Trophic Levels in an Ecosystem

These practice questions can be used by students and teachers and is suitable for GCSE AQA Biology topic Questions 8641

Level: GCSE AQA Biology 8641

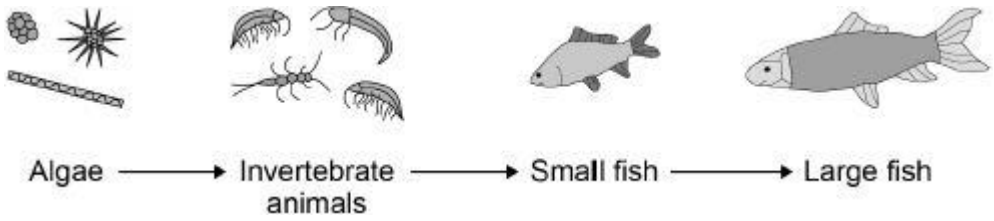
Subject: Biology

Exam board: GCSE AQA

Topic: Trophic Levels in an Ecosystem

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:

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

_____

_____

_____

_____

_____

_____

_____

_____

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)

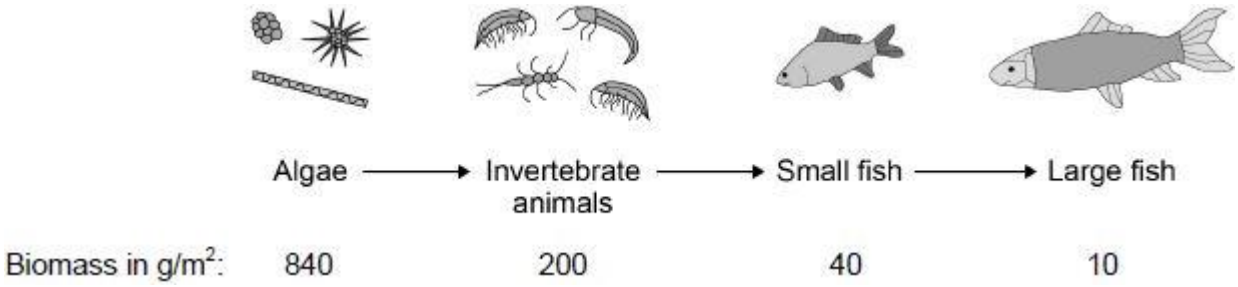
(Total 9 marks)

Q2.

Figure 1 shows:

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

Figure 1

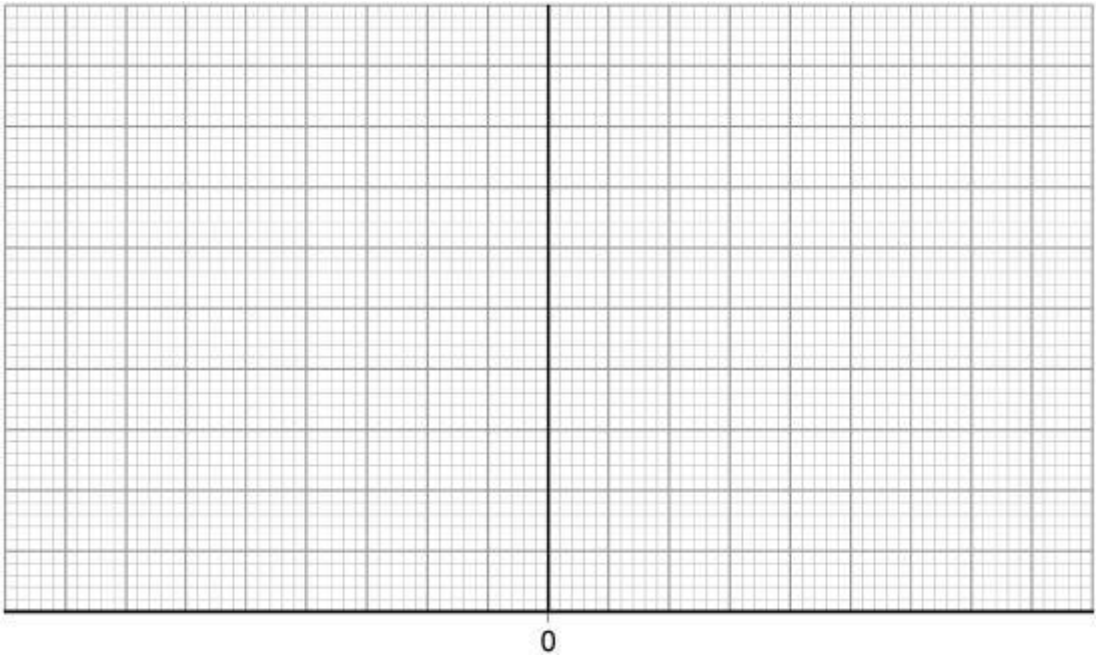


(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

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 = _____

(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)

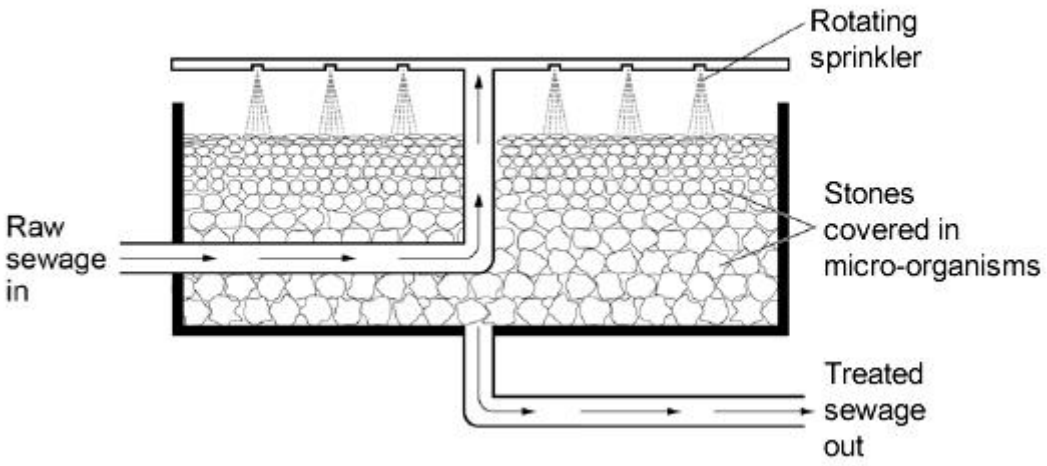
Q3.

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.

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.

_____

___

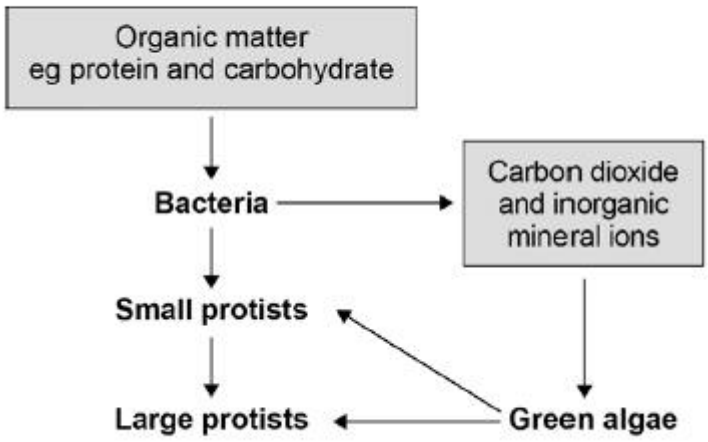
_____

_____

(2)

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

Figure 2



(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.

	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.

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.

_____

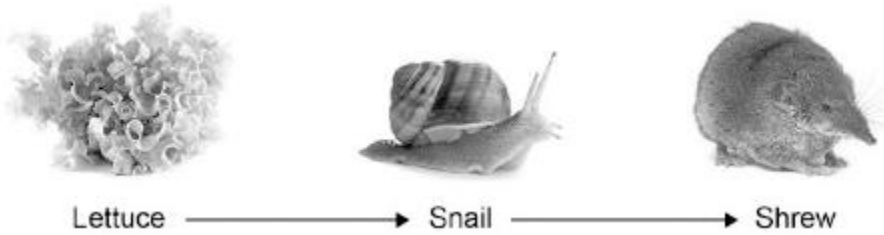
_____

(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?

Tick **one** box.

Community ☐

Ecosystem ☐

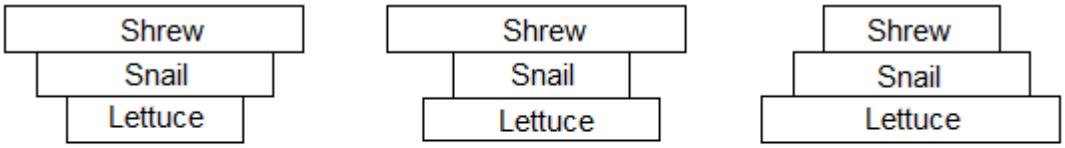
Population ☐

Territory ☐

(1)

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

Tick **one** box.



A ☐ **B** ☐ **C** ☐

(1)

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

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

Calculate the energy transferred to the snails from the lettuces.

_____

_____

Energy = _____ kJ

(1)

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

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

(1)

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

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

_____

_____

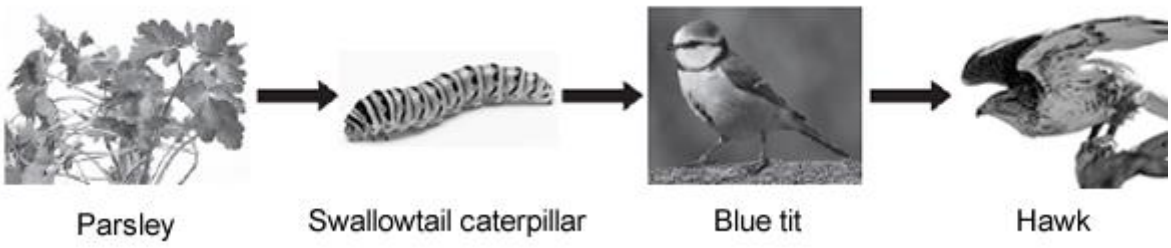
(1)

(Total 8 marks)

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.

_____

_____

_____

_____

_____

_____

_____

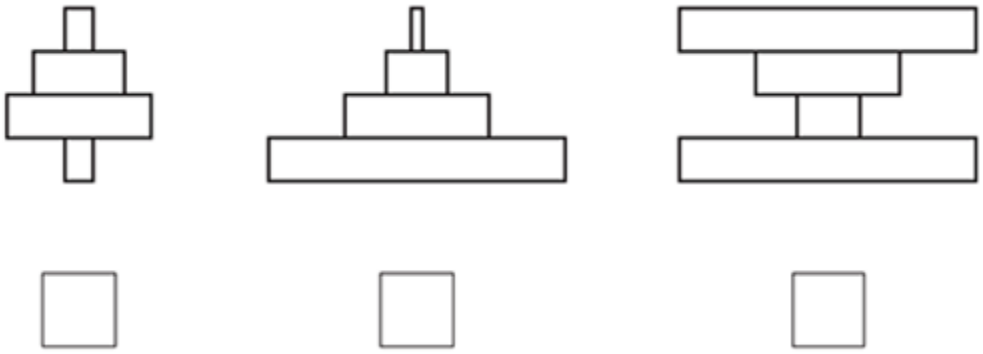
_____

(2)

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

Why is photosynthesis important in the food chain?

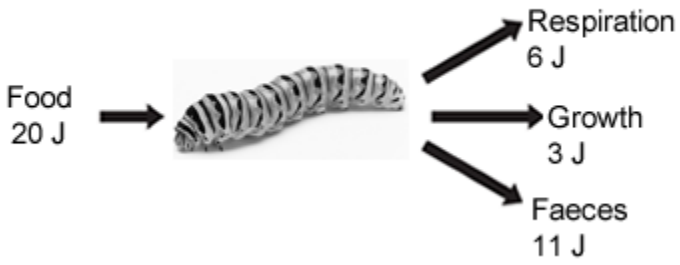
Tick (✓) **one** box.



(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?

_____

_____

_____

_____

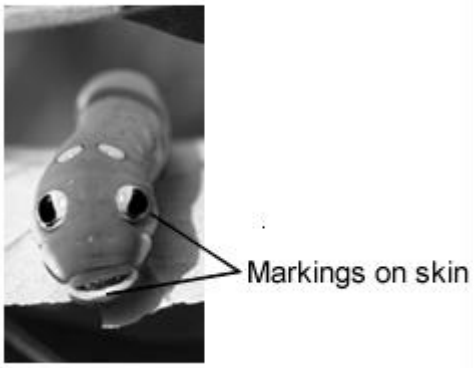
Percentage = _____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(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)

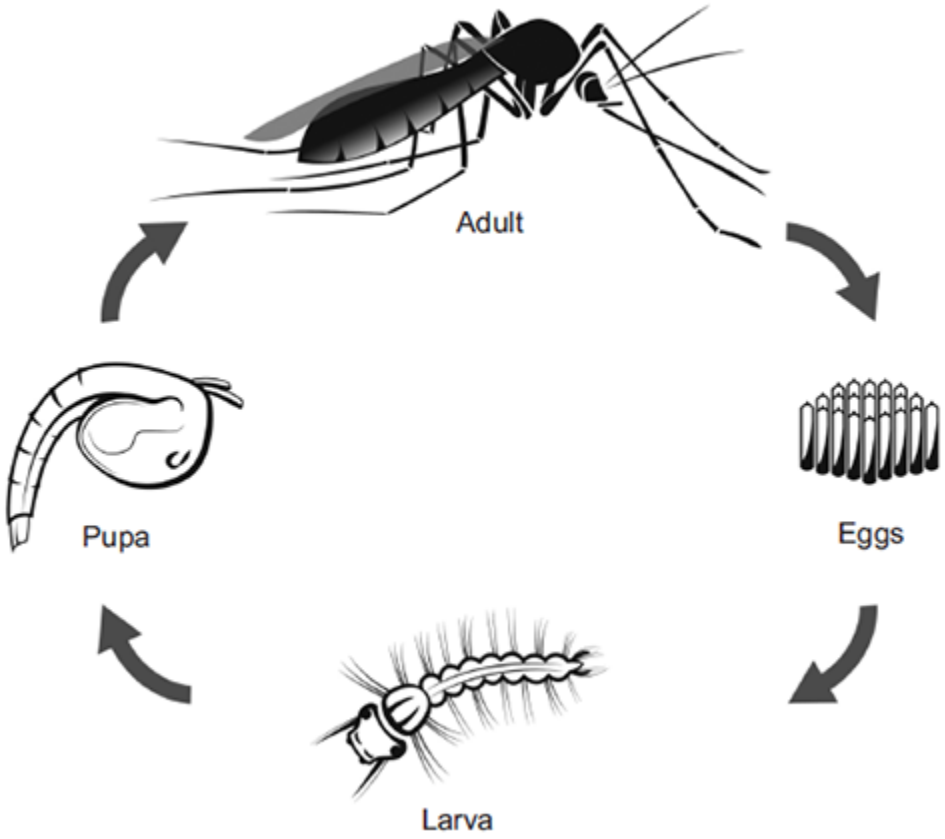
Blue tit: ©JensGade/iStock
Parsley: © Warren_Price/iStock
Caterpillar ©prettyzhizhi/iStock
Hawk: © kojihirano/iStock
Swallowtail caterpillar: © Anna_Po/iStock

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.



