



PLANT PRODUCTION SYSTEMS

ATAR course examination 2019

Marking key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

Section One: Multiple-choice

20% (20 Marks)

Question	Answer
1	b
2	d
3	c
4	a
5	b
6	d
7	c
8	a
9	b
10	a
11	b
12	c
13	b
14	a
15	d
16	c
17	d
18	d
19	c
20	a

Section Two: Short answer

50% (106 Marks)

Question 21

(18 marks)

- (a) Use the grid below to draw a line graph of the average number of aphids per hectare observed over time. (5 marks)

Description	Marks
Relevant graph title	1
Y axis has average number of aphids observed, axis is clearly labelled	1
X axis has days, axis is clearly labelled	1
Average number of aphids is plotted accurately on a line graph	1
Plotted line starts at 0 on the X axis and 10 on the Y axis	1
Total	5

Answer could include:



Question 21 (continued)

- (b) (i) Define economic injury level (EIL). (2 marks)

Description	Marks
Detailed relevant definition that implies costs of control measures are measured against pest damage	2
Basic relevant definition about cost of control measures or pest damage	1
Total	2
Answers could include:	
<ul style="list-style-type: none"> the population of a pest where the costs of control measures are equal to or less than the cost of the damage caused by the pest. 	
Accept other relevant answers.	

- (ii) Using the following parameters, calculate the EIL for aphids in wheat.
- damage caused by each 10 000 aphids/ha reduces the average wheat yield by 1%
 - wheat is valued at \$300/tonne
 - average wheat yield is 2 tonne/ha
 - cost of aphid treatment is \$54/ha.

Show your workings. (2 marks)

Description	Marks
Correctly calculates the EIL for aphids in wheat and shows workings	2
Calculates the EIL for aphids in wheat but does not show workings	1
Total	2
Sample answer: $\$300/\text{tonne} \times 2 \text{ tonne/ha} = \$600 \times 1\% = \$6 \text{ loss}/10\ 000 \text{ aphids.}$ At 90 000 aphids the loss is \$54/hectare, spraying costs \$54/hectare	

- (iii) Place an
- X**
- on the graph on page 9 to indicate the calculated EIL. (1 mark)

Description	Marks
X is placed on the population line at the population of 90 000 aphids or below	1
Total	1
Markers note: Follow through marks to be awarded if the EIL is calculated incorrectly in part (ii) but plotted correctly on the graph.	

- (iv) State what would happen to the EIL if the cost of controlling the aphids increased by \$15/ha. (1 mark)

Description	Marks
The EIL will increase	1
Total	1

- (c) Complete the gross margins above for wheat and chia. (2 marks)

Description	Marks
A = \$80/ha (also accept 80)	1
B = \$90/ha (also accept 90)	1
Total	2

- (d) Outline **one** risk to the farmer's long-term economic sustainability if the advice to grow the alternative crop is followed. (2 marks)

Description	Marks
Outlines that the farmer's long-term economic sustainability is under threat due to the low 10 year average price of Chia	2
States the risk to long-term economic sustainability due to lower income	1
Total	2
Answers could also include: <ul style="list-style-type: none"> • risk of fertiliser prices increasing • preference to use less pest control and receive less income from crop • chia has not established a long-term market and is not a staple food • price fluctuations may be greater for one crop than the other. Accept other relevant answers.	

- (e) Describe **one** new technology that could reduce the cost of crop production. (3 marks)

Description	Marks
Describes how a relevant technology is applied to crop production and which costs can be reduced	3
Outlines how the relevant new technology can reduce costs	2
Identifies a relevant new technology that reduces costs	1
Total	3
Answers could include: <ul style="list-style-type: none"> • weed seeker technology – infrared camera recognises weeds and a chemical is directed to only that weed, reducing chemical costs and resistance • variable rate technology – global positioning system directs fertiliser application according to yield mapping, reducing the cost of fertiliser application • soil moisture sensors – monitors soil moisture availability, indicating when irrigation is required, reducing water and pumping costs. Accept other relevant answers.	

Question 22

(14 marks)

- (a) Outline **two** sources of genetic diversity that could assist in the breeding of new cultivars. (4 marks)

Description	Marks
For each of two sources of genetic diversity	
States a source of genetic diversity and outlines how it would assist in the breeding of a new cultivar	2
Identifies a source of genetic diversity	1
Subtotal	2
Total	4
Answers could include: <ul style="list-style-type: none"> • wild populations – seeds that have been bred by natural selection, providing traits such as disease resistance and drought tolerance to new cultivars • seed bank – preserves genetic material from rarely used cultivars that might be used in a breeding program to increase yield, disease resistance, drought tolerance • cross pollination – higher diversity of gene recombination between plants that could produce different traits • interspecific breeding – crossing two different species with desired traits to produce a unique species. An example is Triticale • genetic engineering – provides a new source of genes not present in plants by introducing genes from non-plant species. An example is Round-Up Ready Canola. 	
Accept other relevant answers.	

