AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



EXAM QUESTION PACK

4.7.2 ORGANISATION OF AN ECOSYSTEM (PACK 2)

SCORE	PERCENTAGE
/239	%

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Q1.

The photographs show four different species of bird.

Great tit



© JensGade/iStock

Blue tit



© Marcobarone/iStock

Coal tit



© MikeLane45/iStock

Long-tailed tit



© Andrew Howe/iStock

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

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

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

_____

_____

_____

Answer = _____ kJ per day per gram of body mass

(2)

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

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_____

_____

_____

(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?

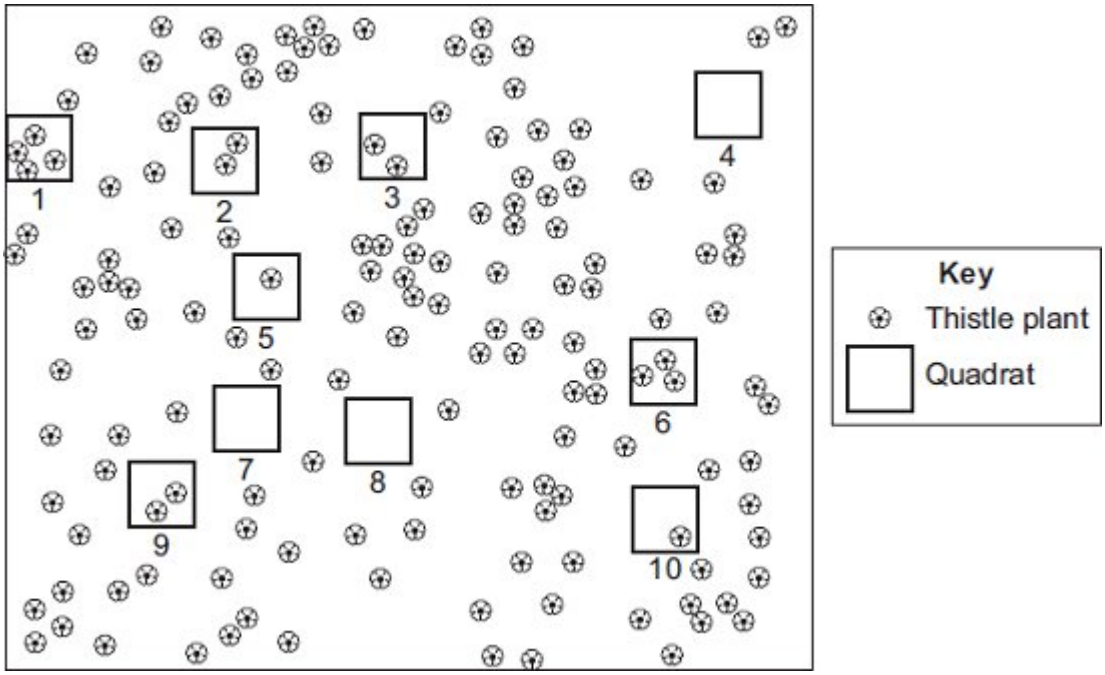
Tick (✓) **one** box.

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.

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(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.

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_____

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)

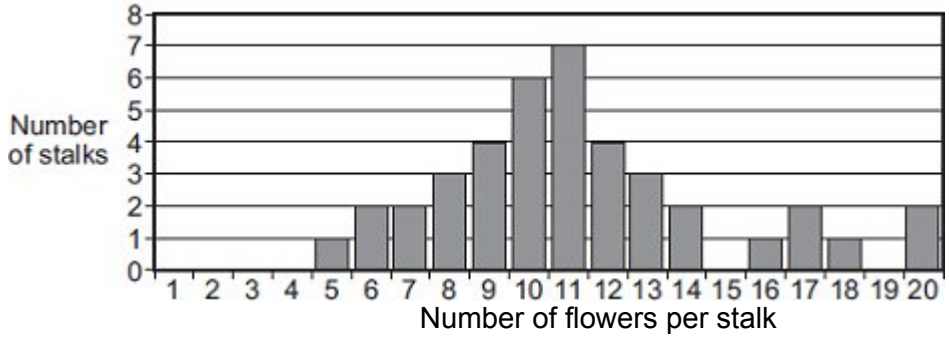
Q3.

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.

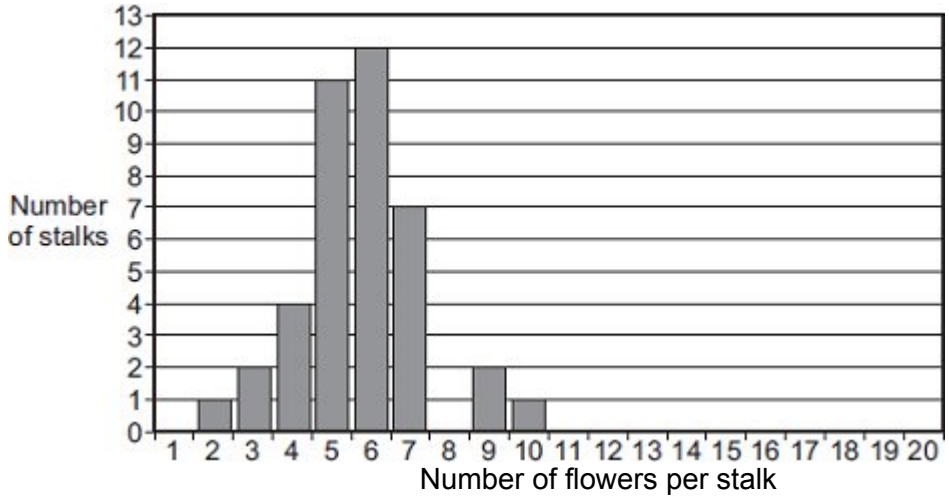
A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.

Habitat A: Sunny field next to woodland



Habitat B: Shady, moist woodland

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(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.

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_____

_____

_____

_____

(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.

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Which gas is needed for decay?

Tick (✓) **one** box.

Carbon dioxide ☐

Nitrogen ☐

Oxygen ☐

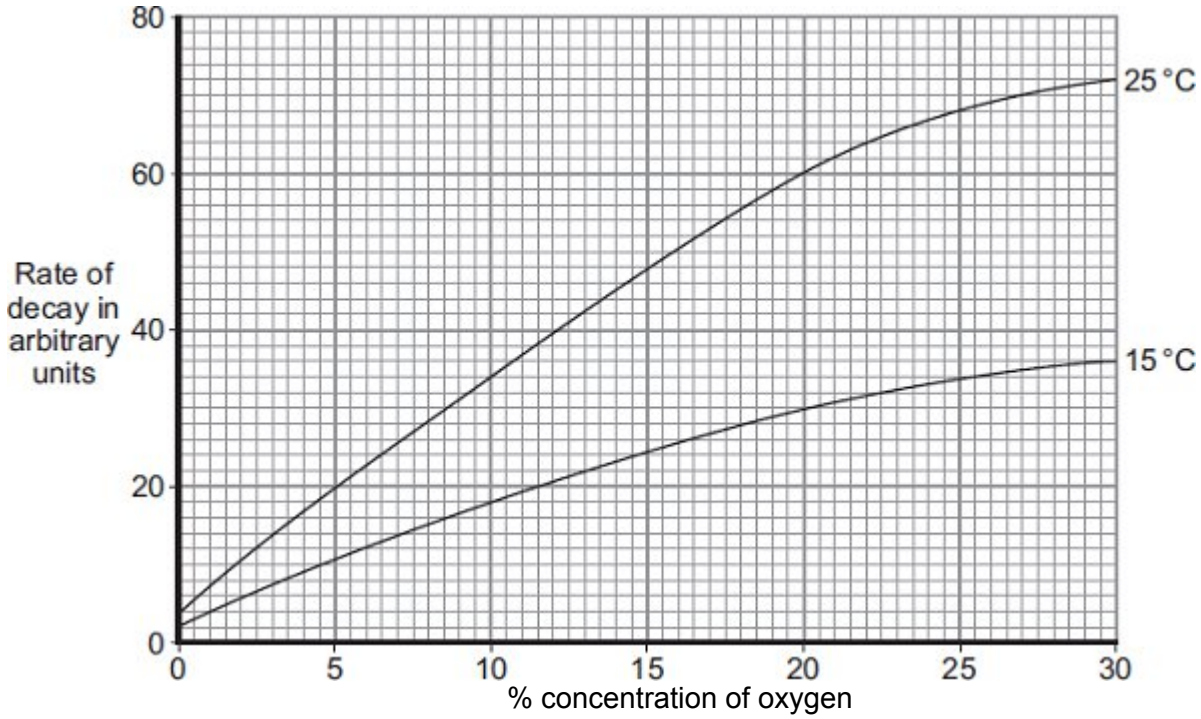
(1)

(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.

_____

_____

_____

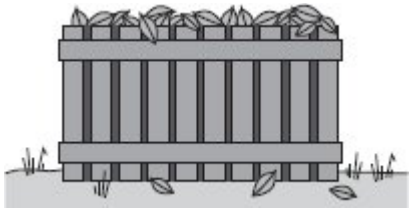
_____

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_____

(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.

_____

_____

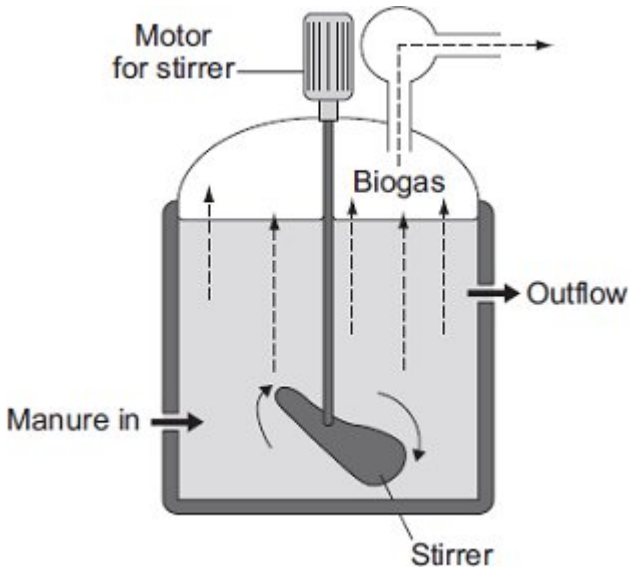
(1)

(Total 5 marks)

Q6.

