Queensland Curriculum and Assessment Authority

Biology 2019 v1.2

IA1: Sample assessment instrument

Data test (10%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name

Student number

Teacher

Exam date

Marking summary

Criterion	Marks allocated	Provisional marks
Data test (10%)	10	
Overall	**10**	

Conditions

Technique	Data test
Unit	Unit 3: Biodiversity and the interconnectedness of life
Topic/s	Topic 1: Describing biodiversity Topic 2: Ecosystem dynamics
Time	60 minutes + 10 minutes perusal
Seen/unseen	Unseen questions and data sets
Other	QCAA-approved graphics calculator permitted

Instructions

Use the datasets to respond to the associated questions in the spaces provided. Each question is associated with the dataset that immediately precedes it.

Data test summary

Dataset	Question	Objective			
		Apply understanding	Analyse evidence	Interpret evidence	
1	1		2		
	2			2	
	3	3			
	4			2	
2	5			4	
3	6	1			
	7	2			
	8		4		
Total		**6**	**6**	**8**	**20**
Percentage		**30%**	**30%**	**40%**	**100%**

Dataset 1

Scientists investigated the biodiversity of butterflies (order *Lepidoptera*) in a rainforest near Cairns. Their investigation lasted several months. The scientists recorded the number of each species of butterfly caught in the traps. Table 1 summarises their results.

In writing your response, you may use the abbreviations given in the table for the species' names.

Table 1: Mean number of butterflies recorded in a rainforest near Cairns

Species of butterfly	Mean number of butterflies		p-value
	Canopy	Understorey	
Papilio ulysses (PU)	14	0	< 0.001
Cethosia cydippe (CC)	25	11	< 0.05
Papilio aegeus (PA)	19	21	< 0.001
Hypolimnas alimena (HA)	32	3	< 0.001

Question 1 (2 marks)

Contrast the difference in the mean number of butterflies caught in the canopy and understorey for *Papilio ulysses* and *Papilio aegeus*.

.....

.....

.....

.....

.....

.....

.....

Question 2 (2 marks)

Draw a conclusion about what the different p-values in Table 1 show. Give reasons for your conclusion.

.....

.....

.....

.....

.....

.....

Question 3 (3 marks)

Calculate the species diversity for the understorey (to two decimal places) using the following formula:

$\text{SDI} = 1 - \left(\frac{\sum n(n-1)}{N(N-1)}\right)$

where:

N = total number of organisms of all species

n = number of organisms of one species

SDI = (2 d.p.)

Question 4 (2 marks)

In a follow-up experiment, two butterflies were captured from the understorey of this rainforest.

Infer the probability that these two butterflies were from the same species. Give reasons for your response.

.....

.....

.....

.....

.....

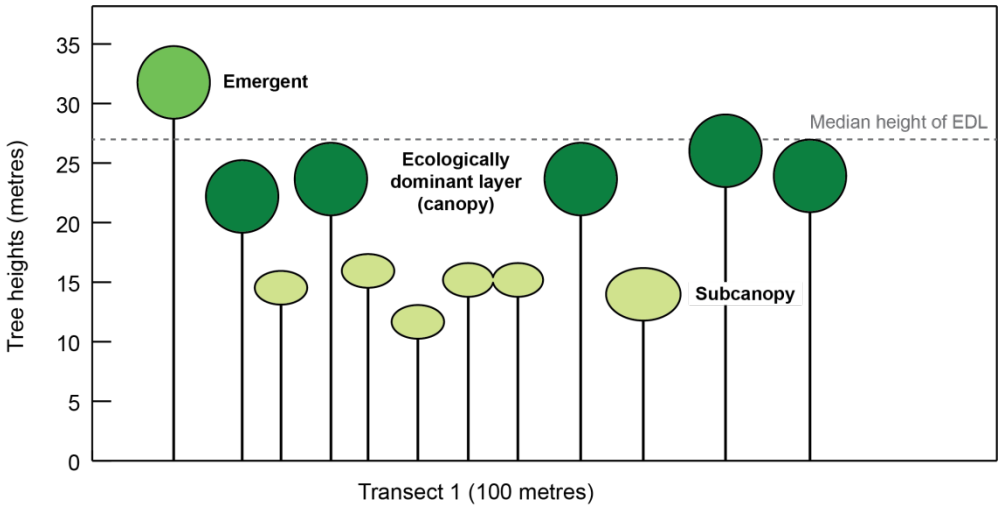
.....

Dataset 2

The data below was collected during a terrestrial field experiment. Multiple 100-metre transects were constructed, and the species, height and percentage canopy cover of each organism were recorded.

