lost' as the organisms' waste materials
- energy is transferred / lost during respiration
- energy is transferred / lost as movement (kinetic energy)
- energy is transferred / lost as heat (thermal energy)
- energy is transferred / lost to the surroundings
- the only energy transferred to a higher level is that which the organisms have used in growing

statements about energy flow the wrong way are neutral

[5]

Q5.

(a) all bars correct for greenfly, ladybird (± one square) and blackbird (less than one square)

1

bars are centred

*do not accept pyramid shape if **all** to left or right of centre*

1

bars are labelled (in correct sequence)

1

(b) $\frac{1}{12}$ **or** 8.3% **or** 1:12

if answer is incorrect accept correct

working out (eg $\frac{50}{600}$) for 1 mark
accept 12 or 12:1 for 1 mark
accept 8.3 for 1 mark (without %)

2

[5]

Q6.

(a) 115

1

(b) any **four** from

less energy lost / used

as heat lost to the atmosphere

since warm indoors

accept temperature controlled

(less energy lost) in movement

since movement restricted

more growth / eggs

*accept prevents loss of body mass **or** gets fatter / weight gain*

4

[5]

Q7.

(a) any **three** from

different factors are required for each mark

hares breeding

(amount) of food **or** plants available

eaten by lynx **or** predators **or** reference to size of lynx / predator population

hares dying **or** reference to being killed by humans

disease (spreads through the population)

(competition) for space **or** (lack of) space)

*alternative to either of these points but not both change in environment **or** habitat*

temperature **or** weather **or** climate

3

(b) any **two** from

more food **or** hares for lynx encourages more breeding (in lynx)

accept less food, less breeding

more food **or** hares allows greater survival rate of cubs **or** adult lynx

accept less food, less survival

idea of time lag for breeding **or** time lag for dying

2

[5]

Q8.

(a) (i) photosynthesis

1

(ii) respiration

do not credit combustion

do not credit decay

1

(iii) dry

*accept hot **or** windy **or** drought*

1

(b) any **three** from

* evaporation (of water)

__or__ loss of water vapour

* (mostly) from the leaf / leaves

do not credit incorrect reference to leaves

* through the stomata

accept through each stoma

accept through the stomas(sic)

* causing a pull

__or__ causing an increase in osmotic potential (at the top of the plant)
__or__ causing an increase in water potential (at the top of the plant) __or__ causing a decrease in osmotic pressure (at the top of the plant)

* (so that) water moves up (through the plant)

do not credit water vapour moves up through the plant

* as the transpiration stream

* water enters through roots (and goes up plants)

3

[6]

Q9.

(a) evaporates

1

sea

1

sun

accept sun

1

wind

1

condenses

1

rain

1

(b) (i) carbon dioxide

accept CO_2 provided it is correct in every detail

1

(ii) (process) D

1

millions of years

a million years upwards

1

[9]

Q10.

(a) diatoms photosynthesise **or** are producers

1

the amount of growth depends upon the energy **or** light they get

accept more light means more growth
***or** they multiply more in more light*
do not accept they need light

1

(b) (i) eaten by small fish

do not accept eaten by fish

1

minerals **or** nitrate **or** phosphates
or nutrients **or** food supply used up
or reduced

1

(ii) any **two** from

gets colder

light decreases
end of their life span **or** die

accept more being eaten than being formed

eaten by small fish

*do not accept a decrease in nitrates **or** phosphates*

1

(c) increased minerals **or** nitrates **or** phosphates

1

any **one** from

due to death **or** decay of diatoms **or** fish

do not accept death of large fish

1

influx of minerals in an ocean current

*do not accept extraneous pollution **or** dumping by a ship*

1

[8]

Q11.

(a) more oxygen/microbes more active

1

(b) plenty of microbes
moisture/not too wet
warmth food for microbes

any 2 for 1 mark each

2

[3]

Q12.

(a) (i) predator (allow carnivore)

(ii) prey

each for 1 mark

2

(b) fewer ladybirds; because less food/ladybirds starve
or
no change; because alternative food supply

each for 1 mark

2

(c) any two suitable environmental effects e.g.
food;
diseases;
other predators;
space;
insecticides

any two for 1 mark each

2

[6]

Q13.

(a) warmth/heat
oxygen/air
moisture
microbes/micro-organisms/fungi/moulds/bacteria

any three for 1 mark each

3

(b) do not rot

for 1 mark

1

[4]

Q14.

(a) *idea:*
wood goodness recycled/crops goodness removed

gains 1 mark

1

but
wood minerals/nutrients recycled/crops remove nutrients/minerals

gains 2 marks

wood and crops compared

for 1 mark

2

(b) (add) fertiliser/nutrients/minerals
(add) manure/animal waste/compost

any two for 1 mark each

(accept move to new area for 1 mark)
rotation

max marks 2

2

[5]

Q15.

