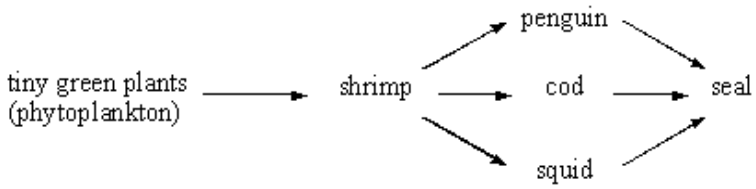
Q1. Scientists have found the following food web in the cold Antarctic Ocean.



(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.

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(1)

Why they might stay the same.

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(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.

(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.

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(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,

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(2)

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

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(1)

(Total 11 marks)

Q2. A food chain has four organisms, **A**, **B**, **C** and **D**.

A → B → C → 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)

Q3. Read the passage.

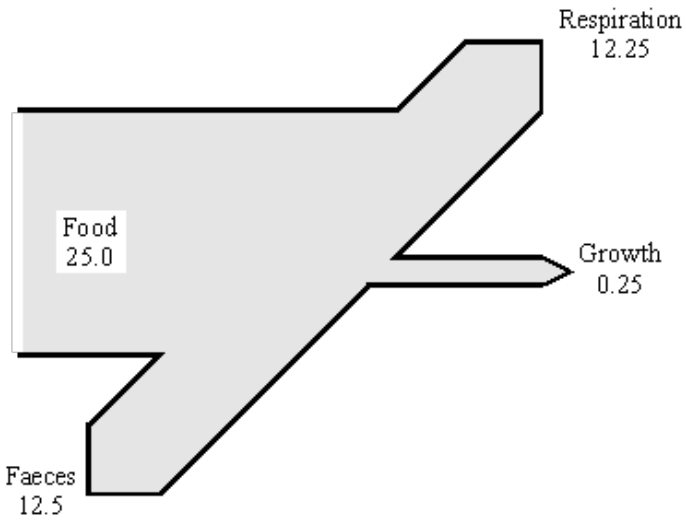
Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

The diagram shows the flow of energy through a koala.
The numbers show units of energy.



(i) Calculate the percentage of the food intake which is converted into new tissues for growth.
Show your working.

..... %

(2)

(ii) Give **three** different ways in which the koala uses the energy released in respiration.

1 .....

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2 .....

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3 .....

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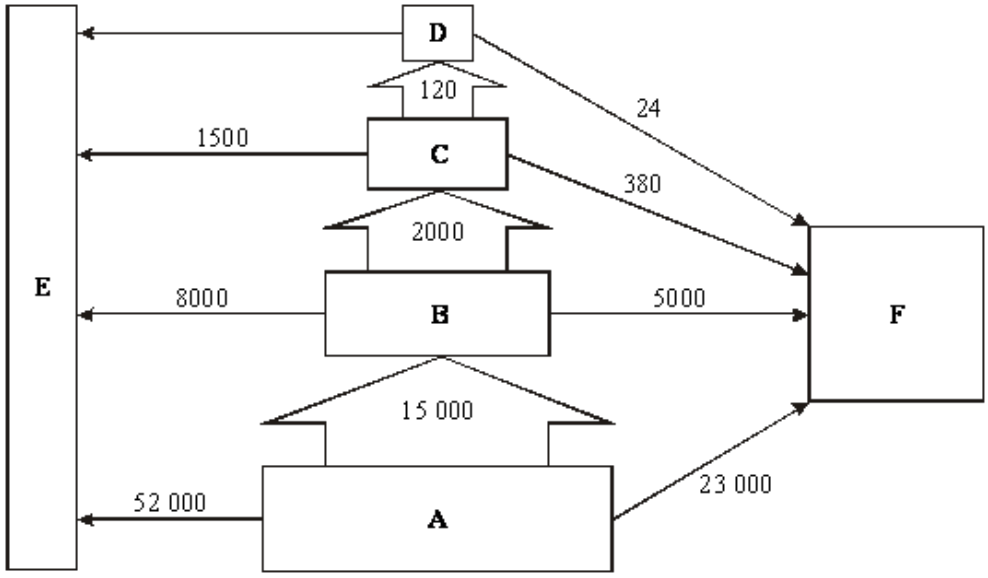
(3)
(Total 5 marks)

Q4. The diagram shows the flow of energy through 1 m^2 of an ecosystem.