- (b) (i) List **one** example of a plant species or cultivar recently adopted in Western Australia and state how it could meet changing consumer trends. (2 marks)

Description	Marks
Lists a relevant plant species or cultivar	1
States how the plant species or cultivar could meet changing consumer trends	1
Total	2
Answers could include: <ul style="list-style-type: none"> • Bravo apple – healthier apple with more antioxidants for consumers that are more health conscious • quinoa – lower risk of cardiovascular disease for consumers with heart-related issues • Ninja A noodle wheat – making udon noodles. 	
Accept other relevant answers.	

- (ii) State **four** steps used to develop a cultivar by crossbreeding. (4 marks)

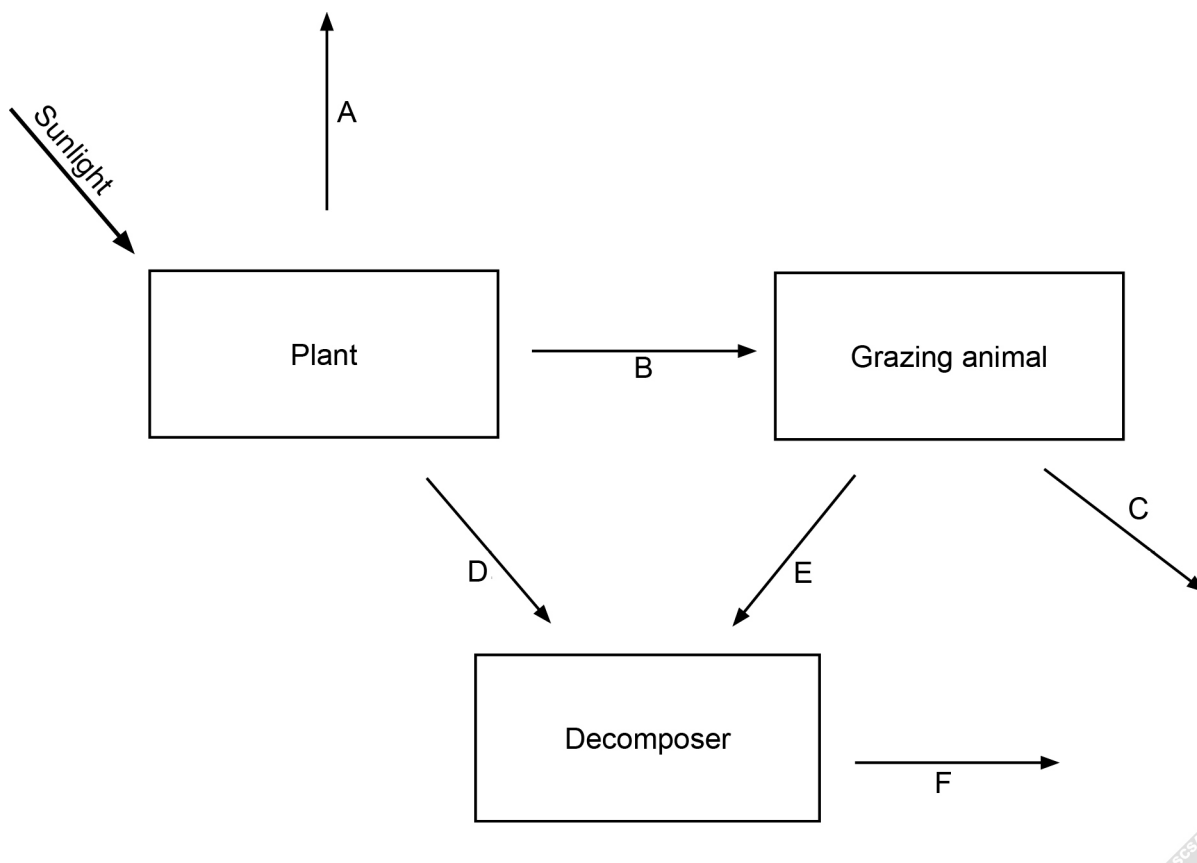
Description	Marks
1. Select the existing cultivars/lines that have the desired characteristics for the new cultivar	1
2. Crossbreed the cultivars to get a combination of the desired characteristics	1
3. Select the offspring of the crosses that have the desired characteristics	1
4. Evaluate the selected offspring for general performance under paddock conditions	1
Total	4
Accept other relevant answers.	

- (c) Outline **two** ethical issues related to genetically modified organism (GMO) food crops. (4 marks)

Description	Marks
For each of two ethical issues related to GMO food crops	
Outlines a relevant ethical issue related to a food crop	2
States a relevant ethical issue related to a food crop	1
Subtotal	2
Total	4
<p>Answers could include:</p> <ul style="list-style-type: none"> • some people may think it is unacceptable for humans to put genes from one species into another • some people may think it is unacceptable to risk contaminating the crop of your organic neighbour, which may cause them to lose their certification. <p>Other answers may be based on the ethical issues around risks such as:</p> <ul style="list-style-type: none"> • allergies – transference of genes that are from an allergenic plant to one that does not cause allergies • diseases – some DNA is taken from bacteria which may create a new disease when humans consume the plant • environment – containing genetically modified crops in a specific area so that they cannot establish in the environment can be difficult and they may spread and contaminate a neighbour's crops • cross pollination – genes from genetically modified plants crossing with other plants to breed a plant that has traits that are undesirable • food web – reduces the need for natural predators, thus reducing the biodiversity of food webs. <p>Accept other relevant answers.</p>	

