AQA GCSE Biology | 8461

SPECIFICATION POINT 4.7.4.3

Transfer of biomass

Past-paper questions

Tier	**Higher**
Question groups	**19**
Available paper years	**2008–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

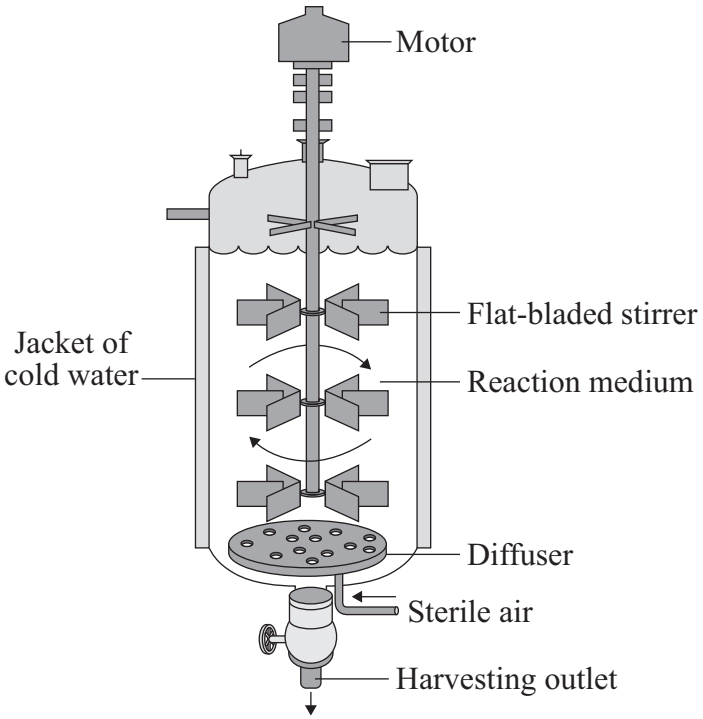
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.4.3 Transfer of biomass

Question 01

January 2008 | BLY3H | Original Q7 | Legacy

7 The diagram shows a fermenter. This fermenter was used to grow the fungus *Cephalosporium* which makes the antibiotic Cephalosporin C. The reaction medium contains a mixture of the sugars glucose and sucrose and a variety of mineral ions.



(a) (i) The stirrer continuously mixes the contents of the fermenter. Why is this important?

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(1 mark)

(ii) Explain why the fermenter is surrounded by a jacket of cold water.

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(2 marks)

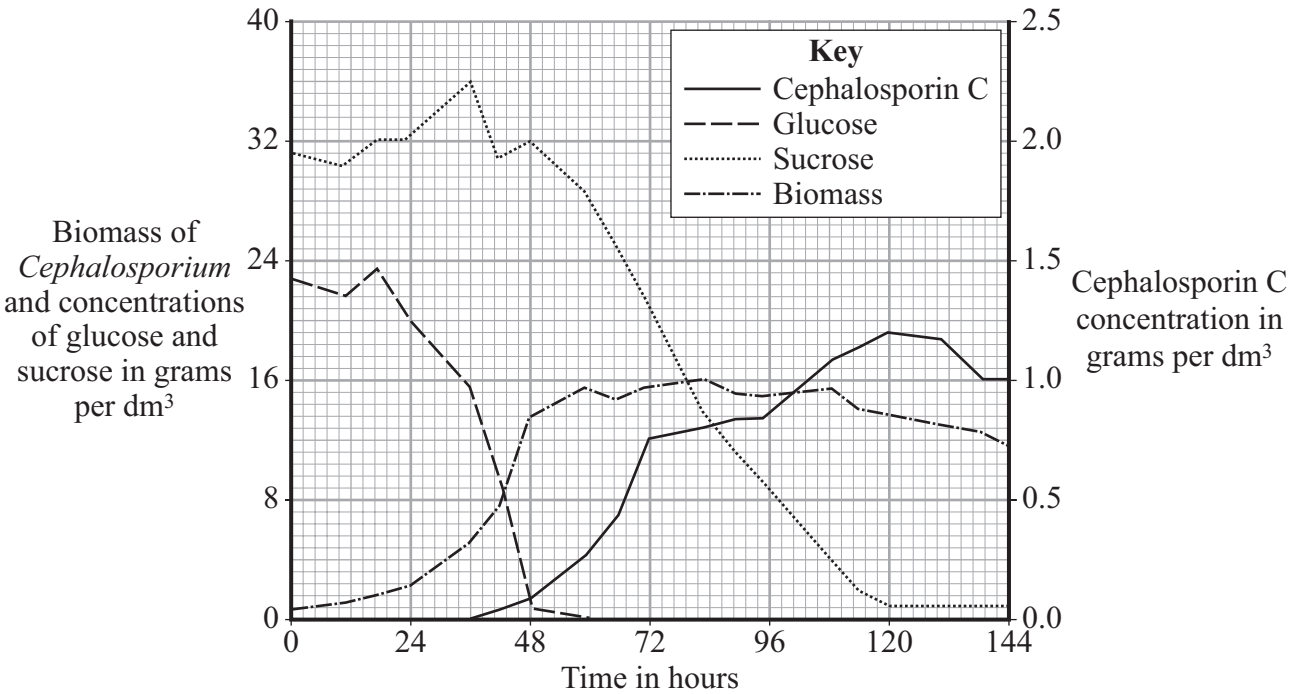
Question 7 continues on the next page

4.7.4.3 Transfer of biomass

Question 01 · continued

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(b) The graph shows changes in the concentrations of glucose, sucrose, Cephalosporin C and the biomass of *Cephalosporium* measured in the fermenter over 6 days.



(i) During which 6-hour time period is the antibiotic being produced at its maximum rate?

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(1 mark)

(ii) What evidence is there that *Cephalosporium* is able to use glucose more easily than sucrose?

.....

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(1 mark)

4.7.4.3 Transfer of biomass

Question 01 · continued

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(iii) Describe and explain the relationship between glucose concentration, the biomass of *Cephalosporium* and the concentration of Cephalosporin C.

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(4 marks)

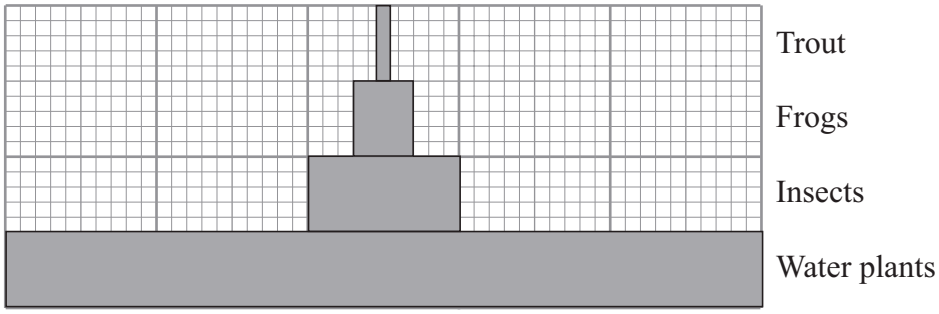
9

4.7.4.3 Transfer of biomass

Question 02

January 2009 | BLY2H | Original Q1 | Legacy

1 The diagram shows a pyramid of biomass drawn to scale.



1 (a) What is the source of energy for the water plants?

.....

(1 mark)

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.

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ratio = ... : 1

(2 marks)

1 (c) Give **two** reasons why the biomass of the frog population is smaller than the biomass of the insect population.

1 .....

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2 .....

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(2 marks)

4.7.4.3 Transfer of biomass

Question 02 · continued

for mark

1 (d) Some insects die.

Describe how the carbon in the dead insect bodies may be recycled.

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(4 marks)

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4.7.4.3 Transfer of biomass

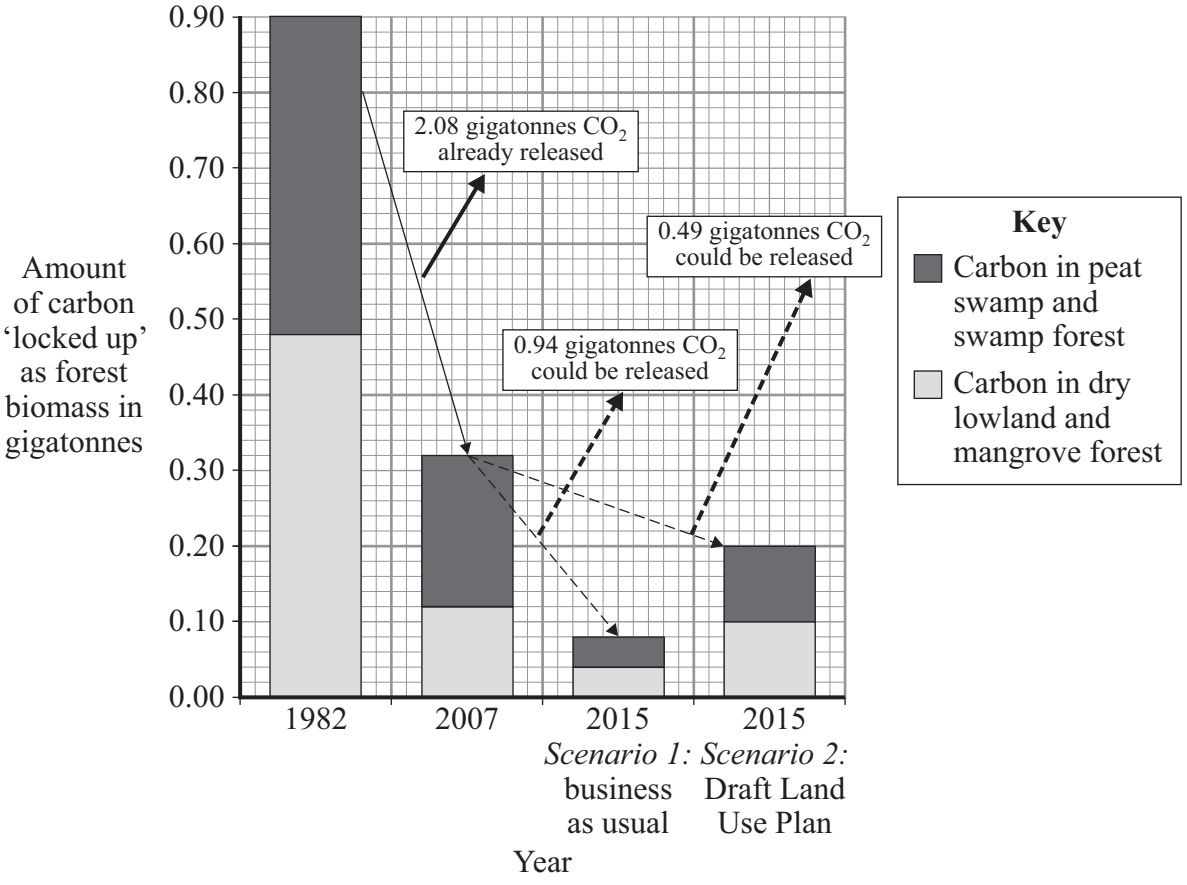
Question 03

November 2009 | BLY1BP | Original Q7 | Legacy

QUESTION SEVEN

Deforestation affects the environment.

