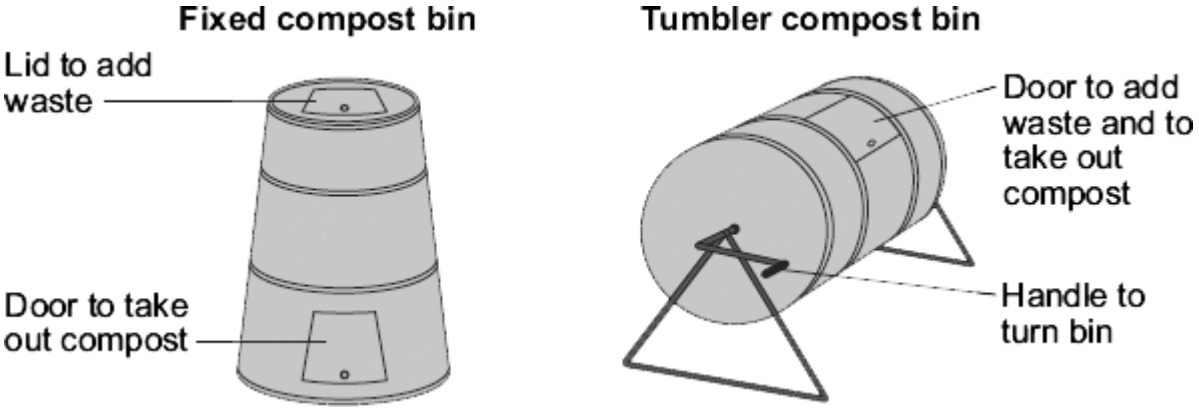
ORGANISATION OF AN ECOSYSTEM PART II

Q1.

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)

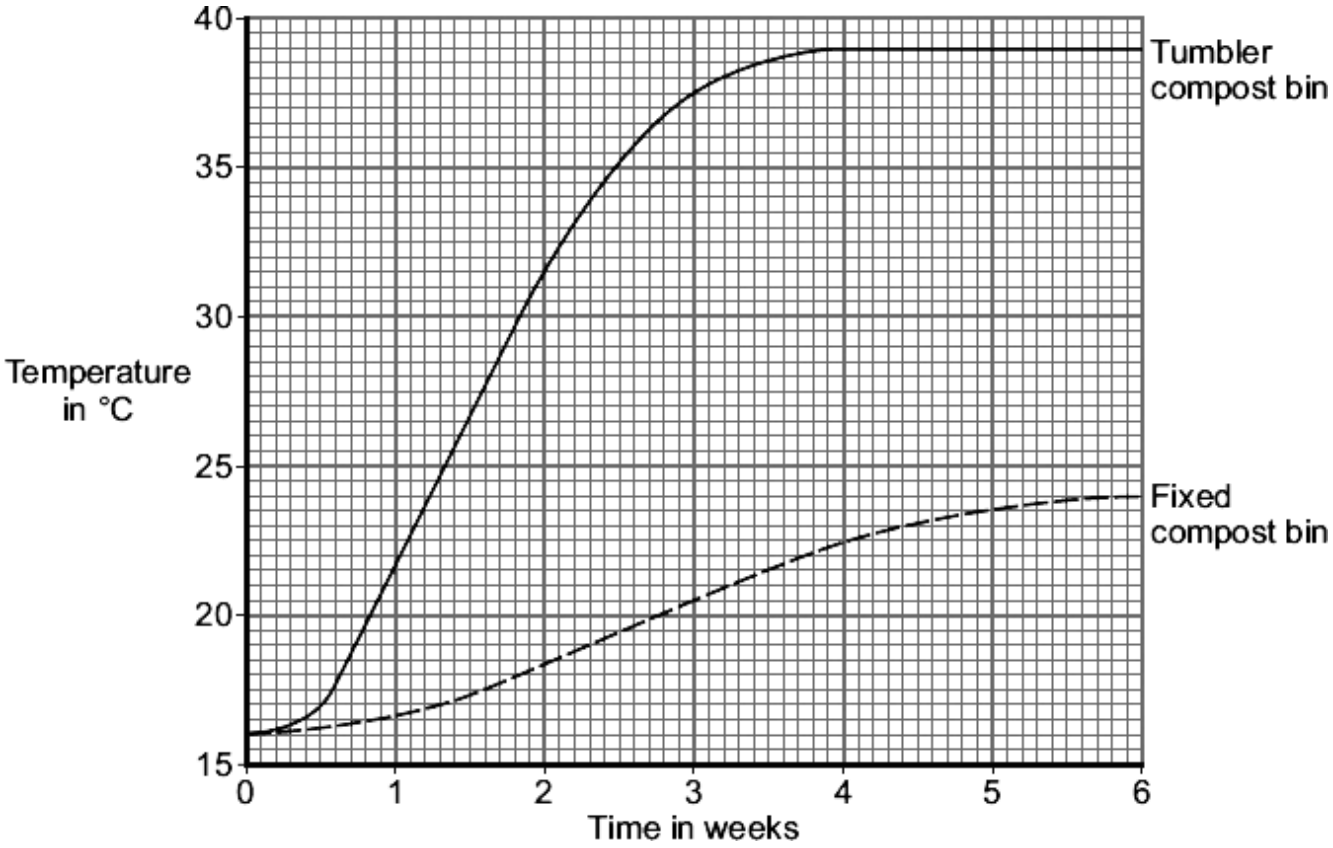
(ii) Give **two** advantages to the gardener of buying a fixed compost bin and not a tumbler compost bin.

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.

_____

_____

_____

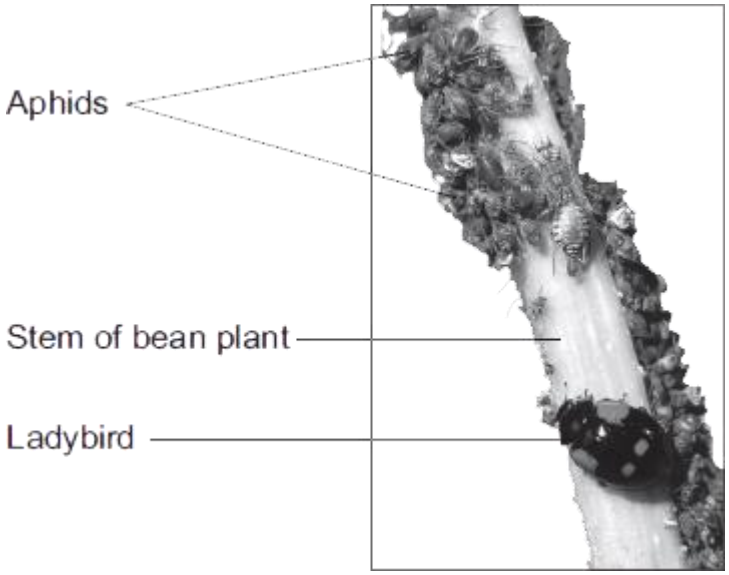
(2)

(Total 9 marks)

Q2.

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.

_____

(4)
(Total 8 marks)

Q3.

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**

_____

_____

_____

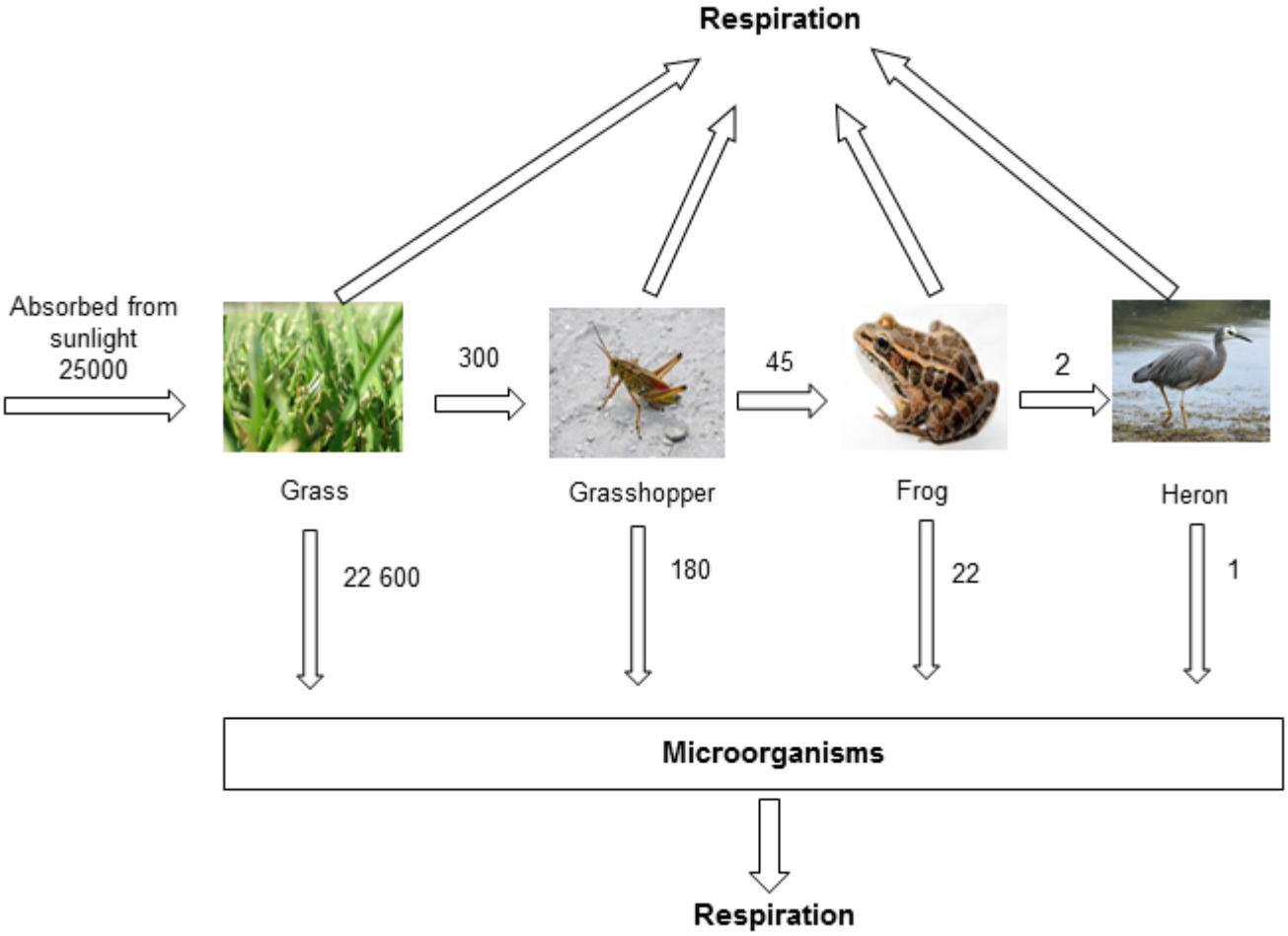
(3)

(Total 3 marks)

Q4.

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)

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.

Q5.

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)

Q6.

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)

Q7.

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

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?

