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Genetic Diversity and Adaptation Pack

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Genetic Diversity and Adaptation Pack

1 Read the following passage.

Some insect species feed on the leaves of plants. These leaf-chewers bite off pieces of leaves. Other insect species feed on sap from phloem or xylem. These sap-feeders have sharp, piercing mouthparts that they insert directly into either xylem or phloem. Leaf-chewers and insects that feed on xylem sap are active feeders; this means they use their jaw muscles to obtain their food. In contrast, insects that feed on phloem sap are passive feeders; this means they do not use their jaw muscles to take up sap from phloem.

Feeding on phloem sap presents two problems. Firstly, phloem sap has sa high sugar concentration. This could lead to a high pressure of liquid in the insect's gut because of water entering the gut from the insect's body tissues. A phloem-sap-feeder polymerises some of these sugars into polysaccharides which are passed out of its anus as 'honey dew'. The second< >problem is that phloem sap has a low concentration of amino acids. Phloem-sap-feeding insects rely on bacteria in their guts to produce amino acids. Each phloem-sap-feeding insect receives a few of these bacteria from its parent. This has resulted in a reduction in the genetic diversity of the bacteria found within these insects.

A scientist investigated the effect of three different insects on the growth of a plant called the goldenrod. He found that leaf-chewing insects and xylem-sap-feeding insects caused a much greater reduction in total leaf area than did phloem-sap-feeding insects.

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

(a) Phloem-sap-feeders are passive feeders (lines 6–7).
Phloem-sap-feeders do not use their jaw muscles to take up sap from phloem.

Explain why they can take up sap without using their jaw muscles.

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(3)

(b) A phloem-sap-feeder polymerises some of these sugars into polysaccharides (line 12-13). Suggest the advantage of this.

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(2)

(c) Each phloem-sap-feeding insect receives a few of these bacteria from its parent. (lines 16–17).

Suggest how this has caused a reduction in genetic diversity of the bacteria.

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(2)

(d) A scientist found that leaf-chewers and xylem-sap-feeders had a greater effect on plant growth than phloem-sap-feeders (lines 20–22).

Other than environmental factors, give **two** features the scientist would have controlled in his experiment to ensure this conclusion was valid.

1. _____

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2. _____

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(2)

(e) The scientist used the reduction in total leaf area of the experimental plants as an indicator of plant growth.

Outline a method by which you could find the area of a plant leaf.

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_____

(1)

(Total 10 marks)

2 (a) Name the process by which bacterial cells divide.

_____

(1)

A microbiologist investigated the ability of different plant oils to kill the bacterium *Listeria monocytogenes*. She cultured the bacteria on agar plates. She obtained the bacteria from a broth culture.

(b) Describe **two** aseptic techniques she would have used when transferring a sample of broth culture on to an agar plate.
Explain why each was important.

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(4)

The microbiologist tested five different plant oils at two different temperatures and determined the minimum concentration of plant oil that killed the *L. monocytogenes*.

The table below shows her results.

Plant oil	**Minimum concentration of plant oil that killed *Listeria monocytogenes* / percentage**	
	4 °C	**35 °C**
Bay	0.10	0.04
Cinnamon	0.08	0.08
Clove	0.05	0.05
Nutmeg	>1.00	0.05
Thyme	0.02	0.03

(c) Which plant oil is least effective at killing *L. monocytogenes* at 35 °C?

_____

(1)

L. monocytogenes is a pathogen of great concern to the food industry, especially in foods stored in refrigeration conditions (4 °C) where, unlike most food-borne pathogens, it is able to multiply. It has been suggested that plant oils, together with refrigeration may help to reduce the growth of *L. monocytogenes*.

(d) What conclusions can be drawn about the effectiveness of using plant oils with refrigeration to reduce food-borne infections caused by *L. monocytogenes*?

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(3)

(e) Plant oils are hydrophobic and can cross the cell-surface membrane of the bacterium. The low temperature of 4 °C can slow the rate of entry of plant oils into the cells.

Suggest how the low temperature slows the rate of entry.

_____

_____

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(1)

(Total 10 marks)

3 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.

_____

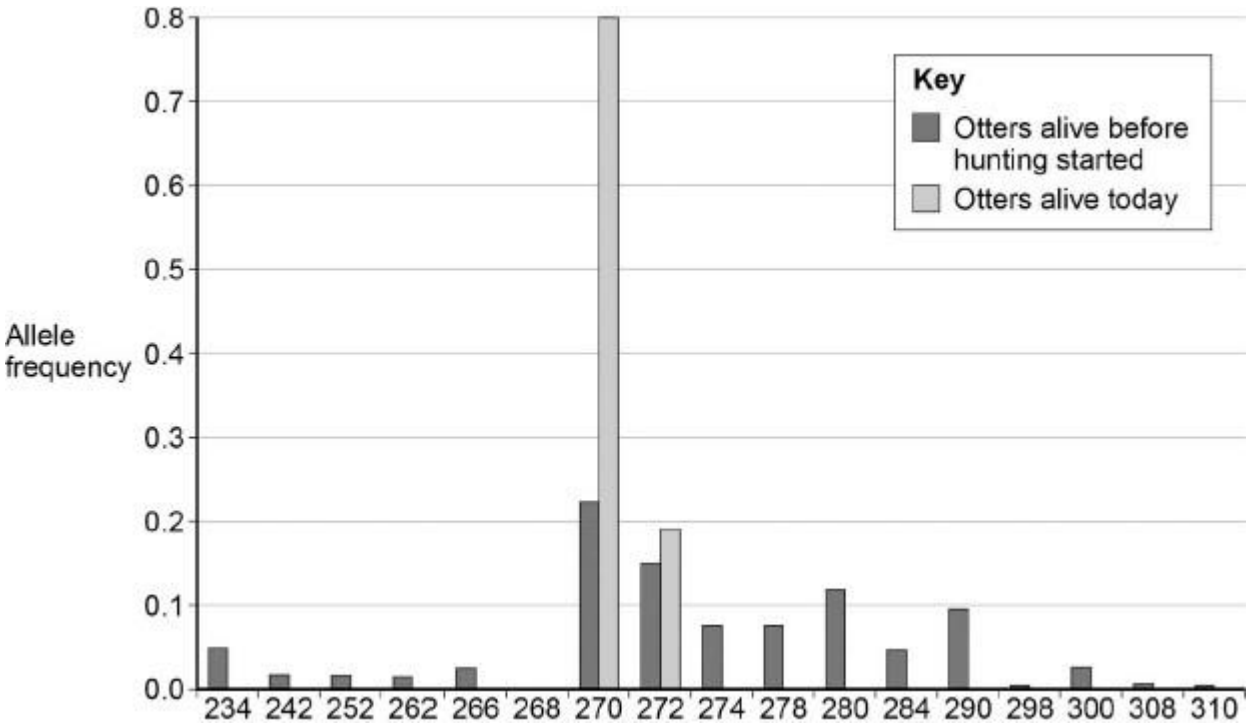
(1)

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.

