Western Australian Certificate of Education
ATAR course examination, 2016

Question/Answer booklet

PLANT PRODUCTION SYSTEMS

Please place your student identification label in this box

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

To be provided by the candidate

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 this 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

<table>
<thead>
<tr>
<th>Section</th>
<th>Number of questions available</th>
<th>Number of questions to be answered</th>
<th>Suggested working time (minutes)</th>
<th>Marks available</th>
<th>Percentage of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section One Multiple-choice</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Section Two Short answer</td>
<td>7</td>
<td>7</td>
<td>90</td>
<td>94</td>
<td>50</td>
</tr>
<tr>
<td>Section Three Extended answer</td>
<td>3</td>
<td>2</td>
<td>60</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

Total 100

Instructions to candidates

1. The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the *Year 12 Information Handbook 2016*. 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. 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. Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space 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. 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. Training farm staff in the safe operation of machinery is considered
   (a) good practice.
   (b) a duty of care.
   (c) an ethical requirement.
   (d) quality assurance.

2. Carbohydrates produced during photosynthesis are utilised by plants for
   (a) nutrient uptake.
   (b) nodulation.
   (c) transpiration.
   (d) respiration.

3. Which one of the following is a by-product of photosynthesis in a plant production system?
   (a) oxygen
   (b) sugar
   (c) water
   (d) carbon dioxide

4. Which one of the following factors would increase the rate of photosynthesis in a plant?
   (a) a high concentration of carbon dioxide
   (b) high water loss in the plant
   (c) very high temperatures
   (d) high wind conditions

5. Keeping records of pesticides that have been sprayed on crops is a requirement of
   (a) planning next year’s crop rotation.
   (b) financial management.
   (c) quality assurance.
   (d) intergenerational equity.
6. A number of management strategies are recommended for weed control because
   (a) a single control method will eradicate the weed.
   (b) weeds exist as populations of species.
   (c) this allows integration of strategic controls that are very effective.
   (d) grazing management of weeds is not always practical.

7. Synthetic auxins are used in plant production to improve
   (a) selective weed control.
   (b) water use efficiency.
   (c) fruit colour.
   (d) net photosynthesis.

8. A herbicide’s ‘mode of action’ is determined most easily by knowing the
   (a) group name.
   (b) active ingredient.
   (c) crop to which it is applied.
   (d) method of application.

9. A farmer finds weeds emerging following crop germination. Which type of herbicide
    should be used?
   (a) broad-spectrum herbicide
   (b) grass weed herbicide
   (c) broad-leaf herbicide
   (d) selective herbicide

10. Fertiliser applications on a crop need to match soil types, rainfall and
    (a) weed populations/burden.
    (b) expected yield.
    (c) types of pesticide used.
    (d) location of farm.

11. What does risk mitigation involve?
    (a) identifying potential risks
    (b) finding solutions to reduce risk
    (c) identifying consequences of risk
    (d) assessing risk probability

See next page
Questions 12, 13 and 14 relate to the table below.

### Water-holding capacity of soil (mm of water per metre of soil depth)

<table>
<thead>
<tr>
<th></th>
<th>Soil type X</th>
<th>Soil type Y</th>
<th>Soil type Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field capacity of the soil</td>
<td>140</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td>Permanent wilting point</td>
<td>80</td>
<td>150</td>
<td>250</td>
</tr>
</tbody>
</table>

12. The amount of water available (mm of water per metre of soil depth) for the soil types is

(a) $X = -60$, $Y = -200$, $Z = -150$
(b) $X = 60$, $Y = 200$, $Z = 150$
(c) $X = -220$, $Y = -500$, $Z = -650$
(d) $X = 220$, $Y = 500$, $Z = 650$

13. Select the **best** explanation as to why there are differences in water availabilities in each of the soil types. Each soil has a different

(a) fertility.
(b) pH.
(c) texture.
(d) microbial population.

