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3

90715

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 3 Biology, 2006

90715 Describe the role of DNA in relation to gene expression

Credits: Four
9.30 am Thursday 30 November 2006

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 2–9 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 the role of DNA in relation to gene expression. ☐	Explain the role of DNA in relation to gene expression. ☐	Discuss the role of DNA in relation to gene expression. ☐
Overall Level of Performance ☐		

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

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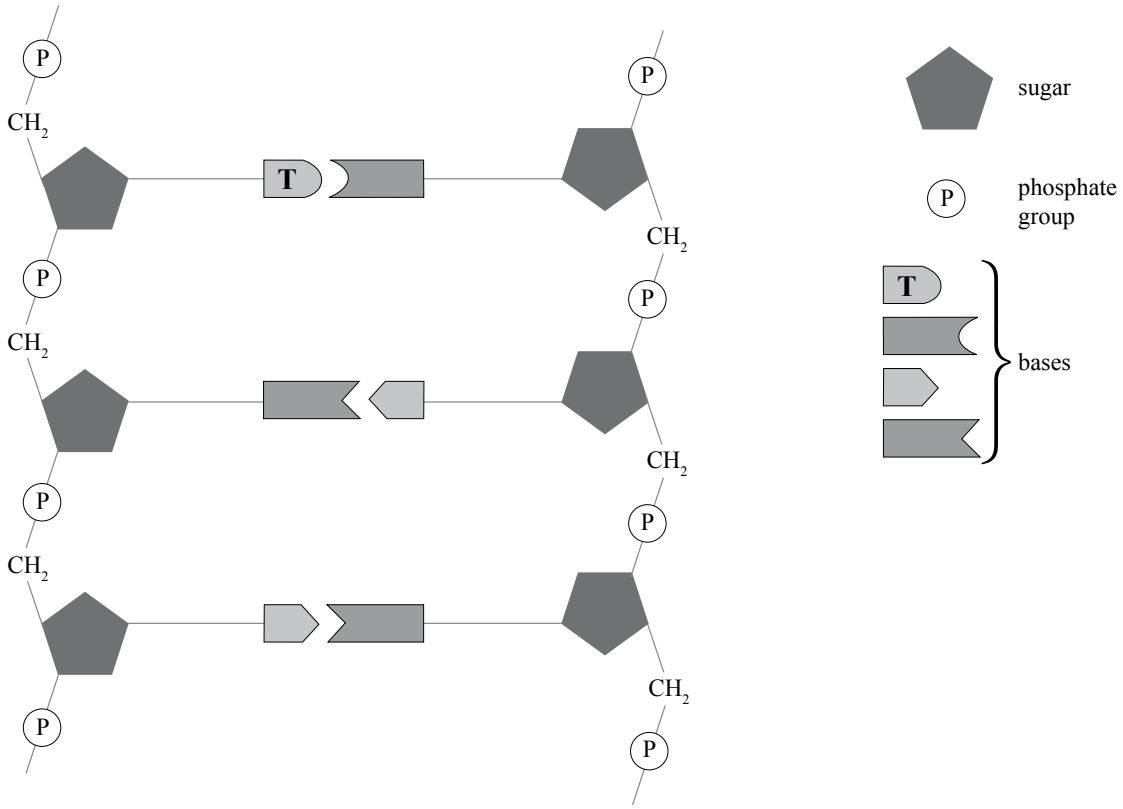
QUESTION ONE: DNA STRUCTURE, FUNCTION, AND REPLICATION

DNA is a polymer, made up of a large number of sub-units (nucleotides).

(a) The unlabelled diagram below shows the basic structure of a DNA molecule. Complete the diagram by giving information that clearly identifies:

- the four bases and their positions (one base has been identified in the diagram)
- the number of hydrogen bonds between bases
- the anti-parallel nature of the molecule
- which end of the DNA strand new nucleotides are added to.

Simplified structure of part of a DNA molecule



(b) Explain why DNA replication is necessary.

(c) Discuss how DNA replicates. In your discussion, you should explain:

- how replication begins
- the roles of the main enzymes involved
- leading and lagging strands
- Okazaki fragments
- the source of materials for replication.

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QUESTION TWO: GENE EXPRESSION AND PROTEIN SYNTHESIS

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Deoxyribonucleic acid (DNA) is found in almost all cells, and carries the genetic code that controls many aspects of cellular structure and function.

(a) Explain how the DNA molecule carries genetic information.

(b) Compare and contrast the processes of **transcription** and **translation**.

The proteins that some genes code for are constantly expressed, eg those involved in cellular respiration. Other proteins are produced only as needed, ie the expression of these genes is controlled.

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(c) Explain the role of **enhancers** in **eukaryote** gene expression.

(d) Discuss reasons for the role of **inducers** and **repressors** in **prokaryote** gene expression.

QUESTION THREE: PHENOTYPE DETERMINATION

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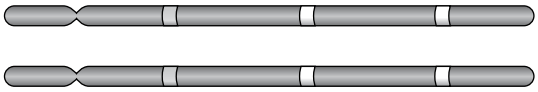
Genes are found on chromosomes, and eukaryote cells usually contain two copies of each chromosome.

The members of a pair of chromosomes have the same sequence of genes, but the genes may come in slightly different forms.

(a) On the diagram below, show the position of alleles for an individual who is:
- homozygous dominant for gene A
- heterozygous for gene B
- homozygous recessive for gene R.



People affected by Duchenne muscular dystrophy (DMD) lose muscle function from an early age and rarely survive to adulthood. The disease is caused by a mutation in a gene found on the short arm of the human X chromosome. The dominant allele (M) results in normal muscle function, while the recessive allele (m) produces the slow, irreversible muscle wasting that is characteristic of this disease.

(b) Give ALL the possible genotypes for the phenotypes listed below:

(i) female not affected _____

(ii) female affected _____

(iii) male affected _____

(iv) male not affected _____

(c) (i) A female who is heterozygous for the DMD allele has children with an affected male. Use a Punnett square to show all possible genotypes for the offspring of this couple.

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(ii) From your Punnett square, list the phenotypic and genotypic proportions for male and for female offspring.

Phenotypic proportions

male: _____

female: _____

Genotypic proportions

male: _____

female: _____

(d) Explain why more males than females are affected by Duchenne muscular dystrophy.

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Note that this question continues on the next page.

Many metabolic pathways are controlled by multiple genes. An example is the metabolic pathway that produces normal skin pigmentation. Albinism, which is the total lack of pigment, can be caused by a mutation in any one of the genes controlling this pathway.

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(e) Discuss the fact that it is possible for two albino parents to have a child with normal skin pigmentation.

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

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Question number	