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Government of **Western Australia**
School Curriculum and Standards Authority

Externally set task 2016

Student Number: In figures | | | | | | | | |

In words _____

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INTEGRATED SCIENCE
GENERAL COURSE

Students can use the following items for this task

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the externally set task

Ref: 16-043

Total time for the task: 50 minutes
Total marks: 38 marks
Weighting: 15% of the school mark

Question 1 **(19 marks)**

David grows mangoes on his farm near the Moore River. While he was overseas on a holiday, he visited an aquarium shop and recognised one of the fish on sale. It was a *tandanus bostocki*, better known as a freshwater cobbler. He was surprised that it was selling for $500 when the same fish was plentiful in the section of the Moore River that ran through his farm.

David's mangoes are not very profitable. He wondered whether it would be possible to both grow mangoes and breed cobblers for sale to the international aquarium market. All he would have to do was dig some deep canals from the river, running between the rows of mango trees. These canals would irrigate the trees, while also being used to hold the fish.

There would be some extra costs in buying food for the fish, but the waste products from the fish would be an excellent source of nutrients for the mango trees. It may also save him money by reducing the amount of fertiliser he would use on the trees.

David decided to carry out an investigation to find out whether the nutrients provided by the fish would actually benefit his mangoes. He selected five different rows of mango trees and dug a deep canal beside each row.

Each canal was stocked with different quantities of fish and steel grates were used to prevent them from escaping. When it came time to harvest the mangoes, he recorded the weight of mangoes from each row. The results are shown in the table below.

Rows of mango trees, numbers of fish and average weight of mangoes per tree

Row	Number of mango trees	Number of fish	Weight of mangoes harvested (kg)	Average weight of mangoes per tree (kg)
1	11	100	150	13.6
2	11	200	180	16.4
3	12	300	200	16.7
4	12	400	175	14.6
5	11	500	80	7.3

(a) What was the independent variable in the investigation? (1 mark)

(b) What was the dependent variable in the investigation? (1 mark)