_____

_____

_____

x

(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)

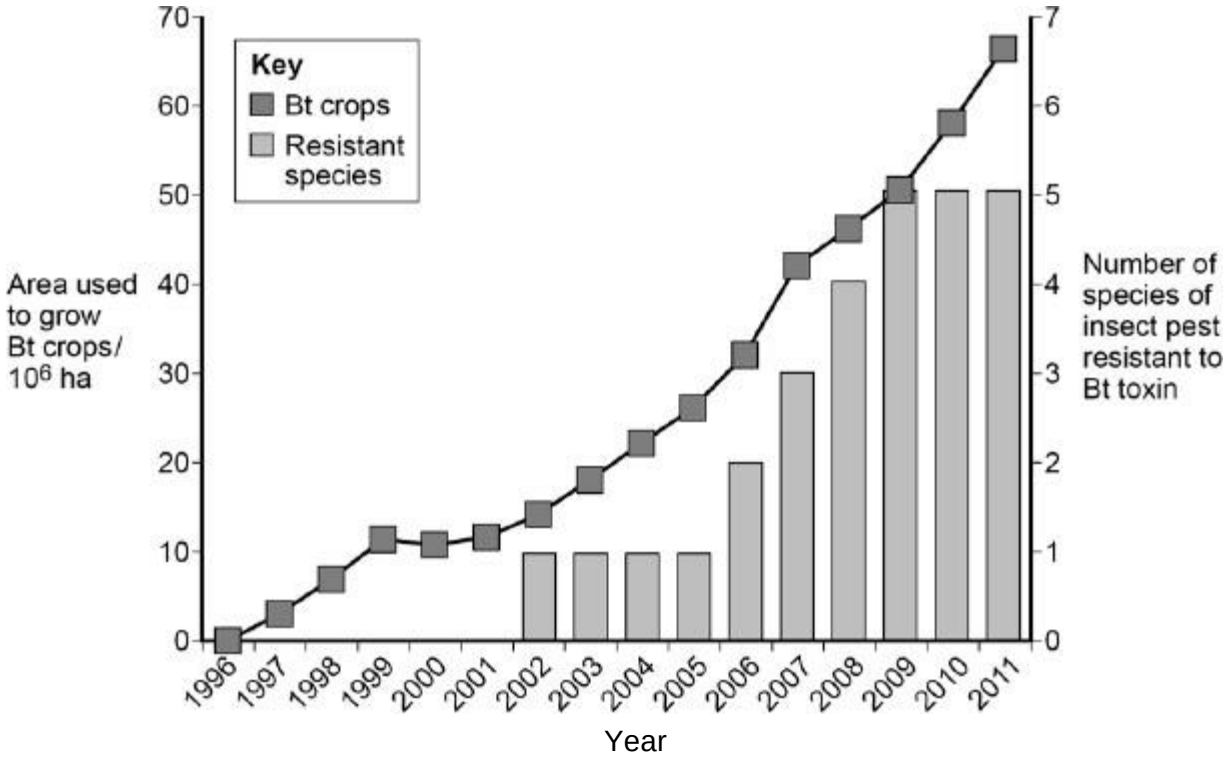
(Total 7 marks)

4 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.

_____

X

(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)

5 **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?**

_____

X

(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.

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_____

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(2)

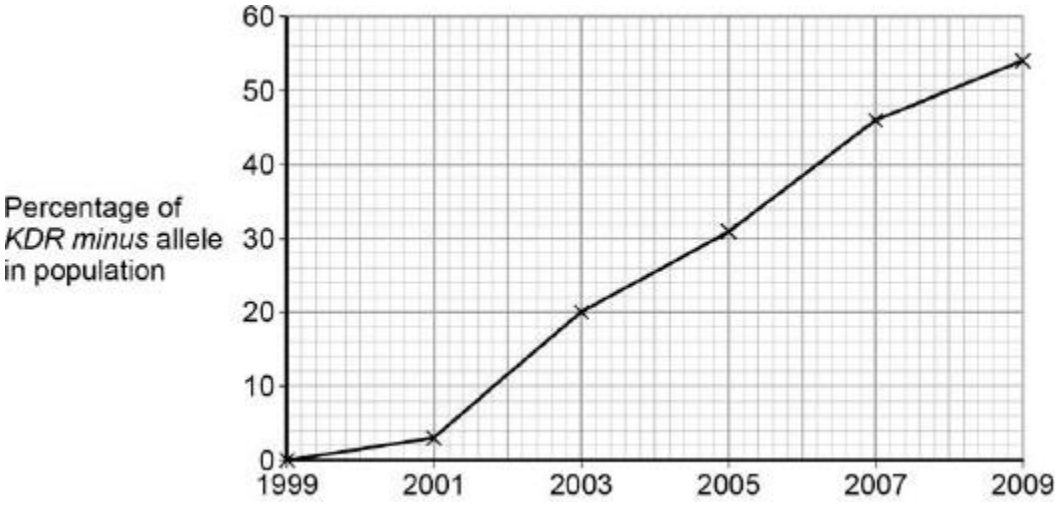
(Total 5 marks)

6 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)

7 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. _____

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2. _____

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3. _____

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(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.

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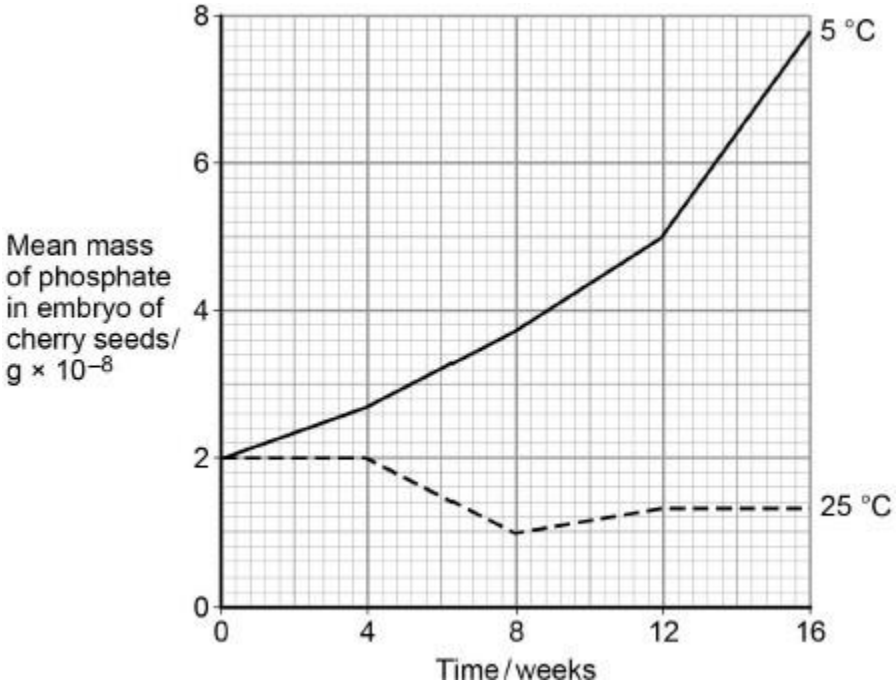
(2)

(Total 8 marks)

8 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.

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(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. _____

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2. _____

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X

(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)

9 (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.

(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 onthe 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. _____

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2. _____

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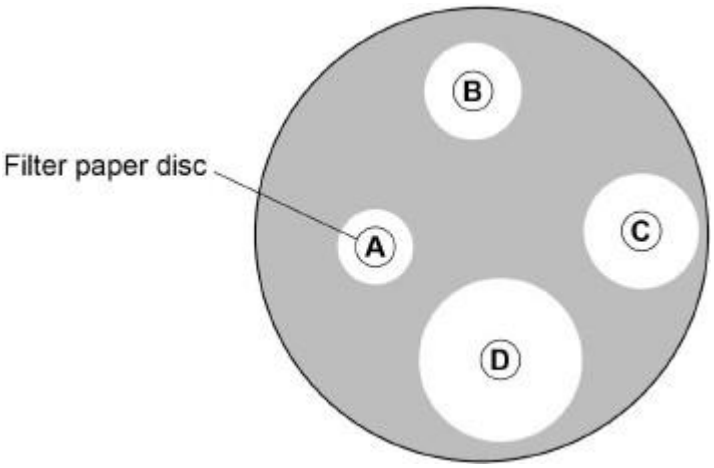
(2)

(Total 8 marks)

10 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.

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_____

(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 ofdisinfectant of 40%.

Use the diagram to explain why.

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(1)

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

1. _____

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2. _____

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(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)

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

_____

(1)

(b) What is meant by genetic diversity?

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_____

(1)

A geneticist investigated genetic diversity in four different breeds of dog. She comparedDNA 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?

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(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.

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(2)

x

(Total 7 marks)

12 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 _____

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_____

Hypothesis 2 _____

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_____

(2)

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

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(2)

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

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(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.

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(1)

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

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(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.

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x

(2)

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

Suggest reasons why.