Question 23

(15 marks)



(a) Outline **two** of the energy flows (including whether they are gains or losses) for the agricultural ecosystem shown in the diagram above. (4 marks)

Description	Marks
Any two of the following	
A. Plant to atmosphere – energy lost through plant respiration	1–2
B. Plant to grazing animal – energy gained by grazing animal from plants	
C. Grazing animal to environment – energy lost by grazing animals through movement and body maintenance (e.g. faeces/urine, heat)	
D. Plant to decomposers – energy gained by decomposers from plant waste	
E. Grazing animal to decomposers – energy gained by decomposers from animal waste	
F. Decomposer to environment – energy lost through decomposer respiration	
Subtotal	2
Total	4
Marker's note: Products exported off-farm also represent losses to the ecosystem.	
Accept other relevant answers.	

- (b) Identify **one** negative impact of climate change on a plant production system and describe how it could affect the flow of energy through that system. (4 marks)

Description	Marks
Identifies a relevant negative impact of climate change	1
Describes how a relevant negative impact could affect a plant production system	3
Outlines how a relevant negative impact could affect a plant production system	2
States how a relevant negative impact could affect a plant production system	1
Total	4
Answers could include: <ul style="list-style-type: none"> • temperature – rising, increasing evaporation and transpiration, reducing growing season length, some plant species will die out, producing less plant material for grazing animals, affecting growth rates/stocking rates, higher heat stress levels for some breeds, less organic matter for decomposers • rainfall – lower, greater variability impacting length of growing seasons, lower plant production, less livestock feed, lower growth rates, lower stocking rates, less organic matter for decomposers • extreme events – flood/fire, disrupts normal plant growth patterns, reduces feed availability, increased erosion events, removal of nutrients, reduced decomposer activity, less nutrients returned to the system. 	
Accept other relevant answers.	

- (c) Outline **one** practical application you could implement in a plant production system to minimise the impact identified in part (b). (2 marks)

Description	Marks
Outlines one relevant strategy to minimise loss of energy in a plant production system	2
States one relevant strategy to minimise loss of energy in a plant production system	1
Total	2
Answers could include: <ul style="list-style-type: none"> • temperature – reducing evaporation rates by mulching, retaining trash cover on the soil, selecting cultivars that have lower transpiration rates • rainfall – select cultivars with greater drought tolerance, lower water use, higher palatability to livestock. 	
Accept other relevant answers.	

Question 23 (continued)

- (d) (i) Outline **one** impact of reduced biodiversity in a plant production system. (2 marks)

Description	Marks
Outlines one relevant impact of reduced biodiversity in a plant production system	2
States one relevant impact of reduced biodiversity in a plant production system	1
Total	2
Answers could include: <ul style="list-style-type: none"> • loss of species due to habitat loss reduces the system's capacity to maintain a healthy environment for all living things • reduced breakdown of organic matter into nutrients, recycling nutrients to sustain biodiversity • removal of perennial trees (clearing) for grazing/cropping, that keep the water and salt at a level where it does not impact on water quality and soil conditions. 	
Accept other relevant answers.	

- (ii) Describe **one** effective strategy for conserving biodiversity in a plant production system. (3 marks)

Description	Marks
Describes one relevant effective strategy for conserving biodiversity in a plant production system	3
Outlines one relevant effective strategy for conserving biodiversity in a plant production system	2
States one relevant effective strategy for conserving biodiversity in a plant production system	1
Total	3
Answers could include: <ul style="list-style-type: none"> • reduce the use of chemical fertilisers and pesticides, using integrated pest management methods to promote less destructive procedures, making better use of natural predators and companion planting to control pests and diseases • grow a variety of crop/pasture species that have a variety of genetic variation • fencing off natural bush area from livestock to reduce preferential grazing of native plants, destruction of natural habitats for small ground living native birds and animals, reduce compaction of the top soil and animal waste getting into natural waterways causing eutrophication. 	
Accept other relevant answers.	

Question 24

(14 marks)

- (a) State what happens to water during transpiration. (1 mark)

Description	Marks
Water is drawn up from the roots and/or evaporates from the leaves	1
Total	1
Answers could also include: <ul style="list-style-type: none"> plant draws water up through the roots, allowing most of it to evaporate through the leaf stomata. While the stomata are open CO₂ enters the leaf for photosynthesis. 	

- (b) (i) Outline what would happen to the rate of transpiration if the temperature increased. (2 marks)

Description	Marks
The rate of transpiration would increase due to water being evaporated from the leaves at a faster rate	2
States there would be more transpiration	1
Total	2

- (ii) Write an hypothesis that would test part (b)(i). (1 mark)

Description	Marks
If the temperature increases, there will be an increase in the rate of transpiration	1
Total	1
Accept other relevant answers.	

