2

SUPERVISOR'S USE ONLY

91157

911570

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 2 Biology, 2016

91157 Demonstrate understanding of genetic variation and change

9.30 a.m. Friday 18 November 2016
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 2–11 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.

Merit

TOTAL 16

ASSESSOR'S USE ONLY

QUESTION ONE: INHERITANCE AND MEIOSIS

ASSESSOR'S USE ONLY

Roses display complete dominance in both their flower colour and in their susceptibility to some diseases. The allele for red petals (R) is dominant to the allele for white petals (r). In addition, the allele for healthy leaves (H) is dominant to the allele for being susceptible to leaf lesions (h). Leaf lesions are spots on the leaf that are very prone to disease and injury. The genes for petal colour and healthy leaves are located on different chromosomes.

Leaf with lesions.
https://edis.ifas.ufl.edu/pp267

http://www.tophdwallpaersland.com/red-white-rose-wallpaper.htm

A rose that was homozygous for both red petals and healthy leaves was crossed with a white rose that was susceptible to leaf lesions. RR HH x rrhh

(a) State the genotype of the F1 generation this cross produces.

RrHh

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

F_1 gametes

F_1 gametes	RH	Rh	rh	rH
RH	RRHH	RRHh	RrHh	RrHH
Rh	RRHh	RRhh	Rrhh	RrHh
rh	RrHh	Rrhh	rrhh	rrHh
rH	RrHh	RRHh	rrHh	rrHH

1 x RRHH
3 x RRHh
4 x RrHh
1 x RrHH
1 x RRhh
2 x Rrhh
1 x rrhh
2 x rrHh
1 x rrHH

9x
3x
3x

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

ASSESSOR'S USE ONLY

9 red petals and healthy leaves : 3 red petals and leaf lesions : 1 white petals and leaf lesions : 3 white petals and healthy leaves

(d) Discuss the processes that produce genetic variation during meiosis, and how gametes differ from parent cells.

