

No part of the candidate evidence in this exemplar material may be presented in an external assessment for the purpose of gaining credits towards an NCEA qualification.

1

90948



909480



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

SUPERVISOR'S USE ONLY

Level 1 Science, 2015

90948 Demonstrate understanding of biological ideas relating to genetic variation

9.30 a.m. Tuesday 10 November 2015

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of biological ideas relating to genetic variation.	Demonstrate in-depth understanding of biological ideas relating to genetic variation.	Demonstrate comprehensive understanding of biological ideas relating to genetic variation.

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 room for any answer, use the extra space 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.

Merit

TOTAL

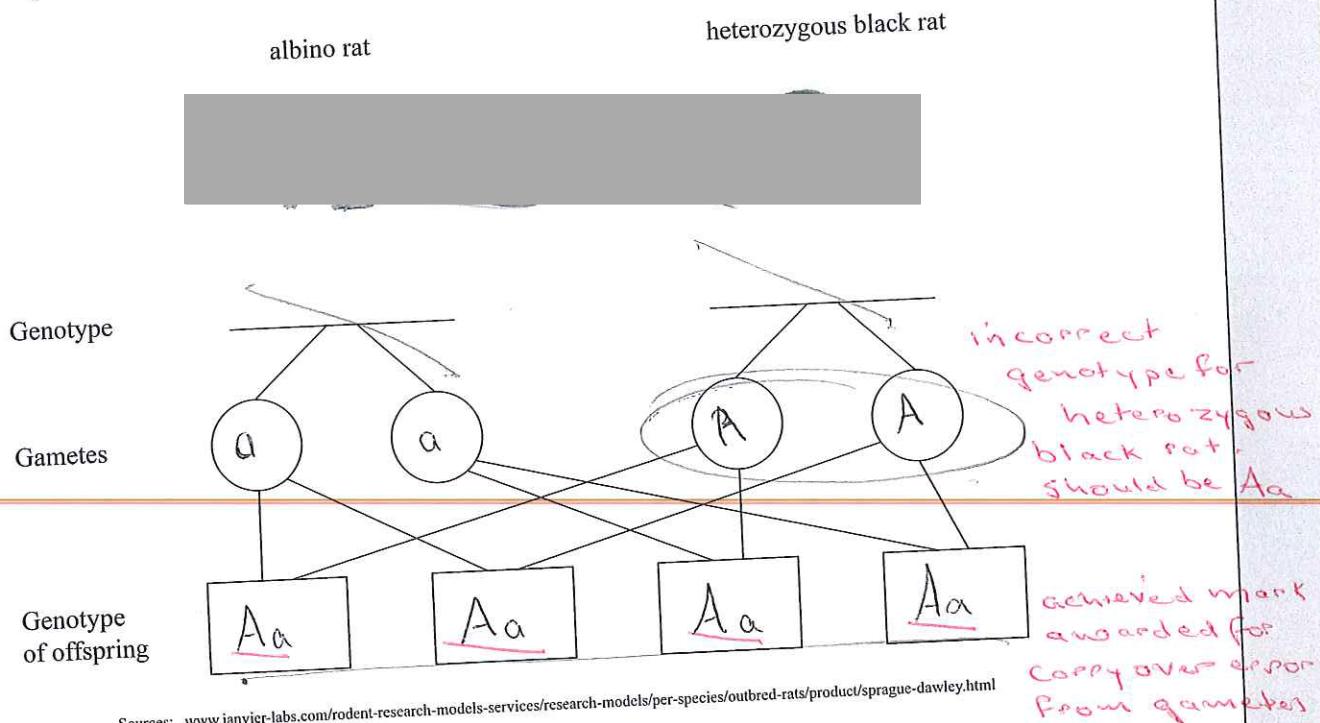
16

ASSESSOR'S USE ONLY

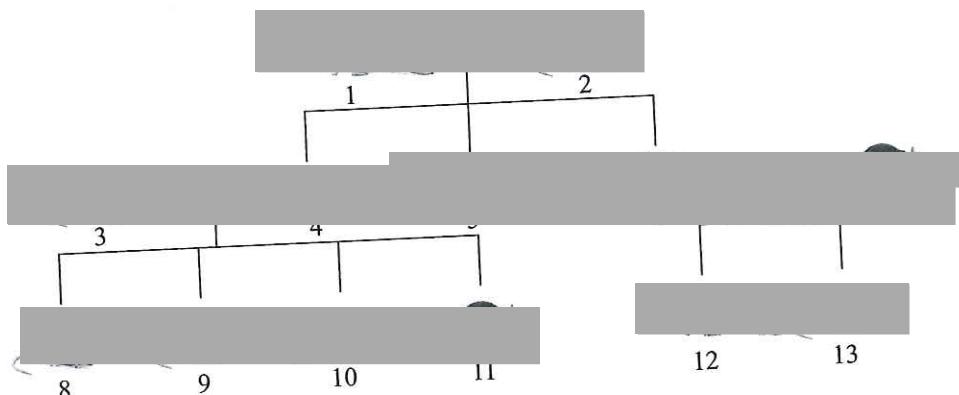
QUESTION ONE: FAMILY PEDIGREES

QUESTION ONE: FRAME 1
Albinism in rats results in white fur and pink eyes. Albinism is caused by a recessive allele a .

- 1) Complete the following diagram:



- (b) The albino rat and the heterozygous black rat produced the following two generations of offspring, as shown in the pedigree chart below.



What are the genotypes of the following rats?

Rat 4: ~~heterozygous~~, homozygous recessive

Rat 6: Heterozygous

Rat 10: Heterozygous

achieved marks
awarded for
genotype in words
instead of letters

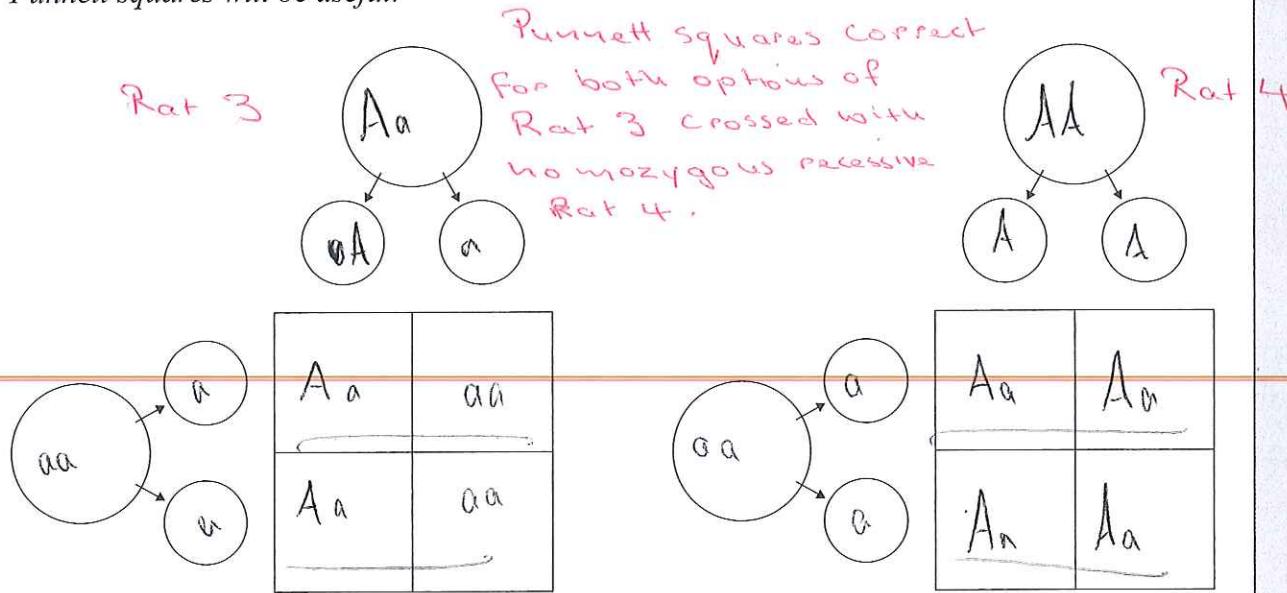
- (c) Rat 3 was **not** an offspring of Rat 1 and Rat 2 in the family tree.

