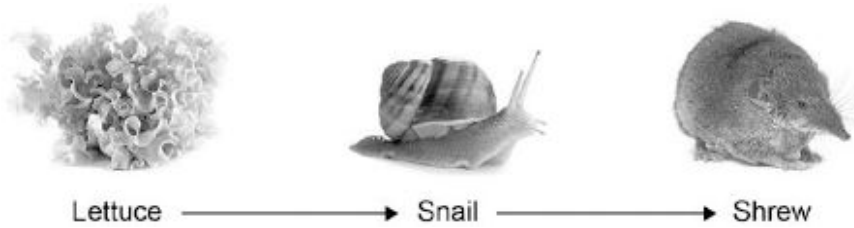


1 The diagram below shows a food chain in a garden.



Lettuce © destillat/iStock/Thinkstock; Snail © Valengilda/iStock/Thinkstock; Shrew © GlobalIT/iStock/Thinkstock

(a) Name **one consumer** shown in the diagram above.

.....

(1)

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

.....

(1)

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

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

.....

.....

(1)

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community

Ecosystem

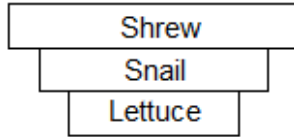
Population

Territory

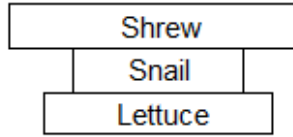
(1)

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

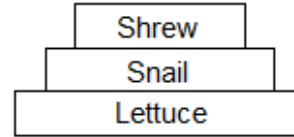
Tick **one** box.



A



B



C

(1)

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

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

Calculate the energy transferred to the snails from the lettuces.

.....

Energy = kJ

(1)

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

Tick **one** box.

The lettuces carry out photosynthesis

The snails do not eat the roots of the lettuces

Not all parts of a snail can be eaten

(1)

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

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

.....

(1)

(Total 8 marks)

2

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

(a) The diagram below shows a food chain.



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.

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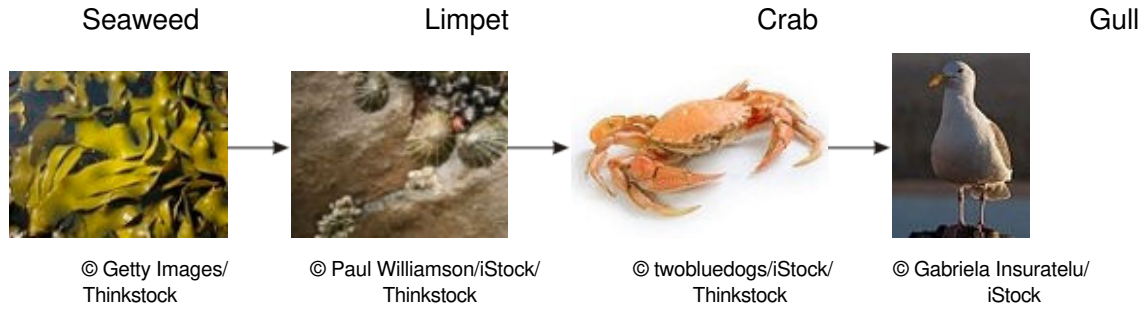
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(3)
(Total 6 marks)

3

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



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)

4

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.

.....

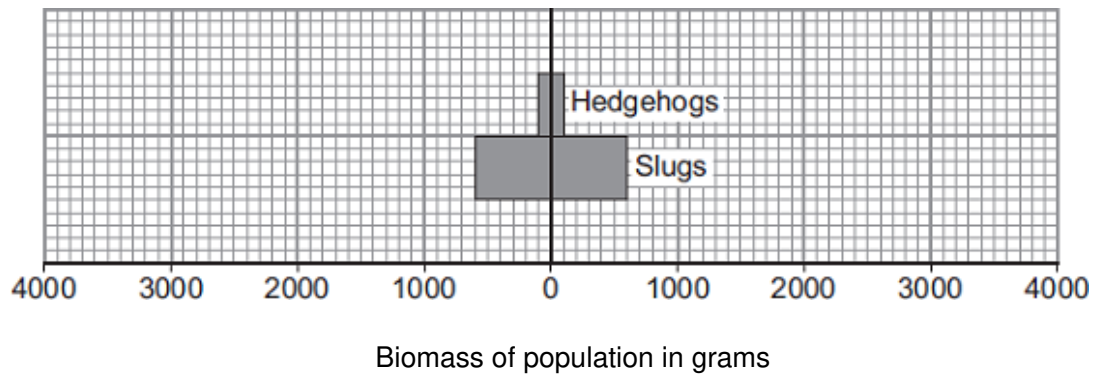
.....

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.



(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.

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(3)
(Total 7 marks)

5 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:



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

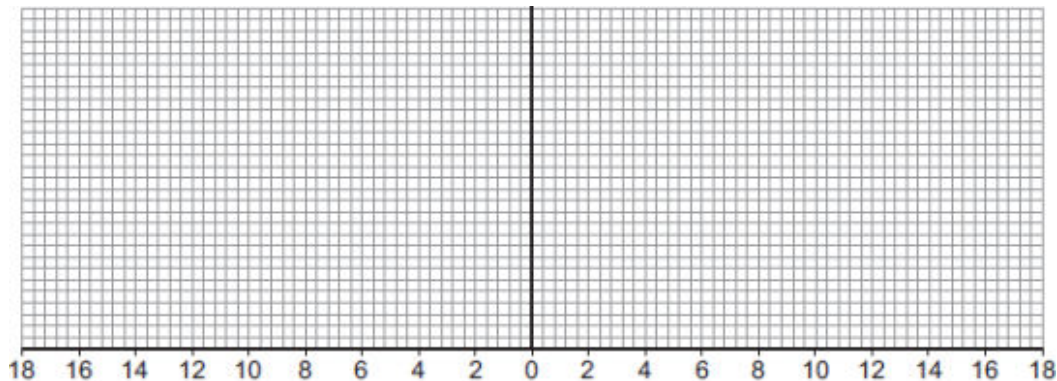
(i) Complete the table by calculating the total biomass of red kites and of field mice.

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.

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(2)

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

Suggest **two** reasons why.

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.....

(2)
(Total 10 marks)

6

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.



© 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.

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(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

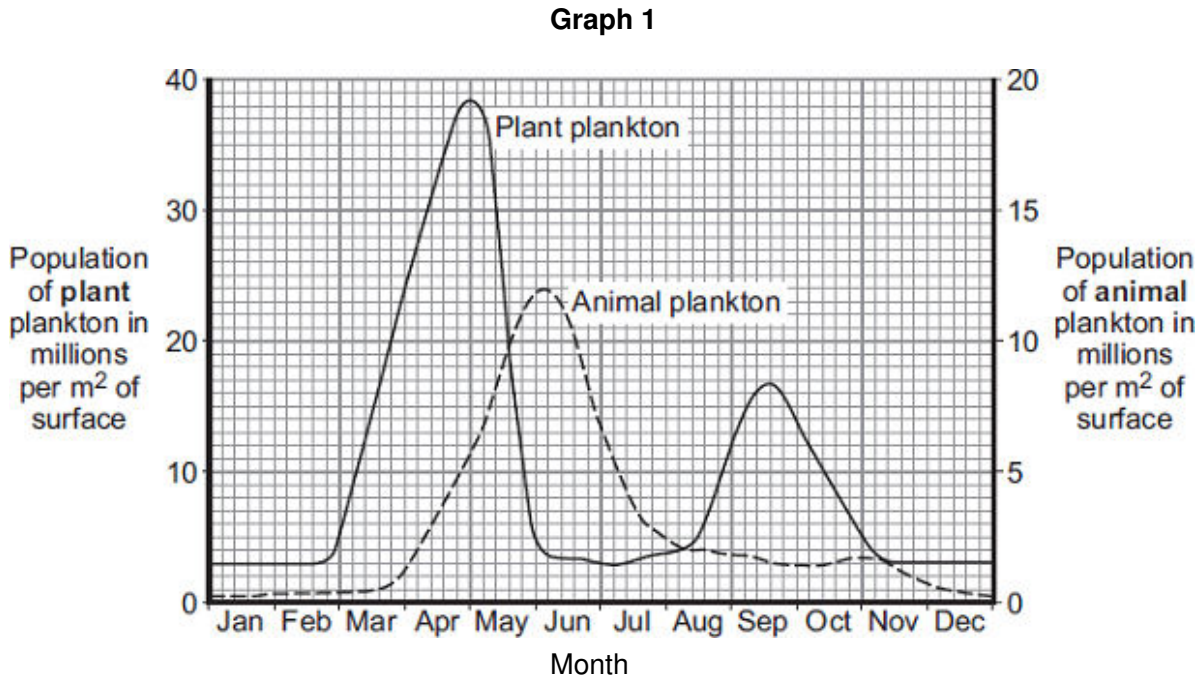
Peppered moth larvae do not eat all the leaves from the trees

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

(2)
(Total 9 marks)

- 7** 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.