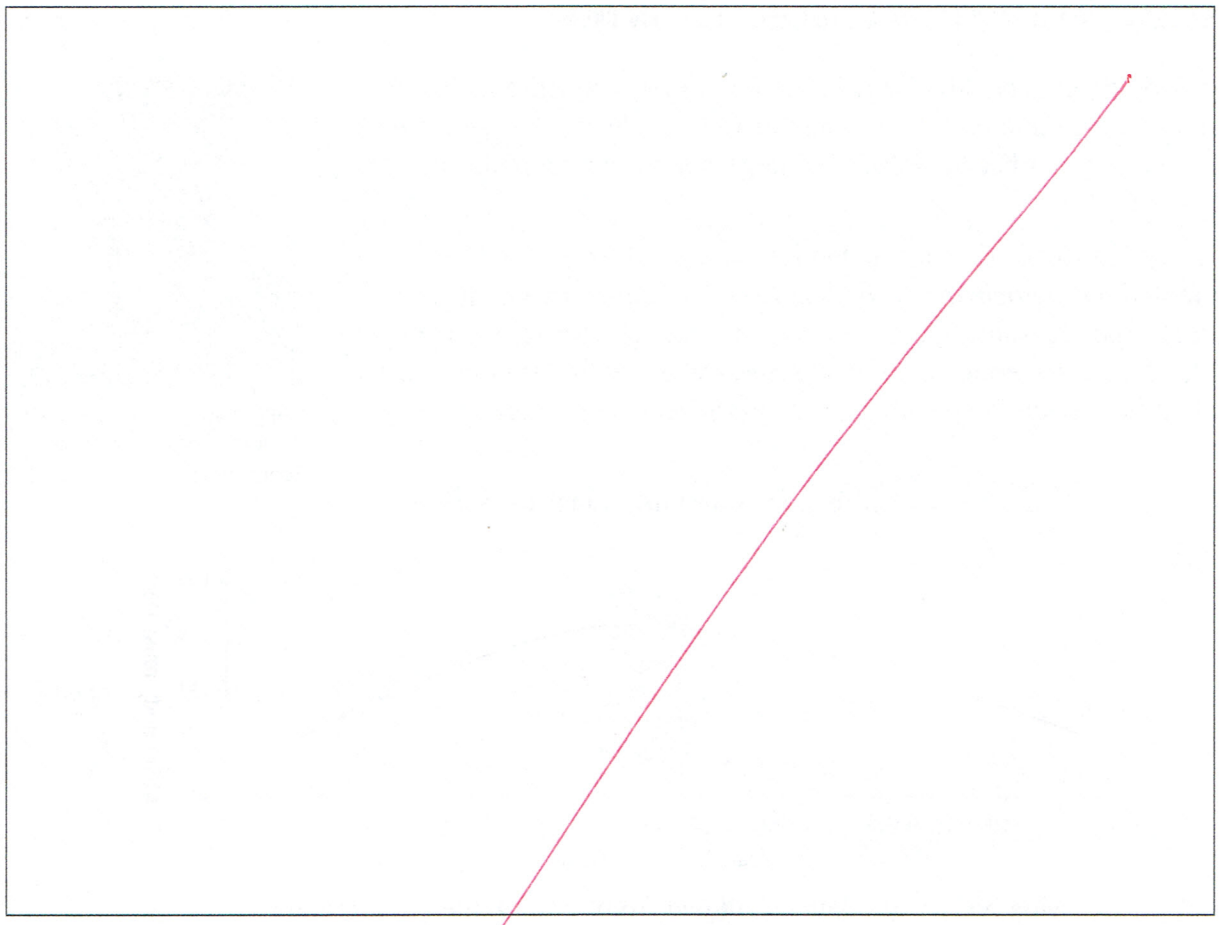
ASSESSOR'S USE ONLY

Your answer should include:

- a description of meiosis and the type of cells produced by meiosis
- an explanation of the processes of independent assortment, segregation, and crossing over
- a discussion of how each process contributes to the genetic variation of cells produced.

You may use diagrams in your answer.

Meiosis produces gametes (set cells) eg Sperm and egg cells. Crossing over exchanges alleles between homologous chromosomes, therefore new combinations of alleles result. ~~These new~~ Crossing over separates linked genes, therefore the genes that end up in the gametes are different from parental cells and the offspring are genetically different from their parents This is because the offsprings combination of alleles differ from the parental combinati therefore increasing genetic variation.



ASSESSOR'S USE ONLY

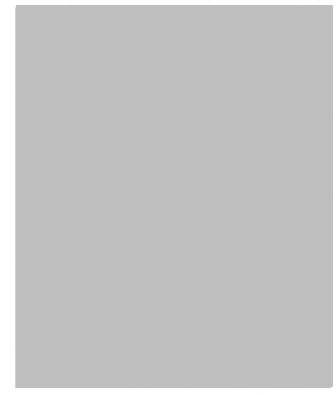
A4

QUESTION TWO: NATURAL SELECTION IN MOA

ASSESSOR'S USE ONLY

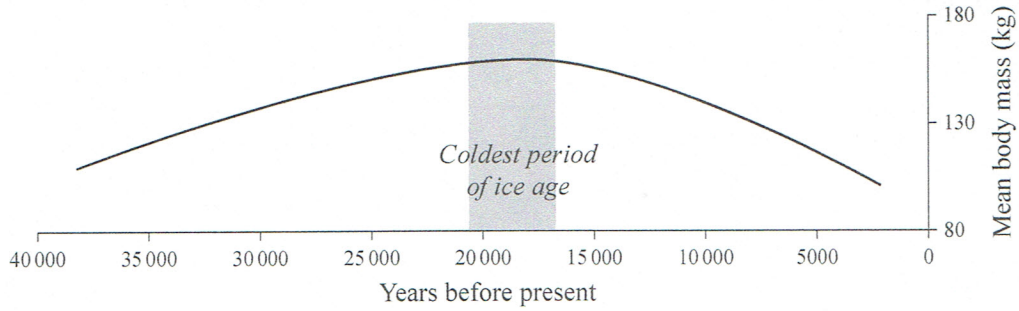
A large body mass is an advantage in cooler climates because its low surface area to volume ratio helps animals to retain heat. Many examples of this, such as polar bears, walrus and large polar sea mammals, are seen today.

Fossil evidence shows that during the last ice age, the population of heavy-footed moa, *Pachyornis elephantopus*, contained much larger individuals than the same species of moa that existed during warmer times. As the ice age ended and temperatures warmed, the fossil evidence shows that the heavy-footed moa's body mass became smaller again.



http://collections.tepapa.govt.nz/search.aspx?term=Heavy-footed moa

Change in moa body mass over time



Moa body mass data calculated from femur bone circumferences.

Worthy, Trevor H. and Richard N. Holdaway, 2002. *The Lost World of the Moa, Prehistoric life in New Zealand* (Indiana University Press, Bloomington), Table 5.6, p. 20.

The large body mass allele may have entered the population via a mutation.

Discuss how the allele for large body mass became established in the heavy-footed moa gene pool during the last ice age.

Your answer should include:

- a description of what a gene pool is
- a description of what a mutation is and an explanation of how it affects genetic variation in a species
- a discussion of the process of natural selection and how it affected both the body mass and the gene pool of the heavy-footed moa
- a discussion, with justified reasons, why the body mass of the heavy-footed moa returned to a smaller mass once the climate warmed again.

