EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed

54 Minutes

Score /45

Percentage %

Biology

Topic Questions

AQA
AS & A LEVEL

3.4 Genetic information, variation and relationships between organisms

1 **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.

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 **(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?**

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(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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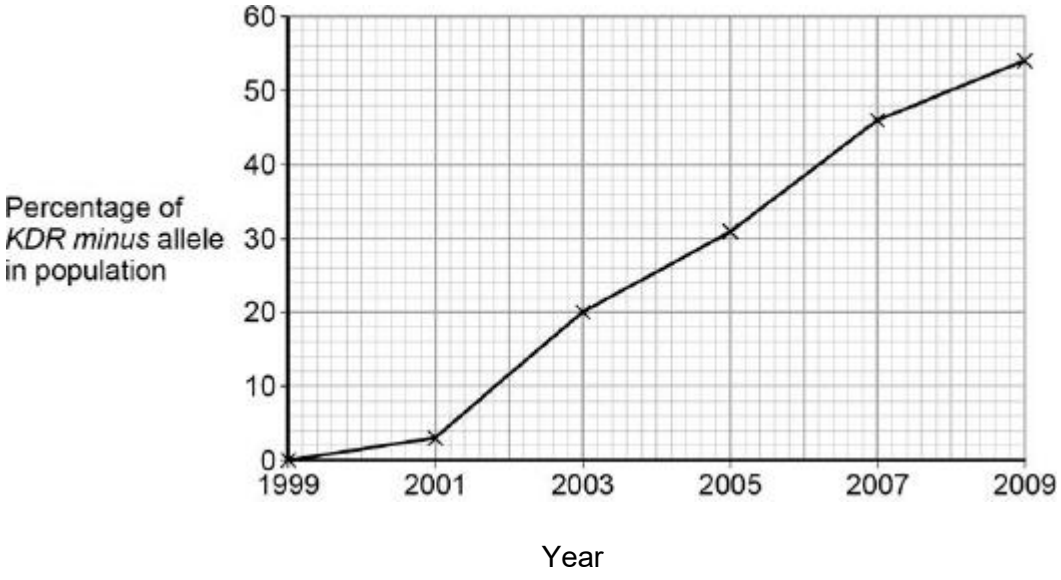
(2)
(Total 5 marks)

2 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.

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(Extra space) .....

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(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.

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(2)

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

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(2)

(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.

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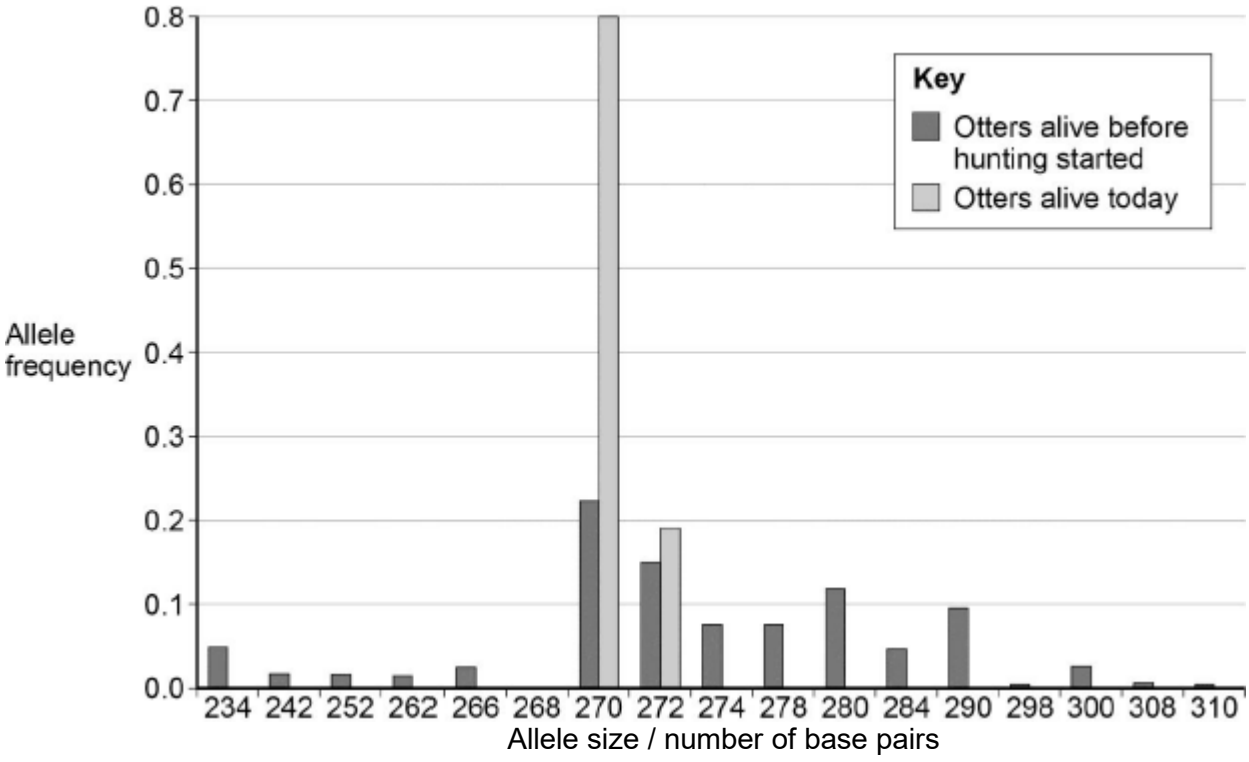
(1)