14. Predict the soil types used in the table.

<table>
<thead>
<tr>
<th>Soil type X</th>
<th>Soil type Y</th>
<th>Soil type Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sand</td>
<td>clay</td>
<td>loam</td>
</tr>
<tr>
<td>(b) clay</td>
<td>loam</td>
<td>sand</td>
</tr>
<tr>
<td>(c) sand</td>
<td>loam</td>
<td>clay</td>
</tr>
<tr>
<td>(d) loam</td>
<td>clay</td>
<td>sand</td>
</tr>
</tbody>
</table>

15. Which statement indicates how energy from sunlight can flow between natural and agricultural ecosystems and assist in farm production?

(a) Energy from the sun can be absorbed and warms the soil, assisting microorganism activity.
(b) Energy from the sun is absorbed by annual grasses that die out quickly during dry seasons.
(c) Energy from the sun can warm the water in lakes and rivers and assist in the growth of algae.
(d) Energy from the sun is absorbed by pasture plants for photosynthesis and consumed by animals for feed.
16. Rehabilitating a waterlogged paddock with plants is an example of a
   (a) duty of care to reduce intergenerational equity.
   (b) short-term approach to reducing waterlogging.
   (c) long-term strategy toward sustainability by reducing waterlogging.
   (d) legal requirement to reduce the impact of climate change.

Questions 17, 18 and 19 relate to the table below.

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lupin crop</td>
<td>25</td>
<td>28</td>
<td>30</td>
<td>27</td>
<td>27.5</td>
<td>1.80</td>
</tr>
<tr>
<td>Oat crop</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>12</td>
<td>10.5</td>
<td>1.12</td>
</tr>
</tbody>
</table>

17. What does the standard deviation indicate for the lupin and oat enterprises?
   (a) the lupin crop data are clustered closer around the mean, indicating less variation
   (b) the oat crop data are clustered closer around the mean, indicating less variation
   (c) the lupin crop data are clustered closer around the mean, indicating more variation
   (d) the oat crop data are clustered closer around the mean, indicating more variation

18. How could plant producers use the above data to save on fertiliser expenditure?
   (a) sow a cereal crop followed by a lupin crop
   (b) sow a lupin crop followed by a cereal crop
   (c) sow a lupin crop followed by a lupin crop
   (d) sow a cereal crop followed by a cereal crop

19. In which one of the following cropping situations would a farmer consider applying extra
    nitrogen fertiliser?
   (a) A lower than average rainfall has occurred during the growing season.
   (b) The cropping paddock has a heavy soil type.
   (c) Continuous cereal cropping has occurred on a paddock.
   (d) A lupin crop has followed a cereal crop.

20. The purpose of randomisation in experimental design is to
   (a) control experimental variables.
   (b) test the effects of different variables.
   (c) act as a control.
   (d) reduce experimental bias.

End of Section One
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Barley growers in Western Australia conducted an investigation into the effect of nitrogen application rates on grain yield.

The investigation was done as a field trial and used two different varieties of barley. The results are outlined in the table below.

<table>
<thead>
<tr>
<th>Rate of nitrogen applied (kg/ha)</th>
<th>Barley</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variety X</td>
<td>Variety Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grain yield (t/ha)</td>
<td>Grain yield (t/ha)</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3.5</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>5.0</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>5.5</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>5.0</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

(a) Write an hypothesis for the investigation. (2 marks)

(b) Name the independent variable and the dependent variable for the investigation. (2 marks)

Independent variable: ____________________________________________________________

Dependent variable: _____________________________________________________________
(c) Graph the grain yield for the **two** varieties of barley at different rates of nitrogen applied. (5 marks)

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

(d) Outline the grain yield trend shown on the graph as the rate of nitrogen applied is increased. Also state which rate of nitrogen applied gives the highest yield for **each** variety. (3 marks)
Question 21 (continued)

(e) Explain how the barley growers conducting this investigation could use randomisation, replication and controls to produce more reliable results. (6 marks)

Randomisation: ________________________________
______________________________
______________________________

Replication: ________________________________
______________________________
______________________________

Controls: ________________________________
______________________________
______________________________
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A producer has extra land to grow produce and needs to decide what crop would be most cost-effective. The table below shows a budget for two possible cropping enterprises.

