4.4 GENETIC INFORMATION, VARIATION AND RELATIONSHIP – GENETIC DIVERSITY AND ADAPATATION – 1 – QUESTIONS

Q1.

A student investigated the effect of three types of disinfectant on the growth of *Lactobacillus* bacteria.

During the investigation, the student:

- boiled the agar before pouring the agar plates
- transferred 0.5 cm^3 of a diluted liquid culture of *Lactobacillus* onto each agar plate
- left some agar plates as controls
- added to other agar plates different concentrations of the disinfectants as shown in the table in part (a).

After 2 days, she counted the number of colonies of bacteria on each agar plate.

(a) Explain the purpose of:

boiling the agar _____

_____

_____

_____

transferring the same volume of liquid culture onto each agar plate.

_____

_____

_____

_____

(2)

The three disinfectants used by the student were Lysol, propan-2-ol and ammonia.

The table shows the student's results.

Concentration of disinfectant / arbitrary units	Number of colonies of bacteria		
	Lysol	Propan-2-ol	Ammonia
0	300	300	300
5	0	290	300
10	0	195	295
15	0	0	275

20	0	0	240

The liquid culture the student transferred was diluted by 1 in 10 000 (10^{-4}).

(b) Use information in this question to calculate how many bacteria were present in 1 cm^3 of undiluted liquid culture.

Answer = _____

(2)

(c) The student concluded that the minimum concentration of propan-2-ol needed to stop the growth of *Lactobacillus* was 15 units. This conclusion is incorrect.

Describe how you could obtain a more accurate estimate of the minimum concentration of propan-2-ol needed to stop the growth of this species of bacterium.

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_____

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_____

(2)

(Total 6 marks)

Q2.

Read the following passage.

Azidothymidine (AZT) is a drug used to treat people infected with human immunodeficiency virus (HIV). It inhibits the enzyme that synthesises DNA from HIV RNA. This does not destroy HIV in the body but stops or slows the development of AIDS.

In the past, some people who took AZT on its own eventually developed AIDS. Some of the HIV in their bodies had become resistant to AZT. To prevent this from happening, people infected with HIV are now treated with highly active antiretroviral therapy (HAART). This involves taking AZT with other anti-HIV drugs at the same time.

AZT is taken in low doses. This is because people who took high doses over long periods of time suffered muscle wastage. It was found that high doses of AZT inhibit replication of mitochondria.

Use information from the passage and your own knowledge to answer the questions.

(a) Suggest and explain why AZT does not destroy HIV in the body but stops or slows the development of AIDS (lines 3–4).

(4)

(b) Suggest and explain **two** advantages of using HAART (lines 7–9).

Advantage 1 _____

Advantage 2 _____

(4)

(c) Suggest why high doses of AZT lead to muscle wastage (lines 10–11).

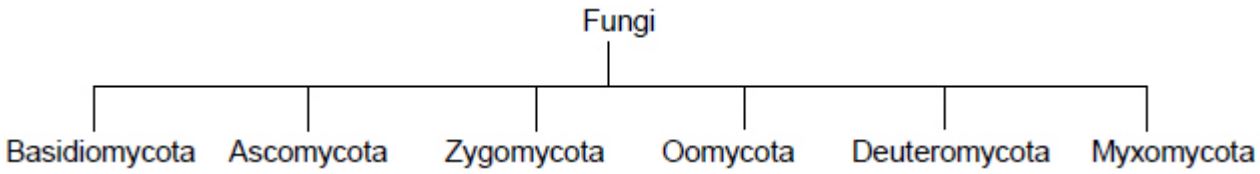
(2)

(Total 10 marks)

Q3.

Figure 1 shows one way in which the kingdom Fungi can be classified.

Figure 1



(a) Name the taxon represented by Zygomycota.

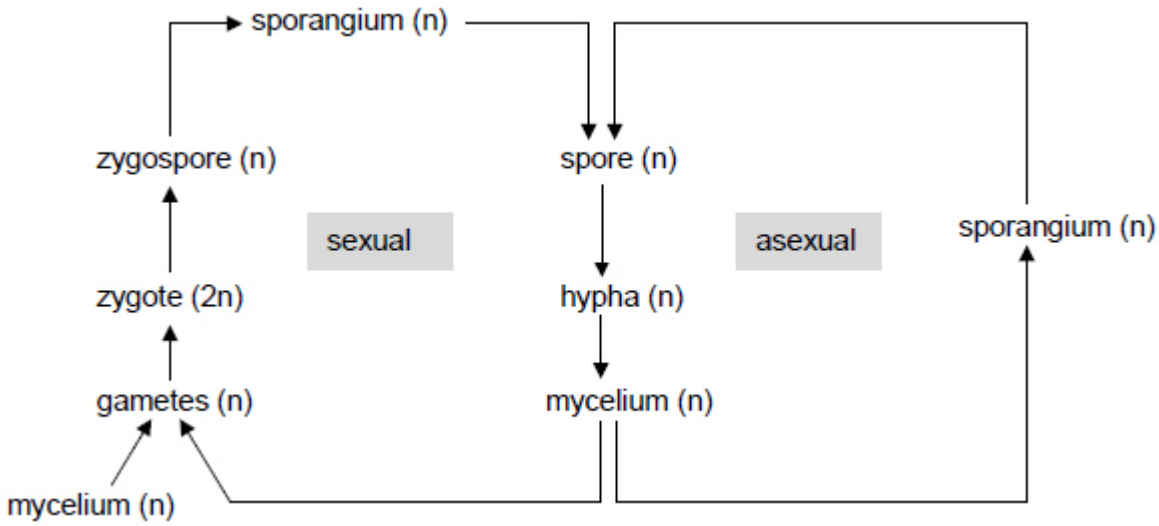
_____

(1)

Rhizopus is a member of the Zygomycota. It has thread-like hyphae that form a mass, called a mycelium, across its food source. Vertical hyphae form spore-carrying sporangia. A new hypha grows from each spore.

Figure 2 shows the life cycle of *Rhizopus*.

Figure 2



(b) Write the letter **M** on **Figure 2** to show where meiosis occurs.

(1)

(c) **Figure 2** shows that *Rhizopus* is able to reproduce both asexually and sexually. Suggest and explain **one** advantage of asexual reproduction and **one** advantage of sexual reproduction in this life cycle.

Asexual _____

_____

_____

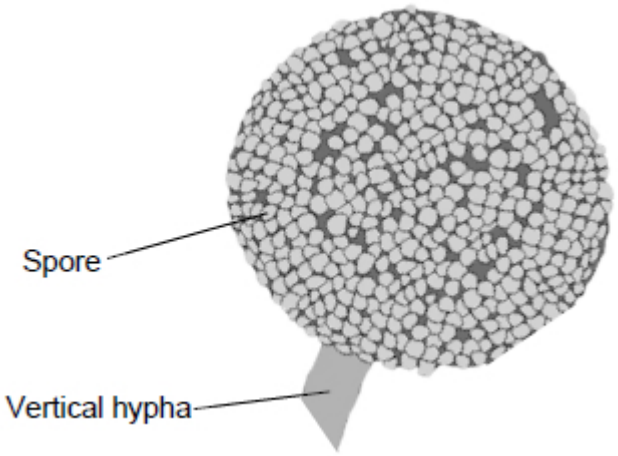
Sexual _____

_____

(2)

Figure 3 shows one spore-carrying sporangium from *Rhizopus*. The magnification of **Figure 3** is × 700.

Figure 3



(d) The hypha supporting the spore-carrying sporangium is vertical.
Suggest **one** advantage of the hypha being vertical.