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.

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(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.

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(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.

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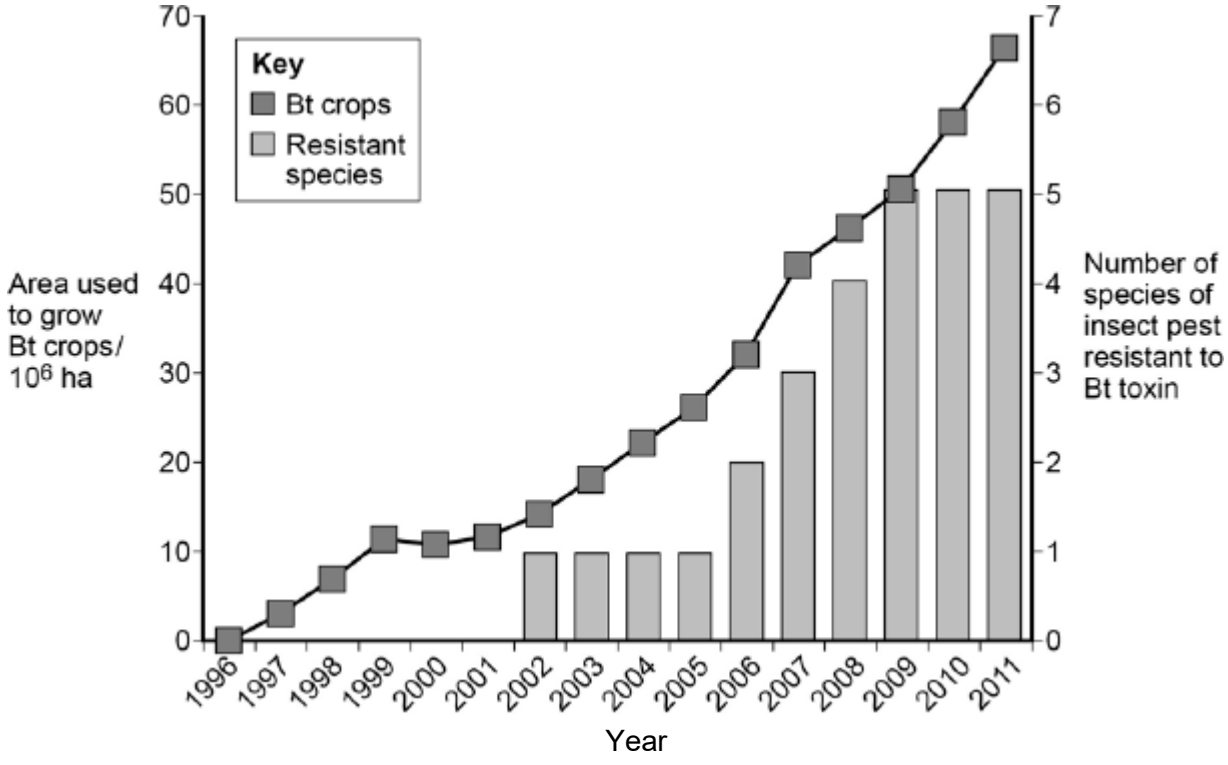
(2)
(Total 7 marks)

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.