- (c) Propose how you would test the hypothesis in part (b)(ii), taking into consideration the four aspects of experimental design. (8 marks)

Description	Marks
For each of the four aspects of experimental design	
Outlines an aspect of experimental design	2
States an aspect of experimental design	1
Subtotal	2
Total	8
Answers could include: <ul style="list-style-type: none"> randomisation – where all parts of the experiment have an equal chance of being involved. Each replication was placed in different positions within the controlled area to make sure that there was no undue influence from external factors such as being near the door replication – repeating the experiment a number of times. The experiment is repeated several times to validate the data or includes replicates of treatments standardisation – all the conditions under which the experiment took place are similar. The experiment is set up in a climate and light controlled room where the only variable is the air temperature control – inclusion of a control plant or treatment. This plant did not receive any treatment and was able to transpire under normal conditions. 	

Question 24 (continued)

- (d) Outline what the standard deviation reveals about the data in the table above.
(2 marks)

Description	Marks
Outlines that the standard deviation is high which indicates that the data have a large range of values and are spread out from the mean	2
States the standard deviation is high	1
Total	2

Question 25

(16 marks)

- (a) (i) State the **two** net products of photosynthesis. (2 marks)

Description	Marks
Glucose	1
Oxygen	1
Total	2
Accept other relevant answers.	

- (ii) List **two** limiting environmental factors that affect the rate of photosynthesis. (2 marks)

Description	Marks
Any two of the following	
<ul style="list-style-type: none"> • light intensity • carbon dioxide concentration • water • nutrient availability • temperature. 	1–2
Total	2
Accept other relevant answers.	

- (iii) Describe **one** effect that climate change will have on the rate of photosynthesis. (3 marks)

Description	Marks
Describes a relevant fact about the effect of climate change on the rate of photosynthesis	3
Outlines a relevant fact about the effect of climate change on the rate of photosynthesis	2
States a relevant fact about the effect of climate change on the rate of photosynthesis	1
Total	3
Answers could include: <ul style="list-style-type: none"> • higher temperatures due to increases in average temperatures – increased transpiration rates which increases photosynthesis provided there is enough water in the plant root zone • higher levels of CO₂ in the atmosphere due to an increase in greenhouse gases – more CO₂ entering stomata and increasing levels of photosynthesis • lower soil water levels due to drier winters and lower average rainfall – decreased transpiration, less CO₂ entering stomata and decreasing photosynthesis. 	
Accept other relevant answers.	

Question 25 (continued)

- (b) (i) Outline **one** mechanism that plants use to absorb nutrients from the soil. (2 marks)

Description	Marks
Outlines a relevant mechanism	2
States a relevant mechanism	1
Total	2
Answers could include:	
<ul style="list-style-type: none"> osmosis – different concentrations of nutrients between the soil and the plant root in a water solution. The solution moves from an area of low concentration, the soil, to an area of high concentration, the plant's vascular system. 	
Accept other relevant answers.	

- (ii) Describe the purpose of translocation in a plant. (3 marks)

Description	Marks
Describes a relevant purpose of translocation	3
Outlines a relevant purpose of translocation	2
States a relevant purpose of translocation	1
Total	3
Answers could include:	
<ul style="list-style-type: none"> translocation is the movement of dissolved materials (carbohydrates and minerals) from the leaf tissue to parts of the plant that cannot photosynthesise through the phloem vascular bundles. 	
Accept other relevant answers.	

- (iii) Identify a plant hormone that inhibits growth and speeds up the ripening process. (1 mark)

Description	Marks
Ethylene	1
Total	1

- (iv) Describe a practical application for the plant hormone identified in part (b)(iii). (3 marks)

Description	Marks
Describes a relevant practical application of ethylene	3
Outlines a relevant practical application of ethylene	2
States a relevant practical application of ethylene	1
Total	3
Answers could include:	
<ul style="list-style-type: none"> hasten fruit ripening – applying ethylene gas to pre-ripe harvested fruit to bring all fruit to same point of ripeness. An example is citrus fruit fruit thinning – encourage fruit drop in a thinning process so that remaining fruit has enough room and resources to ripen and grow large. An example is cherry trees inhibit terminal bud growth so that their flowering stems are more compact to promote the formation of female flowers in plants like cucumbers, to avoid self-pollination and increase yields. 	
Marker's note:	
Follow through marks to be awarded if the answer to part (iii) is incorrect but a practical application of the hormone is given in part (iv).	
Accept other relevant answers.	

Question 26

(17 marks)

- (a) (i) Outline **one** critical factor that will have to be addressed in this paddock before a crop can be grown next year. (2 marks)

Description	Marks
Outlines the excessive amount of potassium that has been removed in the hay crop means that the fertiliser plan would need to incorporate a potash application on that area	2
States that a fertiliser with potassium in it will need to be added	1
Total	2

- (ii) Which of the fertilisers shown above will provide the required nitrogen at the lowest cost? (1 mark)

Description	Marks
Betafert	1
Total	1

- (iii) State the stage in the crop's growth at which the application of nitrogen fertiliser would have the greatest effect on the potential yield. (1 mark)

Description	Marks
Tillering to early stem elongation or flag leaf emergence	1
Total	1

- (iv) Other than fertiliser cost, outline **one** factor the producer should consider when selecting their fertiliser. (2 marks)

Description	Marks
Outlines one factor the producer should consider when selecting their fertiliser	2
States a factor the producer should consider when selecting their fertiliser	1
Total	2
Answers could include: <ul style="list-style-type: none"> • spreading costs • effective uptake by the crop (i.e. reduced leaching) • type of crop being grown • application method • other nutritional requirements of crop • cartage costs. Accept other relevant answers.	

