PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 4: ECOLOGY AND THE ENVIRONMENT (PACK 1)

SCORE	PERCENTAGE
/205	%

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Q1.

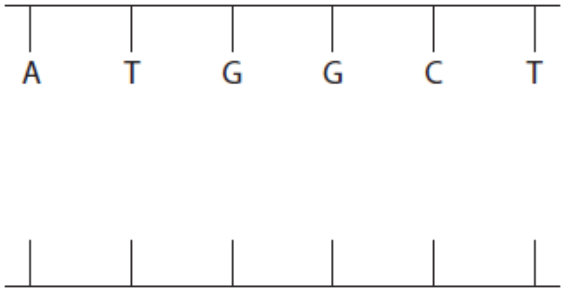
Decomposer bacteria are involved in the nitrogen cycle.

The bacteria release an enzyme called urease.

(a) The diagram shows part of one strand of DNA used to make urease.

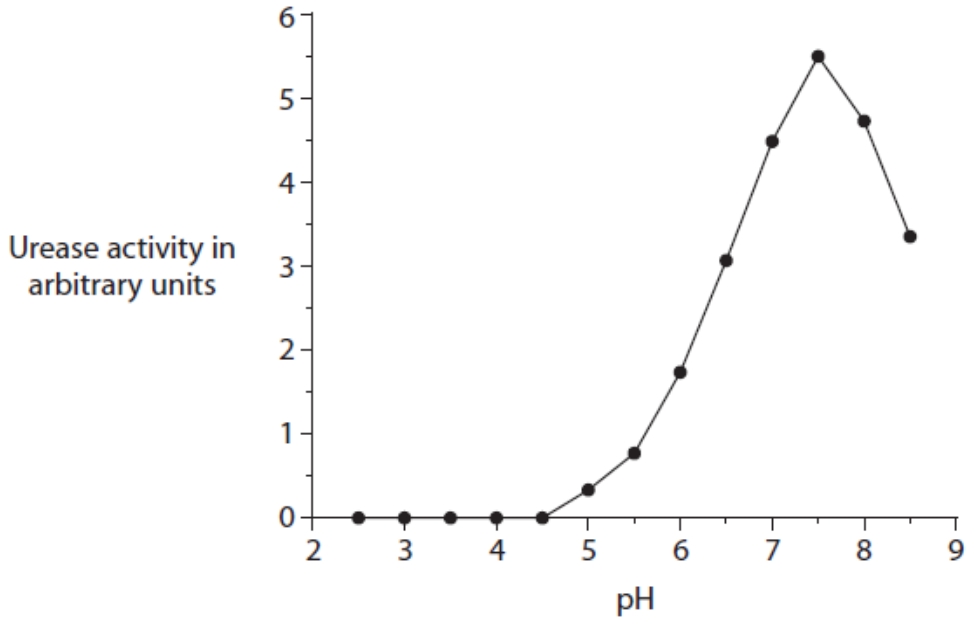
Complete the diagram by giving the missing bases on the other strand of DNA.

(1)



(b) Urease acts on urine to produce ammonia.

The graph shows how pH affects the activity of urease.



(i) Which of these is the optimum pH for urease?

(1)

☒ **A** 2.5

☒ **B** 4.5

☒ **C** 7.5

☒ **D** 8.5

(ii) Explain the activity of urease at pH 8.5

(2)

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(c) Describe the role of the other bacteria involved in the nitrogen cycle.

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(Total for question = 9 marks)

Q2.

The biodiversity in an ecosystem can be determined by counting the number of different species present and the number of individuals of each species present.

(a) Give the term that describes the number of individuals of one species present in a habitat at one time.

(1)

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(b) Students compared the biodiversity of two fields, A and B.

They determined the number of individual plants of three species in each field.

They also calculated the percentage of each species of plant compared to the total number of plants of all three species for each field.

The table shows the results.

Species	Field A		Field B	
	Number of each plant	Percentage (%) of each species	Number of each plant	Percentage (%) of each species
daisy	19	76	15	
dandelion		16	18	38
buttercup		8	14	30
total	25	100	47	100

(i) Complete the table by calculating the missing values.

(2)

(ii) Explain which field has the greater biodiversity.

(2)

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(c) Explain how a shortage of one named mineral could affect the size of plants in the fields.

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(Total for question = 7 marks)

Q3.

Deforestation is the cutting down of trees.

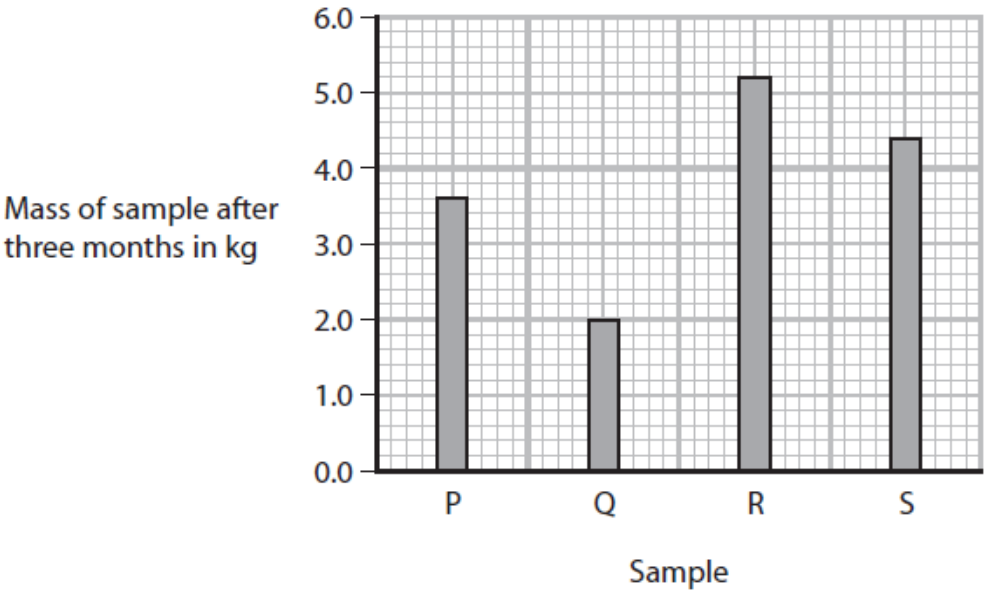
After deforestation many dead leaves are left on the forest floor.

A student investigates the decomposition of these leaves.

This is her method.

- collect four samples of dead leaves each with a mass of 6.0 kg
- label the samples P, Q, R and S
- cut sample P into small pieces and keep at 10 °C
- cut sample Q into small pieces and keep at 20 °C
- do not cut sample R and keep at 10 °C
- do not cut sample S and keep at 20 °C
- measure the mass of each sample after three months

The graph shows her results.



(a) Explain the results obtained by the student.

(4)

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(b) Calculate the difference between the rate of decomposition in sample P and the rate of decomposition in sample Q.

(3)

Give your answer in kg per month.

difference = ... kg per month

(c) The student needs to control biotic variables in her investigation.

Give two biotic variables she should control.

