PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 4: ECOLOGY AND THE ENVIRONMENT (PACK 2)

SCORE	PERCENTAGE
/198	%

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Q1.

Scientists collect data from a grassland ecosystem.

For each trophic level they determine

• the mean number of organisms in a square metre

• the mean dry mass of these organisms in a square metre

The table shows the scientists' data.

Trophic level	Mean number of organisms	Mean dry mass in g
producer	592	821.0
primary consumer	68	37.0
secondary consumer	35	10.60
tertiary consumer	3	2.40

(a) (i) Draw a labelled pyramid of numbers for this data.

(2)

(ii) Describe how you could collect data to find the mean number of producers per square metre in the ecosystem.

(3)

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(b) The mass of organisms at each trophic level is called the biomass.

The percentage of biomass in the producers that is transferred to the primary consumers is 4.5%.

(i) Calculate the percentage of biomass in the secondary consumers that is transferred to the tertiary consumers.

(1)

percentage = ... %

(ii) Comment on the energy transfers in this ecosystem.

In your answer, refer to data from the table and the percentages of biomass transferred.

(4)

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(Total for question = 10 marks)

Q2.

(a) Fish do not have lungs. They use gills for gas exchange.

Fish gills have similar adaptations to the alveoli in lungs.

Suggest how fish gills are adapted for gas exchange.

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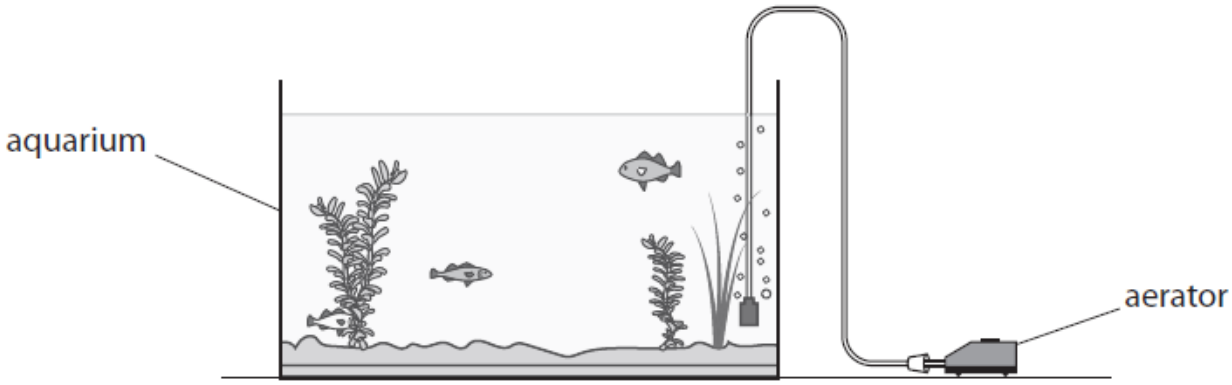
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(b) A person keeps small fish in a glass container called an aquarium.

The diagram shows an aquarium.

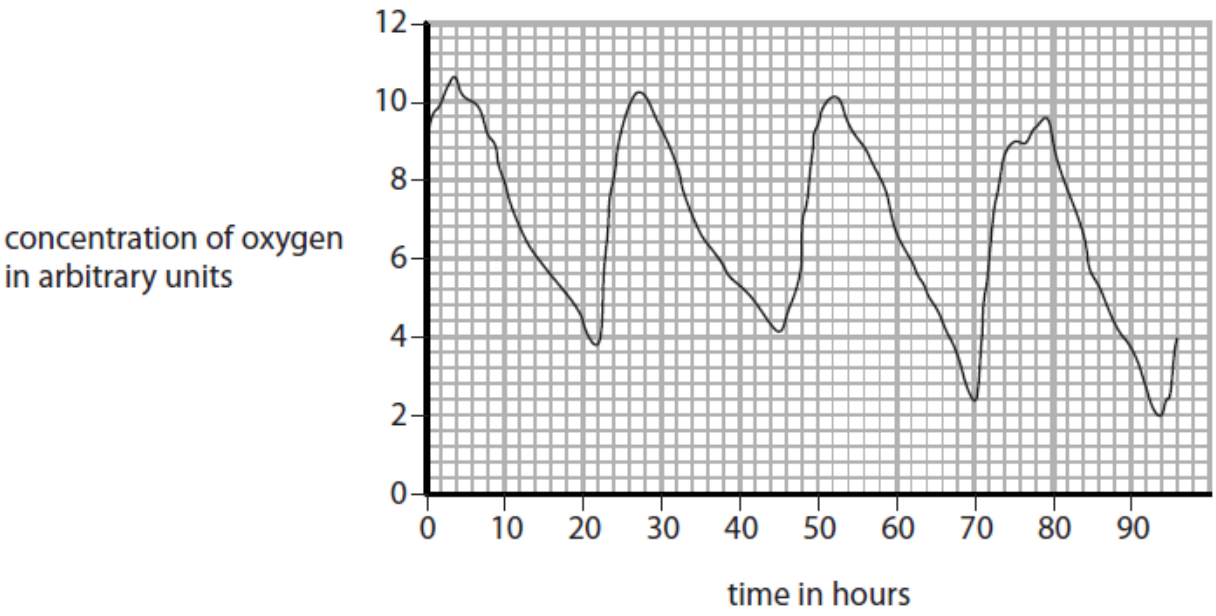


He follows these steps to try and keep his fish healthy.

- place the aquarium near a window
- use the aerator for one hour each day
- set the aerator to pump large bubbles of air rather than small bubbles
- feed the fish several times a day with large amounts of food
- change the water in the aquarium every four days

He measures the changes in oxygen concentration in the aquarium water over a period of four days.

The graph shows these changes in oxygen concentration.



The person claims he keeps his fish in good conditions.

Evaluate this claim.

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(Total for question = 9 marks)

Q3.

Car exhaust fumes contain air pollutants including carbon monoxide and sulfur dioxide.

(a) Explain why carbon monoxide is a harmful air pollutant.

(2)

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(b) Which of the following is a direct consequence of sulfur dioxide pollution?

(1)

☒ **A** production of acid rain

☒ **B** soil erosion

☒ **C** production of ozone

☒ **D** eutrophication

(c) A species of plant does not grow by the side of roads.

One hypothesis to explain this observation is that sulfur dioxide inhibits seed germination.