- (v) Outline how the producer can determine which rate of fertiliser will maximise crop yields. (2 marks)

Description	Marks
Outlines the process of soil/tissue testing to determine the required nutrients to maximise yields	2
States a relevant fact about soil testing or tissue testing	1
Total	2

Question 26 (continued)

- (b) Describe **two** strategies that can be implemented to reduce the negative impact of fertiliser on the environment. (6 marks)

Description	Marks
For each of two strategies	
Describes a relevant strategy that can be implemented to reduce the negative impact of fertiliser on the environment	3
Outlines a relevant strategy that can be implemented to reduce the negative impact of fertiliser on the environment	2
States a relevant strategy that can be implemented to reduce the negative impact of fertiliser on the environment	1
Subtotal	3
Total	6
Answers could include: <ul style="list-style-type: none"> • applying fertiliser that a growing plant can uptake readily. Soil pH can affect the uptake of some nutrients • timing of application – avoid applications to bare soil, before rainfall events and when plant growth is not at the right stage to utilise the nutrients • avoid spreading fertiliser near natural waterways and use a buffer zone to reduce the amount of fertiliser that enters waterways • use a liquid fertiliser that is more readily taken up by plants • frequency of application – spread little and often to match the growth rate of the plant • use a slow release fertiliser that does not readily leach. Accept other relevant answers.	

- (c) Heavy rainfall has been forecast pre-seeding. Describe **one** strategy that will enable soil water to be managed so that the potential yield of a crop is maximised. (3 marks)

Description	Marks
Describes a relevant strategy for managing soil water to maximise potential crop yield	3
Outlines a relevant strategy for managing soil water to maximise potential crop yield	2
States a relevant strategy for managing soil water to maximise potential crop yield	1
Total	3
Answers could include: <ul style="list-style-type: none"> • use no-till method of seeding to minimise soil disturbance, less soil structure damage enables greater capacity to drain • ensure adequate surface drainage • deep rip compacted soil so that water can drain through the soil profile • dry seed before rainfall to avoid a delay to seeding and loss of yield potential • seed into raised beds to enable root zones of crops to grow in less waterlogged conditions • add organic matter to create more air spaces and better drainage in dense soils. Accept other relevant answers.	

Question 27

(12 marks)

- (a) Clarify the relationship between mode of action and pest control. (2 marks)

Description	Marks
Clarifies the relationship between mode of action and pest control	2
States a relevant fact about mode of action and pest control	1
Total	2
Answers could include: <ul style="list-style-type: none"> the mode of action of a pesticide is how that pesticide targets specific sites within an organism while not having a significant detrimental effect on the host plant or non-target organisms. Accept other relevant answers.	

- (b) Describe **two** on-farm factors that could lead to pesticide resistance. (6 marks)

Description	Marks
For each of two on-farm factors	
Describes a relevant on-farm factor that could lead to pesticide resistance	3
Outlines a relevant on-farm factor that could lead to pesticide resistance	2
States a relevant on-farm factor that could lead to pesticide resistance	1
Subtotal	3
Total	6
Answers could include: <ul style="list-style-type: none"> continuous use of a pesticide group with the same mode of action poor equipment calibration, incorrect mixing or choosing weather conditions that result in uneven application (e.g. windy, wet) or under dosing target pests growing the same crop species year in, year out poor biosecurity, allowing pests to establish that may have developed a resistance to pesticides. Accept other relevant answers.	

Question 27 (continued)

- (c) (i) Identify a strategy in a plant production system that reduces the reliance on pesticides. (1 mark)

Description	Marks
Identifies a relevant strategy	1
Total	1
Answers could include: <ul style="list-style-type: none"> • natural predators (e.g. biological control) • integrated pest management • cultivation of soil to disrupt pest life cycle • removing host plants of pests • burning crop residue to destroy infected material • solarise soil before sowing to kill soil borne pests and diseases • grow resistant cultivars. Accept other relevant answers.	

- (ii) Describe how the strategy in part (c)(i) could affect the productivity of a plant production system. (3 marks)

Description	Marks
Describes how a relevant strategy has affected the productivity of the plant production system	3
Outlines how this strategy has affected the productivity of the plant production system	2
States a relevant fact about how this strategy affected the productivity of the plant production system	1
Total	3
Answers could include: <ul style="list-style-type: none"> • natural predators – less use of pesticides, however, takes time for predator population to build up to counter the pest, loss of production inevitable during this time • cultivation of soil to disrupt pest life cycle – has other benefits such as aerating the soil, however, soil structure is broken down and could lead to problems of erosion • removing host plants of pests – without a host plant, pests will decline in numbers (i.e. increasing yield) or pests may move into the crop causing greater damage (i.e. reducing yield) • burning crop residue to destroy infected material – destroys most eggs/seeds/spores in the dry residue but exposes the soil to erosion and releases nitrogen back into the atmosphere, reducing soil fertility • solarise soil before sowing to kill soil borne pests and diseases – while sterilising the soil it also has a major impact on beneficial microbes and small insects, potentially reducing the breakdown of organic matter into the soil, resulting in yield loss due to nutrient limitation • grow resistant cultivars – as plant breeding programs are able to isolate the traits for resistance, the damage will be minimised but the cost of replacing the cultivars will affect profitability. Accept other relevant answers.	

