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91603

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NZQA

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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.

Excellence

TOTAL 22

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2 territory

QUESTION ONE: TUI

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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

mutualism

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 ¼ of a second), and the birds can then insert their beaks to drink nectar, and thereby pollinate the flower.

exploitation

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.

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 that is defended by an individual or group, requiring expenditure of energy to defend which is a cost, and in return get exclusive access to the resources of the territory.

territoriality is the behaviour of having and defending a territory.

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such as food, breeding grounds and more. The territory is defended against members of the same species and other species. It acts to reduce both interspecific and intraspecific competition. In the case of the tui it will defend a flowering or fruiting tree against other tui and other bird species by using aggressive behaviour/displays such as making loud noises. The cost of this is that it requires a high energy expenditure. However, the benefits gained outweigh the costs. As tui feed on the nectar of the red mistletoe that it defends, it has a reliable and abundant food/energy source which will allow it to carry out its life processes, survive, reproduce, and pass on its genes to the next generation. As it reduces interspecific and intraspecific competition for the tui's it increases chances of survival. The tui has a relationship with the red mistletoe that is mutual-ism. Mutualism is a relationship between organisms of two different species which is beneficial to both. In this case, while the tui benefits as it has a food/energy source, the red mistletoe also benefits. While feeding the tui's pollinate the flowers of the red mistletoe, therefore the tui helps the mistletoe carry out sexual reproduction, so the mistletoe is able to pass on its genes to the next generation. In this case there is very little no cost for the mistletoe, and it is benefitted. Another relationship is the one between the mistletoe and the host tree, the mountain beech. This is a form of exploitation

continued on the back

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

where the red mistletoe benefits. Using its specialised roots it is able to attain an abundant amount of water and minerals from the ~~beech~~ mountain beech tree which the mistletoe benefits from as it is able to use them in order to carry out its life processes, reproduce, survive, and pass on its genes to the next generation. Benefits gained with little cost. The mountain beech however, incurs serious costs. It is harmed by the mistletoe as its water and mineral ions are taken. It gains nothing from this relationship to the mistletoe. That is why it is an exploitative relationship. The costs outweigh the benefits (none) for the beech tree, while the benefits outweighs the cost for the mistletoe. (1

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E7

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QUESTION TWO: THE SPOTTED HYENA

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

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.

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.

A hierarchy is a social order that is maintained in a group of individuals of the species made up of dominant and submissive members. The dominant members are benefitted by access to more of the

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resources such as food and mates, while the submissive members are less likely to be injured seriously or fatally. In this case, the linear hierarchy of hyena is F, E, D, C, B, A, from most dominant, to most submissive. A hierarchy is maintained through mostly agonistic behaviour (threat displays that aren't fatal or serious injury causing), in this case biting. We can see how the most dominant female of the group, F, bites everyone that is submissive to her to keep them in check and to keep her place as the most dominant female confirmed. while females ~~B~~, D A and E aren't biting, therefore challenging their superiors for a higher rank, we can see how A bit B 7 times while B didn't bite back, C biting D 17 times while D didn't bite back, ~~and~~, showing that A, and ~~but~~ especially C, is challenging for a higher position. D also challenges E on occassion by biting 4 times, however, E is clearly dominant as it bites D 12 times. factors that can influence an individuals position in the hierarchy is the rank they inherited from their mother. It is likely that the mother of female F was the most dominant female before, therefore she inherited the rank and remained dominant. Hyenas are also territorial. The hyena that are stronger and better able to defend are also more likely to be stronger, ∴ more dominant. ✱

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There are many advantages to females in a social hierarchy in the clan. The more dominant members are more likely to gain access to better food, better breeding ~~and~~ grounds, and areas to raise young, and better or more mates. This means that they are more likely to survive, reproduce, and pass on their genes to the next generation. Disadvantages could be that less dominant, or submissive females will not get as much food, less access to the most genetically/adaptively fit males and other resources, and are less likely to pass on their genes. Another advantage is that as a hierarchy is maintained through agonistic behaviour, submissive members are less likely to be killed or injured, increasing their chances of survival for males, they have access to mates and food and can avoid injury and are likely to pass on their genes even if they are submissive. A hierarchy is much more beneficial than a solitary lifestyle for both sexes as less energy expenditure is required to find a mate, less energy expenditure to find groups as members of the clan can work as a team, and they are safer in large numbers and can defend themselves against more powerful individuals like lions. They ~~are more likely~~ while males forsake their hierarchy which is a disadvantage, they gain access to mates which is an advantage.