(2)

1 .....

2 .....

(Total for question = 9 marks)

Q4.

(a) The diagram shows one strand of DNA from a section of a gene.

ATTCCGAGT

What would be the complementary sequence of bases on the messenger RNA produced from this strand of DNA?

(1)

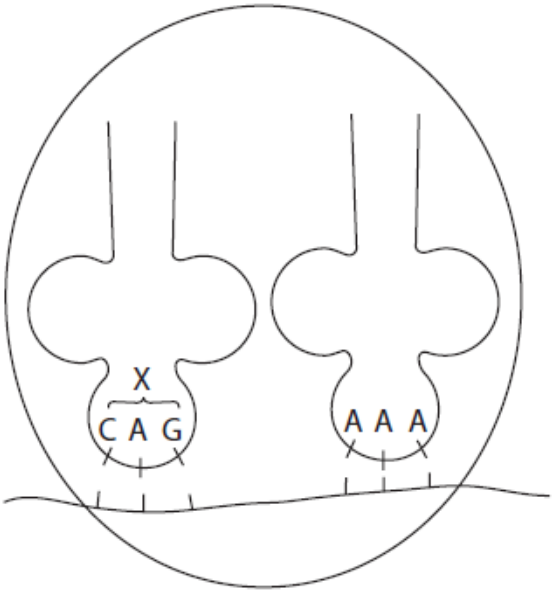
☒ **A** TAAGGCTCA

☒ **B** ATTCCGAGT

☒ **C** UAAGGCUCA

☒ **D** AUUCCGAGU

(b) The diagram shows a stage during protein synthesis.



Which row gives the correct names for the stage of protein synthesis shown and the sequence of bases labelled X?

(1)

	Stage of protein synthesis	X
☒ A	transcription	anticodon
☒ B	transcription	codon
☒ C	translation	anticodon
☒ D	translation	codon

(c) Explain how a mutation in a gene can affect the phenotype of an organism.

(3)

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(d) In an accident at a nuclear power station, radioactive material was released into the surrounding areas of land.

Scientists investigated the impact of this on a species of butterfly.



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

Samples of adult butterflies were collected from an area near the power station two months after the release of the radioactive material.

The percentages of butterflies with abnormalities were calculated.

The butterflies were then mated in the laboratory and the percentage of offspring with abnormalities calculated.

The experiment was repeated with butterflies collected from the same area, 10 months after the release of the radioactive material.

(i) Describe how the scientists could have sampled the population of butterflies in the area.

(3)

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(ii) The results of the investigation are shown in the table.

Butterfly generation	Percentage of butterflies with abnormalities	
	two months after the accident	ten months after the accident
adult	12.4	28.1
offspring	18.3	60.2

The scientists concluded that the increased level of radioactivity has led to an increased rate of mutation of DNA.

Discuss the scientists' conclusion referring to data from the table to support your answer.

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(Total for question = 13 marks)

Q5.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Badgers and bovine tuberculosis

The bacterium *Mycobacterium bovis* causes the lung disease bovine tuberculosis (TB) in cattle. Infected cattle have damaged lungs, which causes gas exchange problems and makes them cough into the air. The pathogen spreads to humans if they inhale air containing the bacterium. Humans also become infected if they drink unpasteurised milk from infected cattle. Milk is usually pasteurised by heating it for a period of time at a high temperature.

Bovine TB can kill humans. In one year, 13 400 people died from a total of 149 000 reported cases of TB. Some of these cases were from Europe, where 103 people died from 1290 reported cases. The rest of the cases were from outside Europe.

Some farmers in the United Kingdom are concerned that badgers spread the TB pathogen to cattle.

The photograph shows a badger.



Badgers act as a reservoir for the TB pathogen and can live for several years without showing any signs of TB. Some farmers want badgers to be culled (killed) to stop the spread of bovine TB to cattle.

However, some scientists claim that only a fraction of cattle catch TB from badgers, and that culling badgers could spread the disease to new areas. This is because badger culling changes the behaviour of the badgers that survive. Normally, badgers live in social groups and will defend their territory from other badgers by being aggressive. This territorial behaviour reduces the spread of disease between groups. If badgers are culled, then their territories cannot be defended. Surviving badgers could move in to occupy the undefended territory, bringing TB with them. This could spread TB to new animals and new areas.

Some people believe that badgers should be vaccinated to stop the spread of TB. However, there is some concern that vaccination may increase the spread of TB because it might also change badger behaviour.

An investigation is needed to find out if badger vaccination can reduce TB both in badgers and in cattle.

(a) Explain why cattle with damaged lungs have gas exchange problems (lines 2 to 3).

(2)

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(b) Explain the advantage of drinking pasteurised milk rather than unpasteurised milk (lines 4 to 5).

(2)

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(c) Suggest two reasons why there were fewer cases of bovine TB in Europe compared with outside Europe (lines 7 to 9).

(2)

1 .....

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2 .....

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(d) The case to death ratio in Europe is 12.5 : 1 (lines 7 to 9).

Calculate the case to death ratio from outside Europe.

(2)

case to death ratio = ...

(e) Territorial behaviour reduces the spread of disease between badger groups (lines 19 to 20).

Suggest two other ways that badgers benefit from territorial behaviour.

(2)

1 .....

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2 .....

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(f) Explain how vaccination reduces the risk of infection in badgers (line 24).

(3)

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(g) Describe how scientists could find out if badger vaccination reduces TB in cattle (lines 27 to 28).

(3)

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(Total for question = 16 marks)

Q6.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Global warming and the Great Barrier Reef

The Great Barrier Reef is found in the sea off the North-East coast of Australia. It is the largest coral reef in the world.



Coral reefs are underwater ecosystems. Coral grows best on rock found in shallow, clear moving water. The coral is made from a hard calcium shell that contains small animals. Inside the bodies of these animals there are microscopic organisms called algae. These animals and algae have a mutualistic relationship. In a mutualistic relationship, both species benefit by living together.

A scientific study found that higher sea temperatures in 2016 caused the worst destruction of corals ever recorded on Australia's Great Barrier Reef. Many scientists believe that the increase in sea temperature is the result of an increase in carbon dioxide in the atmosphere.

About 70% of coral died in the northern section of the reef. One of the worst-hit areas was around Lizard Island in North Queensland, where almost 90% of the coral died. The situation was better in the central section, where only about 5% died. The southern section of the reef was healthy. Scientists warn that recovery of the coral reefs will be difficult if climate change continues.

Some coral death is the result of overheating. However, far more coral has been lost through bleaching. Coral bleaching happens when sea temperatures rise for a long period of time. The algae cannot survive so the coral starves. The pigments in the algae give coral its colour. After bleaching, the coral appears white because it is now without the colourful algae that provide its main source of energy.

Some coral survives the higher sea temperatures. However, another study has found that this coral has now come under increased threat from predators such as snails and the crown-of-thorns starfish.

Scientists are hopeful that the reef is capable of recovery, but fear it may not have an opportunity as sea temperatures continue to rise. The Australian Government has published recommendations in a long-term sustainability plan for the coral reef.