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

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

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

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

_____

_____

_____

_____

_____

_____

_____

(2)

(b) An internet article states:

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

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

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

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

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

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

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

(3)

(Total 11 marks)

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	Biomass of population	Biomass from previous	Percentage of biomass lost

		in g	in g	organism that is lost in g	
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

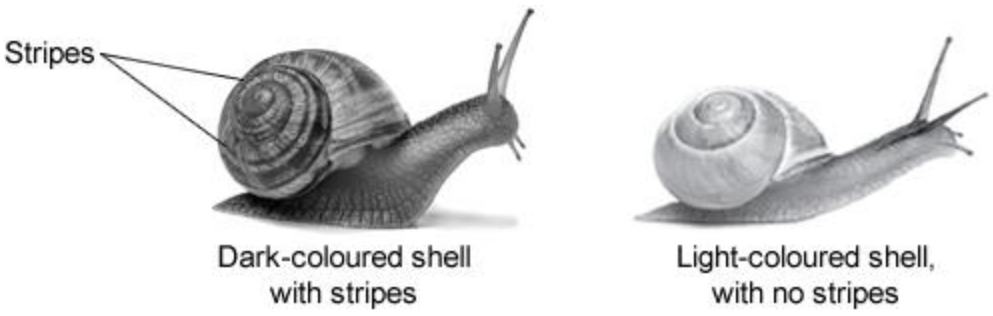
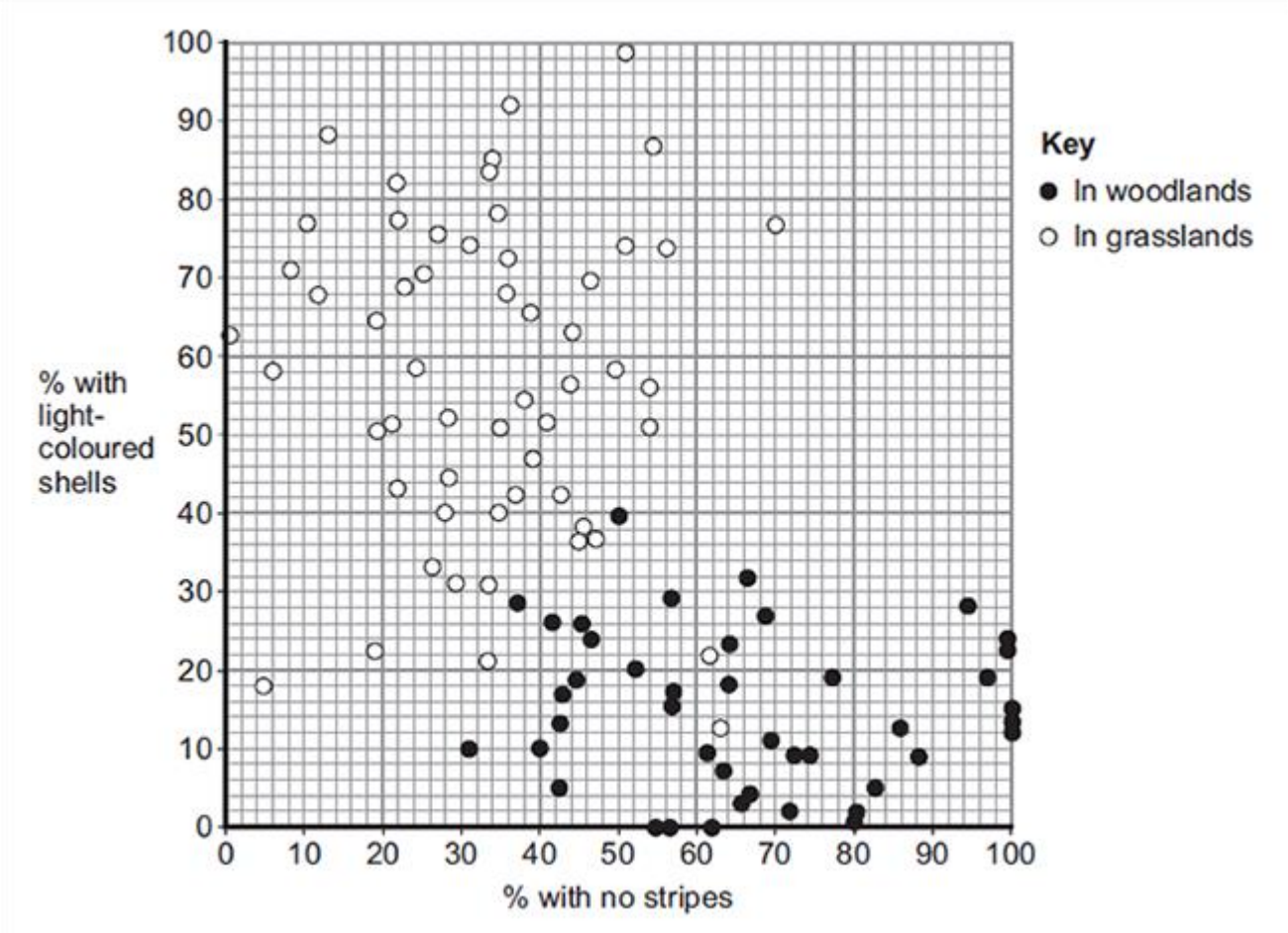


Figure 2 shows results from surveys in woodlands and in grasslands of the percentage of snails with light-coloured shells and the percentage of snails with no stripes.

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

Figure 2



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

Why is a scatter graph used for this data?

_____

_____

_____

_____

(1)

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

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

(1)

(Total 7 marks)

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. _____

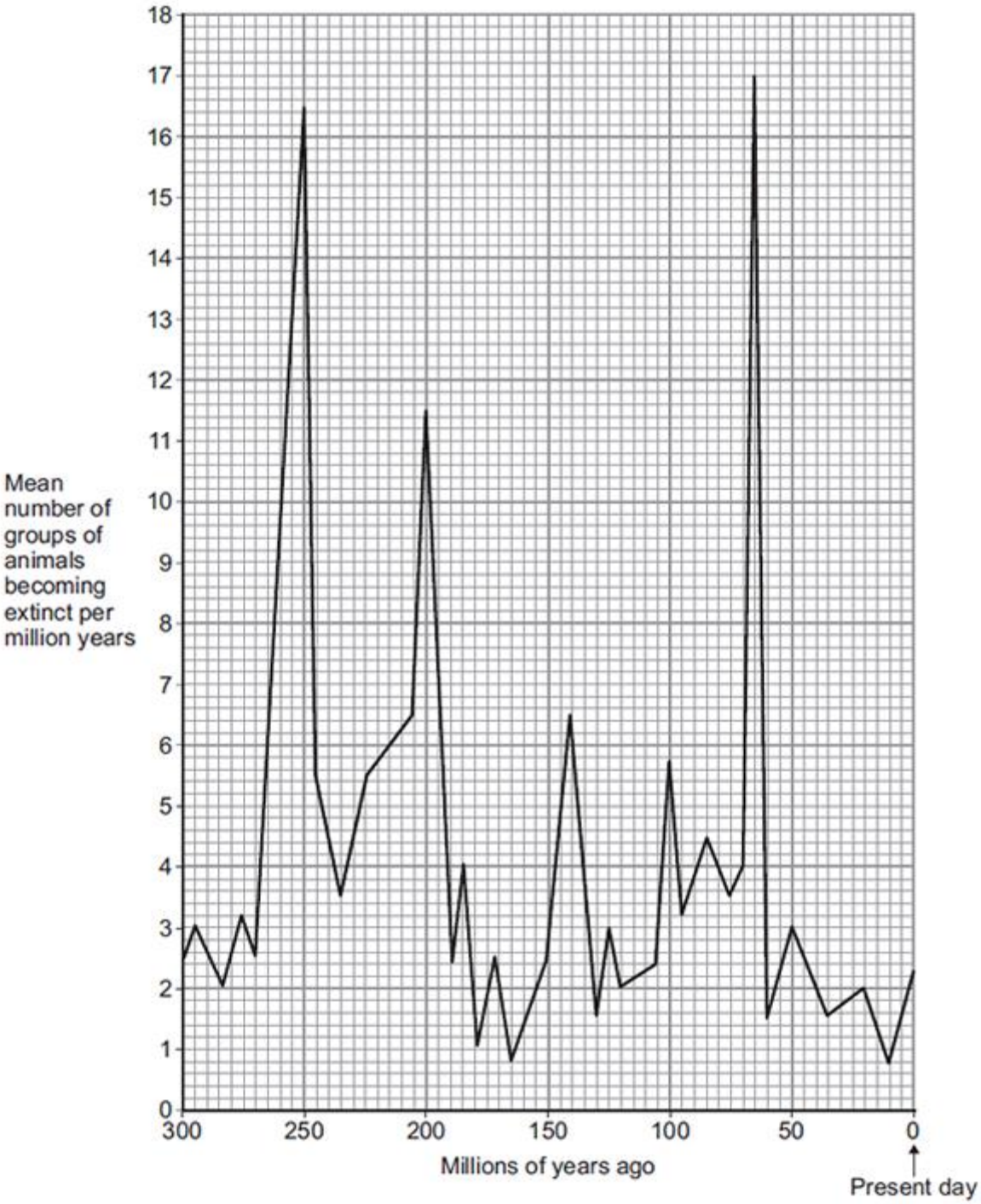
_____

2. _____

_____

(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)

(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)

(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.

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

The table shows the students' results.

Organism	Population	Mean mass of one organism in grams	Biomass of population in grams
Seaweed	50	4000	200 000
Limpet	1200	30	36 000
Crab	100	90	9 000
Gull	2	900	

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

_____

_____

_____

_____

Biomass = _____ g

(1)

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

Label the pyramid.

(2)

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

Suggest **two** reasons why.

1. _____

_____

_____

2. _____

_____

_____

_____

(2)

(Total 5 marks)

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 garden	Mean mass of each one in grams	Biomass of population in grams
Hedgehog	1	200	200
Slug	600	2	1200
Lettuce	60	100	

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

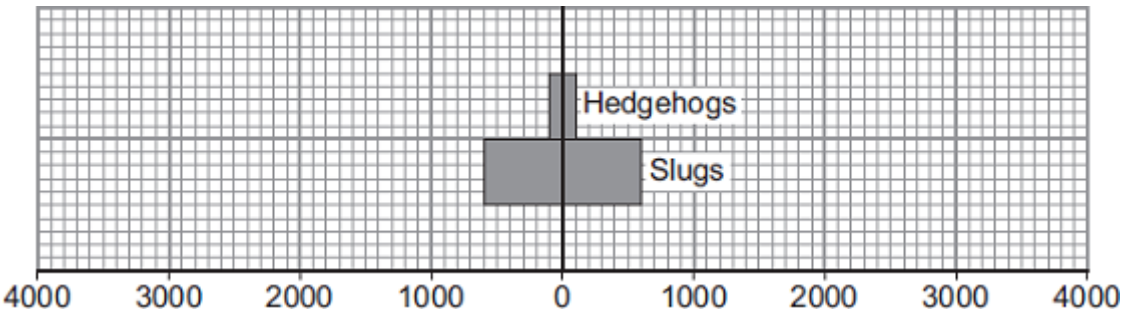
Show clearly how you work out your answer.

Biomass = _____ grams

(2)

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

Show the biomass of the lettuce population in the garden.



(2)

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

Explain why as fully as you can.

_____

_____

_____

(3)

(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	_____

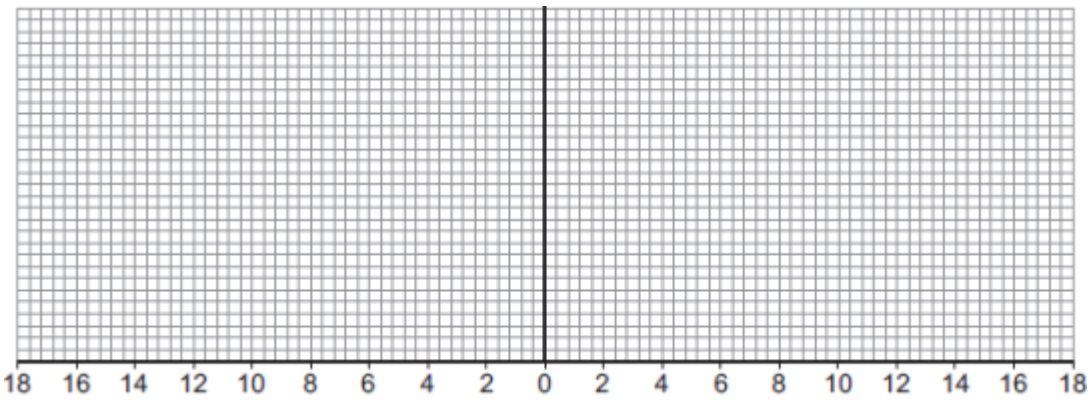
(i) Complete the table by calculating the total biomass of red kites and of field mice.

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.



Total biomass for field in kg

(3)

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

Give **two** reasons why.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

Suggest **two** reasons why.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

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.

Tree bark covered with lichens Tree bark made black by pollution

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

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

characteristic	**clone**	**mutation**

A change in genetic material is called a

_____

(1)

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

Explain why:

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

The diagram shows the food chain:

birch trees → peppered moth larvae → birds

Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

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

Tick (✓) **two** boxes.

Some material is lost in waste from the birds	☐
The trees are much larger than peppered moth larvae	☐
Peppered moth larvae do not eat all the leaves from the trees	☐
The trees do not use all of the Sun's energy	☐

(2)

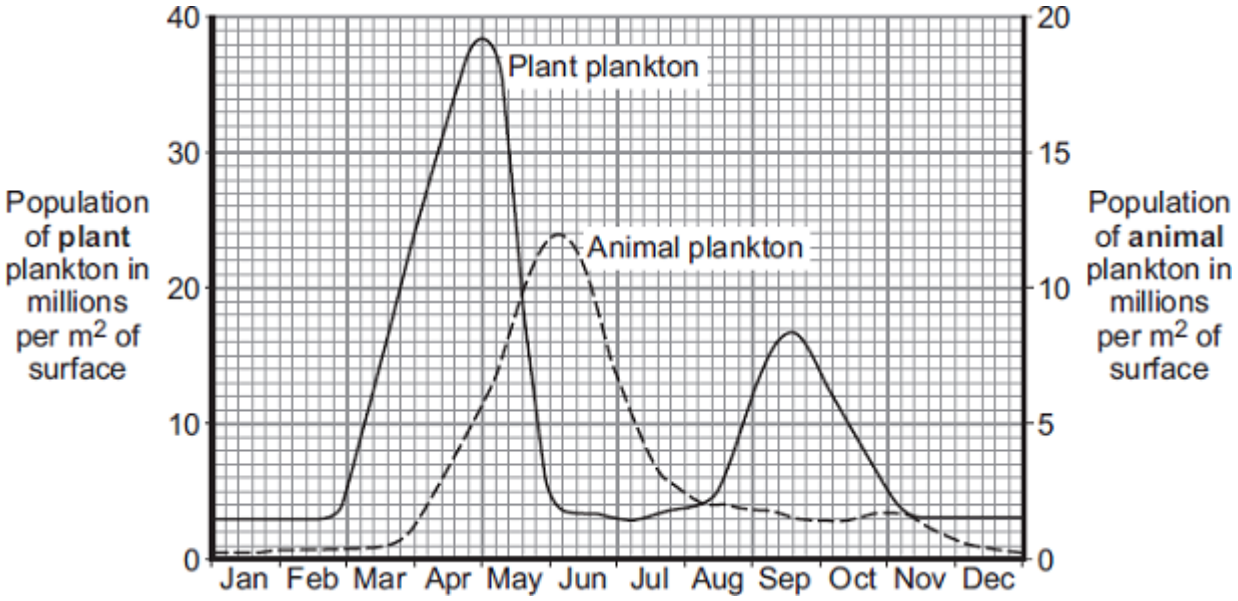
(Total 9 marks)

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

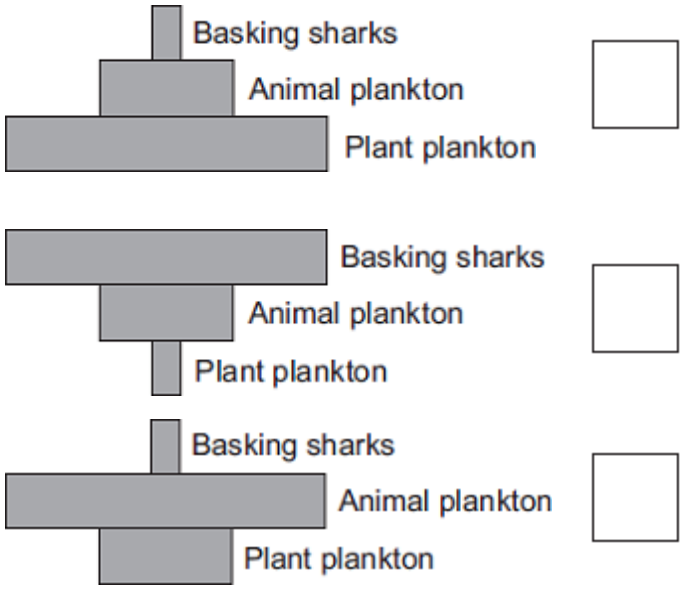


(a) Basking sharks eat animal plankton. Basking sharks grow up to 8 metres long.

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

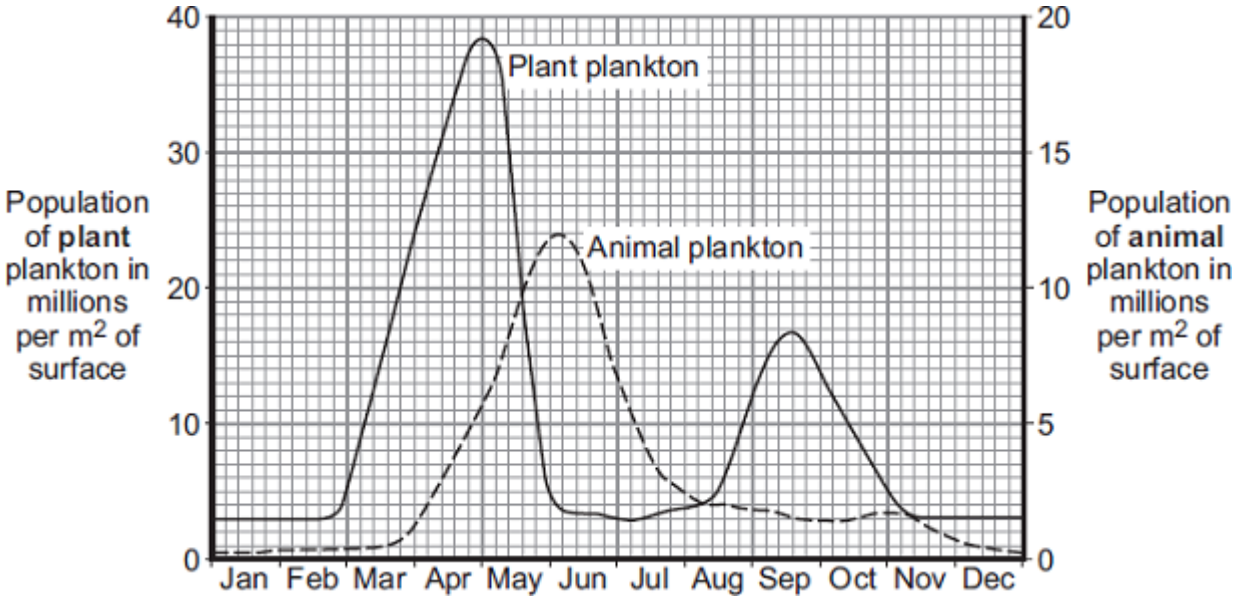
Which is the correct shape for the pyramid of biomass to show the relationship between plant plankton, animal plankton and basking sharks, in June?

Tick (✓) **one** box.



