1. Sewage treatment works receive raw sewage.

This sewage contains food molecules, such as cellulose, starch, protein and fat.

(b) Explain how bacteria breakdown these nutrient molecules.

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..... [4]

The concentration of nitrate ions is often very high in the water leaving a sewage treatment works.

In some places, the water passes through a series of reed beds as shown in Fig. 5.2.

The water leaving the reed beds and entering the river contains very low concentrations of nitrate ions.

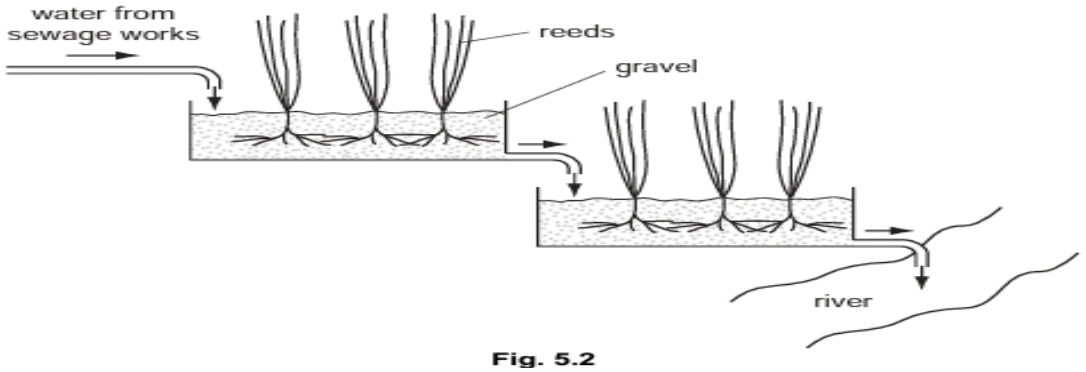

Fig. 5.2

(c) Explain **two** ways in which the concentration of nitrate ions may be reduced as the water flows through the reed beds.

.....

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..... [3]

(d) Some bacteria that live in reed beds release methane. Other sources of methane are cattle and flooded rice fields.

Explain the environmental consequences of an increase in the methane concentration in the atmosphere.

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..... [3]

(c) Some pesticides used against insects kill them on contact. Others are systemic pesticides.

Explain how these systemic pesticides kill insects.

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..... [2]

The membranes of root hair cells contain proteins for the absorption of ions.

(b) Describe how root hair cells are adapted for the absorption of ions.

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..... [3]

2. Sweet potato plants produce flowers to reproduce sexually. Sweet potato plants also reproduce asexually when shoots grow from the storage roots to form new plants.

Fig. 3.2 shows the life cycle of sweet potato. The diploid number of this species is 90.

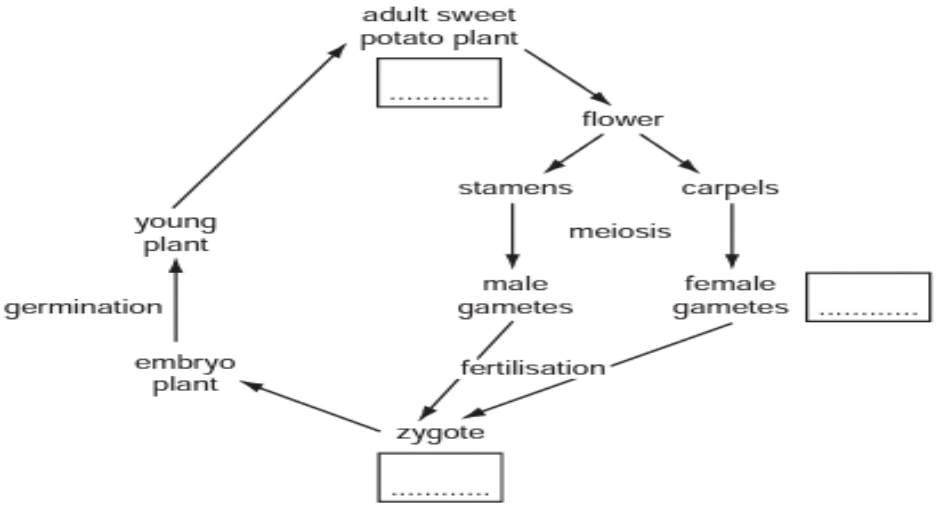

Fig. 3.2

(c) Complete Fig. 3.2 by writing the number of chromosomes in the three boxes. [2]

(d) State **two** advantages and **one** disadvantage of **asexual** reproduction for plants, such as sweet potato.

advantage 1 .....

.....

advantage 2 .....

.....

disadvantage .....

..... [3]

3. Sewage disposal involves the removal of human waste in pipes from houses to sewage treatment works.

Fig. 6.1 is a diagram that shows how sewage is treated.

