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91159

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Biology, 2016

91159 Demonstrate understanding of gene expression

9.30 a.m. Friday 18 November 2016
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.

Achievement

TOTAL 09

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QUESTION ONE: NUCLEIC ACIDS

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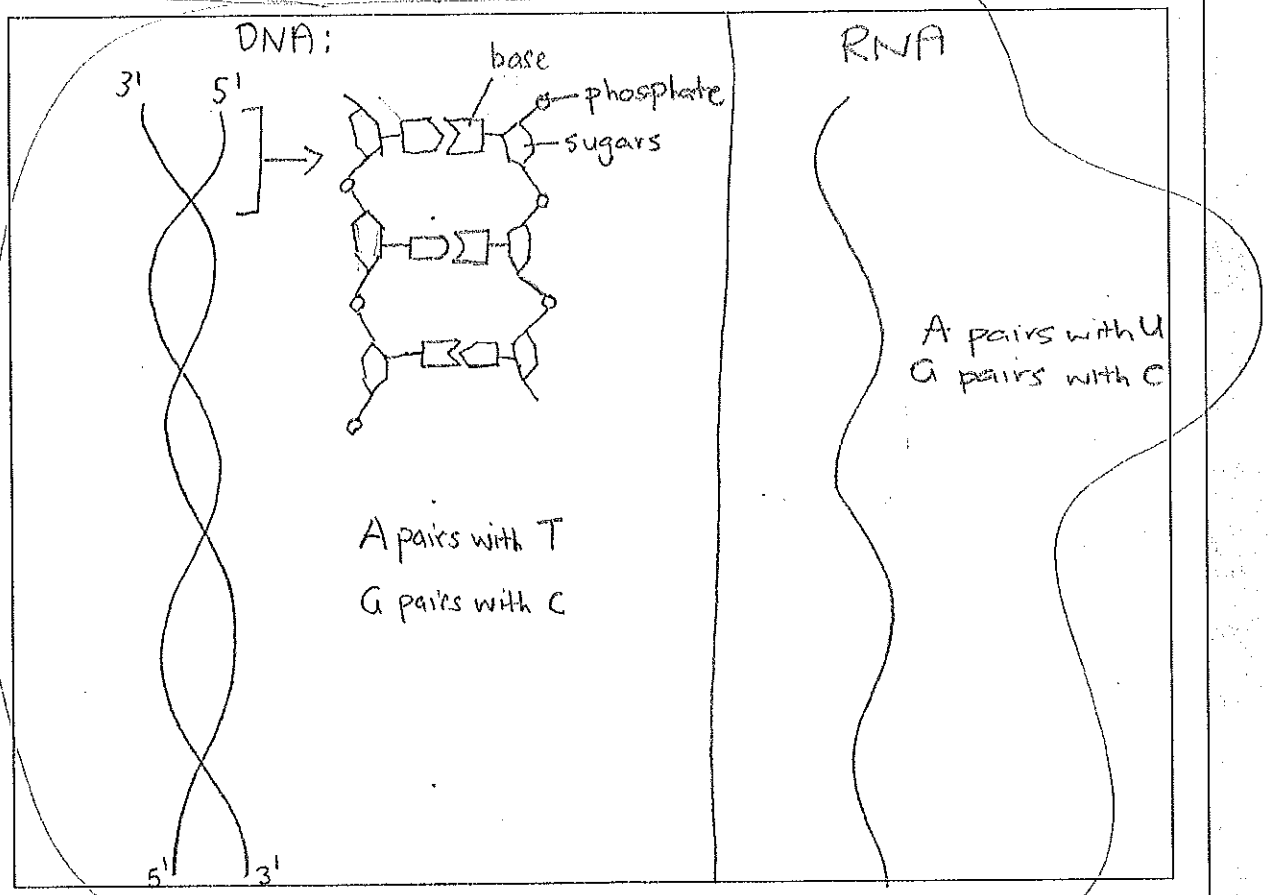
(a) Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are both involved in protein synthesis.

