AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



EXAM QUESTION PACK

4.7.4 TROPHIC LEVELS IN AN ECOSYSTEM (PACK 1)

SCORE	PERCENTAGE
/268	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

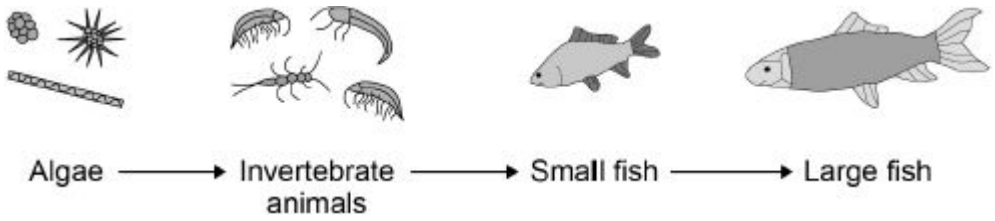
Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

The diagram below shows a food chain in a river.



(a) Draw **one** line from each scientific term to the correct organism in the food chain.

Scientific term	Organism in the food chain
	Algae
Apex predator	
	Invertebrate animals
Primary consumer	
	Large fish
Producer	
	Small fish

(3)

(b) The table below shows the biomass of the organisms at each stage in the food chain.

Organism	Biomass in arbitrary units
Algae	840
Invertebrate animals	200
Small fish	40
Large fish	10

Calculate the percentage of the biomass of the invertebrate animals that is transferred to the large fish.

Use the equation:

$$\text{percentage} = \frac{\text{biomass of large fish}}{\text{biomass of invertebrate animals}} \times 100$$

_____

_____

STEMUP.CO.UK

_____

_____

Percentage = _____

(2)

(c) A large amount of biomass is lost from the food chain.

Complete the sentences.

Choose answers from the box.

coordination	**digestion**	**excretion**
filtration	**ingestion**	**respiration**

When the small fish eat the invertebrate animals, not all of this material is broken down during _____ .

Materials absorbed from the gut may enter the body cells of the small fish. These materials are broken down into carbon dioxide and water by _____ .

The carbon dioxide and other waste materials from the body cells are removed from the small fish by _____ .

(3)

(d) A disease kills many of the small fish.

Why does the number of invertebrate animals increase?

_____

_____

(1)

(Total 9 marks)

Q2.

Figure 1 shows:

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

Figure 1

STEMUP.CO.UK



Algae → Invertebrate animals → Small fish → Large fish

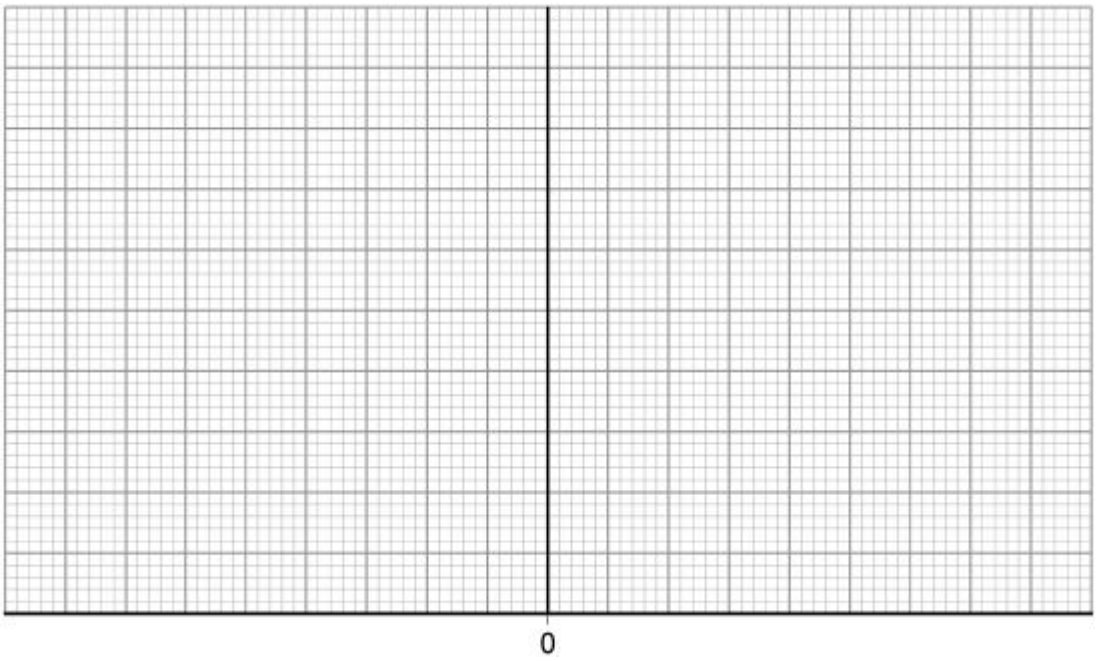
Biomass in g/m^2:	840	200	40	10

(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

You should:

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

Figure 2



(4)

(b) Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

_____

Percentage loss = _____

STEMUP.CO.UK

(3)

(c) Give **one** way that biomass is lost between trophic levels.

_____

_____

(1)

(d) 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)

(Total 13 marks)

Q3.

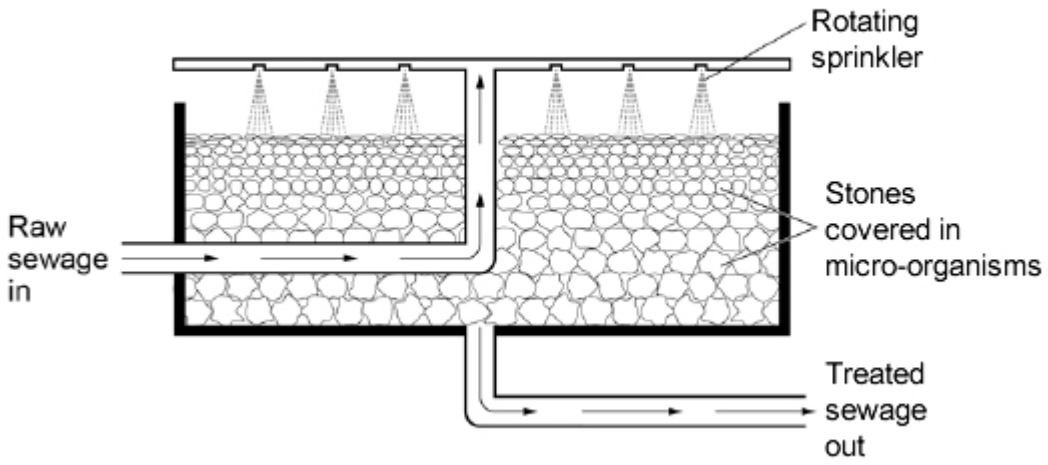
Pollution of rivers with untreated sewage can kill plants and animals.

Figure 1 shows a sprinkler bed at a sewage works.

The sewage trickles slowly downwards over the surfaces of the stones.

STEMUP.CO.UK

Figure 1



Some of the microorganisms on the stones feed on organic matter in the sewage.

The treated sewage is safe enough to pass into a river.

(a) Most of the microorganisms in the sprinkler bed respire aerobically.

Describe **two** features of the sprinkler bed that encourage **aerobic** respiration.

Use information from **Figure 1**.

1. _____

_____

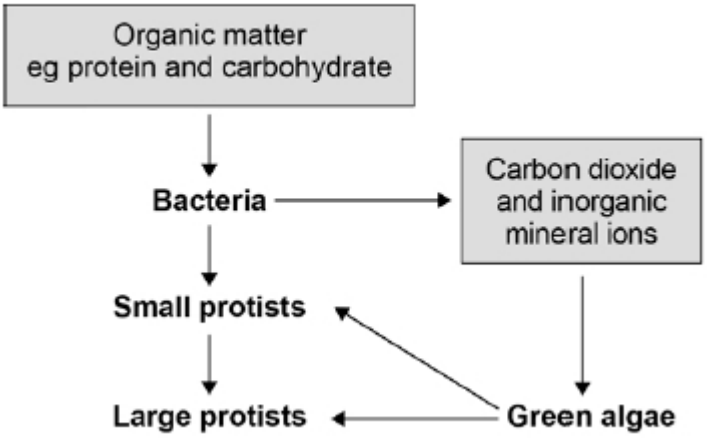
2. _____

_____

(2)

Figure 2 shows the feeding relationships between the microorganisms in the sprinkler bed.

Figure 2



STEMUP.CO.UK

(b) Which organisms in **Figure 2** are producers?

Tick **one** box.

Bacteria	☐
Green algae	☐
Large protists	☐
Small protists	☐

(1)

(c) Name **one** organism in **Figure 2** which is both a primary and a secondary consumer.

_____

(1)

(d) The bacteria are decomposers.

Figure 2 shows that the bacteria change organic matter into carbon dioxide and inorganic mineral ions.

Describe how the bacteria do this.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q4.

Cows are reared for meat production.

The cows can be reared indoors in heated barns, or outdoors in grassy fields.

The table shows energy inputs and energy outputs for both methods of rearing cows.

STEMUP.CO.UK

	kJ / m² / year		
	Energy input		Energy output
	Food	Fossil fuels	Meat production
Indoors	10 000	6 000	40
Outdoors	5 950	50	**X**

(a) The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate the energy output value **X**.

Use the equation:

$$\text{percentage efficiency} = \frac{\text{energy output}}{\text{total energy input}} \times 100$$

Energy output value **X** = _____ kJ / m² / year

(3)

(b) The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate how many times more efficient it is to rear cows indoors than to rear cows outdoors.

Use the equation from (a).

Answer = _____ times

(3)

(c) A large amount of energy is wasted in both methods of rearing cows.

STEMUP.CO.UK

Give **two** ways in which the energy is wasted.

1. _____

_____

2. _____

_____

(2)

(d) Suggest **two** reasons why it is more efficient to rear cows indoors than to rear cows outdoors.

1. _____

_____

2. _____

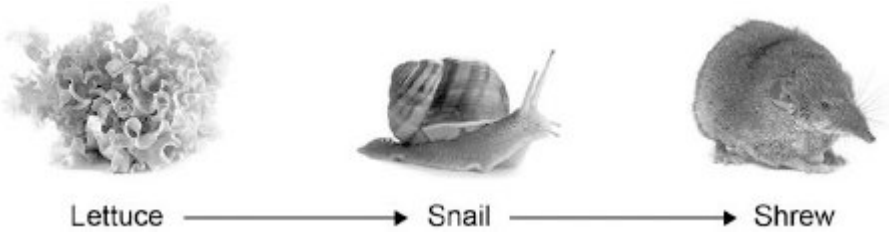
_____

(2)

(Total 10 marks)

Q5.

