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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2026

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

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.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (////). This area will be cut off when the booklet is marked.

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QUESTION ONE: Ant behaviour

Ants live in a cooperative group called a colony. There can be up to several thousand ants living in the colony at a time.

Female worker ants do not reproduce; only queen ants lay eggs for the colony.

Worker ants use kinesis and taxis responses to care for larvae and find food for the colony (Table 1).

Table 1: Worker ant responses

Worker ant response one	Worker ant response two
Ant larvae cannot move far and are completely dependent on worker ants for survival. Larvae secrete pheromones that stimulate worker ants to care for them. When the worker ants do not sense the larvae pheromones, they search for them by moving fast and turning often. When worker ants sense the larvae pheromones, they move slowly and turn less often.	Some worker ants are sent out to find food. These ants search randomly for food in different directions from the nest. When a worker ant finds food, they turn back directly towards the nest and lay a pheromone trail on the ground. Other worker ants detect the pheromone trail and follow it. If they reach the food, they lay more pheromones on the way back to the nest and the trail gets stronger.
	
Figure 1: Worker ants and larvae	**Figure 2:** Worker ants foraging

Discuss the responses shown by worker ants and the advantage they have by living in a cooperative group (ant colony).

In your answer, include discussion of:

- a cooperative group
- two named repsonses displayed by the worker ants linked to pheromones
- how displaying these named responses helps to provide an advantage for the entire ant colony
- a disadvantage and an advantage for worker ants of living in a cooperative group.

QUESTION TWO: Kaimanawa horses

Kaimanawa horses (*Equus ferus caballus*) are wild horses found in Aotearoa New Zealand.

Horses form breeding groups that are made up of one dominant stallion and a number of female horses. These groups live across the Kaimanawa Mountains in the central North Island and have overlapping home ranges.



Figure 3: Kaimanawa horses

The female horses display a hierarchical system.

Agonistic displays through body language, such as ear position, and head and body posture, and actions, such as vocalisation sounds, biting, kicking, and lip licking, are important in the group.

Table 2 shows how many times the female horses (A, B, C, D) in the group bite each other.

Table 2: Biting among individual female horses of a Kaimanawa horse group

		Female horse inflicting bite			
		A	**B**	**C**	**D**
Female horse being bitten	**A**	–	0	15	0
	B	12	–	10	0
	C	8	0	–	0
	D	16	18	12	–

Discuss the intraspecific agonistic behaviours of Kaimanawa horses and link these to hierarchy.

In your answer, include discussion of:

- social hierarchy and its purpose
- the positions of all female horses in the group and how A and C maintain their positions in the hierarchy
- a disadvantage and an advantage for A and D within the hierarchy.

QUESTION THREE: New Zealand monarch butterflies

In Aotearoa New Zealand, the swan plant (*Gomphocarpus fruticosus*) (Figure 4) demonstrates photoperiodism. Figure 5 shows how the concentration of abscisic acid changes throughout the year.



Figure 4: Monarch butterfly on a swan plant

From April, the swan plant begins dormancy. The change in season brings longer, warmer days from September, and the dormant plant starts to grow new shoots and leaves. Through summer, flowers are produced.

The life cycle of New Zealand's monarch butterfly (*Danaus plexippus*) occurs from September to February. The typical life cycle from egg to adult is approximately 30 days, with the adult butterfly having a lifespan of 60–70 days.

The monarch butterfly caterpillars depend specifically on swan plants, on which females lay eggs from the beginning of spring (September). Once hatched, the caterpillars eat a large amount of the swan plant leaves for growth.

Figure 5: Seasonal concentration of abscisic acid in swan plants

Abscisic acid concentration in a swan plant during different seasons of the year

Discuss biological rhythms and evaluate the costs and benefits of the relationship between the swan plant and monarch butterfly.

In your answer, include discussion of:

- photoperiodism and how it is measured, using the swan plant context
- the biological rhythm demonstrated by the monarch butterfly and swan plant, and the role of abscisic acid in dormancy of the swan plant
- the interspecific relationship between the monarch butterfly and the swan plant.

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