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

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

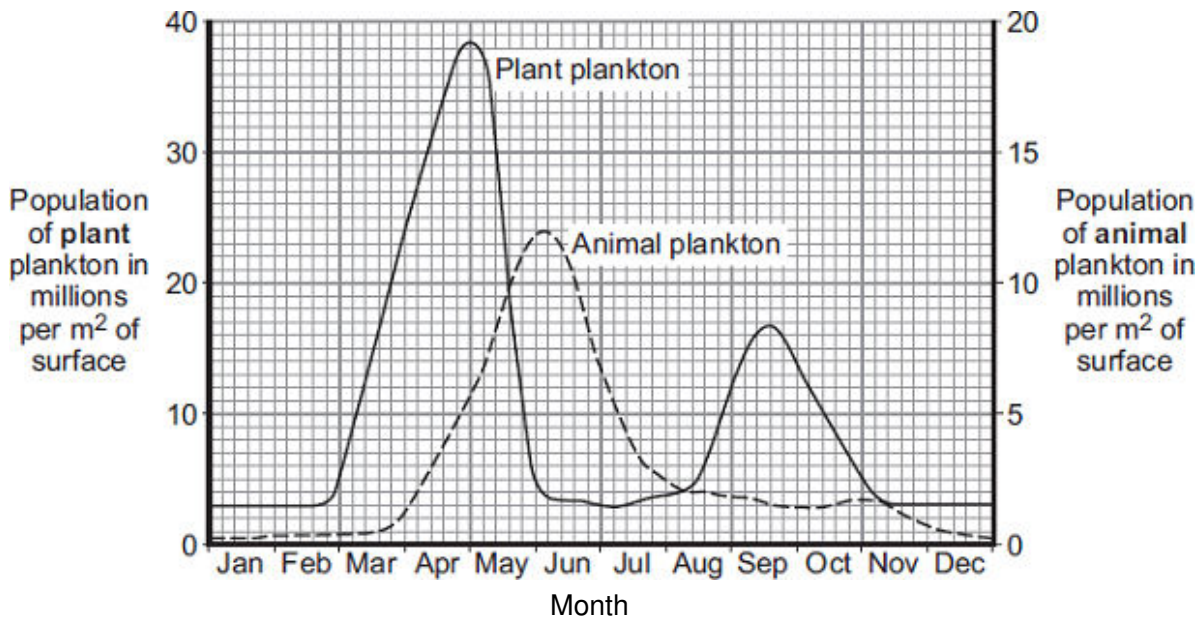
Which is the correct shape for the pyramid of biomass to show the relationship between plant plankton, animal plankton and basking sharks, in June?

Tick (✓) **one** box.

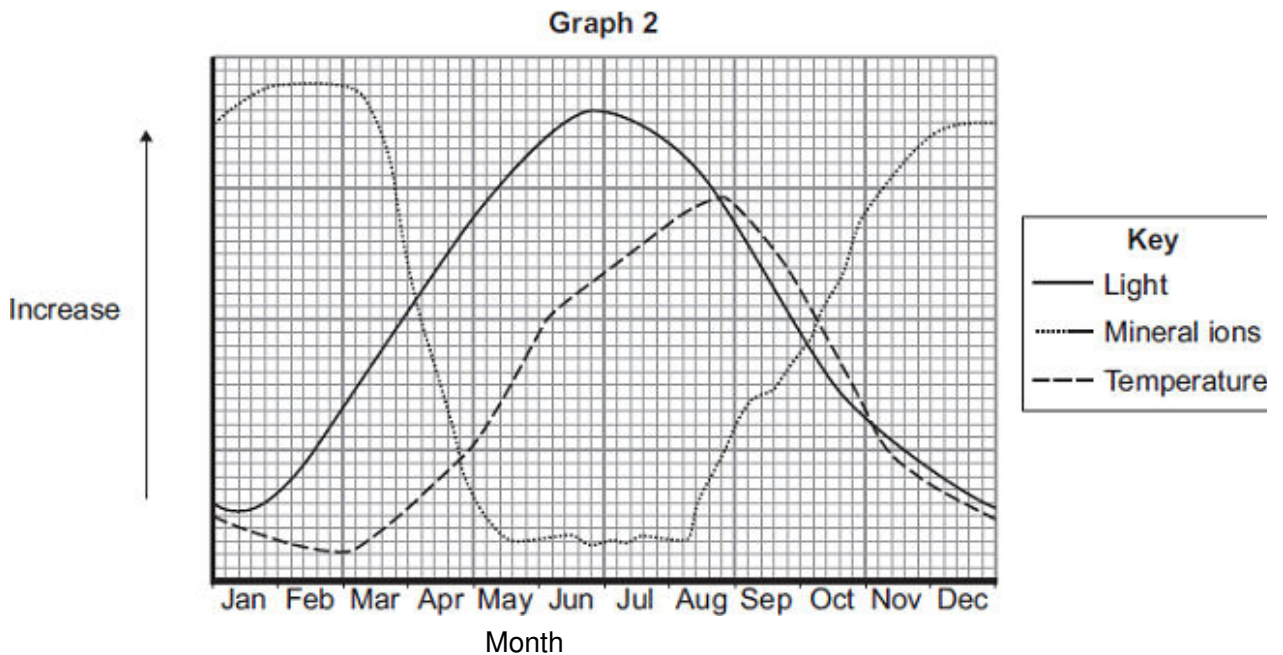
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(1)

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.



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

Suggest **one** reason for the increase.

Explain your answer.

.....

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.....

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

Suggest explanations for the changes.

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(2)

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

Suggest explanations for the changes.

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(3)

(Total 8 marks)

8

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.

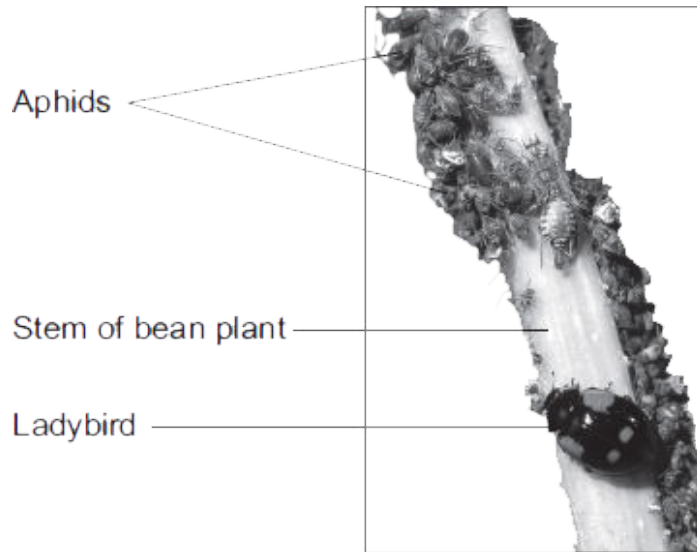
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(6)
(Total 8 marks)

9

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.

.....

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(2)

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

Describe this part of the carbon cycle.

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(4)
(Total 8 marks)

10

The photographs show four ways of farming.

Growing wheat



Keeping sheep outside



Keeping pigs outside

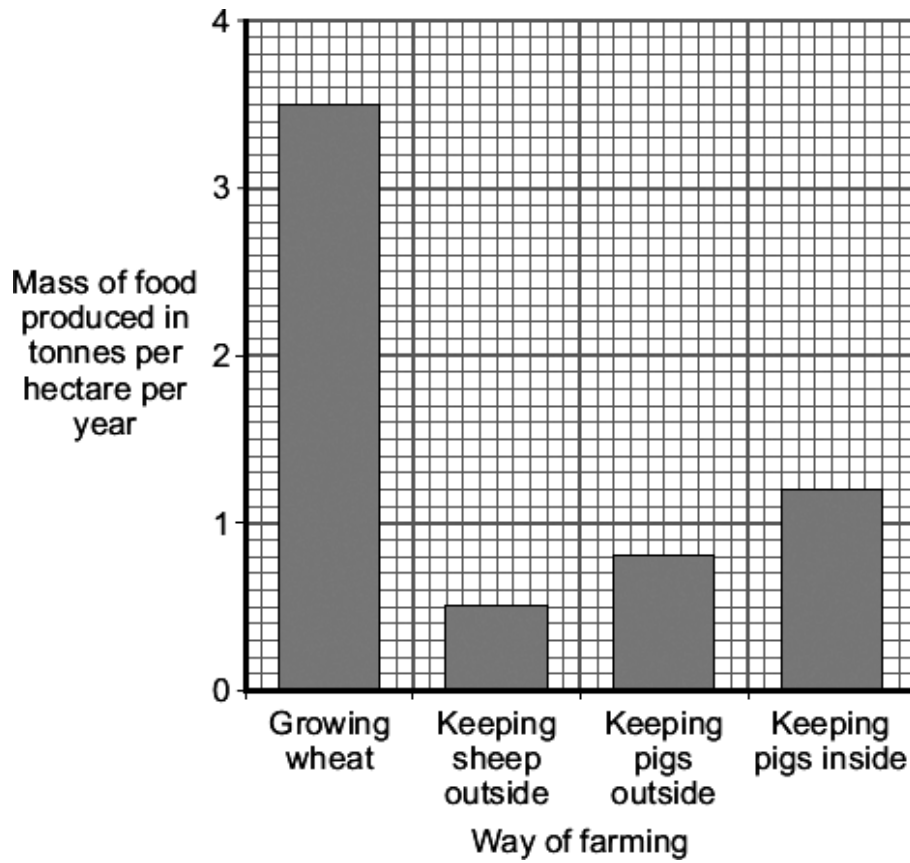


Keeping pigs inside



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.

