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3

91603



916030



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## Level 3 Biology, 2016

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

2.00 p.m. Thursday 10 November 2016  
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 2–15 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.**

Merit

TOTAL

16

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## QUESTION ONE: TUI

Tui (*Prosthemadera novaeseelandiae*) are notoriously aggressive, and will defend a flowering or fruiting tree, or a small part of a large tree, from all comers, whether another tui or another bird species. They vigorously chase other birds away from their feeding area with loud whirring wings. Tui have a display flight, in which they fly upwards above the canopy, and then make a noisy, near-vertical dive back into the canopy.

<http://www.nzbirdsonline.org.nz/species/tui>

[http://www.biol.canterbury.ac.nz/mistletoes/photo\\_library.shtml](http://www.biol.canterbury.ac.nz/mistletoes/photo_library.shtml)

Tui feed on nectar from the red mistletoe (*Peraxellia tetrapetala*). The red mistletoe grows on the mountain beech (*Fuscospora cliffortioides*).

The flowers are pollinated by tui. To open flowers, tui grasp the top of the bud with their beaks and twist. This causes the flower petals to spring open (in less than  $\frac{1}{4}$  of a second), and the birds can then insert their beaks to drink nectar, and thereby pollinate the flower. *mutualism*

Red mistletoe use specialised roots to get water and dissolved mineral ions from a host tree rather than from the soil, causing harm to its host tree mountain beech. *parasitism*

Identify and explain the behaviours and types of competition between the red mistletoe, tui, other birds, and the mountain beech, and evaluate the costs and benefits of maintaining these behaviours and relationships.

In your answer you should:

- describe territoriality
- explain the costs and benefits of the tui's territorial behaviour
- identify and describe the other types of relationships mentioned
- evaluate the costs and benefits to each species in the relationships identified.

A territory is an area around the home base which is actively defended from other animals of the same or different species. Territoriality is the behaviour displayed by the animal which it uses in order to defend its territory. The tui aggressively

Defend the red mistletoe and other flowering/fruiting trees as they provide a source of food for the bird which in turn enhances its survival. However there are many costs which come from portraying territorial behaviour for the tui as it expends copious amounts of energy which could have otherwise been spent on reproduction or feeding which would have furthered the population. Therefore the ideal size of a territory is a compromise between the energy expended and the benefits gained. Such benefits of this particular behaviour means that the tui has a reliable source of food which is protected from other birds or predators causing a depletion in it. By using loud whirring ~~sound~~ wings it intimidates other animals from attempting to also feed off of the trees and may also startle predators, therefore increasing the survival of the tui population. There are also two relationships which can be observed between both the flowers and the tui, and the roots of the red mistletoe and another tree species mountain beech. The flower and the tui share a mutualism relationship which benefits both species. This ~~can~~ is an example of facilitated mutualism as the two do not require each other for survival (the tui could find another food source and the flowers could be pollinated by another bird). The tui grasps the top of the bud enabling them to insert their beaks to pollinate the flowers. This enables ~~the~~ greater genetic variation between the flowers of the red mistletoe from cross pollination therefore increasing their chance of survival of the species if environmental conditions changed. Not only is the survival of the tree flowers

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increased but the tree itself is at an advantage as it  
 obtains ~~an~~ a reliable source of food due to its pollination  
 allowing flowers to continue to grow. The tree feeds from the  
 nectar of the tree which provides them with energy to  
 survive. This energy is essentially crucial in order for them  
 to sustain their territorial behaviour also which provides  
 them with the source of food and deter predators. The red  
 mistletoe itself has a type of exploitation relationship  
 with another tree 'mountain beech' of which it grows  
 on, this is called a parasitism where by the <sup>red</sup> mistletoe  
 lives off of the mountain beech which acts as a host.  
 This is advantageous for the red mistletoe however is at  
 cost to mountain beech as although parasitism relationships  
 do not usually kill they will harm the host. The red mistletoe  
 uses specialised roots to get water and ions from the other  
 tree meaning that it does not have to expend energy seeking  
 a source of water which in turn is essential for photosynthesis  
 and the production of glucose, therefore growth and survival of  
 the tree. It also means that predators are less able to access it  
 overall producing the best conditions for the tree's survival.  
 However the mountain beech is losing water and ions  
 meaning it is having to expend extra energy in order to  
 produce enough not only for its own survival but the  
 survival of the red mistletoe also as a result it is using  
 energy which it could have otherwise been using to grow  
 and for production of seeds therefore depleting the  
 overall health of the tree and although not causing death,  
 causing immense harm which affects survival.

m6

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## QUESTION TWO: THE SPOTTED HYENA

The spotted hyena (*Crocuta crocuta*) is one of the most social of all carnivores. It lives in groups containing up to 90 individuals, and exhibits the most complex social behaviour. These animals live in social groups called clans that defend group territories.

