Unit 4 Biology

Revision Booklet 12

Topics

Population Genetics

Variation & Genes in Populations

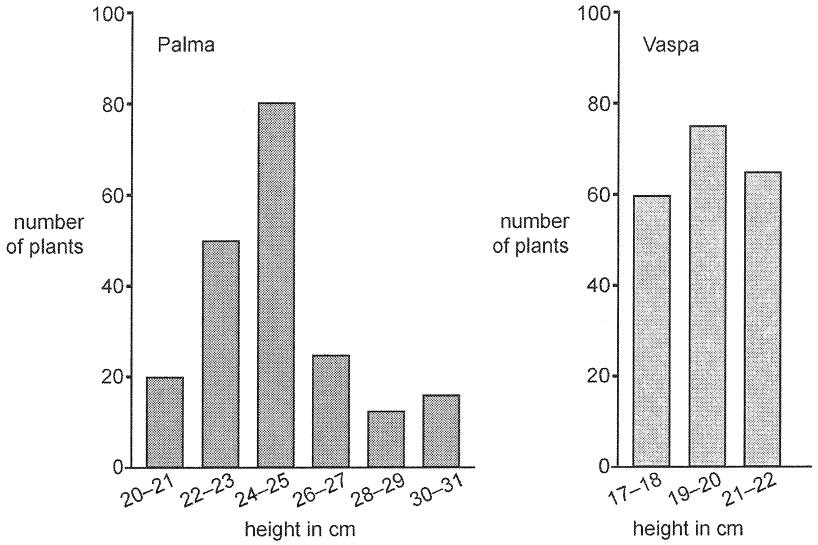
Mutation

Change agents in a population

Name: .....

Question 3

An experiment was set up to investigate the growth of two varieties of pea plants, Palma and Vaspa. Two hundred plants of each variety were grown from seed for 10 weeks. The histograms below show the heights of the plants (measured to the nearest whole number) at the end of 10 weeks.



a. **i.** Name the independent variable (also known as the experimental variable) in this experiment.

_____

ii. Equal numbers of each type of seed were grown for the same amount of time.
State one environmental variable that should be controlled in this experiment.

_____

_____

1 + 1 = 2 marks

b. What difference in height exists between the tallest Palma and tallest Vaspa plants?

_____

1 mark

c. Is height in pea plants controlled by one or many genes? Circle your answer and justify your choice.

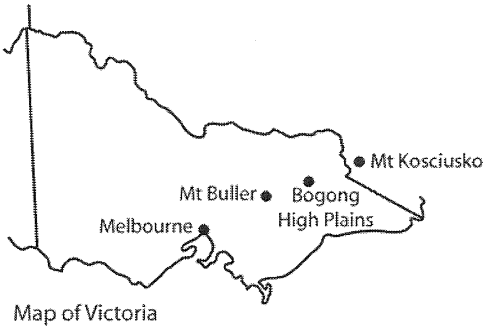
one gene many genes

_____

_____

2 marks

The endangered pygmy possum (*Burramys parvus*) lives in three restricted alpine areas, Mt Buller, Bogong High Plains and Mt Kosciusko.



Map of Victoria

About 2000 individuals remain in the wild. Studies show that there is a lot of genetic diversity between the three populations. Due to the isolation of these populations, scientists think that each population has a separate gene pool.

d. Explain what is meant by gene pool.

_____

_____

1 mark

e. Explain how exchange of genetic material may be beneficial in the survival of endangered species like the pygmy possum.

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2 marks

Total 8 marks

Question 4

In the late 1950s, a series of nuclear tests involving the detonation of hydrogen bombs was carried out in the mid-Pacific Ocean. Witnesses of these tests included 500 New Zealand sailors.

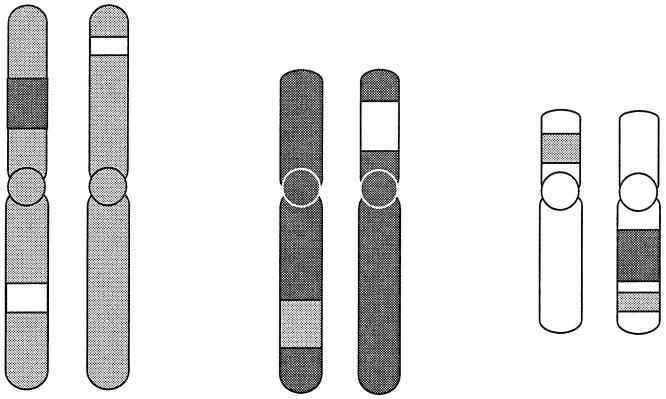
Since the tests, the New Zealand sailors have claimed that their lives have been affected because, as a direct result of radioactivity from the tests, a number of genetic disorders have appeared among them and their offspring.