(a) What is meant by the term **ecosystem** (line 3)?

(2)

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(b) Suggest how the mutualistic relationship between the small animals and the algae inside them is of benefit to both species (lines 6 and 7).

(2)

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(c) (i) Explain why coral grows best in shallow, clear water (lines 3 and 4).

(2)

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(ii) Suggest why coral grows best in moving water (lines 3 and 4).

(2)

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(d) Suggest how scientists are able to find the percentage of coral that has died in a section of the reef.

(3)

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(e) Give one reason why coral that survives higher sea temperatures is under increased threat from predators (lines 22 to 24).

(1)

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(f) Suggest what recommendations should be included in the sustainability plan for the coral reef (lines 26 and 27).

(3)

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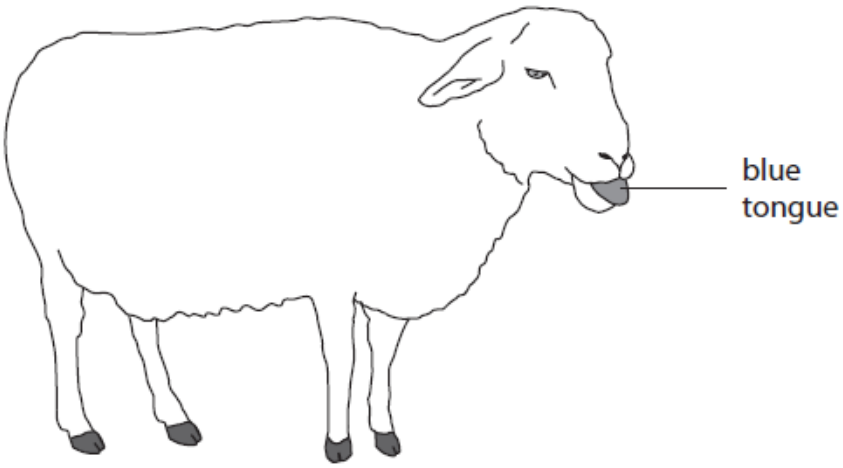
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(Total for question = 15 marks)

Q7.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Bluetongue disease in sheep



Global warming can lead to biological consequences. Some insects are vectors for disease. These insects can move to habitats that were previously too cold for their survival. These insects spread diseases, such as malaria, when they feed on the blood of animals that they bite. Warmer air temperatures increase the rate at which insects reproduce, as well as increasing the number of times that the insects bite animals to feed on their blood.

Bluetongue is a disease that affects sheep. It is common in countries in southern Europe, but was not found in the UK until 2007. The disease has been found in sheep further north in the UK since 2007. Bluetongue is caused by a virus that is spread by a small insect, called a midge. Although there are about 995 species of midge, only 20 species are vectors for the bluetongue virus.

One symptom of bluetongue is fever. When a sheep has a fever, its body temperature rises. If the sheep's temperature becomes very high, it can affect enzymes in sheep cells, which can lead to the death of the sheep. Sheep do not sweat, but can lower their body temperature by panting. Panting involves blowing air out of the lungs over the tongue. Another symptom is swelling of the lips and the tongue, which change colour from pink to blue. The blue colour is caused by reduced blood circulation, and it gives the disease its name.

Bluetongue is difficult to treat. It is possible to prevent the disease by vaccination or by controlling the midge vector. The disease can also be controlled by quarantining infected sheep. This involves keeping the infected sheep indoors, away from other sheep.

The cabins of aircraft arriving from other countries are often sprayed with insecticide to kill any insects that may have been present.

(a) The spread of bluetongue may be one consequence of global warming (line 1).

Explain one other biological consequence of global warming.

(2)

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(b) Suggest how the midge acts as a vector (line 1).

(1)

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(c) Explain why sheep with bluetongue need to pant (line 14).

(2)

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(d) Give **one** reason why bluetongue was not found in the UK before 2007 (line 7).

(1)

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(e) Calculate the percentage of midge species that are vectors of the bluetongue virus (line 10).

(2)

percentage = ... %

(f) Explain why the lips of sheep with bluetongue turn blue (line 16).

(2)

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(g) Explain how vaccination could protect a sheep from bluetongue (line 19).

(3)

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(h) Explain how quarantine could protect sheep from bluetongue (line 20).

(2)

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(Total for question = 15 marks)

Q8.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Supercharging plants to reduce global warming

The proportion of carbon dioxide in the atmosphere has increased in the last 100 years. In 2020, a mass of 727 gigatonnes of carbon dioxide was released into the atmosphere from natural processes, along with a mass of 37 gigatonnes from human activities. Scientists have estimated that plants naturally remove a mass of 746 gigatonnes of carbon dioxide from the atmosphere every year. The difference between what is removed and what is released causes atmospheric carbon dioxide to rise every year. Carbon dioxide is a greenhouse gas, and a significant rise will cause global warming.

To help solve the problem of rising concentrations of atmospheric carbon dioxide, scientists are planning to produce transgenic, supercharged plants that can remove atmospheric carbon dioxide and store it in their roots. The scientists estimate that if these plants can be developed, the plants could remove a mass of carbon dioxide equivalent to 50% of the emissions from human activities.

Coastal plants that have their roots in seawater contain a substance called suberin in the cell walls of the outer layer of the roots. Suberin is a waterproof substance that contains a high proportion of carbon atoms. Suberin is decomposed very slowly so remains in the soil for a long time.

The photograph shows a coastal plant called a mangrove.



(Source: © Snow At Night/Shutterstock)

To produce the supercharged plants, scientists intend to take the gene that codes for high suberin production from a coastal plant and insert it into crop plants. The crop plants used are perennial plants. Perennial plants live for many years rather than dying each winter. The transgenic crops would take in large amounts of carbon dioxide and use the carbon atoms to make suberin. The carbon would then be locked up and stored as suberin in the roots. After successfully producing one plant, they will use micropropagation rather than pollination to produce others.

These supercharged crop plants may have other uses. Suberin in roots helps to make them tolerant to soil with a high salt concentration, helping to produce higher crop yields in areas that have difficult growing conditions.

(a) (i) Carbon dioxide is a greenhouse gas.

State the name of another greenhouse gas (line 7).

(1)

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(ii) Calculate the increase in mass, in kg, of atmospheric carbon dioxide in 2020 (lines 2 to 7).

Give your answer in standard form.

[1 gigatonne = 1 000 000 000 000 kg]

(3)

Increase in mass = ... kg

(iii) State two consequences of global warming for the environment.

(2)

1 .....

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2 .....

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(b) Explain why producing genetically engineered plants with additional suberin in their roots could reduce atmospheric carbon dioxide (lines 14 to 17 and lines 19 to 24).

(4)

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(c) Which enzyme is used to remove a gene from a section of DNA?

(1)

☒ **A** amylase

☒ **B** ligase

☒ **C** lipase

☒ **D** restriction

(d) Explain why the additional suberin in the cell walls of the roots will make the transgenic plants tolerant to soil with a high salt concentration (lines 26 to 28).