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(4)

(Total 15 marks)

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

(6)

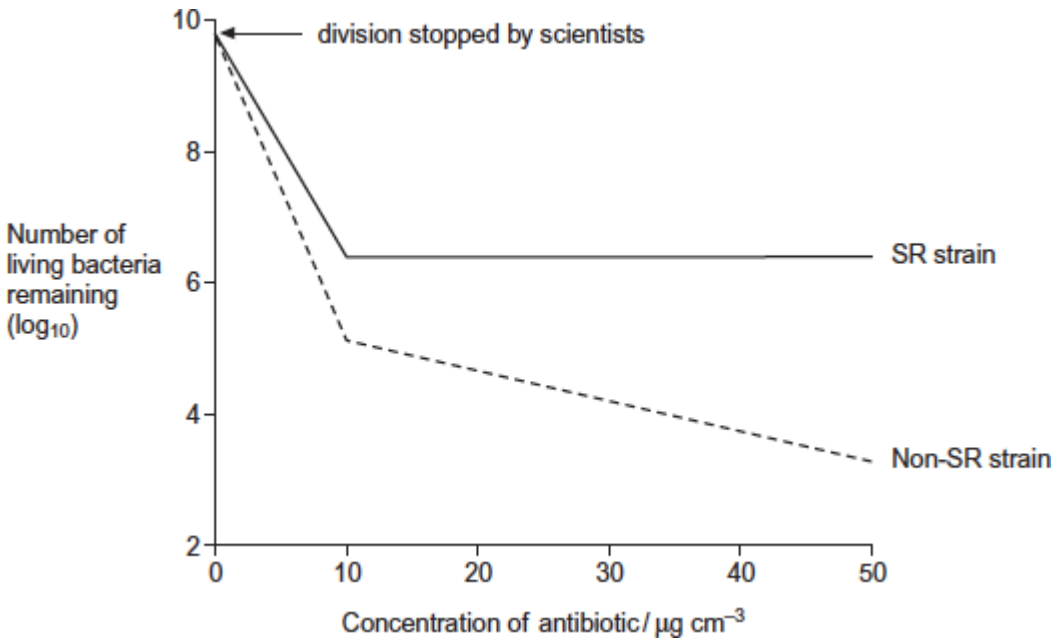
Scientists investigated the effect of a specific antibiotic on two strains of the same species of bacterium.

- 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 SRstrain 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.

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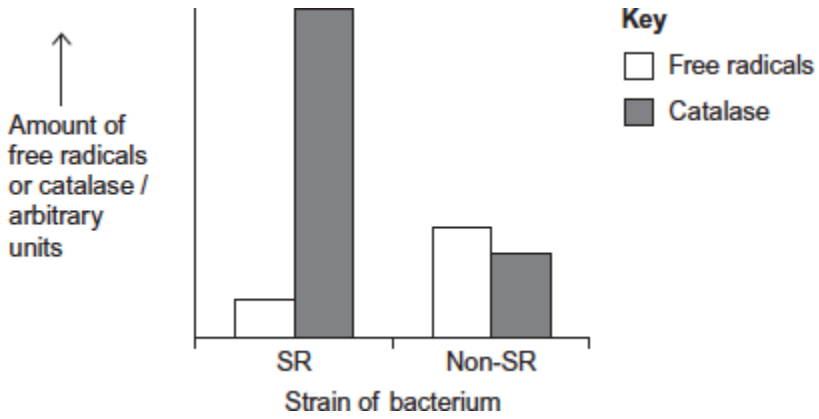
(2)

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 greaterresistance of the SR strain to this antibiotic.

[Extra space]

(3)

(Total 15 marks)

x

14 (a) Explain how the structure of DNA is related to its functions.

(Extra space)

(6)

Scientists investigated three genes, **C**, **D** and **E**, involved in controlling cell division.
They studied the effect of mutations in these genes on the risk of developing lung cancer.

The scientists analysed genes **C**, **D** and **E** from healthy people and people with lung cancer.

- If a person had a normal allele for a gene, they used the symbol N.
- If a person had two mutant alleles for a gene, they used the symbol M.

They used their data to calculate the risk of developing lung cancer for people with different combinations of N and M alleles of the genes. A risk value of 1.00 indicates no increased risk.
The following table shows the scientists' results.

Gene C	Gene D	Gene E	Risk of developing lung cancer
N	N	N	1.00
M	N	N	1.30
N	N	M	1.78
N	M	N	1.45

N = at least one copy of the normal allele is present
M = two copies of the mutant allele are present

(b) What do these data suggest about the relative importance of the mutant alleles of genes **C**, **D** and **E** on **increasing** the risk of developing lung cancer? Explain your answer.

(3)

x

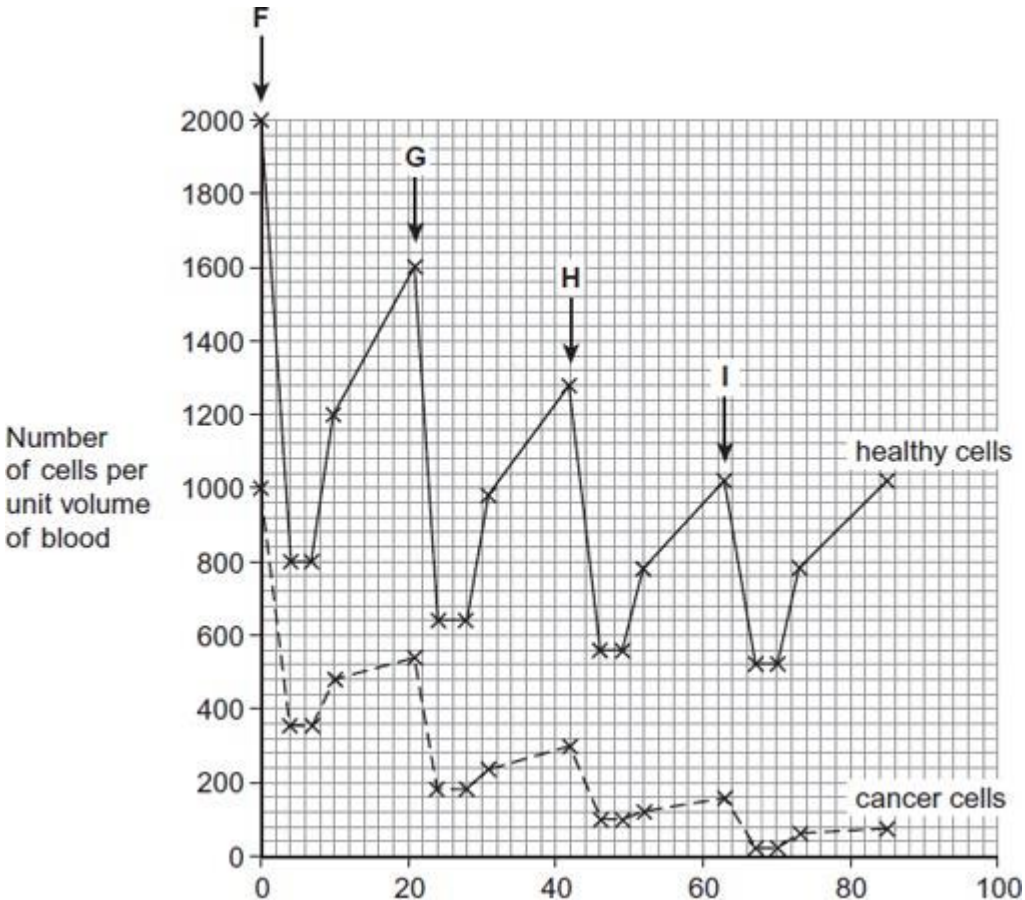
Chemotherapy is the use of a drug to treat cancer. The drug kills dividing cells.
The figure below shows the number of healthy cells and cancer cells in the blood of a patient receiving chemotherapy. The arrows labelled **F** to **I** show when the drug was given to the patient.

Time / days

(c) Calculate the rate at which healthy cells were killed between days 42 and 46.

_____cells killed per unit volume of blood per day

(1)



(d) Describe similarities and differences in the response of healthy cells and cancer cells to thedrug between times **F** and **G**.