E7

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QUESTION THREE: WETA

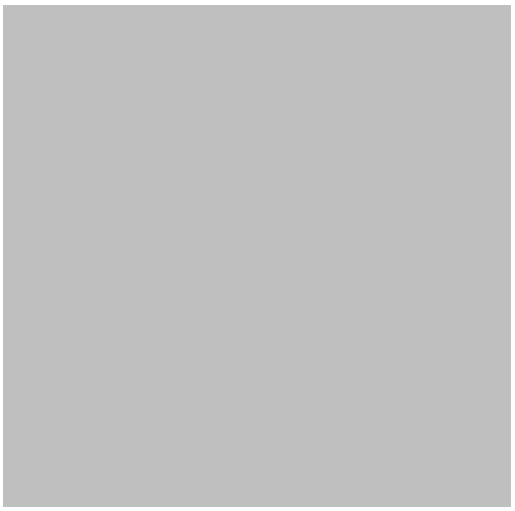
The Auckland tree weta (*Hemideina thoracica*) tokoriro remains secluded in the daytime under bark or in holes in trees in dim light. It emerges from cover soon after sunset to forage for mainly plant material, to return before dawn.

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

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.

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

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.

As the weta remains inactive during the day and is active during the night we know that it is heterotrophic. It has an internal (endogenous) biological rhythm that is a circadian rhythm. The rhythm is controlled by the process of entrainment (the body clock is reset) through the use of a zeitgeber, light. We know that its rhythm is endogenous as when it is placed under a constant environmental state of 20°C darkness, free-running period, in the absence of environmental cues, it still carries out its normal processes where it is active for about 12 hours. However, due to the lack of light to act as a zeitgeber, to reset the body clock through the process of entrainment, a phase shift occurs. where the weta becomes active roughly 10 hours later than normal. Therefore every day in the free-running environment the weta was active about 15 minutes later than normal, a phase shift of 15 mins every day. On day 15 ~~of~~ of the record graph, we can see how the weta is active for a very small amount of time, 3-4 hours, due to the extra 8 hours of light being present. Confirming that the light acts a a zeitgeber, making the weta inactive. An adaptive advantage to this is that the weta is able to be active during the night when there are less predators

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or predators would have a hard time seeing it, and it can eat and forage for plant material. As the presence or absence of light acts as a zeitgeber it can used to maximise the time of darkness for foraging. As its rhythm makes it inactive during the day when more predators are active and visibility is increased, the survival chances and reproduction chances of the weta have increased. The use of a zeitgeber to ~~monitor and~~ cause entrainment is extremely useful. This is because as seasons change, periods of light and darkness change. ~~This~~ The use of exogenous environmental cues ensures that the weta is/is active during day time in summer, or inactive during ~~night time~~ time in winter. The zeitgeber ensured dark hours are used effectively and light hours are avoided/the weta remains inactive and hidden.