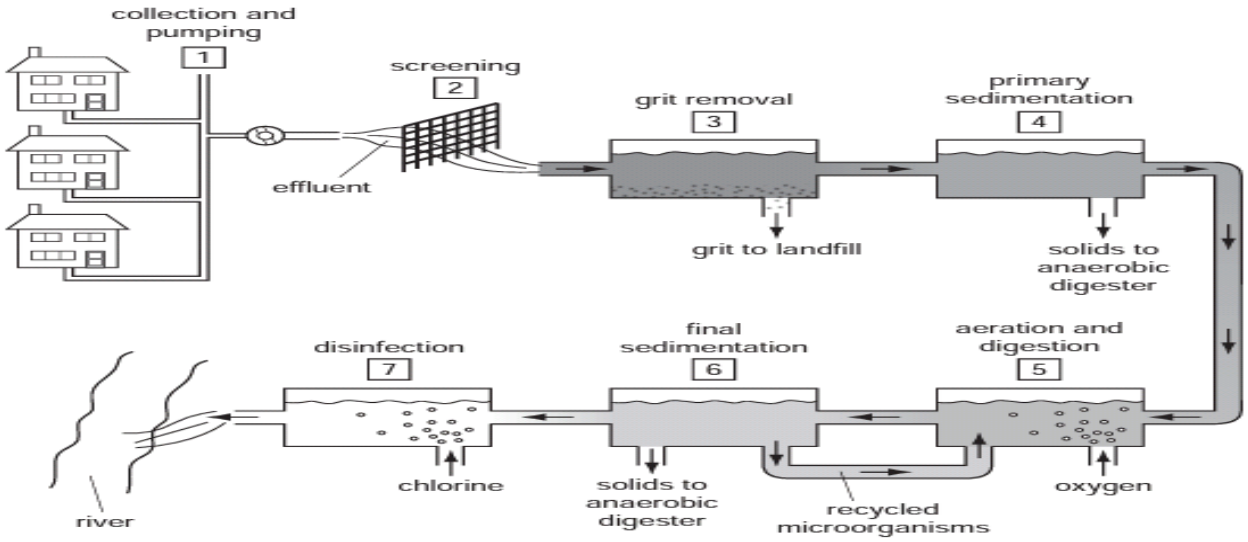

Fig. 6.1

(b) State why it is important that sewage is treated.

.....

.....

..... [1]

(c) At stage **5** in Fig. 6.1, oxygen and microorganisms are added.

Explain why oxygen is bubbled through the tank at this stage.

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..... [4]

(d) Suggest **and** explain the advantage of recycling microorganisms from stage **6** to stage **5** as shown in Fig. 6.1.

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..... [3]

(a) During stage **5** microorganisms break down organic matter consisting of cellulose, starch, protein and lipid (fat). The microorganisms multiply during this stage and are recycled.

Complete Fig. 6.2 by writing in the boxes the names of the enzymes used to catalyse the reactions shown. The first box has been completed for you.

Fig. 6.2 [3]

(d) Suggest **and** explain the advantage of recycling microorganisms from stage **6** to stage **5** as shown in Fig. 6.1.

.....

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.....

..... [3]

(e) Explain why chlorine is added at stage **7**.

.....

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..... [2]

[Total: 13]

4. Nitrogen is one of the most important chemical elements in the biosphere.
Nitrogen must be continually recycled if life is to continue on Earth.

Savanna grasslands are an important ecosystem in Africa.
Fig. 6.1 shows part of the nitrogen cycle in a grassland ecosystem in southern Africa.