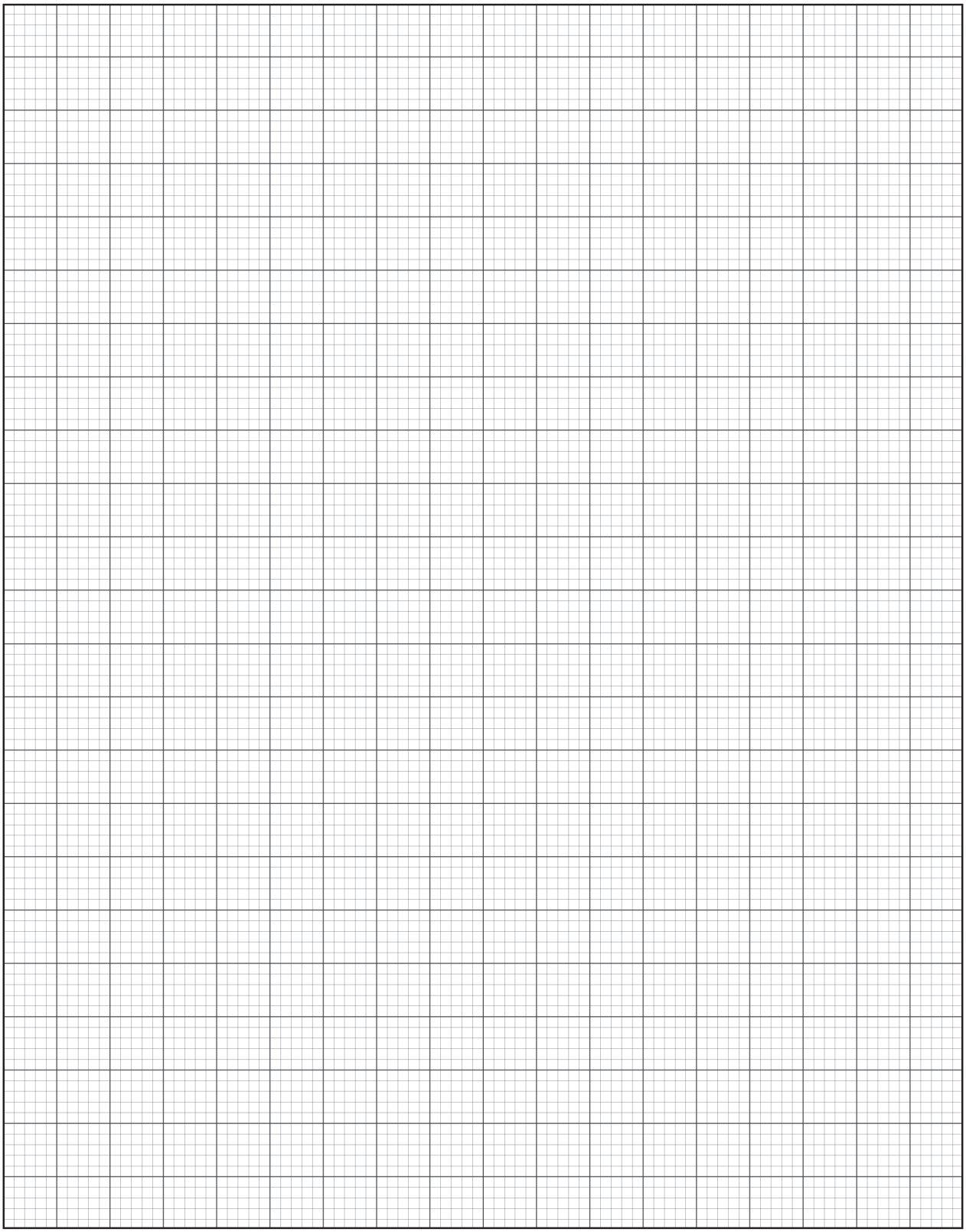
See next page

(c) Write a suitable hypothesis for the investigation. (2 marks)

See next page

(d) Using the data from the table, draw a line graph comparing the average weight of mangoes per tree and the number of fish stocked. (4 marks)

Title: _____



See next page

(e) David wants to maximise the total weight of mangoes he harvests. Use the graph you have drawn to work out the **best** number of fish to stock in each canal. In your answer, explain the relationship between the average weight of mangoes per tree and the number of fish. (4 marks)

(f) David's daughter, Sue, is studying Integrated Science at school. Sue tells her father that his investigation was not well designed. Outline **three** improvements that Sue could have suggested to her father to enhance the investigation design. (3 marks)

One:

Two:

Three:

(g) Describe **two** ethical issues that David should have considered before starting his investigation. (4 marks)

One: _____

_____

_____

_____

Two: _____

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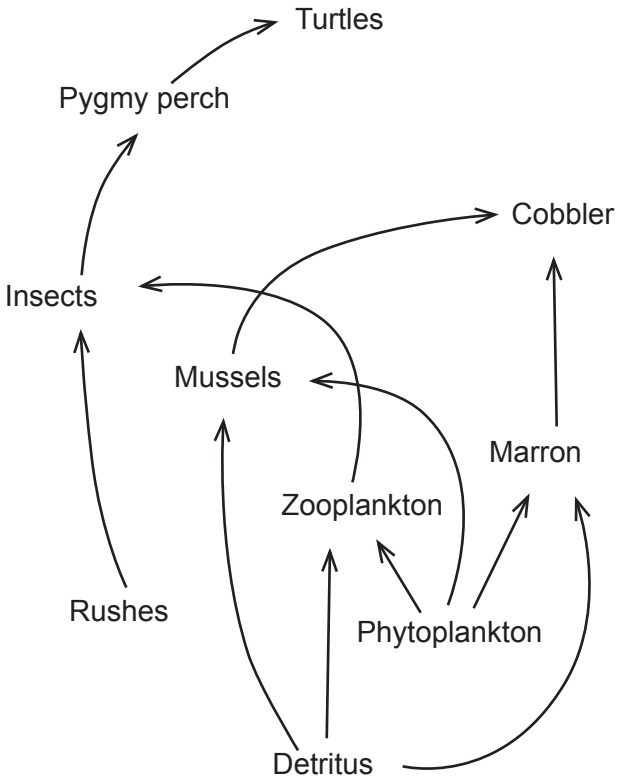
Question 2 **(19 marks)**

David notices a species of fish in the Moore River that he hasn't seen before. After some research, he identifies it as a mosquito fish. The mosquito fish was introduced into Western Australia from Central America in 1934 to lower mosquito populations. Unfortunately, mosquito fish will only eat mosquito larvae if there is no other food supply. They prefer to eat juvenile marron and zooplankton, while their only major predators are turtles.