In the year 2000, the New Zealand veterans commissioned research to assess DNA damage that they may have.

a. Describe three factors that scientists would need to consider in the design of their research.

3 marks

The chromosomes of men who participated in the study were examined. Each homologous pair of chromosomes was stained with a specific colour. This technique meant that segments of chromosomes that have moved between non-homologous chromosomes can be readily identified. The following diagram shows the result for three homologous pairs of chromosomes from veteran X.



b. **i.** Assume that you are veteran X. Use the data to present an argument supporting your claim that you have genetic defects that adversely impact on your health.

_____

_____

_____

_____

_____

_____

ii. Explain how the results for veteran X could lead to an increase in genetic disorders in his children and grandchildren.

_____

_____

_____

_____

2 + 2 = 4 marks

c. One individual claimed the chromosomal changes observed in veteran X were mutations involving a single base pair on each chromosome. Explain whether you agree or disagree with this individual.

_____

_____

1 mark

Total 8 marks

Question 8

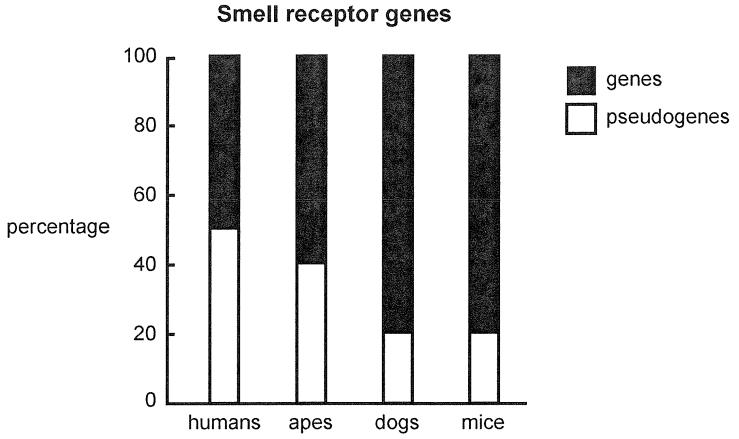
Pseudogenes are the remains of broken genes which are unable to function and can be considered to be genetic fossils. Some are relics of genes lost through evolution while others reflect an earlier version of a present functional gene. Pseudogenes are able to accumulate all kinds of mutations.

The gene G in mice makes an enzyme that helps synthesise vitamin C, but this gene became faulty in primates more than 40 million years ago and is now a pseudogene in humans.

a. What is one possible consequence of the loss of gene G in primates?

1 mark

In mammals, more than one thousand genes coding for smell receptors have been identified. Individual species vary in the proportion of these genes that have become pseudogenes, and humans have fewer than 500 functional genes coding for smell receptors. The majority of these genes are still functional genes in rats and mice.



b. From the graph, what can be concluded about the importance of smell to the survival of these four groups?

1 mark

c. Mice and dogs can only distinguish shades of grey, while some apes and monkeys are able to distinguish colours. Would you expect to find any change in the numbers of smell pseudogenes in apes and monkeys able to distinguish colours? Explain why.

1 mark

d. Why are pseudogenes able to accumulate mutations that do not exist in functional genes?

2 marks

Total 5 marks

SECTION B – continued

Question 4

Species of the fruit fly *Drosophila* generally have four pairs of homologous chromosomes.

a. What is meant by the term 'homologous chromosomes'?

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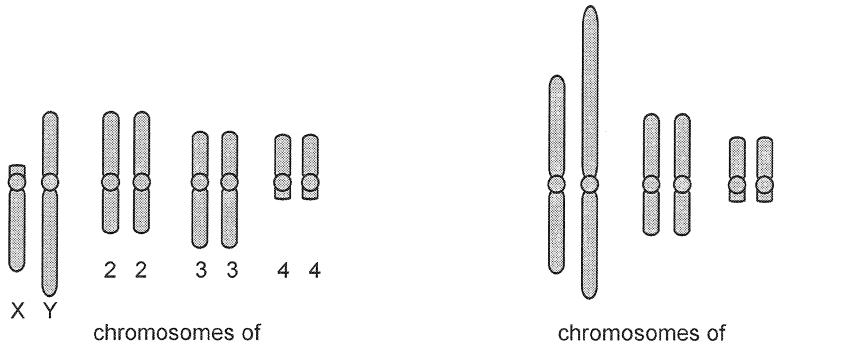
_____

1 mark

The number of chromosomes sometimes varies from the usual four pairs. Karyotypes of two different *Drosophila* are shown in the following diagram. Note that one is a subspecies of the other.



b. Describe an event that could have caused the chromosome differences between *D. nasuta* and *D. nasuta* subspecies *albomicans*.

_____

_____

1 mark

A cross between a female *D. nasuta* and a male *D. nasuta* subspecies *albomicans* results in offspring.

c. What would be the diploid number of these hybrid flies?

