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

## ATAR course examination, 2021

## 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.

2022/3233
Web version of 2021/61013

Ref: 21-070

## 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 | 96 | 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 2021: 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.

**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 is an example of a practice compatible with a long-term balanced plant production system?

   (a) applying fertiliser to increase growth
   (b) irrigating from subsoil aquifers
   (c) using lime to adjust the soil pH
   (d) clearing native vegetation

2. Quality assurance programs assist plant producers to

   (a) increase profits through better product marketing.
   (b) use management practices to produce safe food.
   (c) manage risk in food production by avoiding penalties.
   (d) produce food that is not genetically modified.

3. The main reason plant producers should conserve biodiversity is to

   (a) comply with government legislation on natural ecosystems.
   (b) ensure the natural ecosystem aids long-term farm sustainability.
   (c) maximise profits by using natural resources to reduce input costs.
   (d) attract tourists to rural areas and so benefit the community.

4. Gross margins are calculated by

   (a) adding the variable costs and income.
   (b) multiplying the income by the variable costs.
   (c) dividing the income by the variable costs.
   (d) subtracting the variable costs from the income.

5. Seed banks are

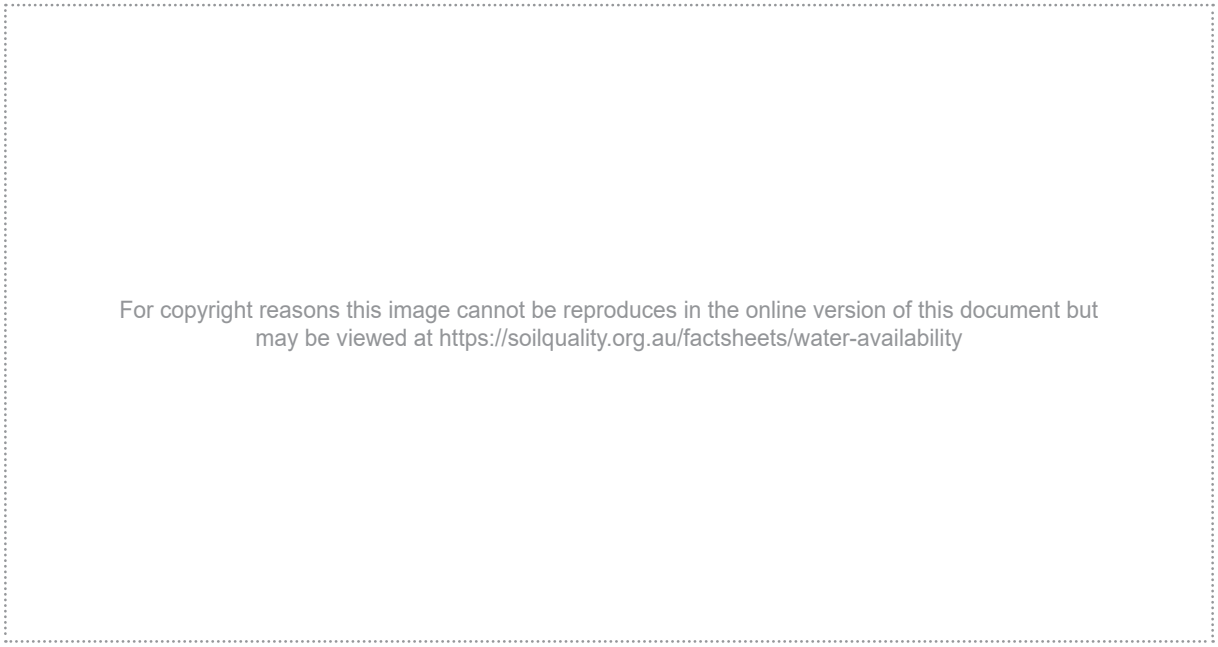
   (a) the amount of non-viable weed seed reserves in the soil.
   (b) examples of small-scale community banking institutions.
   (c) a proportion of harvested seed set aside for the next year.
   (d) stores of genetic material for future breeding programs.

