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3

90717

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 3 Biology, 2006

90717 Describe processes and patterns of evolution

Credits: Three
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 processes and patterns of evolution.	Describe processes and explain patterns of evolution.	Describe processes and discuss patterns of evolution.
Overall Level of Performance		

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

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QUESTION ONE: SPECIATION

Balloon vine is a South American plant that has become an invasive weed in Australia. Scientists are investigating whether a native insect, the soapberry bug, has the potential to become a biological control agent for this weed.

The soapberry bug usually feeds on seeds from the thin-walled fruits of native plants. It uses piercing mouthparts ('beaks') to reach these seeds. However, when the balloon vine first reached Australia, very few soapberry bugs had 'beaks' long enough to allow them to exploit this new food source.

Figure 1: Soapberry bugs on (a) native plant and (b) balloon vine.

S. P. Carroll, J. E. Loye, et al., 'And the beak shall inherit – evolution in response to invasion', *Ecology Letters* (2005), 8: 944–951

(a) Describe changes in the **gene pool** of the soapberry bug population as the bugs adapted to the new food source.

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(b) Discuss how the **process of natural selection** would work to produce a population of soapberry bugs with mouthparts ('beaks') long enough to reach the seeds of the balloon vine.

Since 1965, when the balloon vine became common in Australia, soapberry bugs have evolved mouthparts 5–10% longer than those in pre-1965 populations. Laboratory experiments show that the longer-beaked bugs are more effective at feeding from the seeds of the balloon vine than bugs with shorter beaks.

(c) Define **speciation**.

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Figure 2: Beak lengths of soapberry bugs feeding on golden rain tree fruit and balloon vine fruit (x-axis refers to beak length (mm) in both cases).

S. Freeman & J. C. Herron, *Evolutionary Analysis* (3rd edition, 2004).

(d) Explain whether the longer-beaked soapberry bugs can be called a new **species**.

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QUESTION TWO: PATTERNS OF EVOLUTION

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Recent DNA analyses have suggested that cicadas arrived in New Zealand around 11.6 million years ago, and subsequently evolved into a number of different species.

This was a time of considerable environmental change. The Southern Alps were beginning to form, and the world was entering a new 'ice age'. This meant that a new alpine environment was available for colonisation. During glaciations, New Zealand forests were found only in patches in the upper part of the North Island, while grasslands became widespread.

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Figure 3: A cicada from the genus *Kikihia*.

http://collections2.eeb.uconn.edu

(a) Define **adaptive radiation**.

(b) Explain how the uplifting of the Southern Alps may have been a factor in the evolution of a number of different cicada species in New Zealand.

Five cicada species belonging to the genus *Kikihia* are sympatric in North Island forests. They can be distinguished on the basis of their songs, and also features of their reproductive behaviour.

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(c) Discuss the process that could have resulted in these species coexisting in the same habitat.

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Figure 4: Phylogenetic relationships in cicada species belonging to the genus *Kikihia*.

P. Arensburger et al., 'Evolution and phylogeny of the New Zealand cicada genus *Kikihia*', *Journal of Biogeography* (2004), 31: 1769–1783

(d) Does the phylogenetic tree shown in Figure 4 support a model of **gradualism** or a model of **punctuated equilibrium**? Explain your answer.

New Zealand's bird species have also adapted to a range of environments and niches. The curved-beak wren had a long, curved beak adapted to extracting grubs from crevices in tree trunks. Other bird species, such as the woodcreepers in South America and some tree creepers in Australia, have similar beaks to the curved-beak wren. They also feed by probing cracks in tree trunks. However, these birds are not closely related to the New Zealand wrens.

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(e) Explain how these unrelated species could have evolved their physical similarities.

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

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Question number	