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(Extra space) _____

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(3)

(e) More cancer cells could be destroyed if the drug was given more frequently.

Suggest why the drug was **not** given more frequently.

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(2)

(Total 15 marks)

15 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 fromoutside 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.

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(2)

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

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(2)

(Total 5 marks)

16 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)

17 (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.

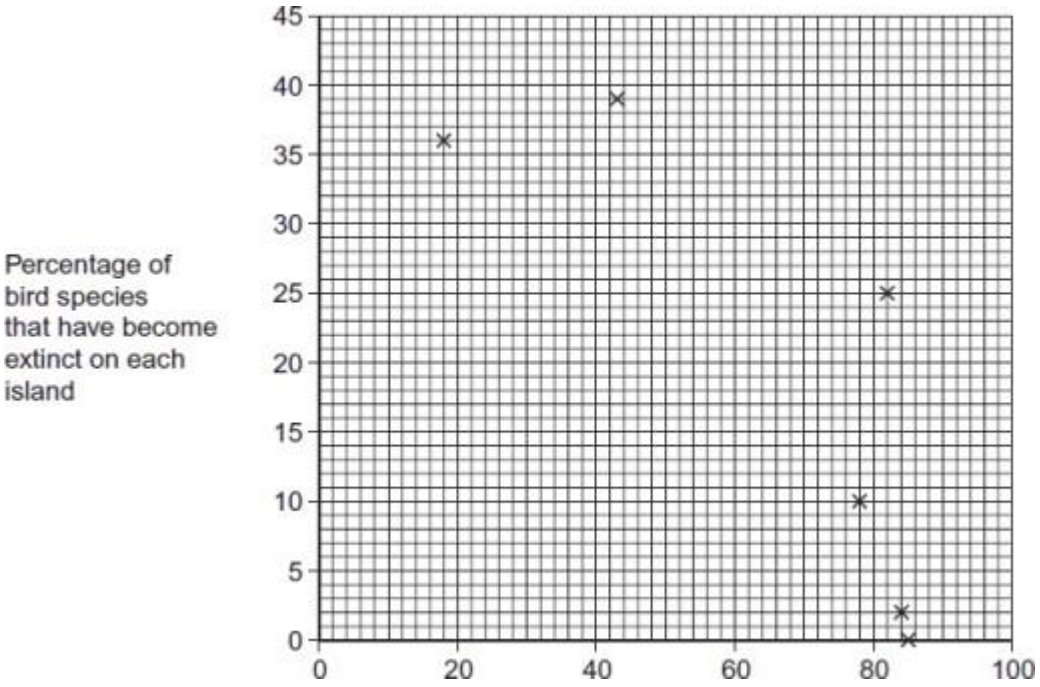
_____

_____

_____

(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 largerbody size than those surviving on warmer islands.

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

_____

_____

_____

_____

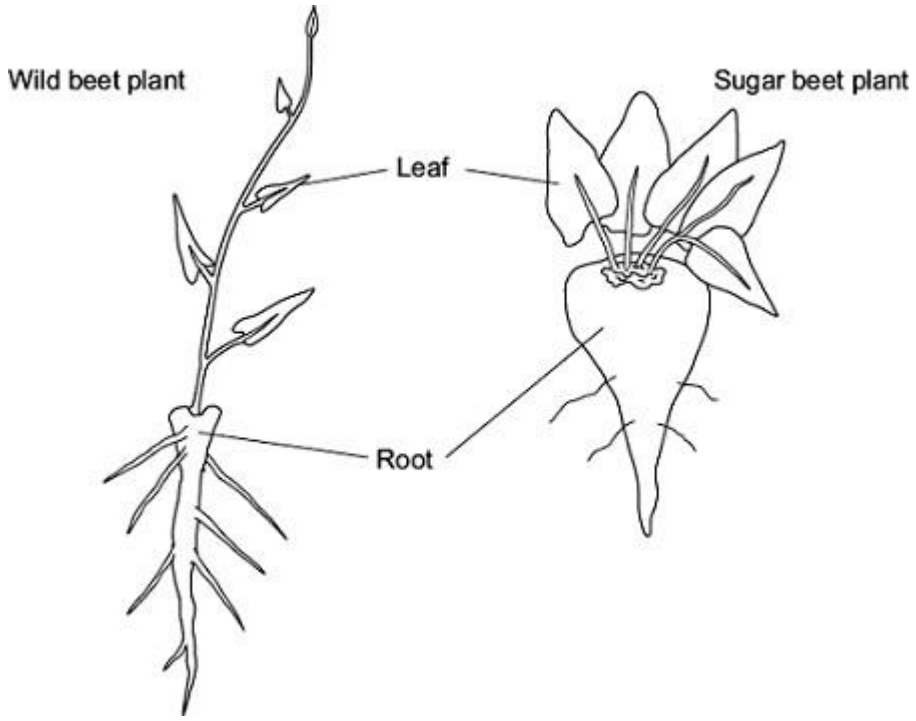
_____

(2)

(Total 8 marks)

18 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 _____

x

(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.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

19 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)

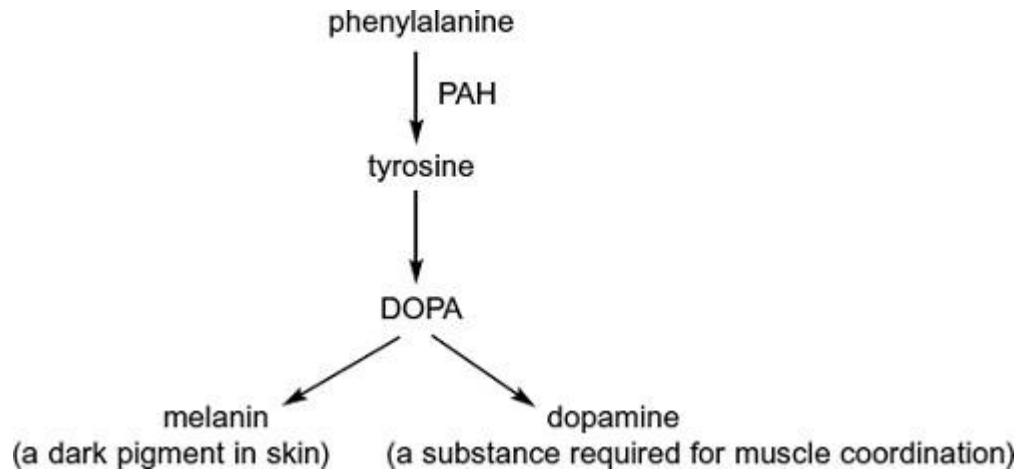
(ii) Explain how this mutation leads to the formation of non-functioning PAH.

(*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

x

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 thespread of this mutation may have occurred.

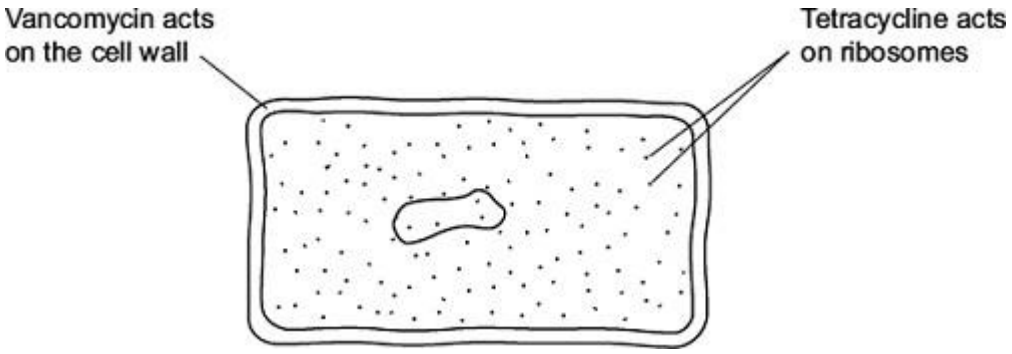
_____

_____

_____

(1)

20 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.

(Extra space)

(2)

(Total 4 marks)

21 (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.

(2)

(Total 4 marks)

22 (a) *Clostridium difficile* is a bacterium that is present in the gut of up to 3% of healthy adultsand 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.

