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MANA TOHU MĀTAURANGA O AOTEAROA

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Level 2 Biology, 2019

91157 Demonstrate understanding of genetic variation and change

9.30 a.m. Tuesday 19 November 2019
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of genetic variation and change.	Demonstrate in-depth understanding of genetic variation and change.	Demonstrate comprehensive understanding of genetic variation and change.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

ASSESSOR'S USE ONLY

QUESTION ONE: MEIOSIS

Drosophila with brown body and red eyes   *Drosophila* with black body and brown eyes
www.indiana.edu/~oso/lessons/Genetics/Dihybrid.html

The fruit fly, *Drosophila melanogaster*, displays a complete dominance inheritance pattern for body colour and eye colour. The brown body colour allele (B) is dominant to the black body colour allele (b), and the allele for red eyes (R) is dominant to the allele for brown eyes (r). The genes for body colour and eye colour are not genetically linked.

(a)   A biologist crossed a fruit fly homozygous for the brown body colour allele and the red eye allele, with a fruit fly homozygous for black body colour and brown eyes.

State the gametes produced by each parent: _____

State the genotype of the F1 generation: _____

(b)   Use the Punnett square below to show the gametes of the F1 generation, and all of the possible genotypes of the F2 generation.

F1 gametes

F1 gametes

(c)   Describe the predicted phenotype (F2) ratios produced by this cross.

(d)   Wing length is another phenotype in fruit flies and the gene is found on the same chromosomes as body colour and eye colour. However, in contrast to the phenotype ratio F2 cross in part (c), when the genes for body colour and wing length are crossed, the observed phenotype ratio of 5 brown, long wings : 1 brown, short wings : 1 black, long wings : 5 black, short wings is produced.

Analyse the diagram below.

Adapted from: Campbell, N. A., & Reece, J. B. *Biology. 7th. Ed* (Capetown: Pearson Benjamin Cummings, 2005)

Discuss with justified reasons why genes on the same chromosome can be both linked and unlinked.

In your answer include:

•   a description of linked AND unlinked genes

•   an explanation of how crossing over and segregation affect linked AND unlinked genes

•   a discussion of why body colour and eye colour are considered unlinked, whereas body colour and wing length are considered linked.

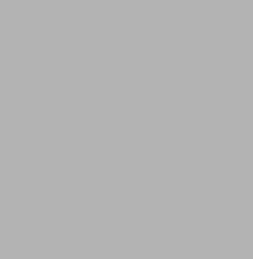There is more space for your answer to this question on the following page.

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The examination continues on the following page.

QUESTION TWO: NATURAL SELECTION

Kārearea, *Falco novaeseelandiae*, live throughout Aotearoa. They are predators that use flight to hunt their prey. Research shows that males tend to remain in a particular area, while females migrate to new areas.

Birds found in the North and South Islands have two distinct phenotypes.

Population size is estimated at 7000. Genetic analysis has found that gene flow occurs between North and South Island populations, and the population has low genetic diversity.

Phenotypes	Location	Habitat	Annual Mean Temperature (°C)
Small size www.oiseaux-birds. com/card-new-zealand-falcon.html	North Island	Native bush and pine forest www.aucklandbotanicgardens.co.nz/our-gardens/ native-forest/	10.6 – 14.5
Large size http://nzbirdsonline.org. nz/species/new-zealand-falcon	South Island	Open habitat and high country farms www.odt.co.nz/rural-life/rural-life-other/increase-visitors-could-close-high-country-walks	5.9 – 10.5

Discuss the selection pressures that drive the kārearea's two distinct phenotypes AND the factors that cause changes to allele frequency in a gene pool.

In your answer include:

*   a description of allele frequency AND gene pool

*   an explanation of how migration AND genetic drift may affect the kārearea's gene pool

*   consider the two distinct phenotypes and discuss how natural selection has influenced the phenotypes in the North and South Island. Use the information from the table to support your discussion.

QUESTION THREE: SOURCES OF VARIATION WITHIN A GENE POOL

The southern platyfish, *Xiphophours maculatus*, is a freshwater fish native to North and Central America. It is easy to keep in an aquarium, so has become a popular aquarium fish among breeders.

A gene that codes for a pigmentation pattern at the base of the tail fin is found at P locus (location) on one of its chromosomes. There are 8 multiple alleles found at this locus.

www.bunnycart.com/shop/fishes/
mickey-mouse-platy/

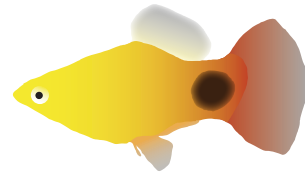(a)   Describe the term multiple allele.

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(b)   The pictures below show some of the tail spot (allele) patterns expressed by platyfish.

All alleles are co-dominant except the no spot allele, which is recessive to all other alleles.
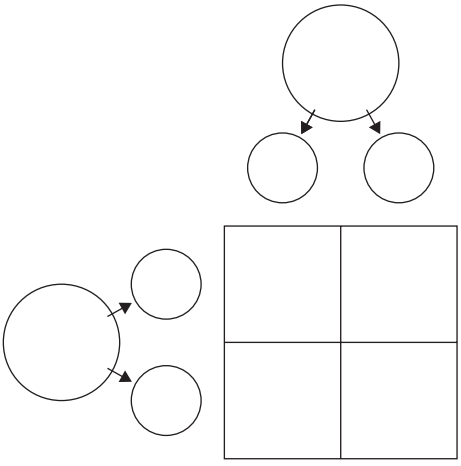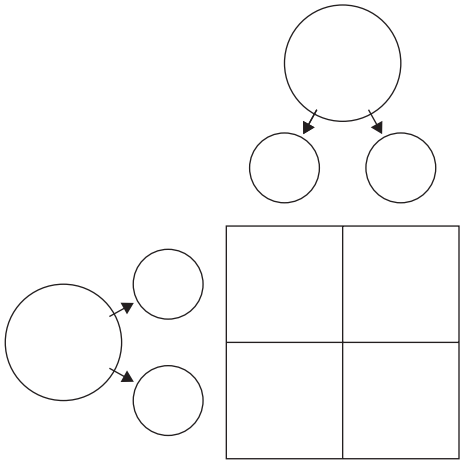
No spot found on tail
Allele symbol: P^+

Crescent spot found on tail
Allele symbol: P^C

Dot spot found on tail
Allele symbol: P^D

Explain the difference between co-dominance and recessive inheritance.

_____

_____

_____

_____

_____

_____

_____

(c) Complete the following monohybrid Punnett squares.

A fish breeder crossed two fish that were both heterozygous for crescent and no spot (P^CP^+). Complete the Punnett square below and describe the expected genotype and phenotype ratio.	The fish breeder also crossed two fish that were both heterozygous for crescent and dot spot (P^CP^D). Complete the Punnett square below and describe the expected genotype and phenotype ratio.
Expected genotype ratio:	Expected genotype ratio:
Expected phenotype ratio:	Expected phenotype ratio:

(d) Discuss why the genotype ratios are the same for the above crosses, but the phenotype ratios are different, AND the advantages of multiple alleles to a population.

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Extra space if required.
Write the question number(s) if applicable.

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