//A gene pool is all the alleles held by individuals within a population. A mutation is a permanent change in the nucleotide sequence in a gene or chromosome. Gametic mutations become established in a gene pool when an individual with the mutation crosses

with another individual and the offspring inherit it. If the mutation gives the individual a selective advantage then any further offspring that the individual has will inherit the mutation. Their survivorship and reproduction will ensure increased frequency of the mutated allele over time. For example the allele for large body mass in ~~the~~ Moa's during the ice age gave the individual a selective advantage.

However if the mutation doesn't give the individual a selective advantage then it is unlikely to survive to ~~pass on~~ reproduce and pass on the mutation to successive generations. For example a mutation for large body mass in moa's ~~after~~ in warm climates.

Natural selection is when individual with genes that are favourable to the environmental conditions survive to ~~pass on~~ reproduce and pass on these favourable genes to their offspring. However, individuals with genes that are considered unfavourable and are not suited to the environmental conditions, will be selected against and will be unlikely to survive and reproduce. Moa's with genes for large body mass ~~will survive~~ during ice age will survive and reproduce whereas moa's with genes for large body mass in warmer temperatures will not survive and reproduce. Due to natural selection, when temperatures got warmer, the body mass of moa's returned to smaller mass.

ASSESSOR'S USE ONLY

M6

QUESTION THREE: GENETIC DRIFT AND MIGRATION

ASSESSOR'S USE ONLY

Many of New Zealand's native species have suffered population bottlenecks due to hunting, introduced predators, and habitat destruction. The Department of Conservation has successfully saved some of these species from extinction by moving several breeding pairs from mainland populations to predator-free islands. However, maintaining genetic diversity on island populations can be difficult for many species of flightless birds, such as the takahe, *Porphyrio hochstetteri*.

www.nzbirdsonline.org.nz/species/south-island-takahe

Discuss the issues of maintaining genetic diversity in small island populations of flightless birds, such as the takahe.

Your answer should use the takahe and include:

- a description of what genetic diversity is
- an explanation of how allele frequency in a population is affected by genetic drift and migration
- a discussion of how migration and genetic drift affect genetic diversity of flightless birds on small island populations compared to larger mainland populations.

// Allele frequency is the percentage of each allele in a gene pool. Genetic drift is the random change in allele frequency of a population. ~~Migration is~~ In a small population, natural mortality is more likely to lead to a loss of alleles and reduced variati This is as a small change in number of allele can have a large impact on allele frequency in a small population. Whereas in a large population, natural mortality is less likely to lead to a loss of alleles due to the buffer effect of more indivds, therefore there tends to be more genetic variation in larger populations. //

// Migration is when individuals move into or out of a population. Migration can affect

allele frequency, especially in a small population where alleles held by an emigrant or ~~immigrant~~ imigrant aren't representative of alleles held by the total population. An imigrant or emigrant could hold the only kind of one specific allele, therefore affecting allele frequency a lot. However in a large population it is unlikely that an imigrant or emigrant will hold the only kind of one specific allele as there are more individuals in the populati... Therefore ~~S~~ Migration is less likely to have an affect on allele frequency in a large population. Migration ~~add~~ affects allele frequency in a population by adding alleles (immigration) which increases allele frequency. Or by removing alleles (emigration) which decreases allele frequency. //

ASSESSOR'S USE ONLY

M6

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

2 This is because the genes for large body mass would be selected against as it isn't favourable for the environmental conditions now that it is warmer. Therefore alleles for large body mass wouldn't be passed on as individuals with these alleles wouldn't survive and reproduce. Whereas individuals with alleles for small body mass would be selected for as they are better suited to the environment. Therefore these alleles will be passed on to offspring and will become more common in the gene pool. //

seen

Merit exemplar for 91157 year 2016		Total Score	16
Q		Annotation	
1	A4	Correct responses provided for (a) (b) and (c). Answer to (d) is at a minimal level. Response provides details to crossing over and the formation of gametes that are different to parental cells. The answer does not describe or explain Independent Assortment or segregation. There is some confusion over the gametes being linked to children and parents rather than the haploid gametes and diploid cells from which they were formed.	
2	M6	The answer provides a good description to Natural Selection. There is an error in linking "genes" rather than "alleles" to changes in the gene pool. There is a repetition on genes in several parts of the answer, though it is corrected in the last page. There is no evidence to show why the alleles are selected for or selected against in a given climatic/environmental situation.	
3	M6	Several correct definitions are provided. The response to differentiate how migration affects the two populations is attempted but no clear justifications are provided in the answer. Comparisons made are at a Merit level, rather than an Excellence level. The idea of buffer effect is well explained for the mainland population but comparisons and	
		justifications for both are not provided.	