TROPHIC LEVELS IN AN ECOSYSTEM

Q1.

The diagram below shows a food chain in a garden.
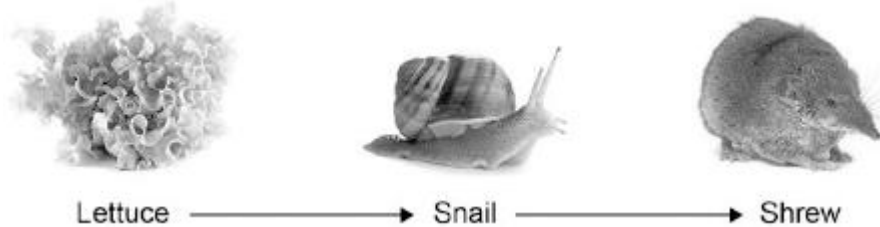
(a)   Name **one consumer** shown in the diagram above.

_____

(1)

(b)   Name **one carnivore** shown in the diagram above.

_____

(1)

(c)   A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

_____

_____

(1)

(d)   What is the name given to all the snails in the garden shown in the diagram above?
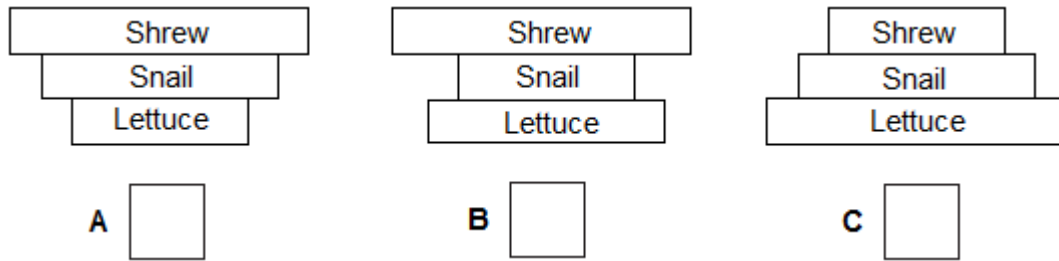
Tick **one** box.

Community   ☐

Ecosystem   ☐

Population   ☐

Territory   ☐

(1)

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

Tick **one** box.

Shrew		Shrew		Shrew
Snail		Snail		Snail
Lettuce		Lettuce		Lettuce

A ☐   B ☐   C ☐

(1)

(f)   Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

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

Calculate the energy transferred to the snails from the lettuces.

_____

Energy = _____ kJ

(1)

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

Tick **one** box.

The lettuces carry out photosynthesis   ☐

The snails do not eat the roots of the lettuces   ☐

Not all parts of a snail can be eaten   ☐

(1)

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

Wind direction is one abiotic factor.
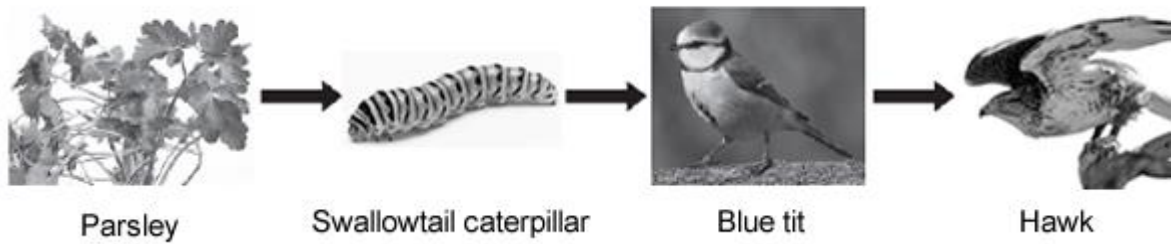
Name **one other** abiotic factor.

_____

(1)
(Total 8 marks)

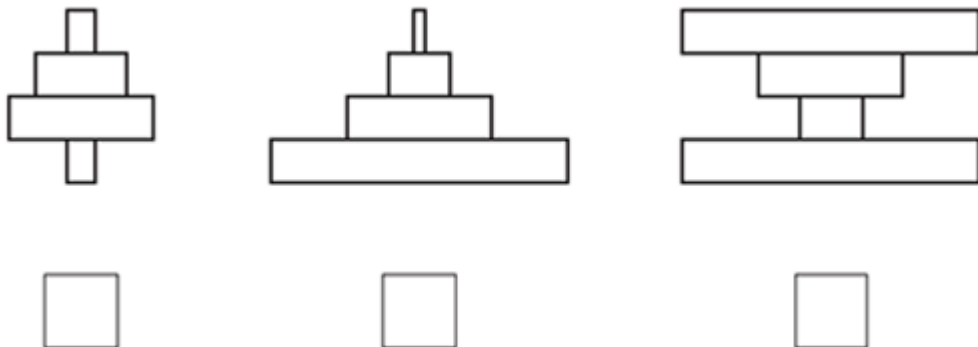## Q2.

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

Figure 1

| Parsley | Swallowtail caterpillar | Blue tit | Hawk |

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

_____

_____

_____

_____

(2)

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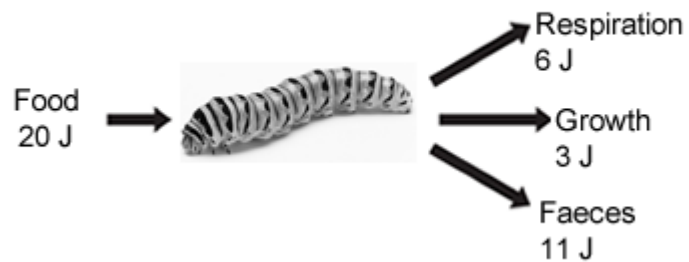
Why is photosynthesis important in the food chain?

Tick (✔) **one** box.

(1)

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

Figure 2

Food 20 J → caterpillar → Respiration 6 J, Growth 3 J, Faeces 11 J

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

_____

_____

Percentage = _____

(2)

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

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

Figure 3

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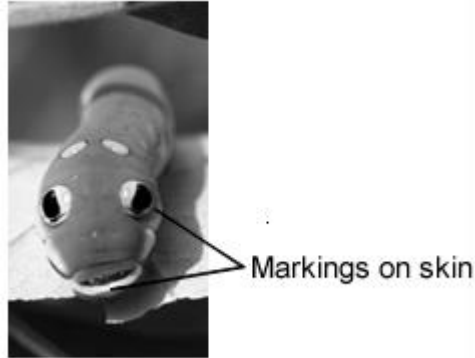
Suggest how the swallowtail caterpillar shown in **Figure 3** is adapted to reduce the chance of being eaten by blue tits.

_____

_____

_____

_____

(2)

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

Figure 4

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

1. _____

_____

2. _____

_____

Q3.

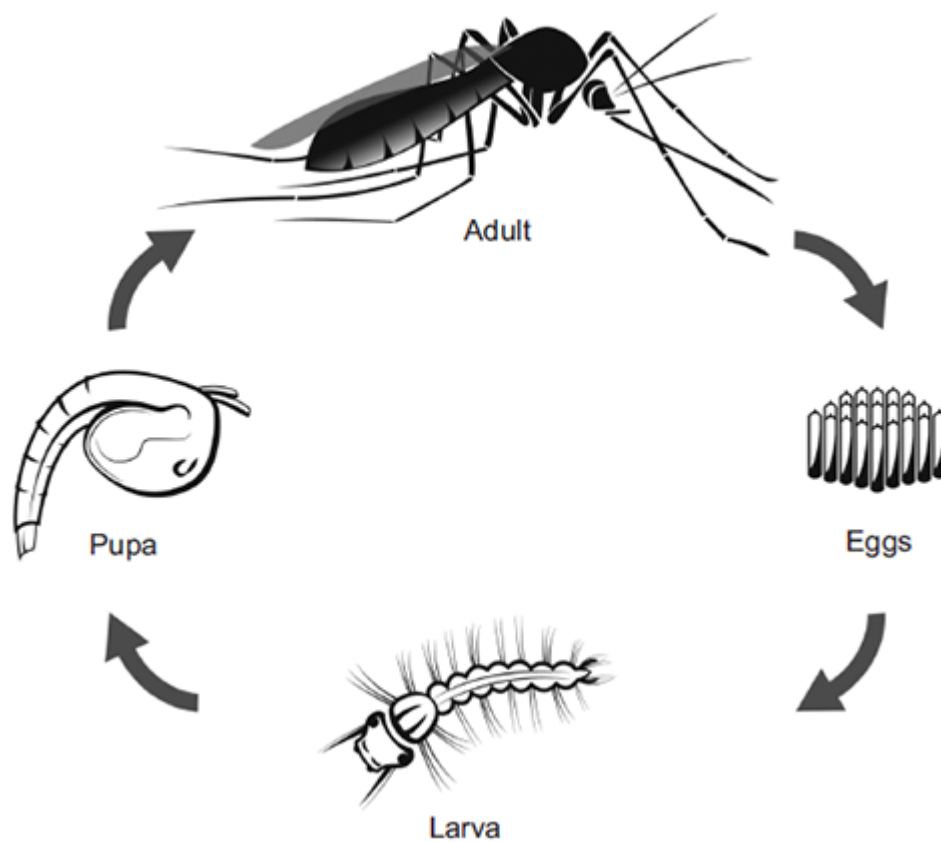Malaria is a disease caused by a microorganism carried by mosquitoes.

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

The figure below shows the life cycle of a mosquito.

© watcharapon/iStock

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

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

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

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

_____

_____

_____

_____

(2)

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

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

Explain why.

_____

_____

_____

_____

(2)

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

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

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

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

_____

_____

_____

_____

_____

_____

_____

_____

(4)

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

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q4.

Students investigated a food chain in a garden.

lettuce $\longrightarrow$ **snail** $\longrightarrow$ **thrush (bird)**

The students:
*   estimated the number of lettuce plants in the garden
*   estimated the number of snails feeding on the lettuces
*   counted two thrushes in the garden in 5 hours.

The table below shows the students' results and calculations.

Organism	Population size	Mean mass of each organism in g	Biomass of population in g	Biomass from previous organism that is lost in g	Percentage of biomass lost
Lettuce	50	120.0	6000		
Snail	200	2.5	500	5500	91
Thrush	2	85.0	170	330	66

(a) (i) Give **two** ways that biomass is lost along a food chain.

_____

_____

_____

_____

(2)

(ii) Scientists estimate that about 90% of the biomass in food is lost at each step in a food chain.

Suggest **one** reason why the students' value for the percentage of biomass lost between the snails and the thrushes is only 66%.

_____

_____

(1)

(b)   European banded snails have shells with different colours (light or dark) and with stripes or with no stripes.

Figure 1 shows two examples of European banded snails.

Figure 1

Dark-coloured shell
with stripes

© Eric Lsselee/iStock

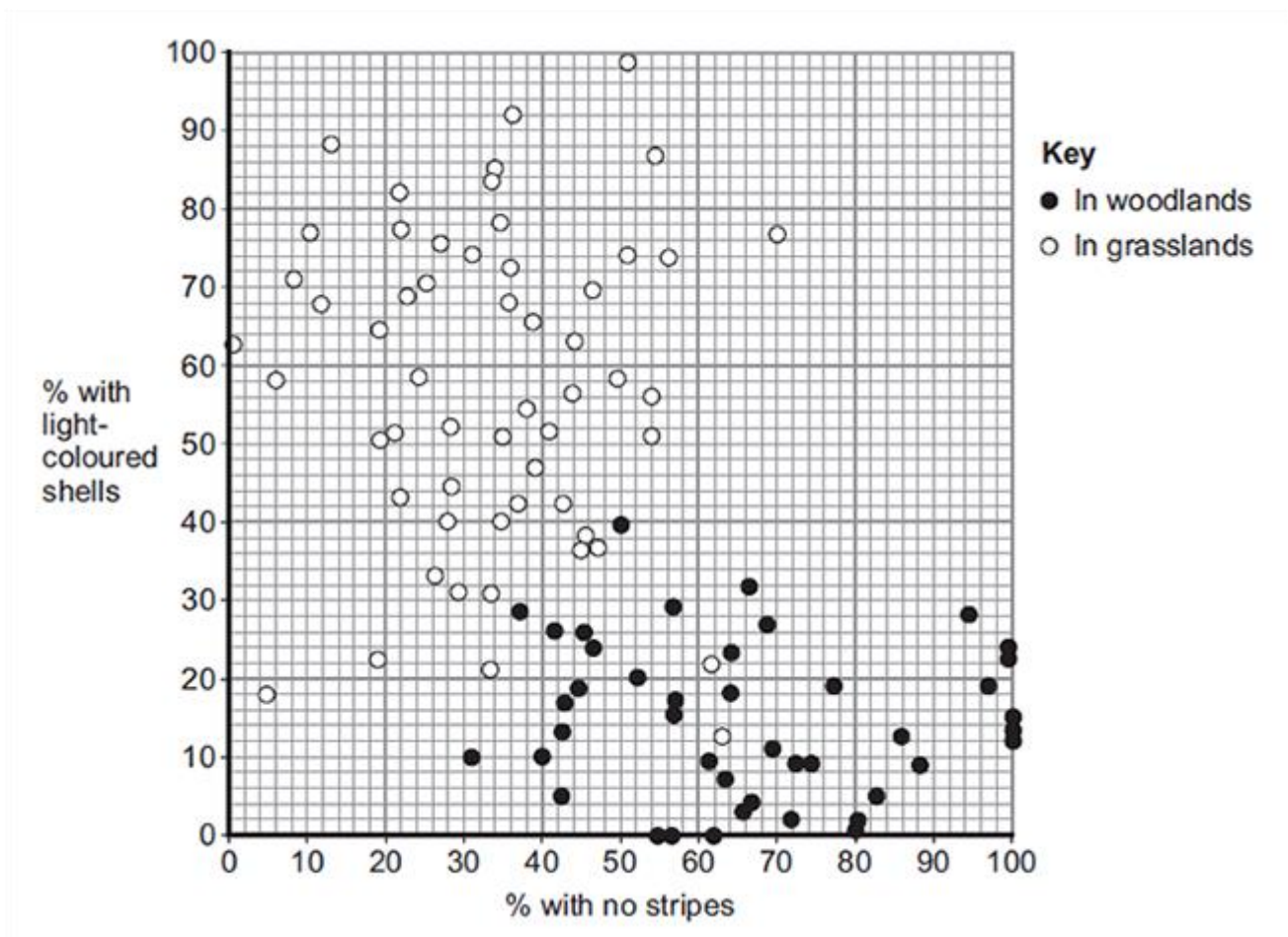Light-coloured shell,
with no stripes

© filipfoto/iStock

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

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

Figure 2

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

Why is a scatter graph used for this data?