**See next page**

6. With which country would Australia be **most** likely to have a comparative advantage in wheat production?

   (a) Japan
   (b) Canada
   (c) United States of America
   (d) Russia

Questions 7 and 8 relate to the graph below.




7. The soil texture that has the **most** water available for plant growth is

   (a) sandy loam.
   (b) loam.
   (c) silt loam.
   (d) clay loam.

8. Regular irrigation would **most** benefit plant growth in which soil texture?

   (a) sand
   (b) loam
   (c) clay loam
   (d) clay

9. Soil moisture can be monitored accurately by using which method?

   (a) observation of wilting plants
   (b) soil tensiometer
   (c) soil test
   (d) tissue test

**See next page**

10. At which stage of plant growth is phosphorus fertiliser **most** beneficial?

(a) germination
(b) tillering
(c) stem elongation
(d) flowering

11. Ensuring employees are provided with safety glasses is considered to be the employer

(a) using common sense.
(b) meeting their duty of care obligation.
(c) preventing accidents.
(d) avoiding workers compensation payouts.

12. When day length and temperature decrease simultaneously there is generally a change from

(a) reproductive growth to ripening.
(b) germination to vegetative growth.
(c) vegetative to reproductive growth.
(d) vegetative growth to ripening.

13. Increasing levels of carbon dioxide will

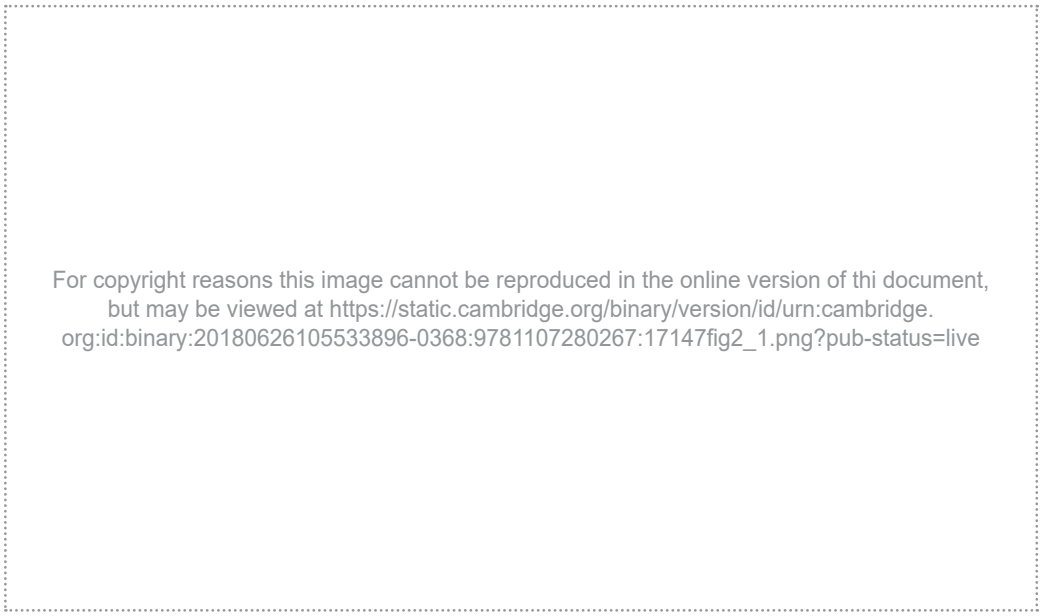
(a) increase plant growth.
(b) decrease plant growth.
(c) increase germination rate.
(d) decrease germination rate.

14. A common strategy to manage soil water on light, sandy soils is to

(a) deep rip before the rain.
(b) cultivate after the rain.
(c) burn the plant residues.
(d) retain surface organic matter.

**See next page**

Questions 15 and 16 refer to the graph below.




15. Which of the following statements **best** reflects the pest population in the graph above? The pest

    (a) is under control.
    (b) needs a higher dose rate.
    (c) cannot be controlled.
    (d) does not cause much damage.

16. The graph above suggests that the number of insects trends upwards over time due to

    (a) changing seasonal conditions.
    (b) larger area of crop grown.
    (c) lower number of natural predators.
    (d) resistance to the treatment.