_____

_____

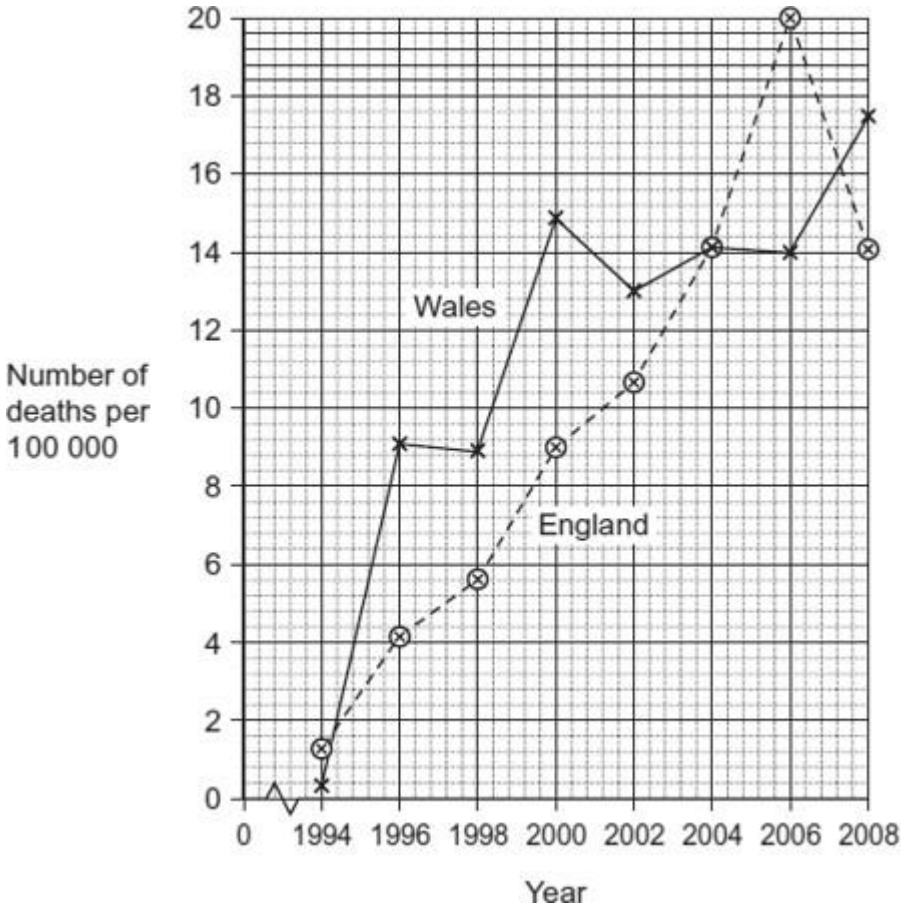
_____

_____

_____

(2)

(c) MRSA is a variety of *Staphylococcus aureus*. It is difficult to treat infections caused by thisbacterium 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 causedby 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 inWales from 1996 to 2006. Show your working.

Answer _____

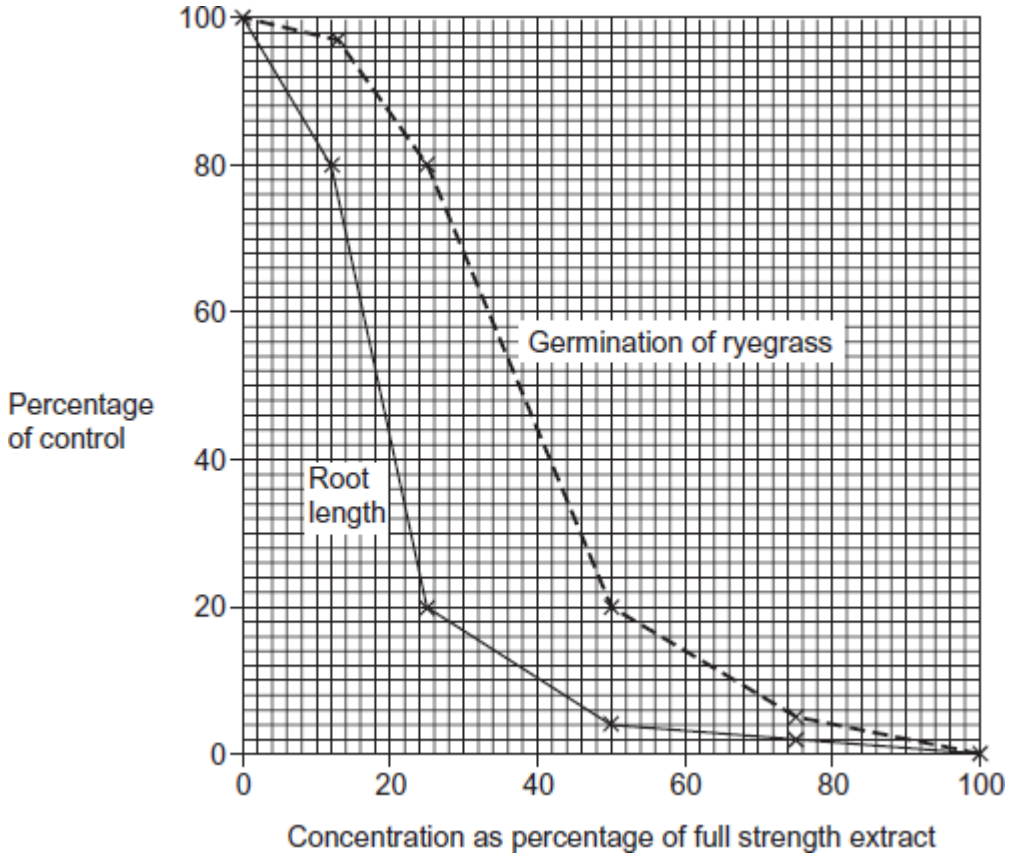
(2)

(Total 9 marks)

23 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.

_____

_____

_____

_____

x

(2)

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

_____

_____

_____

(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)

24 The body markings of cheetahs vary, in particular the pattern of bands on their tails. Cheetahsare solitary animals but the young stay with their mother until they are between 14 and 18 months old.

Scientists investigated the banding pattern on the tails of cheetahs living in the wild.

- They drove a car alongside a walking cheetah and used binoculars to study the tail pattern.
- They gave each cheetah a banding pattern score based on the width of the dark and light bands on the end of the tail.
- They scored the width of the bands on the right and left side of the tail using a 5 point scale of width.

A typical pattern on the right side of one cheetah's tail is shown in **Figure 1**.

Figure 1

Band number 1 2 3 4 5 6 7

Band width score 3 1 1 4 3 3 3

The scientists collected data from each cheetah on four separate occasions. **Figure 2** shows the data for one of the cheetahs.

Figure 2

Side of tail	**Mean band width score (± standard deviation)**						
	Band 1	**Band 2**	**Band 3**	**Band 4**	**Band 5**	**Band 6**	**Band 7**
Right	3.00 (± 0.82)	1.00 (± 0.00)	1.00 (± 0.00)	3.75 (± 0.50)	2.75 (± 0.50)	3.00 (± 0.00)	3.00 (± 0.00)
Left	3.75 (± 0.50)	3.25 (± 0.50)	2.00 (± 0.50)	3.00 (± 0.00)	2.00 (± 0.00)	2.50 (± 0.50)	3.00 (± 0.50)

(a) The scientists only used data from cheetahs which were fully grown. Suggest why.

_____

_____

(1)

(b) The scientists estimated the width of the bands on the same cheetah on four separateoccasions. They did not always get the same score.

(i) Give **two** pieces of evidence from **Figure 2** which show that the scientists sometimes obtained different scores for the same band.

1. _____

_____

2. _____

_____

(2)

(ii) The method the scientists used resulted in them getting different scores for the same band. Suggest why.

_____

_____

(1)

(c) What is the evidence from **Figure 2** that the dark and light bands do **not** form rings of equal width around the tail?

_____

_____

(1)

(d) The scientists found the difference in banding pattern between

- offspring in the same family
- cheetahs chosen randomly.