The diagram below shows a food chain in a garden.



Lettuce © destillat/iStock/Thinkstock; Snail ©Valengilda/iStock/Thinkstock; Shrew © GlobalT/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?

STEMUP.CO.UK

Tick **one** box.

Community ☐

Ecosystem ☐

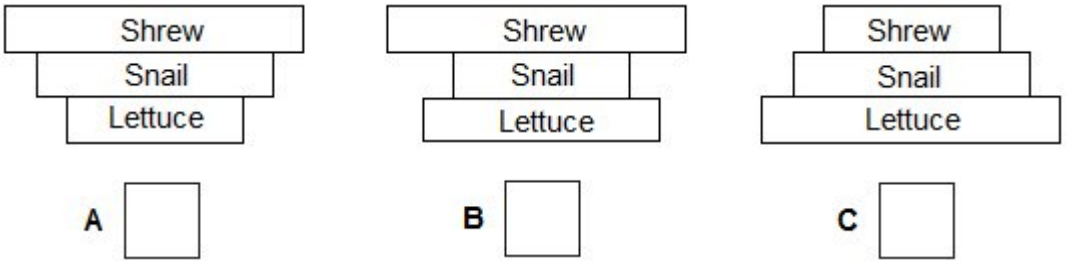
Population ☐

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 ☐

STEMUP.CO.UK

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.

_____

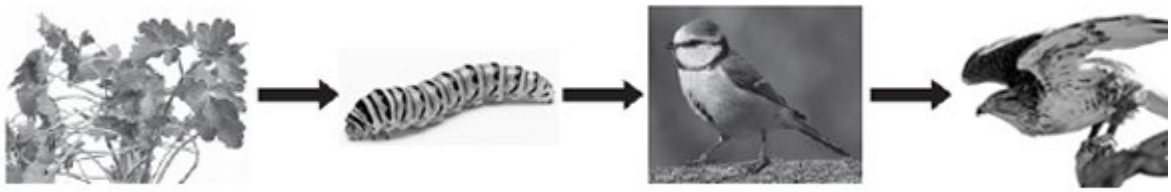
(1)

(Total 8 marks)

Q6.

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

Figure 1



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

_____

_____

_____

_____

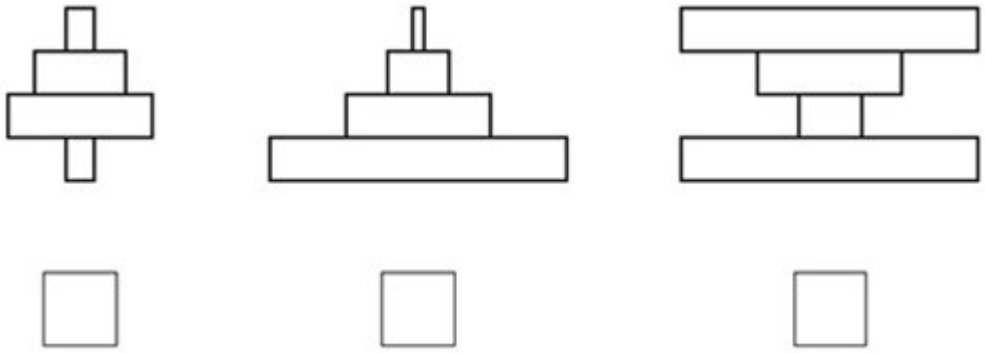
(2)

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

Why is photosynthesis important in the food chain?

Tick (✔) **one** box.

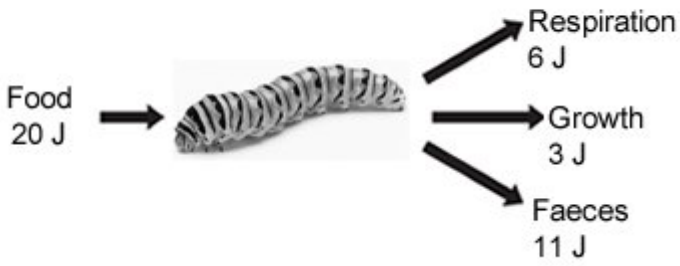
STEMUP.CO.UK



(1)

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

Figure 2



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

_____

_____

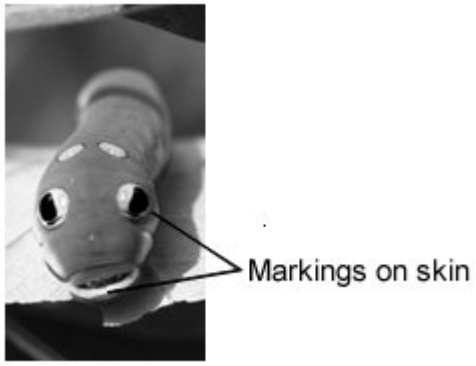
Percentage = _____

(2)

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

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

Figure 3



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

_____

STEMUP.CO.UK

_____

_____

_____

(2)

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

Figure 4



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

1. _____

_____

2. _____

_____

(2)

(Total 9 marks)

Blue tit: ©JensGade/iStock
Parsley: © Warren_Price/iStock
Caterpillar ©prettyzhizhi/iStock
Hawk: © kojihirano/iStock
Swallowtail caterpillar: © Anna_Po/iStock

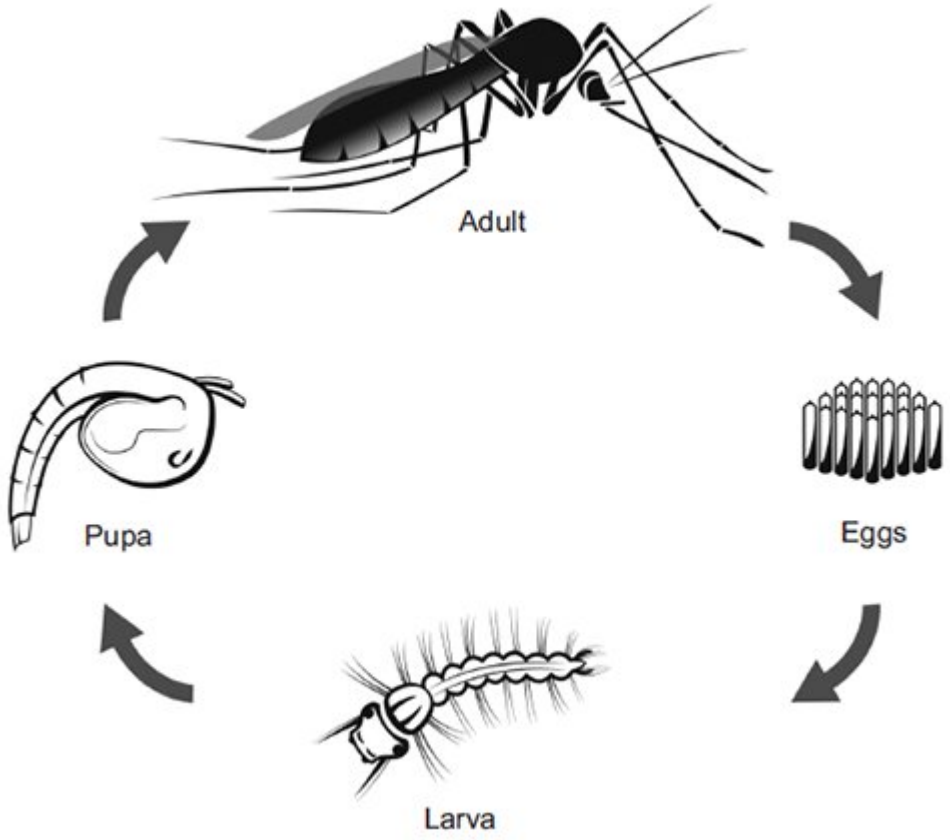
Q7.

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

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

The figure below shows the life cycle of a mosquito.

STEMUP.CO.UK



© watcharapon/iStock

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

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

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

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

_____

_____

_____

_____

(2)

(b) An internet article states:

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

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

Explain why.

STEMUP.CO.UK

_____

_____

_____

_____

(2)

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

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

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

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

_____

_____

_____

_____

_____

_____

_____

_____

(4)

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

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

STEMUP.CO.UK

Q8.

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.

The table below shows the students' results and calculations.

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

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

_____

_____

_____

_____

(2)

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

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

_____

_____

(1)

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

Figure 1 shows two examples of European banded snails.