_____

1 mark

d. Explain how chromosome differences between *Drosophila nasuta* and *Drosophila nasuta* subspecies *albomicans* could result in their reproductive isolation and speciation.

Relates to AOS 2.

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2 marks

Total 5 marks

Question 6

a. Define genetic drift.

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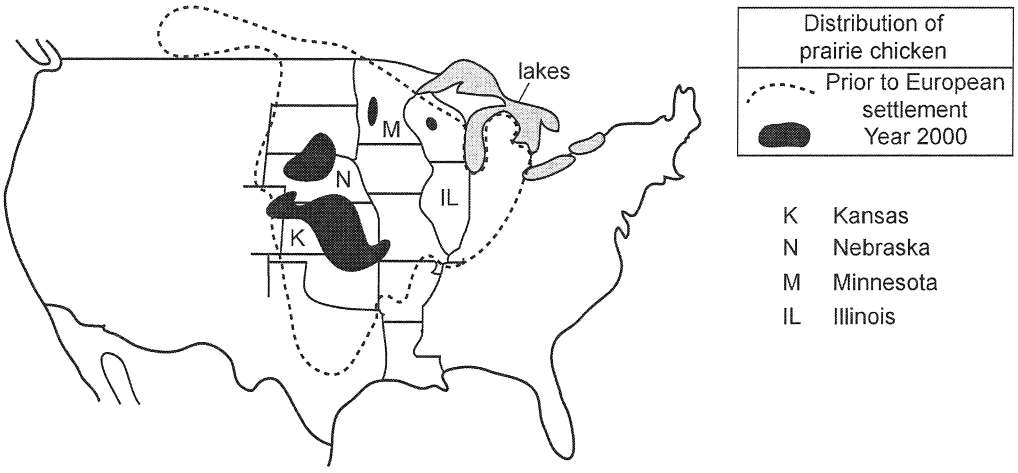
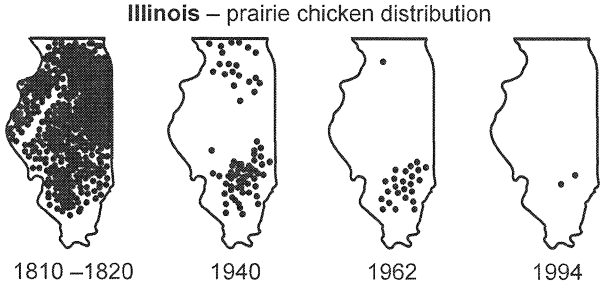
_____

1 mark

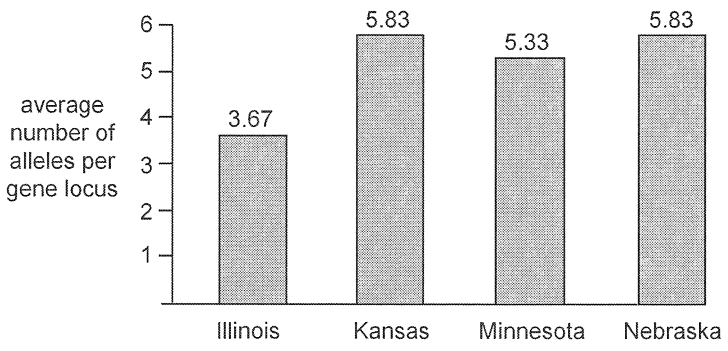
The prairie chicken (*Tympanuchus cupido pinnatus*) is a grassland bird native to North America. A prairie chicken spends its entire life within several kilometres of its birthplace. Prior to European settlement, prairie chickens numbered in the millions across the Midwest of the United States of America. As a result of the grasslands being replaced by plant food crops, the distribution of prairie chickens has diminished, as shown below.



By 1994, Kansas, Nebraska and Minnesota still supported large and widespread populations; however, in the state of Illinois, the number of prairie chickens fell to less than fifty individuals isolated in two separate geographical areas.



Representative samples of prairie chickens from the four states were selected for testing. Each prairie chicken had six gene loci tested. The average number of alleles at each gene locus for each prairie chicken group is shown in the graph below.



b. **i.** Explain the significance of the results for the Illinois birds compared to the results of the birds from the three other states.

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_____

_____

_____

ii. Explain why the results for the Kansan birds and Nebraskan birds are similar to each other.

_____

_____

_____

2 + 1 = 3 marks

Measures were taken in the 1990s to prevent the Illinois prairie chicken from dying out completely.

c. **i.** Explain why low genetic diversity in a population threatens the survival of the population.

_____

_____

_____

_____

ii. Describe one measure that could be used to prevent the Illinois prairie chicken from dying out.

_____

_____

2 + 1 = 3 marks

Total 7 marks