<table>
<thead>
<tr>
<th>Performance data</th>
<th>Wheat</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average yield (t/ha)</td>
<td>2.2</td>
<td>1.50</td>
</tr>
<tr>
<td>Average price ($/tonne)</td>
<td>200</td>
<td>520</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income ($/ha)</th>
<th>Wheat</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable costs ($/ha)</th>
<th>Wheat</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeding costs</td>
<td>46</td>
<td>34</td>
</tr>
<tr>
<td>Seed</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>38</td>
<td>141</td>
</tr>
<tr>
<td>Herbicide</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>Harvest costs</td>
<td>37</td>
<td>54</td>
</tr>
<tr>
<td>Levies</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Crop insurance</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Windrowing</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total variable cost ($/ha)</th>
<th>Wheat</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gross margin ($/ha)</th>
<th>Wheat</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td></td>
<td>F</td>
</tr>
</tbody>
</table>

(a) For each crop, calculate the income, total variable cost and gross margin. (6 marks)

Wheat:
- Income: A
- Total variable costs: B
- Gross margin: C

Canola:
- Income: D
- Total variable costs: E
- Gross margin: F
(b) List two factors in the budget that account for the differences in gross margins between enterprises. (2 marks)

One: 

Two: 

(c) By comparing wheat and canola yields, calculate what wheat yield the farmer would need to achieve to be comparable with the canola gross margin. Show all workings. (3 marks)

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________
Most Australian plant products are sold overseas into a very competitive market. A comparative advantage is important to plant producers.

(a) (i) Define the term ‘comparative advantage’. (2 marks)

(ii) Explain one example of how Australian producers have a comparative advantage compared to producers in other countries. (3 marks)

(b) Using one example, describe how Australian quarantine laws help plant producers maintain their global competitiveness. (4 marks)
(c) Countries that produce similar primary products to Australia often pay their farmers subsidies. Explain how the Australian Government can use tariffs to overcome the problems of competing with countries that pay their producers subsidies. (3 marks)

(d) Identify a change in consumer trends relevant to a plant enterprise you have studied. Explain one way in which you could modify your production system in response to the change in the consumer trends. (3 marks)
There are many environmental issues that farmers must manage if they are to continue operating profitably.

(a) Name an environmental issue that could affect a plant production enterprise and explain how each of the three parts of the triple bottom line could impact a farmer’s ability to deal with it. (6 marks)

Environmental issue: ________________________________ (0 marks)

Economic: _________________________________________

_________________________________________________

_________________________________________________

Social: ___________________________________________

_________________________________________________

_________________________________________________

Environmental: ___________________________________

_________________________________________________

_________________________________________________
(b) Using land clearing as an example, justify how you would balance short-term profitability with the long-term sustainability of a plant production enterprise. (3 marks)

(c) Define the term 'intergenerational equity'. Explain how intergenerational equity is affected by environmental problems. (4 marks)
Plant hormones have a role in plant physiology.

(a) Give the role of each of the plant hormones listed below. (4 marks)

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Role in plant physiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gibberellins</td>
<td></td>
</tr>
<tr>
<td>Ethylene</td>
<td></td>
</tr>
<tr>
<td>Cytokinins</td>
<td></td>
</tr>
<tr>
<td>Auxins</td>
<td></td>
</tr>
</tbody>
</table>

(b) Select two of the above plant hormones and describe how each can be used to manipulate plant production. (4 marks)

One: ______________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

Two: ______________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________
Question 26

Transpiration plays a vital role in maintaining a healthy plant.