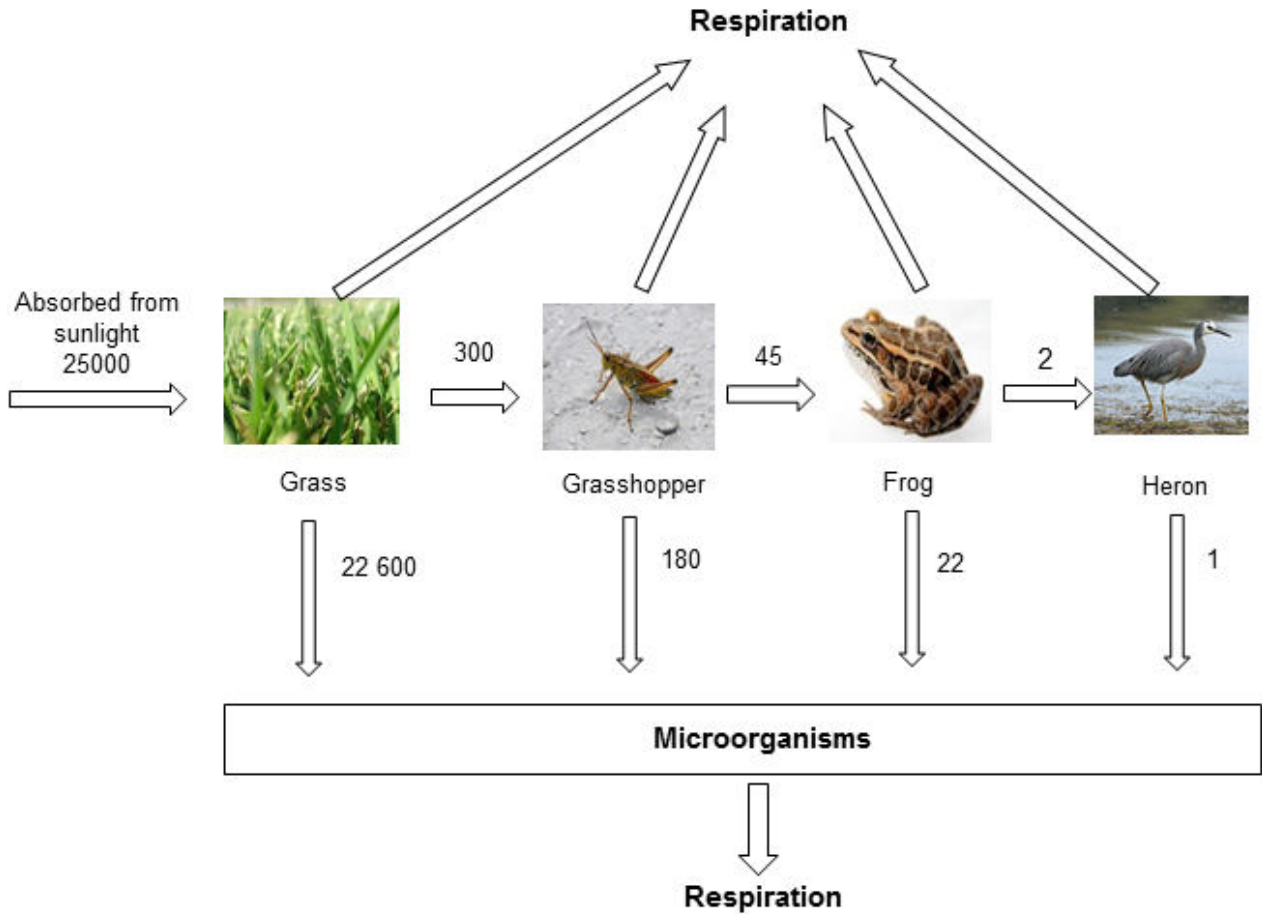
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(1)
(Total 7 marks)

11

The diagram shows the annual energy flow through 1 m² of a habitat.

The unit, in each case, is kJ per m² 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 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.

12

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 \longrightarrow caterpillar \longrightarrow blue-tit \longrightarrow hawk

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

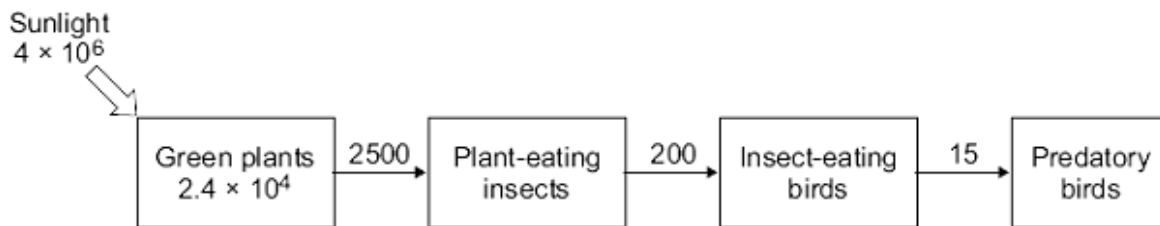
Tick (✓) **two** boxes.

- 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)

13 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.

.....
.....
.....
.....
.....
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.....
.....

(3)

(Total 7 marks)

14

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 by Pirhan [CC BY-SA 2.0], via Flickr. Traditional cattle farming by Mat Fascione[CC-BY-SA-2.0], via Wikimedia Commons

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

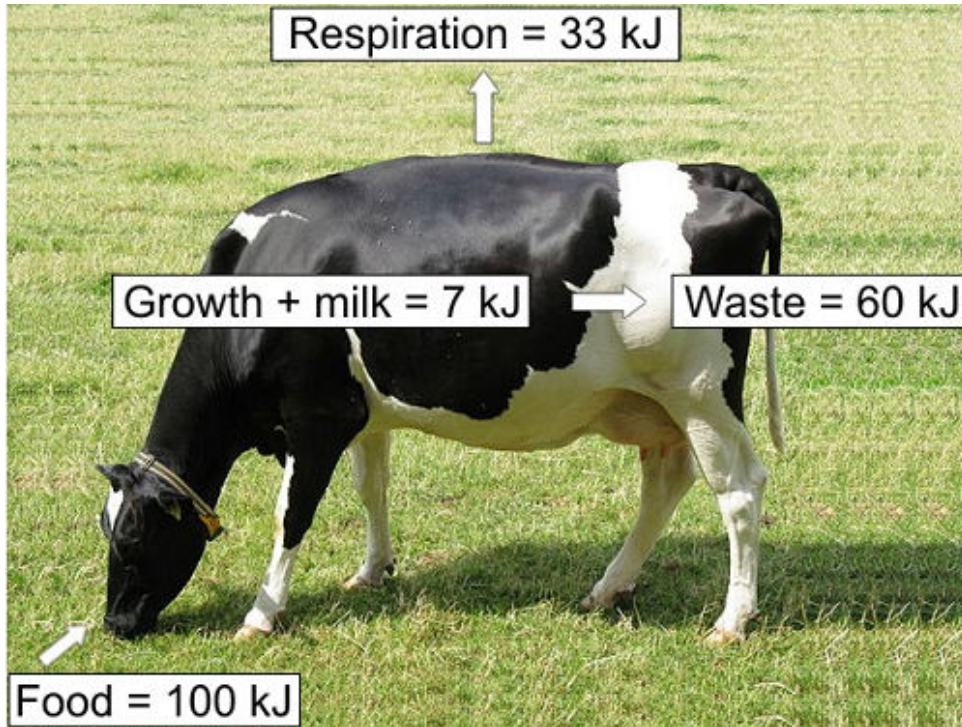
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2

.....

(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)

15

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.