Females are dominant over males, and even the lowest ranking female is dominant to the highest ranking male. Although males typically disperse from the clans they were born into, when they are between two and six years of age, females usually remain in their natal clan, so large clans may contain several different female lines of descent.

Females give birth at any time of year to litters containing one or two cubs. At the communal den, cubs are maintained for a period of 8 to 12 months; during this period the major source of food for cubs is milk provided solely by their mother. Although cubs of both sexes 'inherit' their mothers' social ranks, males voluntarily forsake those to assume much lower ranks in the neighbouring clans to which they disperse.

<http://animalsversesanimals.yuku.com/topic/1856#.Vx64pTZ9650>

The following set of data shows the interactions of six female hyenas.

|                     |   | Hyenas doing the biting |   |    |    |    |    |
|---------------------|---|-------------------------|---|----|----|----|----|
|                     |   | A                       | B | C  | D  | E  | F  |
| Hyenas being bitten | A | -                       | 0 | 10 | 11 | 9  | 20 |
|                     | B | 7                       | - | 18 | 8  | 6  | 8  |
|                     | C | 0                       | 0 | -  | 0  | 0  | 0  |
|                     | D | 0                       | 0 | 17 | -  | 12 | 11 |
|                     | E | 0                       | 0 | 6  | 4  | -  | 27 |
|                     | F | 0                       | 0 | 18 | 0  | 0  | -  |

Compare and contrast the advantages and disadvantages of belonging to the hierarchy of a clan, or living a solitary lifestyle.

In your answer you should:

- describe what a linear hierarchy is, and give the order of the linear hierarchy in the table above
- explain how a hierarchy is maintained, and identify which hyena is challenging for a higher position in the hierarchy
- explain factors that could influence an individual's position in the hierarchy
- discuss the advantages and disadvantages to individual male and female hyenas belonging to a social hierarchy in the clan, compared to living a solitary lifestyle.

1/6 linear hierarchy is a social construct by which certain animals dominate others. The female spotted hyenas are dominant over males - even the highest ranking ones. This can be explained by the table above, the order shown you could

Assume that the order goes C, F, E, D, A, B based off of who bit who and the amount of times each animal was bitten. It is through this table that we can establish that the dominance hierarchy is determined through mild fighting behaviour. <sup>of biting</sup> Hierarchy fighting has become extinctive therefore although biting is an aggressive behaviour they will not generally harm each other. A hierarchy will be maintained once established and will only change when a hyena which feels ready to move up the social construct will 'challenge' some other hyena of a higher ranking. Based off the table we could assume that female hyena F was trying to move up in the construct due to the challenging with E where by they are fighting to see who can bite each hyena the most. Hyena F has shown some signals of strength over E with obtaining 20 bites on hyena A compared to E's were 10. It is this almost 'overkill' which is showing the determination for F to show its complete strength / capability. Many factors could influence an individual's position in a hierarchy however given the aim of a hierarchy is for those with the best genes to pass on their <sup>idea</sup> alleles to the next generation a main factor would be their strength as they would therefore be more able to hunt for food, startle/intimidate predators enhancing their chances of survival in the grasslands. As the groups 'clans', maintain a high social complexity another ideal feature would be their ability to source resources / food and plan hunting which in turn would increase not only their own survival but the survival of the entire population.

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(It is such traits which are viewed as ideal to all hyena's therefore determines the value of a hyena's genetic make up and therefore their position within the hierarchy. Living within a social hierarchy in the clan is mostly advantageous to the survival of the hyena population. This is because it provides mates for both male and females enabling them to then not have to exert energy attempting to find a mate of their own which can also be time consuming. Instead they're able to focus on obtaining resources for their survival such as food and mating in order to pass on their genes to the next generation. If they lived a solitary lifestyle they would have to endure this unnecessary consumption of energy. Living within these clans also produces protection from predators as roaming in a group is more intimidating than moving on your own this therefore leaves both them and vulnerable offspring more safe when the cubs are born as males are able to defend the area whilst females can provide milk/energy to their young to increase their chances of survival. This means a division of labour can occur and both species genders benefit as males passed on their genes successfully and females will ~~be able to~~ not have to worry about exerting energy to protect their young also as they would had they not lived in a clan. However it can be slightly disadvantageous to live within clans as it induces fighting and disease can be spread within the clan easier than if living a solitary lifestyle. ~~However~~ <sup>adding</sup> the advantages outweigh the negatives hence their ~~choosing~~ to live this lifestyle.