Give the possible genotypes for Rat 3 and explain which is the most likely genotype for Rat 3.

In your answer you should:

- state the possible genotypes for Rat 3
- explain why both genotypes are possible but one is more likely
- explain what you could do to be more certain about the genotype of Rat 3.

Punnett squares will be useful.



Rat 3 can either be a homozygous dominant (AA) or a heterozygous (Aa) rat.

Both homozygous dominant and heterozygous have a dominant allele, this means that the dominant phenotype will be shown, but the rat will have two possible genotypes. This is because the dominant allele will always over power the recessive therefore any rat whether it is homozygous dominant with same alleles (AA) or heterozygous with different alleles (Aa) the dominant phenotype will always be over rule. Because the other parent is recessive and all off spring have a dominant phenotype shows me that the Rat is a homozygous dominant genotype as from results shown all offspring have dominant phenotype.

QUESTION TWO: DNA, ALLELES, GENES, AND CHROMOSOMES

A snail known as *Cepaea nemoralis* can have either a plain shell or a banded shell.



Plain shell

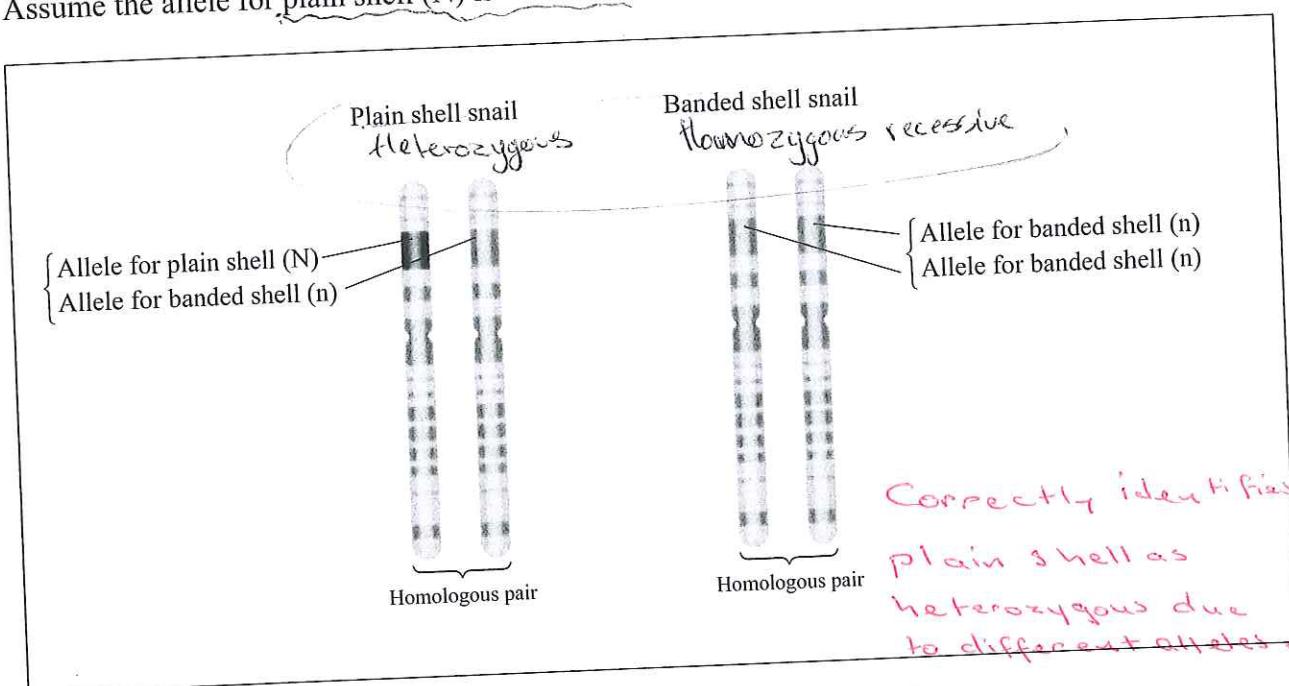
http://en.wikipedia.org/wiki/List_of_non-marine_molluscs_of_Ireland