(2)

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(e) Give three reasons why the scientists use micropropagation to reproduce the transgenic crop plants (lines 24 to 25).

(3)

1 .....

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2 .....

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3 .....

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(Total for question = 16 marks)

Q9.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Plastic pollution

A mass of 12.7 million tonnes of plastic is dumped into our oceans every year. This is equivalent to the mass of 1.8 million adult elephants. This plastic pollution is a concern because of its harmful effect on living organisms.

Turtles eat plastic bags, mistaking them for jellyfish, and sea birds have been found with stomachs full of plastic. Researchers have reported 800 kg of plastic found in the carcass of a stranded whale in France. The stomach of another whale in Australia contained six square metres of plastic sheeting and 30 plastic carrier bags. Plastic items can block the tubes leading from the mouth to the stomach and to the lungs in some animals. This can cause death because it affects digestion and gas exchange.

Whale sharks are the largest fish in the world, yet feed on microscopic plankton that photosynthesise. The plankton is also eaten by crustaceans, which are then eaten by fish. These fish are eaten by humans. Many whales are filter feeders. They swallow hundreds of cubic metres of water a day to capture plankton and may take in microplastics during the process. The microplastics are produced from the breakdown of larger pieces of plastic. Microplastics are similar in size and mass to many types of plankton. These microplastics are not biodegradable and build up in the bodies of organisms that occupy higher trophic levels in food chains. This is called bioaccumulation.

Plastic pollution may be responsible for putting filter feeding whale sharks and other filter feeders at risk of extinction. The whale shark, for example, is listed as being endangered.

Studies have found toxic chemicals associated with plastics in the bodies of large filter feeders. Scientists think these chemicals might reduce the population sizes of the large filter feeders. This is because the toxins might affect many biological processes involving hormones that regulate the body's growth and development, metabolism, and reproduction.

Whale sharks feeding in the Sea of Cortez near Mexico, an important breeding ground, ingest 200 microplastic particles per day. Fin whales in the Mediterranean Sea ingest 2000 microplastic particles per day. Any reduction in the reproduction of these species will have consequences for biodiversity.

Attempts are being made to reduce the use of plastic. Coffee companies are being encouraged to use wooden spoons and straws rather than plastic ones. Also, shoppers are being given biodegradable plastic bags, or paper bags.

(a) (i) Which organism named in the passage is a producer?

(1)

☒ **A** crustaceans

☒ **B** microscopic plankton

☒ **C** sea birds

☒ **D** turtles

(ii) Which organism named in the passage is a tertiary consumer?

(1)

☒ **A** crustaceans

☒ **B** fin whale

☒ **C** human

☒ **D** whale shark

(b) Explain how blocked tubes leading from the mouth can lead to death in some animals. (lines 8 to 10)

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(c) Suggest why bioaccumulation of microplastics is a problem for humans. (lines 17–20)

(2)

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(d) Calculate the difference between the number of plastic particles ingested in a year by a fin whale and a whale shark. (lines 29–31)

Give your answer in standard form.

(3)

difference = ...

(e) Explain the effects of reduced reproduction on biodiversity. (lines 31–32)

(2)

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(f) Suggest a benefit of using biodegradable plastic bags. (line 35)

(2)

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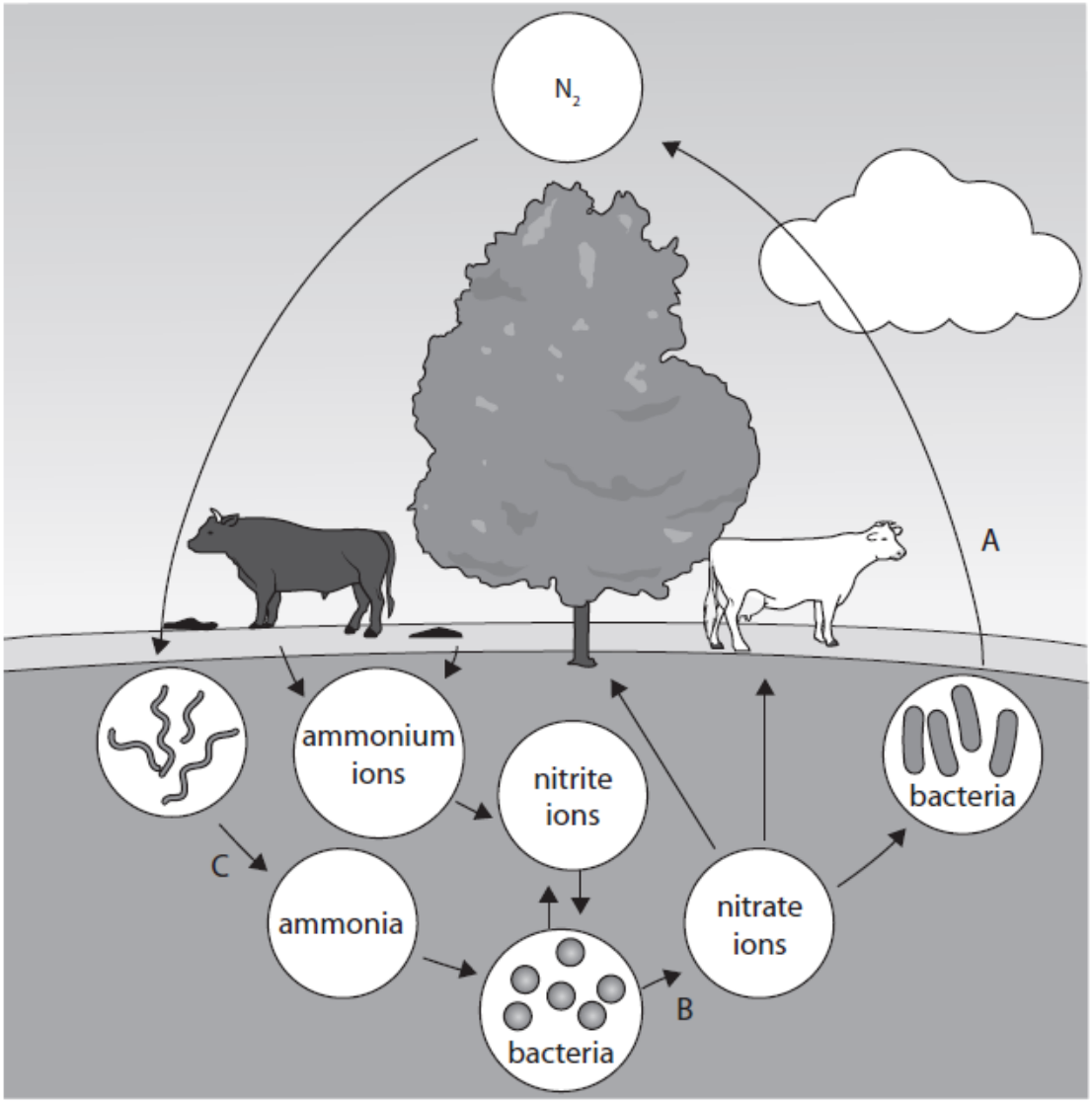
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(Total for question = 16 marks)

Q10.