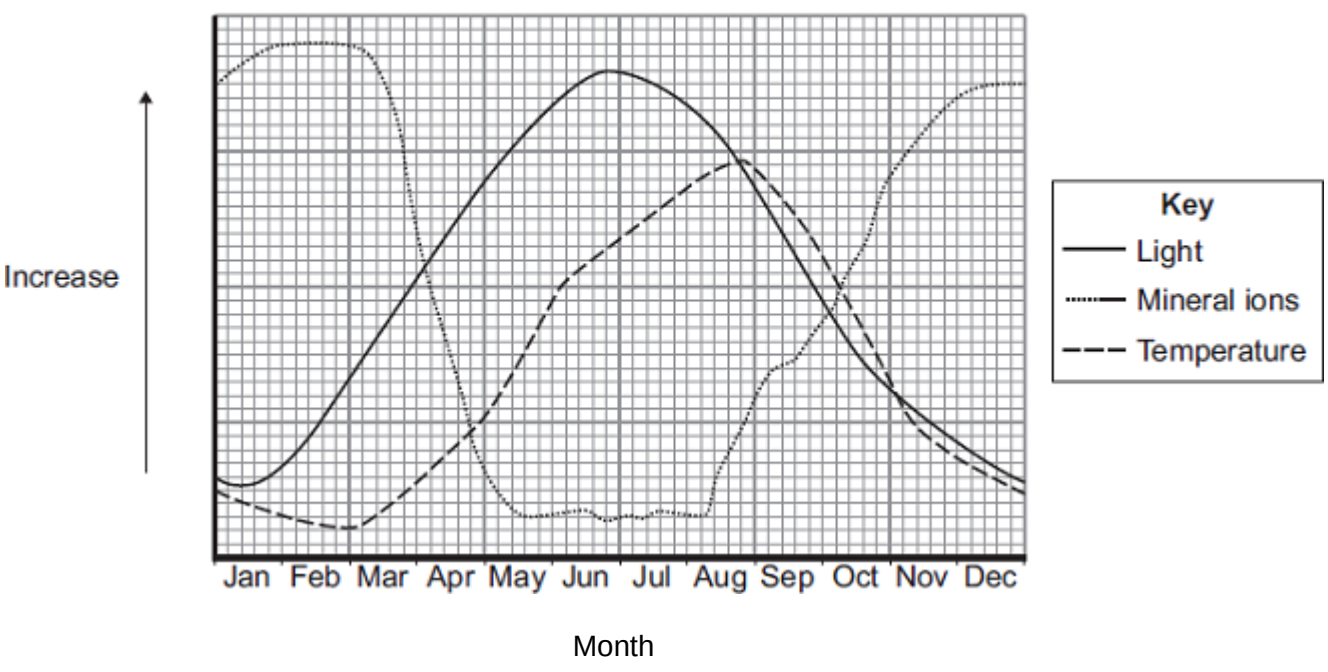
(1)

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.

Graph 2



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

Suggest **one** reason for the increase.

Explain your answer.

(2)

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

Suggest explanations for the changes.

(2)

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

Suggest explanations for the changes.

_____

_____

_____

(3)

(Total 8 marks)

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)

(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.

_____

_____

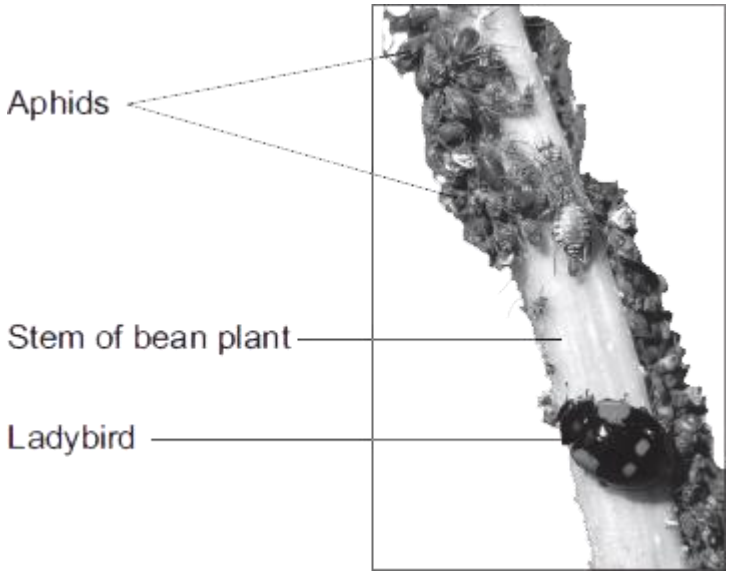
(6)

(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.



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.

(4)

(Total 8 marks)

Q18.

The photographs show four ways of farming.

Growing wheat

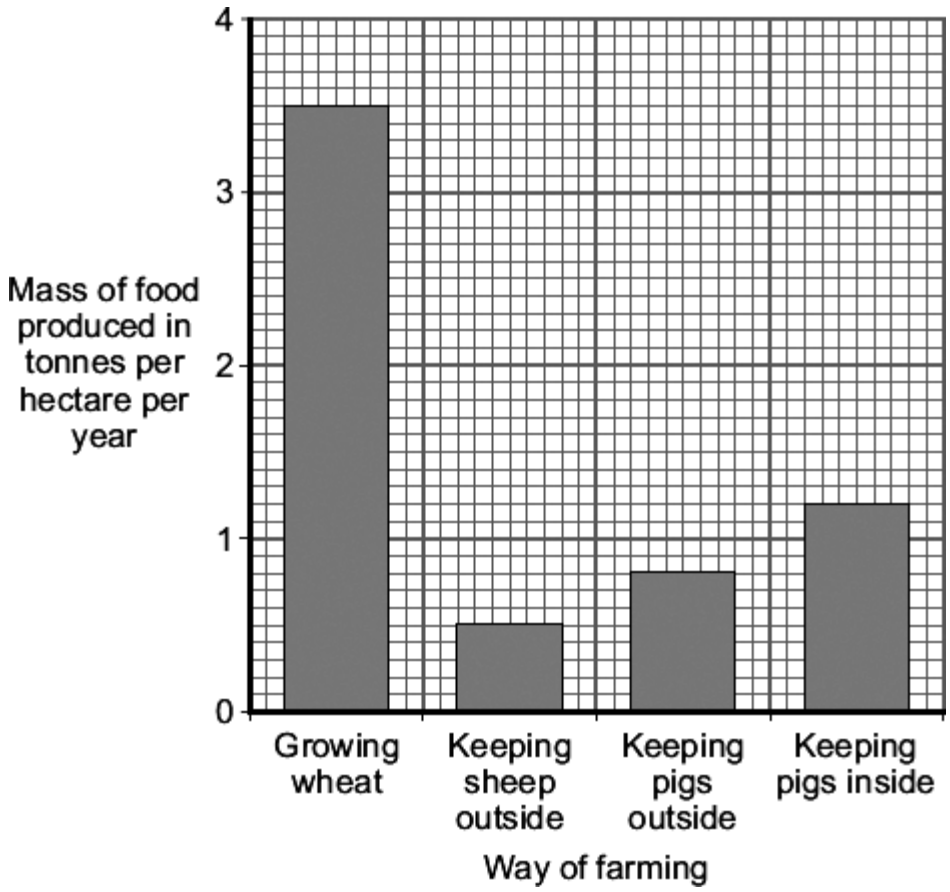
Keeping sheep outside

Keeping pigs outside

Keeping pigs inside

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

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



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

Show clearly how you work out your answer.

_____

_____

_____

_____

Answer _____ tonnes per hectare per year

(2)

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

How is the other 950 g lost?

Tick (✓) **two** boxes.

As oxygen from photosynthesis ☐

As faeces ☐

As meat ☐

As carbon dioxide from respiration ☐

(2)

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

Why?

Tick (✓) **two** boxes.

Pigs kept inside are fed more. ☐

Pigs kept inside are kept in small pens. ☐

Pigs kept inside are kept warm in the winter. ☐

Pigs kept inside are healthier. ☐

(2)

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

Give **one** reason why.

_____

_____

_____

_____

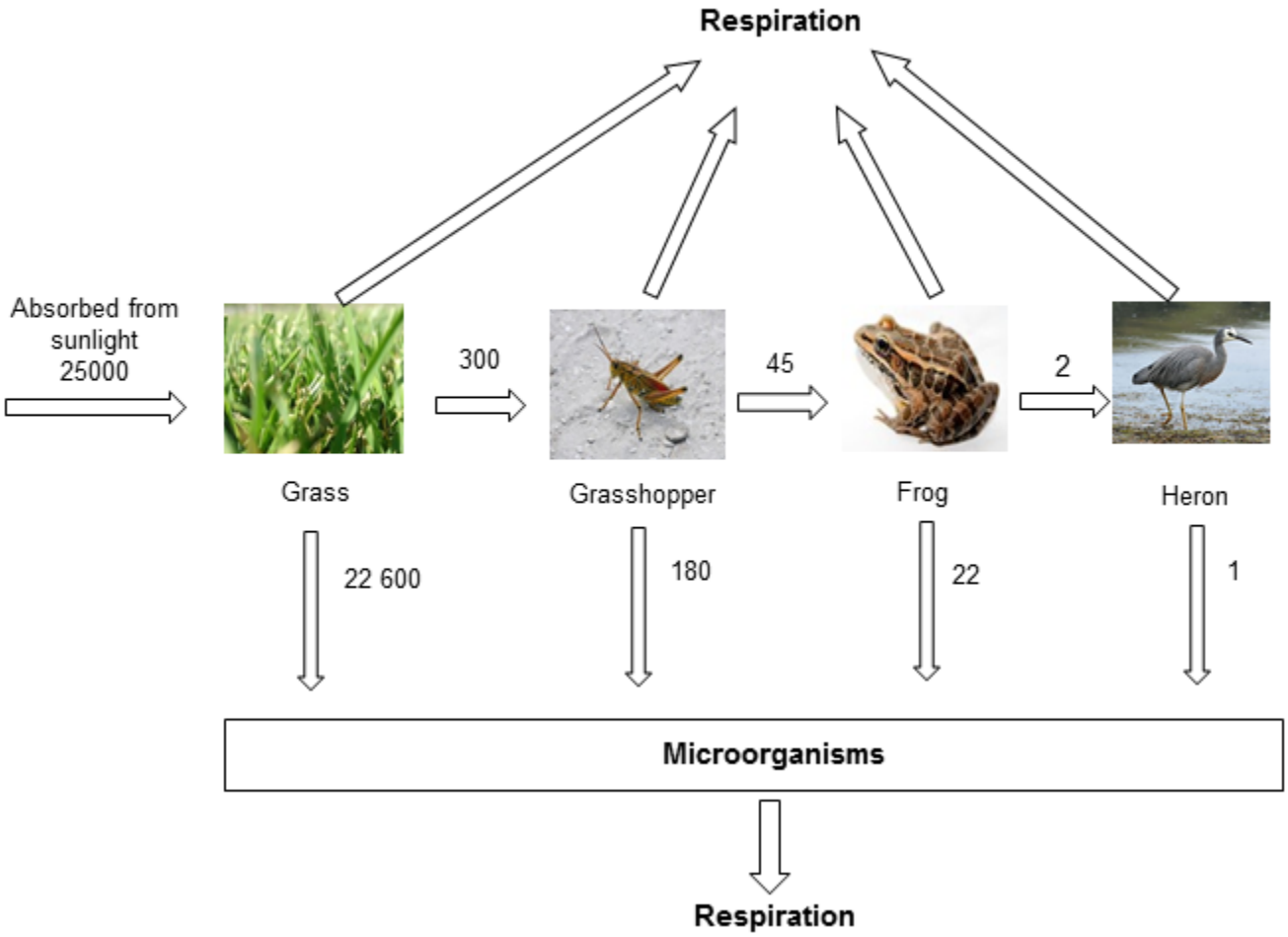
(1)

(Total 7 marks)

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.



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

Show clearly how you work out your answer.

_____

_____

_____

_____

Answer _____ %

(2)

(b) All of the energy the grass absorbs from the sun is eventually lost to the

surroundings.

In what form is this energy lost?

_____

(1)

(c) Food chains are usually **not** more than five organisms long.

Explain why.

To gain full marks you must use data from the diagram.

_____

_____

_____

_____

(2)

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

Explain how.

_____

_____

_____

_____

(3)

(Total 8 marks)

Grass by 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)

(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 ☐

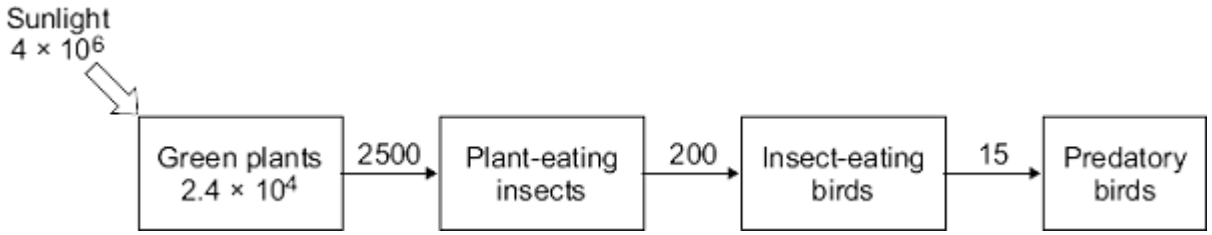
(2)

(Total 7 marks)

Q21.

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

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



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

Show clearly how you work out your answer.

_____

_____

Answer = _____ %

(2)

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

(2)

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

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

_____

_____

_____

_____

(3)

(Total 7 marks)

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. _____

_____

(2)

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

1. _____

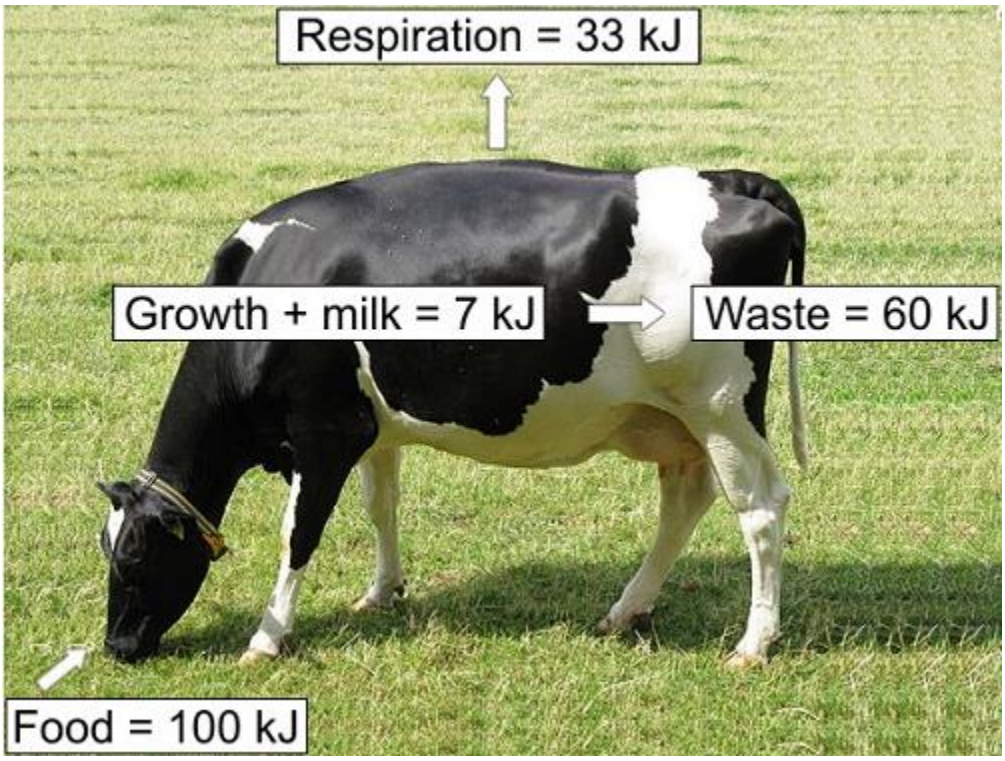
_____

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
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.

_____

_____

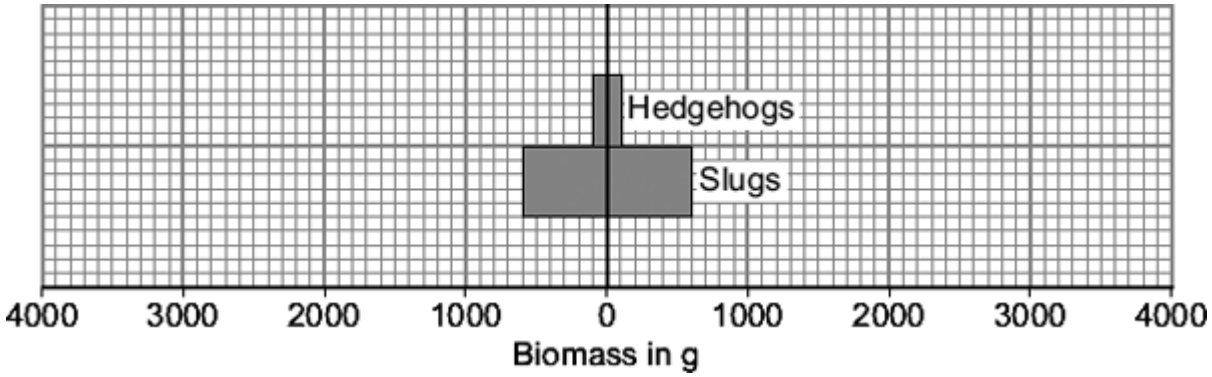
_____

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.