17. Economic threshold is the point at which the

    (a) pest population is static and control measures are not economic.
    (b) cost of control is less than the damage caused by the pest.
    (c) pest is causing damage and control measures need to start.
    (d) damage caused by the pest is greater than the cost of control.

**See next page**

18. Imposing tariffs on Australian agricultural products can have a significant impact on farm viability because

(a) Australia exports around 70% of its agricultural outputs.
(b) the value of Australian imports will rise significantly.
(c) products that attract tariffs will not be harvested.
(d) Australia will lose its 'clean, green' credentials.

19. The **most** effective strategy for protecting Australian producers from the spread of an unwanted pest or disease is

(a) tariffs.
(b) fumigation.
(c) quarantine.
(d) spraying.

20. Which of the following would be considered an alteration to a production system in response to consumer trends? The

(a) use of mechanised potato harvesting to increase production output.
(b) development of a gluten free wheat variety.
(c) development of automated spraying robots to control weeds.
(d) introduction of zero till crop establishment methods.

**End of Section One**

**See next page**

**Section Two: Short answer** **50% (96 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.

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**Question 21** **(18 marks)**

Under experimental conditions, the bubbles produced by pondweed growing underwater can be counted. The rate of bubbling can indicate the rate of photosynthesis.

(a) (i) State which product of photosynthesis is being observed when counting bubbles. (1 mark)

(ii) Propose an hypothesis relevant to the data in the table below. (2 marks)

| Light intensity (Lux) | Rate of bubbles (Bubbles per minute) |
|---|---|
| 20 000 | 10 |
| 60 000 | 20 |
| 100 000 | 50 |
| 140 000 | 80 |
| 180 000 | 60 |

(iii) Using the table on page 8, graph the data on the grid below. (5 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.

(iv) Draw a conclusion from the graphed data in part (a)(iii). (2 marks)

**See next page**

**Question 21** (continued)

(b) Complete the table below by writing **increase** or **decrease** in the description of the effect of environmental conditions on the rate of transpiration. (4 marks)

| Environmental condition | Description |
|---|---|
| High relative humidity | The effect on the plant is to _____ the rate of transpiration. |
| Warmer air | The effect on the plant is to _____ the rate of transpiration. |
| Low soil water | The effect on the plant is to _____ the rate of transpiration. |
| Windy conditions | The effect on the plant is to _____ the rate of transpiration. |

(c) Using the terms ‘absorbed’ and ‘translocated’, describe how nutrients and sugars are transported by plants. (4 marks)

**See next page**

**Question 22** **(14 marks)**

Hormones are used artificially in plant production systems for specific tasks.

(a) Describe the role of plant hormones in plant physiology. (3 marks)

(b) (i) Complete the table below. (8 marks)

| Stage of growth | A plant hormone used at this stage of growth | An example of the use of this hormone at this stage of growth |
|---|---|---|
| Germination | | |
| Growth | | |
| Flowering | | |
| Fruit ripening | | |

(ii) Identify a common plant hormone that can be used as a selective weed killer. (1 mark)

(iii) Outline the reason why a plant hormone weed killer can be selective. (2 marks)

**See next page**

**Question 23** **(14 marks)**

Plant breeding is in a constant battle to stay ahead of pests.

(a) State an impact of a pest on the financial return for a crop. (1 mark)

(b) List the **four** basic steps in developing a pest-resistant variety by using crossbreeding. (4 marks)

One:

Two:

Three:

Four:

(c) Outline a key advantage genetically-modified organisms (GMOs) have over crossbred varieties in a plant breeding program. (2 marks)

(d) Identify a genetically-modified organism (GMO) crop and evaluate the aspects of the 'triple bottom line' that a producer needs to consider when choosing to grow a GMO crop instead of a crossbred variety. (7 marks)

GMO crop: _____

Evaluation: _____

See next page

**Question 24** **(17 marks)**

Russian wheat aphid is a major production pest of cereal crops and was detected for the first time near Mount Barker, Western Australia, in late 2020. The graph below shows the number of Russian wheat aphids on each wheat tiller (stem) when aphid enemies were present or absent for a selected period.