Unit in each case is kJ per m^2 per year



KEY

A producers
B primary consumers
C secondary consumers
D tertiary consumers
E heat transfer to environment
F detritus feeders and decomposers

(a) (i) Name the process in which green plants transfer solar energy into chemical compounds.

.....

(1)

(ii) Name the process in living organisms which results in the transfer of heat to the environment.

.....

(1)

(b) Tertiary consumers receive energy from secondary consumers.

(i) Calculate the amount of heat energy which tertiary consumers transfer to the environment as a percentage of the energy received from secondary consumers. Show your working.

Energy transferred ..... %

(2)

(ii) Primary consumers transfer a low percentage of their energy intake to the environment as heat. Tertiary consumers transfer a much higher percentage of their energy intake to the environment as heat.
The tertiary consumers are mainly mammals and birds.
The primary consumers are mainly insects and molluscs.

Explain why mammals and birds lose a greater percentage of their energy intake to the environment as heat than do insects and molluscs.

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(2)
(Total 6 marks)

Q5. 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 .....

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2 .....

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(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 .....

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3 .....

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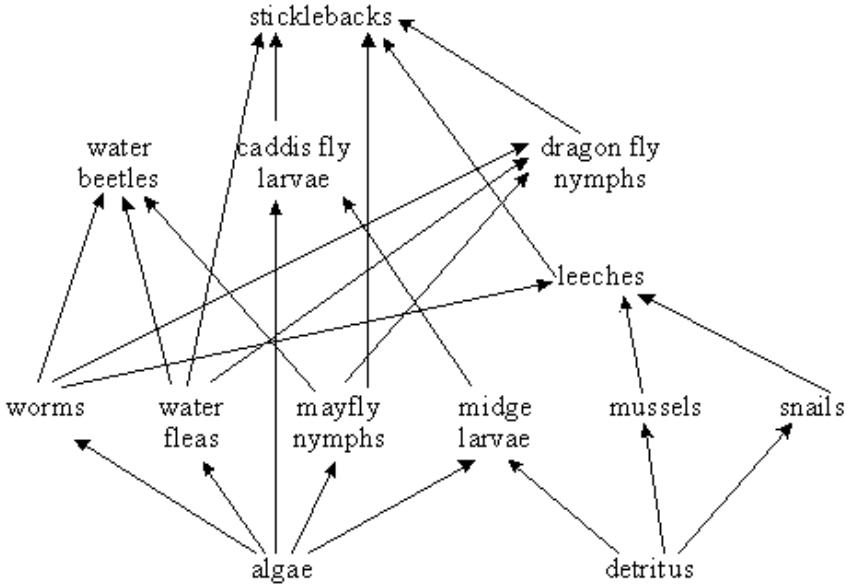
(3)

(Total 9 marks)

Q6. 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.

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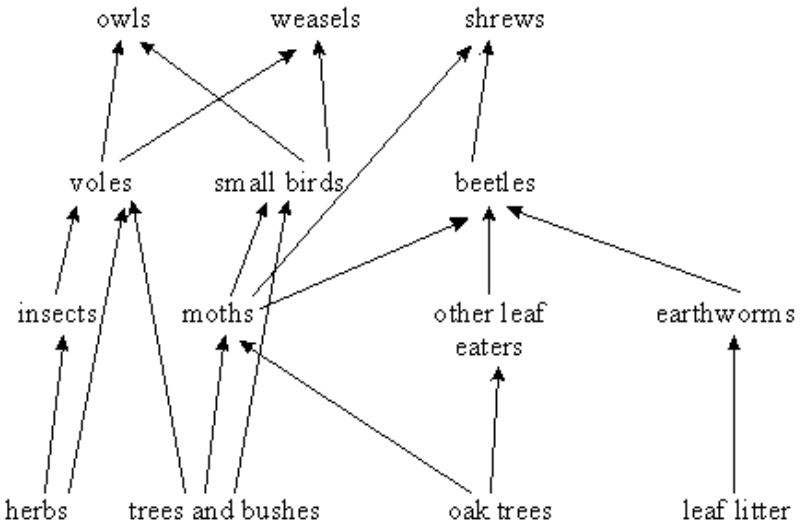
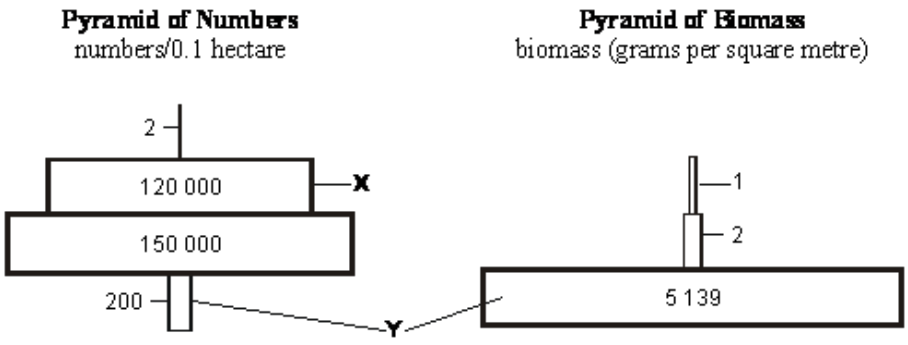
(8)
(Total 10 marks)

