



ATAR course examination, 2020

Question/Answer booklet

PLANT PRODUCTION SYSTEMS

Please place your student identification label in this box

WA student number: In figures

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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.

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	101	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 2020: 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.

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.

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.

1. Nutrients are transported from the roots to the shoots of plants through the
 - (a) stomata.
 - (b) root hairs.
 - (c) xylem.
 - (d) phloem.

2. Under which condition will plants transpire more slowly?
 - (a) low rainfall
 - (b) high rainfall
 - (c) low humidity
 - (d) high humidity

3. Reliable sources of genetic diversity are
 - (a) seed banks.
 - (b) commercial nurseries.
 - (c) plant breeders.
 - (d) seed merchants.

4. Glucose is the net product from which plant process?
 - (a) transpiration
 - (b) respiration
 - (c) photosynthesis
 - (d) osmosis

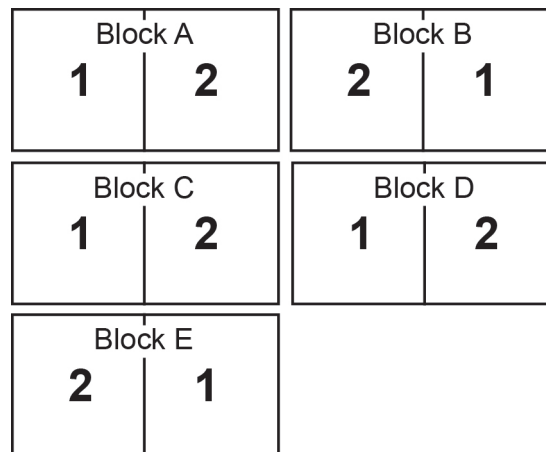
5. Intergenerational equity can be maintained by
 - (a) sub-dividing and selling part of the farm to reduce debt.
 - (b) using sustainable farming practices to preserve natural resources.
 - (c) clearing any remaining bushland to increase the arable area.
 - (d) dividing the farm assets amongst the next generation.

See next page

6. Crops are **most** vulnerable to frost during
- (a) seeding.
 - (b) germination.
 - (c) stem elongation.
 - (d) flowering.
7. What is the **main** role of cytokinins in plant production systems?
- (a) increased cell division
 - (b) faster fruit ripening
 - (c) extended cell elongation
 - (d) longer seed dormancy
8. Fencing off natural bushland to exclude livestock is an example of
- (a) reducing biodiversity.
 - (b) protecting natural ecosystems.
 - (c) preventing eutrophication.
 - (d) providing grazing areas for native animals.
9. Compared with agricultural ecosystems, natural ecosystems have
- (a) a lower level of nutrient recycling.
 - (b) less biodiversity.
 - (c) greater stability.
 - (d) more simple relationships.
10. Plant nutrition programs are usually based on
- (a) data on previous years' yield.
 - (b) cost per unit of fertiliser.
 - (c) soil tests matched to production plans.
 - (d) an annual application of a base fertiliser.
11. The **main** factor that should determine whether to initiate a spray program against an insect in a crop is
- (a) cost per hectare.
 - (b) crop yield.
 - (c) crop height.
 - (d) insect population.
12. A self-audit of a quality assurance (QA) program is carried out to
- (a) create extra checks within the QA program.
 - (b) replace costly external audits.
 - (c) identify any non-compliance within the QA program.
 - (d) hide any non-compliance within the QA program.

See next page

13. Which market information would be considered valuable for next year's production planning?
- long-term rain forecast
 - new variety releases
 - results of herbicide resistance trials
 - fertiliser prices
14. Applying too much fertiliser can result in
- pesticide resistance.
 - contamination of waterways.
 - nutrient deficiencies in plants.
 - a sudden drop in soil pH.
15. The push to minimise the use of pesticides in the fresh produce industry mainly comes from
- producers.
 - consumers.
 - wholesalers.
 - government.
16. Consider the diagram shown below



The pattern in the diagram **best** represents an example of

- standardisation.
- replication.
- randomisation.
- variance.

17. To manage the availability of soil water effectively, which of the following measurements are critical?
- (a) field capacity and wilting point
 - (b) field capacity and soil type
 - (c) root depth and wilting point
 - (d) soil porosity and root depth

Questions 18, 19 and 20 relate to the soil nitrogen (N) data in the table below, showing the results of a replicated trial.