The graph shows some possible effects of deforestation in part of Indonesia.



7A By how much did the total amount of carbon 'locked up' in peat swamp and swamp forest decline between 1982 and 2007?

1 0.16 gigatonnes

2 0.22 gigatonnes

3 0.36 gigatonnes

4 0.58 gigatonnes

4.7.4.3 Transfer of biomass

Question 03 · continued

7B What mass of carbon dioxide will be released between 1982 and 2015 if *Scenario 2* is adopted?

1 0.49 gigatonnes

2 1.43 gigatonnes

3 2.57 gigatonnes

4 3.02 gigatonnes

7C The graph refers to a *Draft Land Use Plan* for 2015.

How could this plan reduce the amount of carbon dioxide in the atmosphere by 2015?

1 by building more roads

2 by building more houses

3 by replanting forests

4 by giving protected status to more animal species

7D The *Draft Land Use Plan* is an example of . . .

1 biodiversity.

2 increasing the human population.

3 recycling.

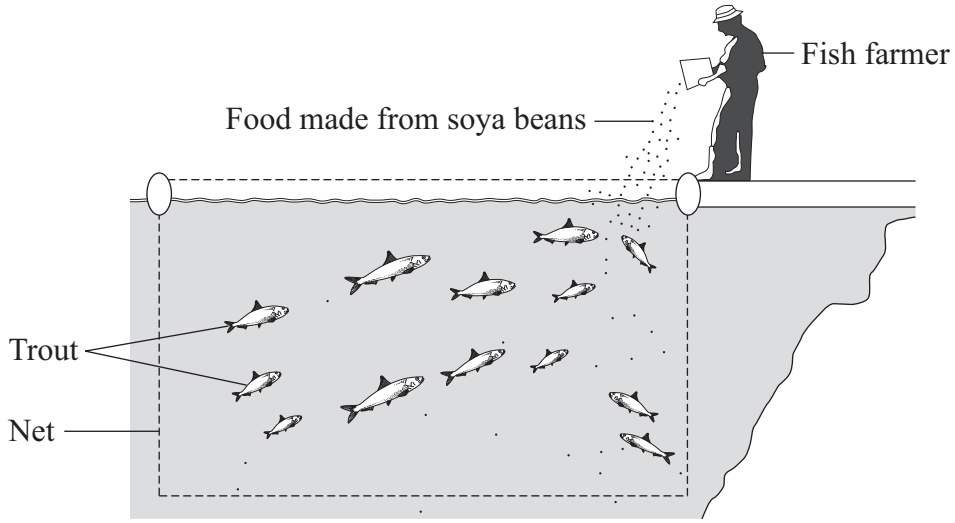
4 sustainable development.

4.7.4.3 Transfer of biomass

Question 04

January 2010 | BLY2H | Original Q1 | Legacy

1 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.

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

Label the pyramid.

(2 marks)

4.7.4.3 Transfer of biomass

Question 04 · continued

for mark

1 (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 marks)

1 (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.

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(1 mark)

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 marks)

7

4.7.4.3 Transfer of biomass

Question 05

2 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	

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

Show clearly how you work out your answer.

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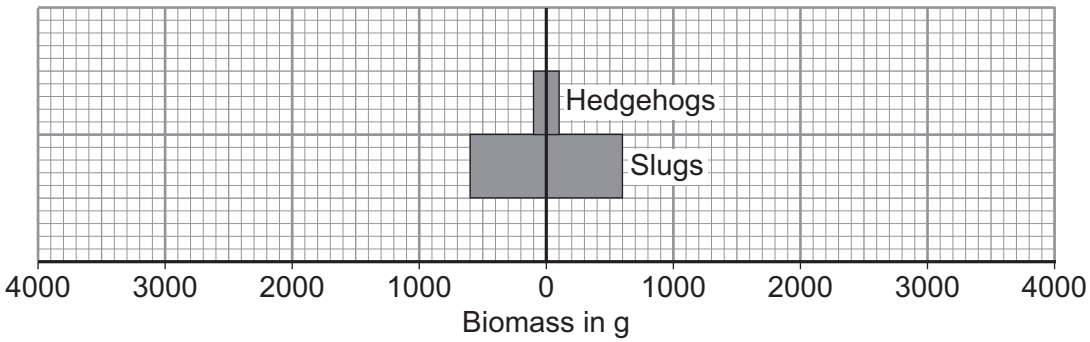
.....

Biomass = ... g

(2 marks)

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

Show the biomass of the lettuces in the garden.



(2 marks)

4.7.4.3 Transfer of biomass

Question 05 · continued

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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(3 marks)

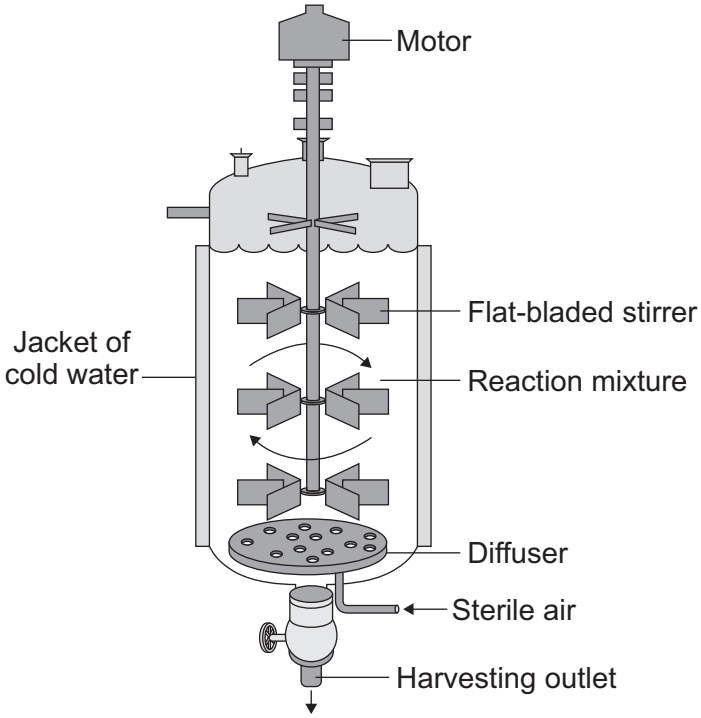
7

4.7.4.3 Transfer of biomass

Question 06

January 2011 | BLY3H | Original Q6 | Legacy

6 The diagram shows a fermenter.
This fermenter can be used to grow a fungus which makes a protease enzyme.



6 (a) Explain, in detail, why the fermenter needs to be surrounded by a jacket of cold water.

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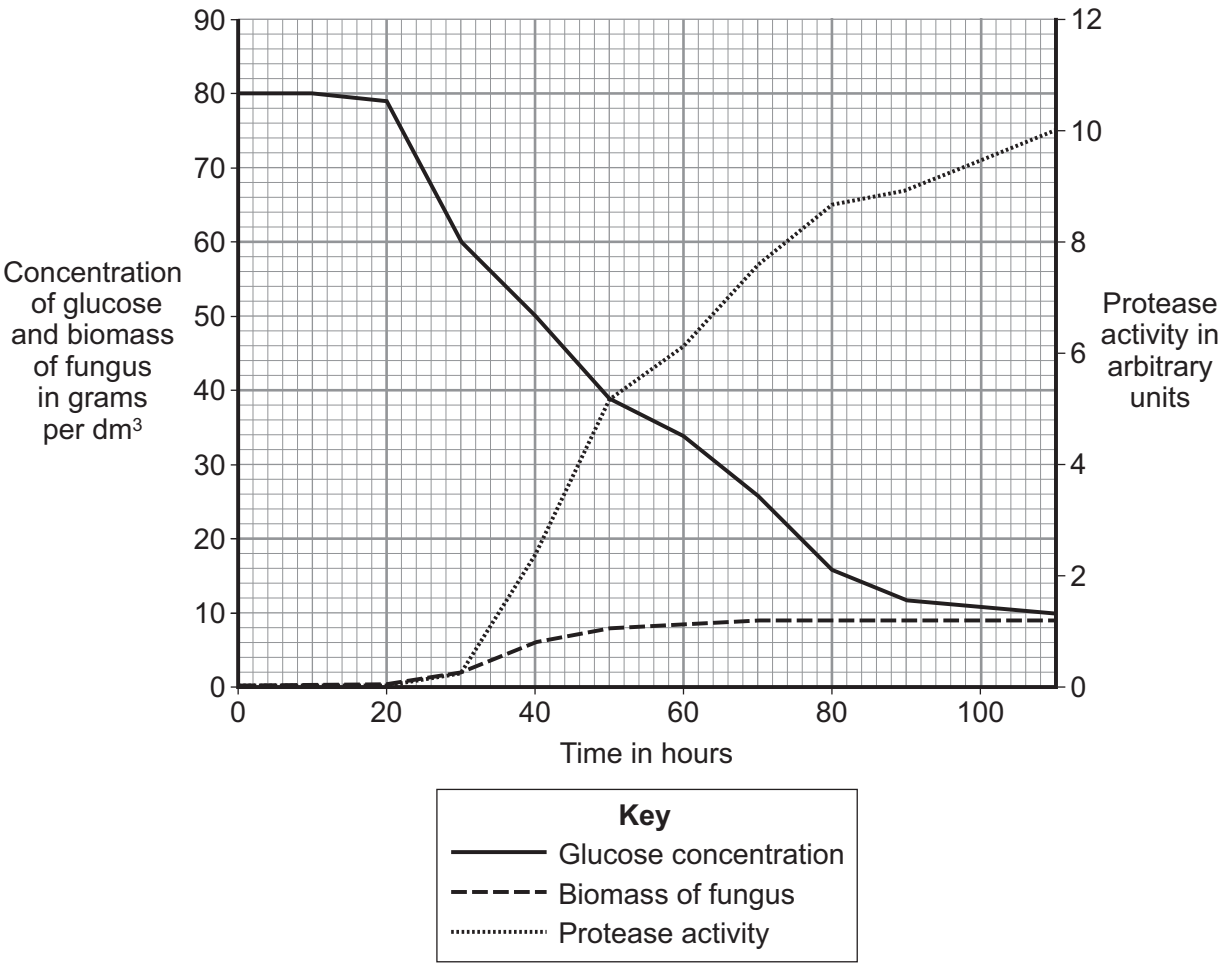
(3 marks)