Section Three: Extended answer

30% (40 Marks)

Question 28

(20 marks)

- (a) For a plant production system you are familiar with, name the main product, its main market destination and Australia's main competitor. (3 marks)

Description		Marks
Names relevant main product		1
Names main market destination for the product stated		1
Names the main competitor to Australia for the product stated		1
Total		3
Answers could include:		
Product	Main market	Main competitor
wheat	Indonesia	Canada
sugar	South Korea	Brazil
vegetables	Singapore	China
wine	European Union	New Zealand
chickpeas	India	Russia
Accept other relevant answers.		

- (b) (i) Describe a quality assurance (QA) program related to the product. (3 marks)

Description		Marks
Describes a quality assurance program related to the product		3
Outlines a quality assurance program related to the product		2
Lists a quality assurance program related to the product		1
Total		3
Answers could include:		
<ul style="list-style-type: none"> wheat – Graincare: based on HACCP principles, applied to the production process, identifying hazards, implementing control measures and recording details of the hazard and its treatment vegetables – Freshcare: provides a practical industry focused, science based, food safety and quality management program covering the on-farm production of fresh produce. 		
Accept other relevant answers.		

Question 28(b) (continued)

- (ii) Identify **two** on-farm criteria used in the QA program and outline how they enable the producer to maintain product quality. (6 marks)

Description	Marks
For each of two criteria	
Identifies a relevant on-farm criteria used in a quality assurance program to maintain product quality	1
Outlines how the criteria enables producers to maintain a quality product	2
States how the criteria enables producers to maintain a quality product	1
Subtotal	3
Total	6
<p>Answers could include:</p> <p>Graincare criteria:</p> <ul style="list-style-type: none"> • paddock selection and preparation; production records kept for each paddock enable the producer to check the history of the paddock, looking for particular weeds and diseases that could impact on the current crop. Any previous issues can be planned into the paddock preparation rather than reacting once they become a problem and affect product quality • obtaining and storing chemicals correctly reduces on-farm contamination and ensures food security • paddock, crop and grain treatment involves recording which products have been used on which crops at which rates, and the associated withholding periods • on-farm storage (i.e. insect free, appropriate environmental conditions) and correct handling helps to avoid contamination and ensure that varieties are kept separated. <p>Freshcare criteria:</p> <ul style="list-style-type: none"> • management; documentation, internal audits and customer specifications helps to ensure food safety and quality by implementing quality assurance procedures • food safety and quality; hazard analysis, growing site, planting materials, chemicals, fertilisers/additives, water, equipment, product ID and traceability. <p>Accept other relevant answers.</p>	

- (c) Name **two** variations in product quality caused by adverse weather conditions and explain a strategy to mitigate each of them. (8 marks)

Description	Marks
For each of two variations	
Names a relevant variation in product quality caused by adverse weather conditions and explains a strategy to mitigate the variation	4
Names a relevant variation in product quality caused by adverse weather conditions and describes a strategy to mitigate the variation	3
Names a relevant variation in product quality caused by adverse weather conditions and outlines a strategy to mitigate the variation	2
Names a relevant variation in product quality caused by adverse weather conditions	1
Subtotal	4
Total	8
<p>Answers could include:</p> <ul style="list-style-type: none"> frost damage at flowering causing loss of the plant flowers and may affect grain size and quality (as well as lowering yields). Planting cultivars that flower outside of historical frost periods to avoid effect on grain size waterlogging during heavy rainfall stresses plants, reduces growth or may lead to splitting of fruit. Using raised beds in known waterlogged areas, reducing water on the surface by using drainage systems and maintaining a well-drained soil by incorporating organic matter wind damage to ripening fruit from bruising and lowering quality. Planting or erecting windbreaks across the path of prevailing winds, planning row directions to reduce buffeting during ripening period low grain protein due to poor nitrogen uptake or pinched grain at harvest caused by poor finishing rains. Select short season cultivars that do not require large amounts of rainfall, use water conservation techniques such as water harvesting furrows, stubble mulching and reduce water repellence with soil conditioners. 	
Accept other relevant answers.	