Figure 1

STEMUP.CO.UK



Dark-coloured shell with stripes

© Eric Lsselee/iStock

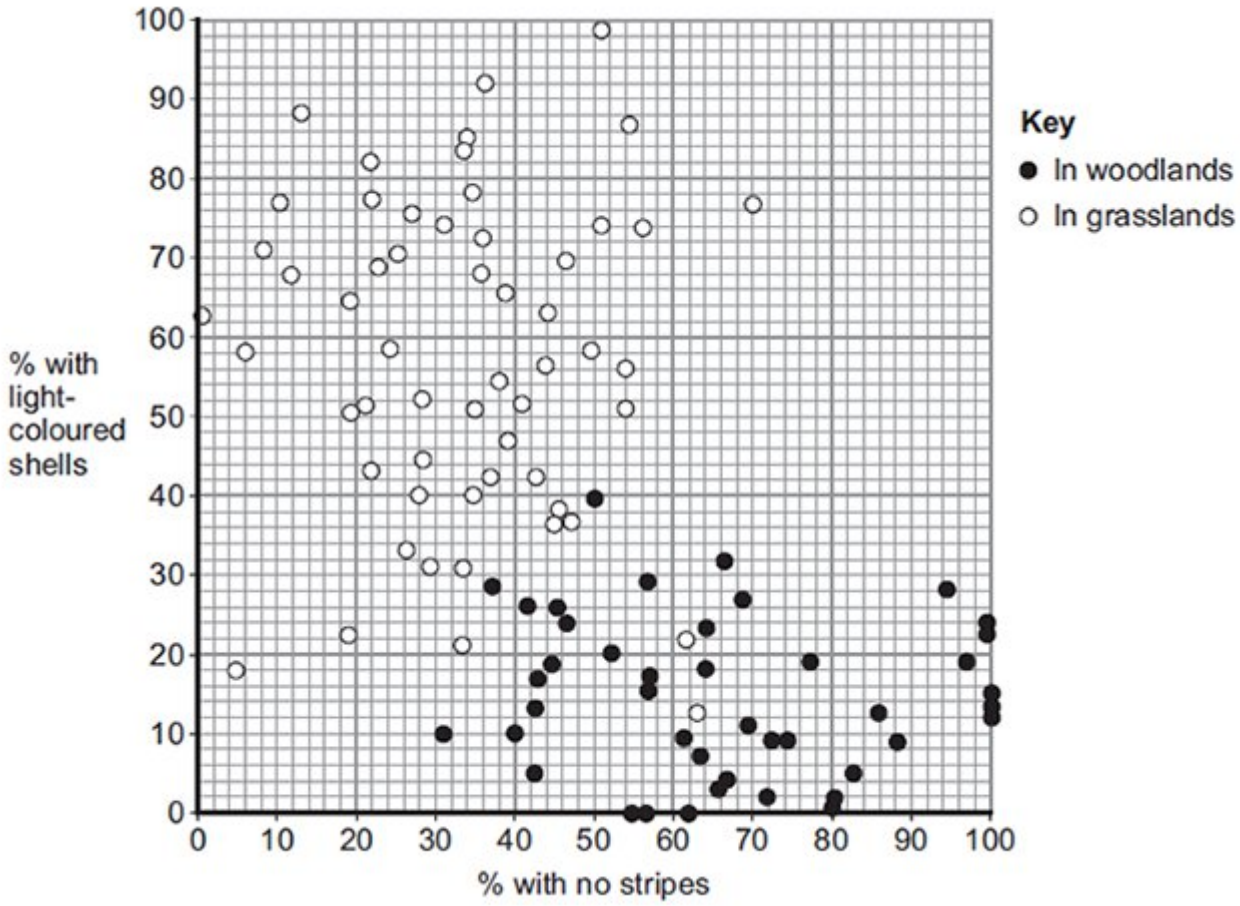
Light-coloured shell, with no stripes

© filipfoto/iStock

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

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

Figure 2



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

Why is a scatter graph used for this data?

_____

_____

(1)

STEMUP.CO.UK

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

_____

_____

_____

_____

(2)

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

_____

_____

(1)

(Total 7 marks)

Q9.

Over millions of years:

- new groups of organisms have evolved
- other groups of organisms have become extinct.

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

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

Suggest how.

_____

_____

(1)

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

_____

_____

(1)

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

1. _____

_____

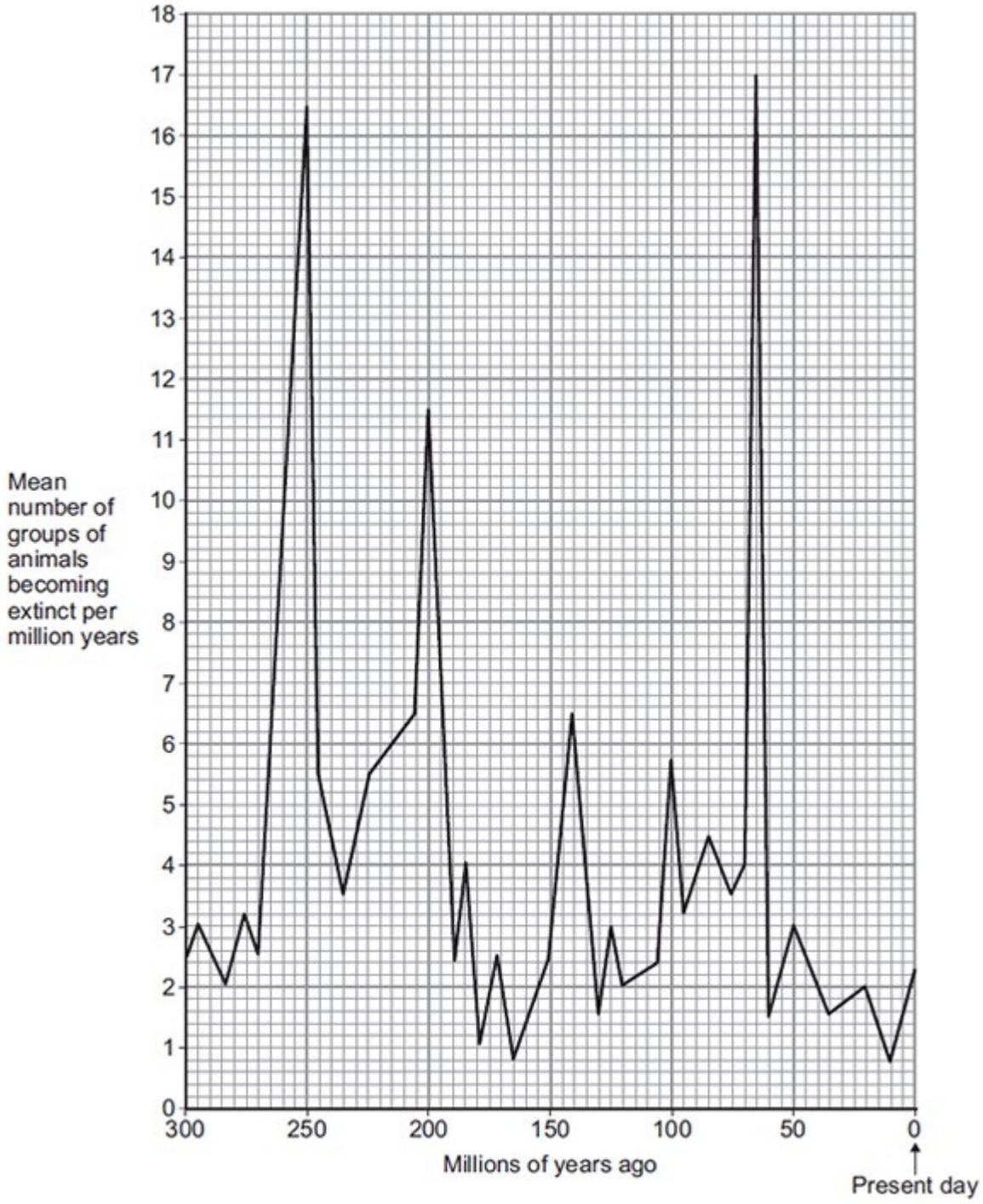
2. _____

STEMUP.CO.UK

_____

(2)

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



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

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

_____

(1)

STEMUP.CO.UK

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

_____

_____

(1)

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

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

Tick (✔) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

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

_____ groups per million years

(1)

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

_____

_____

(1)

(Total 9 marks)

Q10.

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

(a) The diagram below shows a food chain.

grass → sheep → human

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

Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

STEMUP.CO.UK

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

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

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

(1)

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

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q11.

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



© Getty Images/ Thinkstock | © Paul Williamson/iStock/ Thinkstock | © twobluedogs/iStock/ Thinkstock | © Gabriela Insuratelu/ iStock

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

The table shows the students' results.

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

STEMUP.CO.UK

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)

Q12.

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**	**Mean mass of each one in**	**Biomass of population in**

STEMUP.CO.UK

	garden	grams	grams
Hedgehog	1	200	200
Slug	600	2	1200
Lettuce	60	100	

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

Show clearly how you work out your answer.

_____

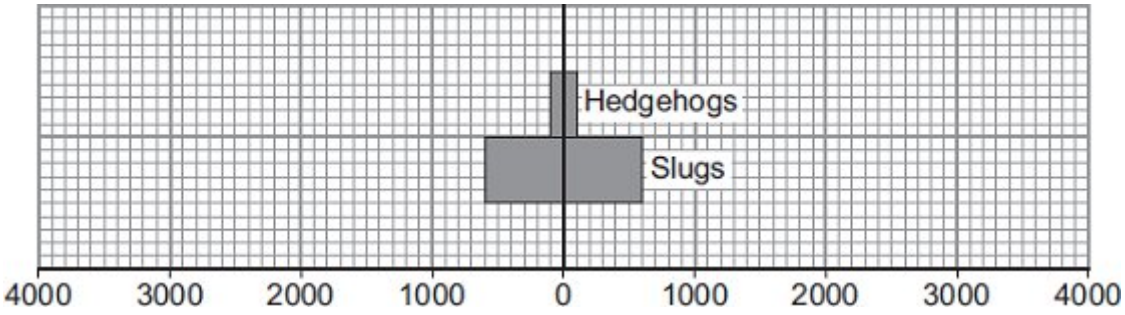
_____

Biomass = _____ grams

(2)

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

Show the biomass of the lettuce population in the garden.



Biomass of population in grams

(2)

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

Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

STEMUP.CO.UK

(Total 7 marks)

Q13.

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

Red kites are birds of prey.

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

Wheat grains → Field mice → Red kites

What is the source of energy for the food chain?

_____

(1)

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

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

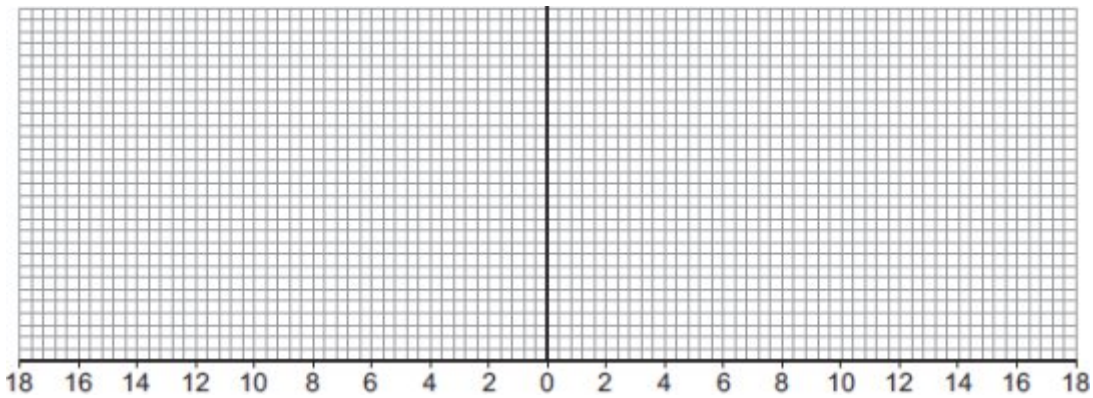
(i) Complete the table by calculating the total biomass of red kites and of field mice.

Write your answers in the table.

(2)

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

You should label each layer of your pyramid.



(3)

STEMUP.CO.UK

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

Give **two** reasons why.

_____

_____

_____

_____

(2)

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

Suggest **two** reasons why.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q14.

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.