MS



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### QUESTION THREE: WETA

The Auckland tree weta (*Hemideina thoracica*) tokoriro remains secluded in the daytime under bark or in holes in trees in dim light. It emerges from cover soon after sunset to forage for mainly plant material, to return before dawn. *< nocturnal*

In the experiment below, the environmental conditions were maintained at 20°C in constant darkness for an experiment to observe its biological timing. The results are shown in **Graph 1** below left. The dark bars show when the weta is active.

The weta was then placed in 12 hours of light followed by 12 hours of darkness until day 18 (when it was exposed to 8 hours of light during the dark period), after which it was left in constant darkness. The results are shown in **Graph 2** below right.



<http://auckland-west.co.nz/wordpress/wp-content/uploads/2010/03/PICT6794aw.jpg>

**Graph 1: Constant Darkness**



Single plotted actogram of weta activity in a 24-hour period in constant environmental conditions.

**Graph 2: 12 hr Light + 12 hr Darkness**



A double-plotted actogram of weta with 8 hrs light (arrowed) on day 18 during the hours of darkness.

[www.tandfonline.com/doi/pdf/10.1080/03014223.1994.9517476](http://www.tandfonline.com/doi/pdf/10.1080/03014223.1994.9517476)

Analyse the findings from these actograms to explain how the responses shown above help the weta adapt to its ecological niche.

In your analysis you should:

- describe the activity and rhythm shown by the weta
- explain how this rhythm is controlled
- explain the effect of the additional 8 hours of light-on day 18 on the weta
- evaluate the adaptive advantage that this rhythm and control mechanism have for the weta.

(In normal conditions a weta is nocturnal, coming out at night time before returning to shelter before the sun rises. It portrays a circa (meaning about) ~~and~~adian rhythm. In order to determine whether this rhythm was endogenous or exogenous the ~~weta~~ weta was placed under constant conditions of darkness in a controlled environment. The graph 1 shows that the weta's general trend when under these conditions was a shift in the activity to the right indicating that the endogenous rhythm of the weta is slightly greater than 24 hours however when in its natural conditions external cues act as a zeitgeber prompting regular entrainment to occur in order to ensure the weta is active at dark and not active during the day (potentially when majority of its predators are active) ~~therefore~~ we can determine the weta uses the photoperiod as a stimulus to when to remain in shelter and when to leave to seek food. The constant conditions promote a phase shift to occur during the free running period therefore enabling those observing the experiment to acknowledge the actual endogenous rhythm of the weta without a zeitgeber. The experiment then changed after determining the existence of an endogenous rhythm where the weta was then placed in 12 hours light : 12 hours dark where it retained its ~~previous~~ <sup>as observed in graph 2</sup> rhythm being entrained by the light ~~period~~. However at day 18 8 hours of light were ~~additionally~~ added where it would generally be night period (active) for the weta. In all other hours it remained ~~to~~ dark. ~~Based off of graph 2~~ we can see a significant phase shift to the right of the activity of the weta. The active

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period nearly completely shifting those 8 hours which had been added. However this also provided some confusion in the weta (hence the unlinear beginning of activity after day 18) as it was not allowing a free running period and was instead forcing the endogenous clock to completely shift (which it can only do 30-60 minutes per day). This accounts for random <sup>shifts</sup> parts of activity and rest when the weta would generally be ~~asleep~~ inactive (or vice versa). It is an adaptive advantage for weta to have an endogenous rhythm as it can take some time for any body to react to environmental changes at the beginning/end of the day therefore by having an endogenous rhythm the weta is able to anticipate the changes in environment which in turn benefits the survival as it can avoid predators at the exact right time and seek food when ~~necessary~~ necessary rather than endangering its life. //