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E8

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

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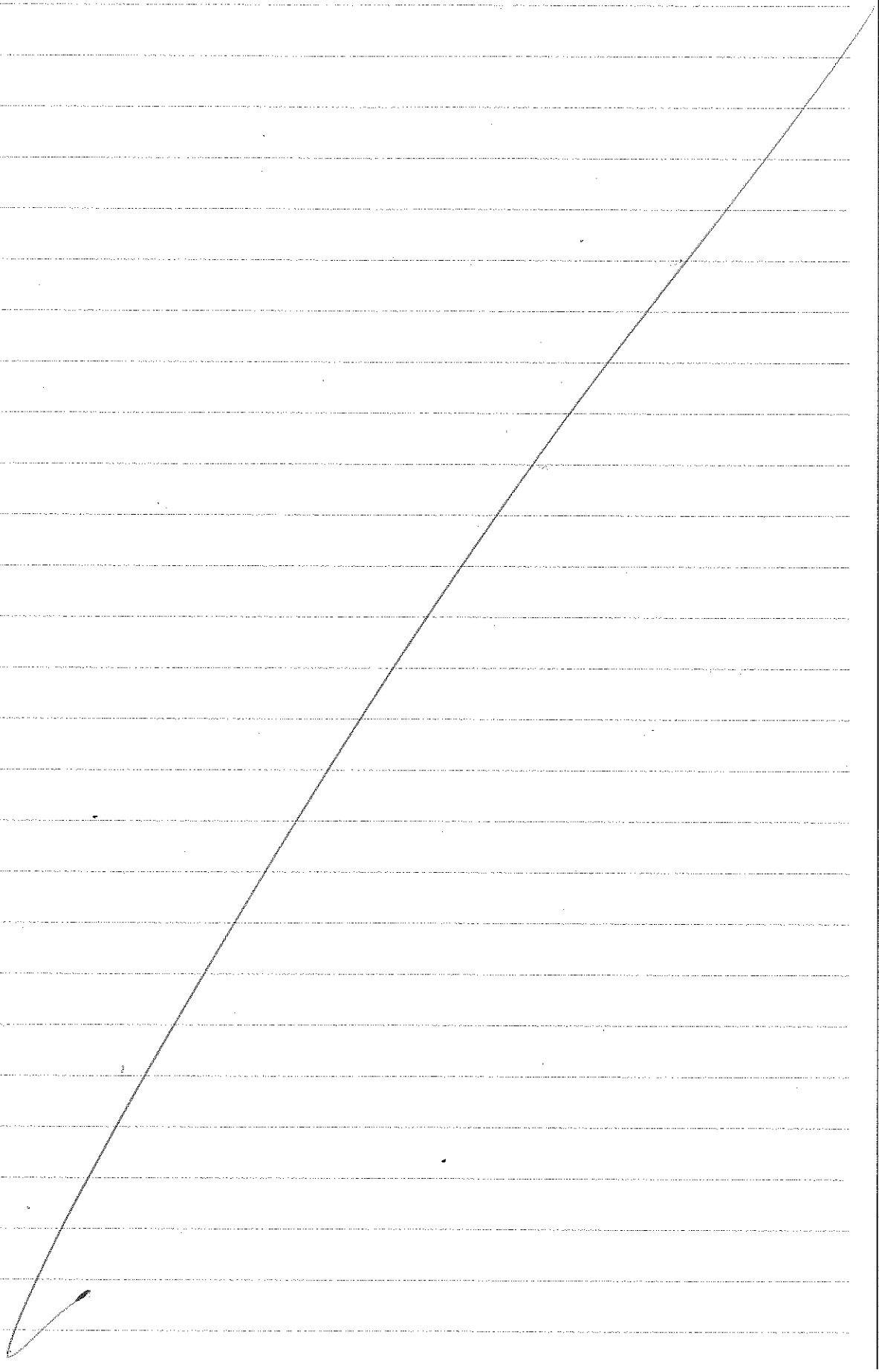

