

Q1.(a) A mutation can lead to the production of a non-functional enzyme. Explain how.

(6)

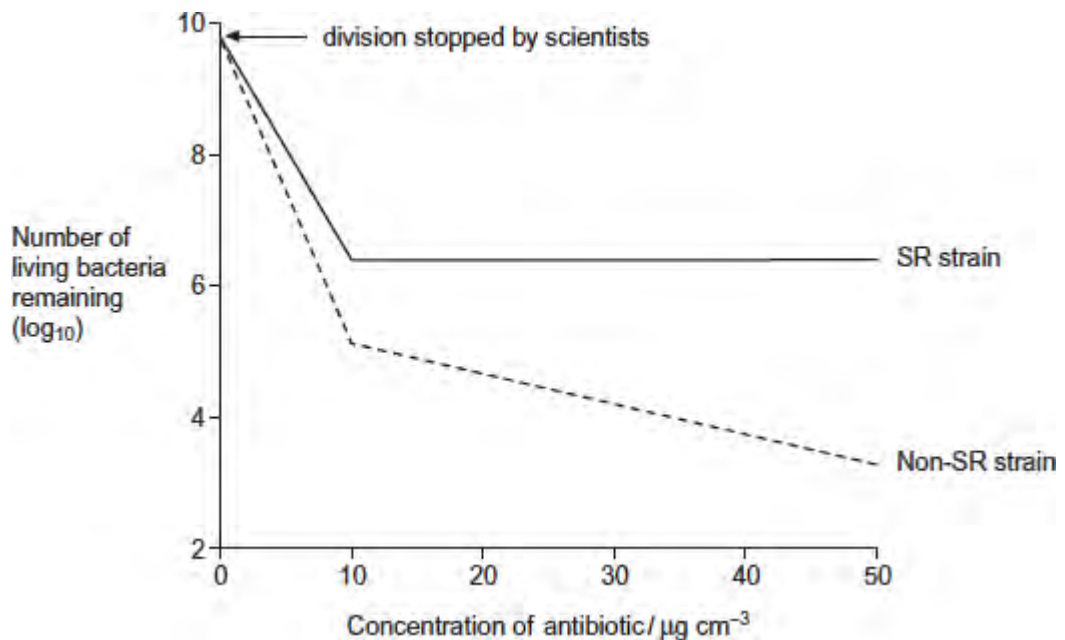
Scientists investigated the effect of a specific antibiotic on two strains of the same species of bacterium.

- 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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(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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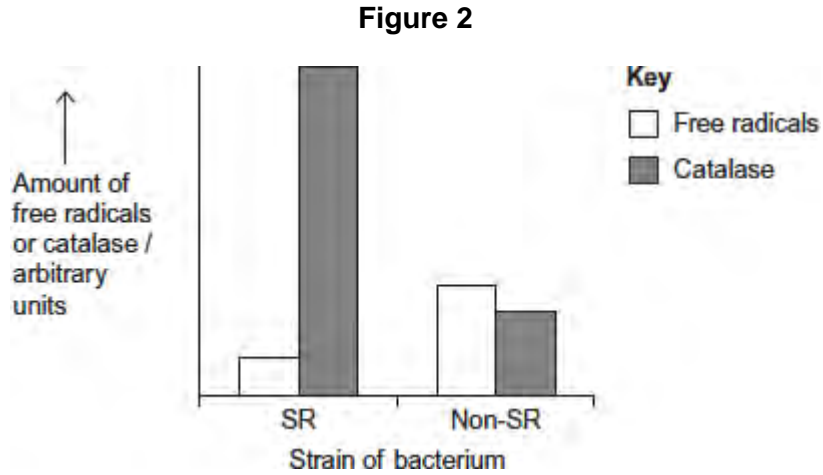
(2)

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.



- (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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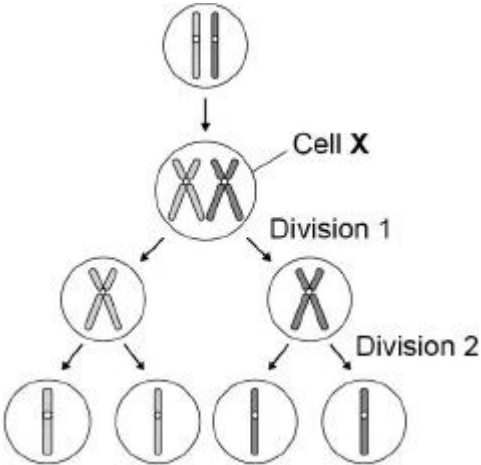
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(3)
(Total 15 marks)

Q2. The figure below summarises the process of meiosis. The circles represent cells and the structures within each cell represent chromosomes.