The diagram shows some parts of the nitrogen cycle.



(a) Name the processes labelled A, B and C.

(3)

A .....

B .....

C .....

(b) The mass of nitrogen that moves within the nitrogen cycle has been estimated and some of the masses are given in the table.

Process	Mass of nitrogen per year in $g \times 10^{12}$
released into atmosphere by burning of biomass	40
removed from atmosphere for manufacture of fertiliser	120
released into atmosphere by denitrification	100
removed from atmosphere by nitrogen fixation	58
removed from atmosphere by lightning	5
released into atmosphere in the form of ammonia	60
released into atmosphere as oxides of nitrogen	5
removed from atmosphere by deposition of oxides of nitrogen	70

(i) Some of these processes remove nitrogen from the atmosphere.

Calculate the total mass of nitrogen removed from the atmosphere by these processes.

Give your answer in standard form.

(2)

mass = ... g

(ii) Calculate the percentage of the nitrogen released into the atmosphere that comes from burning of biomass.

(2)

percentage = ...

(iii) Explain how burning biomass returns nitrogen to the atmosphere.

(2)

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(c) Explain the effect of nitrous oxide on global warming.

(2)

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(Total for question = 11 marks)

Q11.

Pyramids of biomass and energy transfer are ways of representing what happens in an ecosystem.

(a) Diagram 1 shows pyramids of biomass for a crop field ecosystem and for a coral reef ecosystem.

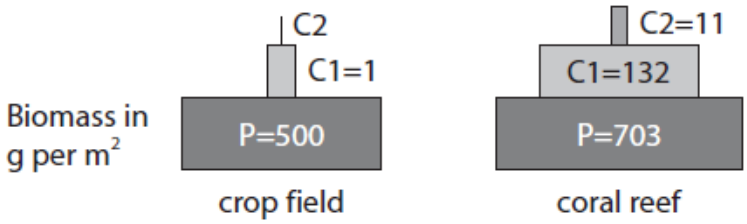


Diagram 1

(i) Use data from Diagram 1 to calculate the efficiency of the transfer of biomass from producers (P) to primary consumers (C1) in the coral reef.

(1)

producer to primary consumer = ... %

(ii) The efficiency of the transfer of biomass from primary consumers (C1) to secondary consumers (C2) in the crop field is 1%.

Calculate the biomass of the secondary consumers in the crop field in g per m^2.

(1)

biomass = ... g per m^2

(iii) Suggest why the biomass transfer is different in the coral reef compared to the crop field.

(1)

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(b) Diagram 2 shows pyramids of biomass for an ocean and a lake.

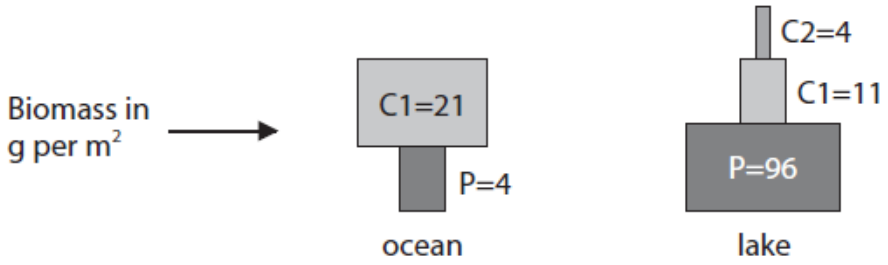


Diagram 2

Explain the shape of the pyramid of biomass for the ocean.

(2)

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(c) Suggest how scientists could estimate the energy of the producers in 1 m^2 of the crop field.

(2)

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(Total for question = 7 marks)

Q12.

Fish farming is often used to produce protein rich food.

(a) Selective breeding is often used to produce fish that grow rapidly and do not waste much food.

Explain how selective breeding can be used to produce fish that grow rapidly.

(2)

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(b) Fish farming systems can often release ammonia into the water. The ammonia is converted into nitrates.

Describe how ammonia is converted into nitrates.

(2)

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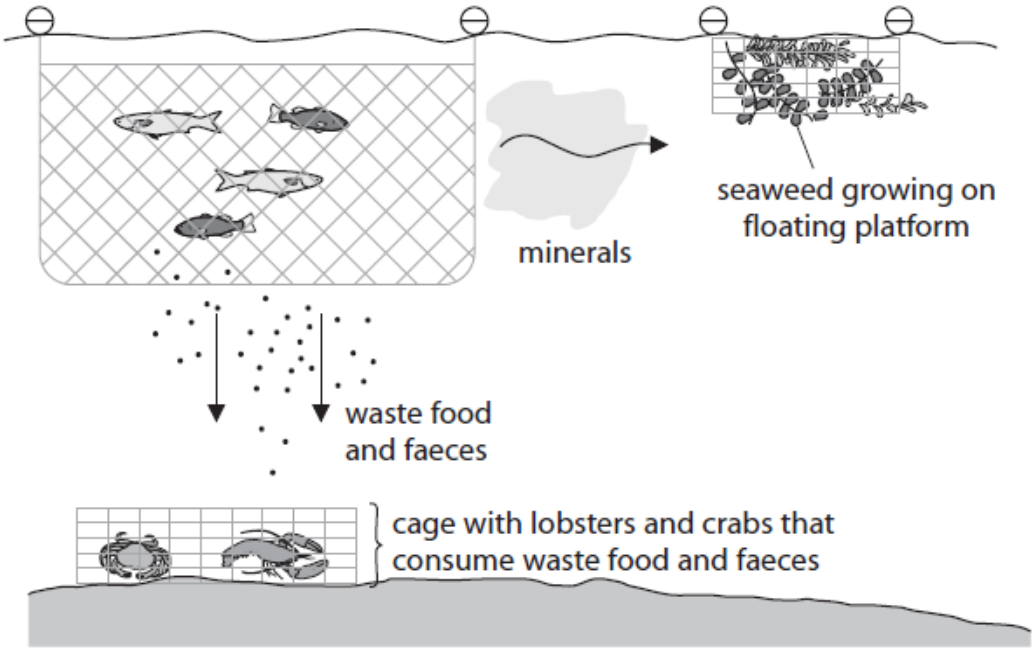
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(c) Multi-trophic level aquaculture is a method of fish farming that has been developed to reduce environmental pollution and increase profits.

The diagram shows a multi-trophic level aquaculture system.



Explain how the multi-trophic level aquaculture system reduces environmental pollution, and increases the profits of fish farming.

Use information from the diagram and your own knowledge to support your answer.

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(Total for question = 9 marks)

Q13.

Sewage pollution affects the distribution of organisms in a river.