(1)

(e) A scientist wanted to calculate the mean volume of *Rhizopus* spores.
Describe how she could use **Figure 3** do this.
You may assume the spores are perfectly spherical.

(3)
(Total 8 marks)

Q4.

Bacterial meningitis is a potentially fatal disease affecting the membranes around the brain. *Neisseria meningitidis* (Nm) is a leading cause of bacterial meningitis.

(a) In the UK, children are vaccinated against this disease. Describe how vaccination can lead to protection against bacterial meningitis.

(6)

(b) Penicillin has been the antibiotic of choice for the treatment of bacterial meningitis. Since the year 2000, strains of *Neisseria meningitidis* that are resistant to penicillin, sulfonamides and rifampin have been discovered in the UK.

Describe how a population of *Neisseria meningitidis* (Nm) can become resistant to these antibiotics.

(4)

(c) Contrast the structure of a bacterial cell and the structure of a human cell.

(5)

(Total 15 marks)

Q5.

The table shows the taxons and the names of the taxons used to classify one species of otter. They are **not** in the correct order.

	Taxon	**Name of taxon**
J	Family	Mustelidae
K	Kingdom	Animalia
L	Genus	Lutra
M	Class	Mammalia
N	Order	Carnivora
O	Phylum	Chordata
P	Domain	Eukarya
Q	Species	lutra

(a) Put letters from the table above into the boxes in the correct order. Some boxes have been completed for you.

		O	**M**			**L**	**Q**

(1)

(b) Give the scientific name of this otter.

_____

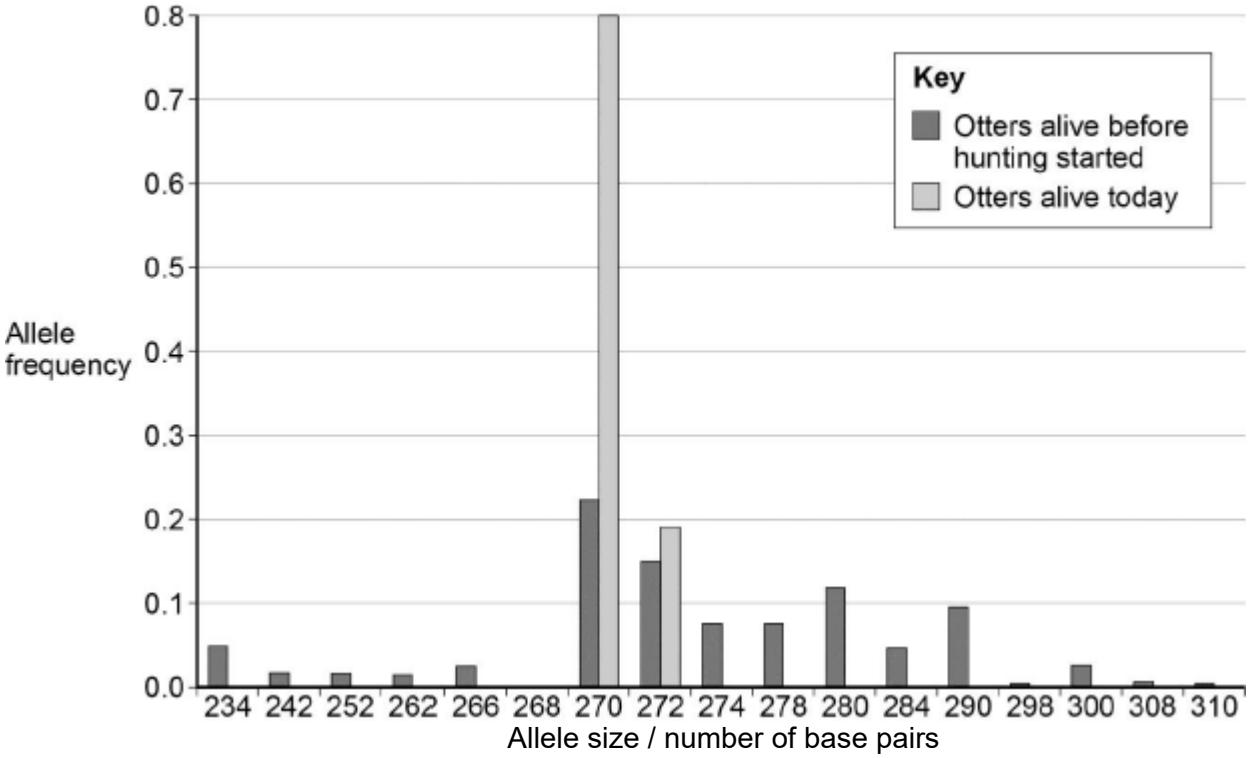
(1)

Scientists investigated the effect of hunting on the genetic diversity of otters. Otters are animals that were killed in very large numbers for their fur in the past.

The scientists obtained DNA from otters alive today and otters that were alive before hunting started.

For each sample of DNA, they recorded the number of base pairs in alleles of the same gene. Mutations change the numbers of base pairs over time.

The figure below shows the scientists' results.



(c) The scientists obtained DNA from otters that were alive before hunting started.

Suggest **one** source of this DNA.

_____

_____

(1)

(d) What can you conclude about the effect of hunting on genetic diversity in otters? Use data from the figure above to support your answer.

_____

_____

_____

_____

(2)

(e) Some populations of animals that have never been hunted show very low levels of genetic diversity.

Other than hunting, suggest **two** reasons why populations might show very low levels of genetic diversity.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

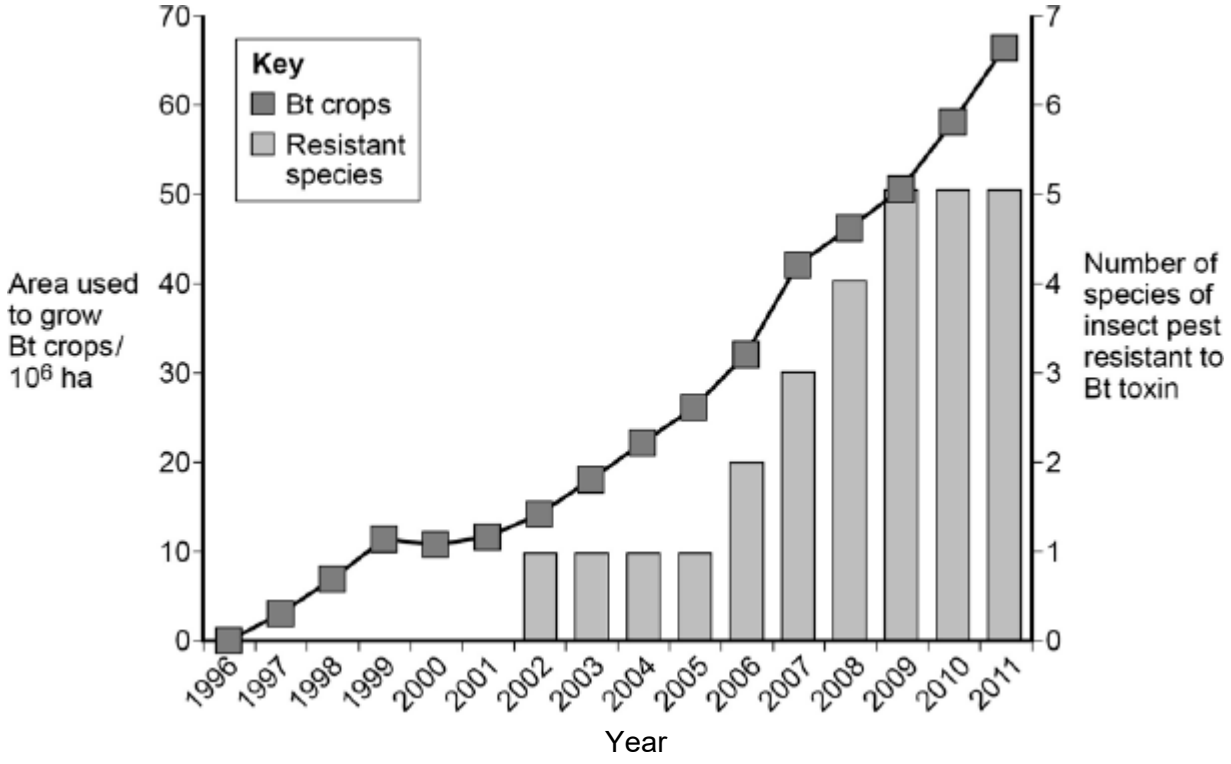
Q6.