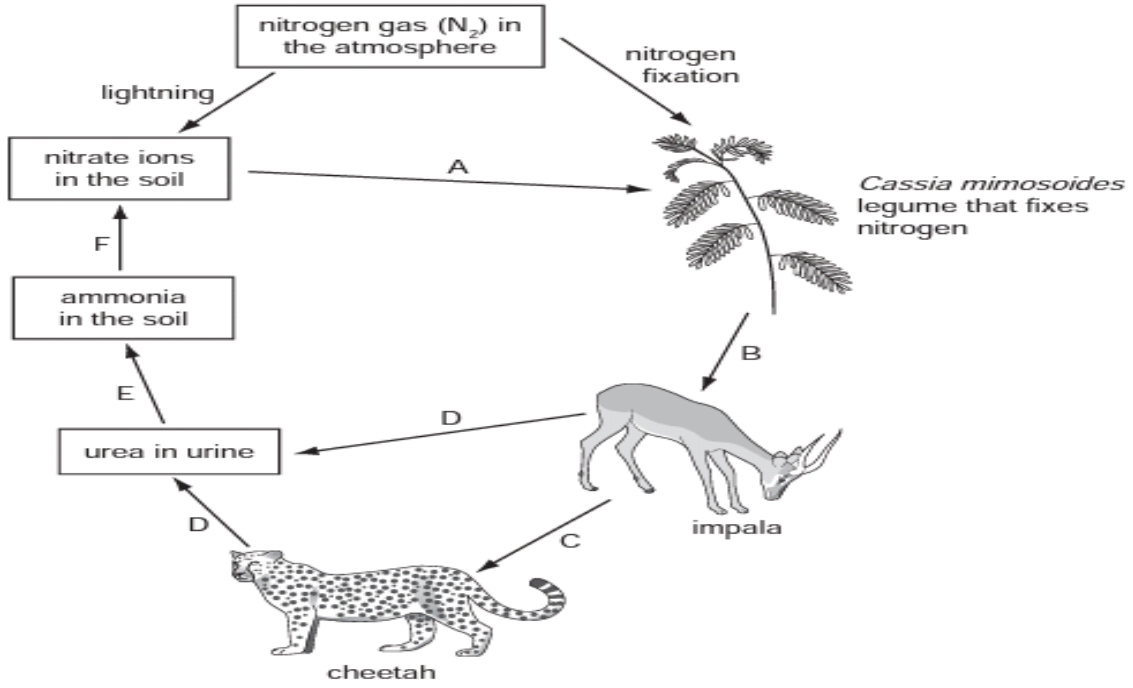

Fig. 6.1

(a) Name:

(i) a type of nitrogen-containing compound that is made by *Cassia mimosoides*, eaten by the impala and by the cheetah;

..... [1]

(ii) the type of consumer as represented by the cheetah;

..... [1]

(iii) the process by which urea is removed from the body of the animals as shown by **D**;

..... [1]

(iv) process **F**.

..... [1]

(b) Explain the importance of recycling nitrogen in ecosystems, such as the African savanna.

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..... [3]

(c) The most common plants that grow in the African savanna are grasses. There are very few legume plants, such as *C. mimosoides*.

Suggest reasons why *C. mimosoides* is a rare plant in the African savanna.

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..... [3]

(d) Explain why there are far fewer cheetah than impala.

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..... [4]

(e) The cheetah is an endangered species.

It is important to conserve their food supply and all the species that inhabit their ecosystem.

Explain why.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 17]

5 Marine conservationists are concerned that fish stocks in the sea are decreasing. Drastic measures will have to be taken to stop the extinction of many fish species.

Fig. 5.1 shows a marine food web. Tuna are large carnivorous fish that are an important human food. Dolphins may be caught in fishermen's nets and die.

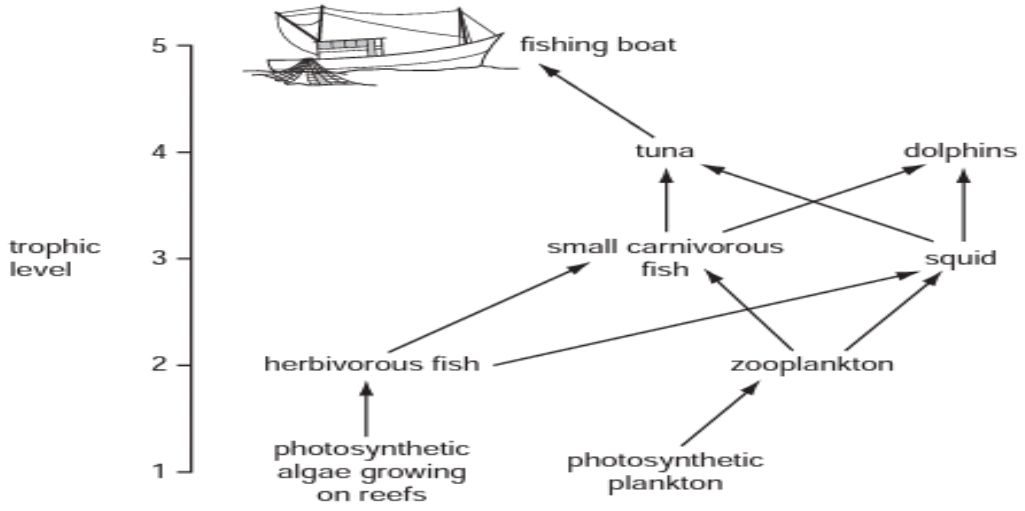

Fig. 5.1

(a) State the names given to trophic levels **1** and **3**.

1 .....

3 ..... [2]

(b) Explain why it is more energy efficient for humans to eat herbivorous fish rather than tuna.

.....

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.....

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.....

.....

..... [3]

(c) Explain why it is necessary to conserve animals, such as tuna and dolphins, which are at trophic level 4.

.....

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.....

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.....

.....

..... [4]

(d) Many seas are polluted by non-biodegradable plastics.

Suggest the likely effects of this pollutant on the marine environment.

.....

.....

.....