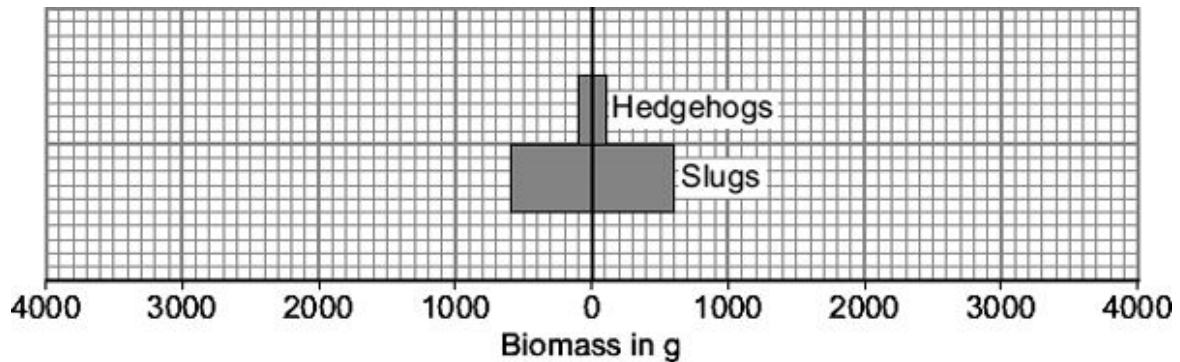
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Biomass = g

(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.

.....

.....

.....

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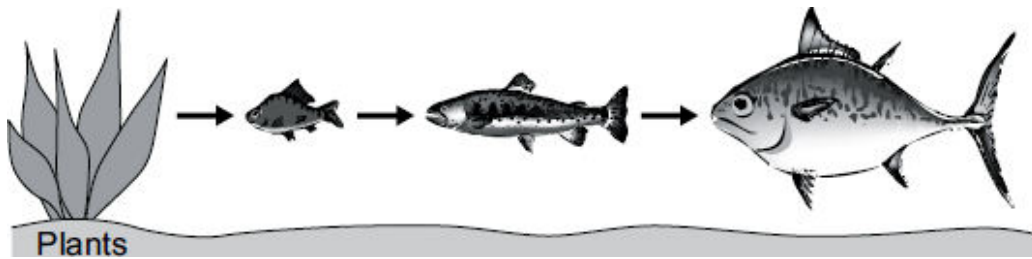
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(3)
(Total 7 marks)

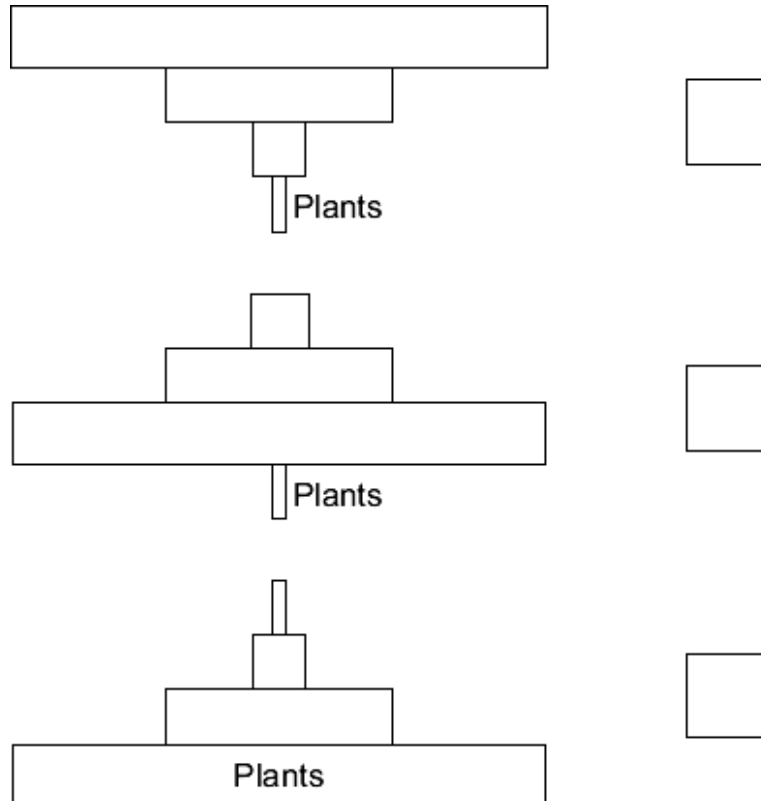
16

The picture shows a food chain.



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

Tick (✓) **one** box.



(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)

17

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

Both animals feed mainly on grass.

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

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

Show clearly how you work out your answer.

.....

.....

.....

Answer = %

(2)

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

Explain why as fully as you can.

You should include references to the data in your answer.

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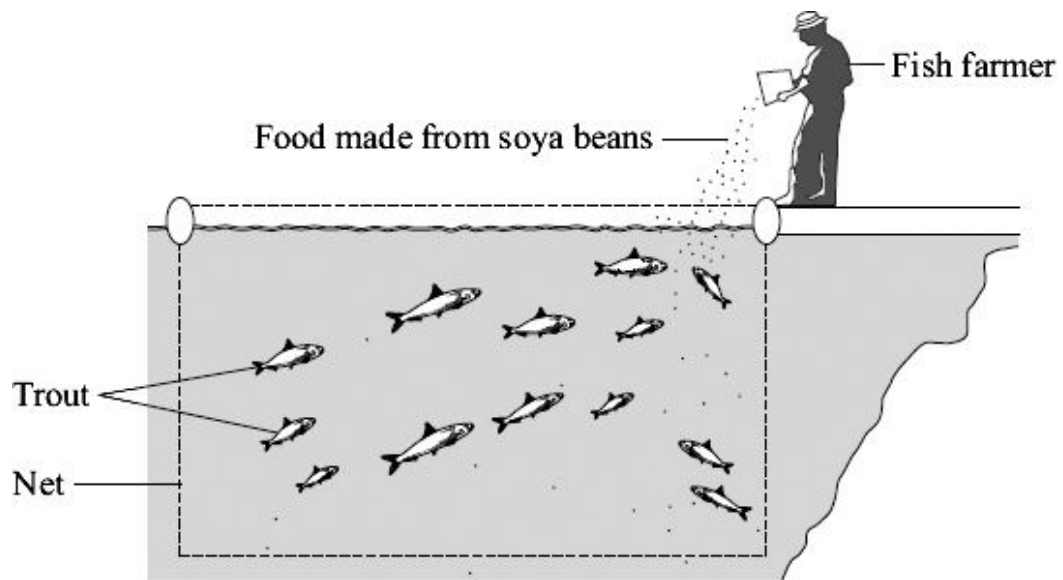
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.....

(3)
(Total 5 marks)

18

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.

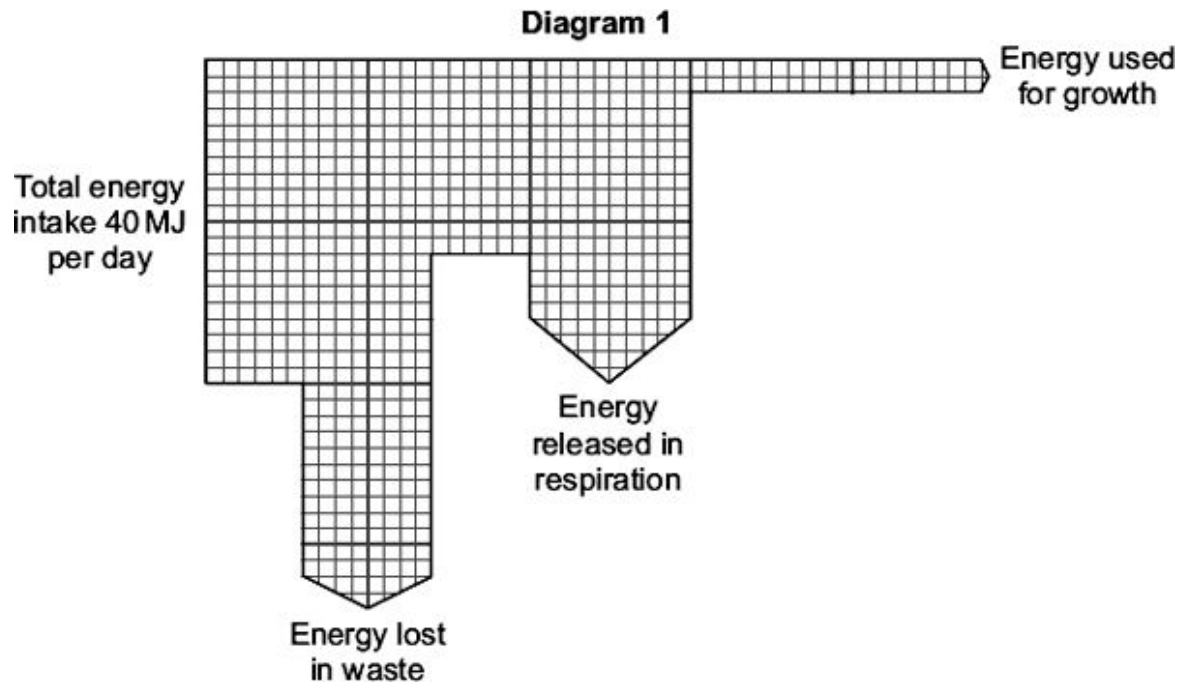
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(2)