To reduce the damage caused by insect pests, some farmers spray their fields of crop plants with pesticide. Many of these pesticides have been shown to cause environmental damage.

Bt plants have been genetically modified to produce a toxin that kills insect pests. The use of Bt crop plants has led to a reduction in the use of pesticides.

Scientists have found that some species of insect pest have become resistant to the toxin produced by the Bt crop plants.

The figure below shows information about the use of Bt crops and the number of species of insect pest resistant to the Bt toxin in one country.



(a) Can you conclude that the insect pest resistant to Bt toxin found in the years 2002 to 2005 was the same insect species? Explain your answer.

_____

_____

(1)

(b) One farmer stated that the increase in the use of Bt crop plants had caused a mutation in one of the insect species and that this mutation had spread to other species of insect. Was he correct? Explain your answer.

(Extra space) _____

(4)

(c) There was a time lag between the introduction of Bt crops and the appearance of the first insect species that was resistant to the Bt toxin.
Explain why there was a time lag.

(3)

(Total 8 marks)

Q7.

Table 1 shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists.

Table 1

Taxon	Name of taxon
Domain	Eukaryota
	Animalia
	Chordata
	Aves
	Passeriformes
	Muscicapidae
Genus	
Species	

(a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

(2)

A group of scientists investigated genetic diversity in different species of bird. For each species, the scientists:

- collected feathers from a large number of birds
- extracted DNA from cells attached to each feather
- analysed the samples of DNA to find genetic diversity.

Table 2 summarises their results.

Table 2

Species of bird	Number of genes examined	Number of genes examined that showed genetic diversity
Willow flycatcher	708	197
House finch	269	80
Bluethroat	232	81

(b) In this investigation, what is meant by **genetic diversity?**

_____

_____

(1)

(c) The scientists concluded that the bluethroat showed greater genetic diversity than the willow flycatcher. Explain why they reached this conclusion. Use calculations to support your answer.

_____

_____

_____

_____

(2)

(Total 5 marks)

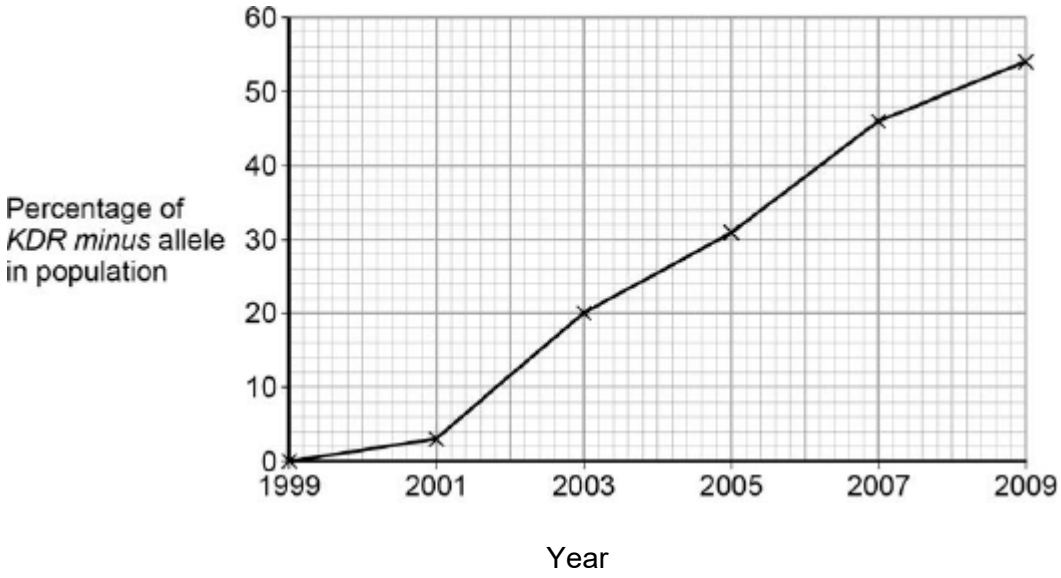
Q8.

Malaria is a disease that is spread by insects called mosquitoes. In Africa, DDT is a pesticide used to kill mosquitoes, to try to control the spread of malaria.

Mosquitoes have a gene called *KDR*. Today, some mosquitoes have an allele of this gene, *KDR minus*, that gives them resistance to DDT. The other allele, *KDR plus*, does not give resistance.

Scientists investigated the frequency of the *KDR minus* allele in a population of mosquitoes in an African country over a period of 10 years.

The figure below shows the scientists' results.



(a) Use the Hardy–Weinberg equation to calculate the frequency of mosquitoes heterozygous for the *KDR* gene in this population in 2003.

Show your working.

Frequency of heterozygotes in population in 2003 _____

(2)

(b) Suggest an explanation for the results in the figure above.

(Extra space) _____

(4)

The *KDR plus* allele codes for the sodium ion channels found in neurones.

(c) When DDT binds to a sodium ion channel, the channel remains open all the time. Use this information to suggest how DDT kills insects.

(2)

(d) Suggest how the *KDR minus* allele gives resistance to DDT.

(2)

(Total 10 marks)

Q9.

Iodine has many uses. One use is as an antiseptic to kill bacteria and another is helping apple farmers decide when to harvest their apples.

Iodine solution has been used as an antiseptic on wounds for over 150 years. At first, its use in hospitals was limited because it irritated people's skin. In the 1950s, iodine solution was made into providone iodine that caused less skin irritation. A surgeon investigated how effective providone iodine was at killing bacteria on skin.

The surgeon treated the forearms of 25 people in 4 ways.

Treatment **A** − no washing
Treatment **B** − washed with soap and water only
Treatment **C** − washed with soap and water then rubbed with Hex scrub for 5 minutes (Hex scrub was the treatment the surgeon used at that time to wash a patient's skin before surgery)
Treatment **D** − washed with soap and water then rubbed with providone iodine for 5 minutes

After each treatment, the surgeon collected bacteria by rubbing each person's skin with a sterile cotton swab. He put the swab into sterile liquid agar. He then poured the agar into a Petri dish and allowed it to set. He incubated the Petri dish and when bacterial colonies had grown, he counted them.

The surgeon's results are shown in the table below.

Treatment	**Mean number of bacterial colonies (± standard deviation)**
A	401.6 (±96.4)
B	191.4 (±63.7)
C	25.9 (±15.6)
D	0.7 (±1.5)

(a) Suggest **three** factors the surgeon kept constant when sampling from the skin and growing the bacterial colonies.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) Calculate the percentage difference in mean number of bacterial colonies for Treatment **D** compared with Treatment **A**. Show your working.