Banded shell

<http://de.wikipedia.org/wiki/Hainb%C3%BCnderschnecke>

The diagrams below show the homologous chromosomes that contain the gene for shell pattern for each of the snails in the photographs above.

Assume the allele for plain shell (N) is dominant over the allele for banded shell (n).



- (a) In the diagram above, which snail is heterozygous for shell pattern?

Plain Shell Snail

Explain why you chose this snail.

Heterozygous is the genotype where there are different alleles, a dominant and recessive. As shown in the diagram above the plain snail has Nn.

- (b) Referring to the examples shown previously for shell pattern, explain the difference between an allele and a gene.

A gene is the base sequence which codes for a particular characteristic protein. This protein produces a characteristic trait. For example a snail's shell. An allele is the different variations of a gene for example a plain shell or a banded shell.

(Clear definition of gene + allele + linked to snail example merit)

- (c) These two snails were produced by sexual reproduction from the same male and female.

Discuss how they have inherited different alleles for shell pattern.

In your answer you should:

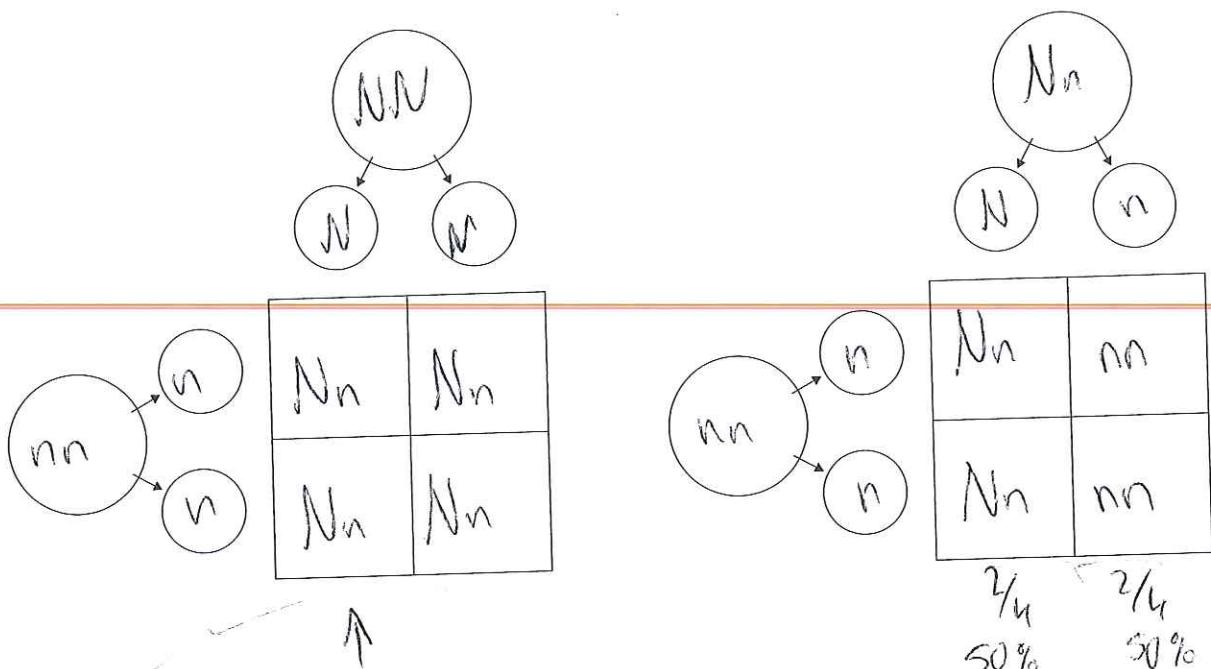
- explain where the homologous chromosomes have come from
- give the possible genotypes of both parents and explain how you determined these possible genotypes.