Describe the structure of DNA and RNA.

You may use diagrams in your answer.

DNA is a double stranded helix. It is made up of bases, phosphates and sugars. The bases complimentary to eachother are A-T and G-C.

RNA is one stranded. The bases complimentary to eachother are A-U and G-C.//



(b) DNA, mRNA, and tRNA are all involved in the formation of proteins.

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Discuss the significance of these molecules in forming proteins, and why the cell continually makes mRNA molecules, but not DNA molecules, during protein synthesis.

In your answer include:

- an explanation of the function of DNA, mRNA, and tRNA molecules
- an explanation of how mRNA is produced
- a discussion of the significance of DNA, mRNA, and tRNA in forming specific proteins.

DNA, mRNA and tRNA are involved in the processes of translation and transcription. In the first process of translation the DNA double stranded helix is unwinded by the RNA polymerase. An enzyme, Ribosome then comes along and adds nucleotides complimentary to the DNA strand now called the template strand. The ribosome reads 3 bases at a time called triplets adding complimentary ~~A to~~ U to A, ~~T to~~ A to T, G to C and C to G. ~~This~~ The Ribosome begins at the start AUG sequence. It then creates the new strand called the ~~mRA~~ mRNA. Translation occurs in the nucleus and once the mRNA strand is complete by stopping at the stop UAG, UGA, UAA sequence, it then moves out of the nucleus through a pore ~~and~~ into the Cytoplasm where the second process of Transcription occurs. In this process the mRNA strand is used to form proteins. This occurs when the Ribosome attatches itself to the mRNA strand beginning at AUG and reading it 3 bases at a time now //

called codons. It then "calls" the tRNA whos job is to bring nucleotides complimentary to the ones read by the Ribosome. These are called anti-codons. ~~This creat~~ The combination codes for an amino acid and as the ribosome moves along the mRNA strand, the amino acids created form a polypeptide chain which gets released once the ribosome reaches the ~~codon~~ stop codons UAG, UGA or UAA. Once the polypeptide chain is released it then ~~the~~ forms into a 3D structure of a protein. If the 3D structure unwinds the protein will denature. //

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The examination continues on the following page.

QUESTION TWO: ENVIRONMENTAL FACTORS AND GENE EXPRESSION

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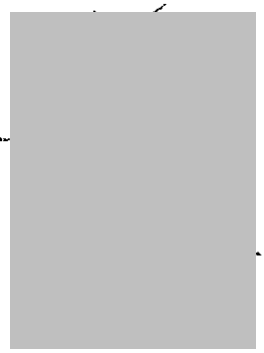
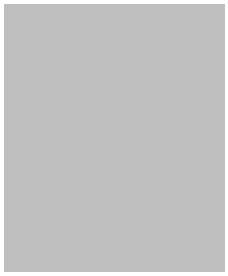
The honey bee (*Apis mellifera*) has two female phenotypes.

Female type	Larvae Diet	Adult phenotype	Genotype
Queen bee 	royal jelly	• increased ovary size • large body mass • live for 2 years	the same
Worker bee 	royal jelly for 3 days, then only pollen and honey	• infertile ovaries • smaller body mass • live for 3 – 6 weeks	

www.britannica.com/media/full/171791/141787

(a) Describe the term gene expression.

Gene expression is how your genes are presented in phenotype and genotype.

(b) Explain why comparing worker and queen honey bee females is ideal for experiments on environmental factors and gene expression.

It shows how the difference in diet and how they live and work affects their phenotype even if they have a similar genotype.

(c) Experiments have confirmed that royal jelly is not a mutagen.

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Discuss the effect the environment has on the expression of the phenotype in honey bee females.