David is worried about the impact mosquito fish will have on the Moore River if they establish themselves. Below is a food web of the river as it runs through his farm.

(a) Based on the information above, complete this food web to include the mosquito fish. (2 marks)



(b) From the food web, draw a food chain that includes at least four organisms. (2 marks)

(c) Do you think the population of cobblers would increase, decrease or stay the same after the introduction of mosquito fish? Explain your answer. (3 marks)

(d) Using your food web, predict **two** effects that the mosquito fish might have on organisms in the web other than the cobbler. (2 marks)

One:

Two:

(e) On the basis of your knowledge of how energy transfers through a food chain, explain why such chains are rarely longer than four or five organisms. (4 marks)

(f) Name **two** abiotic factors in this river system that might be altered by human activity. Explain how these changes could affect the ecosystem. (6 marks)

One: _____

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Two: _____

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End of questions

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GENERAL COURSE

2016 Marking key for Externally set task 2016

Question 1 **(19 marks)**

(a) What was the independent variable in the investigation? (1 mark)

Description	Marks
Number of fish	1
Total	**1**
Note: do not accept just "fish"	

(b) What was the dependent variable in the investigation? (1 mark)

Description	Marks
The weight of mangoes harvested	1
Total	**1**

(c) Write a suitable hypothesis for the investigation. (2 marks)

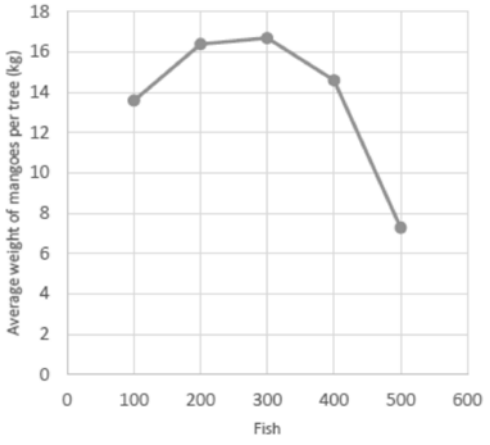
Description	Marks
Hypothesis showing the relationship between independent and dependent variables	2
Statement made about fish stock and/or weight of mangoes harvested	1
Total	**2**
Answers may include, but are not limited to the following: • an increase in the number of fish stocked in each canal will result in an increase in the weight of mangoes harvested	

(d) Using the data from the table, draw a line graph comparing the average weight of mangoes per tree and the number of fish stocked. (4 marks)

Description	Marks
Title appropriate with both independent and dependent variable included	1
X-axis correctly labelled with a linear scale and units	1
Y-axis correctly labelled with a linear scale and units	1
Correctly plot points.	1
Total	**4**

Answers may include, but are not limited to the following:

Title: Average weight of mangoes per tree verses the number of fish



(e) David wants to maximise the total weight of mangoes he harvests. Use the graph you have drawn to work out the **best** number of fish to stock in each canal. In your answer, explain the relationship between the average weight of mangoes per tree and the number of fish. (4 marks)

Description	Marks
Using the graph, the optimum number of fish is around 300.	1
Explains clearly the relationship between the weight of mangoes harvested and the number of fish stocked, including nutrient levels	3
Outlines the relationship between the weight of mangoes harvested and the number of fish stocked	2
States some relevant information about the weight of mangoes harvested and/or the number of fish stocked	1
Total	**4**
Answers may include, but are not limited to the following: • an increase in the number of fish stocked (increase in nutrient levels for the mango trees) to around 300 will increase the weight of mangoes harvested after that increasing fish stock will decrease the weight of mangoes harvested (possible due to an oversupply of nutrients being harmful to the mango trees).	