_____

_____

(1)

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

_____

_____

_____

_____

(2)

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

_____

_____

(1)
(Total 7 marks)

Q5.

Over millions of years:

*   new groups of organisms have evolved

*   other groups of organisms have become extinct.

(a)   If an asteroid collided with the Earth, large amounts of dust and water vapour would
       be thrown up into the air. This would mean less light and heat would reach the
       Earth's surface from the Sun.

(i)   A reduced amount of light and heat could have caused the extinction of plants.

        Suggest how.

_____

_____

(1)

(ii)   How could the extinction of plants have caused the extinction of some
        animals?

_____

_____

(1)

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

        1. _____

_____

2. _____

_____

(2)

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

Mean number of groups of animals becoming extinct per million years

Millions of years ago

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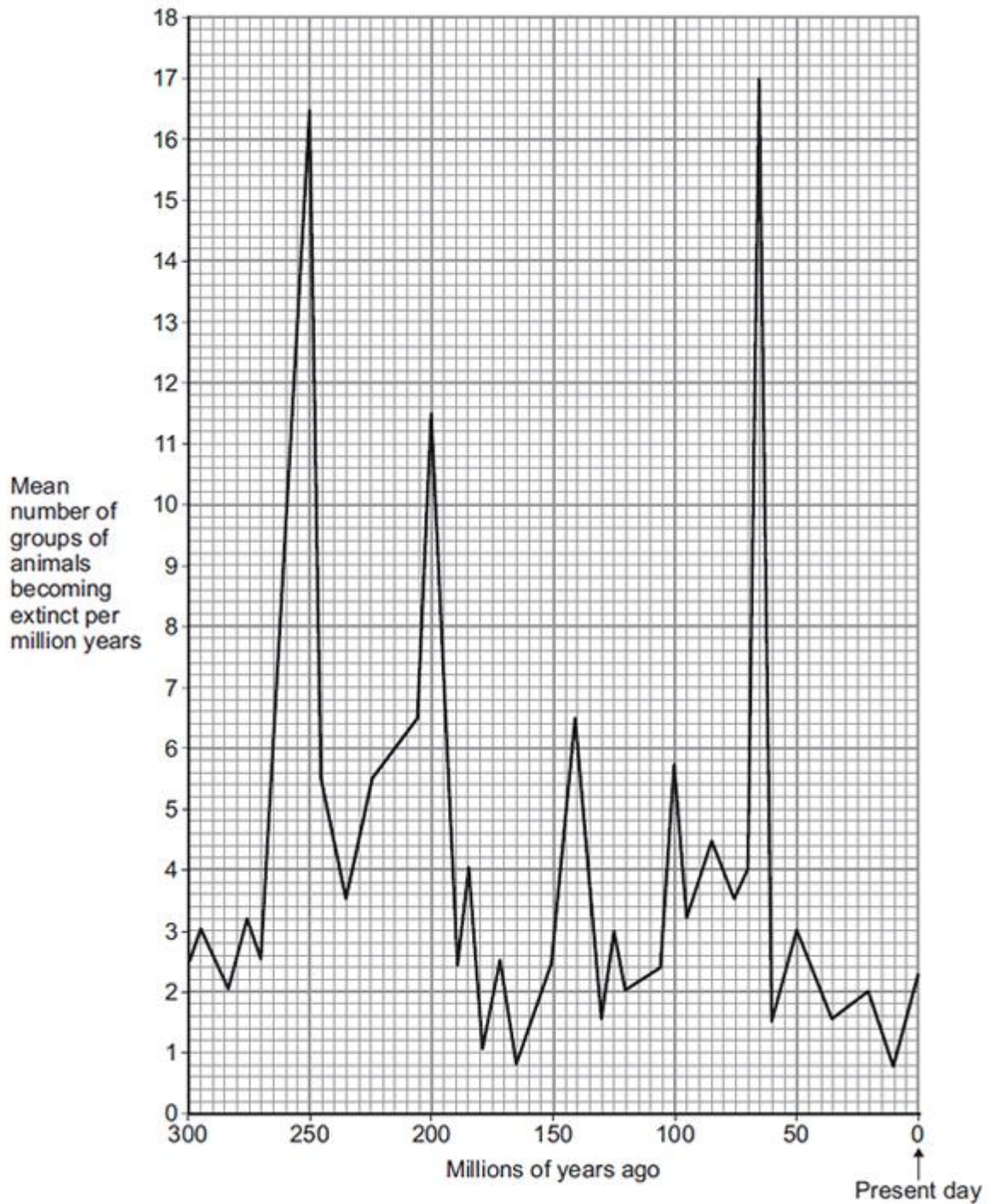
(i)   If more than 10 groups of animals become extinct in a 1 million year period, scientists call this a 'mass extinction'.

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

_____

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

_____

_____

(1)

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

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

Tick (✔) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

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

_____ groups per million years

(1)

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

_____

_____

(1)
(Total 9 marks)

Q6.

Food chains show the flow of energy through the organisms in a habitat.

(a)   The diagram below shows a food chain.

grass ⟶ sheep ⟶ human

The biomass in each stage of the food chain changes as food passes along the food chain.

Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

(b)   The table below shows three food chains, **A, B** and **C**.

	Food chain
A	plants ⟶ sheep ⟶ human
B	plants ⟶ grasshoppers ⟶ frogs ⟶ trout ⟶ human
C	plants ⟶ human

(i)   In which food chain, **A**, **B** or **C**, will the greatest proportion of biomass and
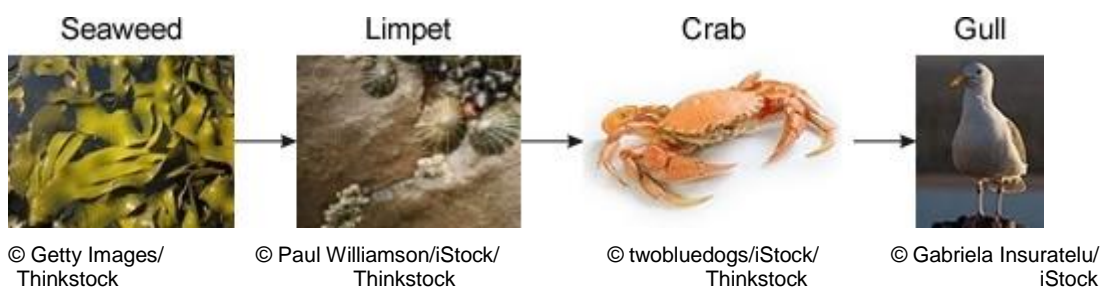
energy of the plants be passed to humans?

(1)

(ii)   Give reasons why the food chain that you chose in part **(b)(i)** passes on the
greatest proportion of biomass and energy to humans.

_____

_____

_____

_____

_____

_____

(3)
(Total 6 marks)

Q7.

The photographs show a food chain from a seashore. The photographs are **not** to the
same scale.

Seaweed	Limpet	Crab	Gull
© Getty Images/ Thinkstock	© Paul Williamson/iStock/ Thinkstock	© twobluedogs/iStock/ Thinkstock	© Gabriela Insuratelu/ iStock

Students estimated the population and biomass of each of the organisms on part of a
seashore.

The table shows the students' results.

Organism	Population	Mean mass of one organism in grams	Biomass of population in grams
Seaweed	50	4000	200 000
Limpet	1200	30	36 000

Crab	100	90	9 000
Gull	2	900	

(a)   (i)   Use the data in the table to calculate the biomass of the gull population.

_____

_____

Biomass = _____ g

(1)

(ii)   Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

(b)   The biomass of the crab population is much less than the biomass of the limpet population.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

Q8.

A group of students investigated populations in a food chain in a garden.

The table shows the estimates of the number and biomass of some of the organisms the students found.

Organism	Number in the garden	Mean mass of each one in grams	Biomass of population in grams

Hedgehog	1	200	200
Slug	600	2	1200
Lettuce	60	100	

(a) (i) Calculate the biomass of the lettuce population.
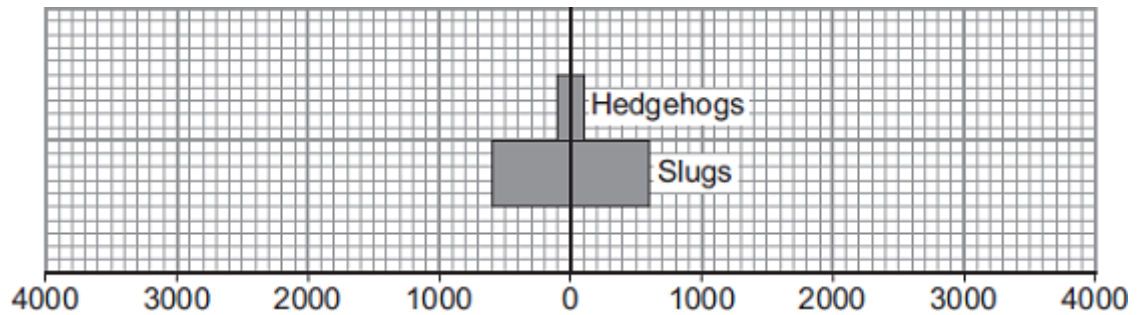
Show clearly how you work out your answer.

_____

_____

Biomass = _____ grams

(2)

(ii) Use your answer to part (a)(i) to complete the pyramid of biomass.

Show the biomass of the lettuce population in the garden.

Biomass of population in grams

(2)

(b) The energy in the hedgehog population is much less than the energy in the slug population.

Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

_____

(3)
(Total 7 marks)

Q9.

Scientists investigated a food chain in a wheat field immediately after the wheat had been harvested.

Red kites are birds of prey.

(a)   The food chain for the wheat field is:

Wheat grains ⟶ Field mice ⟶ Red kites

What is the source of energy for the food chain?

_____

(1)

(b)   The table shows the data the scientists collected.

| Organism	Estimated number in the field	Biomass of one organism in kg	Total biomass for field in kg
Fallen wheat grains	40 000	0.0006	24.0
Red kites	2	1.0	....
Field mice	200	0.04	....

(i)   Complete the table by calculating the total biomass of red kites and of field mice.

Write your answers in the table.

(2)

(ii)   Use data from your completed table to draw a pyramid of biomass for the food chain shown in the table.

You should label each layer of your pyramid.
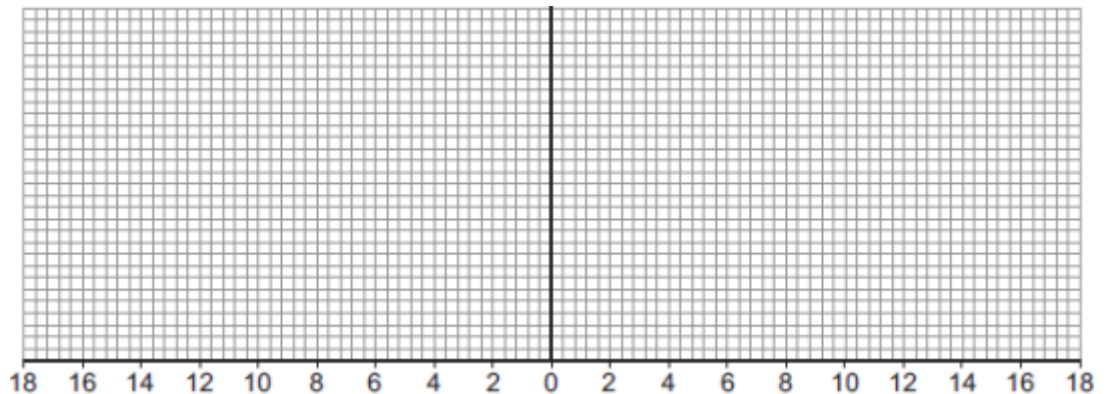
Total biomass for field in kg

(3)

(c)   The total biomass of the red kites is less than the total biomass of the field mice.

Give **two** reasons why.

_____

_____

_____

_____

(2)

(d) The scientists could **not** find the exact number of organisms in the wheat field.

Suggest **two** reasons why.

_____

_____

_____

_____

(2)
(Total 10 marks)

Q10.

There are two forms of peppered moth, dark and pale.
Birds eat the moths when the moths are resting on tree bark.

Pollution in the atmosphere may:

• kill lichens living on tree bark

• make the bark of trees go black.

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

Lichens are very sensitive to air pollution caused by

| carbon dioxide. |
| nitrogen. |
| sulfur dioxide. |

(1)

(b) The photographs show the two forms of peppered moth, on tree bark.