Design an investigation to test this hypothesis.

Your answer should include experimental details and be written in full sentences.

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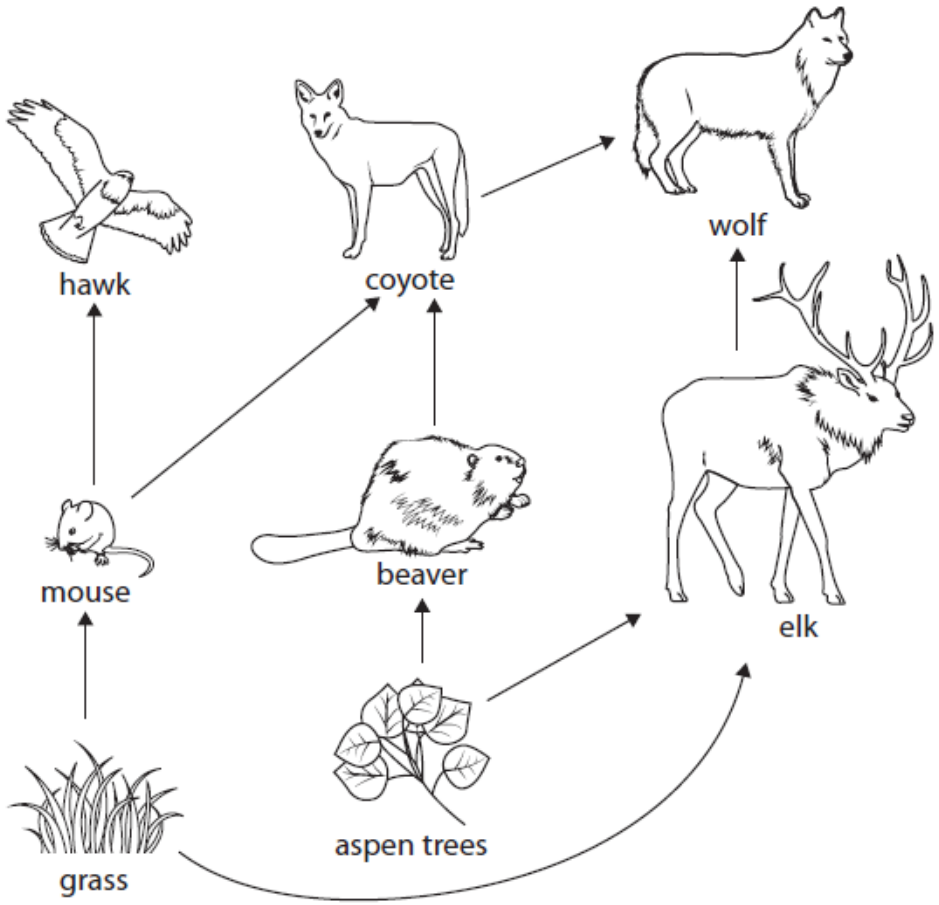
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(Total for question = 9 marks)

Q4.

The diagram shows part of a food web from an ecosystem in a region of North America.



(a) (i) Which of these organisms in the food web is a primary consumer?

(1)

☒ **A** beaver

☒ **B** coyote

☒ **C** grass

☒ **D** wolf

(ii) State what is meant by the term **ecosystem**.

(1)

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(b) Wolves were hunted in this region of North America until they became extinct in 1926.

The extinction of wolves damaged the ecosystem in these ways.

- the population of mice, hawks and beavers decreased
- the population of producer species decreased

Beavers are important in this ecosystem because they cut down old trees and create shelters that other organisms nest in.

Discuss why the extinction of wolves damaged the ecosystem.

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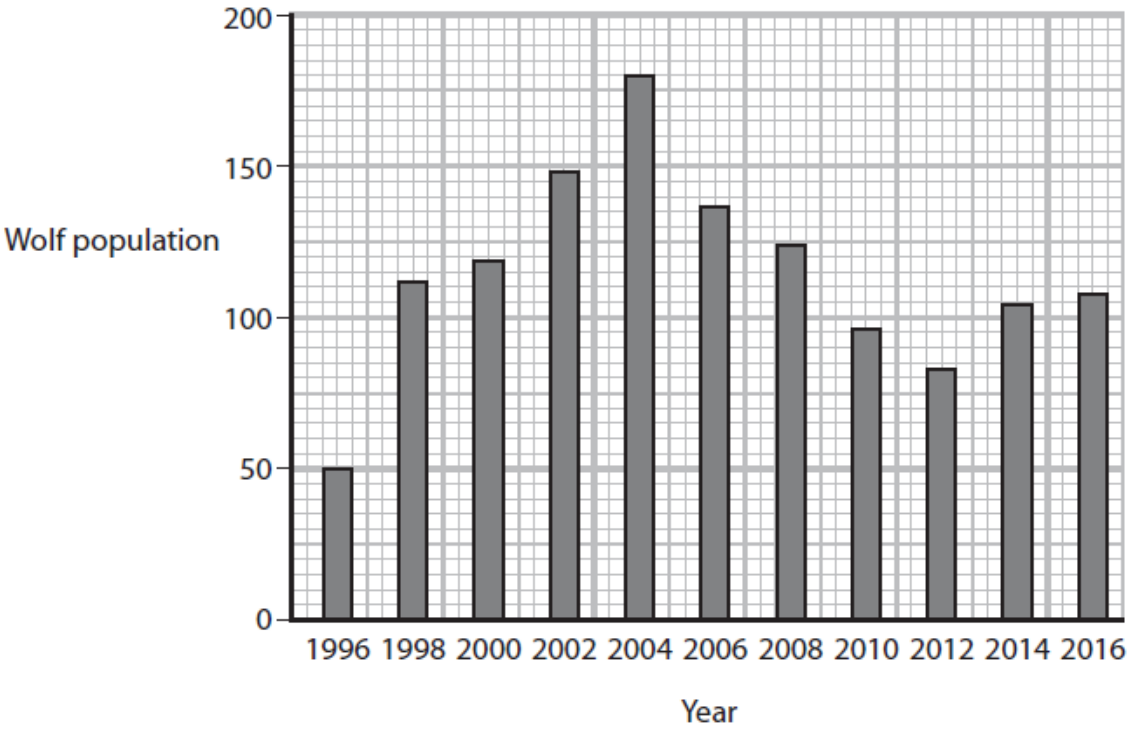
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(c) In 1995, 14 wolves were reintroduced to this region.