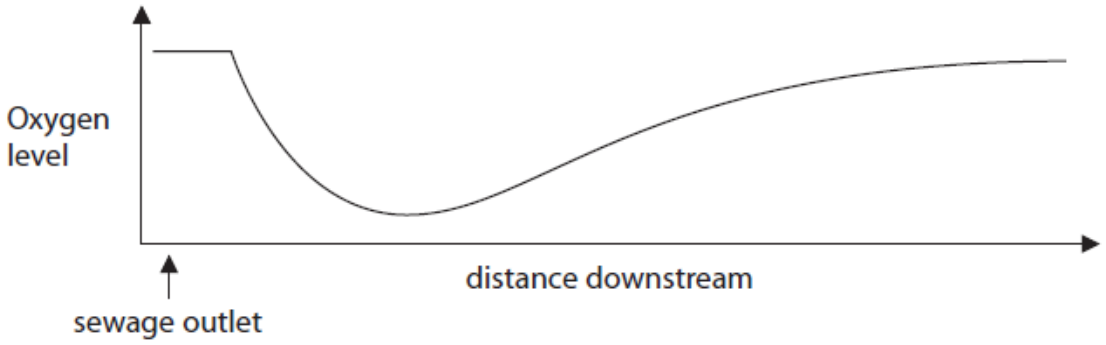
Scientists measured the oxygen level, the number of bacteria, the number of mayfly nymphs and the number of tubifex worms in the river.

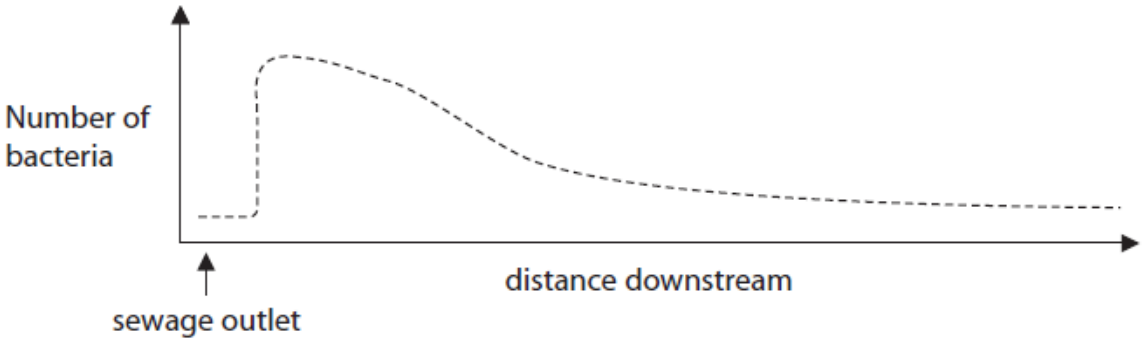
The mayfly nymph is an immature form of an insect and the tubifex is a small worm usually growing to a length of about 10 cm.

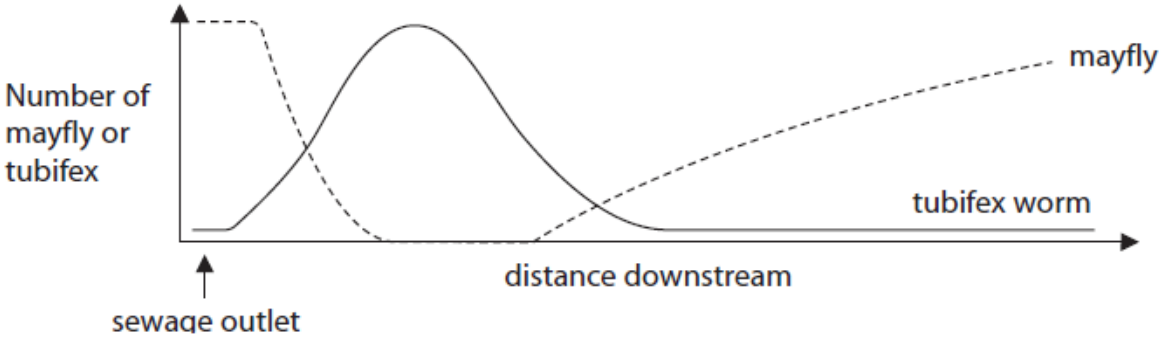


(Sources: © Hhelene / Shutterstock, © Aldona Griskeviciene / Shutterstock)

The scientists recorded how these measurements changed at different distances from the sewage outlet.







(a) Comment on the changes in the measurements as the distance from the sewage outlet increases.

You should use information from the graphs and your own knowledge in your answer.

(5)

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(b) Scientists often use information about the organisms present in a habitat as an indication of the level of pollution and as a measure of biodiversity.

(i) Explain what is meant by the term **biodiversity**.

(2)

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(ii) Suggest how the number of mayfly nymphs and the number of tubifex worms can be used to indicate the level of pollution.

(2)

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(Total for question = 9 marks)

Q14.

A group of students compares the distribution of plant species in two fields using this method.

- use random sampling
- use a 0.5 m × 0.5 m quadrat
- count the number of each species in a quadrat

Repeat this method for five quadrats in each field.

The tables show the students' results.

Species	Field A						
	Number of plants in each quadrat						Number of plants per m^2
	First	Second	Third	Fourth	Fifth	Mean	
dandelion	7	0	6	3	4	4	16
buttercup	2	1	0	3	2	2	6
violet	1	0	2	1	2	1	5
heather	2	3	1	2	1	2	7

Species	Field B						
	Number of plants in each quadrat						Number of plants per m^2
	First	Second	Third	Fourth	Fifth	Mean	
dandelion	7	3	2	1	2		
buttercup	0	0	0	0	0	0	0
violet	0	0	0	1	0	0	0
heather	0	0	0	0	0	0	0

(a) Describe how the students would obtain random samples from each field.

(2)

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(b) (i) Calculate the mean number of dandelions per quadrat in field B.

(1)

mean number = ...

(ii) Calculate the number of dandelions per m^2 in field B.

(1)

number of dandelions per m^2 = ...

(c) Describe the differences in species distribution in field A and field B.

(2)

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(d) A teacher suggests that there are no buttercups in field B because of poor water drainage from the field.

Describe what further experiment the students could do to investigate this suggestion.

(3)