Tree bark covered with lichens   Tree bark made black by pollution

© Kim Taylor/Warren Photographic

(i) The dark form of the peppered moth was produced by a change in the genetic material of a pale moth.

Use **one** word from the box to complete the sentence.

| characteristic | clone | mutation |

A change in genetic material is called a _____

(1)

(ii) In the 19th century, pollution made the bark of many trees go black.

Explain why:

• the population of the pale form of the moth in forests decreased

• the population of the dark form of the moth in forests increased.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) (i) The larvae (young) of the peppered moths eat the leaves of birch trees.

The diagram shows the food chain:

birch trees → peppered moth larvae → birds

Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

(ii)   Which **two** reasons explain the shape of the pyramid you drew in part (c)(i)?

Tick (✓) **two** boxes.

Some material is lost in waste from the birds ☐

The trees are much larger than peppered moth larvae ☐

Peppered moth larvae do not eat all the leaves from the trees ☐

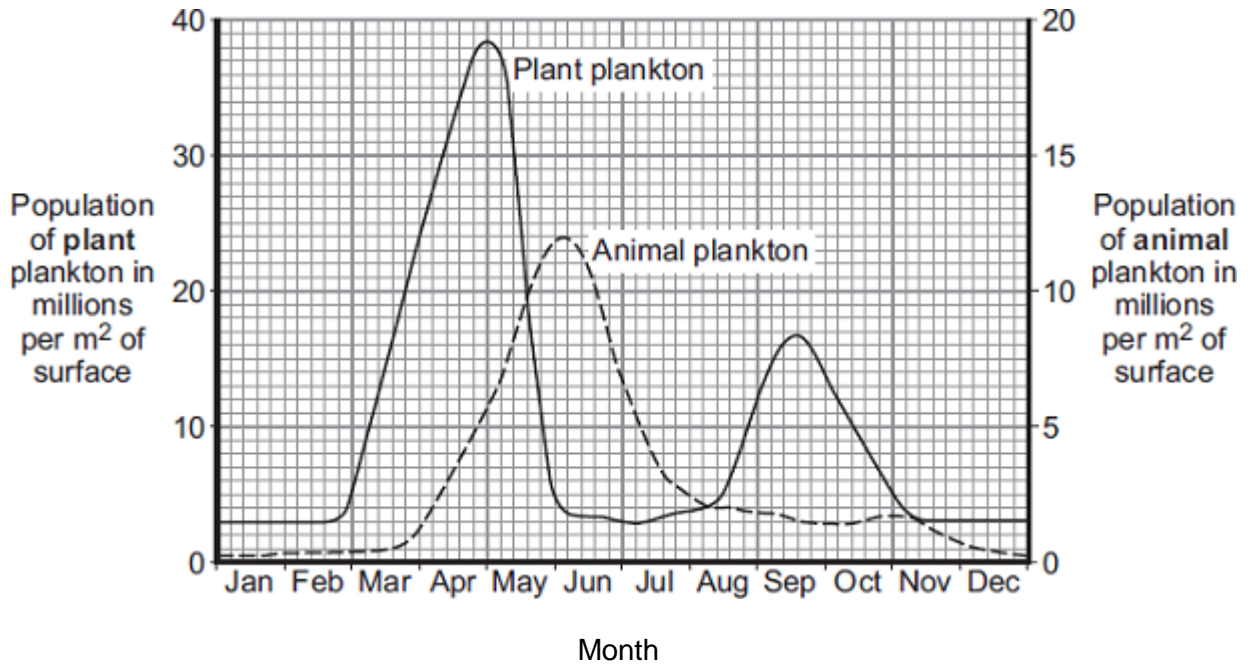The trees do not use all of the Sun's energy ☐

(2)
(Total 9 marks)

Q11.

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.
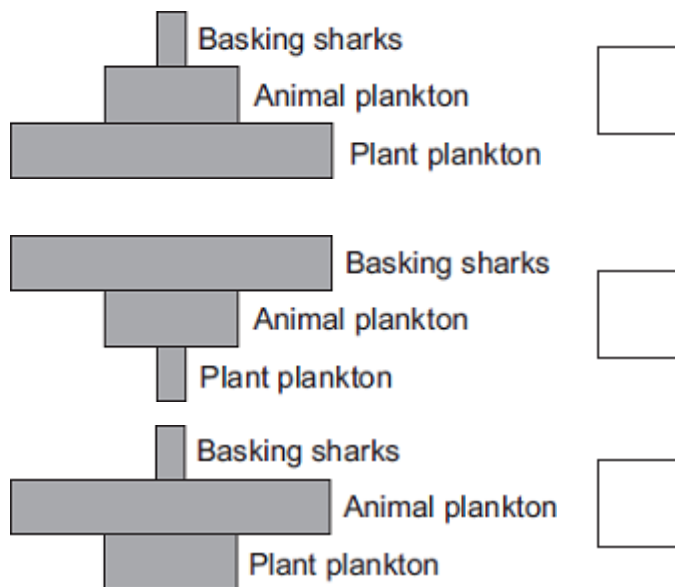
Graph 1

Month

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

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

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

Tick (✓) **one** box.

Basking sharks
Animal plankton
Plant plankton

Basking sharks
Animal plankton
Plant plankton

Basking sharks
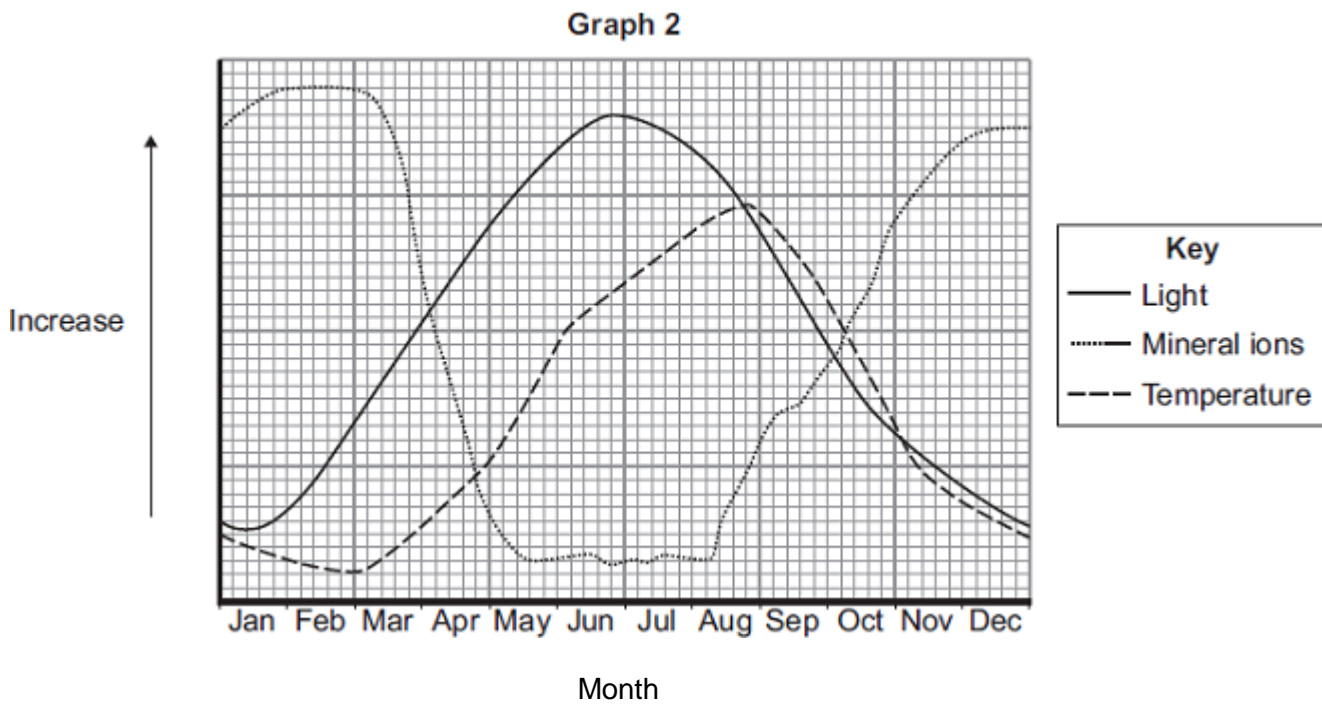Animal plankton
Plant plankton

(1)

Graph 1 is repeated here to help you answer the following questions.
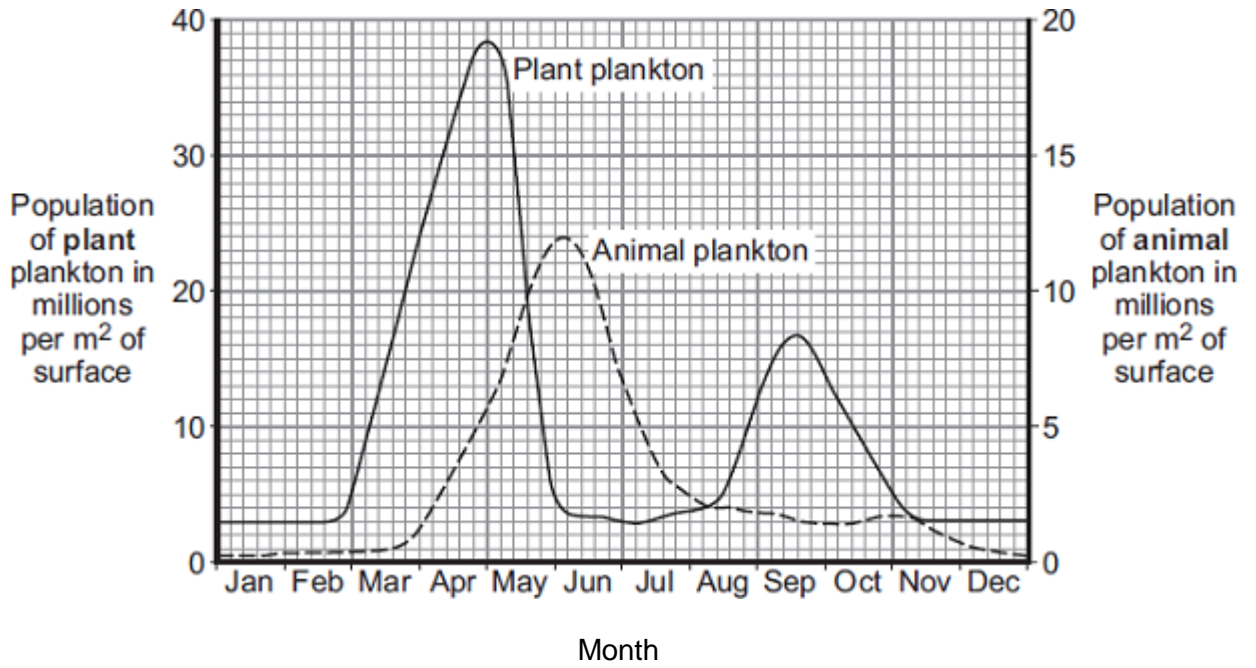
Graph 2 shows changes in some of the conditions in the upper layers of the sea around the UK.

Graph 2

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

Suggest **one** reason for the increase.

Explain your answer.

_____

_____

_____

_____

(2)

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

Suggest explanations for the changes.

_____

_____

_____

_____

_____

(2)

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

Suggest explanations for the changes.

_____

_____

_____

_____

_____

_____

_____

(3)
(Total 8 marks)

Q12.

There are many ways to increase the efficiency of food production.

(a) The table shows the energy available to humans from two different food chains.

Food chain	Energy transferred to humans in kJ per hectare of crop
Wheat → humans	900 000
Wheat → pigs → humans	90 000

(i) Compare the amount of energy the two food chains transfer to humans.

_____

_____

(1)

(ii) Give **one** reason for the difference in the amount of energy the two food chains transfer to humans.

_____

_____

(1)

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

Give methods used in the factory farming of animals.
Explain the advantages and disadvantages of these methods.

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

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_____

_____

(6)
(Total 8 marks)

Q13.

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.

Aphids

Stem of bean plant

Ladybird

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.

_____

_____

_____

_____

_____

_____

_____

_____

Q14.

The photographs show four ways of farming.