The diagram shows the change in wolf population from 1996 to 2016.



(i) Calculate the percentage change in the wolf population between 1996 and 2004.

(2)

percentage change = ... %

(ii) Suggest why the wolf population changed between 2004 and 2012.

(2)

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(iii) The reintroduction of wolves caused changes in the populations of some plant species.

Describe how the population size of a plant species in the region could be determined.

(3)

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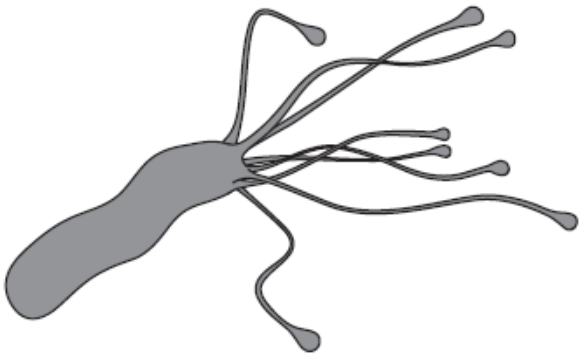
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(Total for question = 13 marks)

Q5.

The bacterium *H. pylori* causes stomach ulcers.

(a) The diagram shows this bacterium.



(i) Which of these is found in this bacterium?

(1)

☒ **A** cellulose

☒ **B** chitin

☒ **C** cytoplasm

☒ **D** nucleus

(ii) The bacterium has evolved to release an enzyme called urease.

The action of the bacterium neutralises the acid in the stomach.

What is the pH changed to?

(1)

☒ **A** 1

☒ **B** 2

☒ **C** 7

☒ **D** 12

(iii) Use the theory of evolution by natural selection to explain how *H. pylori* bacteria could have evolved to produce urease.

(4)

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(b) Probiotics are live microorganisms that can have health benefits when consumed.

Scientists investigate the ability of probiotics and cranberry juice to reduce the growth of *H. pylori*.

The scientists give various treatments to a group of people who have *H. pylori*.

The treatments are given daily for three weeks.

The scientists measure the mean percentage reduction of *H. pylori* for each treatment.

The table shows the scientists' results.

Treatment	Mean percentage (%) reduction in *H. pylori*
probiotics	14.9
cranberry juice	16.9
probiotics and cranberry juice	22.9
control	1.5

Give two conclusions from these results.

(2)

1 .....

2 .....

(Total for question = 8 marks)

Q6.

(a) The table gives some examples of biological processes.

Complete the table by giving the name of each process.

The first one has been done for you.

(3)

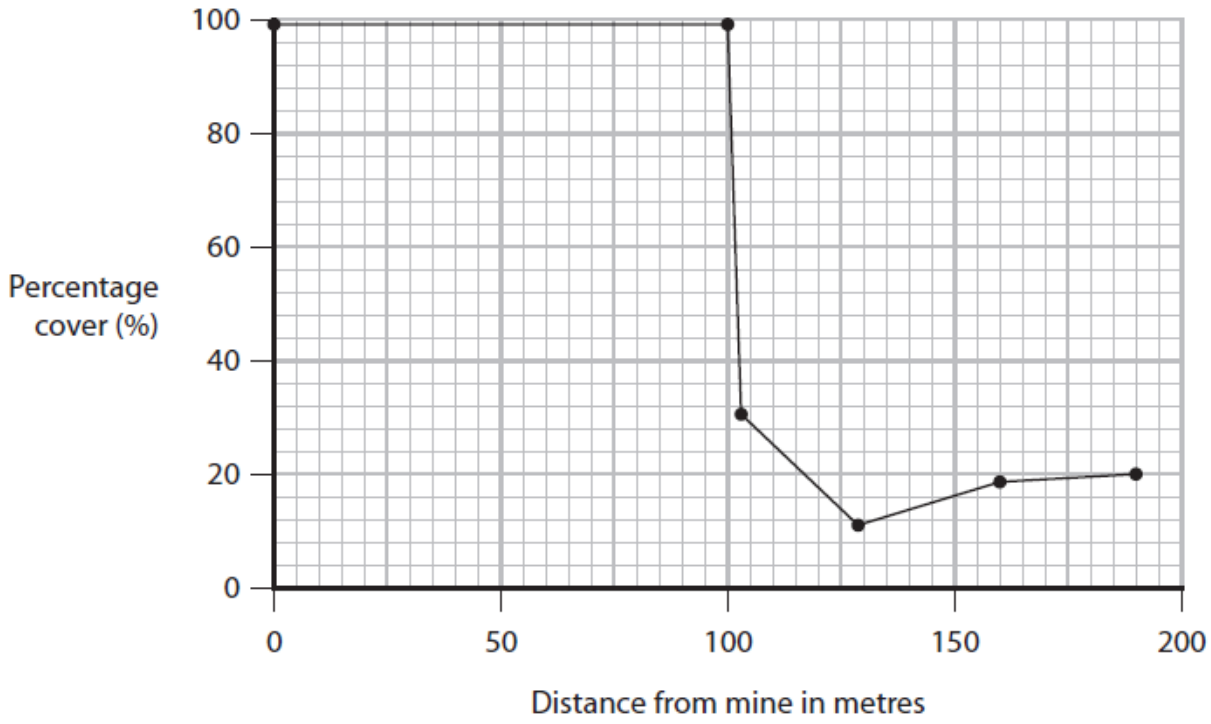
Example of process	Name of process
plants with a short growing season survive drought	natural selection
growth of algae in rivers polluted by fertiliser	
pollen transferred from one plant to another by an insect	
absorption of nitrate ions from soil using ATP	

(b) Zinc is poisonous to many plants and can affect natural selection.

A scientist investigates the ability of one grass species to survive at different distances from a zinc mine.

The scientist uses a sampling method to measure the percentage cover of this grass species at different distances from the zinc mine.

The graph shows the scientist's results.



(i) The zinc concentration in soil is higher near the zinc mine than it is further from the zinc mine.

Explain how natural selection could be responsible for the results shown in the graph between 0 and 100 metres.

(4)

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(ii) Describe a method the scientist could use to compare the population size of the grass species at 50 metres and 100 metres from the mine.

(4)

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(Total for question = 11 marks)

Q7.

Plants use some of the biomass that they produce as a source of energy.