The diagram shows one type of biogas generator.

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(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.

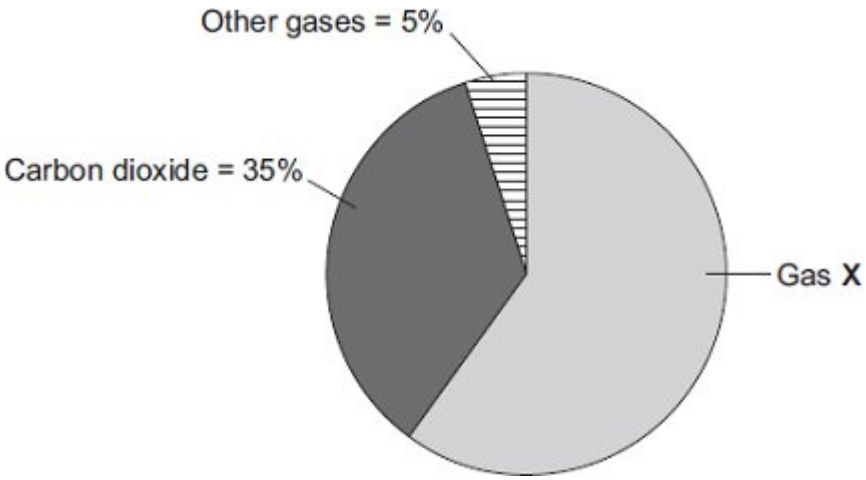
A higher concentration contains too little oxygen. ☐

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**?

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Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

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

Show clearly how you work out your answer.

_____

_____

Percentage of gas **X** = _____

(2)

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

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

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

aerobic respiration.

anaerobic respiration.

fermentation.

(1)

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

ammonia.

nitrogen.

oxygen.

(1)

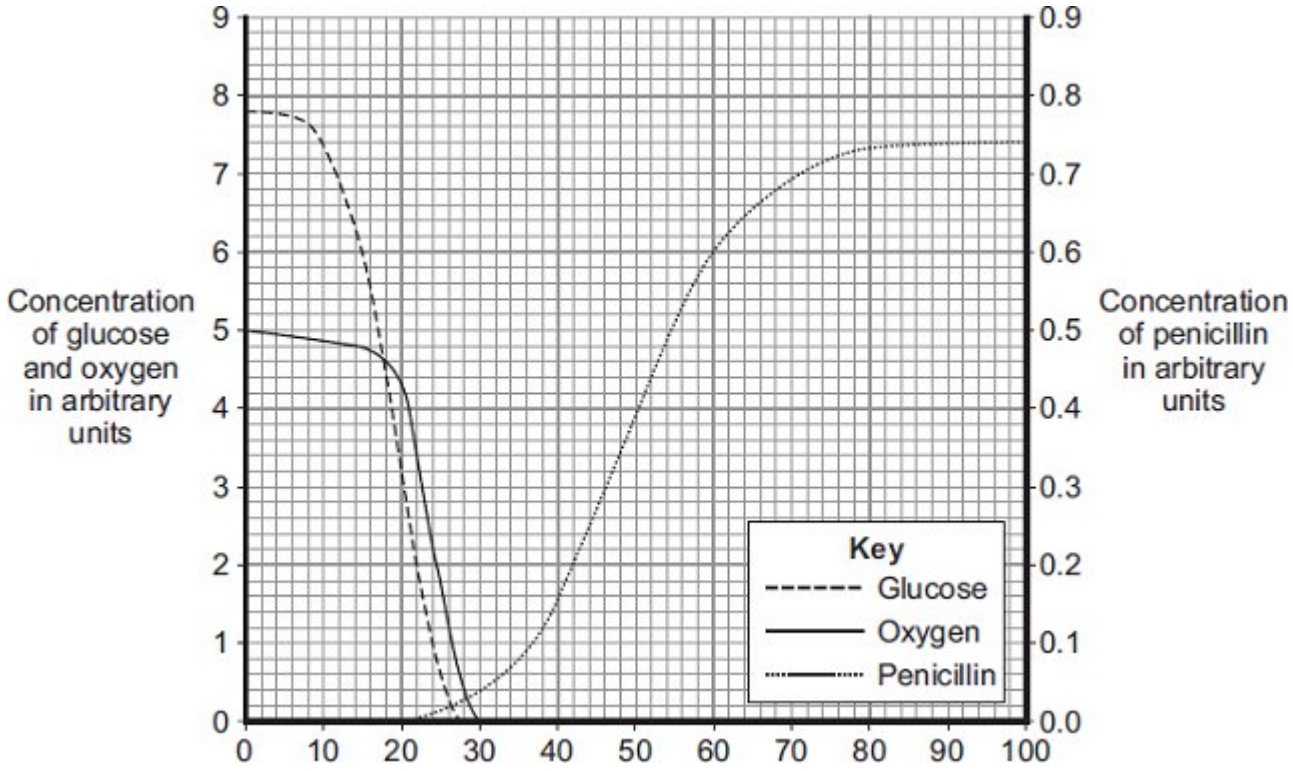
(Total 6 marks)

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.

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(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. ☐

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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.

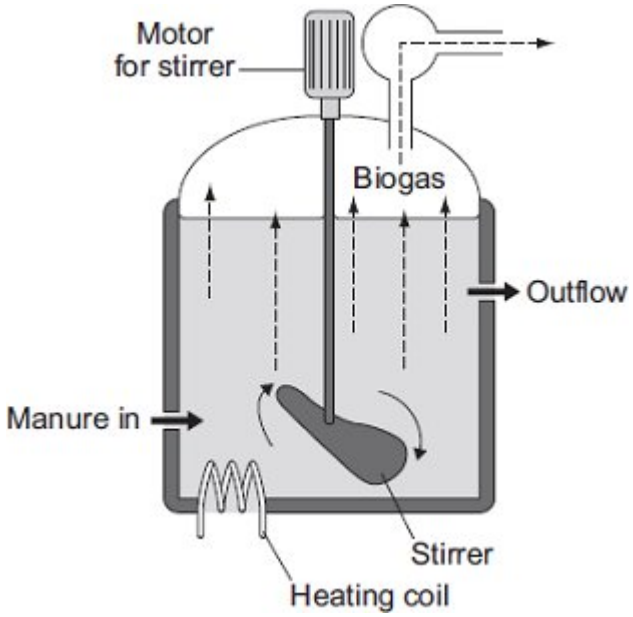
distillation **filtration** **respiration**

(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.

_____

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_____

(1)

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

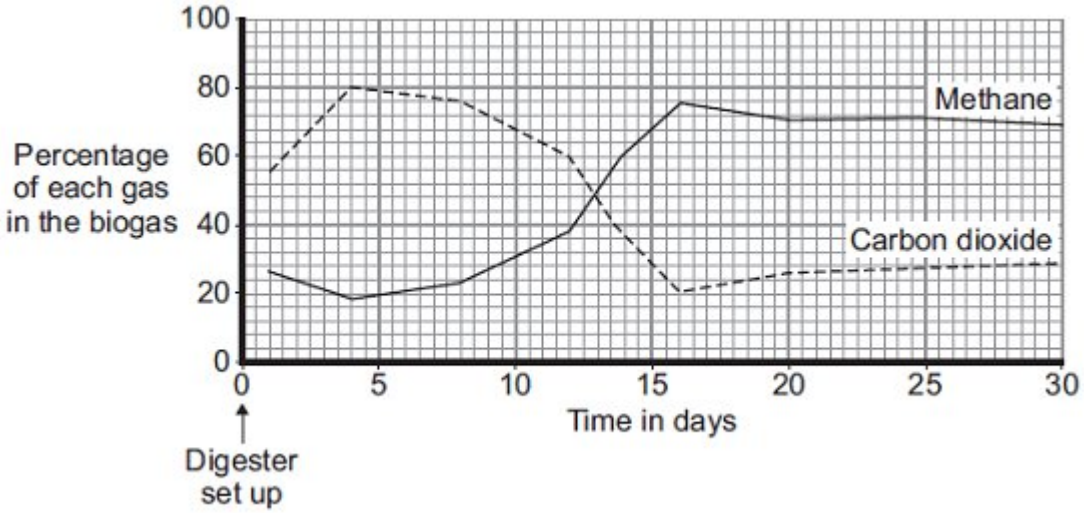
Suggest **one** reason why.

_____

_____

(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.

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_____

_____

_____

_____

(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:

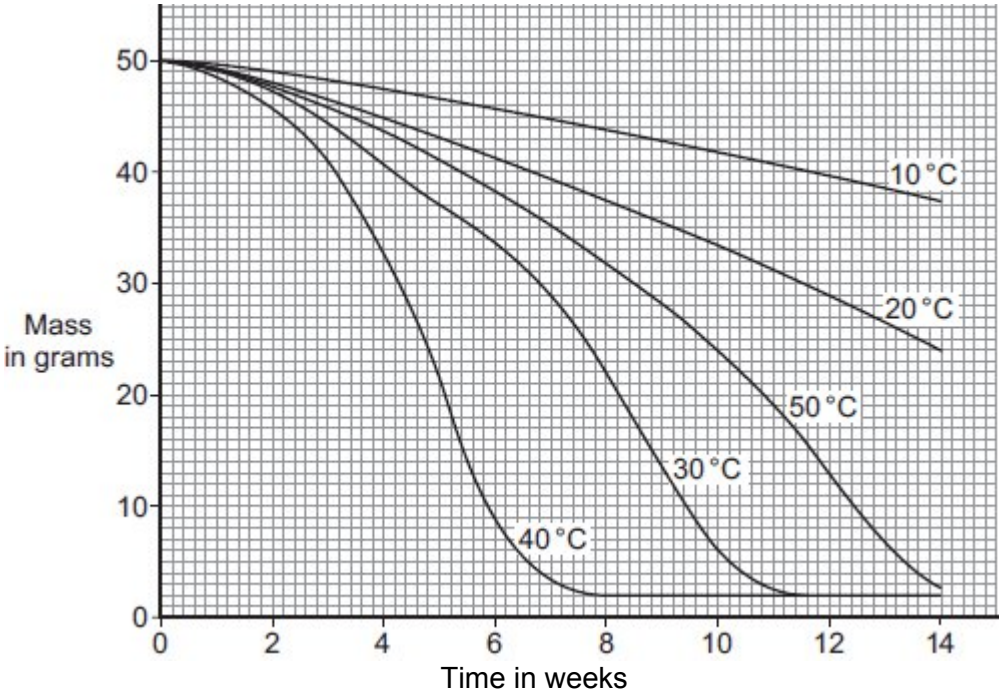
'The higher the temperature the faster the potato will decay.'