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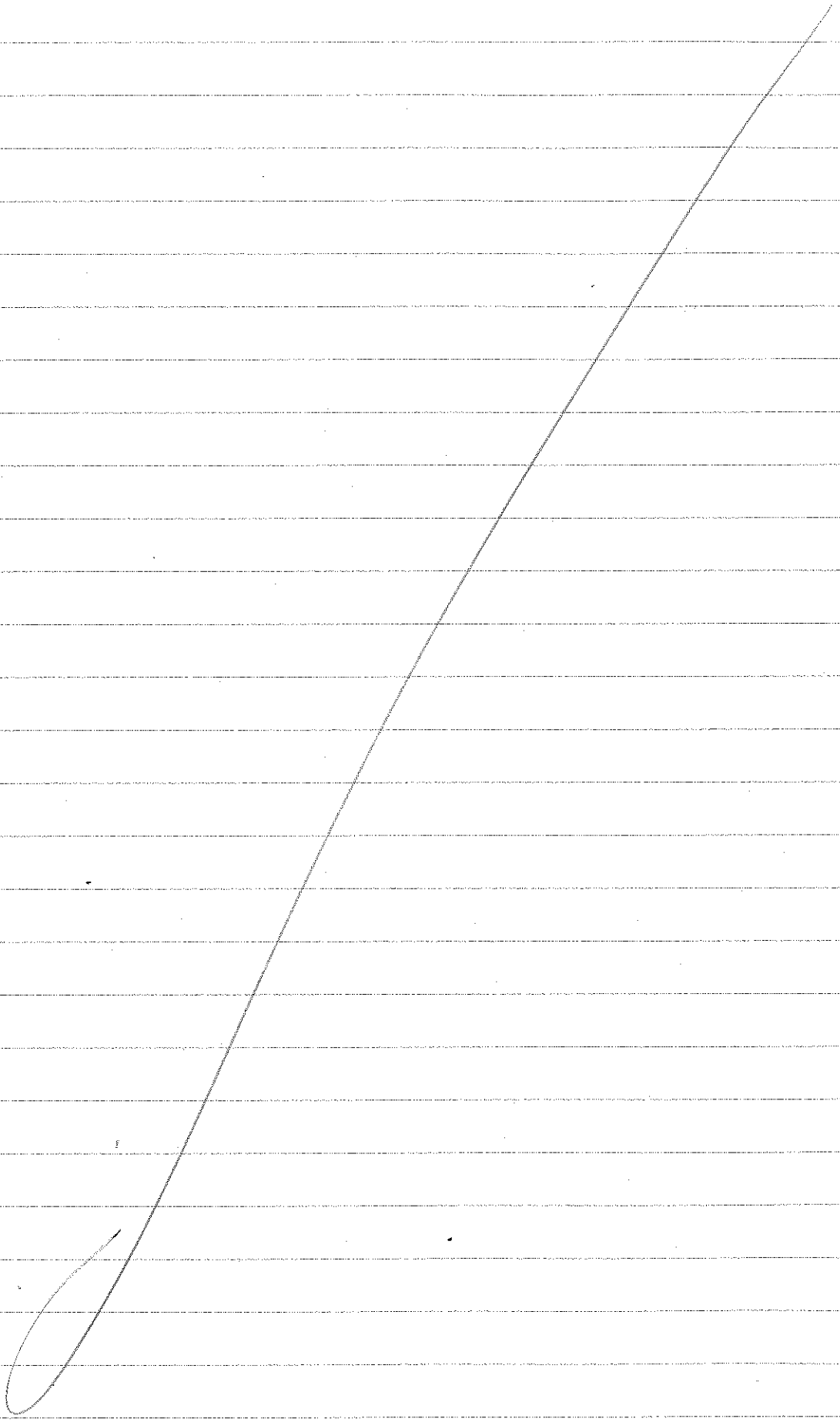

