2023/3661
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Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2022

Question/Answer booklet

PLANT PRODUCTION SYSTEMS

Please place your student identification label in this box

WA student number: In figures

In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Multiple-choice answer sheet

Number of additional answer booklets used (if applicable):

To be provided by the candidate

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

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	20	20	30	20	20
Section Two Short answer	6	6	90	99	50
Section Three Extended answer	3	2	60	40	30
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2022: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Sections Two and Three: Write your answers in this Question/Answer booklet, preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

4. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

Section One: Multiple-choice **20% (20 Marks)**

This section has **20** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 30 minutes.

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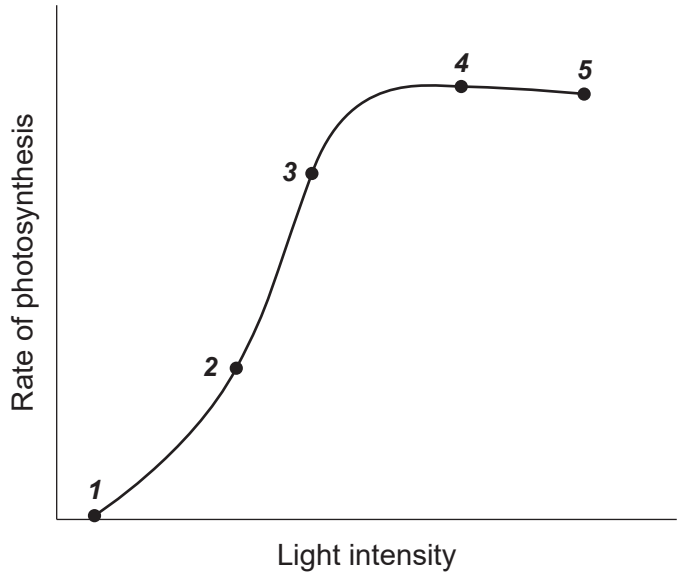
1. Which of the following plant hormones is commonly used in agricultural production to break seed dormancy?

   (a) ethylene
   (b) auxin
   (c) cytokinin
   (d) gibberellin

Question 2 relates to the graph shown below, which shows the relationship between the rate of photosynthesis and light intensity.