Total stored soil nitrogen (N) after harvest (mg N/kg soil)

Crop	Replicate 1	Replicate 2	Replicate 3	Replicate 4
Barley	12	15	19	18
Lupins	22	28	34	26

18. According to the data, the crop that contributed the **most** stored soil nitrogen (N) after harvest was the
- (a) lupins, because it could fix atmospheric N in its root system.
 - (b) lupins, because the average soil N level was higher than that of barley.
 - (c) barley, because the average soil N level was lower than that of lupins.
 - (d) barley, because more N was removed during harvest.
19. The standard deviation for the data was 5.0 for the lupins and 3.2 for the barley. This indicates that
- (a) there was more variability in the lupin data.
 - (b) nitrogen levels were higher in the legume crop.
 - (c) nitrogen levels were more variable in the barley.
 - (d) there was more variability in the barley data.
20. If a barley crop requires a minimum of 24 mg N/kg of soil, use the above data to describe how the producer could better manage the cropping program.
- (a) Apply higher levels of N to a barley crop that follows a lupin crop.
 - (b) Grow barley crops if they follow a lupin crop.
 - (c) Apply N to barley crops in order to build soil N levels.
 - (d) Only grow barley and apply more N fertiliser.

End of Section One

See next page

Section Two: Short answer**50% (101 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**(19 marks)**

While biological control is considered a potential alternative to pesticides, thorough trial work is required before it is made commercially available.

- (a) Clarify, using a relevant example, the role biological control measures play in pest management. (3 marks)