M5

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

QUESTION  
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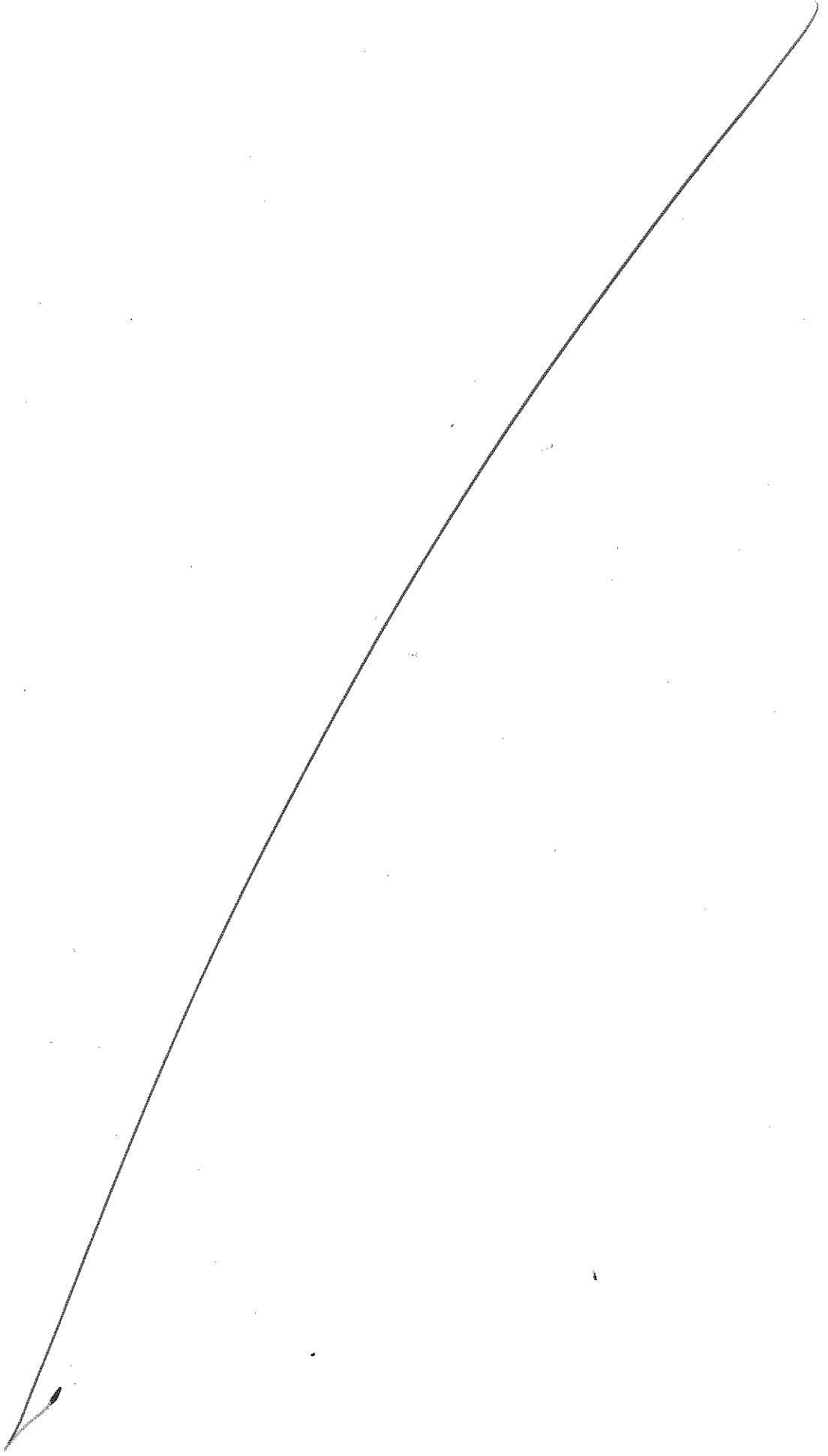
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91603





## Annotated Exemplar – M16 - 125928754

### Merit exemplar 2016

| <b>Subject:</b> |                    | <b>Biology</b>  | <b>Standard:</b> | <b>91603</b> | <b>Total score:</b> | <b>16</b> |
|-----------------|--------------------|---|------------------|--------------|---------------------|-----------|
| <b>Q</b>        | <b>Grade score</b> | <b>Annotation</b>   |                  |              |                     |           |
| 1               | M6                 | This is a strong Merit answer that prides clear evidence that the student understands the behaviours with the costs and benefits to the species involved. This answer fails to reach Excellence because the student does not convey the impression that they understand that the costs of the behaviours must be outweighed by the benefits, and therefore does not provide sufficient evidence of an evaluation.   |                  |              |                     |           |
| 2               | M5                 | The candidate provides good explanations of how hierarchy is maintained and also of factors that affect position. (M5 = 2 points) They incorrectly identify the hyena challenging for position, so the explanation given for it being hyena 'F' is incorrect. To attain Excellence the candidate would have needed to compare and contrast the costs and benefits of being a particular sex/rank within a hierarchy vs solitary living.   |                  |              |                     |           |
| 3               | M5                 | The candidate provides a clear explanation of how the behaviour can be identified as endogenous. In addition they explain an adaptive advantage well. Differences in the actograms are not sufficiently detailed, so the third Merit point was not awarded. (M6 = 3 points) If the adaptive advantages had been considered further, this candidate may have been awarded E7 for this question, though their overall performance would still be in the Merit category, with a potential score of 18. |                  |              |                     |           |