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(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.

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(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.

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(3)
(Total 8 marks)

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

(6)

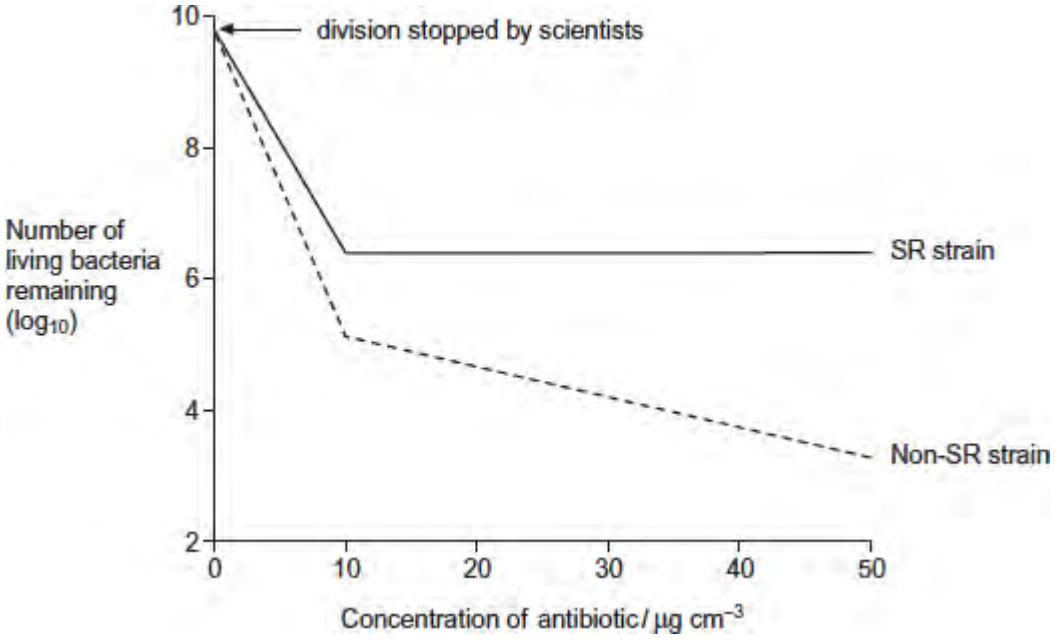
Scientists investigated the effect of a specific antibiotic on two strains of the same species of bacterium.

- 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.

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[Extra space] .....

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(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.

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(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)

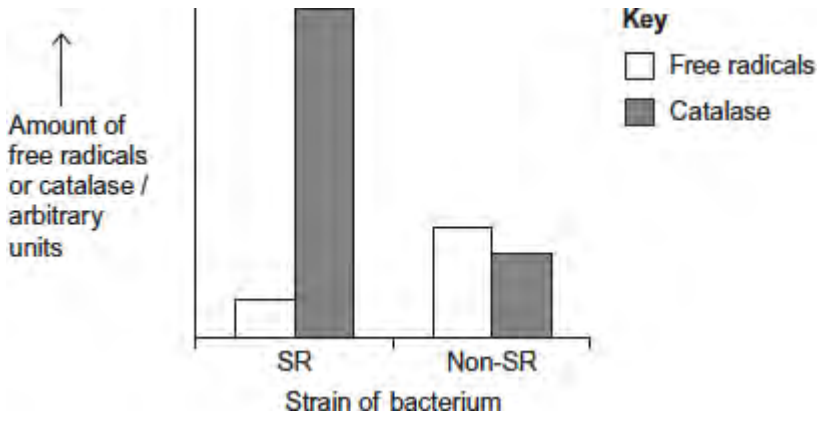
The antibiotic damages the bacterium by causing the production of substances

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 greater resistance of the SR strain to this antibiotic.

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(3)
(Total 15 marks)