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NZQA
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MANA TOHU MĀTAURANGA O AOTEAROA

3

SUPERVISOR'S USE ONLY

Level 3 Biology, 2012

90717 Describe processes and patterns of evolution

2.00 pm Tuesday 13 November 2012
Credits: Three

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 attempt 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.

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 ☐		

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

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QUESTION ONE

The bullhorn acacia is a small swollen-thorn tree native to Mexico and Central America. Colonies of stinging ants occupy its hollowed-out thorns and defend the tree against harmful insects, browsing mammals and epiphytic or hanging vines. The ants also cut and clear vegetation from around the tree. The host supplies the ants with protein-lipid Beltian bodies from its leaflet tips and carbohydrate-rich nectar from glands on its leaf stalk. There is no known function for the Beltian bodies, except to provide food for the ants that share a mutualistic relationship with the tree.

Bullhorn acacia plant with ant emerging from thorn.

http://ecolibrary.org/images/full_image/Ant_w_bullhorn_acacia_thorn_DP162.jpg

Evaluate the **evolutionary** relationship between the bullhorn acacia and the stinging ants and how this relationship may have developed.

In your answer you should:

- describe this pattern of evolution
- explain why this mutualistic relationship may have developed
- discuss a possible evolutionary outcome, should the ants become reduced in numbers over time.

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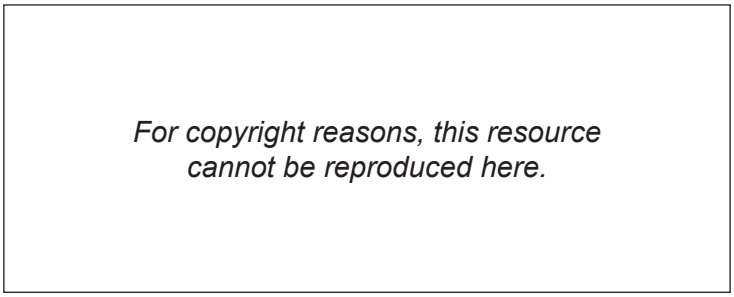
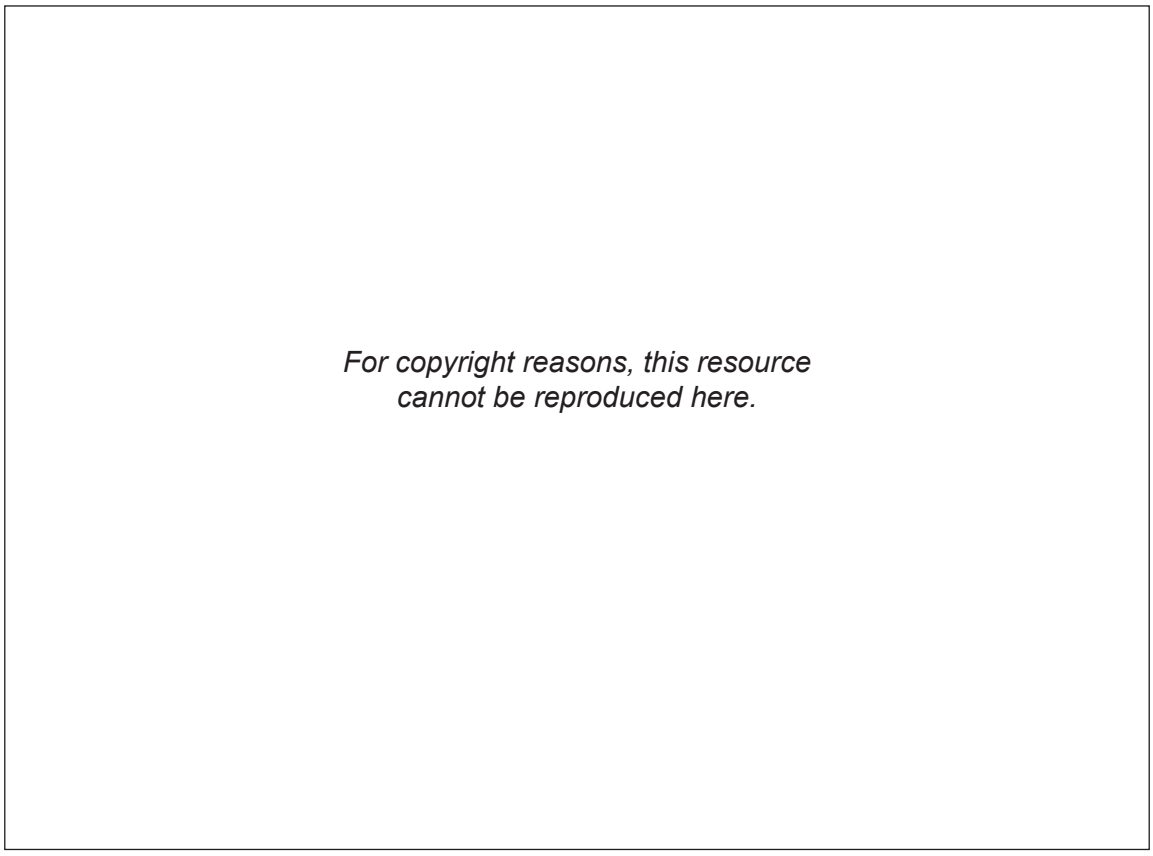
QUESTION TWO

The foraminiferan plankton *Globorotalia*, found in temperate New Zealand waters, had a compressed shell and peripheral keel (*G. conoidea*) seven million years ago. The ancestral organism no longer exists. The plankton microfossil record shows many tiny changes towards the modern form, which has a rounded shell with no keel (*G. inflata*).



Adapted from *Biology Learning Workbook*, (Auckland, ESA, 2003), p 180

In comparison, four closely related stag beetles (*Lissotes spp*.) found in the upper North Island of New Zealand are thought to have shared a common ancestor ten million years ago, before sea levels rose and the climate warmed.



Adapted from Level 1 Biology Student Workbook (Biozone, Hamilton, 2011), p 274

Compare the evolutionary patterns for *Lissotes* and *Globorotalia*.

In your answer you should:

- describe the patterns of gradualism and punctuated equilibrium with reference to the above organisms
- explain how each pattern could arise
- discuss why these groups of organisms have evolved in different ways.

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QUESTION THREE

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Lord Howe Island is a small land mass of less than 15 km^2, 580 km off the eastern coast of Australia.

Two closely related species of palm, *Howea forsteriana* and *Howea belmoreana* are strikingly different, yet they co-exist in many parts of the island. Both are wind pollinated and are diploid ($2n = 32$). Hybrids are uncommon. It is estimated that the two *Howea* species diverged less than one million years ago.

Data has been collected on the distribution and frequency of flowering of the two species.

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Flowering frequency for each *Howea* species. *H. belmoreana* is shown in grey, *H. fosteriana* is shown in black, with male (solid line) and female (dotted line) phases.	Distribution of *H. fosteriana* (black) and *H. belmoreana* (grey), according to mean pH per quadrat in **a** and altitude in **b**.

Savolaienen et al, Vol 441; 11 May 2006:doi:10.1038/*Nature* 04566

Discuss the reasons why this speciation event between *H. forsteriana* and *H. belmoreana* is more likely to be sympatric and NOT allopatric.

In your answer you should:

- define both sympatric and allopatric speciation
- explain how the two palm species have become reproductively isolated
- discuss the evidence that supports this being a sympatric speciation and **not** an allopatric speciation.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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