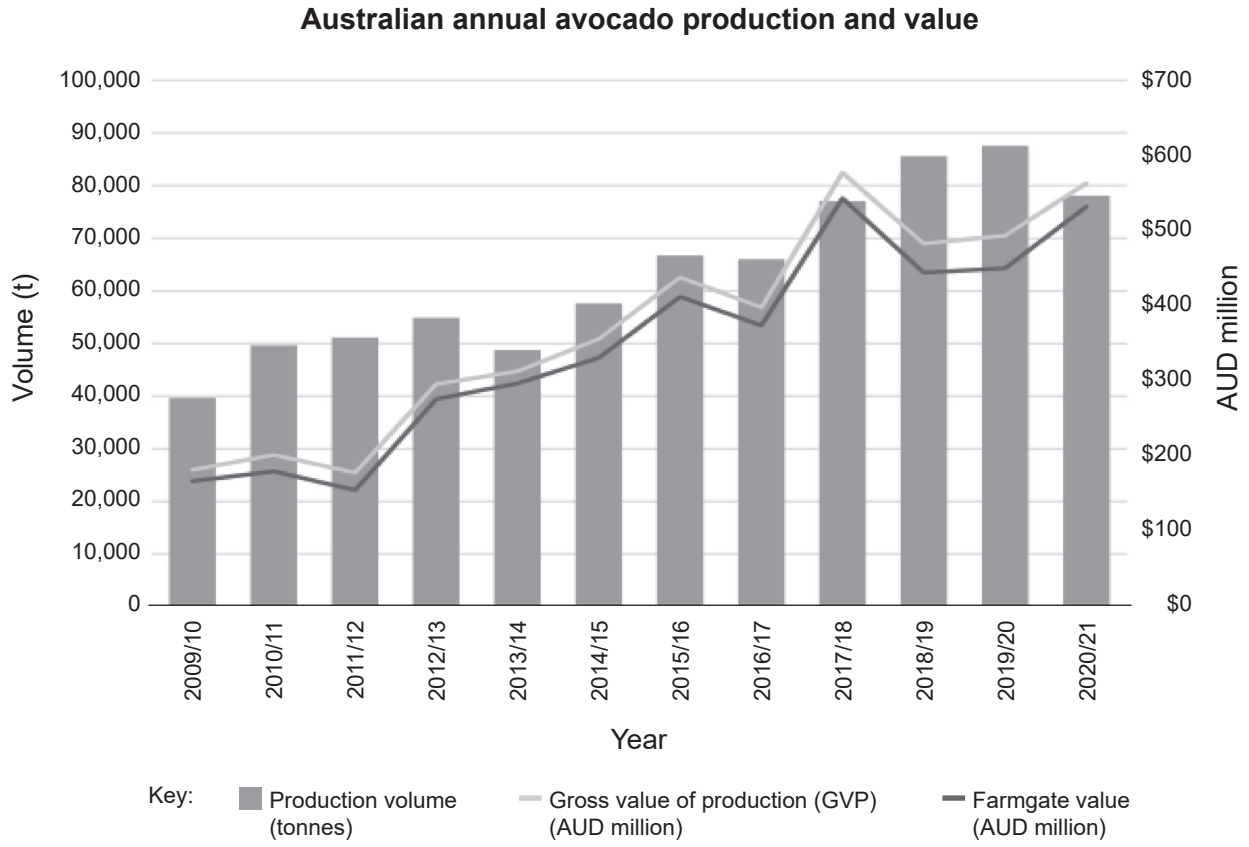


2. The optimum light intensity to maximise the rate of photosynthesis is represented on the graph between points

   (a) 1 and 2.
   (b) 2 and 3.
   (c) 3 and 4.
   (d) 4 and 5.

See next page

Questions 3 and 4 relate to the graph shown below.



3. Avocado producers interpreting this graph when planning for the 2021/22 season would **most** likely

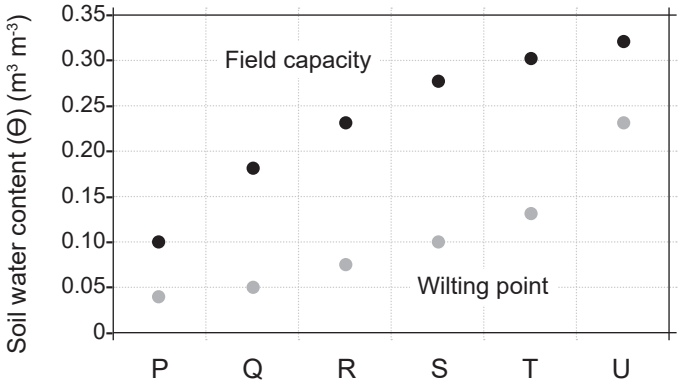
   (a) try to increase production to take advantage of rising prices.
   (b) start pulling out trees due to the falling price.
   (c) defer planting more trees until the price trend improves.
   (d) reduce their production in case there is another price drop.

4. In 2017/18, avocado production peaked in value. What was the **most** likely reason for the drop in value in 2018/19?

   (a) reduced production
   (b) poor quality
   (c) over supply
   (d) consumer trend

See next page

Questions 5 to 7 relate to the graph shown below.



5. The letters on the X axis represent the soil

(a) pH.
(b) texture.
(c) structure.
(d) depth.

6. Which letter on the X axis would require close monitoring during hot weather?

(a) U
(b) T
(c) R
(d) Q

7. The technical term describing the area between field capacity and wilting point is called

(a) free water.
(b) stored water.
(c) required water.
(d) available water.

8. Mode of action can be **best** described as the action of the pesticide

(a) on its target site.
(b) on different types of pests.
(c) entering the pest.
(d) being applied.

9. Which of the following statements about plant breeding using genetically modified organisms (GMO) and conventional techniques is **false**?

(a) The goal is to produce crops with improved characteristics.
(b) GMO adds a new gene to the plant genome.
(c) Conventional techniques have no control over the new characteristics.
(d) Natural selection tends to favour plants that can compete.