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.

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(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.

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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.

_____

_____

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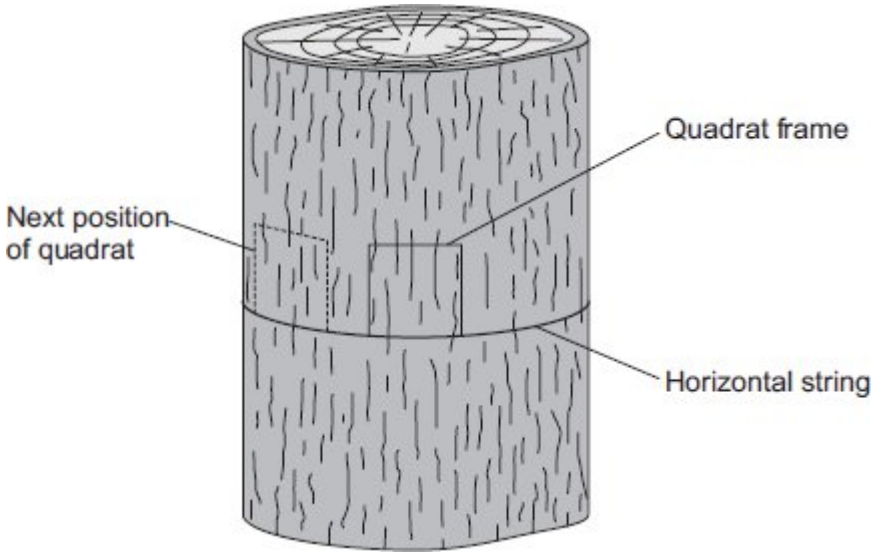
_____

(6)

(Total 8 marks)

Q11.

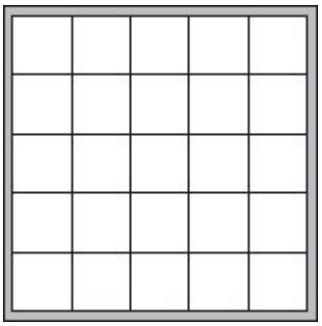
Students investigated the distribution of a green alga on a tree trunk.



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.

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_____

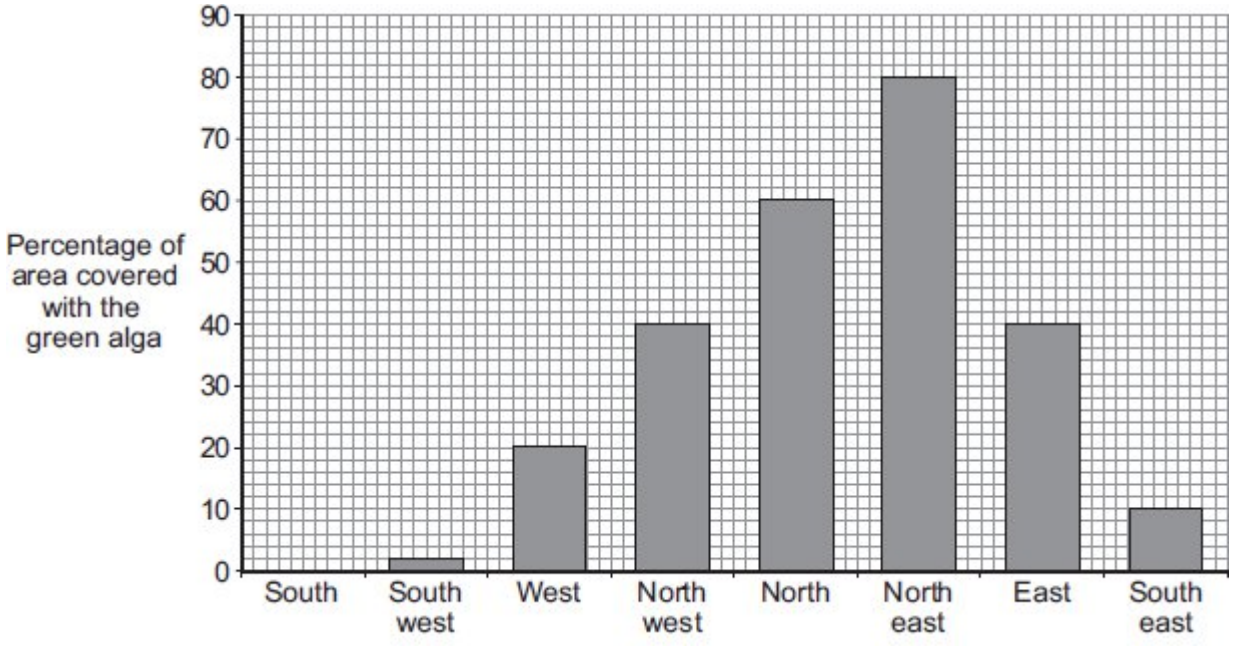
_____

_____

_____

(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.

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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 _____

_____

_____

_____

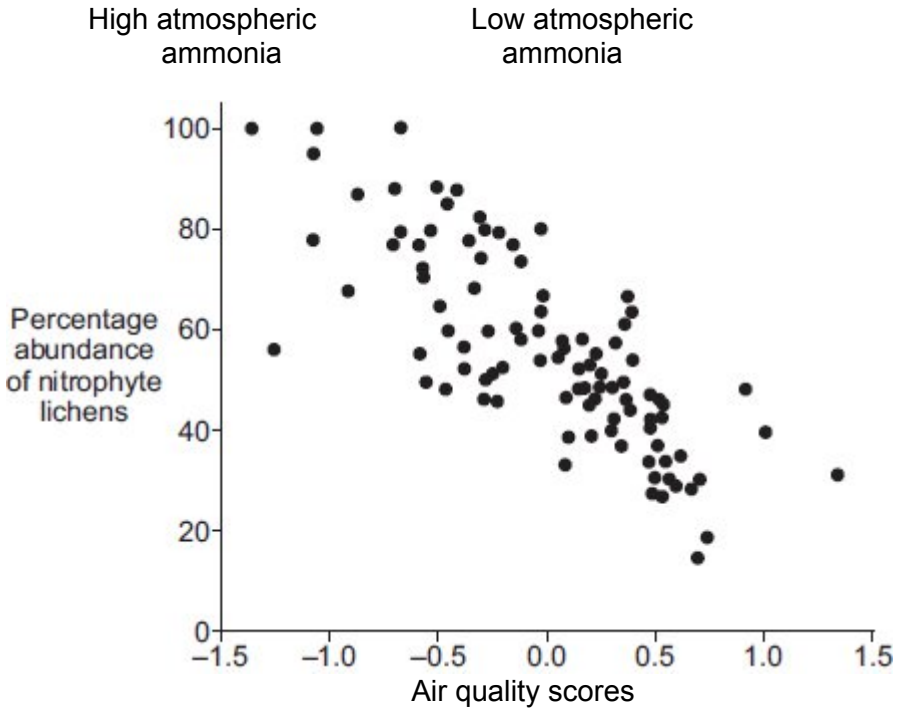
_____

_____

_____

(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.



© U.S. Department of Agriculture

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

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_____

_____

_____

_____

(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.

_____

_____

_____

_____

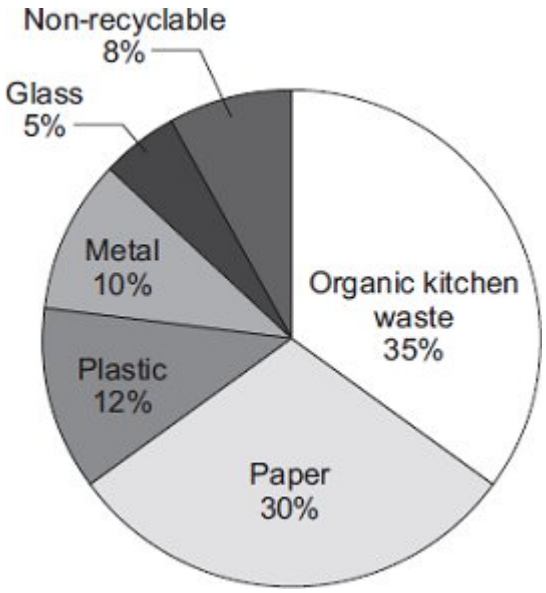
(2)

(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.

_____

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_____

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.

_____

_____

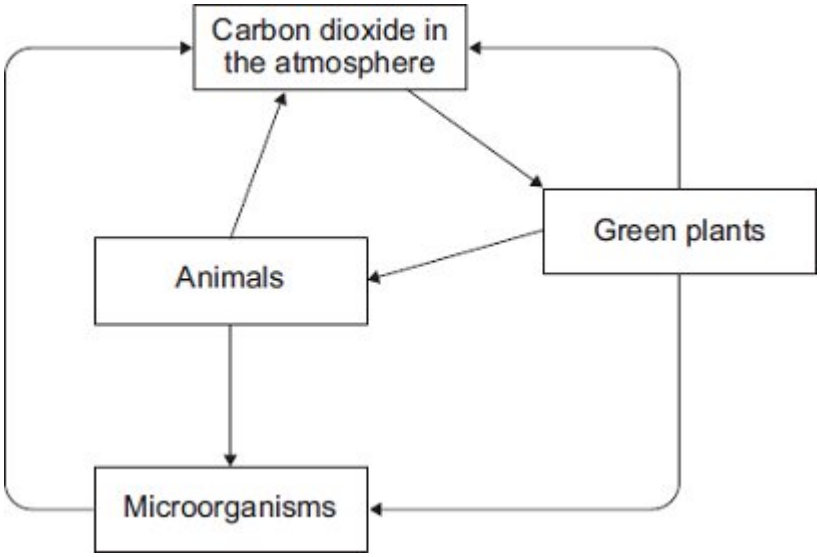
(1)

(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.