Relevant example: _____

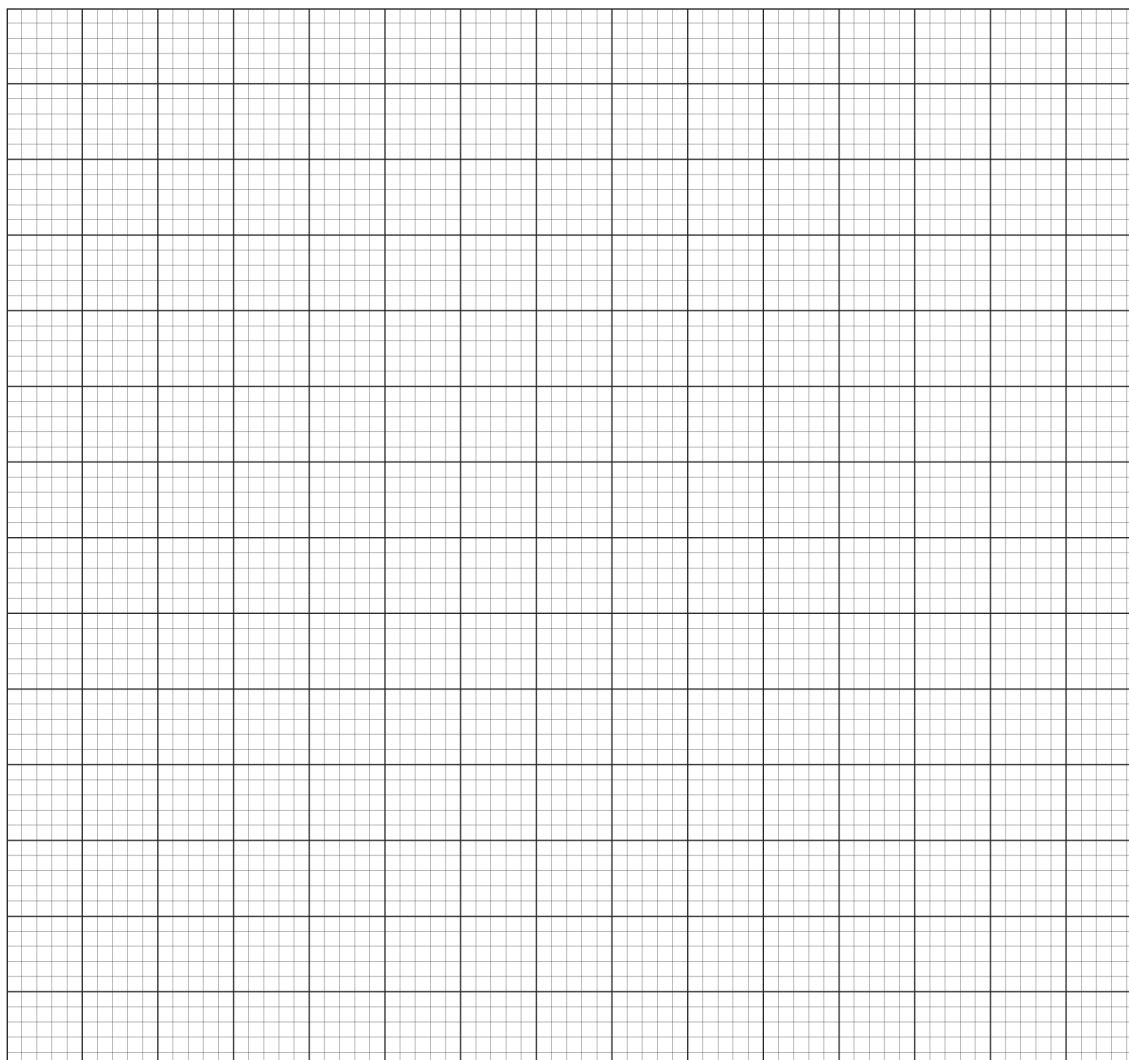
Role: _____

Question 21 (continued)

A trial was conducted to test the effectiveness of an introduced virus in controlling aphids in crops, with data being collected from three farms. The table below shows a summary of the data.

Average numbers of aphids after the release of the virus				
Crop	Aphids/m ² Week 5	Aphids/m ² Week 10	Aphids/m ² Week 15	Aphids/m ² Week 20
Wheat	20	5	15	15
Barley	50	10	20	20
Oats	30	10	5	5

(b) (i) Using the table above, graph the data. (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.

- (ii) Outline **one** relevant conclusion you could draw from the graph in part (b)(i). (2 marks)

- (iii) Explain **two** areas of potential experimental error in this trial. (6 marks)