Answer _____ %

(2)

(c) Treatment **D** produced a mean of 0.7 colonies and a standard deviation of ±1.5.
What does this suggest about the number of colonies on the Petri dish?

_____

_____

_____

(1)

(d) After this investigation, the surgeon wanted to test the effectiveness of providone iodine when used on patients who were about to have surgery.
In this new investigation, the test group was given Treatment **D**.
Suggest and explain the treatment that he should give to the control group to ensure that this is an ethical investigation.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q10.

(a) HIV attaches to a specific protein receptor on helper T cells. A low percentage of people have a mutation of the *CCR5* gene which codes for this protein receptor. This mutation results in a non-functional protein receptor.

Explain how this mutation can result in the production of a non-functional protein receptor.

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(4)

(b) People with the *CCR5* mutation show a greater resistance to developing AIDS.

Explain why.

_____

_____

_____

_____

_____

(2)

(c) The frequency of the *CCR5* mutation is highest in Europe. Scientists have collected data on the history and number of HIV infections in Europe. Using these data, scientists have concluded that the high frequency of the *CCR5* mutation is not due to natural selection in response to HIV.

Suggest **two** reasons why scientists reached this conclusion.

1. _____

_____

2. _____

_____

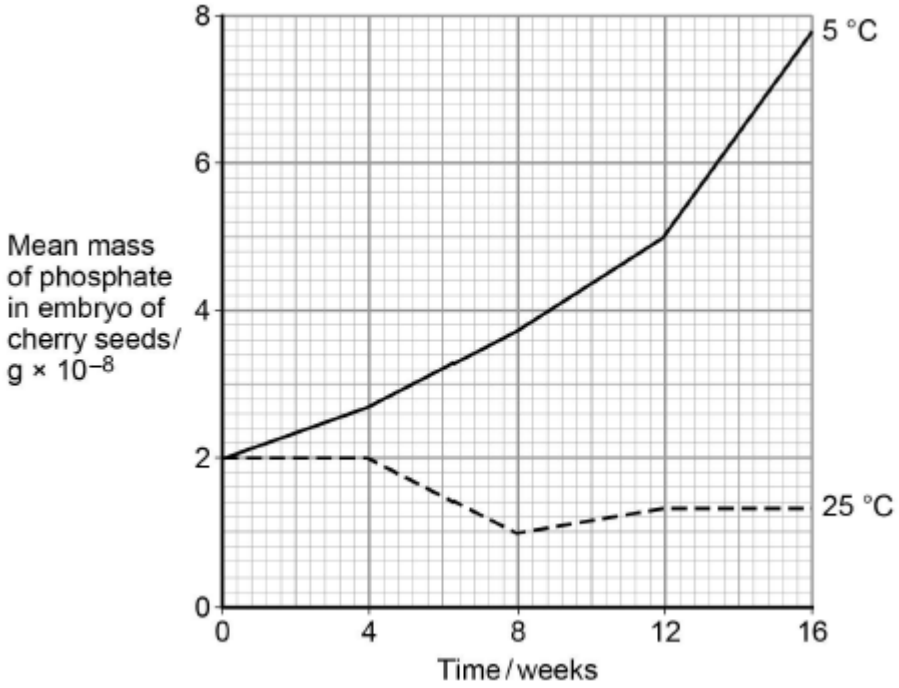
(2)

(Total 8 marks)

Q11.

The seeds of some plant species require chilling (exposure to low temperatures) before the embryos they contain grow into plants. During chilling, storage molecules in the seed that contain phosphate are broken down and phosphates are transported to the embryo. Scientists investigated the change in the mass of phosphate in the embryos of cherry seeds exposed to two different temperatures for 16 weeks.

The following graph shows their results.



(a) Phospholipids are one of the storage molecules found in cherry seeds.

Name the type of reaction used to break down phospholipids to release phosphate.

_____

(1)

(b) The scientists concluded that an increase in phosphate in the embryo was linked to growth of the embryo.

Suggest **two** reasons why an increase in phosphate can be linked to growth of the embryo.

1. _____

_____

_____

2. _____

_____

_____

(2)

(c) Calculate the ratio of the mean mass of phosphate found at 5 °C to the mean mass of phosphate found at 25 °C after 9 weeks of chilling.

Ratio = _____

(1)

(d) The chilling requirement of seeds of certain plant species is considered to be an adaptation for survival in countries with seasonal changes in environmental conditions.

Suggest how this adaptation may enable these plant species to survive and respond to seasonal changes.

_____

_____

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_____

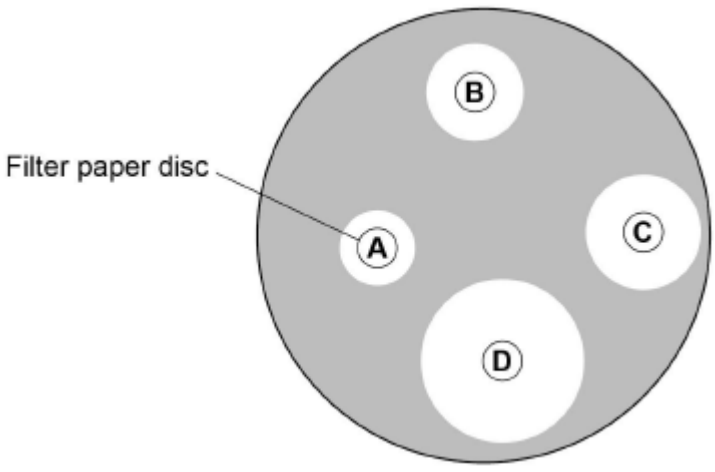
(3)

(Total 7 marks)

Q12.

A student investigated the effectiveness of four different concentrations, **A**, **B**, **C** and **D**, of the same disinfectant on the growth of a bacterium. He grew a culture of this bacterium on nutrient agar (a solid growth medium) in a Petri dish. The student then cut out four filter paper discs and soaked each disc in one of the four concentrations. He then placed the discs on the nutrient agar in the Petri dish. He then left the Petri dish at 25 °C for 24 hours.

The diagram below shows the appearance of the Petri dish after 24 hours.



(a) Explain why there is a clear zone around each paper disc.

_____

_____

(1)

(b) The student researched information on this disinfectant prior to carrying out his investigation. On the basis of this research, the student used a maximum concentration of disinfectant of 40%.

Use the diagram to explain why.

_____

_____

_____

(1)

(c) Suggest **two** variables the student should control in using the filter paper discs in this investigation.

1. _____

_____

2. _____

_____

(2)

(d) Use the areas of the clear zones in the diagram above to determine how many times more effective concentration **D** is than concentration **B**. Show your working.

Answer = _____

(2)

(Total 6 marks)

Q13.

(a) What is the name of a position of a gene on a chromosome?

_____

(1)

(b) What is meant by genetic diversity?

_____

_____

(1)

A geneticist investigated genetic diversity in four different breeds of dog. She compared DNA base sequences of the same genes from a large number of dogs from each breed.

The geneticist calculated the mean genetic diversity for each breed of dog. The value of this mean was between 0 and 1.

- A mean value of 1 shows maximum genetic diversity.
- A mean value of 0 shows no genetic diversity.

Her results are shown in the table

Breed of dog	Mean genetic diversity	Standard deviation
Airedale terrier	0.51	± 0.03
Bull terrier	0.38	± 0.02
Jack Russell terrier	0.76	± 0.01
Miniature terrier	0.47	± 0.02

(c) What do these data show about the differences in genetic diversity between these breeds of dog?