Question 6 continues on the next page

4.7.4.3 Transfer of biomass

Question 06 · continued

6 (b) Scientists investigated the effect of glucose concentration on the growth of the fungus and on the production of the protease enzyme.
The graph shows the results when the glucose concentration in the fermenter at the start was 80 grams per dm^3.



There was no measurable amount of protease activity in the reaction mixture until after 20 hours.

Suggest an explanation for this.

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4.7.4.3 Transfer of biomass

Question 06 · continued

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(4 marks)

6 (c) The scientists repeated the investigation using 40 grams of glucose per dm^3 and using 60 grams of glucose per dm^3.

The table shows all of their results.

Concentration of glucose in grams per dm^3	Yield of fungus biomass in grams per gram of glucose consumed	Protease activity in arbitrary units per gram of glucose consumed	Protease activity in arbitrary units per gram of fungus biomass produced
40	0.09	0.83	8.93
60	0.11	0.22	1.92
80	0.13	0.14	1.11

The scientists plan to set up the fermenter for commercial production of the protease enzyme.

Which concentration of glucose should they use in the fermenter?

..... grams per dm^3

Explain, in detail, why you chose this concentration.

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(2 marks)

9

4.7.4.3 Transfer of biomass

Question 07

June 2011 | BLY2H | Original Q8 | Legacy

8 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

8 (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.

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Answer = ... %

(2 marks)

4.7.4.3 Transfer of biomass

Question 07 · continued

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

Explain why as fully as you can.

You should include references to the data in your answer.

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(3 marks)

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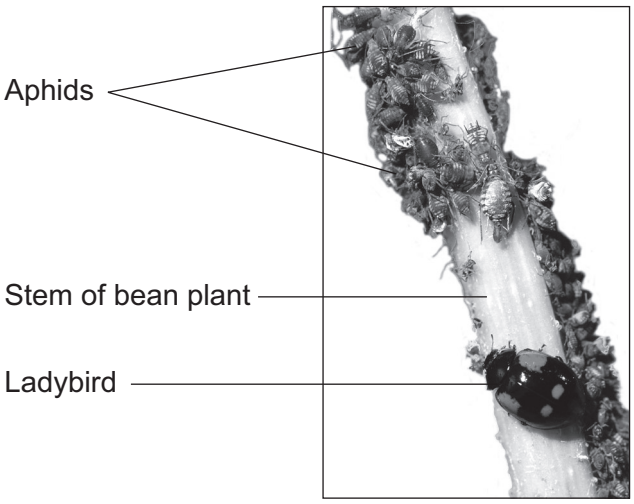
4.7.4.3 Transfer of biomass

Question 08

January 2012 | BL1HP | Original Q3 | Legacy

3 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.



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

(2 marks)

4.7.4.3 Transfer of biomass

Question 08 · continued

3 (a) (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 marks)

3 (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 marks)

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4.7.4.3 Transfer of biomass

Question 09

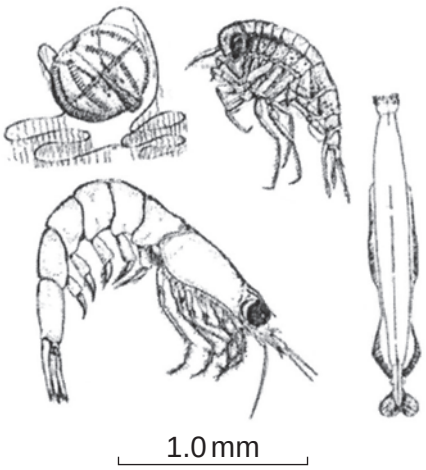
June 2013 | BL1HP | Original Q9 | Legacy

9 Plankton live in the sea.
The diagram shows plant plankton and animal plankton drawn to the scales shown.

Plant plankton



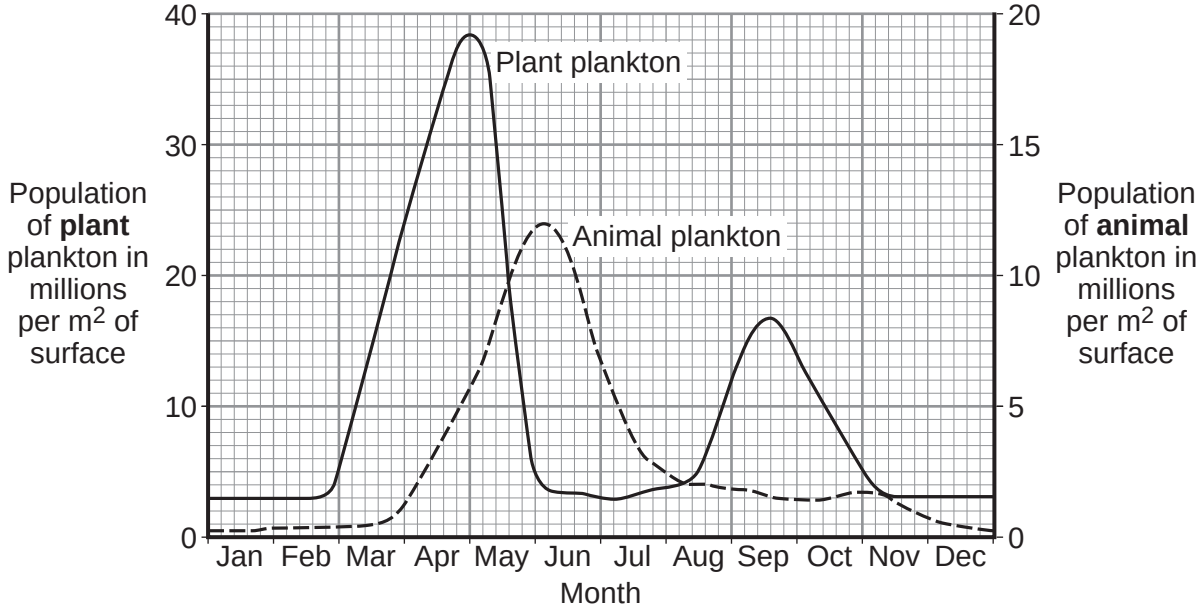
Animal plankton



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



4.7.4.3 Transfer of biomass

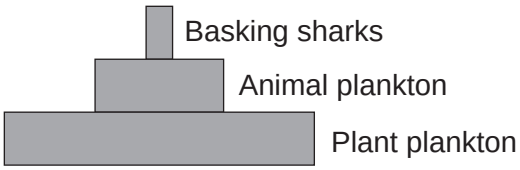
Question 09 · continued

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

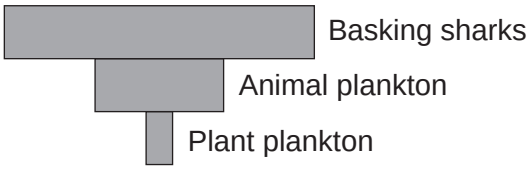
Look at the diagram and **Graph 1**.

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

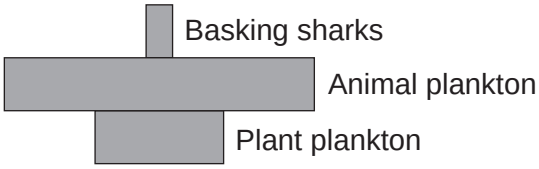
Tick (✓) **one** box.