Q7. 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.

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(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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(10)
(Total 14 marks)

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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.

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..... per cent

(2)

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

1 .....

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2 .....

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3 .....

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(3)

(Total 5 marks)

Q9. 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.

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.....

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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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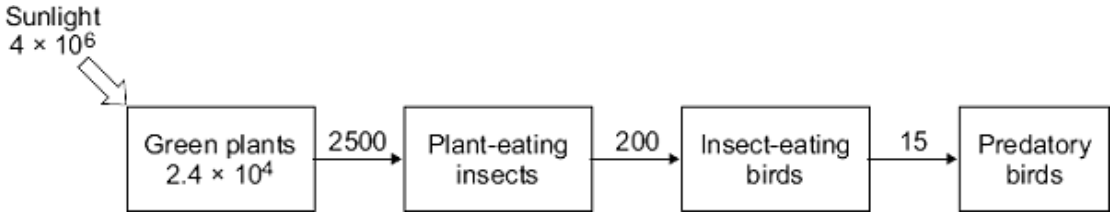
(3)
(Total 5 marks)

Q10. 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.

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Answer = ...

(2)

(ii) Suggest reasons why the percentage energy transfer you calculated in part (a)(i) was so low.

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(2)

(b) Compare the amount of energy transferred to the insect-eating birds with the amount transferred to the predatory birds.

Suggest explanations for the difference in the amount of energy transferred to the two types of bird.

