3

SUPERVISOR'S USE ONLY

91603

916030

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Biology, 2017

91603 Demonstrate understanding of the responses of plants and animals to their external environment

9.30 a.m. Thursday 16 November 2017
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the responses of plants and animals to their external environment.	Demonstrate in-depth understanding of the responses of plants and animals to their external environment.	Demonstrate comprehensive understanding of the responses of plants and animals to their external environment.

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 room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 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.

Achievement

TOTAL 12

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

Mānuka seeds.
www.amazon.co.uk/Manuka-tree-leptospermum-scoparium-seeds/dp/B01BP3WCGA

Mānuka seeds germinating.
http://slideplayer.com/slide/5661375/

Mānuka seedlings after 2 months.
http://www.treeproject.org.au/seedling-database/leptospermum-scoparium

When the mānuka (*Leptospermum scoparium*) seed germinates below the soil surface, two different plant responses occur at the radical and plumule.

Mature mānuka trees release leptospermone, a chemical that acts as a natural herbicide.

Discuss how the different responses that the mānuka plant displays in germination and early growth are beneficial to the survival of the plant.

In your answer:

- identify and describe the two different responses shown by the mānuka seedling as it germinates below the soil
- explain the type of interaction between the mature mānuka and other plants growing nearby, due to the release of leptospermone into the soil
- explain how these responses occur below the soil as the mānuka germinates
- discuss the adaptive advantage of these two responses below the soil, and compare them with the response once the plumule is exposed to light.

You may use annotated diagrams as a part of your answer.

M • As the seed germinates the radicle ~~it~~ displays a positive geotropism response. Positive geotropism is a directional response, where the roots will grow towards/in the same direction as gravity. The plumule ~~shoots~~ however displays a ~~pb~~ negative ~~positive~~ geo ~~phototropic~~ growth response, this ~~is~~ is a directional response of shoot growth ~~towards the light~~ away from/in the opposite direction of gravity.

• These responses occur because of Auxin. Auxin is a plant growth hormone that elongates cells. Auxin settles into the lower half of

4

the germinating seed, elongating those cells. If the seed is planted on its side, the elongation of cells causes the plumule to grow upwards (negative geotropically) and the radicle downwards (positive geotropically). The adaptive advantage of positive geotropism in the germinating seed is that the roots grow far into the ground reaching ideal soil, benefiting the fitness / health of the plant overall. The adaptive advantage of negative geotropism is that the plumule is growing towards the surface to eventually grow and recieve the environmental factors required for a healthy plant. Once the plumule is exposed to light, ~~it displ~~ the ~~plant~~ plumule displays a positive phototropic response. This means the response allows the plant to grow towards the light. This is possible as if Auxin ~~is~~ detects light, it moves into the opposing direction of the shoot, elongating those cells and causing the shoot to bend and grow towards the light stimulus. The adaptive advantage of this is that the plant has a higher rate of photosynthesis when exposed to more light - resulting in greater fitness of the plant overall. When the mānuka tree matures, the release of leptospermone into the soils affects other plants as it is advantageous ~~for all~~ plant sharing the same soil, this is a

ASSESSOR'S USE ONLY

M mutualistic relationship as both species will benefit. The chemical acts as a natural herbicide, decreasing the chances of these plants being eaten by herbivourous organisms that would cause the plants harm. The mānuka and other plants sharing the same soil have a better chance of survival against predation, ~~and~~ passing on stronger genes to successive generations. The other plants sharing soil with the mānuka may be able to benefit their own successive generations as a result of living in ~~prod~~ leptospeumone invested soils. Passing on genes carry the release of the chemical and building a stronger, more protected species. M

ASSESSOR'S USE ONLY

A4

QUESTION TWO

ASSESSOR'S USE ONLY

http://www.nzbirdsonline.org.nz/species/sooty-shearwater http://www.teara.govt.nz/files/5484-enz_0.jpg

The sooty shearwater or mutton bird (*Puffinus griseus*) leaves New Zealand in the Southern Hemisphere's winter – summer in the Northern Hemisphere – and takes advantage of prevailing winds along different portions of their migration route.

When plotted on a map, their paths look like giant figure eights over the Pacific Ocean (see map above).

They are spectacular long-distance migrants, travelling north up the western sides of the Pacific and Atlantic Oceans at the end of the nesting season in March–May, reaching subarctic waters in June–July, where they cross from west to east, then returning south down the eastern sides of the oceans in September–October, reaching the breeding colonies in November. They do not migrate as a flock, but rather as single individuals, associating only opportunistically.

Recent tagging experiments have shown that birds breeding in New Zealand may travel 74 000 km in a year, reaching Japan, Alaska, and California, averaging more than 500 km per day.

Discuss why migration is important to the health and survival of the sooty shearwater.

In your answer:

- describe migration
- explain how the sooty shearwater might determine the time for migration, AND how they may navigate during migration
- discuss the costs and benefits of migration to the sooty shearwater.

(Migration is the mass movement of populations on a long distance journey ~~to~~ to source favourable environmental conditions for breeding, food sources, and nesting sites. Migration includes the return trip home again.

The migration of the sooty Shearwater is based around desirable e (warmer) environm

There is more space for your answer to this question on the following pages.