In your answer include:

- a description of the environmental factor that affects honey bee phenotype
- using an example, an explanation of the difference between environmental factor and mutagen
- a discussion of how honey bee phenotype can change without changing the genotype
- a discussion of why the queen bee's phenotype is fully expressed, but the worker bee's phenotype is not.

The honey bees phenotype is affected by the environment and its surroundings because they have to live off pollen and honey which does not give them the proper nutrients they need. The honey bees genotype always remains the same regardless of the change in phenotype. Only mutagens can affect/change the genotype. ~~They~~ The honey bees phenotype can change can change depending on its environment, living conditions and amount of work it does, all the factors are not mutagens so cannot affect the genotype. The queen bees phenotype is fully expressed because it lives on a good consistent diet of royal jelly which gives it the nutrience to have a larger body mass than worker bees, live a lot longer than worker bees and have a larger ovary size and the ability to create //

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

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fertile ovaries. Worker bees are unable to reach the size of the queen bee because they lack the nutrients provided by the royal jelly, instead they live off of pollen and honey. ~~Unlike~~ Unlike Queen bee, worker bees have infertile ovaries and die within 3-6 weeks. Their environment causes them to work collecting more pollen to create honey to survive and because that is the main purpose of their lives. The queen bee has to have an increase in the size of their ovaries to keep producing larvae to replace the worker bees that die between 3 and 6 weeks.//

A3

QUESTION THREE: MUTATIONS

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(a) Describe what a mutation is.

A mutation is the affect of a mutagen which permanetly changes the gene expression / genotype and phenotype of an //

Question Three continues on the following page.

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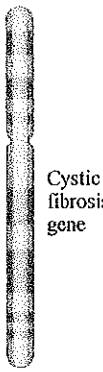
(b) There are over 1000 mutations that can cause cystic fibrosis. A common mutation is a deletion mutation that results in the absence of one amino acid in the final protein. Another mutation is a substitution mutation that results in a different amino acid in the final protein.



Chromosome 7

Discuss how these two mutations affect the cystic fibrosis gene's final protein and resulting phenotype.

In your answer include:

- an explanation of why the deletion mutation causes one amino acid to be absent in the final protein, and how this affects protein folding
- an explanation of why the substitution mutation causes a different amino acid to be present in the final protein, and how this affects protein folding
- a discussion of why the deletion mutation causes severe cystic fibrosis disease, whereas the substitution mutation causes milder cystic fibrosis disease.

Deletion mutation removes one nucleotide from a sequence. In most cases this mutation causes a frame shift which changes the whole sequence and ~~the finishing~~ amino ~~acids~~, unless the deletion is at the end of the sequence then there would just be one amino acid missing which would change the final protein. This denatures the protein. In t a substitution mutation one nucleotide from the sequence is substituted with another. This can cause a silent mutation if the 3 nucleotides code for the same amino acid. This is called degeneracy of the code which is when ~~one amino acid can have multiple~~ multiple codes which are different still code for the same amino acid. If this occurs there will be no change to the final protein. Although if it is different only one amino acid will change slightly

changing the final protein causing a mutation but not denaturing it. Deletion mutation causes severe cystic fibrosis disease because it is lacking a protein which may be essential as for substitution mutation, it can cause a milder cystic fibrosis disease because the final protein is only changed and not completely missing //