_____

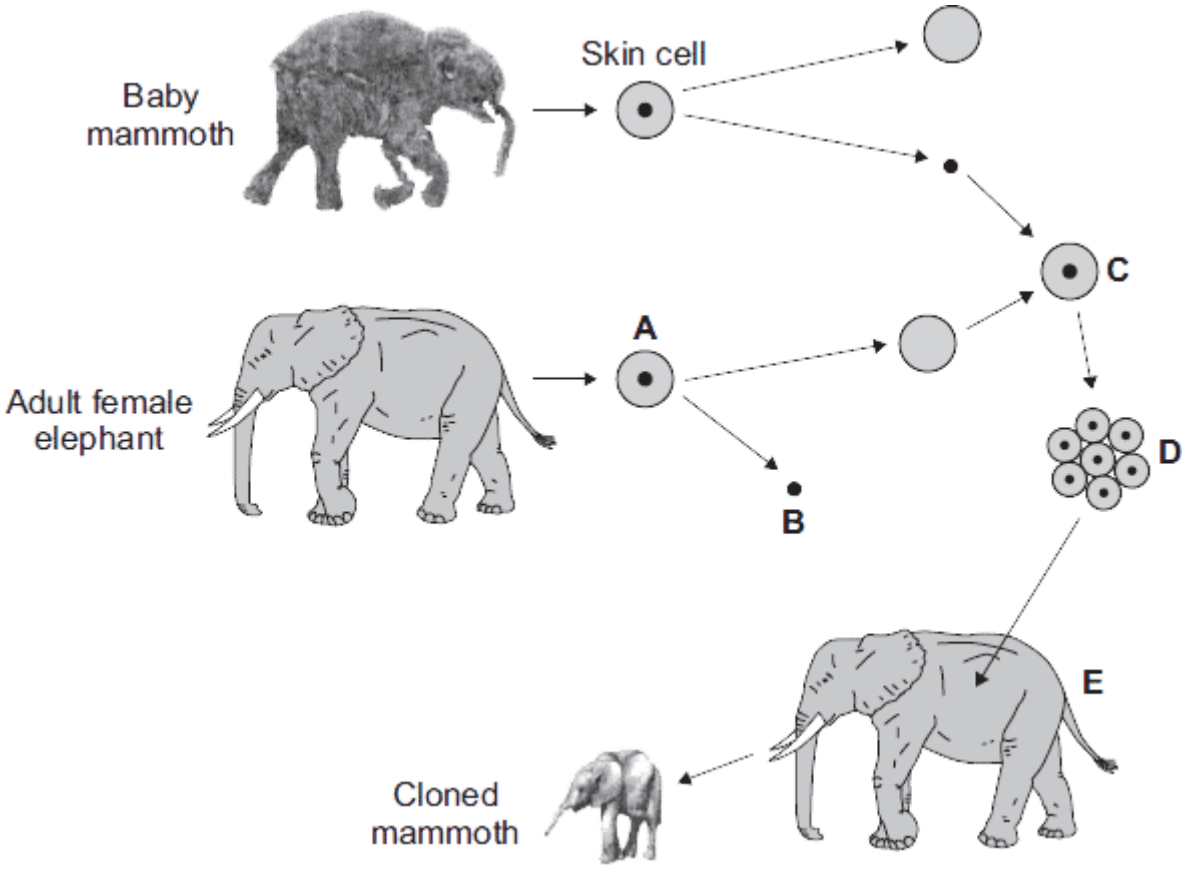
_____

(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.



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?

_____

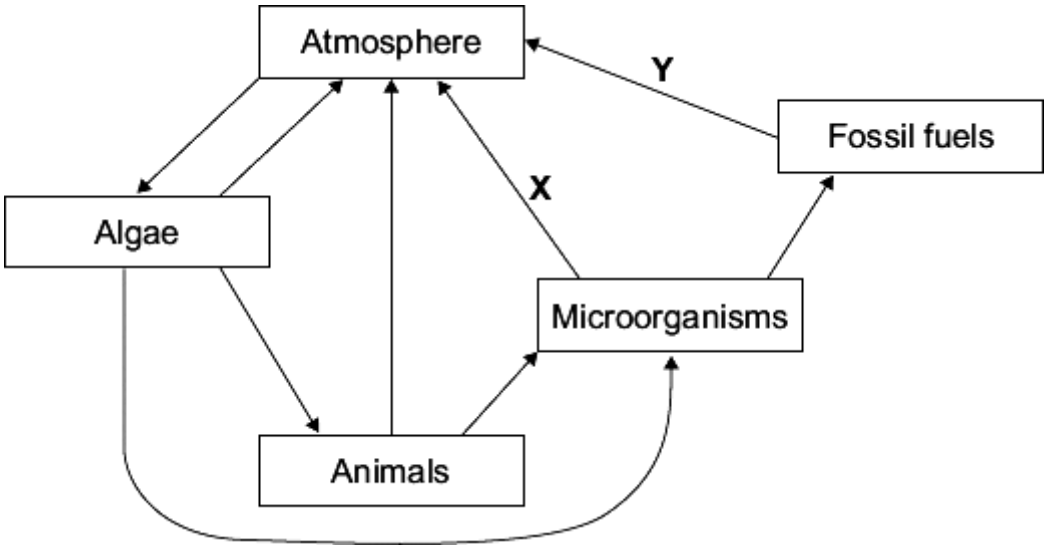
_____

(1)

(Total 8 marks)

Q8.

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.

_____

_____

_____

_____

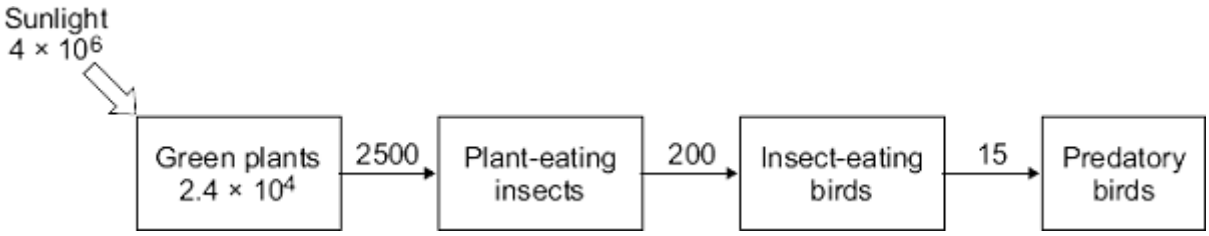
(2)

(Total 7 marks)

Q9.

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.

_____

_____

_____

_____

_____

_____

_____

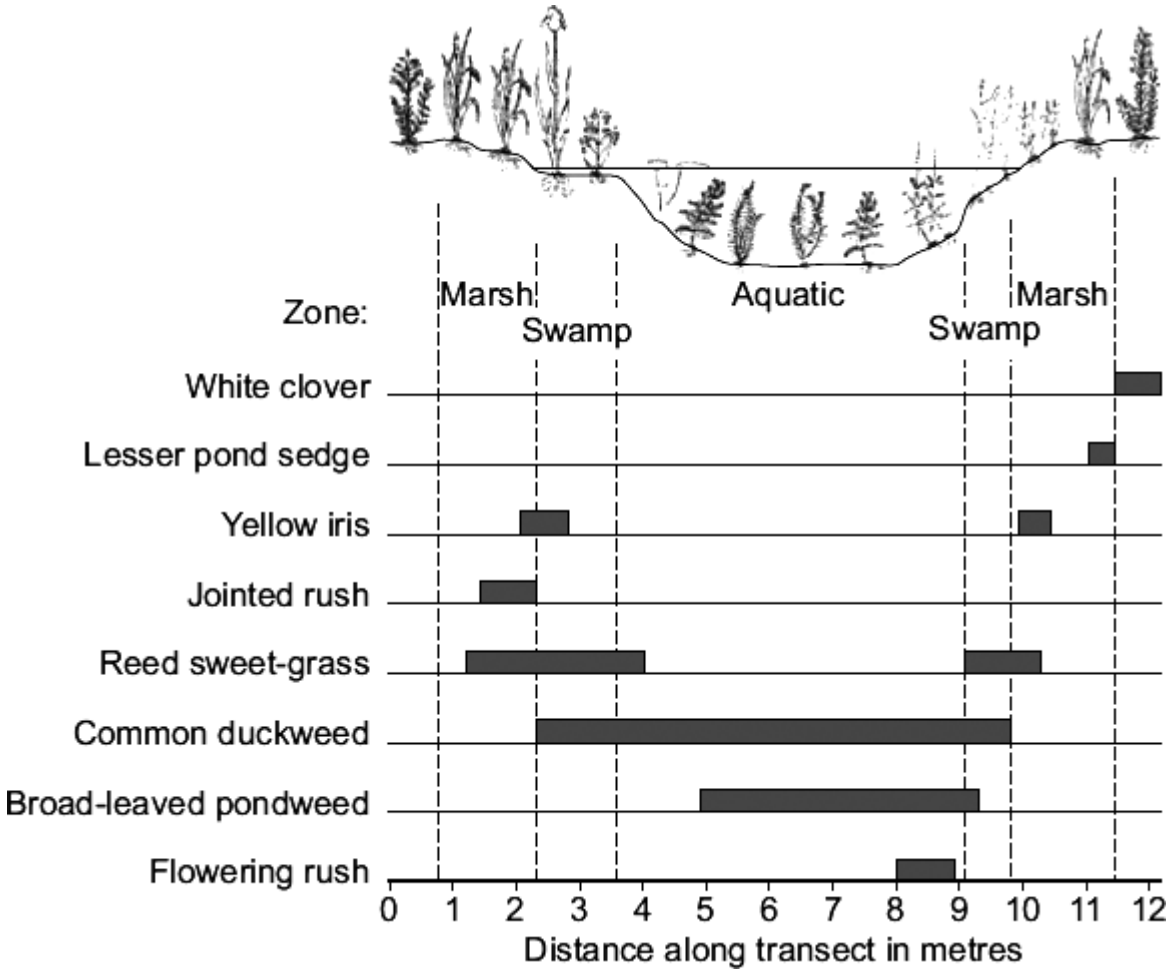
(3)

(Total 7 marks)

Q10.