_____

_____

_____

_____

_____

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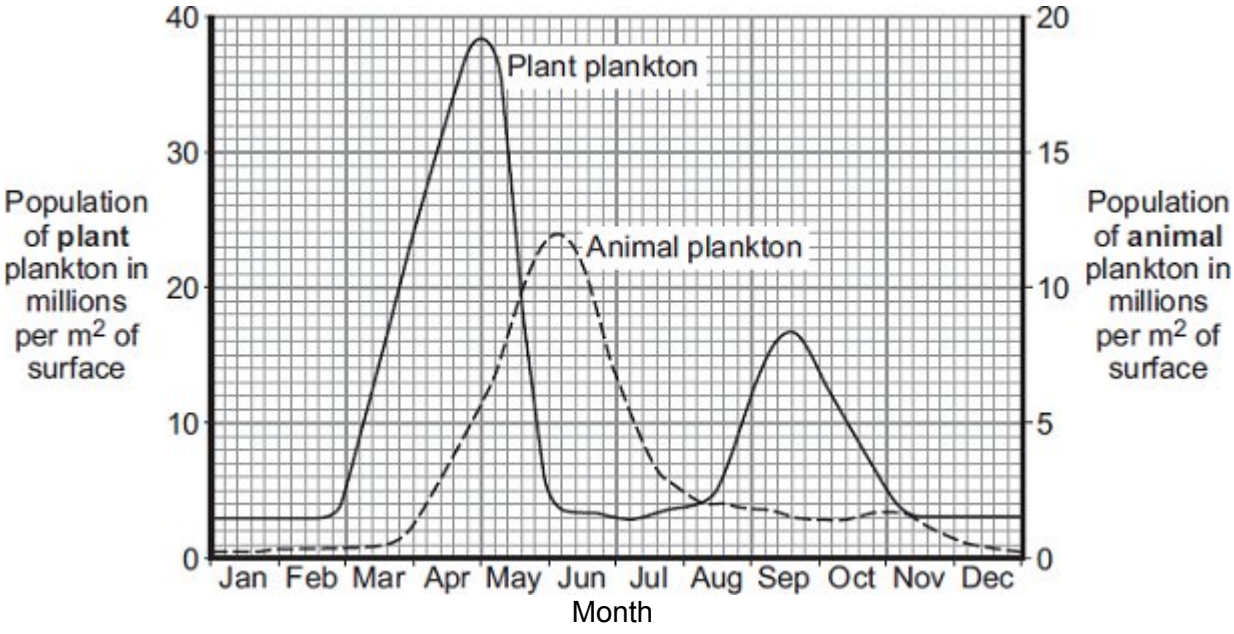
(Total 6 marks)

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



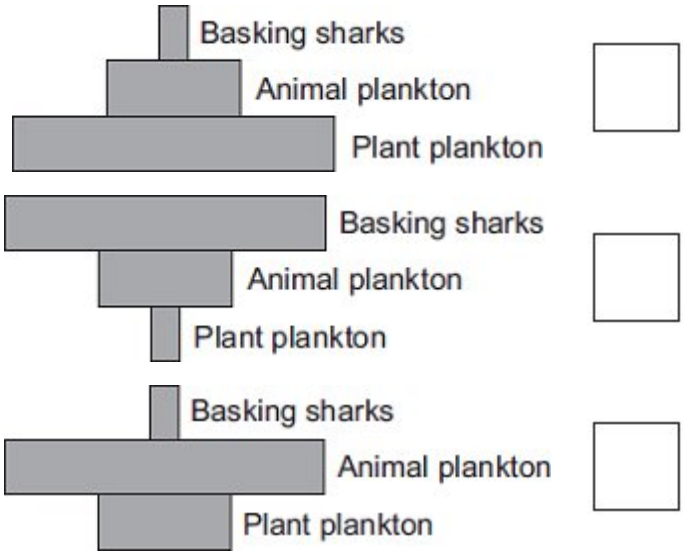
(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

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

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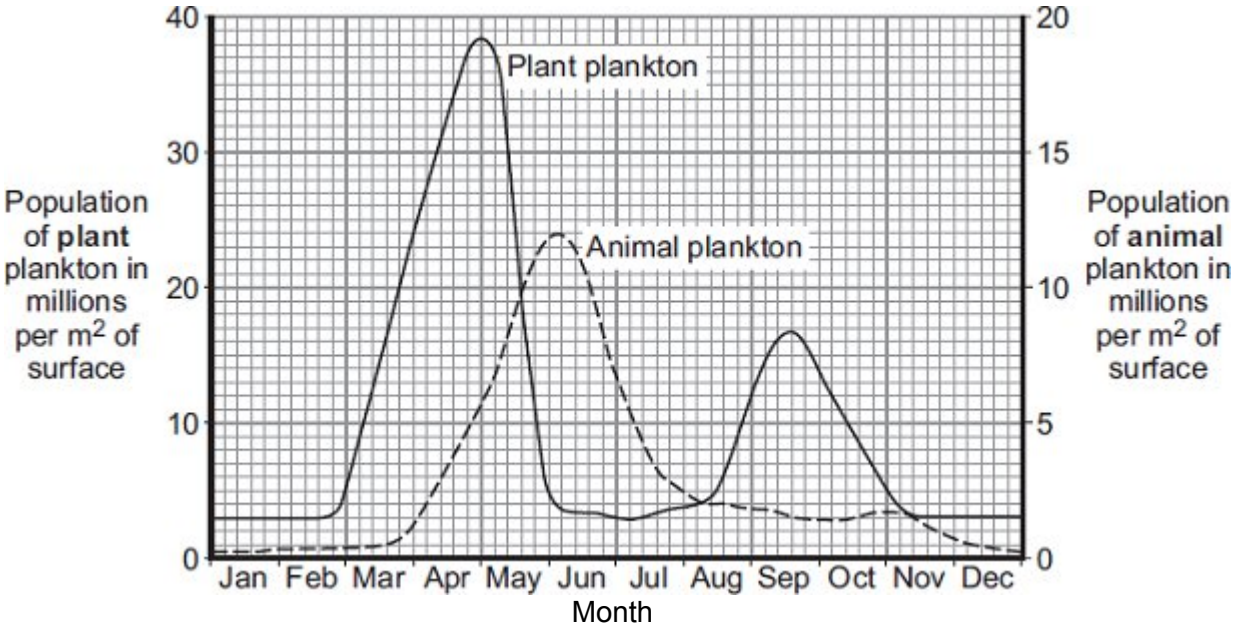
Which is the correct shape for the pyramid of biomass to show the relationship between plant plankton, animal plankton and basking sharks, in June?

Tick (✓) **one** box.



(1)

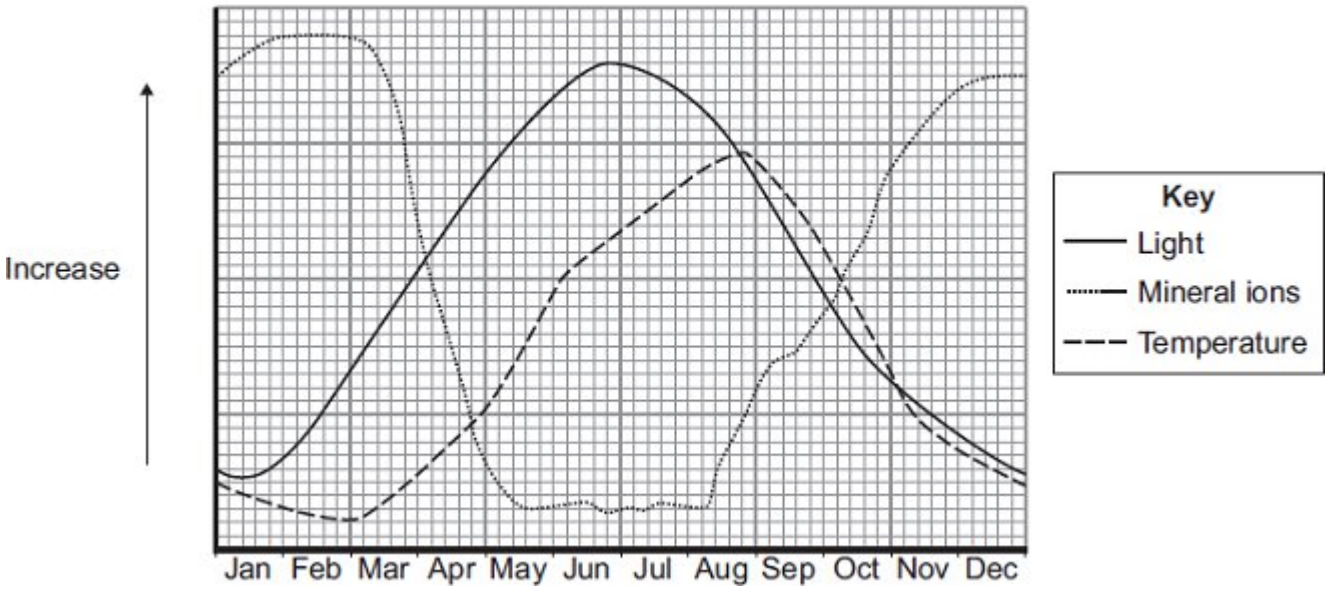
Graph 1 is repeated here to help you answer the following questions.



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

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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.

_____

_____

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_____

_____

_____

_____

_____

(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.

_____

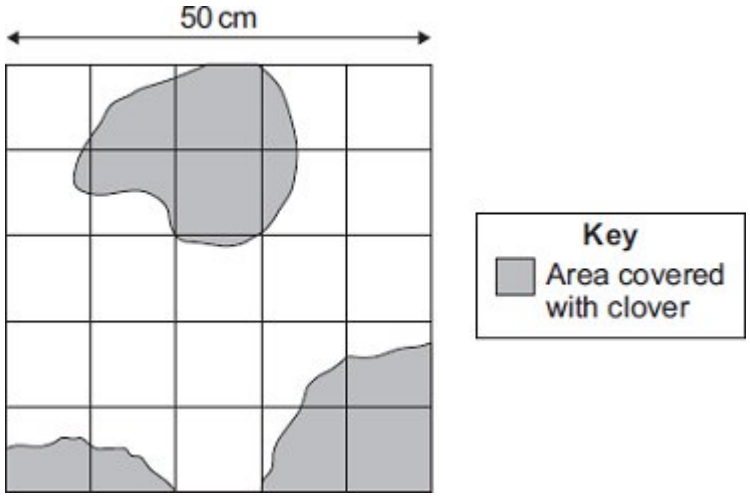
_____

_____

_____

(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)

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(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.