..... [2]

[Total: 11]

6 Lake Victoria is the largest tropical lake in the world. Until the 1960s it provided an ecosystem with habitats for 500 species of small cichlid fish. They feed on algae (aquatic plants). Prawns also feed on algae.
Nile perch were introduced into the lake. These fish are excellent food for humans, as well as providing sport for tourists. The Nile perch eat cichlids.
Deforestation of the lake shore and pollution by humans caused eutrophication and resulted in a huge reduction in cichlid numbers. However, the Nile perch are able to survive in poor quality water, even when the oxygen level is low. As the cichlid population dropped, prawn numbers increased and Nile perch now eat them.

(a) Define the term *ecosystem*.

.....

..... [2]

(b) Using information in the text above, state two reasons why Nile perch were introduced into Lake Victoria.

1. .....

.....

2. .....

..... [2]

(c) Complete the table to identify at which trophic level each of the organisms named in the text are feeding.

algae **cichlid fish** **human** **Nile perch** **prawn**

trophic level	**organism(s)**
producer	
herbivore	
carnivore	

[3]

(d) Explain how eutrophication could have resulted in a reduction in the numbers of cichlid fish.

.....

.....

.....

.....

..... [4]

[Total: 11]

7. Toads are amphibians. Only two species are native to Britain, the Common toad (*Bufo bufo*) and the Natterjack toad (*Bufo calamita*).
Natterjack toads like warm sandy soil in open and sunny habitats, with shallow pools for breeding. Examples of these habitats are heathland and sand dunes.
Common toads like cooler, more shady habitats, such as woodland.
Many areas of sand dunes are being developed for camp sites. Heathland can easily change to woodland as trees grow on it. In the summer, woodland is colder than heathland due to the shade the trees create.
These conditions suit the Common toad, but not the Natterjack. As a result of the changing habitats the Natterjack toad is becoming an endangered species.

(a) (i) Name **one** external feature that identifies an animal as an amphibian.

.....[1]

(ii) Amphibians are a class of vertebrate.
Name two other vertebrate classes.

1. .....
2. ..... [2]

(b) State **one** piece of information from the passage to show that the Common toad and Natterjack toad are closely related species.

.....
..... [1]

(c) From the information provided, state two reasons why Natterjack toads are becoming endangered.

1. .....
.....
2. .....
..... [2]

(d) Suggest measures that could be taken to protect the Natterjack toad from extinction.

.....
.....
..... [2]

Fig. 1.1 shows a food web for British toads.

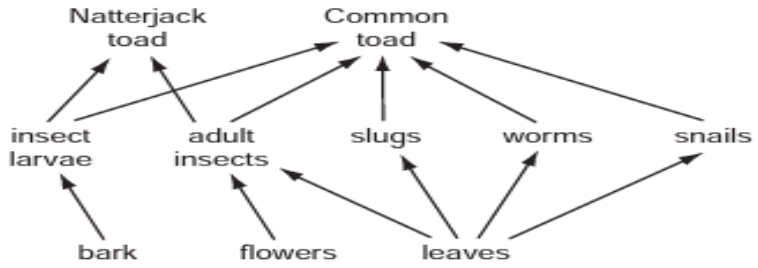

Fig. 1.1

(e) (i) State the trophic level of toads.

.....[1]

(ii) State which foods the two species of toad both eat.

.....[1]

(iii) With reference **only** to food, suggest why the Common toad is more likely to survive when the two species are in competition.

.....
..... [1]

[Total: 11]

8. In 2003, 25 000 square kilometres of Amazon rainforest were cut down and cleared. The land was then used for agriculture, producing beef and soya beans for export. However, within three years the land was no longer suitable for agriculture and had to be abandoned.

(a) (i) State the term used for cutting down and clearing areas of forest.

..... [1]

(ii) Complete Table 3.1, to state different reasons why forests are cut down. The first has been done for you.

Table 3.1

	reason
1	for agricultural land
2	
3	

[2]

(iii) Outline and explain the likely effects of clearing forests.

.....

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..... [6]

(b) Soya beans and beef produced on the land are both good sources of protein. Table 3.2 shows the nutritional content of products made from soya and beef.

Table 3.2

	nutritional content per 100 g of product			
product	energy / kJ	protein / g	saturated fat / g	fibre / g
corned beef	905	26.9	12.1	0.0
soya sausages	1128	19.0	2.1	2.0

(i) Using data from Table 3.2, state and explain two reasons why soya sausages may be healthier than corned beef as a major item in the diet.

1 .....

.....

.....

2 .....

.....

..... [4]

(ii) Soya beans are harvested from plants. Corned beef is produced from cattle that have fed on grass.

Explain why it is more energy efficient for humans to eat soya products as a source of protein than corned beef. Use the food chains involved to support your answer.

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..... [4]

[Total: 17]

9. Fig. 1.1 shows a food web in an ecosystem.

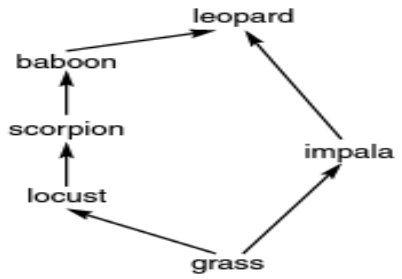

Fig. 1.1

(a) Define the following terms:

(i) *ecosystem*;

.....