One: _____

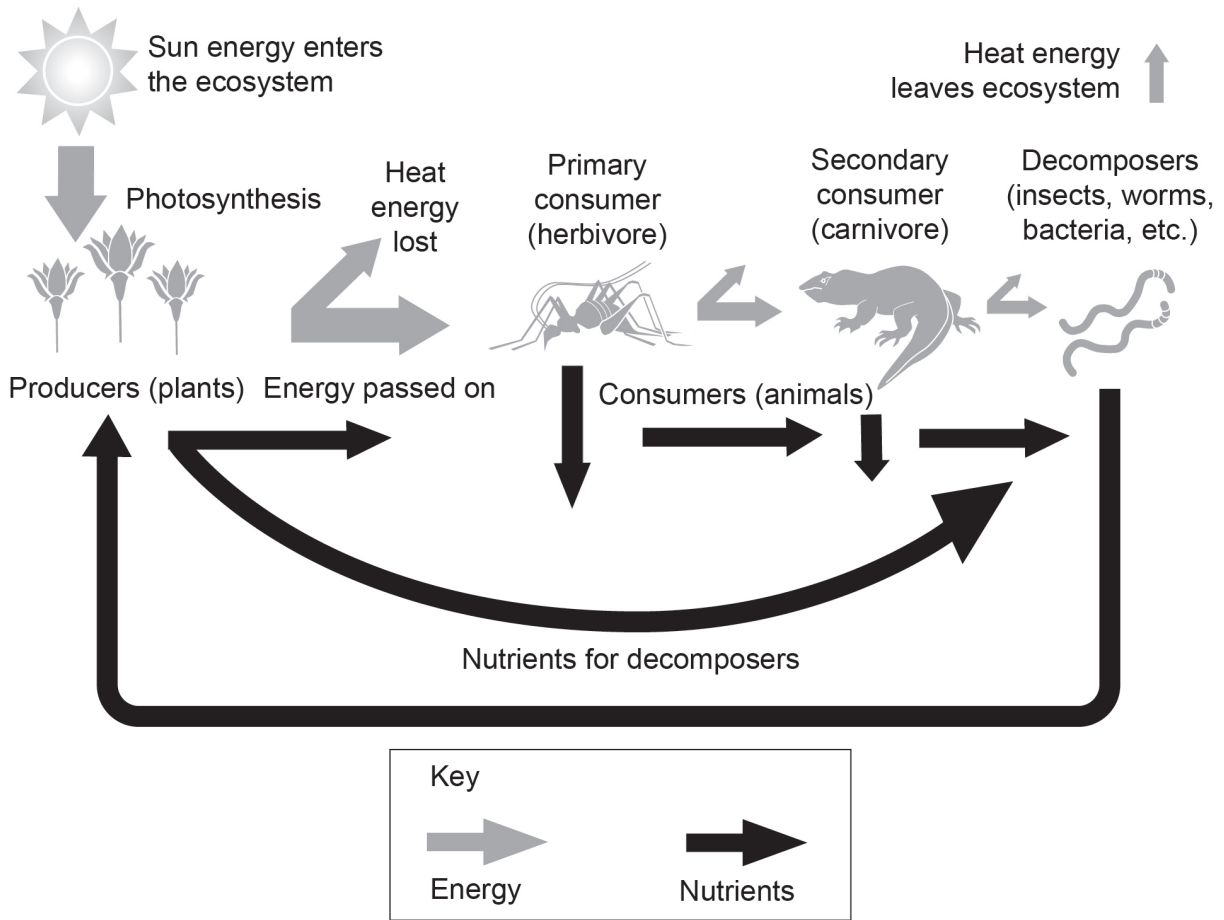
Two: _____

- (iv) Outline how **one** of the errors in part (b)(iii) could be rectified in a future investigation. (2 marks)

Question 22

(14 marks)

The living and non-living components of an ecosystem are linked together through nutrient cycles and energy flows.



- (a) Refer to the above diagram. Replace producers (plants) with annual crops. Explain the effects this will have on the flow of energy and recycling of nutrients in this ecosystem? (4 marks)

- (b) Outline how the change to annual crops in part (a) would affect the ecosystem's biodiversity. (2 marks)

- (c) Outline **two** short-term plant production strategies and **two** long-term management strategies to ensure intergenerational equity is **not** compromised in an agricultural ecosystem. (8 marks)

Short-term plant production strategies

One: _____

Two: _____

Long-term management strategies

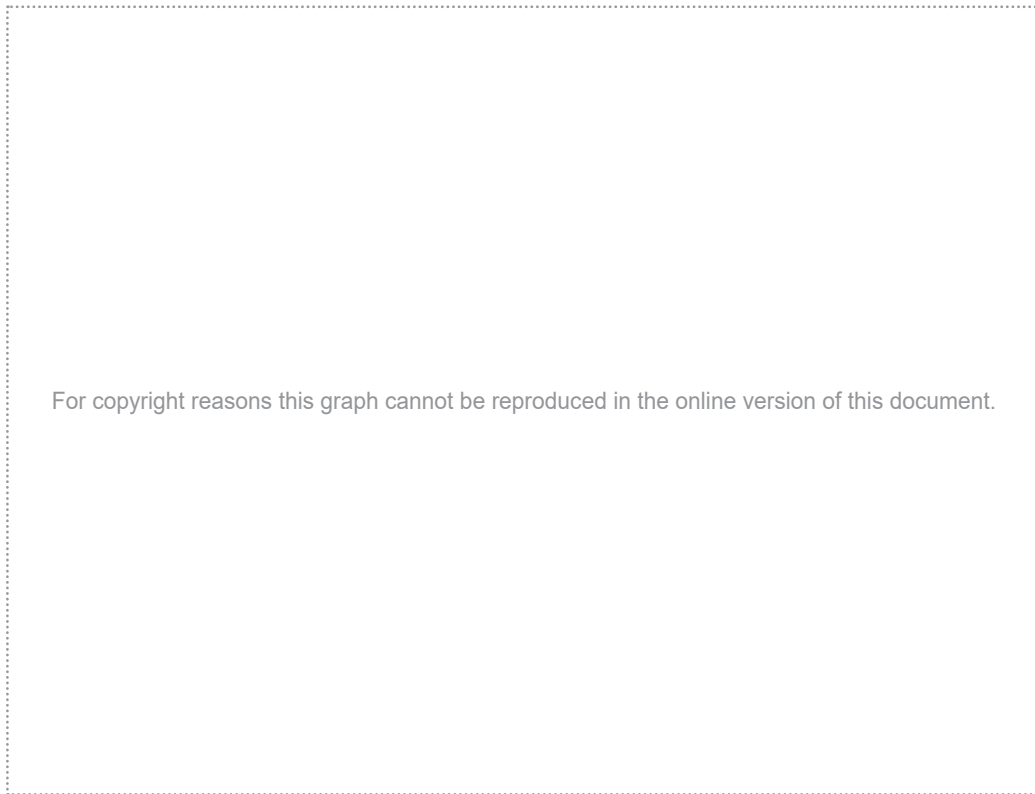
One: _____

Two: _____

Question 23

(19 marks)

One of the net products of photosynthesis is sugar, which provides an energy source for respiration.