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)

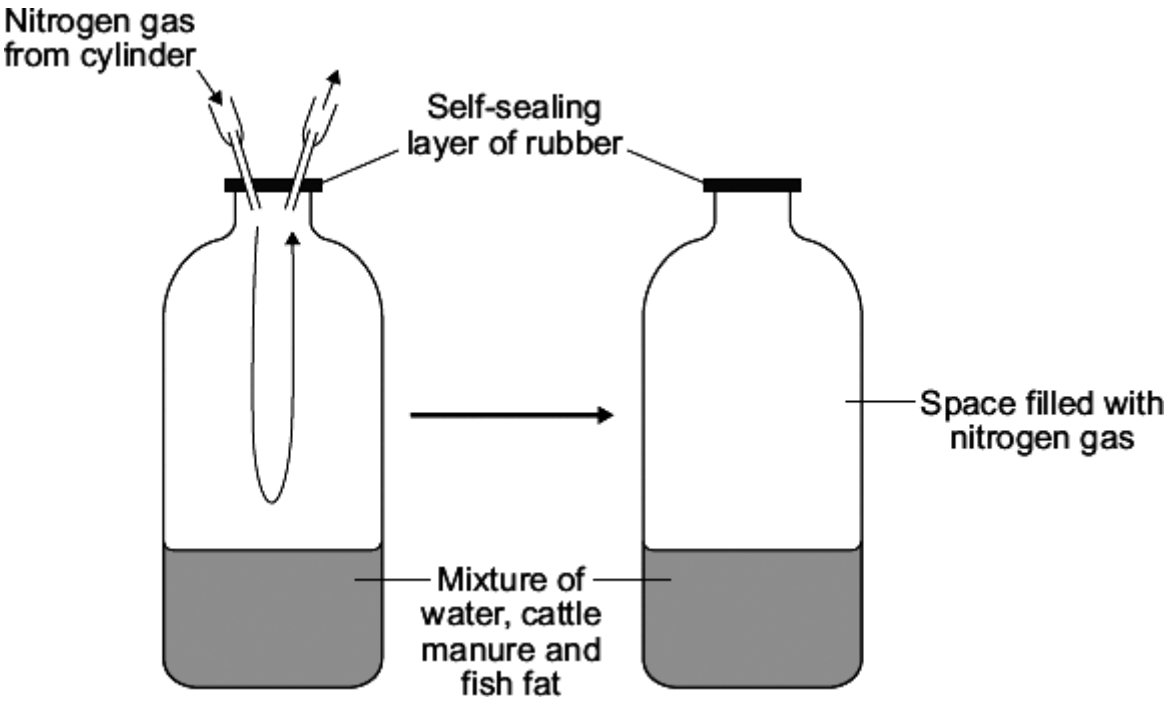
(Total 9 marks)

Q11.

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	999	630	0.63

+ 10 % fish fat			

(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)

Q12.

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.

Plants use carbon dioxide in the process of

decomposition.
photosynthesis.
respiration.

(1)

(Total 5 marks)

Q13.

Animals in a habitat compete with each other.

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

1. _____

2. _____

(2)

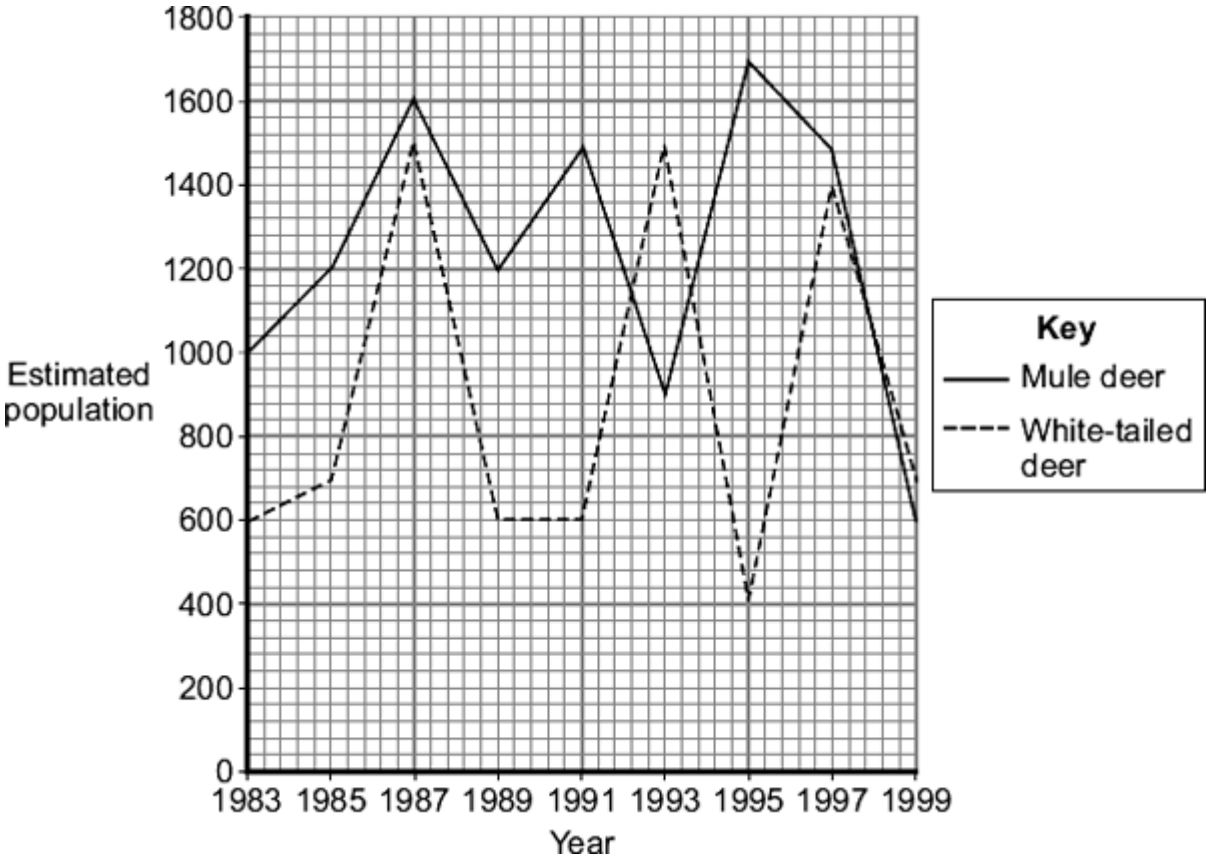
(b) The photographs show a mule deer and a white-tailed deer.

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)

Q14.

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.

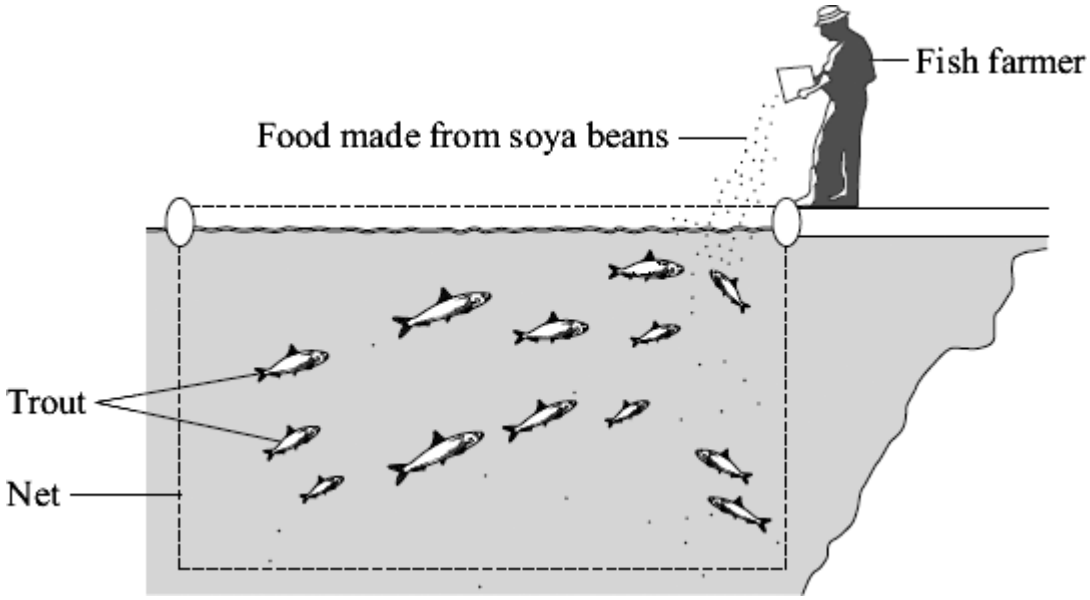
Explain why as fully as you can.

You should include references to the data in your answer.

(3)
(Total 5 marks)

Q15.

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.

_____

_____

_____

_____

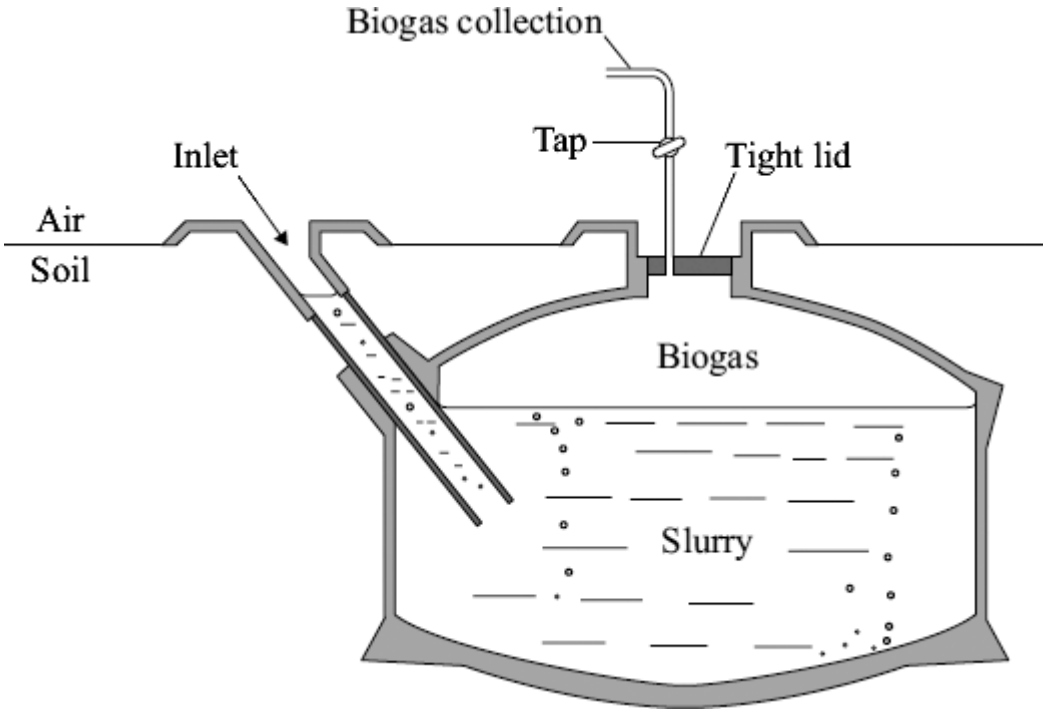
_____

(2)

(Total 7 marks)

Q16.

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)

Q17.