Question 29

(20 marks)

- (a) Describe the factors that affect the ability of the Australian agricultural plant industry to maintain both its competitiveness and access to global markets. Explain the effective strategies used to address **one** of these factors. (10 marks)

Description	Marks
Describes factors that affect competitiveness	3
Outlines factors that affect competitiveness	2
Identifies a factor that affect competitiveness	1
Subtotal	3
Describes factors that affect access to global markets	3
Outlines factors that affect access to global markets	2
Identifies a factor that affect access to global markets	1
Subtotal	3
Explains effective strategies to address one identified factor	4
Describes effective strategies to address one identified factor	3
Outlines effective strategies to address one identified factor	2
Identifies an effective strategy to address one identified factor	1
Subtotal	4
Total	10
<p>Answers could include:</p> <p>Factors that affect competitiveness:</p> <ul style="list-style-type: none"> • cost price squeeze – fluctuating/reducing returns versus increasing input costs (e.g. comparatively high labour costs, increasing fertiliser and chemical cost) • regulated industry – restrictions on use of chemicals, strict enforcement of labour, environmental and occupational health and safety laws • ability to maintain a clean and green image (i.e. biosecurity laws) whilst remaining competitive • relative infertile soils resulting in reliance on fertilisers • reduction in government spending on research and development • competition from other countries • the parity of the Australian dollar with other major currencies. An increasing Australian dollar reduces the competitiveness of agricultural exports. <p>Factors that affect access to global markets:</p> <ul style="list-style-type: none"> • impact of trade restrictions – trade wars (e.g. movement towards protectionism policies versus free trade agreements) • international trade agreements that restrict access to markets from countries outside that agreement • global insecurity – threat of terrorism, conflicts between trade nations • threats that impact on food security – potential outbreak of pest and/or diseases • global economy – decline in economic growth and volatility (e.g. prolonged periods of instability and poor growth). <p>Effective strategies could be based on:</p> <ul style="list-style-type: none"> • improve the competitiveness of inputs within the supply chain – upskilling (i.e. training and educating labour), investing in infrastructure that assists development and efficiency, channelling investment into research/development • reduce ineffective regulations – review regulations that impact on efficiency and effectiveness of agricultural production • enhance agricultural exports – negotiate free trade agreements, improve the flow of market information, promote clean and green image (food security) • adopt new technologies that have the capacity to significantly increase productivity whilst maintaining or reducing production costs. 	
Accept other relevant answers.	

- (b) Identify a disease/pest that would affect the sustainability of Australia's plant production systems and describe the consequences of an outbreak. Consider **two** management strategies that would need to be put in place, **one** on-farm and **one** at a national level, to combat an outbreak of the stated disease/pest. (10 marks)

Description	Marks
Identifies a relevant disease/pest, describes how it would affect the sustainability of Australia's plant production systems and the consequences of an outbreak	4
Identifies a relevant disease/pest, outlines how it would affect the sustainability of Australia's plant production systems and the consequences of an outbreak	3
Identifies a relevant disease/pest and outlines how it would affect the sustainability of Australia's plant production systems	2
Identifies a relevant disease/pest	1
Subtotal	4
For each of two levels of action	
Considers a relevant management strategy	3
Outlines a relevant management strategy	2
States a relevant management strategy	1
Subtotal	6
Total	10
<p>Answers could include:</p> <p>Pest/disease – Khapra Beetle (as an example): This beetle is a destructive pest of stored grain, originating in India. If it became established in Australia it would restrict who we could export grain to as many countries have strict quarantine restrictions on infested produce. The beetle can also be transported in any dry goods. Treatment is restricted to a few chemicals but the larvae have developed a low metabolic rate which helps it resist contact insecticides. Consequences include:</p> <ul style="list-style-type: none"> • an outbreak of an exotic plant pest or disease will have a serious impact on the \$28 billion broadacre and horticultural crop industries • an outbreak of an exotic plant pest/disease has serious consequences for the ongoing sustainability of both the natural environment and agricultural production systems • serious impact on economic sustainability of all sectors of industry – threatens export markets and restricts ability of individual property owners to operate whilst under quarantine. <p>On-farm management of this pest would include regular inspection of stored grain, maintaining clean grain handling equipment and being able to identify and isolate any outbreaks. Relevant strategies are:</p> <ul style="list-style-type: none"> • in an outbreak of an exotic disease or pest occurs, the state government immediately quarantines the effected property and enforces movement restrictions. They trace the movement of people, animals, produce, vehicles and equipment on and off the property to determine the limit of the spread • the Department of Agriculture has developed a Biosecurity Incident Management System (BIMS) which provides a framework for the management of a disease outbreak • Quarantine WA also assists in preventing the spread of pests and diseases throughout Western Australia. A number of pests are present but confined to specific parts of Western Australia through quarantine practices such as controlling movement of vehicles • mandatory reporting of exotic disease and possible subsequent destruction of animals and/or quarantine of property 	

Question 29 (continued)

- local level – regular monitoring and early control, limit machinery movement between paddocks, rotate crops to reduce disease risk, avoid having a ‘green bridge’ over summer for diseases.