Growing wheat

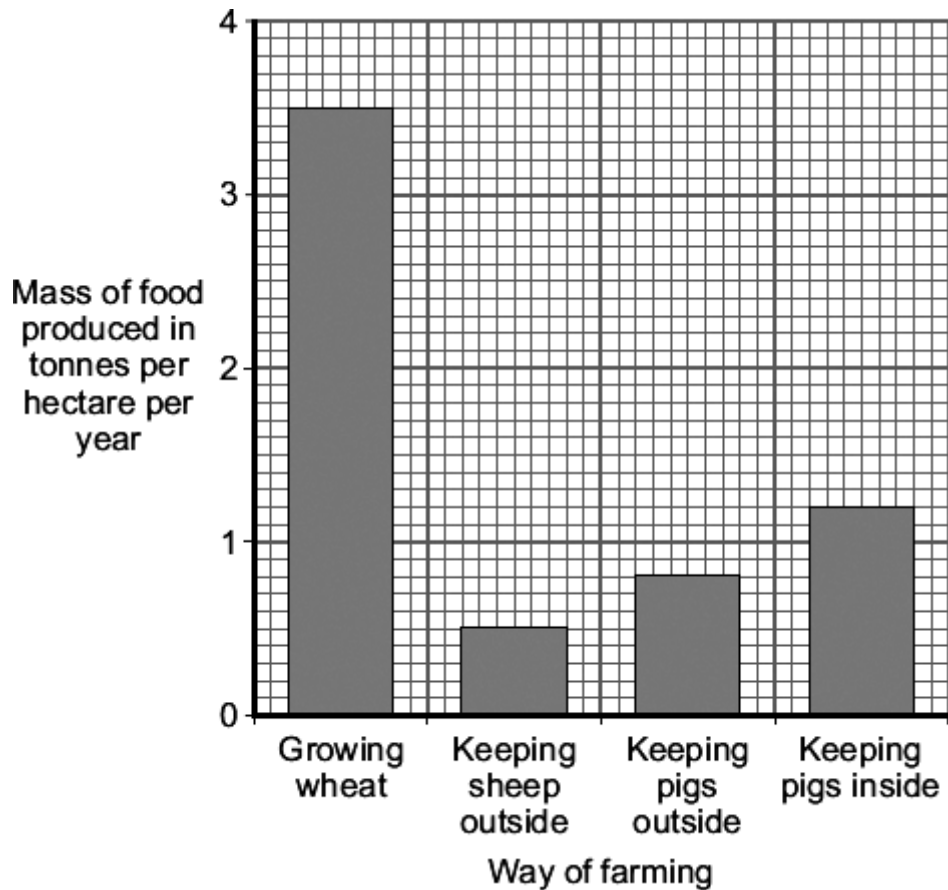**Keeping sheep outside**

Keeping pigs outside

Keeping pigs inside

Growing wheat by Eileen Henderson [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Sheep outside by Andrew Smith [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs outside by David Williams [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs inside supplied by iStockphoto/ Thinkstock.

The bar chart shows the amount of food produced from these four ways of farming.

(a) How much extra food can be produced when farmers grow wheat, compared with keeping sheep outside?

Show clearly how you work out your answer.

_____

_____

Answer _____ tonnes per hectare per year

(2)

(b) Sheep eat grass.
For every 1000 g of grass eaten, a sheep increases in mass by only 50 g.
The other 950 g is lost.

How is the other 950 g lost?

Tick (✓) **two** boxes.

As oxygen from photosynthesis ☐

As faeces ☐

As meat ☐

As carbon dioxide from respiration [ ]

(2)

(c)   (i)   Pigs kept inside lose less energy than pigs kept outside.

Why?

Tick (✔) **two** boxes.

Pigs kept inside are fed more. [ ]

Pigs kept inside are kept in small pens. [ ]

Pigs kept inside are kept warm in the winter. [ ]

Pigs kept inside are healthier. [ ]

(2)

(ii)   Meat from pigs kept inside is usually cheaper than meat from pigs kept outside.
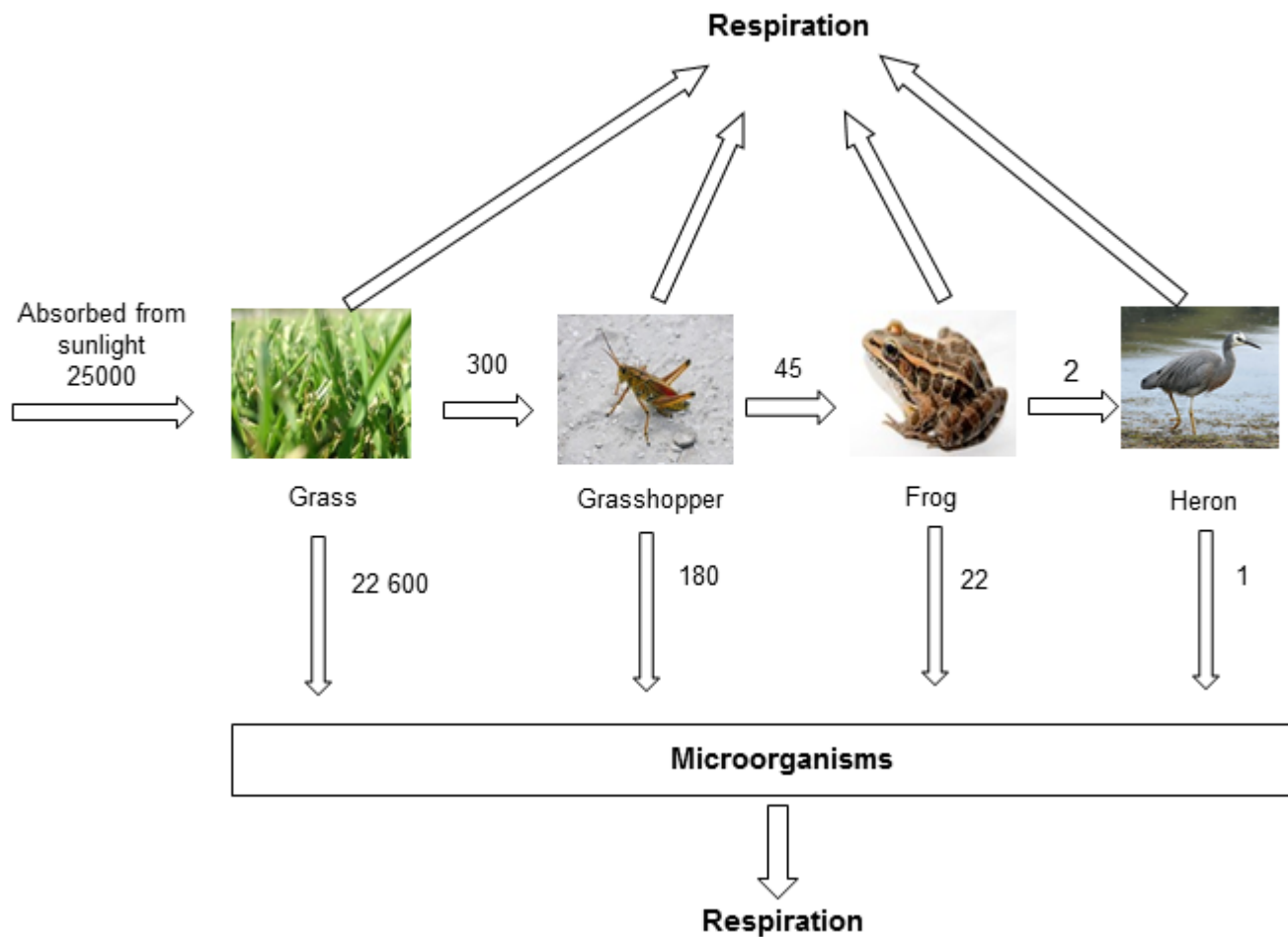
Give **one** reason why.

_____

_____

(1)
(Total 7 marks)

Q15.

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.

Respiration

(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)

Q16.

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)

| carbon dioxide. |

(ii)   The process uses the gas

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 ☐
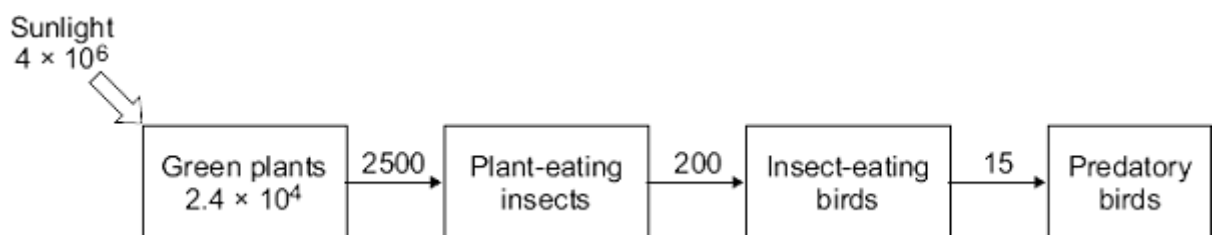
As faeces (droppings) from the blue-tit ☐

(2)
(Total 7 marks)

Q17.

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)

Q18.

There are plans for a 'cattle factory' to be built in the UK.

Information about the cattle factory and traditional cattle farming in the UK is given below.

Cattle factory   Traditional cattle farming

Cattle factory

• There will be over 8 000 cows in three large sheds.

• Each cow will be milked three times a day.

• Each cow will produce about 50 litres of milk every day.

• Waste will be collected and used to produce electricity for 2 000 homes.

• Cows are kept near to each other so disease can spread easily.

Traditional cattle farming

• Most farms have between 5 and 500 cows.

• The cows spend most of the time in fields.

• Cows are milked once or twice a day.

• Each cow produces up to 20 litres of milk a day.

• The waste is used as natural fertiliser for crops.

(a)   Use the information to answer the questions.

   (i)   Give **two** reasons why some people think the cattle factory is a good idea.
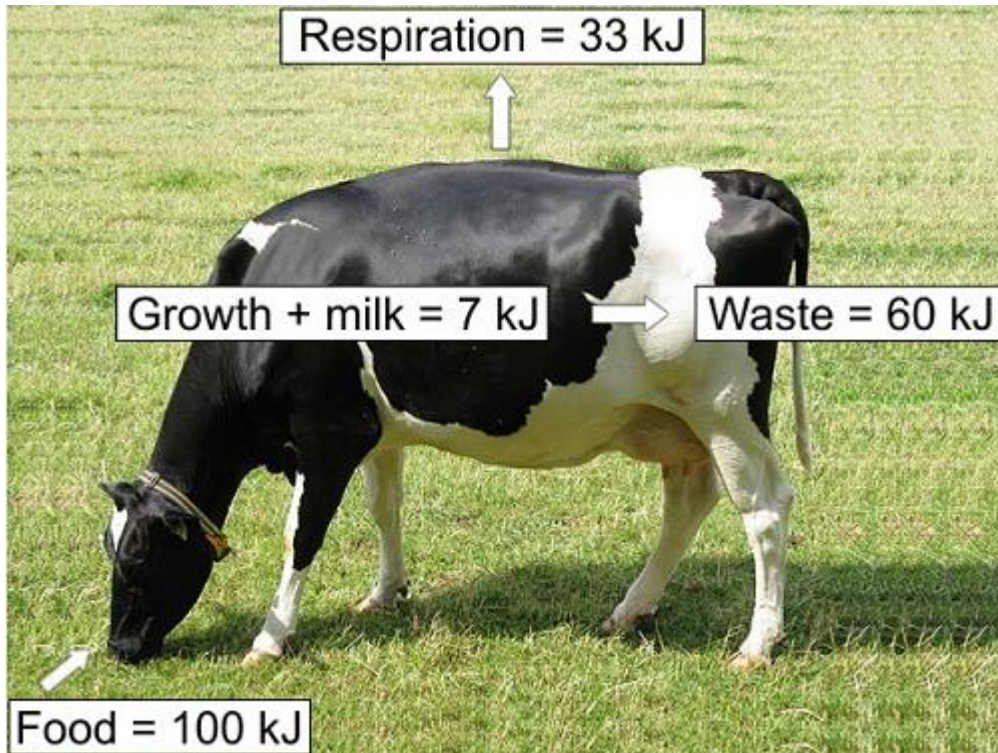
      1. _____

      _____

      2. _____

      _____

(2)

   (ii)   Give **two** reasons why some people think traditional farming is better than the cattle factory.

      1. _____

      _____

      2. _____

(b)   The diagram shows what happens to 100 kJ of energy in the food eaten by a cow on a traditional farm.

By Dohduhdah (Own work) [Public domain], via Wikimedia Commons

Use your knowledge and the information in the diagram to answer this question.

Compare the transfer of energy from the food eaten by cows in the cattle factory with the energy transferred by cows on a traditional farm.

Use words from the box to complete the table.

more	less	the same

Energy	Amount of energy transferred by cows in a cattle factory compared with cows on a traditional farm
transferred for growth and milk	
transferred in respiration	

(2)
(Total 6 marks)

Q19.

A group of students investigated a food chain in a garden.

The table shows the estimates of the population and biomass of some of the organisms

the students found.

Organism	Number in the garden	Mean mass of each one in g	Biomass of population in g
Hedgehog	1	200	200
Slug	600	2	1200
Lettuce	20	300	

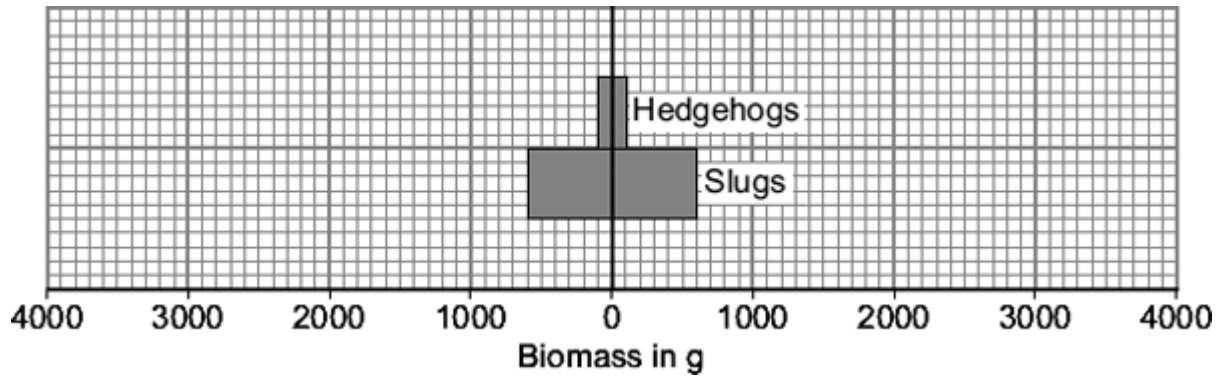(a) (i) Calculate the biomass of the lettuce population.