(a) Name the process that releases energy in plant cells.

(1)

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(b) The productivity of plants in different ecosystems can be compared by calculating their net primary productivity.

Net primary productivity is the difference between the biomass produced and the biomass used.

The table shows the net primary productivity of different ecosystems in one year. This is measured in grams of biomass produced by one square metre of ground.

Ecosystem	Mean net primary productivity in one year in g per m^2
desert	80
temperate grassland	600
cultivated farmland	625
temperate deciduous forest	1250
tropical rainforest	2200

A temperate ecosystem has no extremes of temperature.

(i) Describe a method that a scientist could use to determine the mean net primary productivity of temperate grassland in a year.

(3)

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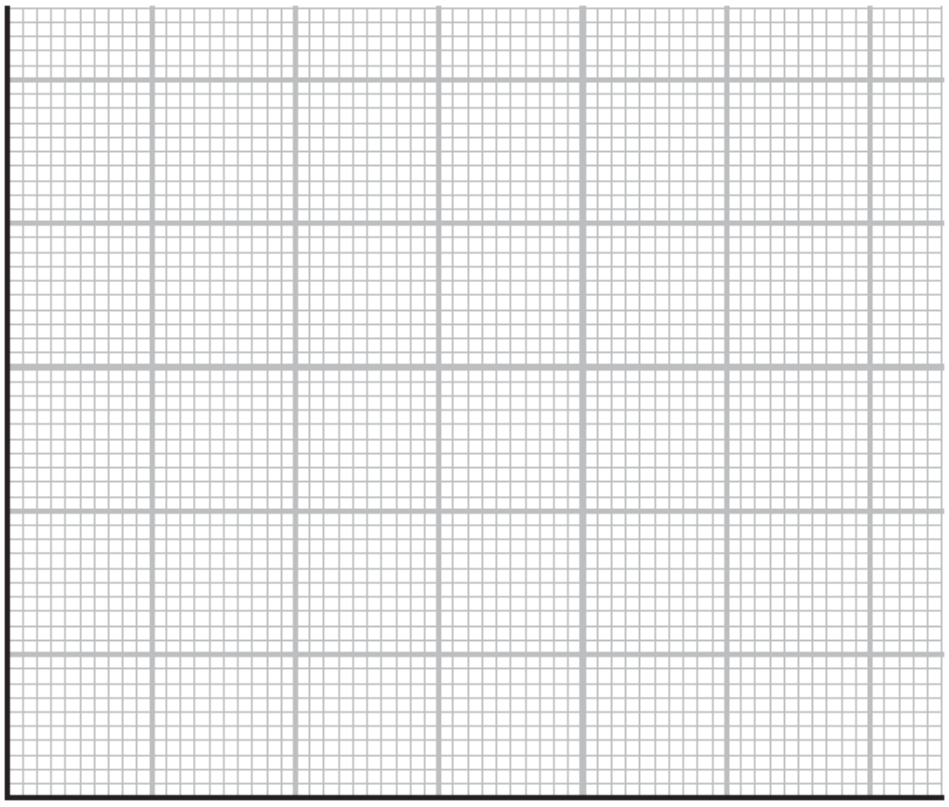
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(ii) Draw a bar chart to show the mean net primary productivity in g per m^2 for each ecosystem in one year.

(5)



(iii) Comment on the differences between the mean net primary productivity in the ecosystems.

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(Total for question = 14 marks)

Q8.

Large quantities of food are wasted every year. Waste food needs to be disposed of using methods that do not harm the environment.

The table shows the mass of each gas released into the air from three different methods of waste disposal.

Method of waste disposal	Mass of each gas released into the air from 1000 kg of waste food in kg			
	carbon dioxide	carbon monoxide	methane	sulfur dioxide
anaerobic digester	37	0.012	3.05	0.23
burying in landfill	220	0.680	14.70	0.14
burning	680	0.059	3.12	0.08

(a) Calculate how much carbon dioxide would be released from 125 kg of waste food when using an anaerobic digester.

Give your answer to two significant figures.

(2)

mass of carbon dioxide released = ... kg

(b) Some scientists have claimed that anaerobic digesters are the most environmentally friendly method of waste disposal.

Evaluate this claim using data from the table and your own knowledge.

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(Total for question = 7 marks)

Q9.

Farmers may add chemical fertilisers to their soil.

(a) Explain how chemical fertilisers can increase crop yield.

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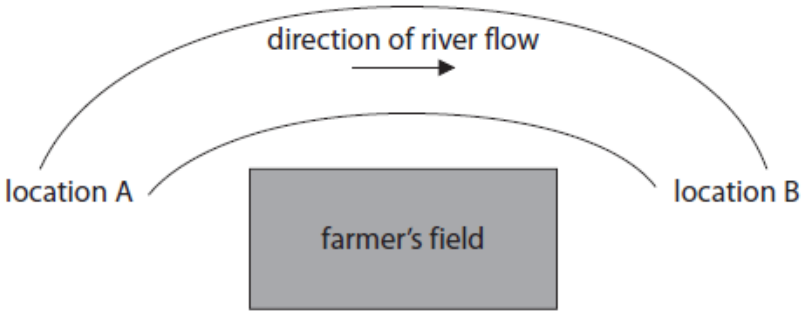
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(b) These fertilisers may leak into rivers.

A scientist measures the oxygen content of water in two different locations of the same river during the month of April.



In location A he finds that the mean dissolved oxygen was 6 mg per litre and at location B he finds that the mean dissolved oxygen was 3 mg per litre.

He concludes that the use of fertiliser in the field has affected the oxygen content of the river.

Discuss his conclusion.

(4)

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(c) Some farmers use alternative substances to chemical fertilisers.

Suggest one alternative substance that a farmer may use.

(1)

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(Total for question = 9 marks)

Q10.

Pollution can occur in the atmosphere and in rivers.

(a) Carbon monoxide can pollute the atmosphere.

Describe the effects of carbon monoxide pollution on humans.

(3)

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(b) Water pollution can occur if sewage enters a river.

Explain the biological consequences of sewage pollution on a river ecosystem.