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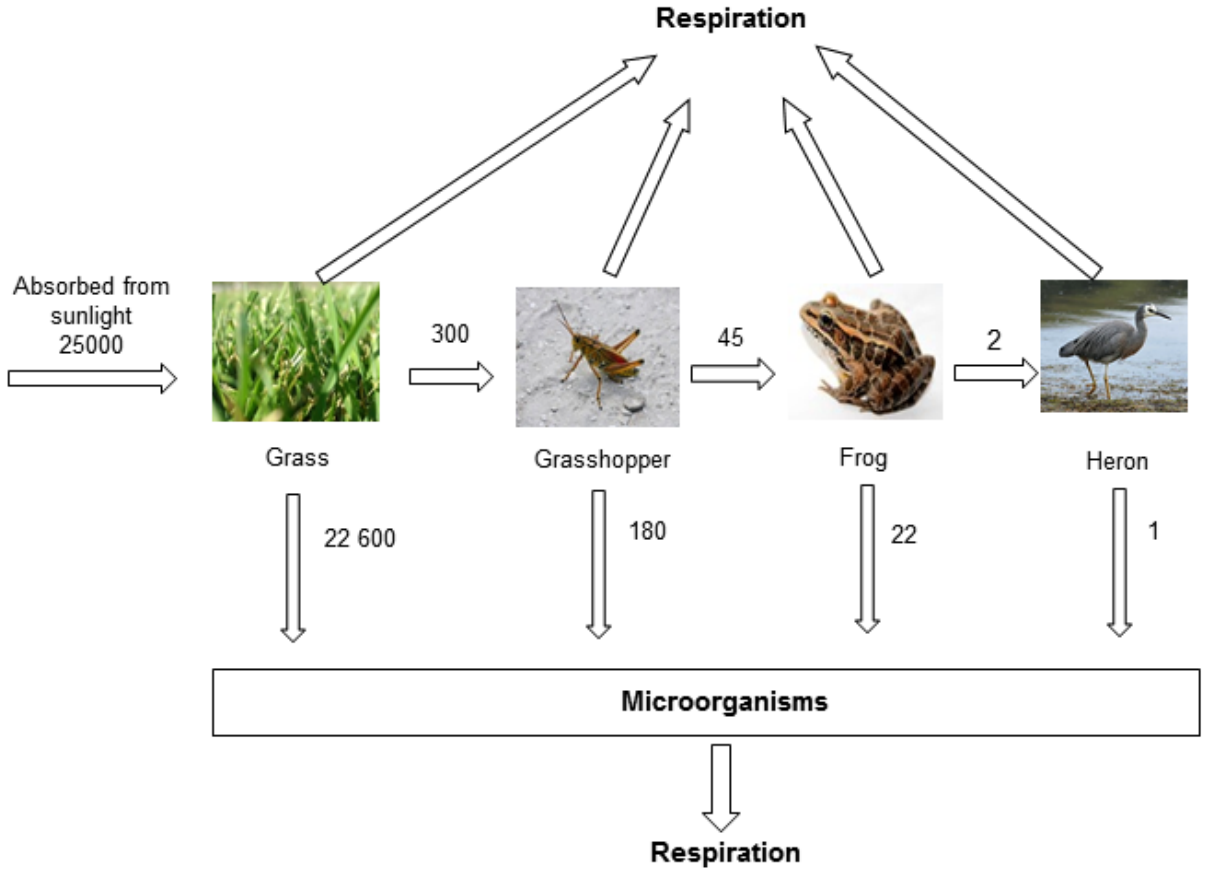
(3)
(Total 7 marks)

Q11. The diagram shows the annual energy flow through 1 m^2 of a habitat.

The unit, in each case, is kJ per m^2 per year.



(a) Calculate the percentage of the energy absorbed by the grass from sunlight that is transferred to the frog.

Show clearly how you work out your answer.

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.....

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?

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(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.

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(2)

(d) In this habitat microorganisms help to recycle materials.

Explain how.

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(3)
(Total 8 marks)

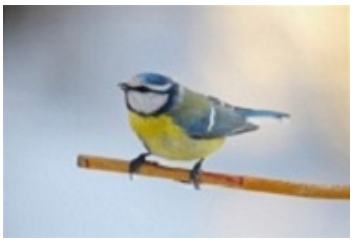
Grass by By Catarina Carvalho from Lisboa, Portugal (Flickr) [CC-BY-2.0], via Wikimedia Commons. Grasshopper by I, Daniel Schwen [GFDL, CC-BY-SA-3.0], via Wikimedia Commons. Frog by Brian Gratwicke (Pickerel Frog) [CC-BY-2.0], via Wikimedia Commons. Heron by Glen Fergus (Own work, Otago Peninsula, New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

Q12. The photographs show four different species of bird.

Great tit

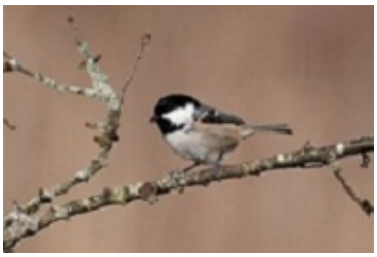
© JensGade/iStock

Blue tit



© Marcobarone/iStock

Coal tit



© MikeLane45/iStock

Long-tailed tit

© Andrew Howe/iStock

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

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

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

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Answer = ... kJ per day per gram of body mass

(2)

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

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(1)

(iii) Suggest an explanation for the trend you have described in part (a)(ii).

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(2)

(b) Describe and explain the trend shown by the data for the time spent feeding in winter for the birds.