(a) (i) carbohydrate*/fat/protein in cell
(or example e.g. glucose/starch)

for 1 mark

1

(ii) $\frac{21500}{1050000} \times 100$ or 2.(05)%

for 1 mark

1

(b) *ideas that:*
little energy used for growth/most wasted/lost

gains 1 mark

but
only 4% used for new growth

gains 2 marks

evidence/idea that this is repeated at each stage
idea of diminishing return/less energy at each stage

for 1 mark each
(maximum of 3)

3

(c) *idea:*
plants at the start of all food chains
shorter food chain
more efficient/less energy lost/more food
cheaper/more economic
(must bear consequence of at least one of earlier marks)

any three for 1 mark each

3

[8]

Q16.

(a) microbes/worms/bacteria/fungi/moulds/
micro-organisms/decomposers
(not germs/bugs/slugs/organisms - ignore these)

any one for 1 mark

1

(b) idea warm/hot/heat (not sun)
oxygen/air
moist/water/wet/rain (not ‘turn the compost’ unless qualified)
If no answer given in (a), one e.g. could be credited in (b)

any two in any order for 1 mark each

2

[3]

Q17.

(a) (i) methane/biogas/natural gas

(accept formula) for 1 mark

1

(ii) cooking/heating/burning/fuel/vehicle fuel/lighting

for 1 mark

1

(b) *idea that* it is a soil <u>improver</u>/fertiliser/provides nutrients or makes soil richer or <u>improves</u> plant growth/makes plants grow better
(not “plants” alone/gardens/spreading on land)

for 1 mark

1

[3]

Q18.

(a) predator/carnivore

(not consumer/hunter)

for 1 mark

1

(b) (i) number decrease
not ‘no’ <u>less</u> food (for large mites)/less prey/fewer small mites <u>to eat</u>
(not ‘fewer small mites’ etc)
starve/cannot grow/cannot breed/die/die out

each for 1 mark

3

(ii) increase small mites breeding faster (than they are eaten)

each for 1 mark

(accept different food found)
decrease = O maths but 1 mark for possible reason can be awarded - more (small mites) eaten

each for 1 mark

2

[6]

Q19.

(a) *idea:*
soil wetter
soil less aerated
less food for moles/voles/foxes/badgers/birds
soil less fertile (less leaves in soil <u>not</u> enough on its own)
less food grown
earthworms die out/fewer earthworms
(<u>not</u> just “earthworms get eaten”)

any 4 for 1 mark each

4

(b) method
advantage
disadvantage
*e.g.**

- chemical

- kills worm/affects reproduction/maintains earthworm population
- persistent/food chain/kill earthworm

or

- import biological central/predator/disease/parasite
- kills worm/affects reproduction/maintains earthworm population
- may attack other animals/cause same sort of problems as New Zealand worms

(* credit other plausible suggestions for method/advantage/disadvantage)

for 1 mark each

3

[7]

Q20.

idea that

microbes/bacteria/fungi/moulds/micro-organisms/decomposers.
NOT germs/worms/bugs/organisms

gains 1 mark

but microbes etc. need/grow/cause decay/decompose in

gains 2 marks

but microbes etc. need/grow/caused decay/decompose
faster in warm/moist conditions

gains 3 marks

(Allow reverse arguments)

[3]

Q21.

(a) predator
prey

no alternatives
for 1 mark each

2

(b) *idea that*
(wasps) increase OR decrease

gains 1 mark

but
(wasps) increase then decrease/peaks at

gains 2 marks
answers must match

idea of change in food supply/whiteflies more food/whiteflies OR less food/ whiteflies

gains 1 mark

but
more food/whiteflies then less food/whiteflies

gains 2 marks

or
wasps follow trend in whiteflies

for 2 marks

or
linked to increase/decrease other environmental effects
e.g. more/less food for wasps, use of insecticide
e.g. temperature change, other predator
If increase/decrease not given then second part (reason) gains no marks

for 1 mark each

4

(c) *idea that*
wasps die out/die off/fly away/migrate/leave greenhouse but NOT 'die' alone

for 1 mark

1

[7]

Q22.

Factor and effect needed.
idea

- killed by poachers (for tusks/ivory)
- not enough food for elephants because humans cut down trees
- not enough space because more used by people/agriculture
- food/space destroyed by humans
- killed for food

any three for 1 mark each

[3]

Q23.

(a) (i) (tiny green) plants / phytoplankton

for 1 mark

1

(ii)
- penguin
- shrimp
- cod

- squid

  any two for 1 mark

1

(b) <u>Decrease:</u> seals will eat more squid and penguins

for 1 mark

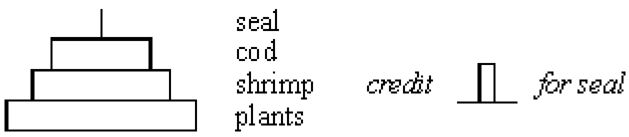
1

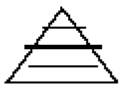
<u>Stay the same:</u>

- more shrimp for squid and penguins
- squid and penguins increase balances the extra eaten by seals
- seals find other prey [allow shrimps]

  any two for 1 mark each

2

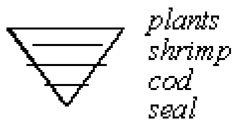
(c) 

allow 

- correct / shape (designs need to be to scale)
- correctly labelled with organisms

(if wholly correct but inverted then credit 1 mark)

each for 1 mark



2

[7]

Q24.