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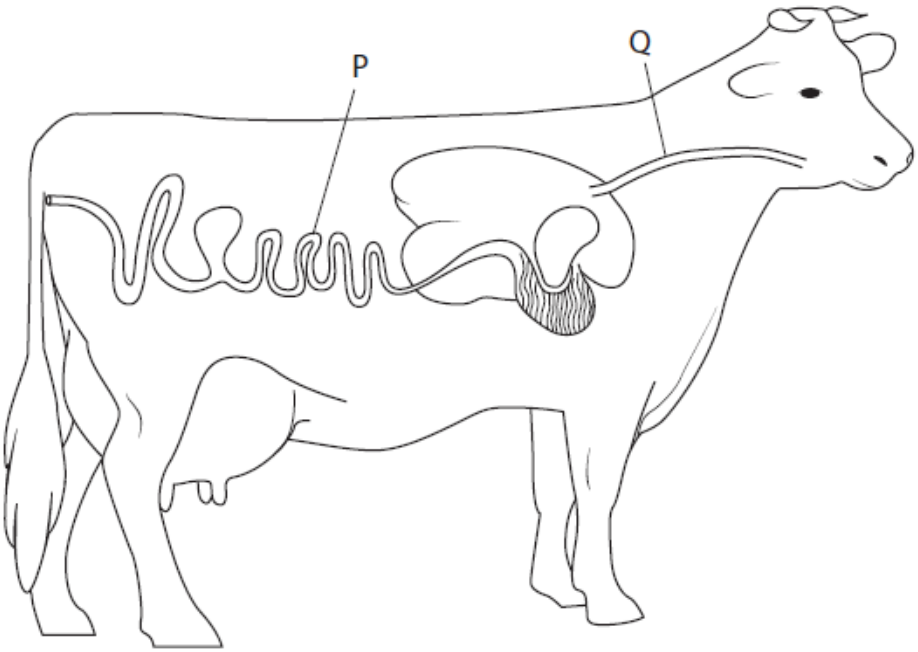
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(Total for question = 9 marks)

Q11.

The diagram shows part of the digestive system of a cow.



(a) Name the parts labelled P and Q.

(2)

P .....

Q .....

(b) The cow's stomach contains microorganisms that digest plant cell walls.

Suggest why these microorganisms are useful to a cow.

(2)

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(c) Farmers keep cows to produce milk.

Injecting cows with growth hormone (GH) will increase milk production.

This allows farmers to obtain the same volume of milk from fewer cows.

Digestion in cows releases methane gas into the atmosphere.

A scientist claims that injecting GH into cows would reduce climate change.

Comment on this claim.

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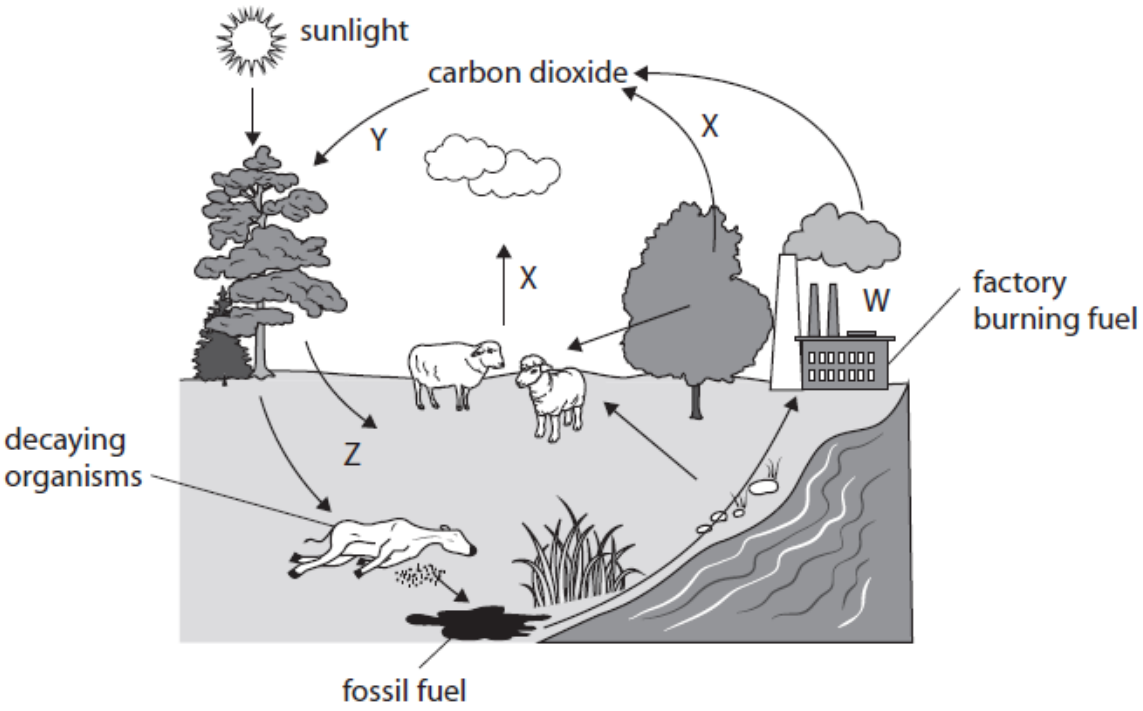
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(Total for question = 8 marks)

Q12.

The diagram shows a cycle found in ecosystems.



(a) Give the name of the cycle.

(1)

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(b) (i) Which process is represented by the letter W?

(1)

☒ **A** combustion

☒ **B** decomposition

☒ **C** feeding

☒ **D** respiration

(ii) Which process is represented by the letter X?

(1)

☒ **A** combustion

☒ **B** decomposition

☒ **C** feeding

☒ **D** respiration

(c) Name a group of organisms that is responsible for decomposition.

(1)

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(d) Carbon dioxide is released into the atmosphere by the decomposition of organic material.

The rate of this decomposition depends on a number of factors.

Design an investigation to find out if changing the pH of organic material affects the rate of decomposition.

Include experimental details in your answer and write in full sentences.

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(Total for question = 10 marks)

Q13.

Squirrels are animals that live in woodland. They feed on nuts produced by the trees.

The diagram shows a squirrel eating a nut.



(a) Describe a method you could use to show that the nut contains fat.

(3)

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(b) The table lists substances found in two types of nut, A and B.

The mass of each substance is given in milligram per gram of nut.

Substance	Mass of substance in milligram per gram of nut	
	nut A	nut B
carbohydrate	167	143
protein	150	78
fat	587	693
fibre	96	86
iron	0.05	0.03

(i) Explain the role of fibre in the squirrel's diet.