Show clearly how you work out your answer.

_____

_____

_____

Biomass = _____ g

(2)

(ii) Use your answer to part (a)(i) to complete the pyramid of biomass.

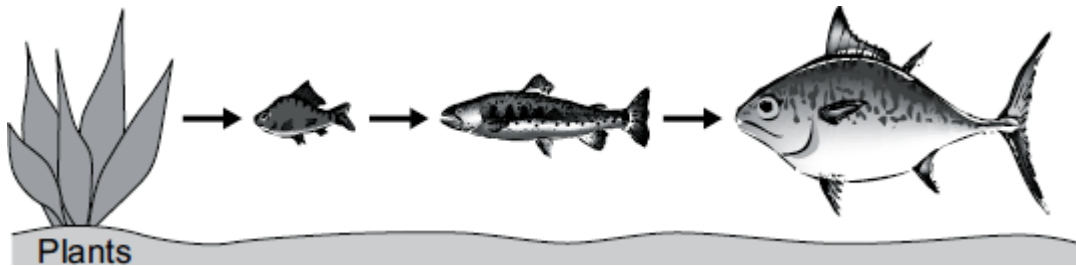Show the biomass of the lettuces in the garden.

(2)

(b) Hedgehogs eat slugs.

The biomass of the hedgehog population is much less than the biomass of the slug population.

Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q20.

The picture shows a food chain.

Plants

(a)   Which diagram shows a pyramid of biomass for the food chain in the picture?

Tick (✓) **one** box.

Plants

□

Plants

□

Plants

□

(1)

(b)   The plants at the start of the food chain absorb energy.

Where does this energy come from?

Draw a ring around **one** answer.

the water   the sun   minerals

(1)

(c)   Some energy is lost at each stage of the food chain.

Give **two** ways in which energy may be lost from the food chain.

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q21.

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)

Q22.

A fish farmer keeps trout in a large net in a lake.
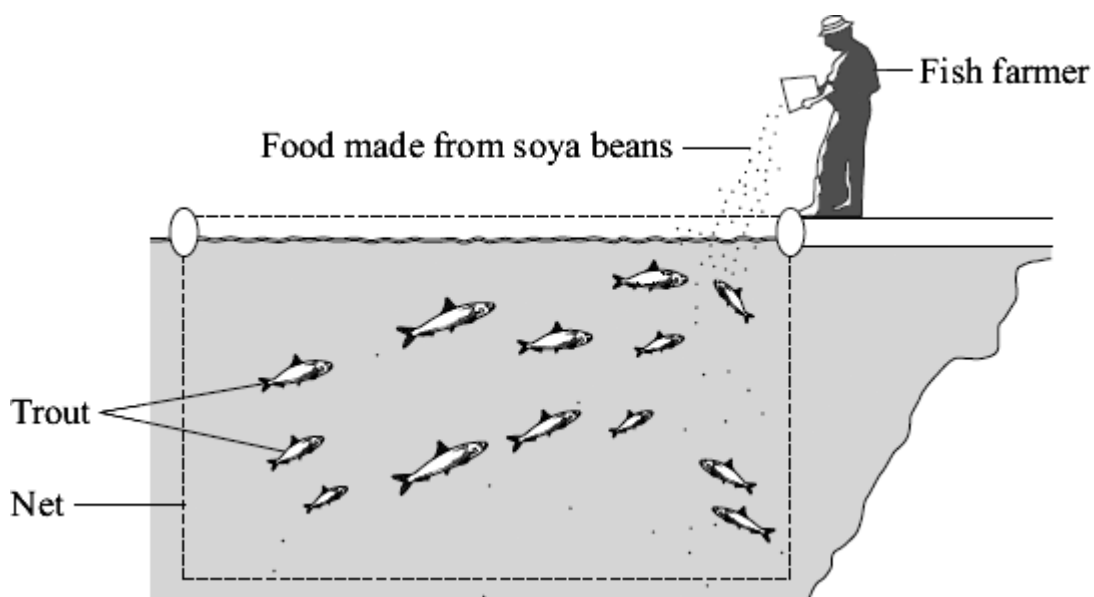
The fish farmer feeds the trout on food made from soya beans.

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.
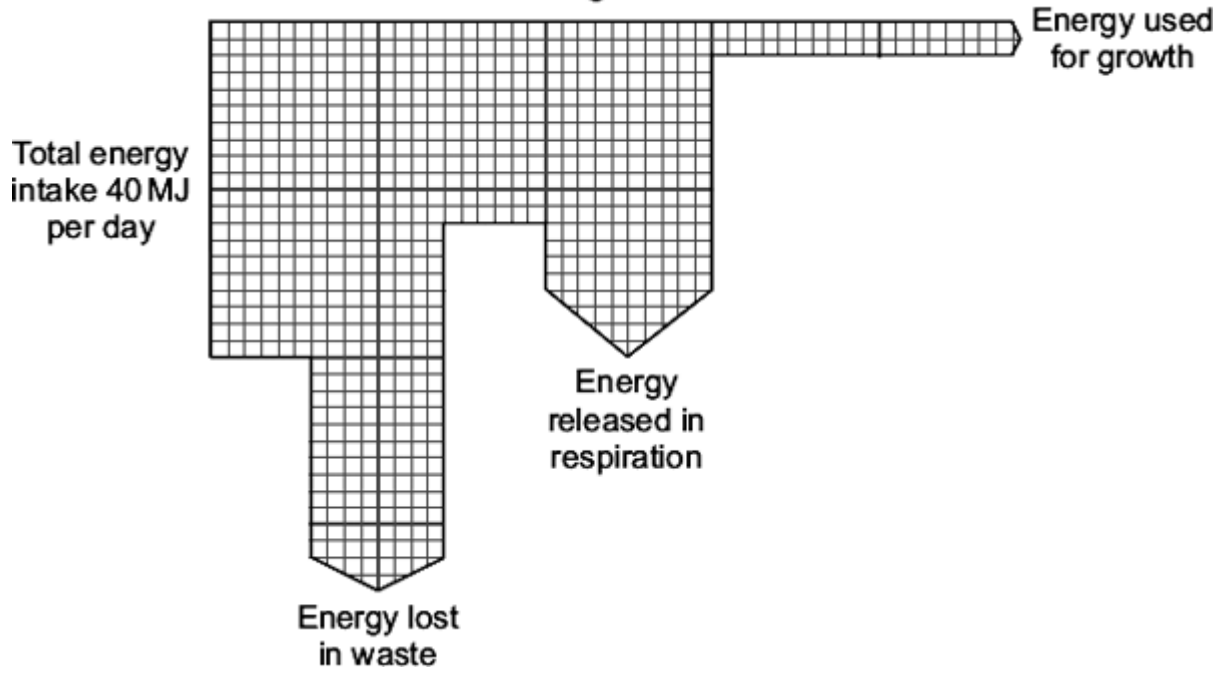
_____

_____

_____

_____

_____

(2)
(Total 7 marks)

Q23.
(a)   **Diagram 1** represents what happens to the energy in the food eaten by a herbivore (an animal that eats plants).

Diagram 1

Total energy intake 40 MJ per day

Energy used for growth

Energy released in respiration

Energy lost in waste

(i)   How much energy is released in respiration by the herbivore?

_____

_____

Answer _____ MJ per day

(1)

(ii)   What proportion of the total energy intake of the herbivore is used for growth?

Show clearly how you work out your answer.

_____

_____

_____

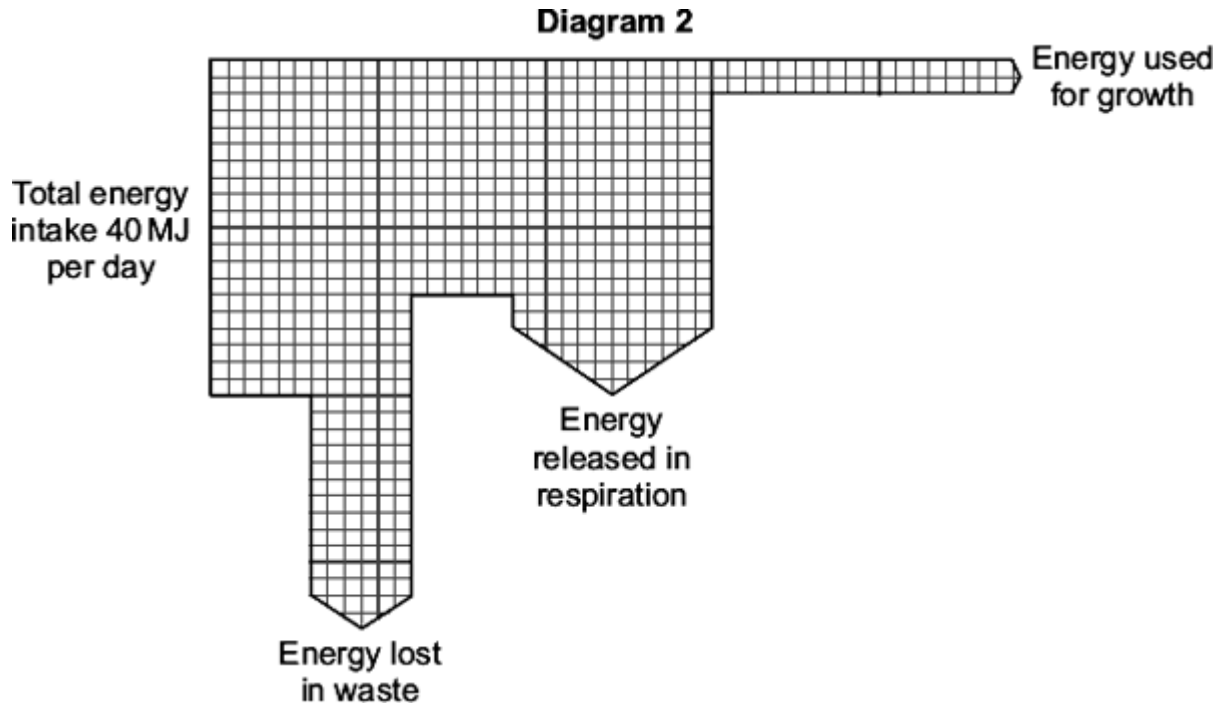Proportion _____

(2)

(b)   Give **two** ways in which the energy, released in respiration, is used by a herbivore.

1. _____

2. _____

(2)

(c)   **Diagram 2** represents what happens to the energy in the food eaten by a carnivore (an animal that eats other animals).

Diagram 2

Energy used
for growth

Total energy
intake 40 MJ
per day

Energy
released in
respiration

Energy lost
in waste

The carnivore releases a greater proportion of energy in respiration than the herbivore.

Suggest **one** reason for this.

_____

_____

(1)

(d)   Some farmers keep their animals outdoors. Other farmers keep their animals indoors.

Keeping farm animals indoors increases the proportion of energy in their food that is converted into growth.

Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)
(Total 8 marks)

Q24.

The diagram shows a pyramid of biomass drawn to scale.
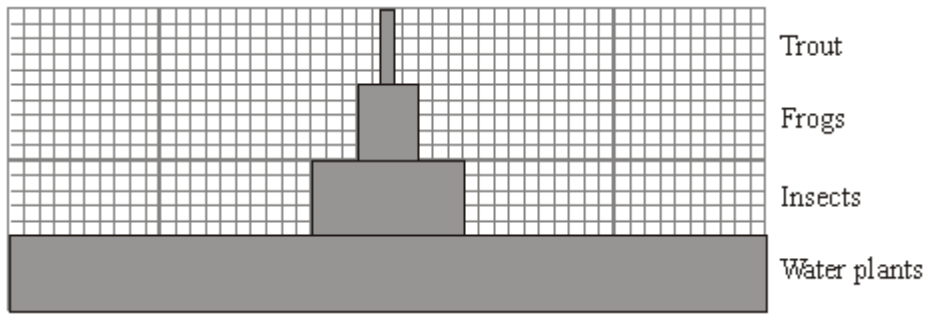
(a) What is the source of energy for the water plants?

_____

(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)

Q25.

(a) The diagrams show three pyramids of biomass.

    (i)   Which pyramid would be the most efficient in providing food for humans?

        Tick (✔) **one** box.

(1)
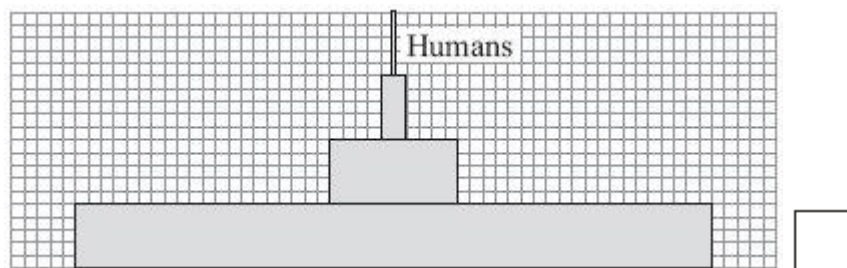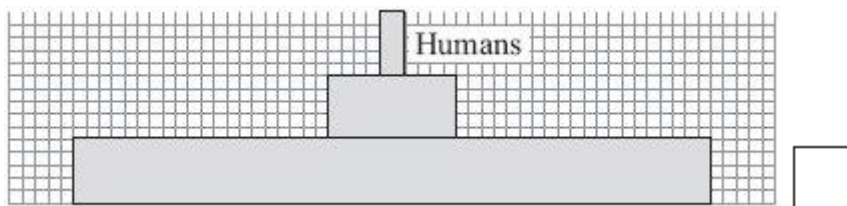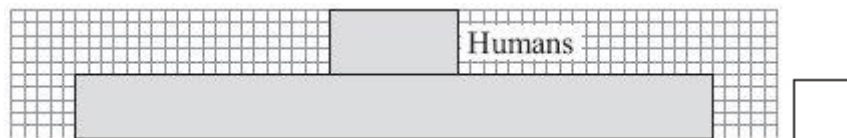
    (ii)   Give **one** reason for your choice.