(Total 7 marks)

19

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



- (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)

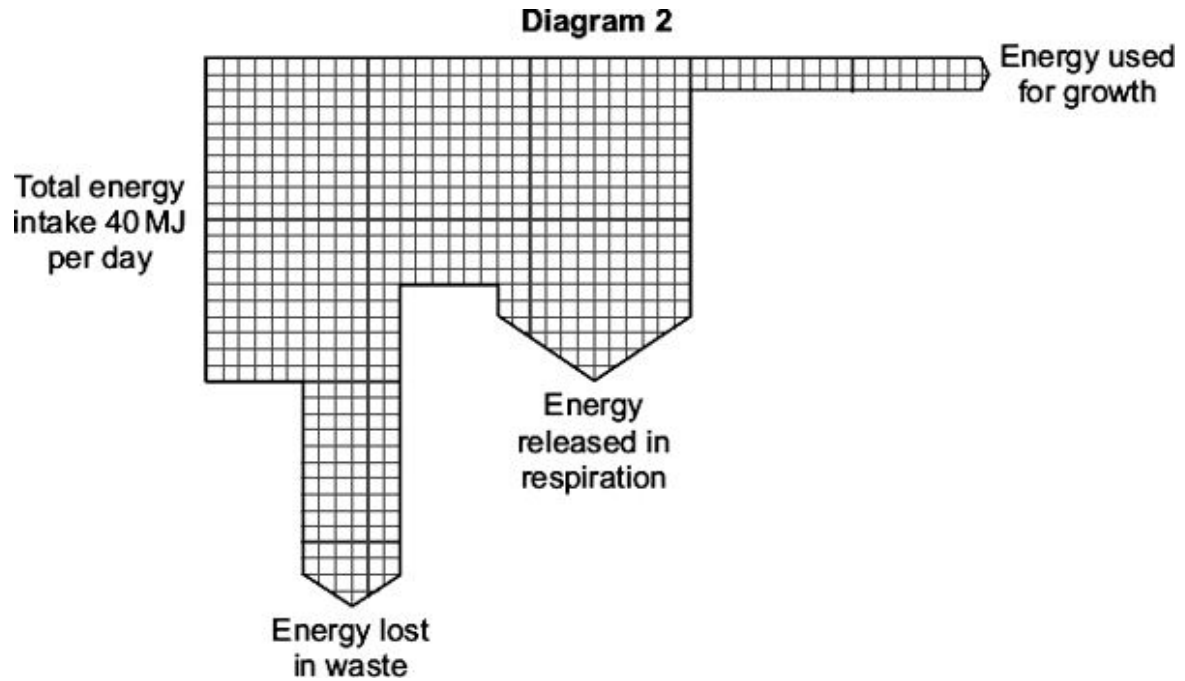
- (b) Give **two** ways in which the energy, released in respiration, is used by a herbivore.

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).



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

.....

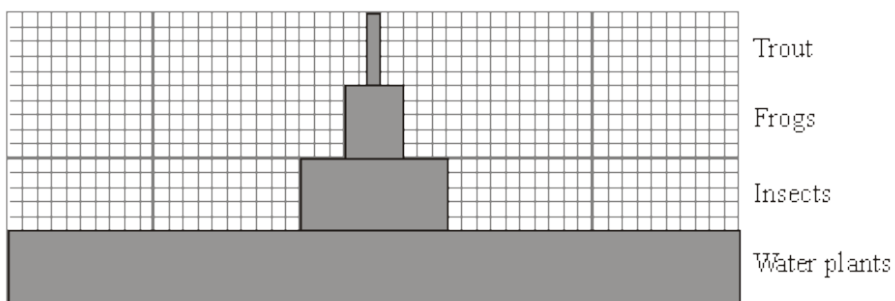
2

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(2)
(Total 8 marks)

20

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.

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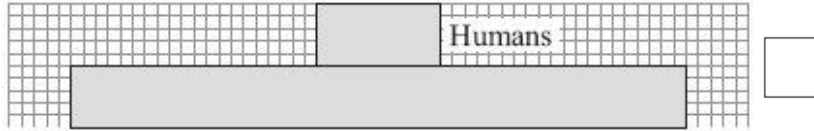
(4)
(Total 9 marks)

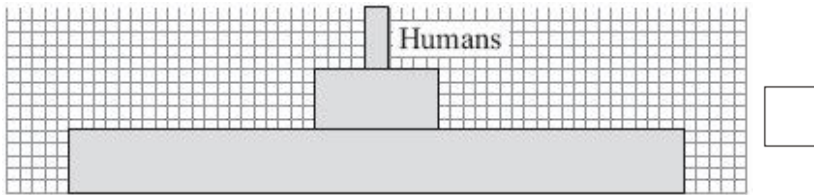
21

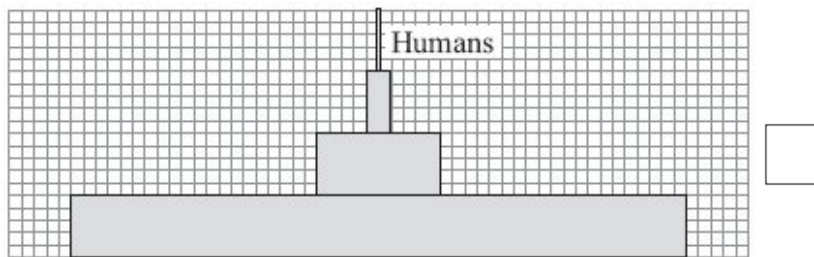
(a) The diagrams show three pyramids of biomass.

(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.

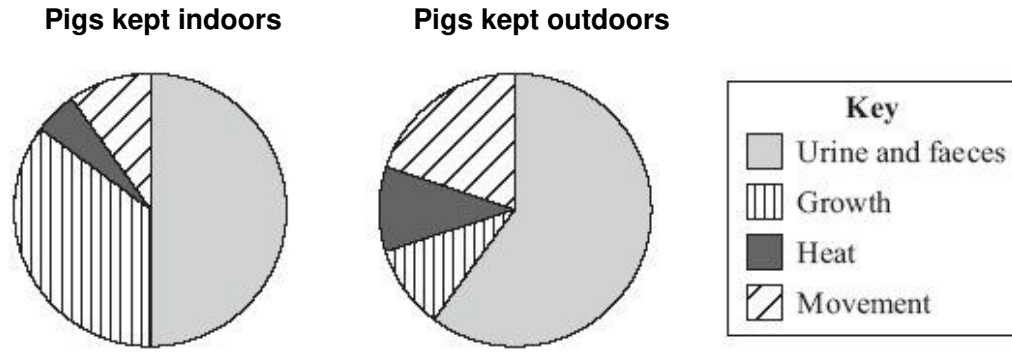
Pigs kept indoors



Pigs kept outdoors



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



- (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.

.....

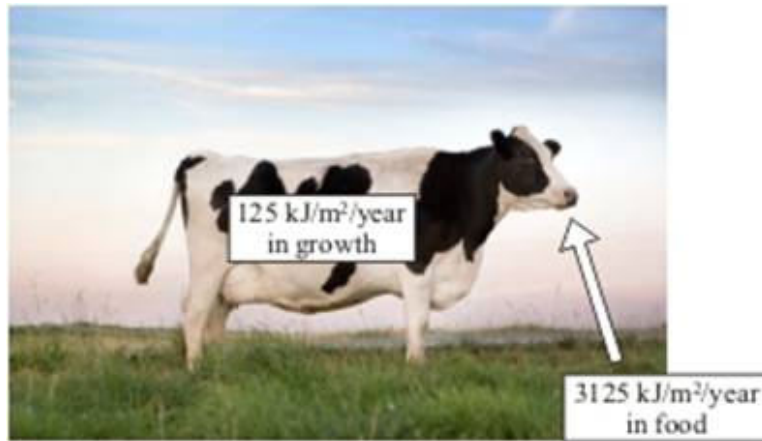
.....

(1)

(Total 5 marks)

22

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



- (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.

.....

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.....