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

Explain why as fully as you can.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

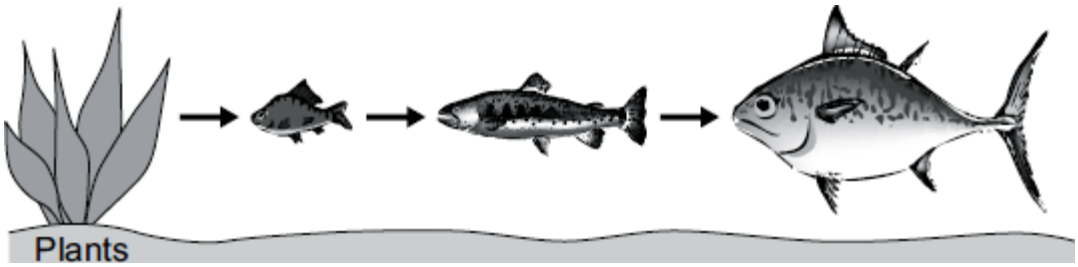
_____

(3)

(Total 7 marks)

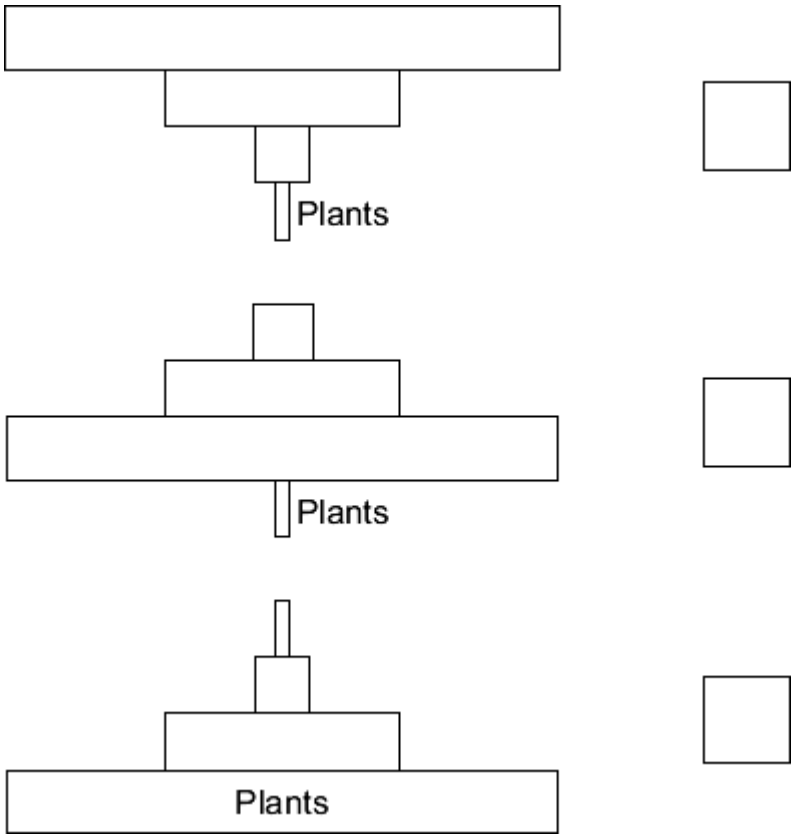
Q24.

The picture shows a food chain.



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

Tick (✓) **one** box.



(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.

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.

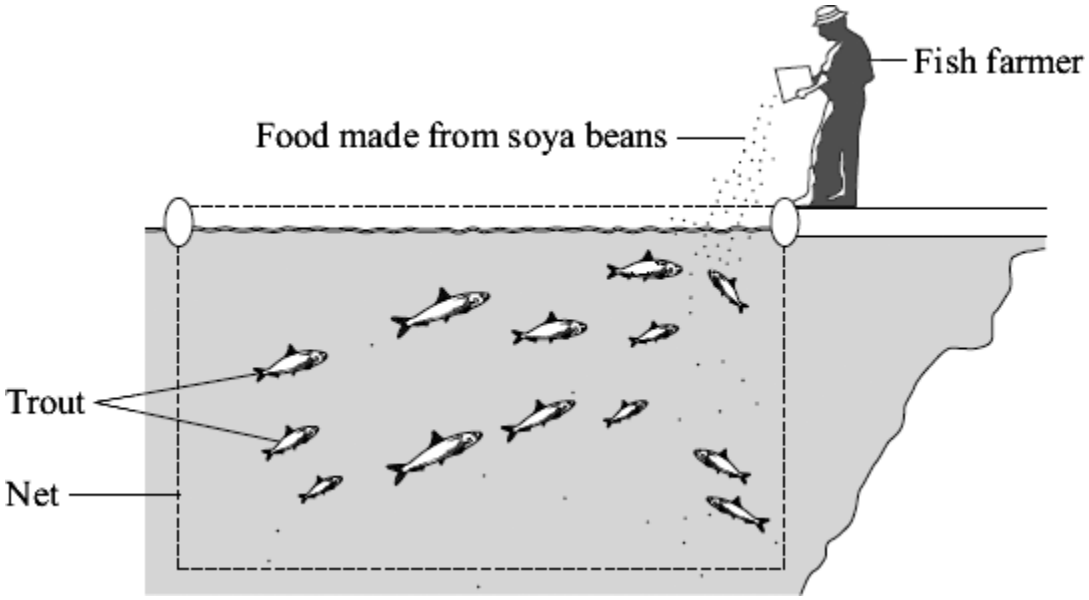
You should include references to the data in your answer.

(3)

(Total 5 marks)

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. ☐

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

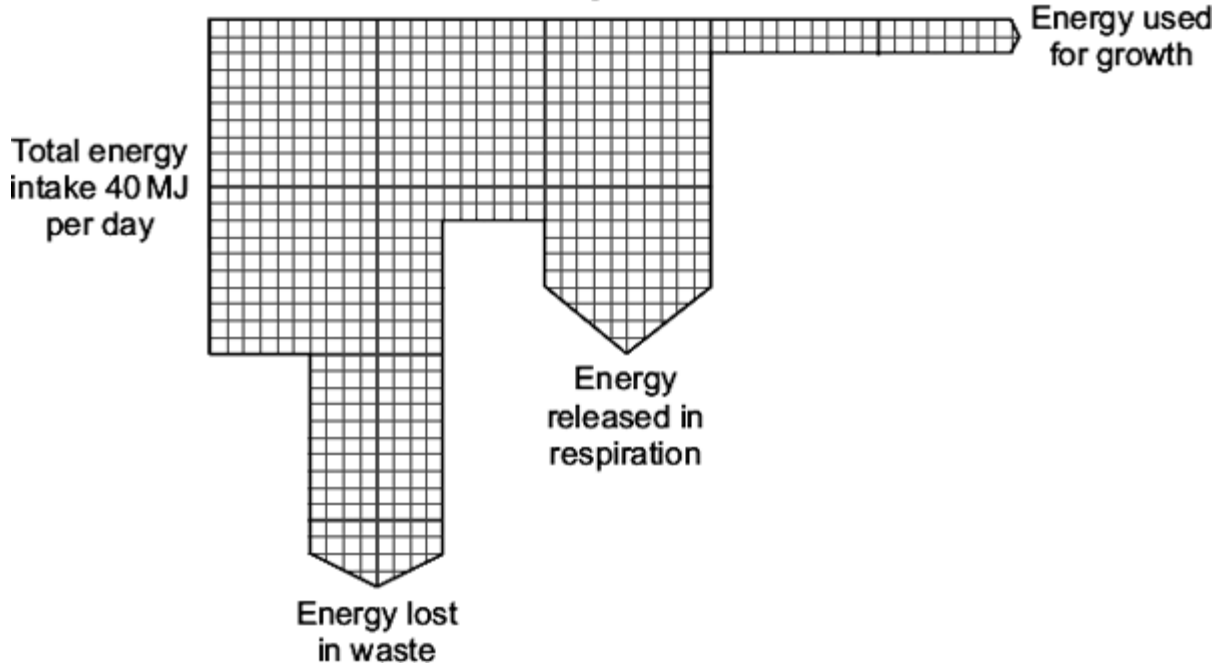
(2)

(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).

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.

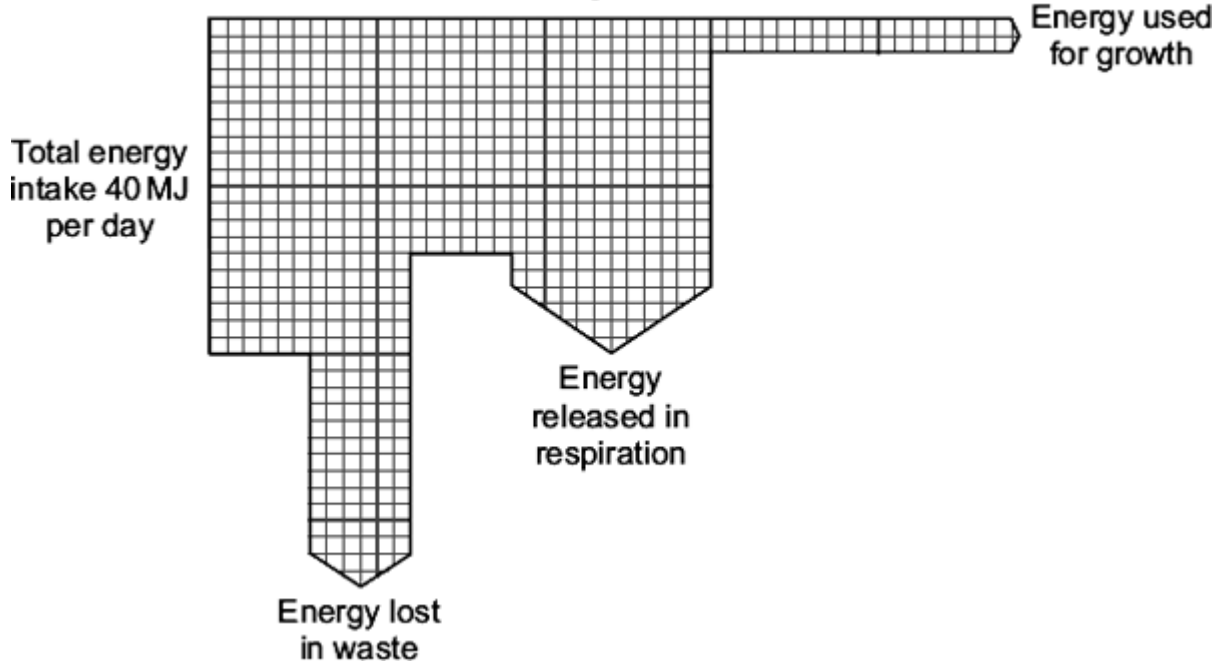
1. _____

2. _____

(2)

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

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. _____

_____

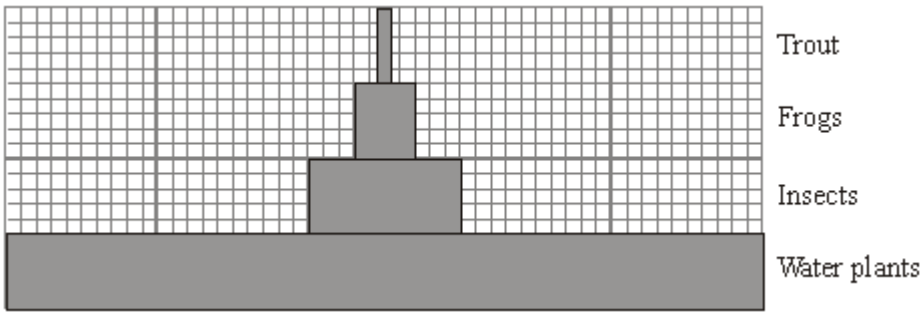
_____

(2)

(Total 8 marks)

Q28.

The diagram shows a pyramid of biomass drawn to scale.



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

_____

_____

(1)

(b) The ratio of the biomass of water plants to the biomass of insects is 5 : 1.

Calculate the ratio of the biomass of insects to the biomass of frogs.

Show clearly how you work out your answer.

_____

_____

ratio = _____ : 1

(2)

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

1.

2.

(2)

(d) Some insects die.

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

_____

_____

_____

(4)

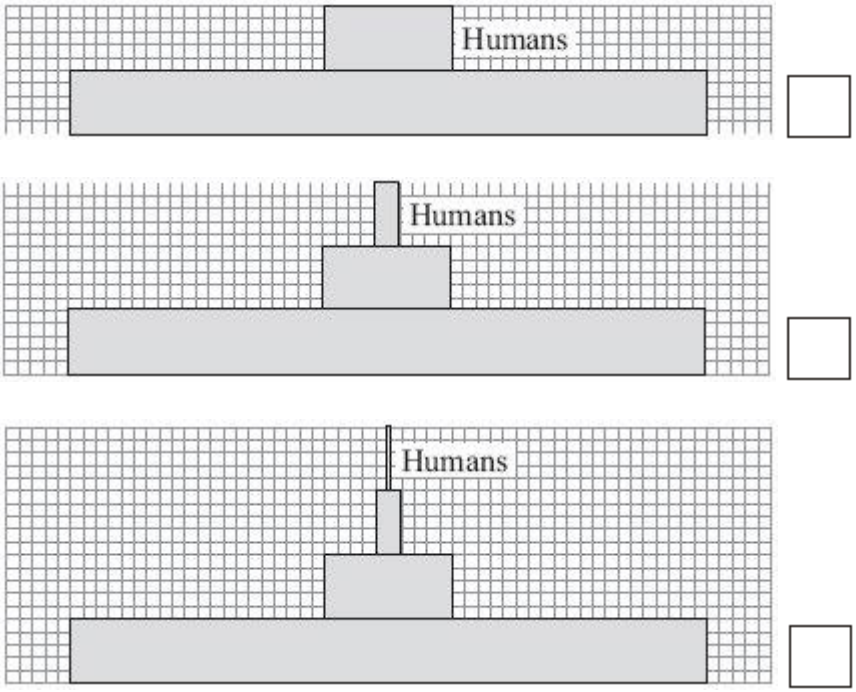
(Total 9 marks)

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.

_____

_____

_____

_____

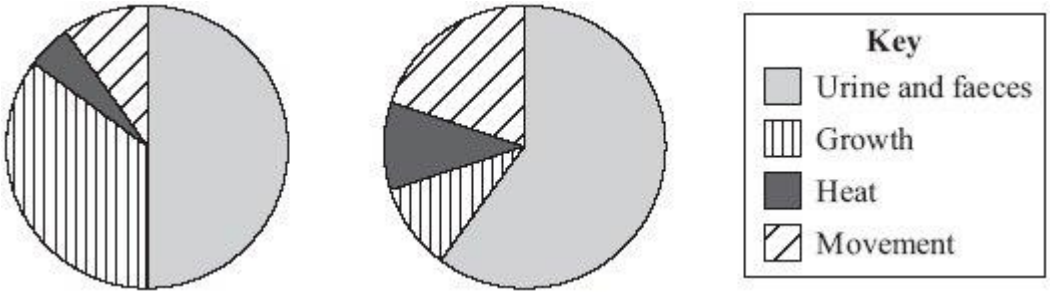
(1)

(b) Pigs may be kept indoors or outdoors.

Pigs kept indoors **Pigs kept outdoors**

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.

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

Show clearly how you work out your answer.

_____

_____

_____

_____

Answer = _____ %

(2)

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

lost.

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

1. _____

2. _____

3. _____

(3)

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

Explain why.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

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. _____

_____

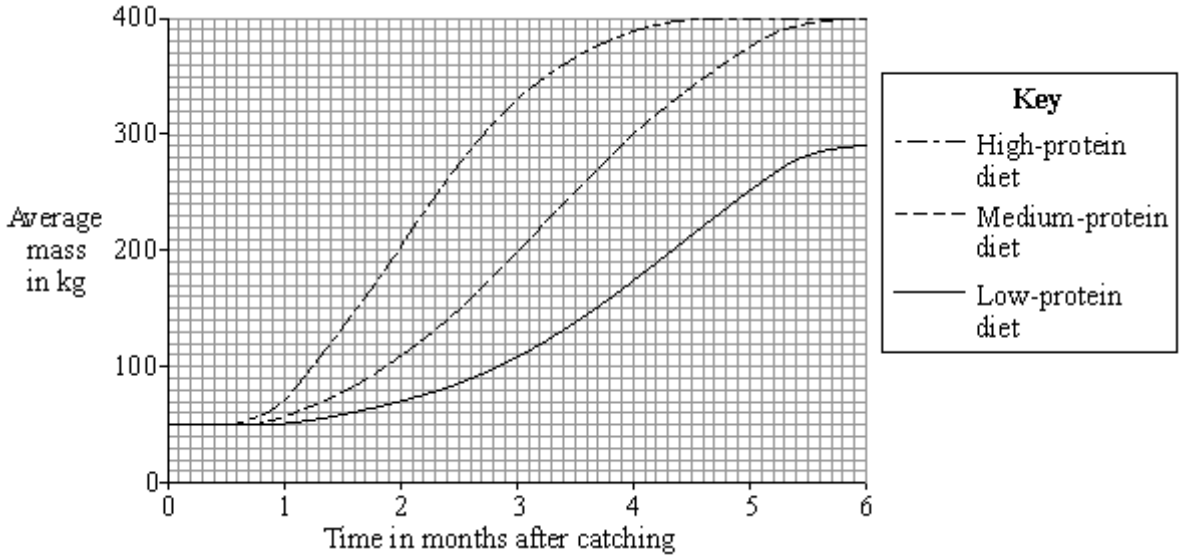
_____

(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.



(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.

_____

_____

_____

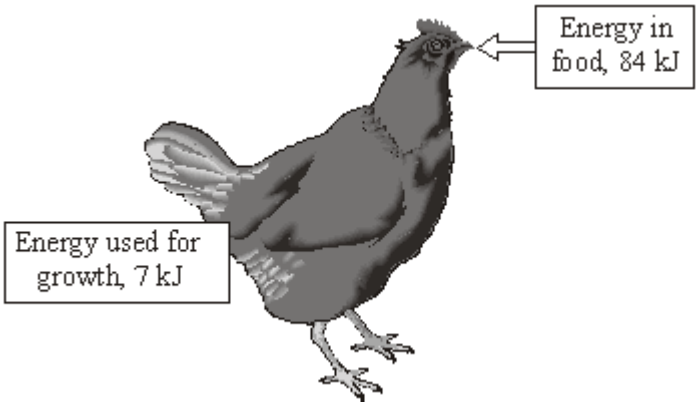
_____

(1)

(Total 8 marks)

Q32.