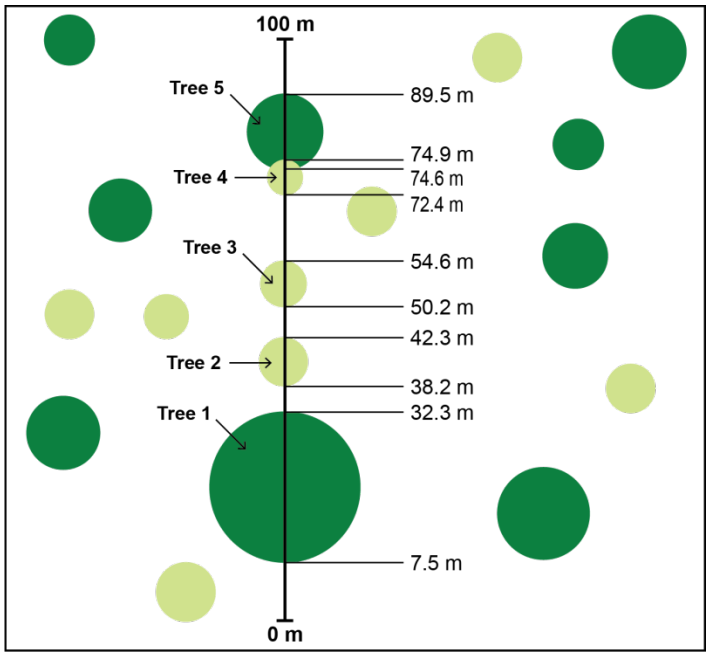
The figures below show data recorded for two different transects at the same site.

Figure 1: Tree heights (m) along Transect 1 (100 m)



Source: Eyre, TJ, Kelly, AL, Neldner, VJ et al. 2015, *BioCondition: A condition assessment framework for terrestrial biodiversity in Queensland* (assessment manual), version 2.2, Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane, p. 17, Creative Commons Attribution Generic 3.0 Licence, www.qld.gov.au/environment/assets/documents/plants-animals/biodiversity/biocondition-assessment-manual.pdf.

Figure 2: Canopy cover along Transect 2 (100 m) — using the line intercept method for measuring canopy cover



Source: Eyre, TJ, Kelly, AL, Neldner, VJ et al. 2015, *BioCondition: A condition assessment framework for terrestrial biodiversity in Queensland* (assessment manual), version 2.2, Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane, p. 20, Creative Commons Attribution Generic 3.0 Licence, www.qld.gov.au/environment/assets/documents/plants-animals/biodiversity/biocondition-assessment-manual.pdf.

Table 2: Structural forms of vegetation in Australia (based on Specht 1970)

	Percentage foliage cover of tallest plant layer			
Life form and height of tallest stratum (m)	**Dense (70–100%)**	**Mid-dense (30–70%)**	**Sparse (10–30%)**	**Very sparse (<10%)**
Trees > 30 m	Tall closed-forest	Tall open-forest	Tall woodland	Tall open-woodland
Trees 10–30 m	Closed-forest	Open-forest	Woodland	Open-woodland
Trees 5–10 m	Low closed-forest	Low open-forest	Low woodland	Low open-woodland
Shrubs 2–8 m	Closed-scrub	Open-scrub	Tall shrubland	Tall open-shrubland
Shrubs 0–2 m	Closed-heath	Open-heath	Low shrubland	Low open-shrubland

Source: Australian National Herbarium 2015, 'A simplified look at Australia's vegetation', www.anbg.gov.au/aust-veg/veg-map.html.

Question 5 (4 marks)

Infer which ecosystem is represented in Figure 1 and Figure 2 using Table 2. Give reasons for your response.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