(2)
(Total 7 marks)

23

- (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

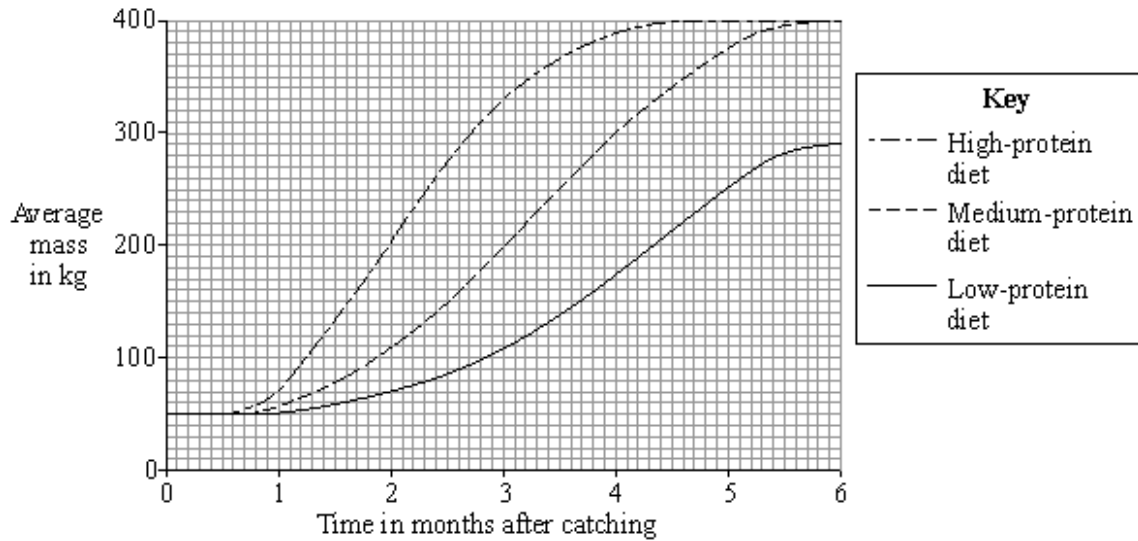
.....

(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.

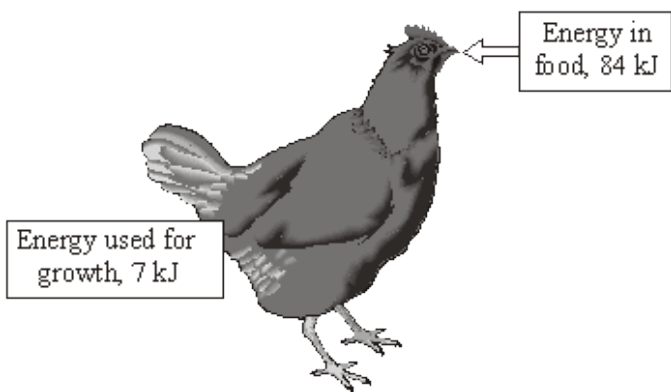
Suggest **one** reason for their decision.

.....
.....

(1)
(Total 8 marks)

24

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



(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.

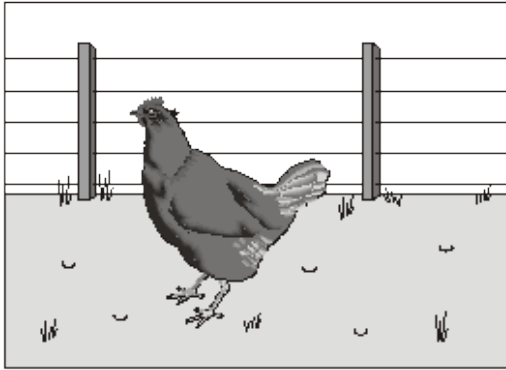
Give **three** ways in which this energy is lost.

- 1
- 2
- 3

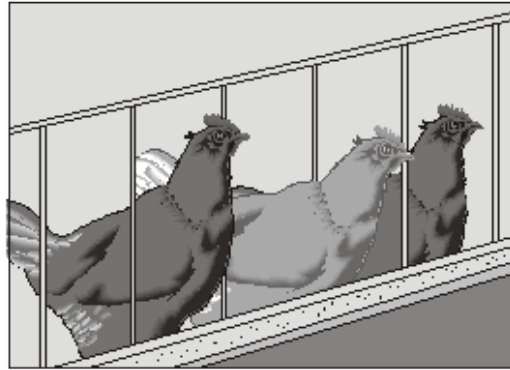
(3)

(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.

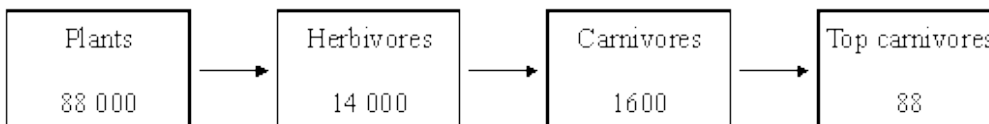
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(2)

(Total 8 marks)

25

The diagram shows a food chain in a pond. The figures show the amounts of energy in each type of organism, in kilojoules per m² 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)

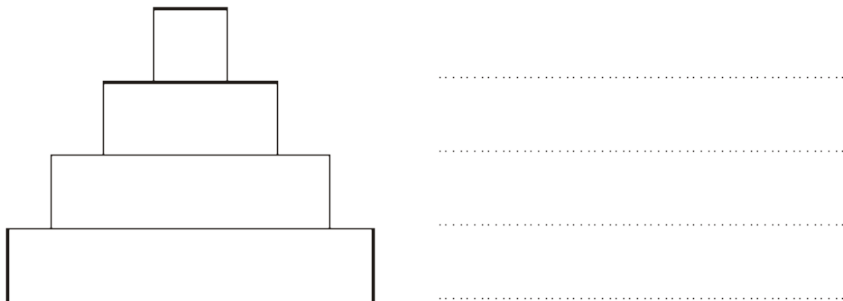
(Total 5 marks)

26

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)

27

Figure 1 shows a food chain containing three organisms.

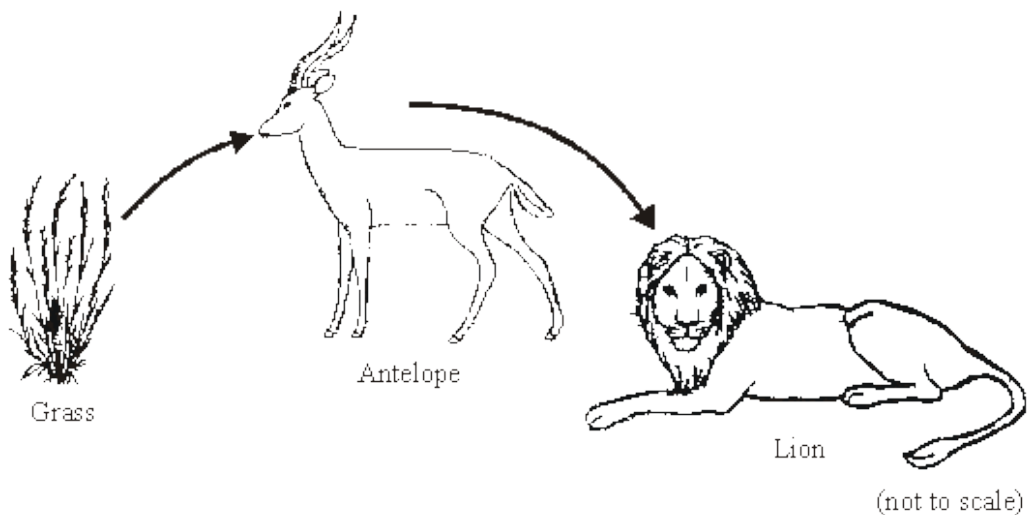


Figure 1

- (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** **nitrites** **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**.

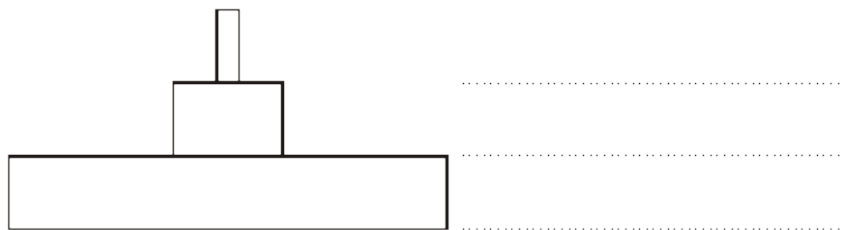


Figure 2

(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)

28

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

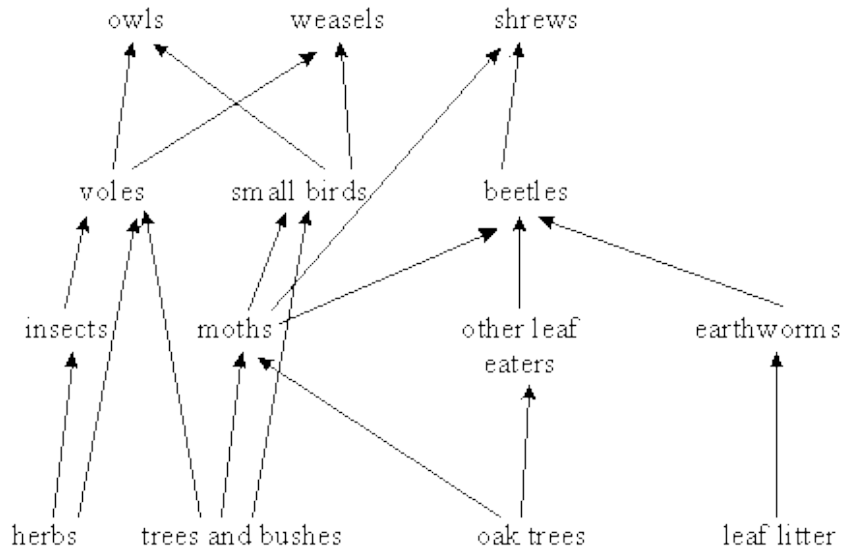
(2)

(b) Give **three** reasons why so little of the energy in the trees is passed on to the carnivores.