STEMUP.CO.UK



Tree bark covered with lichens Tree bark made black by pollution

© Kim Taylor/Warren Photographic

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

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

characteristic	**clone**	**mutation**

A change in genetic material is called a _____

(1)

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

Explain why:

- the population of the pale form of the moth in forests decreased
- the population of the dark form of the moth in forests increased.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

The diagram shows the food chain:

birch trees → peppered moth larvae → birds

STEMUP.CO.UK

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)

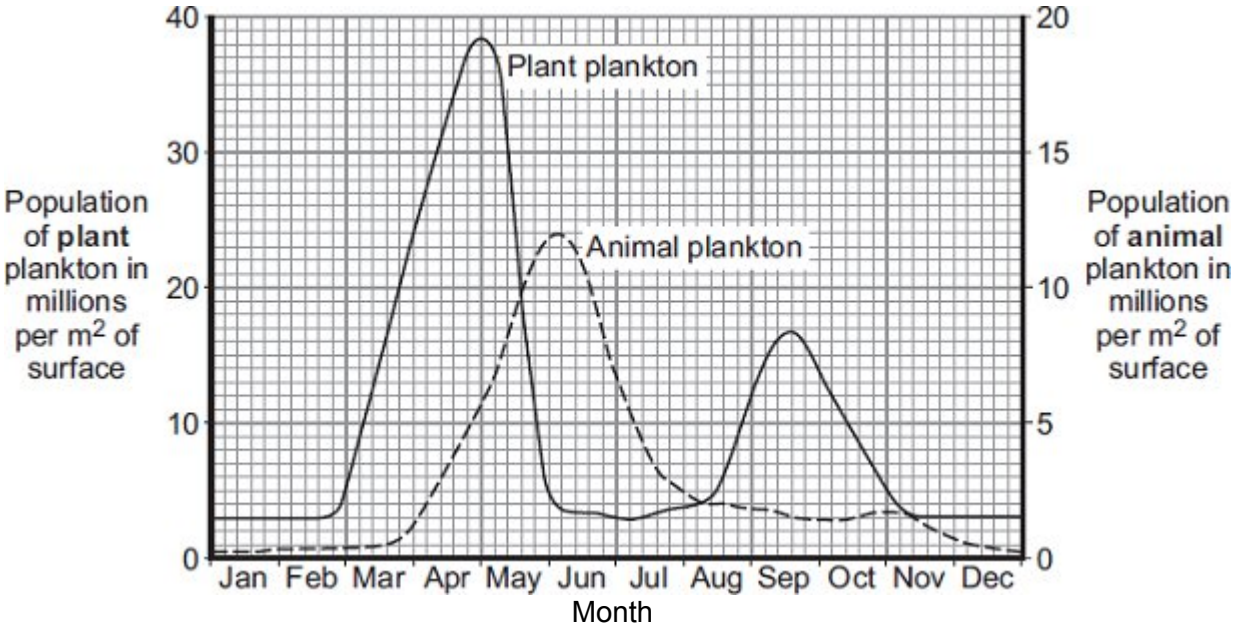
Q15.

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

STEMUP.CO.UK

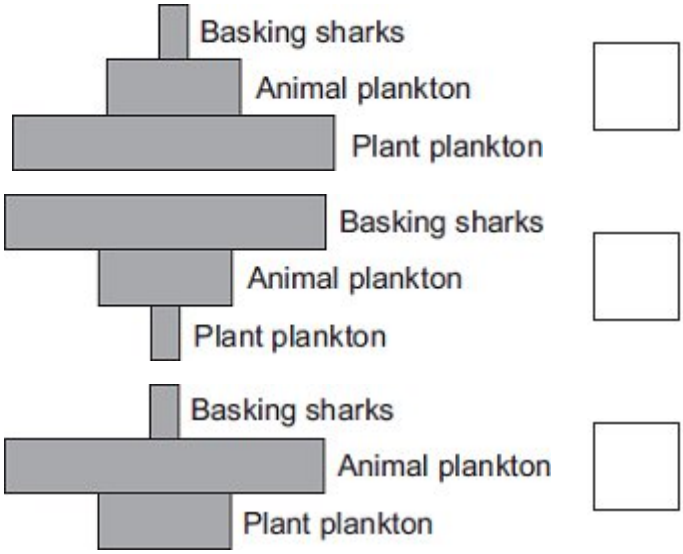


(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

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?

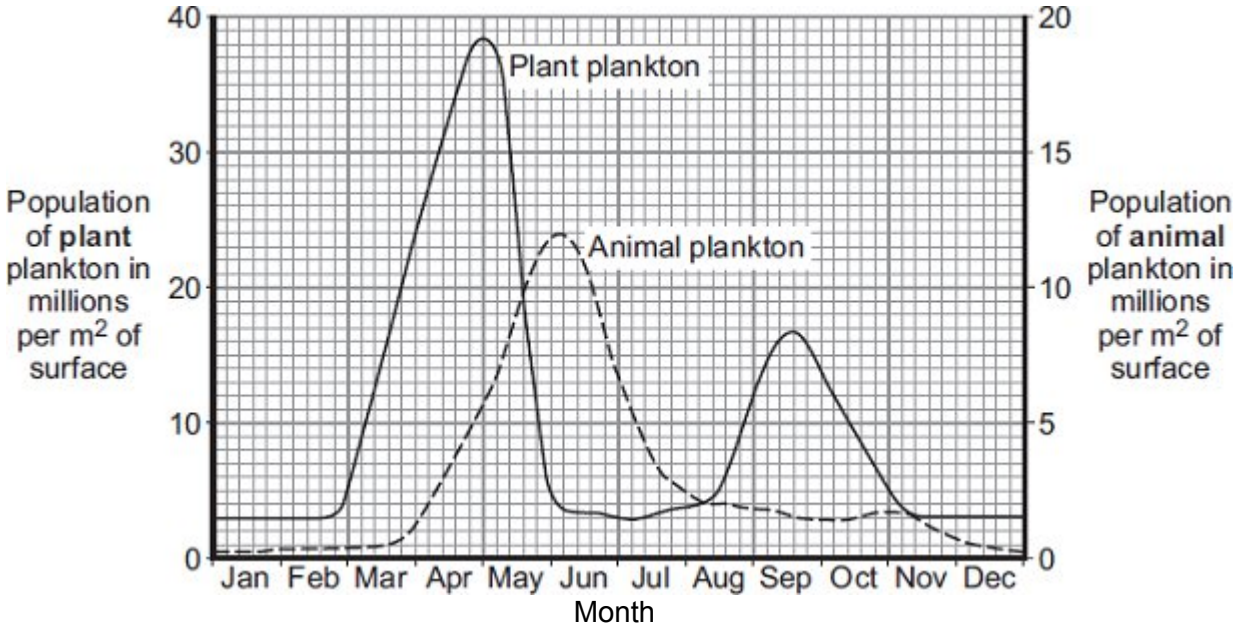
Tick (✓) **one** box.



(1)

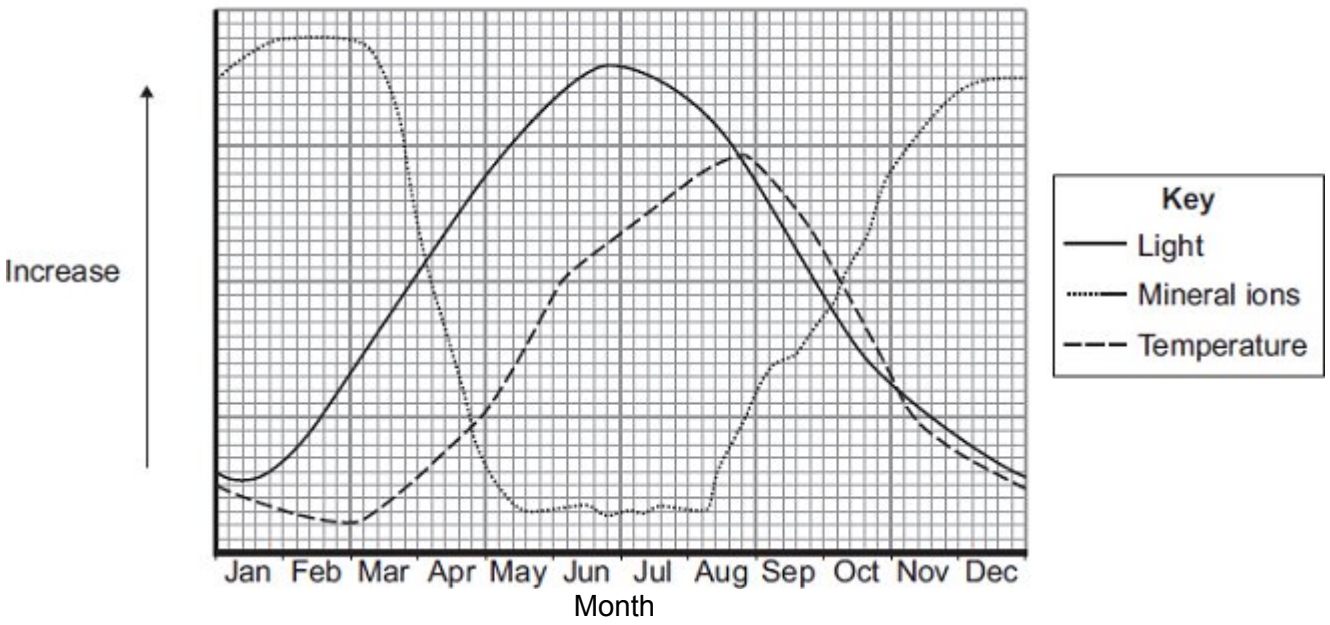
Graph 1 is repeated here to help you answer the following questions.

STEMUP.CO.UK



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

Graph 2



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

Suggest **one** reason for the increase.

Explain your answer.

_____

_____

_____

_____

(2)

STEMUP.CO.UK

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

Suggest explanations for the changes.

_____

_____

_____

_____

_____

(2)

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

Suggest explanations for the changes.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q16.