(a) Describe the above graph as it relates to the rate of plant growth. (3 marks)

- (b) Outline how each of the following factors affects the rate of plant growth. (8 marks)

Factor	Effect on the rate of plant growth
Availability of inorganic nutrients	
Day length	
Canopy density	
Insect and disease damage	

- (c) (i) Outline **one** method used to determine accurately the amount of water available in the soil. (2 marks)

See next page

Question 23 (continued)

- (ii) Explain **two** strategies that can be applied to increase soil water availability in a dryland cropping system. (6 marks)

One: _____

Two: _____

Question 24**(17 marks)**

Gibberellic acid (GA) is a plant hormone that affects cell elongation.

- (a) Name a plant production system that would benefit from the application of GA and state the role it would play. (2 marks)

A new mango variety with a short, strong fruit stem has been released. Researchers believe GA will decrease harvesting time by increasing the length of the stem. By spraying a one litre solution on each tree, the stem length increases by four centimetres.

- (b) (i) Propose an hypothesis to test this belief. (1 mark)

- (ii) Outline the steps of an investigation to test the hypothesis in part (b)(i), taking into consideration **four** key aspects of experimental design. (8 marks)

Question 24 (continued)

A different investigation measured the time taken to harvest mangoes at two tree heights. The following data summary was published.

Tree Height – metres	Two	Three
Values – Picking time in minutes per tree	15, 14, 16, 17, 13.	23, 37, 36, 24, 40.
Mean – Picking time in minutes per tree	15.0	32.0
Standard deviation (SD)	1.41	7.07
Standard error (SE)	3.22	

(c) (i) State whether the difference in tree height is significant. (1 mark)

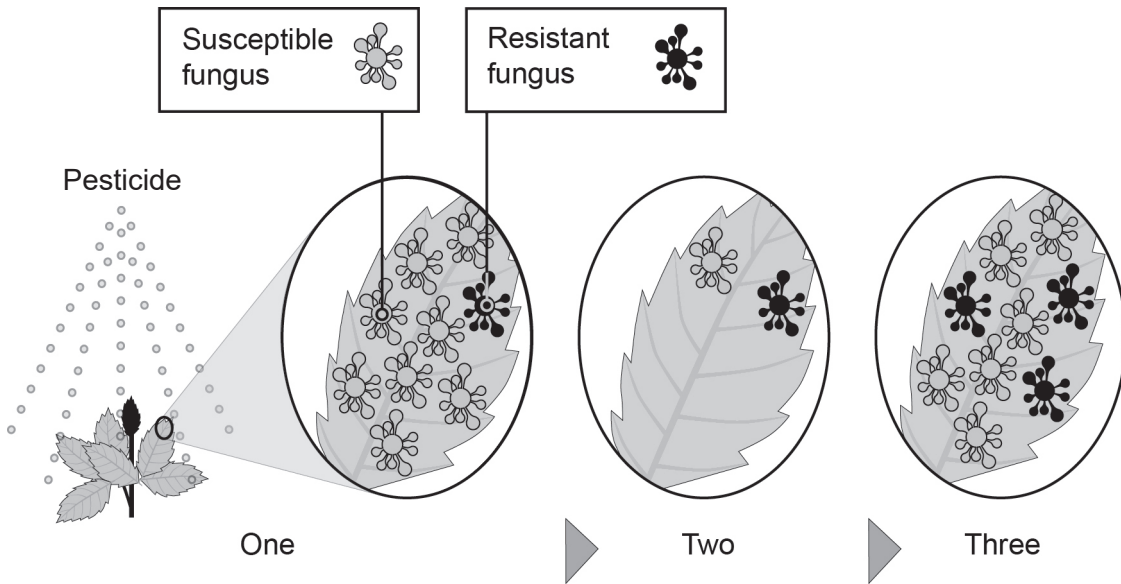
(ii) Outline how you reached your answer in part (c)(i). (2 marks)

(iii) Consider how bias could have affected the results in the data summary. (3 marks)

Question 25

(15 marks)

Pesticide resistance is a constant issue for producers seeking higher levels of production.