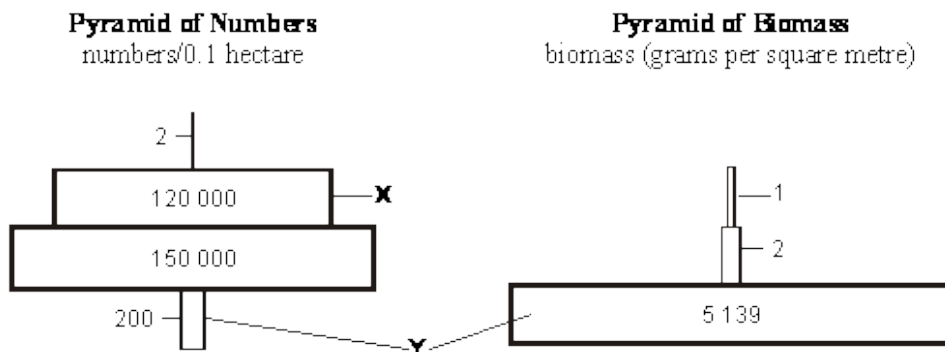
- 1
-
- 2
-
- 3
-

(3)
(Total 5 marks)

29 The diagram below shows a food web for a wood.



(a) The diagrams below show a pyramid of the numbers and a pyramid of the biomass for 0.1 hectare of this wood.



(i) Name **one** organism from the level labelled X.

.....

(1)

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

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(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.

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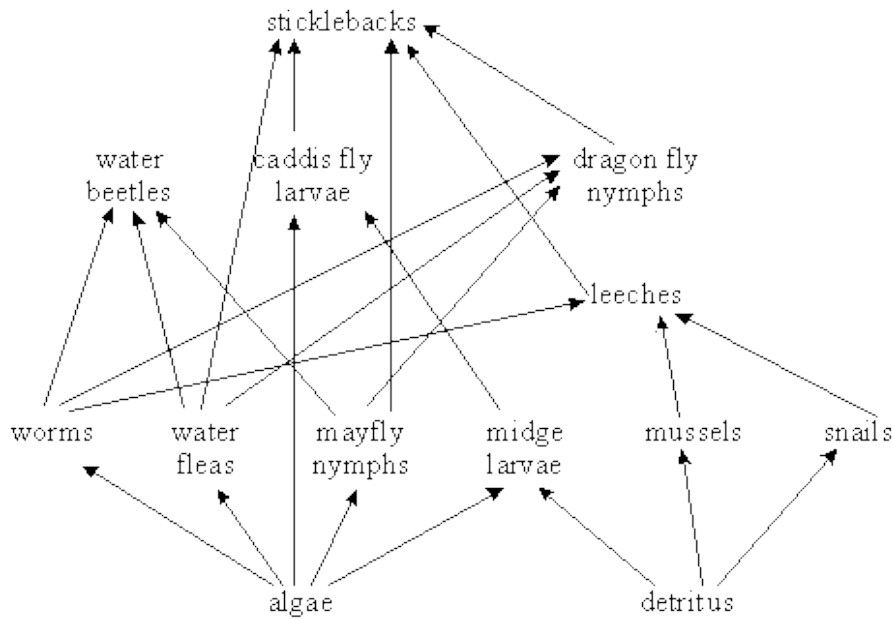
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(10)

(Total 14 marks)

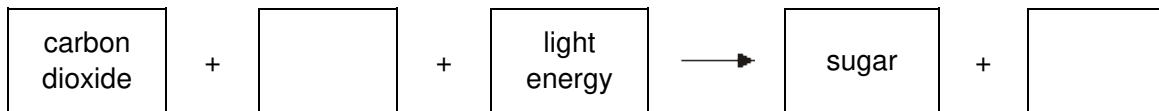
30

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.



(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.

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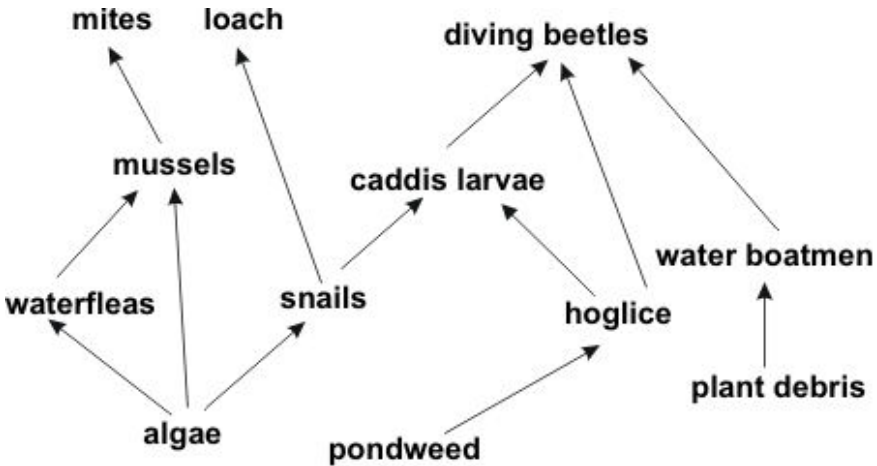
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(8)
(Total 10 marks)

31

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



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

.....

(1)

(ii) The algae are small green plants.

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

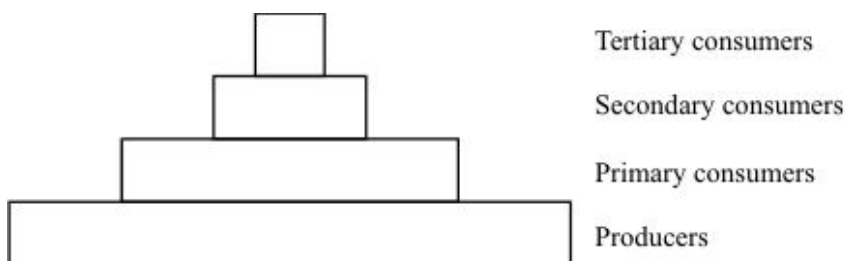
1

2

3

(3)

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



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

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

(6)

(Total 10 marks)

32

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)

33

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 m² per year

Energy in sugar produced by trees 44 000 kJ per m² per year

Energy transferred to primary consumers 2 920 kJ per m² per year

Energy transferred to secondary consumers 700 kJ per m² 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.