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☐



☐

(1 mark)

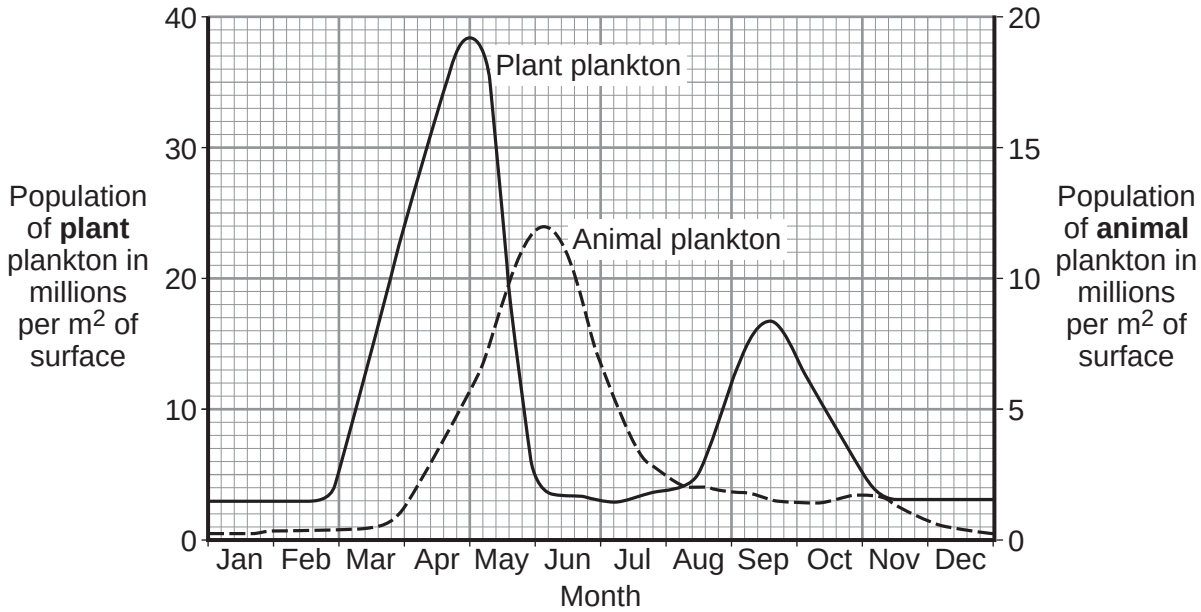
Question 9 continues on the next page

4.7.4.3 Transfer of biomass

Question 09 · continued

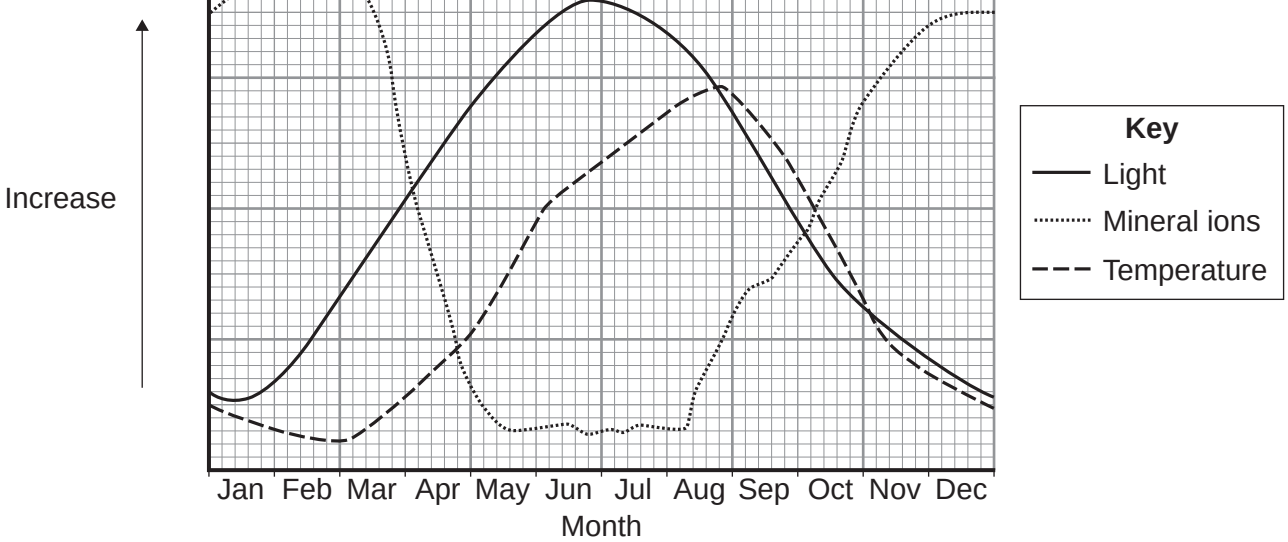
Graph 1 is repeated here to help you answer the following questions.

Graph 1



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

Graph 2



4.7.4.3 Transfer of biomass

Question 09 · continued

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

Suggest **one** reason for the increase.

Explain your answer.

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(2 marks)

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

Suggest explanations for the changes.

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(2 marks)

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

Suggest explanations for the changes.

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(3 marks)

8

4.7.4.3 Transfer of biomass

Question 10

June 2014 | BL1HP | Original Q1 | Legacy

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

1 (a) **Figure 1** shows a food chain.

Figure 1



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 marks]

4.7.4.3 Transfer of biomass

Question 10 · continued

1 (b) **Table 1** shows three food chains, **A**, **B** and **C**.

Table 1

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

1 (b) (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 mark]

1 (b) (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 marks]

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6

4.7.4.3 Transfer of biomass

Question 11

June 2016 | BL1HP | Original Q7 | Legacy

7 Students investigated a food chain in a garden.

lettuce ⟶ **snail** ⟶ **thrush (bird)**

The students:

- estimated the number of lettuce plants in the garden
- estimated the number of snails feeding on the lettuces
- counted two thrushes in the garden in 5 hours.

Table 2 shows the students' results and calculations.

Table 2

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

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

[2 marks]

7 (a) (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 mark]

Question 7 continues on the next page

Question 11 · continued

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

Figure 6 shows two examples of European banded snails.

Figure 6



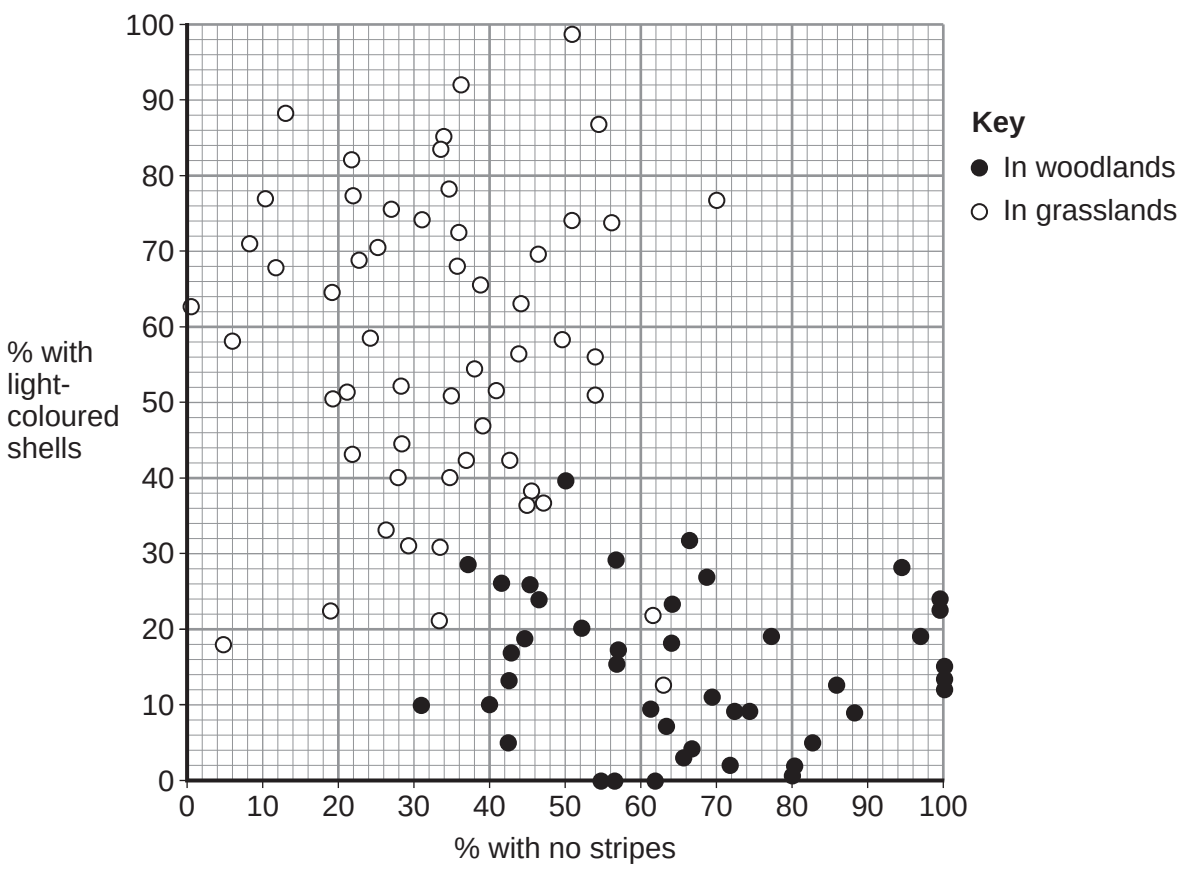
Dark-coloured shell, with stripes

Light-coloured shell, with no stripes

Figure 7 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 **Figure 7** represents the results of one survey in one habitat.

Figure 7



4.7.4.3 Transfer of biomass

Question 11 · continued

7 (b) (i) **Figure 7** is a scatter graph.

Why is a scatter graph used for this data?

[1 mark]

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

[2 marks]

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

[1 mark]

7 (c) Snails are **not** used as indicator species as they cannot give us information about pollution levels.

7 (c) (i) Name **one** type of animal that can be used as an indicator species.
State the environmental factor that the animal indicates.

[1 mark]

Indicator species _____

Environmental factor _____

7 (c) (ii) Give **one** different method of measuring the environmental factor you gave in part **(c)(i)**.