        _____

        _____

(1)

(b)   Pigs may be kept indoors or outdoors.

          Pigs kept indoors   **Pigs kept outdoors**

The pie charts show what happens to the energy in the food eaten by pigs kept indoors and pigs kept outdoors.

Pigs kept indoors   **Pigs kept outdoors**

Key
- Urine and faeces
- Growth
- Heat
- Movement
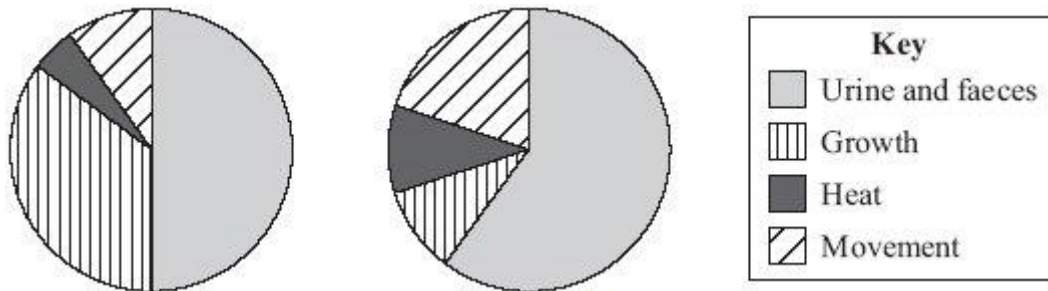
(i) Farmers make more profit from keeping pigs indoors than from keeping pigs outdoors.

Use information from the pie charts to explain why.

_____

_____

_____

_____

(2)

(ii) Meat from pigs kept outdoors may cost more than meat from pigs kept indoors.

Some people prefer to buy meat from animals that have been kept outdoors.

Suggest **one** reason why.

_____

_____

(1)
(Total 5 marks)

Q26.

The photograph shows what happens to some of the energy in the food that a cow eats.

125 kJ/m²/year in growth

3125 kJ/m²/year in food

(a) Calculate the percentage of the energy in the cow's food that is transferred into new growth.

Show clearly how you work out your answer.

_____

_____

Answer = _____ %

(2)

(b) The energy from the cow's food which is not transferred into new growth is lost.

Give **three** ways in which this energy is lost.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(c) The animals that we raise for food are usually herbivores (plant eaters) rather than carnivores (flesh eaters).

Explain why.

_____

_____

_____

_____

_____

(2)
(Total 7 marks)

Q27.

(a)   Tuna fish are carnivores. In the wild they feed on smaller fish called herring. Herring feed on plankton. Tuna can be attacked by parasitic worms which feed on their flesh.

(i)   In the space below sketch the appearance of a pyramid of biomass for this food chain.

Do not forget to label each section of the pyramid.

(2)

(ii)   If a tuna eats 1 kg of herring, it gains about 65 g in mass.

Give **two** reasons why so little of the mass of the herring is converted into mass of the tuna.

1. _____

_____

2. _____

_____

(2)

(b)   Young tuna are caught by fish farmers and reared in large pens in the sea.

The fish are fed more food than they would normally catch themselves so they grow quickly. When they reach 400 kg they are sold.

The graph below shows the effect of feeding tuna different amounts of protein in their food.
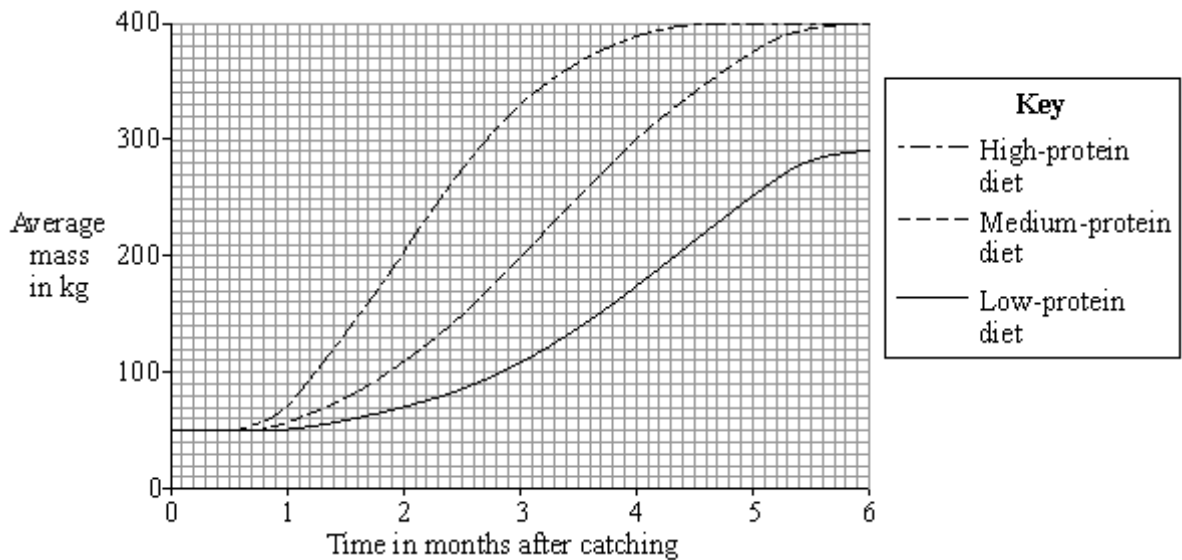
(i)   Calculate the average increase in mass per month of the fish fed on the low-protein diet over the six months.

Show clearly how you work out your answer.

_____

_____

Average increase in mass per month _____ kg

(2)

(ii) There is not enough information in the graph to allow the fish farmer to decide whether to use the high-protein diet or the medium-protein diet.

Suggest **one** other piece of information that he needs in order to make this decision.

_____

_____

(1)

(c) Some consumers will not buy tuna grown in this way.

Suggest **one** reason for their decision.

_____

_____

(1)

(Total 8 marks)

Q28.

The diagram shows what happens to some of the energy in the food that a chicken eats.

Energy in food, 84 kJ

Energy used for growth, 7 kJ
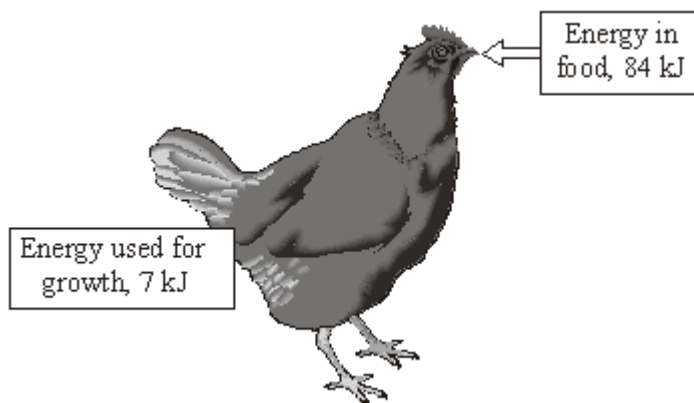
(a) Calculate the percentage of energy used for growth.

Show clearly how you work out your answer.

_____

_____

Energy used for growth = _____ %

(2)

(b) The energy that is not transferred into growth is lost.

Give **three** ways in which this energy is lost.

1. _____

2. _____

3. _____

(3)

(c) The pictures show two ways of keeping chickens to produce eggs.

Chickens kept outdoors (free-range)   Chickens kept in cages (battery chickens)
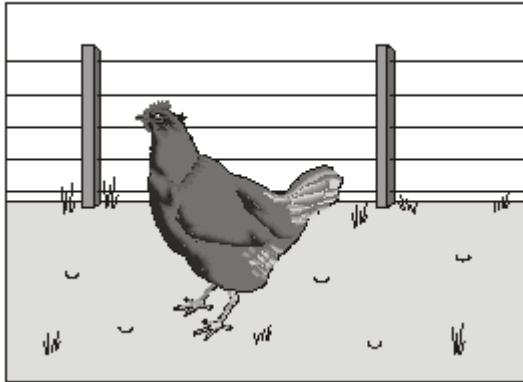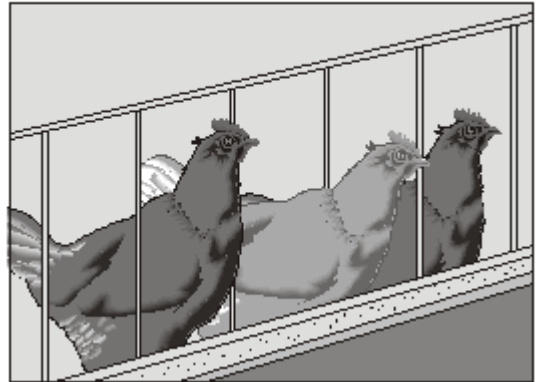
Battery chickens produce more eggs per year than free-range chickens.

Suggest **one** reason why.

_____

_____

(1)

(d) The animals that we raise for food are usually herbivores (plant eaters) rather than carnivores (flesh eaters).

Explain why.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q29.

The diagram shows a food chain in a pond. The figures show the amounts of energy in each type of organism, in kilojoules per m^2 of pond per year.

Plants		Herbivores		Carnivores		Top carnivores
88 000	→	14 000	→	1600	→	88
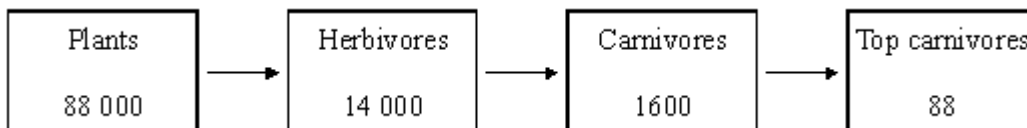
(a) Calculate the percentage of the energy in the plants that is passed to the top

carnivores. Show clearly how you work out your final answer.

_____

_____

_____

Answer _____ %

(2)

(b)   In the space below, draw a pyramid of biomass for this food chain. Label your drawing with the names of the organisms.

(2)

(c)   If humans ate organisms from this food chain, it would be more efficient to eat plants than to eat herbivores. Why is this?

_____

_____

_____

(1)
(Total 5 marks)

Q30.

This is a simple food chain.

Lettuce plant → Slug → Frog → Heron

The diagram shows a pyramid of biomass for this food chain.

....

....

....

....
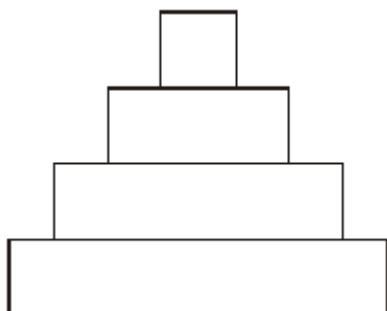
(a)   Write the names of the organisms in the food chain on the correct lines next to the pyramid of biomass.

(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.

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

_____

_____

_____

Amount of energy = _____ kJ

(2)

(Total 5 marks)

Q31.

Figure 1 shows a food chain containing three organisms.

Antelope

Grass

Lion

(not to scale)
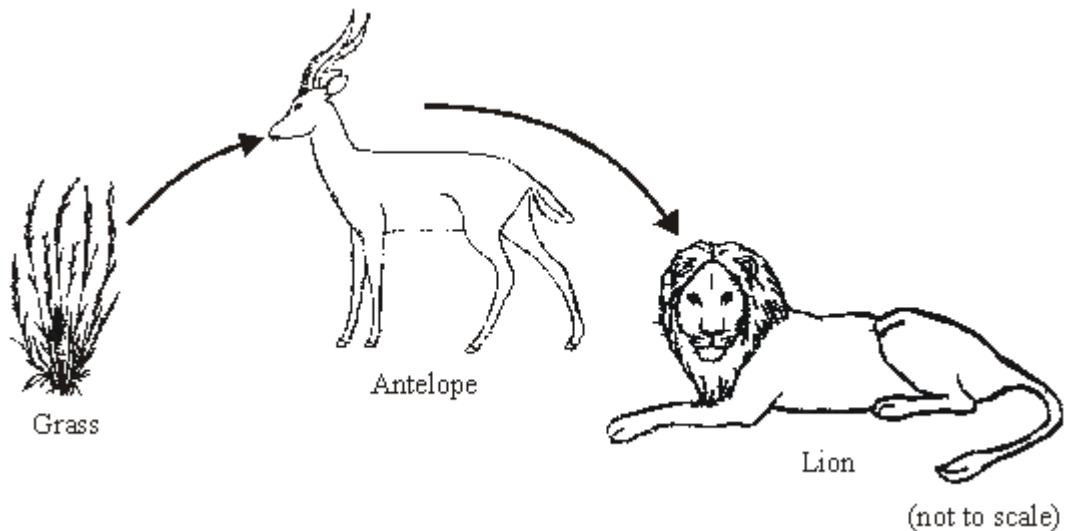
Figure 1

(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.**
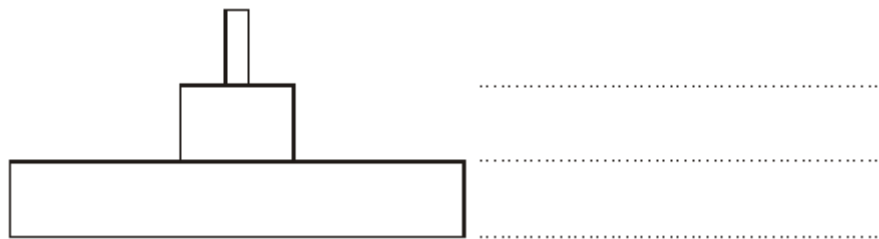
Figure 2

(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 ☐

Q32.

