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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Biology, 2013

91157 Demonstrate understanding of genetic variation and change

9.30 am Friday 22 November 2013
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 2–10 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

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The examination continues on the following page.

You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE: DIHYBRID INHERITANCE

http://brian-howlett.blogspot.co.nz/2010/05/sweet-pea-purple.html

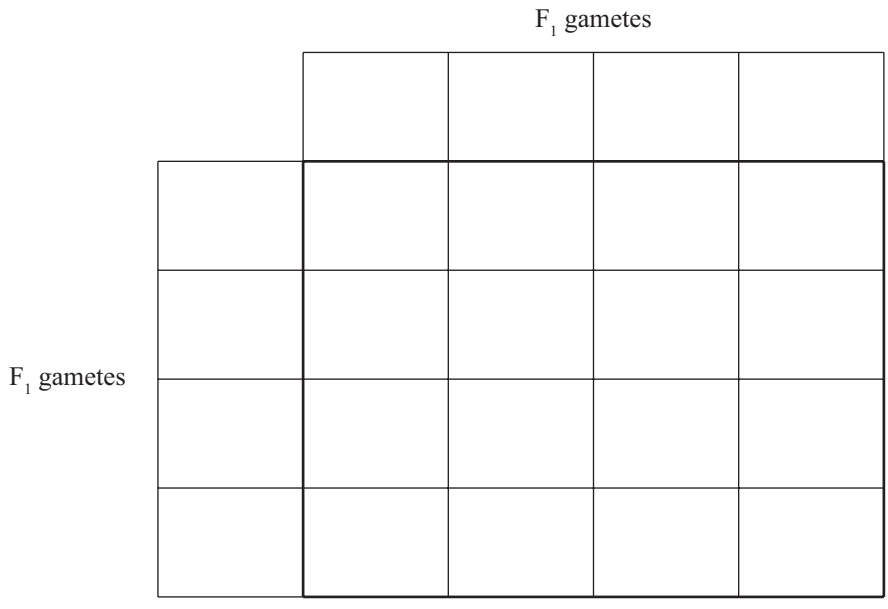
In the sweet pea plant, *Lathyrus odoratus*, the allele for purple (P) flower colour is dominant over the allele for red (p) flower colour. A second gene determines the shape of the pollen. Long (L) pollen is dominant over round (l) pollen.

(a) A purple, long-pollen plant, PPLL is crossed with a red, round-pollen, ppll plant.

Give the genotype of the F_1 generation: _____

Two F_1 generation plants were crossed to produce the F_2 generation plants.

(b) Use the Punnett square to show the gametes and the expected genotypes of all the possible F_2 offspring from these two F_1 plants.



(c) Give the expected phenotype ratio for the cross you have completed.

_____

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(d) When biologists crossed the F_1 plants to produce F_2 offspring, their observed phenotype ratio was different from the expected phenotype ratio in (c).

	Observed phenotype ratio
Purple, long (PpL1)	12
Purple, round (Pp11)	1
Red, long (ppL1)	1
Red, round (pp11)	2

They concluded that the gene for colour and the gene for pollen shape were not independently assorting as expected; therefore the genes must be linked.

Discuss why the **expected phenotype** ratio you calculated is different from the **observed ratio** the biologists actually observed.

In your answer:

- describe **linkage**
- explain why linked genes do not assort independently
- explain how crossing over produces recombinants
- discuss how crossing over resulted in the low occurrence of purple, round-pollen and red, long-pollen phenotypes.

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QUESTION TWO: VARIATION

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The phenotype of a cat's coat is determined by different genes and alleles.

http://www.warrenphotographic.co.uk/29139-tabby-and-black-kittens

Co-dominance		Incomplete dominance		Complete dominance	
BB	black coat	SS	extensive spotting in coat	LL	short hair coat
Bb	black and tan coat (tabby)	Ss	medium spotting in coat	Ll	short hair coat
bb	tan coat	ss	no spotting in coat	ll	long hair coat

(a) Using the table above, explain why co-dominance, incomplete dominance, and complete dominance produce different phenotypes in cats.

In your answer include:

- a **description** of co-dominance, incomplete dominance, and complete dominance
- an **explanation** of how genotypes for each gene produce the different phenotypes.

(b) Sources of variation in a gene pool result from the biological processes such as independent assortment and mutation.

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Discuss how independent assortment and mutation lead to variation within a gene pool.

In your answer:

- **describe** independent assortment and mutation
- **explain** why mutations are the major source of new alleles in a population AND why independent assortment does not introduce new alleles into a population
- **compare and contrast** how independent assortment and mutation produce variation within an organism.

QUESTION THREE: GENE POOLS

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The fruit fly *Drosophila pseudoobscura* is endemic to North America. Within the last 50 years, the species has invaded New Zealand.

Recent genetic analysis comparing the North American and New Zealand populations has shown a strong founder effect of *D. pseudoobscura* colonising New Zealand, with 6 individuals in the founding population.

A comparison of the number of alleles in *Drosophila pseudoobscura* in North America and New Zealand

Reiland, J et al, *Journal of Heredity*, 2002, 93: 415–420

The New Zealand population shows fewer alleles at each gene locus studied.

Discuss why the New Zealand population of *D. pseudoobscura* shows such low genetic diversity compared to the North American population.

In your answer include:

- a description of the **founder effect**
- an explanation of how **genetic drift** has affected New Zealand's population
- a discussion of why the New Zealand population has fewer alleles at each locus compared to the North American population.

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

QUESTION NUMBER

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