_____

_____

_____

_____

_____

(3)

(d) Miniature terriers were first bred from bull terriers in the 19th century.

Suggest **one** explanation for the observed difference in genetic diversity between miniature terriers and bull terriers.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q14.

Scientists investigated the presence of bacteria resistant to the antibiotic neomycin in

turkeys, chickens and the farmers who kept the turkeys and chickens. They looked for *Escherichia coli* (*E. coli*) resistant to neomycin. At 46 farms, the scientists obtained samples of bacteria from faeces of turkeys, turkey farmers, chickens and chicken farmers. The turkey farmers very often used turkey food containing neomycin. The chicken farmers did not use chicken food containing neomycin very often.

The bacteria were grown on nutrient agar in cultures. The nutrient agar contained neomycin. Any resistant bacteria grew and divided to form visible colonies.

The results are shown in the table

Samples taken from	**Percentage of samples of faeces containing *E. coli* resistant to neomycin**
Turkeys	81
Turkeys farmers	57
Chickens	24
Chicken farmers	8

(a) Suggest **two** hypotheses the scientists were testing in this investigation.

Hypothesis 1 _____

_____

_____

Hypothesis 2 _____

_____

_____

(2)

(b) (i) Describe what the results in the table show.

_____

_____

_____

_____

_____

(2)

(ii) Suggest and explain **one** reason for the observed differences in percentage of neomycin-resistant *E. coli* in turkeys and chickens.

_____

(2)

(c) The scientists followed strict safety guidelines when collecting samples of faeces. Apart from the risk of contamination from *E. coli* this was especially important when collecting samples from humans.

Explain why.

(1)

(d) Use the information provided to identify and explain **one** way in which the scientists increased the reliability of their method.

(2)

(e) Suggest how the scientists could use DNA to investigate whether the neomycin-resistant bacteria in farmers were identical to the strain of bacteria in the birds they kept.

(2)

(f) At one time, most animal feeds contained antibiotics that increased the rate of animal growth. In the UK, fewer animal feeds now contain antibiotics.

Suggest reasons why.

(4)

(Total 15 marks)

Q15.

(a) A mutation can lead to the production of a non-functional enzyme. Explain how.

(6)

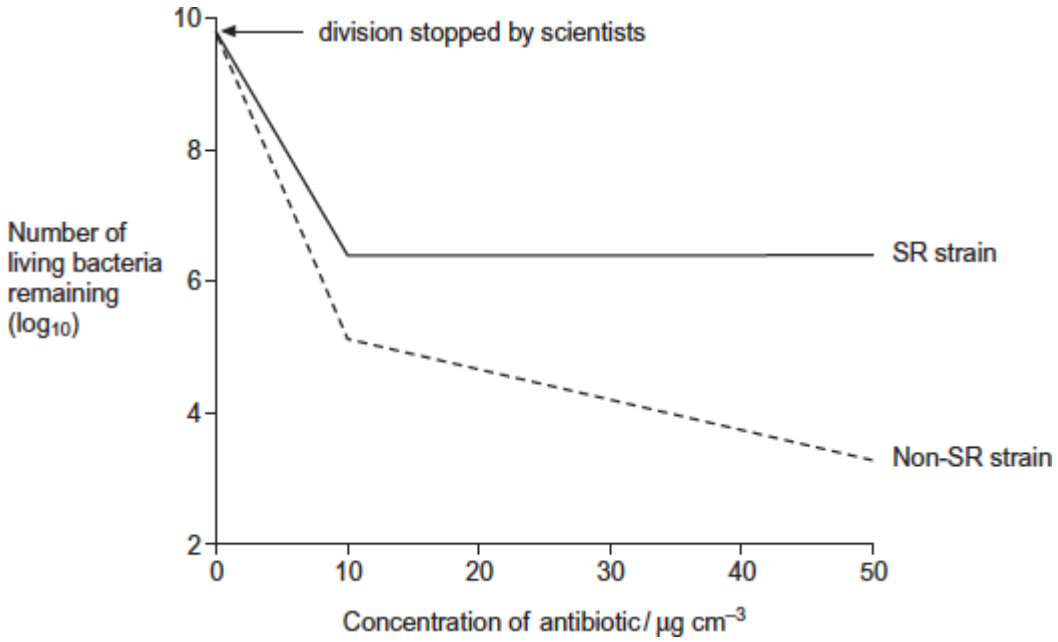
Scientists investigated the effect of a specific antibiotic on two strains of the same species of bacterium.

- One strain, SR, shows a **stringent response** in the presence of this antibiotic. Part of this response involves stopping cell division. This gives this strain a greater resistance to the effects of this antibiotic.
- The other strain, non-SR, cannot carry out a stringent response.

The scientists grew cultures of the SR strain and the non-SR strain containing the same number of bacterial cells. They then stopped each strain from dividing and exposed them to different concentrations of the antibiotic. After a fixed time, the scientists estimated the number of living bacteria remaining in the cultures.

Figure 1 shows their results.

Figure 1



(b) Describe differences in the effect of increasing the concentration of antibiotic on the SR strain and the non-SR strain.

[Extra space]

(2)

(c) One way in which the stringent response gives resistance to this antibiotic is by stopping cell division.

The scientists concluded that stopping cell division is not the **only** way in which the stringent response gives resistance to this antibiotic.

Explain how **Figure 1** supports this conclusion.

[Extra space]

(2)

(d) The stringent response involves a number of enzyme-catalysed reactions.

Explain how scientists could use this knowledge to design drugs that make the treatment of infections caused by the SR strain more successful.

(2)

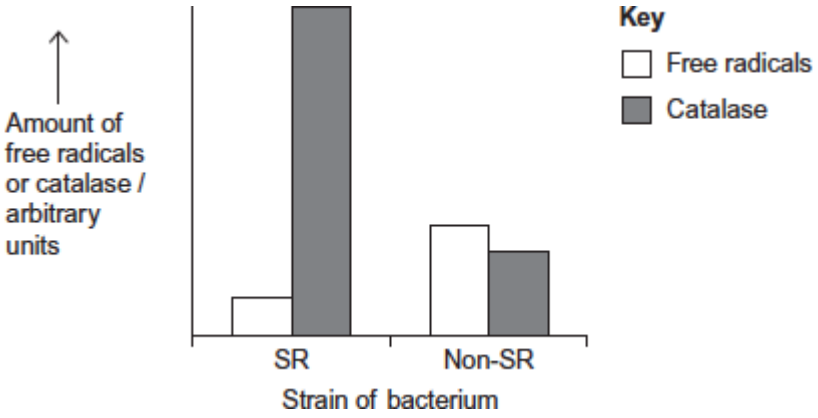
The antibiotic damages the bacterium by causing the production of substances called free

radicals.

The scientists exposed the SR strain and the non-SR strain to the antibiotic. They then measured the amounts of free radicals and an enzyme called catalase in both strains.

Figure 2 shows their results.

Figure 2



(e) Use the information provided and **Figure 2** to suggest an explanation for the greater resistance of the SR strain to this antibiotic.

[Extra space]

(3)

(Total 15 marks)

Q16.

The Amish are a group of people who live in America. This group was founded by 30 Swiss people, who moved to America many years ago. The Amish do not usually marry people from outside their own group.

One of the 30 Swiss founders had a genetic disorder called Ellis-van Creveld syndrome. People with this disorder have heart defects, are short and have extra fingers and toes. Ellis-van Creveld syndrome is caused by a faulty allele.

In America today, about 1 in 200 Amish people are born with Ellis-van Creveld syndrome. This disorder is very rare in people in America who are not Amish.

