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90729

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 3 Science, 2005

90729 Describe genetic processes

Credits: Four
9.30 am Friday 18 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 2–8 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 genetic processes. ☐	Explain genetic processes. ☐	Discuss genetic processes. ☐
Overall Level of Performance ☐		

You are advised to spend 45 minutes answering the questions in this booklet.

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QUESTION ONE: DNA AND DNA REPLICATION

DNA is made up of repeating units called nucleotides.

(a) Draw a labelled diagram of a **nucleotide** in the box below.

Two strands of these nucleotides form a double helix because of complementary base pairing.

(b) What are the bonds between the base pairings of the two strands called?

(c) Describe why complementary base pairing is important in DNA replication.

(d) DNA polymerase is a key enzyme in DNA replication. Explain the **main** function of DNA polymerase.

QUESTION TWO: RNA AND PROTEIN SYNTHESIS

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There are three types of RNA

- ribosomal RNA (rRNA)
- messenger RNA (mRNA)
- transfer RNA (tRNA)

(a) Describe TWO key ways in which **RNA** differs from **DNA**.

_____

_____

_____

_____

The sequence of the bases along a DNA molecule enables a cell to make proteins. The table below shows the **DNA triplets** for some of the amino-acids forming proteins.

Amino-acid	DNA triplet
Leucine	AAT
Cysteine	ACA
Glutamine	GTT
Methionine	TAC
Lysine	TTT
Alanine	CGA
Glycine	CCA

Amino-acid	DNA triplet
Phenylalanine	AAA
Tyrosine	ATA
Histidine	GTA
Isoleucine	TAA
Asparagine	TTA
Valine	CAT
Glutamic acid	CTT

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(b) Below are three **mRNA codons.**

Write the amino-acid sequence for the mRNA codons shown below.

mRNA sequence: **CAA** **UUU** **CAU**

Amino-acid sequence: _____ _____ _____

(c) Discuss the function of **transfer RNA** (tRNA) in the translation stage of protein synthesis. Draw a diagram in the box below if this will help your answer.

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QUESTION THREE: GENE THERAPY

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A rare genetic disease called "bubble baby" disorder stops the development of part of the immune system. Such children need to be kept in isolation to protect them from catching infections, and they usually die at a young age.

(a) Explain the **difference** in the genetic code between two family members when one has the faulty gene and one has the correct gene.

"Bubble baby" disorder is caused by a faulty gene that results in a key enzyme not being produced.

(b) Explain how the difference in the genetic code results in the key enzyme not being produced.

Gene therapy has cured some children of the "bubble baby" disorder. The bone marrow is extracted from the child and the correct gene put into the bone marrow cells. Then the bone marrow is returned to the child's body.

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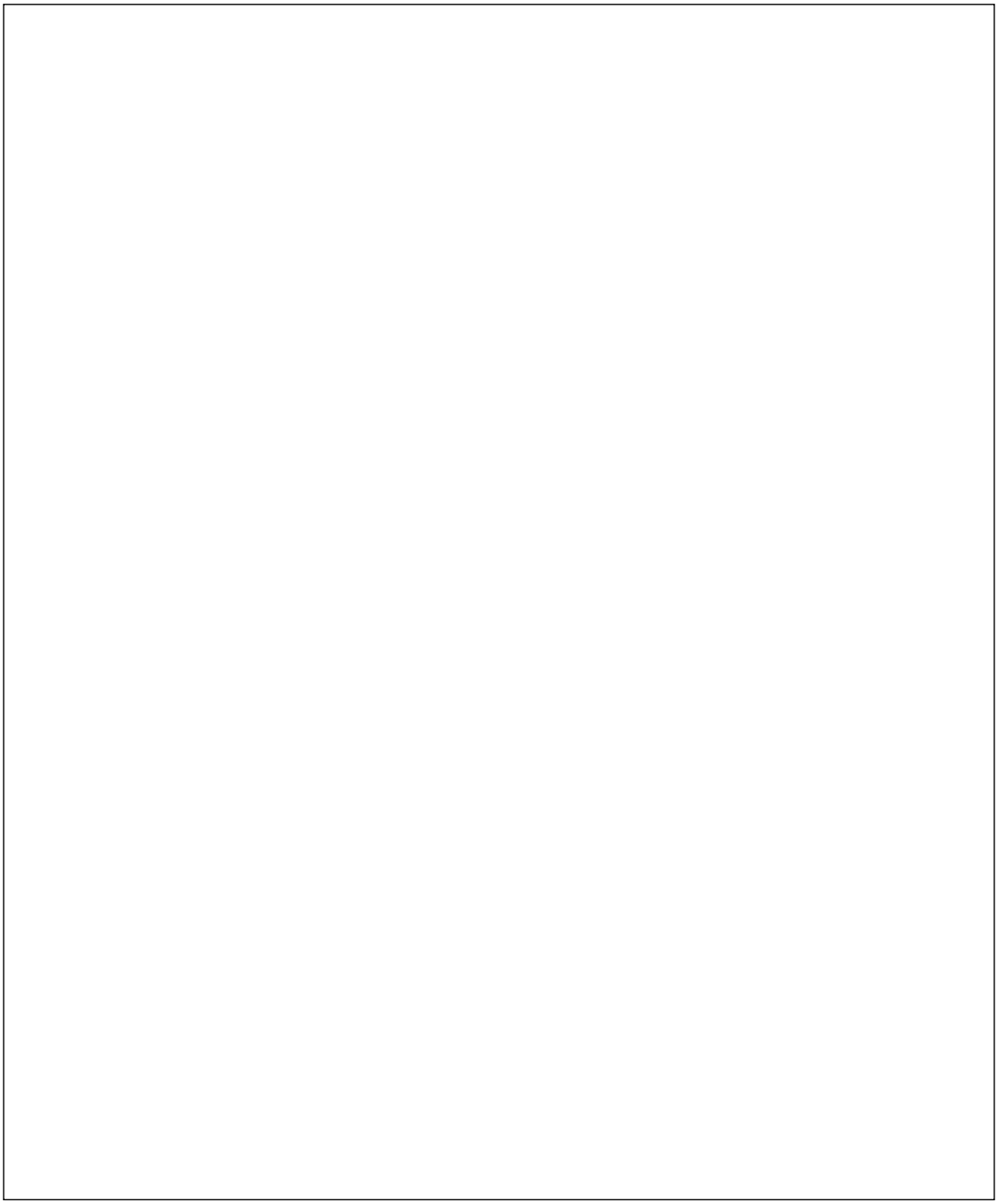

adapted from: http://www.jeansforgenes.com/2_about/2070_howitworks.php

(c) (i) Many copies of the correct gene would be required. Name the technique that replicates genes many times.

_____

(ii) One gram of the gene undergoes four cycles of the process named in (c)(i).

How many grams of the gene will there be after four cycles?

_____

_____

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(d) A virus, acting as a vector, introduces the correct gene into the bone marrow cell. First, the gene needs to be inserted into the virus. Restriction enzymes are used to assist this process.

Explain the role of restriction enzymes in the formation of such a vector.

Sadly, a few of the children having gene therapy to cure "bubble baby" syndrome have developed leukaemia (cancer of the white blood cells). This is because the introduced gene can sometimes disrupt another gene normally present in the children's cells.

(e) Discuss the implications of another gene being disrupted by an introduced gene.

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

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Question number	