See next page

10. A sustainable practice in response to climate change is to

    (a) continuously crop.
    (b) retain bushland.
    (c) apply fertiliser.
    (d) burn stubble.

11. Which of the following plant production strategies would **best** mitigate climate change?

    (a) plant shelter and shade areas to conserve soil moisture
    (b) continue to sow crops in marginal rainfall zones
    (c) use mulch and stubble retention to conserve soil moisture
    (d) retain the current, proven crop varieties

12. Which environmental benefit results when an insect resistant crop variety replaces a non-resistant crop variety?

    (a) reduced water use
    (b) improved fertiliser uptake
    (c) reduced use of herbicides
    (d) reduced use of insecticides

13. Light is artificially supplied in greenhouses to increase crop yields by

    (a) increasing the rate of photosynthesis.
    (b) raising the temperature.
    (c) increasing the translocation of nutrients.
    (d) increasing the rate of transpiration.

See next page

Questions 14 to 16 relate to the diagrams below.

For copyright reasons this diagram cannot be reproduced in the online version of this document, but may be viewed at the following link https://extension.umn.edu/herbicide-resistance-management/herbicide-resistant-weeds#how-selection-of-resistant-weed-biotypes-occurs-928413

14. Select the correct order of the development of herbicide resistance.

(a) ABCD
(b) ADCB
(c) ACBD
(d) CABD

15. Weeds can develop a resistant population by

(a) avoiding contact with the herbicide.
(b) having a different leaf shape.
(c) crossbreeding with unsprayed plants.
(d) flowering and producing seed.

16. Resistance to chemical pesticides happens when

(a) the same method of application is used continuously.
(b) the same mode of action is used continuously.
(c) heavy rain dilutes the pesticide during application.
(d) pesticides become inactive as they pass their use-by date.

See next page

Questions 17 to 19 relate to the table shown below.

Environmental Change	Transpiration Response	Reason
↑ Light	↑ Transpiration	Light causes most stomata to open
↑ Temperature	↑ Transpiration	Cold air holds more moisture
↓ Soil water	↓ Transpiration	Less water enters the plant roots
↑ Wind	↓ Transpiration	Humid boundary around the leaf is reduced

17. Which environmental change has the **incorrect** transpiration response?

(a) light
(b) temperature
(c) soil water
(d) wind

18. Which environmental change has the **incorrect** reason?

(a) light
(b) temperature
(c) soil water
(d) wind

19. Which environmental change would have the **most** effect on the translocation of nutrients?

(a) light
(b) temperature
(c) soil water
(d) wind

20. Transpiration, translocation and absorption have one thing in common. They

(a) all require water to carry out their function.
(b) are all involved in the process of photosynthesis.
(c) cannot function without a root system.
(d) only carry out their function in daylight.