_____

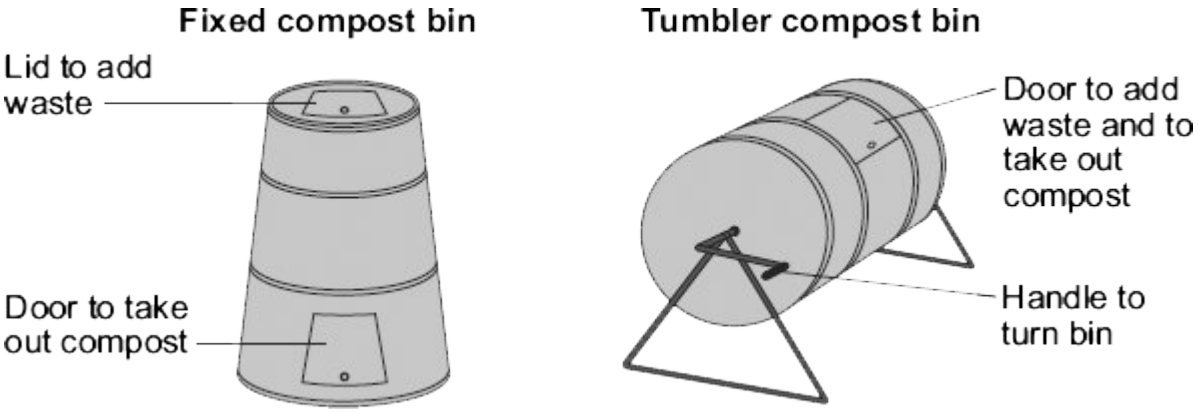
(1)

(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.

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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)

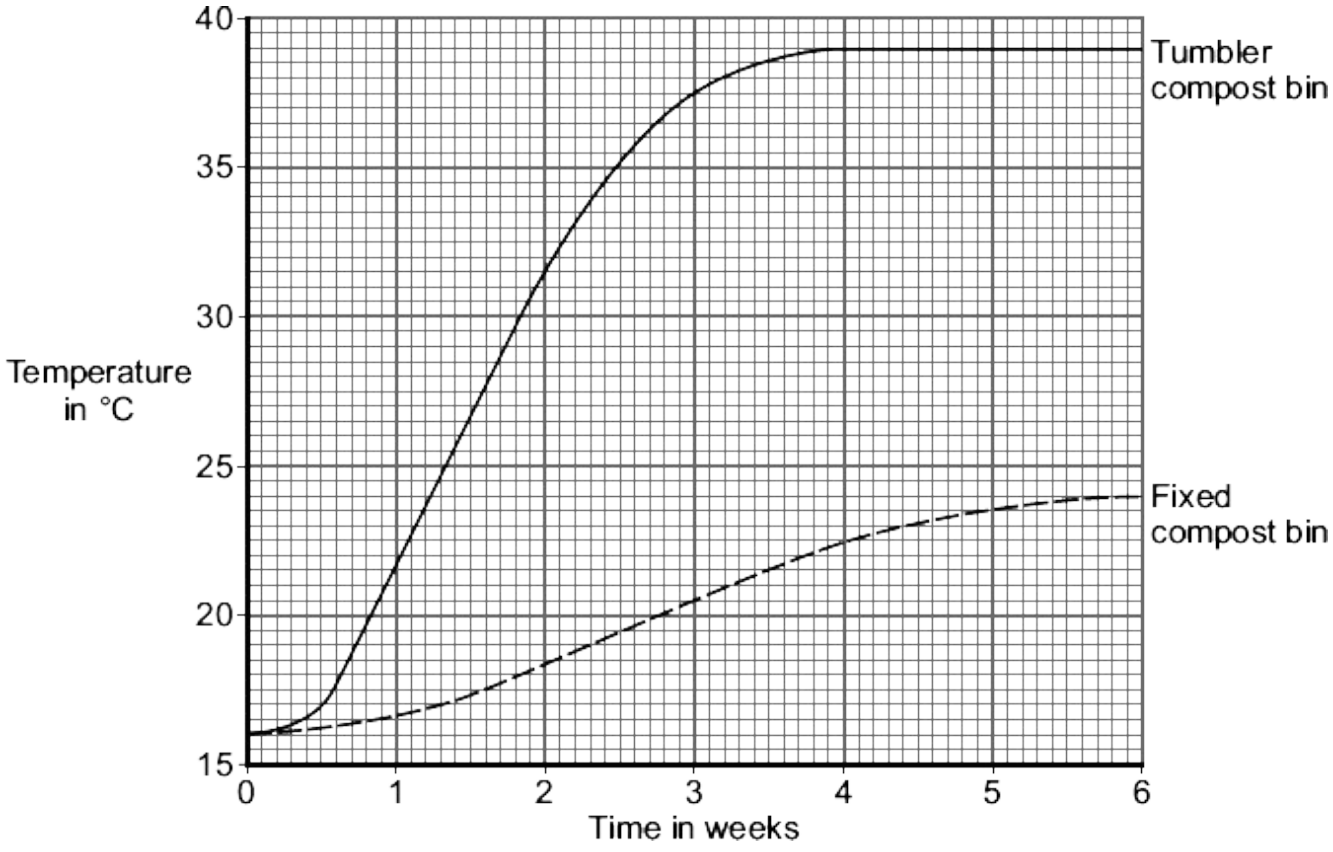
(ii) Give **two** advantages to the gardener of buying a fixed compost bin and not a tumbler compost bin.

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.



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(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)

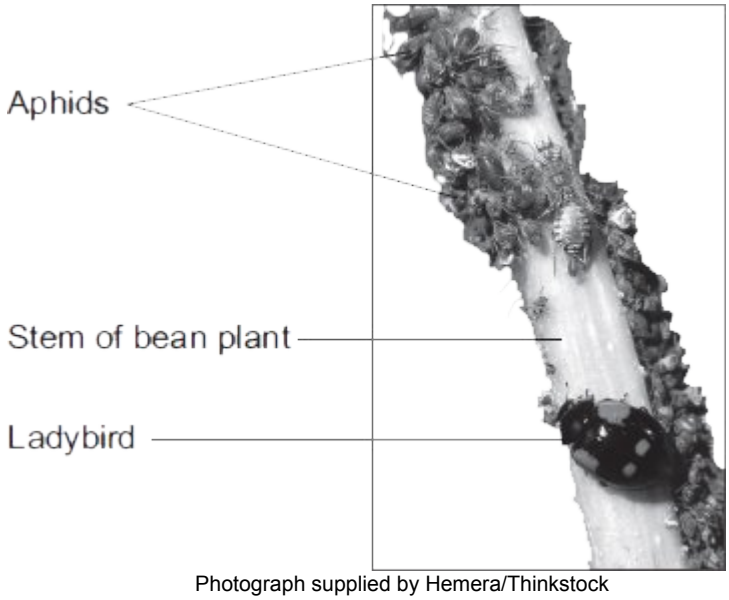
(Total 9 marks)

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.

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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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_____

_____

(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**

_____

_____

_____

_____

_____

_____

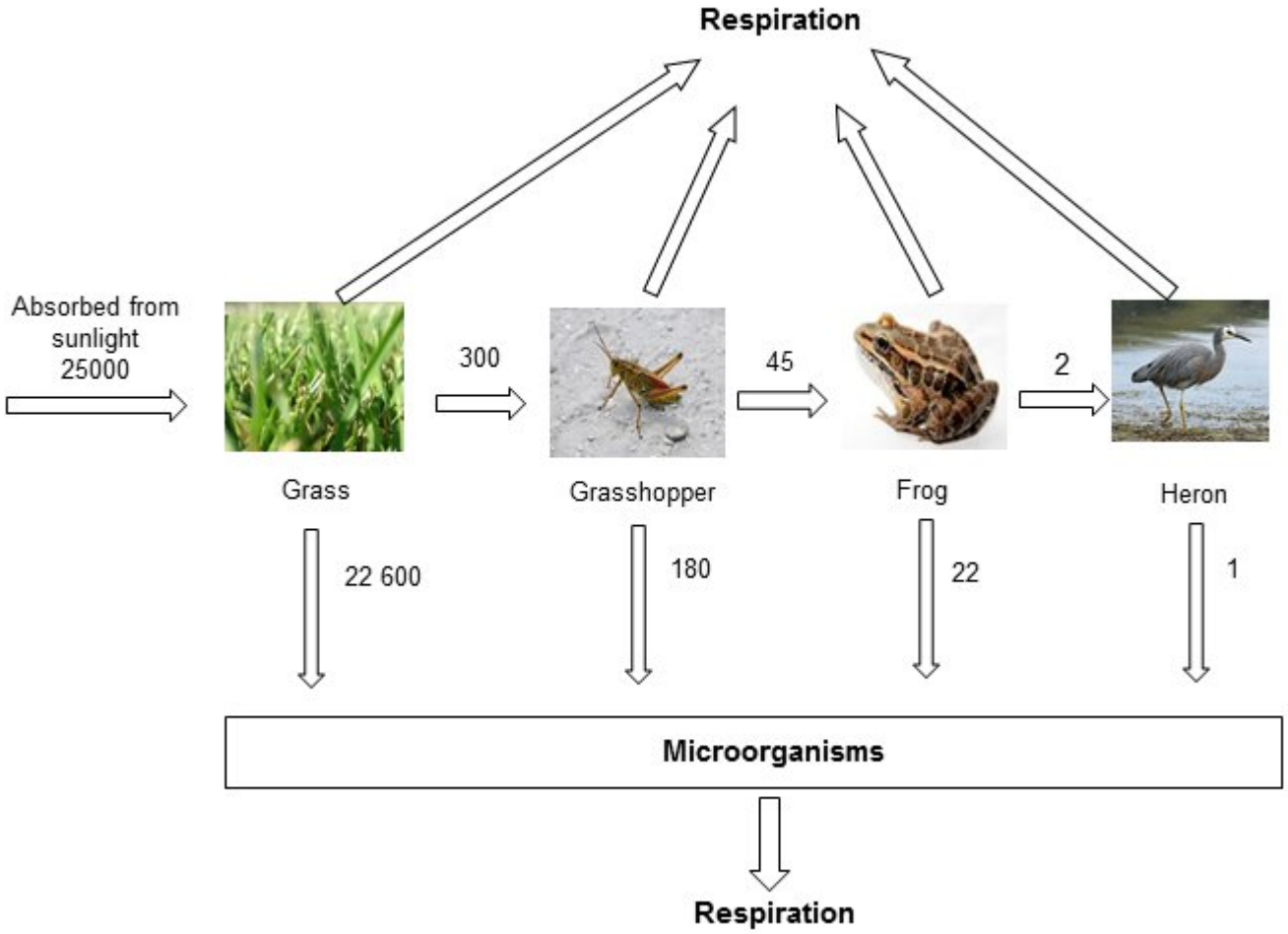
(Total 3 marks)

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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.