(a) (i) Explain the information presented in the graph. (3 marks)

(ii) Outline the economic implications for production from the data in the graph above. (2 marks)

**See next page**

(b) Discuss **two** possible sources of experimental error for the data graphed on page 14. (6 marks)

One: _____

Two: _____

(c) Recommend on-farm management strategies that should be adopted to restrict the wider spread of Russian wheat aphid in Western Australia. (4 marks)

(d) Outline a critical reason for controlling Russian wheat aphid to maintain Australia's global competitiveness. (2 marks)

**See next page**

**Question 25** **(18 marks)**

Minimising herbicide resistance relies on a number of strategies.



(a) (i) Summarise the **most** important points from the graph above. (3 marks)

(ii) Outline the benefit to a producer of herbicides having different modes of action. (2 marks)

**See next page**

(iii) Outline how herbicide resistance develops in a weed population. (2 marks)

(b) Using a plant production system you are familiar with, describe **two** short-term and **two** long-term strategies you could use to slow the development of herbicide resistance. (8 marks)

Plant production system:

Short-term strategies

One:

Two:

Long-term strategies

One:

Two:

**Question 25** (continued)

(c) Evaluate a new technology that will minimise the development of herbicide resistance.
(3 marks)

**See next page**

**Question 26** **(15 marks)**

Cultivar selection is one tool a producer can use to maximise production.

The table below summarises three new canola cultivars for the 2022 growing season.

| Attributes | Alpha | Beta | Gamma |
|---|---|---|---|
| Yield potential | 1–3.5 t/ha | 2.0–6.5 t/ha | 1–2.5 t/ha |
| Oil potential | High | Moderate | Very high |
| Maturity | Mid | Late | Early |
| Plant height | Short | Tall | Medium |

(a) (i) From the table above, select a cultivar that would be **best** suited to a shorter growing season. (1 mark)

(ii) Outline the reasons for your selection in part (a)(i). (2 marks)

**See next page**

**Question 26** (continued)

(b) Apart from using an improved cultivar, propose **two** adaptations to a plant production system in response to climate change. (6 marks)

One: _____

Two: _____

(c) (i) State which cultivar in the table on page 19 is most likely to have the **greatest** benefit for the producer's financial return in a good season. (1 mark)

(ii) Outline a reason for your selection in part (c)(i). (2 marks)

(iii) For a new cultivar that has been harvested, evaluate **one** on-farm practice used to meet the grain quality requirements. (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.

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**Question 27** **(20 marks)**

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

Plant Production Enterprise: _____ (0 marks)

You are considering purchasing a farm which includes Paddock 38. This paddock has been soil tested and the results are shown in the table below. The paddock is well drained and should receive 200 to 300 mm of rainfall during the growing season.

**Soil test report – interpreted**

| **Site**<br>**Sample depth** | **North**<br>**0–10 cm** | **South**<br>**0–10 cm** | **East**<br>**0–10 cm** | **West**<br>**0–10 cm** |
|---|---|---|---|---|
| pH<br>(1:5 soil/$CaC\ell_2$) | 5.5<br>< | 5.2<br>< | 5.7<br>< | 5.2<br>< |
| Electrical Conductivity<br>(1:5 ds/m) | 0.161<br>OK | 0.142<br>OK | 0.070<br>OK | 0.054<br>OK |
| Organic Carbon<br>[W&B] (%) | 2.7<br>OK | 2.1<br>< | 2.9<br>OK | 2.4<br>< |
| N (Nitrogen)<br>(mg/kg) | 54<br>High | 41<br>High | 20<br>High | 21<br>High |
| P (Phosphorus)<br>[Colwell] (mg/kg) | 60<br>Low | 81<br>Low | 75<br>Low | 87<br>Low |
| K (Potassium)<br>[Colwell] (mg/kg) | 79<br>Low | 31<br>Low | 43<br>Low | 28<br>Low |
| S (Sulfur)<br>[KC$\ell$-40] (mg/kg) | 31<br>High | 25<br>High | 19<br>High | 26<br>High |