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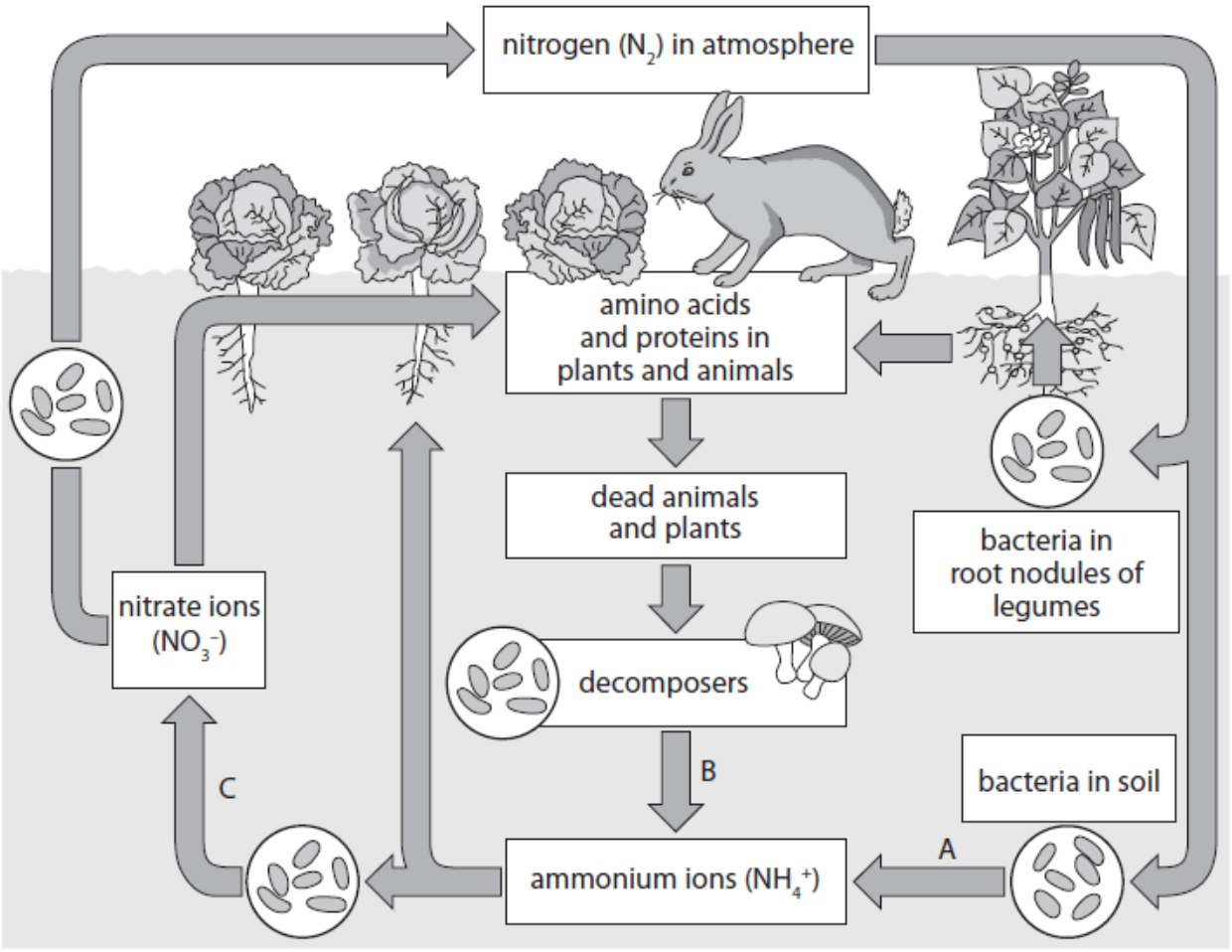
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(Total for question = 9 marks)

Q15.

The diagram shows the nitrogen cycle.



(a) Name the processes labelled A, B and C.

(3)

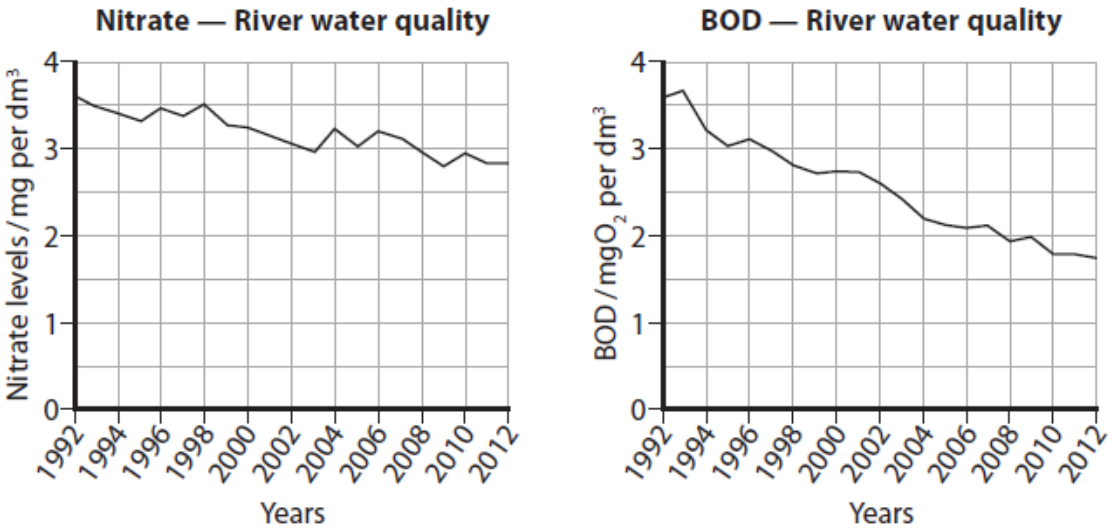
1 .....

2 .....

3 .....

(b) Nitrates are one cause of pollution in rivers.

The graphs show the changes in nitrate levels and the biological oxygen demand (BOD) of the same rivers over a number of years. A high BOD means that there is a large population of microorganisms in a water sample.



(i) Describe how the nitrate levels and BOD change over the time period shown.

(2)

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(ii) Explain the relationship between nitrate levels and BOD in these rivers.

(4)

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(Total for question = 9 marks)

Q16.

A student uses this method to investigate the nitrogen cycle.

- take two samples of soil, each of mass 100 g
- sterilise one sample of soil by heating at 100 °C for one hour
- place the sterilised and unsterilised samples into separate filter funnels
- pour 25 cm^3 of water through each soil sample and collect the filtrate in a test tube
- test each filtrate for nitrates

• pour water through each soil sample for 5 minutes

• pour another 25 cm^3 of water through each soil sample and collect the filtrate in a test tube

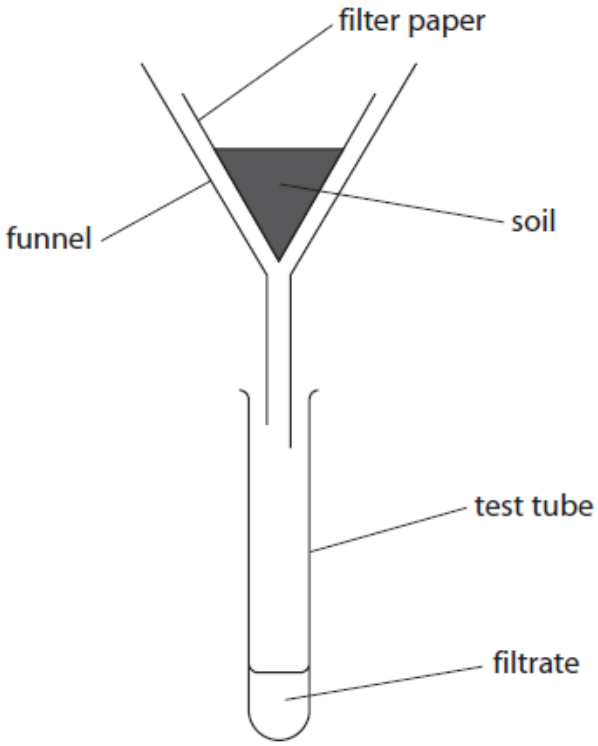
• test each filtrate for nitrates

• add 1 cm^3 of a solution of ammonium salts to each soil and leave for three days

• pour 25 cm^3 of water through each soil sample again and collect the filtrate in a test tube

• test each filtrate for nitrates

The diagram shows the student's apparatus.