Explain how scientists could use this information to show that some variation in tail banding was genetic.

(Extra space)

(3)

(Total 8 marks)

Mark schemes

1

(a) 1. Contents of phloem vessel pushed into insect's mouth by high pressure;

2. (High pressure in phloem vessel) caused by loading of sugars into phloem in leaf;

3. And (resulting) entry of water by osmosis.

3

(b) 1. Polysaccharides are insoluble;

2. So do not affect water potential of gut.

2

(c) 1. (Only few bacteria passed from parent, so) only a few (copies of) genes passed on (in bacteria);

2. May not / does not include all alleles (of genes, so diversity reduced)
OR
Small number of bacteria transmitted means unrepresentative sample.

2

(d) 1. Number / mass / density of insects per plant;

2. Stage of development / size of plants / insects;
Ignore any abiotic factor

2

(e) Draw around leaf on graph paper **and** count squares;

1

[10]

2

(a) Binary fission;
Reject mitosis

1

x

(b) 1. Keep lid on Petri dish
OR
Open lid of Petri dish as little as possible.

2. To prevent unwanted bacteria contaminating the dish.
OR
L. monocytogenes may be dangerous / may get out.

OR

3. Wear gloves
OR
Wear mask
OR
Wash hands;

4. To prevent contamination from bacteria on hands / mouth
OR
Prevent spread of bacteria outside the lab;

OR

5. Use sterile pipette
OR
Flame the loop
OR
Flame the neck of the container of the culture;

6. To maintain a pure culture of bacteria

4 max

(c) Cinnamon;

1

(d) 1. Thyme is the most effective / best (at 4 °C);

2. Clove and cinnamon same effectiveness at 4 °C as 35 °C (so suitable);

3. Bay and nutmeg are less effective at 4 °C than 35 °C (so unsuitable).

3 **1**

(e) Less kinetic energy
OR
Less movement of oil molecules / of phospholipid molecules

1 max

3

(a) PKNJ.

1

(b) Lutra lutra.

1

(c) Bone / skin / preserved remains / museums.

x

[10]

(d) 1. (Hunting) reduced population size(s), so (much) only few alleles left;

Accept bottleneck

2. Otters today from one / few surviving population(s);

Accept founder effect

3. Inbreeding.

*Allow any **two***

2 max

(e) 1. Population might have been very small / genetic bottleneck;
2. Population might have started with small number of individuals / by one pregnant female / founder effect;
3. Inbreeding.

*Allow any **two***

2 max

[7]

4

(a) (No – no mark)
Graph / bar chart only shows number of species, not the name of the species.

1

(b) (No – no mark)
1. Mutations are spontaneous / random;
2. Only the rate of mutation is affected by environment;
3. Different species do not interbreed / do not produce fertile offspring;
4. So mutation / gene / allele cannot be passed from one species to another.

Ignore references to correlation does not prove causation

4

(c) 1. Initially one / few insects with favourable mutation / allele;
2. Individuals with (favourable) mutation / allele will have more offspring;
3. Takes many generations for (favourable) mutation / allele to become the most common allele (of this gene).

3

[8]

5

(a) 1. Kingdom, Phylum, Class, Order, Family;
2. *Luscinia svecica.*

1 mark for each correct column

Allow Genus and Species if both placed in box for species but not if both placed in genus box

2

(b) Number of different alleles of each gene.

Accept number of different base sequences (found) in each gene

1

(c) 1. Has greater proportion of genes / percentage of genes showing diversity;
2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278

2

[5]

6 (a) 0.32.

Correct answer = 2 marks

Accept 32% for 1 mark max

Incorrect answer but identifying 2pq as heterozygous = 1 mark

2

(b) 1. Mutation produced *KDR minus* / resistance allele;
2. DDT use provides selection pressure;
3. Mosquitoes with *KDR minus* allele more likely (to survive) to reproduce;
4. Leading to increase in *KDR minus* allele in population.

4

(c) 1. Neurones remain depolarised;
2. So no action potentials / no impulse transmission.

2

(d) 1. (Mutation) changes shape of sodium ion channel (protein) / of receptor (protein);
2. DDT no longer complementary / no longer able to bind.

2

[10]

x

7

(a) 1. Size of cotton swab;

2. Dampness of cotton swab;

3. Size of area of skin;

4. Time rubbed on skin;

5. Part of the body / skin sampled;

6. Volume of agar / nutrient concentration of agar;

7. Incubation time;

8. Incubation temperature;

3 max

(b) 99.8;

OR

57 271;

1 mark for writing out correct calculation: (401.6 – 0.7)/401.6 × 100
***OR** (401.6 – 0.7)/0.7 x 100*

1 mark max for incorrect rounding

Accept answers to any number of significant figures as long as rounding is correct

2

(c) 1. Spread here greater above the mean than below;

2. Some / many Petri dishes had no colonies;

Accept idea that data are not normally distributed / is skewed.

1 max

(d) 1. Treatment **C** / treatment normally used at the time;

2. (Because) using untreated / soap and water / treatment **A** / treatment **B** would have too great a risk of infection;

Accept C has least / lower risk of infection

Accept description of 'infection'

2

[8]

8

(a) Hydrolysis (reaction);

1

(b) 1. (Phosphate required) to make RNA;

2. (Phosphate required) to make DNA;

1 and 2. If neither DNA or RNA are named allow one mark for nucleotide/nucleic acid/phosphodiester bonds/sugar-phosphate backbone.

3. (Phosphate required) to make ATP/ADP;
4. (Phosphate required) to make membranes;

Ignore: phospholipids without reference to membranes.

5. (Phosphates required) for phosphorylation;

Accept: as additional mark points any named biological molecule containing phosphate e.g. NADP, AMP, RuBP. **2 max**

(c) Accept answer in range from 3.7 : 1 to 4.1 : 1;

Reject any ratio not : 1. **1**

(d) 1. Seeds/embryo remain dormant/inactive in winter/cold
OR
Growth/development of seed/embryo during winter/cold;

Ignore: hibernate.

Accept: 'seed survives winter/cold'.

Reject: plant develops or seed germinates during winter/cold.

2. Seeds/plants develop in spring/summer
OR
Seeds/plants develop when temperature/light increases;

Accept: seeds/plants develop when more light or when temperature is higher.

Accept: seed germinates/'sprouts' during spring/summer or when temp/light increases.

3. Plant photosynthesise (in spring/when warm);
4. Produce (more) seeds/offspring in spring/growing season; **3 max**

[7]

9 (a) 1. Change in DNA base/nucleotide (sequence);

Accept: mutation in DNA base (sequence).

Accept: deletion/substitution/addition of a DNA base/nucleotide.

2. Change in amino acid (sequence)/primary structure;

Reject: different amino acid formed.

Ignore: change in code for amino acid.

3. Alters (position of) hydrogen/ionic/disulfide bonds;
4. Change in tertiary structure (of receptor);

Reject: any reference to active site.

Ignore: 3°. **4**

(b) 1. (Receptor) is not complementary
OR
(HIV) cannot bind/attach and enter/infect (helper) T cell;

Accept: 'complimentary'.

Accept: invade as alternative to infect.

2. No replication (of virus)
OR
No destruction of (helper) T cell;

Accept: reproduction (of virus).

2

(c) 1. Low/lower exposure to HIV (in Europe)
OR
Low/lower number of HIV/AIDS (infections/cases);

Accept: converse.

2. (HIV) has only been present for a short time period
OR
(HIV relatively) recently evolved;
3. Mutation/CCR5 has been around for many years;

Accept: frequency of mutation has always been high.

4. Mutation/CCR5 is advantageous (for something else);

2 max

[8]

10 (a) Bacteria killed;

Ignore: no growth or growth of bacteria prevented.

Accept: bacteria destroyed.

Accept: no living bacteria.

1

(b) Clear zone would be too large
OR
Clear zones would overlap/merge
OR
Could kill all bacteria (on the plate);

Must convey idea of too large.

1

(c) 1. (Same) size;

Accept: any measure of size e.g. thickness, area, diameter.