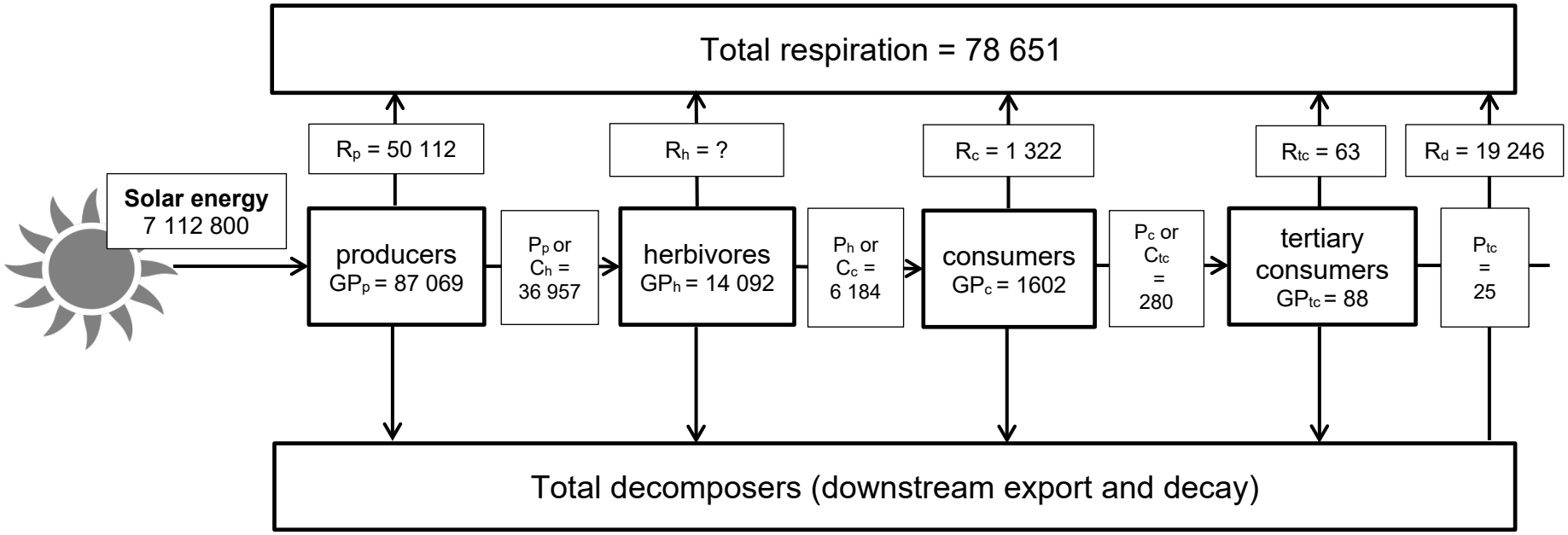
Dataset 3

The diagram below shows energy transfer through a model ecosystem, where:

- C = consumption; P = production; R = respiration; GP = gross productivity
- subscripts indicate the feeding group $_{p}$ = producers, $_{h}$ = herbivores, $_{c}$ = carnivores, $_{d}$ = decomposers, $_{tc}$ = tertiary consumers
- units are in kJ m^{-2} $year^{-1}$.

Note: The model does not represent 100% energy efficiency.

Figure 3: Energy diagram and data adapted from Odum's Silver Springs Florida experiment



Source: Odum, HT 1957, 'Trophic structure and productivity of Silver Springs, Florida', *Ecological Monographs*, vol. 27, no. 1, pp. 55–111, https://doi.org/10.2307/1948571.

Question 6 (1 mark)

Determine the gross productivity of producers.

Answer: kJ m^{-2} $year^{-1}$

Question 7 (2 marks)

Calculate the respiration of herbivores (R_h).

Answer: kJ m^{-2} $year^{-1}$

Question 8 (4 marks)

Identify which trophic level has the highest percentage energy transfer. Show your working.

END OF PAPER

Instrument-specific marking guide (ISMG)

Criterion: Data test

Assessment objectives

2. apply understanding of biodiversity or ecosystem dynamics to given algebraic, visual or graphical representations of scientific relationships and data to determine unknown scientific quantities or features
3. analyse evidence about biodiversity or ecosystem dynamics to identify trends, patterns, relationships, limitations or uncertainty in datasets
4. interpret evidence about biodiversity or ecosystem dynamics to draw conclusions based on analysis of datasets

The student work has the following characteristics	Cut-off	Marks
• consistent demonstration, across a range of scenarios about biodiversity or ecosystem dynamics, of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct and appropriate use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 90%	10
	> 80%	9
• consistent demonstration, in scenarios about biodiversity or ecosystem dynamics, of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 70%	8
	> 60%	7
• adequate demonstration, in scenarios about biodiversity or ecosystem dynamics, of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 50%	6
	> 40%	5

The student work has the following characteristics	Cut-off	Marks
• demonstration, in scenarios about biodiversity or ecosystem dynamics, of elements of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual or graphical representations of scientific relationships or data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations or uncertainty – correct interpretation of evidence to draw valid conclusions.	> 30%	4
	> 20%	3
• demonstration, in scenarios about biodiversity or ecosystem dynamics, of elements of – application of scientific concepts, theories, models or systems to predict outcomes, behaviours or implications – calculation of quantities through the use of algebraic or graphical representations of scientific relationships and data – use of analytical techniques to identify trends, patterns, relationships, limitations or uncertainty – interpretation of evidence to draw conclusions.	> 10%	2
	> 10%	1
• does not satisfy any of the descriptors above.	≤ 1%	0