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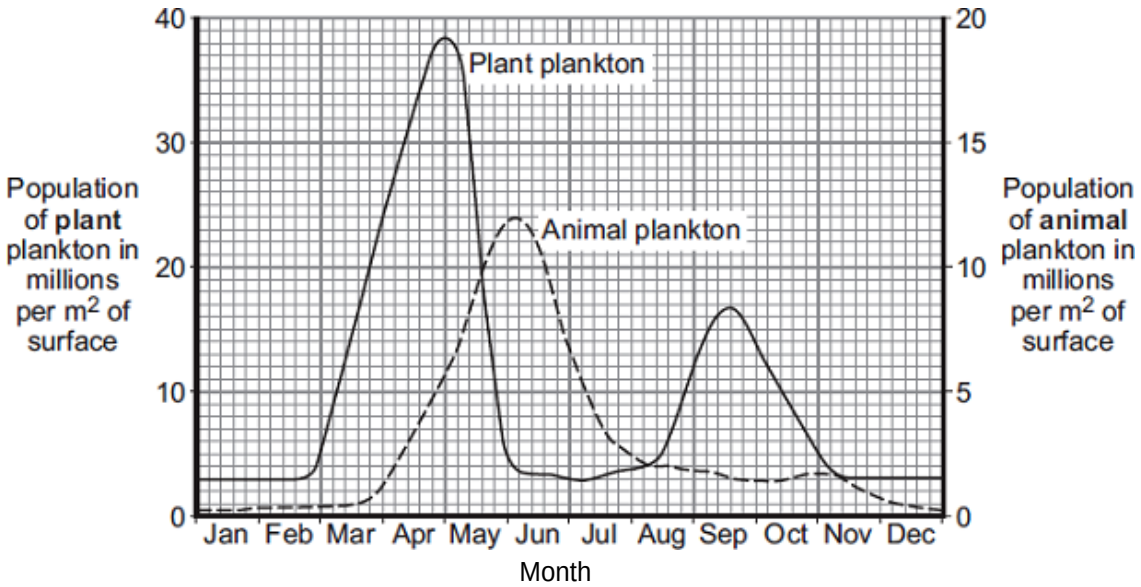
(2)

(Total 7 marks)

Q13. Plankton live in the sea.
Animal plankton eat plant plankton.

Graph 1 shows how the populations of the plankton change through the year in the seas around the UK.