Maintaining a strong border inspection program at all ports and airports is the first national defence against the introduction of the pest, particularly imports from countries that are known to have the beetle. Relevant strategies could include:

- PLANTPLAN – (Australian Emergency Plant Response Plan) – is the plan used to respond to an emergency plant pest incident. Provides guidelines on key roles and responsibilities of industry and government. Also includes best practice in emergency plant pest responses. This includes site disinfection and decontamination, standard operating procedures, forms and templates that include a response plan for eradication.
- the Emergency Plant Pest Response Deed – this is a legal agreement between Plant Health Australia, the Australian Government, all state and territory governments and national plant industry bodies. This agreement covers the management and funding of the response to an emergency plant pest outbreak. If a disease or pest is found that is exotic to Australia, the Australian Government Department of Agriculture coordinates the national response from a National Coordination Centre (NCC) in Canberra

Accept other relevant answers.

Question 30

(20 marks)

- (a) Describe how a producer might assess the data in the yield table above. Analyse the future role of Cultivar D by applying the triple bottom line factors. (10 marks)

Description	Marks
If you select Cultivar B the average yield is not as high as A but it has been tested at more sites than the other cultivars, giving the data collected more reliability. Cultivar D should not be considered because its results could be due to a good season in a particular environment	2
States a relevant fact about how a producer might assess the data	1
Subtotal	2
Analyses the future role of Cultivar D by applying the triple bottom line factors to support the analysis	7–8
Explains relevant facts about the future role of Cultivar D, using the triple bottom line factors to highlight the potential benefits and pitfalls	5–6
Outlines more than one relevant fact about the future role of Cultivar D and links it to at least two of the triple bottom line factors	3–4
States a relevant fact about the future role of Cultivar D. States at least one of the triple bottom line factors	1–2
Subtotal	8
Total	10
<p>Answers could include:</p> <div style="border: 1px dashed gray; padding: 10px; margin: 10px auto; width: fit-content;"> <p>For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at the link listed on the acknowledgements page.</p> </div>	
Accept other relevant answers.	

Question 30 (continued)

- (b) Explain why new cultivars of all crops need to be developed to meet short-term production goals and ensure the long-term sustainability of resources. (10 marks)

Description	Marks
Explains why new cultivars of all crops need to be developed to meet short-term production goals	4–5
Outlines why new cultivars of all crops need to be developed to meet short-term production goals	2–3
States why new cultivars of all crops need to be developed to meet short-term production goals	1
Explains why new cultivars of all crops ensures the long-term sustainability of resources	4–5
Outlines why new cultivars of all crops ensures the long-term sustainability of resources	2–3
States why new cultivars of all crops ensures the long-term sustainability of resources	1
Total	10
<p>Answers could include:</p> <p>To meet short-term production goals:</p> <ul style="list-style-type: none"> • increase in yield and quality to increase profitability • disease resistance to increase yield and quality and reduce cost of pesticides • herbicide tolerant cultivars to improve efficacy of non-selective herbicides and provide bigger windows for timing of spray applications • increased tolerance to insect pests, less pesticides, less harmful effects on the environment • frost resistance/flowering earlier or later than documented frost periods. <p>To ensure the long-term sustainability of resources:</p> <ul style="list-style-type: none"> • more drought tolerant varieties, as rainfall reliability drops, enabling marginal farmland to continue to be cropped • saline tolerant cultivars that can be productive on farmland that is affected by rising salt, increasing the productivity of land that would usually be bare • longer storage capacity to reduce wastage • greater weed suppression ability • yield and quality stability in fluctuating climatic conditions • increasing yield but not at the expense of the environment • producing cultivars that are nutritionally valuable to the consumer • cultivars that use less inorganic fertiliser and more organic, like legumes that fix nitrogen from the atmosphere. <p>Accept other relevant answers.</p>	

ACKNOWLEDGEMENTS

- Question 28(b)(i)** Freshcare. (n.d.). *The standard for Australian fresh produce*. Retrieved October, 2019, from <https://www.freshcare.com.au/>
- Question 28(b)(ii)** Adapted from: Freshcare. (n.d.). *Food Safety and quality – supply chain*. Retrieved October, 2019, from <https://www.freshcare.com.au/standards/food-safety-quality-supply-chain/>
- Question 29(b)** Under maintain a strong border inspection ... Relevant strategies are: Dot point one and two adapted from: Commonwealth of Australia (Department of Agriculture) (n.d.). *National pest and disease outbreaks – How we respond to outbreaks*. Retrieved October, 2019, from <https://www.outbreak.gov.au/how-we-respond-to-outbreaks>
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- Under maintain a strong border inspection ... Relevant strategies are: Dot point three adapted from: Commonwealth of Australia (Department of Agriculture) (n.d.). *National pest and disease outbreaks – Media arrangements during an outbreak*. Retrieved October, 2019, from <https://www.outbreak.gov.au/for-media>
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- Under On-farm management of this pest ... Relevant strategies are: Dot point one adapted from: Commonwealth of Australia (Department of Agriculture) (n.d.). *National pest and disease outbreaks – Media arrangements during an outbreak*. Retrieved October, 2019, from <https://www.outbreak.gov.au/for-media>
Used under a Creative Commons Attribution 3.0 Australia licence
- Question 30(a)** Adapted from: Van Acker, R., Rahman, M., and Cici, S. Z.H. (2017, October). *Environmental science: Pros and cons of GMO crop farming*. Retrieved October, 2019 from, <https://oxfordre.com/environmentalscience/view/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-217>

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