End of Section One

See next page

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See next page

Section Two: Short answer **50% (99 Marks)**

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 21 **(17 marks)**

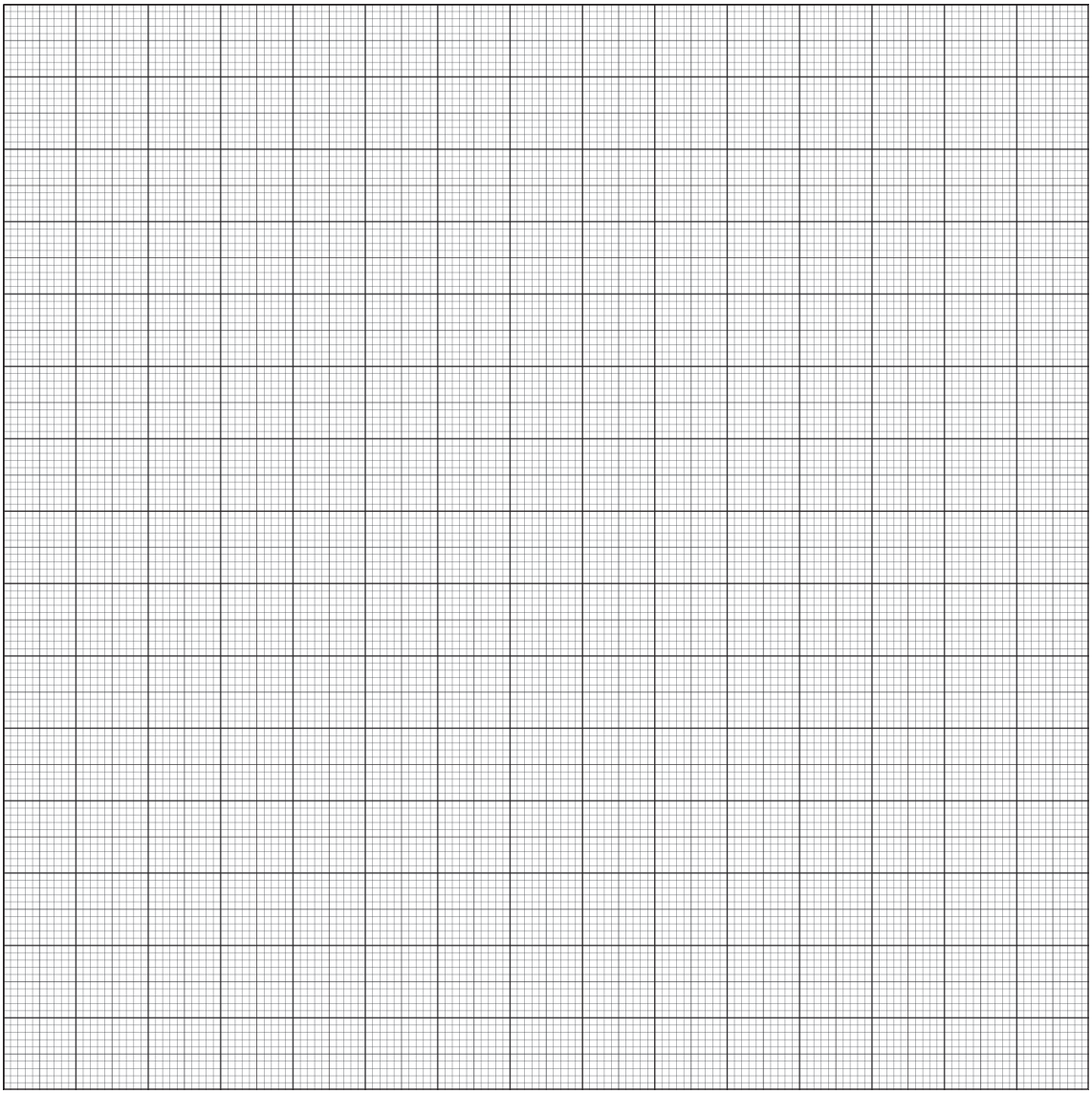
A citrus producer is concerned about poor fruit quality in their oranges and lemons. The producer conducts an experiment in which they spray 10 trees in the orchard before harvest with a hormone that will improve fruit ripening on the tree. The results of the experiment are shown in the table below.

Rate of hormone application (ppm)	Saleable fruit at harvest (kg/tree)	
	Orange	Lemon
0	100	100
10	115	105
20	130	110
25	130	115
30	125	120

(a) State the type of hormone used in the citrus producer's experiment. (1 mark)

(b) State the hypothesis that the citrus producer was testing. (2 marks)

(c) Using the grid below, graph the data from the producer's experiment. (6 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

(d) Outline **one** conclusion from the graphed data about the impact of a hormone treatment on the saleable fruit yield. (2 marks)

See next page

Question 21 (continued)