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)

STEMUP.CO.UK

(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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

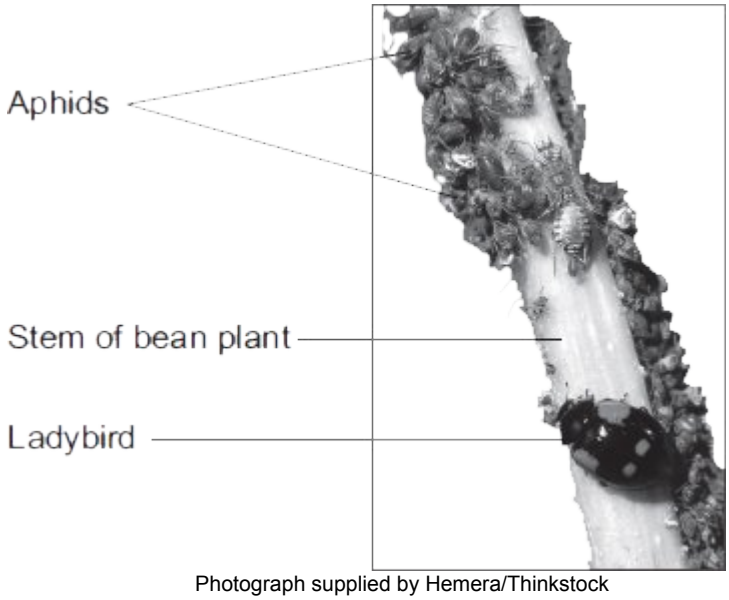
(Total 8 marks)

Q17.

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.

STEMUP.CO.UK



Photograph supplied by Hemera/Thinkstock

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

(2)

(ii) The biomass in the five ladybirds is less than the biomass in the bean plant.

Give **two** reasons why.

_____

_____

_____

_____

_____

_____

(2)

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

Describe this part of the carbon cycle.

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

(4)

(Total 8 marks)

Q18.

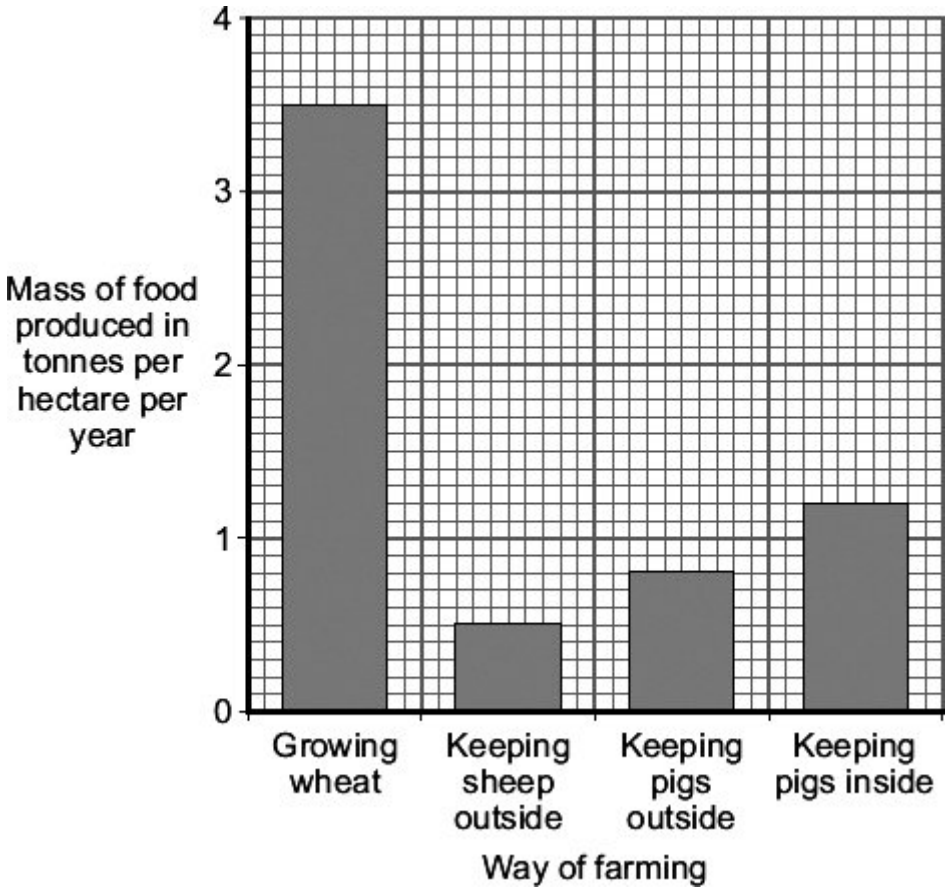
The photographs show four ways of farming.



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.

STEMUP.CO.UK



(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 ☐

STEMUP.CO.UK

As carbon dioxide from respiration ☐

(2)

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

Why?

Tick (✓) **two** boxes.

Pigs kept inside are fed more. ☐

Pigs kept inside are kept in small pens. ☐

Pigs kept inside are kept warm in the winter. ☐

Pigs kept inside are healthier. ☐

(2)

(ii) Meat from pigs kept inside is usually cheaper than meat from pigs kept outside.

Give **one** reason why.

_____

_____

(1)

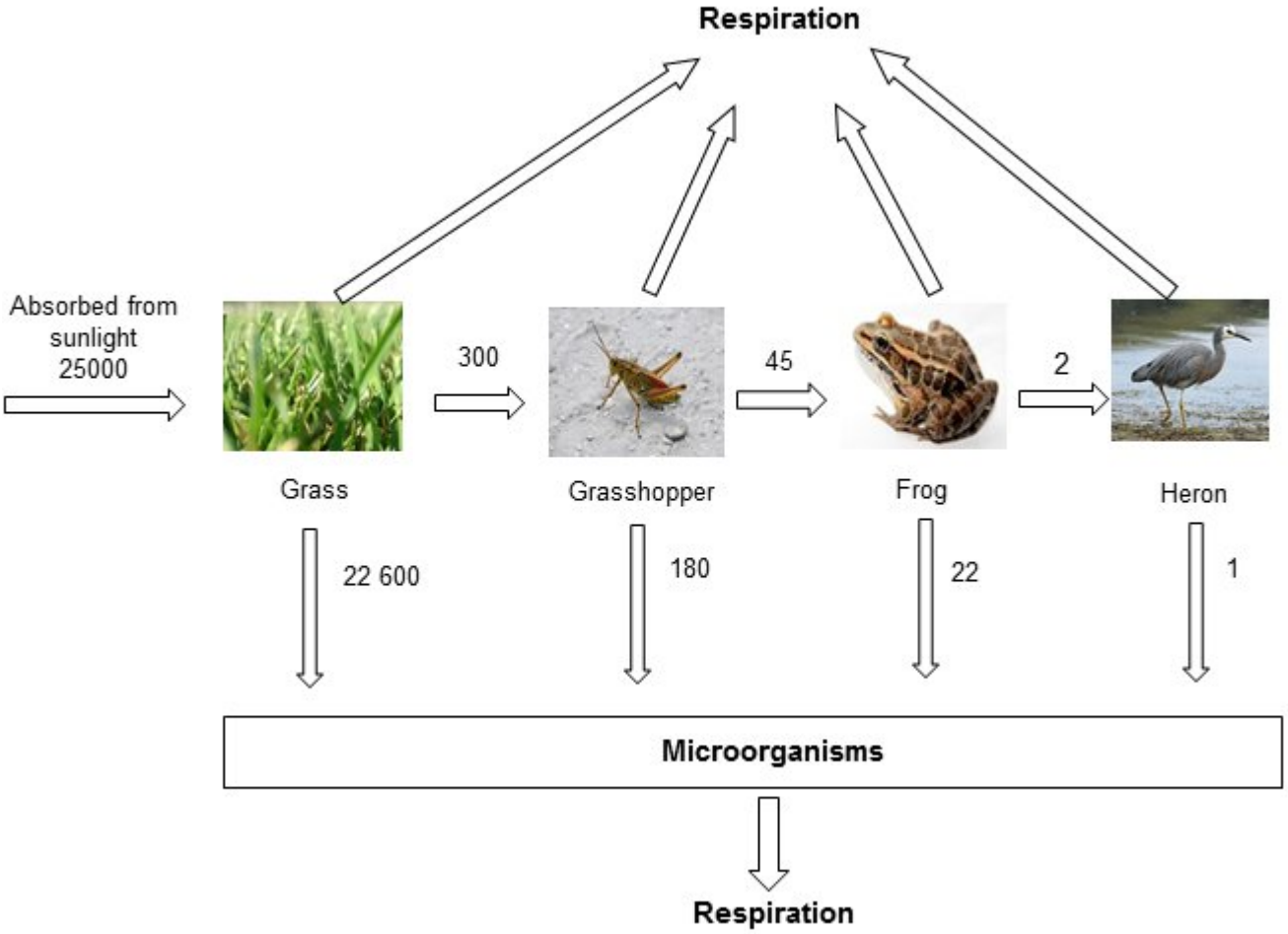
(Total 7 marks)

Q19.

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.

STEMUP.CO.UK



(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.

_____

STEMUP.CO.UK

_____

_____

_____

(2)

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

Explain how.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

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

Q20.

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)

STEMUP.CO.UK

(ii) The process uses the gas

carbon dioxide.
oxygen.
water.

(1)

(iii) The process produces carbon-containing compounds called

carbohydrates.
minerals.
salts.

(1)

(c) The amount of living material (biomass) at each stage in a food chain is less than at the previous stage.

The diagram shows a food chain.

oak tree → **caterpillar** → **blue-tit** → **hawk**

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

Tick (✓) **two** boxes.

As carbon dioxide from the caterpillar	☐
As food eaten by the hawk	☐
As oxygen from the oak tree	☐
As faeces (droppings) from the blue-tit	☐

(2)

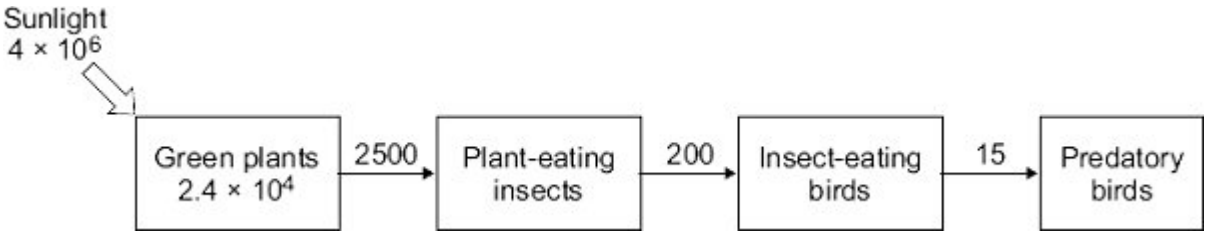
(Total 7 marks)

Q21.

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

The figures are in kJ m^{-2}.

STEMUP.CO.UK



(a) (i) Calculate the percentage of the energy in sunlight that was transferred into energy in the green plants.

Show clearly how you work out your answer.

_____

_____

_____

_____

Answer = _____ %

(2)

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

_____

_____

_____

_____

(2)

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

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

_____

_____

_____

_____

_____

_____

_____

_____

(3)

STEMUP.CO.UK

(Total 7 marks)

Q22.