[1 mark]

9

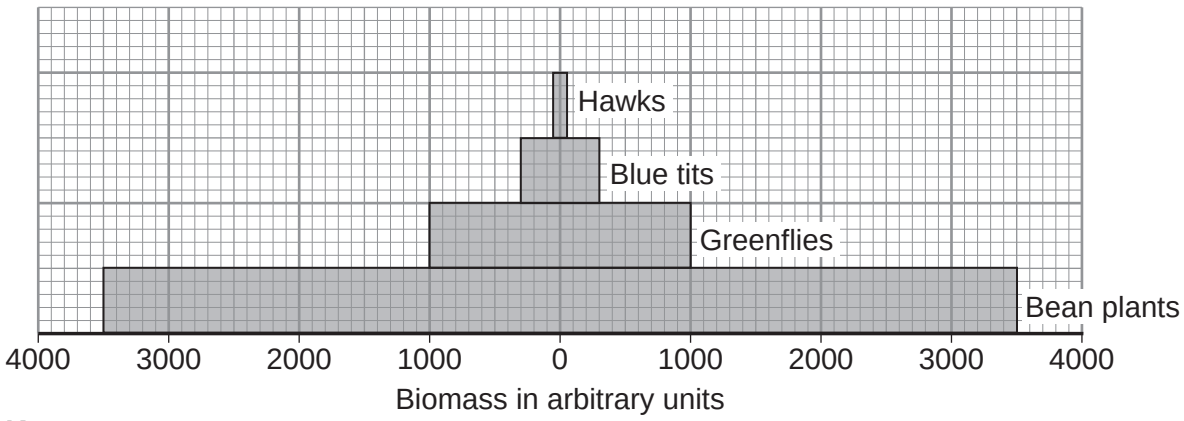
4.7.4.3 Transfer of biomass

Question 12

June 2017 | BL1HP | Original Q1 | Legacy

1 **Figure 1** shows a pyramid of biomass for a food chain.

Figure 1



Key

= 500 arbitrary units

1 (a) (i) Not all of the biomass of the bean plants is converted into the biomass of greenflies.

Calculate the biomass of bean plants that is **not** converted into the biomass of greenflies.

[2 marks]

Use information from **Figure 1**.

_____

_____

Biomass = _____ arbitrary units

4.7.4.3 Transfer of biomass

Question 12 · continued

1 (a) (ii) For every 10 grams of biomass eaten by the hawks, more than 8 grams of biomass are lost.

Give **one** way in which the biomass eaten by hawks is lost from the food chain.

[1 mark]

Tick (✓) **one** box.

Hawks reproduce ☐

Hawks produce faeces ☐

Hawks grow ☐

Hawks feed on other birds ☐

1 (b) When the bean plants grow they gain biomass.

Complete the sentences.

[2 marks]

The bean plants gain biomass by the process of _____ .

In this process, the bean plants make a carbohydrate called _____ .

5

4.7.4.3 Transfer of biomass

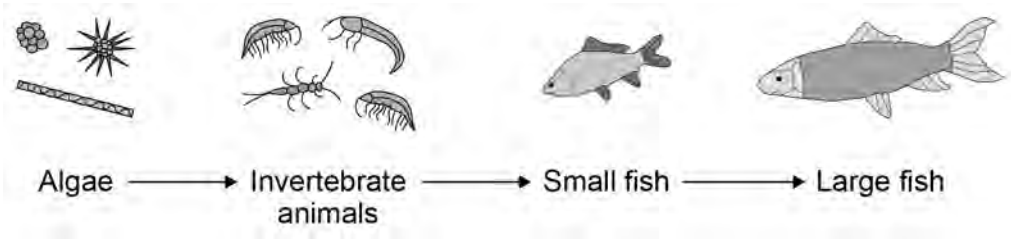
Question 13

June 2018 | 8461/2H | Original Q7

0 7 **Figure 8** shows:

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

Figure 8



	Algae	Invertebrate animals	Small fish	Large fish
Biomass in g/m^2:	840	200	40	10

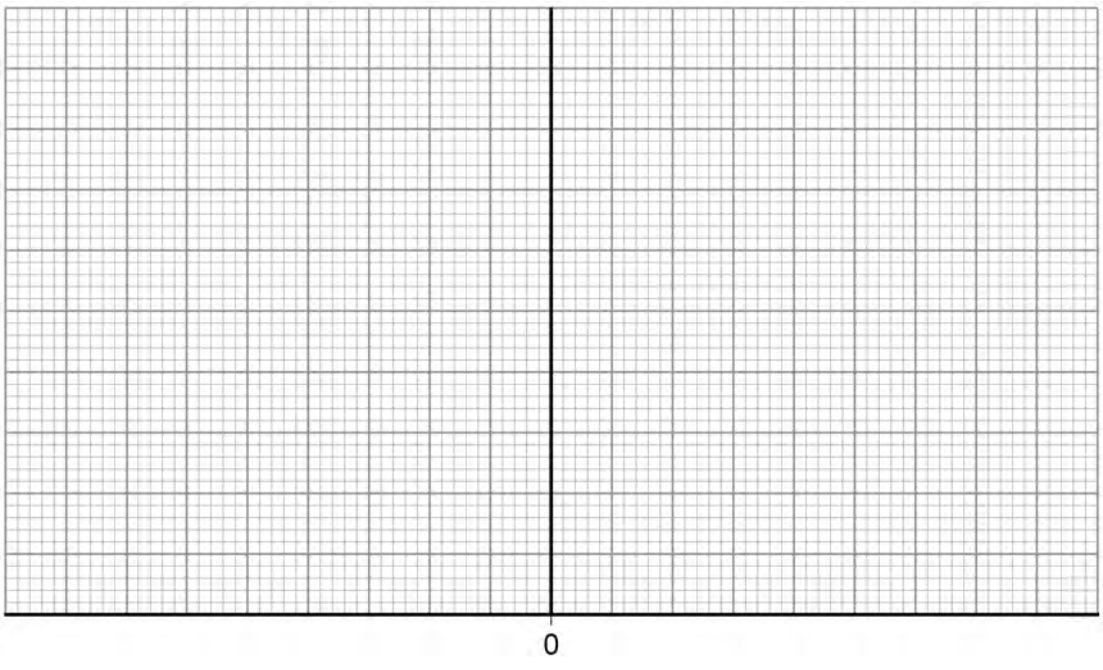
0 7 . 1 Draw a pyramid of biomass for the food chain in **Figure 8** on **Figure 9**.

You should:

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

[4 marks]

Figure 9



4.7.4.3 Transfer of biomass

Question 13 · continued

0 7 . 2 Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

[3 marks]

Percentage loss = _____

0 7 . 3 Give **one** way that biomass is lost between trophic levels.

[1 mark]

Question 7 continues on the next page

4.7.4.3 Transfer of biomass

Question 13 · continued

0 7 . 4 A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died.

[5 marks]

13

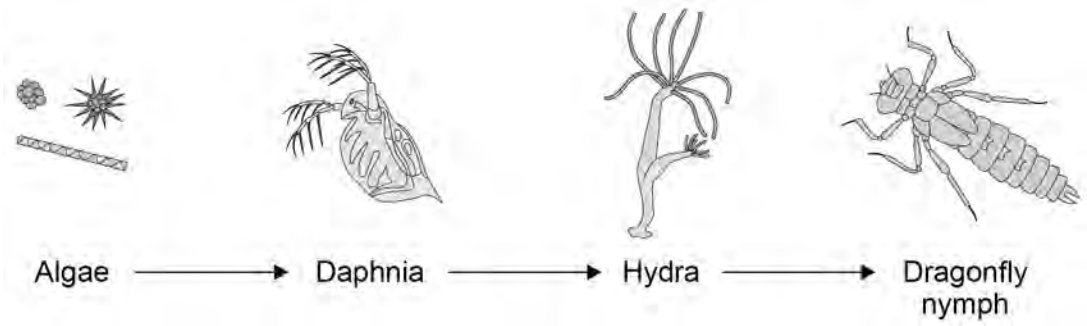
4.7.4.3 Transfer of biomass

Question 14

June 2019 | 8461/2H | Original Q1

0 1 **Figure 1** shows a food chain in a pond.

Figure 1



0 1 . 1 Which term describes the Daphnia in this food chain?

[1 mark]

Tick (✓) **one** box.

- Apex predator ☐
- Primary consumer ☐
- Producer ☐
- Secondary consumer ☐

4.7.4.3 Transfer of biomass

Question 14 · continued

0 1 . 2 Draw a pyramid of biomass for the food chain.

Label each trophic level.

[2 marks]

0 1 . 3 Give **one** reason why the total biomass of the Daphnia in the pond is different from the total biomass of the algae.

[1 mark]

_____

_____

Question 1 continues on the next page

Question 14 · continued

Students investigated the size of the population of Daphnia in the pond.

This is the method used.

1. Collect 1 dm^3 of pond water from near the edge of the pond.
2. Pour the water through a fine net.
3. Count the number of Daphnia caught in the net.
4. Repeat steps 1–3 four more times.

Table 1 shows the results.

Table 1

Sample number	Number of Daphnia in 1 dm^3 water
1	5
2	21
3	0
4	16
5	28

0 1 . 4 Calculate the mean number of Daphnia in 1 m^3 of pond water.

1 m^3 = 1000 dm^3

[2 marks]

Mean number of Daphnia in 1 m^3 of pond water = _____

4.7.4.3 Transfer of biomass

Question 14 · continued

0 1 . 5 The pond was a rectangular shape, measuring:

- length = 2.5 metres
- width = 1.5 metres
- depth = 0.5 metres.

Calculate the estimated number of Daphnia in the pond.

Use your answer from Question **01.4**.

Give your answer in standard form.