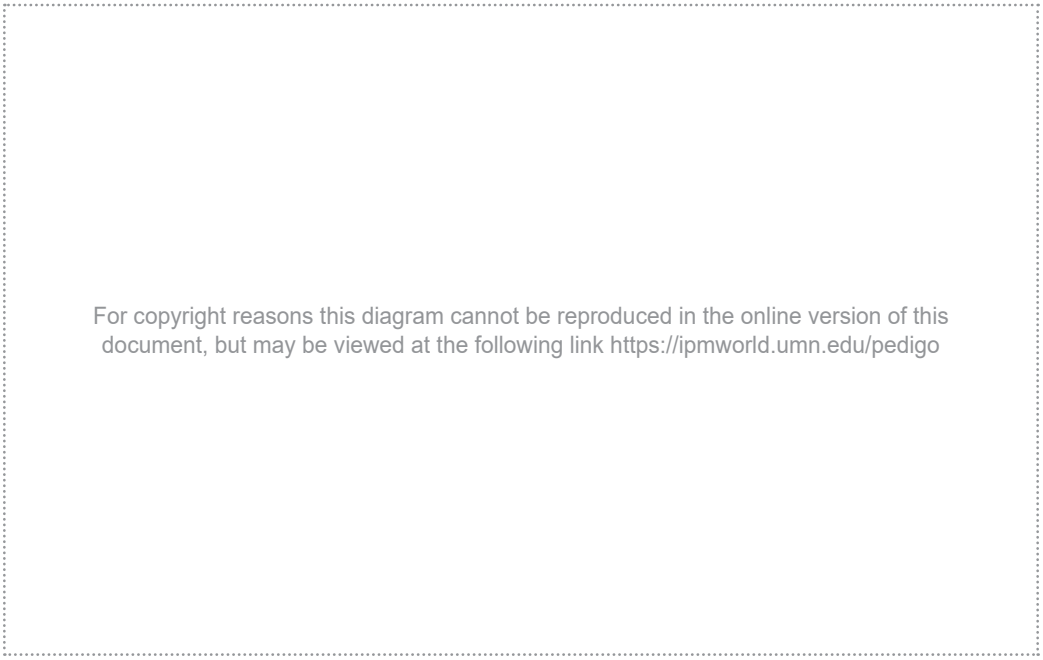
(e) Discuss how randomisation could be applied in a future experiment to ensure the results of the experiment were valid. (4 marks)

(f) Propose a question for a future investigation that could make the results from the experiment more relevant to the citrus producer. (2 marks)

See next page

Question 22 **(15 marks)**

If control methods are not maximised pests and diseases are a constant drain on profitability. The graph below shows the relationship of the economic threshold (ET) to the economic injury level (EIL) over time.



Use the graph shown to answer the following question parts.

(a) (i) Outline the **main** reason for the management activities marked on the graph. (2 marks)

(ii) Describe how the producer could use the information provided in the graph to manage the number of insects. (3 marks)

See next page

Question 22 (continued)

(b) Explain why the gap between the economic threshold and economic injury level may vary. (4 marks)

Contact insecticides are commonly used to control insects.

(c) Describe **two** strategies a producer could use to slow the progress of resistance, if the management activity shown in the graph was applying a contact insecticide. (6 marks)

One:

Two:

See next page

Question 23 **(16 marks)**

Plant production requires well-planned management to produce a quality product.

(a) Match up the following cause and effect statements relating to plant product quality by writing the correct numbers in the spaces provided. (5 marks)

	Caused by		Effect on quality
1	Plant variety		Growth deficiency
2	Weather conditions (frost)		Disease susceptibility
3	Soil nutrients		Mouldy fruit
4	Product handling (harvesting)		Wilted leaves
5	Product transport		Cracked grain

(b) Select **one** of the matched statements in part (a) and recommend an adaptation to the plant production system to improve the product quality. (3 marks)

(c) (i) Explain, using a relevant example, how productivity can be improved by developing cultivars for a specific environment. (4 marks)

Question 23 (continued)

(ii) Explain, using a relevant example, how profitability can be improved by developing cultivars for a specific market. (4 marks)

Question 24 **(15 marks)**

(a) Clarify the role of tariffs as a strategy to protect Australia's domestic market. (3 marks)

(b) (i) Name a quality assurance program used in a plant production system with which you are familiar. (1 mark)

See next page

(ii) Outline **three** strategies used in the quality assurance program named in part (b)(i) that support best practice quarantine standards. (6 marks)