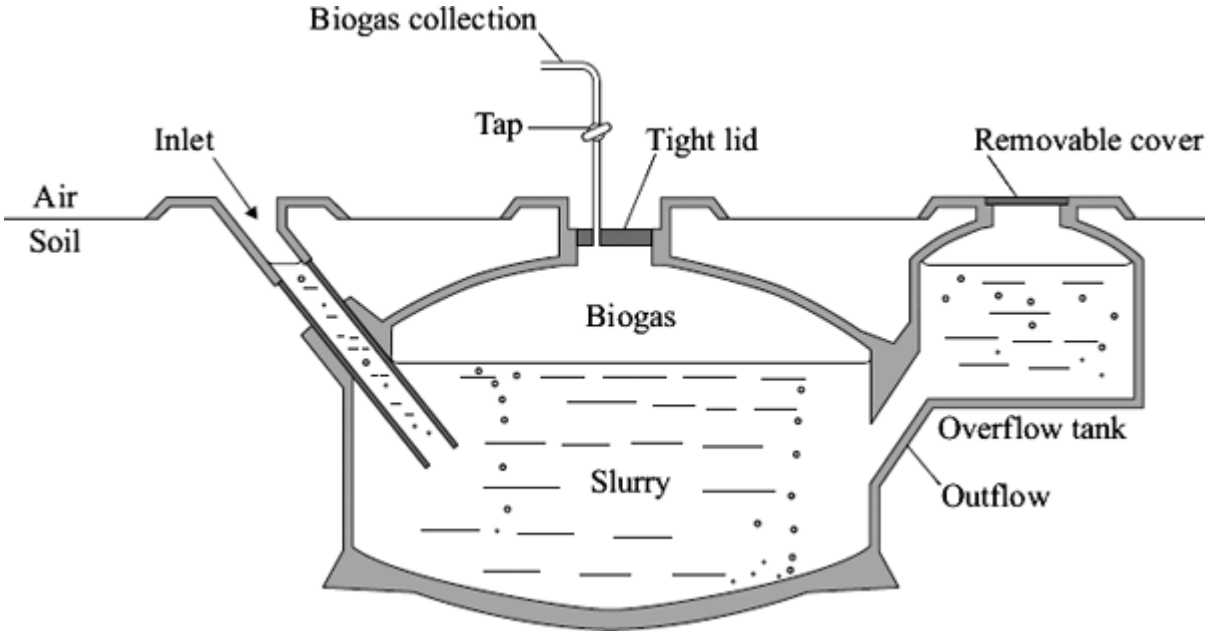
Biogas can be produced from waste materials that contain carbohydrates.

(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.

_____

_____

_____

_____

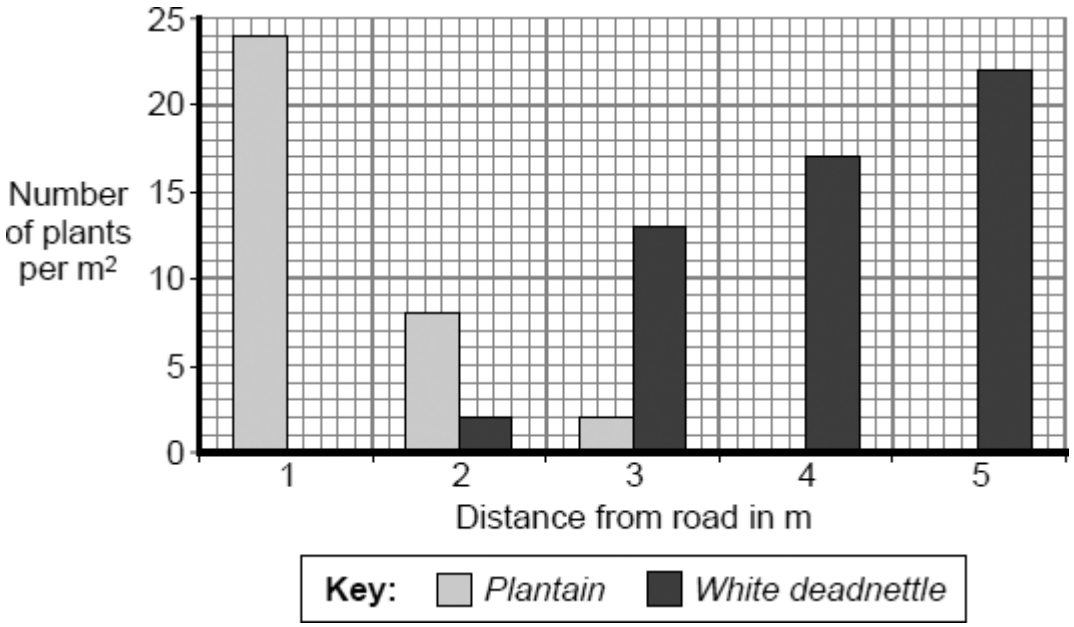
_____

(2)

(Total 6 marks)

Q18.

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)

Q19.

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

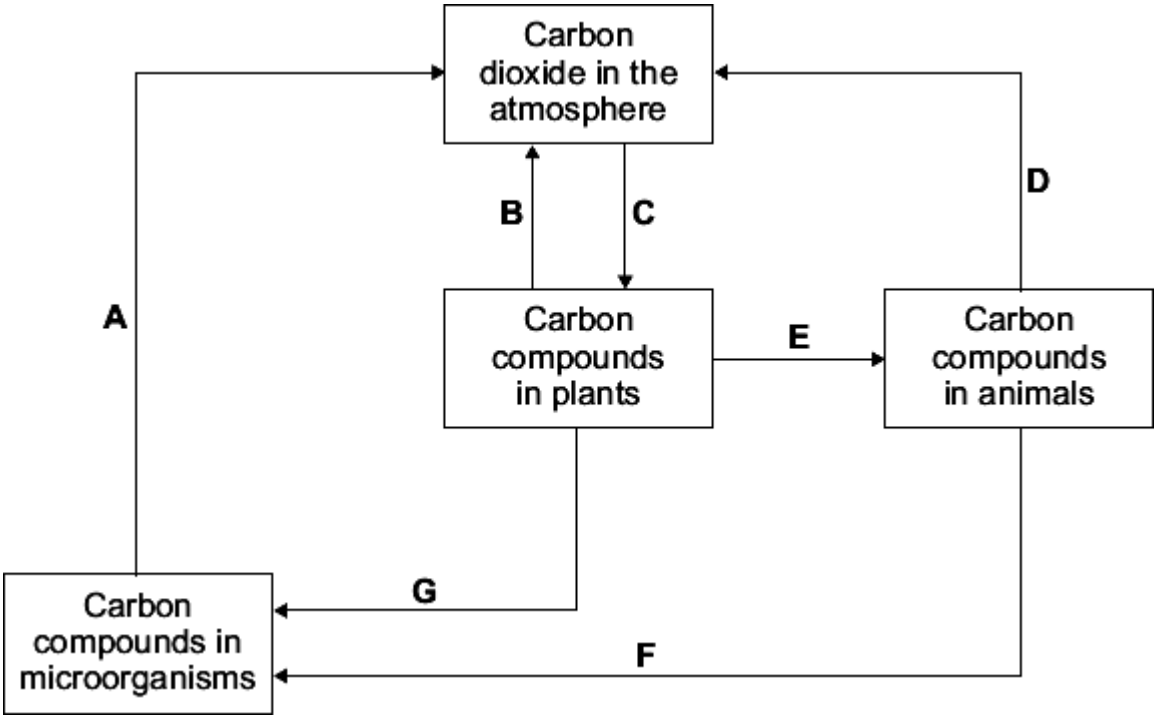
leaves.
roots.
stems.

(1)

(Total 4 marks)

Q20.

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.

_____

_____

_____

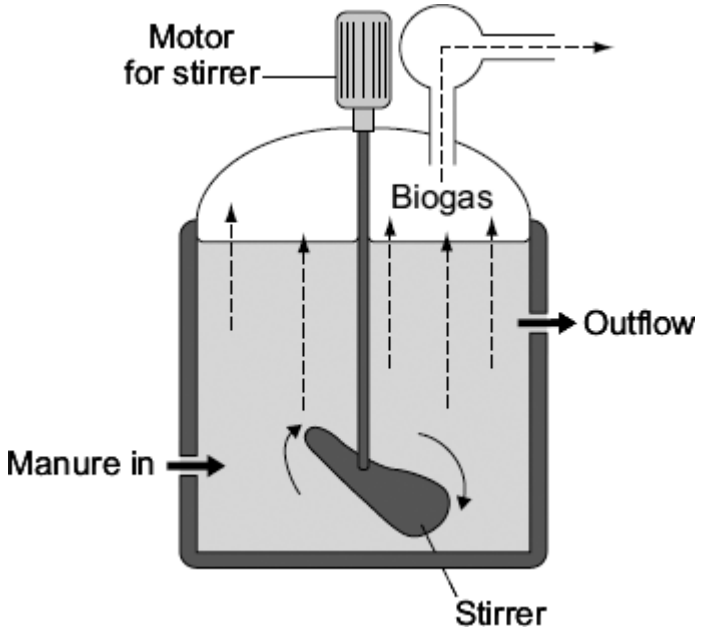
_____

(2)

(Total 5 marks)

Q21.

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.

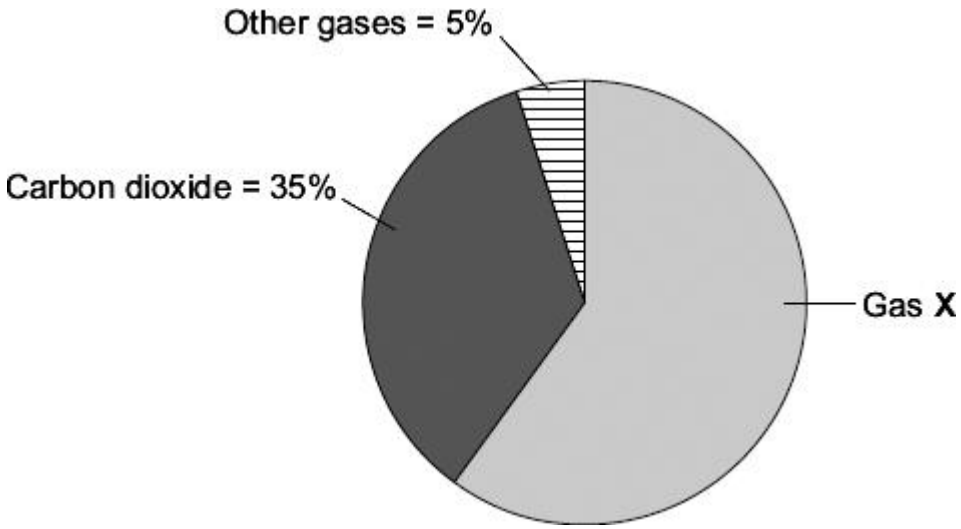
A higher concentration contains too little oxygen. ☐

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

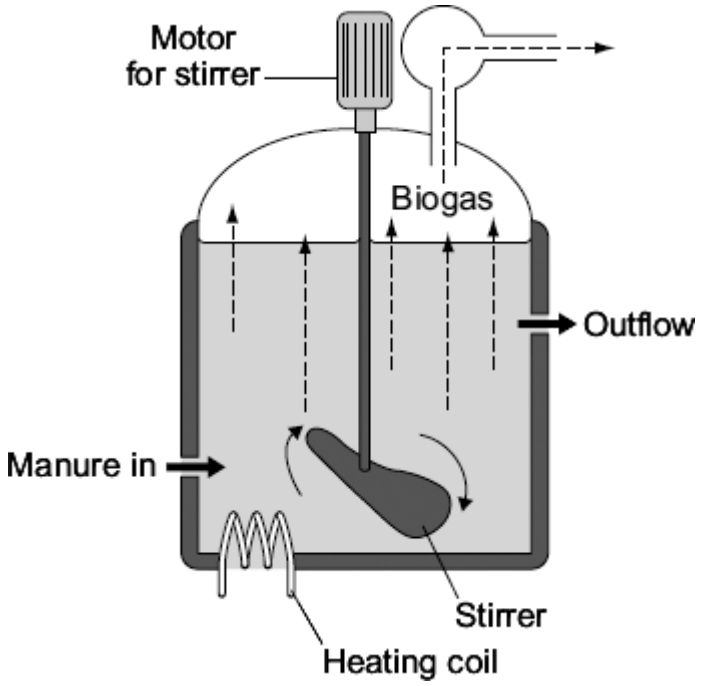
ammonia.
nitrogen.
oxygen.