(f) David's daughter, Sue, is studying Integrated Science at school. Sue tells her father that his investigation was not well designed. Outline **three** improvements that Sue could have suggested to her father to enhance the investigation design. (3 marks)

Description	Marks
One mark for each improvement. Maximum of three marks.	
Answers may include, but are not limited to the following: • add a control group with zero fish • the number of trees per row should have been kept constant (controlled variable) • do more trials (lacks reliability) • look at factors such as size of mangoes, quality of mangoes, (or other examples of measure of dependent variable) • control the size of fish or other 'controlled variables' not accounted for.	1–3
Total	**3**

(g) Describe **two** ethical issues that David should have considered before starting his investigation. (4 marks)

Description	Marks
Two marks for each ethical issue. Maximum of four marks.	
Describes clearly an ethical issue	2
States an ethical issue	1
Total	**4**
Answers may include, but are not limited to the following: • well-being of fish – habitat conditions in canals • release of additional nutrients to river (fish food or waste, agricultural runoff) • impact on water aquifers, etc through nutrients leaching • other damage to river environment or surrounding environment.	

Question 2 **(19 marks)**

(a) Based on the information above, complete this food web to include the mosquito fish. (2 marks)

Description	Marks
Mosquito fish eating zooplankton and marron - arrow correct direction	1
Mosquito fish being eaten by turtles – arrow correct direction	1
Total	**2**

(b) From the food web, draw a food chain that includes at least four organisms. (2 marks)

Description	Marks
Any valid food chain which includes four or more organisms	2
Valid food chain but arrows in wrong direction	1
Total	**2**
Answers may include, but are not limited to the following: • rushes → insects →pigmy perch → turtles • detritus → zooplankton → insects →pigmy perch → turtles • phytoplankton → zooplankton → insects →pigmy perch → turtles	

(c) Do you think the population of cobblers would increase, decrease or stay the same after the introduction of mosquito fish? Explain your answer. (3 marks)

Description	Marks
Decrease	1
Explains clearly the reason is competition for a food source - marron	2
States information about a decrease in food source	1
Total	**3**

(d) Using your food web, predict **two** effects that the mosquito fish might have on organisms in the web other than the cobbler. (2 marks)

Description	Marks
One mark for each effect.	
Answers may include, but are not limited to the following: • marron population falls • zooplankton population falls • turtle population increases	1–2
Total	**2**

(e) On the basis of your knowledge of how energy transfers through a food chain, explain why such chains are rarely longer than four or five organisms. (4 marks)

Description	Marks
Explains clearly that energy is lost at each level in food chains leaving very little (10%) for use at the next trophic level	4
Explains that energy is lost at each level in food chains leaving less for use at the next trophic level	3
Outlines that energy is lost at each level in food chains	2
States that energy is lost in food chains	1
Total	**4**
Answers may include, but are not limited to the following: • energy enters the system through the producers and therefore the amount energy in the system is determined by the producers. Energy transfers from one trophic level to the next and energy is lost at each level. Approximately 90% is lost (usually as heat or due to metabolic activity). Therefore insufficient energy remains for higher levels (as only 10% is available to next trophic level).	

(f) Name **two** abiotic factors in this river system that might be altered by human activity. Explain how these changes could affect the ecosystem. (6 marks)

Description	Marks
Three marks for each abiotic factor. Maximum six marks.	
Names a feasible abiotic factor	1
Explains clearly how the changes impact on the ecosystem	2
States some relevant information about how the changes impact on the ecosystem	1
Total	**6**
Answers may include, but are not limited to the following: • temperature decrease in aquatic organisms that are not temperature tolerant • pH decrease in aquatic organisms that are not pH tolerant • water levels due to damming or irrigation usage increase in aquatic organisms that favour still water decrease in aquatic organisms that favour flowing water • salinity reduction in non-salt tolerant plants, reduction in non-salt tolerant aquatic animals migration of salt tolerant organisms from estuary into river system • nutrient levels encourage growth of algae, eutrophication, etc. • turbidity impact on photosynthetic organisms, energy in ecosystem.	

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