- (a) The image above shows how fungicide resistance develops in stages. State what is shown at each stage. (3 marks)

One: _____

Two: _____

Three: _____

- (b) (i) Give **one** reason why identifying the mode of action (MOA) in selecting a pesticide is important. (2 marks)

Question 25 (continued)

- (ii) Explain **two** strategies, other than the use of chemicals, that will slow the rate of pesticide resistance in a plant production system. (6 marks)

One: _____

Two: _____

- (c) Explain how the quarantine system operates to minimise the entry of foreign plant diseases and if necessary, to control their spread into Australia’s plant production systems. (4 marks)

Question 26**(17 marks)**

Well-informed decisions about input costs allow farmers to plan for maximum profit.

- (a) Outline **one** advantage a gross margin has over a budget. (2 marks)

An agronomist has provided a nitrogen (N) fertiliser plan for the coming season. Each unit of N is valued at \$5.

Wheat variety incomes (\$) at different rates of N (units)

Wheat variety	Rate of nitrogen applied			
	0 units	10 units	20 units	30 units
Jasper	\$300	\$380	\$440	\$500
Day	\$300	\$350	\$450	\$470
Hollamby	\$300	\$400	\$500	\$520

- (b) State which variety and rate of N (units) will give the best return (\$). (2 marks)

Variety: _____

Rate of N (units): _____

Question 26 (continued)

The agronomist also recommends a split application of the N fertiliser.

- (c) (i) Explain why this practice would be environmentally responsible. (3 marks)

The farmer decides to check the financial outcome of split applications by completing a partial budget.

Income	Single application	Split application
Wheat – single application 2.5 t/ha x \$300/t	A =	
Wheat – split application 2.7 t/ha x \$300/t		B =
Costs		
Seed	30	30
Seeding – \$50/ha		
Herbicide	150	150
Herbicide spraying – \$25/ha		
Fertiliser	100	100
Fertiliser spreading – \$25/ha		
Harvesting – \$100/ha		
Total costs/hectare	C =	D =
Profit/hectare	\$	\$

- (ii) Calculate the value of A, B, C and D in the budget on page 20. (4 marks)
- (iii) State which fertiliser application method is more profitable. (1 mark)
-
- (iv) There is a late start to the growing season resulting in forecast wheat yields being reduced by 25%. Outline the effect this will have on the choice of fertiliser application method. (2 marks)
-
-
-
-
- (v) Explain **one** management strategy the farmer could adopt to minimise the possibility of a financial loss in the cropping enterprise. (3 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 allocated)

- (a) Outline **two** variations in plant product quality and state how each will affect the plant production system's financial returns. (4 marks)

One: _____

Two: _____

- (b) State the quality assurance (QA) system used in the plant production system and describe **two** on-farm practices that focused on meeting the QA standards. (7 marks)

QA system : _____
One: _____

Two: _____

- (c) Identify a variation in product quality caused by weather and outline a strategy the producer could use to minimise financial losses. (3 marks)

- (d) Identify a technology that has been recently introduced to the plant production system. Explain how this technology could affect the producer’s financial returns. (6 marks)

Question 28

(20 marks)

Planning for climate change in plant production systems is part of risk management.

- (a) Discuss the issues surrounding climate change, including its causes and the impact plant production can have on climate change. Examine the potential consequences of climate change on plant production in Western Australia. (10 marks)
- (b) Evaluate how a plant producer would assess the risk of climate change to their plant production system and propose risk mitigation strategies to create long-term sustainability for the system. (10 marks)