(a) Describe and explain the appearance of **one** of the chromosomes in cell **X**.

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(3)

(b) Describe what has happened during division 1 in the figure above.

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(c) Identify **one** event that occurred during division 2 but **not** during division 1.

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(1)

(d) Name **two** ways in which meiosis produces genetic variation.

1

2

(2)

(Total 8 marks)

Q3. 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.

(1)

(b) Give the scientific name of this otter.

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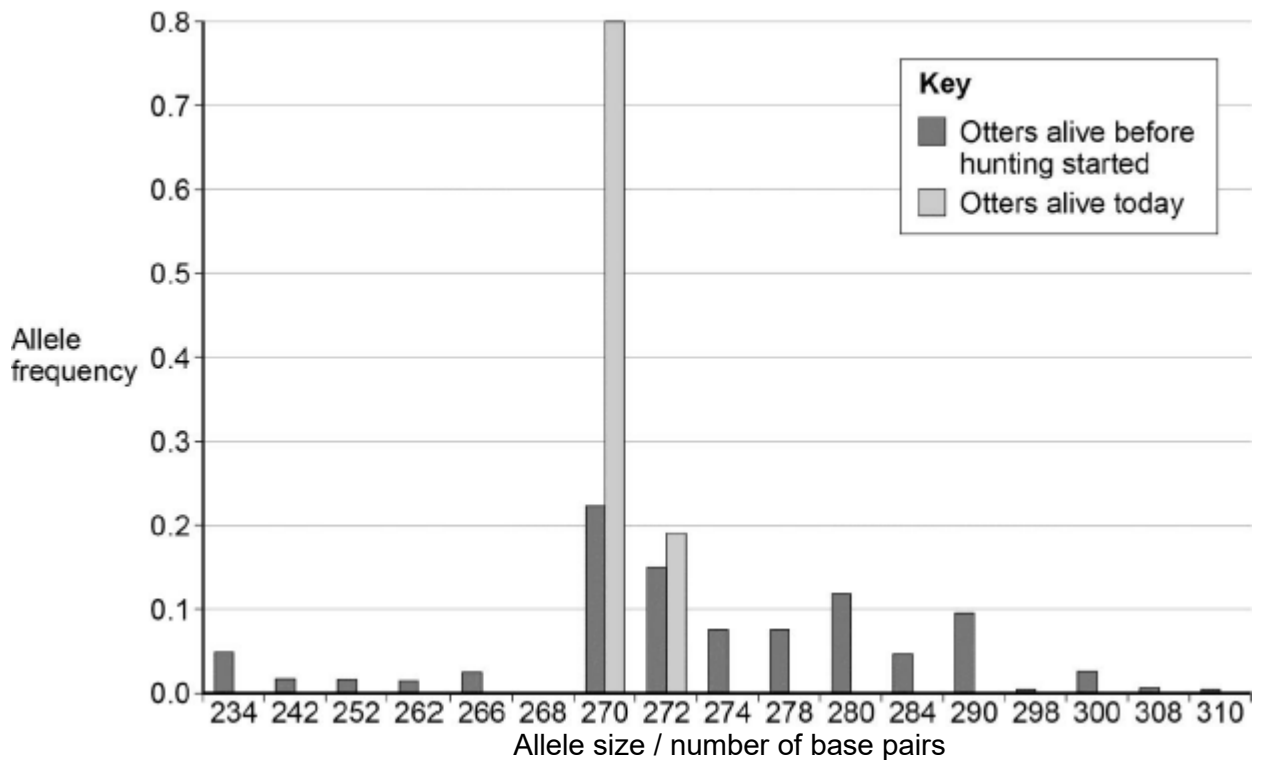
(1)

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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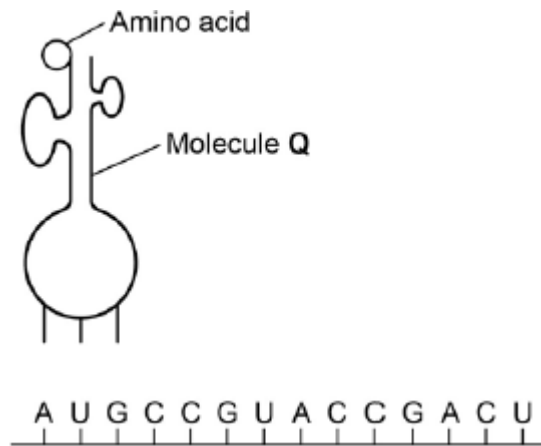
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(2)

(Total 7 marks)

Q4.The diagram below represents one process that occurs during protein synthesis.