.....[1]

(ii) *food web*.

.....

.....

.....[2]

(b) **(i)** Name the herbivores shown in the food web.

.....[1]

(ii) Suggest why it is difficult to state the trophic level to which the leopard belongs in this food web.

.....

.....[1]

(c) In some years, there are plagues of locusts.

State and explain the effect such a plague might have on numbers of

(i) impala;

.....

.....[1]

(ii) scorpions.

.....

.....[1]

(d) During one locust plague, although the baboons had more food, their numbers subsequently dropped.

(i) In terms of the food web, explain how this happened.

.....

.....

.....[2]

(ii) Suggest another reason, **not** related to the food web or hunting, for the drop in baboon numbers.

.....

.....[1]

(e) Leopards are sometimes hunted for their fur and other uses.

Suggest two reasons for banning the hunting of leopards.

1. .....

.....

2. .....

.....[2]

[Total : 12]

10. Fig. 2.1 shows pie charts of the diets of two twelve year old girls, one from Europe and one from Africa.

Fig. 2.1

(a) Using information from Fig. 2.1, complete the table to compare the African diet with that of the European diet.
In each box, write ***more*** or ***less*** or ***the same***.

	dairy products	cereals	meat, eggs, fish	sugar, sweets	vegetables, fruit
African diet contains					

[1]

(b) The daily energy intake is provided mainly by carbohydrates and fats.
Select **one** of the food groups from Fig. 2.1 that would provide a good source of:

(i) carbohydrates; .....

(ii) fats. .....[2]

(c) With reference to the pie charts:

(i) suggest why the African girl may not grow as fast as the European girl;

.....

.....[1]

(ii) suggest why the European girl is more likely to suffer from scurvy than the African girl;

.....

.....

.....[2]

(iii) suggest why the European girl is more likely to suffer from constipation and colon cancer than the African girl.

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.....[3]

[Total: 9]

11. Fig. 3.1 is a diagram of the water cycle.

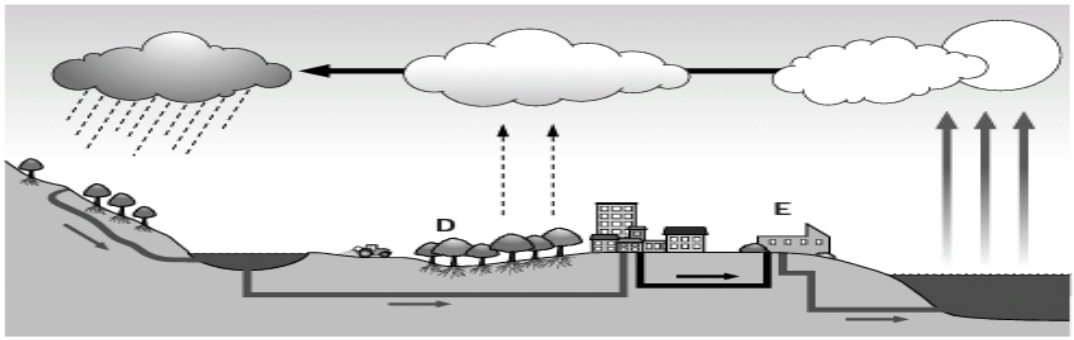

Fig. 3.1

(a) Water is a large component of the cells in the leaves of trees, as labelled **D** on Fig. 3.1.

Explain how water passes from a leaf cell to the atmosphere.

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..... [4]

(b) Explain how the loss of water from the leaves helps to move water from the roots to the leaves.

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..... [4]

(c) Explain how water enters the roots of the trees from the soil.

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..... [3]

(d) Fig. 3.1 shows a sewage treatment works, labelled **E**.

Describe **three** processes used in the treatment of sewage.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(e) Herbicides are used by farmers to control weeds.

Explain the environmental damage that may be caused by herbicides.

.....

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..... [3]

[Total: 17]

12. Sulfur dioxide (SO_2) can cause acid rain.

(a) Name **one** other pollutant that can cause acid rain.

.....[1]

(b) Describe the effects of acid rain on the environment.

.....

.....

.....

.....

.....

.....

.....[3]

(c) State **three** methods to reduce atmospheric SO_2 pollution.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

13. Moose, *Alces americanus*, shown in Fig. 6.1, are large herbivores that primarily live in northern parts of North America. They have a varied diet that includes young shoots of willow trees and aquatic plants.

Fig. 6.1

Isle Royale is a large island in Lake Superior in the United States where there is a population of moose that has been studied by ecologists for a long time. The animals' only predator is the wolf. The island has a population of wolves that has changed in numbers over the years.

(a) (i) Draw a food chain for the organisms in the passages above.