(1)

(Total 6 marks)

Q22.

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.

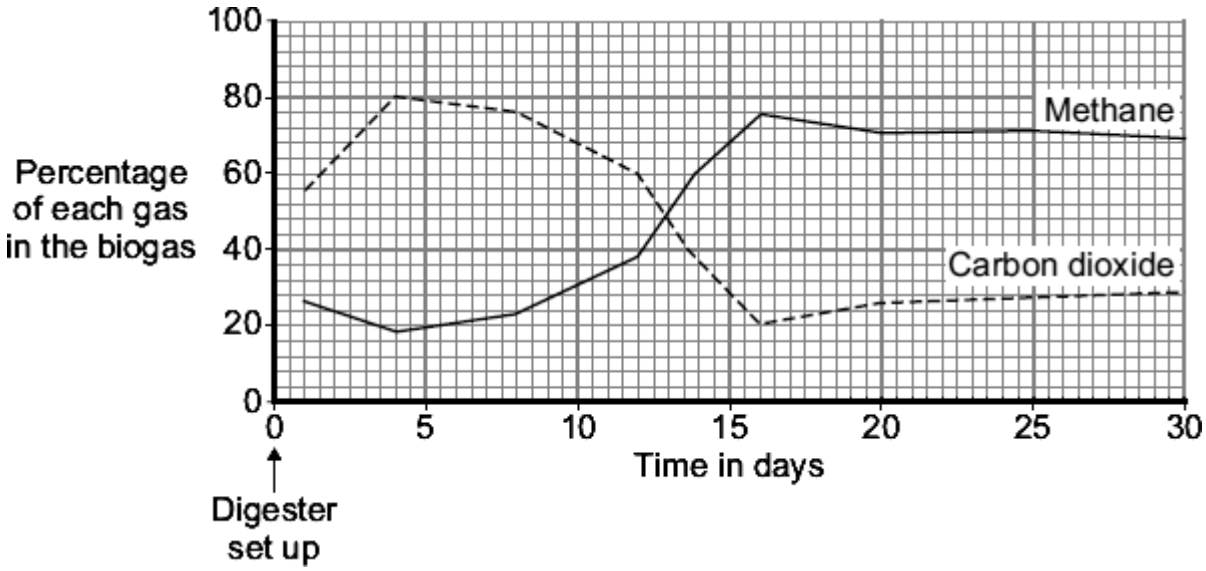
Suggest **one** reason why.

_____

_____

(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.

_____

_____

_____

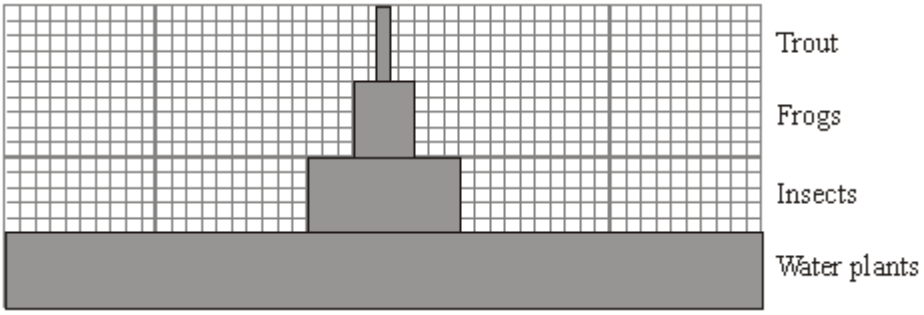
_____

(2)

(Total 9 marks)

Q23.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

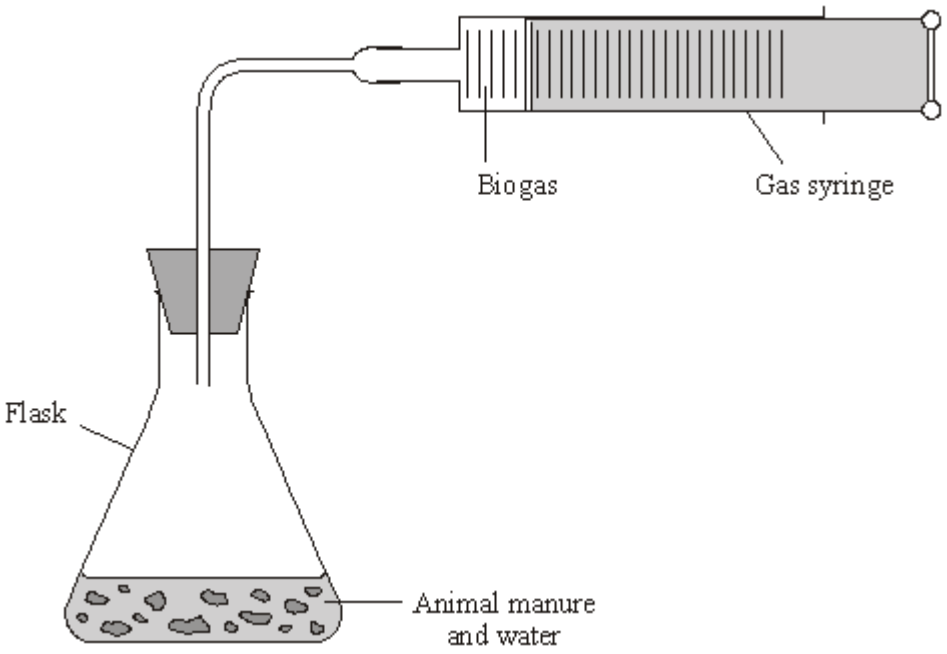
(4)

(Total 9 marks)

Q24.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

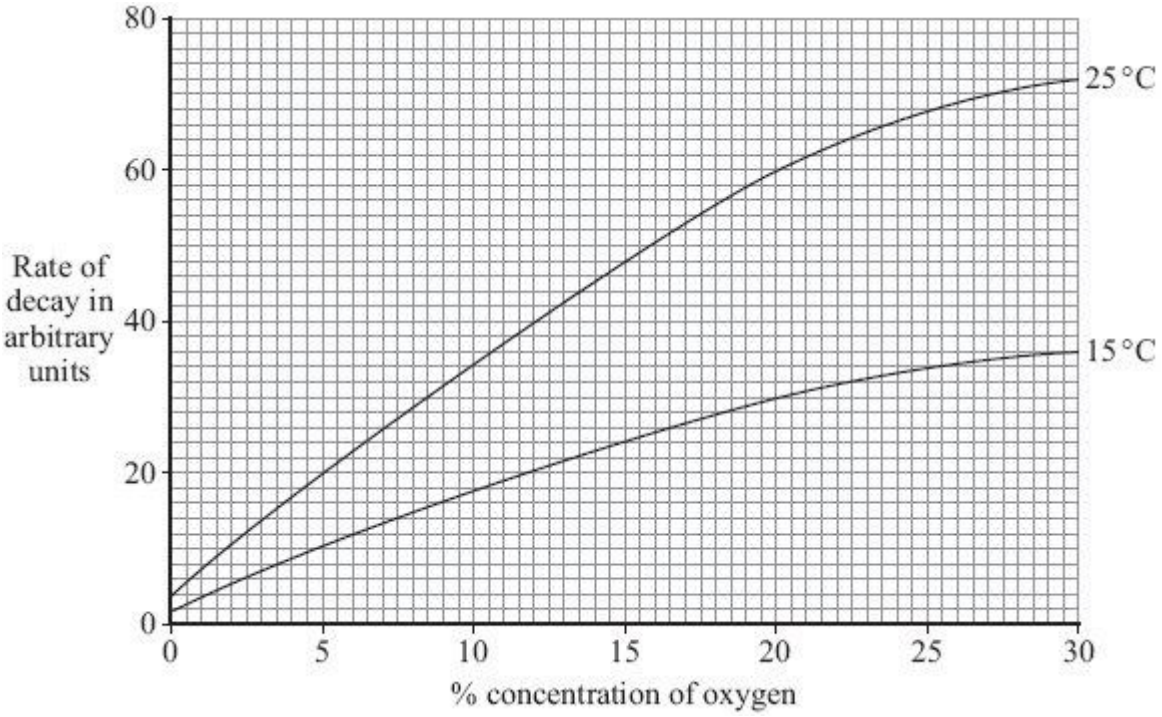
(4)

(Total 5 marks)

Q25.

Gardeners often put waste materials onto compost heaps.

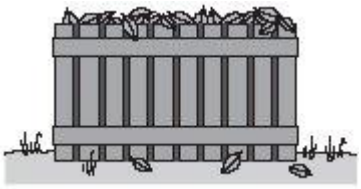
The graph shows how the conditions in a compost heap affect how quickly waste materials in the heap decay.



(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)

Q26.

(a) Name the fuel gas present in biogas.

_____

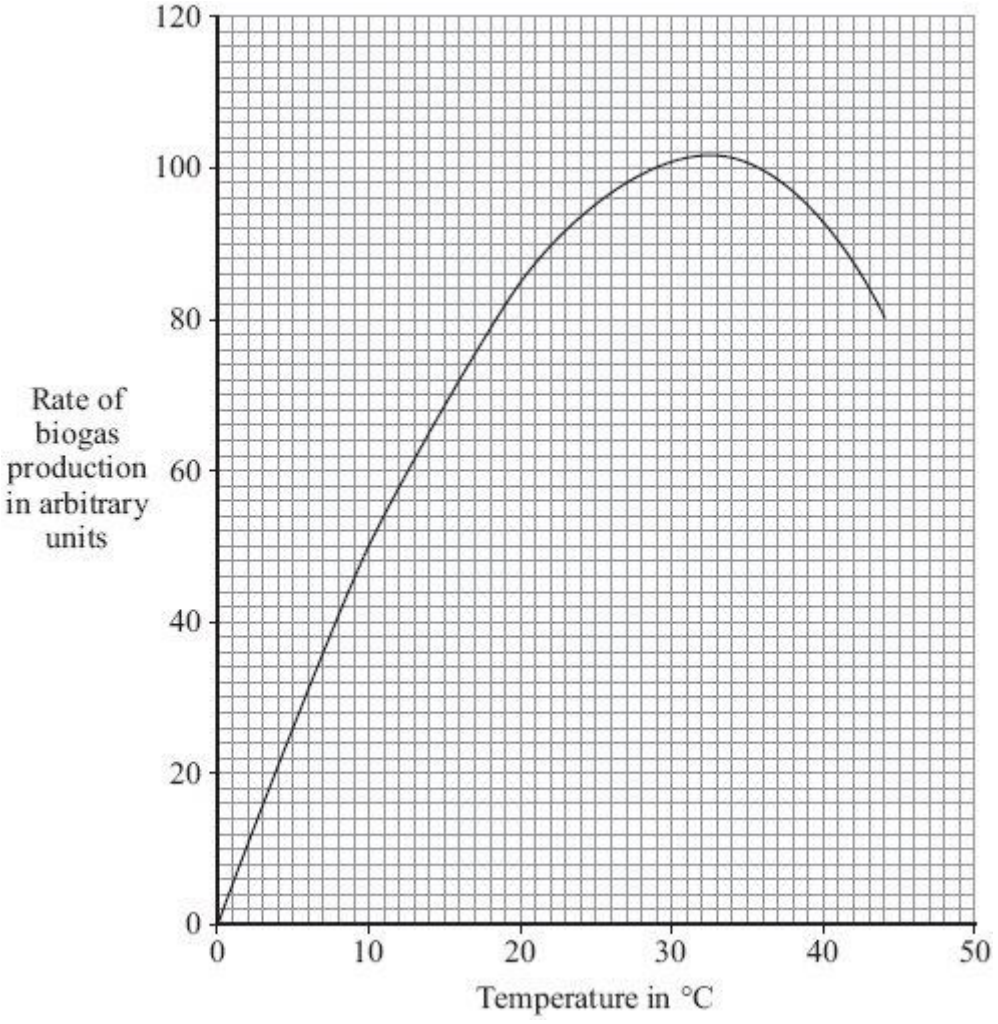
(1)

(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.