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



(a) Calculate the percentage of energy used for growth.

Show clearly how you work out your answer.

_____

_____

_____

_____

Energy used for growth = _____ %

(2)

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

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

1.

_____

___

2.

_____

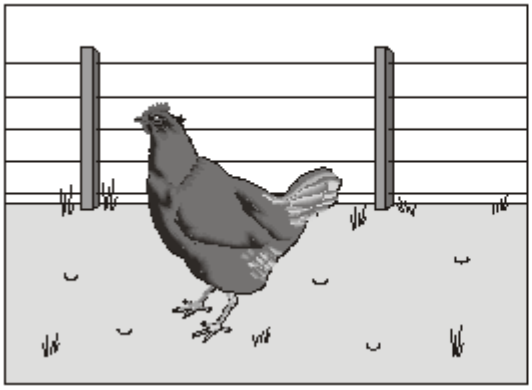
___

3.

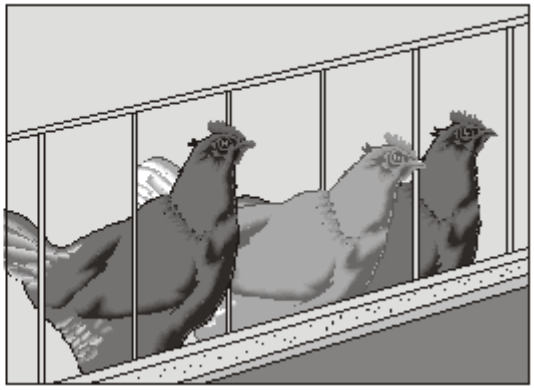
(3)

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

Chickens kept outdoors (free-range)



Chickens kept in cages (battery chickens)



Battery chickens produce more eggs per year than free-range chickens.

Suggest **one** reason why.

(1)

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

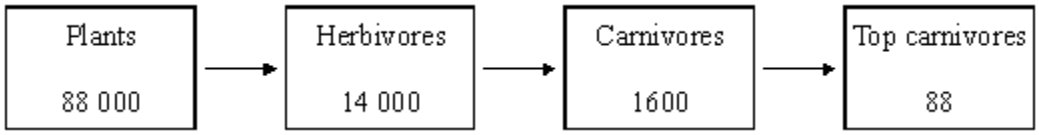
Explain why.

(2)

(Total 8 marks)

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.

(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)

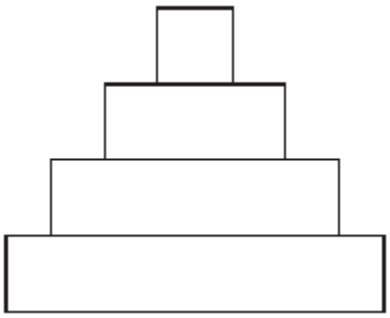
(Total 5 marks)

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.

Amount of energy =

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

_____

_____

_____

Amount of energy = _____ kJ

(2)

(Total 5 marks)

Q35.

Figure 1 shows a food chain containing three organisms.

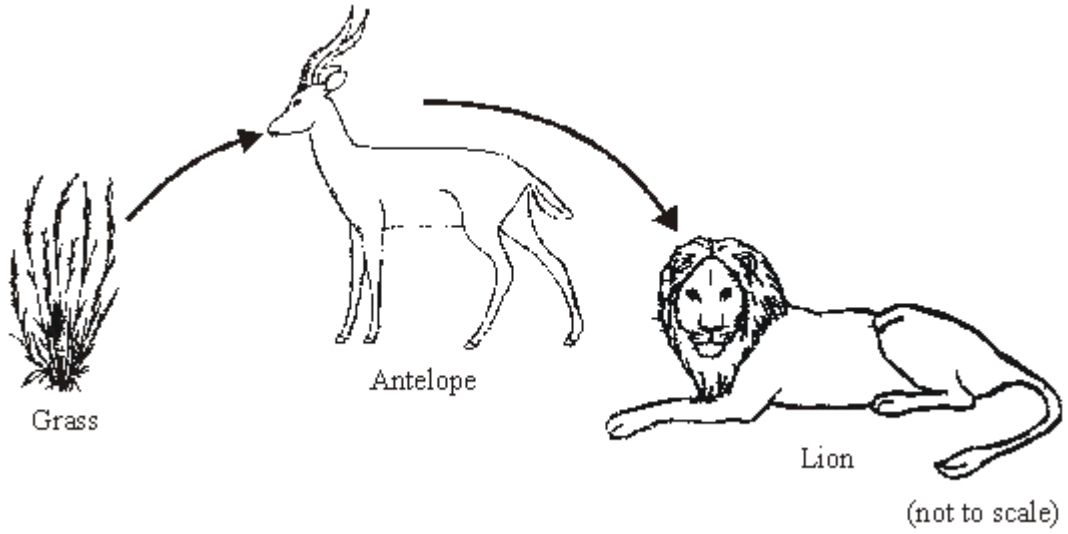


Figure 1

(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.**

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 ☐

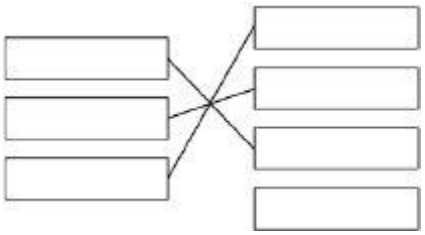
(2)

(Total 10 marks)

Mark schemes

Q1.

(a)



extra line from a scientific term cancels the mark **1**

1

1

(b) $\frac{10}{200} \times 100$ **1**

5 / 5.0 **1**

*an answer of 5 / 5.0 scores **2** marks*

(c) digestion **1**

respiration **1**

excretion **1**

in this order only

(d) fewer are eaten (by small fish) **1**

allow there are fewer (small) fish eating them

*do **not** accept none are eaten*

[9]

Q2.

(a) *x*-axis: scale + labelled, including units **1**

scale ≥ ½ width of graph paper label: biomass in g/m²

bar widths correct **2**

± ½-square each side

allow 1 mark if 3 correct

all 4 bars correctly labelled

large fish + small fish + invertebrate (animals) + algae
or
(trophic level) 4 + 3 + 2 + 1
or
tertiary consumer + secondary consumer + primary consumer + producer
ignore bar heights

1

(b) $\frac{840-10}{840} \times 100$

allow equivalent calculation

1

98.809523... / 98.810 / 98.81 / 98.8

1

99

allow answer given to two significant figures from an incorrect calculation in step 2

1

*an answer of 99 scores **3** marks*

(c) inedible parts / example

*allow eaten by other animals **or** not all organisms eaten*

or

egested / faeces

allow not digested
allow excretion / urine
ignore waste

or

respiration / as CO_2

ignore energy losses
ignore movement

1

(d) bacteria decay organic matter / sewage / algae / dead plants

1

(by) digestion

allow example such as starch broken down to sugar
or
protein broken down to amino acids

1

(and) bacteria respire aerobically
or
respire using oxygen

1

(which) lowers oxygen concentration (in water)
or
fish have less oxygen

allow reduced respiration of fish

1

(so) reduced energy supply causes death of fish

allow toxins in the sewage kill fish

ignore pathogens or (pathogenic) bacteria cause disease in fish and kills them

1

[13]

Q3.

(a) any **two** from:
- sprinkled through air
- air spaces between stones
- thin layer over stones (for efficient diffusion)
- slow flow (for efficient diffusion)

2

(b) green algae

1

(c) (large / small) protist

1

(d) **Level 2 (3-4 marks):**
Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

Level 1 (1-2 marks):
Facts, events or processes are identified and simply stated but their relevance is not clear.

No relevant content (0 marks)

Indicative content

digestion:
- (external) enzymes released
- role of enzymes – e.g. amylase / protease / lipase
- substrates & products – e.g. starch ⟶ sugar / protein ⟶ amino acids / fat ⟶ fatty acids

absorption:
- by diffusion / active transport

deamination:
- amino acids ⟶ ammonia / ammonium ions

release of other ions:
- e.g. phosphate / nitrate / magnesium

respiration:
- produces carbon dioxide (+ water)
  or
  equation is given
- release of energy allows other processes to take place e.g. active transport

[8]

Q4.

(a) $0.03 = \frac{\text{output}}{5950 + 50} \times 10$

*an answer of 1.8 scores **3** marks*

1

$\text{output} = \frac{0.03 \times (590 + 50)}{100}$

1

1.8

1

(b) indoor % efficiency = $\frac{40}{10000 + 6000} \times 100$

1

or

$\frac{40}{16000} \times 100$

0.25(%)

*an answer of 8.33 scores **3** marks*
allow 8 / 8.3 / 8.333...

1

$\left(\frac{0.25}{0.03} =\right) 8.33 \text{ (times)}$

1

(c) any **two** from:
- in faeces / egestion
  or
  not all food is absorbed
- not all food is ingested
- in urine / excretion
- in respiration
- keeping warm
- movement

*do **not** accept 'for respiration'*
allow as 'heat'

2

(d) warmer indoors so less energy wasted in keeping warm

allow less energy lost as 'heat'

1

less movement indoors so less energy wasted

*if no other mark awarded, allow it is warmer and there is less movement indoors for **1** mark*

1

[10]

Q5.

(a) snail
or
shrew

additional incorrect answer negates correct answer

1

(b) shrew

additional incorrect answer negates correct answer

1

(c) fewer shrews to eat them

1

(d) population

1

(e) **C**

1

(f) (11 000 × 0.1 =)
1 100 (kJ)

1

(g) the snails do not eat the roots of the lettuces

1

(h) any **one** from:
- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)
- wind intensity / speed

  ignore wind direction
- carbon dioxide (levels)
- oxygen (levels)

1

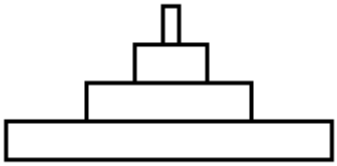
[8]

Q6.

(a) any **two** from:
- *idea of* absorption of light / energy
- transfer to chemical energy

  allow produce sugars / glucose / starch / carbohydrate / food / biomass
- provides food / energy for animals / caterpillar
- releases oxygen

2

(b) 

1

(c) 15(%)

$\frac{3 \times 100}{20}$ *with no answer or incorrect answer*

or

*allow **1** mark for 0.15*

2

(d) (i) any **two** from:

- markings look like eyes / face / mouth of much larger animal
- looks fierce / scary / dangerous
  allow it looks like a snake
- to frighten blue tit / bird

max 1 if reference to camouflage

2

(ii) any **two** from:

- sharp / long / big claws
  ignore strong
- sharp / hooked beak
  ignore strong / big
- large wings **or** flies quickly
  allow streamlined / aerodynamic
  ignore powerful wings
- good eyesight

2

[9]

Q7.

(a) 0.67(%)

allow $0.\dot{6}$ *or* 0.7

*allow **1** mark for evidence of* $(2 \times 10^6) \div (3 \times 10^8)$

or

*allow **1** mark for 0.0067 or 0.6*

2

(b) (i) idea that food chains start with plants / producers

*allow food chains do not start with animals **or** larvae are consumers*

1

idea that these make food (for other organisms in the chain)

*allow idea that plants / producers photosynthesise **or** plants / producers get energy from the sun*

*allow mosquito larvae do not make food / photosynthesise **or***

mosquito larvae do not get energy from the sun

1

(ii) any **four** from:

- reasoned argument for **or** against release
  must refer to at least one advantage and one disadvantage.
  *max **3** marks for either only advantages **or** only disadvantages*

advantages:

- fewer mosquitos biting **or** spreading malaria
- fewer people get / die from malaria
  allow people won't get / die from malaria
- lower medical costs (for those infected **or** for treatment) **or** less healthcare needed
- better economically for developing / tropical countries.

disadvantages:

- fewer crops reproduce
  allow fewer crops pollinated
- poorer crop yield
- possible starvation (of people)
- high cost of GM production / mosquito release
- less food for bats / birds **or** bats / birds die
  *allow disruption to food chain / ecosystem **or** reduction of biodiversity*
- gene could 'escape' into other wildlife / species
  ignore into plants

4

(iii) any **three** from:

- gene from bacteria cut out
  allow allele for gene
- ref to enzymes (anywhere in process)
  allow at any point in process, ie in cutting or in splicing
- (gene) transferred to chromosome of mosquito
  allow DNA for chromosome
- at an early stage of development
  allow egg / embryo

3

[11]

Q8.

(a) (i) any **two** from:

- not all eaten
  allow eaten by other animals
- used for respiration
  ignore used / lost in heat / movement

- lost as CO_2 / water / urea
- lost as faeces **or** not all digested
  if neither mark awarded allow 1 mark for lost as waste

ignore references to energy losses

do not allow for growth / repair / reproduction

2

(ii) any **one** from:
- thrushes eat other things
- thrush numbers likely to vary (considerably)
  allow it is only an estimate (of population size) ***or*** *only counted thrushes for 5 hours*
- thrushes were not present all the time
- thrushes feed on a much bigger area

1

(b) (i) any **one** from:
- there are two dependent variables
- there is no independent variable
- to show the association / correlation / pattern (between the two variables)

1

(ii) (snails in woodlands)
more have dark(er) colour(ed shells) **or** fewer have light-coloured shells
allow converse for grassland, if clear

1

(shells have) no / fewer stripes or have no stripes
allow converse for grassland, if clear

1

(iii) less likely to be seen (by predators / birds / thrushes)
allow camouflaged (from predators / birds / thrushes)
allow light coloured shells with stripes would be more visible (to predators / birds / thrushes in woodland (than grassland)).

1

[7]

Q9.

(a) (i) reduced photosynthesis
ignore growth
*do **not** allow need light for respiration*

1

(ii) less food (for animals) **or** less oxygen (for animals)
allow loss of habitat

1

(iii) any **two** from:
accept 2 physical factors or 2 biological factors or one of each for full marks

examples of physical factors, eg
- flooding
- drought
- ice age / temperature change

ignore pollution

- volcanic activity

examples of biological factors, eg

- (new) predators (allow hunters / poachers)
- (new) disease / named pathogen
- competition for food
- competition for mates
- cyclical nature of speciation
- isolation
- lack of habitat or habitat change

*If no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for **1** mark*

2

(b) (i) 3

1

(ii) fossils

ignore bones, remains, fossil fuels

1

(c) (i) 65 million years ago

1

(ii) 17

allow ecf

1

(iii) fossil record incomplete
or
some fossils destroyed

accept not enough evidence

or

cannot perform experiment to test

1

[9]

Q10.

(a) 3-layered triangular pyramid

as blocks or layered triangle, ignore (small) gaps between layers

1

(pyramid) labelled in food chain order

all three labels are required

*for **2** marks the pyramid must be fully correct*

1

(b) (i) C

1

(ii) shortest **or** fewest stages / transfers / (trophic) levels

allow only if (b)(i) is C or blank

1

less losses in waste / faeces / urine / CO_2 / excretion

allow smaller amount uneaten

1

less loss in respiration / heat / movement

allow less lost keeping warm

*do **not** allow energy for respiration*

*do **not** allow respiration makes energy*

*allow less loss (of biomass / energy) **or** less transfer (of biomass / energy) to surroundings if neither 2nd nor 3rd point given, for **1** mark*

1

[6]

Q11.

(a) (i) 1800(g)

1

(ii) triangular pyramid with four layers

accept ecf from (a)(i)
allow inverted pyramid

1

correctly labelled in order of food chain

1

(b) any **two** from:

- (lost as) crab faeces / not all digested

  *allow waste / excretion for **one** mark if neither faeces nor urine are given*

- (lost as) crab urine / urea

- loss of carbon dioxide by crab

  accept (lost via) respiration

- not all the limpet is eaten eg don't eat the shell

- not **all** limpets are eaten (by crabs)

  *allow not enough crabs to eat **all** the limpets / the limpet population*

  ignore energy losses, such as movement

2

[5]

Q12.

(a) (i) 6000

*award **2** marks for correct answer irrespective of working*

*allow **1** mark for 60 × 100 with incorrect or no answer*

allow answer in table if answer line blank

2

(ii) bar width 6000 **or** to match answer to (a)(i)

anywhere on scale ignore depth / height of bar

1

drawn below slugs

label not required

1

(b) any **three** from:

ignore references to number / size / mass of organisms

assume reference is to / of hedgehog unless stated otherwise

- respiration (by hedgehog)

  *do **not** accept idea that respiration uses / produces energy*

- faeces (of hedgehog) **or** (slug) not absorbed (by hedgehog) **or** (slug) not digested (by hedgehog) /
- excreted / urine / urea (by hedgehog)

  *accept waste for **1** mark if neither faeces nor excretion point made*

- not all slug (s) eaten (by hedgehogs) **or** some slugs eaten by other things **or** not all parts (of slug) eaten

  ignore (some) slugs die

- movement (by hedgehog)

- heat (from hedgehog)

  allow appropriate references to biomass lost by these methods, rather than energy losses

3

[7]

Q13.

(a) Sun / sunlight / light

accept radiation from the Sun / solar energy

1

(b) (i) 2 (.0)

1

8 (.0)

1

(ii) 3 layers of decreasing size as they go up

1

labelled wheat grains, field mice, red kites <u>in correct order of food chain</u>

1

sizes correct (showing half on each side)

*allow ecf from **(b)(i)***

error ± half square

1

(c) any **two** from:

- not all the field mice are eaten
- not all parts of eaten mice are absorbed / some passed as faeces (of red kite)
- due to respiration (of red kites) / production of CO_2

allow reference to uric acid / urea / urine (of red kite)

*reference to waste / excretion alone gains **1** mark*

2

(d) any **two** from:

- cannot find all wheat grains / too many to count
- field mice hiding / in hedgerows

allow ref to hibernation / nests / burrows

- red kites / mice come and go all the time

allow count an organism more than once

2

[10]

Q14.