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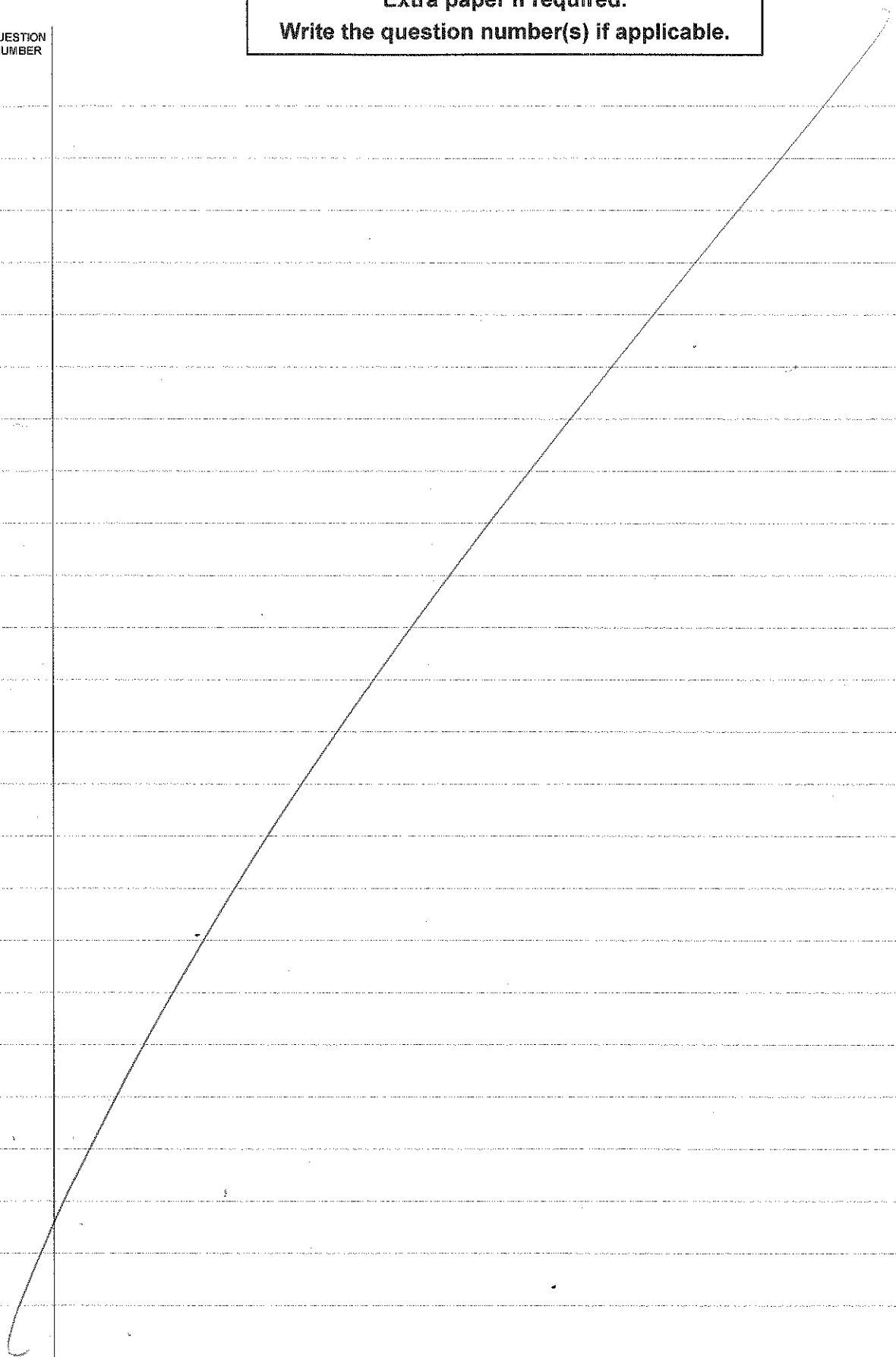