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. _____

STEMUP.CO.UK

_____

(2)

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

1. _____

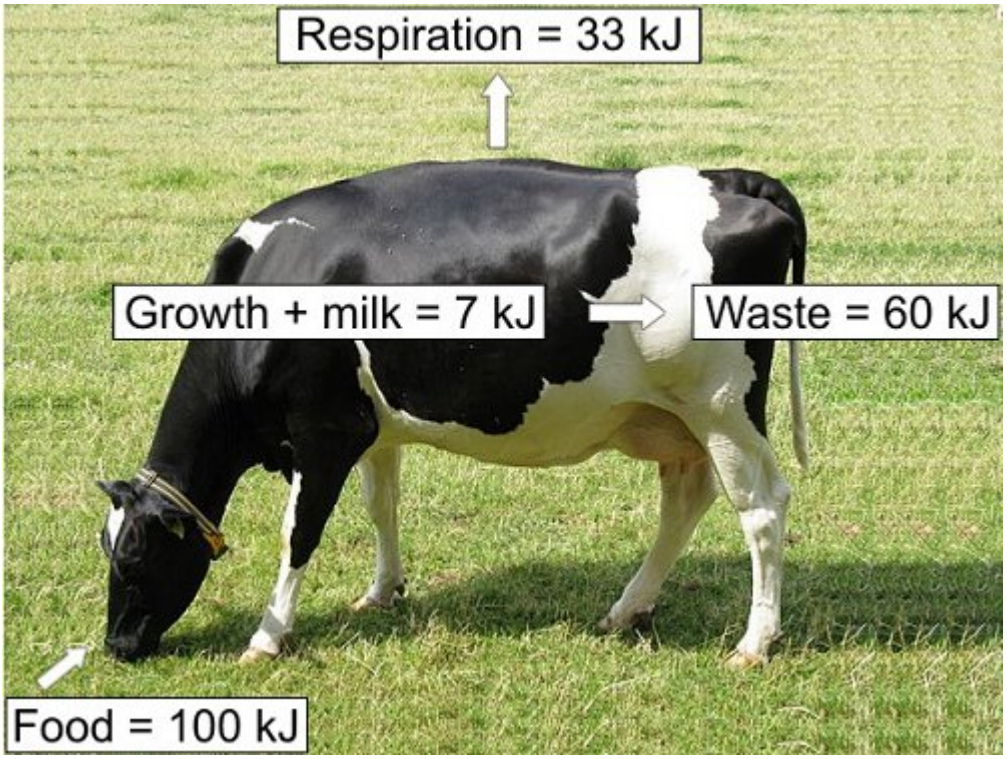
_____

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

STEMUP.CO.UK

transferred for growth and milk	
transferred in respiration	

(2)

(Total 6 marks)

Q23.

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

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

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

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

Show clearly how you work out your answer.

_____

_____

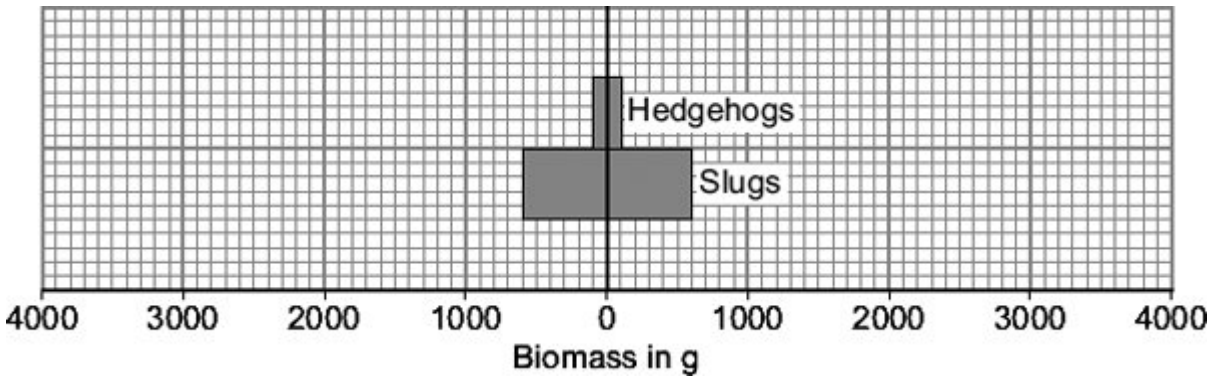
_____

Biomass = _____ g

(2)

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

Show the biomass of the lettuces in the garden.



(2)

(b) Hedgehogs eat slugs.

STEMUP.CO.UK

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

Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

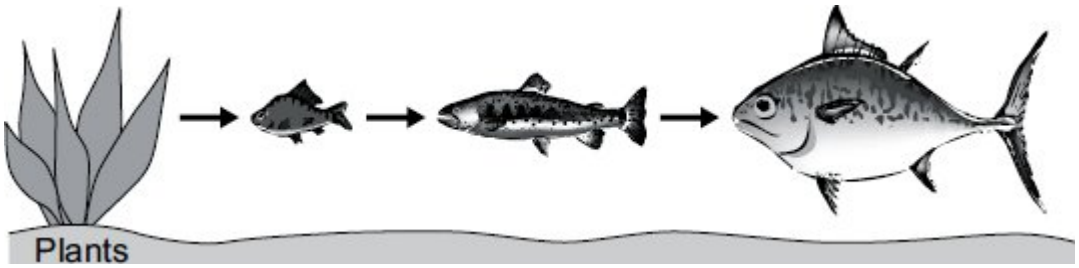
_____

(3)

(Total 7 marks)

Q24.

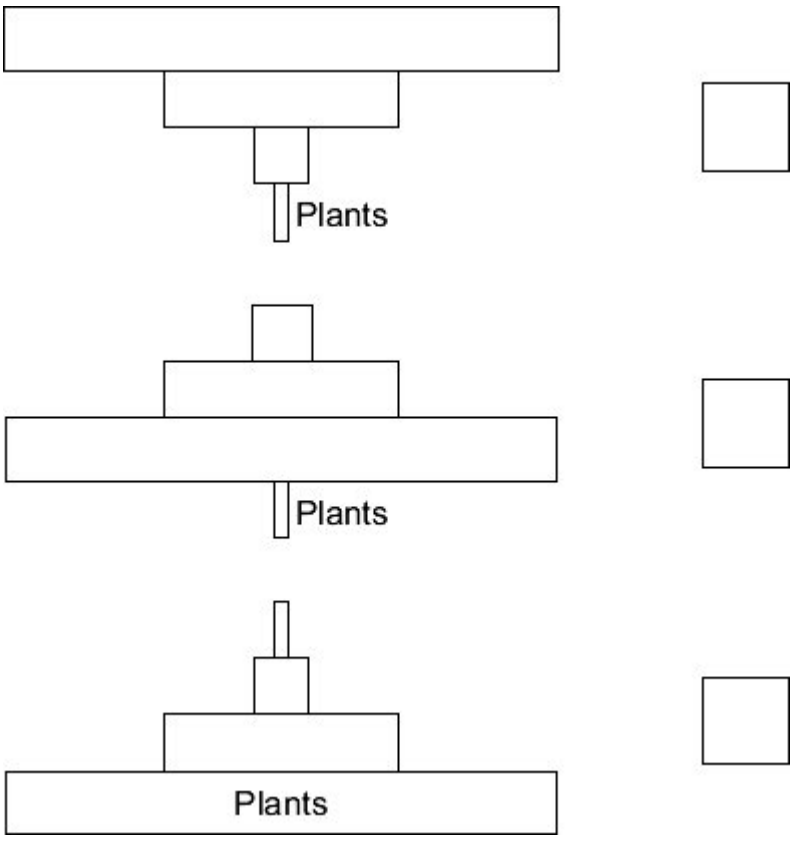
The picture shows a food chain.



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

Tick (✓) **one** box.

STEMUP.CO.UK



(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)

Q25.

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

Both animals feed mainly on grass.

STEMUP.CO.UK

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

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

Show clearly how you work out your answer.

_____

_____

_____

Answer = _____ %

(2)

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

Explain why as fully as you can.

You should include references to the data in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

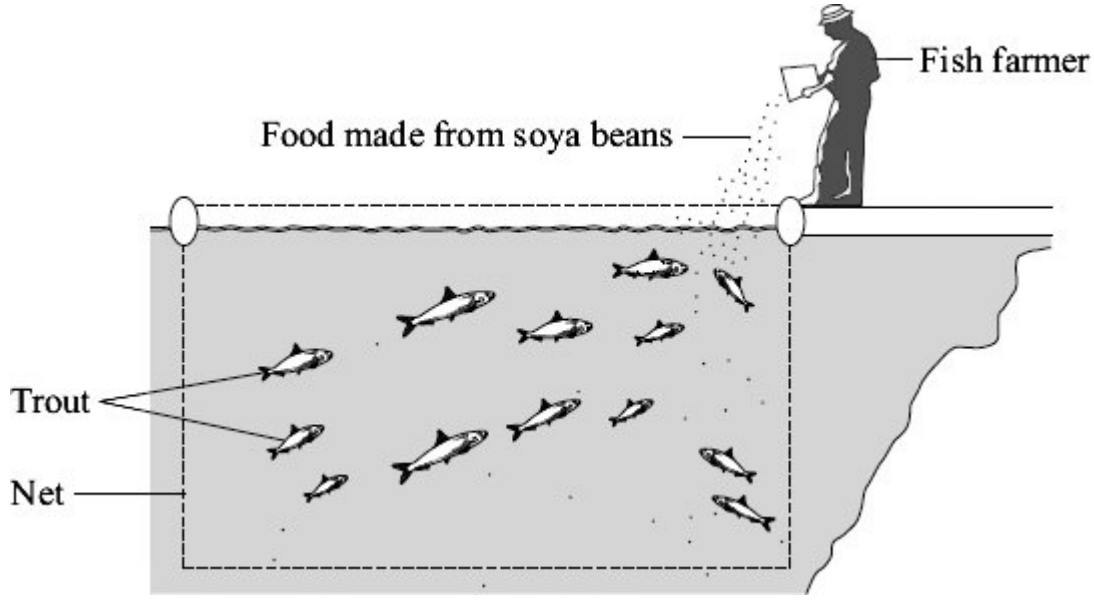
(3)

(Total 5 marks)

STEMUP.CO.UK

Q26.

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. ☐

STEMUP.CO.UK

Soya bean plants release energy when they respire. ☐

Some energy will be lost in waste from the trout. ☐

Soya bean plants absorb energy during photosynthesis. ☐

(2)

(c) Suggest **one** advantage to the fish farmer of keeping the trout in a large net instead of letting them swim freely in the lake.