(a) sulfur dioxide

1

(b) (i) mutation

1

(ii) pale form now (more) easily seen (by predators) **or** dark form now less easily seen (by predators)

accept ref to camouflage

1

so pale form (more) likely to be eaten **or** dark form less likely to be eaten

1

so dark form (more likely to) breed / pass on genes

or

pale form less likely to breed / pass on genes

1

(c) (i) pyramid of three layers of diminishing size

either way up

1

three labels in food chain order

award 2 marks only if the pyramid is correctly labelled

accept trees / birch

accept (peppered) moth(s) / larvae

1

(ii) some material is lost in waste from the birds

1

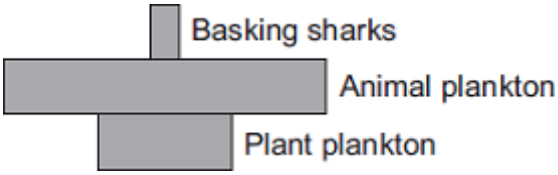
peppered moth larvae do not eat all the leaves from the trees

1

[9]

Q15.

(a)



if more than one box is ticked award no mark

1

(b) increasing / higher light / temperature

ignore references to months other than February – April

*do **not** accept mineral / ions increase*

1

more / increased photosynthesis

*for both marks there must be a reference to 'more' at least once (e.g. 'more light for photosynthesis' gains **2** marks)*

*allow **1** mark for reference to light **and** photosynthesis without an idea of 'more'*

1

(c) increase due to increase in plant plankton / food

ignore references to months other than April – July

1

decrease due to fall in plant plankton / food **or** decrease as eaten by (basking) sharks

allow decrease as eaten by predators / animals / fish

1

(d) fall due to use / intake by <u>plant</u> (plankton)

ignore ref to no change section of graph

for fall allow March / April

ignore May / February

1

increase due to decay / decomposition / breakdown

for increase allow any month in range August to November

ignore December

1

of dead (plant / animal) plankton

allow of dead organisms / waste

1

[8]

Q16.

(a) (i) wheat → humans chain transfers 10 times more energy than wheat → pigs → humans chain

allow 10% if given as a comparison e.g. one is 10% of the other

or

wheat → pigs → humans chain transfers 810 000 (kJ per hectare) less

ignore less unqualified

1

(ii) any **one** reason for energy loss from pigs e.g :

ignore respiration, growth

ignore heat unqualified

- movement
- (maintaining) body temperature
- waste materials

  allow named examples
- not all parts of pig eaten by human
- because there is an extra stage (pigs) in the food chain and energy is lost at each stage

  allow longer food chain so more energy lost

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic description of at least one factory farming method
or
identification of an advantage or disadvantage of factory farming.

Level 2 (3-4 marks)
There is a description of at least one factory farming method
and
an advantage or disadvantage is explained.

Level 3 (5-6 marks)
There is a description of factory farming methods
and
advantage(s) and disadvantage(s) are explained.

Examples of Biology points made in the response:

factory farming methods e.g.:

- Kept in cramped conditions / battery hens / calf crates / pig barns / fish tanks
- Controlled temperature / heating
- Controlled feeding / modified food given / growth hormones
- Controlled lighting
- Treated with prophylactic antibiotics

Advantages e.g.:

- Increased efficiency / profit / greater food production / cheaper food / faster growth
- Farmer can have more livestock
- Less energy is lost through movement
- Less energy is used keeping warm
- (Food is high in calories / protein) so animals will grow faster / lay more eggs
- Easier to vaccinate all the animals
- Easier to protect animals from predators
- Antibiotic treatment stops infections in animals

Disadvantages e.g.:

- Stress / cruelty / inhumane / unethical
- Restricted movement / overcrowding
- Faster spread of diseases
- Antibiotics in the food chain / residual chemicals in the food chain
- Wasting fossil fuels / increasing global warming
- Increased pollution from animal waste and from additional transport

6

[8]

Q17.

(a) (i) triangular pyramid with 3 layers

may be as blocks or as triangle

ignore food chains and arrows

1

layers appropriately labelled:
bean / plant

aphid,

ladybird

*labelled in food chain order must **not** contradict correct pyramid*

*allow correctly labelled inverted pyramid for **2** marks*

1

(ii) any **two** from:
(for aphid / ladybird)

ignore energy

- not all digested / faeces
- loss in urine
- loss of CO_2

  ignore loss of CO_2 from bean plant
- not all eaten

*if none of first 3 points given then allow waste (materials) / excretion for **1** mark*

2

(b) microorganisms / microbes / bacteria / fungi / decomposers / detritivores /named

*do **not** accept germs*

allow mould

ignore aphids

1

decay / breakdown / digest / decompose / rot (bean plant)

ignore eat

1

respiration (of microorganisms etc / aphids)

allow burning / combustion

1

carbon dioxide released (from respiration of microorganisms etc / aphids)

allow carbon dioxide released / produced (from burning / combustion)

ignore other parts of the carbon cycle
ignore formation of fossil fuels

1

[8]

Q18.

(a) 3 (.0)

*correct answer, irrespective of working gains **2** marks.*

*if the answer is incorrect or there is no answer, award **1** mark for use of correct figures (0.5 and 3.5) [and no other figures]*

2

(b) as faeces

*if more than two boxes ticked deduct **1** mark for each additional tick*

1

as carbon dioxide from respiration

1

(c) (i) pigs kept inside are kept in small pens

*if more than two boxes ticked deduct **1** mark for each additional tick*

1

pigs kept inside are kept warm in the winter

1

(ii) any **one** from:

- faster growth
  ignore bigger / less flavour / fatty
- need less food
  ignore references to movement / energy
- ready for market sooner
  ignore ethical arguments

1

[7]

Q19.

(a) 0.18

award both marks for correct answer irrespective of working

if no answer or incorrect answer

*allow **1** mark for 45 × 100 / 25000*

2

(b) heat / thermal

allow heat <u>from</u> respiration

1

(c) energy / mass / biomass lost / not passed on **or** energy / mass / biomass is used **or** not enough energy / mass / biomass left

ignore reference to losses via eg respiration / excretion / movement / heat

1

a sensible / appropriate use of figures including heron

*eg <u>only</u> **2** from frog / to heron*

ignore units

1

(d) any **three** from:

accept marking points if candidate uses other terms for microorganisms

- (microorganisms) decay / decompose / digest / breakdown / rot
  ignore eat
- (breakdown) releases minerals / nutrients / ions / salts / named
  ignore food
- (microorganisms) respiration
  ignore other organisms respiring
- (microorganisms / respiration) release of carbon dioxide

3

[8]

Q20.

(a) (i) sun

ignore light
apply list principle

1

(ii) photosynthesis

apply list principle
allow approximate spelling
*do **not** accept phototropism*

1

(b) (i) chemical

1

(ii) carbon dioxide

1

(iii) carbohydrates

1

(c) As carbon dioxide from the caterpillar

if more than 2 boxes ticked deduct one mark for each additional incorrect box

1

As faeces (droppings) from the blue-tit

1

[7]

Q21.

(a) (i) 0.6 **or** 6×10^{-1}

for correct answer

if no / incorrect answer $\frac{2.4\times10^{4}}{4\times10^{6}}\times100$

or

0.006 ***or*** *6 x* 10^{-3} *gains* ***1*** *mark*

2

(ii) any **two** from:

- reflected
  ignore some of light is green
- not absorbed **or** misses chloroplasts / chlorophyll
  allow transmitted ***or*** *passes through leaves*
  allow hits other plant parts
- wrong wavelength
- photosynthesis inefficient
  accept other limiting factors / named
- allow some lost through respiration / as heat (from respiration)

2

(b) energy lost via faeces / not digested / waste / excreted (of insect-eating birds)

1

energy loss via respiration / movement / muscle contraction / heat (by insect-eating bird)

accept examples of muscle contraction
do ***not*** *accept energy used for respiration*

1

some of (insect eating) bird not eaten <u>but</u> all / most / more of insect is eaten

1

[7]

Q22.

(a) (i) any **two** from:

- more milk
  (about) 50 litres milk compared to (up to) 20 litres / 30 litres more
  ignore costs / profit
- electricity produced
- farmers can keep more cows in the space
  answers must refer to number of cows <u>and</u> space

2

(ii) any **two** from:

- less stress for cow **or** not cruel to cow **or** cows have freedom to move around
  ignore references to ethical / unnatural without qualification
- crops fertilised
- less disease **or** disease not as easily spread

2

(b) more

1

less

in this order

1

[6]

Q23.

(a) (i) 6000

*award **2** marks for correct answer irrespective of working*
*allow **1** mark for 20 x 300 with incorrect or no answer*
allow answer in table if answer line blank

2

(ii) bar width 6000 **or** to match answer to (a)(i)

anywhere on scale
ignore depth / height of bar

1

drawn below slugs

*label **not** required*

1

(b) any **three** from:

ignore reference to size / mass / number of organisms
assume reference is to / of hedgehog unless stated otherwise

- respiration (by hedgehog)
  *do **not** accept idea that respiration uses / produces energy*
- (results in) loss of CO_2
- faeces (of hedgehog) **or** not digested
- excreted / urine / urea (by hedgehog)
  *accept waste for **1** mark if neither faeces nor excretion point made*
  ignore sweat alone

- not all slug(s) are eaten (by hedgehogs) **or** some slugs eaten by other things

  ignore some slugs die

  ignore reference to movement / heat / growth

  allow references to energy losses by these methods, rather than biomass losses

3

[7]

Q24.

(a) bottom / third pyramid ticked

extra box ticked cancels the mark

1

(b) the sun

extra ring drawn cancels the mark

1

(c) any **two** from:

- heat

  ignore keeping warm

- movement / named example internal or external

  ignore digestion

- respiration

  *do **not** allow <u>for</u> respiration*

- faeces / not all digested

  *allow waste for **1** mark if neither faeces nor excretion given (ie waste + movement = **2** marks waste + faeces = **1** mark*

- excretion/ urine

- not all of animal / all parts eaten

  *do **not** accept growth / reproduction*

2

[4]

Q25.

(a) 16

*accept correct answer for **2** marks, irrespective of working*

*if no answer **or** answer incorrect accept 0.64 x 100 / 4 (.0) **or** 0.16 for **1** mark*

2

(b) insect cold-blooded / not warm blooded **or** does not control body temperature

accept mammal warm-blooded / constant (high) body temperature / controls body temperature

1

reference to insect 0.96 (kJ) **and** mammal 12.25 (kJ) transferred by respiration **or** relevant calculation of this transfer

ignore references to other data

1

(less respiration) so more energy / biomass / food available (for growth of insect)

(more respiration) so less energy / biomass / food available (for growth of mammal)

1

[5]

Q26.

(a) three layer triangular pyramid

either way up (as blocks or triangle)

1

(soya / beans / food – trout / fish – people / human (in sequence)

ignore reference to producers /herbivores / consumers

*award **1** mark only for a correct food chain with 2 correct arrows showing energy flow*

1

(b) the trout release energy when they respire

1

some energy will be lost in waste from the trout

1

(c) any **one** from eg

- easy / easier to catch / more caught

  allow easy / easier to monitor

- easy / easier to feed

  allow control food

- no / less predation

  allow less fishing / poaching

- less energy loss

  allow grow faster

- less movement

  ignore less space to move

  *do **not** allow easier to farm*

1

(d) any **two** from:

- microorganisms / bacteria /decomposers / microbes / fungi /detritus feeders
- decay / rot / decompose / digest /break down

  ignore biodegrade

- (microorganisms) respire

  *do **not** award this mark if response implies the trout respire*

- turned into fossil fuels / named fossil fuels

- carbon dioxide / CO_2 released

2

[7]

Q27.

(a) (i) 20

1

(ii) one tenth / 0.1 / 10% / 1:9 / 1 in 10 / 1 out of 10 / $\frac{1}{10}$

*for correct answer irrespective of working **2** marks*
ignore any units
accept equivalent fractions eg $\frac{4}{40}$ / $\frac{2}{20}$

*do **not** allow eg 1:10 / 1 to 10*
if answer is incorrect
*clear selection of 2 **and** 20, **or** equivalent **or** 1:4:5 / 1:5:4 gains **1** mark*

2

(b) any **two** from:

*do **not** accept sweating / cooling /excretion*

- (body) heat / maintaining body temperature

  allow keep warm

- movement (max 2)

  *allow **2 different** examples of movement, internally and / or externally eg breathing / exercise / eating / circulation*
  allow muscle contraction if no other muscle action is credited
  movement + breathing = 1 mark

- growth / cell division / repair / reproduction / building molecules

  allow examples eg making proteins (from amino acids)
  ignore 'chemical reactions' / digestion

- accept active transport

2

(c) more movement / have to hunt / catch food

allow converse if stated for herbivore eg herbivores food is all around
*ignore reference to size **or** predator unqualified*

1

(d) any **two** from

ignore reference to food

- less movement
  allow no movement
  allow less space to move
  ignore less space unqualified

- less heat loss
  *allow no heat loss **or** they are kept warm*

- less respiration

2

[8]

Q28.

(a) the sun / light / sunshine / solar
allow radiation from the sun
ignore photosynthesis / respiration
apply list principle
*do **not** allow water / minerals / heat*

1

(b) 2.5 (:1)

correct answer with or without working
ignore rounding with correct working
*do **not** allow other equivalent ratios for both marks*
*evidence of selection of 10(insects) **and** 4(frogs) **or** 50 **and** 20 **or** 1 **and** 0.4 for **1** mark*

if no other working allow **1** mark for 0.4:(1) on answer line

2

(c) any **two** from:
*allow for insects **or** frogs*
allow energy for biomass

- some parts indigestible / faeces
- waste / examples of waste eg urea / nitrogenous compounds / urine / excretion
- movement / eg of movement
  allow keeping warm
- heat
- not all eaten / eg of not all eaten
- respiration
  do not accept energy for respiration

2

(d) any **four** from:

- (bodies) consumed by animals / named / scavengers / detritus feeders
- microorganisms / bacteria / fungi / decomposers
- reference to enzymes
- decay / breakdown / decompose / rot
  ignore digest(ion)
- respiration
- carbon dioxide produced
- photosynthesis
- sugar / glucose produced
  accept other organic molecules
- fossilisation / fossil fuels / named
- combustion / burning
  must be linked with fossilisation / fossil fuels
- (burning) produces carbon dioxide
  allow carbon dioxide produced once only

4

[9]

Q29.

(a) (i) tick in box of FIRST pyramid

1

(ii) any **one** from:

- less energy / biomass lost / wasted
- greatest biomass / energy for humans
  ignore human box is bigger
  ignore .food. for humans
- shortest food chain **or** less stages **or** least number of different organisms **or** only one predator **or** only 2 boxes tall **or** least boxes
  allow only one stage

1

(b) (i) any **two** from:

- quicker / more growth **or** grow fatter
- less* urine **or** less faeces
- less* heat (lost)

- less* movement

  assume for pigs indoors
  allow converse if clear for pigs outdoors

  *(*) do **not** allow no for less*
  ignore less space

2

(ii) any **one** from:

- less cruelty **or** more ethical **or** better animal welfare

  ignore more natural
  ignore ideas referring to against God's will

- better flavour / quality (of meat)

  *ignore pig health **or** free range / organic*

- less pollution / etc / less fossil fuel used for heating

  ignore quality of life

  assume for pigs outdoors
  allow converse if clear for pigs indoors

1

[5]

Q30.

(a) 4

*award **both** marks for correct answer, irrespective of working.*
*allow 125/3125 (× 100) **or** 0.04 for **1** mark*

2

(b) any **three** from:

- excreted / urine / urea(*)
- not digested / faeces(*)

  *(*) if neither of these marks is awarded then waste gains **1** mark*

- methane
- respiration

  *do **not** allow **for** respiration*

- movement / named internal / external movement

  allow sound

- heat / temperature control / sweating

  allow milk production
  allow active transport

3

(c) any **two** from:

- no / less biomass / energy lost (by intermediate) **or** examples of losses
  herbivores contain more energy is insufficient
- shorter food chain
- cheap(er) to feed herbivores
  ignore reference to carnivores being dangerous

2

[7]

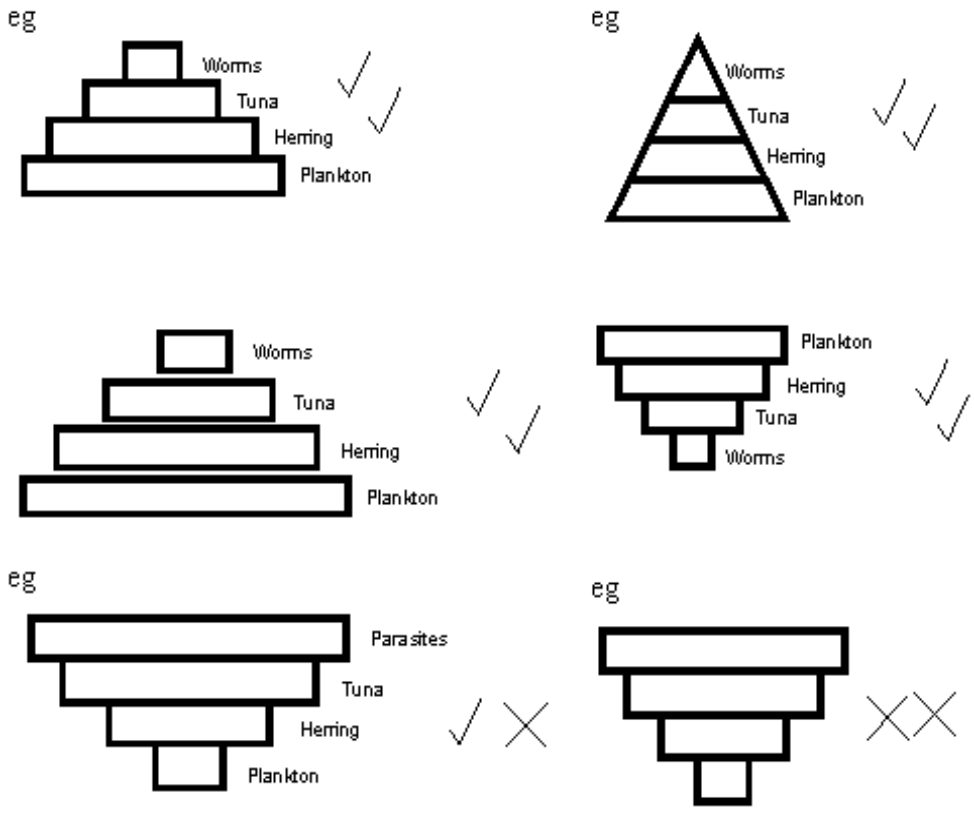
Q31.