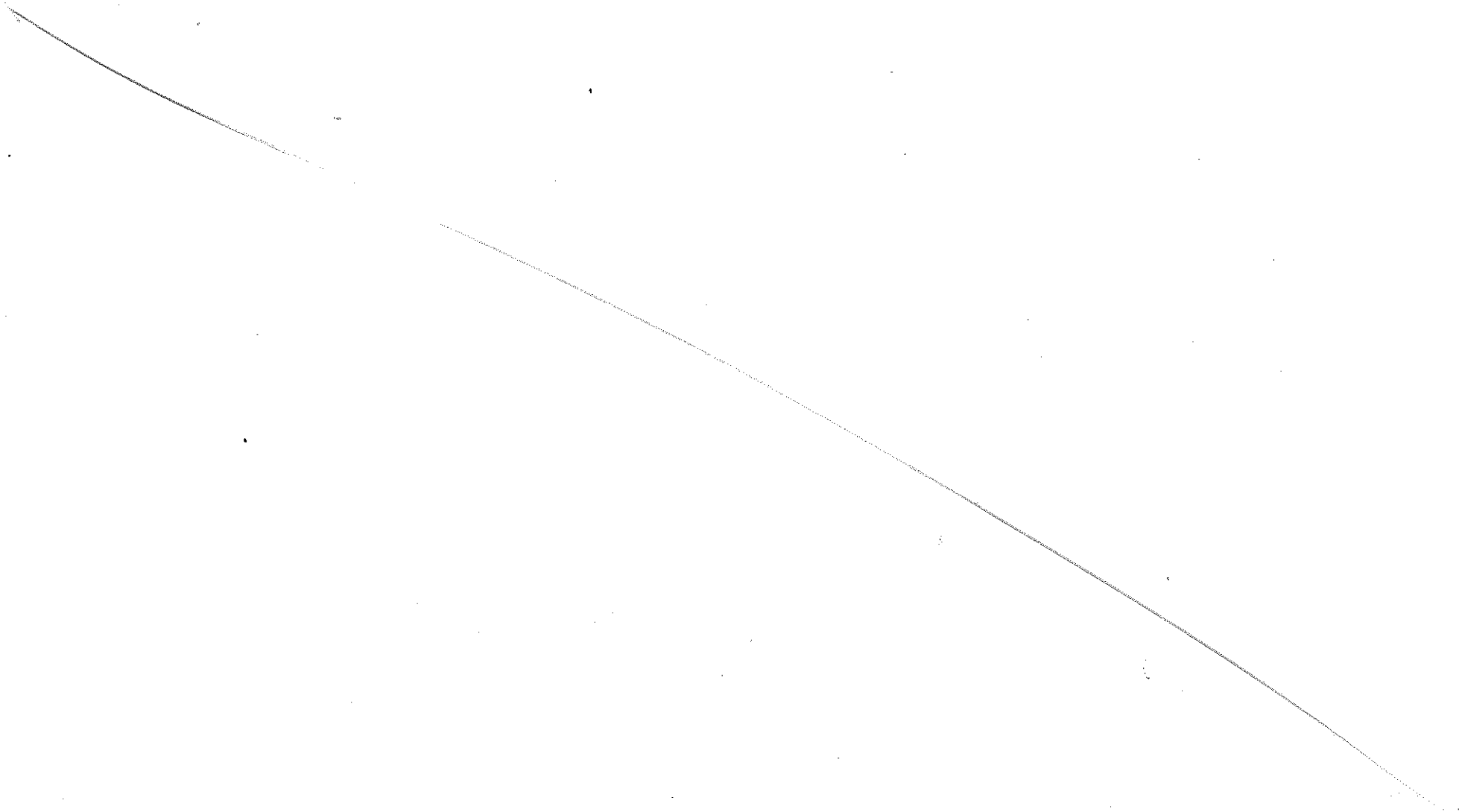

Annotated Exemplar – E22 - 133117838

Excellence exemplar 2016

Subject:	Biology	Standard:	91603	Total score:	22

Q	Grade score	Annotation
1	E7	This is a good Excellence answer with the candidate correctly identifying and explaining territorial behaviour and mutualism. Although they identify exploitation, they fail to parasitism as the type of exploitation. Despite this, their Excellence mark is awarded as there is a clear understanding of the benefits outweighing the costs in the territorial behaviour. If there was greater evaluation of mutualism, or indeed, if parasitism had been mentioned along with the current depth of answer, then this question would have reached E8.
2	E7	In this question there were multiple opportunities to compare and contrast the costs and benefits to the hyena of their position in the hierarchy vs solitary living. This candidate particularly identifies the advantages of being a dominant female and the consequences of that ranking in terms of being the best adapted and therefore able to breed more successfully and pass on their genes to the next generation. The other areas of explanation were insufficiently linked to the actual position/status in the hierarchy, which was needed for a further E point. Close to getting E8.
3	E8	The candidate provides a clearly written, well-structured answer that covers the main points of the question well. In particular, they show a clear understanding of the actograms and are able to compare them sufficiently to relate the data to the behaviour of the weta. This candidate also demonstrates that they can consider the adaptive advantages of having an endogenous rhythm that is further modified by exogenous environmental cues.