_____

_____

(1)

(d) Some trout die before they are large enough to be sold.
The dead trout contain carbon.

Use your knowledge of the carbon cycle to describe how this carbon is returned to the atmosphere after the trout die.

_____

_____

_____

_____

_____

(2)

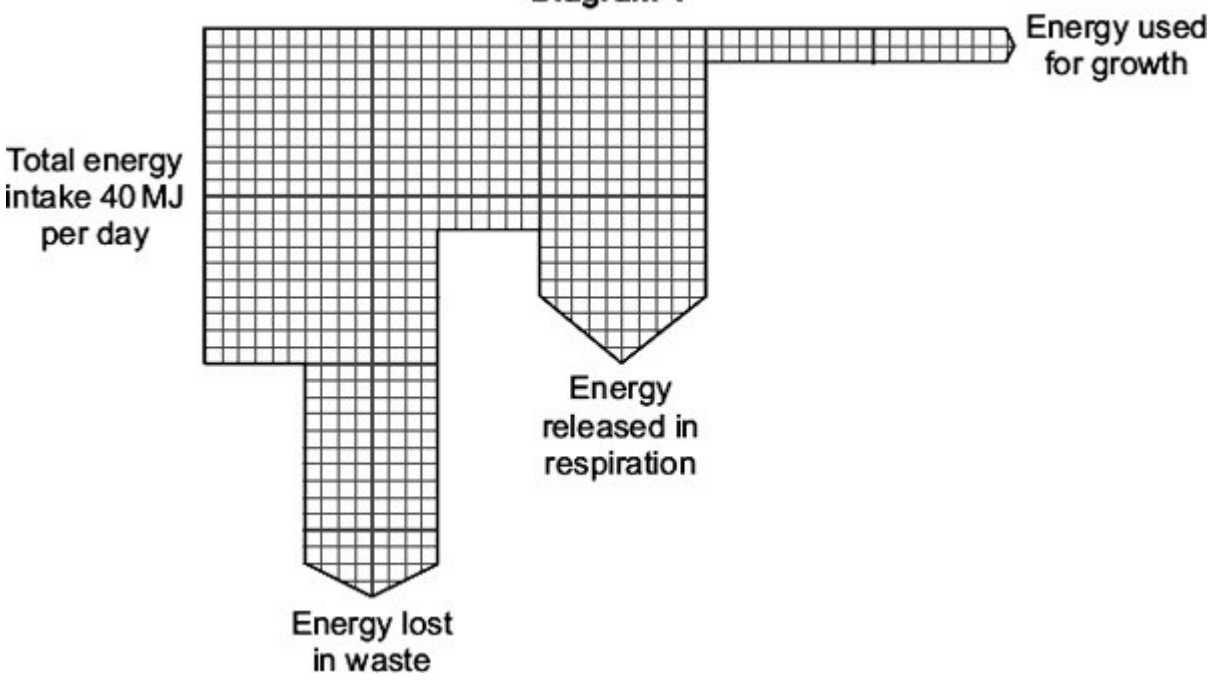
(Total 7 marks)

Q27.

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

STEMUP.CO.UK

Diagram 1



(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. _____

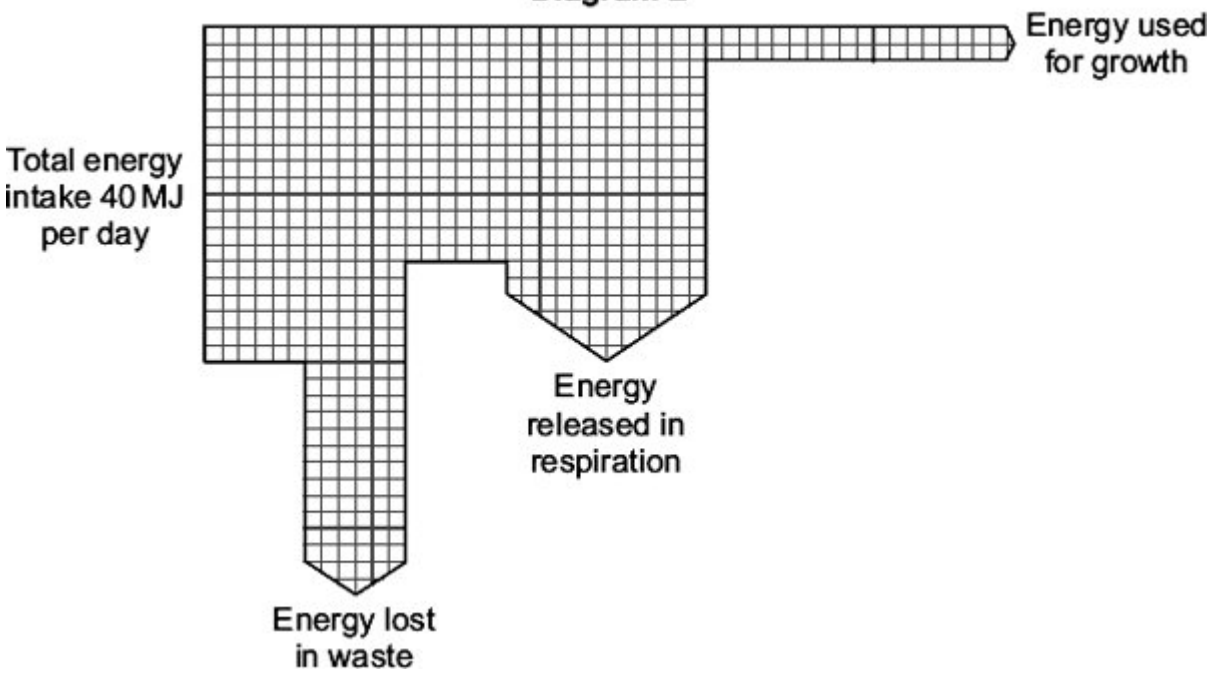
2. _____

(2)

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

STEMUP.CO.UK

Diagram 2



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

Suggest **one** reason for this.

_____

_____

(1)

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

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

Give **two** reasons why.

1. _____

_____

2. _____

_____

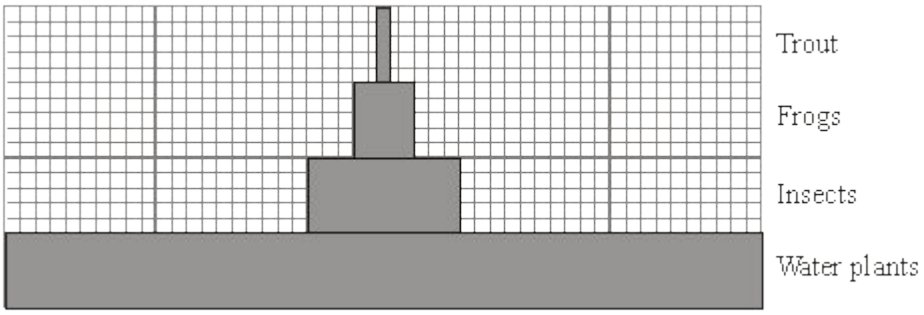
(2)

(Total 8 marks)

Q28.

The diagram shows a pyramid of biomass drawn to scale.

STEMUP.CO.UK



(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.

_____

_____

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

(4)

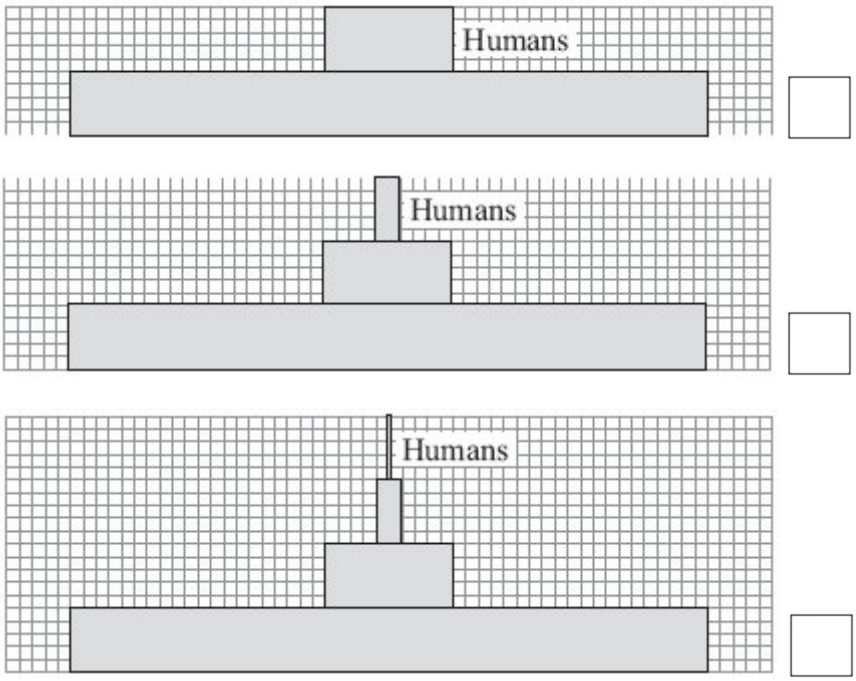
(Total 9 marks)

Q29.

(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**

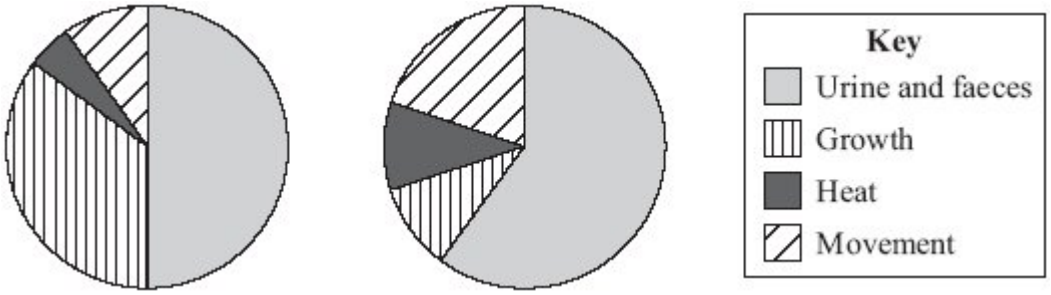
STEMUP.CO.UK





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

Pigs kept indoors **Pigs kept outdoors**



(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.

