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

Alligators save lives



Many humans are frightened of being attacked and eaten by alligators. However, alligators may have a role as potential lifesavers. Scientists have discovered proteins in alligator blood called alligacins. They hope these proteins may provide a source of new antibiotics to help fight infections, particularly those associated with diabetic ulcers and severe skin burns.

The scientists collected blood samples from alligators. They extracted the antibiotic proteins from the white blood cells involved in destroying pathogens. In laboratory tests the protein extracts killed a wide range of bacteria, including MRSA (methicillin-resistant *Staphylococcus aureus*). These 'superbugs' are increasingly resistant to many antibiotics and cause thousands of deaths each year.

The investigation by the scientists of the antibiotic properties of alligacins discovered a range of other uses for these proteins. For example, they help to cure infection caused by the yeast *Candida albicans* in AIDS patients. The antibiotic proteins killed six out of eight different strains of *Candida albicans*. They also discovered that the blood proteins may help destroy HIV, the virus that causes AIDS.

Alligators have an immune system that is different from the immune system of humans. Humans need a vaccination to be able to respond quickly to infection by pathogens. However, the alligator immune system can quickly destroy pathogens without having had prior exposure to them. Scientists believe that natural selection has created this evolutionary adaptation as it promotes quick wound healing. These wounds are caused by alligators fighting to defend their territory from other alligators.

The scientists are hoping to identify the exact chemical structures of the antibiotic proteins. They can then begin to develop antibacterial or antifungal drugs.

(a) What is meant by the term **pathogens** (line 8)?

(1)

(b) Describe how a non-resistant *Staphylococcus aureus* bacterium can produce a bacterium that is resistant to methicillin (lines 8 and 9).

(2)

(c) A pathogen named in the passage is *Staphylococcus aureus*. Name one other pathogen named in the passage.

(1)

(d) What term is used in the passage to describe pathogens that are resistant to antibiotics?

(1)

(e) Suggest why an MRSA infection may have to be treated with many different antibiotics (line 10).

(1)

(f) Explain how a vaccination will protect a human from having an infection.

(3)

(g) Describe how natural selection increases the number of alligators with alligacin in their blood.

(3)

(h) Suggest two reasons why an alligator defends its territory (line 24).

(2)

1 .....

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2 .....

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(Total for Question = 14 marks)

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

Japanese knotweed: a space invader

Invasive species are one of the biggest threats to wildlife and plants worldwide. The Department for Environment, Food and Rural Affairs (DEFRA) is introducing new measures that will ban the sale of some of the most dangerous foreign species in the UK.

DEFRA is attempting to prevent a problem before it happens. The majority of invader species are plants. Of the most recent count of 2 721 non-native species, 1 798 were plants. Over £1.5 billion has been spent removing a single plant species, the Japanese knotweed.

Japanese knotweed was first introduced as a garden plant. Japanese knotweed causes problems as it lacks natural predators in the UK and is very difficult to remove completely. Also, the vegetation of the knotweed is so dense, that other plants cannot grow through it. The fast-growing plant can grow up to 4 metres tall and is so strong it can break through paving stones and tarmac.



Japanese knotweed has a large network of underground stems (rhizomes). These rhizomes have to be killed if the plant is to be completely removed. The rhizomes might also be described as 'underground runners'. All above-ground portions of the plant need to be controlled repeatedly for several years in order to weaken and kill the entire patch. Digging up the rhizomes is a common solution where the land is to be developed, as this is quicker than the use of herbicides.

Scientists have looked at the weed's natural predators with the aim of finding one that feeds on Japanese knotweed and little else. After testing the predators on 90 different UK plant species, including plants closely related to Japanese knotweed, they discovered that the insect, *Aphalara itadori,* was the best control agent. It keeps the weed under control in its native Japan by feeding on the sap in the transport tissue in the leaves, which reduces the growth of the plants. The introduction of *Aphalara itadori* would be the first time that biological control has been used in Europe to fight a weed.

(a) Suggest what is meant by the term **invasive species** (line 1).

(2)

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(b) Calculate the percentage of invasive species in the UK that are plants (lines 6 and 7).

Show your working.

(2)

Answer ..... %

(c) Give **one** reason why Japanese knotweed has spread so successfully in the UK.

(1)

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(d) Suggest why the dense growth of the Japanese knotweed reduces the growth of other plants (line 11).

(2)

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(e) The use of *Aphalara itadori* to feed on Japanese knotweed is an example of biological control.

Describe another example of biological control.

(2)

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(f) (i) Name the transport tissue in the leaves that contains sap (line 25).

(1)

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(ii) Suggest why the plant growth is reduced when insects feed on the plant sap (lines 24 and 25).

