

91159



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

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## Level 2 Biology 2020

### 91159 Demonstrate understanding of gene expression

9.30 a.m. Wednesday 2 December 2020

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**

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## QUESTION ONE: MUTATIONS

Table 1: mRNA (codon) : Amino Acid

		Second Position				
		U	C	A	G	
First Position	U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	Third Position
		UUC Phe	UCC Ser	UAC Tyr	UGC Cys	
		UUA Leu	UCA Ser	UAA STOP	UGA STOP	
		UUG Leu	UCG Ser	UAG STOP	UGG Trp	
	C	CUU Leu	CCU Pro	CAU His	CGU Arg	
		CUC Leu	CCC Pro	CAC His	CGC Arg	
		CUA Leu	CCA Pro	CAA Gln	CGA Arg	
		CUG Leu	CCG Pro	CAG Gln	CGG Arg	
	A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	
		AUC Ile	ACC Thr	AAC Asn	AGC Ser	
		AUA Ile	ACA Thr	AAA Lys	AGA Arg	
		AUG Met	ACG Thr	AAG Lys	AGG Arg	
G	GUU Val	GCU Ala	GAU Asp	GGU Gly		
	GUC Val	GCC Ala	GAC Asp	GGC Gly		
	GUA Val	GCA Ala	GAA Glu	GGA Gly		
	GUG Val	GCG Ala	GAG Glu	GGG Gly		

Tracey Greenwood, Richard Allan, *Year 12 Biology 2003*, (Hamilton: Biozone, 2003), p 287.

- (a) A mutation in a membrane protein gene (CFTR) causes the disease cystic fibrosis. The template DNA sequence for part of the normal and mutated protein is shown in Table 2 below. The affected bases are shown in **blue**, and underlined.

Complete Table 2.

Table 2

	Normal CFTR gene sequence	Mutated sequence causing cystic fibrosis
<b>DNA template strand</b>	TAA TAG <u>GA</u> A CCA CAA	TAA TAA CCA CAA
<b>mRNA strand</b>		
<b>amino acid sequence</b>		

- (b) Discuss the effect of this mutation on the amino acid sequence and final protein.

In your answer include:

- a description of the mutation shown in Table 2
- an explanation of why the triplets TAG and TAA, code for the same amino acid
- an explanation of a frameshift, and how it affects the final amino acid sequence
- a discussion of how this mutation affects the amino acid sequence and final protein function.





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**QUESTION TWO: PROTEIN SYNTHESIS**

(a) On the diagram below, label the following structures:

- DNA template strand
- mRNA strand
- tRNA
- ribosome
- polypeptide chain.



Adapted from Tracy Green and Richard Allan, *Year 12 Biology 2011* (Hamilton: Biozone, 2011), p.89

(b) Transcription and translation are both required to build a polypeptide chain.

Compare and contrast these two processes AND justify why both are required to build a polypeptide chain.

In your answer include:

- a description of DNA template strand, mRNA, tRNA, ribosome and polypeptide chain
- an explanation of transcription
- an explanation of translation
- justify why both processes are required to build a polypeptide chain.

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