_____

_____

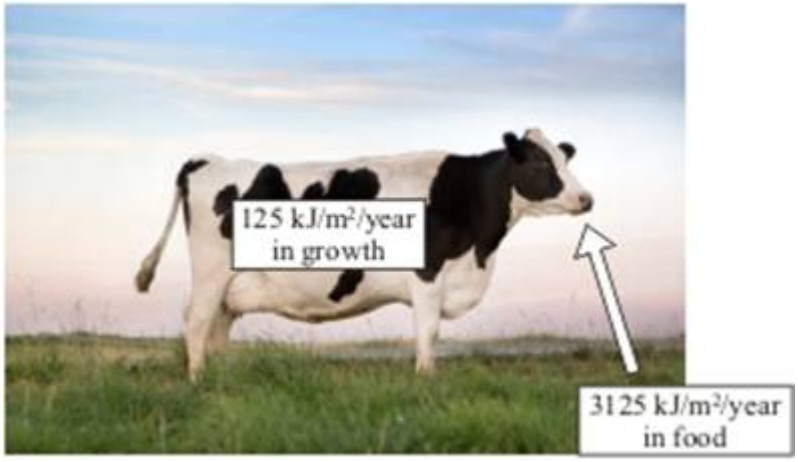
(1)

(Total 5 marks)

Q30.

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

STEMUP.CO.UK



(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.

_____

_____

_____

_____

_____

STEMUP.CO.UK

(2)
(Total 7 marks)

Q31.

(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. _____

_____

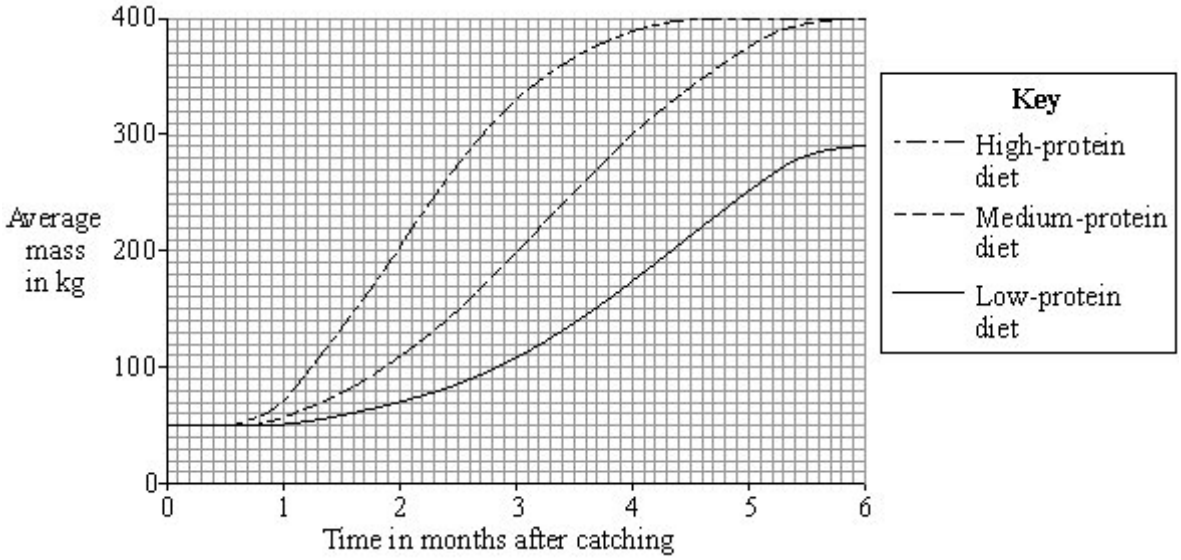
(2)

(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.

STEMUP.CO.UK



(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.

_____

_____

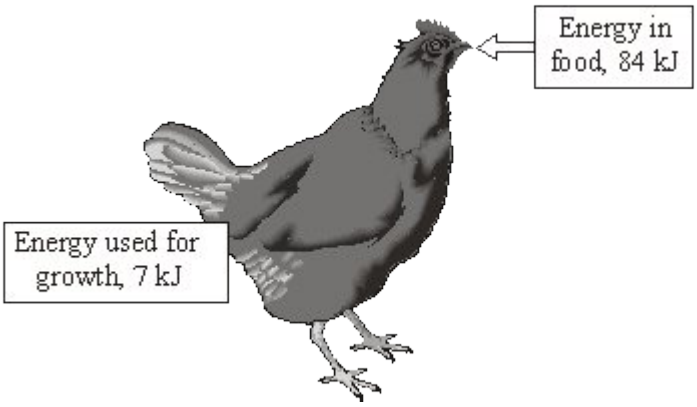
(1)

(Total 8 marks)

Q32.

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

STEMUP.CO.UK



(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. _____

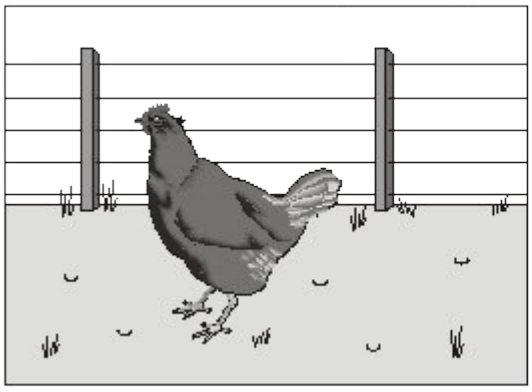
2. _____

3. _____

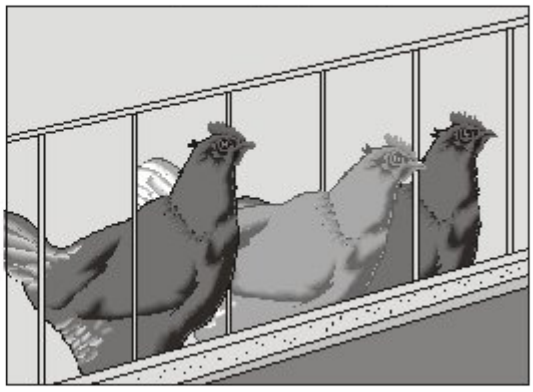
(3)

(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.

_____

_____

STEMUP.CO.UK

(1)

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

Explain why.

_____

_____

_____

_____

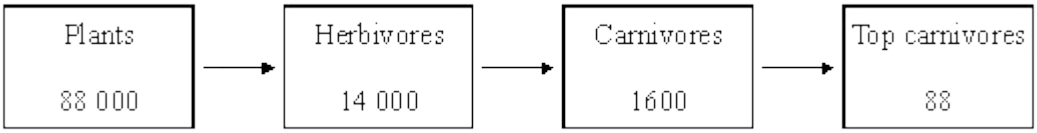
_____

(2)

(Total 8 marks)

Q33.

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



(a) Calculate the percentage of the energy in the plants that is passed to the top carnivores. Show clearly how you work out your final answer.

_____

_____

_____

Answer _____ %

(2)

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

STEMUP.CO.UK

(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)

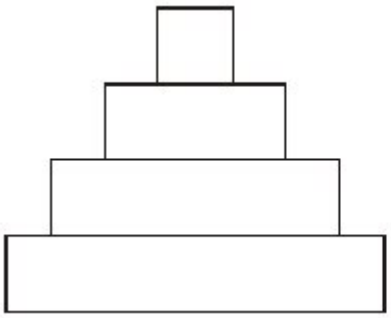
(Total 5 marks)

Q34.

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.

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

STEMUP.CO.UK

_____

_____

_____

Amount of energy = _____ kJ

(2)

(Total 5 marks)

Q35.

Figure 1 shows a food chain containing three organisms.

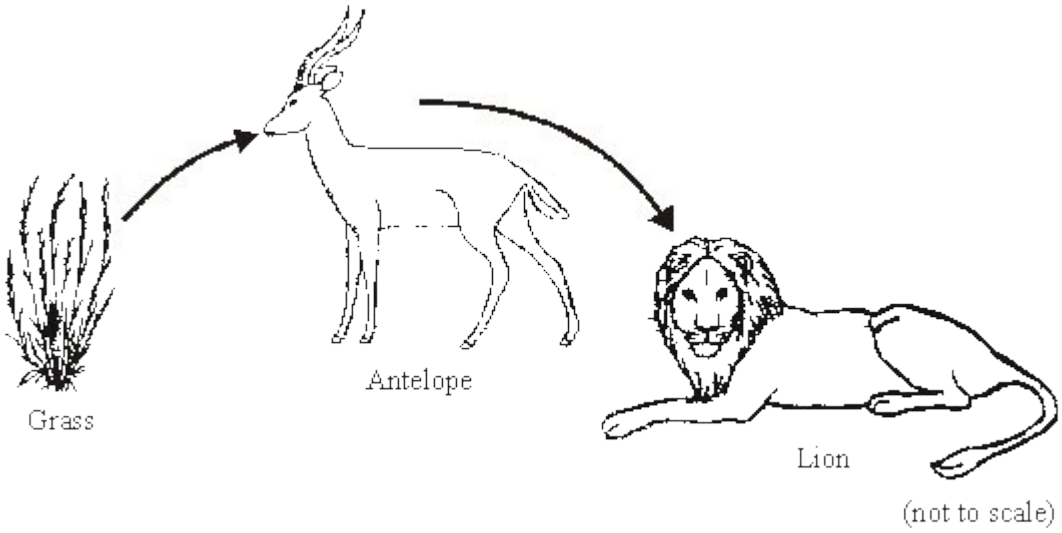


Figure 1

(a) (i) In this food chain, name:

the predator; _____

the prey. _____

(2)

(ii) What is the source of energy for the grass?

Draw a ring around **one** answer.

carbon dioxide **light** **nitrates** **water**

(1)

(iii) **Figure 2** shows a pyramid of biomass for the organisms in **Figure 1.**

Write the names of the organisms on the correct lines in **Figure 2.**

STEMUP.CO.UK

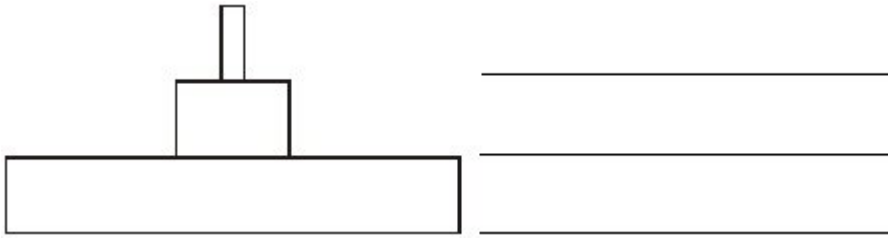


Figure 2

(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)

STEMUP.CO.UK