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)

Q33.

The diagram below shows a food web for a wood.

```
        owls          weasels          shrews


        voles      small birds      beetles


     insects       moths      other leaf      earthworms
                                 eaters


     herbs     trees and bushes      oak trees      leaf litter
```
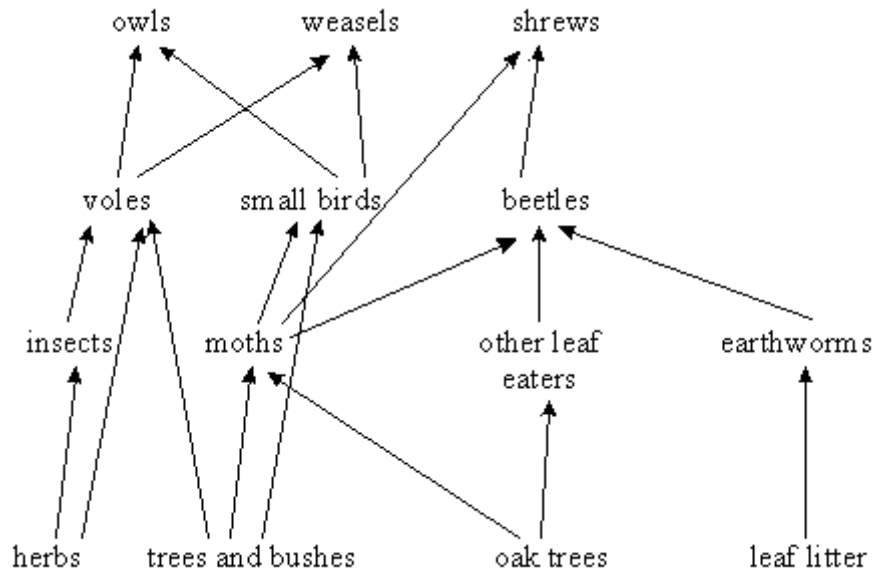
(a)   The diagrams below show a pyramid of the numbers and a pyramid of the biomass for 0.1 hectare of this wood.

Pyramid of Numbers
numbers/0.1 hectare

Pyramid of Biomass
biomass (grams per square metre)

```
2 ┤
      ┌─────────────────┐
      │   120 000    ├─X
   ┌──┴─────────────────┴──┐
   │        150 000        │
   └──┬─────────────────┬──┘
 200 ┤  └┐
         └──────────────Y
```

```
      │┐
      ││├─1
      │┘
      │├─2
 ┌────────────────────────────┐
 │           5 139            │
 └────────────────────────────┘
```
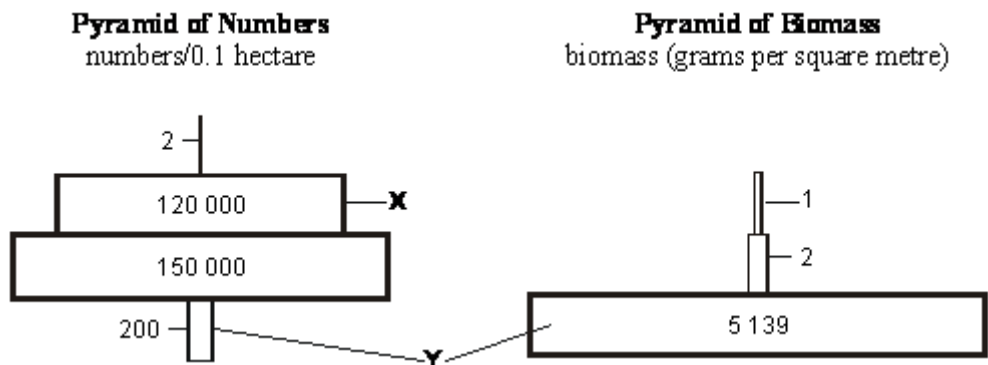
(i)   Name **one** organism from the level labelled X.

_____

(1)

(ii)   Explain, as fully as you can, why the level labelled Y is such a different width in the two pyramids.

_____

_____

_____

_____

(3)

(b)   Explain, as fully as you can, what eventually happens to energy from the sun which is captured by the plants in the wood.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(10)

(Total 14 marks)

Q34.

The diagram below shows a food web for some of the organisms which live in a pond.
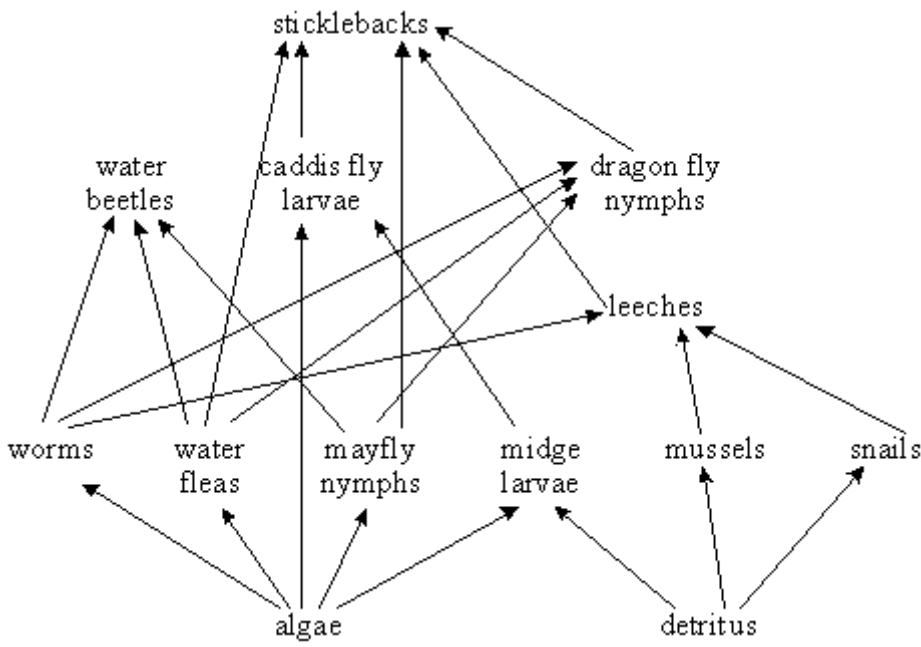
You may need to use information from the food web to help you to answer the following questions.

(a)   The algae photosynthesise.   Complete the equation for photosynthesis.

carbon dioxide	+		+	light energy	→	sugar	+	

(2)

(b)   Only a small percentage of the Sun's energy captured by the algae is eventually incorporated into the body tissues of the stickleback. Explain, as fully as you can, what happens to the rest of the energy captured by the algae.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(8)
(Total 10 marks)

Q35.

The diagram below shows a food web for some of the organisms which live in a pond.

(a)   (i)   Name **one** secondary consumer in this food web.

_____

(ii)   The algae are small green plants.

Give **three** conditions needed by green plants to produce sugars.

1. _____

2. _____

3. _____

(3)

(b)   This is a pyramid of biomass for the organisms in the aquarium.

Tertiary consumers

Secondary consumers

Primary consumers
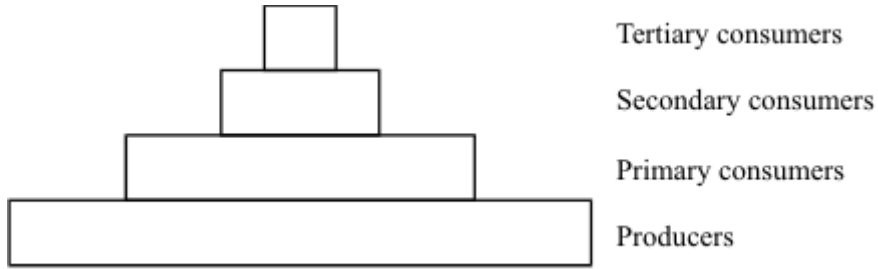
Producers

Some of the biomass of the producers is **not** transferred to the tertiary consumers.

Explain, as fully as you can, what happens to this biomass.

(6)
(Total 10 marks)

Q36.

A gardener pulled up weeds and used them to start a compost heap. The compost heap soon became colonised by large numbers of earthworms and slugs. The gardener then noticed a hedgehog rooting through the compost heap, eating the earthworms and slugs. Every so often the hedgehog stopped to scratch itself. This was because it had large numbers of fleas which fed by sucking the hedgehog's blood.

(a)   Use **only** information from the passage to answer the following.

Construct and label a pyramid of **biomass** for your food chain.

(2)

(b)   Gardeners put plant material onto compost heaps so that it will decay. They then put the decayed compost onto soil where they are growing their plants.

Give **three** conditions which are needed for plant material to decay rapidly.

1. _____

2. _____

3. _____

(3)

(Total 5 marks)

Q37.

An oak wood contained the following:

200 oak trees

150 000 primary consumers

120 000 secondary consumers

(a)   Draw and label a pyramid of biomass for **this** wood. (Your pyramid does **not** have to be drawn to scale.)

(2)

(b)   A scientist estimated the total amount of energy flow through each level of the pyramid per year.

The results were:

Energy absorbed by oak trees   4 600 000 kJ per m^2 per year

Energy in sugar produced by trees   44 000 kJ per m^2 per year

Energy transferred to primary consumers   2 920 kJ per m^2 per year

Energy transferred to secondary consumers   700 kJ per m^2 per year

(i)   Calculate the percentage of the energy absorbed by the trees that is transferred to sugar by photosynthesis. Show your working.

Answer _____ %

(2)

(ii)   Suggest **two** reasons why a large proportion of the energy is not transferred to sugar.

1. _____

_____

2. _____

_____

(2)

(iii)   Give **three** reasons why some of the energy in the primary consumers is not passed on to the secondary consumers.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 9 marks)

Q38.

(a)   The diagram shows what happens to each 1000 kJ of light energy absorbed by plants growing in a meadow.

1000 kJ light energy absorbed during photosynthesis

respiration 200 kJ

death and decomposers 600 kJ

transferred to herbivores

respiration and faeces

transferred to carnivores 20 kJ
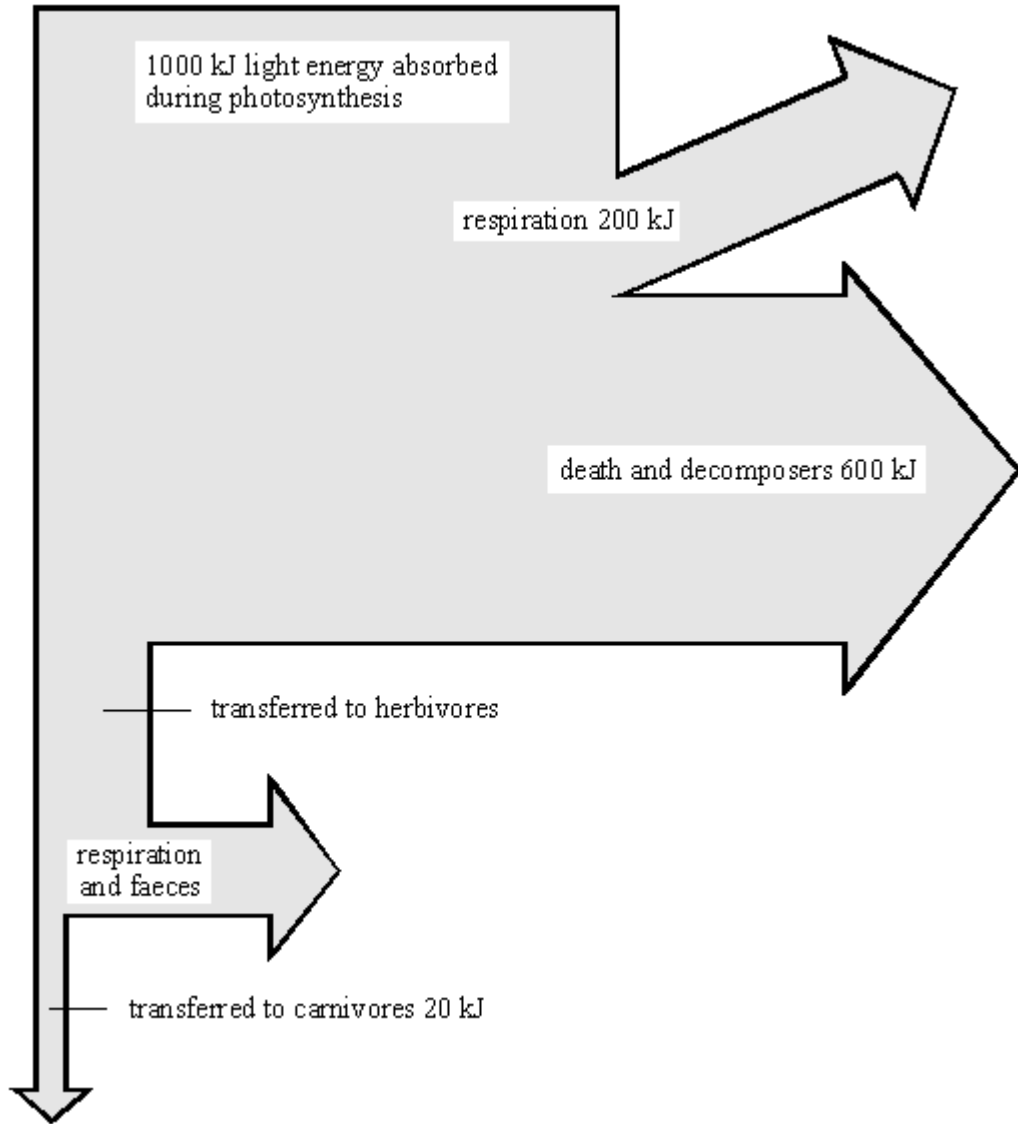
Use the information from the diagram to calculate:

(i)   how much energy was transferred to herbivores;

_____ kJ

(1)

(ii)   the percentage of the energy absorbed during photosynthesis that was eventually transferred to carnivores. Show your working.