[2]

(ii) Complete Table 6.1 by stating the name and identifying the trophic level of each organism in the food chain.

Table 6.1

name of organism	trophic level

[3]

(iii) State **two** factors that influence the numbers of a top predator, such as wolves.

1 .....

2 .....

[2]

(b) In the 1970s, the American ecologist Paul Colinvaux investigated the energy flow between moose and wolves.

His results are summarised in Table 6.2.

Table 6.2

energy input or output or energy flow	energy / MJ
consumed by moose	4 320 000
respiration of moose	380 000
consumed by wolves	56 000
respiration of wolves	53 000

(i) Calculate the percentage of the energy obtained by the moose that is consumed by the wolves. Show your working.

..... % [2]

(ii) Explain why the number of wolves on Isle Royale has never risen above 50 while the highest number of moose recorded is 2450.

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.....[5]

[Total: 14]

14. Fig. 6.2 shows the causes of severe food shortages in the 1980s, 1990s and 2000s.

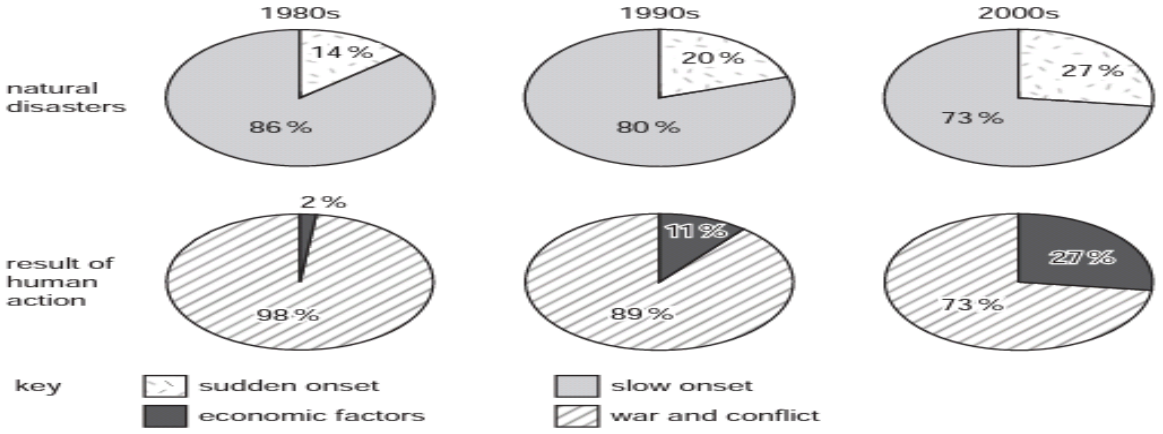

Fig. 6.2

(a) **(i)** State two types of natural disaster that occur suddenly and may lead to severe food shortages.

1. .....

2. ..... [2]

(ii) State **one** type of natural disaster that may take several years to develop.

..... [1]

(b) Use the information in Fig. 6.1 and Fig. 6.2 to **describe** the changes in food shortages between 1981 and 2007.

.....

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..... [5]

(c) Explain how the increase in the human population may contribute to severe food shortages.

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..... [3]

The quality and quantity of food available worldwide has been improved by artificial selection (selective breeding) and genetic engineering.

(d) Use a **named** example to outline how artificial selection is used to improve the quantity or quality of food.

.....

.....

.....

.....

.....

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.....

..... [4]

(e) Define the term *genetic engineering*.

.....

..... [1]

[Total: 16]

15. Some information about pollutants, their sources and their effects on the environment are shown in Table 1.1.

Table 1.1

pollutant	source	effect on the environment
heavy metals in chemical waste		disrupts functioning of plants, causes brain damage
phosphate		eutrophication of streams, rivers and lakes
sulfur dioxide		damage to trees, e.g. death of leaves
ionising radiation		
DDT	pesticide sprays	accumulates in tissues of animals

(a) Complete Table 1.1. [5]

(b) Explain what happens in streams, lakes and rivers when eutrophication occurs.

.....

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.....[5]

(c) Sulfur dioxide dissolves in rain water to form acid rain.

Describe **two** measures that can be taken to reduce the effects of acid rain.

1 .....

.....

2 .....

.....

[2]

[Total: 12]

16. Acid rain is a serious environmental problem in some areas of the world. Lakes in Canada, Norway and Scotland are highly acidic as a result of acid rain.

Fig. 4.1 shows a cause of acid rain.

