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90718

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 3 Biology, 2004

90718 Describe applications of biotechnological techniques

Credits: Three
9.30 am Thursday 25 November 2004

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 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.

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Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe applications of biotechnological techniques to meet human needs and requirements. ☐	Explain applications of biotechnological techniques to meet human needs and requirements. ☐	Discuss applications of biotechnological techniques to meet human needs and requirements. ☐
Overall Level of Performance ☐		

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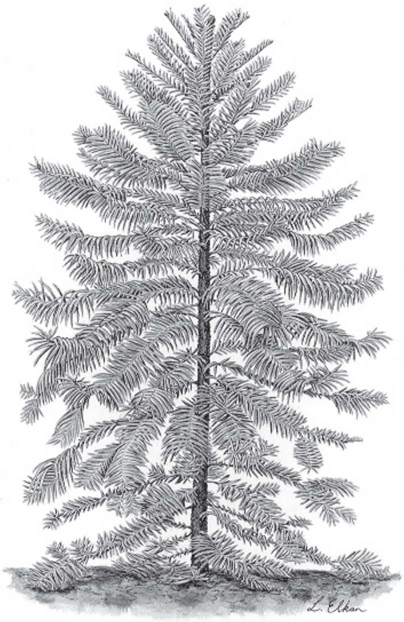
You are advised to spend 35 minutes answering the questions in this booklet.

QUESTION ONE: WOLLEMI PINE – THE DINOSAUR TREE OF AUSTRALIA

Ten years ago a grove of unusual pine trees (*Wollemi nobilis*) related to the New Zealand kauri were found in a canyon near Sydney in Australia. They are the only members of the extremely rare *Wollemi* genus. Fascinated people want to see and grow them. Authorities and conservationists demanded that the trees be protected. Their location has been kept secret because there are so few of them and they are vulnerable to fire, disease or other disaster. Australian authorities have a plan to protect the trees. Two of the objectives of this plan could involve applications of biotechnological techniques. These objectives are:

- determine the range of genetic variability of the species
- establish populations in botanical gardens.



The Wollemi Pine

(a) Describe an **application of a biotechnological technique** that may be needed to meet the human demand of the objective to determine the range of genetic variability of the species.

(b) Conservationists want to establish populations of *Wollemi* pines that show diversity, in botanical gardens. Explain how a **technique of biotechnology** could be used to establish these populations of *Wollemi* pines in botanical gardens.

(c) The *Wollemi* pines have been shown to be susceptible to the die-back fungus (*Phytophthora cinnamomi*) that attacks trees in other Australian native forests. One species of pines has resistance to this fungus because of a single gene. Discuss how biotechnological techniques could be used to develop *Wollemi* pines that are resistant to the die-back fungus. In your discussion, include concerns that may result from the procedures involved.

QUESTION TWO: MOA (Genus *Dinornis*)

Studying moa helps scientists to understand the biology of living birds. The following is an extract from the *New Scientist* magazine in September 2003. It followed analysis of the DNA found in moa bones. The bones were thought to have come from three different species. The two teams of scientists involved found that instead of the bones coming from three different species of moa, they came from one species, in which the females were up to three times as big as the males. This was the first time an extinct species had been sexed using ancient DNA.

> Both teams used PCR to amplify mitochondrial DNA, which showed that differently sized *Dinornis* bones belonged to the same species. But to sex the bones they had to amplify nuclear DNA, as that is where the sex chromosomes are. This is harder, as each cell only has two copies of each chromosome compared to thousands of mitochondria. The teams used DNA from the closely related rhea, ostrich and kiwi to isolate sequences unique to the moa's female 'W' chromosome. One team validated the technique by correctly predicting the sex of two bones known by their shape to have come from females.

Page 17 *New Scientist* 13 September 2003.

(a) Describe why the use of PCR is a help to the scientists who want to gain information from the skeletons.

(b) Discuss how the scientists used applications of biotechnological techniques to sequence the mitochondrial DNA coming from the differently-sized moa bones to show that they belonged to the same species.

(c) Discuss why the procedures used to 'sex' the bones of the moa were harder than just identifying that they belonged to the same species. In your discussion, say why the procedures were needed and why the researchers used DNA from closely related living birds for comparison.

QUESTION THREE: MEDICAL MIRACLES OR MEDDLING

Some inherited genetic diseases are caused by the lack of an essential protein. Biotechnology may be used to treat individuals affected by these genetic diseases. Research into genetic diseases caused by the lack of an essential protein can focus on using biotechnology in two ways:

- produce the protein cheaply and effectively using micro-organisms so that the patient can be regularly dosed with the protein
- 'cure' the affected person by inserting functioning genes so that the person is capable of producing the required protein.

(a) Describe the genetic application that would use micro-organisms to produce the required human protein.

(b) Explain how a technique could be used so that a micro-organism can produce the required human protein.

The second research focus outlined above promises a more permanent solution for those affected by genetic diseases involving a single protein. It also brings greater problems delivering the gene to the cells or tissues of the body where it can be effective.

(c) Explain how a sequence of techniques could be used to get a working gene into an affected person so that they can produce the required protein that they cannot produce on their own.

(d) Discuss difficulties that could occur when delivering a gene into a patient. These are things that researchers would need to consider, and check for, and ensure were not a problem before the patient could be said to be 'cured' and able to produce their own essential protein.

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

Question number

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