Ignore: 'same shape' as shape shown on the diagram.

2. (Same) material/absorbency;
3. In solution for same time period;

Ignore: reference to volume of disinfectant.

2 max

(d) Any number between 2.5 to 3.2 = **two** marks;;

*Allow **one** mark for an incorrect answer but shows method of calculating how many times more effective D is than B*

e.g. 22 divided by 13/14

or 11 divided by 6.5/7

or 1.57/1.6/1.69/1.7.

2

[6]

11

(a) Locus;

Accept: loci

1

(b) Differences in DNA / differences in base sequence of DNA;

Accept: number of different alleles / size/variation in gene pool

Reject: genes

1

(c) 1. Jack Russell (genetic) diversity is (significantly) greatest;
2. Bull terrier (genetic) diversity is (significantly) smallest / is most inbred;
3. Miniature terrier and Airedale terriers are similar;

1-3: do not credit just a list of values

4. Standard deviations do not overlap / do overlap with correct ref to significance;

Reference to significance must be relevant to examples given

Max 3

(d) 1. (Bull terrier) breeding has included a genetic bottleneck/ small population/more inbreeding/ greater selection (pressure);

Accept: founder effect

2. Reduced number of different alleles/size of gene pool;

Reject: decrease in number of genes

Ignore ref to mutations

OR

3. Miniature (terrier) breeding has included more outbreeding/less selection (pressure);
4. Increased number of different alleles/larger gene pool/more variety of alleles;

Reject if genes used instead of alleles

Reject: lower frequency of alleles

Ignore ref to mutations

2

[7]

12

(a) 1. Type of feed affects (antibiotic) resistant bacteria (in animals);

Accept: null hypotheses

Accept predictions, for example

More antibiotic resistant bacteria form in animals fed with antibiotics in their food

2. (Antibiotic) resistant resistant infect /are passed on to animals/farmer / resistant resistant are passed between animals;

Accept: bird to bird/bird to human/human to human

Accept: a link (exists) between (antibiotic) resistance in animals and their keepers/farmers – as lowest level QWC

3. Incidence of (antibiotic) resistant resistant differs in chickens and turkeys;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

4. Incidence of (antibiotic) resistant resistant differs in chicken farmers and turkey farmers;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

Max 2

(b) (i) 1. Large(r) percentage of resistant bacteria in turkeys/low(er) percentage of resistant bacteria in chickens;

Accept: E coli for bacteria

Ignore: number, eg. ignore 'more'/'fewer' turkeys/chickens

2. Large(r) percentage of resistant bacteria in turkey farmers/low(er) percentage of resistant bacteria in chicken farmers;

2

(ii) 1. (More) antibiotic in turkey feed kills (more) non-resistant bacteria / resistant bacteria survive;

Accept: antibiotic creates selection pressure

Survive must be explicit, not implied by 'reproduce'

2. (Resistant bacteria) reproduce / pass on gene for resistance;

2

(c) (Human) faeces contain pathogens;

Accept: harmful organisms

1

(d) 1. Large number of farms / farmers (surveyed) / 46;

'Reliable' is used in the question stem

2. So results are (likely to be) representative / can identify anomalous results;

Ignore: reproducible / accurate / valid / reliable

Accept valid explanation of replicates minimising effects of chance

2

(e) 1. (DNA) hybridisation (of gene for resistance in bacteria takenfrom bird and farmer);
2. (Identical) strands separate at high(est) temperature;

OR

3. Compare base/nucleotide sequence (of gene for resistance in bacteria taken from bird and farmer);
4. (Identical strains) have identical/same base sequences

Mark in pairs, do not mix and match.

Accept: bacteria in bird and farmer/both types of bacteria have identical base sequences = 2 marks

2

(f) 1. (Antibiotic use has) increased cases of bacterial resistance;

Accept: number

2. Transfer/horizontal transmission of (resistance) gene to pathogens/harmful bacteria;

Accept: conjugation

3. (Antibiotic) resistant bacteria cause harm / medical treatments less effective;

Accept: superbug

4. Avoids side effects on animals;
5. Increased demand for organic food;
6. Antibiotic/resistant bacteria could be present in human food;
7. High cost of antibiotics;
8. Legislation has controlled antibiotic use;

Accept: EU/government guidelines

4 max

[15]

13 (a) 1. Change / mutation in base / nucleotide sequence (of DNA / gene);

Q.

Ignore: references to changing base-pairing

Accept: affect for change, if in correct context

Accept: changes triplets / codons

2. Change in amino acid sequence / primary structure (of enzyme);

Accept: different amino acid(s) coded for

***Q** Reject: different amino acids produced / formed / made*

3. Change in hydrogen / ionic / disulfide bonds;

Accept: references to sulfur bonds

4. Change in the tertiary structure / shape;

Neutral: alters 3D structure / 3D shape

5. Change in active site;

6. Substrate not complementary / cannot bind (to enzyme / active site) / no enzyme-substrate complexes form.

Accept: no E S complexes form

6

(b) 1. Non-SR strain falls more / SR strain falls less / up to 10(µg / cm−3);

Must include 10 but only required once in either MP1 or MP2

Ignore: units or absence of

This must be a comparative statement

2. Above 10(µg / cm^{-3}), SR strain levels out / off and non-SR strain continues to decrease;

3. Greater difference between strains with increasing concentration of antibiotic.

This must be a comparative statement

2 max

(c) 1. Division stopped (of both strains by scientist);

Reject: references to mitosis stopping

2. SR strain still more resistant / fewer die / none die (at higher concentrations of antibiotic).

Accept: SR strain and non-SR strain would be similar if resistance is due to only stopping division

Need some comparison with non-SR

2

x

(d) 1. Make a competitive / non-competitive inhibitor;

Mark in pairs

either MP1 and MP2 OR MP3 and MP4

2. Competitive competes with / blocks active site / non-competitive inhibitor affects / changes active site;

Do not mix and match

OR

3. (Make a drug) that inhibits / denatures / destroys enzyme / stringent response;

Accept: drug that 'knocks out' / destroys enzyme

4. Give at the same time as / before an antibiotic.

2 max

(e) (SR strain)

1. Fewer free radicals (than non-SR);

Note: has to be comparative statement

2. Produces more catalase (than non-SR);

Accept converse statements for non-SR.

3. Catalase (might be) linked to production of fewer free radicals / breaking down / removing free radicals.

Accept: hydrolysis of radicals by catalase.

3

[15]

14 (a) 1. Sugar-phosphate (backbone) / double stranded / helix **so** provides strength / stability / protects bases / protects hydrogen bonds;

Must be a direct link / obvious to get the mark

Neutral: reference to histones

2. Long / large molecule **so** can store lots of information;

3. Helix / coiled **so** compact;

Accept: can store in a small amount of space for 'compact'

4. Base sequence allows information to be stored / base sequence codes for amino acids / protein;

Accept: base sequence allows transcription

5. Double stranded **so** replication can occur semi-conservatively / strands can act as templates / complementary base pairing / A-T and G-C so accurate replication / identical copies can be made;

6. (Weak) hydrogen bonds **for** replication / unzipping / strand separation / many hydrogen bonds **so** stable / strong;

Accept: 'H-bonds' for 'hydrogen bonds'

6

(b) 1. (Mutation) in **E** produces highest risk / 1.78;

2. (Mutation) in **D** produces next highest risk / 1.45;

3. (Mutation) in **C** produces least risk / 1.30;

Must be stated directly and not implied

E *>* ***D*** *>* ***C*** *= 3 marks*

Accept: values of 0.78, 0.45 and 0.30 for MP1, MP2 and MP3 respectively

If no mark is awarded, a principle mark can be given for the idea that all mutant alleles increase the risk

3

(c) **180**;

1

(d) (Similarities):

1. Same / similar pattern / both decrease, stay the same then increase;

2. Number of cells stays the same for same length of time;

Ignore: wrong days stated

(Differences):

(Per unit volume of blood)