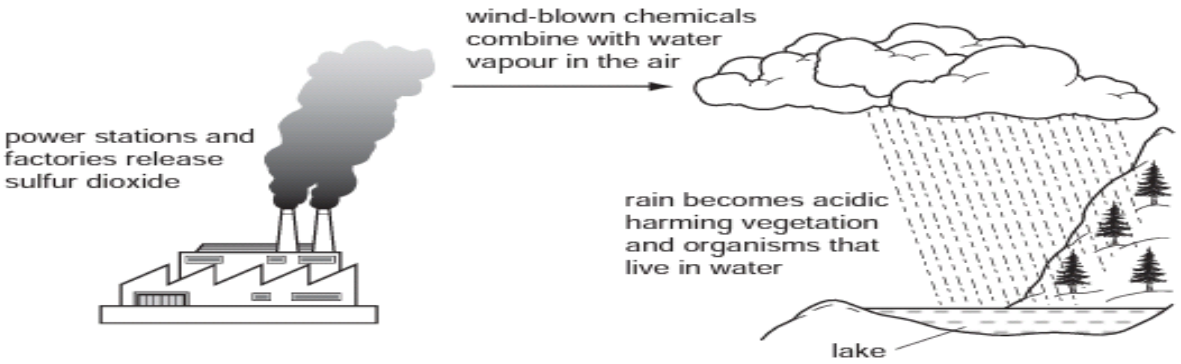

Fig. 4.1

(a) (i) State **one** cause of acid rain **other than that shown in Fig. 4.1**.

.....

.....

[1]

(ii) Describe two effects of acid rain on forest ecosystems.

1. .....

.....

2. .....

.....

.....

[2]

(b) Describe two different ways to reduce pollution so that there is less acid rain.

1. .....

.....

2. .....

.....

.....

[2]

17. Fig. 5.1 shows the processes involved in the manufacture of yoghurt.

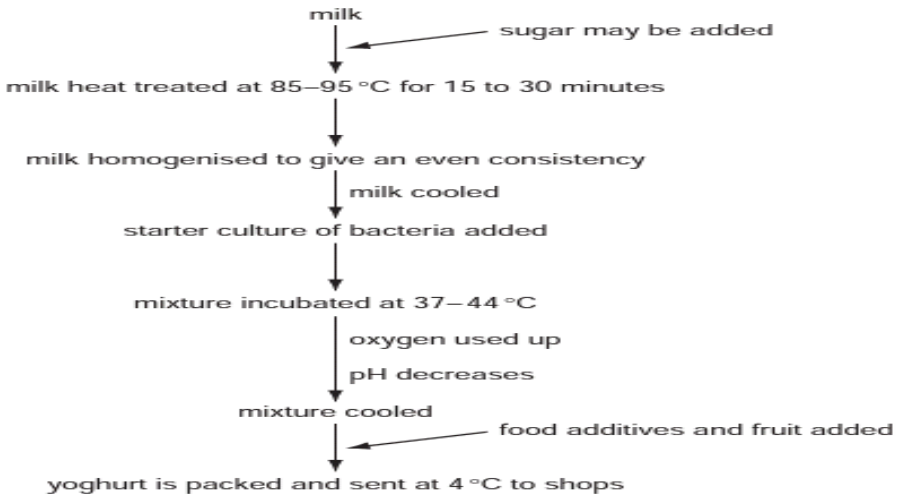

Fig. 5.1

(a) (i) Explain why the milk must be cooled before the bacteria are added.

.....

.....

.....

[2]

(ii) Explain why the pH decreases only **after** the oxygen in the milk has been used up.

.....

.....

.....

[2]

(iii) Suggest **one** type of food additive that could be added to yoghurt.

.....

[1]

18. **(a)** Explain why it is important to recycle paper rather than burn it.

.....

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.....

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.....

.....

..... [3]

When paper is recycled printing ink has to be removed.

Printing ink contains lipid-based compounds. The ink is removed by making the paper into a pulp and mixing it with lipase for several hours.

Scientists in India discovered that the marine bacterium, *Vibrio alginolyticus*, produces lipase. They carried out an investigation to find out whether using *V. alginolyticus* to remove ink from paper pulp was as effective as mixing it with a solution of lipase.

(b) The bacteria were found to be more effective at removing the ink from the paper pulp than using the solution of lipase.

Suggest why.

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..... [3]

(c) The scientists also investigated the effect of temperature on the ability of the bacteria to remove ink from paper pulp. They found that bacteria kept at high temperatures did not remove ink from the paper pulp.

Explain why.

.....

.....

.....

.....

..... [2]

[Total: 8]

19. In some countries forests are cleared by burning. This produces carbon dioxide and ash.

(a) Outline the environmental effects of an increase in carbon dioxide in the atmosphere as a result of burning forests.

.....

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.....

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.....

.....

.....

..... [4]

(b) The ash helps crops to grow because it is rich in minerals, such as magnesium ions, but it is deficient in nitrate ions.

Explain why nitrate ions and magnesium ions are important for plants.

.....

.....

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.....

.....

.....

.....

..... [4]

(c) When mineral ions from soils are washed into streams and rivers there is often a rapid growth of algae.

(i) State the name of the effect that is caused by adding mineral ions to streams and rivers.

.....

[1]

(ii) These streams and rivers often have low concentrations of dissolved oxygen. Explain why.

.....

.....

