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90715

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 3 Biology, 2005

90715 Describe gene expression

Credits: Four
9.30 am Tuesday 15 November 2005

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 answer 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 2–10 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.

For Assessor's use only	**Achievement Criteria**		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe biological concepts and processes relating to gene expression.	Explain biological concepts and processes relating to gene expression.	Discuss biological concepts and processes relating to gene expression.
Overall Level of Performance		

You are advised to spend 40 minutes answering the questions in this booklet.

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QUESTION ONE

The left side of the diagram below shows how a eukaryote synthesises mRNA as part of normal protein synthesis. The right side shows how the mRNA formed can also be used to make a special form of DNA called cDNA (complementary DNA). This cDNA is the form of DNA that is needed if human genes are to be inserted into bacteria for genetic engineering purposes.

[FOR COPYRIGHT REASONS, THIS RESOURCE CANNOT BE REPRODUCED HERE. SEE BELOW.]

Lea C, Lowrie P, and McGuigan S, *AS Biology for AQA Specification B – Resource Pack*, Heinemann, 2000.

(a) Describe how mRNA is formed from DNA as shown by the first arrow in the diagram.

(b) Explain the role of tRNA in the formation of the protein.

(c) Explain why Okazaki fragments are formed when DNA **replicates**.

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(d) The cDNA shown on the right of the diagram on the opposite page can also be synthesised using the analysis of the amino acids of the protein formed by translation on the left. However, if scientists use this analysis of the protein to form cDNA, it may not have the same code sequence as cDNA formed using mRNA. Discuss why this situation occurs.

QUESTION TWO

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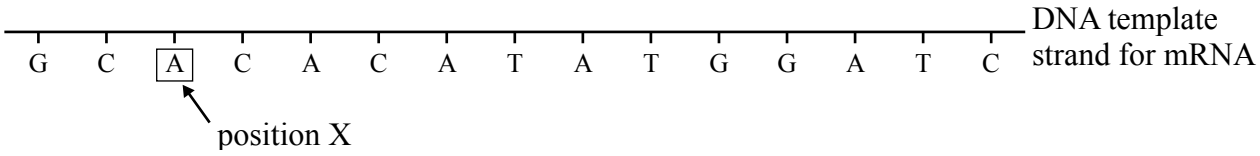
The base sequence from the end of a gene is shown below. Use it and the table given to answer the questions that follow.



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

(a) Use the table to determine the sequence of amino acids formed from this portion of the gene.

(b) The table is in the form of codons of mRNA. Codons are made up of nucleotides. Describe what makes up the nucleotides of **codons**.

(c) Discuss why a substitution point mutation at the position marked X will have very little effect on the polypeptide formed, whereas a deletion point mutation at position X would prevent production of the same protein.

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QUESTION THREE

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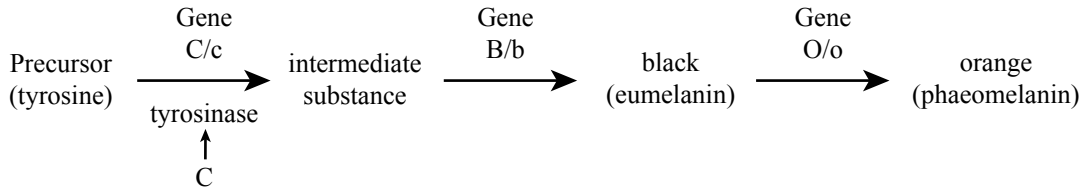
The development of coat colour patterns in cats is very complex. It involves at least 10 genes, each of which has a different effect on the phenotype. Effects include different colours, spots, different intensities, stripes, colour in different parts of the body and texture.

(a) Explain why the 10 genes involved in coat colour patterns in cats could not really be called an example of polygene inheritance.

(b) There are 3 main genes that control the metabolic pathway that produces the pigment melanin in cats. Melanin production starts with the amino acid tyrosine. There are two forms of melanin: eumelanin (black) and phaeomelanin (orange/yellow).

The metabolic pathway for this is shown below.



Dominant alleles are needed at each locus to complete all steps of the pathway to produce phaeomelanin (orange).

Discuss how this pathway shows epistasis. In your discussion include the effect on the phenotype if one of the genes was homozygous recessive.

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The first gene in the pathway has four alleles. Allele C produces an enzyme that gives full coat colour. It is dominant over the alleles c^b (Burmese) and c^s (Siamese). There is another allele, c, recessive to all three other alleles, that does not produce an active enzyme at all so the cats are albino. The alleles c^b and c^s are incompletely dominant with respect to each other.

(c) Describe the term incomplete dominance with reference to this series of alleles.

(d) Explain how four alleles can be involved in the first step of the metabolic pathway.

(e) Consider the other two genes from this pathway.

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- The allele B produces eumelanin (black pigment) and is dominant to b. Homozygous recessive bb cats are brown or chocolate.

- The orange gene (O or o) is located on the X chromosome. X with O produces an enzyme that results in the conversion of eumelanin (black) to phaeomelanin (red/orange/yellow). The X with o cannot carry out this conversion.

(i) Use this information to explain why male cats are nearly always either orange or black whereas females are often an orange-black mixture called tortoiseshell.

(ii) Occasionally a male cat with tortoiseshell features is born. Such male cats are sterile. Discuss how male tortoiseshell cats can occur and why they are sterile. You may use Punnett diagrams in your answer.

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Extra paper for continuation of answers if required.
Clearly number the question.

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Question number	