(a) (i) a triangular-shaped pyramid, with 4 layers – widest at the bottom
either in blocks or as a triangle

1

labels in food chain order (from widest part)
ie plankton – herring – tuna – parasitic / worms
*upside down labelled pyramid with producer at top gains **2** marks*
*upside down labelled pyramid with producer at bottom gains **1** mark for labels*
*unlabelled upside down pyramid = **0** marks*
accept separate boxes
*correct food chain with correct arrows if given gains **1** mark*

1



(ii) any **two** from:

- waste / excreted / urine / faeces / CO_2 (from tuna)
  from / of tuna not required but do not accept if of / from other organisms
- respiration (of tuna)
  ignore used in reproduction
- movement (of tuna) / hunting
  *if a mark is not awarded for respiration / movement / heat allow **1** mark for energy (unqualified)*
- used for heat (production) (of tuna)
- not digested / absorbed

2

(b) (i) 40

*award **both** marks for correct answer, irrespective of working*
*allow (290 – 50) /6 **or** 240/6 for **1** mark*

*allow 48.3 **/** 48 $\frac{1}{3}$ **/** 48 for **1** mark*

2

(ii) cost of food / protein

1

(c) any **one** from:

- concern about animal welfare **or** examples **or** cruel to tuna **or** unethical **or** lack of space
  allow immoral
  ignore not natural
- poorer flavour / quality

1

[8]

Q32.

(a) 8.3 **or** 8.3 recurring **or** 8

*award **both** marks for correct answer, irrespective of working*
*7 / 84 × 100 or equivalent for **1** mark*

2

(b) any **three** from:

- heat
  allow keeping warm
- respiration
  ***not** <u>for</u> respiration*
- movement **or** example of movement eg exercise / kinetic

- faeces / waste / urine / excretion / urea
  ignore eggs / sound

3

(c) any **one** from:

- less / no movement
  allow examples of movement
- less / no heat loss
- reference to selective breeding
- reference to controlled / better / more feeding

1

(d) any **two** from:

- less steps in food chain
- less losses of biomass / energy / examples of losses
- cheaper to feed herbivores
  allow dangerous to keep carnivores
  herbivores contain more energy is insufficient

2

[8]

Q33.

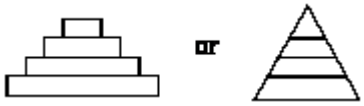
(a) 0.1

ignore working or lack of working

$\frac{88 \times 100}{88\,000}$ *for 1 mark*

2

(b) <u>shape</u>: pyramid with 4 tiers



1

<u>labels:</u>

Plants + Herbivores + Carnivores + Top carnivores
(in sequence – largest to smallest)

allow suitable named examples

*inverted pyramid correctly labelled = **1** mark*

1

(c) more energy / biomass / materials / matter available or less energy lost or energy used up (by herbivores)

***not** just plants*

1

[5]

Q34.

(a) In sequence:

heron
frog
slug
lettuce

1

(b) (i) light / sun

ignore photosynthesis / respiration
cancel mark if water / ions etc given
*do **not** accept heat*

1

(ii) traps / absorbs light

accept energy for light
*do **not** accept collects / attracts*
*do **not** accept 'traps sun'*

1

(iii) 162

if correct answer, ignore working / lack of working

$\frac{10 \times 1620}{100}$ *for **1** mark*

2

[5]

Q35.

(a) (i) (predator) lion

1

(prey) antelope

1

(ii) light

accept other positive indications

1

(iii) in sequence (top to bottom):

lion
antelope
grass

1

(b) (i) bacteria / fungi / saprotrophs

accept moulds / decomposers / microorganisms / microbes / saprophytes / saprobionts

1

(ii) aerobic

1

moist

1

warm

accept other positive indications1

1

(iii) carbon dioxide

1

mineral salts

1

[10]

Q1.

The diagram shows the flow of energy through a forest. The figures are in kilojoules of energy per square metre per year.

(a) What percentage of the energy in the trees is passed on as food for the carnivores? Show clearly how you work out your final answer.

_____

_____

_____ per cent

(2)

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

1. _____

_____

2. _____

_____

3. _____

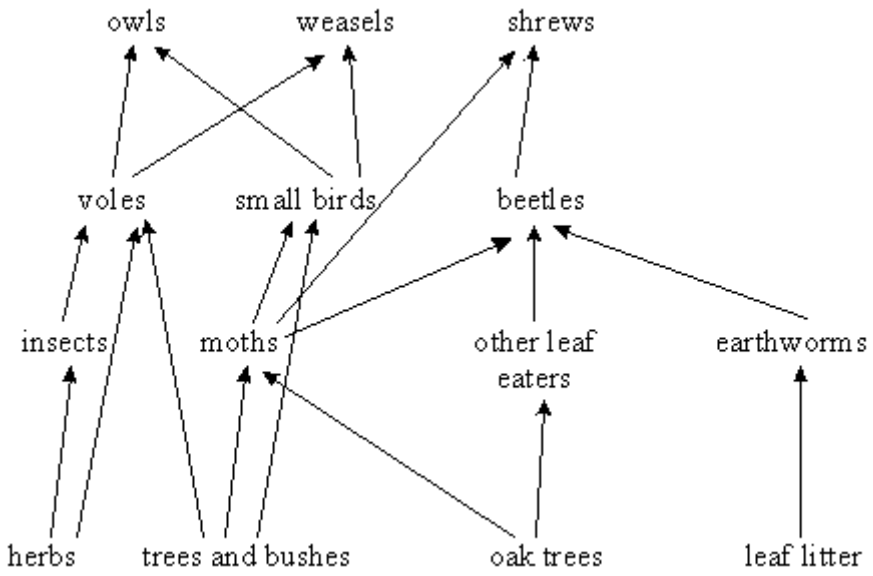
_____

(3)

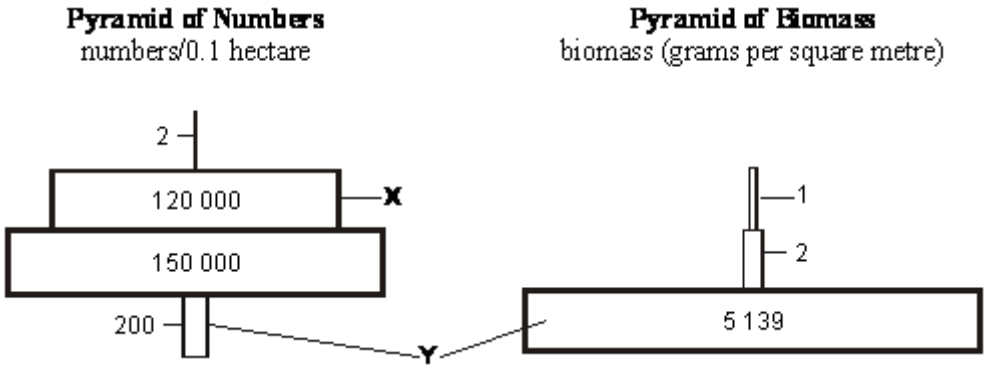
(Total 5 marks)

Q2.

The diagram below shows a food web for a wood.



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



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

_____

(1)

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

_____

_____

_____

_____

(3)

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

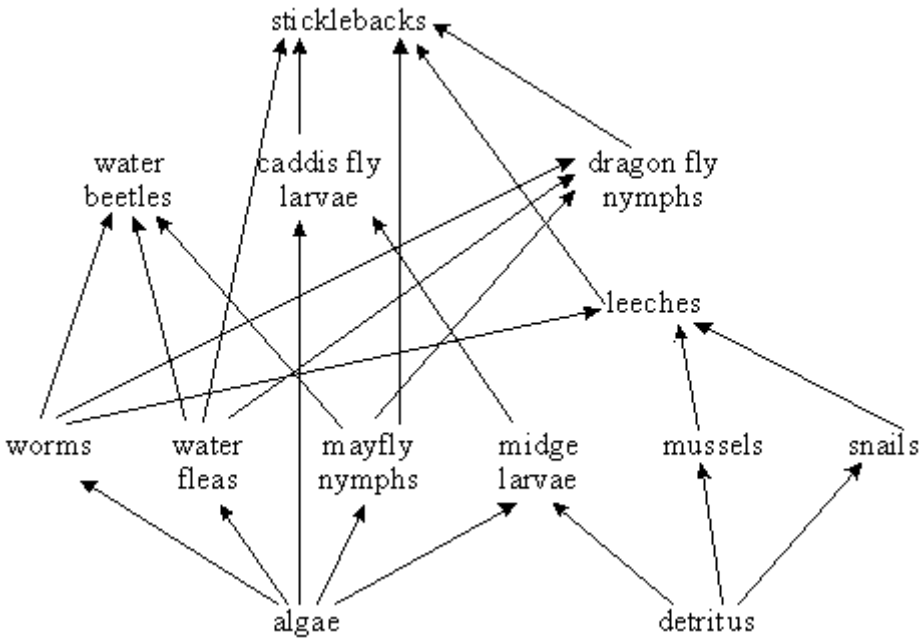
_____

(10)

(Total 14 marks)

Q3.

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



You may need to use information from the food web to help you to answer the following questions.

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

carbon dioxide	+		+	light energy	→	sugar	+	

(2)

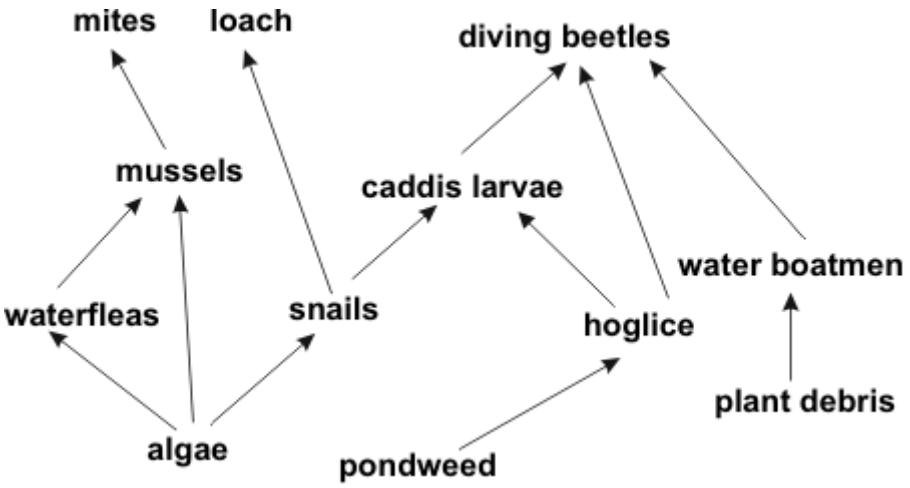
(b) Only a small percentage of the Sun's energy captured by the algae is eventually incorporated into the body tissues of the stickleback. Explain, as fully as you can, what happens to the rest of the energy captured by the algae.

(8)

(Total 10 marks)

Q4.

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



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

_____

(1)

(ii) The algae are small green plants.

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

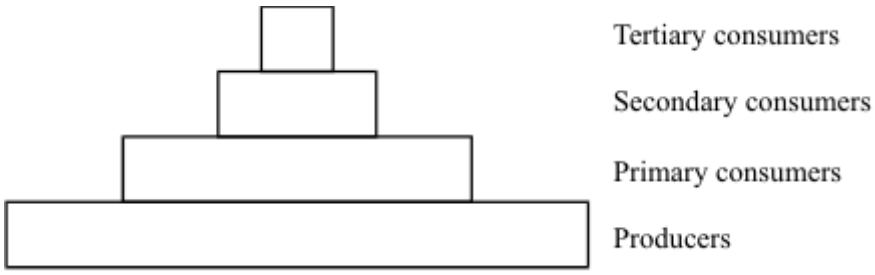
1. _____

2. _____

3. _____

(3)

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



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

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

(6)

(Total 10 marks)

Q5.

A gardener pulled up weeds and used them to start a compost heap. The compost heap soon became colonised by large numbers of earthworms and slugs. The gardener then noticed a hedgehog rooting through the compost heap, eating the earthworms and slugs.

Every so often the hedgehog stopped to scratch itself. This was because it had large numbers of fleas which fed by sucking the hedgehog's blood.

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

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

(2)

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

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

1. _____

2. _____

3. _____

(3)

(Total 5 marks)

Q6.

An oak wood contained the following:

200 oak trees

150 000 primary consumers

120 000 secondary consumers

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

(2)

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

The results were:

Energy absorbed by oak trees	4 600 000 kJ per m^2 per year
Energy in sugar produced by trees	44 000 kJ per m^2 per year
Energy transferred to primary consumers	2 920 kJ per m^2 per year
Energy transferred to secondary consumers	700 kJ per m^2 per year

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

Answer _____ %

(2)

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

1. _____

_____

2. _____

_____

(2)

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

1. _____

_____

2. _____

_____

3. _____

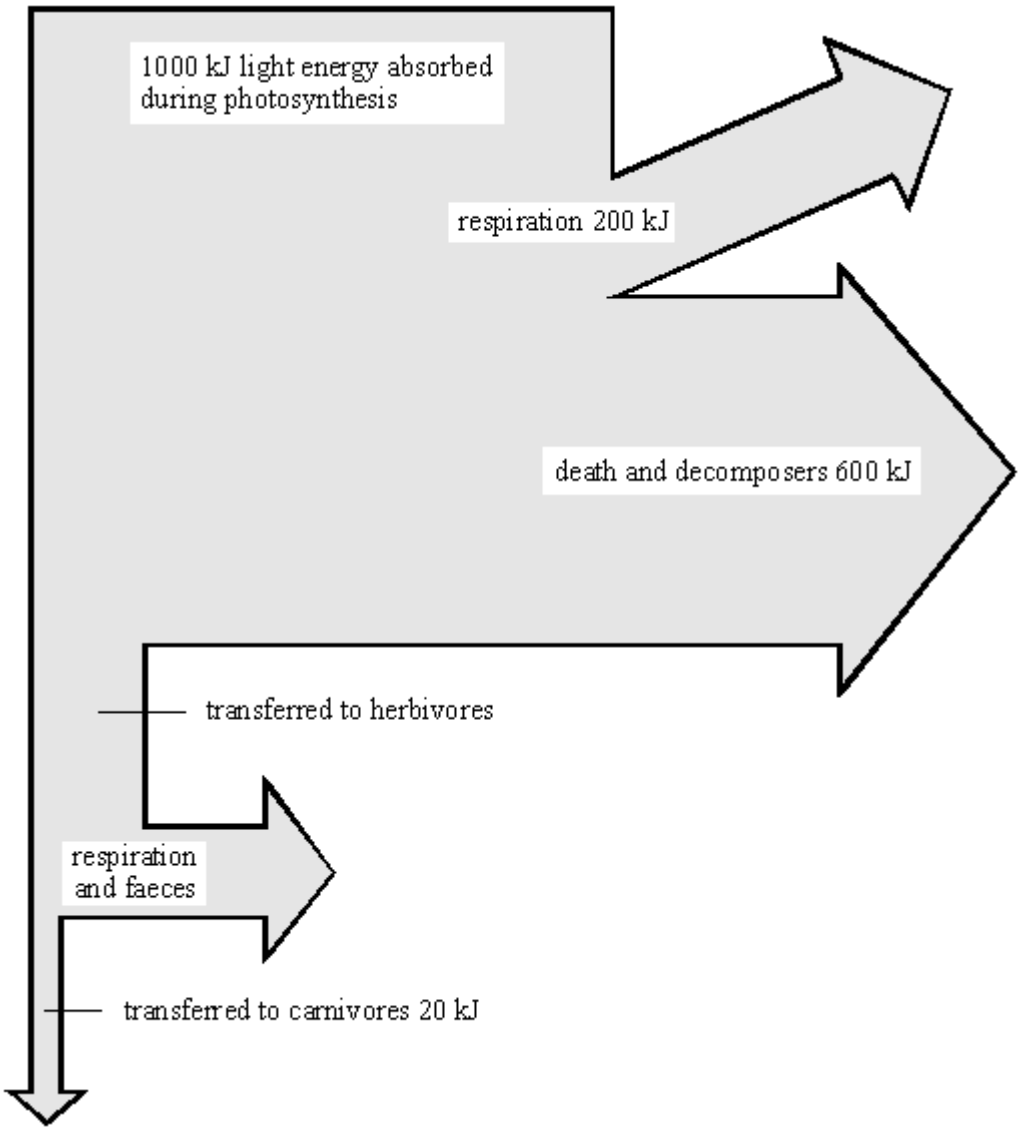
_____

(3)

(Total 9 marks)

Q7.