-ental conditions for breeding. They leave New Zealand just before the colder winter season and arrive in either Alaska or Japan in time for the Northern Hemisphere's summer season. The ~~reason~~ benefits for their migration include sufficient food resources for the return trip home and warmer climate for mating/breeding. As they return to the southern hemisphere, it is the summer season again where they breed young fledgings. After leaving for 5-6 months there is a high food availibility for their young and for preperation to leave and migrate again the following year. Migration is an innate behaviour. Innate behaviour is the passing on of behaviours genetically and the behaviour is instinctive whether the animal is on their own, or living within a population.

~~The shearwater uses prevailing~~

Navigation is the ability of an animal to locate and stay on tracic during migration using landmarks, star composition and the earth's magnetic field. ~~The~~ ~~and~~ It is likely that the sooty shearwater uses landmarks as their source of navigation. Homing is the ability of which an animal can find its way home in an unknown area. The shear-waters would of used homing on their first couples of trips before the route became

ASSESSOR'S USE ONLY

more familar throughout the period of its life.

•The costs of migration include sufficient energy use. The birds are required to travel over 74 000 km during the period of one year. A benefit of this is that the birds avoid cold climates, as they thrive in a warmer environment. ~~Another benefit of migration includes~~ The shearwaters uses weather conditions to its advantage to preserve as much energy as possible by using prevailing winds to carry them to the desired location rather than relying just on itself to fly. Young sooty shearwaters are bred in warmer climates and have a ~~m~~ greater chance of survival to adulthood.

A3

QUESTION THREE

ASSESSOR'S USE ONLY

http://howardcheek.photoshelter.com/image/I00005Pm3.HDRznI

http://cursa.ihmc.us/rid=1Q19NCQSR-1PH7VJX-2V1Q/flowering%20in%20plants.png

Mānuka (*Leptospermum scoparium*) are long-day plants which flower in spring and into summer. Flowering in the mānuka plant is controlled by the phytochrome system. The flowers are used by beekeepers to produce mānuka honey. Honeybees (*Apis mellifera*) seek their food within a circumference of 3 to 4 km around their hive. The bees navigate from the hive to the flowers using different cues during the day.

Relate the role of the phytochrome system to the survival of the mānuka plant population.

In your answer:

- identify and describe the relationship between the mānuka tree and the bees
- describe the process of photoperiodism AND explain how the phytochrome system could work in the mānuka tree
- discuss how photoperiodism in the mānuka tree provides an adaptive advantage to BOTH species.

You may use annotated diagrams to support your answer.

The flowers and the honeybees share a mutualistic relationship. Both the bees and the flowers benefit from this relationship as the bees collect nectar and pollen for nutrients and the flower is being pollenated with its pollen being widely spread, increasing variation and chances of survival. Both species supply a benefit for the other.

• Photoperiodism is the relative day-length of a plant. Phytochromes are plant pigments which detect light and communicate this to the rest of the plant. The mānuka

U tree is a long-day plant. Long day plants require their critical day length to be exceeded before flowering. The phytochrome, within the mānuka tree detect light, converting Pr (~~fav~~ red light) into Pfr (far-red light). Once the critical day length has been exceeded, the mānuka tree flowers. The Bees use endogenous rhythms which is synchronised with the critical day length of the mānuka tree. The bee is active during the time of flowering and can go pollinate the flower whilst also gaining nutrients. Photoperiodism provides an adapt -ve advantage for both species. The bees are preserving their energy by only being active when the plant flowers, ~~rather than~~ having a reliable food source. In contrast to flying around and using energy to find that the ~~flowers~~ plant ~~are~~ is yet to flower. This is also an advantage to the mānuka as pollination is occuring at a higher rate. When the bees feed off of the flowers nectar, the pollen sticks to its body, as the bee flies, the pollen disperses over a large area, creating greater variation as it can reproduce with a wider range of plants, building a stronger ~~pop~~ mānuka population. This is advanta-

ASSESSOR'S USE ONLY

There is more space for your answer to this question on the following page.

grow to the mānuka as it is more protected against disease. If a disease were to arise, with increased variation the mānuka population will not be completly wiped out. The fittest genes will survive and continue to reproduce, passing favourable genes onto successive generations.

ASSESSOR'S USE ONLY

MS

Subject:	Biology	Standard:	91603	Total score:	12

Q	Grade score	Annotation
1	A4	This student identifies and describes three tropisms correctly. Positive and negative geotropism and positive phototropism. (1 point each) They clearly differentiate that positive phototropism is happening only once the plumule is exposed to light. The adaptive advantages for the geotropisms are vague and not described or explained fully. The mechanism of the geotropisms is also not clear enough to gain marks at the Achieved or Merit levels. The adaptive advantage of positive phototropism is described (1 point), and the mechanism explained . (2 explainations of tropisms were necessary for M5). The role of the leptospermone is misunderstood.
2	A3	The definition/description of migration is adequate (1 point). The student determines a reason that can determine the time for navigation as the innate genetic drive (1 point). Several navigation methods are identified but are not described sufficiently for any credit in this section of the answer. Several costs and benefits are identified and described briefly, but not explained sufficiently to gain credit at the Merit level. (1 point). This candidate could have gained M5 if at least 1 cost and 1 benefit had been explained in more detail.
3	M5	This is the best answer and shows that the candidate has the potential to reach Merit level if they had taken the time to explain processes in Q1 & Q2 in more detail. M5 is awarded in this question because the student fully explains the adaptive advantage to the månuka tree. M6 is not awarded because the adaptive advantage to the bee is a truncated explanation which lacks detail.

Overall: A total of 12 points gives this student a solid Achieved grade and shows the potential to reach Merit level. This is a good example of the need for students to read through their answers to determine if they have described or explained the processes/concepts that they are being questioned on.