_____

_____

_____

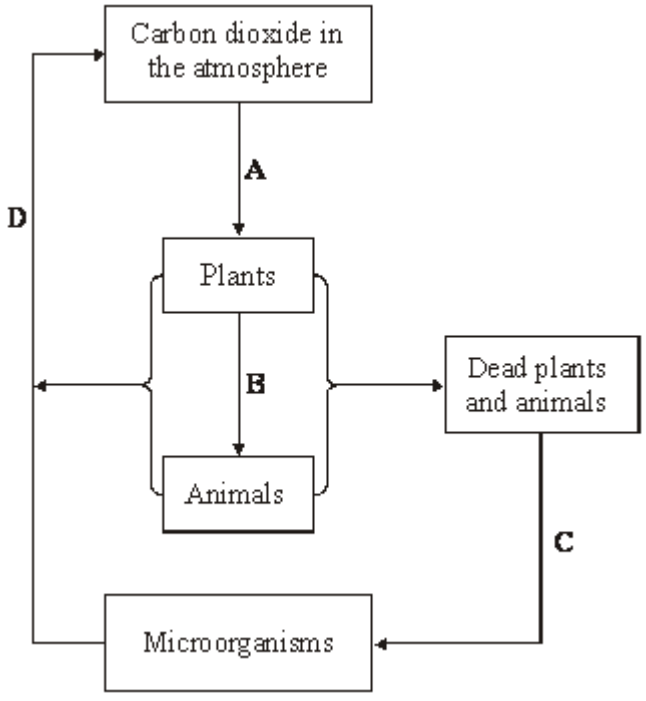
_____

(2)

(Total 7 marks)

Q27.

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)

Q28.

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.

_____

_____

_____

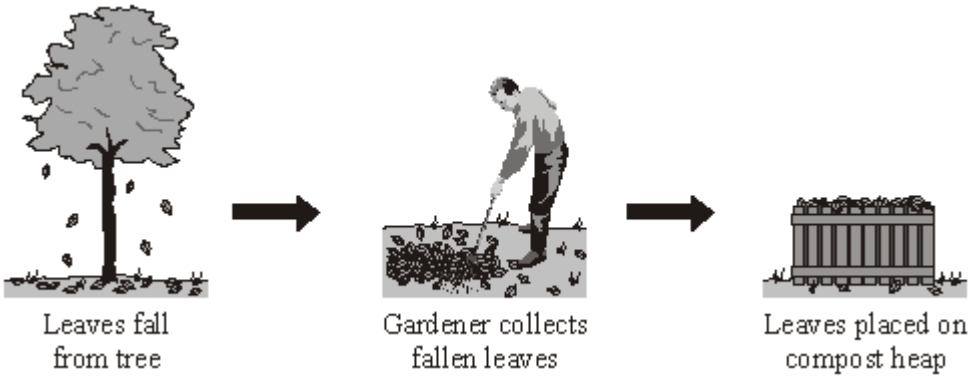
_____

(2)

(Total 6 marks)

Q29.

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 ☐

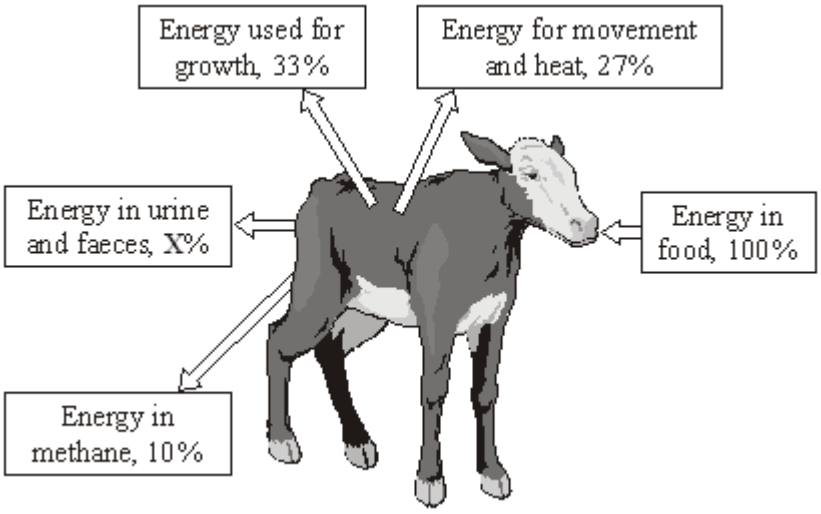
Nitrogen ☐

Oxygen ☐

(1)
(Total 3 marks)

Q30.

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?

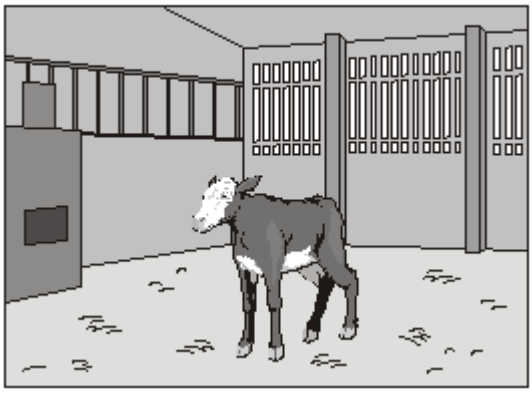
_____

(1)

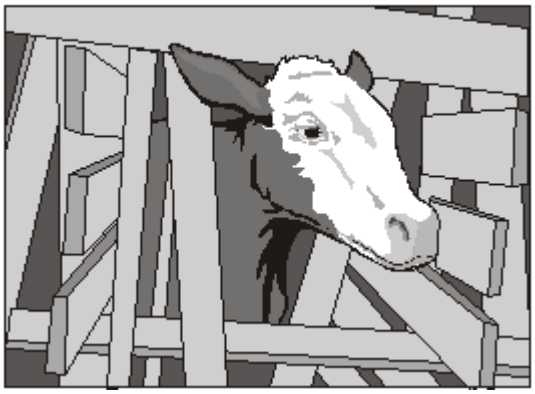
(d) The pictures show two methods of raising calves indoors.

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.

_____

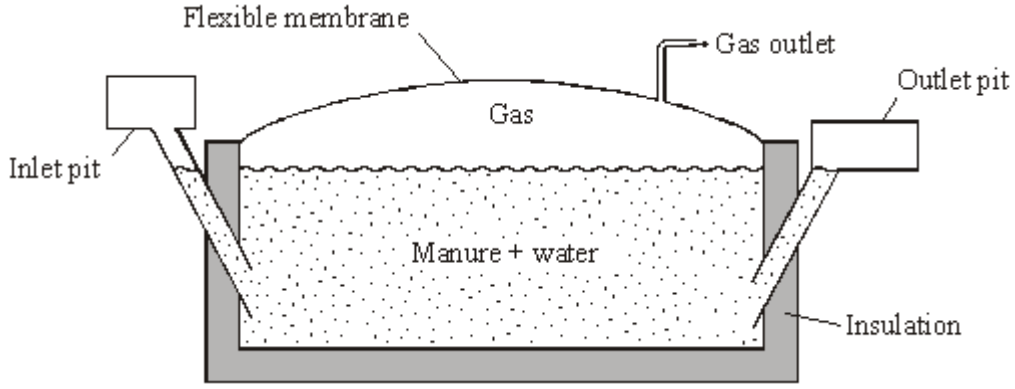
_____

(1)

(Total 7 marks)

Q31.

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)

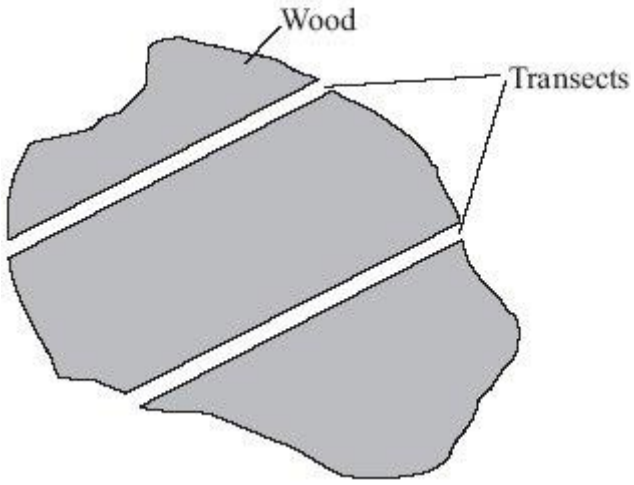
Q32.

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.

_____

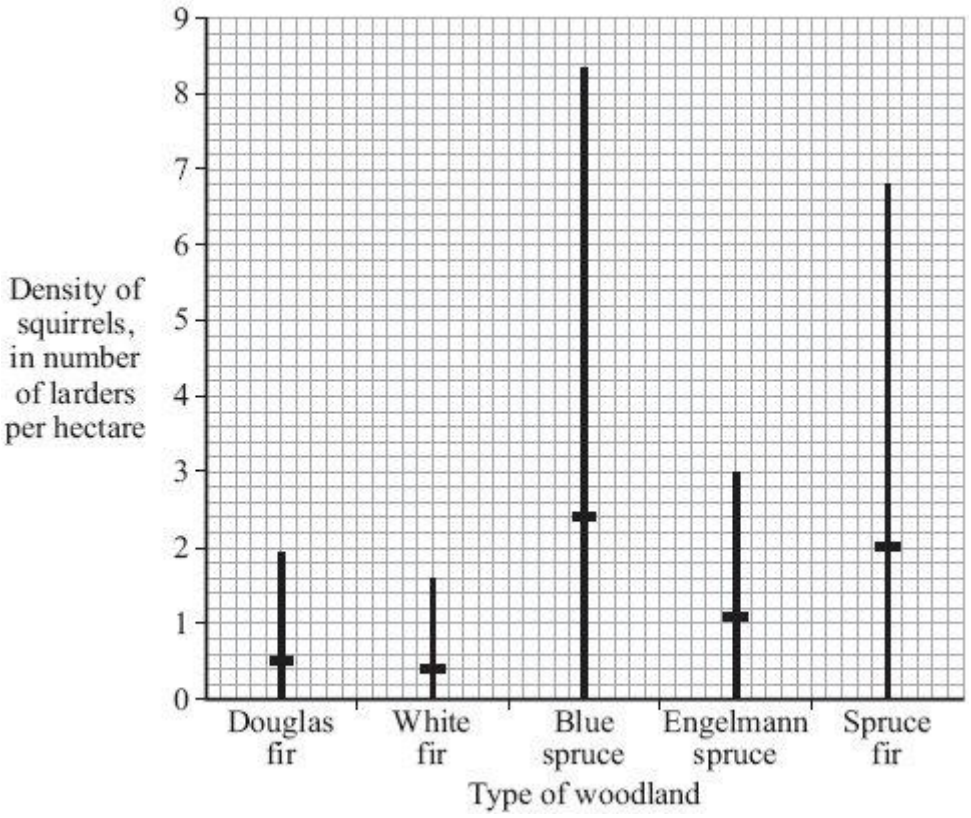
_____

_____

_____

(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.