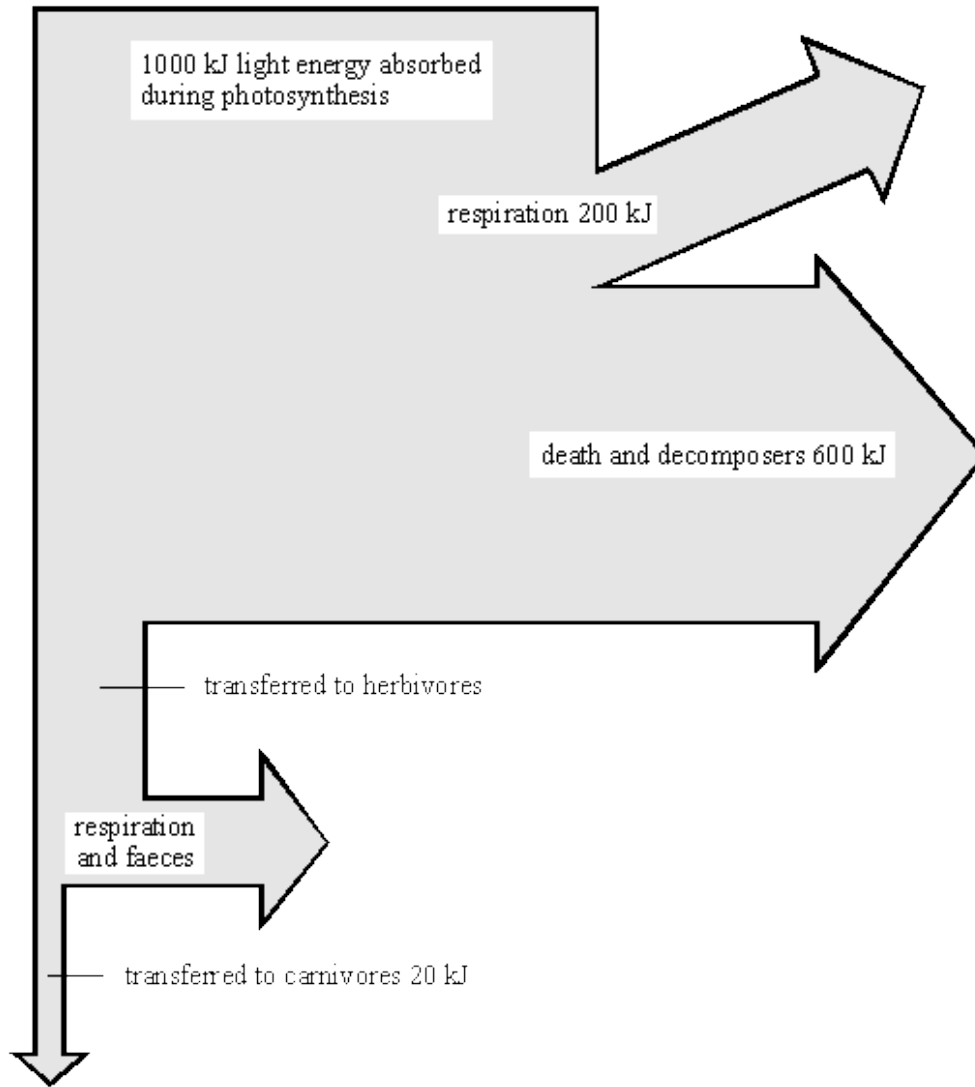
- 1
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- 2
-
- 3
-

(3)

(Total 9 marks)

34

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



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 \Rightarrow humans	800 000
cereal crop \Rightarrow pigs \Rightarrow humans	90 000
cereal crop \Rightarrow cattle \Rightarrow humans	30 000

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

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(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)

35

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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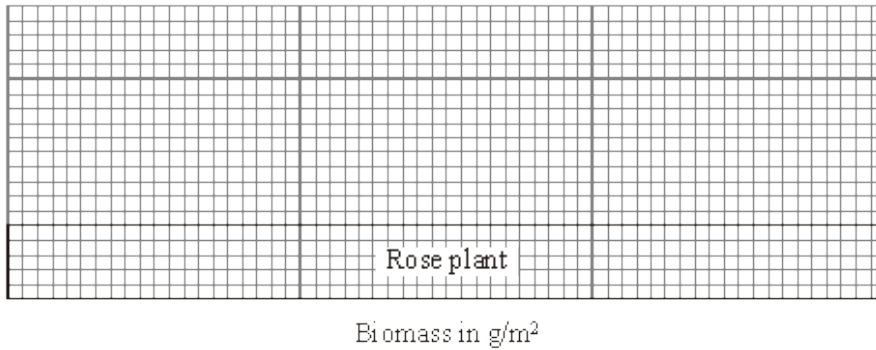
(Total 5 marks)

36

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/m²	600		50		10		1

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



(3)

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

.....

.....

.....

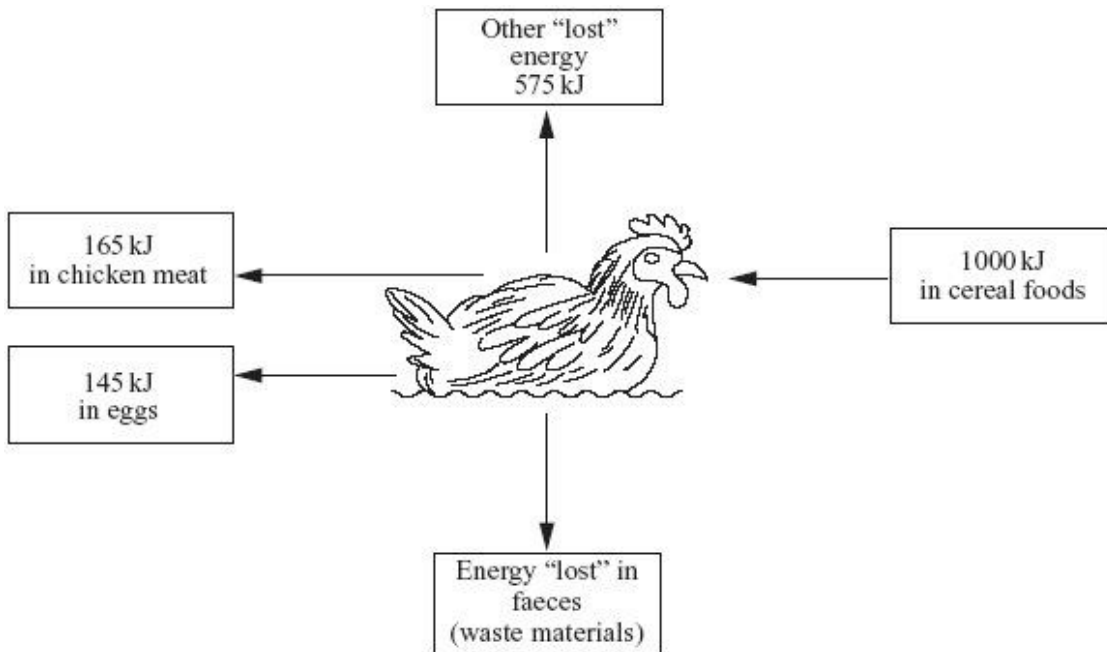
Proportion =

(2)

(Total 5 marks)

37

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)

38

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 one year	Number of people whose energy requirements 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.

.....
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.....
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.....
.....

(4)

(Total 10 marks)

39

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.

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(Total 4 marks)

40

(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?

.....

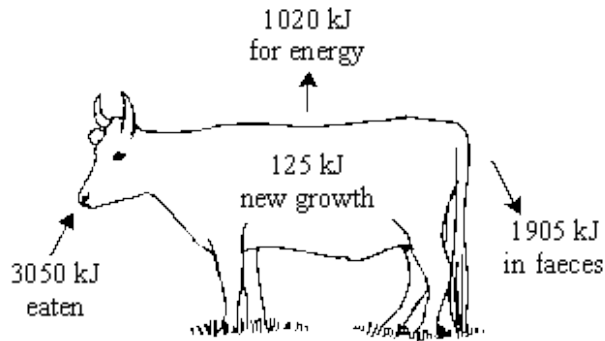
(1)

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

.....
.....
.....

(1)

(b)



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.

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(3)

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

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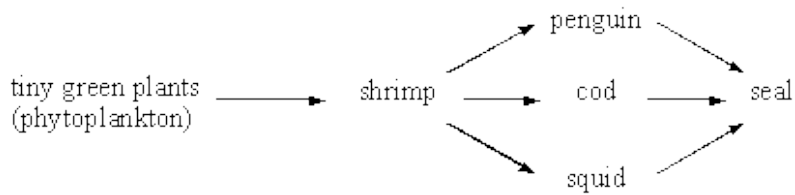
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(3)
(Total 8 marks)

41

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



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

.....

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

.....

.....

(3)

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

Carefully explain each argument.

Why they might decrease.

.....

.....

.....

Why they might stay the same.

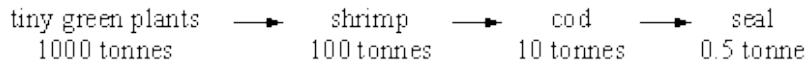
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(2)

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

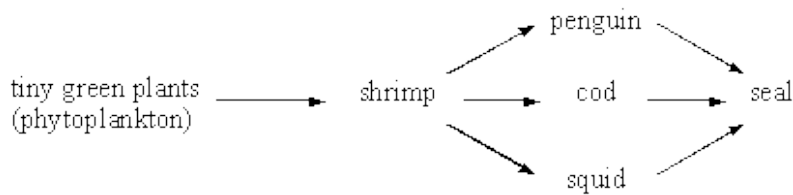


Draw and label a pyramid of biomass for this chain.

(2)
(Total 7 marks)

42

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.

.....
.....
.....

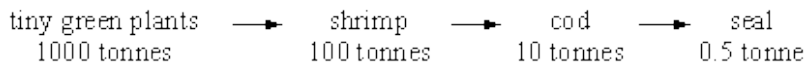
(1)

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.



Draw and label a pyramid of biomass for this chain.

(2)

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

.....

.....

.....

.....

(3)

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

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

.....

.....

(2)

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

.....

.....

(1)

(Total 11 marks)