(a) Explain the process of transpiration. Include two of the plant structures involved. (4 marks)

(b) Explain two environmental conditions that can affect transpiration. (4 marks)

One:

Two:

(c) Explain how the absorption and translocation of nutrients in the plant occurs. (4 marks)
Question 27  (17 marks)

(a) For a plant enterprise of your choice, outline how the following factors affect decision-making involved in fertiliser selection. (6 marks)

Plant enterprise: ____________________________________________________________ (0 marks)

Soil type:
________________________________________________________________________
________________________________________________________________________

Crop type:
________________________________________________________________________
________________________________________________________________________

Stage of growth:
________________________________________________________________________
________________________________________________________________________

Cost of fertiliser:
________________________________________________________________________
________________________________________________________________________

Availability of fertiliser:
________________________________________________________________________
________________________________________________________________________

Application method:
________________________________________________________________________
________________________________________________________________________
(b) For your chosen plant enterprise use the following table to outline a fertiliser program that you would recommended for three plant growth stages. Give a reason for each choice. (6 marks)

<table>
<thead>
<tr>
<th>Plant growth stage</th>
<th>Fertiliser</th>
<th>Reason for fertiliser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early growth stage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid growth stage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final stage of growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(c) (i) List two strategies you could use to monitor your enterprise to ensure plants are receiving the correct amount of fertiliser. (2 marks)

One: ____________________________________________________________

Two: ____________________________________________________________

(ii) Describe the impact of excess fertiliser on the environment and identify a strategy to lessen the impact. (3 marks)

________________________________________________________________

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________________________________________________________________

________________________________________________________________

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End of Section Two
See next page
Question 28 (20 marks)

This compulsory question must refer to one plant enterprise and marketable product you studied during the year.

Plant enterprise: __________________________________________________________ (0 marks)

(a)  (i) Marketable product: ____________________________________________ (1 mark)

(ii) Outline how the following factors affect quality and quantity of your selected marketable product. (8 marks)

Plant variety

• quality: ______________________________________________________________

________________________________________________________________________

________________________________________________________________________

• quantity: ______________________________________________________________

________________________________________________________________________

________________________________________________________________________

Weather conditions

• quality: ______________________________________________________________

________________________________________________________________________

________________________________________________________________________

• quantity: ______________________________________________________________

________________________________________________________________________

________________________________________________________________________

See next page
Nutrition

- quality: 
  - 
  - 
  - 

- quantity: 
  - 
  - 
  - 

Handling and transport

- quality: 
  - 
  - 
  - 

- quantity: 
  - 
  - 
  - 

(b)  (i) Name a quality assurance program relevant to your production enterprise.  
(1 mark)

(ii) Outline how this program assists in meeting market expectation.  
(2 marks)
Question 28 (continued)

(c) (i) Outline a new technology relevant to your enterprise to make your plant production system more efficient. (2 marks)

(ii) Evaluate the risk of using this new technology to improve production by completing the risk assessment table below. (6 marks)

<table>
<thead>
<tr>
<th>Describe a risk related to the introduction of this new technology.</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If the farmer continues to use the new technology what could be the long-term effects?</th>
<th>Long-term effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What strategy could the farmer use to decrease the risk effect?</th>
<th>Management strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

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Question 29  
(20 marks)

Conservation of biodiversity and natural ecosystems is considered important to the management of plant production systems.

(a) Describe the structure of a natural ecosystem and use examples to explain why it is important for plant producers to protect natural ecosystems to maintain productivity. (11 marks)

(b) Describe three impacts climate change has on the natural ecosystem and explain how plant producers could reduce each impact. (9 marks)

or

Question 30  
(20 marks)

Plant producers are looking at ways to enhance production, while consumers of plant products are becoming increasingly selective about their food purchases.

(a) Explain how plants can be improved through the use of seed banks and genetically modified organisms (GMOs). Use examples for each in your answer. (12 marks)

(b) Discuss why consumers have become more selective on the grounds of ethical concerns about GMOs used in plant breeding. Use examples in your answer. (8 marks)

End of questions
Question number: ____________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________

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________________________________________________________________________
ACKNOWLEDGEMENTS