or

Question 29

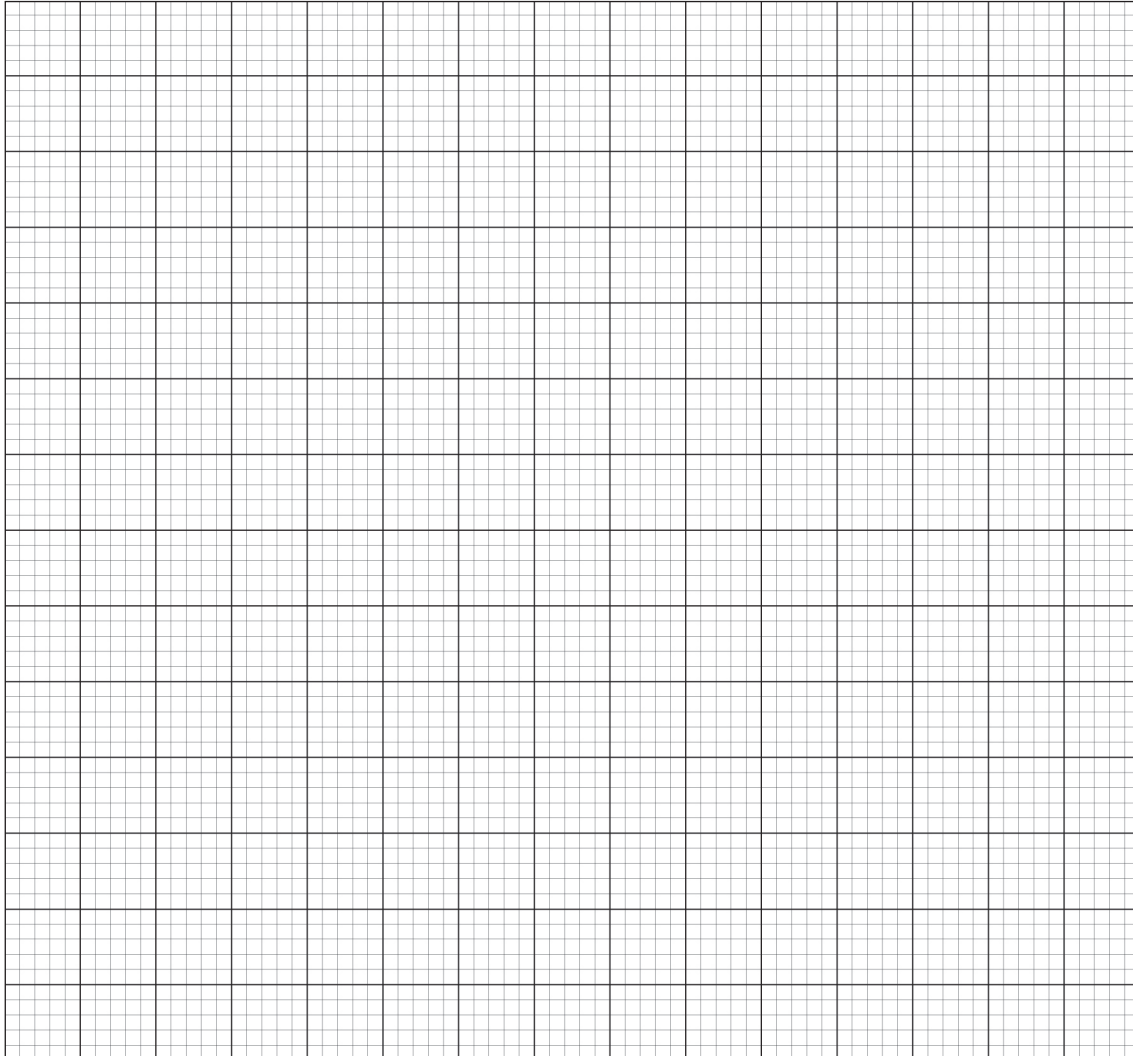
(20 marks)

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- (a) State the main difference between genetic modification (GMO) and cross-breeding. Explain, using an example for each, how **both** of these breeding techniques are carried out. (11 marks)
- (b) Evaluate the role of GMO plants in Australian agriculture, using the triple bottom line tool to measure sustainability. (9 marks)

End of questions

Spare grid



ACKNOWLEDGEMENTS

- Question 22** Adapted from: The University of Waikato. (2008). *Diagram of a simple ecosystem*. Retrieved June, 2020, from <https://www.sciencelearn.org.nz/images/1113-simple-ecosystem-diagram>
- Question 23** Adapted from: Hindmarsh, R., Brown, L., & McGregor, R. (2015). *Dynamic agriculture: Years 11–12* (3rd ed.). Melbourne: Cengage Learning Australia, p. 277, fig. 19.2.
- Question 25** Adapted from: CropLife Australia. (2017). *Fact sheet - Fungicide resistance management*. Retrieved June, 2020, from <https://www.croplife.org.au/resources/programs/resistance-management/fact-sheet-fungicide-resistance/>
- Question 29** Adapted from: National Association of Plant Breeders. (n.d.). *What is plant breeding?* Retrieved June, 2020, from <https://www.plantbreeding.org/content/what-is-plant-breeding>

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