One: _____

Two: _____

Three: _____

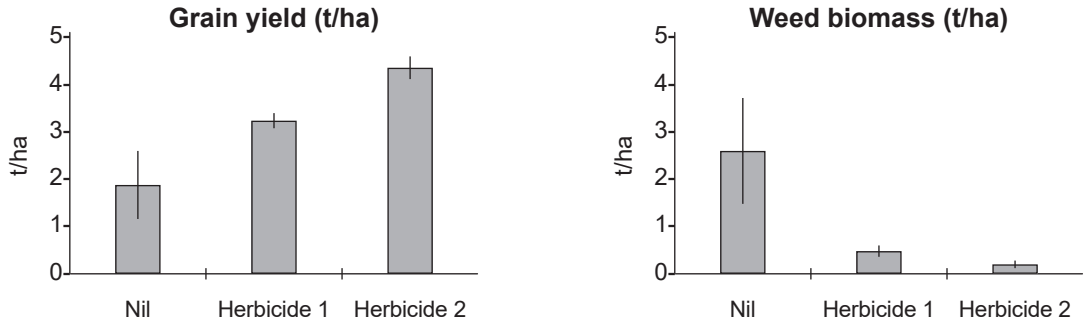
(c) (i) Outline the importance of the global economy to Australia's plant production industry. (2 marks)

(ii) Describe how quarantine standards can assist Australian plant producers to maintain their global competitiveness. (3 marks)

See next page

Question 25 **(16 marks)**

An experiment compared the impact of 'herbicide type' on weed control in wheat crops. The experiment was replicated in five paddocks on one farm. Final crop grain yield and weed biomass were measured.



Refer to the graphs shown to answer the following question parts.

(a) (i) State which treatment is the control in this experiment. (1 mark)

(ii) State the variable in this experiment. (1 mark)

(iii) Draw a conclusion on the basis of the information provided in both graphs. (2 marks)

(iv) The graphs show the mean and standard error for each treatment. Outline a key conclusion which can be drawn from the standard errors. (2 marks)

See next page

(v) Clarify **one** reason why the standard error for weed biomass is largest in the 'Nil' treatment. (2 marks)

(vi) Clarify why 'herbicide type' could differ in its impact on weed biomass if the experiment were to be repeated on a different farm. (2 marks)

(b) (i) State **one** new digital weed control technology. (1 mark)

(ii) Outline how the technology stated in part (b)(i) benefits weed control. (2 marks)

(iii) Consider how the technology stated in part (b)(i) makes production more sustainable. (3 marks)

See next page

Question 26 **(20 marks)**

A common source of nitrogen fertiliser used in agriculture is urea.

The table shown below details the production records for a grass-based grazing enterprise. As the stocking rate increases, income from the enterprise increases, provided urea fertiliser is applied to the pasture.

(a) (i) Complete the table to calculate which stocking rate would be the most profitable if urea is the only input. Urea costs $1/kg and each 0.5 stocking rate/ha earns $50 income. (3 marks)

Urea				
Stocking rate/ha	**Income/ha**	**Kilograms/ha**	**Cost/ha**	**Profit/ha**
1.0		45		
1.5		60		
2.0		80		
2.5		100		
3.0		225		

(ii) State the **most** profitable stocking rate/ha. (1 mark)

_____

_____

(iii) State how a producer might utilise these production records. (1 mark)

_____

_____

See next page

(iv) Outline **two** strategies a producer could use to mitigate the potential negative effects of urea fertiliser on the environment. (4 marks)

One: _____

_____

_____

_____

Two: _____

_____

_____

_____

Due to the rising cost of urea, the producer decides to investigate another method of supplying nitrogen fertiliser to the pasture. Ammonium sulfate is about half the cost of urea but has about half the amount of nitrogen.