(a) photosynthesis

for 1 mark

1

(b)
- grass eaten by rabbit
- rabbit eaten by fox
- carbon becomes part of fats/proteins in the fox’s body
- or passes along the chain as (carbohydrate) / fat / protein

each for 1 mark
[Do not accept 'carbon gets into fox's body', for third mark]

3

[4]

Q25.

(a) <u>Decrease:</u> seals will eat more squid and penguins

for 1 mark

1

<u>Stay the same</u>:

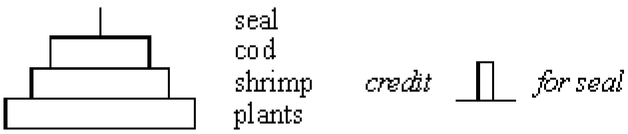
- more shrimp/food for squid and penguins

ideas that

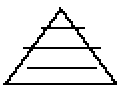
- increase in squid and penguins balances the extra eaten by seals
- seals find other prey (<u>allow</u> start to eat shrimps)

any two for one mark each

2

(b) 

allow



- correct shape (doesn't need to be to scale)
- correctly with organisms

(if wholly correct but inverted then credit 1 mark)

each for 1 mark

2

(c)

- seals are mammals
- *idea that* seals have (to maintain) a constant body temperature *[allow warm blooded]*
- heat losses to cold seas
- more of food eaten used to replace heat loss

(credit <u>use</u> of figures i.e. 95% loss compared to 90%
or 5% efficient compared to 10%
or 20 : 1 conversion ratio compared to 10 : 1
with 1 mark)

any three for 1 mark each

3

(d) (i) *ideas that*

- reduce number of fishing boats allowed
- breed in captivity and then release
- agree quotas [not an unqualified 'ban']
- avoid breeding areas
- avoid breeding seasons
- increase size of net mesh/don't catch small fish
- limit catches of shrimps
- cull seals

any two for 1 mark each
[allow any other reasonable answer]

2

(ii)
- breeding areas closer to some countries than others
- difficult to police/easy to cheat/'poach'
- difficult to agree quotas
- some countries eat more fish than others
- best weather for fishing maybe in breeding seasons
- fisherman/trawlers need employment
- big demand for cod

any one for 1 mark
[allow any other sensible response]

1

[11]

Q26.

(a) (i) (too) cold / all moisture / water frozen / no moisture / no warmth / conditions for decay are absent.

for 1 mark

(*No* oxygen is neutral)
(*Do not accept* frozen or ice has preserved them)

1

(ii)
- (bacteria have) no oxygen / air (because dead fish covered in mud)

(No moisture x)

(No moisture and no oxygen or warmth x)

- bones / hard parts do not decay easily

idea that

- material of fish replaced by minerals
  any two for 1 mark each

2

(b) *ideas that*

- mammoths lived at the same time as humans / there was man in these times
- mammoths lived in the same place as humans
- humans hunted mammoths / ate mammoths / were carnivorous / for fur etc
- reference to later use of more advanced weapons
- humans needed to protect themselves from mammoths
- humans used flints / weapons / tools
  any two for 1 mark each

2

(c) *idea that*

- environment changed / became too cold / became too warm / vegetation changed / humans destroyed environment
- (new) predator / humans killed them
- new disease
- new competitor / type of elephant
- shortage of food / no food / ran out of prey
- mammoths reproduced too slowly
- mammoths didn't adapt to changes
  any two for 1 mark each

2

[7]

Q27.

(a)

- warmth / heat / hot / not cold
- moisture / water
- air / oxygen (*allow idea that* not squashed down)

if refer to weather or conditions outside the compost heap, *do not allow* *in any order for 1 mark each*

3

(b) *idea that* nutrients / minerals / nitrates are recycled / fertilise the soil
(*do not allow* food / goodness)

for 1 mark

1

[4]

Q28.

(a) idea that

- light doesn't reach deeper parts
- plants need / absorb light
- to make food

gain 1 mark each to maximum of 2

but
so they can photosynthesise

gains 2 marks

2

(b) herring will be on the bottom
herring follow / will be feeding on the copepods — independent marking points

for 1 mark each

2

[4]

Q29.

(a) prey

for 1 mark

1

(b)
- disease
- eaten (by predators) / predators
- (over)fished / caught by fishermen
- competition for food / not enough food (for all the baby fish) / no food

(*do not allow* they migrate or move elsewhere)

any three for 1 mark each

3

[4]