Graph 1

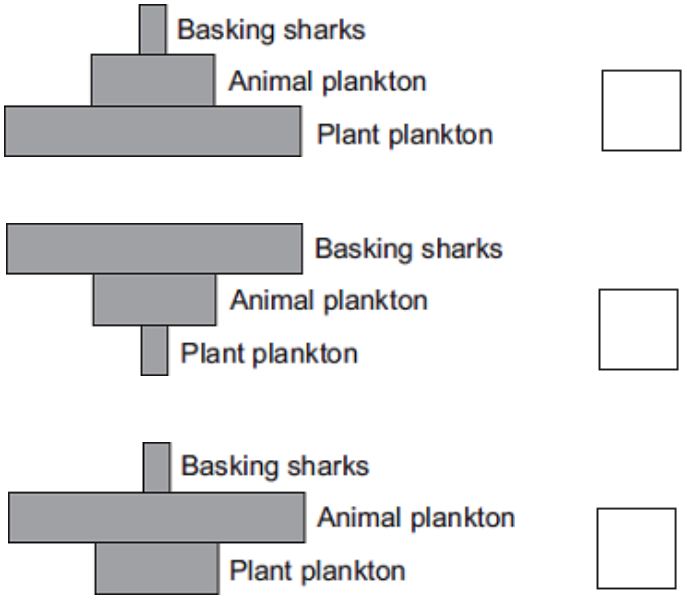


(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

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

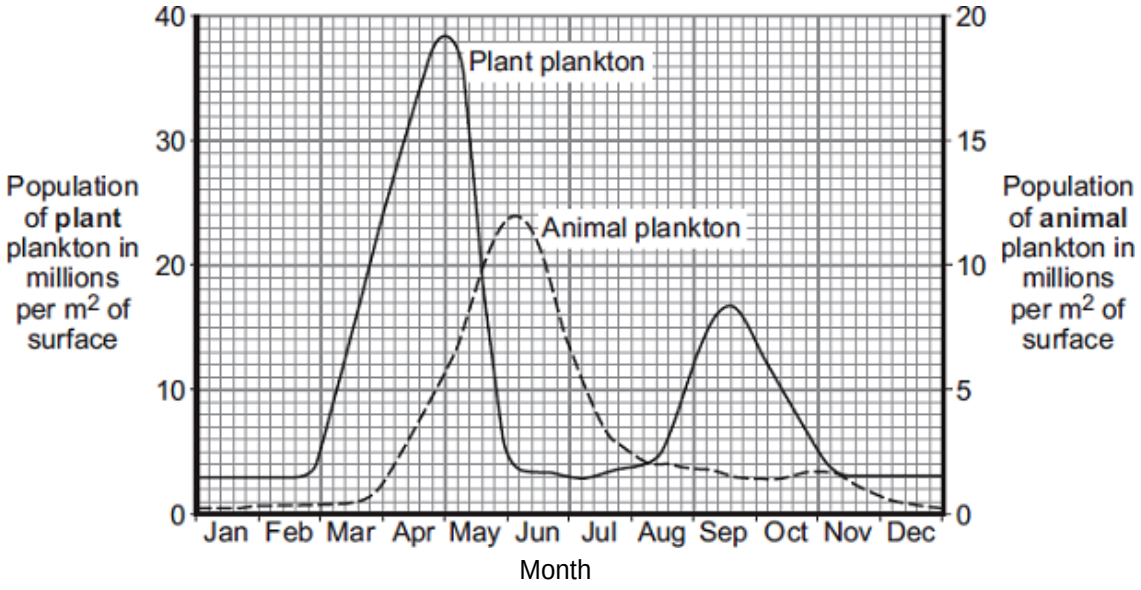
Which is the correct shape for the pyramid of biomass to show the relationship between plant plankton, animal plankton and basking sharks, in June?

Tick (✓) **one** box.

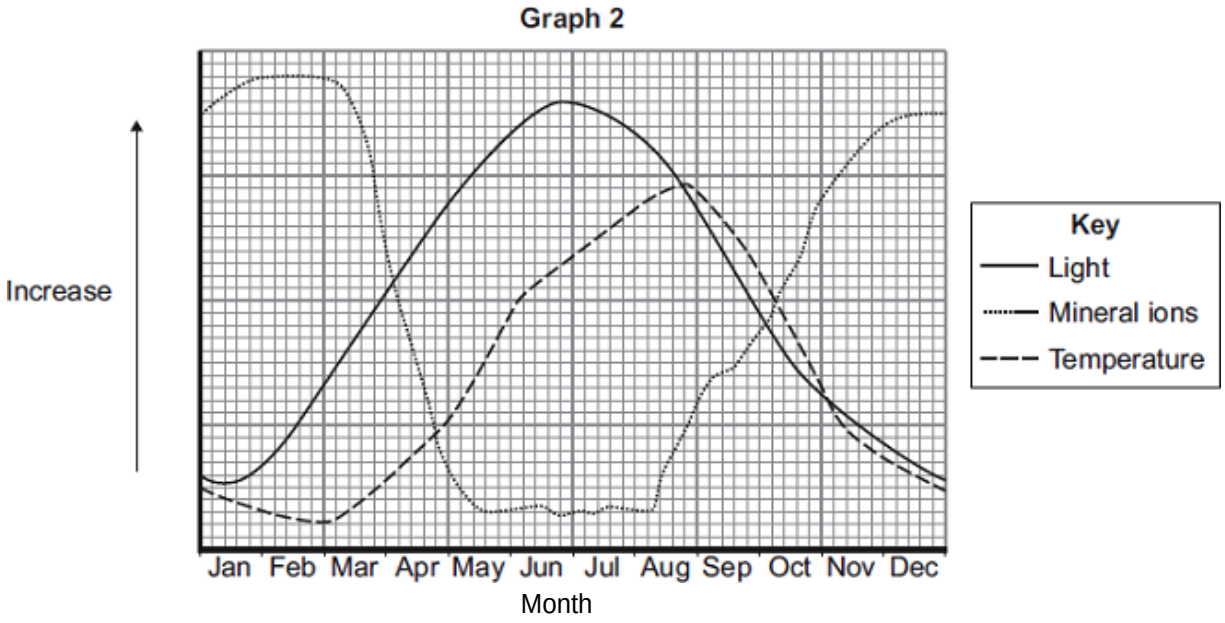


(1)

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



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



(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)

(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)