(2)

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(ii) Explain which nut is better at helping the squirrel make red blood cells.

(2)

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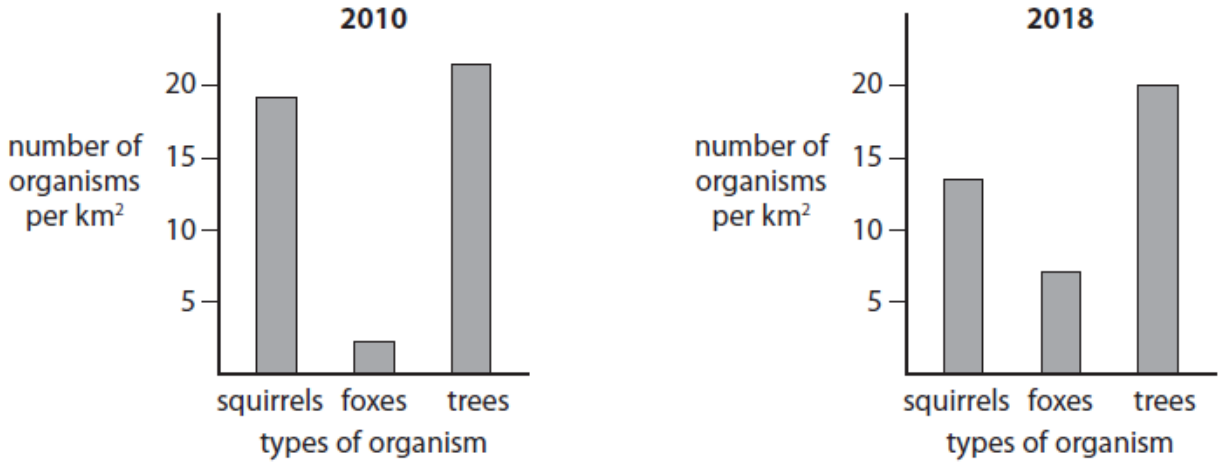
(iii) Nut A has a mass of 28.0 grams.

Calculate the total mass of carbohydrate in this nut.

(2)

total mass of carbohydrate = ... grams

(c) The graphs show the number of squirrels, foxes and trees in a woodland in 2010 and in 2018.



Discuss possible reasons why there is a decrease in the number of squirrels from 2010 to 2018.

Use information from the graphs and your own knowledge in your answer.

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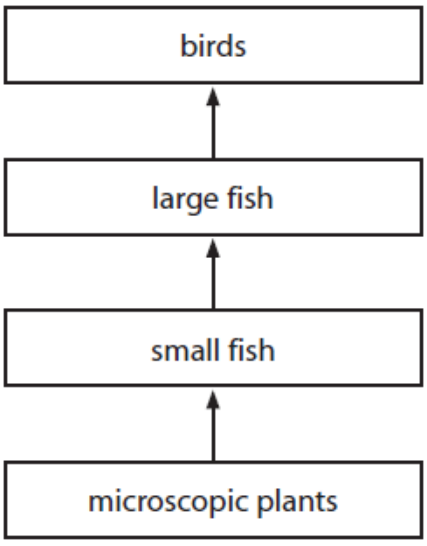
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(Total for question = 14 marks)

Q14.

The diagram shows a food chain from a lake.



(a) Name the primary consumer in this food chain.

(1)

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(b) The microscopic plants convert light energy into chemical energy.

(i) Describe the process that converts light energy into chemical energy.

(3)

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(ii) Give two reasons why some of the energy in the microscopic plants is not transferred to the small fish.

(2)

1 .....

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2 .....

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(c) The birds do not have teeth.

The fish they eat is initially crushed in part of their digestive system called a gizzard.

Suggest why crushing the fish in the gizzard helps the birds to digest the fish.

(2)

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(Total for question = 8 marks)

Q15.

Two different areas, A and B, of a woodland habitat were studied.
This food chain in area A was observed.

oak leaves → caterpillars → blue tits → sparrowhawks

(a) (i) Give the producer in this food chain.

(1)

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(ii) Give the tertiary consumer in this food chain.

(1)

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(b) A sample is taken from area A of the woodland.

Table 1 shows the number of individuals of each species recorded in area A.

Area A	
Species	**Number**
oak leaves	150 000
caterpillars	12 000
blue tits	140
sparrowhawks	2

Table 1

(i) Draw a labelled pyramid of numbers for this data.

(3)

(ii) A sample is also taken from area B in the woodland.

Table 2 shows the number of individuals of each species recorded in each area.

Species	Area A	Area B
	Number	Number
oak leaves	150 000	190 000
caterpillars	12 000	8000
blue tits	140	90
sparrowhawks	2	1

Table 2

A scientist concludes that, because area B is next to farmland, the differences in species numbers are due to the farmer using a chemical to kill insects on his land.

Evaluate this claim.