(a) In America today, there are approximately 1250 Amish people who have Ellis-van Creveld syndrome. Use the information provided to calculate the current Amish population of America.

Amish population _____

(1)

(b) The faulty allele that causes Ellis-van Creveld syndrome is the result of a mutation of a gene called *EVC.* This mutation leads to the production of a protein that has one amino acid missing.

(i) Suggest how a mutation can lead to the production of a protein that has one amino acid missing.

_____

_____

_____

_____

_____

(2)

(ii) Suggest how the production of a protein with one amino acid missing may lead to a genetic disorder such as Ellis-van Creveld syndrome.

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q17.

The Amazonian forest today contains a very high diversity of bird species.

- Over the last 2 000 000 years, long periods of dry climate caused this forest to separate into a number of smaller forests.
- Different plant communities developed in each of these smaller forests.
- Each time the climate became wetter again, the smaller forests grew in size and merged to reform the Amazonian forest.

(a) Use the information provided to explain how a very high diversity of bird species has developed in the Amazonian forest.

(Extra space)

(5)

(b) Speciation is far less frequent in the reformed Amazonian forest. Suggest one reason for this.

(1)

(Total 6 marks)

Q18.

(a) There are ethical and economic arguments for maintaining biodiversity.

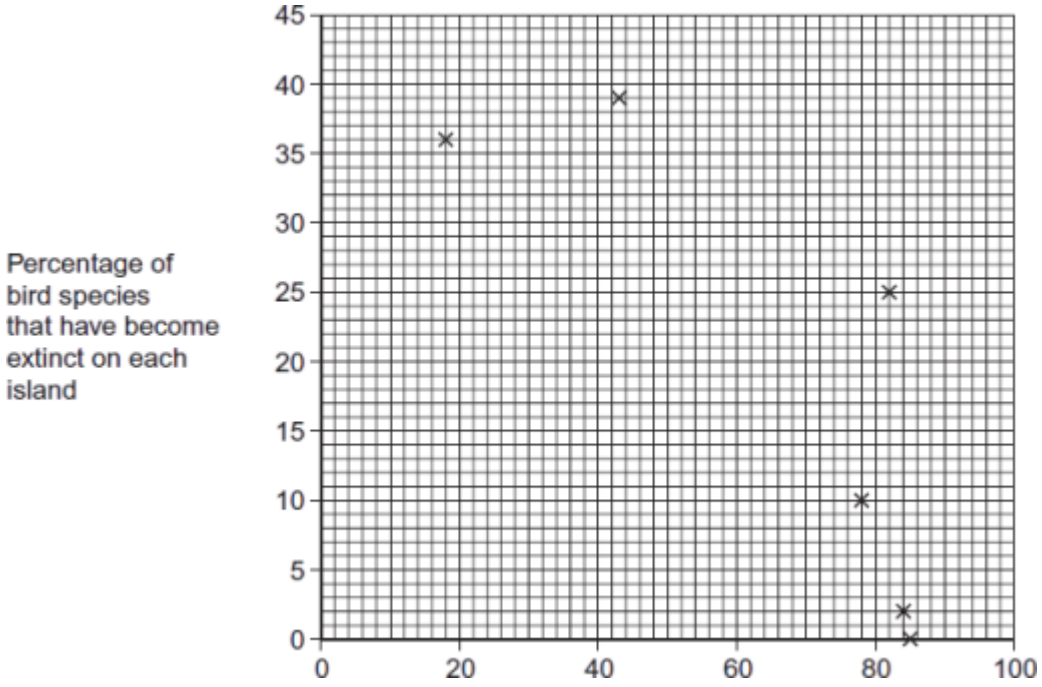
(i) Suggest **one** ethical argument for maintaining biodiversity.

(1)

(ii) Suggest **one** economic argument for maintaining biodiversity.

(1)

Ecologists calculated the percentage of bird species that have become extinct on six islands in the last one hundred years. They also calculated the percentage of original forest area remaining on each island after the same time period. The graph shows their results.



(b) Explain the relationship between the percentage of original forest area remaining and the percentage of bird species that have become extinct.

(2)

(c) What **two** measurements would the ecologists have needed to obtain to calculate the index of diversity of birds on each island?

1. _____

2. _____

(2)

(d) The ecologists noted that the species of birds surviving on the coldest islands had a larger body size than those surviving on warmer islands.

Explain how a larger body size is an adaptation to a colder climate

_____

_____

_____

_____

_____

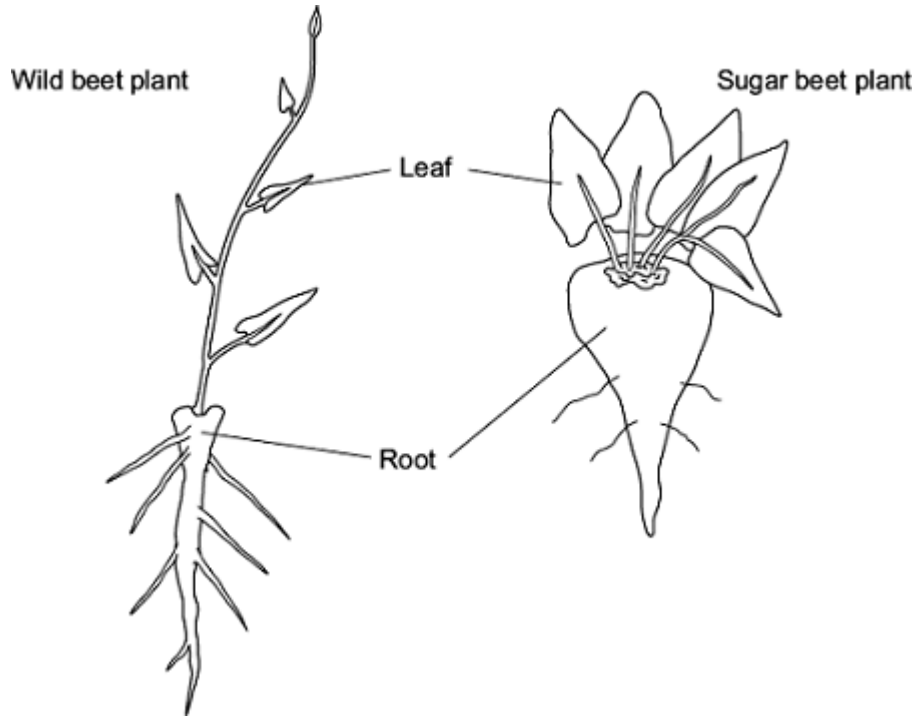
(2)

(Total 8 marks)

Q19.

Sugar beet is a crop grown for the sugar stored in its root. The sugar is produced by photosynthesis in the leaves of the plant. Plant breeders selected high-yielding wild beet plants. They used these plants to produce a strain of sugar beet to grow as a crop.

The drawings show a wild beet plant and a sugar beet plant. The drawings are to the same scale.



(a) Use the drawings to describe **two** ways in which a sugar beet plant is different from a wild beet plant.

Explain how each of these differences would give an increased yield of sugar.

Difference 1 _____

_____

Explanation _____

_____

Difference 2 _____

_____

Explanation _____

_____

(4)

(b) Sugar beet plants have been selected for a faster rate of growth.

Suggest how the faster rate of growth may increase profit for a farmer.

_____

_____

_____

(1)

(c) Describe and explain how selection will have affected the genetic diversity of sugar beet.

_____

_____

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_____

(2)

(Total 7 marks)

Q20.