(b) (i) Complete the budget outline to compare urea and ammonium sulfate. Assume that double the ammonium sulfate will produce the same pasture growth as urea and that ammonium sulfate costs 40c/kg. (4 marks)

Ammonium sulfate				
Stocking rate/ha	**Income/ha**	**Kilograms/ha**	**Cost/ha**	**Profit/ha**
1.0				
1.5				
2.0				
2.5				
3.0				

(ii) State which fertiliser type **and** rate is **most** profitable. (1 mark)

_____

_____

See next page

Question 26 (continued)

(iii) Outline **one** advantage and **one** disadvantage of swapping from urea to ammonium sulfate. (4 marks)

Advantage: _____

_____

_____

_____

Disadvantage: _____

_____

_____

_____

(c) Outline **one** alternative plant production strategy, apart from using a different nitrogen fertiliser, that could improve the profitability of the grazing enterprise. (2 marks)

_____

_____

_____

_____

End of Section Two

See next page

Section Three: Extended answer **30% (40 Marks)**

This section contains **three** questions. You must answer **two** questions: the compulsory question (Question 27) and **one** of the other questions (Question 28 or Question 29). For Question 27, write your answer in the spaces provided. For Question 28 or Question 29, write your answers on the lined pages following Question 29.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 60 minutes.

Question 27 **(20 marks)**

Select a plant production system that you have studied to answer this question.

Plant production system: _____ (0 marks)

(a) Compare the rate of matter recycling in a natural ecosystem with that of the plant production system you have identified. (6 marks)

Question 27 (continued)

(b) Explain a strategy that would improve the level of matter recycling in the plant production system you have identified. (4 marks)

(c) Explain **one** adaptation to the plant production system you have identified that could have a positive short-term effect on production caused by one of the following circumstances:

- lower average winter rainfall, or
- higher average summer temperatures. (4 marks)

Circumstance: _____ (0 marks)

Explanation: _____

See next page

(d) Propose a strategy that could assist with the conservation of biodiversity in a natural ecosystem **and** the plant production system you have identified. (6 marks)

Natural ecosystem: _____

_____

_____

_____

_____

_____

Plant production system: _____

_____

_____

_____

_____

_____

See next page

Question 28 **(20 marks)**

Conditions caused by climate change have the potential to force plant producers to adapt their practices.

(a) Explain **two** adaptations a producer could make to their plant production practices in response to climate change, in order to remain sustainable. Discuss how these adaptations could have long-term effects on the improvement of farm resources. (11 marks)

(b) Select **one** of the adaptations, identified in part (a), and explain how the conflicting demands of the triple bottom line could be managed by the producer. (9 marks)

or

Question 29 **(20 marks)**

Plant breeding is used to introduce desirable traits into new plant varieties.

(a) Compare the complexity of the breeding method for genetically modified organisms (GMO) and a conventional plant breeding method. (10 marks)

(b) Explain the effect the **two** breeding methods, identified in part (a), could have on farm sustainability by applying the triple bottom line framework. (10 marks)