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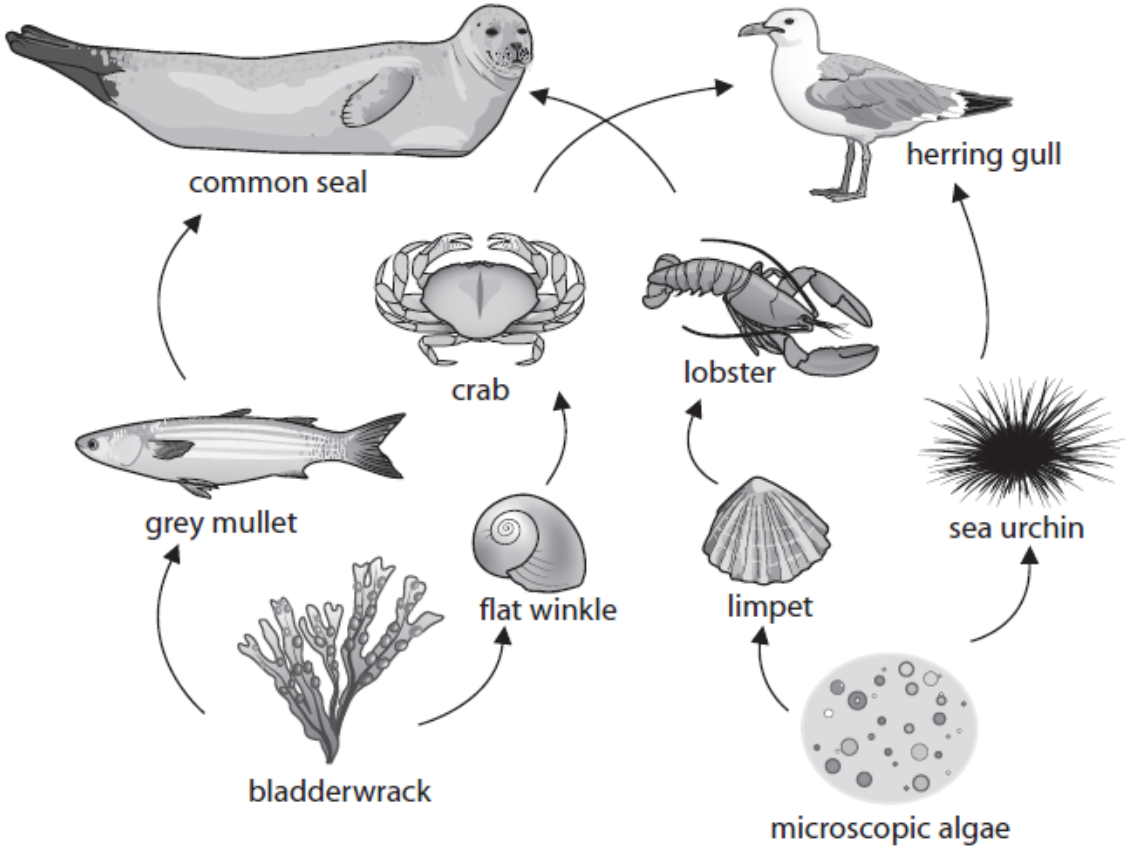
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(Total for question = 10 marks)

Q16.

The diagram shows an ocean food web.



(a) (i) Name the producers in this food web.

(2)

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(ii) Name two secondary consumers in this food web.

(2)

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(iii) Draw a food chain from this food web that contains four organisms and includes the herring gull.

(2)

(b) (i) This food chain is found in the food web.

microscopic algae → limpet → lobster → common seal

Sketch and label the pyramid of energy for this food chain.

(2)

(ii) Explain why the amount of energy available to the organisms changes along this food chain.

(3)

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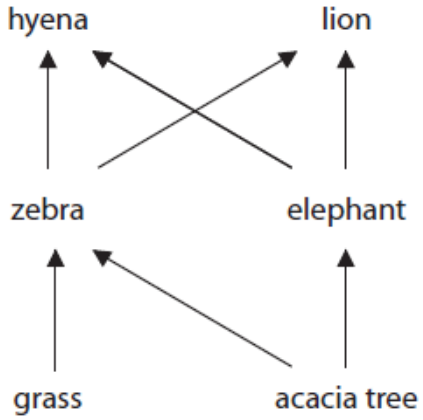
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(Total for question = 11 marks)

Q17.

The diagram shows a food web for a region in Africa.



(a) Use information from the food web to complete the table.

The first one has been done for you.

(3)

number of plants	2
number of primary consumers	
number of carnivores	
number of food chains	

(b) The flowers of the acacia tree produce nectar.

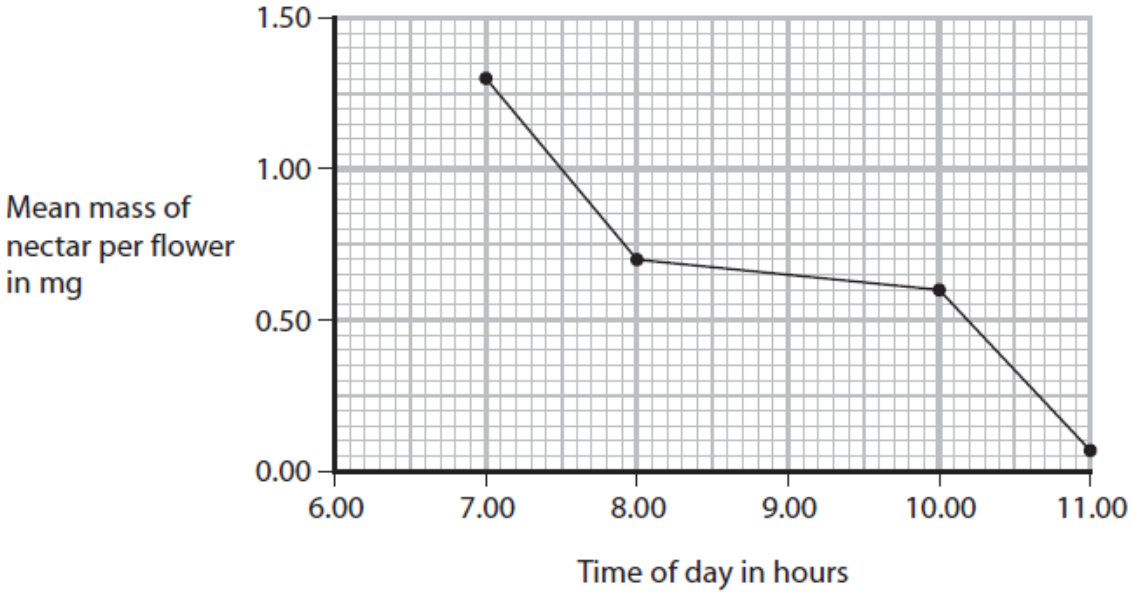
Give two other features you would expect to find in an acacia flower.

(2)

1 .....

2 .....

(c) The graph shows the decrease in the mean mass of nectar in flowers during one morning.



(i) Use the graph to calculate the greatest rate of decrease in the mean mass of nectar.

(2)

greatest rate = ... mg per hour

(ii) Give a reason why the mass of nectar decreases during the morning.

(1)

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(d) Acacia flowers produce a chemical that repels ants.

Suggest two advantages for the acacia plant of producing this chemical.