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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)

Grass by By Catarina Carvalho from Lisboa, Portugal (Flickr) [CC-BY-2.0], via Wikimedia Commons. Grasshopper by I, Daniel Schwen [GFDL, CC-BY-SA-3.0], via Wikimedia Commons. Frog by Brian Gratwicke (Pickerel Frog) [CC-BY-2.0], via Wikimedia Commons. Heron by Glen Fergus (Own work, Otago Peninsula, New Zealand) [CC-BY-SA-2.5], via Wikimedia Commons.

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

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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.

_____

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_____

(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.

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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

Modern elephant

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



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

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

_____

_____

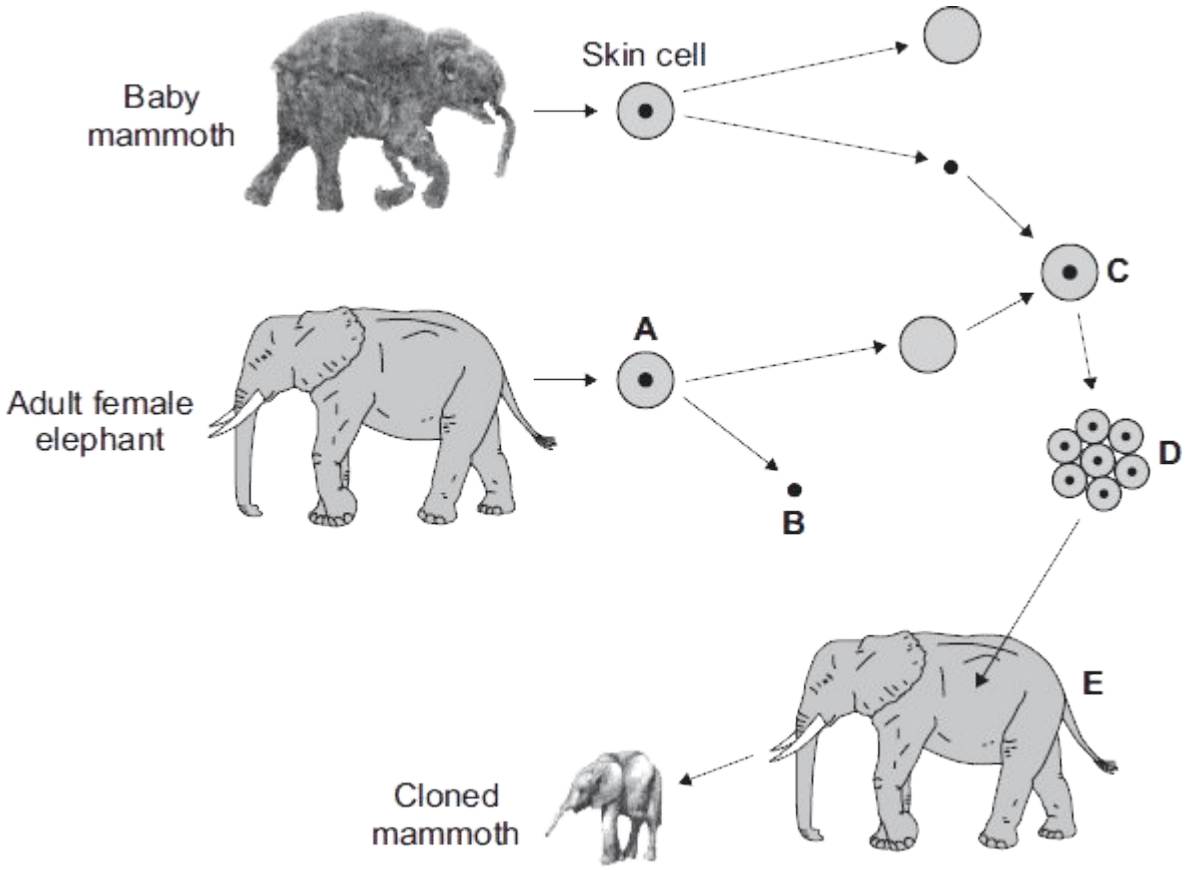
(1)

(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.

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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**.

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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?

_____

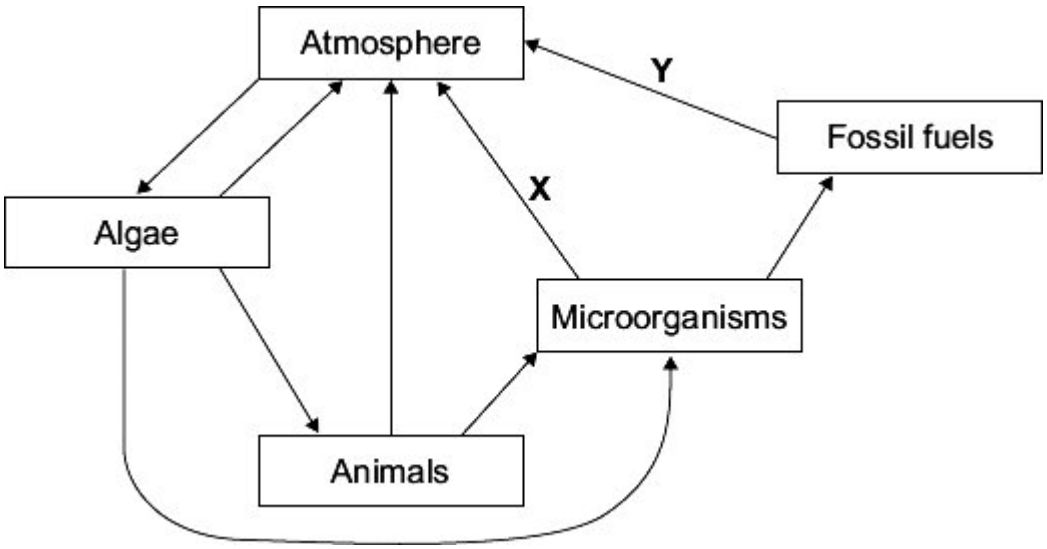
_____

(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.

_____

_____

_____

_____

_____

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_____

(3)

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

Suggest why.

_____

_____

_____

_____

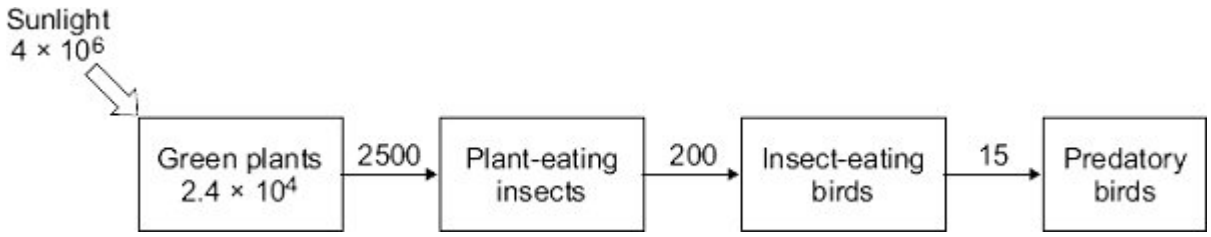
(2)

(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.

_____

_____

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_____

_____

(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)

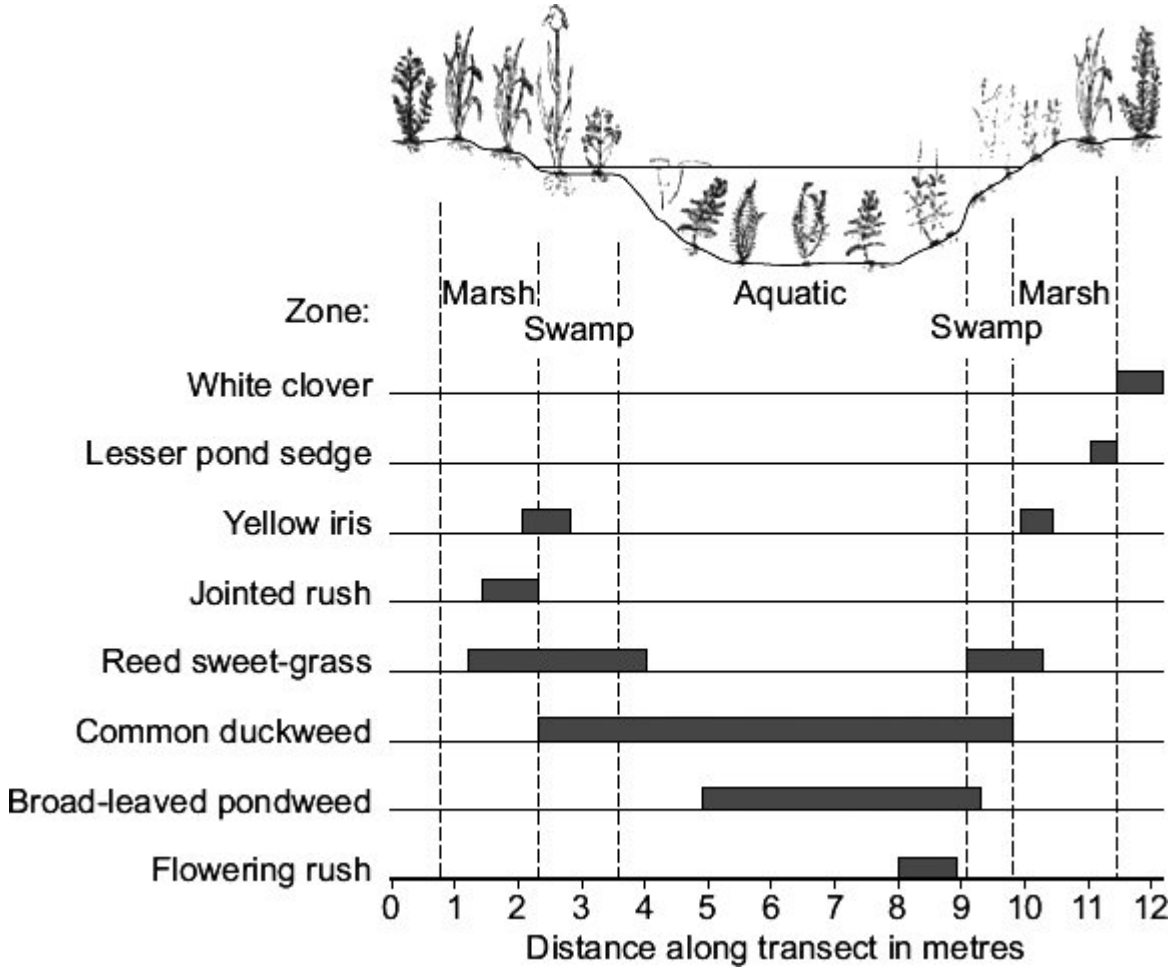
(Total 7 marks)

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.