Key: < indicates a lower measurement than the previous year

**See next page**

(a) Would your nominated plant production enterprise be suitable for production in paddock 38? Justify your decision based on the nutrient status shown in the soil test report on page 22. (3 marks)

(b) (i) Assess the soil test results on page 22 and recommend which nutrients would need to be provided to optimise production in your plant production enterprise. (3 marks)

(ii) Describe the plant nutrition program, including the nutrients recommended in part (b)(i), to maximise production. (3 marks)

(iii) Outline how the soil test results from the table on page 22 might influence your future management of the paddock. (2 marks)

**See next page**

**Question 27** (continued)

(c) Assume you have purchased the farm. In the following year, you decide to apply lime to adjust the soil pH. There are two products available. Complete the budget below and state the **most** cost-effective product. (7 marks)

| | **Crushed lime** | **Crushed lime costs/ha** | **Calcium pellet** | **Calcium pellet costs/ha** |
|---|---|---|---|---|
| Price/tonne | $20 | | $600 | |
| Product rate/ha | 4 tonne/ha | $80 | 250 kg/ha | $150 |
| Cartage cost/ha | $8/tonne | A | $8/tonne | D |
| Spreading cost/ha | $12/tonne | B | $12/tonne | E |
| Total cost/ha | | C | | F |

A = _____

B = _____

C = _____

D = _____

E = _____

F = _____

**Most** cost-effective product: _____

(d) Outline how fertilisers should be applied to mitigate environmental impacts. (2 marks)

_____

_____

_____

_____

**Question 28** **(20 marks)**

Climate change requires farmers to be aware of the risk to their production systems.

(a) Describe the known impacts of climate change on plant production systems in Western Australia. (8 marks)

(b) For **one** of the impacts described in part (a), assess the risk of crop failure using the matrix below by applying it to a plant production system you are familiar with and propose how to manage that risk. (12 marks)

| **Probability** | **Consequences** | | | | |
|---|---|---|---|---|---|
| | **Insignificant** | **Minor** | **Moderate** | **Major** | **Severe** |
| Almost certain | M | H | H | E | E |
| Likely | M | M | H | H | E |
| Possible | L | M | M | H | E |
| Unlikely | L | M | M | M | H |
| Rare | L | L | M | M | H |

L - Low risk M - Medium risk H - High risk E - Extreme risk

**or**

**Question 29** **(20 marks)**

Australia has a comparative advantage in many plant products.

(a) State an example of a plant production system and its major export market. Discuss the reasons Australia has a comparative advantage in that plant production system. (10 marks)

(b) Explain **three** strategies Australian plant producers can use to satisfy the short-term need for production against the long-term improvement of resources, and still remain sustainable. (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: _____

Supplementary page

Question number: _____

Spare grid

## ACKNOWLEDGEMENTS


**Questions 7–8** Graph adapted from: Kramer, P. J. (1983). *Water relations of plants.* Academic Press. Retrieved June, 2021, from http://soilquality.org.au/factsheets/water-availability

**Questions 15–16** Adapted from: Hajek, A. E. (2018). *Natural enemies: An introduction to biological control* (2nd ed., p. 24, fig. 2.1). Retrieved June, 2021, from https://static.cambridge.org/binary/version/id/urn:cambridge.org:id:binary:20180626105533896-0368:9781107280267:17147fig2_1.png?pub-status=live

**Question 24** Adapted from: Knutson, A., Emory, P., Boring, J. et al. (n.d.). *Figure 2. Predators and parasites in action* [Graph]. Retrieved June, 2021, from https://cdn-ext.agnet.tamu.edu/wp-content/uploads/2018/10/biological-insecticide-fig2.jpg

**Question 25** Adapted from: Grain Central. (2018). *Figure 1. Change in ryegrass resistance levels in Western Australia over the last 15 years* [Graph]. Retrieved June, 2021, from https://www.graincentral.com/wp-content/uploads/2018/03/180305-WA-herbicide-resistance-Figure-1.jpg





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