(2)

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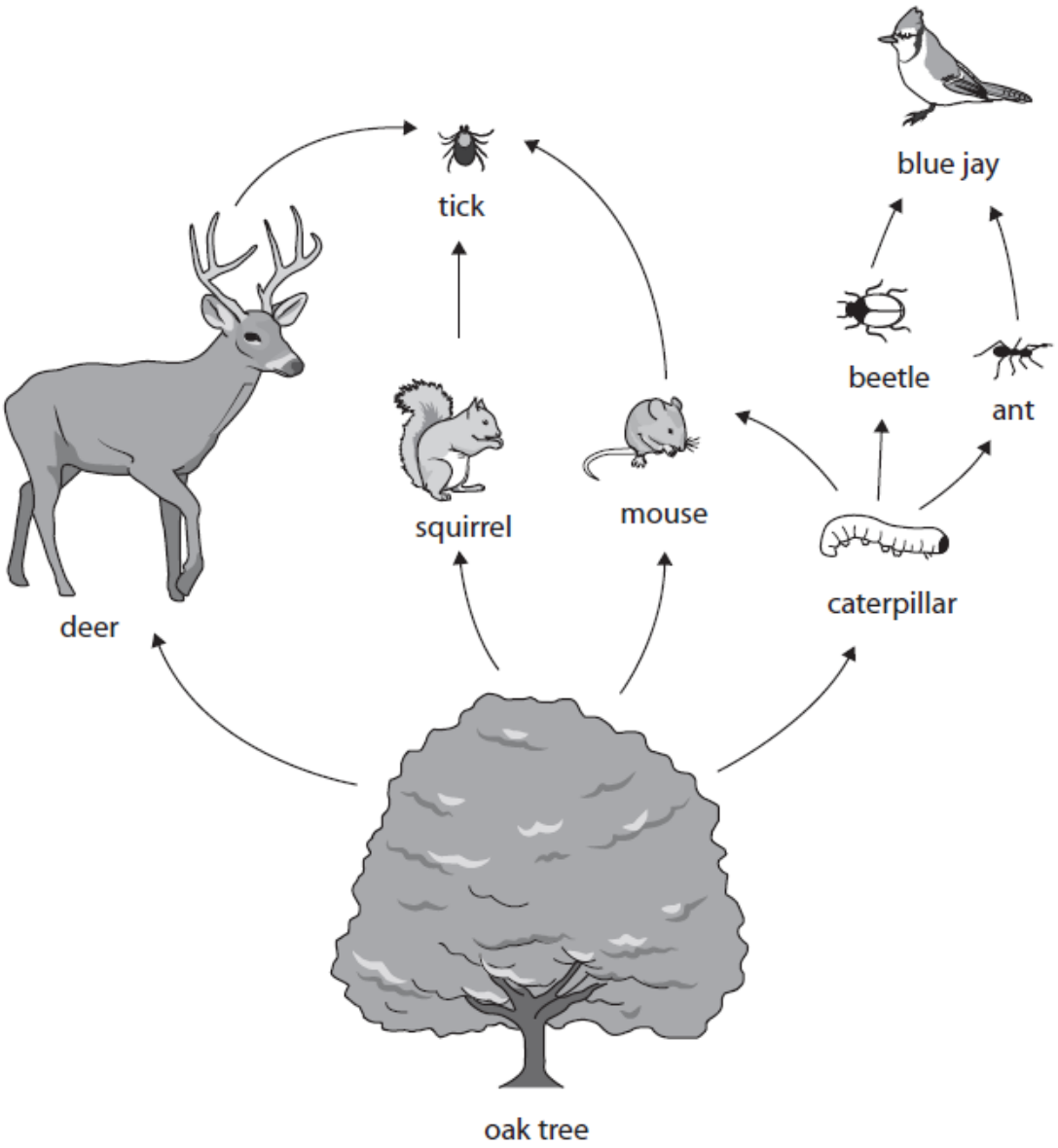
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(Total for question = 10 marks)

Q18.

The diagram shows part of a food web from a forest.



(a) From the food web, give a food chain that has four trophic levels and includes the mouse.

(1)

(b) The number of caterpillars in the forest decreases.

Explain what effect this would have on the mouse population.

(2)

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(c) Explain why the biomass of the oak tree is much greater than the total biomass of all of the organisms at the end of all of the food chains.

(3)

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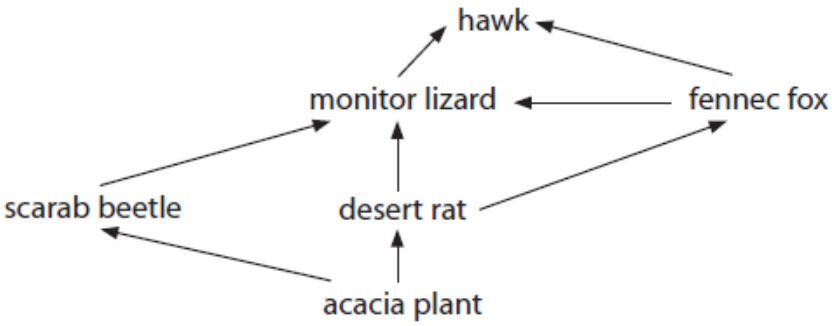
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(Total for question = 6 marks)

Q19.

The diagram shows part of a food web for a desert community.



(a) (i) How many organisms in this food web are secondary consumers?

(1)

☒ **A** 2

☒ **B** 3

☒ **C** 4

☒ **D** 5

(ii) Draw the longest food chain in this food web.

(1)

(iii) Explain why most of the energy in the producers is **not** transferred to the hawk.

(3)

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(b) The photograph shows a fennec fox.



(Source: anolis01.123rf.com/PAL)

Fennec foxes live in the Sahara Desert, which is very hot. They have very large ears and a thin body.

Explain how the body shape of the fennec fox has evolved by natural selection.

(4)

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(Total for question = 9 marks)

Q20.

The plants in a woodland are eaten by mice and caterpillars.

The mice also eat the caterpillars.

The mice are eaten by birds called owls.

(a) Draw a food web showing these feeding relationships.

(2)

(b) Give the term that describes the trophic level of a caterpillar.

(1)

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(c) The woodland covered a total area of 5 km^2.

A scientist investigates the number of mice and owls in the woodland.

He counts the number of mice and owls on the same summer day each year for five years.

The table shows the scientist's results.

Year	Number of mice per km²	Number of owls in entire woodland
1	2×10^3	10
2	2×10^3	12
3	3×10^3	12
4	5×10^3	16
5	1×10^3	14

(i) Calculate the number of mice in the total area of woodland in year 3.

(2)

number of mice = ...

(ii) Suggest why there were more mice in year 4 than in the other years.

(3)

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(iii) Suggest why the number of owls was fairly constant each year.

(2)

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(iv) Suggest a method you would use to estimate the number of mice in the woodland.

(3)

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(Total for question = 13 marks)