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(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.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

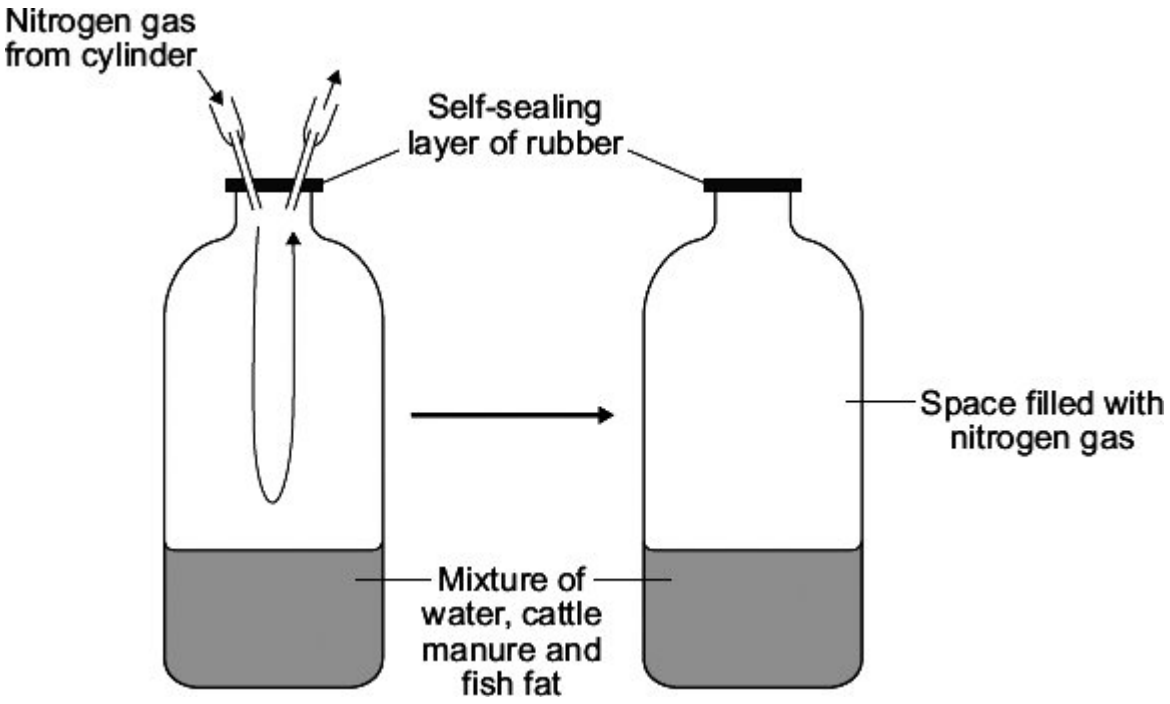
Q26.

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.

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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

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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.

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	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.

Plants use carbon dioxide in the process of

decomposition.

photosynthesis.

respiration.

(1)

(Total 5 marks)

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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.



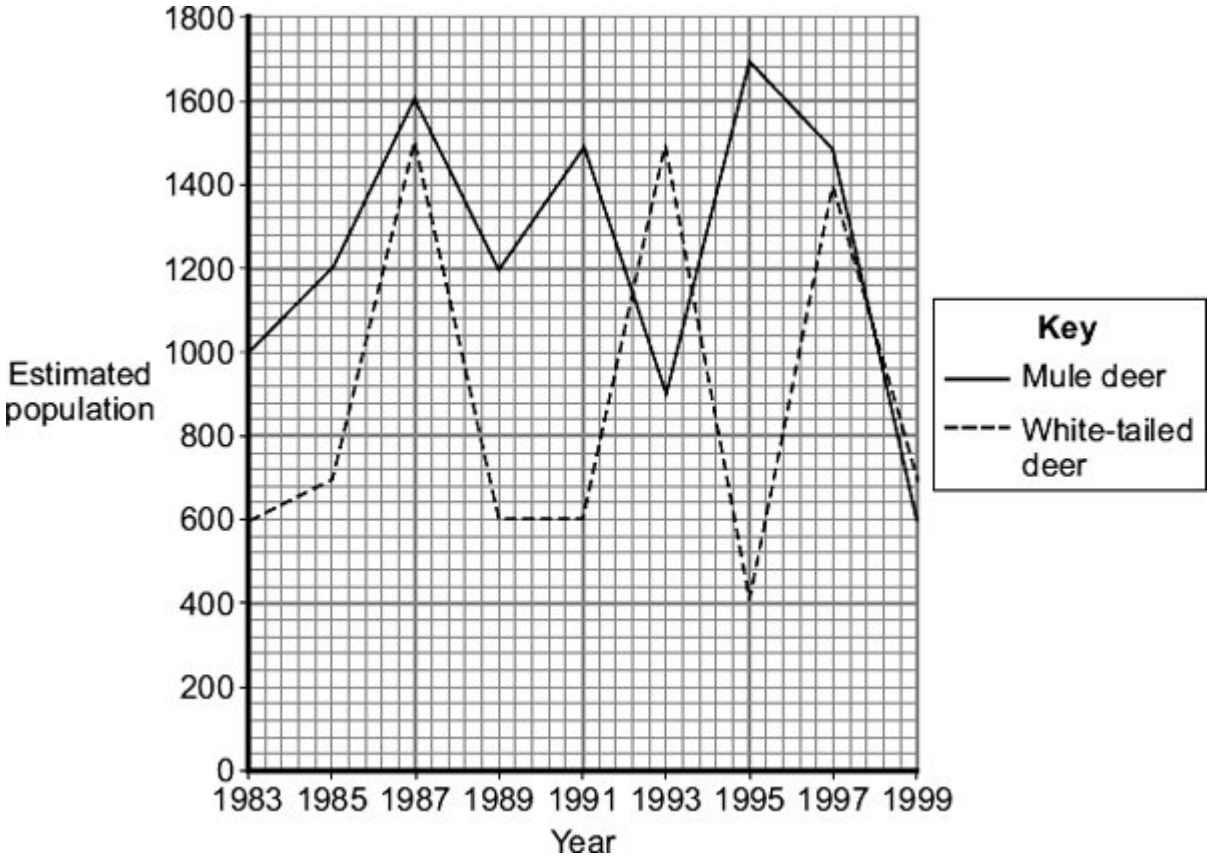
Mule deer **White-tailed deer**

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.

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(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.

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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.

_____

_____

_____

_____

_____

_____

_____

_____

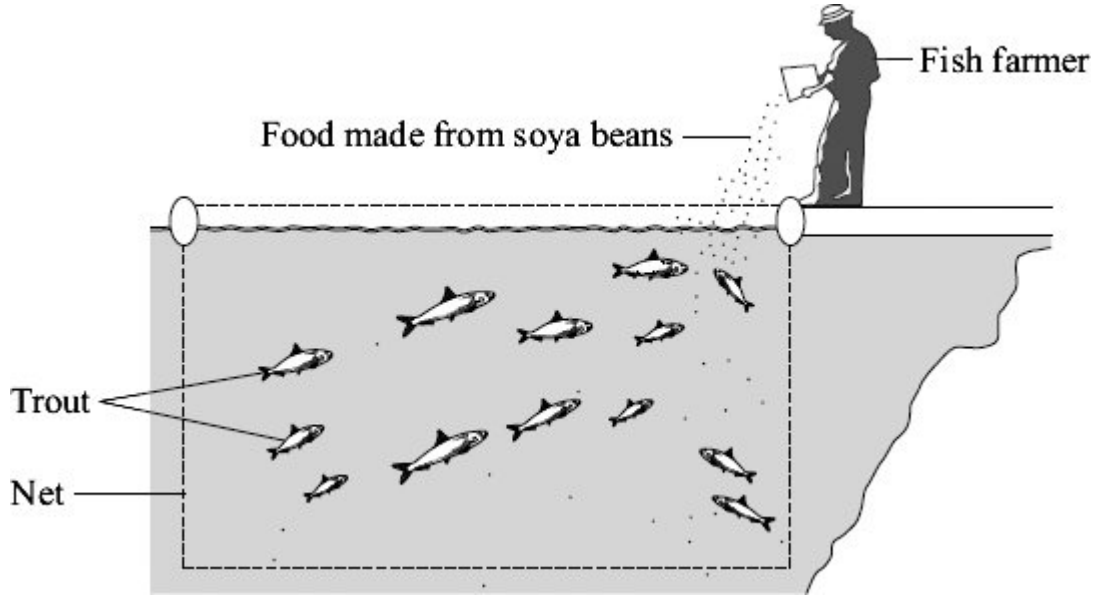
(3)

(Total 5 marks)

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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. ☐

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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.