_____

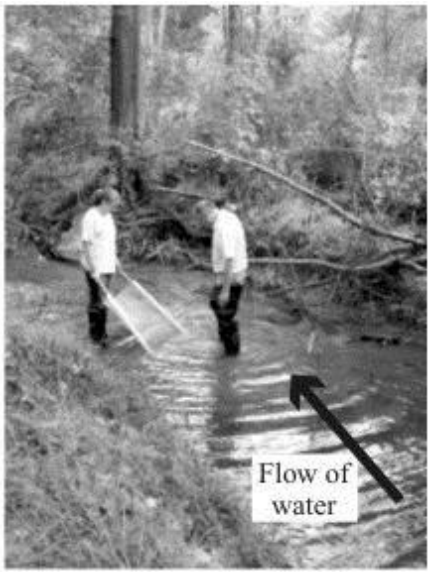
_____

(1)

(Total 8 marks)

Q33.

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. _____

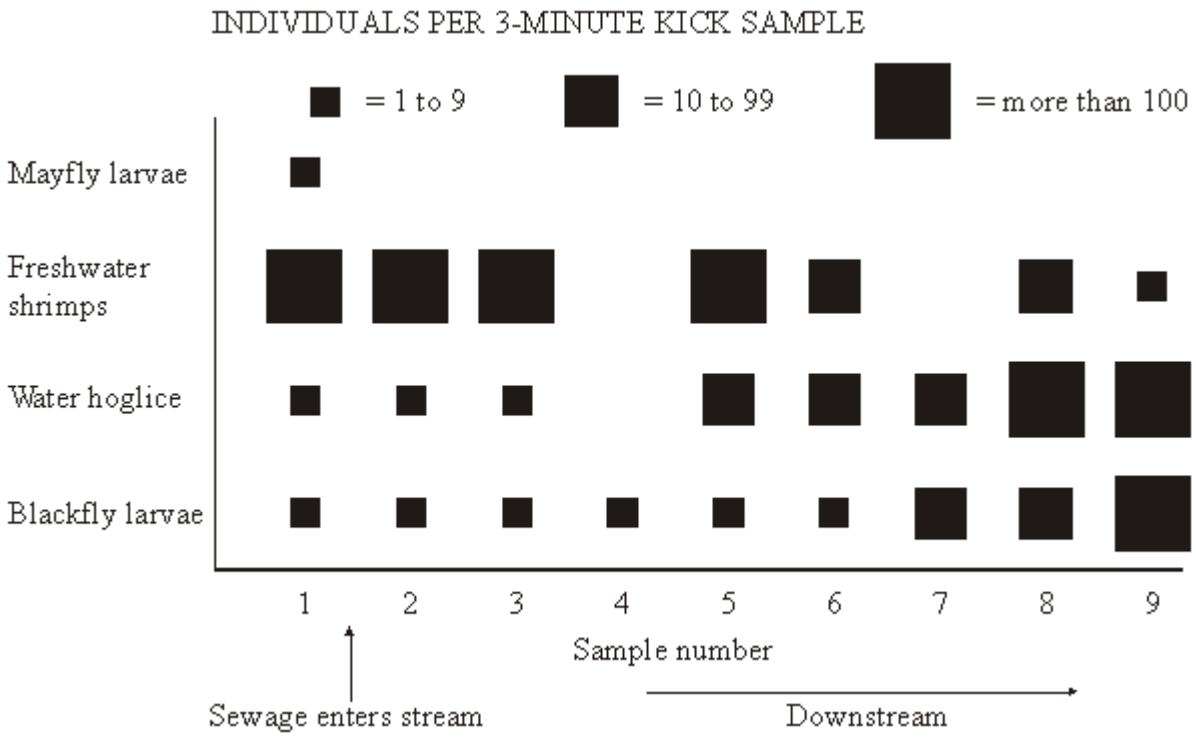
_____

(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)

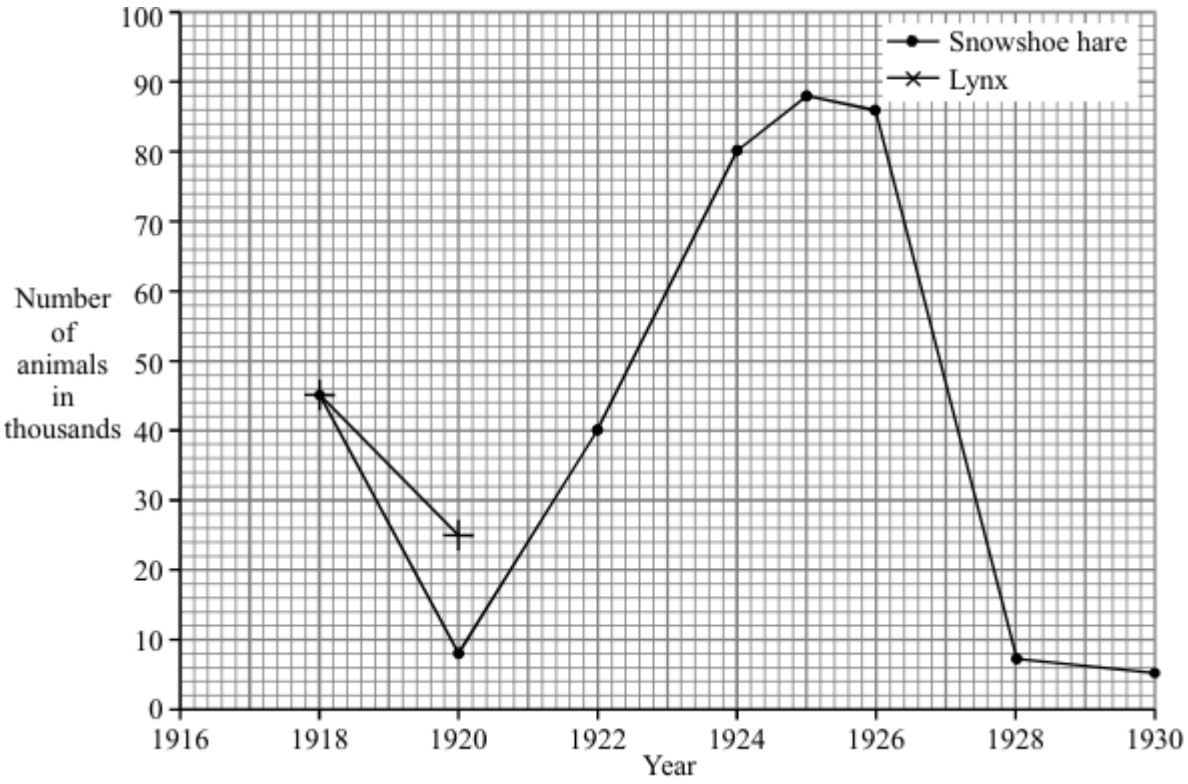
(Total 9 marks)

Q34.

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?

_____

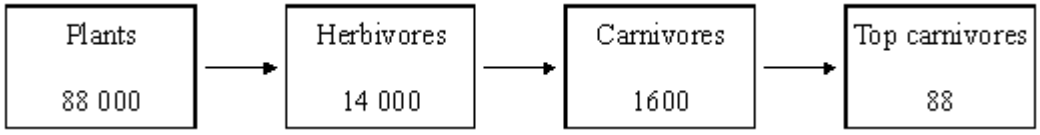
_____

(1)

(Total 6 marks)

Q35.

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.



(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)

Q36.