(2)

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(g) Why is it important that the insect 'feeds on Japanese knotweed and little else' (line 21)?

(1)

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(Total for Question = 13 marks)

3 The passage describes how viruses can affect humans.

Complete the passage by writing a suitable word or words in each of the spaces.

(7)

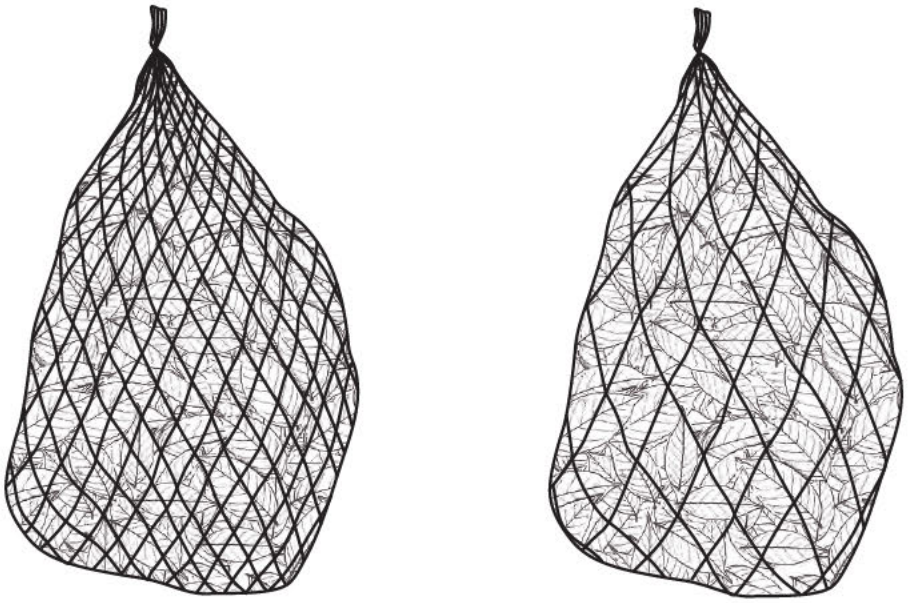
Humans are affected by many viruses. Viruses only contain one sort of .....acid, either DNA or .....

One virus, which causes the disease AIDS, is the ..... virus. People with AIDS are vulnerable to infection because their ..... system does not work so effectively. This means they are unable to produce .....blood cells that normally fight off infections by producing specific proteins called ..... that help to destroy pathogens.

Diseases caused by viruses can be prevented by injecting the body with an inactive form of the virus. The method of injecting is known as ..... and stimulates the body's defence system to produce memory cells.

(Total for Question = 7 marks)

4 Scientists in Malaysia studied the rate of decomposition of leaf discs placed in bags in the soil. Leaf discs from a forest tree were placed in bags of two different mesh sizes. At intervals of four weeks, some of the bags were removed from the soil and the dry mass of the leaves was measured. The experiment was continued over a period of 20 weeks.



The data they obtained are shown in the table.

Weeks	Dry mass of leaves remaining (% of original mass)	
	Small mesh	Large mesh
0	100	100
4	92	88
8	84	78
12	74	66
16	72	60
20	68	58