Phenylketonuria is a disease caused by mutations of the gene coding for the enzyme PAH. The table shows part of the DNA base sequence coding for PAH. It also shows a mutation of this sequence which leads to the production of non-functioning PAH.

DNA base sequence coding for PAH	C	A	G	T	T	C	G	C	T	A	C	G
DNA base sequence coding for non-functioning PAH	C	A	G	T	T	C	C	C	T	A	C	G

(a) (i) What is the maximum number of amino acids for which this base sequence could code?

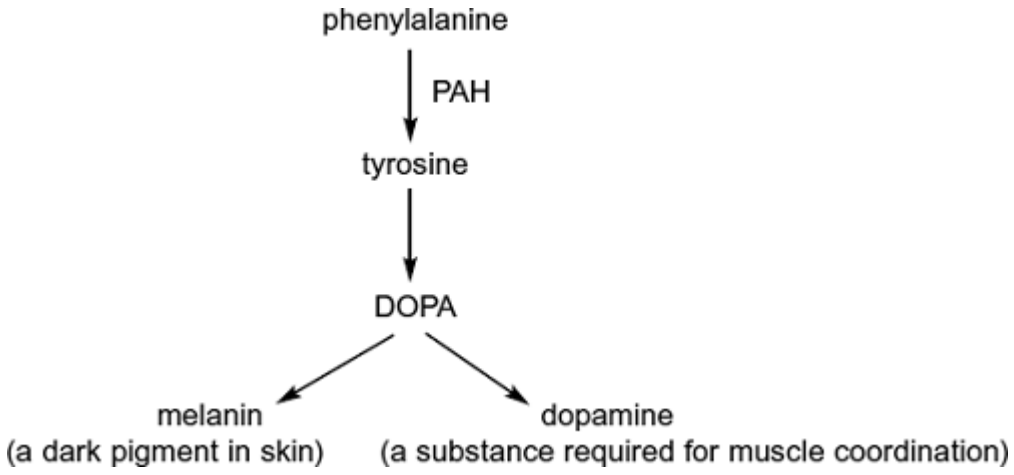
(1)

(ii) Explain how this mutation leads to the formation of non-functioning PAH.

(*Extra space*)

(3)

PAH catalyses a reaction at the start of two enzyme-controlled pathways.
The diagram shows these pathways.



(b) Use the information in the diagram to give **two** symptoms you might expect to be visible in a person who produces non-functioning PAH.

1.

2. _____

(2)

(c) One mutation causing phenylketonuria was originally only found in one population in central Asia. It is now found in many different populations across Asia. Suggest how the spread of this mutation may have occurred.

_____

_____

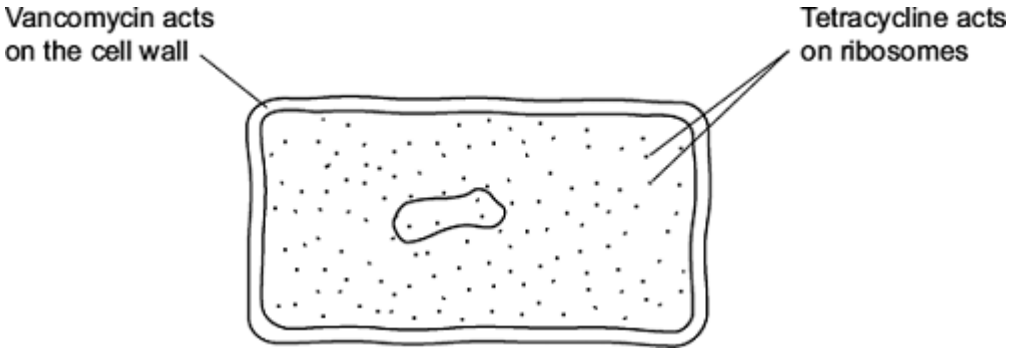
_____

(1)

(Total 7 marks)

Q21.

The diagram shows the structure of a bacterium and the sites of action of two antibiotics.



(a) (i) Use information in the diagram to explain why vancomycin does **not** affect human cells.

_____

_____

(1)

(ii) Use information in the diagram to explain how tetracycline prevents bacterial growth.

_____

_____

(1)

(b) Frequent treatment with vancomycin can result in resistant strains of bacteria. Explain how.

_____

_____

_____

_____

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_____

*(Extra space)*_____

_____

_____

(2)

(Total 4 marks)

Q22.

(a) Explain what is meant by genetic diversity.

_____

_____

(1)

(b) Apart from genetic factors what other type of factor causes variation within a species?

_____

(1)

(c) The spotted owl is a bird. Numbers of spotted owls have decreased over the past 50 years. Explain how this decrease may affect genetic diversity.

_____

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_____

_____

_____

(2)

(Total 4 marks)

Q23.

(a) *Clostridium difficile* is a bacterium that is present in the gut of up to 3% of healthy adults and 66% of healthy infants.

(i) *C. difficile* rarely causes problems, either in healthy adults or in infants. This is because its numbers are kept low by competition with harmless bacteria that normally live in the intestine.

Use this information to explain why some patients treated with antibiotics can be affected by *C. difficile*.

_____

(2)

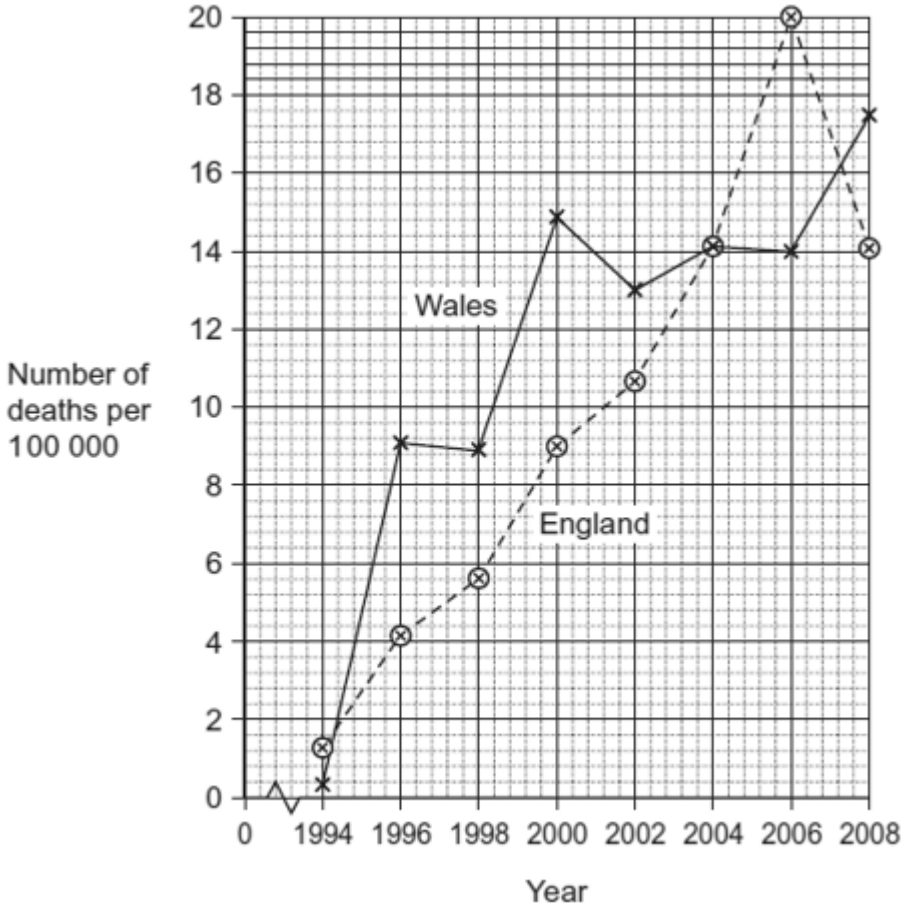
(ii) Suggest why older people are more likely to be affected by *C. difficile*.