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 _____

_____

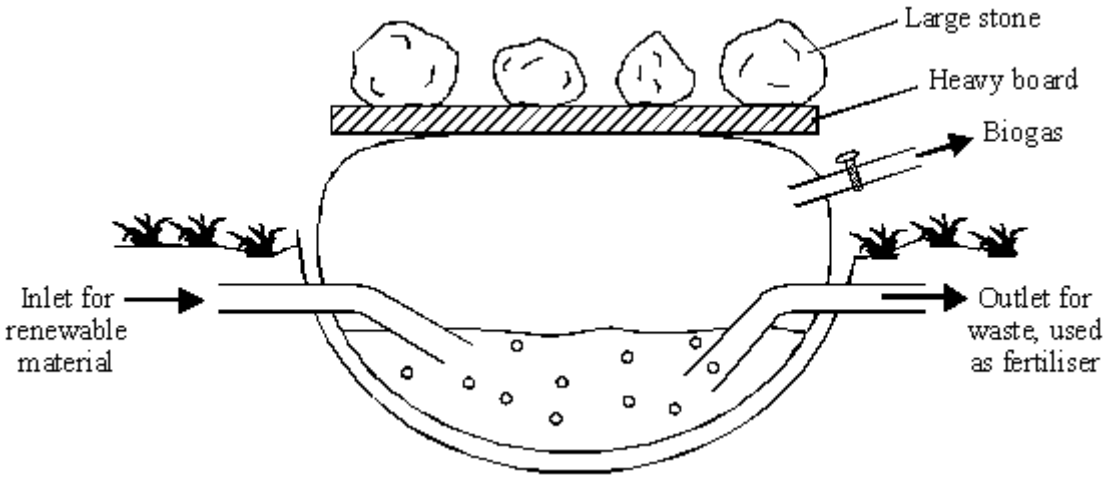
1970 _____

_____

(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

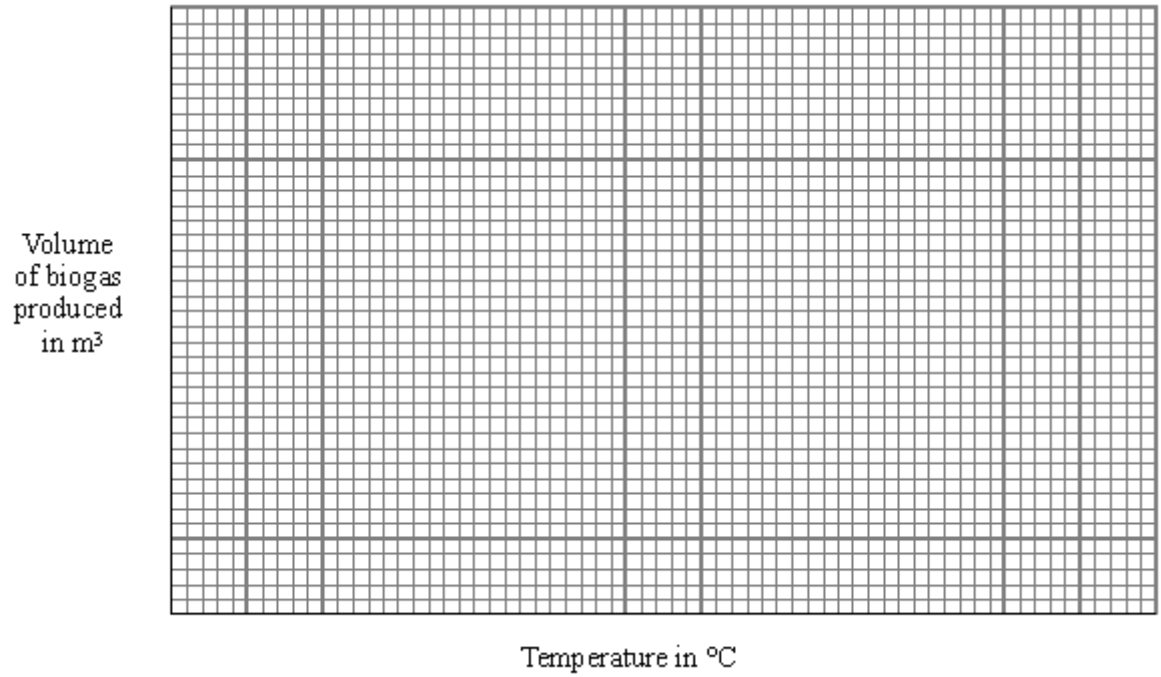
Evaluate the advantages and disadvantages of using this type of generator.

(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.



(3)

(ii) Temperatures in India may reach over 35 °C. Explain the advantage of the generator being mainly underground.

_____

_____

_____

(2)

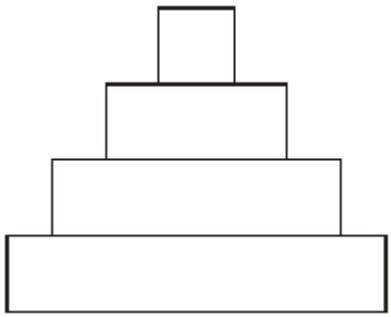
(Total 12 marks)

Q37.

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.

$$\text{Amount of energy} = \frac{(\text{Percentage of energy used by slugs}) \times (\text{Amount of energy in lettuce})}{100}$$

_____

_____

_____

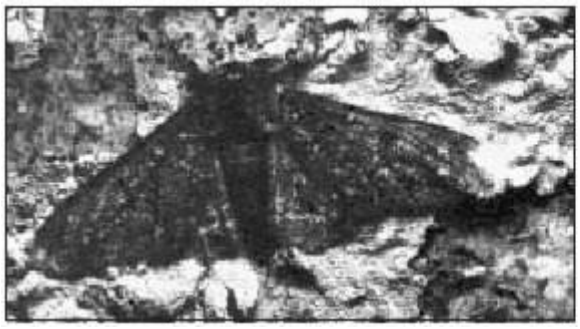
Amount of energy = _____ kJ

(2)

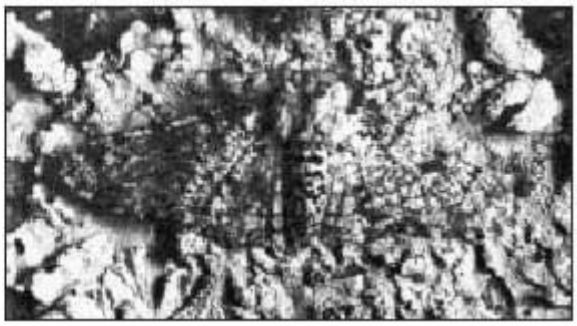
(Total 5 marks)

Q38.

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 _____

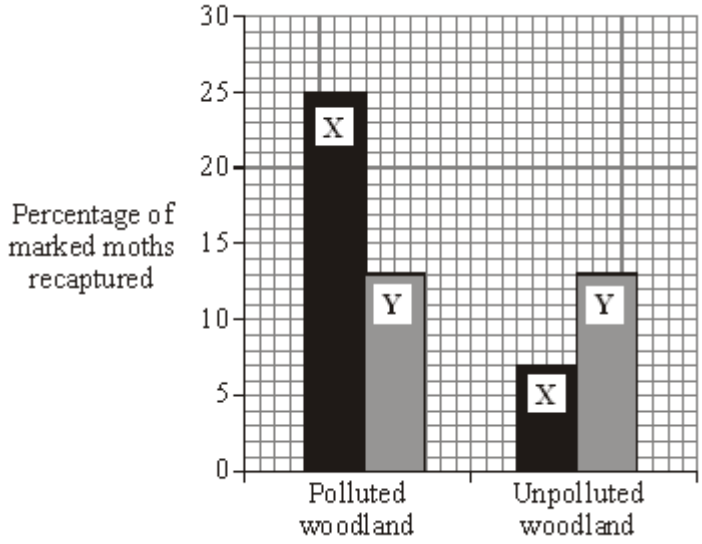
_____

(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)

Q39.

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)

Q40.

Figure 1 shows a food chain containing three organisms.

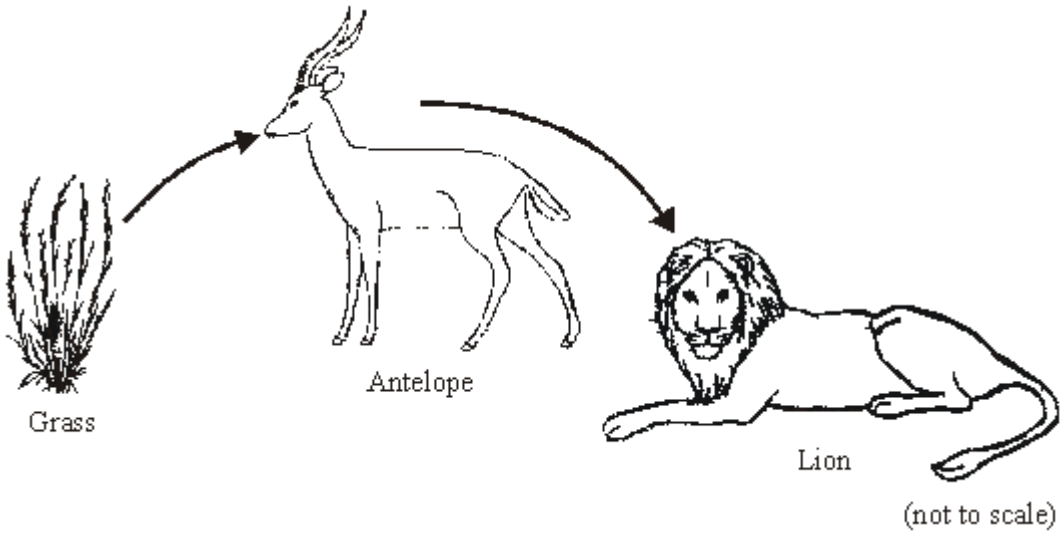


Figure 1

(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.**

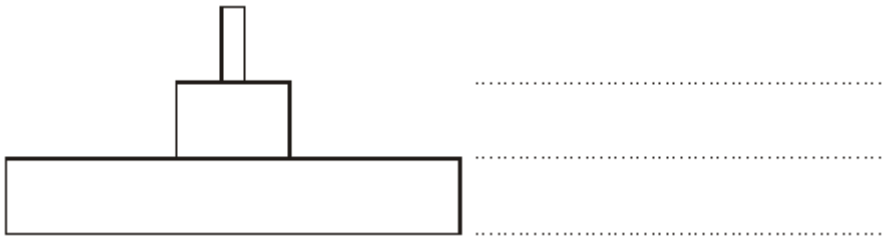


Figure 2

(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)

Q41.

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. _____

_____

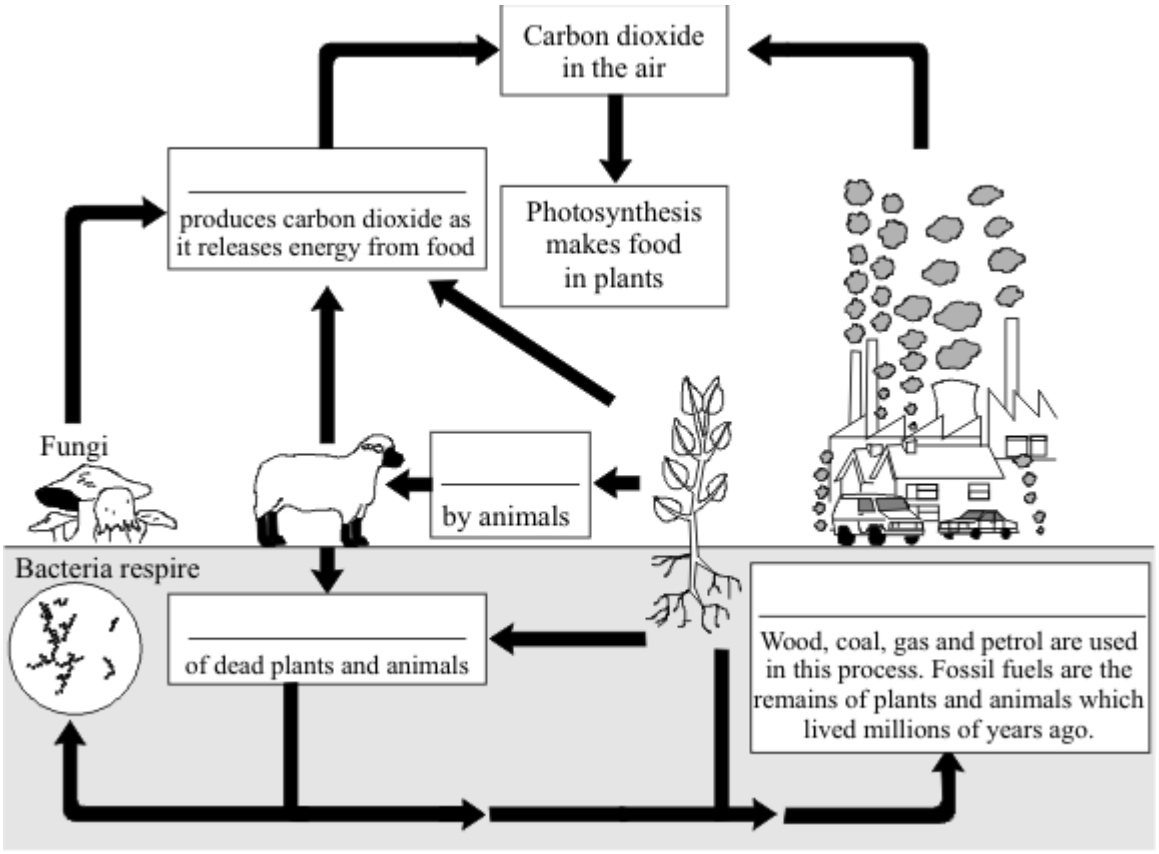
(3)

(Total 5 marks)

Q42.

(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)