[4 marks]

Number of Daphnia in the pond = _____

Question 1 continues on the next page

4.7.4.3 Transfer of biomass

Question 14 · continued

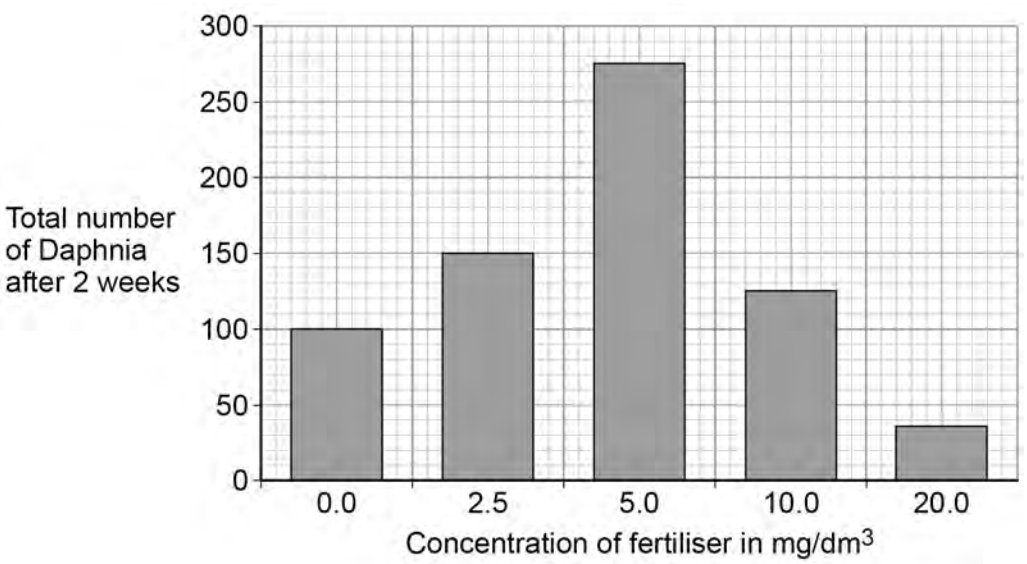
Rainfall can cause fertiliser to be washed from farmland into a pond.

The students investigated the effect of fertiliser on the population of Daphnia in water from the pond.

- The students put 20 Daphnia in each of five different concentrations of fertiliser.
- The students counted the total number of Daphnia in each concentration of fertiliser after 2 weeks.

Figure 2 shows the results.

Figure 2



0 1 . 6 A concentration of 5.0 mg/dm^3 of fertiliser caused a large increase in the population of Daphnia.

Explain why.

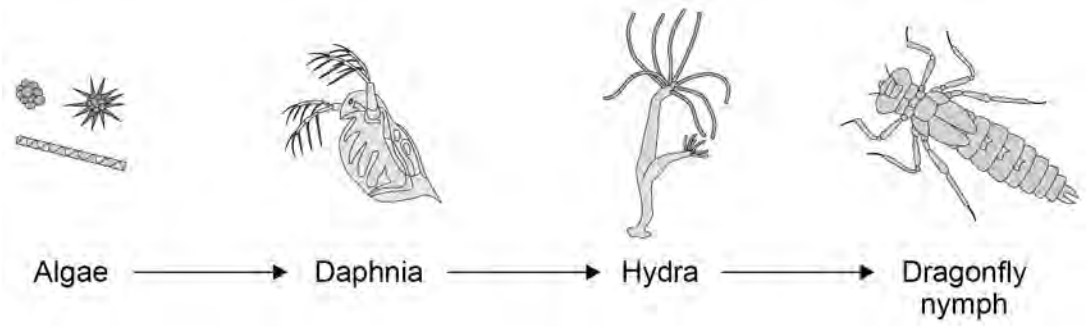
[2 marks]

4.7.4.3 Transfer of biomass

Question 14 · continued

0 1 . 7 **Figure 1** is repeated below.

Figure 1



The population of **Hydra** will decrease when 20 mg/dm^3 of fertiliser is added to the pond.

Explain why.

[2 marks]

14

4.7.4.3 Transfer of biomass

Question 15

November 2020 | 8461/2H | Original Q7

0 7 A new dog food has been developed that does **not** contain meat from cows, sheep or chickens.

The new dog food contains insects.

The insects in the dog food factory are fed on waste vegetables.

0 7 . 1 Sketch the pyramid of biomass for the food chain that produces food for dogs from insects.

Label the pyramid.

[2 marks]

0 7 . 2 Describe **two** reasons why the biomass of the insects eaten by dogs does **not** all become biomass of the dogs.

[2 marks]

1 _____

_____

2 _____

_____

4.7.4.3 Transfer of biomass

Question 15 · continued

0 7 . 3 Explain how making dog food from insects could improve **human** food security in the future.

[4 marks]

8

4.7.4.3 Transfer of biomass

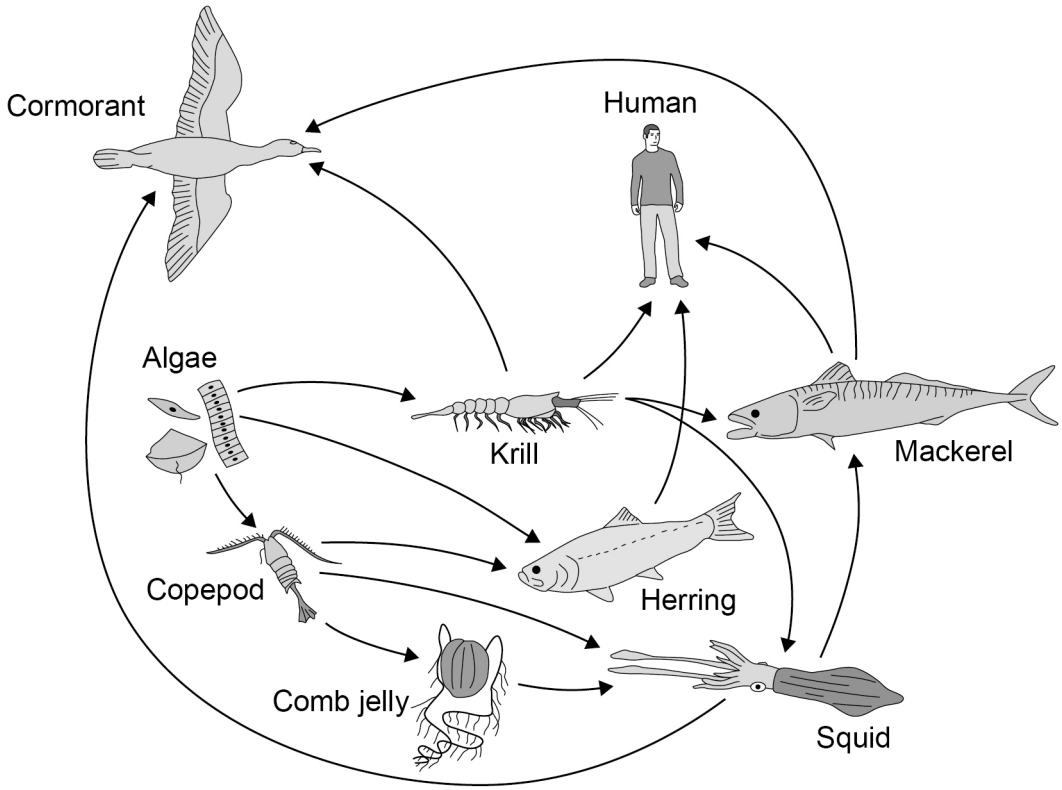
Question 16

November 2021 | 8461/2H | Original Q7

0 7 A food web contains several food chains.

Figure 9 shows a food web.

Figure 9



0 7 . 1 The animals in **Figure 9** get their energy by eating other organisms.

Describe how the algae get energy.

[2 marks]

0 7 . 2 Name **one** primary consumer in **Figure 9**.

[1 mark]

4.7.4.3 Transfer of biomass

Question 16 · continued

0 7 . 3 Name **one** producer in **Figure 9**.

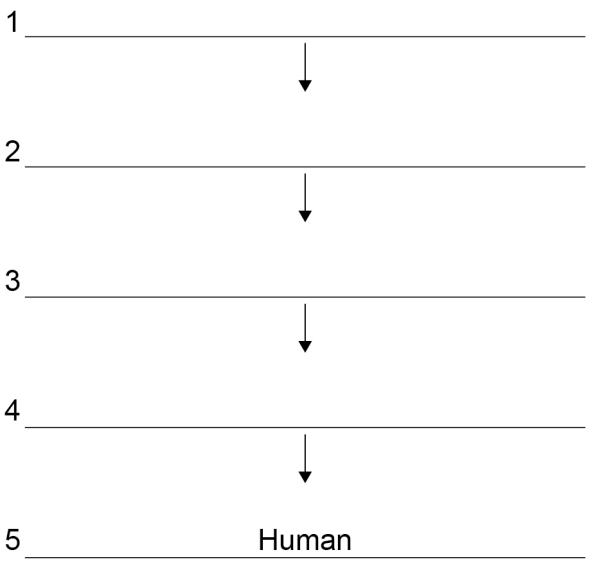
[1 mark]

0 7 . 4 The different food chains in **Figure 9** have different numbers of organisms.

Complete **Figure 10** to show a food chain in **Figure 9** with **five** organisms, including the human.

[1 mark]

Figure 10



0 7 . 5 **Figure 9** shows that mackerel eat krill and squid.

The biomass of mackerel is much less than the combined biomass of krill and squid.

One reason for this is that the mackerel cannot digest all parts of the krill and squid.

Give **two** other reasons.