The table shows the student's results.

Soil sample	Result of test for nitrates		
	At start of investigation	After water has passed through for five minutes	Three days after adding ammonium salts
unsterilised	present	absent	present
sterilised	present	absent	absent

(a) Give the independent variable in the investigation.

(1)

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(b) (i) Suggest why the student poured water through the soil samples for five minutes before adding the ammonium salts.

(2)

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(ii) Comment on the results of the nitrate tests on the two soil samples three days after adding ammonium salts.

(4)

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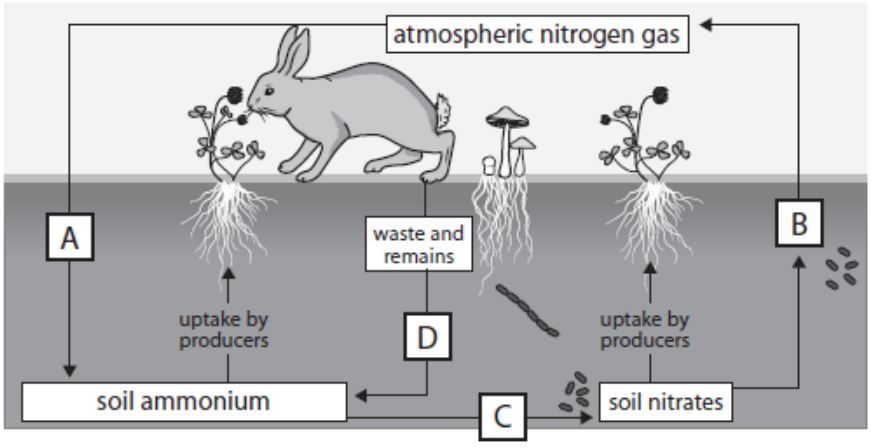
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(Total for question = 7 marks)

Q17.

(a) The diagram shows the nitrogen cycle with four processes labelled A, B, C and D.



(Source: https://www.shutterstock.com/image-vector/diagram-nitrogen-cycle-process-by-which-1400843660)

(i) Which process is nitrogen fixation?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Which process is decomposition?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(iii) Which process is nitrification?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(iv) Name a type of organism that carries out process C.

(1)

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(b) A student does an investigation to determine if nitrate ions are required for plant growth.

He uses this method.

Step 1 Use a measuring cylinder to add 10 cm^3 of the control solution containing all the minerals a plant requires
to a test tube

Step 2 Cover the top of the tube with foil

Step 3 Make a small hole in the foil

Step 4 Push the root of a germinated bean seedling through the hole so it is in the solution

Step 5 Rinse the measuring cylinder with distilled water

Step 6 Repeat Steps 1 to 4 using a test solution containing all the mineral a plant requires apart from nitrate ions

Step 7 Wrap both tubes in black paper

Step 8 Place both tubes in a test tube rack in bright sunlight

(i) Explain why the control solution contains all the mineral ions the plant requires but the test solution contains all the mineral ions the plant requires except nitrate.

(2)

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(ii) State the purpose of Step 5.

(1)

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(iii) Explain the purpose of Step 7.

(2)

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(iv) Explain the measurements that the student could make to determine if nitrate ions are required for plant growth.

(2)

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(Total for question = 11 marks)

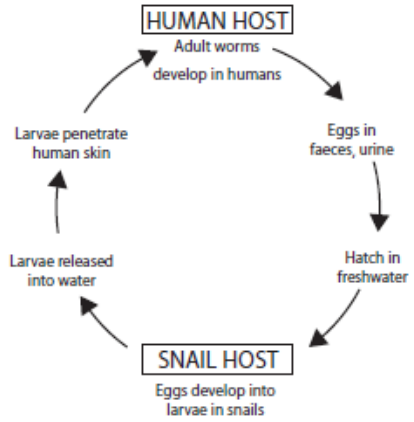
Q18.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Schistosomiasis

Schistosomiasis is an infection caused by a parasitic worm called a schistosome. The immature or larvae of the worm live in rivers and lakes in tropical parts of the world.

The diagram shows the life cycle of the schistosome worm.



Some people in tropical parts of the world use water from these rivers and lakes for their daily lives. These people risk infection because the larvae burrow into their skin. The larvae are then transported to other parts of the body where they damage organs such as the kidneys, intestines, lungs and brain. The larvae develop into adult worms.

The adult worms lay eggs in the human body. Some of these eggs are destroyed by the immune system, but most eggs survive. These eggs can get into water if faeces or urine from infected people pass into rivers or lakes. In the water, the eggs develop into small larvae which grow inside freshwater snails. Larvae are released from the snails and infect any person they contact. These larvae develop into adult worms inside the human body.

Doctors diagnose schistosomiasis when they find eggs in the faeces or urine of infected people. Infected people also have blood cells in their urine and antibodies for the pathogen in their blood.

At present, the drug praziquantel is used to kill the worms. A dose of 0.040 g per kg of body mass is usually effective. With no treatment, affected organs can be permanently damaged, leading to death. It is estimated that 240 million people (in the world) have schistosomiasis. Every year 8×10^{-4} per cent of infected people die from the disease.

A vaccine is being developed using a plasmid. The plasmid has DNA inserted that makes a protein found on the body surface of the adult schistosome worm.

In one investigation, a vaccine made using the DNA plasmid was given to a group of infected people. The results showed a mean number of 21.53 worms per person in this group. In the control group, a mean number of 40.53 worms per person was found.

(a) Which process is affected if kidneys are damaged (line 8)?

(1)

- ☒ **A** digestion
- ☒ **B** mutation
- ☒ **C** ultrafiltration
- ☒ **D** vaccination

(b) Suggest three ways to reduce the risk of being infected by schistosomes.

(3)

1 .....

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2 .....

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3 .....

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(c) Name two different blood cells that would be found in the urine of infected people (line 17).

(2)

1 .....

2 .....

(d) An infected person has a body mass of 120 kg.

What dose of drugs would be effective for this person (lines 19 to 20)?

(1)

☒ **A** 0.04 mg

☒ **B** 4.8 mg

☒ **C** 40 mg

☒ **D** 4800 mg

(e) Using the estimated number of people in the world who have schistosomiasis (lines 21 to 22), calculate the number of people who die each year from schistosomiasis.

(2)

number = ...

(f) Which of these is the correct description of a plasmid?

(1)

☒ **A** a circle of DNA

☒ **B** a circle of mRNA

☒ **C** a circle of protein

☒ **D** a circle of tRNA

(g) Explain how a vaccine could protect people from schistosomiasis (lines 24 to 25).

(3)

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(h) (i) Suggest what is given to the control group (lines 27 to 29).

(1)

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(ii) A scientist claims that the investigation proves the vaccine is effective against schistosomiasis (lines 27 to 29).

Comment on this claim.

(3)

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(Total for question = 17 marks)