_____ %

(2)

(b)   The table gives the energy output from some agricultural food chains.

FOOD CHAIN	ENERGY AVAILABLE TO HUMANS FROM FOOD CHAIN (kJ PER HECTARE OF CROP)
cereal crop ⇒ humans	800 000
cereal crop ⇒ pigs ⇒ humans	90 000
cereal crop ⇒ cattle ⇒ humans	30 000

Explain why the food chain *cereal crop* ⇒ *humans* gives far more energy than the other two food chains.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c)   The amounts of energy available to humans from the food chain
cereal crop ⇒ *pigs* ⇒ *humans*
can be increased by changing the conditions in which the pigs are kept.

Give **two** changes in conditions which would increase the amount of energy available. In each case explain why changing the condition would increase the available energy.
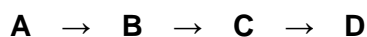
Change of condition 1 _____

Explanation _____

_____

_____

Change of condition 2 _____

Explanation _____

_____

(4)
(Total 10 marks)

Q39.

A food chain has four organisms, **A**, **B**, **C** and **D**.

$$A \rightarrow B \rightarrow C \rightarrow D$$

The table shows the amount of energy transferred by each organism in one year.

Organism	Energy transferred in kJ per year
A	87 000
B	14 000
C	1600
D	70

Explain, as fully as you can, why organism **D** would transfer much less energy than organism **A**.

_____

_____

_____

_____

_____

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_____

_____

(Total 5 marks)

Q40.

Energy is stored in the materials that make up organisms. These materials are called

biomass.

Organisms in food chain	Rose plant	→	Greenfly	→	Ladybird	→	Blackbird
Biomass in g/m^2	600		50		10		1

(a)   Complete the pyramid of biomass for this food chain. The rose plant has been done for you. You should draw the rest of the pyramid to the same scale. (5 small squares = 50 g/m^2.)
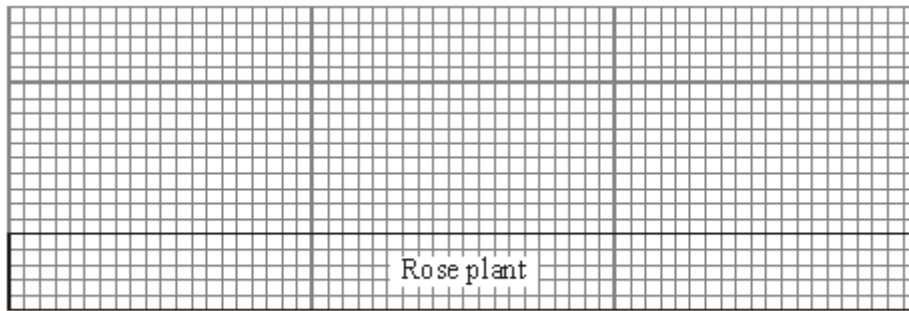
Biomass in g/m²

(3)

(b)   What proportion of the energy in a rose plant is transferred to greenfly?
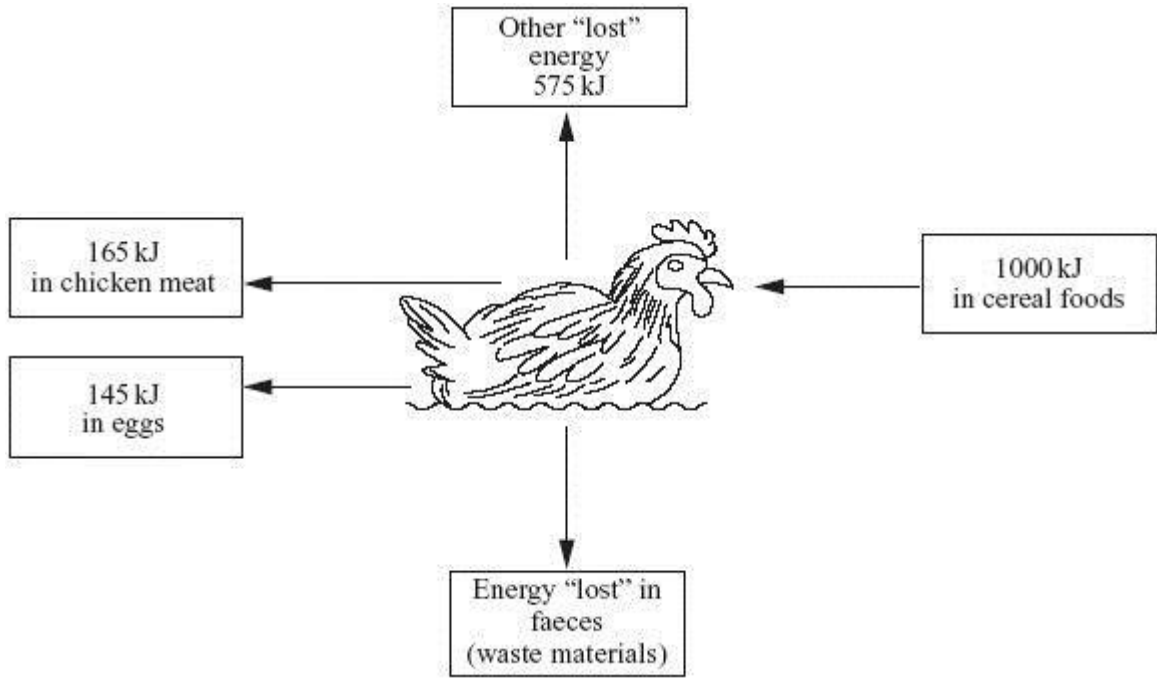
_____

_____

_____

Proportion = _____

(2)

(Total 5 marks)

Q41.

Chickens are kept as farm animals to produce food. Free-range chickens are allowed to feed in a large space outside. The diagram shows how energy supplied in food to a free-range chicken is transferred.

(a) Calculate the amount of energy "lost" in faeces.

_____

_____

Energy "lost" = _____ kJ

(1)

(b) Some farmers use the battery method. They keep large numbers of chickens in a small indoor space. The food yield from these chickens is higher than that from free-range chickens. Explain why, as fully as you can.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 5 marks)

Q42.

The information in the table compares two farms. Both are the same size, on similar land, close to one another and both are equally well managed.

Name of farm	Activity	Energy value of food for humans produced in	Number of people whose energy requirements

		one year	can be met by this food
Greenbank Farm	Grows food for humans	3285 million kJ	720
Oaktree Farm	Grows food for animals on the farm which become food for humans	365 million kJ	80

(a)   Use this information to work out the average daily human energy requirement in kilojoules (kJ) per day.

_____

_____

Energy requirement = _____ kJ/day

(2)

(b)   The figures show that farms like Greenbank Farm can be nine times more efficient at meeting human food energy requirements than farms such as Oaktree Farm.

(i)   The food chain for Greenbank Farm is:

vegetation   →   humans

What is the food chain for Oaktree Farm?

_____

(1)

(ii)   Explain why Greenbank Farm is much more efficient at meeting human food energy requirements.
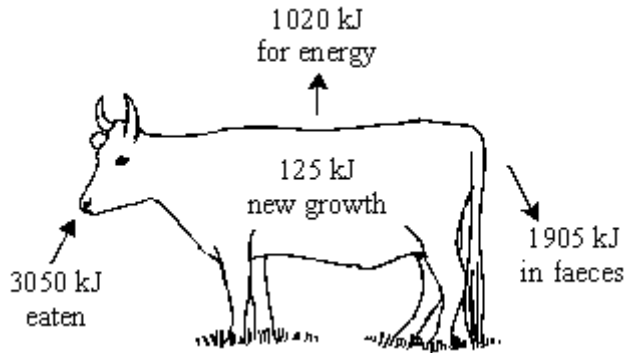
_____

_____

_____

_____

_____

(3)

(c)   The human population has been increasing rapidly throughout this century. It is now about 6 billion and is still growing. What does the information in this question suggest about likely changes in the human diet which may need to occur during the coming century? Explain your answer.

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q43.

Compare the efficiency of these two food chains.

Food chain **A**   grain → humans

Food chain **B**   grain → bullocks → humans

In your answer, make **full use** of the following data.

Food	Consumer	Percentage of available energy transferred as useful energy
Grain	Human	9%
Grain	Bullock	12%
Bullock	Human	10%

One kilogram of grain has 80 000 kJ of available energy.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q44.

(a)   1m² of a field gets about 1050MJ of light energy per year.

Only 21 500kJ of energy is stored in the new grass.

(i)   How is the energy stored in the new grass?

_____

(1)

(ii)   What is the % of light energy stored in the grass?

_____

_____

_____

(1)

(b)

1020 kJ
for energy

125 kJ
new growth

1905 kJ
in faeces

3050 kJ
eaten

The diagram shows what happens to the energy from grass in part of a field which is grazed by a bullock.

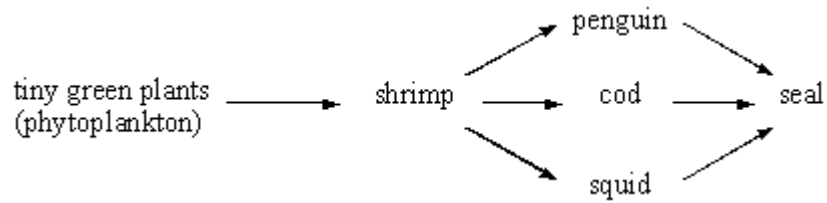Using information in the diagram suggest why food chains are usually short.

_____

_____

_____

_____

_____

(3)

(c)   Many of the animals which from part of our diet are herbivores rather than carnivores. Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

(3)
(Total 8 marks)

Q45.

Scientists have found the following food web in the Antarctic Ocean.

penguin

tiny green plants ⟶ shrimp ⟶ cod ⟶ seal
(phytoplankton)

squid

(a) (i) Write down the name of the producer in this web.

_____

(ii) Write down the names of **two** organisms which are prey in this web.

_____

_____

(3)

(b) Humans are removing large numbers of the cod.
Some scientists argue that this could lead to a decrease in the numbers of squid
and penguins.
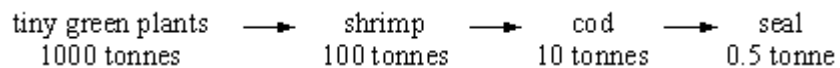Others argue that the numbers of squid and penguins will stay the same.

Carefully explain each argument.

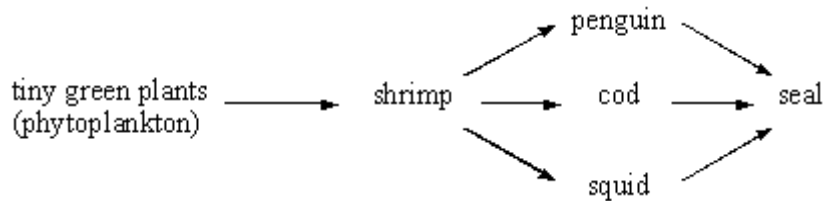Why they might decrease.

_____

_____

_____

Why they might stay the same.

_____

_____

_____

(2)

(c) The following information is about the biomass of the organisms in one of the food
chains in the web.

tiny green plants ⟶ shrimp ⟶ cod ⟶ seal
1000 tonnes 100 tonnes 10 tonnes 0.5 tonne

Draw and label a pyramid of biomass for this chain.

Q46.

Scientists have found the following food web in the cold Antarctic Ocean.

(a)   Humans are removing large numbers of the cod.

Some scientists argue that this could lead to a decrease in the numbers of squid and penguins.

Others argue that the numbers of squid and penguins will stay the same.
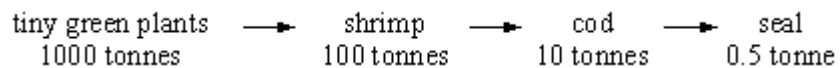
Carefully explain each argument.

Why they might decrease.

_____

_____

_____

(1)

Why they might stay the same.

_____

_____

_____

(2)

(b)   The following information is about the biomass of the organisms in one of the food chains in the web.

tiny green plants ⟶ shrimp ⟶ cod ⟶ seal
1000 tonnes   100 tonnes   10 tonnes   0.5 tonne

Draw and label a pyramid of biomass for this chain.

(c)   Explain, as fully as you can, why the conversion of shrimp biomass into cod biomass is more efficient than that of cod biomass into seal biomass in the cold Antarctic Ocean.

_____

_____

_____

_____

(3)

(d)   Boats from many countries fish the Antarctic Ocean. The cod are being overfished. If the numbers of cod are to increase, the population must be carefully managed.

(i)   Suggest **two** control measures which would prevent a further drop in numbers,

_____

_____

(2)

(ii)   Suggest why **one** of your control measures would be difficult to put into practice.

_____

_____

(1)
(Total 11 marks)