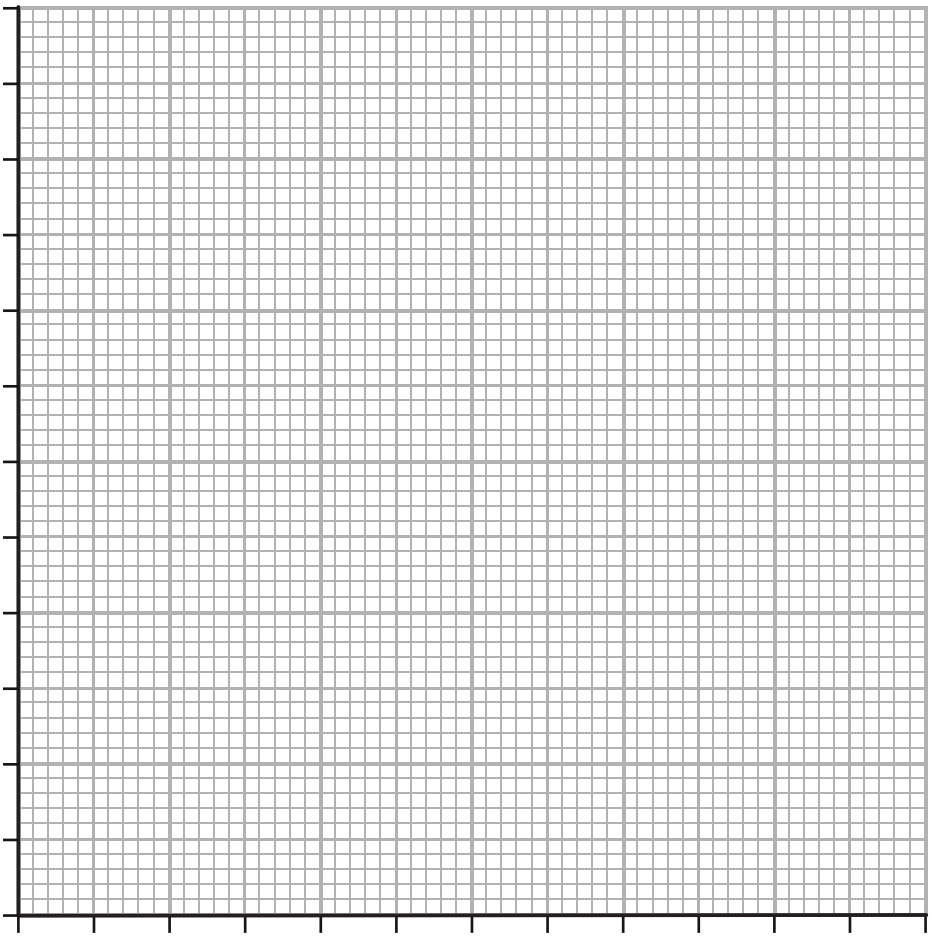
(a) Calculate the percentage change in mass in the small mesh bag by week 20.

(1)

Answer ..... %

(b) On the grid below plot a graph of the data, using straight lines to join the points.

(5)



(c) Describe how the dry mass of the leaves changed during the 20 week period.

(2)

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(d) The scientists wrote that, 'leaf decomposition by bacteria ensures the release of nitrate ions into the soil'.

Explain how other bacteria can reduce the availability of nitrate ions to plants.

(2)

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(Total for Question = 10 marks)

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

Glucose control

Many years ago some scientists wanted to find out more about the role of the pancreas in digestion. They used surgery to remove the pancreas from dogs to see what would happen. During this investigation a laboratory assistant noticed that flies collected around the dogs' urine. This urine was later found to contain large amounts of glucose. Urine from dogs with a pancreas does not contain glucose.

Another scientist used string to tie a knot around the pancreatic duct of rabbits, which closed the duct. This meant that no pancreatic enzymes could reach the small intestine. It was noticed that when this was done, the cells in the pancreas that made enzymes died, but no glucose appeared in the rabbit urine.

Other scientists made pancreas extract by crushing up a pancreas in water. They injected this extract into dogs that had their pancreas removed. They found that the blood glucose level in these dogs was much reduced.

These investigations and observations suggest that the pancreas has two different functions. Some of the cells produce enzymes needed for digestion. Other parts of the pancreas are not involved in digestion but are important in controlling blood glucose levels.

We now know that pancreas extract contains two hormones involved with the regulation of blood glucose levels – insulin and glucagon. High blood glucose levels are detected by the pancreas. This stimulates the pancreas to release insulin. The role of insulin is to lower blood glucose levels. The insulin is released from specialised cells directly into the blood. The insulin travels in the blood to target cells that are in the liver and in large muscles. Insulin causes these cells to absorb glucose and use it to make an insoluble storage carbohydrate called glycogen.

The second hormone called glucagon is released by different cells in the pancreas when the blood glucose level falls too low. Glucagon causes liver and muscle cells to change glycogen into soluble glucose.

(a) Explain what is meant by the term **digestion** (line 2).

(2)

(b) Explain why dogs that had their pancreas removed produced urine that contained glucose (lines 4 and 5).

(3)

(c) Name two enzymes produced by cells in the pancreas (lines 8 and 9).

(2)

1 .....

2 .....

(d) Suggest why rabbits that have had their pancreatic duct tied can still regulate their blood glucose levels (lines 10 and 11).

(1)

(e) The scientists who injected pancreas extract into dogs should have carried out a control experiment (line 13).

Explain the control experiment they should have carried out.

(2)

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(f) Name the blood vessel that transports hormones into the liver (line 24).

(1)

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(g) Suggest one advantage of storing glycogen in cells rather than storing glucose in cells (lines 25 and 26).

(1)

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(h) A number of different substances and structures are involved in the control of blood glucose.

(i) Describe the stimulus.

(1)

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(ii) Name the structure that acts as a receptor.

(1)

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(iii) Name a structure that acts as an effector.

(1)

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(iv) Describe the response.

(1)

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(Total for Question = 16 marks)