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



Use the information from the diagram to calculate:

(i) how much energy was transferred to herbivores;

_____ kJ

(1)

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

_____ %

(2)

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

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

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

(3)

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

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

Change of condition 1 _____

Explanation _____

Change of condition 2 _____

Explanation _____

(4)

(Total 10 marks)

Q8.

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**.

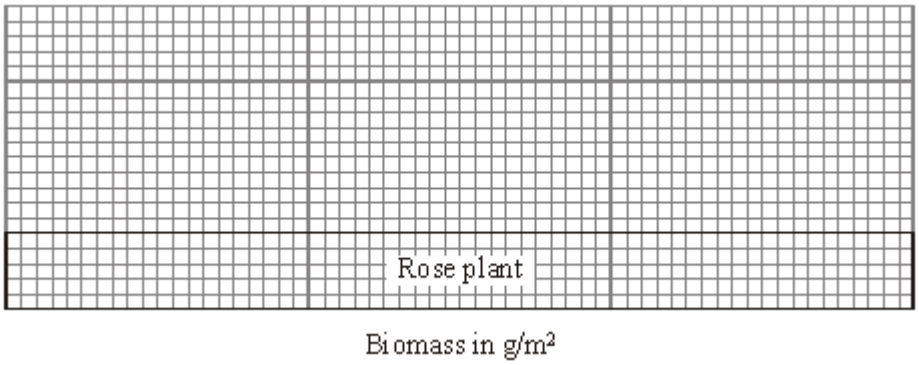
(Total 5 marks)

Q9.

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

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

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



(3)

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

_____

_____

_____

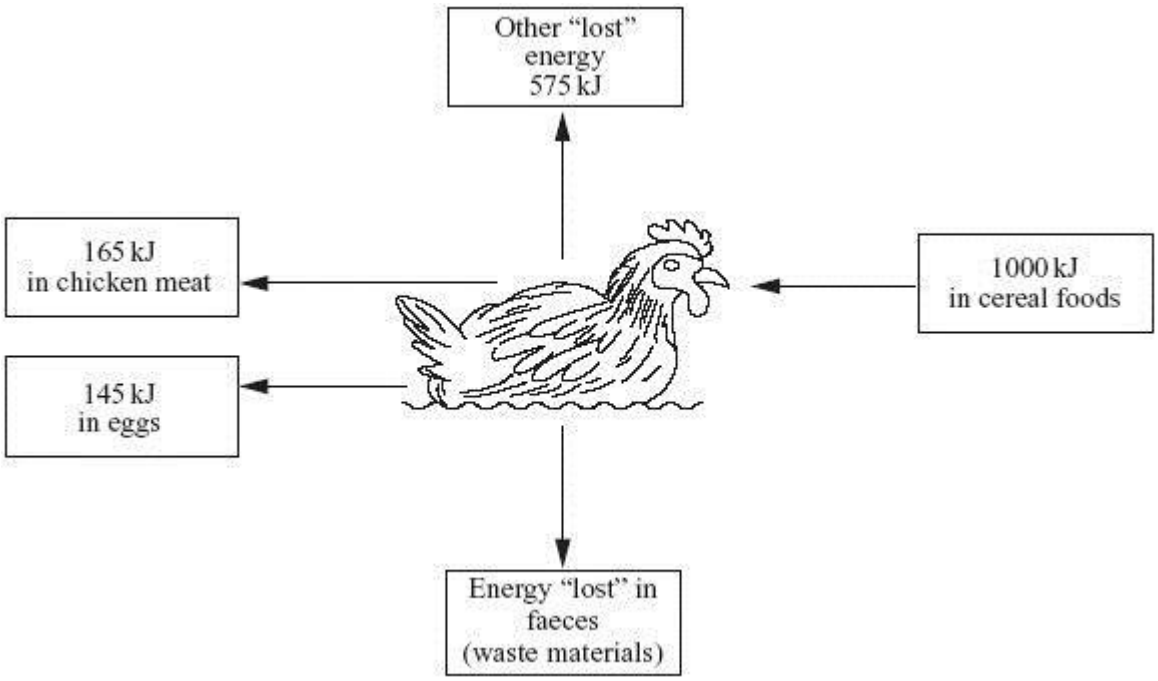
Proportion = _____

(2)

(Total 5 marks)

Q10.

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



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

Energy "lost" = _____ kJ

(1)

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

(4)

(Total 5 marks)

Q11.

The information in the table compares two farms. Both are the same size, on similar land,

close to one another and both are equally well managed.

Name of farm	Activity	Energy value of food for humans produced in one year	Number of people whose energy requirements can be met by this food
Greenbank Farm	Grows food for humans	3285 million kJ	720
Oaktree Farm	Grows food for animals on the farm which become food for humans	365 million kJ	80

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

_____

_____

Energy requirement = _____ kJ/day

(2)

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

(i) The food chain for Greenbank Farm is:

vegetation → humans

What is the food chain for Oaktree Farm?

_____

(1)

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

_____

_____

_____

_____

_____

(3)

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

(4)

(Total 10 marks)

Q12.

Compare the efficiency of these two food chains.

Food chain **A** grain → humans

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

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

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

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

(Total 4 marks)

Q13.

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

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

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

_____

(1)

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

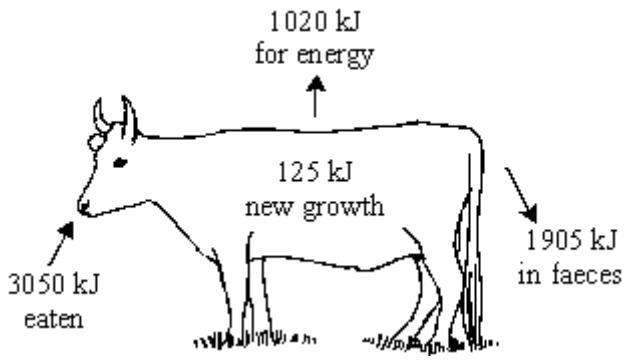
_____

_____

_____

(1)

(b)



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

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

_____

_____

_____

_____

_____

(3)

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

_____

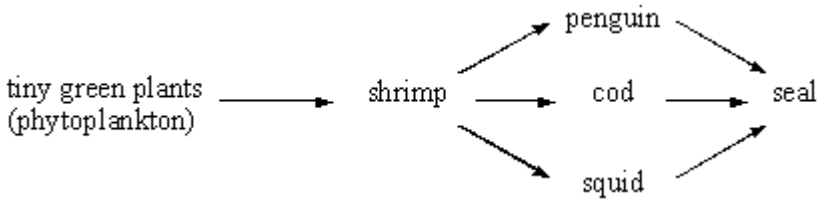
_____

(3)

(Total 8 marks)

Q14.

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



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

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

(3)

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

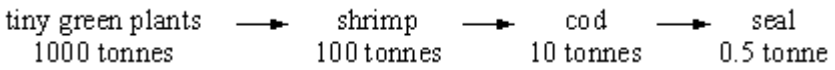
Carefully explain each argument.

Why they might decrease.

Why they might stay the same.

(2)

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



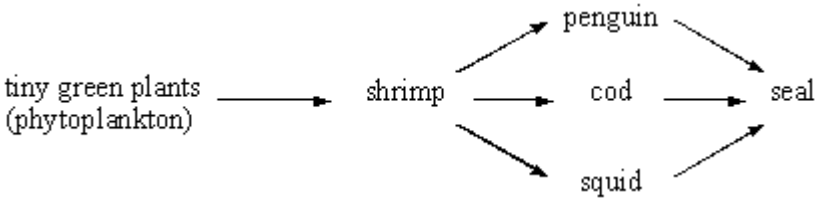
Draw and label a pyramid of biomass for this chain.

(2)

(Total 7 marks)

Q15.

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



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

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

Others argue that the numbers of squid and penguins will stay the same.

Carefully explain each argument.

Why they might decrease.

_____

_____

_____

(1)

Why they might stay the same.

_____

(2)

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

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

Draw and label a pyramid of biomass for this chain.

(2)

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

(3)

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

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

(2)

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

practice.

_____

_____

(1)

(Total 11 marks)

Mark schemes

Q1.

(a) 1.67 / 1 $\frac{2}{3}$

accept 1.6 to 1.7

ignore working or lack of working $\frac{400 \times 100}{24000}$ *for **1** mark*

2

(b) any **three** from:

deduct only 1 mark for any mention of in carnivore

lost as heat **or** keeping body warm

lost in metabolic functions is not enough

lost in respiration

*do **not** accept 'used for respiration*

movement

not eaten parts or individuals / non-edible parts / dead leaves / wood / bones / faeces / urine

ignore 'waste'

ignore references to growth / reproduction

3

[5]

Q2.

(a) (i) vole/small bird/beetle

gains 1 mark

1

(ii) oak trees are large organisms;
therefore their biomass is large; but their numbers are small

each for 1 mark

3

(b) 8 of:
energy stored in chemicals in cells/tissues/growth;
passed up food chain;
less energy stored at each stage in food chain/pyramid level;
because only part of energy taken in used for growth;
some lost in waste;
some used for repair;
used to main body systems;
some lost in respiration;
some converted into other forms of energy;
e.g. movement;
much lost as heat;
by time detritus feeders have used remains;

all returned to environment

each for 1 mark

8

c1 → animals
c2 → decomposers

2 marks for sequencing and organising the information

2

[14]

Q3.

(a) water

gains 1 mark

oxygen

gains 1 mark

2

(b) e.g.:
some materials/energy lost in animals' waste materials
respiration releases energy
some materials/energy used in maintenance/repair
some energy used for movement
much lost as heat to surroundings
some organisms die (rather than eaten)
reference to detritivors
reference to microbes

each for 1 mark

8

[10]

Q4.

(a) (i) e.g. mussels/caddis loach

for 1 mark

1

(ii) 3 of:
carbon dioxide
water
chlorophyll/chloroplasts
light

any 3 for 1 mark each

3

(b) 6 of e.g.
some plant/animal material not digested by consumers passes out with faeces
respiration releases energy used in movement lost as heat
some 'lower' organisms die energy transferred to decomposers/detritivores
thence to environment

any 6 for 1 mark each

6

[10]

Q5.

(a) pyramid correct shape labelled

2

(b) warm
moist
oxygen

3

[5]

Q6.

(a) levels in correct order
sizes correct
for 1 mark each

2

(b) (i) working
0.96% (correct answer = 2)
for 1 mark each

2

(ii) 2 of e.g.
heat up leaves
absorbed by non-photosynthetic parts
transmitted through leaves
any 2 for 1 mark each

2

(iii) 3 of e.g.
respiration of primary consumers
movement of p.c.
waste from p.c.
repair/growth of p.c.; heat losses to surroundings
any 3 for 1 mark each

3

[9]

Q7.

(a) (i) 200 kJ
for 1 mark

1

(ii) 2
gains 2 marks
(if answer incorrect, 20 / 1000 × 100 gains 1 mark)

2

(b) *ideas that*
energy lost by animal (pig / cattle) / extra stage / extra trophic level
in waste materials e.g.
in muscular activity / movement
in keeping body temperature higher than surroundings / lost as heat

any three for 1 mark each
references to respiration regarded as neutral

3

(c) *ideas that*
controlling (high) temperature of surroundings / keeping indoors / insulating
reduces energy transferred from animal as heat / animal uses body heat to maintain temperature restricting movement (e.g. caging or keeping in darkness)
reduces muscular contraction / muscular activity

each for 1 mark
accept respiration as explanation once only if neither explanation point has received credit
reject give more food / different food

4

[10]

Q8.

any **five** from:

- the amount of energy (in the biomass of organisms) is reduced at each successive stage in a food chain
- all of prey organism is not consumed
- energy is 'lost' as the organisms' waste materials
- energy is transferred / lost during respiration
- energy is transferred / lost as movement (kinetic energy)
- energy is transferred / lost as heat (thermal energy)
- energy is transferred / lost to the surroundings
- the only energy transferred to a higher level is that which the organisms have used in growing

statements about energy flow the wrong way are neutral

[5]

Q9.

(a) all bars correct for greenfly, ladybird (± one square) and blackbird (less than one square)

1

bars are centred

*do not accept pyramid shape if **all** to left or right of centre*

1

bars are labelled (in correct sequence)

1

(b) $\frac{1}{12}$ **or** 8.3% **or** 1:12

if answer is incorrect accept correct working out (eg $\frac{50}{600}$ *) for 1 mark*
accept 12 or 12:1 for 1 mark
accept 8.3 for 1 mark (without %)

2

[5]

Q10.

(a) 115

1

(b) any **four** from

less energy lost / used

as heat lost to the atmosphere

since warm indoors

accept temperature controlled

(less energy lost) in movement

since movement restricted

more growth / eggs

*accept prevents loss of body mass **or** gets fatter / weight gain*

4

[5]

Q11.

(a) 12 500

*incorrect numerical answer but clear evidence of correct working e.g. 365 million ÷ 365 ÷ 80 **or** 3285 million ÷ 365 ÷720 credit with (1)*

2

(b) (i) vegetation
→ (farm) animals → humans

accept any correct variation on this theme
e.g. grass → lambs → humans

1

(ii) any **three** linked points from

* less links in the food chain

or *only one link in the food chain*

* energy 'wasted' **or** 'lost' **or** 'used' at each link
* energy 'wasted' **or** 'lost' in (the process of) respiration
* energy 'used' to maintain body temperature
* energy 'used' by the animals in movement

3

(c) people will eat more/greater proportion of food from plants

accept people will eat less/smaller proportion of food from animals
do not credit 'everyone will stop eating meat'

1

any **three** linked points from

these marks are independent of the 'prediction' mark
do not credit 'food from plants will become less expensive'

* meat will become more expensive
* only a limited area of land available on the planet (for food production **or** otherwise)
* more people means less land available for food production because some used for housing etc.
* land will become more expensive
* land will have to be used more efficiently

or *more people will go hungry*
or *people will (each) eat less*

* livestock farmers will try to improve efficiency
* (leading to) growth of 'factory farming'
* demand for food will rise (total)

3

[10]

Q12.

(food chain) A gives 7200kJ (of useful energy)

or *7.2MJ*
or *7200000J*
unit essential in each case

1

(food chain) B gives 960kJ (of useful energy)

or *0.96MJ*
or *960000J*
unit essential in each case

*credit 1 mark if **both** are numerically correct but unit omitted*

1

same comparison made in **each** case
e.g. for each kilogram of grain

***or** refers to more stages in food chain results in less efficiency*

1

(so) (food chain) A is 7.5 times more efficient than (food chain) B

***or** for every unit of useful energy given to a person by B, A gives $7\frac{1}{2}$ units*

***or** food chain B is only 13(.3)% as efficient as food chain A*
***or** makes a correct comparison in percentage terms*

1

[4]

Q13.

(a) (i) carbohydrate*/fat/protein in cell
(or example e.g. glucose/starch)

for 1 mark

1

(ii) $\frac{21500}{1050000} \times 100$ or 2.(05)%

for 1 mark

1

(b) *ideas that:*
little energy used for growth/most wasted/lost

gains 1 mark

but
only 4% used for new growth

gains 2 marks

evidence/idea that this is repeated at each stage
idea of diminishing return/less energy at each stage

for 1 mark each
(maximum of 3)

3

(c) *idea:*
plants at the start of all food chains
shorter food chain
more efficient/less energy lost/more food
cheaper/more economic
(must bear consequence of at least one of earlier marks)

any three for 1 mark each

3

[8]

Q14.

(a) (i) (tiny green) plants / phytoplankton

for 1 mark

1

(ii)
- penguin
- shrimp
- cod
- squid

any two for 1 mark

1

(b) Decrease: seals will eat more squid and penguins

for 1 mark

1

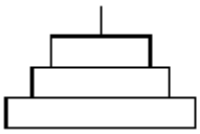
Stay the same:

- more shrimp for squid and penguins
- squid and penguins increase balances the extra eaten by seals
- seals find other prey [allow shrimps]

any two for 1 mark each

2

(c)



credit  *for seal*

allow 

- correct / shape (designs need to be to scale)
- correctly labelled with organisms

(if wholly correct but inverted then credit 1 mark)

each for 1 mark

2

[7]

Q15.

(a) Decrease: seals will eat more squid and penguins

for 1 mark

1

Stay the same:

- more shrimp/food for squid and penguins

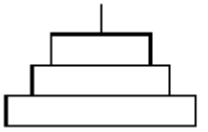
ideas that

- increase in squid and penguins balances the extra eaten by seals
- seals find other prey (allow start to eat shrimps)

any two for one mark each

2

(b)



credit  *for seal*

allow

- correct shape (doesn't need to be to scale)
- correctly with organisms

(if wholly correct but inverted then credit 1 mark)

each for 1 mark

2

(c)

- seals are mammals
- *idea that* seals have (to maintain) a constant body temperature *[allow warm blooded]*
- heat losses to cold seas
- more of food eaten used to replace heat loss

(credit use of figures i.e. 95% loss compared to 90%
or 5% efficient compared to 10%
or 20 : 1 conversion ratio compared to 10 : 1
with 1 mark)

any three for 1 mark each

3

(d) (i) *ideas that*

- reduce number of fishing boats allowed

- breed in captivity and then release
- agree quotas [not an unqualified 'ban']
- avoid breeding areas
- avoid breeding seasons
- increase size of net mesh/don't catch small fish
- limit catches of shrimps
- cull seals

any two for 1 mark each
[allow any other reasonable answer]

2

(ii)
- breeding areas closer to some countries than others
- difficult to police/easy to cheat/'poach'
- difficult to agree quotas
- some countries eat more fish than others
- best weather for fishing maybe in breeding seasons
- fisherman/trawlers need employment
- big demand for cod

any one for 1 mark
[allow any other sensible response]

1

[11]