3. Greater / faster decrease in number of healthy cells / more healthy cells killed / healthy cells killed faster;

Accept: converse for cancer cells

Accept: greater <u>percentage</u> decrease in number of cancer cells / greater <u>proportion</u> of cancer cells killed

4. Greater / faster increase in number of healthy cells / more healthy cells replaced / divide / healthy cells replaced / divide faster;

Accept: converse for cancer cells

For ***differences****, statements made must be comparative*

3 max

(e) 1. More / too many healthy cells killed;

2. (So) will take time to replace / increase in number;

Neutral: will take time to 'repair'

3. Person may die / have side effects;

2 max

[15]

15 (a) 250 000;

1

(b) (i) Loss of 3 bases / triplet = 2 marks;;

'Stop codon / code formed' = 1 mark max unless related to the last amino acid

Loss of base(s) = 1 mark;

eg triplet for last amino acid is changed to a stop codon / code = 2 marks

3 bases / triplet forms an intron = 2 marks

Accept: descriptions for 'intron' eg non-coding DNA

'Loss of codon' = 2 marks

2

(ii) 1. Change in tertiary structure / active site;

Neutral: change in 3D shape / structure

2. (So) faulty / non-functional protein / enzyme;

Accept: reference to examples of loss of function eg fewer E-S complexes formed

2

[5]

16 (a) 1. No interbreeding / gene pools are separate / <u>geographic(al)</u> isolation;

Accept: all marks if answer written in context of producing increased diversity of plants

1 Do not award this mark in context of new species being formed and then not interbreeding

1 Accept reproductive isolation as an alternative to no interbreeding

2. Mutation;

2 Accept: genetic variation

3. Different selection pressures / different foods / niches / habitats;

3 Accept: different environment / biotic / abiotic conditions or <u>named</u> condition

3 Neutral: different climates

4. Adapted organisms survive and breed / differential reproductive success;

5. Change / increase in allele frequency / frequencies;

5

(b) Similar / same environmental / abiotic / biotic factors / similar / same selection pressures / no isolation / gene flow can occur (within a species);

Accept: same environment

1

[6]

17 (a) (i) (We should maintain biodiversity to)

Prevent extinction / loss of populations / reduction in populations / loss of habitats / save organisms for future generations (idea of);

Neutral: references to 'playing God' / animal rights **1**

(ii) A suitable example of how some species may be important financially e.g.

1. medical / pharmaceutical uses;
2. commercial products / example given;
3. tourism;
4. agriculture;
5. saving local forest communities; **1 max**

(b) 1. Fewer plant species / decrease in plant diversity;

Accept: converse arguments for islands with a high percentage of forest remaining

1. Neutral: fewer plants

2. Fewer habitats nesting sites / niches / food sources / varieties / less protection from predators / hunters / environment;

2. Neutral: fewer homes

2. Neutral: less food **2**

(c) 1. Number of (individuals / birds of) each species;

1. Neutral: number of species

2. Total number of individuals / birds of all species;

2. Accept: 'total number of birds' as given context for 'all species' in the investigation **2**

(d) 1. (Larger birds have) a low(er) SA:VOL;

Neutral: reference to fat / feathers

2. (So) less heat loss / more heat retained;

MP2 is independent of MP1 **2**

[8]

x

18 (a) 2 of the following pairs:

Mark for explanation must be paired with correct change in structure

1. Larger leaves;

2. Photosynthesis;

OR

Accept converse descriptions of leaves, root and stem: longer root, taller stem, smaller leaves

3. Larger / bigger / thicker root;

4. Storage;

OR

5. Stem shorter / absent;

Accept converse correct explanation

6. Less energy used in stem growth / more energy for producing sugar;

4 max

(b) Beet ready quicker / less time required / allows land to be used again / harvested earlier;

Allow more crops / many harvests. Ignore references to yield / profit

1

(c) 1. (Diversity) reduced / fewer different alleles / less variation / smaller gene pool;

2. As <u>alleles</u> have been chosen / rejected;

19 (a) (i) 4;

(ii) 1. Change in amino acid / (sequence of) amino acids / primary structure;

1. Reject = different amino acids are 'formed'

2. Change in hydrogen / ionic / disulphide bonds alters tertiary structure / active site (of enzyme);

2. Alters 3D structure on its own is not enough for this marking point.

3. Substrate not complementary / cannot bind (to enzyme / active site) / no enzyme- substrate complexes form;

(b) 1. Lack of skin pigment / pale / light skin / albino;

2. Lack of coordination

x

ted;

2

[7]

1

3

2 max

(c) Founder effect / colonies split off / migration / interbreeding;

Allow description of interbreeding e.g. reproduction between individuals from different populations **1**

[7]

20 (a) (i) (Human cells) don't have a cell wall;

Accept "they" refers to human cells. **1**

(ii) (Affects) protein synthesis;

Allow description e.g. 'amino acids not joined together / translation.

Reject: affects transcription. **1**

(b) 1. Mutation present / occurs;

Ignore antibiotic causes mutation.

2. Resistance gene / allele;

1. or 2.

Reference to immunity disqualifies first credited marking point.

3. Resistant bacteria (survive and) reproduce;

Reference to mitosis negates marking point 3. **2**

[4]

21 (a) Difference in DNA / base sequence / difference in alleles / genes / gene pool;

Neutral: 'fewer alleles' unless qualified e.g. fewer different alleles. **1**

(b) Environmental;

Accept: Environment **1**

(c) Reduced (genetic diversity);

As fewer different / varied alleles / genes / reduced gene pool; **2**

[4]

22 (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;

Less / no competition so (*Clostridium*) reproduces / replicates / multiplies / increases in number;

Reference to bacteria being 'immune' negates first marking point.

Reference to mitosis negates second marking point. **2**

(ii) Immune system less effective / more likely to have otherinfections / been in hospital;

Accept: 'Weak / lower' immune system'.

1

(b) Attaches to active site (of enzyme);
(Methicillin) is a competitive inhibitor / prevents monomers / substrate attaching (to enzyme);

'Competes for active site' = 2 marks.

Neutral: 'Prevents monomers joining / attaching to each other'.

Allow one mark max for answers relating to non-competitive inhibitor changing active site / preventing substrate attaching.

Do not penalise Methicillin forms an enzyme / substrate complex.

2

(c) (i) Have other illness / medical condition / 'weak' immune system / disease / infection;

Reject: Due to 'other factors', 'are smokers', 'are obese' unless related to disease or illness.

1

(ii) Increase up to 2006 / 20 (per 100 000) then decreases;

1

(iii) Correct answer in range of 52 – 59.1% = two marks;

Incorrect answer but shows change as between 4.8 – 5.2 / shows correct subtraction giving this change e.g. 14 – 9 = one mark.

23 (a) Same number of ryegrass seedlings in distilled water;

(b) (i) Produce null hypothesis;

Carry out Spearman Rank correlation test / find correlation coefficient;

Use values to show P < critical value / find probability of results being due to chance;

Accept valid example

E.g. There is no correlation between inhibition of germination and the concentration of the extract.

(ii) May be another factor / named factor (that also inhibits germination);

e.g. amount of water in extract

(c) (i) Extract inhibits ryegrass germination / extract stops ryegrass starting to grow;

x

/ causes ryegrass to have shorter roots;

2

[9]

1

2 max

1

2

(ii) Scientists crushed plants to get extract;

Plants might not secrete substances in the extract into the soil;

These substances might get broken down in the soil;

Wheat and ryegrass might not grow at the same time / wheat plants might not produce substance when ryegrass is growing;

Concentration of extract in the soil might be different from that in solution;

3 max

[9]

24 (a) Banding pattern changes as cheetah gets older / difficult to judge as tail is short / fluffy;

1

(b) (i) Mean not (always) a whole number;
Standard deviation not (always) zero;

2

(ii) Movement of tail / angle of sight / confused it with another band / subjective estimation;

Accept reference to ***Figure 1***

E.g. Bands 2 and 3 have same thickness but look different

1

(c) Band width not the same on both sides of tail;

1

(d) Offspring of the same family will be more similar genetically;
As have same mother (and father) / parent;
Expect to see more differences in randomly chosen cheetahs;

3

[8]