_____

_____

_____

_____

_____

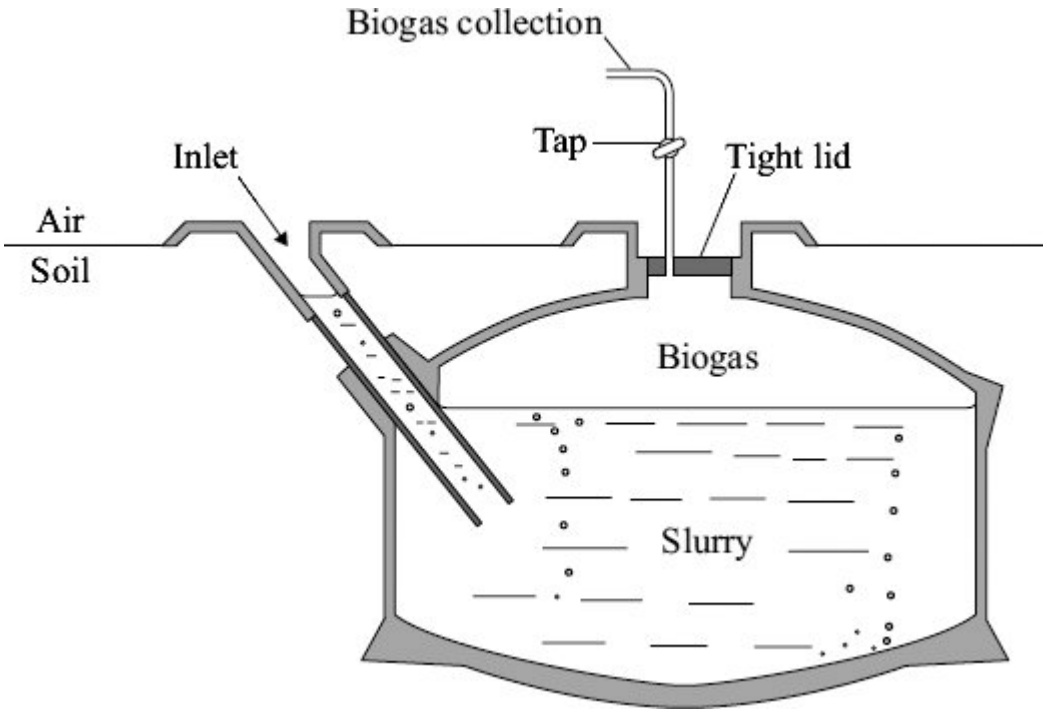
(2)

(Total 7 marks)

Q31.

The diagram shows one type of biogas generator.

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(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

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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.

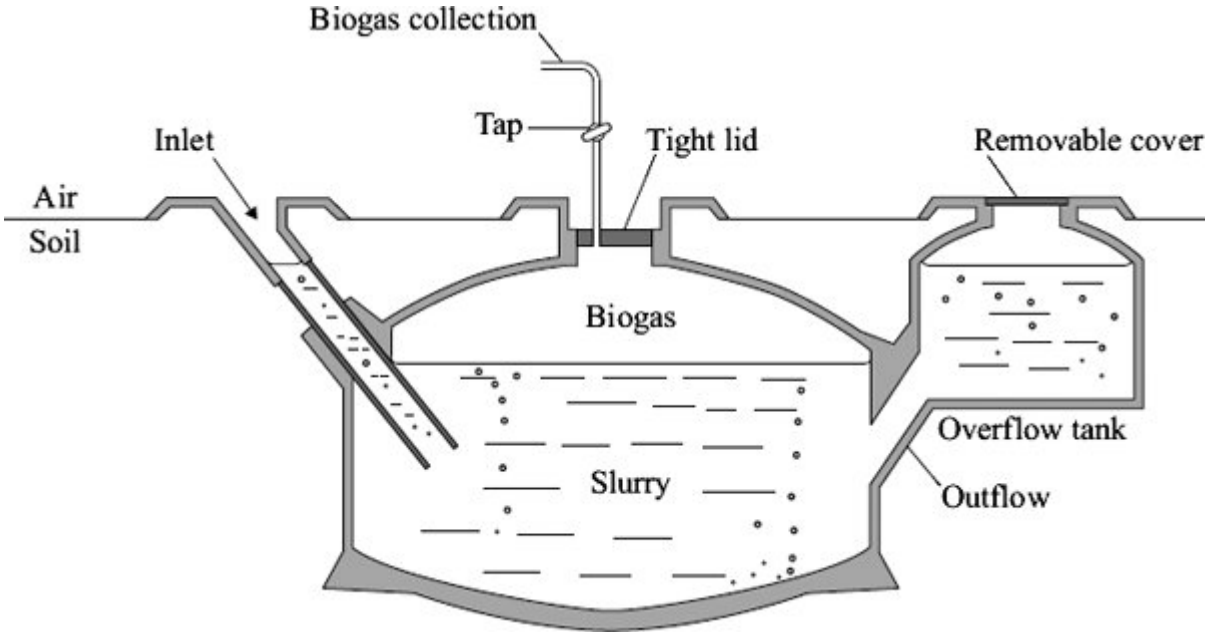
Biogas can be produced from waste materials that contain carbohydrates.

(a) Complete the sentence.

The main fuel gas present in biogas is _____

(1)

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



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(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.

_____

_____

_____

_____

_____

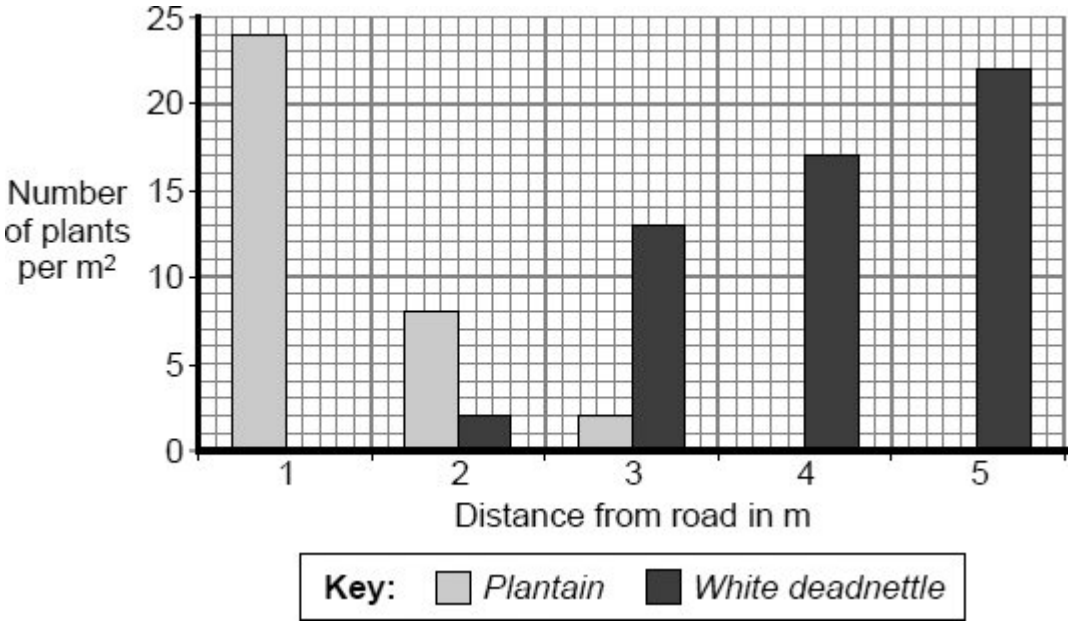
(2)

(Total 6 marks)

Q33.

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

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(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

_____

_____

_____

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_____

_____

(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.

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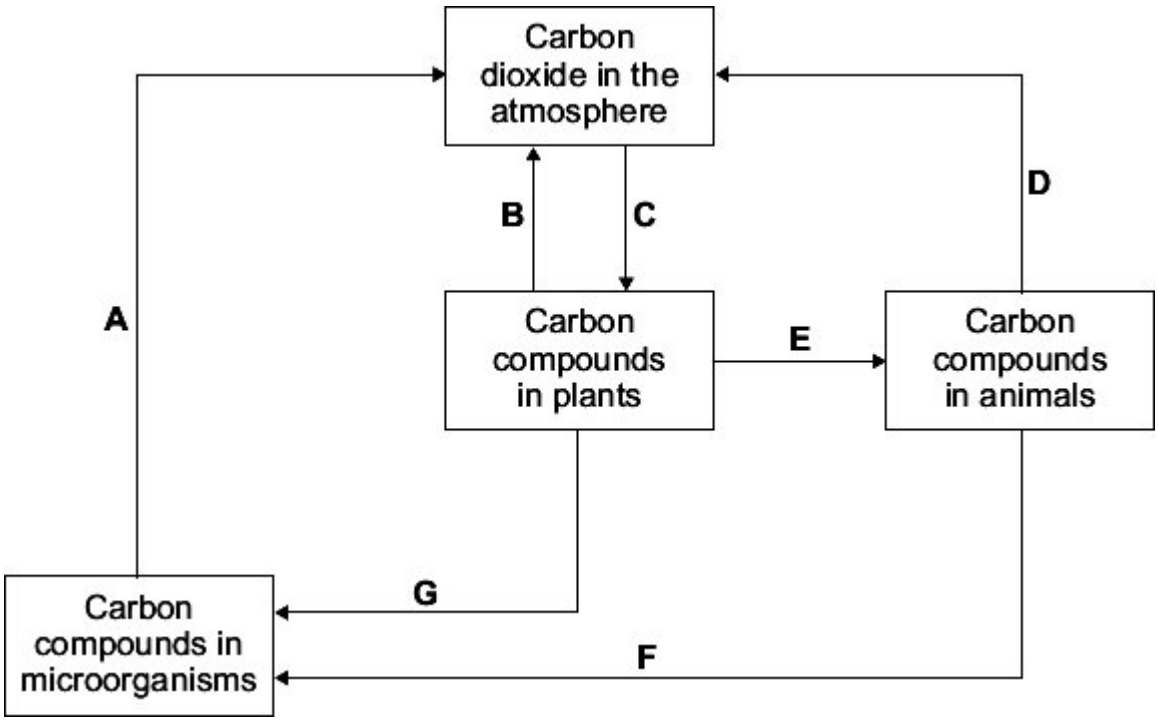
stems.

(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.

_____

_____

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_____

_____

(2)

(Total 5 marks)

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