(1)

(b) The antibiotic methicillin inhibits the enzyme transpeptidase. This enzyme is used by some bacteria to join monomers together during cell wall formation. Methicillin has a similar structure to these monomers. Use this information to explain how methicillin inhibits the enzyme transpeptidase.

(2)

(c) MRSA is a variety of *Staphylococcus aureus*. It is difficult to treat infections caused by this bacterium because it is resistant to methicillin and to some other antibiotics. As a result, some patients who are already very ill may die if they become infected with MRSA. The graph shows the number of deaths in England and Wales between 1994 and 2008 caused by MRSA.



(i) It may be difficult to identify MRSA as the actual cause of death. Explain why.

_____

_____

_____

(1)

(ii) Describe the change in the number of deaths caused by MRSA in England in the period shown in the graph.

_____

_____

_____

(1)

(iii) Calculate the percentage increase in the number of deaths caused by MRSA in Wales from 1996 to 2006. Show your working.

Answer _____

(2)

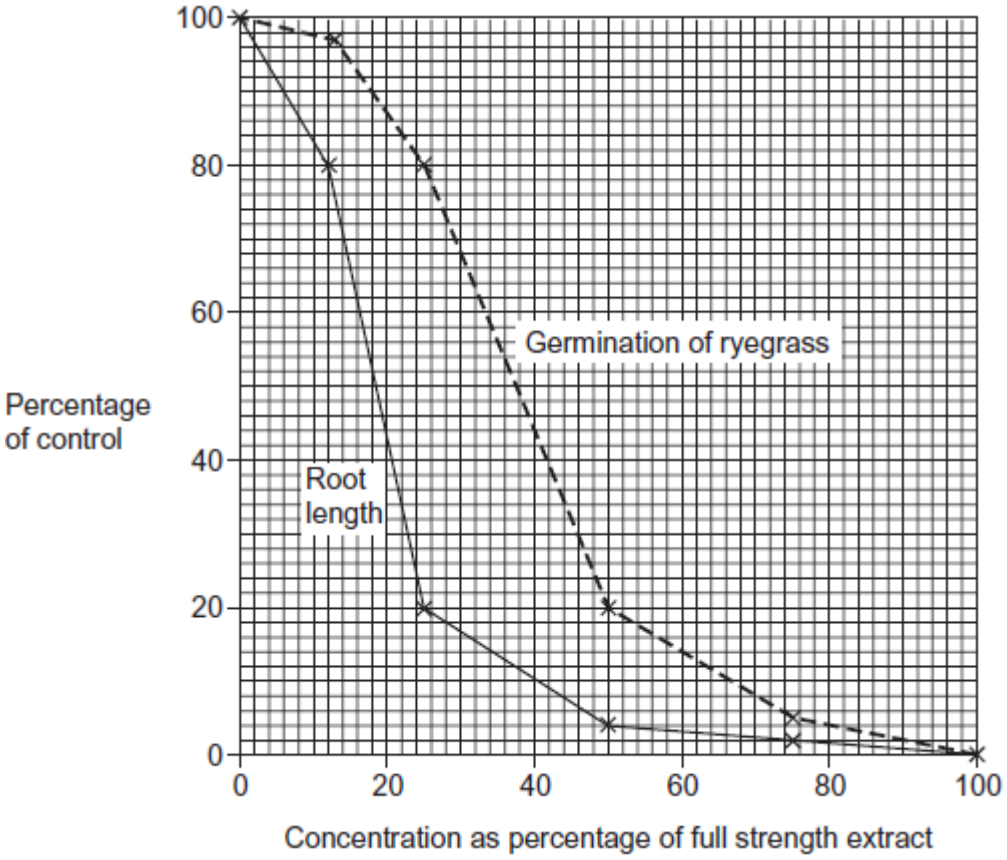
(Total 9 marks)

Q24.

Australian scientists investigated one aspect of competition between wheat and ryegrass.

- They crushed up some wheat plants and mixed the crushed plants with distilled water.
- Water-soluble substances in the crushed plants dissolved in the distilled water. The scientists called this solution the *full-strength* extract.
- The scientists then made a series of dilutions of the full-strength extract.
- They put ryegrass seeds into each dilution and recorded how many seeds germinated (started to grow). If the seeds germinated, they measured the lengths of the roots of the seedlings.
- They presented their results as percentages of a control experiment.

The graph shows the effects of different concentrations of the extract on the germination of ryegrass and on the length of the roots of the seedlings that grew from them.



(a) Describe the control that the scientists set up in this investigation.

_____

(1)

(b) The scientists found a positive correlation between the inhibition of germination and the concentration of the extract.

(i) Describe how they could find out whether this correlation was significant.

(2)

(ii) Explain why a correlation does **not** mean that the extract caused inhibition of germination.

(1)

(c) The scientists concluded that wheat plants produce substances that help them to compete with ryegrass.

(i) Give evidence from the investigation to support this conclusion.

(2)

(ii) Why might their conclusion **not** be valid?

(Extra space)_____

_____

_____

(3)

(Total 9 marks)

Q25.

The table shows some differences between three varieties of banana plant.

	Variety **A**	Variety **B**	Variety **C**
Number of chromosomes in a leaf cell	22	33	44
Growth rate of fruit / cm^3 $week^{-1}$	2.9	6.9	7.2
Breaking strength of leaf / arbitrary units	10.8	9.4	7.8

(a) (i) How many chromosomes are there in a male gamete from variety **C**?

(1)

(ii) Variety **B** cannot produce fertile gametes. Use information in the table to explain why.

_____

_____

_____

_____

_____

(2)

In some countries very strong winds may occur. Banana growers in these countries choose to grow variety **B**.

(b) (i) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **A**.

_____

_____

_____

(1)

(ii) Use the data in the table to explain why banana growers in these countries

choose to grow variety **B** rather than variety **C**.

_____

_____

_____

(1)

(c) Banana growers can only grow new variety **B** plants from suckers. Suckers grow from cells at the base of the stem of the parent plant.

Use your knowledge of cell division to explain how growing variety **B** on a large scale will affect the genetic diversity of bananas.

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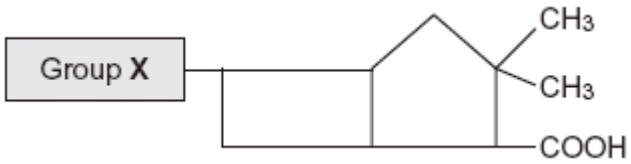
(2)

(Total 7 marks)

Q26.

Penicillins are antibiotics. Some bacteria produce an enzyme that breaks down one sort of penicillin.

(a) There are different sorts of penicillin. All of these have the same basic chemical structure shown in the diagram but group **X** is different.



A bacterial infection that cannot be treated with one sort of penicillin can be treated with a different sort. Use your knowledge of enzyme action to explain why the different sort of penicillin is effective in treating the infection.

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_____

_____

_____

(3)

(b) Farmers often keep large numbers of cattle together. Farmers used to give cattle food which had antibiotics added to it.

(i) Suggest how adding antibiotics to the food of the cattle increased profit for the farmers.

_____

_____

_____

_____

(2)

(ii) Adding antibiotics to the food of cattle is now banned in many countries. Use your knowledge of selection to explain why adding antibiotics was banned.

_____

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(2)

(Total 7 marks)