NAME TEACHER

**NQA**

Nayland Qualification Authority

**Level two Biology, 2014**

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| **91157: Demonstrate understanding of genetic**  **variation and change**  Credits: 4 |

### Suggested Time: 70 minutes

**Instructions**

* Answer all questions in the spaces provided.
* You must hand this examination paper to the supervisor at the end of the examination.
* Check that this paper has all 9 pages numbered and in the correct order.

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| Achievement Criteria. (for assessors only) | | | | | |
| 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. |  |
| Overall Level of performance: | | | |  | |

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Assessor’s use only

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

**QUESTION ONE: BLACK ROBIN**

The Black Robin is an example of a bird species with reduced flight capacity which nearly became extinct due to the arrival of foreign species. Descended from the sole remaining breeding pair in 1980, today there is a population of approximately 280 Black Robins living in the Chatham Islands.

According to conservation records from 1989, 50% of females were displaying previously rare rim-laying behaviour. Rather than laying their eggs safely in the centre of the nest they lay their eggs on the rim. In order to ensure all the eggs would hatch, conservation biologists relocated the eggs closer to the centre of the nest which was safer and warmer.

Observing Black Robins in the wild today, 9% of females demonstrate the rim-laying behaviour. This is due to the presence of a dominant allele.

Discuss the changes in the gene pool of the Black Robin from the arrival of humans to the present. In your discussion:

* Explain how the story of the Black Robin provides an account of a genetic bottleneck
* Compare and contrast how selection pressures affected the frequency of the rim-laying allele from 1980 - 1989 with the period from 1989 - today, giving reasons
* Analyse the evidence provided to justify how current observed genetic diversity demonstrates the effect of genetic drift in the Black Robin population

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**QUESTION TWO: SHEEP**

Sheep breeders have to balance genes involved in producing healthy sheep with those that result in desirable wool. White wool more readily accepts dyes making it more valuable than black wool. Horns can be used by sheep when they fight for social positions in the flock, injuring one another and damaging meat and skins.

Commercial breeds of sheep, such as the New Zealand Corriedale, have been managed over many generations to produce white wool and to mature without growing horns. Hornless sheep possess the dominant “polled” allele.

Many Icelandic sheep show a 4-horned phenotype that is rare in other varieties of sheep. They often have black or brown wool, black being dominant to brown (B = black, b= brown). The four-horned allele is recessive to the polled allele (P = polled, p = horned) and is not sex-linked. The wool colour genes and horned genes are independently assorting.

(a) Describe the possible genotypes of a black 4-horned Icelandic lamb. Give a reason for your answer.

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(b) A brown 4-horned male is mated to a black polled female producing a brown 4-horned lamb. Explain how the farmer can be certain of the genotype of each parent.

Male genotype \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Female Genotype \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) What is the likelihood of these same parents producing a black polled lamb? Draw a Punnett square to provide evidence of your reasoning.

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Several 4-horned lambs are born into a flock of previously pure breeding Corriedale sheep as the result of a single Icelandic 4-horned male escaping from the neighbouring paddock two years ago.

(d) Discuss changes in genetic variation in the Corriedale population. In your answer:

* Explain the effect of migration on the gene pool
* Give reasons why breeding these 4-horned lambs could both benefit and disadvantage the flock
* Detail your knowledge of independent assortment to explain why the 4-horned phenotype could be removed from the flock without losing all the rest of the Icelandic sheep variation (2n = 54).

Assessor’s use only

**QUESTION THREE: DROSOPHILA**

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The fruit fly (*Drosophila melanogaster*) is an important model organism in the study of genetics. In the 1920s Hermann J. Muller observed that after exposing flies to x-ray radiation, their offspring showed new phenotypes not seen previously.

(a) Provide an account of how the x-ray exposure could be linked to a new heritable phenotype in fruit flies.

Curly wing and star eyes are two dominant phenotypes observed in fruit flies. The genes for these two traits are linked. Both the curly wing allele and the star eye allele are lethal alleles, causing death in homozygous flies.

(R = curly, r = normal wing; E = star-eyed, e = normal eye)

(b) Predict the phenotype ratio for the offspring following a pairing of two curly- winged flies. Complete the Punnett square below to provide evidence for your reasoning.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | genotype:  phenotype: | genotype:  phenotype: |
|  | genotype:  phenotype: | genotype:  phenotype: |

Predicted phenotype ratio: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) Explain how knowing that the curly wing allele is lethal affects your prediction.

A curly winged female with star eyes is crossed with a wild-type male (normal wings and normal eyes) to produce the following offspring:

Assessor’s use only

31 curly wing, normal eyed flies

29 star eyed, normal wing flies

1 curly wing, star eyed fly

(d) Discuss the similarities and differences between the phenotypes of the parent flies and their offspring. In your answer:

* Describe segregation and crossing over and give reasons why each process may contribute to variation in a population
* Explain how crossing over between two chromosomes could result in one chromosome carrying both the curly wing and star eyed alleles. (You may use a fully labelled diagram)
* Justify how the observed inheritance pattern of star eyes and curly wings in this cross supports variation by segregation, crossing over, or both. (Punnett squares or labelled diagrams may help you

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Extra paper for continuation of answers if required.

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Clearly number the question