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

QUESTION NUMBER

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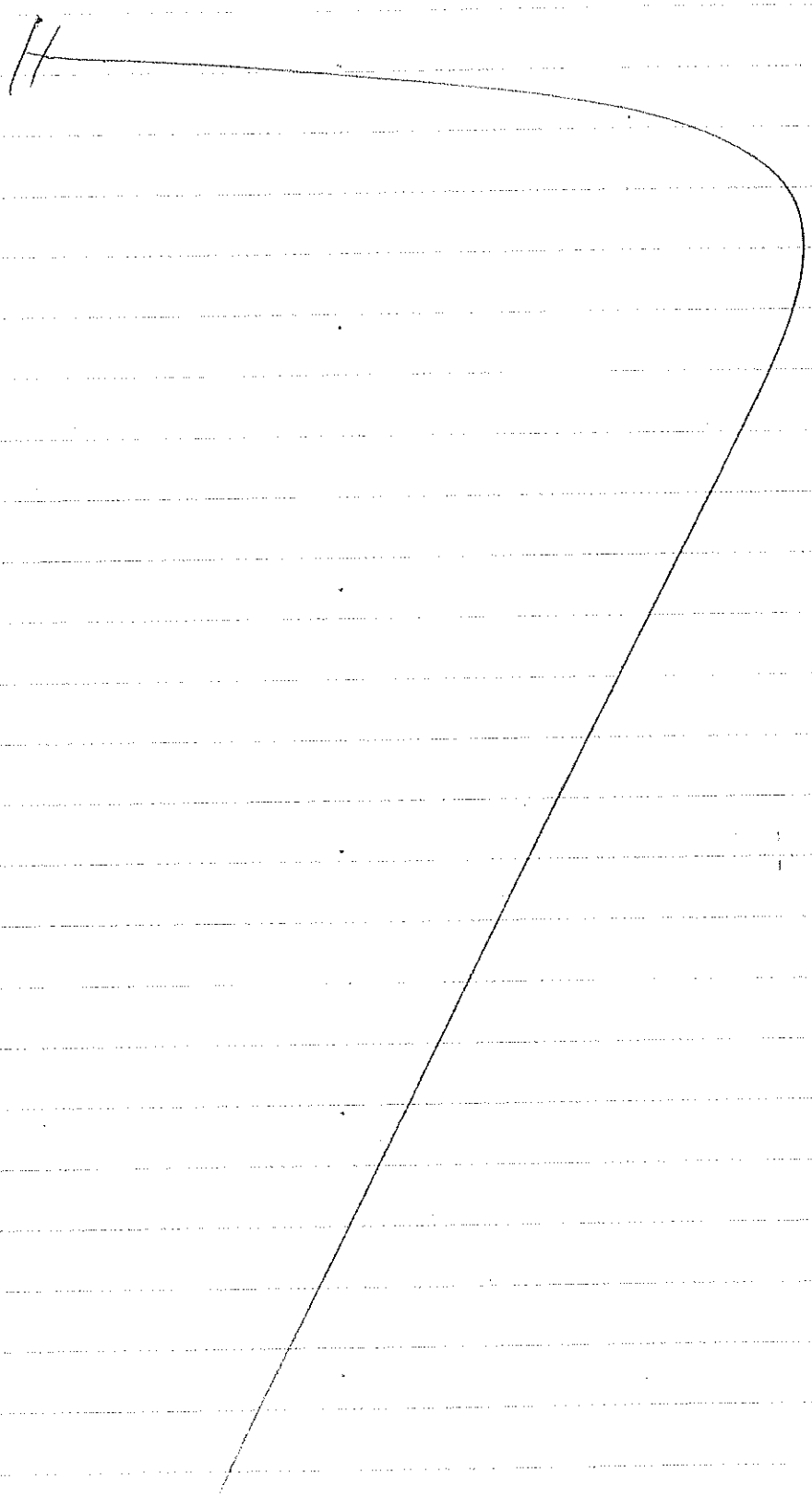

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ACH exemplar for 91159 2016		Total score	09
Q	**Grade score**	**Annotation**	
1	A3	The student has a good logical approach to protein synthesis, while there are some errors the general process is described. It appears as a recall answer and does not attempt to answer the question.	
2	A3	The student has a clear understanding of some key L2 terms and has identified that the different is diet however for an A4 they would have not delved into the final half a page where they go off topic.	
3	A3	There is clear evidence that the student knows what a mutation is. They write some key ideas alongside some errors, such as the comment error that in one case no protein is produced. While they mention terms like a frame shift and degeneracy neither are described.	