.....

.....

[2]

(d) Untreated domestic sewage contains organic waste as well as dissolved minerals.

Outline how sewage is treated so that the water may be recycled as drinking water.

.....

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[3]

[Total: 14]

20. An agricultural student investigated nutrient cycles on a farm where cattle are kept for milk. The farmer grows grass and clover as food for the cattle. Clover is a plant that has bacteria in nodules in its roots.

Fig. 6.1 shows the flow of nitrogen on the farm as discovered by the student. The figures represent the flow of nitrogen in kg per hectare per year. (A hectare is 10000 m^2.)

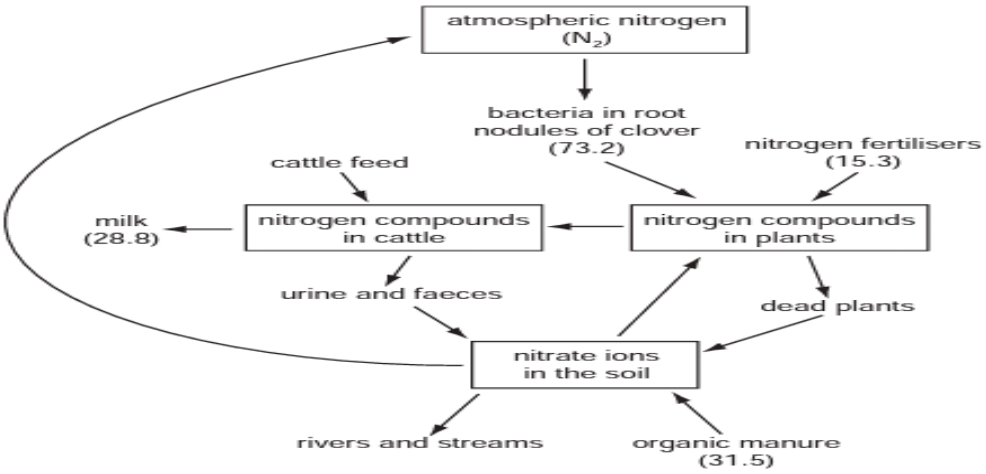

Fig. 6.1

(a) **(i)** Name the process in which bacteria convert atmospheric nitrogen into a form that is available to clover plants.

..... [1]

(ii) Name **two** processes that convert nitrogen compounds in dead plants into nitrate ions that can be absorbed by grass.

..... and ..... [2]

(b) The total quantity of nitrogen added to the farmer's fields is 120 kg per hectare per year.

Calculate the percentage of this nitrogen that is present in the milk.

Show your working.

Answer = ...% [2]

(c) State two ways in which the nitrogen compounds in the cattle's diet are used by the animals **other than to produce milk**.

1. .....

2. ..... [2]

(d) The student found that a large quantity of the nitrogen compounds made available to the farmer's fields was not present in the milk or in the cattle.

Use the information in Fig. 6.1 to suggest what is likely to happen to the nitrogen compounds that are eaten by the cattle, but are **not** present in compounds in the milk or in their bodies.

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.....

[5]

(e) The carbon dioxide concentration in the atmosphere has increased significantly over the past 150 years.

Explain why this has happened.

.....

.....

.....

..... [2]

[Total: 14]

30. The red slender loris, *Loris tardigradus*, is a nocturnal mammal that feeds at night on flowers, fruit and a variety of small animals. It is found in forest ecosystems in South Asia.

Fig. 3.1 shows a red slender loris.

Fig. 3.1

(a) Explain the meaning of the term *ecosystem*.

.....

.....

.....

..... [2]

(b) State three ways in which mammals, such as the red slender loris, differ from other groups of vertebrates.

1 .....

2 .....

3 ..... [3]

(c) The large eyes of the red slender loris show that it is well adapted for a nocturnal way of life.

Suggest other features that the animal is likely to have that are adaptations to being active at night.

.....

.....

.....

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..... [2]

Two species of slender loris are found in Sri Lanka, the grey slender loris, *L. lydekkerianus*, and *L. tardigradus*.

The International Union for Conservation of Nature describes the red slender loris as endangered. Horton Plains National Park in Sri Lanka is one of the few places where *L. tardigradus* is found.

(d) Discuss why areas of land, such as the Horton Plains National Park, must be conserved.

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(e) State how scientists could show that two populations of slender loris belong to the same species or to two different species.

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..... [1]

[Total: 12]

31. Fig. 5.1 shows vehicles driving past a power station in Namibia and women carrying firewood they have cut.

Fig. 5.1

(a) Describe how an increase of carbon dioxide in the atmosphere can affect the environment.

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(b) Without further reference to carbon dioxide, explain how each of the following may have undesirable effects on the environment:

(i) the power station;

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.....[3]

(ii) cutting down trees and burning the wood;

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.....[3]

(iii) running motor vehicles such as the van or car.

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.....[3]

[Total : 11]