End of questions

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Supplementary page

Question number: _____

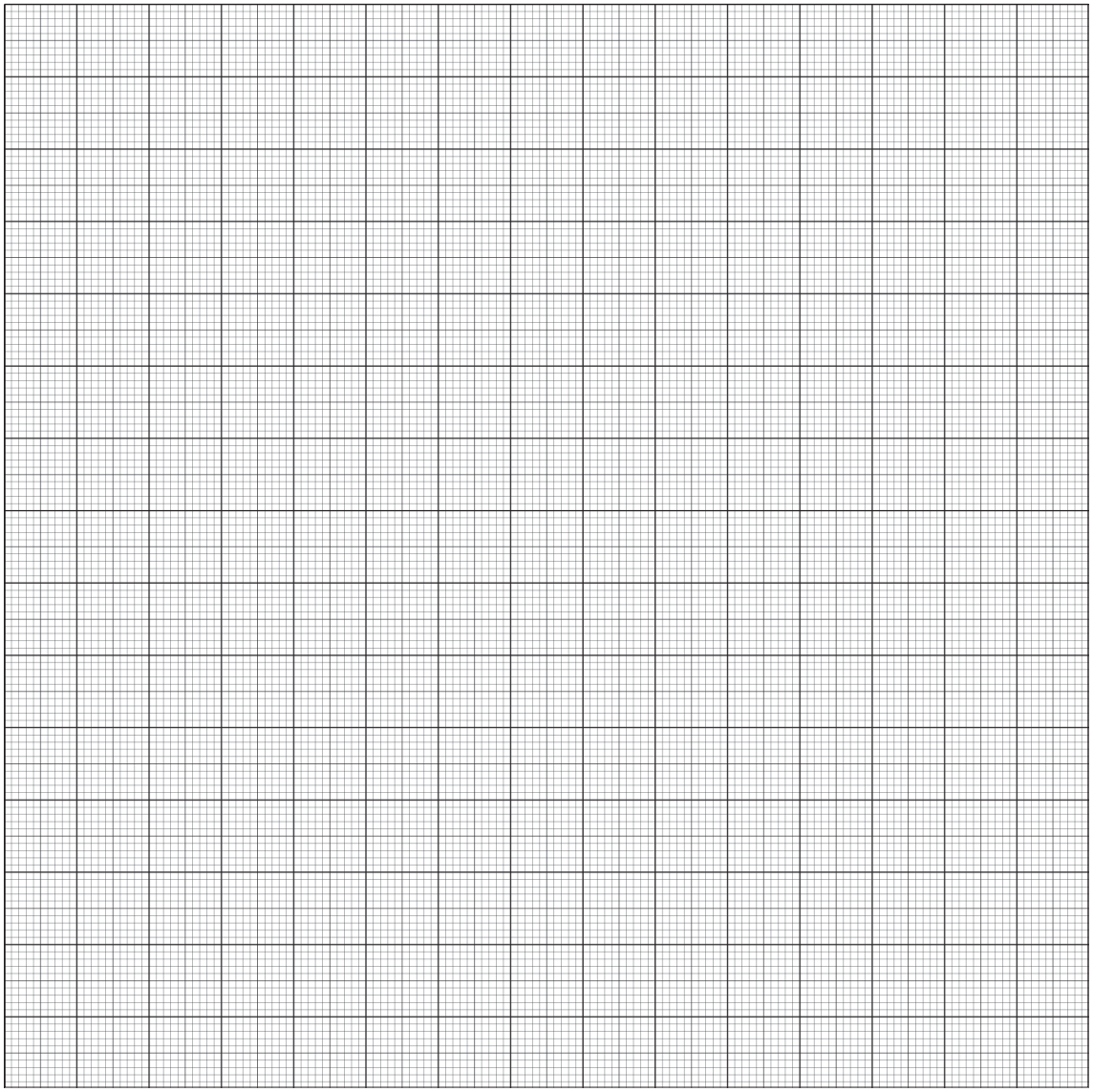
Supplementary page

Question number: _____

Supplementary page

Question number: _____

Spare grid for Question 21(c)



ACKNOWLEDGEMENTS

Questions 3, 4 Adapted from: Avocados Australia. (2021). *Australian annual avocado production and value* [Graph]. Retrieved June, 2022, from https://avocado.org.au/wp-content/uploads/2021/10/2020-21_AAL-Facts-at-a-glance3.pdf

Questions 5–7 Adapted from: Pardossi, A., Incrocci, L., Incrocci, G., et al. (2009, April 21). Root zone sensors for irrigation management in intensive agriculture (Fig. 2) [Graph]. *Sensors, 9*(4). Retrieved June, 2022, from https://www.mdpi.com/1424-8220/9/4/2809
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Questions 14–16 Adapted from: American Cyanamid Company. (n.d.). *How does selection for herbicide resistance occur?* [Diagram]. Retrieved June, 2022, from https://extension.umn.edu/herbicide-resistance-management/herbicide-resistant-weeds#how-selection-of-resistant-weed-biotypes-occurs-928413

Questions 17–19 Adapted from: Holding, D. R., & Streich, A. M. (2013). The rate of transpiration is affected by several environmental conditions (Fig. 3) [Table]. *Plant growth processes: Transpiration, photosynthesis, and respiration* (p. 5). Retrieved June, 2022, from https://extension publications.unl.edu/assets/pdf/ec1268.pdf

Question 22 Adapted from: Pedigo, L. P. (1996–2006). Diagram showing relationship of the economic threshold to the economic injury level and time of taking action (Fig. 4). In E. B. Radcliffe, W. D. Hutchison & R. E. Cancelado (Eds.), *Radcliffe's IPM World Textbook* (Digital ed.). University of Minnesota. Retrieved June, 2022, from https://ipmworld.umn.edu/pedigo

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