2

91159

911590

SUPERVISOR'S USE ONLY

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Biology, 2019

91159 Demonstrate understanding of gene expression

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

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of gene expression.	Demonstrate in-depth understanding of gene expression.	Demonstrate comprehensive understanding of gene expression.

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: EXPRESSION OF PHENOTYPE

ASSESSOR'S USE ONLY

The expression of a gene is dependent on many factors. Experiments on twin lambs have demonstrated the importance of diet in producing healthy lambs. Each set of twins had functioning genes that produce enzymes for energy metabolism and red blood cell production. However, without Vitamin B12, these enzymes cannot function. The resulting phenotypes are shown in the table below.

The lamb on the left is suffering from B12 deficiency, while the lamb on the right is normal.

Source: https://teara.govt.nz/en/photograph/17535/cobalt-deficiency

	Phenotype of lamb	Diet of lamb
Twin #1	• Low red blood cell count • Weak wool fibres • Poor growth	Lacking vitamin B12
Twin #2	• Normal red blood cell count • Strong wool fibres • Normal growth	Sufficient vitamin B12

(a) Describe the difference between genotype and phenotype, AND identify the environmental factor that is affecting the lamb's phenotype.

(b) Discuss how this experiment demonstrates that the environment can change the phenotype without changing the genotype of the lambs.

ASSESSOR'S USE ONLY

In your answer include:

- an explanation of why the study was conducted on twin lambs
- a discussion of the way each lamb's genotype is expressed
- a discussion of the relationship between environment, gene expression, and the resulting phenotypes of both twin #1 and twin #2.

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

ASSESSOR'S USE ONLY

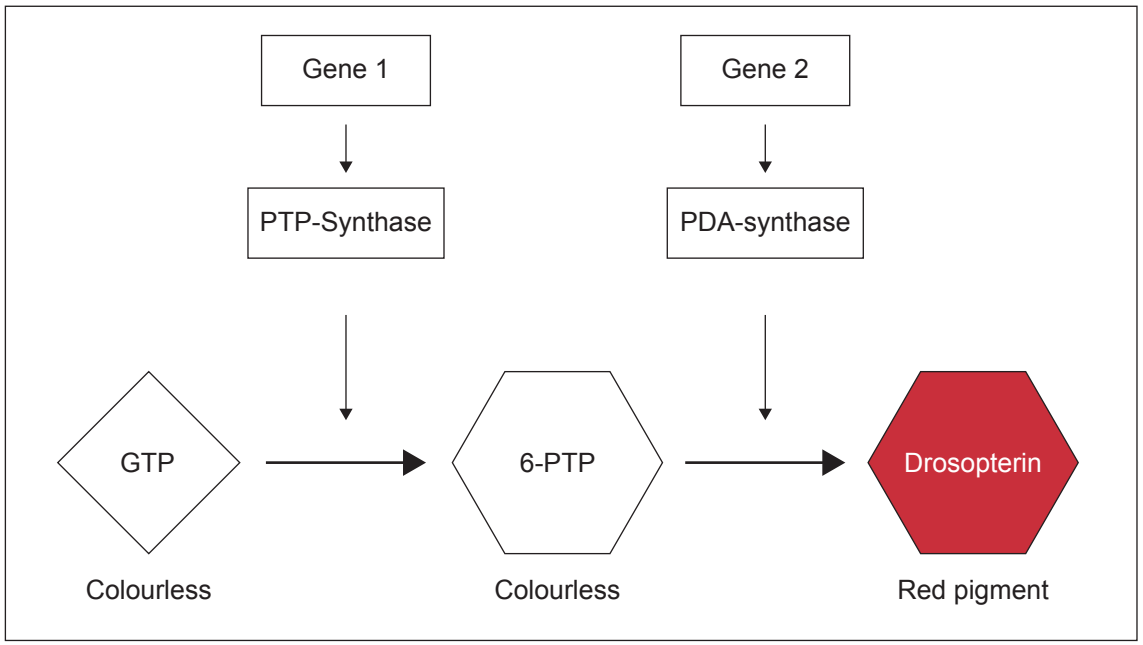
QUESTION TWO: MUTATIONS

ASSESSOR'S USE ONLY

The fruit fly, *Drosophila melanogaster*, is often used for genetic studies because the effect of mutations can be seen easily.

https://smallscienceworks.com/tag/drosophila

A simplified metabolic pathway that makes red pigment for eye colour in fruit flies is shown below:



When biologists expose red-eyed fruit flies to mutagens, they have found that different mutations produce the same phenotype of colourless eyes in their offspring.

(a) Define metabolic pathway.

(b) Discuss how mutations can affect the presence, absence, or amount of specific metabolic products in the metabolic pathway for red eye colour in fruit flies.

ASSESSOR'S USE ONLY

In your answer, refer to the metabolic pathway on the previous page and include:

- a definition of both mutation and mutagen, AND give an example of a mutagen
- an explanation of how genes influence metabolic pathways
- a discussion of how red eye colour is produced AND how mutations to Gene 1 and Gene 2 in the metabolic pathway can produce colourless eyes.

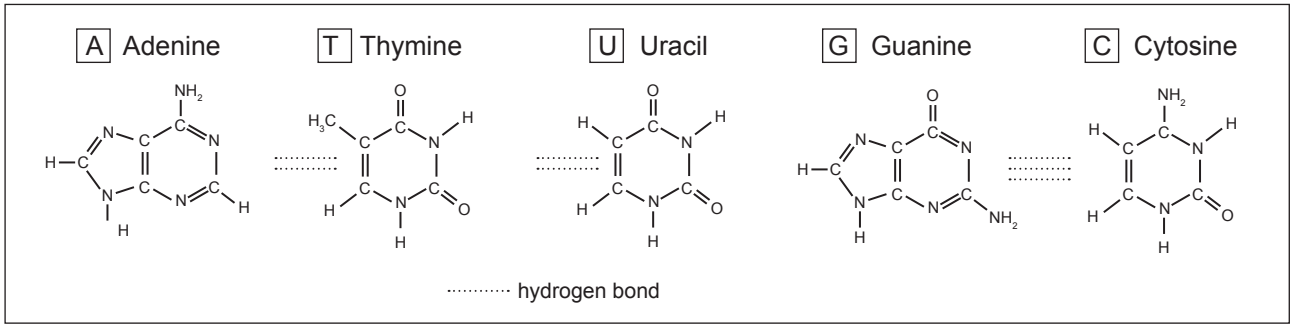
ASSESSOR'S USE ONLY

QUESTION THREE: PROTEIN SYNTHESIS

ASSESSOR'S USE ONLY

The production of a functional protein relies on the accurate transcription of DNA into an mRNA molecule. Below are diagrams of the nitrogenous bases that make up part of nucleotides in DNA and RNA.

Nitrogenous Bases



Adapted from: www.ncbi.nlm.nih.gov/Class/MLACourse/Original8Hour/Genetics/nucleotide.html

(a) Describe the differences between DNA and RNA.

(b) Discuss how the structure of DNA and RNA nucleotides ensure the accurate transcription of DNA.

In your answer include:

- a description of triplets and codons
- an explanation of how the DNA molecule is transcribed
- a discussion of the relationship between a gene, DNA, mRNA, and the final functional protein.

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91159