[2 marks]

1

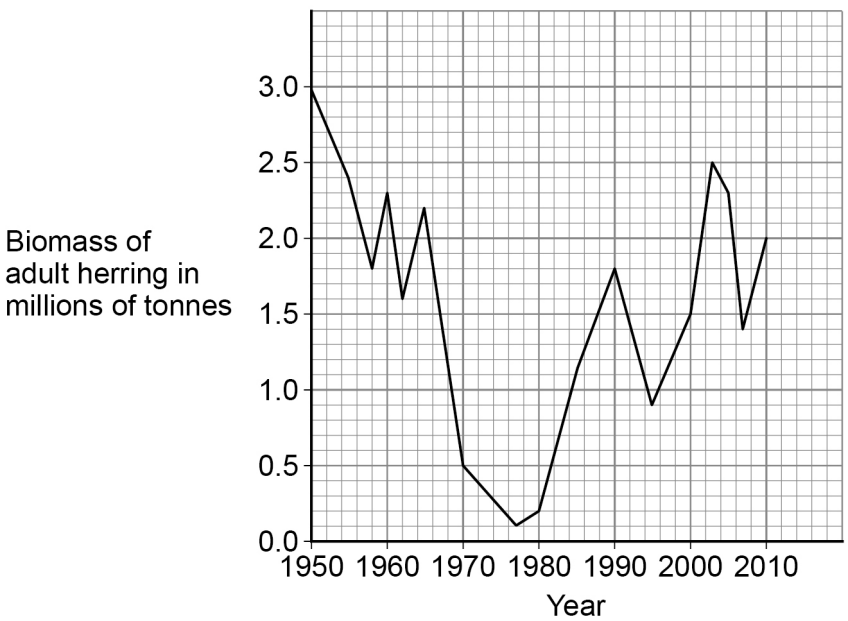
2

4.7.4.3 Transfer of biomass

Question 16 · continued

Figure 11 shows how the biomass of adult herring in the North Sea has changed between 1950 and 2010.

Figure 11



0 7 . 6 Calculate the percentage decrease in the biomass of herring between 1960 and 1977.

Give your answer to the nearest whole number.

[4 marks]

Percentage decrease = _____ %

Question 16 · continued

0 7 . 7 Too many herring were caught by fishermen between 1960 and 1977.

Herring can live for up to 12 years and begin to reproduce when 3 to 4 years old.

Laws have been introduced to help conserve herring:

- 1977 to 1981 – herring fishing was banned in the North Sea
- 1984 to present day – control of mesh size of fishing nets
- 1997 to present day – fishing quotas were introduced
- 1998 to present day – herring fishing was banned in breeding grounds during the breeding season.

Figure 12 shows how a minimum mesh size helps to conserve herring.

Figure 12

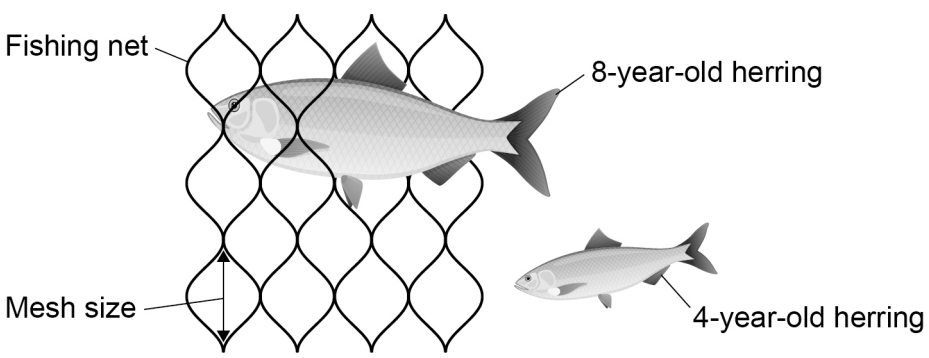
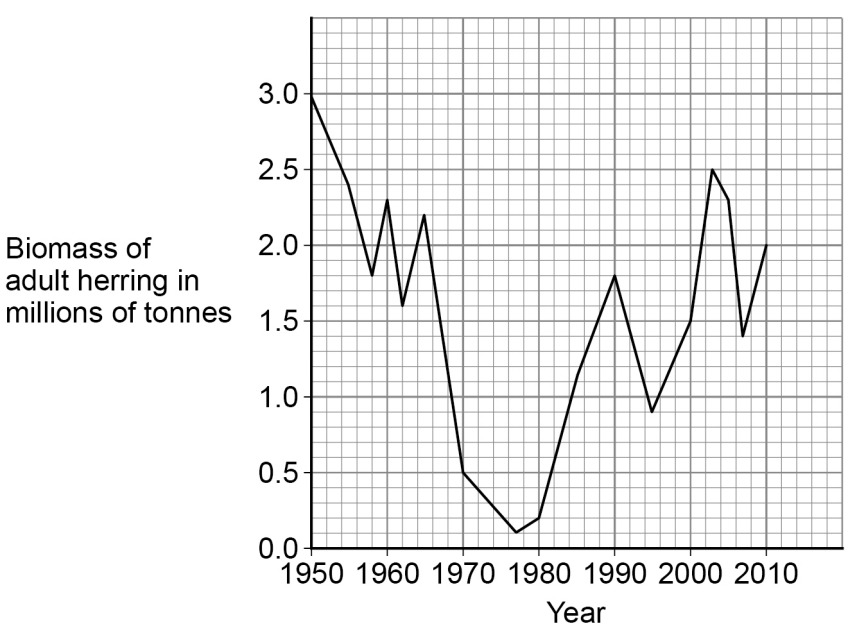


Figure 11 is repeated below.

Figure 11



4.7.4.3 Transfer of biomass

Question 16 · continued

Evaluate the effect of these laws on the conservation of herring stocks.

Use data from **Figure 11** and information from **Figure 12** in your answer.

[6 marks]

17

4.7.4.3 Transfer of biomass

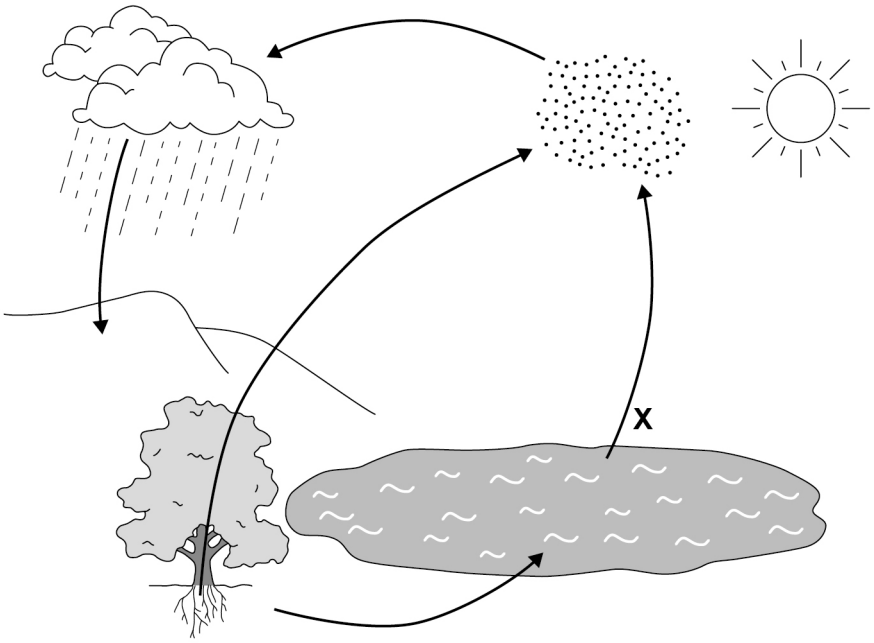
Question 17

June 2022 | 8461/2H | Original Q6

0 6 Energy flows through an ecosystem and materials are recycled.

Figure 6 shows the water cycle.

Figure 6



0 6 . 1 Name process **X**.

[1 mark]

0 6 . 2 Name the process by which water is absorbed into plant roots.

[1 mark]

0 6 . 3 Give **two** uses of water in plants.

[2 marks]

1

2

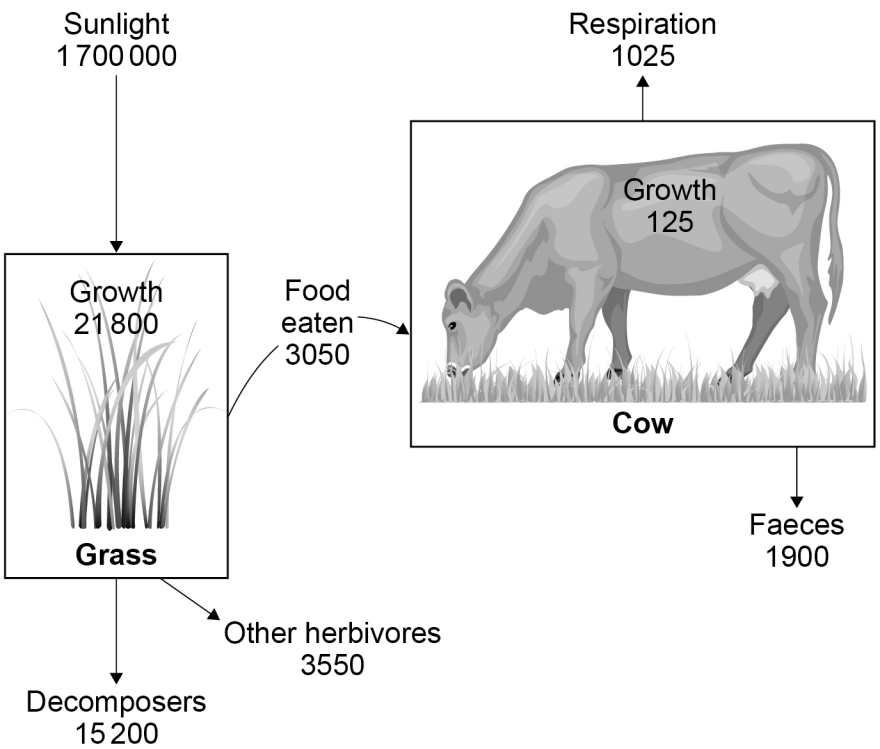
4.7.4.3 Transfer of biomass

Question 17 · continued

Figure 7 shows the flow of energy through a food chain.

The numbers are in kilojoules/m^2/year.

Figure 7



4.7.4.3 Transfer of biomass

Question 17 · continued

0 6 . 4 The cow is more efficient than the grass at converting energy.