(a) Name the process shown.

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(1)

(b) Identify the molecule labelled **Q**.

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(1)

(c) In the diagram above, the first codon is AUG. Give the base sequence of:
 the complementary DNA base sequence
 the missing anticodon

(2)

The table below shows the base triplets that code for two amino acids.

Amino acid	Encoding base triplet
Aspartic acid	GAC, GAU
Proline	CCA, CCG, CCC, CCU

(d) Aspartic acid and proline are both amino acids. Describe how two amino acids differ from one another. You may use a diagram to help your description.

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(1)

(e) Deletion of the sixth base (G) in the sequence shown in the diagram above would change the nature of the protein produced but substitution of the same base would not. Use the information in the table and your own knowledge to explain why.

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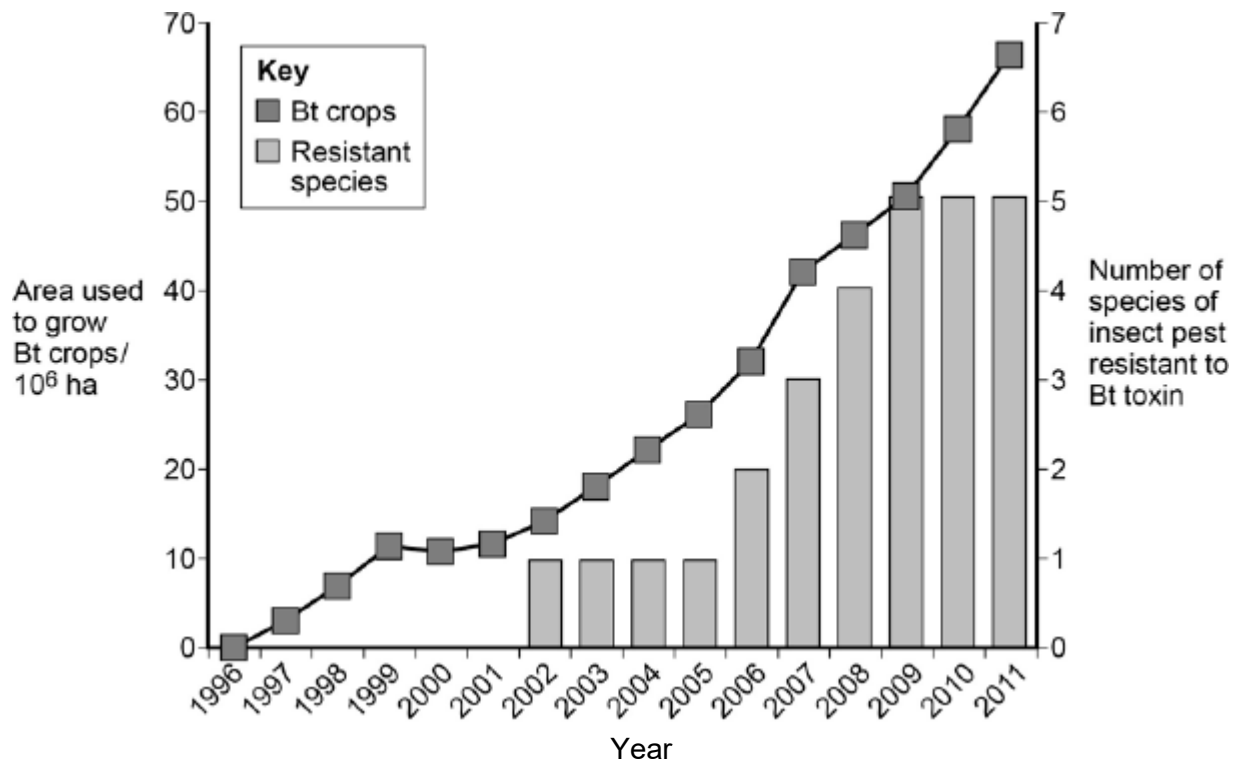
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Q5. To reduce the damage caused by insect pests, some farmers spray their fields of crop plants with pesticide. Many of these pesticides have been shown to cause environmental damage.

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)