Each parent produces a sex cell (gamete), a male produces sperm and the female produces an egg (ova). This is done through the process of meiosis. This is where genes are shared and gametes with half the original pair of chromosomes are made. These chromosomes are homologous chromosomes. When sperm and egg fuse during fertilisation, female and male homologous chromosomes pair up to make homologous pairs. The snails produced by sexual reproduction are a dominant phenotype offspring and a recessive phenotype offspring. This tells us that the must be a parent with a homozygous recessive genotype and a parent with a heterozygous genotype.

Because if one of the parents were homozygous dominant

*(will be)
all offspring will be heterozygous
and will show a dominant phenotype
(plain)*

There are more space and Punnett squares for your answer to this question on the following page.



Would only produce
heterozygous offspring
Therefore all offspring
would show dominant phenotype

Uses this punnett square to
explain that homozygous
dominant not possible as
no recessive (banded) offspring
would result.

This shows the parent
of the snails. One
will heterozygous genotype
and one with homozygous
recessive genotype.

Use punnett to
explain how
plain + banded
snails can result
from one (not two)
set of parent snails

QUESTION THREE: VARIATION IN PLANTS

The photograph below shows a large number of plants that are all the same species.



<http://blogs.ext.vt.edu/soybean-update/files/2013/08/Brown-Stem-Rot-IMAG0159.jpg>

- (a) The yellow-brown colour in some of the plants has been caused by a disease. The disease is present throughout the field, but affects only some plants. This is because of variation in the plants.

Explain why variation means not all the plants get the disease.

of the same
species

Links variation
in plants genetics
with susceptibility
to disease

Because of variation plants some plants will have disease and some will not. This is because they have different variations of genes, as some will not be affected (green leaf) and some plants with genes will be affected (yellow leaf). Variation also shows that these plants reproduce sexually. As only this type of reproduction causes variation among offspring and parents.

- (b) The plants in the photograph were grown from seeds. Seeds are the result of sexual reproduction.

- (i) Name one process that occurs during sexual reproduction, and explain how it results in variation.

Explains how meiosis causes genetic variation.

Sexual reproduction involves two parents. Each parent produces gametes. Gametes are produced through the process of meiosis. Through this process variation is achieved by the process of 'crossing over'. This is when chromosomes line up after at the equator of a cell and share sections of genetic information. This causes variation between parents and offspring as every gamete is different.

- (ii) Discuss the advantages of sexual reproduction for a species when the environment changes.

In your answer you should:

- give examples of a changing environment
- explain the impact of changing environments on a population
- consider the importance of variation in a population in a changing environment.

The world today is changing in an increasing rate with relation to the environment. For example global warming and climate change. This world today is becoming hard for species to survive, also humans cutting down and destroying habitats through deforestation, and urbanisation is putting more and more species at risk. Because of a changing environment a species/populations are having to adapt more and more at a ever increasing rate. Survival of the fittest, this is only achieved through variation. If it is crossed for variation many species would be wiped out and extinct. Through sexual reproduction variation is achieved through the processes of 'crossing over' and 'independent assortament'. Because of variation species will be able to adapt as some ^{offspring} won't make it because of here genes but others will, the ones to do survive the change in environment will pass on their genes which helped them survive to other generation allowing them to now adapt.

Lacks in depth understanding as to how survival of some genetically varied individuals can lead to those favourable genetics being passed on which benefits the species.

M(5)