The energy conversion efficiency of the cow is 4.098%.

Calculate how many times more efficient the cow is at converting energy than the grass.

The equation for energy conversion efficiency is:

$$\text{energy conversion efficiency} = \frac{\text{energy used for growth}}{\text{energy input}} \times 100$$

Give your answer to 3 significant figures.

[5 marks]

Number of times (3 significant figures) = _____

Question 6 continues on the next page

4.7.4.3 Transfer of biomass

Question 17 · continued

0 6 . 5 It is more energy-efficient to rear cows indoors than to rear cows outdoors.

Give **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 6 Suggest **two** possible disadvantages of rearing cows indoors.

[2 marks]

1 _____

_____

2 _____

_____

13

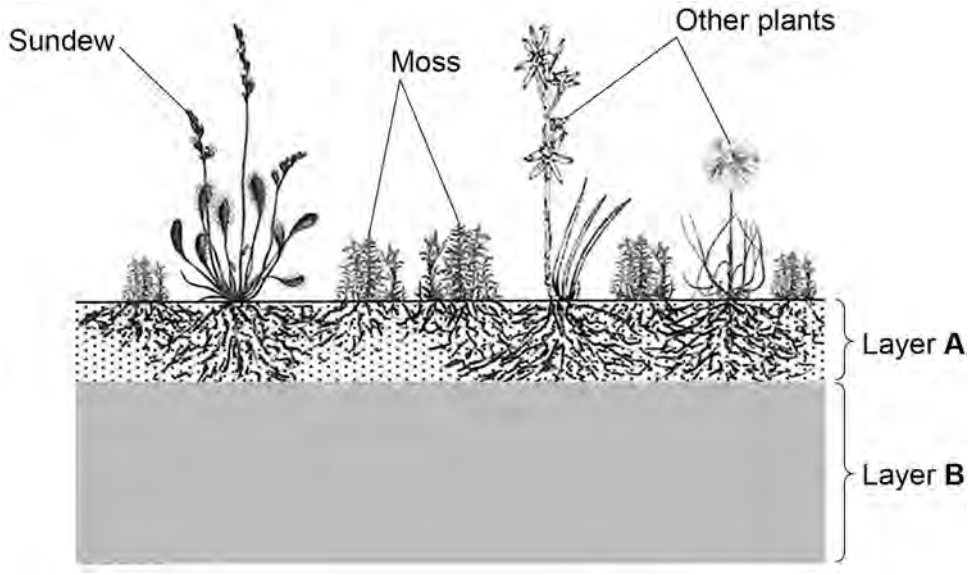
4.7.4.3 Transfer of biomass

Question 18

0 2 Peat bogs are estimated to contain twice as much carbon as all the world's forests.

Figure 2 shows a section through part of a peat bog.

Figure 2



Layer **A** contains a lot of air.

Layer **B**:

- contains the dead remains of plants
- has a low pH
- contains very little oxygen
- contains carbon dioxide and methane.

4.7.4.3 Transfer of biomass

Question 18 · continued

0 2 . 1 Explain why most of the dead remains of plants in layer **B** do **not** decay.

[3 marks]

0 2 . 2 The peat bog in **Figure 2** is a stable community.

The moss produces biomass at a rate of 340 g/m^2/year.

What is the approximate biomass of the moss that becomes biomass in primary consumers?

[1 mark]

Tick (✓) **one** box.

- 0.34 g/m^2/year ☐
- 3.4 g/m^2/year ☐
- 34 g/m^2/year ☐
- 340 g/m^2/year ☐

Question 2 continues on the next page

Question 18 · continued

The sundew plant shown in **Figure 2** on page 4 has leaves with sticky hairs that trap and digest insects.

Digestion of the insects releases phosphates and simple compounds of nitrogen that are used by the sundew plant.

0 2 . 3 What substance can the sundew plant make using the **phosphates**?

[1 mark]

Tick (✓) **one** box.

- Cellulose ☐
- DNA ☐
- Glycerol ☐
- Starch ☐

0 2 . 4 What substance can the sundew plant make using the **nitrogen**?

[1 mark]

Tick (✓) **one** box.

- Fatty acid ☐
- Glucose ☐
- Lactic acid ☐
- Protein ☐

4.7.4.3 Transfer of biomass

Question 18 · continued

0 2 . 5 Humans have destroyed large areas of peat bog to collect peat.

The peat provides fuel and provides compost for gardeners to use.

The peat comes from layer **B** in **Figure 2** on page 4.

Layer **B**:

- contains the dead remains of plants
- has a low pH
- contains very little oxygen
- contains carbon dioxide and methane.

Figure 3 shows the removal of peat from a peat bog.

Figure 3



Explain how the destruction of peat bogs and the use of peat affects the temperature of the Earth's atmosphere.

[4 marks]

10

4.7.4.3 Transfer of biomass

Question 19

June 2024 | 8461/2H | Original Q7

0 7 Farmers can increase the growth rate of farm animals by controlling the animals' diets.

A farmer has 1000 chickens.

- The farmer feeds the chickens on seeds from maize plants.
- 1 hectare of land produces 16.4 tonnes of maize seeds.
- The maize seeds have an energy content of 16 MJ per kg.
- Chickens can use 80% of the energy in maize seeds.
- Each chicken needs 46 MJ of energy to grow to full size.

0 7 . 1 Calculate the area of land needed to provide enough energy from maize seeds for 1000 chickens to grow to full size.

Give your answer in m^2.

Give your answer to 3 significant figures.

1 hectare = 10 000 m^2

1 tonne = 1000 kg

[5 marks]

Area of land (3 significant figures) = _____ m^2

Question 7 continues on the next page

4.7.4.3 Transfer of biomass

Question 19 · continued

0 7 . 2 Another farmer produced 4200 kg of maize seeds in a field.

The farmer fed the maize to 1000 chickens.

At full size, the mean mass of one chicken was 2.2 kg.

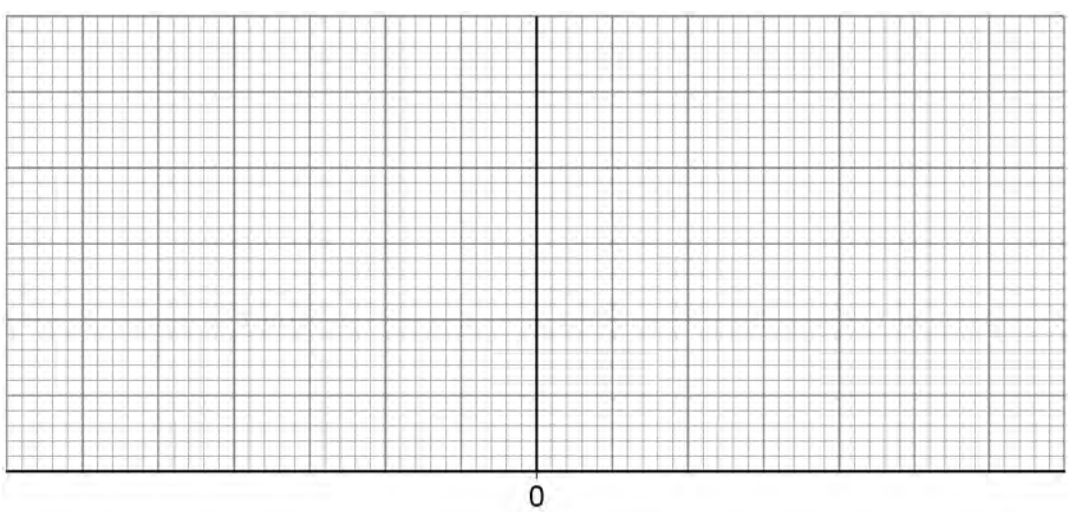
Complete **Figure 11** to show a pyramid of biomass for the food chain from the maize seeds to 1000 chickens.

[3 marks]

You should:

- label the x-axis
- use a suitable scale.

Figure 11



4.7.4.3 Transfer of biomass

Question 19 · continued

0 7 . 3 Calculate the ratio of chicken biomass to maize seed biomass.

Use data from Question **07.2**.

Give your answer in its simplest form.

[2 marks]

Ratio = _____ : _____

0 7 . 4 Chickens can use 80% of the biomass from the maize seeds they eat for respiration and growth.

What happens to the remaining 20% of the biomass in the maize seeds?

[1 mark]

Question 7 continues on the next page

4.7.4.3 Transfer of biomass

Question 19 · continued

Protein is an important part of a chicken's diet.

- Proteins contain 20 different types of amino acid.
- A chicken can make many of the 20 amino acids from other substances in the diet.
- Essential amino acids are amino acids the chicken **cannot** make.
- Essential amino acids must be included in the diet.

Maize seeds contain protein but the proportion of some essential amino acids is low.

Scientists have produced a type of maize called Quality Protein Maize (QPM).

Table 2 compares the proportions of seven essential amino acids in normal maize seeds and in QPM seeds.

Table 2

Amino acid	Mass of amino acid in protein in g/kg	
	Normal maize	Quality protein maize (QPM)
Leucine	122.2	88.1
Lysine	28.9	41.9
Methionine	19.9	18.1
Phenylalanine	49.4	40.9
Threonine	34.5	36.5
Tryptophan	7.3	16.3
Valine	45.9	51.2

4.7.4.3 Transfer of biomass

Question 19 · continued

0 7 . 5 Which amino acids are found in significantly higher proportions in the QPM seeds?

[1 mark]

Tick (✓) **one** box.

- Lysine and tryptophan ☐
- Lysine and valine ☐
- Threonine and tryptophan ☐
- Threonine and valine ☐

0 7 . 6 **Table 2** shows that 1 kg of QPM contains less leucine than 1 kg of normal maize.

Suggest why a diet containing less leucine does **not** slow down the growth of chickens.

[1 mark]

_____

_____

13